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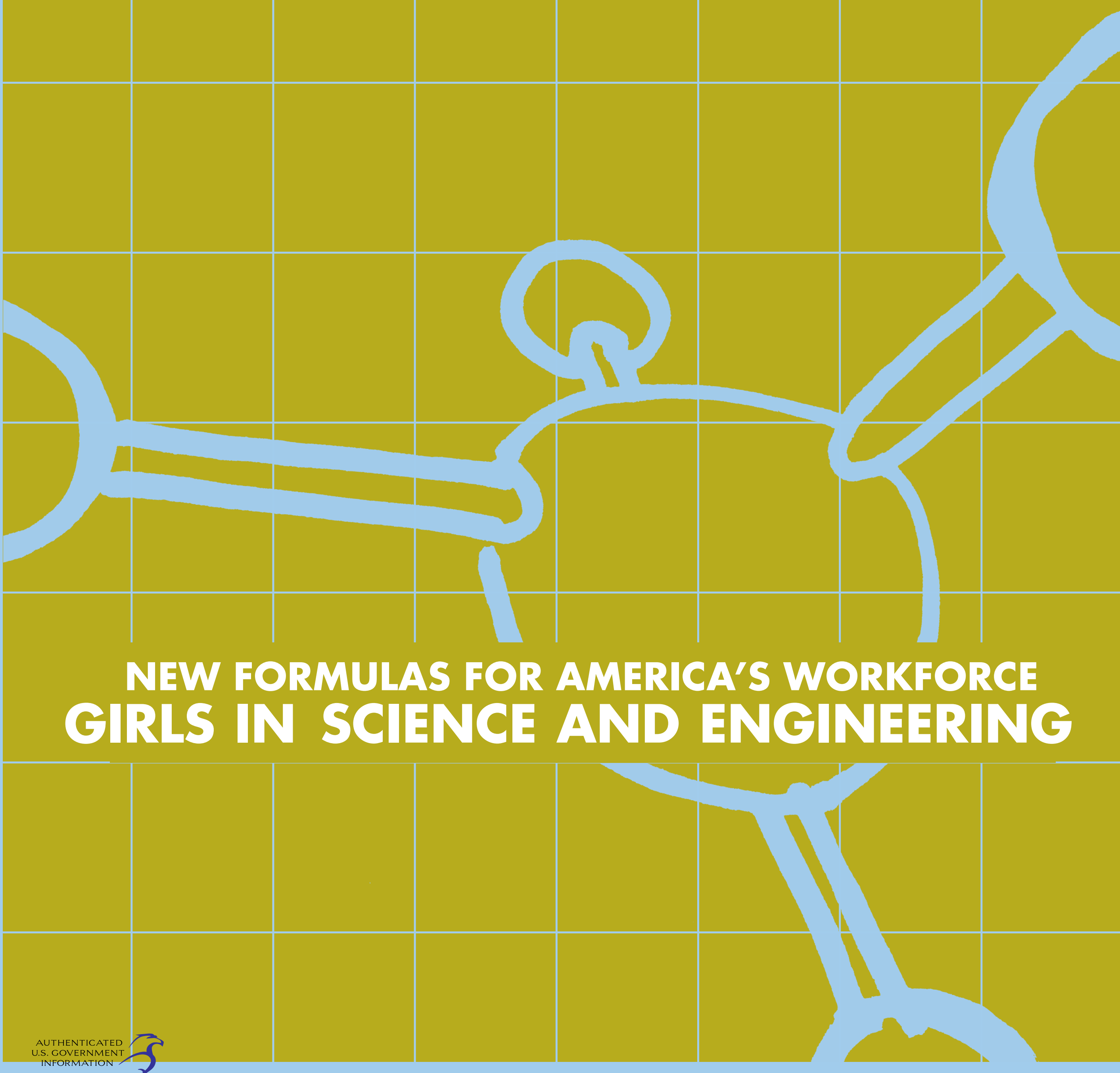

NEW FORMULAS FOR AMERICA'S WORKFORCE
GIRLS IN SCIENCE AND ENGINEERING

NATIONAL SCIENCE FOUNDATION

NEW FORMULAS FOR AMERICA'S WORKFORCE
GIRLS IN SCIENCE AND ENGINEERING

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ORIGINS

INVESTING IN PEOPLE, TOOLS, AND IDEAS

One of the National Science Foundation's (NSF's) key strategic goals is to invest in people: to develop a diverse, internationally competitive, and globally engaged workforce of scientists, engineers, and well-prepared citizens.

In 1981, the Equal Opportunities for Women and Minorities in Science and Technology Act acknowledged that it was U.S. policy and in the national interest to encourage all groups to participate in science and engineering. The act mandated that NSF report statistics on underrepresented groups and initiate programs fostering more proportionate representation. Among the suite of programs that followed was the Program for Women and Girls, created in fiscal year 1993, housed in the NSF's Division of Human Resource Development, Directorate for Education and Human Resources.

The initial budget (FY 1993) of about $7 million was used to fund about a dozen projects over the program's first three years. With over $90 million in awards since inception, the NSF program is the largest public or private funding source for efforts expressly addressing the need to broaden girls' and women's participation in science, technology, engineering, and math (STEM). More than 250 grants to date have populated the national STEM education enterprise with new ideas, proven good practices, innovative products, research publications, and a leadership of savvy, experienced educators and education researchers. The grants are relatively small and reach nearly every state in the U.S. A study of the program's impact from 1993 to 1996 showed that the NSF program has been very successful.

The program supports research, student and educator programs, and information dissemination projects that will lead to change in education policy and practice. Program findings and outcomes will lead to understanding, for example, how to maintain girls' interest in science past middle school, how to bring more girls into elective high school math and advanced placement science courses, and how to increase enrollments in undergraduate studies, particularly in engineering, physical sciences, and computer sciences.

Although the program has accomplished much in its short existence, national statistics reveal that much more remains to be done. And, since 1993, the national need for a larger, more science- and computer-literate and skilled, and diverse workforce is ever greater, as we progress toward an increasingly technological job market and a scientifically complex society.

WHY THIS BOOK?

Every NSF grantee shares findings and results with appropriate national communities. Publications, conference papers, newsletters, radio and TV shows, and educational products (guides for educators, curricula, online courses, and so on) are the media of scholarly communication and education improvement. As much as possible, Principal Investigators develop information products. Some of the projects in this volume are nationally known.

Every NSF grant is represented by a project summary, or abstract, on the NSF website <www.nsf.gov>. NSF publications and publicity make known our investments and impacts in all areas of science and engineering. Press releases often highlight individual grants. Despite such regular dissemination of project results, it is still hard to cull a "body of research." This book collects descriptions of nearly 10 years' investment in one place, written for general audiences. The collection shows how even in a relatively short span of time the way issues are described and the focus of new work have changed, due to increasing knowledge and due to the changing social context of the work.

The investments of the Gender Diversity in STEM Education program offer valuable information to a wide spectrum of groups:

- Teachers of science and math education K–12
- Faculty in STEM disciplines
- Counselors
- School administrators working to meet community needs
- Informal education providers (museums, summer camps, after-school clubs, media organizations)
- Teachers specializing in certain subjects (especially physics, mathematics, computer science, and geo-science)
- Faculty in disciplines where diversity is still an issue (engineering, computer science)
- Deans who are planning on improvements to adopt
- Colleges of education seeking continual improvement
- Organizations in the business of continual professional development of teachers
- Organizations that support professionals (women engineers, chemists, computer scientists)
- Foundations seeking to concentrate funding in areas of high need
- Industry promoting image and workforce development through educational outreach programs
- Public media looking at issues of community and national interest
- Education and workforce policymakers
- Parents who want the best for their own children

All of the groups above have a common interest: improved quality of education, improved access to education, and better student achievement, so that our educational systems deliver more science- and computer-literate citizens to society and deliver better-prepared, more diverse workers to the science and engineering enterprise.

MORE INFORMATION	ABOUT NSF: www.nsf.gov	ABOUT THE PROGRAM: www.ehr.nsf.gov/ehr/hrd
ORIGINAL PROJECT SUMMARIES IN THE "AWARDS DATABASE" AT NSF: https://www.fastlane.nsf.gov/a6/A6AwardSearch.htm		
1. ENTER A NAME, STATE ABBREVIATION, NUMBER —ANYTHING 2. ENTER "1544" TO RETRIEVE ONLY GRANTS MADE BY THIS PROGRAM 3. ENTER THE GRANT NUMBER, E.G., "0210794," TO FIND A SPECIFIC GRANT		
ABOUT GENDER AND SCIENCE ISSUES, LINKS ARE AVAILABLE FROM THE PROGRAM'S WEBSITE, ALSO, ANY SEARCH ENGINE CAN FIND NAMES OF PEOPLE AND PROJECTS ETC. ESPECIALLY A DIGITAL LIBRARY DEVOTED TO THE TOPIC AT http://www.edc.org/GDI/GSDL/ WHICH IS BEING DEVELOPED AS A SIGNIFICANT PORTAL WITH FUNDING FROM NSF'S NATIONAL DIGITAL STEM LIBRARY PROGRAM.		
ANY NSF PUBLICATION MAY BE RETRIEVED AT http://www.nsf.gov/pubsys/ods/ TYPE IN THE PUBLICATION NUMBER, E.G., NSF 00-327		

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U.S. Department of Education, National Center for Education Statistics. Trends in the Educational Equity of Girls and Women. NCES 2000-030

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More than 200 Principal Investigators and their teams who carried out these projects and who responded with additional information, review, and graphics

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Teaching With a Difference

CHAPTER ONE · TEACHING WITH A DIFFERENCE

AMONG MANY TRENDS IN IMPROVED SCIENCE AND MATHEMATICS EDUCATION ARE BETTER TECHNIQUES FOR ENGAGING LEARNERS. NEW PHILOSOPHIES OF LEARNING, SUCH AS CONSTRUCTIVISM,[1] UNDERLIE MANY OF THESE TECHNIQUES. THESE NEW APPROACHES MAY BE ADOPTED IN THE CLASSROOM OR IN INFORMAL EDUCATION SETTINGS, SUCH AS AFTER-SCHOOL CLUBS, SATURDAY ACADEMIES, SUMMER CAMPS, AND MUSEUM PROGRAMS.

THE PROJECTS DESCRIBED IN THIS CHAPTER EXPLORE SEVERAL NEW WAYS OF TEACHING THAT HAVE INDEED PROVEN TO ENGAGE ALL STUDENTS MORE, INCLUDING GIRLS AND OTHER GROUPS WHO PREVIOUSLY TENDED NOT TO BE DRAWN TO THE SUBJECTS:

- HANDS-ON ACTIVITY, USING TOUCH, SMELL, AND MOTION TO EXPERIENCE AND STUDY THE PHYSICAL WORLD
- WORKING IN COOPERATIVE TEAMS, WITH STUDENTS HELPING AND SHOWING EACH OTHER
- LOOKING AT REAL-WORLD CONTEXTS WITH A SCIENTIFIC EYE—CHEMISTRY IN THE HOME, ECOLOGY IN THE COMMUNITY PARK, THE PHYSICS OF SPORTS
- AN EMPHASIS ON PERSONAL MASTERY AND CONFIDENCE THROUGH PROBLEM-SOLVING
- EXPOSURE TO A DIVERSE ARRAY OF WORKING SCIENTISTS AND ENGINEERS, TO CAPTURE STUDENTS' INTEREST AND TO OPEN THEIR MINDS TO MANY ATTRACTIVE CAREERS

WHY ARE SO MANY PROJECTS EXPERIMENTING WITH NEW WAYS OF TEACHING? BECAUSE OUR EDUCATION STATISTICS SHOW THAT, IN TRADITIONAL SETTINGS, AT ABOUT MIDDLE-SCHOOL AGE, GIRLS TEND TO LOSE INTEREST AND CONFIDENCE IN MATH AND SCIENCE AND, UNTIL RECENTLY, HAVE PERFORMED CONSISTENTLY LOWER THAN BOYS ON MOST STANDARD SCIENCE AND MATH TESTS (THE "GENDER GAP"). ONCE SCIENCE AND MATHEMATICS COURSES BECOME ELECTIVE, GIRLS TEND TO ELECT TO TAKE FEWER MATH AND COMPUTER TECHNOLOGY COURSES, FOR EXAMPLE, WHICH LEAVES THEM BEHIND IN SKILLS AND CONFIDENCE. CHILDREN'S VIEWS OF SCIENCE AND ENGINEERING ARE NOT SOPHISTICATED, AND THEIR VIEW OF THEIR ROLE IS COLORED BY GENDER STEREOTYPES ("GIRLS ARE NOT GOOD AT MATH"). WE NEED AND WANT A COMPUTER- AND SCIENCE-LITERATE CITIZENRY AND A WORKFORCE EQUIPPED WITH HIGH-DEMAND SKILLS. NEW WAYS OF TEACHING ARE A RESPONSE TO THE DEMANDS OF OUR MODERN SOCIETY.

TRENDS IN THE LAST 10 YEARS ARE ILLUSTRATED IN MANY OF THE STORIES:

- INFORMAL EDUCATION'S INCREASING ROLE IN EXPOSING CHILDREN TO SCIENCE
- COLLABORATIONS BETWEEN SCHOOLS AND INFORMAL EDUCATION PROVIDERS (SUCH AS MUSEUMS AND GIRLS' PROGRAMS)
- SOPHISTICATION IN INFORMAL EDUCATION, INCLUDING AWARENESS AND REINFORCEMENT OF SCIENCE AND MATH EDUCATION STANDARDS
- RECOGNITION OF AND RESPONSIVENESS TO STUDENTS' CULTURAL DIVERSITY
- A BETTER UNDERSTANDING OF GENDER-RELATED EDUCATION ISSUES, ESPECIALLY AFTER TITLE IX
- TEACHERS' CROSSING OF TRADITIONAL BOUNDARIES BETWEEN INFORMAL AND FORMAL EDUCATION
- TECHNOLOGY'S INTEGRATION INTO EDUCATION.

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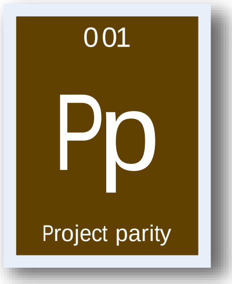
Clewell, Beatriz Chu, Bernice Taylor Anderson, Margaret E. Thorpe. Breaking the Barriers: Helping Female and Minority Students Succeed in Mathematics and Science. Jossey-Bass Publishers, 1992.
American Association for University Women, Educational Foundation. Tech-Savvy: Educating Girls in the New Computer Age. 2000

[1]The belief that we construct our own understanding of the world and use our own mental models to make sense of it and give it meaning. Curricula aim to match and challenge children's understanding of the world in order to develop their minds.



PROJECT PARITY

PROJECT PARITY ENGAGED FOURTH AND FIFTH GRADE GIRLS IN HANDS-ON SCIENCE ACTIVITIES AND EXPOSED THEM TO POSITIVE ROLE MODELS, TO COUNTER THE TENDENCY FOR BOYS TO DOMINATE CLASSROOM SCIENCE ACTIVITIES, ESPECIALLY THOSE INVOLVING SPECIALIZED EQUIPMENT. WORKING WITH THREE URBAN AND SUBURBAN CONNECTICUT SCHOOL DISTRICTS, THE TALCOTT MOUNTAIN SCIENCE CENTER STAFF ENGAGED GIRLS IN ACTIVITIES THAT COMBINED HIGH TECHNOLOGY WITH THE "HIGH TOUCH" OF HANDS-ON SCIENCE.

Building a simple circuit with batteries and bulbs, creating a multimedia presentation, and engaging in robotic engineering were some of the activities that built the girls' self-confidence and taught them how to use science equipment. After such single-sex activities, the girls who had worked in cooperative groups with other girls were observed by evaluators in mixed-gender groups during hands-on science activities. Girls in the "treatment group" were far more active participants in the mixed-gender groups than were those in the control group. Girls in the treatment group were more likely to come forward and share in group leadership rather than remain passive group members.

Given training in attitudes and parenting strategies, parents learned to encourage their girls to be more confident and self-reliant. They were invited to participate in some activities with the girls and were encouraged to work with them on science activities at home. Workshops helped make teachers and parents aware of social bias toward women in science and aware that experiencing the joy of discovery helps girls become interested in science.

CODES: E1	TALCOTT MOUNTAIN SCIENCE CENTER
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HRD 94-53719 (ONE-YEAR GRANT)	
PRODUCTS: A PARITY HANDBOOK FOR DEVELOPING A MODEL PROGRAM AND A TRAINING VIDEOTAPE	
KEYWORDS: DEMONSTRATION, TEACHER TRAINING, PARENTAL INVOLVEMENT, GENDER EQUITY AWARENESS, COOPERATIVE LEARNING, HANDS-ON, ROLE MODELS, MUSEUM, ENGAGEMENT, SELF-CONFIDENCE, MIXED-GENDER	

FAMILY TOOLS AND TECHNOLOGY

MANY OUT-OF-CLASS GENDER EQUITY PROGRAMS HAVE BEEN SINGLE-SEX PROGRAMS, WHICH SERVE A USEFUL FUNCTION, BUT GIRLS AND BOYS ALSO NEED TO LEARN HOW TO WORK TOGETHER. GIRLS NEED A BROADER BASE OF EXPERIENCES, BOYS NEED TO LEARN TO RESPECT AND WORK WITH GIRLS AS EQUAL PARTNERS, AND TEACHERS, PARENTS, AND OTHER ADULTS NEED TO LEARN HOW TO CREATE AN ENVIRONMENT THAT WILL MAKE THESE THINGS HAPPEN.

This belief is at the heart of Family Tools and Technology (FT2), an after-school intervention program that trained 40 middle-school teachers to lead after-school programs for sixth grade students and their parents. The program targets girls in pre-adolescence, before sex role stereotypes about technology have solidified.

The teacher training emphasizes gender-equity awareness, information on workplace readiness skills, hands-on technology activities, and providing a forum in which girls' natural preferences for collaborative and inquiry-based learning can flourish

In the after-school program, girls, boys, and their parents problem-solve collaboratively, using tools and building models that illustrate STEM's everyday importance. The program focuses on technological challenges in pre-engineering, architecture, and physical science that are not usually found in the traditional elementary curriculum.

Family Science and Family Math engage parents and children in hands-on activities that lead to the discovery of basic math and science concepts—for example, discovering density by determining whether a variety of materials will float or sink in water. FT2 seeks both to discover the concept and extend it—for example, by having participants design and construct a rubber-band-powered barge to transport a given mass. Children and their parents jointly engage in such activities as using meters, working with electromagnets, fixing electrical appliances and toys, and programming a VCR—a true problem-solving activity! This is important for girls, who are less apt than boys to have fun doing the out-of-school science-related activities that can lead to an interest in—even a passion for—science.

The first phase of this project (1995–96) focused on a yearlong assessment of the effectiveness of the 14 FT2 activities, materials, and strategies in 12 elementary schools with about 240 families (70 percent being girls and their families). Teachers got 11 days of training in FT2 techniques, warm-ups, and challenges, so they could present and facilitate the warm-ups and challenges in the after-school sessions.

This model was ultimately quite effective at reducing gender stereotypes, increasing student use of tools and tool-related activities, and improving attitudes toward tools. But although both boys and girls found the challenges in the first six sessions to be "original, fun, and interesting," midway through field testing and data collection evaluator Patricia Campbell reported that gender stereotyping was actually increasing rather than decreasing in some students. Responses to the open-ended statement "Girls who use tools to problem solve and build models are ___" included "ugly" and "not nice" (from boys) and "don't use tools as well as boys" (from a girl). Several children thought girls shouldn't use tools because they might break a nail, or said girls need help using tools so they won't hurt themselves.

To provide immediate intervention, the second training sequence included specific gender-equity strategies, activities, role playing, and discussions of how best to address obvious gender stereotyping. When the gender stereotyping was addressed rationally, explicitly, and repeatedly, both girls and boys become less stereotyped in their responses to the open-ended questions, and the boys decreased their stereotypes even more than the girls did.

Streamlining the program

Because FT2 was expensive to implement, NSF funded a one-year follow-up project (1996–98) to determine if a model of FT2 that reduced the number of sessions from 12 to seven and the amount of teacher training from 11 days to five would have similar positive effects on students. Two cycles of teacher teams (14 teams) were trained and, after a five-day teacher training institute, conducted seven FT2 session programs—with a one-day follow-up training session and one onsite training session with a mentor present. (A 15th team conducted a six-session program.) The idea was to refine and streamline the program into a cost-effective, pedagogically sound five-day training session that could be easily disseminated and replicated, together with a leadership component that could prepare experienced FT2 teachers to train others to conduct the program.

Disappointingly, the FT2 learning activities in both phases of the project appeared not to affect children's interest in careers in science, technology, engineering, and math (STEM). Simply listing the titles of STEM-related careers or even bringing in one or two role models to talk to parents and children was not enough to effect change or stimulate their interest. Girls' and boys' career

FAMILIES CONQUER TECHNOLOGY TOGETHER

In FT2 activities, learning proceeds through stages: questioning, investigating, evaluating, implementing, revising, and re-evaluating. When children and their parents build and test a rubber-band-powered boat, for example, they select the needed materials (including waterproof adhesives, fasteners, and rubber bands), take measurements, and test their craft, steps that require prediction, experimentation, and revision. In working together, sharing ideas, comparing results, and talking about them, families gain an intuitive grasp of science concepts (buoyancy, energy, motion, friction), apply mathematical principles (pattern development, weight versus volume), and discover engineering principles (strength, properties of materials).

In a typical session, toolboxes sit unopened on tables as participants get ready for the evening's challenge—in one session, assembling a hydroponic greenhouse. First they test the water to be used in the greenhouse with litmus paper, pick a plant, remove the soil from its roots, then guess the name and variety of "mystery tools" laid out on a table. At session's end, the family has a plant and a handmade greenhouse to take home—and some new skills. The third-grade teacher who facilitates the activities says, "I don't have all the answers. I'm just a problem-solver."

At other sessions, families have built cars, boats, and catapults out of Lego sets and have made kaleidoscopes out of toilet paper tubes (putting colors and beads inside mirrors). Each activity is based on a problem-solving model: accepting a challenge, reviewing criteria, gathering information and materials, brainstorming, planning, making, testing, and revising. The parents find the learning partnership a good way to spend time with their children. "It's a social kind of learning," said one mother, "and it gets my daughter to think," plus "my husband and I get the chance to be a kid again." Fathers hear "math and science" and their participation shoots up. Meanwhile, the challenges are tough enough for all age groups to learn. And by changing the dynamic between parents and teachers, FT2 builds parental support for education.

Children are naturally curious. This kind of hands-on learning turns them into active (rather than passive) learners—learning to ask questions and find their own answers. Instead of looking for "right" answers, they are encouraged to see problem-solving as a process and to feel free to make mistakes because they can learn just as much from their mistakes as they would by getting the answer right the first time. They also learn that if something doesn't work, they can do it again.

Parents appreciate the chance to spend enjoyable learning time with their children and to see how they learn, how they problem-solve, and how they work in a team. They often realize that they should give their children more of a chance to solve problems and work with tools rather than do so for them. Teachers learn to facilitate more than teach: to guide with questions rather than statements and to realize that it is not important that they have all the answers—in fact, that it is better to guide students in their discovery and to learn along with them.

interests remained limited and unchanged and still reflected gender stereotyping. Middle-school girls, often discouraged by the complex names of many scientific career titles, lost interest in them; career titles presented with one-line descriptions were often intimidating or at best confusing. Developing an effective career component will need more work—including finding a way to convey the "how" and "why" of professionals' career choices and somehow to convey their passion for what they do. But this program was a start.

The follow-up project produced Making a Splash: A Guide for Getting Your Programs, Products, and Ideas Out. This user-friendly guide helps individuals and organizations identify their goals and focus on their primary audience(s) as they undertake gender equity efforts in math, science, and technology. It offers ideas, information, and free or low-cost strategies to get the word out; provides sources of research on gender, math, and science; and suggests how program and project developers can evaluate the impact of their efforts.

CODES: E1, PD	Rutgers University
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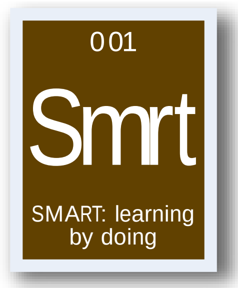
HRD 94-53482 (one-year grant) and HRD 96-32274 (three-year grant)	
Partners: Center for Family Involvement in Schools, Consortium for Educational Equity	
Publication: Making a Splash: A Guide for Getting Your Programs, Products, and Ideas Out	
Useful website: www.campbell-kibler.com	
Keywords: education program, after-school, problem-solving skills, teacher training, parental involvement, intervention, gender equity awareness, hands-on, collaborative learning, inquiry-based, real-life applications	



SMART: LEARNING BY DOING

SCHOOL-BASED SMART (SCIENCE, MATH, AND RELEVANT TECHNOLOGY) IS AN EXEMPLARY, WELL-TESTED MODEL PROGRAM OF HANDS-ON SCIENCE ACTIVITIES TO MAKE MATH AND SCIENCE ACCESSIBLE TO GIRLS. DEVELOPED BY GIRLS INC., SMART IS BOTH A CONCEPT—DEMYSTIFYING THE NOTION OF SCIENCE AND WHO CAN DO IT—AND A CURRICULUM. COMBINING A CONCERN FOR EQUITY WITH AN EMPHASIS ON EXPLORATION, SMART ENCOURAGES GIRLS TO BE SKEPTICS, TO CHALLENGE PAT EXPLANATIONS, AND NOT TO TAKE ANYTHING FOR GRANTED. PARTICIPANTS BECOME "MATH DETECTIVES." THIS SAN LEANDRO, CAL., PROJECT SERVED 300 FOURTH AND FIFTH GRADE GIRLS.

Doing hands-on activities in small groups makes it possible for girls to experience activities teachers might shy away from delivering in classes of 30 to 35 students. In a unit on energy and patterns of change, for example, girls explore everything from heat energy (generated by composting organic materials) and solar power to electrical energy (circuits using batteries, wires, bulbs, and switches). To integrate these concepts and confront open-ended experiments, they might be asked to insulate a structure they have designed and built so that it will retain maximum heat energy.

Encouraging girls to learn and experiment—to take risks and learn by doing—in a single-sex environment, for even one hour a week, helps the girls feel empowered and self-confident enough to try things they otherwise would not try. The interest and enthusiasm shown by participating girls convinces many teachers that the hands-on approach really works—that everyone has a right to scientific understanding and the power that comes with knowledge.

A project manual offers guidance on implementing school-based SMART programs, detailing how they turned SMART from an after-school program into an in-school program. Many affiliates had not considered applying SMART in school because of the difficulty of working with school districts and principals. The manual spells out how to develop an age-appropriate, gender-equitable curriculum responsive to state and local district frameworks for science and math education. It emphasizes the importance of a strong working knowledge of local school politics and should be helpful for affiliates just beginning to establish relationships with local schools.

Several factors affect success in raising girls' levels of interest, motivation, and achievement:

- **Program inclusiveness**. Every fourth and fifth grade girl is involved in the program, eliminating the self-selection factor in other models.
- **Teacher involvement in planning**. Strong support from principals is essential, but the program needs to be a cooperative effort between teachers and the principal, not a top-down effort in which the principal dictates that teachers must participate. It is important to communicate with the teaching staff and gain its commitment before seeking support from the school's administration. In this project, teacher training in gender equity also got a significant turnout, involving all teachers in the building, not just those involved in the program.
- **Built-in teacher feedback**. Such a project takes more than a year, because teachers need training to become comfortable with hands-on activities as well as with back-up resources and personnel. It is helpful if the hands-on activities complement teachers' mandatory science programs. In-service training allows teachers to experience active learning first-hand, so they know what their students will be using and can confront their own feelings and attitudes toward science and math education.
- **Parental involvement**. Family-oriented activities were important in the original project because of their cultural impact on the substantial Hispanic population. Parental influence in discouraging the pursuit of math and science careers is well documented, but in this project parental involvement was fairly high. A newsletter to parents helped them understand many stereotypical issues that create barriers for young girls. At SMART Family Night, parents and guardians could experience SMART firsthand through participatory hands-on activities.

The SMART model and curriculum give girls the confidence to return to their coeducational classes and become leaders. Schools have reason to embrace the model, because boys also benefit from hands-on activities in smaller learning groups.

CODES: E1, PD	Girls Inc. of San Leandro
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HRD 94-53748 (one-year grant)	
Publication: School-Based SMART: Opportunities for Girls and Girls Incorporated Affiliates (a working guide)	
Keywords: demonstration, teacher training, parental involvement, gender equity awareness, experiential learning, hands-on, curriculum, exploration-based, self-confidence, manual; girls, inc., hispanic	

WHAT WE KNOW ABOUT WHAT WORKS

OPERATION SMART IS GIRLS INC.'S MOST POPULAR PROGRAM, CLAIMING TENS OF THOUSANDS OF PARTICIPANTS ACROSS THE NATION. BECAUSE OF IT, GIRLS ALL OVER THE NATION GET MESSY, EXPLORE, ANALYZE, DISSECT, HYPOTHESIZE, AND MAKE BIG, INTERESTING MISTAKES. FOR MORE THAN A DECADE, MOST PARTICIPANTS IN SMART WERE GIRLS AND YOUNG WOMEN OF COLOR. GIRLS INC. IS DEVELOPING A PLAN (MARTINEZ, HRD 01-14680) TO MAKE ITS PROGRAM MORE RELEVANT, ACCESSIBLE, AND EXCITING TO A NEW GENERATION OF GIRLS—INCLUDING THOSE WHO ARE DISABLED OR SPEAK ENGLISH AS A SECOND LANGUAGE—WHILE RETAINING WHAT STILL WORKS IN THE PROGRAM. HERE'S WHAT THE ORGANIZATION'S EXPERIENCED INFORMAL EDUCATORS KNOW ABOUT WHAT WORKS:

- Girls (especially in elementary school) like their science *messy*.
- Middle school girls like the *aesthetics* of math, science, and technology projects—the symmetry and decoration of their Lego® creations, for example, or the beauty of stars (as motivation for studying astronomy).
- Girls of all ages like their math and science to be *useful and relevant to their everyday lives*.
- Girls want *clubs, communities, and face-to-face interactions*. Internet connections may not be intrinsic motivators for girls the way they are for boys.
- A great way to squelch girls' interest in science is to "demonstrate" it while they watch. Another is to play "guess the right answer," as if all girls can do is master a completed body of knowledge.
- *Not all girls are alike*. Some already know they like math and science and just need connections made and barriers reduced. Some have yet to discover that math, science, and technology are for girls. Still others resist and have feelings and experiences we should listen to and learn from.
- *Blanket invitations to participate do not work on any level*. Each girl needs to know that she is special and that her discoveries are amazing, each adult needs to experience the wonder and remember the old days, each parent needs an individual welcome in his or her language and a thank-you for rearing an already curious child, and each tribal elder needs a personal visit and time to get to know that the people in the program are trustworthy and respectful.

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Teaching SMART

TEACHING SMART

GIRLS INC. (THEN GIRLS CLUBS OF AMERICA) DEVELOPED OPERATION SMART IN THE MID-1980S TO ENCOURAGE GIRLS' INTEREST IN SCIENCE, MATH, AND RELEVANT TECHNOLOGY. SINCE THEN, OPERATION SMART HAS EVOLVED INTO TEACHING SMART, A COMPREHENSIVE, EQUITY-BASED, THREE-YEAR TEACHER PROFESSIONAL DEVELOPMENT PROGRAM DESIGNED TO PRODUCE *SYSTEMIC CHANGE IN THE FORMAL CLASSROOM—TO CHANGE THE WAY ALL ELEMENTARY SCHOOLCHILDREN, BUT ESPECIALLY GIRLS AND MINORITY YOUTH, EXPERIENCE SCIENCE EDUCATION*. TEACHING SMART TEACHERS HAVE ADOPTED THE KEY TEACHING STRATEGIES PROMOTED BY THE NATIONAL SCIENCE EDUCATION STANDARDS: A HANDS-ON OR INQUIRY-BASED APPROACH TO SCIENCE ACTIVITIES THAT PROMOTE STUDENT DEVELOPMENT OF SCIENCE PROCESSING SKILLS.

Teaching SMART provides instruction and hands-on training for teachers in grades 3 through 5, to increase their awareness of (and comfort level using) equitable, hands-on, inquiry- and exploration-based approaches to teaching science. The program was first tested in elementary schools in western South Dakota, a largely rural population previously unserved by such a program. In 1996 the program was expanded to 13 sites around the country.

Grade 3 activities deal with simple machines, food groups, and fossils; grade 4 on catapults and fulcrums, senses, and rocks and minerals; and grade 5 on air pressure/movement of molecules, animal adaptations, and food chains and webs. Classroom kits include balloons, flour, cups, and batteries. Equipment kits contain such items as microscopes, beakers, funnels, dissecting kits, magnets, wires, hand tools, Ping-Pong balls, and light bulbs.

The program has had a consistent positive influence on teachers' attitudes and levels of confidence and comfort with hands-on science activities. By using more than a hundred lesson plans designed by Teaching SMART, *the teachers significantly cut their use of the didactic, teacher-centered activities—such as lectures, teacher demonstrations, and whole-class discussions—they were often trained to do. They increasingly used student-centered, hands-on lab activities, cooperative group work, and authentic assessments*. "My goal was to have 60 minutes or more of actual hands-on SMART activities," says one teacher, "and I did, because the kids wouldn't let me forget ever!"

CODES: PD, E, I	Youth & Family Services, Rapid City, S.D.

Melanie Flatt (melanief@rapidnet.com)

HRD 95-53484 (one-year grant), HRD 99-06176 (three-year grant)

Partners: Xavier University, (Louisiana); Girls Incorporated of Greater Atlanta; Bay City (Michigan) Public School; Continental Elementary District (Arizona); Marion County (West Virginia) Public School District; South Bay Union (California) School District; The Bush Foundation (St.Paul, Minn.); Central Michigan University (Mount Pleasant, Mich.)

Publications: Articles by Claudia Douglas, Marsha Lakes Matyas, and Melanie Flatt: Moving Toward Student-Centered Activities: Proven Methods for Change and Teaching SMART: Evidence of Effectiveness.

Keywords: demonstration, teacher training, gender equity awareness, hands-on, after-school, inquiry-based, professional development, self-confidence, achievement, cooperative learning, career awareness; girls, inc.

In Teaching SMART, teachers are asked to practice Three E's and an F—Empowerment, Equity, Enrichment, and Fun—and students respond. More than 90 percent of the students involved give a thumbs-up to the Teaching SMART activities. They not only enjoy active exploration and discovery but also become more confident about their science processing abilities and more likely to believe that both men and women can do science. On tests, their knowledge of science content and their problem-solving skills improve. They show more facility with open-ended, higher-order questions.

Research shows that *without continual coaching and follow-up support, teacher training is unlikely to produce long-lasting improvements in teacher competence or student outcomes. Site specialists are trained to mirror-coach, a form of peer coaching. Peer coaching is an effective way to help educators transfer learned skills*—because an extra set of eyes and ears records what is going on in the classroom.

Mirror-coaching in Teaching SMART stresses

- *Cooperative grouping* (site specialists check to see if students know what role they were assigned—reporter, recorder, engineer—and if they understand their responsibilities, and get feedback on how well they were working together)
- *Group interactions* (recording the number of teacher interactions with the group, who initiated them, and how much time was spent with each group)
- *Language used* (for example, "guys," "the doctor, he") and questioning techniques (open-ended, as preferred, or closed)
- *Individual attention* (which students were questioned and got follow-up questions, and who initiated the interaction)

Teachers' growing awareness of the damaging effects of gender bias has been reflected in greater efforts to call equally on boys and girls (not "guys" and "gals") and to be more sensitive about seating, questioning, grouping, and task assignments. Student awareness has also grown. Boys demand their turn to stir cornbread batter, and girls ask to run the video equipment or help carry materials for guest speakers. Teaching SMART also encourages students to investigate careers that have been traditionally divided between the genders. In "Career Charades," for example, they draw the names of careers that they must then act out in pantomime. If a boy protests having to act out the role of nurse, as a "girly" job, the teacher might respond by describing a male nurse anesthetist, a former nurse in Vietnam, now making a handsome salary.

SECRETS TO TEACHING GIRLS SCIENCE

Assume girls are interested in math, science, and technology. Too many girls—and children of color—still get the message that math and science aren't for them. In SMART classes, girls jump at the chance to dismantle machines, care for and study insects and small animals, and solve logic puzzles. Instead of struggling to get the boys to share the tools, in an all-girl environment girls can focus on and enjoy the task at hand.

Let girls make big, interesting mistakes. Girls who are overly protected in the lab or on the playground have few chances to assess risks and solve problems on their own. In SMART classes, once-dreaded mistakes become hypotheses. Girls are urged to go back to the drawing board to figure out why their newly assembled electric door alarm doesn't work or why their water filter gets clogged. Supported by adults instead of rescued, girls learn to embrace their curiosity, face their fear, and trust their own judgment.

Help them get past the "yuk" factor. Girls who are afraid of getting dirty aren't born that way—they're made. Help them resist pressure to behave in "feminine" ways. Encourage them, for example, to get good and grubby digging in a river bed or exploring a car engine. Let them learn they have a right to be themselves.

Expect girls to succeed. In 1999, boys outnumbered girls 3 to 1 among students taking advanced placement tests in computer science. This gap reflects the barrier of low expectations girls face in male-dominated fields. Girls are capable of mastering math and science. Expect them to do so throughout high school and college.

001

mcx

Making connections

MAKING CONNECTIONS

TO STOP PRE-TEEN GIRLS FROM AVOIDING MATH AND SCIENCE, THIS PROJECT TARGETED THIRD TO FIFTH GRADERS IN THREE URBAN DENVER SCHOOL DISTRICTS WITH INTERVENTIONS TO MODIFY THE CURRICULUM, DEVELOP TEACHERS' PROFESSIONAL SKILLS, AND CHANGE THE ATMOSPHERE IN WHICH GIRLS LEARN AND PERCEIVE STEM. THROUGH A GENDER-NEUTRAL MULTICULTURAL CURRICULUM AND BILINGUAL INSTRUCTION, THE PROJECT USED HANDS-ON MATH AND SCIENCE ACTIVITIES TO ENCOURAGE CRITICAL THINKING AND TO "MAKE CONNECTIONS" BETWEEN MATH, SCIENCE, READING, WRITING, AND HISTORY.

The book *Sweet Clara and the Freedom Quilt*, for example—about a fictional slave girl's patchwork quilt that cleverly directed runaway slaves to the Underground Railroad—linked history to math and became a base for engaging students in discussions of gender stereotyping. Asked if their great-grandparents were likely to have quilted or to have done a lot of math, few students could imagine their great-grandfathers as quilters or their great-grandmothers using much math. They read that in Cairo tentmakers were men only, and by fitting shapes together to make their own quilt/tiling/tessellation patterns they *learned that an everyday activity like quilt-making involves a lot of math, including geometric shapes. The unit was also a good opportunity for parental involvement.*

Training sessions helped 17 new and experienced teachers develop a deeper knowledge of math and science content, learn hands-on instructional techniques, and ask questions in a nonthreatening environment. In six workshops held after school and a summer week of all-day training, teachers learned how to use active learning kits and how a good teacher can unknowingly ignore girls. They planned to use what they learned and wanted to know more.

In the year-round component, classroom activities were implemented in a mixed-gender classroom setting, complementing the single-sex after-school enrichment activities. Staff modeling of the "Making Connections" curriculum was successful, but teachers who took the training weren't yet comfortable implementing it in their classroom and wanted more suggestions about how to integrate it into the curriculum as a whole.

Family Math and Science Nights were a good way to disseminate information about the program. Students who talked excitedly about the program awakened their parents' interest, often to the point of parents taking part in classroom activities.

The Summer Explorers program—three one-week math, science, and engineering camps for girls—ran four hours a day. Veteran teacher-participants facilitated the camps, with new participants assisting. Most of the teachers who took part in the summer camp had weak math backgrounds, and the camp helped them learn math concepts well enough to present them correctly.

They also learned about teaching. Some used disciplinary methods the girls considered "mean," and some came to realize that *worksheets (or "table work") didn't hold girls' interest as much as more active work did. Some teachers who thought the work was too difficult for the girls learned that the girls could do the work more easily if it was taught in smaller increments or in smaller groups*.

The materials lent themselves to use by girls with disabilities. So many activities involved touching, feeling, and building large objects that one girl with limited vision was fully able to participate. The girls, encouraged to write in their journals, provided useful feedback on the experience, but wanted more hands-on experiments and less writing.

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http://math.mscd.edu/gogirls	HRD 97-14751 (THREE-YEAR GRANT)
http://insidedenver.com/news/0301firl2.shtml	
PUBLICATIONS: MAKING CONNECTIONS SUMMER EXPLORER'S HANDBOOK; YEAR 1 TESSELLATIONS TEACHER'S GUIDE	
KEYWORDS: EDUCATION PROGRAM, TEACHER TRAINING, GENDER EQUITY AWARENESS, PARENTAL INVOLVEMENT, URBAN, INTERVENTION, BILINGUAL, EXPERIENTIAL LEARNING, HANDS-ON, MIXED-GENDER, DISABLED, MINORITIES	

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Icn
Interconnections

INTERCONNECTIONS

THIS GRANT SUPPORTED DEVELOPMENT OF INTERCONNECTIONS,™ A SERIES OF MECHANICAL-INTERACTIVE BOOKS THAT EXPLAIN ABSTRACT IDEAS THROUGH UNCONVENTIONAL FORMAT AND ANALOGY. DESIGNED FOR GIRLS 10 TO 12 (GRADES 5–7), THE SERIES EXPLAINS CONCEPTS SUCH AS MAGNETIC FIELD, ATOMIC STRUCTURE, AND PYTHAGOREAN THEOREM THROUGH METAPHOR AND IMAGERY AND SHOWS HOW THE CONCEPTS ARE CONNECTED. THE PREMISE IS THAT EDUCATION SHOULD BE A "NON-FLAT THINKING ADVENTURE"—THAT INTERCONNECTIONS WILL HELP GIRLS FIND THE ESSENCE OF CHALLENGING CONCEPTS INSIDE FAMILIAR THINGS. THREE PROTOTYPES HAVE BEEN TESTED WITH CHILDREN OF DIFFERENT AGES.

This effort grew out of Mitzi Vernon's market research in the 1990s into why girls aren't interested in computer games. *She found that girls' interests are consistently socially oriented; that girls tend to want things to be tangible, collectible, and communal and are inclined to create character and storyline as they play. There is an apparent correlation between their lack of interest in computer games and their general feelings about technology*.

A project called the Peninsula study (at Peninsula School in Menlo Park, Cal.) sought a new way to introduce abstract phenomena to young girls. Originally it did so through "character construction exercises": giving the girls a collection of geometrical shapes with plastic connectors and asking them to create something, so the researchers could investigate how girls would approach and interpret geometry. In this and subsequent exercises, *the girls almost invariably returned to images of faces or bodies, focusing on themselves: what they looked like and how they related to each other*. They also had an almost insatiable appetite for variety and embellishment, always asking for more pieces, more colors, more intricate shapes.

This investigation led to creation of *The Universe Is in My Face*, a mechanically interactive explanation of molecules and atoms that moves from large to small images: face to eye to iris (molecule to atom to electron). This was not a traditional book but a kit of interlocking panels—a puzzle for children to put together, to help demystify concepts. With *The Universe*, a series of boards in geometrical face shapes comes with magnets of various shapes and colors, which the reader manipulates. The mechanical format encourages the concrete, mechanical activity important to learning in young children. Key phrases in story development are located on the backs of various boards. The MagneWidget,™ a magnetic disc, illustrates the concept of magnetism, gives girls a concrete connection to new technology, and serves a practical purpose: Girls use it to play with the magnetic particles (which come in a pouch in a specially designed book bag). The storyline and hands-on engagement keep girls interested and rereading.

The project team decided that field theory should precede atoms as a subject and might be a better place to introduce the narrator, so the first book in the series is *Phoebe's Field*, which introduces Phoebe and the concept of *fields* (such as cornfields, magnetic and electric fields, and gravitational fields) and the *quarks* that make a field. Phoebe, invisible to the reader, is a navigational character who asks questions; the visuals in the story are everything she sees and the way she sees it. A second and smarter character, "Phleck," answers questions.

Book 2, *My Horizon*, discusses the field as a plane and geometry as a natural phenomenon as seen through the eyes of Pythagoras. Book 3, *The Universe Is in My Face*, takes the reader on a journey inside the iris of an eye to discover molecules, atoms, and electrons and the reason we see different colors in eyes. Books 4 through 7 will present the science of color (*Color Me Red*), the concept of light waves and waves of water and sound (*Wiggles in Space*), sound waves and music (*Wiggles in Time*), and Phythagoras' harmony in numbers (*Fields of Harmony*).

CODES: E, M, I	VIRGINIA POLYTECHNICAL INSTITUTE AND STATE UNIVERSITY (VIRGINIA TECH)	
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PARTNERS: OFF THE PAGE WORKS, INC.; BARBARA CILETTI (ODDYSEY BOOKS); LORD CORPORATION (ENGINEERS DAVID CARLSON AND LYNN YANYO); KATHY ANDERSON (JOURNEY DESIGNS); DESIGN RESEARCH ASSOCIATES, INC.; GIRLS MIDDLE SCHOOL (MOUNTAIN VIEW, CAL.); GILBERT LINKOUS ELEMENTARY SCHOOL AND BLACKSBURG MIDDLE SCHOOL (BLACKSBURG, VA.).

PRODUCTS: PROTOTYPES FOR PHOEBE'S FIELD, THE UNIVERSE IS MY FACE, AND MY HORIZON

KEYWORDS: DEMONSTRATION, BOOK SERIES, HANDS-ON, INTERACTIVE, MATH, PHYSICS, CONNECTIONS

001

As+

After-school science PLUS

AFTER-SCHOOL SCIENCE PLUS

AFTER-SCHOOL SCIENCE PLUS (AS+) GREW OUT OF ANOTHER SUCCESSFUL NSF-FUNDED SCIENCE ACTIVITY PROGRAM: PLAYTIME IS SCIENCE. BOTH WERE DEVELOPED BY EDUCATIONAL EQUITY CONCEPTS (EEC), A NONPROFIT ORGANIZATION THAT DEVELOPS EQUITY-BASED MATERIALS FOR CHILDREN AND CLASSROOMS AND OFFERS TRAINING FOR TEACHERS, ADMINISTRATORS, AND PARENTS.

Playtime Is Science (PS) is an early-childhood parental-involvement project that uses developmentally appropriate hands-on science activities for children, parents, and the classroom to bring science to a broader range of students and parents—to level the playing field for all students. It increases young girls' participation in science when science abilities and attitudes are first being formed—and when physical science activities barely exist in most classrooms. Playtime Is Science employs science activities that are fun and use inexpensive, recyclable items such as cooking oil, plastic bottles, empty boxes, and old socks. It has been successfully implemented in schools, community centers, and Head Start centers.

With After-School Science PLUS, EEC applied the concepts and activities of PS to after-school centers, designing 11 inquiry-based science activities for school-age students—activities that emphasized equity, career/role models, and literacy. AS+ was pilot-tested and field-tested in 1997 and 1998 in three New York City settlement houses. The AS+ activities include, among others, Oobleck: Solid or Liquid?, Sink and Float, Bubble Science, Building with Wonderful Junk, and Who Does Science?

The program gave students positive information about who does science, dispelled stereotypes about girls and women in science, and created opportunities for students to see science as part of their everyday experience. The students kept journals about science role models diverse in terms of race, ethnicity, gender, and disability. *Parents were involved so they could become science enthusiasts and role models for their children*.

AS+ provided staff development institutes, opportunities for parent involvement, and ongoing professional program support, coordination, and technical assistance. It developed and field-tested a model for staff development suited to the needs of group leaders/counselors. Group leaders typically are young people, part-time college students, or youth workers who lack the experience and education of classroom teachers. They enjoyed the hands-on activities as much as their students. "The most helpful part of the training," says one group leader, "was how to make science fun and understandable for kids." Without the training, group leaders were not always able to draw links between PS+ and gender equity or science careers in ways that students followed or understood.

The evaluator found that *doing AS+ in an after-school center increased the amount of equity-based science done in that center. With training, staff encouraged all students to participate in the activities. There was a perceptible improvement in student attitudes about girls who do science and both girls and boys became more aware of science careers* (although "doctor" remained the most frequently mentioned job, followed by "scientist" and "nurse"). The project also learned that it takes time and training for centers to take ownership of the program and to develop administrative support for it, and for staff to understand how to make the connections between science activities, equity, careers, and literacy.

All these issues and concerns were incorporated into the AS+ training model and guides. *After-School Science PLUS: Hands-on Activities for Every Student* provides tools for implementing inquiry-based science that meet the National Science Standards in after-school settings. The Planning Guide (for administrators) has sections on staff development, resources, and family outreach materials in English and Spanish. The Activity Guide (for group leaders) provides hands-on activities, career and role model materials, print and website resources, family letters in English and Spanish, and more. Each activity includes reproducible biographies of women and men of science from diverse backgrounds.

CODES: E, I, PD	EDUCATIONAL EQUITY CONCEPTS
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HRD 96-32241 (ONE-YEAR GRANT)	
PARTNERS: UNITED NEIGHBORHOOD HOUSE OF NEW YORK; PARTNERSHIP FOR AFTER SCHOOL EDUCATION; THE STANLEY ISAACS NEIGHBORHOOD CENTER, THE GROSVENOR NEIGHBORHOOD HOUSE (SINGLE-SEX GROUPINGS), AND THE HUDSON GUILD NEIGHBORHOOD CENTER.	
PRODUCTS: AFTER SCHOOL SCIENCE PLUS: HANDS ON ACTIVITIES FOR EVERY STUDENT; AFTER SCHOOL SCIENCE PLUS: A PLANNING GUIDE; ACTIVITY GUIDE.	
KEYWORDS: EDUCATION PROGRAM, AFTER-SCHOOL, COMMUNITY-BASED SITE, STAFF TRAINING, GENDER EQUITY AWARENESS, PARENTAL INVOLVEMENT, HANDS-ON, INQUIRY-BASED, ROLE MODELS, BIOGRAPHIES, RESOURCE GUIDE, BILINGUAL, REAL-LIFE APPLICATIONS	

001
Nbs
Nosebag science

NOSEBAG SCIENCE

IN HELPING TO BRING GIRL-FRIENDLY SCIENCE ACTIVITIES TO GIRL SCOUTS IN THE HORNETS' NEST COUNCIL, DISCOVERY PLACE, INC., IN NORTH CAROLINA, DEVELOPED A "NOSEBAG SCIENCE" PROGRAM—SCIENCE ACTIVITIES THAT MAKE USE OF COMMON OBJECTS, PROVIDED IN A BAGGIE. ADDED AFTER THE ORIGINAL BRIDGING THE GAP GRANT PROPOSAL, NOSEBAG SCIENCE WAS DEVELOPED AS A CONCRETE WAY TO PROVIDE EASY, FUN, ACCESSIBLE HANDS-ON SCIENCE ACTIVITIES AND TO HELP SCOUTS EARN THEIR "WORLD OF TODAY AND TOMORROW" CONTEMPORARY ISSUES PATCH.

Girls can do Nosebag Science activities at troop meetings, day camp programs, and large events such as overnights and camporees. Scout leaders say that the girls decide which activities to select, but it was clear to interviewers that the girls are heavily influenced in that decision by what the Scout leaders feel comfortable with (an influence many leaders are reluctant to acknowledge).

It is important to make science fun for the girls, to convince leaders that science is important for their girls, and to make it easy for the leaders to do science activities. Among obstacles to success with science activities, mechanical issues (such as the cost and location of materials) and lack of training in science were easiest to address. Discovery Place could train troop leaders, give them materials (or make it easy to get them), develop step-by-step instruction cards, and so on.

Dealing with negative attitudes toward science was harder. Many leaders were not as comfortable with science-related activities as others; it interested but scared them and they wanted to be sure activities were safe. Troop leaders often saw science as a foreign language or culture. They feared being unable to predict or answer girls' questions or even to know where to look for answers. *Girls and leaders must be shown how fun, meaningful, and relevant to everyday life hands-on science activities can be*.

Troop leaders said they needed activities that work, are fun, are age-appropriate and badge-related, can be done in a single session, and require only readily available low-cost materials, especially materials that can be requested by e-mail and sent to the leaders. They wanted activities immediately relevant to the girls (they can "eat it, wear it, or use it") in the medium term (related to earning a badge or patch) or in the long term (related to their life or career). They wanted activities that sound interesting, meaningful, and challenging (not babyish) but not academic or bookish. They wanted simple, clear, complete instructions, letting them know step by step what to do, what would happen, what to do after that, what might go wrong, and what to do about it. They wanted a volunteer science consultant accessible at all times and were frustrated when one wasn't.

The project staff adopted a fun, collaborative approach to training—with leaders training other leaders, who in turn trained the girls—which gave those who felt "afraid" of science new satisfactions and self-confidence. Those who felt science didn't apply to them discovered how important it is in their lives.

This project was designed to empower local Girl Scout facilitators and leaders to plan, organize, and direct grassroots activities to encourage an interest in STEM. A Science Resource Center (or "Science Pod") was up and running the second year. The first program developed was "Critters, Creatures, and Other Things" for Brownies.

It takes an academic year (August–May) to implement Bridging the Gap locally: to introduce activities, empower leaders, and engage the girls. Exposing the girls to high-interest activities at council events helps start word-of-mouth. As of December 1996, 7,361 girls and 900 adults had been exposed to Bridging the Gap activities, and the Hornets' Nest Council was planning dissemination to councils around the country.

CODES: E, M, H, I, PD	Discovery Place, Inc. (Charlotte, N.C.); Hornets Nest Girl Scout Council
Marilynn Sikes (marilynns@discoveryplace.org), Patricia K. Blake, Jerald H. Reynolds, Beverly Sanford, and Patricia Baldwin	HRD 94-50006 (one-year grant)
Partner: Hornets Nest Girl Scout Council	
Materials available: Brownie leader guides and nosebag kits for My Body, Numbers and Shapes, Science in Action, Science Wonders, Senses and Outdoor Happenings. Junior level guides are available for World of Today and Tomorrow Dabller, Aerospace, Weather Watch, Geology, Science in Action, and Discovering Technology.	
Keywords: demonstration, staff training, support system, resource center, girl scouts, activity-based, hands-on, self-confidence, collaborative learning, engagement	

001
Ssl
Science-based service learning

SCIENCE-BASED SERVICE LEARNING

PROJECTS THAT HELP PRESERVE A COMMUNITY STREAM OR GET HIGH SCHOOL STUDENTS EXCITED ABOUT HIGHER LEARNING HELP CEMENT TIES BETWEEN SCIENTISTS AND THE COMMUNITY, SAYS DEBORAH WIEGAND, WHO IN 1994 PIONEERED SCIENCE SERVICE LEARNING IN THE UNIVERSITY OF WASHINGTON CHEMISTRY DEPARTMENT. MORE THAN A THOUSAND COLLEGE STUDENTS HAVE PARTICIPATED—LEADING HANDS-ON SCIENCE PROJECTS IN AREA ELEMENTARY SCHOOLS, MENTORING AT-RISK KIDS IN SCIENCE ACTIVITIES, MONITORING WATER QUALITY IN AREA STREAMS, AND HELPING HIGH SCHOOL TEACHERS ON DNA SEQUENCING PROJECTS. THE CITY OF BELLEVUE "STREAM TEAM," FOR EXAMPLE, WORKS WITH LANDOWNERS ON WAYS TO CONTROL RUNOFF AND PROTECT THE CITY'S WATERWAYS. A STUDENT MIGHT SPEND WEEKS EXAMINING THE ECOLOGY OF A PARTICULAR SITE AND THEN RECOMMEND PLANTING NATIVE SPECIES THAT WOULD DO WELL LOCALLY.

Congress created the Corporation for National and Community Service in September 1993 to support, among other activities, service-learning initiatives in higher education (called Learn and Serve America). The idea was *to make service an integral part of the education and life experiences of the nation's students—to produce educated citizens, not just educated people*. UW started its science service learning project at a time when service learning in colleges mostly involved tutoring high school students. Wiegand saw *intergenerational community service learning with measurable academic outcomes as a vehicle to engage undergraduates actively in science and to expand their vision to include issues of scientific literacy, ethics, and objectivity as well as social and political influences on community scientific decisions*. The Association of American Colleges and Universities declared her approach a national model.

With service learning, students contribute positively to the community while learning. They also experience the value and necessity of service to others and the importance of bringing science back into the community. This course's nontraditional format dispels an "ivory tower" attitude by forcing students to do science off campus.

The three service learning courses UW's chemistry department offers are progressively more challenging. The first tightly structures how students take part in community service. In the second, which can be taken as many as six times, students are expected to take on independent projects relating to their service sites. For the third, they assume leadership roles in the work being done at their sites. Students who stay for two or three quarters get more from the experience than those who stay for one. The students enjoy general acceptance, whether working with teenagers in a high school classroom (where they serve as informal ambassadors, answering questions about university life) or with patrons of a senior citizens center.

In providing a community service, students in all three courses must apply principles and methods learned in the classroom, so that they understand the value of what they are learning and how to apply it in everyday life. They can work directly with a community group or nonprofit organization on science-based projects to benefit the community, help teachers and students implement ongoing community service projects (such as growing food for community food banks), or, working with local teachers, help generate hands-on activities to draw K–12 students into scientific inquiry related to community needs and concerns. They can be especially helpful on science-based activities involving measurable change—for example, water monitoring, stream revegetation, and salmon habitat efforts.

The course *encourages the students to take more responsibility for the outcome of their learning experience*. They reflect on their service experience in two essays and a final paper. Wrote one student, "Coming up with simple, but still accurate, explanations for complex situations was one of the greatest challenges of the course. . . . It forced me to reexamine my understanding of chemical principles and interpret them for a group of ninth graders."

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HRD 95-53448 (one-year grant)	
Partner: Fund for the Improvement of Postsecondary Education (FIPSE) (Department of Education)	
Keywords: demonstration, service learning, hands-on, mentoring, real-life applications	

001
Tsp
Traveling science programs

TRAVELING SCIENCE PROGRAM

THIS SERVICE LEARNING PROJECT CHALLENGED ELEMENTARY SCHOOL GIRLS (AND BOYS) WITH HANDS-ON SCIENCE ACTIVITIES UNDER THE GUIDANCE OF UNDERGRADUATE AND GRADUATE STUDENTS, WHO SERVED AS ROLE MODELS FOR THE YOUNGER CHILDREN AND HELPED DESIGN THE SCIENCE CURRICULUM—A WORTHWHILE OUTLET FOR THEIR TECHNICAL KNOWLEDGE.

The project provided science activities in extracurricular settings (in elementary science clubs, before- and after-school programs, and community-based science programs, including some in neighborhood centers serving low-income and minority children). Older children served as peer leaders ("scientist assistants") in these activities. Parents were invited to evening activities.

Three curriculum design teams developed curriculum packets—on edible chemistry (grades K–1), brain power (grades 2–3), and genetics (grades 4–6). Each curriculum packet contained some exploratory activities that could be completed within 15 minutes or less, some that took 30 to 60 minutes, and some that could be completed at home, with or without parental involvement.

Under "brain power," for example, one class activity might be to design helmets (made of packing materials) for raw eggs, which the students would "crash test" by rolling the helmeted eggs off a cardboard ramp. (The most obvious application of this exercise is to stress the importance of wearing a helmet during sports activities.) At home, the students might train a goldfish to swim to the surface for food.

Each design team consisted of one female scientist or engineer (faculty, staff, or postdoctoral), one woman from the Iowa science center's staff, and four to six female undergraduate and graduate students. Because of the emphasis on gender-equitable science, team members attended 90-minute training workshops on gender-equitable teaching, cooperative teaching and learning, and inquiry-based learning. *Under the team model of service learning, the undergraduate and graduate students benefited from goal-oriented mentoring and developed teaching skills in a supportive environment.*

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HRD 96-31243 (ONE-YEAR GRANT)	
PARTNERS: WISE, AWS, IOWA CITY COMMUNITY SCHOOL DISTRICT, IOWA CITY AREA SCIENCE CENTER, INC., CREIGHTON UNIVERSITY	
KEYWORDS: EDUCATION PROGRAM, HANDS-ON ROLE MODELS, SCIENCE CLUBS, AFTER-SCHOOL, COMMUNITY-BASED, SERVICE LEARNING, GENDER EQUITY AWARENESS, COOPERATIVE LEARNING, INQUIRY-BASED	

001
Sgs
Science horizons for Girl Scouts

SCIENCE HORIZONS FOR GIRL SCOUTS

THE MONTSHIRE MUSEUM OF SCIENCE, IN COLLABORATION WITH THE SWIFT WATER COUNCIL OF THE GIRL SCOUTS AND THE WOMEN IN SCIENCE PROJECT OF DARTMOUTH COLLEGE, DEVELOPED A PILOT PROGRAM TO ENCOURAGE GIRLS IN GRADES 7–9 TO KEEP STUDYING MATH AND SCIENCE BY BOOSTING THEIR CONFIDENCE AND INTEREST IN THE SUBJECTS. ROUGHLY 80 CADETTE SCOUTS FROM NEW HAMPSHIRE AND VERMONT PARTICIPATED IN THE PILOT PROGRAM.

The project provided for hands-on science education at the Montshire Museum of Science; visits to science labs at Dartmouth College, organized by "Women in Science" undergraduates conducting research projects there; and community-based science activities (developed by the Scouts, with help from the university students and museum staff). The project also conducted a workshop on gender equity issues for the Scout leaders and for teachers from the girls' home schools.

CODES: M, I, PD	MONTSHIRE MUSEUM OF SCIENCE
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HRD 94-50593 (ONE-YEAR GRANT)	www.vtc.vsc.edu/wit/links.htm#girls
PARTNERS: SWIFT WATER COUNCIL OF THE GIRL SCOUTS; WOMEN IN SCIENCE PROJECT, DARTMOUTH COLLEGE	
KEYWORDS: DEMONSTRATION, HANDS-ON, SELF-CONFIDENCE, MUSEUM, GIRL SCOUTS, INFORMAL EDUCATION, ROLE MODELS, GENDER EQUITY AWARENESS	

001
Ttr
Tech trek

TECH TREK

TECH TREK USED THE TECHNICAL AND COMMUNICATIONS EXPERTISE OF PUBLIC TELEVISION TO DESIGN, DEVELOP, TEST, AND EVALUATE A MODEL PROGRAM TO ENCOURAGE MIDDLE SCHOOL GIRLS TO PURSUE CAREERS IN STEM. IN WEEKLONG SUMMER CAMPS FOR GIRL SCOUTS, WGTE'S RADIO AND TELEVISION STATIONS PROVIDED ENGAGING, COLLABORATIVE, HANDS-ON LEARNING ACTIVITIES THAT INCREASED THE GIRLS SCIENTIFIC LITERACY AS THEY EXPLORED SCIENCE AND TECHNOLOGY OPPORTUNITIES IN BROADCAST COMMUNICATIONS. A TOTAL OF 50 SCOUTS AND 10 SCOUT LEADERS ATTENDED TWO ONE-WEEK SESSIONS.

In June, campers, their parents and/or siblings, and the staff boarded buses for the Center for Science and Industry (COSI), learning about Tech Trek by video on the way. After icebreakers and a scavenger hunt of exhibits about communications, the girls built their own crystal radio. The trip to COSI also launched the Tech Trek camps held in July at WGTE's studios.

Each girl served as a member of a news team that was assigned a topic for a video report. They toured WGTE's TV and FM studios, learning about master control, production control, and so on, and interviewed their mentors. Monday they learned how to produce for television, experimented with the cameras, and wrote scripts and storyboards for their video reports. Tuesday they videotaped at the Toledo Zoo, with mentors there to review tapes and offer suggestions for second takes. Wednesday and Thursday they edited their reports and produced promotional materials for their programs (a print ad, a radio promo, and a video tune-in spot). At-home activities guided the girls through a critical look at TV programming and advertising. Along the way they kept track of expenses based on a WGTE rate card.

Thursday afternoon they explored the science behind broadcast technologies, moving through a series of hands-on activities that demonstrated persistence of vision, the principles of electricity, how sound and light travel, how TV screens show color, and how electromagnetic waves play a role in communications. Friday they worked with the studio cameras and production switcher to put the video reports together into a news program, complete with studio hosts.

There was a statistically significant improvement in the participating Girl Scouts' attitudes toward science; many of them reported changing their goals to careers in science and technology. They also became more skilled at using electronic equipment. WGTE offered grants of $250 to organizations interested in replicating some aspect of Tech Trek in their community. By July 1997, it had formed 45 partnerships with 116 organizations.

CODES: M, I,	WGTE TV-FM
MARY RICHTER (MARY_RICHTER@WGTE.PBS.ORG)	
HRD 94-53076 (THREE-YEAR GRANT)	www.wgte.org
PARTNERS: MAUMEE VALLEY GIRL SCOUT COUNCIL (CADETTE GIRL SCOUTS), SCIMATEC (UNIVERSITY OF TOLEDO), AND COSI	
PRODUCTS: TECH TREK HOW TO HANDBOOK, CURRICULUM GUIDE, AND A VIDEOCONFERENCE VIDEOCASSETTE	
KEYWORDS: DEMONSTRATION, TELEVISION, GIRL SCOUTS, SUMMER CAMP, HANDS-ON, MENTORING, BROADCASTING, VIDEOS, CAREER AWARENESS	

001
Mas
Mountaineering after-school and summer camps

MOUNTAINEERING AFTER-SCHOOL AND SUMMER CAMPS

IMPORTANT ACADEMIC DECISIONS ARE MADE DURING THE MIDDLE SCHOOL YEARS, WHEN GIRLS ARE MOST VULNERABLE TO LARGE DROPS IN SELF-ESTEEM, FEEL LESS CONFIDENT ABOUT THEIR ABILITY TO DO SCIENCE AND TECHNOLOGY, FACE MORE INTENSE PRESSURES NOT TO COMPETE WITH THE BOYS, AND BEGIN TO AVOID COURSES IN COMPUTER TECHNOLOGY.

To learn what type and degree of contact is most effective in increasing middle school girls' understanding of, and interest in, STEM, Washington State University will offer three types of informal science activities, each providing 30 hours of instruction:

- After-school camps that meet at a middle school two days a week for eight weeks
- Weeklong nonresidential summer camps that meet six hours a day on an urban university campus
- A week-long residential summer camp held at WSU's Camp Roger Larson, a residential research and teaching facility located on Lake Coeur d'Alene, Idaho

The project's mountaineering theme is appropriate in the Pacific Northwest, where outdoor activities are highly visible and strongly encouraged. Moreover, mountaineering integrates math, physics, physiology, communications, materials science, geology, environmental science, and computer technology.

Students will learn about the types of materials used for ropes, tents, packs, and other equipment; about why outdoor equipment is designed the way it is and what it took to develop those designs; about the use of computers in engineering design, GIS applications, and so on; about the formation and erosion of Mt. Rainier and its context within the Pacific Rim of Fire; about dehydration techniques and foods appropriate for outdoor activities; about physiological responses before and after a rock climb (with and without full backpacks); about basic first-aid skills and water safety; and so on. They will take a field trip to Wild Walls, a certified indoor climbing gym, for a climbing experience.

Experiential learning supports the learning styles of young women. Expeditions are highly interdependent, requiring teamwork and group problem solving—from route choice, selection of equipment, physical conditioning, food selection, and first aid preparation to actual route finding. Camps will be taught by a certified teacher, helped by local outdoors experts, with support from women science professionals—who will provide six months of electronic mentoring support after the camp experience.

Evaluators will try to learn whether or not the mode of delivering content material, combined with a strong mentoring program, affects the girls' disposition toward STEM courses and careers.

CODES: M, I, U	WASHINGTON STATE UNIVERSITY, PULLMAN
SYLVIA A. OLIVER (OLIVERS@WSU.EDU), MICHAEL S. TREVISIAN	
HRD 00-86440 (ONE-YEAR GRANT)	
PARTNER: WSU SPOKANE'S CITY LAB	
KEYWORDS: DEMONSTRATION, SELF-CONFIDENCE, AFTER-SCHOOL, SUMMER CAMP, INFORMAL EDUCATION, MOUNTAINEERING, FIELD TRIPS, EXPERIENTIAL LEARNING, TEAMWORK APPROACH, MENTORING	

001
Sis
Sisters in sport science

SISTERS IN SPORT SCIENCE

EVERY DAY, GIRLS LEARN HOW TO RIDE A BIKE, THROW A BALL, OR JUMP ROPE IN AN UNTHREATENING, UNCOMPETITIVE ENVIRONMENT, UNAWARE OF THE MATHEMATICAL AND SCIENTIFIC PRINCIPLES EMBEDDED IN THESE ACTIVITIES. IN THE CLASSROOM, THEY LEARN PRINCIPLES UNRELATED TO THEIR EVERYDAY EXPERIENCES—OR THEY MAY LEARN ABOUT THE TRAJECTORY OF A GOLF BALL WITHOUT CONNECTING THAT PRINCIPLE TO THE PRACTICE OF HITTING A GOLF BALL. USING SPORTS AS AN ENTRÉE TO SCIENCE, THIS THREE-YEAR INTERVENTION AIMS TO HELP SIXTH, SEVENTH, AND EIGHTH GRADE GIRLS EMBRACE MATH AND SCIENCE PRINCIPLES THROUGH A CONNECTION WITH SPORTS. SPORTS ALSO TEACH HOW TO COMPETE, HOW TO PERFECT STRATEGIES FOR OVERCOMING OBSTACLES, AND HOW TO DEVELOP TRUST, RAPPORT, TOLERANCE, PATIENCE, AND PERSISTENCE.

The project expects to involve 540 girls from six Philadelphia middle schools (as well as teachers, college students, minority athletes, and mentors) in after-school programs, Saturday academies, special sport day events, academic and summer internships, and career connections. The first year, 126 girls participated regularly, but some weeks 300 come.

Forty curriculum activities driven by science and math standards are presented after school through five team sports (volleyball, basketball, soccer, hockey, and softball) and five individual sports (fencing, golf, tennis, and track—running and throwing), in five-week rotations. (The girls *love* fencing, because smaller girls can beat larger ones; they want the science and math behind it, to get better. The project quickly realized it should also have included jump rope, an important activity in the inner city.) Roughly an hour is spent on sport mechanics and an hour on the science and math behind them. After spending time on how to hit a tennis ball, the girls might spend the rest of the time on where the ball travels (trajectory, motion, and force). In basketball, they might study the math and science of the rebound effect.

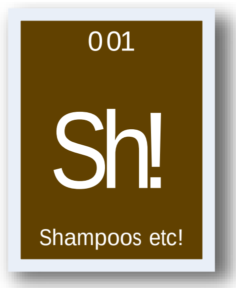
After-school activities take place one afternoon a week, in 10-week sessions. A teacher from each school and two graduate students co-facilitate, supported by undergraduate education students and minority athletes. At the end of a sport's rotation, families join the girls in a special sport day event, where the girls explain the principles involved.

At the Saturday academies, a graduate student and a teacher from each school co-facilitate (supported by undergraduate education students and minority athletes) four-hour sessions: an hour on sport mechanics and three hours on the principles involved. The second year, the girls spend more time on the science and math—including time doing computer simulations. Parent volunteers help at after-school and Saturday activities.

The girls also work on a research project that interests them, seeing their mentor once a week and keeping in touch with them online. Mentors are paid to participate, to help cover the cost of public transportation, meals, and so on. (It's important to select mentors with access to public transportation.)

On a competitive basis, 20 percent of the girls (45 to 50) are awarded summer internships to participate in the sport science career camp. There they revisit sport science and math, explore career connections, and conduct research on a sport (exploring, for example, how the speed of runners has increased greatly over time—although one girl might explore the biochemistry of it and another the technology that led to the increase in speed). The girls are partnered electronically with a scientist in the field of their choice and conduct an experiment to test their hypothesis. They get service credit at their school for participating in the camp.

CODES: M, U, I	TEMPLE UNIVERSITY
PENNY L. HAMMRICH (PHAMMRICH@TEMPLE.EDU), TINA S. GREEN, GREER M. RICHARDSON	
HRD 00-02073 (THREE-YEAR GRANT)	
PARTNERS: PHILADELPHIA SCHOOL SYSTEM, TEMPLE COLLEGE OF TECHNOLOGY AND ENGINEERING, LASALLE UNIVERSITY, AND BLACK WOMEN IN SPORTS FOUNDATION	
KEYWORDS: EDUCATION PROGRAM, SPORTS-BASED, AFTER-SCHOOL, INTERNSHIPS, CAREER AWARENESS, MENTORING, URBAN, INTERVENTION, PARENTAL INVOLVEMENT, RESEARCH EXPERIENCE	



SHAMPOOS ETC!

AROUND THE ROOM'S PERIMETER, NUMBERED TABLES HOLD INFORMATION PACKETS, SCIENTIFIC EQUIPMENT, AND CONTAINERS LABELED "CITRIC ACID," "COCAMIDE DEA," "KATHON," "SODIUM CHLORIDE," AND "DETERGENT." AT TABLES FORMING A "U" IN THE MIDDLE OF THE ROOM, A TEACHER WITH A FRIENDLY SMILE WELCOMES STUDENTS TO "SHAMPOOS ETC!," AN INQUIRY-BASED SCIENCE WORKSHOP FOR MIDDLE SCHOOL GIRLS.

Soon 24 girls from sixth to eighth grade arrive, fill out questionnaires, and examine the equipment with curious skepticism. Half an hour later the room is buzzing with energy as the girls, four to a table, discuss how to measure various ingredients, who gets to use the cool pumps, pipettes, and cylinders to do the measuring (they quickly work out taking turns), what the various ingredients are (they read the explanations on the ingredients list), and why they have to take safety precautions, such as wearing gloves and goggles.

Two hours later, the groups come together and discuss their results. The groups have used the same ingredients but in varying amounts, testing their products to find out which shampoo cleans better, is more viscous, has a better pH balance. From this discussion, they hypothesize about what combination makes the best product.

Then they're pouncing on "Jeopardy!"-like buzzers, vying with one another to answer questions such as "What chemical is used to thicken shampoo?" and "What do you use to measure small volumes?" Finally, the room fills with laughter and chatter as each girl chooses and mixes in scent and color, then designs a label to personalize her product. These girls have spent all of Saturday morning doing science and loving every minute of it.

Shampoos Etc! is a project designed to spark middle-school girls' interest in science through the formulation of personal care products. In an area where few girls take chemistry and even fewer take physics, biochemist Anna Tan-Wilson *wanted to provide performance-based science lessons that teach concepts in the physical sciences so interesting to girls that they will be compelled to explore all the sciences, not just the biological sciences they seem to prefer. The project approaches science teaching from applications students are familiar with but probably never associate with the sciences learned in school*.

First, Tan-Wilson *wanted to isolate girls from boys because when boys and girls perform science experiments together, boys measure and girls write*. She figured middle school girls would be attracted to a program in which

they could make their own creams, shower gels, shampoos, and hair conditioners. And *the possibility of varying the formulas for the products lent itself naturally to teaching measurement, good lab processes, the process of inquiry, and the testing of hypotheses*—which in turn could lead to the study of concepts in the physical sciences. By becoming familiar with chemical terms and scientific equipment now, the girls would not be put off or intimidated when they came across them later. After gaining confidence in their lab work, when confronted with a similar project in future they would be able to plunge right in.

Before each workshop, the girls tour the Lander Company's personal care products manufacturing facility, which also provides ingredients for the experiments. Asked to check off properties they might consider when purchasing shampoo, students ticked off far fewer before the activities than after—when they checked fragrance, their own skin type, brand name, antibacterial agents, color, detergent action, foaming, and viscosity.

The project developed a workshop for middle-school teachers on how to incorporate Shampoos Etc! into classroom science. It emphasized the formulation of shower gels, renamed "liquid soap" to be more acceptable to boys. After suggestions from teachers at the workshop were incorporated, an outreach education specialist went to these teachers' classrooms, brought materials and equipment, and stayed to co-teach. This unit reached more than 500 students.

CODES: M, U, I	State University of New York, Binghampton
Anna Tan-Wilson (annatan@binghampton.edu), Dale Ketcham, Christeen Gnad, Cynthia Schlagter, Susan Granat, and Elizabeth Button	
HRD 99-08729 (one-year grant)	
Http://bingweb.binghamton.edu/~annatan/shampoo/	
Partners: Robertson Museum and Science Center, The Lander Co.; Union-Endicott School District.	
Adapted with permisssion from an article by Janice Endresen in the Binghampton Alumni Journal.	
Keywords: education program, museum, inquiry-based, personal care products, industry partners, informal education, field trips, teacher training, self-confidence	

001
fem
FEMME continuum

FEMME CONTINUUM

CONFIDENCE IS THE VARIABLE THAT CORRELATES MOST STRONGLY WITH ACHIEVEMENT IN MATH AND SCIENCE, ESPECIALLY FOR GIRLS. TO COUNTERACT WOMEN'S NEGATIVE FEELINGS ABOUT SCIENCE AND THEIR ROLE IN SCIENCE, HOWARD KIMMEL, HAROLD DEUTSCHMAN, AND DANA LEVINE (OF THE NEW JERSEY INSTITUTE OF TECHNOLOGY'S CENTER FOR PRE-COLLEGE PROGRAMS) DESIGNED AND IMPLEMENTED FEMME (FEMALES IN ENGINEERING, METHODS, MOTIVATION, AND EXPERIENCE). THIS RIGOROUS, INTENSIVE FOUR-WEEK PROGRAM OFFERED POST–NINTH GRADE GIRLS ACTIVITIES IN SCIENCE, ENGINEERING, MATH, ARCHITECTURE, COMPUTER SCIENCE, AND THE ENVIRONMENT.

Many intervention programs designed to encourage young women to enter STEM fields are discontinued after the trial period because they are no longer innovative or because they have "done the job." But NJIT, building on its success with FEMME, sponsored an Introduction to FEMME program for high-achieving or high-potential fourth and fifth grade girls from the greater Newark area. Then, in 1994, it launched the FEMME Continuum, to give post–fifth and sixth graders (Intro to Femme alumnae) otherwise unavailable opportunities to sustain their math and science achievement, self-esteem, self-confidence, and feelings of competence.

The nonresidential program included five spring workshops, four weeks of daily summer activities, and a follow-up session in September, with content developed to encourage inquisitive minds and introduce contemporary ideas. The summer program provided 60 hours of hands-on science and math and lab experiences; daily athletic experiences (including volleyball, swimming, water polo, and tae kwon do) that encouraged team building and cooperative achievement and challenged fear of failure; math and science study groups and cooperative learning; and field trips to places like the Newark Museum, the New Jersey Marine Science Consortium, the Franklin Institute for Science (in Philadelphia), the Beuhler Space Center, and Liberty Science Center.

Whether building rockets and Popsicle-stick houses (problem solving through teamwork), doing chemistry experiments, or being introduced to marine life, the students learned about scientific methods and improved in skills, persistence, and self-sufficiency. After classes in Word and Excel, the girls prepared a newsletter. They and their parents learned about college prep courses.

Of the original 41 participants, 38 completed the project and wanted to keep participating in NJIT's Women in Engineering and Technology initiative—a series of pre-college experiences designed to advance their academic preparation in STEM. Surveys showed they were more willing to make the effort to do well in science and math, and their percentage of correct responses increased on process skills tests.

The program's most effective component was the holistic, nontraditional approach to teaching. *The most effective tools in motivating girls 10 to 12 were hands-on instructional techniques, a thematic approach to teaching and learning, and exposure to women who were practicing scientists*. But the girls were also exposed to a college atmosphere and to other students of diverse ethnic and socioeconomic backgrounds and became more willing to experiment with active learning that involved taking risks.

In cooperative learning, success does not depend on quick response time or the loudest voice, but the project team learned an unexpected lesson—*that cooperative learning must be carefully monitored, because the most outgoing personality in the group tends always to be the leader.*

CODES: E, M, H, I, U	New Jersey Institute for Technology
Howard Kimmel (kimmel@admin.njit.edu)	HRD 94-50592 (one-year grant)
Keywords: demonstration, workshops, field trips, cooperative learning, career awareness, athletics, museum, self-confidence, achievement, intervention, hands-on, summer program	

001

Scx

Science connections

SCIENCE CONNECTIONS

THE PLUS CENTER (PROMOTING LEARNING AMONG THE UNDERREPRESENTED IN SCIENCE) AT THE COLLEGE OF ST. SCHOLASTICA OFFERS WEEKLONG AND MONTHLONG SUMMER SCIENCE PROGRAMS FOR GIRLS THAT EMPHASIZE GENDER EQUITY AND REGULAR INTERACTION WITH FEMALE ROLE MODELS IN SCIENCE. BUT THE ENTHUSIASM GIRLS DEVELOP DURING SHORT-TERM ENRICHMENT PROGRAMS IS RARELY SUSTAINED IN THEIR HOME AND SCHOOL ENVIRONMENTS. THIS IS ESPECIALLY TRUE IN RURAL COMMUNITIES, WHERE GIRLS HAVE LITTLE EXPOSURE TO FEMALE ROLE MODELS AND ARE UNLIKELY TO RECEIVE STRONG PARENTAL SUPPORT FOR SCIENTIFIC PURSUITS—AND WHERE TEACHERS ARE RARELY FAMILIAR WITH COOPERATIVE ACTIVITY-BASED LEARNING AND LACK EVEN THE RUDIMENTARY SUPPLIES AND EQUIPMENT NEEDED FOR HANDS-ON ACTIVITIES. ONE PURPOSE OF THE PLUS PROGRAMS IS TO *OVERCOME TWO STEREOTYPES: THAT WOMEN CAN'T DO SCIENCE OR, IF THEY DO, THEY MUST BE NERDS*.

Students and parents had rated FAST Camp (a weeklong summer enrichment camp for sixth and seventh grade girls) highly, and the girls appeared to be highly motivated to continue math and science studies after camp. But despite strong encouragement, only eight of 122 FAST camp graduates actually participated in a follow-up summer enrichment experience when they reached eighth, ninth, or tenth grade. The single follow-up session the PLUS Center provided was not enough to counter the peer pressure and lack of support these students experienced after their initial summer experience was over.

To prevent these "leaks" from the science and math pipeline, St. Scholastica involved teachers, families, and scientists in Science Connections, a model program designed to give girls enrichment opportunities that would sustain their interest in science during the impressionable middle-school years. The two-year program let sixth graders from the summer camp continue to be involved with a peer group and with role model scientists and activities until they entered the eighth grade (when the PLUS Center has programs that focus on eighth grade students). Each year, 25 participants—sixth and seventh grade girls (from predominantly low- and middle-income rural or minority families) who had already participated in the weeklong science enrichment program—participated in a monthly series of Saturday Science workshops during the school year and a Summer Science weekend.

The PLUS Center has developed a consortium of local educational institutions and community partners to expand and maintain a pipeline of youth and family programming for grades 4 through 12 (while improving teacher training) and to produce systemic reform in STEM education. Many PLUS programs serve primarily students of color and low-income youth, many from rural communities. Survey results indicate that 76 percent of Plus Center alums have graduated from high school, 63 percent of those graduates have gone on to postsecondary education, and of those who have declared a major, 68 percent have selected majors in math and science-related fields.

CODES: M, U, I	THE COLLEGE OF ST. SCHOLASTICA
ANN SIGFORD (IASTAFF@STF0.CSS.EDU)	www.css.edu/PLUS
HRD 95-54497 (ONE-YEAR GRANT)	
PRODUCTS: THE LAKE SUPERIOR GAME, AVAILABLE FROM THE UNIVERSITY OF MINNESOTA SEA GRANT EXTENSION PROGRAM, COULD PROBABLY BE ADAPTED TO OTHER BODIES OF WATER.	
KEYWORDS: DEMONSTRATION, SUPPORT SYSTEM, WORKSHOP, SUMMER CAMP, HANDS-ON, PARENTAL INVOLVEMENT, ROLE MODELS, RURAL, ACTIVITY-BASED, COOPERATIVE LEARNING, TEACHER TRAINING, UNDERPRIVILEGED	

TYPICAL ACTIVITIES

Activities at the Saturday Science workshops featured, in turn, "MacGyver" problem-solving, a FAST Camp reunion, careers, kitchen science, computers, snow science, chemistry, and ecology. In the "kitchen science" workshop, students and parents made ice cream in ziplock bags, using milk, which launched a discussion of what the salt does and how recipes might freeze differently, depending on the ingredients (variables). In a milk chemistry experiment, they added food coloring and dish detergent to whole milk at room temperature, creating a reaction that surprised and baffled both students and parents. In the ensuing discussion of variables, they discussed what might happen if the experiment were repeated with skim milk or buttermilk—and were sent home with an assignment to repeat the experiment comparing different kinds of milk products at different temperatures.

At the end of each workshop, the girls received a science or math puzzle (from Marilyn Burns's books and the EQUALS book *Math for Girls*) to work on over the month; there was a drawing for a small prize from among those with correct responses. Families received two AAAS publications suggesting home activities, *Science Books and Films* and *Sharing Science With Children*. Teacher and parental involvement were emphasized as a vital link in the support network for each girl.

The Summer Science Weekend began with a chemistry magic show that included experiments with dry ice, helium, indicator solutions, and so on. Saturday morning problem-solving activities were followed by "What's My Line?" featuring eight female scientists who brought along one piece of equipment they use regularly. Saturday afternoon water activities included the "Lake Superior Game," in which a bucket of water that represents Lake Superior gradually becomes polluted and depleted as the game progresses, with game cues such as this: *I am a sixth grader. I go fishing with my friend. When we clean our fish we dump the guts in the lake instead of wrapping them up and throwing them away. We think this is okay because they are biodegradable.*

GIRLS FIRST

"WHEN YOU THINK OF SCIENCE YOU THINK OF BORING, BUT IT'S NOT LIKE THAT," SAYS A GIRL WHO ONCE DISLIKED SCIENCE. HER ATTITUDE CHANGED WHEN HER MOTHER TALKED HER INTO JOINING FIRST (FEMALE INVOLVEMENT IN REAL SCIENCE AND TECHNOLOGY). UNDER A THREE-YEAR GRANT, THE CHABOT SPACE & SCIENCE CENTER SUPPORTED ALL-GIRLS AFTER-SCHOOL SCIENCE CLUBS IN SEVEN ELEMENTARY AND MIDDLE SCHOOLS IN THE OAKLAND UNIFIED SCHOOL DISTRICT, LATER ADDING THE CALIFORNIA SCHOOL FOR THE BLIND. SEVERAL SCHOOLS CONTINUED HOSTING FIRST CLUBS AFTER GRANT FUNDING ENDED. *WHEN GIRLS GET TO MEET OTHER GIRLS WHO LIKE SCIENCE, THEY SEE THAT IT'S OKAY TO BE GOOD AT SCIENCE. IN THE COMPANY OF GIRLS WHO SHARE THEIR INTERESTS, THEY CHALLENGE STEREOTYPES AND HELP MAKE SCIENCE THE "IN" THING TO DO IN SCHOOL.*

FIRST offered girls a safe environment in which to develop the kinds of spatial and problem-solving skills boys learn by playing with building blocks or tool sets. It gave them a chance to engage in informal experiments and to "get messy like boys do." And it avoided the deadly didacticism of traditional science classes. "We don't just sit around, take notes, and memorize," said a seventh grader. "We learn things in a fun way, so we won't forget."

Clubs ranging in size from 10 to 35 girls met weekly or biweekly. Within the group setting, girls in one school played with building blocks, tinkered with tools, made solar ovens, and observed crayfish under microscopes. Girls in another school crafted their own airplanes and learned about variables and velocity. "If I make a mistake, I don't feel as embarrassed," said a fifth grader. "I don't know why."

HELPING THE VISUALLY IMPAIRED

How many of us have seen these hissing cockroaches and scorpions, let alone held them? Imagine the challenge visually impaired students face in trying to observe an insect directly. Through FIRST, girls at the California School for the Blind got a chance to touch and learn about certain insects' skeletal structures and characteristics. The giant African millipede felt like "a walking toothbrush, only better" and the walking stick from Thailand felt "kind of like rubber." This club designed and planted an organic garden for its adopted animals, including a desert tortoise, millipede, and dwarf rabbit.

Unable to look through the lens of a microscope or view the patterns on delicate seashells, students who are visually impaired have found themselves on the sidelines in science classes more because of people's attitudes than because of their visual impairment. *With the right combination of opportunities and expectations, students who are blind or visually impaired can participate in hands-on science if their teachers are resourceful*. Under Marcia Vickroy's leadership, the science club members did hands-on projects—such as making body glitter, lip balm, and scented soaps—that introduced them to chemistry and to valuable lessons about following directions, measuring, using scientific equipment, and making careful observations.

During the transition from elementary to middle school, the opinions of peers can make it difficult for a girl to take the lead in a science experiment or to assume her fair share of computer time. The girls-only setting helps students expand their interests and try new activities without feeling pressure to conform to stereotypes. "You can be more yourself because there's no one to say, 'Ha-ha, you did that.' Girls understand."

Such clubs provide a supportive environment in which girls can try out new roles. *Girls who are typically reserved in classrooms flourish in science clubs, speaking up and asking questions. And the skills and confidence developed in clubs often transfer to coed classrooms*. After a session designing and building, third-grade girls at one school returned to their classroom and began playing in the block corner previously occupied by boys. Moreover, boys were more likely to seek FIRST girls out as partners in cooperative activities, valuing the knowledge they brought to the situation. Field trips—to such places as Slide Ranch, the Berkeley Botanical Gardens, and the emergency room of a local hospital (to observe various diagnostic procedures)—helped round out the students' understanding of science. Although gender equity was important to FIRST, not all schools pushed the all-girls aspect of it, and boys often benefited indirectly.

With high expectations and hands-on experience, girls become leaders. FIRST girls played key roles, planning projects that addressed real local needs. Students at one elementary school alerted their neighbors to the dangers of dumping chemicals in storm drains. Students at a middle school created survival kits for natural disasters. In some schools, the girls in middle school taught what they learned to girls in elementary school. Survey results confirm that FIRST increased girls' confidence. Girls in FIRST were more likely than other girls, and boys, to agree with the statement "I am good at science."

Visiting scientists, who also served as role models, also helped girls and their families make informed choices about school and career options. Ask one of the girls in FIRST what she'd like to be when she grows up and you are likely to hear about a career in science.

Benefits extended beyond the science clubs. FIRST teachers received books and science equipment that enriched classroom libraries and science and technology lessons—making it possible for some students to use a microscope for the first time. A summer institute for teachers conducted by the Community for Resources in Science provided training in gender equity and science inquiry, helping FIRST teachers engage every student in class activities and discussions. *Teachers met regularly throughout the project to exchange ideas and resources*. "This is where we review, reflect, and plan," said one teacher. "We learn about gender equity issues and gender neutral strategies, try out new science activities, and network with our colleagues. *If there is one thing I would keep going even when this project is no longer funded, it would be these meetings*."

CODES: M, E, I	Chabot Space and Science Center
Etta Heber (eheber@chabotspace.org), Doris Ash, Jane Bowyer, Margaret Hauban, Dale E. Koistenen, Jane Nicholson, and Linda Kekelis	
HRD 95-55807 (three-year grant)	
www.chabotspace.org/visit/programs/first.asp	
Partners: Fruitvale, Sequoia, John Swett, Thornhill elementary schools and Claremont, Bret Harte, and Montera middle schools in Oakland Unified School District; California School for the Blind (in Fremont) AWIS (East Bay chapter).	
Products: Girls FIRST: A Guide to Starting Science Clubs for Girls by Linda Kekelis and Etta Heber.	
Keywords: demonstration, hands-on, field trips, role models, after-school, science clubs, spatial skills, problem-solving skills self-confidence, career awareness, parental involvement, gender quity awareness	

001
Tkb
Techbridge

TECHBRIDGE

WITH TOOLS OR TECHNOLOGY, MANY WOMEN EXPERIENCE APPREHENSION INSTEAD OF JUST JUMPING IN AND GIVING THEM A TRY, AND IT DOESN'T HELP THAT MOST COMPUTER GAMES AND COURSE OFFERINGS ARE DESIGNED FOR BOYS. BUT TECHBRIDGE, A THREE-YEAR PROJECT TARGETED AT JUNIOR AND SENIOR HIGH GIRLS, IS DEMONSTRATING THAT GIRLS CAN BE INTERESTED IN TECHNOLOGY WHEN A PROGRAM INCLUDES

- ACTIVITIES THAT DEMYSTIFY TECHNOLOGY
- ACTIVITIES THAT BUILD BOTH SKILLS AND CONFIDENCE IN HANDLING TECHNOLOGY
- A SAFE PLACE TO LEARN AND WORK WITH COMPUTERS
- PROJECTS THAT ADDRESS GIRLS' REAL NEEDS AND INTERESTS
- TASKS THAT ARE CHALLENGING—BUT NOT TOO CHALLENGING.

Before- and after-school programs for middle and high school girls lie at the heart of Techbridge. A self-selected team of 17 teachers hosts Techhbridge programs serving about 170 students (and their families) at five Oakland middle schools and four high schools, with a project under way for the Fremont School for the Blind. Teachers welcome applications from girls who like math and science, are curious by nature, or see themselves as leaders.

Teachers can see the impact such clubs have on young girls' lives, especially in middle school, where it's not cool to be smart. The club sponsors create a comfortable space where girls can talk about report cards and academic achievement, with no fear of being teased, and can encourage each other to succeed.

Techbridge classes were expected to meet once every week or two, but several schools met more regularly or added lunchtime sessions to accommodate students who took school buses home. One school added a class that meets an hour before school and is fully enrolled, with two dozen girls who have had more than 150 lessons. At one school, half the girls enrolled show up even for a Friday afternoon session, hardly the most popular time to be at school. *One reason some girls attend is that there is no alternative after-school activity that is both physically and socially safe. After-school programs like Techbridge also give girls a chance to connect with caring teachers, which is difficult in classrooms where teachers have 150+ students a day.*

Learning is project-based. Lessons on hardware helped demystify technology for the girls, who are given a chance to take computers apart and learn the names and functions of hardware components. *This is the first time many girls have ever had a chance to tinker and use tools*. In some classes, as a follow-up lesson girls are asked to reassemble components and to install additional memory in their computers. Girls arrived in one class to find that the computers, hard drives, and mouses had been disconnected, and that it was up to them to figure out how to get their computers working.

Girls in urban settings where access to technology is limited, especially in middle schools, greatly benefit from access to computers. Some girls don't have computers in their homes or have inadequate equipment and software. An enrichment program like Techbridge gives them time to learn and explore computers and the various applications available. Multimedia projects often capture the interest of girls not already interested in computers.

Many program activities are based on ideas the girls proposed, such as designing school yearbooks or creating a girls' magazine—activities that sustain students' interest for months, allowing girls with varying skills and interests to work together and bridging cultural divisions. Girls were free to select the content, themes for which ranged from Asian Pride to Barbie and Ken to Techbridge.

A special-education student who struggled with academic subjects in the regular classroom successfully worked her way through a tutorial for creating a website, with the teacher referring other students to her as "the expert." *Without Techbridge, such a success would have been impossible, because academic skills are gatekeepers to computer course electives at her middle school. Such successes can turn around girls' behavior and attitudes*. That Techbridge is for girls only is critical for the ease with which girls try new activities.

Field trips and summer programs are social learning experiences. Girls participating in the summer Media Academy come to the Chabot Science Center for a week, working six hours a day to learn the ins and outs of digital video production. Many of them say that making the videos doesn't feel like work at all. That's exactly the *message Techbridge tries to get across: that being involved in technology doesn't mean sitting in front of the computer without friends—that you can have a good time with it*. A summer program will introduce girls to geographic information systems (GIS) and to art and technology projects through which they learn programming skills. Field trips to museums like the Tech Museum of Innovation in San Jose offer hands-on learning but are very hard to schedule during the regular school day in middle school and high school. Often scheduled on the weekend, they require that teachers give their personal time.

Technology is more than computers. Girls learned to use power tools in the school's woodshop, built phones and called home on them, and made electronic products from kits. On starting to assemble AM–FM robots, the girls in one group looked first at the kit instructions and then at the teacher, expecting her to tell them what to do—they had little patience for reading or following directions. But the following week they came in with all the radios playing and were astounded that they had done it. And then it got easier. By the spring, they were turning to each other for help putting together other kits, proud to be figuring things out for themselves.

Teachers learned the importance of selecting the right level of challenge. With radio kits that required considerable soldering, not a single kit worked at one school, while girls at another school proudly played music on their simpler, solderless radio kits.

How do the girls fare back in a coed classroom? *With the skills and confidence gained in the after-school program, where they feel safe and proficient, the girls are often leaders back in the classroom, and the boys sometimes ask them how to do something. Some girls even become advocates*, challenging teachers and asking them, for example, why they call more on boys than on girls. Meanwhile, boys, seeing what is going on, often wish for such a Techbridge of their own.

Role models are important. Girls who can identify with someone in a technical field find it easier to picture themselves doing similar work one day. Women working in STEM fields come to the clubs to work on projects with the girls and to discuss the paths they took that led to their current positions. *Finding role models was easy, but considerable planning, support, and*

follow-up are required to make their involvement smooth and successful. The Oakland-based Community Resources for Science helps train the role models, giving them *ideas for hands-on activities and tips for speaking to students in a way that doesn't come across as lecturing*. Techbridge is developing guidelines to make the process more meaningful for everyone.

Teachers need support. Some benefits extend to students (including boys) not participating in the programs, *Teachers learned, for example the importance of supporting problem-solving and encouraging girls to persevere instead of rescuing them.* Teachers involved in Techbridge attend monthly meetings at the Chabot Center to share resources, swap ideas, and hear speakers. Teachers find the meetings useful for networking across groups and learning what worked and what didn't. Many of them need technological training and support and want more hands-on lessons that demonstrate real projects and activities. Several teachers reported that their involvement in Techbridge provided much-needed resources and role models, a group of motivated students, freedom to try new projects, respite from stress, and the infrequent opportunity to get feedback about their teaching (from Techbridge staff).

Techbridge researchers will interview 30 girls and their parents to find out what role gender and culture play in technology and to learn how they might improve the Techbridge program. The program will know it has succeeded if the programs last beyond the three years of NSF support, if the host schools take over support for the prorgram (as happened in six of the seven schools that hosted the FIRST program), or if the business community provides support at specific sites. Progress is being made, but *much work must be done at the family level, because so many things about gender roles are unconscious. Parents want to do the right thing, and if given information and resources make the right choices. But many parents are unaware of the reasons girls are under-represented in science and technology.*

CODES: M, H, I, PD	CHABOT SPACE AND SCIENCE CENTER
ETTA HEBER (EHEBER@CHABOTSPACE.ORG), ELLEN SPERTUS, YOLANDA PEEKS, JOANN HATCHMAN, LINDA KEKELIS	
HRD 99-06215 (PLANNING GRANT) AND 00-80386 (THREE-YEAR GRANT)	
www.chabotspace.org/visit/programs/techbridge.asp	
PARTNERS: OAKLAND UNIFIED SCHOOL DISTRICT, CALIFORNIA STATE UNIVERSITY (HAYWARD), MILLS COLLEGE, LAWRENCE LIVERMORE NATIONAL LABORATORY, AND COMMUNITY RESOURCES FOR SCIENCE.	
KEYWORDS: DEMONSTRATION, TECHNOLOGY, SELF-CONFIDENCE, PROJECT-BASED, COMPUTER SKILLS, COMPUTER PROGRAMMING, FIELD TRIPS, SUMMER PROGRAM, HANDS-ON, TEACHER TRAINING, GENDER EQUITY AWARENESS, ROLE MODELS	

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Gsi

Girls in science

GIRLS IN SCIENCE

THIS CRANBROOK INSTITUTE OF SCIENCE PROJECT GIVES MIDDLE SCHOOL GIRLS AN OPPORTUNITY TO BUILD THEIR SCIENCE SKILLS AND ENCOURAGES FUTURE TEACHERS TO LEARN GENDER-FAIR TEACHING PRACTICES. THE PROJECT STARTED WITH INFORMAL SCIENCE ACTIVITIES AS VEHICLES FOR CHANGING CLASSROOM CLIMATES: WEEKLY AFTER-SCHOOL GIRLS-IN-SCIENCE CLUBS (ATTENDED BY 25 TO 30 GIRLS) AND AN ANNUAL EXPLORATHON—A ONE-DAY EVENT FEATURING HANDS-ON SCIENCE WORKSHOPS LED BY FEMALE SCIENTISTS. THE PROGRAM THEN TRAINED MORE THAN 60 OAKLAND UNIVERSITY STUDENT TEACHERS IN GENDER-FAIR BEHAVIORS AND TEACHING STRATEGIES.

Field supervisors and teaching peers wrote evaluations and video-monitored the student teachers in real classroom environments. The videotapes allowed the student teachers to see for themselves what aspects of their classroom demeanor were satisfactory or needed improving. A coding system helped evaluators track how well teachers maintained gender and ethnic equity in their own classrooms and the videotapes were all coded.

To disseminate knowledge about gender-equity issues, the project created a community-based Girls in Science resource room at the institute. This room—available to regular and student teachers, parents, youth leaders, and students—is stocked with books, papers, training manuals, and information about summer camps, workshops, science scholarships, and classroom activities that focus on girls and women.

CODES: PD, M	Cranbook Institute of Science
Janet Johnson, Dawn M. Pickard, Dyanne M. Tracy	
HRD 94-53112 (three-year grant)	
Partner: Oakland University	Product: A handbook for student teachers
Keywords: demonstration, teacher training, gender equity awareness, resource center, science clubs, museum, informal education, after-school, hands-on, workshops, videos	

001

wia

Women in astronomy

WOMEN IN ASTRONOMY

SCIENCE TEACHERS KNOWLEDGEABLE ABOUT ASTRONOMY DEVELOPED THE IDEA FOR THIS PILOT AFTER-SCHOOL PROGRAM FOR MIDDLE AND HIGH SCHOOL GIRLS. THEY SAW A CHANCE TO COMBINE A MODEST, EXISTING VOLUNTEER PROGRAM WITH A MORE FULL-FLEDGED PROGRAM SERVING THE BROADER COMMUNITY.

The idea was to get adolescent girls interested in science through astronomy-related activities, including their own research for, and production of, a new planetarium show and video about women's contributions to the field. Involving adolescent girls in this creative project would teach them basic concepts of astronomy, the skills needed to contribute to science, and how to use computers for research and multimedia production. After eight months, the two teachers and 40 girls directly trained would provide a model for others who wanted to use active learning to tell their own stories of scientific achievement.

Project design was influenced by the work of researchers Elizabeth Cohen and Ann Brown, using especially their strategies for developing multiple abilities and distributed expertise to improve intergroup relations, to promote teamwork, and to create an end product—in this case, the planetarium show and video. (For example, Cohen's study of groupwork strongly suggests eliminating low-status designations for students.) It also built on Brown's work on involving students in their own research to improve their performance and capabilities.

CODES: M, H, I	Chabot Space and Science Center
Etta Heber (eheber@chabotspace.org), Maragaret Hauban, Dale E. Koistenen, Jane Nicholson, and Doris Ash	
HRD 95-53488 (one-year grant)	
www.chabotspace.org	
keywords: demonstration, astronomy, after-school, research experience, role models, video, teamwork approach	

001

gpe

Girls for planet earth

GIRLS FOR PLANET EARTH

BUILDING ON THE HUGELY SUCCESSFUL WILDLIFE SCIENCE CAREERS PROGRAM, THIS THREE-YEAR PROGRAM FROM THE WILDLIFE CONSERVATION SOCIETY/BRONX ZOO WILL CAPITALIZE ON YOUNG WOMEN'S ENTHUSIASM FOR ANIMALS, NATURE, AND INFORMAL SCIENCE CENTERS TO GET THEM INVOLVED IN SCIENCE. IN A WORLD INCREASINGLY ALTERED BY HUMAN ACTIVITY, WHAT HAPPENS TO THE ENVIRONMENT IS TREMENDOUSLY IMPORTANT TO YOUNG PEOPLE. BY TACKLING SUCH RELEVANT REAL-WORLD SUBJECTS AS ECOLOGY AND ENVIRONMENTAL SCIENCE, GIRLS FOR PLANET EARTH HOPES TO INCREASE GIRLS' PARTICIPATION IN SCIENCE.

Many women professionals on the WCS and zoo staff are national and international leaders in their fields, so WCS is in a unique position to provide

- An annual Earth Summit, introducing 80 girls (aged 14 to 17, in teams of two and three) to environmental science, to regional environmental issues, and to careers and female role models in environmental science
- A series of service-learning projects through which Earth Summit participants will be encouraged to apply what they have learned in community-based projects that combine knowledge, service, and reflection
- A program of technical assistance to help girls with these projects
- A "virtual" clubhouse through which girls can communicate with one other about the program and environmental issues—and through which to showcase (and learn from) model community outreach and research projects

The program is expected to reach thousands of girls across the United States, with the help of its important partner organizations.

CODES: R, H, I	Wildlife Conservation Society
Annette Berkovits (aberkovits@wcs.org)	www.wcs.org
HRD 01-14649 (one-year grant)	
Partners: Girl Scouts of the USA, the National 4-H Council, the Boys and Girls Clubs of America, Girls Inc., and the Children's Aid Society	
Keywords: demonstration, field trips, support system, conference, career awareness, role models, service-learning, informal education, ecology, environmental science, girl scouts, 4-H; girls, inc., peer groups, real-life applications	

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gtek
Girls and technology

GIRLS AND TECHNOLOGY

IN 1995 THE NATIONAL COALITION OF GIRLS' SCHOOLS SPONSORED A THREE-DAY CONFERENCE FOR TEACHERS AT WELLESLEY COLLEGE. TEACHERS ENJOYED WORKSHOPS ON EVERYTHING FROM UNDERSTANDING SIMPLE MACHINES, TO ROBOTICS, TO BUILDING SOLAR-POWERED MODEL CARS, TO USING COMPUTERS FOR DATA COLLECTION, SIMULATION, AND COMMUNICATION. THEY HEARD FROM PRESENTERS KNOWLEDGEABLE ABOUT CURRENT USES OF TECHNOLOGY IN SCHOOLS, WHY GIRLS STILL LAG BEHIND IN STEM, AND WHAT EDUCATORS AND PARENTS CAN DO TO ENCOURAGE GIRLS' CURIOSITY, CONFIDENCE, AND INVOLVEMENT IN TECHNOLOGY.

Paula Rayman (of the Radcliffe Public Policy Institute) identified four factors that influence whether girls and women are attracted to science:

- **Interactivity.** The opportunity to play around with science is unquestionably important.
- **Social relevance.** Science needs to be presented in useful, meaningful ways, in a social context. Why, for example, is physics important in everyday life?
- **Software not based on violence or conflict**. There is not yet enough gender-neutral, life-affirming software.
- **Evidence that science is relevant to women's lives.** Parental involvement and support is crucial in confirming science's importance to girls' lives.

Three products useful to educators and parents emerged from the conference: a video, a resource guide, and an Idea Book, containing guidance and awareness-raising exercises for educators, guidelines for evaluating science books for stereotyping and bias, guides to online resources and software for girls, and hands-on activities for students in grades 1–8 and grades 9–12.

CODES: M, H, I	THE NATIONAL COALITION OF GIRLS SCHOOLS
MEG M. MOULTON (NCGS@NCGS.ORG), ELIZABETH W. RANSOME, ANN POLLINA, PAULA RAYMAN	
HRD 95-52986 (ONE-YEAR GRANT)	www.wcs.org
AVAILABLE FROM NCGS'S USEFUL WEBSITE: VIDEO, RESOURCE BOOK, AND GIRLS & TECHNOLOGY: AN IDEA BOOK FOR PARENTS AND EDUCATORS	
KEYWORDS: DISSEMINATION, BEST PRACTICES, ENGAGEMENT, TECHNOLOGY, HANDS-ON, REAL-LIFE APPLICATIONS, PARENTAL INVOLVEMENT, VIDEO, RESOURCE GUIDE, CAREER AWARENESS, COLLABORATIVE LEARNING, SELF-CONFIDENCE	

TIPS FOR PARENTS AT HOME

Cultivate your daughter's interest in how things work by having her tinker, take things apart, and put things together. Keep expectations high. Children are natural scientists because they are inquisitive. Encourage her to learn how to repair the loose chain on her bicycle, program the VCR, take apart a broken appliance, change a tire. Work with her as she does these things.

Engage her in projects that develop spatial reasoning and analytical skills. Older girls may enjoy tinkering with a chemistry set or building a robot from a kit. For younger ones, try some at-home science experiments—many books at your local library include fun activities with step-by-step instructions. Better yet, have her do these things with her girlfriends.

Create a computer area within your home that is as accessible to your daughter as it is to your son.

TIPS FOR PARENTS AT SCHOOL

Ask your daughter's teachers about specific hands-on lessons in math, science, and technology. Find out what computer programs, materials, and equipment are available for her use and how often she uses them. If the teacher replies "not often," find out why not.

Talk with your daughter as she plans her class schedule each year.

Monitor her math, science, and computer course choices. Urge her to take more than the minimum requirements as these fields are often gateway subjects for future career choices. Encourage her to pursue physical as well as biological sciences. Talk to her teachers about which math and science courses will help prepare her for the widest variety of career choices.

Urge your daughter's school to plan special events with an emphasis on technology and women. Offer suggestions of local resources and other parents who might have experience in related fields.

Consult with your daughter's teachers. Make sure they are aware of the subtle messages that can steer girls away from computers.

Suggest that your daughter's teachers set aside time in the computer room just for girls. Or be sure that teachers make computer use a mandatory activity for all students.

TIPS FOR TEACHERS

Connect math, science, and technology to the real world and real people in their historical, philosophical, and functional contexts. Show them contributing to the good of the world.

Choose metaphors that reflect both girls' and boys' experiences. Balance the use of words like "master," "command," or "tackle" with words like "connect," "choose," or "embrace."

Monitor which students are at the computer most often, have their hands on the equipment, and are leading the experiments. Be sure the girls are as active as the boys. Require equal time on the computer as part of your assignments. Don't let only the boys act as experts in the computer class.

Brainstorm with students about all the careers that use technology. Help them develop a more inclusive definition of who will need to be computer literate. Develop a list of people in various occupational niches who use technology, such as architects, fashion designers, teachers, artists, musicians, choreographers, home design consultants, athletes, business people, and librarians.

Foster an atmosphere of true collaboration. Many teachers insist that a true group project is one in which no single group member could complete the project without the group's help.

Encourage girls to act as experts. When the teacher has all the answers, students rarely exhibit self-confidence. As students critique their own work and that of their peers, they begin to see themselves as scientists. The technique of the teacher refusing to act as an expert is a powerful learning prompt for students.

Experiment with alternatives to note taking. Girls often get so absorbed in taking down every bit of information that they miss out on discussions. Set aside some classes where no note taking is allowed, hand out lecture notes ahead of time, or rotate the note-taking responsibility, with notes shared afterward.

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Sum
Summerscape

SUMMERSCAPE

SUMMERSCAPE WAS A TWO-WEEK "TEACHING AND LEARNING" SUMMER CAMP THAT HELPED AN ETHNICALLY AND SOCIOECONOMICALLY DIVERSE GROUP OF MIDDLE SCHOOL BOYS AND GIRLS WHO HAD EXPRESSED AN INTEREST IN STEM EXPERIENCE SUCCESS IN SCIENCE AND ENGINEERING. GEORGIA TECH'S CENTER FOR EDUCATION INTEGRATING SCIENCE, MATHEMATICS, AND COMPUTING DESIGNED SUMMERSCAPE.

The camp was also an effective model for professional development in gender equity. Over two years, 32 teachers recruited from Metro Atlanta school systems learned about SummerScape, the National Science Education standards, inquiry-based science, collaborative learning, and gender equity. They also administered an attitudinal survey and a "draw a scientist" activity to their students and observed their SummerScape teammates in class using a simple coding instrument. The second year, they participated in four days of professional development, covering science content, with an emphasis on inquiry-based science. Curriculum units were designed to reflect real-world science and engineering problems and to give students hands-on technological experiences girls rarely encounter (e.g., wiring circuit boards and using soldering irons and electric drills).

Immediately after teacher training, the teachers were able to practice new teaching strategies in the low-risk environment of a two-week summer science camp. There they team-taught one curriculum unit to two 90-minute classes of about 20 students a day. In daily workshops, they learned more about gender equity, basic classroom equity issues, learning styles, multiple intelligences, alternative assessment, visual organizers, instructional models for organizing lessons, and action research.

During Year 1 the curriculum covered Electricity and Circuits (which involved building and racing a solar-powered car), Bottle Biology (activities using recycled plastic bottles and emphasizing creation-of-life science experiments), and Learning By Design (a design-based engineering curriculum). During Year 2 the curriculum was Civil Engineering and Earthquakes (rated the most significant and worthwhile by participants, this unit culminated in students creating balsawood towers and testing their strength with an earthquake simulation machine), Thinking Like Leonardo (designing, constructing, and testing a large chair of heavy cardboard), and Learning By Design.

To aid in judging teachers' progress, the project developed a scale of teacher awareness and concern about gender equity, as shown in the following table:

SCALE OF TEACHER AWARENESS AND CONCERN

0	**UNAWARE**	negligible awareness
1	**ATTENDER**	aware of literature, national statistics, what experts say
2	**REFLECTOR**	applies awareness to self, reflects own behavior
3	**MODIFIER**	actively monitors own behavior, changes own classroom practice
4	**DIRECTOR**	actively acts as agent of change in school or district

At level-1 awareness, teachers were learning about subtle, unconscious teacher bias based on student gender and were becoming aware of girl–boy interactions in the classroom. They were learning how important "wait time" and alternative assessment are and that gender-equitable cooperative groups benefit both girls and boys. They were also learning new content (basic electrical engineering and how to solder, for example). At level 2, they were thinking about their own practices. At level 3, they were making plans to change their classroom behavior.

During the school year, teacher participants were asked to conduct a gender equity workshop for staff at their school, to identify a related problem or question and investigate it using action research, to return to Georgia Tech for periodic SummerScape meetings (attended better if the project provided dinner and a room for teachers' children), and to submit a report and modified lesson plans. They were compensated in full if they completed the school-year component.

Action research projects—using observation sheets to code faculty–student interactions—tended to make true believers out of teacher participants. After even a short period of observation, it was clear that boys typically benefited more from teacher–student interactions than girls did. These SummerScape teachers presented their coded results to the teachers observed, and the total consolidated results at their gender-equity staff meetings, thereby deflecting criticism from their peers that the national data don't apply in their schools.

It's worth mentioning that one of these teams consisted of two African American men from a primarily African American school, who initially signed up for SummerScape because they weren't placed in another program. They came with open minds but were ignorant of the issue. They went back to school preaching about equity (by gender, race, and socioeconomic level). Using release days to do their research convinced them of the issues. *Generally, however, faculty in primarily minority schools resisted gender-equitable approaches because in their schools the high-achieving students tended to be African American girls. They believed it was African American boys who needed best practices, and it was difficult to convince them that gender-equitable practices benefit all students, not just girls.*

Strong teachers who teach in lower-risk school settings (schools with good leadership and supportive parents, where teachers feel valued as professionals and are not overwhelmed with job responsibilities) were able to implement the school-year component with little help from the project staff. Some teachers could have successfully implemented it if the project had built more hands-on assistance and emotional support into the program. A certain number of able, concerned teacher participants paid only lip service to the school-year component or disappeared from the program altogether. Time was a problem, compounded by the low priority some schools gave to gender issues. For effective school-year implementation, *it is crucial to have support from the school principal and not to have the school system "impose" participation*.

CODES: M, I, PD	Georgia Institute of Technology (Georgia Tech) Research Corp.
Marion Usselman (marion.usselman@ceismc.gatech.edu), Donna Whiting, Carolyn C. Thorsen	
HRD 97-11046 (one-year grant)	www.ceismc.gatech.edu/ceismc/programs/tlcamps/summer.htm
Partners: Board of Regents, University System of Georgia; Fulton County, DeKalb County, Henry County, and Clayton County School Systems; Atlanta Public Schools.	
Many project activities and resources are reproduced in InGEAR Professional Development Manual for Gender Equity in Collegiate Science, Engineering, Mathematics, and Education, available online at (www.ceismc.gatech.edu/ceismc/programs/ingear/homepg.htm) Videos used: Failing at Fairness (two videos from the Dateline TV show), Girls Can! (AAUW), Girls in the Middle: Working to Succeed in School (AAUW), and Gender Equity in the Classroom (Sadker).	
Keywords: demonstration, summer camp, teacher training, gender equity awareness, self-confidence, achievement, professional development, inquiry-based, collaborative learning, hands-on, engineering, real-life applications, workshop, gender differences, research findings	

WHICH WORKS BEST: SINGLE-SEX OR COED CLASSES?

Year 1, the SummerScape classes were either all girls or a mix of boys and girls, to permit analysis of the differences between class dynamics and interactions in all-girl and coed classes. More girls than boys enrolled in the camp but many of the coed classes were disproportionately boys. Year 2, the project decided it was important to analyze the dynamics of both all-boy and all-girl groups. During Year 2, all teachers taught both a single-sex class and a coed class and were asked to compare the classroom environments in single sex and coed classes and groupings.

To make notes about interactions in a group setting, teachers coded behavior using a student–student interaction observation sheet, recording (for each student) the frequency of social interactions and of academic interactions and whether they listened to others, waited until a speaker was finished before speaking, used an appropriate tone of voice, asked for help from peers, asked for help from the teacher, shared materials, made suggestions, or initiated solutions. Coding data (for a "snapshot" in time) were also collected for on-task and off-task behavior.

Classroom coding data suggest that *both girls and boys feel freer to interact and ask questions in single-gender groups. Boys especially interact more in all-boy groups than in coed groups, tending to be more asocial and off-task in coed than in same-sex groups.* (Girls appear to be a stabilizing influence on classroom behavior.) All-boy groups tend to be louder and rowdier than coed groups, whether on- or off-task, and off-task boys feel freer to be disruptive in all-boy groups than in coed groups.

Boys are less inclined than girls to ask for help from the teacher while working on a project, and are more likely to progress or experiment without consulting the written instructions. These characteristics were accentuated in the single-sex classrooms to the point that teachers in the all-girl robot-building class sometimes felt overwhelmed by the number of girls approaching them for assurance about each step in the sequence. This slow and deliberate construction style led some girls to not complete their robots by the end of camp. By contrast, many of the boys "completed" the robots without much concern for the written instructions, ending up with robots that didn't necessarily work properly.

In general, teachers loved the all-girl classes, thought the coed ones were generally fine, and disliked the all-boy classes. Virtually all students stated that they would prefer a coed class to a single-sex one.

Girls working in same-sex groups or classes tended to do quiet, calm, focused work according to written instructions, punctuated by specific, content-related questions to the teacher. Such behaviors produce the calm environment some girls prefer and lead to traditionally "satisfactory" results, which classroom teachers tend to value. But little high-risk experimentation takes place under these conditions, and in SummerScape a number of girls became bogged down in the instructions and in ensuring that each step was done properly.

When boys experiment without consulting the teacher, teachers get less immediate feedback about student progress during the project and more boys than girls do not complete the task "correctly," leading to the view that the groups of boys are "off task." But this type of free-form, independent behavior is central to scientific inquiry and should have ample sanctioned outlets within the educational system.

Clearly, both single-sex and coed groupings and classes present benefits and drawbacks. Middle school students report preferring coed groups, but within coed groups they tend to work primarily with members of their own sex. Even at that age they recognize that there are benefits to getting ideas from people who think differently than they do but also that diversity presents its own challenges.

After observing girls and boys tackle science and engineering projects, *the SummerScape staff had a dual wish: that the boys would read the instructions a little more often and perhaps show more concern for the final product, and that the girls would exhibit a bit more risk-taking behavior by not being so tied to the written instructions. Single-sex groups accentuated these tendencies and allowed students to stay within their behavioral comfort zone, leading to all-girl groups that were highly manageable and well behaved and to all-boy groups that tried the patience of the teachers*.

The project's conclusion about classroom grouping, based on the SummerScape experience: *Middle school students should be given the opportunity to work in both balanced coed and single-sex groups. Single-sex groups allow students to concentrate on content, to be freer in their interactions with their groupmates, and to work in a more focused way. The balanced coed group allows them to interact with the opposite sex (which as adolescents they like to do) and forces them to deal with a more diverse way of thinking and problem solving*. It also gives students a chance to learn to appreciate what students of the opposite sex bring to the table (and lets boys learn that girls can excel in math and science).

The worst grouping tactic is to have unbalanced coed groups with only one child of a particular sex. A child alone in a class of the opposite sex is likely to be ignored, interrupted, and generally disregarded by the other members of the group, gaining none of the advantages of either of the other types of grouping.

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Sius
Science is for us

SCIENCE IS FOR US

THIS PROJECT AIMS TO IMPROVE GIRLS' ATTITUDES TOWARD SCIENCE, KNOWLEDGE OF SCIENCE CONTENT, AND AWARENESS OF CAREERS IN SCIENCE. PARTICIPANTS WILL BE SEVENTH, EIGHTH, AND NINTH GRADE GIRLS FROM TWO OHIO AND GEORGIA SCHOOLS THAT SERVE MANY LOW-INCOME FAMILIES.

In after-school science clubs meeting once a week for two hours, 60 girls will engage in scientific inquiry on topics that require them to connect science to their lives. They will visit two female scientists in their labs once a month to learn about the women's research programs and discuss the girls' science club projects. As they move through the science club experience, the girls will map their personal career goals.

At the same time, teachers, parents, and school counselors will learn about female-friendly ways of teaching and fostering girls' interest in science. The teachers' component will show teachers how to create a gender-equitable science classroom and how to compensate for subtle gender bias in textbooks. Parents and school counselors will be taught to nurture the interest in science that the science clubs should generate.

CODES: M, I	Ohio State University Research Foundation
Anita Roychoudhury (roychoa@muohio.edu), Gerri Susan Mosely-Howard	
HRD 99-08776 (one-year grant) and HRD 01-96449 (one-year grant)	
Keywords: demonstration, after-school, science clubs, career awareness., underprivileged, field trips, real-life applications, role models, parental involvement, teacher training, gender equity awareness	

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Poss
Calculate the possibilities

CALCULATE THE POSSIBILITIES

THIS BALL STATE UNIVERSITY PROJECT FOR INDIANA GIRLS IN GRADES 11 AND 12 EMPHASIZED CAREER AWARENESS AND SKILL DEVELOPMENT IN STEM. THE FOUR-WEEK RESIDENTIAL PROGRAM ON THE BSU CAMPUS ENGAGED 24 GIRLS IN CAREER-RELATED ACTIVITIES, TECHNOLOGY TRAINING, AND COLLABORATIVE WORK WITH A BSU MENTOR IN BIOLOGY, CHEMISTRY, NUTRITION, PHYSICS, OR PSYCHOLOGY. JAZZERCISE, BOWLING, SOFTBALL, SWIMMING, AND HIKING ROUNDED OUT THE PROGRAM.

The girls were each given a T1-92 graphing calculator and learned how to use it to solve algebra, geometry, and statistics problems; they learned to use Lotus software to solve math problems and were introduced to e-mail and the Internet. They spent time in a university laboratory and afterward independently solved a related research problem at their home school, using the Internet and supported by an onsite resource teacher and their university mentor.

Through career training and seminars, visits to industrial sites, and panel discussions, the girls learned about their own values, preferences, and attitudes toward various STEM careers and opportunities. Through visits to Eli Lilly and other industrial sites, they learned firsthand what each STEM career and job opportunity requires and how to meet those requirements. All of the girls produced reports on careers for their school peers.

Participants valued meeting role models and learning what various careers required. They completed the "My Vocational Situation" inventory (Consulting Psychologists Press, Inc.) at the beginning and end of the project. Possible scores range from 0 to 18; a score above 13 indicates that the student is fairly clear about her career path. Average scores on the test rose from 9.47 to 12.09, indicating increasing clarity about what they might become.

Although none of the 12 participants who attended a reunion in 2000 had decided on a career in math, several had decided on careers in science and technology and all were grateful to have participated.

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HRD 95-53486 (one-year grant)	
Partner: American Association for University Women	
Keywords: demonstration, career awareness, role models, mentoring, field trips, hands-on, graphing calculator, athletics, summer program, math, computer skills	

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Douglass project's pre-college program

DOUGLASS PROJECTS PRE-COLLEGE PROGRAM

TO SUPPORT WOMEN IN SCIENCE, MATH, AND ENGINEERING, THE UNDERGRADUATE WOMEN'S UNIT OF RUTGERS UNIVERSITY ESTABLISHED THE DOUGLASS PROJECT IN 1986. TWO YEARS LATER, IT LAUNCHED THE DOUGLASS SCIENCE INSTITUTE FOR HIGH SCHOOL WOMEN, BRINGING 46 "RISING" ELEVENTH GRADE WOMEN FROM NEW JERSEY HIGH SCHOOLS TO DOUGLASS COLLEGE FOR A SINGLE-SEX RESIDENTIAL EXPERIENCE, HANDS-ON MATH AND SCIENCE LABS, FIELD TRIPS, AND WORKSHOPS IN MATH AND COMPUTERS. THE PROJECT GAINED RECOGNITION AS A STRATEGY FOR SERVING A DIVERSE GROUP OF WOMEN—HALF THE PARTICIPANTS WERE WOMEN OF COLOR—WITH A SINGLE INTERVENTION FEATURING STUDENT-CENTERED ACTIVITIES IN A SINGLE-SEX ENVIRONMENT. IN 1995 DOUGLASS EXPANDED THE PROGRAM TO A FOUR-YEAR SUMMER RESIDENTIAL PROGRAM STARTING WITH GIRLS ENTERING NINTH GRADE.

This NSF grant helped Douglass evaluate and modify the tenth grade program and develop the first year of the eleventh grade program. The program for ninth, tenth, and eleventh graders serves roughly 126 students (46 in ninth grade, and 40 each in tenth and eleventh). Students reside at Douglass College for one week, with seniors spending an extra week exploring careers and planning for college and choice of a major.

In labs, workshops, and field trips, students explore new horizons in math, physics, biology, chemistry, computers, engineering, and environmental and marine sciences. The institute helps them establish strong peer networks, and the supportive environment nurtures students intellectually, creatively, and socially. Participants learn about career options by talking with undergraduates, university faculty, and women working in the corporate world.

By recruiting average and above-average students from eighth grade who demonstrate curiosity and an enthusiasm for math and science—whether or not they have reached their potential—the project hopes to counteract the practice of reaching only the straight-A students. It aims to spark potential and nurture young women unsure of their capabilities and put them together with other young women with similar interests.

Activities provided for parents help them understand why such intervention programs exist and help them explore ways they can help their daughters make informed decisions about their education and careers.

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Partners: AT&T Foundation, Bell Atlantic-New Jersey, Bristol-Myers Squibb, Colgate-Palmolive Company, E. J.Grassman Trust, William Randolph Hearst Foundation, Hewlett-Packard Corporation, Johnson & Johnson, Johnson & Johnson Pharmaceutical Research & Development, L.L.C., Merck Institute for Science Education, PSE&G, the Turrell Fund, the Verizon Foundation, and Wyeth.	
Keywords: demonstration, hands-on, field trips, career awareness, peer groups, parental involvement, intervention, summer camp, role models	

THE CRITICAL HIGH SCHOOL YEARS

The high school years are important because by the end of that time more young women than men have opted out of math and science studies. From ninth grade on, boys express more positive attitudes toward math and science and more interest in science courses and careers, while girls take fewer advanced courses. Tenth grade is especially crucial for girls because they have completed their minimum math and science requirements for high school graduation and are beginning to choose what they will pursue in more depth.

Preliminary results of a longitudinal study begun in 1994 suggest that participants in the multiyear program continue to enroll and actively participate in their high school math and science courses, have raised their levels of educational expectation and continue to show high levels of perceived academic ability, *maintain their interest in math- and science-related careers, and express more confidence in their ability to succeed in those careers*. A three-year evaluation of the multiyear institute reports that it helped women "move away from an interest to a commitment to math and science." *It moved them "away from the 'nerd' image of mathematics and science and help[ed] them see that they are neither alone nor weird because they are good in math and science*."

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Effct

Project EFFECT

PROJECT EFFECT

MOST UNDERGRADUATE ATTRITION FROM STEM OCCURS AT THE END OF THE FIRST YEAR OF COLLEGE OR THE BEGINNING OF THE SECOND. WITH THIS IN MIND, THE PROGRAM FOR WOMEN AND GIRLS AT WASHINGTON STATE UNIVERSITY (WSU) DEVELOPED PROJECT EFFECT, WHICH USED SUPPORT, TECHNOLOGY TRAINING, AND CURRICULUM TO RECRUIT AND RETAIN WOMEN (AND HELP THEM SUCCEED) IN COLLEGE STEM PROGRAMS.

The Bridge Program. This fast-start program helped empower and teach survival skills to all women and ethnic minority men interested in math, engineering, architecture, physics, chemistry, or other science majors in which women and minorities are underrepresented. For five days, participants were welcomed, toured campus facilities (including STEM halls), talked with role models, were given a basic orientation to computers on campus, and attended study skills workshops in chemistry, math, and general studies. The Bridge students could go to the director of the Women in Engineering and Science Program and to older STEM students for advice. Many minority students were first-generation college students, so this network of advisers was invaluable as they came to understand the new environment of science and engineering courses. Scholarships and financial support were also available.

Tech Star seminars. Seven two-hour computer-training seminars (on the computer, Word, the Internet, Mathematica, Excel, PowerPoint, and Web pages) were offered to improve students' computer skills and confidence. Students participated in three or four group projects and got detailed references on each topic. The project also prepared information on how to train personnel to facilitate Tech Star seminars.

During the Bridge program, participation and enthusiasm were high. Once the semester began and time was short, participation in the free-standing Tech Star seminars dropped dramatically, but four of the seminars were used as labs for the Women, Science, and Culture course, where enthusiasm for the seminars again ran high.

Innovation workshops. These workshops for STEM faculty and teaching assistants were designed to encourage more equitable and inclusive teaching, curricula, and departmental climates. Having learned the reasons for academic attrition of women and ethnic minorities, the faculty learned about *strategies to reduce attrition, including collaborative learning groups, describing the work of female and ethnic scientists, relating class work to real-world problems, and recognizing and improving patterns of classroom interaction*. Half-day workshops were offered on creating a more inclusive STEM climate, on teaching strategies to reach all learners, and on issues of gender, race, and science.

Participants stated on pre-workshop survey questionnaires that their number one priority was to teach students higher order thinking skills, and that didn't change. Even before the workshops they were interested in changing their teaching practices, and they became more receptive to *innovative teaching techniques* that they had not listed on their pre-workshop survey, including *hands-on exploratory projects, in-class writing, bringing industry speakers into class, doing industry case studies, having open-ended labs, doing interdisciplinary group projects, holding group discussions, encouraging student presentations in large lecture classrooms, using structured teams for projects, and expanding the use of Web technologies*. About 65 percent of the participants were determined to change their teaching practices, voiced some reservations about being able to do so, but believed that unbiased communications and role models or mentoring were important for students.

Course on women, science, and culture. This 15-week course was designed to lay a foundation of support for first-year female and minority students' success and persistence in STEM majors. Participants attended two 50-minute discussion periods and one three-hour computer lab weekly. They learned about role models throughout the world who had been active in STEM and why their numbers were relatively few—how culture shapes who does science, what types of science are done, and what methods are used. Enrollment was low, but with enough demand the course would become permanent.

Through the pilot course, the university learned that assigning an average 75 pages of reading weekly was too much and that students found it helpful to be told the relevance of a homework assignment beforehand. Students highly rated in-class exercises and computer labs (except for students already skilled in computer use). The course raised the confidence of students who participated—during that critical first year in college, when self-confidence in math and science typically declines. In the end, students also found the workload manageable, mainly because the assignments were predictable.

Before the pilot course, STEM faculty designing and leading the course's case study labs were given a workshop on selecting and developing a case study of a role model and creating a hands-on lab where students would be challenged to engage in the scientific process: using the knowledge they already have, define a problem, gather information, create hypotheses, design an experiment or generate solutions, predict results, test, revise theories/predictions, manipulate variables and retest, draw conclusions, handle lab equipment, and come to understand some of the underlying concepts or processes.

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Product: TECH STAR Seminars: A Self-Guided Approach to Computer Technology, ed. Claudia M. Pacioni, 1999	
Keywords: demonstration, achievement, seminars, mentoring, recruitment, retention, computer skills, self-confidence, workshops, role models, scholarships, teacher training, collaborative learning, gender equity awareness	

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Sisn
Southern Illinois support network

SOUTHERN ILLINOIS SUPPORT NETWORK

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE (SIUC) LIES AT THE CENTER OF THE 22-COUNTY REGION SOUTH OF INTERSTATE 64 KNOWN UNOFFICIALLY AS "SOUTHERN ILLINOIS." SIXTEEN OF THESE COUNTIES ARE MISSISSIPPI DELTA COUNTIES. THE MAIN INDUSTRIES IN THIS ECONOMICALLY DEPRESSED RURAL REGION ARE FARMING AND COAL MINING. MANY RURAL SCHOOLS ARE NOT EQUIPPED TO PROVIDE GOOD SCIENCE EDUCATION, ESPECIALLY IN PHYSICS AND CHEMISTRY. IT IS NOT UNUSUAL FOR TEACHERS ASSIGNED TO TEACH MATH, PHYSICS, AND CHEMISTRY TO BE UNTRAINED IN THESE AREAS. WITH SUPPORT FROM MANY PARTNERS, THIS PROJECT PROVIDED A RANGE OF EXPERIENCES FOR GIRLS IN THE AREA, FROM GRADE 4 ON, LEADING SUCCESSIVELY TO MORE INTENSE EXPERIENCES AND MASTERY AS THE GIRLS MOVE TOWARD COLLEGE.

In grade school, *the idea was to pique girls' curiosity*. In addition to hands-on activities, the NSF grant funded the first two fields trips for Girl Scouts in grades 4–6. Underwriting the cost of a trip to the St. Louis Science Center, one of the largest science centers in the country, more than doubled participation.

Expanding Your Horizons (EYH) conferences, sponsored nationwide by the Math Science Network, provide girls in grades 7–9 with a full day of hands-on workshops led by women faculty, graduate students, and practicing scientists, including veterinarians, physical therapists, and crime lab technicians. Participants can choose three workshops. Small-group activities are hands-on lab experiences, not lecture or observation, although at the 1998 conference parents and educators were allowed to observe two of the regular workshops (but not those involving their own daughters). EYH conferences, held annually, are highly successful activities that cost relatively little but require many volunteer woman-hours. A civil service worker is employed halftime to manage the enormous amount of paperwork involved in this fully institutionalized activity.

In some ways, the **Gateways workshops** (1998 and 1999) for girls in high school are extensions of EYH and in some ways they are summer camps. The workshops are longer and more complex than those in EYH, which means fewer (60 to 70) girls can participate but they work more intensively. Workshops are led by male and female faculty from SIUC's colleges of science and engineering and school of medicine.

WISE summer camps (1991 and 1996) provided two or three dozen high school seniors with hands-on, small group activities. Girls enjoyed meeting new people, hearing about science careers, and learning about the Internet and other new subjects (especially biology and zoology). Girls for whom the camp was residential were given room, board, and a stipend. This relatively expensive activity was not institutionalized. *The advantage of having mostly girls-only activities is that girls are assured of a hands-on experience they might not get in a mixed-gender classroom. The disadvantage is that girls-only activities are necessarily limited to extracurricular activities in public schools—and hence by time and money*.

Participants were expected to give a helping hand to younger girls. Parents, teachers, school counselors, and SIUC undergraduate and graduate assistants were also involved, learning how girls best learn science, what career opportunities are open to women, and what hands-on experiences they could do with girls. A database of local STEM activities was available to the community through schools, libraries, and community organizations.

The common denominator of all project activities was hands-on experiences in small groups with role models. Project activities demonstrated that students *love to be paid to learn*. (Being paid a stipend of $50 to $100 a day reduced the apprehension of students—or their parents—who might otherwise lose a day of work at a part-time or summer job.) *They also love to learn with their peers*. Girls who normally sit quietly through classes with outspoken males or inexperienced teachers—or who find themselves in a culture with few role models and discouraging comments like "why would you want to do that?"—find it enormously encouraging to attend workshops surrounded by peers as competent and excited as they are.

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www.scu.edu/SCU/Projects/NSFWorkshop99/html/wright.html	HRD 94-53099 (ONE-YEAR GRANT)
PARTNERS: WISE; SOUTHERN ILLINOIS SCIENCE, ENGINEERING AND MATH (SISEM) WOMEN AND GIRLS SUPPORT NETWORK; SHAGBARK COUNCIL OF THE GIRL SCOUTS; ST. LOUIS SCIENCE CENTER; CARBONDALE SCIENCE CENTER; SIUC'S UNIVERSITY WOMEN'S PROFESSIONAL ADVANCEMENT, SCHOOL OF MEDICINE, COLLEGE OF SCIENCE, AND COLLEGE OF ENGINEERING; MATH SCIENCE NETWORK	
KEYWORDS: DEMONSTRATION, RURAL, UNDERPRIVILEGED, HANDS-ON, ROLE MODELS, INTERNSHIPS, PEER GROUPS, WORKSHOPS, FIELD TRIPS, CONFERENCES, SUMMER CAMPS, CAREER AWARENESS, PARENTAL INVOLVEMENT, TEACHER TRAINING	

002

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A Welcoming Learning Environment

CHAPTER TWO · A WELCOMING LEARNING ENVIRONMENT

PROJECTS IN THIS CHAPTER ILLUSTRATE ANOTHER KIND OF "INTERVENTION" AND INNOVATION IN THE EDUCATIONAL SETTING; THEY HIGHLIGHT HOW EDUCATORS CAN CREATE A SOCIAL SUPPORT SYSTEM FOR STUDENTS IN ORDER TO ENCOURAGE THEIR ENGAGEMENT OF SCIENCE AND MATHEMATICS. WE KNOW THAT EVEN NOW PARENTS, TEACHERS, COUNSELORS, AND OTHER ADULTS MAY THEMSELVES BE UNCOMFORTABLE WITH SCIENCE AND PERSONALLY UNAWARE OF SCIENTISTS AND ENGINEERS AS PROFESSIONALS. THERE MAY BE NEGATIVE MESSAGES FROM FELLOW STUDENTS ("DON'T BE SO NERDY"), FROM PARENTS ("I WAS NEVER GOOD IN MATH"), FROM COUNSELORS ("GIRLS DON'T NEED VERY MUCH MATH"), AND EVEN TEACHERS ("IT IS HARD").

WE HAVE LEARNED THAT EXPOSURE TO ROLE MODELS—ESPECIALLY "PEOPLE LIKE YOU"—HELPS STUDENTS IDENTIFY WITH A PROFESSION. EVEN BETTER, A MENTOR CAN OFFER A VOICE THAT IS PERSONAL AND INVITING. A MENTOR OFFERS INFORMATION AND FACTS THAT DISPEL STEREOTYPES AND NEGATIVE IMPRESSIONS AND PERSONALIZES THE ENCOUNTER WITH UNFAMILIAR TERRITORY. MENTORS CAN BE "NEAR-PEERS"—OTHER STUDENTS WHO ARE AHEAD IN CONFIDENCE AND SKILLS, OR JUST IN AGE AND MATURITY, OR ADULTS (PARENTS, COUNSELORS, TEACHERS, VOLUNTEERS).

IN MANY, MANY CASES, PART OF THE PROJECT AIMED TO BUILD A COMMUNITY AROUND THE STUDENTS, TRAINING EVERYONE IN NEW APPROACHES TO INCLUSIVE EDUCATION, IN AWARENESS OF TRADITIONAL BARRIERS, AND IN KNOWLEDGE OF GOOD PRACTICES. IN FACT, IT IS IMPOSSIBLE TO CHANGE THE WAY SCIENCE AND MATH ARE TAUGHT AND TO CHANGE THE SOCIAL NETWORKS WITHOUT CHANGING THE PEOPLE WHO INTERACT WITH AND INFLUENCE CHILDREN. WORKSHOPS FOR TEACHERS, COUNSELORS, PARENTS, MENTORS, AND THE WIDER STUDENT COMMUNITY ARE A MEANS TO THOSE ENDS. AN INFORMED AND COMMITTED COMMUNITY CAN DISPEL MISCONCEPTIONS THAT DISCOURAGE OR DRIVE INTELLECTUAL AND SCIENTIFIC INTEREST UNDERGROUND. AMONG MISCONCEPTIONS THAT NEED DISPELLING:

- GIRLS ARE NOT GOOD AT MATH
- GIRLS WHO ARE SMART WILL NOT BE POPULAR WITH BOYS
- SCIENTISTS AND ENGINEERS ARE NERDS
- THE WORK OF SCIENCE IS NOT FAMILY-FRIENDLY
- SCIENTISTS ARE OUT OF TOUCH WITH SOCIETY
- THE WORK OF SCIENCE IS TEDIOUS
- SCIENCE IS ONLY FOR THE TOUGH, EXTRAORDINARY STUDENT

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Ota
On the air with gender equity

ON THE AIR WITH GENDER EQUITY

TO ENGAGE, INFORM, AND INSPIRE LISTENERS, RADIO WAMC (ALBANY, N.Y.) WILL DEVELOP A WEEKLY SEGMENT AND FOUR REGIONAL CALL-IN SHOWS FOR NATIONAL DISTRIBUTION ON ISSUES, POSSIBILITIES, AND ROLE MODELS FOR—AND BARRIERS TO—GENDER EQUITY IN THE SCIENCES FOR GIRLS FROM KINDERGARTEN THROUGH EIGHTH GRADE. THE GENDER EQUITY SEGMENTS WILL BE INCORPORATED INTO WAMC'S AWARD-WINNING RADIO PROGRAM "51 PERCENT" (A SHOW ABOUT WOMEN'S ISSUES) AND PLAYED ON THE CALL-IN PROGRAM "VOX POP."

WAMC will create, produce, air, and distribute the weekly segments and call-in shows regionally through its 10-station network and nationally and globally via Public Radio, ABC satellites, and Armed Forces Radio—with compact disks available for stations not connected by satellite. The programs can also be heard over the Internet at the WAMC website <www.wamc.org> or at <www.ThePublicRadioStation.com>. This project could reach more than 300,000 listeners a month in WAMC's regional area alone, plus which "51 Percent" is heard over 125 radio stations nationally.

WAMC is collaborating with an advisory board of professional women nationally known for their involvement with gender equity and with the Capital Area School Development Association, a study council affiliated with the school of education at the State University of New York in Albany.

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HRD 01-14472 (one-year grant)	
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Keywords: dissemination, gender equity awareness, barriers, role models, radio, engagement	

002
T-grl
TechGirl: a website for middle school girls

TECHGIRL: A WEBSITE FOR MIDDLE SCHOOL GIRLS

SUPERVISED UNDERGRADUATE STUDENTS WILL DEVELOP THIS DYNAMIC, EVOLVING WEBSITE DEVOTED TO HELPING MIDDLE SCHOOL GIRLS LEARN HOW SCIENCE AND ENGINEERING BENEFIT SOCIETY AND ENCOURAGING THEM TO CONSIDER CAREERS IN THE FIELD. INCLUDED ON THE WEBSITE WILL BE

- Biographical sketches of women in different science and engineering settings and at different stages (including high school and college and at the start and peak of their careers).
- Advice on developing their careers, from choosing courses and activities in high school to picking a college and major to choosing a career.
- Challenging games, puzzles, and brainteasers (developed by college undergraduates) that expose girls to different aspects of science and engineering—for example, estimating the number of electrical devices in a home that could be powered by solar cells on the roof, given some basic information (electrical engineering); estimating the number of people who could commute into San Francisco across the four-lane Golden Gate Bridge during rush hour, knowing that in the morning there are three lanes heading in and in the afternoon three lanes heading out (civil engineering); or estimating the number of pounds gained by drinking one soda a day for a year (biology).
- Engineering Encounters, a role-playing game (analogous to the popular Oregon Trails or to the board game Life) in which girls simulate how their life could develop through high school, college, and their career. Presented with a series of choices, they choose responses that result in their life taking different paths. Playable online or from a CD, the game allows girls to assign their own values (in points) to the goals of Happiness, Fame, or Wealth; at the end of the game they can find out if they met their goals based on their game decisions.

Many young women are turned off by technical fields as not supporting goals they value, including ecology, family, and personal communications. This website will underscore the positive aspects of technical careers.

Two major programs at Arizona State University—Women in Applied Science and Engineering and the Minority Engineering Program—will collaborate on the website, after extensive feedback from middle and high school girls, their teachers and counselors, college girls in WISE, engineers who mentor for WISE, and college students in the minority engineering program. A Hispanic version will be provided.

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HRD 00-86452 (one-year grant)	
Partners: WISE; Office of Minority Engineering Programs	
Keywords: demonstration, career awareness, role models, website, engineering, computer games, Hispanic, bilingual	

002

The adventures of Josie True

THE ADVENTURES OF JOSIE TRUE

IN TESTING BETA VERSIONS OF COMPUTER SOFTWARE GAMES, MARY FLANAGAN NOTICED THAT GIRLS WERE DRAWN TO NARRATIVE SECTIONS WHILE BOYS RACED TO COMPETE FOR THE PRIZE, CLEARLY MORE CONTENT THAN MOST GIRLS WITH SOFTWARE THAT FEATURED VIOLENCE AND COMPETITION. RESEARCH HAD SHOWN THAT THE WEB HAS BECOME A PLAYGROUND FOR GIRLS BECAUSE IT EMPHASIZES CONTENT, WRITING, AND CORRESPONDENCE. BUT ON THE SHELVES OF COMPUTER STORES, MARY FLANAGAN SOUGHT BUT NEVER FOUND GAMES FEATURING "GIRLS WITHOUT BLONDE HAIR, BLUE EYES, AND ROSY CHEEKS." MOST EDUCATIONAL COMPUTER GAMES ARE DESIGNED FOR AND MARKETED TO WHITE KIDS, ESPECIALLY BOYS. SOFTWARE FOR GIRLS ENTERTAINS RATHER THAN EDUCATES—AND OFTEN FEATURES FASHIONS, MAKEUP, AND SHOPPING. "WHILE SOME MIGHT ARGUE THAT BARBIE GAMES ARE GETTING GIRLS ONLINE, WE NEED TO ASK OURSELVES JUST WHAT IT IS THAT BARBIE GAMES TEACH KIDS," FLANAGAN TOLD ONE REPORTER.

Flanagan moved from commercial software to academia so she could take risks rather than crank out game after game for boys. She saw a serious need for learning materials for nonwhite, nonmale audiences—material that was fun, pertinent, interesting, and, if possible, free. Research suggested that *girls, unlike boys, do not like gadgets for gadgets' sake. In educational software, they are drawn to strong content, a good story line, credible and inspiring "get to know" characters, and hands-on activities in a context that makes sense to them*. They are fascinated with the idea of traveling around the world, communicating with the people they meet, and meeting people who are different linguistically and culturally (often wanting to know what they eat). Girls want to use communications technology to have conversations with others like themselves. They want a *backstory*: information about characters and about what motivates them to do what they do. "And that's what *Josie* is about."

In the Josie True project, Flanagan's team is creating a user-friendly, multicultural, Web-based adventure game for pre-adolescent girls, aged 9 to 11. To provide content with which minority girls can identify, *The Adventures of Josie True* features a spunky 11-year-old Chinese American girl, Josie True. In the first game, Josie's science teacher (also an inventor) disappears and Josie sets off to find her.

Her search takes her across time and space: to Chicago and Paris in the 1920s. There she meets Bessie Coleman, the first African American aviatrix. Originally from Texas, Coleman relocated to Chicago, where she worked as a manicurist and as manager of a chili parlor while saving money to get her pilot's license. In the early '20s Coleman went to Paris to get her training and license because African American women were not permitted in any U.S. flight schools, and she returned to France later for training as a stunt pilot. These elements of her life story become factors in the adventure game featuring Josie.

Josie's adventures lead the user to various activities, such as correctly identifying classified objects, expanding a chili recipe (containing fractions) to serve more people, and translating U.S. dollars to French francs.

Both technical and multicultural, the game provides true and fictional ethnic heroes and role models while teaching about science and women's history. It is also designed to appeal to different learning styles. Girls who want to start an activity right away can select from a menu of options. Girls who want to follow the storyline can follow where the characters in the story lead them. Learning is embedded in the narrative.

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HRD 99-79265 (one-year grant)	
Partner: State University of New York, Buffalo	
The Adventures of Josie True is viewable free online at www.josietrue.com	
Keywords: demonstration, software, role models, minorities, adventure game, hands-on	

002
Pro
Profiles of women in science and engineering

PROFILES OF WOMEN IN SCIENCE AND ENGINEERING

SEVERAL BOOKS HAVE DOCUMENTED THE LIVES OF WOMEN SUCCESSFUL IN SCIENCE BY TRADITIONAL STANDARDS (E.G., NOBEL PRIZE WINNERS) AND WOMEN FOR WHOSE WORK MALE COLLEAGUES TOOK CREDIT (E.G., ROSALIND FRANKLIN, CHIEN-SHIUNG WU, AND JULIA HALL). THIS GRANT SUPPORTED COMPLETION OF *JOURNEYS OF WOMEN IN SCIENCE AND ENGINEERING: NO UNIVERSAL CONSTANTS*, A FIELD GUIDE TO 88 WOMEN IN SCIENCE IN ENGINEERING, BASED ON PERSONAL INTERVIEWS—"VOICES FROM THE FIELD."

In first-person narrative profiles, contemporary professional women speak candidly about the different paths they took to various fields of science or engineering, the discrimination they may have encountered, their work environment, their strategies for balancing family and career, and their *own* definitions of achievement and success.

These women—only some of whom are famous—come from many different racial, ethnic, and socioeconomic backgrounds. Marine science educator Judith Vergun worked 15 years as a fashion model before returning (divorced, with three children) to earn a Ph.D. in ecology, with a special interest in Native American and Native Alaskan tribal lands and areas. After graduating from the Bronx High School of Science, mathematician Bonnie Shulman spent 12 years hitchhiking, studying beat poetry, writing, and living on welfare as a single mom before returning to college at the age of 30.

Women with disabilities candidly assess the impact of these disabilities on their personal, educational, and professional lives. Biologist Jane Dillehay, deaf since birth, became dean of the College of Arts and Sciences at Gallaudet University, a college for the hearing-impaired. Psychiatric geneticist Judith Badner speaks about growing up with achondroplastic dwarfism and the ways in which dwarfism shaped her personal, educational, and professional choices. Temple Grandin, an authority on the design of livestock handling equipment and systems, has written extensively about how her autism—she thinks in pictures instead of language—has helped her understand what makes cattle afraid.

Some of the women have led lives of public service, including Rhea L. Graham (the first African American woman to serve as director of the Bureau of Mines), former surgeon general Joycelyn Elders, and Air Force Secretary Sheila Widnall. Some achieved relative celebrity, including Nobel laureate and medical physicist Rosalyn Yalow, biologist and university president Jewel Plummer Cobb, and Susan Love, surgeon, oncologist, social activist, and author of the bestseller *Dr. Susan Love's Breast Book*. Also included are profiles of young scientists just starting out in their careers, including academic scientists with eclectic interests.

This book should help dispel the stereotype of the scientist as a nerdy white male in a lab coat—as well as any notion that the path to a career in science and engineering is the same for everyone. As the subtitle suggests, there are "no universal constants."

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PARTNER: THE SLOAN FOUNDATION.	
PRODUCTS: JOURNEYS OF WOMEN IN SCIENCE AND ENGINEERING: NO UNIVERSAL CONSTANTS BY SUSAN A. AMBROSE, KRISTIN L. DUNKLE, BARBARA B. LAZARUS, INDIRA NAIR, AND DEBORAH A. HARKUS. TEMPLE UNIVERSITY PRESS, 1997.	
KEYWORDS: DEMONSTRATION, BIOGRAPHIES, ROLE MODELS, PUBLICATION, CAREER AWARENESS	

002
Hu
Putting a human face on science

PUTTING A HUMAN FACE ON SCIENCE

WHETHER A WOMAN IS WILLING TO PURSUE A CAREER IN SCIENCE USUALLY DEPENDS ON WHETHER SHE CAN PICTURE HERSELF AS A SCIENTIST WITHOUT UNACCEPTABLE CONFLICT AND CAN INTEGRATE THE ROLE OF BEING A WOMAN WITH THAT OF BEING A SCIENTIST. THE COMMON IMAGES OF SCIENTISTS DISPLAYED IN THE HALLS OF SCIENCE—"DEAD GREATS" IN CAPS AND GOWNS—REINFORCE THE POPULAR PERCEPTION OF SCIENCE AS A DRY AND DUSTY OCCUPATION DOMINATED BY ELDERLY WHITE MALES. MOST FEMALE STUDENTS HAVE FEW ROLE MODELS IN THE FIELD AND FIND IT HARD TO IDENTIFY WITH CONVENTIONAL IMAGES OF SCIENTISTS.

The PDK poster project is using visual media to challenge stereotypes. The project developed and printed 36 gallery-quality posters—co-designed by Pamela Davis Kivelson (PDK) and Inga Dorosz—that put a far livelier and more heterogeneous face on science. Instead of formal portraits of Olympian genius, the posters include images of people (especially women) involved in the joy and excitement of intellectual exploration. Thumbnail images of the posters can be viewed at the project website.

One goal of the project is to encourage scientific literacy and to promote the public's awareness and appreciation of science and technology. By humanizing the image of science and scientists, making that image less threatening and intimidating, the project hopes to help everyone see science and engineering as part of the human enterprise and its practitioners as people like themselves. It also hopes to help girls and young women see science and research as inviting, exciting, and rewarding academic and career choices.

The Stony Brook math department has developed a website that teachers can use as a study guide and that students can use to find hands-on educational activities, biographical information about the women portrayed in the posters, and other educational resources.

CODE: I, E, M, H, U	University of California, Los Angeles
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www.physics.ucla.edu/scienceandart	HRD 96-22321 (one-year grant)
www.math.sunysb.edu/posterproject/www/biographies/index.html	
Partners: Alfred P. Sloan Foundation, Allied Signal, State University of New York at Stony Brook	
The 18 x 24 posters can be viewed and ordered at (www.pdksciart.com)	
Keywords: dissemination, role models, posters, website, hands-on, biographies	

002

W4

Women for women: a mentoring network

WOMEN FOR WOMEN: A MENTORING NETWORK

THIS COMPONENT OF STONY BROOK'S WISE PROGRAM MATCHES 20 UNDERGRADUATE AND GRADUATE STUDENTS WITH 55 MIDDLE SCHOOL GIRLS, WHOM THEY MENTOR. DURING THE SPRING TERM, WISE OFFERS A SEMESTER OF MENTOR TRAINING AND PREPARATION FOR VARIOUS RESEARCH PROJECTS AS A THREE-CREDIT INDEPENDENT RESEARCH COURSE. IN THE FALL, IT RECRUITS MIDDLE SCHOOL STUDENTS TO PARTICIPATE IN A MENTOR-LED CAMPUS-BASED RESEARCH EXPERIENCE DURING THE FALL AND SPRING.

University student mentors bond with their middle school protégées during a two-week summer program. During the school year mentors work with the middle school students on a science research project. Advisers at each middle school support the students and actively engage in the research. A special event in May highlights the students' research results.

HANDS-ON RESEARCH

Two or three mentors, working together, design each research project the middle school students later work on. Among the projects one year were the following:

Photos and fangs (dental anthropology). To learn about primates and dental and general anatomy, students section, polish, and photograph a primate tooth to study the enamel—learning darkroom techniques along the way. Teeth grow incrementally, in a growth pattern analogous to that of tree rings, and the short- and long-period lines may be imaged using several forms of microscopy.

Breeding bettas and bytes (biology, computer science). Students explore how breeding betta splendens (Siamese fighting fish, whose genetics can be easily manipulated) relates to biology, botany, zoology, evolution, ecology, genetics, geology, chemistry, art, computer science.

Making a BMW (mechanical design). Using the computer software IDEAS, students design model cars and, using a technique called "rapid prototyping," build the model in a lab at SUNY Farmingdale.

The heart of the matter (biology). Using medical equipment and anatomical models, students dissect a frog or a fetal pig to learn about the cardiovascular system and how different activities and stimuli affect the heart rate.

An investigation on horseshoes (material, engineering). Students study the forces applied to a horseshoe throughout its life span, as well as properties that affect how materials withstand environmental stress.

Lights, camera, action! (astronomy, physics). Students build a camera, take pictures, develop the film in a darkroom, and produce pictures. Along the way, they learn about the principles of light and also (using telescopes, models, and discussion) of astronomy.

Fractals (mathematics). (A fractal is an object inside of which are embedded infinitely many copies of itself.) Students learn the concepts of fractals and fractal sets, create fractal objects and discover their properties, and learn to measure distances on earth using surveying equipment and Lenart spheres.

DNA detectives (genetics, biology). Students learn basic cellular DNA concepts through lab experiments, learn techniques of microscopy and gel electrophoresis, and examine how ultraviolet radiation causes mutations in cells.

CODES: M, U		STATE UNIVERSITY OF NEW YORK, STONY BROOK
EDITH STEINFELD (EDITH.STEINFELD@SUNYSB.EDU), LOIS ROMAN	www.wise.sunysb.edu (CLICK ON WOMEN FOR WOMEN)	HRD 99-08736 (ONE-YEAR GRANT)
PARTNERS: WISE, COLLEGE OF ENGINEERING AND APPLIED SCIENCES, DEPARTMENT OF TECHNOLOGY AND SOCIETY (SUNY); BRENTWOOD AND RIVERHEAD SCHOOL DISTRICTS; THE BOARD OF COOPERATIVE EDUCATIONAL SERVICES (BOCES); LONG ISLAND POWER AUTHORITY.		
KEYWORDS: DEMONSTRATION, MENTORING, RESEARCH EXPERIENCE, SUMMER PROGRAM, HANDS-ON		

002
Edg
Project EDGE: mentoring and teacher awareness

PROJECT EDGE: MENTORING AND TEACHER AWARENESS

THIS THREE-YEAR PROJECT FROM THE ROCHESTER INSTITUTE OF TECHNOLOGY (RIT) EMPHASIZED MAKING SYSTEMIC CHANGES IN TEACHERS' INSTRUCTIONAL STYLES, CONNECTING YOUNG WOMEN'S LEARNING IN STEM FIELDS WITH REAL-LIFE CAREER EXPERIENCES, AND SHARING RESOURCES AND DATA WITH OTHERS. PLANS WERE TO RECRUIT 100 HIGH SCHOOL STUDENTS, BUT BY THE THIRD YEAR 167 HIGH SCHOOL STUDENTS HAD ENROLLED (UP FROM 98 THE FIRST YEAR).

Teacher bias was addressed in summer workshops for teachers and some vice principals, following the model mentioned in Myra and David Sadker's 1994 work, *Failing at Fairness: How America's Schools Cheat Girls*. David Sadker was an instructor. Recognizing that teachers tend to be isolated from researchers (and vice versa), RIT made teachers the first line of attack against classroom inequity. Teachers were trained to use non-gender-biased teaching strategies, and several classroom observers were trained to be coders (coding teacher-initiated and student-initiated questions and interactions and the type and level of response). Becoming their own investigators—observing, videotaping, and coding teacher behavior in the classroom—helped them become sensitive to bias in their behavior with their own students.

This project gave seven local high schools an early opportunity to work in interactive distance learning technologies. RIT gave the seven schools computers and free links that allowed students to converse electronically with project staff, mentors, and each other. Both girls and teachers learned computer skills, interacting with each other and with mentors through e-mail and chat rooms. Chat rooms were held on Fridays from 11 a.m. to 12:30 on interactive First Class conference software, which had to be used in the schools. RIT's technician had to provide more training and interaction for five of the seven schools because the teachers had only marginal computer skills.

The mentoring gave students a chance to realistically view their career options. Computer interactions enabled girls to converse with RIT staff, professionals, and mentors in ways that were uninhibited by age, appearance, or subject discipline. But the project investigators also learned that early and fairly frequent face-to-face interaction gave participants more of a sense of the "real" people with whom they were conversing.

Students also interacted with mentors and role models through live, interactive teleconferencing, on a two-way audiovideo fiber-optic link capable of simultaneously broadcasting to four sites. The system allowed impressively frank student-to-student and student-to-mentor dialogues, giving the girls insights into racial, cultural, gender-based, and socioeconomic stereotyping. Because technical problems and the necessity for fixed broadcast schedules hampered this activity, in the third year the project switched to monthly face-to-face meetings at a designated school.

CODES: H, U, PD	Rochester Institute of Technology
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HRD 94-53088 (three-year grant)	
Partners: Seven high schools	
Keywords: demonstration, teacher training, gender equity awareness, distance learning, interactive, mentoring, career awareness, role models	

002
How
How to be a mentor (or mentee)

HOW TO BE A MENTOR (OR MENTEE)

MENTORING PROGRAMS HAVE BECOME POPULAR AS A WAY OF RECRUITING AND RETAINING WOMEN AND MINORITIES IN SCIENCE AND ENGINEERING. MENTORS CAN BE POSITIVE ROLE MODELS FOR STUDENTS AND YOUNG PROFESSIONALS, BROADENING THEIR HORIZONS AND PROVIDING PRACTICAL GUIDANCE. THEY CAN ACQUAINT ASPIRING PROFESSIONALS WITH THE WORK ENVIRONMENT AND HELP THEM WITH RÉSUMÉS, MOCK JOB INTERVIEWS, AND PROFESSIONAL CONTACTS. *BUT MENTORING SKILLS DO NOT ALWAYS COME NATURALLY, WHAT PASSES FOR MENTORING IS OFTEN NOT TRUE MENTORING, AND MANY WOMEN AND MINORITY STUDENTS NEVER EXPERIENCE MENTORING.*

The University of Washington's Center for Women in Science and Engineering (WISE—now the Center for Workforce Development), developed and evaluated a curriculum for training mentors and mentees. The goal was to improve mentoring practices by building on and formalizing the university's successful undergraduate mentoring program.

The project developed the Curriculum for Training Mentors and Mentees in Science & Engineering, which includes individual handbooks for students (including graduate students), faculty, and professional scientists and engineers. Graduate students helped write the curriculum, video script, and bibliography.

Four pilot sites were selected: the University of Washington, University of Michigan, Carnegie Mellon University, and Pacific Lutheran University. The curriculum materials have been adopted by 300 academic institutions, corporations, and government agencies. The materials spell out and clarify goals, objectives, and expectations for mentoring relationships; suggest topics for mentors/mentees to discuss and activities to engage in; and identify what students need to learn (such as how to publish), how mentors can help mentees, what the mentor gets out of the relationship. They stress the importance of explicitly relaying positive experiences back to the mentor, giving tips about verbal and nonverbal language. The materials are useful for women in science and engineering, but not in the liberal arts. They have been customized for organizations such as the National Park Service and have also been purchased by professional organizations and corporations.

A manual provides guidelines on what to cover in training. To provide successful training in mentoring, the trainer should have experience either in training or in mentoring (and preferably both); the training should be kept short (one to two hours); and it should be required for mentors. Male mentors may need to be made aware of gender, racial, and cross-cultural bias and ways they may be unintentionally discouraging their mentees; they may also need help dealing with female issues of confidence and inexperience. The key to successfully implementing a mentoring program is probably to build it into an existing program. For organizations with few resources, no mentoring program, and little time, portions of the training materials can be used independently.

WISE's mentoring program received the 1998 Presidential Award in Science, Engineering, and Mathematics Mentoring and the 1998 National WEPAN Women in Engineering and Science Program Award.

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www.engr.washington.edu/cwd	HRD 95-53430 (one-year grant)
Partner: Fund for the Improvement of Postsecondary Education (FIPSE); Women in Engineering Program Advocates Network (WEPAN, Inc.)	
The Curriculum for Training Mentors and Mentees in Science and Engineering is available from WEPAN (www.wepan.org) or by e-mail (wiep@ecn.purdue.edu)	
Keywords: demonstration, mentor training, mentoring, role models, career awareness, manual, gender equity awareness	

002
Eye²
Eyes to the future: telementoring

EYES TO THE FUTURE: TELEMENTORING

THE GENDER GAP IN BOTH ATTITUDE AND ACHIEVEMENT IN SCIENCE PROGRESSIVELY WIDENS FROM AGE 9 THROUGH THE SENIOR YEAR IN HIGH SCHOOL. *MIDDLE SCHOOL IS A TRANSITIONAL TIME FOR ALL STUDENTS, BUT GIRLS IN PARTICULAR HAVE DIFFICULTY ADJUSTING TO THE LOSS OF PERSONAL TEACHER RELATIONSHIPS COMMON IN ELEMENTARY SCHOOL*. EYES TO THE FUTURE (BASED AT TERC INC.) *INTERVENES WITH MIDDLE SCHOOL GIRLS OF ALL ABILITIES DURING THIS TRANSITION, BEFORE THEY HAVE CHOSEN OR RULED OUT POSSIBLE FUTURES FOR THEMSELVES*.

This multi-age mentoring program uses the Web to link middle school girls with local high school girls who have stayed interested in science and technology and with women who use STEM in their careers. The project provides urban middle school girls with enriched science experiences, a broader knowledge of possible options in high school and their careers, and personal relationships with female role models who can give them emotional and academic support.

Eyes to the Future began in 1997 as a pilot program in telementoring supported by the Arthur D. Little Foundation. Fifteen middle school girls and five high school girls communicated electronically with five adult women (a boat builder–engineer, an ecologist, a veterinary technician, a pediatrician, and a geologist). In an extended pilot project the next year in the Boston area, 15 middle school girls met weekly in after-school clubs co-facilitated by a teacher and adult mentors (an astronomer, engineer, biologist, and women in medical fields). Girls in this phase of the pilot communicated electronically but also spent about four weeks engaging in science and technology investigations, communicating about their projects with their high school and adult mentors. Selections from discussions with their mentors were included in their personal electronic scrapbooks, portions of which appeared in a collaborative electronic book.

The pilot's continued success led to the project's full implementation as a three-year NSF-funded program. The project expanded to reach middle school girls from two Somerville schools and three Brookline schools. No prior experience with technology was required. Adult mentors were from earth, space, and sea sciences, such as astronomy, ecology, marine biology, forestry, and archaeology. High school mentors were recruited from among academically talented and motivated local eleventh and twelfth grade girls.

AFTER-SCHOOL ACTIVITIES

The middle school girls met weekly in an after-school club, where they communicated electronically with their high school and adult mentors. Each team of three middle school girls, one high school girl, and one adult had its own private discussion area on the project website. Middle school girls, high school mentors, adult mentors, and teachers had their own separate discussion areas. The website also supported collaborative writing and the sharing of information about science projects. The middle school girls wrote articles about their mentors, about what science is like in high school and in the workplace, about their experiences in the program, and about what it's like to be a girl in middle school today—to post on their websites. They took on the role of investigative reporter, producing an online magazine for other girls their age.

They conducted enriched science activities and took the time to reflect and communicate about them. At after-school clubs, they engaged in earth, sea, and space sciences activities, both with and without their mentors. The third year, they designed rockets powered by balloons, explored local biodiversity, and tested various water samples to determine their pH, salinity, and chlorine content. They also explored local science institutions where their adult mentors work.

MENTORING RELATIONSHIPS

High school girls can see middle school girls' concerns from the viewpoint of someone who has "been there" recently. Carefully selected junior- and senior-year mentors can offer valuable advice about staying involved with science and math, including tips on studying, the consequences of course choices, coping with academic stress, and how to find math and science clubs and supportive teachers. They also provide assurance that they will be there to welcome the eighth graders when they arrive at the high school.

Adult mentors provide a fresh perspective on the relevance and real-life applications of school math and science. Many middle school girls know little about STEM-related arts, trades, and professions and rarely see their current classes in the context of possible careers. They often lack confidence in their ability to succeed and know little about specific specialties, such as biology or physics. In Eyes to the Future they benefit from year-long relationships with adult mentors, learning how they chose their careers, how they use science and math at work, what schooling is needed for such a profession, and what it feels like to be a woman in these fields.

CODES: M, H, I	TERC Inc.
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HRD 99-06153 (three-year grant)	
Partner: Arthur D. Little Foundation	
Products: Two booklets: Eyes to the Future: Guide for High School Mentors and Eyes to the Future: Guide for Middle School Students	
Keywords: education program, after-school, telementoring, teacher training, career awareness; TERC, Inc., mentoring, urban, role models, clubs, self-confidence, publication, website, real-life applications	

002
Tel
Telementoring teens

TELEMENTORING TEENS

WHEN THE EDUCATION DEVELOPMENT CENTER'S CENTER FOR CHILDREN AND TECHNOLOGY (CCT) RECEIVED FUNDING FOR THIS PROJECT IN 1994, THE NOTION OF USING THE INTERNET FOR ONLINE MENTORING WAS NOVEL. BUT CCT SPECULATED THAT THE INTERNET MIGHT BE AN APPROPRIATE MEDIUM FOR ADDRESSING ADOLESCENTS' FEARS AND OBSTACLES AND PROVIDING THEM WITH VALIDATION AND SOUND ACADEMIC AND CAREER ADVICE. IN COLLABORATION WITH THE DEPARTMENT OF ENERGY'S ADVENTURES IN SUPERCOMPUTING PROGRAM, CCT PILOT-TESTED TELEMENTORING WITH GIRLS 14 TO 19 (GRADES 9–12) IN TEN SCHOOLS IN FIVE STATES (ALABAMA, COLORADO, IOWA, NEW MEXICO, AND TENNESSEE). IT RECRUITED 216 STUDENTS (MANY OF THEM 16 AND 17), PAIRING 153 OF THEM WITH 141 ADULT MENTORS—ALL WOMEN, MOSTLY IN TECHNICALLY ORIENTED CAREERS—WHO HAD COMPLETED ONLINE TRAINING IN MENTORING.

The project intended to focus on career mentoring, but it quickly became clear that *preoccupation with conflicts about their personal lives was integral to any academic and career issues most girls had. They valued the opportunity to explore personal issues in a personal way*. Mentors helped students deal with the daunting transition from high school to college, discussing such issues as selecting college courses, balancing personal relationships and academic interests, and overcoming personal or financial obstacles that got in the way of achieving specific goals. In the best cases, telementoring allowed mentors to respond to students' specific, immediate needs and concerns. The project found that *career mentoring online requires addressing girls' immediate interests while simultaneously broadening their relatively narrow understanding of how their interests relate to the world of work*.

More than three quarters of the students found their telementoring experiences rewarding and half felt their mentors had influenced their ideas about science and technology. Mentors' perceptions varied, but 91 percent were willing to mentor again. How satisfied the mentor and protégée felt depended on how often they communicated.

Students who started with negative perceptions of women in these fields were pleasantly surprised to find that their mentors were well rounded. Many students were more inclined to pursue internships and other career-enhancing activities after telementoring, perhaps because their mentors suggested taking a more proactive role in their own career development.

Students and mentors had different perceptions of worthwhile conversations about careers in science and technology. Mentors had high expectations for such discussions, and often felt they hadn't provided consistent enough guidance; students felt they had gained insight into the exciting possibilities of lifestyles in these fields, especially when conversations about career options emerged organically from a discussion of students' and mentors' immediate interests and hobbies. A discussion of music, for example, might lead the student to recognize the importance to a music career of understanding computers.

E-mail appears to be a powerful medium for exploring the complex processes adolescents go through in defining their aspirations. What mentors regarded as casual chat, students often viewed as meaningful exchanges. Mentors wanted to affect the students' career aspirations, but they probably had more influence on their college course-taking behavior.

For many young women in the project, especially in Alabama and Tennessee, traditional values of marriage and family loomed large in their immediate futures. Mentors who could accept and work through these issues with students often found themselves exploring broader issues about life choices, which ultimately affected how students approached their career aspirations.

CODE: H	Education Development Center (Center for Children and Technology)
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www.edc.org/CCT/telementoring	
HRD 94-50042 (three-year grant)	
Partners: Department of Energy's Office of Scientific Computing; National Testbed Project	
National School Network telementoring resources and links: http://nsn.bbn.com/telementor_wrkshp/tmlink.html	
Keywords: demonstration, EDC, career awareness, telementoring, website, peer groups, self-confidence, support system	

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met
MentorNet: e-mail and mentoring unite

MENTORNET: EMAIL AND MENTORING UNITE

E-MAIL'S POPULARIZATION LED CAROL MULLER, CO-FOUNDER OF DARTMOUTH UNIVERSITY'S WOMEN IN ENGINEERING AND SCIENCES PROGRAM, TO CREATE MENTORNET, A NATIONAL ELECTRONIC INDUSTRIAL MENTORING NETWORK FOR WOMEN IN ENGINEERING AND SCIENCE. COMMUNICATING ELECTRONICALLY REMOVES MOST OBVIOUS MARKERS OF STATUS DIFFERENCE, INCLUDING THOSE ROOTED IN GENDER AND HIERARCHY. STUDENTS OFTEN FEEL LESS INTIMIDATED OR HESITANT ASKING QUESTIONS ON E-MAIL THAN THEY MIGHT IN PERSON OR ON THE PHONE. EMAIL ALSO MAKES IT EASY TO COMMUNICATE THOUGHTFULLY AND DELIBERATELY AND PROVIDES A RECORD OF COMMUNICATION. STUDENTS CAN REFER TO THEIR MENTORS' PAST ADVICE WHENEVER THEY NEED TO, AND MENTORS CAN EASILY KEEP TRACK OF STUDENTS' CONCERNS.

A marriage of e-mail and mentoring, MentorNet allows mentoring relationships to flourish where geography, time, or financial constraints might otherwise hamper or prevent them, and it can be especially helpful for students at colleges physically distant from industries in which they are interested. Previously, many people who were willing to serve as mentors lacked the time or other resources to physically meet with a student, and many students didn't have the time to take advantage of mentoring if it required several hours out of a day. MentorNet alleviates time and travel constraints and provides operational economies of scale by offering its services to students at many universities.

MentorNet draws from a pool of volunteer industry mentors to pair male and female professionals in industry with undergraduate and graduate women in STEM. The mentorship lasts one year but often continues unofficially. Careful matches—usually based on educational background and career interests—and training in mentorship are important. Poor rapport between mentors and protégées is uncommon, but when it happens it tends to sour protégées on further mentoring.

A five-year evaluation provided strong evidence that MentorNet supports and promotes the retention of women in STEM majors and careers. MentorNet protégées felt MentorNet was a good use of their time, promoted their ability to network and seek jobs, improved their career awareness, and increased the probability of their seeking mentors in the future. Many participants felt it encouraged them to complete their academic degrees and boosted their confidence of success. Of women who responded to the survey, 53 percent of the 1998–99 protégées either continued with their 1998–99 mentor or applied for a new mentor.

CODES: U, PD	San Jose State University Foundation
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www.mentornet.net	HRD 00-01388 (three-year grant)
MentorNets' many partners (including AWIS) are listed on its website	
Keywords: demonstration, electronic mentoring, engineering, mentor training, retention, career awareness, self-confidence	

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OPT
OPTIONS

OPTIONS

THROUGH A COMBINATION OF CLASSROOM WORK, CAREER EXPLORATION, AND HANDS-ON ACTIVITIES, THIS DEMONSTRATION PROJECT HOPES TO INTEREST 70 FRESHMAN HIGH SCHOOL GIRLS A YEAR (TEN EACH FROM SEVEN SCHOOLS) IN CAREERS IN MATH AND SCIENCE. THE GIRLS ARE EXPLORING THEIR OPTIONS IN SHELBY COUNTY, TENN., WHERE ONLY ABOUT 1 PERCENT OF THE FEMALE GRADUATES SHOW AN INTEREST IN PURSUING COLLEGE DEGREES OR CAREERS IN STEM. OPTIONS TARGETS GIRLS WITH AVERAGE TO ABOVE-AVERAGE ABILITY IN MATH AND SCIENCE.

For four years, learning communities of students, teachers, and mentors will engage in specific after-school, summer camp, and professional development activities. The first year of the program, the girls spend two days a month after school and one week during the summer completing hands-on projects led by volunteers from the Memphis Zoo, Memphis Pink Palace Museum, and FedEx. The second year, they are mentored by local women. The third they are offered paid after-school internships at local corporations and organizations.

Professional development workshops will be designed to change teachers' and counselors' attitudes and skills—in particular to train high school math and science teachers in gender-equitable teaching. The project's emphasis is to encourage girls to explore their options, but the objective of the learning communities and professional development is to increase the number of all students who enroll in science and math classes, choose math and science college majors, and pursue careers in STEM.

Everyone should benefit from the program. For educators, OPTIONS will identify factors that inhibit women's academic and career choices in science and math and will help them adopt better approaches. Girls will learn about the vast opportunities available to them and will learn to problem-solve in small groups. Corporations will be able to interact with educators in the design and evaluation of industry-specific intern programs to prepare the next generation of workers and to generate enthusiasm for that work. And everyone will benefit from the increased emphasis on science and math classes and career opportunities.

Says one participant, who plans to become a pilot, "I don't see a lot of women in math and science careers, but I don't think society's stopping us."

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HRD 01-20860 (three-year grant)	
Keywords: demonstration, project-based, teacher training, gender equity awareness, mentoring, internships, career awareness, industry partners, after-school, professional development, problem-solving skills, self-confidence	

002

com

Community-based mentoring

COMMUNITY-BASED MENTORING

IN 1990, THE ASSOCIATION FOR WOMEN IN SCIENCE (AWIS) ESTABLISHED A FORMAL MENTORING PROJECT WITH FUNDING FROM THE ALFRED P. SLOAN FOUNDATION. AN NSF GRANT HELPED AWIS EXPAND THAT PROGRAM BY ESTABLISHING COMMUNITY-BASED MENTORING PROGRAMS FOR UNDER-GRADUATE AND GRADUATE WOMEN AT 12 SITES NATIONWIDE. LOCAL CHAPTERS COLLABORATE WITH LOCAL CHAPTERS OF OTHER NATIONAL SCIENTIFIC ORGANIZATIONS TO OFFER A SETTING WHERE PROFESSIONAL MENTORS AND STUDENT PROTÉGÉES CAN EXCHANGE INFORMATION.

One-on-one mentoring offers a unique personal experience, but matching professional mentors and student protégées takes considerable time and effort. Small groups can offer the comfort of individual mentor–student interactions and facilitate peer interactions as well. Large-group activities allow students and mentors to network effectively and sample a broad range of advice and backgrounds, among both peers and more experienced scientists.

The activities graduate students found most useful in a 1993 survey reflect their interest in career opportunities: professional conferences, lectures and seminars, and luncheons with guest speakers give graduate students a chance to network with more established scientists and learn about their fields of interest. Also useful were small discussion groups, which most graduate students preferred to one-on-one mentoring, because discussion groups give them a chance to share problems and concerns with their peers and have their experiences validated. Graduate students' preference for group events and group mentoring reflect their interest in exchanging professional advice and concerns with other women scientists rather than in solidifying a tentative commitment to a scientific career.

AWIS compiled resource packets on the six topics students said they considered most important in group programs: career opportunities and options, selection of academic course work, research opportunities, professional contacts and networking, self-image and self-confidence, and balancing work and family. Mentoring helped participants resolve the women/scientist dilemma. Often women cannot see themselves pursuing science because they see conflict between the roles of scientist and the traditional roles of wife and mother. Most (94 percent) of the students said they planned to get married and 77 percent planned to have children. It was important that these students meet women who were managing and transforming those roles to meet their needs.

It will take years to learn if mentoring reduces women's attrition rate in science, but as a result of the AWIS mentoring project, the percentage of graduate students who reported being committed to or certain of a career in science increased from 84 percent to 89 percent. The percentage of women of color reporting themselves as committed to, or certain of, science careers rose from 70 percent to 82 percent, while the percentage for white women remained relatively constant, 82 percent to 88 percent. Overall, *minority women seem to have been more tentative in their initial commitment to scientific career than white women, and the AWIS mentoring project may have been more critical to their retention*.

CODES: U, PD	Association for Women in Science
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www.awis.org/mentoring.html (where you can find links to the project's many partners)	
HRD 94-53754 (one-year grant)	
Publications: Mentoring Means Future Scientists, A Hand Up: Women Mentoring Women in Science, and Grants at a Glance.	
Keywords: demonstration, mentoring, conferences, community-based, seminars, role models, career awareness, resource center, retention, self-confidence, research experience	

002
X
age
Mentoring through cross-age research teams

MENTORING THROUGH CROSSAGE RESEARCH TERMS

UNDER CONSERVATIVE ATTITUDES PREVALENT IN RURAL AREAS, GIRLS ARE RARELY ENCOURAGED TO STUDY MATH AND SCIENCE OR TO PURSUE CAREERS IN STEM. THIS CROSS-GENERATIONAL MENTORING PROJECT—WHICH SERVED EIGHT EXTREMELY RURAL, ECONOMICALLY DISADVANTAGED COUNTIES IN CENTRAL MICHIGAN—CHANGED MANY GIRLS' ATTITUDES ABOUT CAREERS IN STEM AND OPENED MANY ADULTS' EYES TO HOW GIRLS ARE TREATED IN THE CLASSROOM AND HOW MUCH MORE THEY ARE OFTEN CAPABLE OF DOING.

In a two-year period, more than 500 girls from grades 5 through 12 joined undergraduate and graduate women, parents, teachers, and research professionals on 70 research teams. Women on the team provided mentoring, encouragement, and academic support for their younger "colleagues" as they all worked together on a common research project. Adults who helped supervise and mentor girls gained confidence in themselves and learned a lot about encouraging girls to continue in science.

A fall kick-off event brought research teams and professionals together. Mornings, teachers and research professionals met to discuss logistics. Girls and their parents came in the afternoon, to hear and ask questions of a panel of professional women, who talked about how they prepared for their careers and what it was like to be a woman in their field. Then the teams got acquainted and decided what to research.

Research topics covered fields from math, physics, engineering, and aeronautics to geology, health sciences, and microbiology. Most projects had a very practical aspect: One group invented and tested an electric bicycle; another looked at recycling plastics; one studied the physical fitness, dietary habits, and sedentary recreational activities of fourth through tenth graders; one tried to identify substance abuse in students in grades 6 through 12, compared with national norms; one studied the reading habits of junior high students. Some took on additional topics such as the orbits of astronomical objects and the movement of spaceships between and around them.

The girls learned about college, did original research with a professional researcher, and developed poster presentations about their findings, which they presented at a research exposition. In the process, they learned about statistical analysis, scientific method, and how to make a professional presentation. Many surfaced as leaders on their Odyssey of the Mind and Science Olympiad teams. Many of the girls have since entered college, are pursuing STEM-related majors, and attribute much of their confidence and success to their involvement in the research projects.

The project was *revitalizing for teachers. It was the first real research experience many elementary and student teachers had ever had—and their first exposure to equity-based programs*. Several male participants learned that their communication styles were not particularly encouraging to girls and ended up carrying new behaviors back to their own classrooms. To reach other classroom teachers, the project acted as a test site for Operation SMART, which trained a consultant from the Science/Mathematics/Technology Center to work with teachers in grades 3–5.

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HRD 95-54494 (one-year grant)	
Partners: College of Graduate Studies (CMU), Central Michigan Science/Mathematics/Technology Center, local school districts	
Keywords: demonstration, rural, multi-generational, underprivileged, career awareness, gender equity awareness, research experience, teamwork approach, mentoring, self-confidence, parental involvement, field trips	

002

RSE

RISE: research internship in science and engineering

RISE: RESEARCH INTERNSHIP IN SCIENCE AND ENGINEERING

SOCIAL SCIENCE RESEARCH SUGGESTS THAT *ROLE MODELING IS MOST EFFECTIVE WHEN THE MODEL IS PERCEIVED TO BE "MOST LIKE" THE PERSON HERSELF. THIS UNIVERSITY OF MARYLAND INTERVENTION HELPS NEW UNDERGRADUATES SEE THEMSELVES IN ANOTHER UNDERGRADUATE—AND LOOK AHEAD TO THE POSSIBILITY OF BEING A GRADUATE STUDENT AND A FACULTY MEMBER.* THE EXTERNAL FACTORS THE PROJECT ADDRESSES INCLUDE THE ISOLATED AND "CHILLY CLIMATE" OF SCIENCE, THE UNDERSUPPLY OF WOMEN TO SERVE AS MENTORS AND ROLE MODELS, AND THE CRITICAL MASS OF FEMALE STUDENTS AND FACULTY NEEDED IN STEM DEPARTMENTS.

RISE offers a hands-on introductory program for freshmen and an enhanced team research experience for upper class students. The idea is that the first experience will excite and prepare entering freshmen women, who then move on to an extended research internship involving close contact with successful women scientists and engineers.

Upper class students participating in all-women research teams are mentored either by faculty women or by advanced (undergraduate or graduate) students, women who are paid and trained to significantly mentor or teach undergraduate women. The setting for student teamwork and mentoring is the research program of the faculty member involved.

RISE supports faculty women by paying them and training them to be involved in the project (so their efforts don't become a shadow job). Mentoring of undergraduates involves work they want to do anyway—their own research—so they continue to make progress in their own research and on the tenure track while supporting younger women. Built into the project is significant recognition for faculty from their deans and the provost.

The entire research team (the faculty member, RISE fellows, and up to four RISE participants) take part in training: workshops in mentoring, teamwork, and enough basic social psychology to help them understand why the intervention should work. *The chief internal barrier to success and persistence in STEM is students' underestimation of their own abilities (what the literature calls "self efficacy"). Mentors can help by affecting young women's sense that they can "do science."*

This project could bring some of the advantages of a single-sex learning environment (epitomized by women's colleges) into the more mainstream higher education of the College Park campus. Many features of the program—role model hierarchies, mentor training, all-female research teams, and the notion of a two-level program—are replicable.

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HRD 01-20786 (three-year grant)	
Keywords: demonstration, research experience, internships, role models, intervention, barriers, self-efficacy, hands-on, teamwork approach, mentoring, barriers, teacher training	

002

Bcc

Building bridges for community college students

BUILDING BRIDGES FOR COMMUNITY COLLEGE STUDENTS

GENERALLY, STUDENTS AT COMMUNITY COLLEGES ARE LESS LIKELY THAN OTHER COLLEGE STUDENTS TO EXPERIENCE RESEARCH AND MENTORING THAT LEAD TO RESEARCH-BASED SCIENTIFIC CAREERS. VALENCIA COMMUNITY COLLEGE'S BRIDGES PROGRAM HELPED PREPARE 22 YOUNG WOMEN FOR UPPER DIVISION SCIENCE STUDIES AND CAREERS AND HELPED THEM MAKE INFORMED COURSE SELECTIONS AND CAREER CHOICES.

BRIDGES is an acronym (for building and replicating an innovative demonstration model to facilitate gender equity in sciences) but it also means the bridge the community college provides between high school and university-level studies for millions of students each year—especially students from nontraditional populations.

Ten students were selected (on the basis of their personal motivation and career goals) from Apopka High School in Orange County, Fla. Twelve students (ranging in age from 17 to 29) were selected from Valencia. The women were racially and ethnically mixed and from different backgrounds; their career choices ranged from medicine, nursing, and veterinary medicine to chemical and biological research.

The project developed a 10-week course in research methods, offering lectures and labs in three subjects: biochemistry (with labs in protein and DNA electrophoresis, DNA and restriction enzyme mapping, and enzyme kinetics), biology (with labs in microscopy, histology, and anatomy and a tour of the electron microscopy lab at Orlando Regional Medical Center), and chemistry (labs in the use of high-performance liquid chromatography and various types of chemistry computer software). A slightly modified version of the course is now an important part of Valencia's science curriculum.

Valencia's faculty examined existing courses for possible gender bias, and a mentoring program paired high school and college participants on the basis of their academic goals and extracurricular interests. Pairs worked as lab partners in the research methods course and maintained regular contact outside the lab. Valencia sponsored three informational seminars, at which noted female scientists from the science faculty and the local community spoke to the group about their work, their educational backgrounds, and the demands of juggling career and family. Students were in touch not only with these scientists and their mentors but also with counselors who gave the students useful advice about careers, financial aid, and university transfer procedures.

An education specialist interviewed students by phone throughout the semester to monitor the success of the mentoring program and students' opinions about the projects. Students who completed the research methods course were paid a stipend and awarded a framed certificate.

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HRD 95-55734 (one-year grant)	
Partners: University of Florida, Orange County Public Schools, American Association of Women in Community Colleges (Valencia chapter)	
Keywords: demonstration, community college, curriculum, mentoring, research experience, career awareness, minorities, role models	

002

Wze

WISER lab research for first-year undergraduates

WISER LAB RESEARCH FOR FIRST-YEAR UNDERGRADUATES

HIGH DROPOUT AND SWITCH RATES AMONG UNDERGRADUATE WOMEN INTENDING TO MAJOR IN THE SCIENCES AND ENGINEERING DEPLETES THE POOL OF INTERESTED, QUALIFIED, AND PREPARED STUDENTS—FURTHER EXACERBATING THE PROBLEMS OF WOMEN'S UNDERREPRESENTATION IN THESE FIELDS. THE PERIOD OF HIGHEST ATTRITION AT PENN STATE AND OTHER INSTITUTIONS IS THE FIRST YEAR, ESPECIALLY THE FIRST AND SECOND SEMESTERS AND THE SUMMER TRANSITION TO THE THIRD SEMESTER. BECAUSE RESEARCH PLACEMENTS AS A RETENTION DEVICE TYPICALLY COME TOO LATE IN STUDENT CAREERS FOR MAXIMUM EFFECT, IN 1996 PENN STATE INITIATED WISER, AN UNDERGRADUATE RESEARCH PROGRAM FOR FIRST-YEAR STUDENTS IN SCIENCE AND ENGINEERING. OVER FIVE YEARS, WISER PLACED ABOUT 250 FRESHMAN WOMEN IN RESEARCH LABS IN THE SCIENCES AND ENGINEERING.

WISER is for both gifted and average students entering science and engineering. WISERs' SAT scores follow a standard bell curve: 95 percent have cumulative scores of 1400 or less; 74 percent, 1300 or less—refuting the notion that undergraduate research experiences are suitable only for the academically gifted or that only such students will apply. Some faculty and administrators resisted first-year student placements, predicting dire consequences, if not the program's outright failure. But most of the faculty was supportive—even excited—at the prospect of young students in the lab. Those who participate tend to keep accepting WISERs and recommend the program to other faculty.

Faculty members receive up to 30 applications, interview as many students as they have time for, and give their first through third choices to the WISER administrator. Applicants may apply to as many as three labs and state their first three choices after their interviews. The WISER office matches the student and faculty, trying to give everyone her or his first choice. About a third of the applicants—mainly those in the life sciences—cannot be placed. The project emphasizes placements in engineering and the physical sciences, where women are more likely to be both isolated and underrepresented at every stage.

WISER is an adaptation of the research component of a more comprehensive retention initiative, the Women in Science Project (WISP) at Dartmouth College. After Penn had decided on research placements as an intervention, it learned that a model for such a program already existed at Dartmouth College, initiated by Carol B. Muller and Mary Pavone. WISP incorporates formal mentoring, e-mentoring, a newsletter, tutoring, scientific poster sessions, advising, and paid research placements, which sometimes take place in off-campus locations such as hospitals. It was a much more ambitious and comprehensive program than Penn State was prepared to offer. Could the research placement component be separated from WISP's integrated approach and still have a positive effect?

Dartmouth is a small, elite, private, teaching-oriented university, and Penn State is a large, multisite, state-affiliated, research-oriented university—yet Dartmouth and Penn State's main campus share certain features: a high residential (not commuter) student population, a paid staff to administer STEM retention programs, staff adept at collaborative (not competitive), cross-discipline projects, and the institution's acknowledgment that it could not keep blaming the poor retention of undergraduate students in STEM on K–12 schools.

And Dartmouth administrators were generous and trusting in handing off material that could be considered proprietary. With the WISP administrators' permission (and diskette), Penn copied WISP's timetable, its student handbook describing research opportunities, and its application form. This alone allowed Penn to get the program up and running in weeks rather than months or years.

Many Penn State students come from small or rural school districts where they are highly visible and often sought out because of their academic talent. *The assertive behavior needed to successfully negotiate a research placement at a competitive institution such as Penn State is considered rude or even foreign to rural values, especially for women. So rural women (and some men) can miss out on unparalleled opportunities to fast-track their careers. The strength of the WISP application and selection process was that it used a format familiar to students: writing applications and going to interviews to which they were invited*.

Preliminary data show a 50 percent reduction in dropout and switch rates among WISERs, compared with their matched cohorts, at least during the first three semesters when retention of science and engineering students is most at risk.

Unlike the Dartmouth program, WISER offers almost nothing in the way of support services beyond the initial matching of faculty and student. It is up to the student to make her way through an interview, to negotiate a satisfying research experience once placed, and to maintain contact with the faculty member after the two-semester placement has ended.

Interestingly, a spin-off of the program at Abington College, a two-year branch campus of Penn State that is becoming a four-year institution, has returned to the Dartmouth model of high ancillary support activities—with great success. Abingdon values a retention program that directly benefits a few undergraduate students daily more that it values a one-day K–12 program that benefits hundreds of girls. Dissemination to the Abington College site has produced perhaps *the most interesting outcome of all. It has stimulated new research activities among the faculty, brought recognition to faculty already doing research, and helped integrate adjunct faculty*.

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HRD 96-32186 (one-year grant)	
Partners: Pennsylvania Space Grant Consortium, Penn State at Abington-Ogontz	
Keywords: education program, retention, research experience, engineering, physical sciences, intervention, mentoring, electronic mentoring, internships, rural	

SUPPORTING WOMEN IN GEOSCIENCE

002
Geo
Supporting women in geoscience

TO INCREASE THE NUMBER OF WOMEN COMPLETING GRADUATE STUDIES IN EARTH SCIENCES, *IT IS IMPORTANT TO OFFER ENCOURAGEMENT AT THREE CRITICAL TRANSITION POINTS: AS THEY ENTER COLLEGE, WHEN THEY ARE SENIORS ABOUT TO GRADUATE, AND IN THE EARLY YEARS OF GRADUATE SCHOOL*. BY NURTURING FEMALE LEADERS IN GEOSCIENCE WHO CAN SERVE AS ROLE MODELS TO YOUNG WOMEN ENTERING UNIVERSITY IN LATER YEARS, THIS UNIVERSITY OF ARKANSAS PROJECT AIMS TO INCREASE THE NUMBER AND VISIBILITY OF WOMEN IN THE EARTH SCIENCES.

Project activities designed to improve their self-confidence and self-reliance include mentoring and the development of a support network of peers that can be used throughout the women's careers in geoscience. The project also emphasizes developing the skills needed for success, such as written and oral communication, team-building and leadership, and good study habits and organization. Project activities include a weekend field trip for entering female geoscience majors; a 10-day field experience for senior undergraduate and graduate women; *a mentoring ladder in which freshmen are guided by upperclasswomen who are counseled by graduate students, who in turn are supported by a faculty member*; scholarly seminars given by female students of all levels; attendance at national meetings and a role-model lecture series that brings prominent female geoscientists to campus.

The activity that has had the broadest impact to date is the role-model lecture series. Three women are brought to campus each semester to give the Friday afternoon colloquium in the department of geosciences. The students decide whom to invite and handle bringing the speakers to campus. Each speaker has said she came because the request came from the students themselves, so it was an opportunity to be a role model and interact with female students. So far the students have chosen only professors—but professors at different stages of their careers (assistant, associate, full) and at different types of institutions (public, private, research oriented, and comprehensive). Speakers have lunch with the undergraduate and graduate women, give a formal scientific talk in the afternoon, and are guests at a reception for the whole department that evening. Both the luncheons and receptions are well attended.

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HRD 00-96333 (one-year grant); formerly HRD 99-79305	
Keywords: demonstration, role models, geosciences, self-confidence, mentoring, peer groups, field trip	

Conversation at the lunches—sometimes quite lively—ranges from the relevant scientific discipline to the realities of finding jobs for two-career couples and the difficulties of balancing careers and family. *Many of the students are surprised and relieved to discover that the speakers also faced, and sometimes still face, challenges similar to their own. Differences in perspective between full professors and junior women newer to academe enlighten and encourage the students. After these discussions, the students clearly feel they can and will pursue graduate studies, despite any earlier misgivings*. For several students, direct contact with a speaker during her visit has led to e-mail exchanges about graduate school.

002
Fell
Undergraduate research fellowships

UNDERGRADUATE RESEARCH FELLOWSHIPS

A 1996 STUDY OF *FIVE UNIVERSITIES KNOWN FOR RETAINING WOMEN AND STUDENTS OF COLOR IN THE SCIENCES REPORTED THAT CERTAIN PRACTICES WERE COMMON TO THE FIVE INSTITUTIONS: UNDERGRADUATE RESEARCH OPPORTUNITIES, HIGH LEVELS OF FACULTY–STUDENT INTERACTION, AND AN EMPHASIS ON UNDERGRADUATE EDUCATION*. FUNDING CUTS HAVE REDUCED THE NUMBER OF FELLOWSHIP AWARDS AVAILABLE FOR UNDERGRADUATE RESEARCH, HOWEVER, SO INDIANA UNIVERSITY'S UNDERGRADUATE RESEARCH FELLOWSHIP PROGRAM FOR WOMEN IN THE SCIENCES PROVIDED RESEARCH EXPERIENCES FOR UPPER-DIVISION UNDERGRADUATE WOMEN WHO HAD SHOWN INTEREST AND POTENTIAL IN THE SCIENCES.

Upper division participants did 40 hours of research during the summer of 2001 and 10 hours a week during the fall and spring semesters—interacting with faculty who served as mentors and role models. Introducing more undergraduate women to lab work is expected to help retain women in the sciences, build their confidence in their scientific abilities, and make them more competitive for graduate school and the job market.

The program provided training in scientific research and lab skills, as well as in presentation and communication skills, to upper-division women students in the sciences. Lab researchers presented their lab research and experiences at an event organized by the Women in Science Program and presented posters on their research at WISP's annual Women in Science Research Day. They could also compete for three monetary awards to be used for attending or presenting their research at national or regional conferences.

Other factors important to the retention of women in the sciences include frequent contact with faculty in classrooms and laboratories, faculty concern for individual students, and an interactive (rather than competitive) classroom environment. Bloomington's WISP program has had considerable success with research internships, mentoring, and support networks for retaining women in the sciences. This project also provided mentoring opportunities, peer support networks, and role models for women science students, starting in sophomore year. Upper-division mentors were matched up with sophomore students interested in pursuing science majors.

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Keywords: demonstration, retention, research experience mentoring, role models, self-confidence, internships	

TRAINING GRADUATE STUDENTS TO DEVELOP UNDERGRADUATE RESEARCH PROJECTS

MOST TEACHER TRAINING OF GRADUATE STUDENTS EMPHASIZES CLASSROOM INSTRUCTION. GRADUATE TRAINING RARELY ADDRESSES THE NEED TO DEVELOP SKILLS IN DESIGNING AND SUPERVISING UNDERGRADUATE PROJECTS. STONY BROOK, WHICH RECEIVED AN NSF RECOGNITION AWARD FOR INTEGRATING RESEARCH AND EDUCATION, HAS A LONG TRADITION OF RESEARCH COLLABORATION BETWEEN UNDERGRADUATES AND FACULTY.

002
dev
Training graduate students to develop undergraduate research projects

In this project, it found that *the best way to train graduate students in how to supervise science and engineering research is to require every Ph.D. student to develop one teaching module based on his or her research as an integral part of the Ph.D. program. This forces the students to explain the social and scientific context of their research in terms freshmen can understand; to identify a research project that can be completed in two to three weeks, one outcome of which is important to the project; and to define and develop an educational experience—all of which are important to the professional growth of scientists in training*.

In a one-year project, Hanna Nekvasil (in Geosciences) designed a two-semester seminar on the design and supervision of undergraduate research projects. Graduate students were trained to develop and direct short undergraduate research projects and got experience doing both. The interdisciplinary modules in applied research could be repeated by undergraduates in subsequent years. The idea was partly to help women going on in academia to understand the integral relationship between teaching and research, to foster the skills needed to carry out these activities, and to enlarge women's social and intellectual community by fostering collaborations between disciplines and with high-tech R&D scientists.

The course, which met weekly, yielded six projects, five of which were implemented in the hands-on course for freshmen, Introduction to Research. The projects involved hands-on research involving synthetic lavas, exercise's ability to attenuate the human body's response to stressors, DNA fingerprinting, pollution and environmental policy, and the chemistry of photosynthesis.

Undergraduates were able to carry out projects in areas of science with which they were unfamiliar and to which they would not otherwise have been exposed as undergraduates. One in seven students said they planned their intended major from their participation in these projects. They learned about research topics, methodologies, and skills, benefiting greatly from various hands-on experiences and from the collaborative approach to research. They greatly preferred the team project approach to doing research by themselves.

Pairs of graduate students from different disciplines (in new and emerging fields) learned to design research modules and supervise teams of five to six undergraduates, considering such factors as the undergraduates' science backgrounds, how much time they had to spend on the project, and available facilities and materials. They gained skill in promoting an inquiry-based, problem-solving approach to teaching and strategies for encouraging frequent interaction and collaboration among team members. And they valued the chance to work with graduate students from other disciplines.

The project brought home the mutual benefits of graduate–undergraduate interactions, the need for graduate students to be placed in instructional roles (yet the difficulty of finding time to do so), and the difficulties of providing undergraduates with research experiences. For this reason, Nekvasil developed a new required course that places undergraduate geology majors (both male and female) with graduate geochemistry students. Each graduate student becomes primary instructor in the optical identification of minerals for a small group of undergraduate students.

CODE: U, PD	State University of New York (SUNY) at Stony Brook
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www.wise.sunsyb.edu/index.htm	HRD 97-10556 (one-year grant)
Partners: Center for Biotechnology, Collaborative Laboratories, Symbol Technologies, Inc.	
Keywords: demonstration, hands-on, research experience, collaborative learning, inquiry-based, problem-solving skills, geosciences	

002
Awe
AWSEM: networking girls and women in Oregon

AWSEM: NETWORKING GIRLS AND WOMEN IN OREGON

IN OREGON, HIGH-TECH CORPORATIONS HAVE SURPASSED THE TIMBER INDUSTRY TO BECOME THE STATE'S NUMBER ONE EMPLOYER. ALARMINGLY, THESE SAME COMPANIES ARE CURRENTLY FORCED TO HIRE OUTSIDE THE STATE FOR 50 PERCENT OF TECHNICIANS AND 90 PERCENT OF ENGINEERS. AND WOMEN, WHO MAKE UP 45 PERCENT OF THE WORKFORCE, CONSTITUTE ONLY 16 PERCENT OF SCIENTISTS, 10 PERCENT OF COMPUTER SCIENTISTS, AND 4 PERCENT OF ENGINEERS. STUDIES ATTRIBUTE THIS UNDERREPRESENTATION TO LACK OF ENCOURAGEMENT, SUPPORT, AND ROLE MODELS FOR GIRLS IN SCIENCE, ESPECIALLY DURING THE MIDDLE SCHOOL YEARS. GIRLS AS TALENTED AS BOYS IN MATH AND SCIENCE, AND AS EXCITED ABOUT SCIENCE IN CHILDHOOD, BEGIN TO LOSE INTEREST IN MATH AND SCIENCE AROUND THE AGE OF 12. THEY DROP OUT OF MATH AND SCIENCE CLASSES, CLOSING THE DOORS ON MANY CAREER OPPORTUNITIES. THIS LOSS OF TALENT IS A QUIET CRISIS IN AMERICA.

AWSEM (advocates for women in science, engineering and mathematics) developed a model of advocacy and curriculum to encourage girls to pursue their early interests in the sciences. It began in 1994 as a project of the Saturday Academy, a community-based effort that in 1996 received the Presidential Award for Excellence in Mentoring for its support of students from groups underrepresented in science and engineering. AWSEM brings together parents, educators, and women professionals in science-related fields to kindle and support young women's interest in STEM. Regional networks of community leaders work together to dispel pervasive negative attitudes about girls, women, and science; to create local networks of public and private institutions that give young women more science opportunities; and to establish a vertical mentoring system that links middle and high school girls with female college students, teachers, parents, and professionals—to establish sustained contact between young women and science practitioners.

The AWSEM model of advocacy assumes that the most effective way to encourage girls in the sciences is to create meaningful interactions between girls and role models in a wide variety of careers. Girls meet peers with similar interests in after-school clubs where they do fun, hands-on science projects, get to know college women in STEM disciplines, and get to work with experienced women professionals, from aeronautic engineers to zoologists. AWSEM's slogan: "*Making connections between inquiring young minds and accomplished community professionals to solve real problems*."

AWSEM maintains a network of 18 after-school science and math clubs in the Portland metropolitan area where middle and high school girls meet with each other and with college-age women to pursue their interests in science. It tries to locate these clubs in schools serving high minority and low-income populations, and schools with high dropout rates—typically getting outside funding to support the clubs. Monthly site visits to local science institutions such as the Oregon Regional Primate Research Center allow girls to spend their day working with groups of women professionals, getting a hands-on introduction to the excitement and diversity of science careers and the women who pursue them.

AWSEM supports regional advocacy efforts with products, curriculum, and information. It held training for teachers and group leaders, with special sessions on robotics engineering to help them help girls explore computer-controlled Lego robots in their clubs and classes. AWSEM's website features hands-on science and math activities, gender equity research, and links to career information and other science sites.

Participating in AWSEM has changed many girls' and parents' attitudes toward STEM careers and courses as well as their behavior. The girls' grades, activities, TV habits, and plans for education reflect a heightened interest in STEM and STEM professionals. The undergraduates and professionals who mentor benefit from the support network that develops among them when they work together on a project. In developing the interactive site visits, the leadership teams learn how to communicate their careers and subjects to a lay audience of students.

THE M.A.D. SCIENTISTS CLUB

In April 1996, after a monthly meeting of the Lane County Regional Gender Equity Committee, two members were reflecting on how—despite math and science's clear importance to girls' self-esteem, education, and careers—girls were opting out of the more difficult math and science classes at a greater rate than boys. These girls and their parents seemed unaware of the lifelong implications of this action.

"These girls need an advocate," said Mary H. Thompson, publisher and co-author of a series of books on women and science. "Who do you think has the greatest vested interest in a young girl's welfare and future?"

"Their mothers!" said Marjorie DeBuse, director of the Lane County Saturday Academy and mother of a young daughter.

Thus began The M.A.D. (mothers and daughters) Scientists Club program.

Using seed money allocated from the Saturday Academy's NSF-funded AWSEM program, Marjorie added The M.A.D. Scientists Club to the U of O Talented and Gifted Institute's Super Summer program. Mary developed the curriculum and took the first group of mothers and daughters through hands-on science activities, discussing issues the girls were encountering that made it difficult for them to admit to liking their math and science classes.

The M.A.D. Scientists Club brings fourth and fifth grade girls and their mothers (or another significant adult woman) together to do hands-on science experiments and activities, to learn about women scientists throughout history, and to be introduced to gender-related issues that can reinforce positive attitudes about math and science in the girls and their mothers. The program consists of an organizational meeting, six science sessions, and an optional "Mom Talk."

Sessions are coordinated by a trained facilitator who provides the curriculum and helps organize the science activities. Sciences covered are chemistry, structural engineering, physics, astronomy, mathematics, and geology/paleontology. Activities in The M.A.D. Scientists Club are drawn from *The M.A.D. Scientists Club Facilitator's Manual* and Mary Thompson's *The Scientist Within You: Experiments and Biographies of Distinguished Women in Science*.

Mothers enjoy the opportunity to get away on a special outing with their daughter, spending time together learning about science in a comfortable learning environment (especially when science has intimidated them or left a bad taste in their mouth), watching their daughter get excited about science activities, getting involved with other moms, and learning how many doors science can open for their daughters and how to help their daughters grow.

CODES: M, H, I	Oregon Graduate Institute of Science and Technology; Oregon Health & Sciences University

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www.awsem.org | www.alphaci.com/mads/4-progr/progr.htm (MAD Scientists Club) | HRD 94-50030, HRD 97-14862 (three-year grants)

Partners: Portland State University, Oregon Graduate Institute, Oregon University System, Oregon State Department of Education, Women in Technology International (WITI), Oregon Robotics Tournament and Outreach Association, Solar Energy Association of Oregon, Expanding Your Horizons, the Institute for Science, Engineering, and Public Policy, and countless local organizations.

Materials available from AWSEM website: Action Kit; Directory of Practitioners: Role Models for Young Women; Passport to Science; Site Visit Handbook; and Curriculum Guide.

Keywords: education program, role models, parental involvement, support system, after-school, clubs, field trips, hands-on, career awareness

002

WB

WISE beginnings

WISE BEGINNINGS

FIRST-YEAR COLLEGE STUDENTS OFTEN BELIEVE THAT INTRODUCTORY SCIENCE CLASSES ARE DESIGNED TO ELIMINATE STUDENTS NOT GOOD ENOUGH TO DO SCIENCE. *SOME FACULTY ALSO BELIEVE THAT STUDENTS LEAVE SCIENCE EARLY BECAUSE THEY LACK CERTAIN ATTRIBUTES OF ABILITY OR CHARACTER, AND THAT THEIR LEAVING IS PART OF A NATURAL WEEDING-OUT PROCESS. BUT STUDIES REPEATEDLY SHOW THAT MANY STUDENTS WHO LEAVE THE SCIENCES ARE INTELLIGENT AND STRONGLY MOTIVATED BUT DISCOURAGED BY THE COMPETITIVE CULTURE AND THE BELIEF THAT A DEPARTMENT IS MAKING EARLY NEGATIVE JUDGMENTS ABOUT THEIR ABILITIES. THE CHILLY CLIMATE IN MOST SCIENCE CLASSROOMS—AND THE WAY SCIENCE IS USUALLY TAUGHT—ESPECIALLY LEADS MANY WOMEN TO LEAVE SCIENCE FOR MORE CONGENIAL ACADEMIC FIELDS.*

Brown University initiated the successful Women in Science and Engineering (WISE) program to improve the environment for undergraduate women studying science. It launched WISE Beginnings to provide strong support during that year when undergraduate women are first exposed to college-level science and form their opinions about whether or not to become scientists.

More than 300 students participated in facilitated study groups for introductory chemistry, engineering, physics, and calculus courses. The first year of the program, students of color facilitated most of the study groups, to address the dearth of women of color in the WISE program and in the sciences generally. In its third year, the study groups became open to all students. WISE developed a comprehensive training program on group facilitation for study group leaders (using the supplemental instruction model of group facilitation). It also created events for first-year science students for orientation day and for WISE Day, at the beginning of the second semester.

On the Women in Science website, first-year students could read: "One important thing to remember as you are going through introductory science courses is that everyone has a different learning style. The way your course is taught may not be conducive to the way you learn. It is important to try to find study techniques that fit your learning style. Also, the college grading system is very different from the high school one. Medians on exams here are often low, but this does not necessarily reflect any change in intelligence, or ability to do science." Advice on the website aimed to dispel common first-year myths about college science.

Nearly a quarter of the undergraduate population became involved. More than 50 science faculty worked actively often in collaboration with students, to make their courses to more accessible to all students, including traditionally underrepresented groups. Provided with guidance on reforming science education, *many faculty were persuaded that by shifting the pedagogical focus away from a competitive, "weeding out" model to a cooperative, welcoming, stimulating model the sciences would retain more talented students. Science classes had previously tried to engage students in competition, but students often respond more positively to an atmosphere of cooperative learning—small groups of students working together to solve problems, complete a task, accomplish a common goal, ask questions, discuss ideas, learn to listen to others' ideas, offer constructive criticism, and so on*.

Some professors now find it useful to talk to classes about the weeding-out theory, explaining that any weeding out that goes on goes on during the admissions process, and that they expect all their students to do well. When a professor expresses high expectations for a class, students often have more confidence in their own abilities and perform better. To address grade anxieties, some instructors stress that performance in introductory courses is not necessarily an indicator of future performance or ability—that students could earn low grades in introductory science courses because of a weak high school science background or problems making the transition to the college environment, among reasons that might have nothing to do with science ability. By encouraging apprehensive students to take a course on a pass/fail basis, they allow students to explore a subject of potential interest without having to worry as much about the grade—and to base decisions about their future on how much they are learning and their interest in the subject matter instead of on how good a grade they earn in an early course.

To move toward collaborative work, instructors increasingly designed more cooperative and discovery-oriented introductory courses that explore interesting topics yet cover the basics. To personalize large, impersonal classes, they began encouraging more study groups—formal and informal, in class and out. They began to adopt the student-as-learner model, with the teacher as coach. They tried to help students develop the skills in critical thinking and group work that scientists use every day in research and to see that science is not static.

Engineering 3, for example, was a team-taught introductory course that typically weeded out significant numbers of women and students of color, *who found it too boring or difficult. The group that overhauled the course found that instructors were teaching to the "top" of the class (students who already excelled in AP physics and AP calculus and were proficient in computer programming) and ignoring the less well prepared majority of students in the middle and at the bottom*. They split off an advanced class for students already familiar with much of first-year engineering and, for the rest of the students, developed 10 hands-on labs closely connected to the weekly lecture. They encouraged collaborative work, introduced two design contests to make things interesting, assigned students to homework study groups based on dorm location, gave out class e-mail addresses to make communication easier, prepared a course handbook on basics and tips for working productively, and established an ombudsperson position (filled by a junior or senior engineering student) to give the instructors ongoing feedback and to address student concerns. The traditional stream of student complaints about the course ended.

As a result of these efforts to encourage study groups and to change the way science was taught, the retention rate for women in science at Brown increased significantly, from 59.9 percent in the class of 1994 to 67.4 percent in the class of 1996.

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KEYWORDS: DEMONSTRATION, STUDY GROUPS, COOPERATIVE LEARNING, SELF-CONFIDENCE, EXPLORATION-BASED, HANDS-ON, RETENTION	

002

wisp

WISP: Dartmouth's support program

WISP: DARTMOUTH'S SUPPORT PROGRAM

IN 1993, DARTMOUTH LAUNCHED AN INNOVATIVE MODEL PROGRAM TO ENCOURAGE NEW STUDENTS WITH HIGH INTERESTS IN STEM TO RETAIN THOSE INTERESTS, BY IMPROVING THEIR EXPERIENCE IN STEM COURSES, ESPECIALLY THEIR FIRST YEAR. DARTMOUTH'S COMPREHENSIVE WOMEN IN SCIENCE PROJECT (WISP) PROVIDED EARLY HANDS-ON RESEARCH EXPERIENCES, MENTORING, ROLE MODELING, TUTORING, ACCESS TO INFORMATION AND ADVICE, A NEWSLETTER, SCIENTIFIC POSTER SESSIONS, AND THE CHANCE TO BUILD A SENSE OF COMMUNITY IN THE SCIENCES. MENTORING, IN WHICH WISP PIONEERED, TOOK MANY FORMS: FORMAL AND INFORMAL, FACE TO FACE AND ELECTRONIC, AND WITH PEERS, UPPERCLASSWOMEN, AND PROFESSIONALS IN INDUSTRY.

As interns, first-year students spent up to ten hours a week for two terms working with science faculty members (or researchers in nearby industrial or government laboratories) assisting in ongoing research projects—opportunities usually reserved for upper-class science majors preparing for graduate work. NSF funding helped cover stipends to ensure the participation of economically disadvantaged students. Interns were given a student guide written by a former intern. At year's end they could present their work in poster sessions at Dartmouth's annual science symposium. In 11 years, 787 first-year women participated in research internships and 219 faculty and researchers volunteered as WISP intern sponsors. (Graduate students and post docs often served as supervisors and "assistant sponsors.") All of Dartmouth's science departments, including the medical school, participated, as well as such off-campus institutions as the Veterans Administration Research Center and the U.S. Army Cold Regions Research and Engineering Laboratory.

Realizing that they wanted to share information and advice with younger students, two junior science majors initiated WISP's peer mentor program in 1992. Over the years this student-directed program has touched the lives of close to 1500 Dartmouth women.

WISP also pioneered an e-mentoring program that paired undergraduate and graduate women in STEM with industrial scientists and engineers, using mainly e-mail to communicate and build relationships. WISP developed the industrial e-mentoring program so that experienced mentors could help young women connect their classroom studies to the world of work. *The mentors most available to women on rural college campuses are those in the academic profession, but many students eventually seek employment in business and industry. Expansion of the Internet and the increasing prevalence of e-mail on college campuses and in industrial workplaces diminishes the limitations of time and location and opens up new mentoring possibilities*.

Protégées and mentors alike found their telementoring relationships viable, valuable, and personally rewarding. They saw electronic communication *as an ideal medium for quick and easy communication between people in different time zones or remote locations and on different schedules. Written messages allowed protégées to express themselves more thoughtfully, to feel less intimidated, and to preserve the correspondence (because it was sometimes reassuring to go back and reread what the mentor said later)*. There were some limitations, too. E-mail could feel impersonal; conversation and the exchange of ideas may flow more easily in face-to-face or phone conversations than in asynchronous communication; and it is harder on e-mail to maintain an open, spontaneous discussion, to guide a conversation, or to correct a misinterpreted question or comment. *Clearly e-mail has to be supplemented with occasional phone calls and personal visits over meals and at the mentor's workplace*. Some mentors recommended videoconferencing for virtual face-to-face conversations, gatherings, and group discussions.

WISP's model e-mentoring program led to and became part of MentorNet, the national e-mentoring program sponsored by WEPAN and funded by the AT&T and Intel foundations.

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www.dartmouth.edu/~wisp/	HRD 93-53764 (one-year grant)
Guide to first-year research internships: www.dartmouth.edu/~wisp/student_guide.pdf Dartmouth's science teaching website: www.dartmouth.edu/~wisp/faculty/home.html	
Keywords: demonstration, retention, hands-on, research experience, mentoring, role models, internships, electronic mentoring, industry partners	

003

Ch

Courses That Feed, Not Weed

CHAPTER THREE · COURSES THAT FEED, NOT WEED

THE WORLD NEEDS MORE SCIENTISTS AND ENGINEERS, AND IT NEEDS A CITIZENRY THAT UNDERSTANDS THE DISCOVERIES AND INVENTIONS THAT ARE CHANGING OUR LIVES. SCIENCE AND MATH COURSES NEED TO ENTICE, EXCITE, AND APPEAL, AS WELL AS INFORM OUR STUDENTS. THEY CANNOT BE BORING AND OUTDATED AND UNNECESSARILY HARD—AIMED AT “WEEDING” MOST STUDENTS OUT OF ADVANCED STUDIES. WE NEED TO ENGAGE AND INCLUDE MORE STUDENTS, AND A GREATER DIVERSITY OF STUDENTS, SO THAT THEY PERSIST FURTHER THAN BEFORE IN LEARNING THE BASICS OF SCIENCE, MATH, AND TECHNOLOGY.

THE PROJECTS IN THIS CHAPTER REVEAL MANY EXPERIMENTS IN COURSE DESIGN TO APPEAL TO A BROADER BASE OF STUDENTS, PARTICULARLY FEMALE STUDENTS. THE NEW COURSES ARE TESTED IN ACTUAL SCHOOL SETTINGS, AND THEIR EFFECTIVENESS IS EVALUATED. THE STORIES OF THESE PROJECTS SHOW A WIDE RANGE OF CREATIVITY IN BUILDING NONTRADITIONAL TEAMS TO DESIGN AND TEST NONTRADITIONAL APPROACHES.

SOME TRENDS IN THE LAST 10 YEARS ILLUSTRATED IN MANY OF THESE STORIES:

- THE INTRODUCTION OF STANDARDS FOR SCIENCE AND MATHEMATICS EDUCATION AND DEFINITIONS OF MINIMUM COMPETENCIES
- GREATER RELIANCE ON TESTING TO MEASURE LEARNING
- EMPHASIS ON TEAM PROBLEM-SOLVING IN THE CLASSROOM, WITH A MULTIDISCIPLINARY VIEW
- NEW CURRICULA INTEGRATING THE USE OF TECHNOLOGY, AND THE ARRIVAL OF DISTANCE EDUCATION USING TECHNOLOGY
- THE RISE OF THE “NONTRADITIONAL” STUDENT
- COMMUNITY COLLEGES’ GREATER ROLE IN UNDERGRADUATE EDUCATION

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MATHEMATICS

003
ei
Early influences on gender differences in math achievement

EARLY INFLUENCES ON GENDER DIFFERENCES IN MATH ACHIEVEMENT

THIS THREE-YEAR LONGITUDINAL STUDY WILL EXAMINE *GENDER DIFFERENCES IN HOW FIVE FACTORS—SPATIAL SKILL, USE OF STRATEGY, SPEED OF RETRIEVAL, CONFIDENCE ABOUT MATH, AND CONCEPTUAL UNDERSTANDING—PREDICT MATH ACHIEVEMENT*. CHILDREN WILL BE ASSESSED EACH YEAR STARTING IN SECOND GRADE AND ENDING IN FOURTH GRADE. USING THE FIVE FACTORS AS PREDICTORS OF MATH ACHIEVEMENT, THE STUDY TEAM WILL BE ABLE TO SEE WHETHER SOME FACTORS INTERACT WITH EACH OTHER AS PREDICTORS OF MATH ACHIEVEMENT. DOES THE PRESENCE OF ONE FACTOR PROMOTE THE DEVELOPMENT OF THE OTHERS? DOES CONFIDENCE PROMOTE SPATIAL SKILLS AND THE USE OF STRATEGY, FOR EXAMPLE? DO EARLY SPATIAL SKILLS PROMOTE GREATER CONFIDENCE AND USE OF STRATEGY?

This project is studying the early elementary years because although gender differences in strategizing, spatial skills, and confidence have been documented in children of elementary school age, it is not clear how these differences may affect math achievement. If math achievement and conceptual understanding are affected by early emerging gender differences, is there a need to intervene in girls' math in the early elementary years rather than waiting until middle school and high school, when gender differences become more pronounced?

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003
mmc
Math mega camp

MATH MEGA CAMP

A TWO-WEEK NONRESIDENTIAL SUMMER ENRICHMENT PROGRAM IN MATH AND SCIENCE, MEGA CAMP (MATH EXPLORATIONS FOR GIRLS ACHIEVEMENT) TARGETED SIXTH GRADE MINORITY GIRLS, BECAUSE MAJOR DECISIONS ABOUT WHETHER TO PURSUE MATH ARE MADE IN JUNIOR HIGH SCHOOL. HOSTED BY CALIFORNIA STATE UNIVERSITY AT HAYWARD (CSUH), THE CAMP WAS DESIGNED TO SHOW GIRLS HOW IMPORTANT AND USEFUL MATH SKILLS ARE AND TO EXPOSE THEM TO POSITIVE ROLE MODELS.

Sites for four field trips were chosen as much for motivational value as for educational content. Four cycles were built around the field trips, with introductory material before the trip and follow-up activities after. Each girl reported her discoveries and experiences on her page on the camp website.

At the Aerospace Encounter at NASA's Ames Research Center, students could design a commercial airliner on computers, complete a mission in a simulated space station, launch a "space probe" from a spinning chair, and more. In post-trip activities—including NASA's "planets made to scale" (a modeling activity) and a NASA lesson on charting the planets—girls explored really big numbers. At CSUH's Microscope and Graphic Imaging Center (MAGIC), they explored really small numbers, viewing various kinds of samples through different kinds of microscopes.

At Dreyer's Grand Ice Cream plant, they saw various phases of ice cream's manufacture, pondered such questions as why ice cream is sold in cylindrical cartons, and calculated how much of each ingredient was needed to make ice cream for a certain number of people. At the Technology Museum of Innovation, they could design and market their own bikes at a computer-assisted design station; study how robots see, hear, and move in the robot gallery; and see how the basic units of life are changed through gene splicing in the biotechnology station.

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HRD 98-10308 (one-year grant)	
Keywords: demonstration, summer camp, achievement, math skills, field trips, minorities, role models, website	

003

Sg

Single-gender math clubs

SINGLE-GENDER MATH CLUBS

WORKING WITH TEACHERS AND PUBLIC SCHOOLS IN BOSTON, LEXINGTON, THE BERKSHIRE HILLS, THE TECHNICAL EDUCATION RESEARCH CENTERS (TERC) DEVELOPED AND PILOTED SEVERAL SUCCESSFUL MODELS OF SCHOOL-BASED MATH CLUBS FOR ELEMENTARY SCHOOL GIRLS, INCLUDING

- Weekly math clubs for girls held during lunch or after school (boys who wished could attend).
- Single-gender girls' and boys' math clubs. Teachers paired up and traded students to form two single-gender groups. After completing a six-week unit of work, teachers traded groups so each teacher could experience both all-girls and all-boys groups. Most groups met once a week for an hour. One group met one week a month for five straight days.

In each school, the math clubs served as a framework within which teachers could learn about the gender dynamics in their classrooms. *They also used clubs as a low-risk place to experiment with reform math activities. After recognizing and reflecting on classroom gender issues in the math club framework, they could think about how to improve the coed classroom environment. Teachers at each site changed their regular classroom math instruction after experiencing their students' responses to reform math activities*.

The model clubs increased girls' enthusiasm for math, helped teachers improve the learning climate in their math classrooms, and increased community involvement in math education. Girls and boys participating in single-gender math clubs for 16 weeks scored significantly higher (an average 19.1 out of 22) on attitude surveys measuring confidence in math than students at the same grade level in the same schools who did not participate in the clubs (who averaged 16.0). Club participants also tested better on performance after 16 weeks of math clubs.

Girls said the clubs gave them safety from the put-downs they had come to expect from boys in discussions in the coed classrooms, more and better opportunities to participate, more fun socially, and better concentration (because the girls were calm and mature). Most participating girls and boys recommend single-sex math clubs to students in other schools—boys, because they could be with friends and could ask questions they wouldn't feel free to ask in a coed environment (such as "Are girls more mature than boys?" and "Is it true that boys are better at math than girls?").

Teachers who participated expected to continue the work in their communities. *Leading single-gender math clubs had made them aware of gender issues, including their biases toward boys in regular classrooms*. They asked themselves whether boys absorb most teacher attention because of discipline issues or because they are more assertive, whether teachers unknowingly communicate different expectations for boys and girls, and how to address the sometimes quiet culture of put-downs and harassment in many coed classrooms. *Because they traded students, facilitated the same math activities each club day, and met at common prep times, teachers began collaborating more and discussing pedagogical issues*. After hearing about the reform-based curriculum being tested in the math clubs, a number of teachers in other schools chose to experiment with it—and similar math clubs have appeared all over the country.

The experience improved the coed classrooms, where girls began to participate more and boys began to include girls more in class discussion and group work. The math clubs also provided a manageable structure for involving parents and business partners, who regularly visited math clubs to discuss the math they do in their work. Students and teachers learned more about the kind of math required for different careers and met successful women who used math in many different fields of work.

The project was well covered by the media—notably in a segment in a seven-part PBS television series, "Math: the Invisible Universe," which aired in 1998. Project materials included a presentation for parents called "Math Counts: Does Your Daughter?"

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Keywords: demonstration, self-confidence, teamwork approach, math skills, industry partners, school-based, role models, parental involvement, curriculum, engagement, PBS, TERC, Inc., gender equity awareness	

003

rfrm

Weaving gender equity into math reform

WEAVING GENDER EQUITY INTO MATH REFORM

OVER THREE YEARS, TERC AND THE UNIVERSITY OF CALIFORNIA AT SANTA BARBARA COLLABORATED WITH WELL-REGARDED STAFF DEVELOPMENT PROGRAMS FOR ELEMENTARY TEACHERS TO DEVELOP FOUR WORKSHOP SESSIONS FOR USE WITH ELEMENTARY TEACHERS, STAFF DEVELOPERS, SCHOOL AND DISTRICT ADMINISTRATORS, AND OTHERS CONCERNED ABOUT EDUCATIONAL EQUITY. EACH SESSION TACKLED AN AREA OF STANDARDS-BASED MATH (AS ARTICULATED BY THE NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS) THROUGH THE LENS OF GENDER EQUITY.

To incorporate equity into the most visible, well-attended math workshops in the country, this project linked key developers of elementary math curricula and staff development programs. These leaders and project staff came together for an intensive three-day working conference each year to develop four new workshops on equity and elementary math education. These workshop sessions can be integrated into extended in-service training or can be used as stand-alone sessions:

- *What Is Equity?*, an overview of equity in the context of standards-based math
- *Measuring Student Achievement: The Impact of Standardized Testing on Equity and Excellence in Mathematics*, on how state and national tests affect educational equity and on ways to help students prepare for standardized tests
- *Technology, Equity, and Mathematics*, on how computers can support children's math learning and on how to use computer resources equitably
- *The Home-School Connection*, on how parent/caregiver involvement can support in-school math learning

Collectively, the partnering math reform programs reach more than 13,600 elementary school teachers annually, teachers who want to transform their math curricula and pedagogical approaches. Teachers are enthusiastic about the reform curricula, which involve teachers as partners and insist they do math for themselves, understand how children learn math, and take on new roles in the classroom. A central premise of these curricula is that all students can do math, but this requires serious staff development.

As teachers become mathematically self-confident, they are going beyond arithmetic to incorporate strands on geometry, data, algebra, and the mathematics of change. They are learning to support discourse in their math classrooms, to encourage children to develop their own strategies for solving problems, to assess students' work in new and deeper ways, and to use technology to support children's understanding of math.

But the strand of gender equity, although honored as a concept, had not previously been incorporated in staff development workshops and leadership training. The unintended consequence was that few teachers participating in staff development understood that gender equity is essential to math reform. As student voices emerge, *if teachers aren't helped to build classroom cultures inclusive of all voices, the risk is great that assertive voices—all too often those of boys—will replace the previously dominating voice of the teacher*.

Many of the instructional strategies (cooperative learning, hands-on activities) embraced by these reform curricula have particular value for girls and for children of color, a fact rarely highlighted as a rationale for adopting these instructional approaches. Teachers need to know, in concrete ways, how they might change their practices to improve math learning for all students, but especially for girls. *Teachers have experimented with various ways of recording and reporting about games that allow a variety of players to share mathematical understanding. These strategies weren't developed to involve girls more in the number games, but teachers report that these adaptations have improved the quality of girls' engagement with the games and with the underlying mathematical thinking*. The communities involved in equity and in math reform have a great deal to offer each other.

Through this project, an equity component has been introduced into the teacher development work of the three major elementary-math curriculum projects funded by NSF (Investigations, Everyday Math, and Math Trailblazers). Gender equity is increasingly being incorporated in professional development workshops, models of equitable student–teacher interactions have been incorporated into the video training material of two major projects, and many educators have become familiar with the message that gender equity is essential to math education through the Weaving Gender Equity website and resource guide.

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Partners: University of California, Santa Barbara; UCSMP Everyday Learning Center; Mathematics Renaissance; Marilyn Burns' Math Solutions; the Developmental Studies Center's Number Power project; The University of Illinois at Chicago's Institute for Mathematics and Science Education Teaching Integrated Mathematics and Science (TIMS) project; Video Case Studies Project; California's SSI Math Renaissance Project; TERC's Investigations in Number, Data, and Space workshops; Eisenhower Regional Alliance for Mathematics and Science Education Reform; Eisenhower National Clearinghouse; Education Development Center (EDC); National Council of Supervisors of Mathematics (NCSM); Integrating Gender Equity and reform (InGear); Center for Research on Education, Diversity, and Excellence; Intercultural Development Research Association; and many others.		
Products: Four workshops, numerous articles, and a 70-page equity resource guide (available online at (www.terc.edu/wge/publications.html))		
Keywords: teacher training, gender equity awareness, workshops, TERC, Inc., math, curriculum, professional development, resource guide, website		

003
Sm
Genderwise: exporting summermath

GENDERWISE: EXPORTING SUMMERMATH

SINCE 1982, THE INNOVATIVE SUMMERMATH HAS BEEN PREPARING A MULTIRACIAL GROUP OF HIGH SCHOOL GIRLS FOR THE REAL WORLD OF MATH. AFTER PARTICIPATING IN SUMMERMATH, GIRLS RETURN TO SCHOOL WITH MORE CONFIDENCE, INDEPENDENCE, AND PROBLEM SOLVING SKILLS. BY 1993 SUMMERMATH HAD BECOME A NATIONAL MODEL, ELICITING MANY REQUESTS FOR INFORMATION AND MATERIALS FROM EDUCATORS WISHING TO INCORPORATE ELEMENTS OF THE PROGRAM INTO THEIR CLASSES. THE GENDERWISE WORKING CONFERENCE WAS CREATED TO GIVE EDUCATORS A MEANINGFUL WAY TO VISIT SUMMERMATH AND UNDERSTAND ITS ESSENTIAL ELEMENTS—AND TO FACILITATE THE DEVELOPMENT AND IMPLEMENTATION OF NEW MATH INTERVENTION PROGRAMS MODELED AFTER IT. THE MAIN OBJECTIVE WAS TO PROVIDE A LIVELY, HANDS-ON ENVIRONMENT IN WHICH EDUCATORS COULD OBSERVE, EXPERIENCE, AND DISCUSS A PROGRAM DESIGNED EXPLICITLY FOR GIRLS TO LEARN MATH.

The 24 educators selected the first year spent five days at Mount Holyoke while the SummerMath program was in session. They were given a guided half-day experience with pair–problem solving, learned about gender equity issues, and shared experiences and reflections on what works for high school girls (and why), on problem-solving approaches, and on gender-related issues. A full day of observing SummerMath classes was followed by an in-depth discussion of perceptions and questions. Participants then began designing a project they could implement at their home institution. They all left with a copy of the SummerMath curriculum (more than 300 pages of problems, from fractions to precalculus) and with teachers' guides, the camp's Logo curriculum units, support materials for workshops they might hold at home, plans for an intervention project, and a network of colleagues.

During the six years they held the GenderWise conference, SummerMath hosted more than 100 educators from as far away as Alaska and Hawaii—several of them already leaders in bringing girls, minorities, and other underrepresented groups into math and science. Among the participants, for example, was a physicist and educator of the deaf (deaf himself) who brought two deaf staff members and eight deaf and hard-of-hearing girls to SummerMath 2001. GenderWise has widened the network of people committed to supporting young women's mathematical education.

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Chart on women's ways of knowing: www.scu.edu/SCU/Projects/NSFWorkshop99/html/morrow.html	
Keywords: demonstration, summer program, math, self-confidence, conference, intervention, hands-on, problem-solving skills, gender equity awareness	

003
Cg
Computer games for mathematical empowerment

COMPUTER GAMES FOR MATHEMATICAL EMPOWERMENT

POPULAR CULTURE OFFERS LITTLE OUT-OF-SCHOOL SUPPORT FOR CHILDREN'S MATHEMATICAL LEARNING—WITH THE POSSIBLE EXCEPTION OF COMPUTER GAMES, WHICH EXERT A TREMENDOUS PULL ON SOME CHILDREN. MANY GAMES PURPORT TO BE EDUCATIONAL, EVEN TO PROMOTE CHILDREN'S MATHEMATICAL LEARNING, BUT THERE IS LITTLE RESEARCH TO SUPPORT SUCH CLAIMS. RESEARCHERS ARE BEGINNING TO GET A HANDLE ON THE CONDITIONS UNDER WHICH STUDENTS LEARN MATH IN SCHOOL, BUT ALMOST NOTHING IS KNOWN ABOUT HOW COMPUTER GAME-PLAYING CAN SUPPORT AND EXTEND CHILDREN'S MATHEMATICAL KNOWLEDGE.

Researchers and software developers have also paid little attention to the disparities between boys' and girls' involvement with these games. Computer games *could* help increase all children's mathematical learning, but girls are not benefiting from their potential. For girls, the computer's screen is like a kind of glass wall: They can glimpse its worlds from a distance but are not invited inside. Hence this project's website name: "Through the glass wall: computer games for mathematical empowerment."

Through research with elementary and middle school students, this project seeks answers to three broad questions:

- How can children learn significant math from computer games?
- What characteristics of games, and of game-playing contexts, support learning?
- What patterns are there in girls' and boys' approaches to (and learning from) computer games?

In three studies, the project observed and interviewed children 7 to 13. Two studies examined how girls and boys in a summer computer camp used and learned from a variety of math-oriented computer games. One of the two looked at which games girls and boys chose to play and with whom they chose to play them; the other observed a group of girls playing a game designed for girls, focusing on how they collaborated and competed with one another. A third study, done with a small group of children in an after-school program, focused on how the children played a well-designed mathematical computer game and the kinds of mathematical thinking they developed over several months.

The project developed criteria for evaluating computer games for their mathematical potential, gender equity, and ability to engage children. Games that meet all three criteria are called MEGS (mathematical, equitable game software). The project website describes several dozen math-related computer games, provides reviews of many of the games, and gives lists of print and Web-based resources on gender equity, math, and computer games.

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HRD 95-55641 (three-year grant)	
Choosing mathematical game software: www.terc.edu/mathequity/gw/html/ChoosingSoftwarepaper.html	
Keywords: research study, gender differences, computer games, math skills, informal education, evaluation	

003

Aw

AnimalWatch: computer-based math tutor

ANIMALWATCH: COMPUTER-BASED MATH TUTOR

BECAUSE MANY GIRLS DISLIKE AND AVOID MATH, THEY ARE OFTEN UNDERPREPARED FOR COLLEGE SCIENCE AND ENGINEERING PROGRAMS. GIRLS' DECLINING CONFIDENCE IN THEIR OWN MATH COMPETENCE—ESPECIALLY FROM GRADES 5 THROUGH 8—IS PARTLY ATTRIBUTABLE TO THE TYPE OF INSTRUCTION AND FEEDBACK ON PERFORMANCE TEACHERS TYPICALLY PROVIDE, OR FAIL TO PROVIDE. *GIRLS ARE MORE LIKELY THAN BOYS TO BELIEVE THAT SUCCESS WITH MATH COMES FROM INNATE ABILITY, RATHER THAN EFFORT. IN THE TRADITIONAL CLASSROOM, TEACHERS TEND NOT TO "PUSH" GIRLS IF A PROBLEM CHALLENGES THEM, WHICH MAY IMPLY THEY ARE NOT SMART ENOUGH TO LEARN*. AND MOVING TOO SLOWLY THROUGH THE CURRICULUM MAY BE AS RISKY TO GIRLS' CONFIDENCE AS MOVING TOO QUICKLY.

This University of Massachusetts demonstration project uses the power of an intelligent computer-based tutoring system to help girls in grades 4–6 master math skills and gain in confidence and motivation—applying the intervention in late elementary school, when gender differences in attitudes toward math first become apparent. The software interface studies both boys' and girls' interactions. Research shows that *girls benefit from and appreciate*

- *Learning through exploration and collaboration*. Students, especially girls, respond positively to math software that does not rely on gender-stereotypic themes (such as storming a castle to save a princess), or competition with the self, another player, or the computer—characteristics prevalent in commercial math software (such as Math Blaster) that girls typically do not enjoy.
- *An interface and software environment responsive to girls and girls' interest in environmental biology*.
- *Feedback that builds confidence, sets high expectations, provides specific hints about how to overcome errors, and emphasizes appropriate effort, rather than native ability, as the key to math success*.

Combining educational psychology with computer science, this multidisciplinary research team deployed, evaluated, and continuously revised its supportive, adaptive, interactive math tutoring software in trials with hundreds of fourth, fifth, and sixth grade students in three school districts over several years. A teacher who noticed that girls enjoyed learning about endangered species suggested blending mathematical problem-solving with environmental biology. The software WhaleWatch was developed and then expanded to become AnimalWatch.

AnimalWatch uses a four-part narrative about endangered species—the right whale, the giant panda, and the Takhi wild horse (also known as the Przewalski wild horse)—as a context for solving word problems involving fractions, decimals, and percentages. The four-part narrative through which students progress was developed because students using an early version of the program said *they wanted more sense of progress as they worked, and girls do not respond well to the notion of competitive scoring*. Now, for example, a student who chooses the Takhi wild horse adventure begins working on problems about the species, then progresses to problems about Mongolia (the original home of the species), then moves to problems about preparing to go to Mongolia (fund raising, planning the trip, and packing), and finally takes a virtual trip to follow a group of horses being returned to the wild in Mongolia from a reserve in the Netherlands.

Word problems for all math operations are included for each part of the story. Templates now exist for more than a thousand word problems. When students complete one adventure, they can choose another and continue working on the same math level. Students work at their own pace and if they return for multiple sessions the tutor remembers where they left off so they do not have to go through the entire curriculum again.

Intelligent tutoring systems, unlike common drill-and-practice systems, modify themselves to conform to students' learning styles. When a student has trouble solving a problem, the software initiates a tutoring interaction that provides tailored hints and guidance to help the student work through the problem—using techniques from artificial intelligence to generate problems, select hints, and assess and model student preferences and abilities. A module called the "student model" creates a representation of each student's math understanding, selecting problems appropriate to the students' ability levels and responding to student errors with help and feedback tailored to their needs.

Although both boys and girls liked AnimalWatch, girls gave it a higher rating than boys did. Results of the first evaluation study show that WhaleWatch increased girls' self-confidence about math, raising it as high as the boys' self-confidence, even after working with challenging math problems. (The boys' confidence level, which started out higher, remained the same.)

Results of the second evaluation study (adding a control group that did drill-and-practice work with no feedback other than "correct" or "incorrect") were sometimes surprising: *Girls benefited from structured, interactive, concrete hints, examples, and adaptive feedback, whereas boys at the same level of cognitive development* lost *confidence when helped by the tutor* (perhaps feeling slowed down by the time taken by hinting—an argument for either reducing the hinting time or allowing students to turn it off). *Boys learned fastest when presented with demonstrations of algorithms and procedures*.

Male and female students ended up with similar levels of mastery but took different pathways—and the computer is able to adapt its instruction accordingly. Boys remained confident about math even with a drill-and-practice version of the system that responded to student errors with a simple "try again"; with the adaptive feedback turned off, girls were affected more negatively than boys.

Surprisingly, *the tutor was most helpful to students in the middle range of cognitive abilities*, as determined by a Piagetian pre-test. *Students with low cognitive abilities responded better to more concrete procedural hints, using interactive manipulables (such as Cuisenaire rods) that they could drag and drop. Students at the higher end of the cognitive scale preferred more abstract and symbolic hinting* (such as "Are you sure you are using the right operation?").

Even when there was no difference in problem-solving accuracy, girls and boys tended to approach problems differently. When students had to share a computer, girls showed a preference for working with other girls, and same-gender girls' pairs showed more genuine collaboration than mixed-gender pairs, but in terms of math confidence and objective problem-solving, girls also did well working with a male partner.

Finally, intelligent computer tutoring benefited students' math performance. Because AnimalWatch monitors the effectiveness of the help it provides, if a student continues to make errors after viewing one type of hint, the system will change to another type of hint. There was evidence that the software was providing effective instruction, in that *errors on subsequent problems were reduced after hints were presented*. Data are still being analyzed for the final evaluation study, but performance on a paper and pencil test were correlated with progress in AnimalWatch problem solving, and *working with AnimalWatch led to a reduction in errors on fractions problems on the paper and pencil math test*. Students also learned about endangered species.

Teachers often ignore instructional technology for fear that it won't teach the skills needed for standardized testing, so the team welcomed teacher input about math content. The tutoring system was deployed in many classrooms in three elementary school districts over the course of four years (with additional classes for use as controls in evaluation). Several regionwide in-service days helped 35 teachers incorporate the system into their curriculum. The website includes many resources for teachers, including a discussion feature and authoring tools that allow teachers to create their own word problems and even their own endangered species adventure.

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The Animal Watch CD-ROM (suitable for ages 10 to 12) works on both Mac and Windows computers. It is available by request or can be downloaded from the website, but the download time may be prohibitive for most users.

Keywords: demonstration, self-confidence, computer-based tutoring, math skills, intervention, exploration-based, teacher training, CD-ROM, software, research findings, interactive, gender differences, psychology, environmental biology

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wrld

Animal world

ANIMAL WORLD

SOME NATIONAL ASSESSMENTS SHOW THE GENDER GAP IN MATH ACHIEVEMENT TO HAVE NARROWED DRAMATICALLY IN THE LAST DECADE, WITH SIGNIFICANTLY MORE HIGH SCHOOL WOMEN TAKING MATH COURSES. BUT OTHER DATA INDICATE THAT *GIRLS DO NOT CONFRONT THE CRITICAL TRANSITION FROM HIGH SCHOOL TO COLLEGE WITH THE DEEP, CONCEPTUALLY BASED MATHEMATICAL COMPETENCE THAT SUPPORTS ENTRY INTO STEM CAREERS. GIRLS PERFORM MUCH LESS WELL THAN BOYS, FOR EXAMPLE, ON COMPLEX PROBLEM SOLVING, WHEN THEY MUST APPLY NOVEL PROBLEM-SOLVING APPROACHES, AND WHEN THEY MUST WORK UNDER TIME PRESSURE OR TRANSFER SKILLS TO PROBLEMS THEY HAVEN'T SEEN BEFORE*.

Other research points to differences in male and female learning styles. Previous work by the project team indicates that, *on average, girls require more structured, concrete, and repetitive instruction where boys do equally well with more abstract hints and help, suggesting that they have a deeper understanding of math concepts*.

This project is designed to investigate characteristic male and female learning styles during the transition from high school to college as well as the factors that contribute to female students' shallower competence. These investigations will take place in the context of the Web-based multimedia simulation environment of Animal World: Wayang Outpost. Wayang Outpost provides high school women (and men) with

- An intelligent tutor for high school math (fractions, algebra, geometry, ratios/proportions/decimals, and probability) that provides gender-adaptive instruction, permits the analysis of male and female learning styles, and narrows the gender gap on the SAT math exam.
- A virtual mentor component, in which students who are solving math problems in the simulated world can meet real women who are researchers and experts, who discuss their training through video clips embedded in the simulation.
- A math-at-your-fingertips module in which students periodically rehearse math facts to free their cognitive resources for higher-order problem solving, predicting higher math test scores.
- A module to improve students' spatial cognition through dynamic manipulation of objects in simulated three-dimensional environments, which will permit a strong test of the hypothesis that girls' poorer math achievement reflects less well developed spatial cognition.

The project predicts that girls who work with the Wayang Outpost site will show significant increases in their skill at solving complex math problems, including their performance on the math SAT; that gender-adaptive instruction will foster greater conceptual understanding in female students; and that virtual mentors will encourage girls to report greater interest in STEM careers. The results should improve our understanding of male and female learning styles and produce new approaches to effective math instruction for all students.

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Keywords: research study, gender differences, computer-based tutoring, mentoring, SAT prep course, math skills, software, problem-solving skills	

003

got

Girls on Track: applying math to community problems

GIRLS ON TRACK: APPLYING MATH TO COMMUNITY PROBLEMS

UNDER A THREE-YEAR GRANT, NORTH CAROLINA STATE'S CENTER FOR RESEARCH IN MATHEMATICS AND SCIENCE EDUCATION ENGAGED 200 WAKE COUNTY MIDDLE SCHOOL GIRLS IN COMPUTER-BASED MATHEMATICAL INVESTIGATIONS OF COMMUNITY PROBLEMS TO HELP THEM DISCOVER THE ANSWER TO THE AGE-OLD QUESTIONS: WHAT GOOD IS MATH? WHY DO WE HAVE TO LEARN THIS STUFF AND WHEN ARE WE EVER GOING TO USE IT? THE GIRLS ON TRACK (GOT) MATH ENRICHMENT PROGRAM SHOWED MATH'S RELEVANCE TO THEIR LIVES AND IMPORTANCE FOR SOLVING COMMUNITY PROBLEMS. THE PROGRAM ALSO EXPLORED SOCIAL ISSUES RELEVANT TO RETAINING GIRLS IN MATH AND SCIENCES.

The centerpieces of their empirical work were teacher/counselor workshops and free summer camps for middle school girls who like math. Camp helped girls make the leap from arithmetic to algebraic thinking, a bridge many students have trouble crossing. Using computer technology, they explored patterns and functions, spatial reasoning, probability, and statistics. Algebraic concepts embedded in camp activities relied heavily on proportional reasoning (rational numbers, percentages, ratio and proportion, rate of change, slope), which is critical to success in Algebra 1 and beyond. Understanding covariance—how one variable changes in relation to another—is a conceptual leap required to engage in algebraic thinking. Engaging students in rate problems through "Virtual Vacation" activities, helped improve their skills in proportional reasoning. They also learned how to collect, organize, represent, and analyze data, find patterns and generalize, and present the results of their investigation.

To connect algebraic equations with the real world, the girls applied math concepts to community problems such as trash disposal, differences between men's and women's earnings, and whether there should be an HOV lane on I-40. When the topic was trash and recycling, teams of girls measured and weighed their personal and family trash for a week. To analyze the relative amounts of recyclables and decomposable trash, the girls did "action research," gathering data from the Web about the area's population, projected total trash output, potential versus actual recycling, and so on. They investigated problems the communities in Wake County might anticipate in the next 25 years, how fast the county's population is growing, and where the county should dump its trash. Counselors were careful not to burden the girls with their own opinions about these social problems—and to let them make observations on their own.

In a computer lab filled with networked laptops, the girls learned to use PowerPoint and Excel software for research and math exercises. They eagerly learned teamwork, investigative skills, and Web page design. By the second week, girls 11 to 13 were making PowerPoint slides with embedded Excel spreadsheets, animation, sound, and color—and were making team presentations to visiting dignitaries, demonstrating skills many adults lack.

Even daily games and sports algebra activities taught math concepts. In "blind volleyball," for example, they tossed a ball over partitions (a game that required constant scoring, counting, and mathematical analysis). Time was made during Math Moments and sports algebra to discuss the algebraic concepts imbedded in the activities.

Forty girls participated in 1999, 73 in 2000, and 69 in 2001, with some girls returning as junior counselors the following year. Winters, the girls were paired with math mentors. *There was a significant correlation between girls' scores on end-of-grade tests and their Year 1 scores on a Girls on Track test of proportional reasoning (r=79)*. Campers who took Algebra 1 in grades 7 and 8 got midyear grades of A or B. They were also more confident about their math and presentation skills and more positive about math and science. The longitudinal study is expected to yield information about why that trend shifts as girls mature.

To ensure that the professionals interacting with the girls were qualified in both technology and educational approaches, GoT brought together 50 Wake County algebra teachers, 25 guidance counselors, and 30 math-education undergraduates from North Carolina State and Meredith College, to develop year-round activities and summer programs. Very soon, teachers and counselors became proficient with the technology and incorporated sports algebra into their curriculum.

The program also explored some areas of technology development, including models to automatically recognize the level and depth to which a student understands a math or science topic (and models for predicting student achievement). *Early results from the project's work on an approach to computerized instruction called fault-tolerant teaching were promising. The FTT method groups questions into concepts in such a way that the concepts can be recovered from the questions and the questions can be recovered from the concepts. Their experiments showed that they can categorize test questions in concept categories based on student responses to questions and, from that information, can identify the concepts students appear not to understand. The FTT statistical approach is constructed to tolerate errors such as students answering a question correctly without knowing how, or accidentally missing a question they actually understood well*. FTT methods are being implemented in three NovaNET tutorals that will be administered to 100 math students (to be compared with a control group of 50 students). They expect to produce a *fully automated, fault-tolerant intelligent tutoring system*.

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Virtual Vacation activities and materials can be found at (http://ontrack.ncsu.edu/GoT/Materials/Vacation/) and (http://ontrack.ncsu.edu/Materials/index.html)	
Publication: S.B. Berenson, L.O. Cavey, and N.H. Smith, Girls on Track: Community Investigations and Fun with Math (NCSU, 2001).	
Keywords: demonstration, engagement, computer skills, exploration-based, sports-based, industry partners, research findings, teacher training, real-life applications, hands-on	

003

Gem

GEMS: exploring math through social sciences

GEMS: EXPLORING MATH THROUGH SOCIAL SCIENCES

THE DEMONSTRATION PROJECT GEMS (GIRLS EXPLORE MATHEMATICS THROUGH SOCIAL SCIENCE) ENCOMPASSES THREE PROGRAMS DESIGNED TO STRENGTHEN URBAN MIDDLE SCHOOL GIRLS' INTEREST, COMPETENCE, AND CONFIDENCE IN MATH BY ENGAGING THEIR NATURAL INTEREST IN SOCIAL ISSUES; IMPROVING THEIR TECHNICAL SKILLS AND INTERESTS BY BUILDING ON THEIR PREFERENCE FOR COLLABORATION AND CONNECTION; AND ENCOURAGING CONTACT WITH OLDER ROLE MODELS AND MENTORS.

A 10-week Saturday morning version of GO GIRL (gaining options: girls investigate real life) appropriate for urban girls features high-interest, hands-on math, social science, and computing experiences, collaboration, and intergenerational mentoring. This program will be offered in conjunction with Wayne State University in Detroit.

A Web-based version of the program SMART GIRL (surveys mathematics and research technology: girls investigate real life) will expand the capacity of a popular existing website (www.smartgirl.com) to teach girls how to gather and analyze survey data online.

The third program, UM-GIRL (using mathematics: girls investigate real life), was developed at the University of Michigan as a summer intervention program to engage girls in social science research and applied math activities. At both the University of Michigan and Wayne State University, student teachers in math and social studies will observe, train, and teach middle school girls on a small scale how to use computers and math tools to evaluate social science questions.

This project, which grows out of an NSF planning grant activity and an Eisenhower grant project, will yield an economical version of the GEMS curriculum, exportable to other institutions, and support material to help other cities implement the curriculum.

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Keywords: demonstration, urban, self-confidence, math, social science, role models, mentoring, hands-on, website, curriculum	

003
W
Womenwin: learning math through transactional writing

WOMENWIN: LEARNING MATH THROUGH TRANSACTIONAL WRITING

WOMEN TEND TO OUTPERFORM MEN ON MOST MEASURES OF RUDIMENTARY AND MIDLEVEL LITERACY; MEN, ESPECIALLY AT HIGHER LEVELS, TEND TO OUTPERFORM WOMEN IN MATH; *BUT GOOD WRITERS TEND TO DO BETTER IN MATH THAN POOR WRITERS*. IN THE WOMENWIN PROJECT, MATH AND ENGLISH PROFESSORS TEAMED UP TO TEACH MATH TO COLLEGE AND MIDDLE SCHOOL STUDENTS USING A TECHNIQUE CALLED *TRANSACTIONAL WRITING—A KIND OF PUBLIC WRITING THAT STUDENTS USE TO DEVELOP AND CONSTRUCT A CLEAR EXPRESSION OF THEIR MATHEMATICAL UNDERSTANDING*. WITH TRANSACTIONAL WRITING, WRITING BECOMES A TOOL TO LEARN.

In transactional writing, a math concept is broken down into its linguistic parts. For example, teachers who ask middle school students to add integers want both the sum and a written explanation of how they came up with the sum, on the principle that *if you can't explain something, you don't really understand it*. Students learn not only how to explain how they arrive at their answers, but also how to write and solve their own math word problems. They are graded on both their math and linguistic abilities.

Changing the emphasis from "calculating" to "understanding" represents a change in teaching and learning strategy. But alternative delivery strategies are needed in courses with consistently high student attrition such as college-prep math.

Participating in the three-year project were teams of math and English faculty from Miami–Dade Community College—a large urban two-year college—and their students, as well as three middle schools from Miami–Dade County's large urban public school system. The project used a quasi-experimental design with a nonrandomized control group (including pre- and post-tests). Participants were not randomly assigned to treatments, but four of eight college classes and nine of eighteen middle school classes from each school—selected at random each term/academic year—composed the experimental group; the other classes were the control group. The experimental and control groups were further separated by level and gender (females being the focus of the project).

The project examined whether transactional writing is useful both in constructing knowledge and in reshaping beliefs and attitudes about math.

The experimental groups received whole-class instruction, including transactional writing exercises. Using a split-page organizer, students responded to a math exercise on the left side of the page. The assigned mathematics investigator examined the writing exercises for content and accuracy; saw what was written, not what was meant; commented on any errors, omissions, and inconsistencies; and looked especially for failure to define terms, answer the question, or provide reasons.

Designated English and math faculty recorded their comments and suggestions on the right side of the page. Using the critiques and the split-page format, students had to submit a revision, which teachers commented upon and rated on a five-point scale. (To discourage late papers, one teacher placed incentive charts in her classroom. Having a sticker placed next to their name actually encouraged students to turn their papers in faster.)

Initially the project's middle school students were shy, bewildered, and frustrated, asking incessantly, "What do you want me to do?" Some flatly refused to write in their math classes. Slowly, very slowly, changes began to appear: less resistance, a marked increase in use of math terminology ("numerator" instead of "the top"), and, especially in abler students, more effort to write creatively. Those who had flatly refused to write began putting pen to paper.

Soon teachers observed that students in the writing groups were better prepared, more responsive and energetic, and had a better general attitude than those in the nonwriting group. Writers seemed to observe more, ask more, think and hypothesize more. They seemed better able to predict what would come next in the teaching and learning sequence. They were more likely to initiate discussions, especially those based on the draft-to-revision part of the writing cycle. *Through the writing assignments and the ensuing discussions, the instructor was better able to diagnose and remedy the most obscure of missing pieces, such as a student's inability to correctly plot points in a unit on graphing lines. Writing assignments revealed misconceptions that would not be picked up on more traditional assessment measures*.

Females and males participated equally, but, *although all students' math abilities improved, the most demonstrative changes were among female writers and male nonwriters. Writers were more likely to successfully complete their college coursework in one semester and, on both levels, writers scored higher on standardized measures of math achievement and attitudes toward math*.

Teachers outside the project were often perplexed about any possible correlation between mathematics and writing. *The project demonstrated that writing helped students understand relationships in math: If they could explain it, they understood it*. Both the math *and* the writing improved. *Writing reinforced and helped students retain their math skills*. Quiet females wrote and spoke more than they had before. Teachers observed an excitement about writing the draft, a desire for immediate feedback and positive reinforcement, and a definite improvement in self-esteem. Improvements came both academically and emotionally. Females who wrote were less likely to experience "math anxiety," and the stronger students could be more creative. Writing also allowed students to vent frustrations to which teachers were then better able to respond.

In middle schools, the courses ranged from sixth grade regular math to eighth grade gifted pre-algebra. The five community college classes ranged from college prep algebra to general college math. Over three years, this variety of courses, coupled with distinctly different learning and teaching environments and styles, provided ample opportunity to realize this intervention's value and flexibility. The project also contributed to research on the pairing of teachers and students for consecutive years. An incidental benefit to the project investigators was that networking online (because they could get in touch or post materials on their website virtually any time of the day or night) opened their eyes to the power of technology for teaching.

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003

Calc

Calculus research: animation and research portfolios

CALCULUS RESEARCH: ANIMATION AND RESEARCH PORTFOLIOS

SINCE 1987 THE NSF HAS FUNDED DOZENS OF PROJECTS TO REFORM THE TEACHING OF CALCULUS. FOR A WHILE, BOROUGH OF MANHATTAN COMMUNITY COLLEGE (BMCC) WAS THE ONLY TWO-YEAR COLLEGE TO RECEIVE NSF FUNDING FOR CALCULUS REFORM. AWARDED SEVEN GRANTS IN EIGHT YEARS, BMCC HAD BECOME A LEADER IN REFORM OUT OF CONCERN ABOUT LOW SUCCESS AND RETENTION RATES IN CALCULUS. BMCC WAS ESPECIALLY TROUBLED THAT ITS CALCULUS STUDENTS WERE ALMOST EXCLUSIVELY WHITE AND ASIAN AMERICAN MALES, IN A STUDENT POPULATION THAT WAS TWO THIRDS FEMALE (12,000 WOMEN) AND 85 PERCENT MINORITY.

Grant funding allowed BMCC to establish three state-of-the-art calculus computer labs; purchase calculators, graphing calculators, and laptops; send senior faculty to a weeklong workshop with Uri Treisman on collaborative learning; send key faculty to a two-week workshop at Dartmouth with John Kemenny on integrating computers into calculus, differential equations, and numerical analysis; run workshops for City University of New York faculty on the use of MAPLE (a computer algebra system), graphing calculators, and collaborative learning techniques; run two weeks of summer workshops for seven years, for hundreds of faculty from all over the country; conduct half-day workshops on computer use for adjunct faculty; and hire half-time college lab technicians and support staff.

BMCC's math department increased the number of minority students in the calculus sequence by emphasizing collaborative work on complex real-world problems, using appropriate technology; having students do research and make film animations of calculus problems and algorithms; and having them create portfolios of their best work. *Teams of students collaborated to "animate calculus"—to create animations of calculus problems, or "calculus movies." Students "learned to create" and "created to learn." BMCC's math department made mathematics a lively experimental science*. And calculus students learned math in the process. As part of their assessment, students produce "math movies," using computer software and the TI-92 graphing calculator to animate graphs. *Not only can they better visualize functions and series by animating these mathematical expressions but they are continually introduced to the unpredicted*.

With these innovations, *enrollment in Calculus III (BMCC's highest-level calculus course) increased from seven students in 1989 to 46 in 1996. But although reform helped attract and retain minority students, the department still struggled with women's enrollment*. Faculty training and

FLEXIBLE CALCULUS REFORM

The calculus reform begun in 1987 was a response to high failure rates—as many as 40 percent of undergraduates failing introductory calculus—*and the perception that rote learning produced students unable to apply math to complex or real-world problems*.

A reform approach to calculus often encourages students to

- *Work collaboratively in small groups on challenging real-world problems (following Uri Treisman's model)*
- *Do research*
- *Write and speak about their work*
- *Use appropriate technologies (such as computers and graphing calculators) to visualize and manipulate functions and families of functions*
- *Use computer algebra systems such as Maple to differentiate, integrate, and crunch data*

The program at Borough of Manhattan Community College *avoided the pitfalls of some reform projects that experienced backlash from traditional faculty members who longed for a return to the good old days of straight lecturing and textbooks that don't emphasize the use of technology*. The BMCC program adds labs, supervised by a laboratory technician, to the traditional classroom experience. Instructors are free to use as much or as little changed pedagogy as they feel comfortable learning. Some are totally committed to collaborative learning, even allowing some collaborative testing. Some insist on teaching classes in a lab (or with classroom-size amounts of graphing calculators) so the students can actually see graphs, rotate functions, etc., as the need arises in class discussion. Others have not changed their teaching style and rely on the lab to add the reform component. In the lab, students work together in groups on challenging problems. They learn to use a wide variety of software (Maple, Mathematica, Derive, True BASIC) and to write and speak about their projects.

the purchase of classroom-size quantities of graphing calculators and laptop computers allowed BMCC to extend the new, dynamic, interactive learning environment to *precalculus courses* (drawing women who show an interest in math) and statistics courses (drawing women in liberal arts and business majors).

BMCC learned from its highly successful women's portfolio project (HRD 97-10273) that *involvement in real research activities, supervised by an encouraging mentor, is the single most powerful catalyst for engaging women in mathematics. Trying on the persona of a mathematician—which includes doing research—is an important part of a mathematical scientist's education*. One student analyzed the mathematical principles involved in a series of children's games from her local area in Africa, for example, while a student in differential equations did a rigorous project on highway bridge construction.

Students were taught that a proper presentation of results, both written and oral, is a major part of research. One successful student completed an animation project on polar coordinates. Using MAPLE computer algebra software, she created moving images on the screen that showed how the graph changed as she changed variables in her equation. Asked by an evaluator to explain what she was doing, she responded, "What level of explanation do you want? Should I start by explaining what polar coordinates are? Do you want to know about the software that allows me to graph my equations? Would you like to know about the program I wrote that allows me to animate my equations? Do you want to hear what I am concluding based on my animations?" Her response made it clear that she was not just "learning" mathematics but was "doing" mathematics, as a working mathematician does. She went on to major in math at City College of New York.

Emphasizing student research projects and portfolios increased tenfold the number of students retained through Calculus III. And the ethnic make-up of students in BMCC's reform calculus program was now representative of the college as a whole. Although the college was less successful in breaking down gender barriers, it *more than doubled the number of women taking the courses necessary for a career in the mathematical sciences*.

A recent project (HRD 99-08658, *women's animated research in mathematics*) extends the work on women's research portfolios. It *is using successful strategies of calculus reform as well as learning strategies that have successfully changed math for undergraduate women (for example, tracking and respecting different participation styles, stressing the social aspects of learning, and providing role models and mentors*). It is providing summer and academic-year fellowships for women in mathematical research and two-week workshops on such topics as how to do analytical graphing on the Macintosh, how to create animations on the TI-92, how to solve problems using Maple and Mathematica, and how to give oral and panel presentations. As the BMCC faculty has learned, however, *it is working one on one with senior faculty who respect their ideas that will help these women grow*.

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003
Path
Pathways through calculus

PATHWAYS THROUGH CALCULUS

YOUNG WOMEN (ESPECIALLY MINORITY WOMEN) PREPARED FOR COLLEGE BUT DEFICIENT IN MATH WERE GIVEN A CHANCE IN 1993 TO PARTICIPATE IN TWO INTENSIVE FOUR-WEEK SUMMER INSTITUTES TO SHOW THEM THEY COULD EXCEL IN MATH AND TO STRENGTHEN THEIR CHANCE OF SUCCESS. BASED ON AN HONORS CURRICULUM, THE FIVE AND A HALF HOURS OF DAILY CLASSROOM ACTIVITIES WERE DEDICATED TO EXPLORATION AND REAL-WORLD APPLICATIONS OF PRECALCULUS AND CALCULUS. THE WORK WAS DESIGNED TO STRENGTHEN PARTICIPANTS' MATHEMATICAL POWER, KEEP THEM IN COLLEGE, CHANGE THEIR COURSE PATTERNS IN MATH, AND REDIRECT THEM TOWARD STUDY AND CAREERS IN MATH AND THE PHYSICAL SCIENCES. CALIFORNIA STATE UNIVERSITY AT FULLERTON HOSTED THE INSTITUTE.

Each of 34 participants was given a TI-82 graphing calculator and used it extensively, especially for analyzing function behavior. Working in groups of three, and using the text *Contemporary Precalculus Through Applications*, the students covered data analysis, functions, polynomials, rational functions, algorithms, exponential and logarithmic functions, trigonometry, and matrices. They were given a pre-test, four quizzes, and a post-test and directed to enroll in the appropriate math course and supporting workshop for the fall semester. Students were paid a stipend of $400 and given books and supplies, room and board. They lived in campus dorms but spent weekends at home.

The next summer 35 students, each of whom had completed at least one semester of calculus, participated in Pathways Through Calculus. Participants at the second institute included both returning students and new students, some of them junior college transfers. Each student was given a TI-82 graphing calculator and investigated iteration, chaos, fractals, and the elliptic orbits of planets, using as a primary source *Student Research Projects in Calculus*.

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HRD 92-53060 (one-year grant)	
Partner: The California Postsecondary Education Commission Texts used: Contemporary Precalculus Through Applications (developed by the North Carolina School of Science and Mathematics); Student Research Projects in Calculus (published by the Mathematical Association of America).	
Keywords: demonstration, calculus, math, summer program, exploration-based, real-life applications, career awareness, physical sciences, graphing calculator, research experience	

Through projects, they improved their critical thinking skills, learned how to apply multiple skills and technology to one problem, and began to overcome fear of word problems. They worked on projects such as why astronomers use telescopes with parabolic mirrors, preparing for the census, solving systems of linear equations, finding the area of your hand, exploring uncharted waters, and finding the zero of a polynomial. Because of the extended nature of the work, many learned how to work effectively in groups.

003
E-w
E-WOMS: women's ways of learning calculus

E-WOMS: WOMEN'S WAYS OF LEARNING CALCULUS

GIVEN THE RIGHT CLIMATE, WOMEN ARE AS CAPABLE IN MATH AS MEN, BUT AS FEW AS 5 PERCENT OF THE WOMEN WHO TAKE CALCULUS I GO ON TO TAKE MORE COLLEGE MATH. NORTHERN ILLINOIS UNIVERSITY'S E-WOMS PROJECT (EXPANDING WOMEN'S OPPORTUNITIES THROUGH MATHEMATICAL SCIENCE) FOUGHT STEREOTYPES AND CHANGED NIU'S APPROACH TO MATH EDUCATION. EMPHASIZING THAT *SCIENTIFIC LITERACY IS MORE THAN A WOMEN'S ISSUE*, IT USED ADS TO ALTER CAMPUS MISPERCEPTIONS ABOUT WOMEN'S MATH ABILITIES. IT ALSO OFFERED A *CALCULUS I COURSE GEARED TOWARD THE WAYS WOMEN LEARN—WHICH EMPHASIZED COLLABORATIVE PROBLEM SOLVING IN A LEARNING COMMUNITY, RELATED CALCULUS TO REAL LIFE, REQUIRED STUDENTS TO WRITE ABOUT HOW THEY APPROACH PROBLEMS, AND MADE USE OF MENTORS AND SUPPORT GROUPS.*

One aim of the program was to help women pass Calculus I, a barrier course and falling-off point for women. All freshmen passing a math placement test at A-level qualified to take the course and were also admitted to a well-publicized *focused interest group* (FIG) for women in math. Thirteen women self-selected or were placed in the pilot program by college advisers.

The grant staff was chiefly female, but male professors were given a chance to work with the FIG students, because *research suggests that whether women students succeed academically depends more on the instructors' accessibility and teaching techniques than on their gender*. Richard Blecksmith, one of the department's most talented calculus professors, was course instructor for the intervention section.

Blecksmith drew on *research about women's ways of learning* to develop appropriate teaching strategies for the course. *The curriculum humanized math by presenting math concepts and problems in contexts that connected with students' interests, experiences, and relationships*. For example, problem-solving used real-life applications to topics such as wildlife extinction rates and the populations of endangered species, world population growth, the spread of infectious disease, and the rate at which drugs are absorbed into the bloodstream.

Blecksmith listened, and the students talked, more than in a traditional classroom, because women *like to talk through and verbalize problems, rather than being left alone to solve them*. Through the inquiry approach to learning, the teacher guided students through a process of *discovering math concepts for themselves, so that math made sense to them. The learning environment was less competitive and more collaborative than in traditional calculus classes*.

Students discussed how they solved problems and wrote narratives describing how and why they used certain problem-solving strategies, narratives that included both explanations and mathematical computations. They got feedback from each other and from the teacher. They were asked to write about current statistics or polls in the newspaper, to show their understanding of course principles. The instructor used both traditional and alternative forms of assessment, such as journals and self-critiques—and students were asked to critique the course and text at important junctures. Students learned math in a way that convinced them they could and did understand the subject.

To help create a learning community—a support network of peers—the same students were also enrolled in an extended version of a campus orientation course, one that addressed issues pertinent to women. The instructor—a doctoral candidate in math—served as mentor for the women, along with the calculus instructor and the project's principal investigators.

The pilot class met for an extra hour of mentoring each week. Instead of using the extra time to work through calculus equations, students participated in other math-related activities, such as reading the Tony Award–winning play *Proof* (about a woman mathematician) and meeting notable women who spoke on campus—including astronaut Mae Jamison. Many of NIU's students come from *rural communities in which there are few, if any, female role models in careers involving math and higher education*.

Part of the goal was *to see what would happen to women if there were no competition from men in the class*. Blecksmith was surprised by the program's across-the-board success. "I thought we'd be successful," he said, "but not to this extent, to tell the truth. I've never had a calculus class outside of honors where everyone has passed the course with a C or better." *Even though the course and exams were more rigorous than usual—almost to the level of an honors course—test scores were 20 percent higher than they had been the year before and the students had a better grasp of the concepts than any class he had seen in a long time. Many of the women expressed disappointment with their test results, although their grades were higher than average for Calculus 1*.

Research shows that *many women in college will change their majors to avoid taking additional math classes, if they don't find peer support for taking math. None of the women in the FIG did so. Before the intervention, only one or two women usually took Calculus II, but 10 of the 13 students in the pilot project took the regular Calculus II course the next fall, staying together at their own request*. Women made up half the Calculus II class the next year, and women from the FIG got the highest scores on the first exam.

AD BLITZ TO DISPEL STEREOTYPES

NIU's departments of communications and math sciences and the women's studies program collaborated on ads to reverse negative misperceptions about women's abilities in math. Graduate interns in communications designed a campus ad campaign around the slogan "Women Succeed in Math." The social-norms ad blitz was patterned after NIU's nationally recognized social-norms program to curb alcohol consumption among students. The ads appeared in the campus paper once a week or more (usually on Mondays, the heaviest circulation day) and as posters in prominent spots around campus. The first ad stated that 15 percent of the men—and 20 percent of the women—who had completed Calculus I from 1995 through 1999 had earned an A. Another ad asked which of the following was a woman: the head of Hewlett–Packard, the CEO of eBay technologies, the president of the Mathematical Association of America, the inventor of the computer language Cobol, or (the correct answer) "all of the above."

The support/study group, which continued to meet weekly the next year, was an important factor in the project's success and the women's commitment to helping the entire group succeed in math. And several other study groups formed and students unused to collaborative studying began faring better on math tests.

Men can also benefit from classroom and support interventions, but research indicates that the learning environment is especially important for women, who come into the university system not understanding how important math is to their careers and less likely than men to pursue coursework in advanced math. Those who advise women students could play an important role in encouraging more women to take math instead of automatically routing them into humanities and English courses. In this project, positive reinforcement changed the numbers.

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www.clas.niu.edu/wstudies www.clas.niu.edu/wstudies/pdfs (social-norm ads)	
HRD 00-86310 (three-year grant)	
Keywords: demonstration, math, calculus, collaborative learning, problem-solving skills, real-life applications, mentoring, support system, inquiry-based, peer groups, field trips, role models, self-confidence, intervention	

003

Qs

Recruiting women in the quantitative sciences

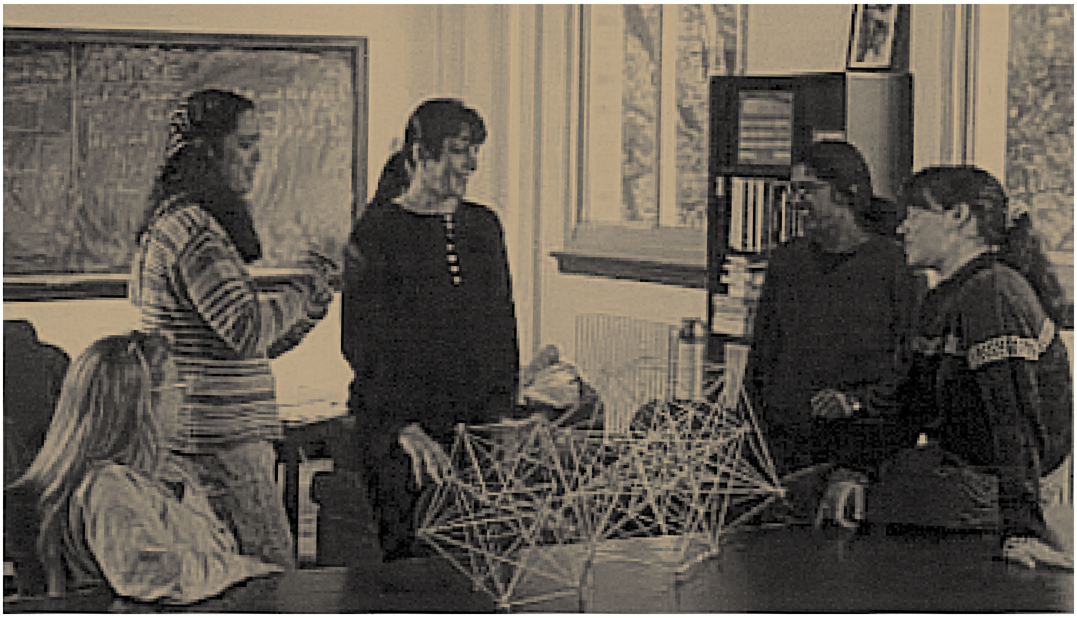
RECRUITING WOMEN IN THE QUANTITATIVE SCIENCES

IMPROVING THE INSTITUTIONAL CLIMATE FOR WOMEN IN SCIENCE REQUIRES ENABLING WOMEN TO DEVELOP ENOUGH RESILIENCE AND ADAPTABILITY TO OVERCOME THE STRESSES INHERENT IN (WOMEN, ESPECIALLY) PURSUING A CAREER IN SCIENCE. WITH PROJECT ADVANCE, DUKE UNIVERSITY AIMED TO RECRUIT A RESILIENT COHORT OF TALENTED FIRST-YEAR WOMEN STUDENTS INTERESTED IN, AND IDENTIFIED WITH, THE QUANTITATIVE SCIENCES—ESPECIALLY MATH, STATISTICS, AND COMPUTER SCIENCE, IN WHICH WOMEN'S PARTICIPATION IS DISMALLY LOW.

The centerpiece of the ADVANCE program has been a model interdisciplinary course, Perspectives on Science. The half-credit course, which meets for two hours once a week, introduces students to a cadre of dynamic women Ph.D.'s in scientific careers, fosters a greater sense of self- and group identity, and showcases research and applications of the quantitative sciences in the light of current research and technology efforts in interdisciplinary science.

In the fall, the course deals with applications in the biological, medical, and environmental sciences. Local and nationally prominent women in science and math come to speak on such topics as chaos and the spread of disease, pesticide exposure in preschool children, string theory and life with five children, and how to mathematically model the optimal decision process for employment, medical care, and insurance. For the spring course—emphasizing engineering and the physical and social sciences—speakers address such topics as conservation laws and traffic flow. Graduate student panels encourage student identification with the speakers.

Duke's curriculum underscores the centrality of writing in all undergraduate work, and the university writing program mandates a first-year writing course: Academic Writing 20. Over two years, ADVANCE students took specially designed sections of Writing 20 to develop skills in scientific writing and analysis: Cooperation, Competition, and Interpretation; Representing Disease; Reading and Writing Science; or The Science Behind Controversy.



A section on Cooperation, Competition, and Interpretation, for example, explored a controversial theory in evolutionary biology, microbiologist Lynn Margulis's theory of evolution by symbiosis, which challenges the primacy of natural selection and the basic paradigm of neo-Darwinism. In short exercises and four draft papers, students sought first to understand traditional Darwinist evolutionary biology and then to interpret and evaluate Margulis's challenges to neo-Darwinist orthodoxy. Students examined such issues as the bias in evolutionary biology toward complex organisms; the challenge Margulis poses to the concept of the "individual" organism; the implications of making cooperation, rather than competition, a major image of evolutionary change; and the effect these conflicting images of biological evolution have on concepts drawn from evolutionary thought (such as *progress and growth*). Working in groups, students discussed and developed ideas, advising each other, reviewing each other's work, and revising drafts. They learned both to write better and how controversies emerge within scientific disciplines.

The writing course and a series of discipline-based seminars echo the theme of the emerging and interdisciplinary nature of science, the variety of its applications, and science's links to society. The idea is that if math doesn't seem to most students to have practical applications, the facts will seem more relevant and alive if emphasis is placed on the process of discovering ideas and the people who discovered them.

ADVANCE also offered discipline-based first-year seminars in 2000–2002, including Artificial Intelligence and Automated Reasoning. Over two years, eight ADVANCE students participated in Duke's summer research fellows program.

Over 60 percent of the 2001–02 participants have declared a major in the sciences, including four math majors, two math/biology majors, and a computer science major. Five other ADVANCE students have chosen science minors, and two nonscience majors are pursuing pre-med studies. The two graduate coordinators are pursuing doctoral degrees in math and physics, and *Duke has begun recruiting more women faculty in the sciences*.

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HRD 99-79478 (one-year grant)	
Keywords: demonstration, quantitative sciences, math, statistics, computer science, curriculum, writing, seminars, recruitment	

ENGINEERING

003

IP

Imagination place

IMAGINATION PLACE

EDC'S CENTER FOR CHILDREN AND TECHNOLOGY DEVELOPED AN INTERACTIVE ONLINE DESIGN SPACE, *INVITING GIRLS 8 TO 14 TO THINK AND ACT AS TECHNOLOGY DESIGNERS, NOT JUST USERS. IMAGINATION PLACE* ENGAGES CHILDREN IN A DESIGN PROCESS THAT INVOLVES IDENTIFYING A NEED, PROBLEM, OR OPPORTUNITY; COMING UP WITH AN IDEA TO MEET THAT NEED; UNDERSTANDING AND SELECTING DESIGN OPTIONS; AND MAKING A DESIGN IDEA A REALITY. ENGAGING GIRLS IN *COLLABORATIVE DESIGN PROVIDES A POWERFUL PATHWAY TO THE WORLD OF ENGINEERING, GIVING THEM NEW WAYS TO SEE AND THINK ABOUT TECHNOLOGY'S IMPORTANCE IN THEIR LIVES*.

EDC is developing the interactive online environment in partnership with Australian Children's Television Foundation (ACTF, creators of KaHootZ interactive software) and with Libraries for the Future (whose agenda is to promote libraries as learning environments, especially to low-income communities and to girls and women, the main users of public libraries).

To research children's conceptions of the Internet, the project asked 30 children to create something to explain what the Internet is to someone who doesn't know. Nearly half the boys described features of navigating and getting on the Internet rather than the functions one can perform. Girls tended to describe its functions as a tool for connection and communication ("it connects people to games and other people"). Creating *an environment that provides a sense of place and community with useful multipurpose tools is more important for engaging girls than the games targeted mainly to boys. Communication and discussion* should be an entry point to the design area. Children also need *guidance in using search engines to answer specific questions*.

When the children were asked to create a fantasy device to their own liking, to name it, and to describe its performance, *girls' inventions were often designed to solve human, health, or performance-related problems* (falling asleep, carrying things home, helping shoot baskets perfectly). Their inventions tended to highlight portability and multiple functions, which they tended to illustrate in a storyboard manner. Boys tended to create computer-related inventions and to focus on their machines' features rather than functions. *Girls were less likely than boys to focus on the parts of their machines in relationship to the whole, so the project stressed games that would stimulate girls to do so*.

By testing ten activities at two sites, the project found *that learning about design carried over from one activity to another, but that children were not experienced at using the computer to draw and create designs. They need explicit instructions and time to experiment with the drawing tools before being able to complete certain activities with minimal frustration*. Timing is crucial: kids are accustomed to working offline for 30 minutes and then on the computer for 30 minutes. And when asked to think about marketing their inventions, *students rarely connect the cost of materials to create an object* to the cost of the final object. Crucial tasks for the project are to *strike the right balance between discussion and computer-based activities and between ease of entry into activities and intellectually challenging content*.

The project learned other important lessons from the final field test, conducted with about 200 students in informal and informal U.S. and Australian settings. First, *design club leaders hosting clubs in libraries and informal settings need additional support to understand how to help girls express their technological ideas and to think about how systems in machines work*. Nearly all leaders reported that their *children had begun to think of themselves as designers and inventors as a result of participating in Imagination Place clubs—a significant first step toward girls participating more fully in technology*.

They also learned that *sharing work online and having an authentic audience for their work is a big motivator for girls creating their own investigations, but this requires that design club leaders help the girls prepare for online discussions of their work by viewing their peers' inventions before chatting and by drafting a set of critical questions to ask*. Participants who had fewer technical resources spent more time doing start-up activities about design and technology, which altered the depth of work students did online.

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www.edc.org/CCT/imagination_place	HRD 97-14749 (three-year grant)
Partners: Australian Children's Television Foundation; Libraries for the Future	
Products: Poster, resource guide	
Keywords: demonstration, interactive, website, mentoring, engineering, EDC, design-based, research findings, engagement, educational games, television, underprivileged	

003

EE

Exploring engineering

EXPLORING ENGINEERING

THIS MOTIVATIONAL PROGRAM FOR EIGHTH GRADE GIRLS—ESPECIALLY GIFTED GIRLS FROM POOR OR MINORITY FAMILIES, WHO TYPICALLY DO NOT SEE THE IMPORTANCE OF PREPARING FOR HIGH-SKILL, HIGH-WAGE CAREERS—BROUGHT TOGETHER EDUCATORS, PRACTICING ENGINEERS, AND OTHER PARTNERS TO TEACH THE GIRLS, THEIR PARENTS, AND THEIR MIDDLE SCHOOL TEACHERS ABOUT OPPORTUNITIES IN MATH, SCIENCE, AND ENGINEERING. SEVENTY MIDDLE SCHOOL TEACHERS RECEIVED TRAINING IN BIAS-FREE TEACHING, INSTRUCTIONAL METHODS FOR BUILDING MATH AND SCIENCE SKILLS, AND STRATEGIES FOR INVENTION AND EDUCATION WITH GIFTED GIRLS.

Activities for the girls involved mentoring, enrichment activities, and career-related experiences. Over two years, about 250 girls and their parents participated in such activities as

- Explorathon, AZ, hands-on workshops to show 100 girls that science is not forbidding. These workshops, coordinated by Arizona State University and the American Association of University Women, were conducted by professional women in STEM. In a simple introduction to aerodynamics, for example, they made paper helicopters (spinning rotor blades made from a single piece of paper and dropped from a height), varying the geometry to make the blades spin or fall faster or more slowly. Activities were designed for the girls to experience success.
- Career and high school exploration, math and science teachers telling eighth grade girls and their parents (200 in all) about high school courses, expectations, and opportunities.
- Engineering exploration, an all-day Saturday event at which the Society of Women Engineers presented demonstrations and talked about their engineering experience. Lunch for girls and their parent or teacher was complimentary and transportation was available, so low-income and minority students could participate. Over two years, 116 girls attended.

Girls also visited local institutions of higher learning, sat in on classes at the high school of their choice, and toured local industries such as the Boeing Company, Motorola, Allied Signal, and a Phoenix hospital. Some entered engineering-based competitions (Future Cities, Sounds of Mars, and the Society of Hispanic Professional Engineers' competition on space travel).

A subset of participating seventh grade girls were told they had to maintain a B average to be a member in good standing, eligible for a mentor and career-related experiences such as job shadowing. Their grades showed an average increase (on a 4.0 scale) from 3.43 to 3.73 in science and from 3.32 to 3.4 in math. The first year's cohort (now in high school) had an overall grade point average of 3.43 during their first year in high school. The year before entering the project, their average national percentile rank score was 63. *During their first project year, their average national percentile rank score increased from 63 (the year before the project) to 74.8—an increase of 11.8 points. The district average that year was 58; the average for all middle school girls was 47.5.*

All of the students had gained confidence and planned to go to college. "When I see other women doing jobs that are mostly dominated by men," said one student, "it gives me confidence that I can do it also."

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HRD 98-10240 (ONE-YEAR GRANT)	
PARTNERS: SOCIETY OF WOMEN ENGINEERS; NEW FRONTIERS/CENTER FOR EDUCATIONAL DEVELOPMENT, ARIZONA SCIENCE CENTER; AMERICAN ASSOCIATION OF UNIVERSITY WOMEN, GLENDALE UNION HIGH SCHOOL DISTRICT, ARIZONA STATE UNIVERSITY (DEPT. OF PSYCHOLOGY), AND LOCAL ENGINEERING BUSINESSES.	
KEYWORDS: DEMONSTRATION, CAREER AWARENESS, GENDER EQUITY AWARENESS, TEACHER TRAINING, PARENTAL INVOLVEMENT, ROLE MODELS, MENTORING, UNDERPRIVILEGED, MINORITIES, SELF-CONFIDENCE, ENGAGEMENT, ENGINEERING, CONFERENCE, HANDS-ON, WORKSHOPS, FIELD TRIPS, INDUSTRY PARTNERS	

003

Hom

Developing hands-on museum exhibits

DEVELOPING HANDS-ON MUSEUM EXHIBITS

IN THIS PROJECT FOR EIGHTH GRADE GIRLS, FIVE "ENGINEERING" TEAMS DEVELOPED MUSEUM EXHIBITS FOR THE DISCOVERY MUSEUM, TWO ADJACENT HOUSES IN ACTON, MASSACHUSETTS, FILLED WITH FOCUSED SPACES AND INTERACTIVE EXHIBITS FOR CHILDREN OF ALL AGES. EACH EXHIBIT ILLUSTRATES A PRINCIPLE OF SCIENCE OR ENGINEERING, ALLOWING VISITORS TO LEARN THROUGH ACTIVITY-BASED LEARNING—AND ALLOWING THE GIRLS DEVELOPING THE EXHIBITS TO LEARN EVEN MORE.

Each engineering team comprised a female Tufts undergraduate, five eighth grade girls from the same school, and at least two mentors (a teacher and a mother), plus a support group: a Tufts University faculty member, a Tufts staff member, and a museum staff member.

Participants in one exhibit, for example, might compete in "feats of strength" using one of the five simple machines to develop "mechanical advantage": the inclined plane, wedge, screw, lever, or wheel. Participants in another might use Legos to learn about gears and the trade-off between speed and power with a lifting crane, a car, or a water well. To understand a mechanical clock (perhaps the most significant invention in the history of our modern world), one exhibit might show a clock constructed entirely from parts scavenged from children's toys. Another exhibit might display the fundamental relationship between switching circuits and Boolean algebra ("if X or Y happens but not Z, then Q results").

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HRD 96-32175 (one-year grant)	
Partner: Acton Discovery Museum	
Keywords: demonstration, recruitment, achievement, mentoring, hands-on, museum, project-based, engineering, parental involvement	

CLOSENESS IN AGE

As the father of two young daughters, engineering professor Ioannis Miaoulis wondered why girls would ever want to become scientists when commercials, movies, and even *Sesame Street* and *The Muppets* typically portrayed scientists as weird white men (usually ugly) wearing thick glasses, carrying 16 pens in their shirt pockets, and determined to destroy the universe. Images of women in science were typically posters of Amelia Earhart and Marie Curie, and he believed a 25-year-old computer programmer would be a better role model for an adolescent than a 90-year-old Nobel laureate.

Miaoulis concluded that it's *important for girls to have a role model or mentor fairly close to them in age*. Mentors for elementary school students might be middle school students who enjoyed doing a project for a science fair, mentors for middle school students might be high school girls who excel in math and science, mentors for high school girls might be college undergraduate or graduate students, and mentors for undergraduates might be young professionals.

003

RCH

Camp REACH: engineering for middle school girls

CAMP REACH: ENGINEERING FOR MIDDLE SCHOOL GIRLS

FOR SIX YEARS, CAMP REACH (REINVENTING ENGINEERING AND CREATING NEW HORIZONS) HAS BEEN OFFERING MASSACHUSETTS GIRLS—GRADUATES OF SIXTH GRADE—AN ENGINEERING SUMMER CAMP THAT INCORPORATES MATH, SCIENCE, AND ENGINEERING CONCEPTS INTO HANDS-ON ACTIVITIES. THE PROJECT DIRECTORS BELIEVE THAT *REALIZING WOMEN'S FULL REPRESENTATION AMONG ENGINEERS LIES IN COMMUNICATING WHAT ENGINEERS DO, HOW THEY HELP SOCIETY, AND WHAT SKILLS THEY NEED TO DO SO. YOU NEED TO CAPTURE THEIR INTEREST AT THIS AGE IF THEY ARE TO TAKE THE MATH AND SCIENCE THEY WILL NEED TO BECOME ENGINEERS.*

The camp encourages girls to pursue engineering through projects and workshops that promote teamwork, boost self-esteem, and establish close ties among the campers and with the faculty (the camp is held on the campus of the Worcester Polytechnic Institute). Workshops at the two-week camp reflect the various fields of engineering. At the forensic workshop girls do a chemical analysis of a mock crime scene; for structural engineering concepts, they examine sand castles built on Cape Cod.

One day the campers cross WPI's campus in search of handicapped-accessible (or inaccessible) features of the built environment, using wheelchairs. They note barriers, from inaccessible curbs to narrow elevators and doors without pressure-sensitive control mechanisms. Armed with rulers, calculators, and protractors, they retrace their steps to measure existing ramps and door jambs for compliance with the Americans with Disabilities Act (ADA). They learn about abilities handicapped people have that they don't—such as being able to turn in a wheelchair. To simulate what it is like to navigate with limited vision, they smear goggles with rubber cement and try to read signs and written materials. They compare their findings with ADA standards.

The girls work as a team on a community service design project to solve a problem for a local "customer." They may modify a bedroom for a disabled child, for example, or design a recycling program for a business. One group designed a Web page for Big Brothers/Big Sisters, using a text-based style to allow for compatibility with screen readers for the blind. Another picked ground cover (such as pebbles or wood chips) to make a new toddler playground wheelchair-accessible. Girls learn at the camp how engineering and technology are used to find solutions to some of the world's most pressing problems—for example, designing earthquake-resistant buildings and safer roads.

On July 22, 2002, Denise Nicoletti, a professor of electrical engineering at WPI and the camp's founder and director, was killed in a car accident, the victim of a teenage driver who had fallen asleep at the wheel.

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www.wpi.edu/~reach	HRD 96-31386 (ONE-YEAR GRANT)
KEYWORDS: DEMONSTRATION, ENGINEERING, SUMMER CAMP, SELF-CONFIDENCE, TEAMWORK APPROACH, REAL-LIFE APPLICATIONS	

003

Goz

Engineering GOES to middle schools

ENGINEERING GOES TO MIDDLE SCHOOLS

ENGINEERING CAREER DAYS AT DREXEL UNIVERSITY ALLOWED GIRLS IN PHILADELPHIA TO PARTICIPATE IN HANDS-ON ENGINEERING EXPERIMENTS WHILE INFORMALLY INTERACTING WITH PRACTICING FEMALE ENGINEERS AND ENGINEERING FACULTY AND STUDENTS. WITH THE GOES PROJECT (GIRLS' OPPORTUNITIES IN ENGINEERING AND SCIENCE), WOMEN IN ENGINEERING HELPED THE COLLEGE OF ENGINEERING TAKE CAREER DAY TO MIDDLE AND JUNIOR HIGH SCHOOLS WITHIN AN HOUR'S RADIUS OF DREXEL.

These traveling workshops in engineering education tried to get sixth to ninth grade girls to view engineering as a viable career option and to take college-track math and science courses that would prepare them for it. Workshops opened with a five-minute warm-up exercise in which girls identified what happened when they woke up and came to school, after which leaders explained how an engineer was involved in every single step. Given a handout listing various engineering specialties and salaries ("startling statistics"), the girls were asked to guess what percentages represented women. The girls loved their name tags, which indicated they were engineers for the day, attending a professional conference.

Hands-on labs (in which teachers and parents were encouraged to participate) conveyed the fun and excitement of engineering, captured students' interest, and acquainted them with the engineering profession:

- Polymers and microencapsulation (chemical and biomedical engineering)
- Sound and image processing, digital video, and videoconferencing (electrical and computer engineering)
- Slime, foam, and metals (materials engineering)
- K'Nex (a construction toy) and the design process (civil engineering)
- Groundwater contamination (hydrology and environmental engineering)
- Drills (mechanical engineering).

Schools preferred all-day to partial-day sessions (with 40-minute labs the best length), many girls began to lose interest in any activity after the third lab, and the girls liked having something to take home with them.

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HRD 94-53683 (ONE-YEAR GRANT)	
PARTNERS: WOMEN IN ENGINEERING, DU'S COLLEGE OF ENGINEERING	
WOMEN IN ENGINEERING PROGRAMS FOR UNDERREPRESENTED POPULATIONS: www.gatewaycoalition.org/underrepresented_populations/wie/support_programs.cfm	
KEYWORDS: DEMONSTRATION, ENGINEERING, HANDS-ON, CAREER AWARENESS, WORKSHOPS, ROLE MODELS, PARENTAL INVOLVEMENT	

003

Hop

Hands-on engineering projects for middle school girls

HANDS-ON ENGINEERING PROJECTS FOR MIDDLE SCHOOL GIRLS

FOR MANY STUDENTS, MIDDLE SCHOOL IS A TURNING POINT IN MAKING CAREER CHOICES. GIRLS EXPERIENCE SOCIAL PRESSURE NOT TO PURSUE TECHNICAL CAREERS, AND MIDDLE SCHOOL STUDENTS—ESPECIALLY IN RURAL AND INNER-CITY AREAS—OFTEN DON'T KNOW WHAT CAREER OPTIONS ARE AVAILABLE. AT BINGHAMTON UNIVERSITY, THE WATSON SCHOOL OF ENGINEERING LAUNCHED A YOUNG WOMEN'S TECHNICAL INSTITUTE TO LET GIRLS IN GRADES 6–9 EXPERIENCE SCIENCE AND ENGINEERING THROUGH POSITIVE, HANDS-ON EXPERIENCES IN A TWO-WEEK SUMMER SCHOOL. THE INSTITUTE, WHICH STARTED AS A PILOT PROGRAM FOR FOUR SCHOOLS, EXPANDED UNDER THIS NSF GRANT. BECAUSE OF ITS LOCATION, THE PROJECT ESPECIALLY HELPED RURAL GIRLS.

Middle school teachers, Binghamton faculty, and industry professionals worked together with the students in classroom activities. Teachers and girls had a common experience and teachers who worked as staff got a feeling for how they might do projects in the classroom that could be related to everyday problems. Parents were invited to project presentations so they could see what their daughters would need to learn to become scientists or engineers. *Everyone learned that there is more to technical subjects than textbooks—that the real fun starts with projects.*

The summer school curriculum consisted entirely of hands-on activities and field trips to local industries. The girls built robots, model rockets, paper towers, electronic circuits, paper and balsa airplanes, and amateur radio and TV antennae. They learned how to use drills, saws, tape measures, soldering irons, and the Internet. After learning how to program a milling machine, they tested how well their instructions worked in making the machine carve their initials into a piece of plexiglas. They solved math puzzles, did chemistry experiments, and learned how household appliances work. They built scale models of the solar system, constructed a model moon base, and visited the Kopernik Space Education Center.

Visits with role models brought to life their discussions of various kinds of careers. They were mesmerized when former television meteorologist Erica Boyd discussed what her career was all about. They did a little karate.

They were especially interested in projects relevant to helping others. *They found recycling paper and building solar ovens much more interesting than just talking about preserving the environment.* They loved learning the importance of mechanical engineering to buildings withstanding collapse in an earthquake. They built model buildings for an earthquake test and tested them using a shake-table, accelerometers, and computers. *Engaging in these activities brought latent interests to the surface in many girls*. Time will tell how many engineers, astronauts, or meteorologists the experience produces, but these middle school girls came to appreciate engineering.

In outlining procedures for an activity such as antenna building, the principal investigators added a *rubric for grading projects*. A rubric is a *well-defined point system for grading projects*, giving a certain number of points for creativity, understanding, display, cooperation, and so on—whatever is important for that project. *It is important that the students know the point system beforehand.*

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003

Pie

Partners in engineering

PARTNERS IN ENGINEERING

THE PARTNERS IN ENGINEERING PROGRAM BROUGHT TOGETHER A TEAM OF CLARKSON UNIVERSITY'S WOMEN ENGINEERING STUDENTS AND 50 SEVENTH AND EIGHTH GRADE GIRLS FROM THE LOW-INCOME, LARGELY RURAL REGION AROUND CLARKSON IN UPSTATE NEW YORK—SOME OF THEM HOME SCHOOLED. UNDERGRADUATE MENTORS, TRAINED DURING THE FALL SEMESTER THROUGH A THREE-CREDIT COURSE ASSOCIATED WITH THE PROGRAM, LED MIDDLE SCHOOL STUDENTS TO SOLVE A REAL-WORLD PROBLEM RELEVANT TO THEIR SCHOOL COMMUNITY—TO START WITH, REDUCING SOLID WASTE IN THE SCHOOL CAFETERIA AND INCORPORATING WASTE MATERIAL INTO CEMENT COMPOSITE. *EMPHASIZING TECHNICAL DETAILS MAY BE ENOUGH FOR YOUNG MEN, BUT GETTING GIRLS INTERESTED IN ENGINEERING GENERALLY REQUIRES SHOWING THAT IT CAN IMPROVE PEOPLE'S LIVES.*

The girls were challenged first to understand critical issues associated with the problem and then to find and implement an acceptable solution. Instead of memorizing a description of the problem-solving process, as they might in a traditional classroom, they experienced it firsthand. They met after school once a week for mentoring, leadership, and problem-solving activities involving math, engineering, economics, communications, and social studies. They visited a solid-waste separation facility, a waste-recycling facility, a landfill operation, a manufacturing facility that uses recycled materials, and an industrial facility—to see how they deal with their own wastes. They investigated the types and amounts of trash generated at school and conducted computer-aided analysis (spreadsheets, graphics) of the data. They designed a bench made of recycled materials.

This holistic, project- and problem-based approach to learning was a female-friendly vehicle for teaching STEM concepts and improving critical thinking and problem-solving skills. The project's collaborative approach to engineering benefited both the middle school students and their college-age mentors. Visiting speakers were local women in the sciences, about whom most of the middle school girls knew nothing.

Findings from the first year indicate that mentors, who were paid a stipend, served 10 to 14 hours a week, which did not interfere significantly with their academic progress. They all maintained fairly constant GPAs. Each mentor, after formal training, was assigned to two or three eighth grade girls, and three to five mentors worked together during a class period. The girls solved problems in small groups, which gave some of the quieter girls a chance to emerge as leaders. The eighth grade girls stayed in touch with their mentors by e-mail and often socialized with them at Clarkson's hockey games. *Most parents saw the mentoring as the most valuable aspect of the project, with hands-on experience in science and problem solving secondary.*

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Keywords: demonstration, after-school, mentoring, problem-based, engineering, underprivileged, rural, project-based, real-life applications, field trips	

003

GRi

Girls RISE

GIRLS RISE

IN THIS 18-MONTH INTERVENTION, A GROUP OF *HIGHLY MOTIVATED SEVENTH GRADE GIRLS*—MOST OF WHOM LIKED MATH AND SCIENCE AND WERE CONSIDERING STEM CAREERS—*LEARNED ABOUT ENGINEERING, A FIELD THEY HAD RARELY CONSIDERED AND KNEW LITTLE ABOUT*. THROUGH RECOMMENDATIONS AND INTERVIEWS WITH THE GIRLS, THE PROJECT SELECTED 24 GIRLS, MORE FOR THEIR INTEREST IN MATH AND SCIENCE THAN FOR THEIR GRADE-POINT AVERAGE, WITH AN EMPHASIS ON GIRLS OF COLOR.

Building on work the Miami Museum of Science had already conducted with underrepresented youth, the Girls RISE (raising interest in science and engineering) *project emphasized things that had worked before: the acquisition of advanced computer skills, the use of college-level mentors as instructors, interaction with professionals in the workplace, project-based active learning, and paid internships.*

Saturday sessions. During the school year, 23 girls attended 20 Saturday sessions at the museum. In the museum technology center's computer lab, mentors introduced the girls to MicroCAD (drafting and emulation software) and to communications and presentation software such as Hyperstudio. The girls learned to use e-mail and the Internet for fun and research, to scan and manipulate images with Adobe PhotoDeluxe, to prepare presentations integrating text and graphics using PowerPoint, and to create Web pages with Netscape 3.0. Each girl designed a personal Web page with links to her favorite engineering websites and kept an electronic journal. In two career academies, the girls interacted with women working in electrical, industrial, and mechanical engineering.

The girls learned engineering principles and conducted hands-on activities at a nearby elementary school. In an informal, collaborative setting, the girls felt safe experimenting with engineering concepts and processes and applying them to real-life projects. They completed projects in basic circuitry and learned about structural engineering through a bridge-building competition, group competing against group. To complement class discussions of bridge design, they visited different Miami bridges, taking photos and notes about the bridge construction materials—learning later why steel is no longer the material of choice and why concrete has replaced it for efficiency.

Summer Academy. Forty girls attended the Summer Academy. Girls new to the program were interspersed with girls who had completed the program during the academic year. Engineering students were recruited as mentor staff from the Society for Women Engineers, Florida International University, and the University of Miami. After a one-week orientation, the mentors helped the girls learn about different kinds of engineering through four weeks of presentations, research, and hands-on activities designed to teach specific concepts.

In cooperative learning groups, they built a line tracker and a miniature electric vehicle—designed to drive a set load up an incline. Each team member had an engineering position with specific responsibilities for design, facilities, development, or test engineering. Such projects helped the girls learn basic principles of electricity, electrical circuits, Ohm's law, conservation of energy, friction, gears and carrying power (gear ratio and wheel size), motor-carrying power, and aerodynamic drag.

In field trips to labs at the University of Miami, they spoke with engineers and students in robotics, environmental engineering, computer animation, and biomedical engineering. They toured the extrusion plant at the Cordis Corporation (seeing how catheters are made), and also visited Epcot Center, the IMAX Theater, and the Metro–Dade County Sewage Treatment Plant.

In the end, the girls not only knew more about engineering and female engineers, but most were more interested in science and technology and planned to attend math or science magnet schools and to pursue careers in STEM. *Most of the girls interviewed had changed their plans because of the program, had more perspective on how things are made and work, and were more aware of the options available to them.* Because parents influence their daughters' academic choices and careers and cannot all attend the final Family Night, it is important to find ways to convey similar information to them. The project would have benefited from having more mentors during the academic year (not just the summer) and from more formal mentor training and orientation—about computer programs, hands-on projects, adolescent development, group processes, conflict resolution, and social problem solving.

SECME RISE EXPANDS THE RISE MODEL

SECME Inc. (formerly Southeasthern Consortia for Minority Engineers) is a national organization that helps school systems provide hands-on engineering experiences for middle and high school students and encourages them to enroll in math and science courses. SECME RISE significantly expanded the Girls RISE model by integrating RISE strategies into SECME activities in 47 Miami–Dade County middle schools. The participants were mostly African American and Hispanic middle school girls from Miami's inner city who showed an interest in math or science. The project exposed this receptive young audience to fields unknown to them, involving them in engineering- and technology-related activities they could enjoy.

Peer leadership summer academy. A four-week session of computer-assisted, team-based engineering experiences built girls' confidence and boosted their interest in math and science. Mentors reported that some of the girls selected to attend the summer academy (two from each school) were neither outstanding students nor leaders in their schools. Some girls were not even initially interested in pursuing careers in STEM but were chosen because their teachers saw they could do well in science if someone could motivate them to become interested in school. The girls were intelligent but had behaved poorly in school and had no interest in academic activities. *Their parents credited the personal attention and hands-on activities they experienced in the academy with changing their children's attitudes toward school and toward their future careers.*

Many of the girls said the team mentors had influenced their thinking. The fact that three of the mentors were African American or Latina and had attended school in the Miami–Dade public system encouraged them to believe that they too could succeed as engineering students. It was important to these middle school girls that the mentors were attractive young ladies who wore nice clothes and had boyfriends—it counteracted their belief that female engineers would look and be "weird."

Four in-service teacher workshops. Each year, up to 32 teachers (two from each middle school) attended workshops that introduced them to e-mail (most had not used it), the Internet, and the graphing calculator, and learned about gender-fair teaching and how girls get excluded from the path to college majors and careers in STEM. The Myra and David Sadker video, "Gender Equity in the Classroom," showed subtle inequities in a middle school science lab and equitable strategies for managing the same classroom situations. Mixed-gender teams of teachers worked on engineering design challenges, observing firsthand the differences between competitive and collaborative processes.

Technology workshops might start with a warm-up game of Internet Lingo Bingo, introducing teachers to Internet vocabulary, followed by staff modeling the use of graphing calculators in hands-on math lessons. In the concluding workshop, teachers worked in teams to meet the most difficult design challenge: Using two sheets of paper, they had to build a support structure that would hold 20 textbooks more than two inches above the ground (a metaphor for building support structures for girls in their classrooms). Finally, they watched "Women Who Walk Through Time," *a video portrait of three successful women scientists, to change their vision of what was possible for their students. In general, the teachers valued and wished for more time spent on hands-on activities, on the computer, and on graphing calculator. They also valued time spent sharing and discussing gender equity issues with their peers.*

Over three years, 48 teachers attended national summer institutes designed to provide SECME club teachers with strategies, suggestions, and sources of support. SECME activities are designed to be flexible, and teachers were encouraged to adapt them to their schools' needs. In some schools, SECME clubs met regularly after school and hosted a variety of activities. In other schools, SECME activities were carried out as part of the regular science curriculum or were not carried out at all.

Family E-Days. Two special engineering days were held at the Miami Museum of Science for girls and their parents. Activities included design challenges for students and parents and talks by women engineers, with an emphasis on pathways toward college and careers in engineering and special seminars on standardized testing, college applications, and financial aid—plus a chance to explore the museum's exhibits.

Lack of transportation for students and of compensation for teachers lowered attendance at E-days and the teacher's technology workshops. Schools have limited budgets, few teachers receive additional pay or even expense money for work performed on Saturdays, and poor communication systems at some schools prevented notices of events reaching students and teachers or reaching them on time. For those who had access to it, the website was useful for keeping calendar and contact info current.

A number of significant accomplishments can be directly linked to the SECME RISE project. *By building robots and bridges and designing Web pages and PowerPoint presentations, girls demonstrated mastery of the engineering and computer skills the program introduced. More important, by the end of the program, the majority of the girls said they wanted to pursue science or engineering careers, and the majority of the students rated themselves one of the smartest, very smart, or above average in science.* The girls also learned to work in cooperative groups, to get along and become friends with girls from different backgrounds, and to resolve problems and interpersonal conflicts. *Almost all teachers who participated in the in-service workshops agreed that the training made them more aware of gender equity issues and more knowledgeable about the use of technology and hands-on engineering activities in the classroom.*

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Partners: SECME Inc.; Miami–Dade County Public Schools Urban Systemic Initiative; Miami–Dade County middle schools; ASPIRA of Florida; Boys and Girls Clubs of Miami, the Coconut Grove Youth and Family Intervention Center.	
Keywords: demonstration, cooperative learning, self-confidence, computer skills, career awareness, role models, project-based, internships, museum, hands-on, engineering, field trips, parental involvement, urban, African-American, Hispanic, teacher training, gender equity awareness, graphing calculator	

003
El
Engineering lessons in animated cartoons

ENGINEERING LESSONS IN ANIMATED CARTOONS

OFTEN YOUNG WOMEN DON'T GO INTO ENGINEERING BECAUSE THEY THINK IT'S TECHNICAL, DIFFICULT, AND BORING—AND FEW TELEVISION SHOWS FEATURE ENGINEERING HEROES OR HEROINES. THIS PROJECT HOPES TO ATTRACT STUDENTS TO ENGINEERING THROUGH A MULTIMEDIA PRESENTATION FOR ALL AGES—SEVEN CARTOON MOVIES VIEWABLE ON THE INTERNET, FEATURING ANIMATION, HUMOR, MUSIC, CHARACTER DEVELOPMENT, SOAP OPERA–LIKE DIALOGUE, AND HUMANIZED CHARACTERS INTERACTING AND USING BASIC ENGINEERING PRINCIPLES AND COMMON SENSE TO GET THEMSELVES OUT OF DIFFICULT SITUATIONS.

Each short cartoon movie presents a challenge in human terms, then explains and illustrates problem-solving approaches or engineering principles to address the challenge, and wraps up by reinforcing the moral of the story. In one cartoon, Pumpy Power (a female student) and Pipy Length (a male student), working on their final project, talk to each other about fluid mechanics in a water tower. Having made a series of mistakes, they are guided by the spirit of Daniel Bernoulli (of Bernoulli's theorem) to solve the problem themselves—by choosing two "smart points" along their assembly that define the smart system and smart process along the flow line.

By demystifying the field with cartoons that humanize engineering principles, the project hopes to interest students in the simplicity and intellectual beauty of basic engineering. All seven animated cartoons can be viewed on the Internet in roughly 90 minutes (allow for slow loading). At a Saturday workshop, 30 pre-college math, physics, and chemistry teachers viewed the cartoons and learned about basic multimedia programming and production.

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Partner: Rockford Public School District	
Keywords: demonstration, engineering, cartoons, problem-solving skills, teacher training, website, animations	

003
Pre
Pre-college engineering workshops

PRE-COLLEGE ENGINEERING WORKSHOPS

THAT MALE STUDENTS TEND TO IGNORE THE FEW WOMEN IN ENGINEERING CLASSES AND GRAVITATE TO OTHER MEN WHEN FORMING STUDY GROUPS OR WORKING ON GROUP PROJECTS CAN AFFECT THE WAY UNDERGRADUATE WOMEN PERCEIVE THEIR ROLE IN ENGINEERING AND THEIR SENSE OF BELONGING. WITH *JEMS* (JUNIOR ENGINEERING, MATH, AND SCIENCE), THE UNIVERSITY OF IDAHO OFFERED A TWO-WEEK SUMMER PRE-ENGINEERING EXPERIENCE FOR HIGH SCHOOL JUNIORS AND SENIORS—MALE AND FEMALE. NEW STRATEGIES AND APPROACHES WERE INCORPORATED INTO AN ONGOING SUMMER ACTIVITY THAT HAD NOT PREVIOUSLY SUCCEEDED IN ATTRACTING YOUNG WOMEN. WOMEN ARE OFTEN LESS INHIBITED IN ALL- OR MAINLY FEMALE CLASSES/SUMMER WORKSHOPS, BUT SUCH APPROACHES DON'T PREPARE THEM FOR THE PROBLEMS THEY WILL FACE WHEN THEY ENTER A COLLEGE OF ENGINEERING.

This two-week program was the first exposure to a university atmosphere for most participants, providing a useful transitional experience for mostly rural high school students. They registered for and attended a two-credit pre-engineering course, worked in university labs, and used other university facilities. The idea was to show engineering as a welcoming environment and encourage engineering as a career option.

A leadership unit informed participants about diversity issues (involving race, gender, and disability) and *encouraged male students' more acceptable (less adversarial) behavior toward female students—in the framework of "human factors engineering*." Faculty and counselors were given sensitivity and gender-equity training and as much as possible the project recruited female faculty and counselors (engineering undergraduates) to provide female role models. *Scholarships for female and minority participants were an important factor in recruitment*. Female enrollment increased from 10 in 1994 to 28 in 1995 (out of 57 total) and to 16 in 1996 (out of 36).

Instructors were trained to work with teams of students, to observe group dynamics, and to encourage team members to rotate all tasks, so girls weren't stuck with note-taking while the boys assumed leadership and did all the hands-on experimentation.

A scavenger hunt was the warm-up activity the first year, but in response to student feedback this was changed to an experiment in an engineering lab. To make the content more interesting, the emphasis shifted from mechanical engineering to environmental engineering. Student teams of two or four were responsible for a group project (for example, figuring out whether the wood-fired boiler on the Moscow, Idaho, campus provided the most cost-effective and environmentally safe option). They used CAD tools to design their project and to prepare posters and visual aids for its presentation to their families and other visitors the final day.

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003

Wi

WISE investments

WISE INVESTMENTS

SOCIALIZED TO ADOPT NURTURING AND PEOPLE-ORIENTED CAREERS, COLLEGE WOMEN OFTEN CONSIDER CAREERS LIKE ENGINEERING MORE DIFFICULT AND LESS IMPORTANT THAN CAREERS LIKE NURSING, ACCORDING TO ONE STUDY—THE PERCEPTION BEING THAT ENGINEERING IS NOT PEOPLE ORIENTED. ACCORDING TO ANOTHER STUDY, YOUNG WOMEN PLANNING CAREERS IN SCIENCE ARE OFTEN DRAWN TO THEM BECAUSE OF A DESIRE TO HELP PEOPLE, ANIMALS, AND THE ENVIRONMENT. THE IDEA BEHIND THIS ARIZONA STATE UNIVERSITY PROJECT WAS TO CONVEY THAT ENGINEERING IS A WAY TO HELP THE WORLD AROUND THEM, SO GIRLS AND STUDENTS IN OTHER UNDERREPRESENTED GROUPS WOULD STUDY MATH AND SCIENCE WITH AN EYE TO POSSIBLE CAREERS IN ENGINEERING AND THE APPLIED SCIENCES.

Many young women do not pursue science and engineering because they are not encouraged to. WISE Investments targeted middle and junior high and community *college teachers and counselors, encouraging them to convey the message that engineering is a helping profession*, that math and science have real-world applications (such as cardiac pacemakers and artificial kidneys), and that engineering welcomes women. It *targeted teachers and counselors at community colleges because half of ASU's undergraduate engineering transfer students do not decide to enter engineering until they are at a community college.*

Interactive workshops for teachers. Teachers and community college faculty participated in a two-week workshop featuring inquiry-based, hands-on labs conducted by ASU engineering faculty and graduate students. They also had the option of a one-week engineering internship in industry. The point of the workshop and internship was to familiarize them with the different engineering disciplines, get them excited about engineering, and help them develop applications they could use to get young women and minority students interested in engineering—and to answer a universal question, "When am I ever going to use math or science?"

They learned about gender-equitable teaching and experienced engineering labs that modeled gender-inclusive engineering activities and a collaborative learning style. They learned about eight fields of engineering (biomedical, chemical, civil/environmental, computer science and engineering, electrical, industrial, materials, and mechanical/aerospace). What they learned about engineering in the labs was reinforced by what they learned through industry tours and keynote speakers (women engineers or other company representatives). They organized and presented a Saturday academy for students. The project also provided year-long mentoring, two half-day follow-up sessions, and participation in an electronic forum.

Workshops for counselors. Counselors influence girls' career choices but are often left out of programs to encourage women to consider STEM career choices. After testing one-day and four-day workshops, the project offered a one-week workshop for counselors, overlapping with the one for educators. The counselors' session offered hands-on labs for engineering disciplines and sessions on recruitment and admissions requirements, financial aid, and career counseling in engineering for female students. They learn what it is like to be a female engineering student, what young women face, and how they have succeeded. Many of the participants had no idea what engineering was about and are now in a better position to advise their students.

Saturday academies for students. To counteract common perceptions of engineers as boring or antisocial nerds, the project invited 40 middle and high school girls and their parents to a dinner featuring a talk by a woman engineer. During the year, students participated in nine single-sex Saturday academies (each emphasizing a different area of engineering) and three industry tours. Pre-college students were also matched with female undergraduates majoring in engineering, who served as mentors and role models

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Partners: Northern Arizona University; Chandler-Gilbert, South Mountain, and Glendale Community Colleges; Phoenix, Tempe, and Chandler Unified High School Districts; Kyrene, Creighton, and Roosevelt School Districts; Intel Corporation, Motorola, Lockheed Martin, Anderson Consulting, Honeywell, Boeing Helicopters, Medtronic Microelectronics, and Salt River Project; the Phoenix Urban Systemic Initiative, the Arizona State Public Information Network (ASPIN), and other programs.	
Keywords: demonstration, engineering, community college, teacher training, real-life applications, inquiry-based, hands-on, gender equity awareness, internships, industry partners, career awareness, parental involvement, mentoring, role models, field trips	

003

k-12

Recruiting engineers in Kentucky, K–12

RECRUITING ENGINEERS IN KENTUCKY, K–12

SOUTH CENTRAL KENTUCKY NEEDED TO DOUBLE ENROLLMENT IN ENGINEERING TO MEET INDUSTRY'S NEEDS, SO IN 2001 THREE UNIVERSITIES—WESTERN KENTUCKY UNIVERSITY (WKU), THE UNIVERSITY OF KENTUCKY, AND THE UNIVERSITY OF LOUISVILLE—BEGAN OFFERING JOINT DEGREES IN CIVIL, ELECTRICAL, AND MECHANICAL ENGINEERING. BECAUSE *MOST K–12 STUDENTS HAVE NO IDEA WHAT ENGINEERS DO,* WKU'S ENGINEERING FACULTY BEGAN MENTORING LOCAL K–12 STUDENTS AND ENGAGING THEM IN HANDS-ON ENGINEERING APPLICATIONS.

Children who succeed despite adverse conditions usually do so because they got support from an adult other than their parents. Building on existing programs, WKU's engineering faculty is bringing engineering activities to elementary, middle, and high schools—to help students understand and appreciate the field and to elicit their interest in various kinds of engineering.

At local schools, engineering faculty are already mentoring impressionable children in engineering activities. One of them is offering an introduction to electrical engineering. After school for nine weeks children in grades 4–6 spend an hour learning about different kinds of engineering, by examining small machines and building small battery-powered devices. WKU's Center for Gifted Studies is also offering five Super Saturday programs for gifted and talented students in grades K–6, giving able students a chance to broaden their interests and develop their creative and critical thinking abilities. Students have 35 classes to choose from. In electrical engineering they can build a small flashlight, fan, boat, and cat; in civil engineering, examine structures and build miniature bridges and canoes, and so on.

In middle school, many children form preferences about subjects they will study in high school and college, so it is important that engineering faculty address their special needs. WKU's Center for Gifted Studies offers a two-week Summer Camp for Academically Talented Middle School Students. Roughly 180 residential students and 50 nonresidential students spend six hours daily, in classes of 90 minutes each, on topics ranging from computer science and math to science and foreign languages. In electrical engineering classes, they study basic concepts, engage in experiments, and build a small robot.

High school students have often decided if they are studying science but may know nothing about engineering. In 2000 the department of engineering organized a high school robot competition through BEST (Boosting Engineering, Science, and Technology) Inc., a Texas organization with 18 hubs nationally. Given a set of rules and a kit of allowable materials, teams of high school students have six weeks to design, test, and build a remote-controlled robot for competition against the other teams. *Building the robot under a time constraint with restricted materials is similar to what engineers do regularly*. In the Kentucky hub's first year, eight Kentucky teams (75 students) participated, creating a lot of excitement among area high schools. *Allowing students to creatively solve an engineering problem and to interact with team coaches (engineers from industry and faculty) has had a great impact on engineering recruitment.* Each kit costs about $700, but the university and local industry, not the high schools, provide the funds.

An engineering career day for students and their teachers offers hands-on engineering experiences for young women, as well as "a day in the life of a WKU student." The project also sponsored a weeklong summer workshop and two follow-up sessions for elementary and middle school teachers and counselors. *Changing attitudes has to start not just with girls but with their teachers and counselors, who, when made aware of subtle gender-inequitable mannerisms and the need for sound career advice, can generate different career expectations in the girls in their charge*. Parents, teachers, and counselors learn about gender equity issues and are given information about engineering, university housing, financial aid, and scholarships. Teacher participants are expected to make presentations to their peers about women's careers in science and engineering.

The younger girls are when you turn them on to science, the better the chances they will pursue it. But you have to give them some attention and they need role models to look up to—and to show them a possible future. The project is establishing a mentoring network, connecting women in STEM with college students and faculty at Western Kentucky University and with middle and high school students and science teachers in Bowling Green/Warren County and the state of Kentucky.

CODES: E, M, H, U, PD	Western Kentucky University
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Partners: Department of Engineering; WISE; Women's Studies; Center for Gifted Studies; BEST	
Keywords: demonstration, hands-on, mentoring, engineering, gender equity awareness, teacher training, parental involvement, career awareness, role models	

003

Real

Realistic modeling activities in small technical teams

REALISTIC MODELING ACTIVITIES IN SMALL TECHNICAL TEAMS

A COLLABORATION BETWEEN THE ENGINEERING AND MATH EDUCATION FACULTY AT PURDUE UNIVERSITY, THIS PROJECT WILL IDENTIFY LIKELY BARRIERS FOR WOMEN IN COURSES ON MATH TOPICS FUNDAMENTAL TO ENGINEERING AND WILL DESIGN ENVIRONMENTS IN WHICH THE SKILLS AND ABILITIES WOMEN BRING TO ENGINEERING ARE VALUED AND REWARDED.

Realistic, small-group mathematical modeling activities will be incorporated into selected early engineering courses at Purdue—including those required of all incoming freshmen engineering students—to demonstrate how their use in college engineering courses may address gender differences in interest and persistence in engineering. These activities will involve more than 3,000 freshman engineering students (about 600 women), all freshman engineering faculty and graduate assistants, and several faculty who teach sophomore engineering. Because the innovation will be systemic, it might well become a permanent part of the Purdue engineering program.

Complementing course lectures, the modeling activities should improve women's experiences in engineering by adding spatial reasoning experiences and contextualizing tasks (making clear who the client is and what the client needs). Presenting tasks in realistic engineering contexts should help students make stronger connections between course content and on-the-job engineering problems.

During phase one, all students in freshmen engineering courses will be required to collaborate in small mixed-gender technical teams on realistic modeling activities. To emphasize team communication, modeling will be presented in a structured environment, via WebCT (<www.webct.com>), an Internet-based instructional tool. All team members will be required to post their initial ideas about a problem's solution individually on the team's WebCT discussion board. After the initial posting by all group members, they will all have access to each other's initial responses. Then the group will be required to form one solution, or product, to respond to the client's needs.

During phase two, additional realistic modeling activities will be incorporated into sophomore-level engineering courses, providing more sustained experiences for a subset of students. This focused effort in sophomore engineering could generate innovation beyond the project's duration, since engineering faculty in fields such as mechanical engineering have expressed interest in working with the activity design team and have agreed to pilot a few activities. The activities design team is already part of Purdue's School Mathematics and Science Center.

During implementation, research will be done to shed light on how these modeling activities are used to identify emerging student talent; how various constituencies—male and female students and instructors—react to the use of these activities; how students use math and generate mathematical models in these activities; and how students' gender is related to their vision of a future career in engineering. This research will provide insights into the potential effects of small technical teams and realistic modeling activities in engineering courses, into the dynamics of gender equity issues in Purdue's engineering program, and into factors outside of engineering that may influence whether students (especially women) remain interested in and persist in the field.

In short, this project will initiate systematic changes in course content, providing an opportunity to study gender-related issues at the student, instructor, and program level. The modeling activities developed for this project will be made available as part of the Digital Library of Case Studies on Purdue's School of Education Twenty-First Century Conceptual Tools Center, and linked to the Women in Engineering Program. As progress reports and research reports become available they will be published on the same website.

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HRD 01-20794 (THREE-YEAR GRANT)	
KEYWORDS: DEMONSTRATION, ENGINEERING, MATH SKILLS, GENDER DIFFERENCES, COLLABORATIVE LEARNING, MIXED-GENDER, RESEARCH STUDY, CURRICULUM	

003
aW
Assessing women in engineering programs

ASSESSING WOMEN IN ENGINEERING PROGRAMS

WOMEN IN ENGINEERING (WIE) PROGRAMS AROUND THE COUNTRY ARE A CRUCIAL PART OF OUR NATIONAL RESPONSE TO THE NEED FOR MORE WOMEN IN ENGINEERING. THIS PROJECT WILL DEVELOP STANDARDIZED, EXPORTABLE, COMPARABLE ASSESSMENT MODELS AND INSTRUMENTS, ALLOWING COLLEGES AND UNIVERSITIES TO ASSESS THEIR WIE PROGRAM'S ACTIVITIES AND PROVIDE THE DATA NEEDED FOR WELL-INFORMED EVALUATIONS. THE PROJECT INVESTIGATORS WILL WORK WITH WIE PROGRAMS AT THE UNIVERSITY OF MISSOURI AND PENN STATE UNIVERSITY AND WITH COOPERATING PROGRAMS AT RENSSELAER POLYTECHNIC INSTITUTE, GEORGIA TECH, AND THE UNIVERSITY OF TEXAS AT AUSTIN. THE FIVE PROGRAMS COLLECTIVELY REPRESENT A VARIETY OF PRIVATE AND PUBLIC INSTITUTIONS, YEARS OF EXPERIENCE FOR WIE DIRECTORS, AND STUDENT BODY CHARACTERISTICS.

The project will develop pilot assessment instruments, implement and revise them, conduct preliminary data analysis, and disseminate reliable, valid, easy-to-access instruments. The principles of formative evaluation will be applied to all instruments and products, and all institutions will use the same set of instruments—giving them access to powerful benchmarking data as well as that from their own institutions.

An earlier project, the Women's Experience in College Engineering Project, sought to characterize the factors that influence women students' experiences and decisions by studying college environments, events, and support programs that affect women's satisfaction and persistence in their engineering major. By contrast, this project's target audience is WIE directors and its focus is on WIE programs, not students.

Data from these instruments should make it easier for directors of the roughly 50 WIE programs nationwide to make decisions about how to revise the programs or redistribute limited resources, and to provide substantiated evidence for administrators, advisory boards, and potential funding agencies.

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HRD 01-20642 (three-year grant)	
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Keywords: evaluation, benchmarks, data collection, recruitment, retention, assessment tools, engineering	

003
ise
Teaching inclusive science and engineering

TEACHING INCLUSIVE SCIENCE AND ENGINEERING

THIS MODEL PROJECT TO IMPROVE THE ENVIRONMENT IN WHICH WOMEN LEARN SCIENCE AND ENGINEERING BUILDS ON RUTGERS UNIVERSITY'S CURRENT KNOWLEDGE AND PROGRAMS, ESPECIALLY ITS PRE-COLLEGE EDUCATIONAL STEM PROGRAMS, ITS STRONG WOMEN'S STUDIES PROGRAM, THE EXPERIENCE OF DOUGLASS COLLEGE (RUTGERS' UNDERGRADUATE COLLEGE FOR WOMEN), AND A RECENT TWO-DAY SYMPOSIUM AMONG FACULTY IN SCIENCE, ENGINEERING, HUMANITIES, AND WOMEN'S STUDIES DEPARTMENTS, "BUILDING BRIDGES: BEGINNING THE CONVERSATION ACROSS TWO CULTURES."

The project designed and sponsored informal *faculty development workshops* to heighten the faculty's interdisciplinary knowledge of science, engineering, and women's issues. Scholars from science/ technology and women's studies/humanities jointly facilitated the workshops, a natural outgrowth of the symposium. These informal workshops will help in establishing a *formal interdisciplinary seminar* spanning 14 weeks, based on a series of readings that raise issues for faculty to consider. Douglass College and the Institute for Women's Leadership will jointly sponsor two public events to highlight women's participation in science and technology.

Working together, scholars in science, engineering, humanities, and women's studies will design three variations on an *engineering studies module*—for students taking engineering courses, for women's studies courses, and for Introduction to Scientific Research.

Module 1, for young women already enrolled in engineering, will cover the history of women in engineering, as well as engineering problems and solutions of particular interest to women (for example, auto air bags designed for the average male and unsafe for women shorter than five feet). It will emphasize teamwork, an interdisciplinary approach to problem-solving, a total-systems view of society (emphasizing responsible knowledge and problem-solving), and students' learning and working styles as they relate to preferences for different engineering disciplines or subspecialties.

Module 2 incorporates a gender focus into Introduction to Scientific Research a prerequisite for summer science research internships offered to women in Project SUPER. Working in teams, students learn how scientists communicate, do literature searches, read scientific papers, prepare abstracts, analyze data, present results, and analyze the social implications of their research problem or project. They also discuss, for example, Rosalind Franklin's role in the work of John Watson and Francis Crick, and read June Goodfield's *An Imagined World: A Story of Scientific Discovery* (about the life and work of a woman scientist).

Module 3 stresses the importance of engineering and technology in a special section of Women, Culture, and Society, a women's studies course for first-year Douglass College students. Students read classic writers in feminist science studies (e.g., Helen Longino, Anne Fausto-Sterling, and Evelyn Fox Keller) and analyze case studies to learn how technology may lead to social change. A woman's introducing icons on Mac computers, for example, changed computer use from arcane and specialized knowledge (traditionally gendered male in our culture, for complicated but traceable reasons) to a more accessible everyday knowledge (traditionally gendered female). Representing the "delete" function with a trash can icon rather than a special code that had to be memorized democratized access to computer skills.

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HRD 99-08931 (one-year grant)	
Partners: Douglass College, the Institute for Women's Leadership	
Keywords: education program, teacher training, seminar, engineering, problem-solving skills, gender equity awareness, research experience, internships, women's studies	

003

d-m

Gender and team decision-making

GENDER AND TEAM DECISION-MAKING

ENGINEERING AND SCIENCE INCREASINGLY USE TEAM DECISION-MAKING—FROM WHICH WOMEN HAVE HISTORICALLY BEEN EXCLUDED—TO MEET THE NEEDS OF A RAPIDLY DEVELOPING TECHNOLOGICAL SOCIETY. RESEARCH SUGGESTS THAT THERE ARE INDEED GENDER DIFFERENCES IN GOALS, LEVELS OF CONFIDENCE, RISK PROPENSITY, PREFERRED DECISION PROCESSES, PROBLEM-SOLVING MOTIVATION, AND VERBAL, QUANTITATIVE, AND VISUAL–SPATIAL ABILITY.

We don't know what implications those differences will have for organizations as women ascend the corporate ladder. So few women work in engineering that it has been difficult to assess how women's inclusion in decision-making affects engineering decisions. This project from the Colorado School of Mines (CSM), an engineering university, is investigating how the gender composition of design engineering teams affects the decision-making process, the quality of the solution developed, the roles of team members, and the quality of their experience.

Women often exit engineering shortly after starting their college careers, so freshman and sophomore years are critical to keeping them in the engineering pipeline. This project will examine interactions between male and female first- and second-year engineering students enrolled in CSM's Engineering Practices and Introductory Course Sequence (EPICS) program as they try to solve open-ended problems in teams of four. Each year roughly 140 women (20 percent) and 560 men enroll in EPICS' 14 sections.

An open-ended problem has no single correct solution. Instead, students on the design teams use their knowledge of math, science, engineering, and computer science to develop one of many appropriate solutions. They might be asked, for example, to design a piece of interactive playground equipment for use by children with disabilities and their typical peers.

Six graduate students are being trained to observe team interactions using the observational guidelines of Jovanovic and King (1998). During a three-minute interval, observers will indicate a score of "1" for every behavior they observe and "0" for those they don't observe, indicating whether a student engages in (for example) *directing* (instructing other group members on the procedure and execution of the activity), *manipulating* (handling the materials/equipment), or *explaining* (explaining a science concept to another student).

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HRD 99-79444 (one-year grant)	
Keywords: research study, teamwork approach, self-confidence, gender differences, engineering	

003

dvs

Developing visualization skills

DEVELOPING VISUALIZATION SKILLS

COLLEGE WOMEN DROP OUT OF ENGINEERING PARTLY BECAUSE OF THE CULTURE AND PARTLY BECAUSE OF PRACTICAL PROBLEMS SUCH AS THE ONE THIS OHIO STATE UNIVERSITY PROJECT ADDRESSED: *WOMEN ACCUSTOMED TO ACADEMIC SUCCESS TEND TO LEAVE ENGINEERING IF THEY PERFORM POORLY IN EARLY ENGINEERING COURSES.* THE FIRST ENGINEERING COURSE OSU ENGINEERING STUDENTS OFTEN ENCOUNTER IS ENGINEERING GRAPHICS—A COURSE IN WHICH FEMALE OSU STUDENTS SCORE AN AVERAGE 12 PERCENTAGE POINTS LOWER THAN THE MALE STUDENTS. A POOR GRADE IN THIS COURSE CAUSES SOME TALENTED WOMEN TO LEAVE ENGINEERING, CONVINCED THEY CANNOT SUCCEED AS ENGINEERS.

The problem seems to be that *most women have trouble visualizing a three-dimensional (3-D) object, given a two-dimensional (2-D) representation such as a set of orthographic views or even an exploded assembly drawing. Assuming that girls don't experience enough hands-on activities to develop visualization skills, this project offers a workshop that helps them do better in engineering graphics*.

In a weeklong workshop, 30 women learned about tools and vocabulary by getting an up-close look at shop tools (such as drills, lathes, and welding equipment), using small hand tools (for example, to tap a hole), and handling and learning the characteristics of various fastening devices (such as nuts and rivets). While improving their skills and knowledge, the women also learned some basics about engineering and engineering courses.

To learn how to relate 2-D representations to 3-D objects, participants were asked to look at orthographic views of an object (on paper or on a computer screen) while holding and rotating the object; to rotate the object to orient it the same way it is oriented in an isometric drawing; to draw orthographic and isometric drawings of a solid object (manually or using a CAD system); to produce an isometric drawing based on a set of orthographic views; to carve a solid object from clay using a set of orthographic views; and to assemble an object from a set of parts, following an exploded assembly drawing.

The activities in this workshop were designed for the critical period between high school and college but could be incorporated into either high school or college courses.

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Keywords: demonstration, workshops, retention, visualization skills, engineering, hands-on	

003

tom

Sissies, tomboys, and gender identity

SISSIES, TOMBOYS, AND GENDER IDENTITY

SOCIOLOGY GENERALLY DEFINES "GENDER IDENTITY" AS "SOCIALLY CONSTRUCTED NOTIONS OF MASCULINITY AND FEMININITY." IN THE SPRING OF 1995, THE POWER PROJECT (POSITIVE OPPORTUNITIES FOR WOMEN ENGINEERS' RETENTION) SURVEYED 614 FACULTY MEMBERS AND 1,314 STUDENTS AT THE NEW JERSEY INSTITUTE FOR TECHNOLOGY AND FOUR NEW JERSEY COMMUNITY COLLEGES ABOUT ISSUES OF GENDER IDENTITY. SURVEY RESULTS REVEALED THAT *WOMEN ENROLLED IN ENGINEERING FELT THEY HAD TO HIDE BOTH THEIR FEMALENESS AND THEIR FEMININITY TO SUCCEED IN ENGINEERING*. LOOKING AND ACTING MORE MASCULINE—TO BLEND IN WITH THE BOYS—HELPED WOMEN SURVIVE. STUDENTS WHO WERE PREGNANT AND COULD NO LONGER HIDE BEING A WOMAN FELT ESPECIALLY VULNERABLE AND WERE NOT TAKEN SERIOUSLY IN THE ENGINEERING CLASSROOM.

Women appear freer about crossing gender identity lines than men. In response to the entry "Based on the way I dress, my outer appearance looks 'very masculine, somewhat masculine, both masculine/feminine, somewhat feminine, neither masculine nor feminine,'" all male faculty and most male students saw themselves as looking masculine, some women said they look masculine, but no male faculty member said he looks feminine.

Men may feel more pressure to conform to gender stereotypes from an early age: 95 percent of male students and 70 percent of female students reported that they were "normal" as kids. Only 3 percent of males said they were labeled sissies and three fourths of those "sissies" said they look masculine today. *Men may feel more compelled to look masculine than women feel compelled to look feminine.*

In this sample of students, about 30 percent of all women, half of the "masculine females," and a quarter of the "feminine females" reported being called tomboys as a child. There were no masculine-appearing or androgynous "sissy" females; all "sissy" girls described themselves as now appearing feminine. *Tomboyishness exists across all disciplines, but the incidence of tomboys increases in the traditionally masculine fields of the "hard sciences" and declines in the traditionally female fields of the "soft sciences" and the liberal arts. A masculine identity favors females in engineering science.*

For purposes of analysis, respondents who said they were either "both masculine and feminine" or "neither masculine nor feminine" were classified as "androgynous." Of *androgynous men, 80 percent identified as "neither masculine nor feminine"; of androgynous women, 80 percent identified as "both masculine and feminine"—a major finding that held true for both faculty and students. People's gender or biological sex seems to affect even the type of androgyny they choose*. Roughly 10 percent of the New Jersey faculty said they look androgynous—of which two thirds are women. Of 52 self-labeled androgynous people in the faculty sample, 81 percent are American and 85 percent are white.

There was a correlation between gendered boys' toys and a major in science, math, and engineering. *Few future engineers liked only girls' toys, as children, even if they were girls. In all disciplines, the majority of girls liked both girls' and boys' toys*. Again, girls felt more freedom to cross gender identity lines. It appears more girls were allowed to play with boys' toys than boys were allowed to play with girls' toys. The great majority (78 percent) of "androgynous" females and a majority (61 percent) of "feminine" females liked both girls' and boys' toys, while 43 percent of "masculine" females liked both girls' and boys' toys (half liked boys' toys exclusively). Even among feminine females (46 percent of whom major in the social sciences, mostly in the humanities, in this sample), 54 percent liked both girls' and boys' toys—only 42 percent preferring girls' toys. *(Parents and toy manufacturers, take note: Provide more girls' toys that teach the same math/science/spatial skills as boys' toys do.)*

Androgyny among men varies by race: 83 percent of androgynous white and Asian males preferred boys' toys, compared with only 57 percent of blacks and Hispanics. No Asian male played exclusively with girls' toys, but more Asian males played with both boys' and girls' toys than any other racial group. In this study, *whites appear less rigid about girls' gender identity than people of color. No black woman in this study was ever called a sissy.*

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Partners: Hudson County College, Middlesex County College, Ocean County College, and Brookdale Community College	
Keywords; research study, engineering, gender differences, survey, gender identity, feminism	

Ethnicity and gender identity were the two of the most interesting variables in the survey. The majority of Asian (59 percent) and Middle Eastern (57 percent) faculty agreed that "women students won't have any problems in my department as long as they blend in with men." EuroAmericans (75 percent), Jews (67 percent), Indo-Pakistanis (56 percent), and other people of color disagreed (96 percent).

003
er
WISE scholars do engineering research

WISE SCHOLARS DO ENGINEERING RESEARCH

ALTHOUGH THE PIPELINE THROUGH WHICH YOUNG WOMEN TRAVEL ON THEIR WAY TO GRADUATE PROGRAMS IN ENGINEERING AND APPLIED SCIENCE LEAKS ALL THE WAY, WOMEN TEND TO EXIT AT THREE JUNCTURES, ESPECIALLY: AT THE POINT OF (NOT) CHOOSING A CAREER IN ENGINEERING, IN THE TRANSITION FROM UNDERGRADUATE TO GRADUATE (ESPECIALLY PH.D.) PROGRAMS, AND WHEN THEY MUST DECIDE WHETHER TO PERSIST AS ENGINEERS IN ACADEME AND INDUSTRY (WHERE THE ENVIRONMENT MAY BE HOSTILE FOR TOKEN WOMEN). THROUGH PROFESSIONAL DEVELOPMENT AND COMMUNITY BUILDING, THE LUCILE B. KAUFMAN SCHOLARS PROGRAM AT ARIZONA STATE UNIVERSITY (ASU) IS ENCOURAGING UNDERGRADUATE WOMEN IN ENGINEERING TO PURSUE GRADUATE DEGREES IN ENGINEERING.

Louise Kaufman was the first woman to become a faculty member in ASU's college of engineering and applied science. The Scholars program—a joint initiative of the graduate college, the college of education, and the college of engineering and applied science (CEAS)—combines professional development and community building.

The summer between her junior and senior years, a Scholar participates in an eight-week research experience, working about 200 hours with local faculty and receiving a $1500 stipend. The faculty working with the Scholars must attend a seminar on gender diversity. Fifteen faculty members with ongoing research projects have agreed to participate.

Scholars completing academic-year program activities also receive a $500 scholarship.

Every other week, workshops and seminars are presented on topics such as what you can do with a graduate degree in engineering, what to expect from graduate school, choosing a graduate program, breaking the glass ceiling, writing an effective résumé/curriculum vitae, how to apply for graduate school, interviewing to get in, gender differences in the classroom, and creative financing in higher education. Participants are invited to monthly networking events sponsored by the Scholars program and are notified of other relevant events. They are mentored and get to know one another and CEAS faculty. Mentors are recruited from ASU, local industry, the Society of Women Engineers, and other professional associations.

Self-efficacy is one's belief that one can perform a certain task or behavior. One builds self-efficacy through accomplishments, vicarious learning (seeing others model the behavior), encouragement and support, and physiological arousal (such as reduced anxiety). Expectations of self-efficacy are viewed as mediators of behavior and behavioral change. Expectations of outcome (one's belief about the consequences that will result) also affect one's motivation to perform a task or behavior. The Scholars program is giving its scholars opportunities for performance, accomplishment, vicarious learning, encouragement, support, and reduced anxiety. And they will be paid for their effort.

Project evaluation will compare Scholars' achievements with those of a cadre of comparably motivated women who did not participate in the Scholars program.

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HRD 97-10554 (ONE-YEAR GRANT)	
KEYWORDS: DEMONSTRATION, ENGINEERING, RESEARCH EXPERIENCE, GENDER DIFFERENCE, MENTORING, SELF-EFFICACY	

93

003

mom

Bring your mother to (engineering) school

BRING YOUR MOTHER TO (ENGINEERING) SCHOOL

TO ATTRACT MORE YOUNG WOMEN TO ENGINEERING, THE SCHOOL OF ENGINEERING AND TECHNOLOGY AT CALIFORNIA STATE UNIVERSITY'S LOS ANGELES CAMPUS (CSULA) WILL EXPAND ITS MOTHER–DAUGHTER ACADEMY—AN INTRODUCTION-TO-ENGINEERING WORKSHOP FOR HIGH SCHOOL STUDENTS AND THEIR MOTHERS. ITS AIM: TO ENCOURAGE GIRLS AND THEIR MOTHERS TO CONSIDER ENGINEERING A VIABLE OPTION FOR WOMEN, TO DISPEL THE MYTH THAT ENGINEERING IS PHYSICALLY DIFFICULT AND UNFEMININE, TO RAISE THE LEVEL OF SCIENTIFIC KNOWLEDGE, AND TO FOSTER A PUBLIC APPRECIATION OF ENGINEERING.

Neda Fabris, a professor of mechanical engineering at Cal State, developed CSULA's first Mother–Daughter Academy in 1995, piloting it on a shoestring. Funded by state lottery income, the workshops have been well received and nationally publicized. Fabris hopes a tradition of Bring Your Mother to School will grow to complement Bring Your Daughters to Work.

Fabris starts her presentation about engineering by holding up a $20 bill and saying she will give it to whoever can name one thing in the room untouched by engineers. Participants often start with themselves; she mentions the toothbrush, coffee cup, and comb they used that morning. They mention air and she discusses smog, which comes mainly from automobiles, which are designed by engineers (whose influence may not always be positive!). She thought she was in trouble when a girl showed a silver ring made by American Indians but then explained how silver must be dug by picks and hammered. She always keeps her money and they get a lecture on how important engineering is to everyday life.

All but one of the daughters who participated in 1996 decided to study engineering, although only a few were considering it before the workshop. At least one mother, intellectually stimulated by the workshop, returned to school to work toward an advanced degree. Ratings were high for all parts of the workshop, with students preferring the hands-on contests and mothers preferring the theory and demonstrations.

"Overselling any profession does not yield results," says Dr. Fabris. "We all know that engineering is a hard and serious profession. Neither students nor professional engineers spend their time making Popsicle bridges and touring companies." *Activities need to be meaningful, yet attainable enough that participants can benefit from the experience.*

Now CSULA will conduct (and evaluate the impact of) two different models of the Mother–Daughter Academy. *The year-round academy* will consist of six five-hour sessions, combining lectures, videos, demonstration experiments, and hands-on contests. Contests scheduled involve girls in building a tower to hold a soda can, using Popsicle Sticks and rubber bands (related to civil engineering); an egg drop test (materials and mechanical engineering); assembling solar cars from kits and racing them (electrical and power engineering); and engraving their initial in a piece of hard wax using Mastercam software (manufacturing engineering). Participants will be introduced both to engineering careers and female role models and will visit a local high-tech company. Winners of hands-on contests and awards for best attendance and most enthusiasm will be awarded scientific calculators.

The project targets high school juniors, who often lack the math required for engineering and rarely consider a career in engineering, for lack of female role models, parental encouragement, or an understanding of what engineers do. Participants will be selected from schools participating in the Mathematics, Engineering, and Science Achievement program. The MESA office will monitor and track the girls' success and career choices.

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Keywords: demonstration, role models, engineering, parental involvement, career awareness, hands-on, teamwork approach	

A MOTHER'S INFLUENCE

Asked what they wanted to study, most high school girls answer, "I don't know." Asked who most influenced their career choices, they usually answer, "My parents"—and for girls, especially, "My mother." Intentionally or unintentionally, mothers influence their teenage daughters' career paths, typically know very little about math and science, and tend to perpetuate stereotypes about math and science being men's work, best avoided by women.

As the daughter of an open-minded mother, Neda Fabris was unaware of research on the subject at the time she launched the Mother–Daughter Academy, but she had noticed that mothers play a significant role in their daughters' career choices. And as the mother of two small children, Fabris noticed that PTA mothers often showed considerable interest in her career as a mechanical engineer. Several middle-aged women told her, often with a touch of sadness or jealousy, that they wanted to major in science or engineering but were discouraged from doing so by their mothers, counselors, and teachers. They were surprised when she told them that her mother, a foreign language teacher, had strongly encouraged her to study engineering. Fabris's mother, from her experience in Sarajevo (Bosnia) in World War II, had concluded that engineering offered a solid chance for survival and prosperity anywhere in the world. Although Fabris was scared to death of engineering, the more she learned, the more she came to enjoy it and agree with her mother. She also became convinced that mothers should be more actively involved in their daughters' academic and career choices.

At the June 2001 meeting in Denver of the Society of Women Engineers, Fabris accepted the Distinguished Educator Award. After a standing ovation greeted her acceptance speech, she said, "It is a long way from Sarajevo to Denver."

PHYSICS

003

X-P

Experiment-based physics for girls

EXPERIMENT-BASED PHYSICS FOR GIRLS

PHYSICS FOR GIRLS SHOWED FIFTH AND SIXTH GRADE GIRLS THAT SCIENCE IS FUN, WHILE INTRODUCING THEM TO BASIC SCIENCE CONCEPTS AND SIMPLE SCIENTIFIC EQUIPMENT. NOW EXPANDED INTO THE SEVENTH GRADE, THE EXPERIMENT-BASED PROGRAM WAS A COLLABORATION BETWEEN A PHYSICS PROFESSOR AT THE UNIVERSITY OF MISSOURI AND THE SCIENCE COORDINATOR OF COLUMBIA'S PUBLIC SCHOOL SYSTEM. THE VOLUNTEER PARTICIPANTS—SOME HIGHLY MOTIVATED, SOME LESS SO—BECAME MORE SKILLED AT BUILDING, EXPERIMENTING, AND LOGICAL REASONING.

The programs were taught by science teachers who were trained at three-week summer institutes, using the same materials and equipment their students would use. The project has developed and tested modules in

- *Optics* (the reflection, refraction, dispersion, and polarization of light)
- *Sound* (resonance in strings and tubes and sound as a wave—interference and beats)
- *Matter and mechanics* (air, air pressure, and Bernoulli's theorem)
- *Fluids, density, and Archimedes' principle* (the mechanics of solid objects, stability and equilibrium with torques and forces, the principles of conservation in simple machines—energy, linear, and angular momenta)
- *Electricity and magnetism* (circuits, or the flow of electricity; magnetic fields; and building small motors, doorbells, and burglar alarms)
- *Energy and rockets* (energy and kinematics, trajectories, collisions, dynamics, and energy conversion)

An average 25 to 40 girls participated in extracurricular after-school programs at 18 schools, with parents providing transportation. Local interest was high, and materials and sources were inexpensive. As a bonus, a female astronaut came to visit.

For each physical concept, children learned in a logical sequence to

- Play a game to internalize the concept
- Use the internalized concept to build a gadget, game, art project, or toy (thereby developing building and mechanical skills)
- Develop the concept through experiments, using simple scientific equipment and commonly available materials
- Perform mathematical analysis (for students in higher grades)

Wildly enthusiastic about the program, all the girls stayed till the end. A six-item instrument sampled their confidence in physics using pre- and post-tests, and comparing them with male and female peers who did not attend the program. *All girls showed less confidence than boys on pre-tests for optics and electricity, but after attending the program the girls reported more confidence, equaling or exceeding that of their male peers on all items in optics and in five out of six items in electricity.*

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THE CD EXPLORING PHYSICS—ELECTRICITY AND MAGNETISM IS AVAILABLE AT (www.exploringphysics.com)	
KEYWORDS: DEMONSTRATION, SCIENCE EXHIBITS, TEACHER TRAINING, EXPERIMENT-BASED, HANDS-ON, PHYSICS, AFTER-SCHOOL, SELF-CONFIDENCE, REAL-LIFE APPLICATIONS	

MAKING BOUNCING BALLS

Newton Academy, a summer science academy for girls who have completed grades 9, 10, or 11. To give high school girls a chance to engage their hands and minds and to show them science's practical applications, the project invited 33 high school girls to make bouncing balls in an 11-day summer science academy. The girls spend a week building a miniature "toy factory" to produce the kind of bouncy balls sold in machines in grocery stores. Working in teams, they had to design a process to mix the materials, roll the balls, transport them from one place to another, and package them. They had to automate two of the manufacturing processes using machines they built themselves and were allowed to patent their designs.

Before building their factories, the girls dismantled copying machines, typewriters, CD players, and Teletypes, using reverse technology to understand the instruments' design and layout. They salvaged many small parts and devices—especially paper feeders for conveyor belts, and gears, motors, and pulleys—for their factory. *Some girls had never "taken stuff apart"—an activity traditionally associated with boys—and loved doing so. Girls who had grown up on farms had often taken things apart and put them back together before, but it was "cool" to have someone there to explain to them how things worked*.

They could purchase other needed parts—including wire, string, batteries, and duct tape—from a "store" in another classroom, using fake Newton dollars distributed to each team, which they had to budget. Before drawing up plans for their facility, they toured the university's engineering manufacturing lab and the nearby Unilever manufacturing facility, where they saw the value of precision and efficiency and got new ideas for their factories, such as using conveyor belts and doing different steps at different stations. Unexpectedly, they also became aware of the importance of reducing waste as they produced the balls. At their final session, a Family (pizza) Night, the students demonstrated their factories to their families and friends and sold their polymer balls. Their families were given Newton dollars to use that evening, which was a big hit among the younger siblings.

The program *allowed teenage girls to identify with their peer group, to see that other girls were interested in science, and to focus more on learning and less on the fact that they were working in an area traditionally dominated by males*. Meanwhile, in addition to their project mentors and role models, they had such visitors as an "awesome" woman from the Jet Propulsion Laboratory, who showed slides of Mars, watched the film *Contact* with them, and told them what was fact and fiction. Their interest in science and astronomy soared.

In producing the balls the girls learned math, computer programming, and graphing skills (determining the optimal mix of glue and borax required to get the highest bounce out of their balls), engineering (system design and factory layout), physics (gears, pulleys, and electrical systems), chemistry (encountering polymers, acid-based chemistry, absorbance spectophometry, and waste generation), economics and cost–benefit analysis (budgeting Newton dollars to purchase factory materials), and law (evaluating designs for novelty and completeness, for patents).

003

Sg

Selling girls on physical sciences

SELLING GIRLS ON PHYSICAL SCIENCES

ONLY 20 TO 25 PERCENT OF HIGH SCHOOL STUDENTS TAKE PHYSICS BEFORE THEY GRADUATE, WITH PERCENTAGES SLIGHTLY HIGHER FOR BOYS THAN FOR GIRLS. *MANY STUDENTS TAKE TWO OR THREE SCIENCE COURSES—ENOUGH TO MEET THEIR REQUIREMENTS—BUT NOT PHYSICS, WHICH THEY DON'T THINK THEY WILL NEED, VIEW AS A COURSE ONLY FOR THE TOP KIDS, AND ARE OFTEN SIMPLY AFRAID OF. WHEN THEY GO TO COLLEGE, WHERE PHYSICS IS REQUIRED FOR MANY FIELDS (INCLUDING ENGINEERING AND MOST HEALTH-RELATED PROFESSIONS), THEY GET CLOBBERED*.

This comprehensive University of Missouri (MU) program to engage girls from grades 5 through 12 in learning physics is a collaboration between MU faculty, teachers and administrators in the Columbia, Mo., public schools, parents, and local industries. Training, curriculum, and extracurricular activities emphasize hands-on learning—such as building a factory to produce bouncing balls—to spark girls' interest in the physical sciences and show them its relevance to their lives. Pre- and post-tests were administered in all project components.

"If they don't see that science is going to be useful, they don't want to take it," says co-director Meera Chandrasekhar, the MU physics professor who received a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring for the project. "Many girls don't feel they can do science, so they shy away from science courses. They are interested in science but haven't done much with their hands. That's where I started out. I really got interested in physics in my first year in college. I had a really good teacher and all of a sudden it just made sense."

Exploring Physics, an after-school enrichment activity for girls, grades 5–7. Middle school girls were offered units in optics, electricity and magnetism, and matter and mechanics. For each unit, they met twice a week for four weeks. In the first seven sessions the girls engaged in hands-on projects, using everyday materials. The eighth session was held in the evening so the girls could share what they had learned with family members.

In the unit on electricity and magnetism, the projects taught the girls the underlying principles of batteries, including those made from vegetables and those that are a natural part of the human body; electric generators; magnets and electromagnets; charging and discharging capacitors in electric circuits; and the resistance of common materials such as pencil lead.

Tests to measure changes in interest and confidence showed that before taking the program, neither the girls in the program nor a control group were as confident as a control group of boys, *but after the program the girls who took the program were as confident as, or more confident than, the boys, on all items but one (out of 12)*.

Saturday Scientist for junior high. With help from local industry, 98 students from three junior high schools learned about what they needed to study to pursue science careers, toured local industrial facilities, saw science professionals in action, and did experiments on their own. At Columbia Water & Light, for example, they built small houses from materials such as cardboard, plexiglass, and sheetrock, and heated them with a light bulb—measuring heat loss to see which material was the best insulator. With an infrared camera, they could see the "hot spots" in their houses and determine where heat loss was the worst.

FEST (families exploring science and technology). Science is rarely one of the things parents and children do together. FEST, which offered hands-on science activities for sixth and seventh graders and their parents, grew out of an earlier program for younger children. In two-hour sessions, children and their parents worked together to build a working drawbridge, incorporated concepts of structure, stability, gears, motors, and electrical circuits. They saw working drawbridges in a video and in clips from *Annie, The Blues Brothers,* and *The Wizard of Oz*. They got lessons on structure, gears, and electricity, and practiced skills they would need to build their own bridges. They built trusses from balsa sticks and tested their designs for strength. They investigated the effect of gear size on force and speed. In the electricity lesson, they assembled simple series and parallel circuits connected to motors and LEDs and learned how to operate a double pole–double throw switch, to operate the drawbridge. They built the floor and sides at home and assembled their drawbridges at the final session.

Parents and children enjoyed the time they spent together on building projects and suggested expanding the program to six or eight sessions and building more projects. *Establishing a positive relationship around science encouraged parents to encourage their children's pursuit of science.*

Summer physics workshops for teachers. In 1998, two one-week summer physics workshops were held, an optics institute (for 18 middle-school teachers) and a sound institute (for 21). Paralleling content covered in the schools and the student programs, the workshops taught concepts through hands-on activities supplemented by lecture, discussion, and problem-solving. For the sake of evaluation, teachers recorded their thoughts and questions in a learning log.

No one came to the workshop with a good understanding of optics, but all learned a lot and left with a much better grasp of a complex subject. They felt challenged and stretched but found the workshop an excellent and enjoyable way to learn difficult material. Initially, however, they were very anxious and not so optimistic. When they were clearly uncomfortable with the material being presented or what they were expected to learn, they interacted little, except to agree that they were confused. One heard, "I don't understand"—especially about frequency and the Doppler effect in the sound course and about focal length and the differences between concave and convex mirrors and lenses, in optics. After a few classes they settled down and began asking pointed questions and using the course terminology.

For their hands-on projects, participants applied their newfound knowledge by building an apparatus. Their projects—for example, a laser light show, a water xylophone, and a kaleidoscope—were all of high quality, some with innovative construction, and showed they'd assimilated the material. *Projects made the concepts concrete for them, reinforcing their understanding. Some participants said they felt they would retain what they learned because of the course expectations, the materials used, the enjoyable hands-on reinforcement of concepts, the real-world applications, and the many homework problems*. They became consultants, often answering questions for each other so the instructor didn't have to do so. In the flexible learning environment, the participants became interactive learners, showing a beginning mastery of the material. Some thought the hands-on projects took up too much (sometimes frustrating) time with no obvious benefit, but in listening to their presentations, looking at their uniformly good writeups, and knowing how far the participants' knowledge level had advanced, the evaluators concluded that the participants had learned a lot without realizing it.

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Keywords: education program, physics, hands-on, real-life applications, after-school, summer program, self-confidence, field trips, peer groups, mentoring, role models, career awareness, parental involvement, teacher training	

003

TNT

TNT girls go to physics camp

TNT GIRLS GO TO PHYSICS CAMP

IN 1998 THE COLLEGE OF ST. SCHOLASTICA PUT 35 MINNESOTA AND WISCONSIN SEVENTH GRADERS THROUGH A FIVE-DAY TOOLS AND TECHNOLOGY (TNT) PHYSICS CAMP, DESIGNED TO ENGAGE THEM AND THEIR PARENTS IN HANDS-ON PHYSICS ACTIVITIES. IT WAS THE SECOND IN A SERIES OF PROGRAMS TO SUPPORT A COHORT OF GIRLS AS THEY MOVED THROUGH K–12.

The girls started by building a pine toolbox. At first some girls were intimidated by the power drills, but soon they were vying for access to them. Guided by women scientists and instructors, they built large-scale inventions such as roller coasters, water-powered rockets, and motor-controlled planes. Each was given a hammer, pliers, and a six-in-one screwdriver to use at camp and to take home.

After building their own siege engine—a medieval invention to catapult objects—they launched the head of a Barbie doll, to mimic the medieval practice of launching diseased corpses over castle walls, to introduce disease among the besieged. Nestling Barbie's head in a sling, they tugged a rope, released a lever, and launched the doll's head in an arc across the college lawn. Her head was too light. By stuffing it with lead sinkers they made it heavy enough to launch. They also catapulted a motorized plastic pig, eggs, and fruit, learning through experience that potatoes and apples were a good weight for the purpose.

Working together, they learned about inquiry, teamwork, physics principles, and the use of tools. Betsy Fochs, a former pilot and a professor at the University of Minnesota at Duluth, taught them about conductors and transistors during a marathon appliance-smashing session in which they smashed open, tore apart, and studied the inner workings of telephones, VCRs, toaster ovens, TV sets, and parking meters. Exposure to science and women scientists is important at this age, says Fochs, "because *it's the age they start to think it's not cool to be smart.*"

As part of TNT, the girls experienced both the intensive summer residential camp and monthly follow-up activities during the school year. On Physics Fridays, they worked in pairs or teams on small-scale inventions that included a simple machine and demonstrated a principle of physics—culminating in a TNT Girls Expo at the Science Museum of Minnesota, whose staff participated in programming. The girls developed a website and presented their inventions with posters and PowerPoint presentations that illustrated their hypothesis, data collection, and conclusion.

They also took field trips to construction sites (to see large tools in action), the Science Museum of Minnesota, a robotics laboratory, an aerial lift bridge, a repair and maintenance facility for large aircraft, a pulp and paper plant, and, for the second cohort, a Science & Technology Weekend at The Works Museum in Eden Prairie, Minn.

The girls enjoyed working together on group construction projects, taking apart household objects, and making friends. Students and parents both noticed that the girls grew in *self-confidence, knowledge of physics, and social relationships. Students said they had better grades and were more familiar with technology.*

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KEYWORDS: DEMONSTRATION, HANDS-ON, PARENTAL INVOLVEMENT, SUMMER CAMP, MUSEUM, STAFF TRAINING, PUBLICATION, PHYSICS, WEBSITE, FIELD TRIPS, TOOLS, TEAMWORK APPROACH, INQUIRY-BASED, SELF-CONFIDENCE	

003
how
Changing how introductory physics is taught

CHANGING HOW INTRODUCTORY PHYSICS IS TAUGHT

TO REDUCE THE DROPOUT RATE FROM CALCULUS-BASED INTRODUCTORY PHYSICS COURSES, AND TO IMPROVE THE LEARNING AND RETENTION OF ALL STUDENTS (BUT ESPECIALLY WOMEN AND MINORITIES), A MODEL PROJECT AT THE UNIVERSITY OF MEMPHIS UNDERTOOK TO CHANGE THE WAY INTRODUCTORY PHYSICS COURSES ARE TAUGHT. THE PROJECT EMPHASIZED *CHANGES NOT IN THE CONTENT BUT IN HOW IT IS PRESENTED*, AN EMPHASIS THAT MAKES THE PROJECT PORTABLE FROM ONE COURSE OR DISCIPLINE TO ANOTHER AND PRESUMABLY MORE ACCEPTABLE TO MORE FACULTY.

Like much current reform in math and science, the project emphasized

- Increasing students' comfort level by establishing a sense of community in the classroom
- *Showing the subject's value and relevance in everyday life*
- *Making the course less competitive and more collaborative (encouraging small-group discussions and problem-solving, for example, and stressing collaboration rather than rivalry)*
- *Using problem-solving as a vehicle for understanding physical concepts and developing intuition*
- Adopting criterion-referenced grading (based on students' progress toward clearly defined class objectives) instead of grading on a curve
- Building students' confidence and skill at self-assessment
- Encouraging risk-taking

Teachers can encourage risk-taking and learning from mistakes by

- Emphasizing improvement and factor improvement into grades
- Emphasizing mastery of the material, not finishing fast, or first
- *Aiming at specific objectives (regardless of time or trials)*
- *Allowing students to drop their lowest grade or redo an assignment*
- *Giving some assignments that are ungraded but carefully read—with students getting feedback but not grades, thereby teaching them to separate the analysis of mistakes from their grade*

Naturally, reforming the way physics is taught and evaluated requires introducing new teaching techniques to STEM faculty—techniques for being more supportive of students and presenting the material in a way that helps engage them with the subject material and learn it better. It also means showing them how the old ways of teaching are turning off many students that the department and the scientific and technical workforce need.

Workshops for professional development emphasized developing awareness of the problem (how current practices limit opportunities for women and students of color), improving classroom climate and dynamics, developing alternative ways of structuring the course and testing for mastery, and improving the course content by providing concrete demonstrations and examples accessible and engaging to a wider audience.

Particular attention was paid to *helping students develop skills in self-assessment—knowing when a project is "good enough" to turn in and when it needs revision, when they have mastered a topic and can stop studying, when to ask for help, whom to ask*, *and what to ask*. Women tend toward underconfidence, so they often set lower goals and avoid risks—a problem exacerbated by many teachers' lower expectations, especially of women of color. Males are more likely to say "I did well," and females to say, "The teacher said I did well," laying emphasis on others' perception of their performance.

The project *taught students to avoid such dysfunctional ways of explaining success and failure, to understand their own role in that success or failure, and to correctly label any external influences on performance*. A teacher might ask students to predict how they will do on exams, for example, have them evaluate their own work, give them clear grading guidelines to help them do so, have them evaluate group projects and group participation, and ask for predictions before in-class physics demonstrations. Making predictions forces students to think about and evaluate factors that cause or affect outcomes. They should also be asked to reflect on discrepancies between their own evaluation and the instructor's.

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Keywords: demonstration, physics, calculus, retention, collaborative learning, real-life applications, self-confidence, teacher training, curriculum	

003

TIP

Teaching internships in physics for undergraduates

TEACHING INTERNSHIPS IN PHYSICS FOR UNDERGRADUATES

WOMEN REPRESENT 25 TO 45 PERCENT OF UNDERGRADUATES ENROLLED IN INTRODUCTORY PHYSICS BUT ONLY 10 PERCENT OF PHYSICS GRADUATE STUDENTS. MANY WOMEN COME TO THE UNIVERSITY OF ROCHESTER EXPRESSING AN INTEREST IN SCIENCE AND ENGINEERING BUT LEAVE SCIENCE IN THEIR LAST TWO YEARS. BY PROVIDING TEACHING INTERNSHIPS FOR UNDERGRADUATES, THIS MODEL PROJECT FROM ROCHESTER'S DEPARTMENT OF PHYSICS AND ASTRONOMY INCREASED BOTH THE NUMBER AND COMPETENCE OF INSTRUCTORS IN LAB SECTIONS FOR INTRODUCTORY PHYSICS. ONLY TIME WILL TELL IF IT INCREASES THE LONG-TERM RETENTION OF UNDERGRADUATE WOMEN IN SCIENCE, BUT THE PROJECT IMPROVED INSTRUCTION IN INTRODUCTORY PHYSICS ENOUGH THAT THE DEPARTMENT OF PHYSICS AND ASTRONOMY HAS INSTITUTIONALIZED IT.

At Rochester, all students preparing for science and engineering majors must take an introductory physics sequence and the associated lab course. Each semester roughly 600 students are placed in 20 lab sections led by graduate student teaching assistants (TA). This project recruited 20 undergraduate women concentrating in science as paid teaching interns (TIs), pairing each of them with an incoming graduate teaching assistant as co-instructors for the introductory physics labs. The undergraduate trainees were recruited from top-scoring sophomores and juniors (not just physics majors) who had already taken the course. The lead TA and the TI shared equally in teaching duties (except for grading, which the TAs did).

Before they got their assignments, the TIs were trained in teaching, leadership, and communication skills. *Instructor training was important for developing confidence, teamwork, and a sense that gender equity was valuable*. Both students and instructors benefited from the team and peer instruction. *The qualities brought to the classroom by the undergraduate TIs complemented those of the graduate student TAs: The TIs were closer to the lab students in age and level of understanding of physics, while the TAs knew more about physics.*

Initially concerned about being able to speak confidently before a group of students, some of the TIs feared knowing too little about physics to answer students' questions. Overwhelmingly, after the experience, they felt more confident about their ability to teach, to speak to a group, and to be a TI for a second year (even if it meant learning new lab material). As teachers, they learned how to be patient with undergraduates, how to get a point across, how to express the same idea patiently in many ways, and how to deal with different levels of understanding. They learned enough about the lab experiments to facilitate completion of the labs, and most of them learned enough about the subject matter, generally, to answer questions adeptly or to say "I don't know."

Undergraduates enrolled in the labs gave the TAs and TIs feedback about instruction through *small group instructional diagnosis*, a method for students to evaluate instructors midcourse through focus groups (or facilitated small-group discussions) to improve learning. *After the instructors discussed the feedback with them, students were more motivated*. Undergraduates had two sets of hands to help them in the lab courses and were largely happy with the interactive, one-on-one teaching they got on lab experiments, especially when TIs circulated, answering questions and giving them hints while the labs were in progress. They were impressed by the TIs' ability to explain the lab material clearly, felt most TIs knew the material well, and were more critical of timing than of clarity and coherence: *They suggested that instructors start the lab with a brief introduction and then dole out the rest of the details in installments as they reached that part of the lab work—rather than give them too much all at once*.

With one exception, TAs and TIs considered the relationship mutually beneficial. The TIs helped the TAs manage the lab and made their life much easier, and the TAs helped the TIs understand their physics homework. The TAs felt the TIs generally were well prepared, knew what they were doing, weren't afraid to ask questions and get clarification if they needed it, and knew the ins and outs of the labs even if they didn't always fully understand the concepts behind them. The TAs who spoke English as a second language were especially grateful for the TIs' help interpreting both the students' questions and the TAs' explanations. *The TIs bridged the TAs' understanding of what the undergraduates would not understand and got high marks from the students for being friendly, approachable, and accessible. The TIs learned about both physics and graduate school from the TAs, who as graduate students had a greater knowledge of physics.*

The dynamics changed the second year, when the project recruited 16 women and four men. A man volunteered to be lead TI, there was less continuity and cohesion in the group, and the project realized that, if the intent was partly to encourage female leaders, attention must be paid to male–female interactions as the program became institutionalized.

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COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

003

Go!

GO team!

GO TEAM!

THIS PILOT AFTER-SCHOOL SCIENCE AND TECHNOLOGY PROJECT FOR UNDERSERVED GIRLS 11 THROUGH 13 IS AN OUTGROWTH OF THE SCIENCE IN THE CITY PROGRAM OF THE CHICAGO ACADEMY OF SCIENCES. DEMAND FOR THE COMPUTER TECHNOLOGY WORKSHOPS OFFERED THROUGH SCIENCE IN THE CITY WAS SO STRONG THAT WITHIN TWO WEEKS THE ACADEMY STAFF HAD TO ADD FOUR WORKSHOPS AND DEVELOP A NEW TECHNOLOGY WORKSHOP FOR OLDER GIRLS.

Responding to this incredible demand, the academy proposed to expand one of its most successful after-school programs, a program for (mostly affluent) students that combined learning about science with learning about computer technology. To broaden its reach into the Chicago community, for the new program—Girls Online (GO Team!)—the academy teamed with El Valor (two community centers serving a largely poor Hispanic population) and James Ward Elementary School, which serves a low-income mixed-ethnic population.

Each semester 45 girls will meet once a week after school in computer labs to learn basic Web design and to engage in hands-on learning in the natural sciences—ecology in the introductory class and water quality in the intermediate course. To offer a creative, engaged style of learning suited to girls, both classes will have the girls create a Web-based magazine, or "webzine," for publication on the academy's website.

In the first week of the introductory session, the girls will learn about a computer's internal and external parts by taking apart a computer, but they will also learn about urban land habitats and ecosystems. The second week they will learn about information storage and computer operation as well as about urban water habitats and systems. As they learn about plant and animal defenses and camouflage, renewable and nonrewable resources, and energy resources, they will also learn about information transfer, the Internet, the World Wide Web, search techniques, digital scanning, and Web design. They will create a science-oriented Web page, using HTML.

In the intermediate class, they will use advanced HTML to create tables, frames, and animated GIFs, as they also learn about water chemistry, macro-invertebrates, and water quality. They will understand the factors involved in purchasing a computer and selecting an Internet service provider. Parents will be invited to events at the beginning and end of the 13-week session.

Two girls from each class will be teacher assistants for the next class. *They will also take part in a job shadow day with museum staff and other professional women in science and technology, because informal social sessions with adult scientists have been shown to change high school girls' perceptions*. If girls team with a woman staff member as she goes about her daily routine and see that she is social and has a sense of humor instead of being "nerdy" and "strange," they are more likely to select a science-related career.

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003

Virt

Designing with virtual reality technology

DESIGNING WITH VIRTUAL REALITY TECHNOLOGY

THIS MODEL PROJECT FROM THE MIAMI MUSEUM OF SCIENCE AIMS TO INCREASE GIRLS' CONFIDENCE, INTEREST, AND PREPAREDNESS FOR COMPUTER SCIENCE AND FOR HIGH-END CAREERS IN INFORMATION TECHNOLOGY. *BUILDING ON RESEARCH ABOUT GIRLS' WAYS OF KNOWING, THE PROJECT IS DEVELOPING HANDS-ON CURRICULUM TO ENGAGE GIRLS IN DESIGNING—NOT SIMPLY USING—IT APPLICATIONS.* FOR 12 WEEKS DURING THE ACADEMIC YEAR, THE FIRST COHORT OF 44 MIDDLE SCHOOL GIRLS PARTICIPATED IN SATURDAY TECHNOLOGY WORKSHOPS, ACQUIRING THE SKILLS THEY WOULD NEED FOR INCREASINGLY SOPHISTICATED SOFTWARE APPLICATIONS.

Most of the girls were highly motivated, enjoyed working on computers, liked math and science, and were confident about their math and science skills. Nine of the girls had participated in an earlier academy at the museum. Most of the girls had access to computers at home, used them often, and were fairly familiar with e-mail and electronic chat rooms—but needed help learning how to use a CD-ROM drive, an external zip drive, a scanner, sophisticated database/spreadsheet software, and the multimedia software they would need for their summer project

Skill-oriented sessions engaged students in using the Internet, creating a public service announcement, creating personal Web pages, using a digital camera, taking and downloading digital images to their desktops, using Adobe PhotoDeluxe to manipulate and save images in formats suitable for incorporation into Web pages, working with graphics, creating panoramic views and object movies, and working with sound files. They would also learn math concepts needed to work with the virtual reality technology: perspective, measurement, scale, polyhedrons, and tessellations.

After finishing the 12-week series of Saturday workshops, the first cohort would complete a four-week intensive design studio, where (working in teams of four) they would produce an invention of their own design, using state-of-the-art virtual reality technology (VRQuest's 3-D Studio Max).

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Keywords: demonstration, museum, self-confidence, information technology, computer skills, math skills, virtual reality	

003

Why

Why girls go to whyville.net

WHY GIRLS GO TO WHYVILLE.NET

NUMEDEON, A SOFTWARE DEVELOPER FOR ONLINE COMMUNITIES, WAS SURPRISED TO DISCOVER THAT MORE THAN 60 PERCENT OF THE PEOPLE WHO USED ITS INTERACTIVE SCIENCE-ORIENTED WEBSITE (WWW.WHYVILLE.NET) WERE GIRLS, MOSTLY FROM GRADES 4–8. SINCE LITTLE COMMERCIALLY AVAILABLE SOFTWARE APPEALS TO GIRLS, NUMEDEON TURNED TO RESEARCHERS AT CALTECH'S PRE-COLLEGE SCIENCE INITIATIVE (CAPSI) TO LEARN WHY.

Whyville is a free and informal learning space launched in 1999 to help kids explore science concepts in a social and interactive learning environment. *Science activities embedded in the site* (presented in the context of a 3-D community) *promote inquiry, experimentation, and discussion*. On a typical summer day, more than 4,000 users visit the site, with a mean log-on time of 50 minutes. Users range from young children to college age, but most of its 225,000 registered users are 11 to 13. The popularity of Whyville with middle school girls is important, because this is the age when the gender gap in science often first appears. *Computer use in girls drops off dramatically after 13, for lack of games that don't involve speed, fighting, or competition.*

Whyville has become so crowded that it can't always accommodate all the users who want in. *Those who enter can chat with other users, visit popular gathering spots such as the town swimming pool, engage in noncompetitive games and activities, interact socially, or create their own identities.* Users especially love shopping at the "mall" for new face parts, clothing, or accessories for their online persona. They can create and sell items such as jewelry and face parts, or they can buy them from other Whyvilleans—with "clams," not dollars. Clams can be earned by engaging in science or math activities or by selling one's own products. The desire to buy things on the site motivates students to engage in and eventually master science activities. Whyvilleans who improve their performance increase their salary; they are further rewarded if they play the games many times over. They can also set up a charity to give away face parts to less fortunate citizens.

Although users may go to the site more to shop and to create new identities than to learn about science, the site is designed to draw them into science learning—in a constantly evolving scenario that affects their online lifestyle. For example, the site introduced a plague ("whypox") to trigger their interest in epimediology. Mysterious spots began appearing on the faces of a few of the most active Whyvilleans, spots that at first looked like freckles and later like red welts. The pox spread through contact. Several days of ugly faces and messages erased by virtual sneezes sent Whyvilleans scurrying for explanations to the bulletin board of Whyville's equivalent of the Centers for Disease Control, where they found a simulation of how disease spreads, a graph of how many Whyvilleans had been affected, and links to a real newspaper article about a wave of unexplained rashes affecting students in East Coast schools.

The site specializes in "edu-tainment," tapping the Internet's capacity for interactivity to get kids engaged in learning. CAPSI's goals are to analyze how much and what students are learning on the site and to explore what types of students (especially girls) are drawn to it. Besides surveying the Whyville population for background, demographics, and interests, CAPSI is doing pre- and post-assessments of science and technology interest for a group of students newly introduced to Whyville for the study. It is also monitoring the movements of the new users and a sample of current users to determine the activities of greatest apparent interest and appeal. Project researchers are conducting online and personal focus group discussions with current and new users to understand more fully their perceptions of the site. Project findings should provide suggestions for making educational websites more effective in attracting girls and may offer ideas for making school-based learning more appealing as well.

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www.capsi.caltech.edu	HRD 00-86338 (one-year grant)
Partner: Numedeon	
Keywords: demonstration, website, inquiry-based, research study, informal education, engagement, interactive	

003

csR

Research in computer science

RESEARCH IN COMPUTER SCIENCE

RURAL LOUISIANA HAS ONE OF THE HIGHEST HIGH SCHOOL DROPOUT RATES IN THE NATION. FOR THAT REASON, RURAL STUDENTS WERE SPECIAL TARGETS OF A THREE-WEEK RESIDENTIAL COMPUTER SCIENCE PROGRAM TO EXPOSE MIDDLE SCHOOL GIRLS TO CAREER OPPORTUNITIES IN COMPUTER SCIENCE. HOSTED BY THE UNIVERSITY OF LOUISIANA AT MONROE, THE PROGRAM ACCEPTED 24 INCOMING EIGHTH AND NINTH GRADE GIRLS WITH GOOD GRADES AND AN INTEREST IN COMPUTER SCIENCE—GIVING SPECIAL CONSIDERATION TO PHYSICALLY CHALLENGED, MINORITY, AND RURAL STUDENTS.

Three weeks may seem like too long for middle school students to live on campus, but experience has shown that it is not, if the students are kept busy and happy. First the girls were introduced to computer science, computer problem-solving techniques, and popular software (including word processing, e-mail, a database manager, a spreadsheet, and presentation and programming tools). They learned HTML, developed their own Web pages, created and edited a newspaper, and developed presentations for a research symposium. *The more students use a technology, the less anxiety it produces*.

For two hours each afternoon they learned about expert systems, data mining, and software engineering, the broad topics within which they would conduct research in computer science. This part of the project *emphasized the science—seeking problems, forming hypotheses, performing tests, and finding solutions—in computer science*. On field trips to Black Bayou and Vicksburg, the girls saw concepts from computer science being applied in local industries and talked with scientists about their careers.

For three weeks, the participants lived in a campus residence hall, ate in university dining facilities, and participated in both program activities and unsupervised recreation such as swimming and volleyball. Six college students majoring in computer science served as the girls' "big sisters," living in the dormitory with them and helping them with program activities.

During the school year, they returned to the university on three Saturdays for follow-up activities, including preparation of a project to enter in a local science fair. To make follow-up visits feasible, the project limited recruitment to girls living within 50 miles of the university.

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www.cs.ulm.edu/~girlsroc/overview.htm	HRD 99-08786 (one-year grant)
Department of Computer Science	
Keywords: demonstration, rural, minorities, career awareness, role models, field trips, research experience, computer science, disabled, html, summer camp, computer skills	

003
Ole
Ole Miss computer camp

OLE MISS COMPUTER CAMP

THE UNIVERSITY OF MISSISSIPPI ("OLE MISS") LIES IN RURAL COUNTRYSIDE IN A RURAL STATE WHERE A HIGHER THAN AVERAGE PERCENTAGE OF CHILDREN LEAVE SCHOOL WITHOUT HIGH SCHOOL DIPLOMAS AND LIVE BELOW THE POVERTY LINE. THIS PROJECT BROUGHT RURAL EIGHTH GRADE GIRLS TO THE OLE MISS CAMPUS FOR AN INTENSIVE WEEKLONG COMPUTER CAMP (TO BUILD A SENSE OF COMMUNITY AND LAY A KNOWLEDGE BASE FOR LATER ACTIVITIES) FOLLOWED BY MONTHLY SATURDAY PROGRAMS AT LOCAL SCHOOLS, CULMINATING IN A CAPSTONE WEEKEND BACK ON CAMPUS

Girls often opt out of computer use because they are unwilling to compete with boys for computing resources. In girls-only sessions, the eighth grade girls in this project learned about basic electronics, computer platforms, operating systems, hardware, software, device drivers, user interfaces, and applications (such as spreadsheets, word processors, databases). They learned how to use e-mail and the Internet, built a home page and learned about algorithms. They played math and communication games. Dedicated sites for the monthly meetings allowed ample opportunity for hands-on experiences to bolster their computer skills, critical thinking, problem-solving abilities, and confidence.

Earlier research had shown that *mentoring—including online mentoring—by female role models is one of the most effective strategies for changing girls' self-images*. These girls networked with each other and benefited from face-to-face and electronic mentoring by undergraduate women in computer science at Ole Miss.

The teachers in charge of monthly site workshops (who were given a special two-day workshop before the girls' activities began) acquired contacts, new skills, and new insights into promoting gender equity in their schools.

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HRD 96-31242 (ONE-YEAR GRANT)	
KEYWORDS: EDUCATION PROGRAM, RURAL, UNDERPRIVILEGED, COMPUTER SCIENCE, HANDS-ON, SELF-CONFIDENCE, PROBLEM-SOLVING SKILLS, ROLE MODELS, MENTORING, WORKSHOPS, TEACHER TRAINING, GENDER EQUITY AWARENESS	

003
cool
Making computer science cool for girls

MAKING COMPUTER SCIENCE COOL FOR GIRLS

BOYS TYPICALLY COME INTO A COMPUTER SCIENCE CLASSROOM WITH A HIGHER COMFORT LEVEL THAN GIRLS, NURTURED PARTLY BY A WELL-DEVELOPED MARKET FOR BOYS' VIDEO GAMES. ON VIDEO GAMES, BOYS LEARN WHAT DOES AND DOESN'T WORK, TEST NEW IDEAS, AND "OUTSMART" THE MACHINE BY LEARNING ITS SECRETS AND STRATEGIES. SEEING BOYS UNAFRAID TO EXPLORE A COMPUTER AND EXPOUNDING ON TOPICS SHE DOESN'T UNDERSTAND CAN BE DAUNTING TO A NEW GIRL IN A COMPUTER CLASS.

At the heart of this University of Delaware *project to make computer science cool for girls* is POWER, an eight-week half-day summer camp for 20 juniors and seniors from high schools in Delaware and nearby Pennsylvania and Maryland. An all-girl activity for students good in math and at about the same skill level with computers, the camp *chose projects that involved programming for practical purposes the girls could relate to. It often had the girls work in groups, because some research shows that girls are less interested in the field since they believe computer specialists work alone with no social interaction—when in truth software development is typically done by project groups*.

Girls often describe their interest in computers in terms of "what they can do in the world" and how computers can link them to the worlds of education, medicine, communication, art, music, and so on. Designing Web projects allows them to see what interesting applications are possible with the programming skills they learn. *The Web's client-server model allows them to create socially oriented applications*, such as electronic RSVPs, shopping carts, chat rooms, and games. Animation, multimedia, interactivity, and graphic user interfaces allow them to be creative and artistic.

In camp the girls learned about static and interactive Web pages, electronic forms (rsvp, survey, etc.), Java applets, animated Web pages, GUI development with Java, and GUI-based interfaces. The project arranged for regular guest speakers from the business world and for occasional social activities. The three tenure-track women who served as faculty had often experienced being the lone woman in a class, especially in graduate school. Things are changing in the field and they hope projects like this will speed that change along.

Components for high school and undergraduate students will *reduce the sense of isolation women in computer science often feel by introducing role models, mentoring, and opportunities to work with other women in the field.*

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HRD 00-86424 (one-year grant)	
Keywords: demonstration, computer science, summer camp, role models, mentoring, field trips, research experience, teamwork approach	

003

C4T

Computer camp for teachers

COMPUTER CAMP FOR TEACHERS

SEVEN HIGH SCHOOL COMPUTING TEACHERS (THREE WOMEN AND FOUR MEN) FROM WISCONSIN AND SURROUNDING AREAS GATHERED AT THE UNIVERSITY OF WISCONSIN AT STEVENS POINT FOR A TWO-WEEK SUMMER WORKSHOP THAT PROVIDED TRAINING ON GENDER ISSUES, ELECTRONIC COMMUNICATION, AND INFORMATION SYSTEMS. THEY DEVELOPED GIRL-FRIENDLY LESSONS TO BE PILOTED WITH 19 HIGH SCHOOL GIRLS IN A SUBSEQUENT TWO-WEEK SUMMER COMPUTER CAMP. UNDERGRADUATE WOMEN SERVED AS TEACHING ASSISTANTS, ROLE MODELS, AND MENTORS TO THE HIGH SCHOOL STUDENTS.

All participants were connected electronically in a virtual learning community. Everyone learned about the university computer environment, e-mail, searching the Internet, and developing Web pages. (Another time, the project would probably also give experienced or fast-learning students a chance to learn C++, Visual BASIC, LegoLogo, and the like.)

That the summer camp for girls was free was important to some students, but making the camp free meant there were no consequences for canceling when a summer job turned up. The project recommended charging a nominal fee (such as $50) in later camps, which could be returned when the girl completed the camp. Recruiting qualified mentors/counselors was similarly challenging because university computer students typically have lucrative summer jobs or internships.

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HRD 97-11023 (one-year grant)	
Keywords: demonstration, gender equity awareness, teacher training, summer camp, computer science, collaborative learning, role models, mentoring	

003

tool

Retooling high school teachers of computer science

RETOOLING HIGH SCHOOL TEACHERS OF COMPUTER SCIENCE

CHANGING THE PROGRAMMING LANGUAGE USED IN THE EDUCATIONAL TESTING SERVICE'S ADVANCED PLACEMENT TEST IN COMPUTER SCIENCE FROM PASCAL TO C++ PRESENTED A WONDERFUL OPPORTUNITY: MOST OF THE ROUGHLY 1,500 TEACHERS OF ADVANCED PLACEMENT COMPUTER SCIENCE (APCS) COURSES NEEDED TRAINING IN HOW TO TEACH THE NEW LANGUAGE AND ITS OBJECT-ORIENTED STYLE OF PROGRAMMING. THIS PROJECT DEVELOPED A SUMMER PROGRAM THAT COMBINED THAT RETOOLING WITH TRAINING IN GENDER EQUITY ISSUES AND IN EDUCATIONAL PRACTICES TO RETAIN FEMALE STUDENTS IN COMPUTER SCIENCE.

Girls tend to be well represented in early computing courses but move on to advanced courses in far smaller numbers than boys. APCS courses are a perfect vehicle for increasing the number of women in computer science. By integrating gender equity activities with the training offered by a prominent computer science department with close ties to the Advanced Placement program, the project hoped to attract a substantial fraction of APCS teachers, who are key players in high school computing education nationwide. Integrating gender equity training into computer science training needed equally by both male and female teachers should make it more effective and equally attractive to all teachers.

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HRD 96-18865 (three-year grant)	
Keywords: professional development, computer science, computer programming, advanced placement, teacher training, gender equity awareness	

003

plug

Plugged in!: an interactive science website

PLUGGED IN!: AN INTERACTIVE SCIENCE WEBSITE

WHEN THIS PROJECT WAS PROPOSED, CLASSROOM COMPUTER EXPERIENCES TYPICALLY FAVORED THE DEVELOPMENT OF BOYS' SKILLS, AND COMMERCIAL SOFTWARE FAVORED COMPETITIVE "DEATH GAMES" (SUCH AS "MORTAL KOMBAT" AND "DOOM") THAT GENERALLY APPEALED MORE TO BOYS THAN TO GIRLS. "WHERE IN THE WORLD IS CARMEN SANDIEGO?," A GEOGRAPHY GAME FEATURING A SMART FEMALE CROOK, WAS THE CLOSEST THING TO A "KILLER AP"—A WILDLY POPULAR COMPUTER APPLICATION—FOR GIRLS. CARMEN APPEALED TO BOTH SEXES, THE SOFTWARE PROVIDED THE KINDS OF STORY-DRIVEN EXPERIENCES MOST GIRLS FAVOR, AND THE CHALLENGES WERE NOT JUST ABOUT WINNING.

The Mid-Continent Council of Girl Scouts and Ottawa University (aided by many other Kansas City, Mo., organizations) collaborated on creating an interactive, graphics-intensive science website for girls who get a kick out of being good at math and science. They concentrated at first on interactions between weather and the environment, making use of real-time data on weather, water, and soil. The idea was that girls could collect data from their own locations to supplement data published on the website, studying science by becoming scientists and contributing meaningful data. Girls' Science Network currently allows girls to share data on acid rain and light pollution.

Specialists designed interactive modules on such topics as water, birds, astronomy, fractals, and computers (demystifying their insides). A problem posed in the popular All-Weather Detectives goes like this: If a local tree farm was vandalized and several trees were cut down while the owner was away, how would a team of meteorologists evaluate the weather data and narrow down the time during which a footprint found at the scene could have been made? Would it be washed away in heavy rain? Was the soil frozen?

Panels of Girl Scouts tested each program. Ottawa University provided trainer training for classroom teachers and volunteer leaders in Girl Scouts and other youth groups. Many adults needed training on Internet skills, program activity options, and strategies for effectively teaching math and science skills to girls.

Plugged In! laptop programs were used at a resident summer camp for elementary school girls (along with Bridging-the-Gap Science Wonder tubs, from another NSF-funded project); at Tech Trek, a weeklong Scout science day camp for fourth through sixth grade girls held at Rockhurst College; and at a summer science institute at Ottawa University, where 44 Girl Scouts from grades 6 through 9 designed a research project. Plugged-In! classes held near Tonganoxie, Kans., offered girls in grades 1–12 hands-on activities involving weather, astronomy, exercise physiology, math, biology, and computers. Scout troops could access programs such as Fractal Finders and StarGazers on 20 laptops available through the council's computer checkout program.

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www.plugged-in.org	HRD 95-55724 (three-year grant)
Partners: Ottawa University, Southwestern Bell, Kansas Collaborative Research Network, Rockhurst College, National Weather Service, Kansas City Museum, Society of Women Engineers	
Keywords: demonstration, website, interactive, Girl Scouts, trainer training, summer camp, hands-on	

003

box

What's in the box? diagnosing and repairing computer hardware

WHAT'S IN THE BOX? DIAGNOSING AND REPAIRING COMPUTER HARDWARE

INTERVENTIONS TO REVERSE THE SHARP DECLINE IN COLLEGE DEGREES IN COMPUTER SCIENCE OFTEN ASSUME THAT WOMEN'S INDIFFERENCE TO OR FEAR OF COMPUTERS IS RELATED TO ATTITUDES ABOUT SOFTWARE. BUT WOMEN MAJORING IN SCIENCE AND ENGINEERING AT PENNSYLVANIA STATE UNIVERSITY PERCEIVED THEMSELVES AS INEXPERIENCED OR INCOMPETENT WITH HARDWARE, NOT SOFTWARE. TO LEAPFROG A GROWING GENDER GAP IN COMPUTER COMFORT AND COMPETENCE, THE WOMEN IN SCIENCE AND ENGINEERING (WISE) INSTITUTE AT PENNSYLVANIA STATE UNIVERSITY DEVELOPED A PROGRAM TO OFFER HANDS-ON WORKSHOPS IN COMPUTER HARDWARE DIAGNOSIS, UPGRADING, AND REPAIR—GIVING YOUNG WOMEN A SKILL RARE EVEN AMONG THE COMPUTER LITERATE.

This project expanded on SCROUNGE (Student Computer Recycling to Offer Underrepresented Groups in Education), *a program that had successfully recycled industry-donated used computers to rural and inner-city schools. In recycling several hundred computers over four years, SCROUNGE had no woman apply to do computer repair, despite vigorous efforts to recruit women*. Even a female honors student in industrial engineering admitted being afraid to open up a computer for fear of breaking it—a common but generally unappreciated version of computer anxiety. Few women *or* men entering college engineering had experience doing computer repairs that require a screwdriver, much less such skills as soldering.

Dr. Richard Devon ran a pilot course in computer repair for undergraduate women majoring in science and engineering, providing collaborative, noncompetitive instruction, with many hands-on activities, including intentional computer glitches to test the students' developing competence. The WISE program added in-service teacher training to the undergraduate training because K–12 teachers who received the recycled computers reported not being skilled enough to troubleshoot the hardware and software problems that inevitably occur with computer use, or even to tell the difference between them. And nothing was more likely to ensure another round of disenchantment with computers in the classroom than schools failing to provide technical support.

Hence the WISE program, where young women were trained in diagnosing, repairing, upgrading, and maintaining personal computer hardware. At hands-on workshops, they were encouraged to take apart, test, and repair used computers solicited from local industry. *Publicizing that the "fixed" computers would be recycled to inner-city and rural schools attracted women to the program*.

Participants learned to diagnose common computer malfunctions, troubleshoot, and cannibalize parts to prepare used computers for reuse in schools and other nonprofit agencies. They learned techniques for repairing minor components (desoldering and soldering) and testing parts, using their computer toolkits. They learned to identify computer system boards and components and to demonstrate techniques for assembling, disassembling, installing, and configuring components—and for preventive maintenance. Workshop instructors covered the evolution of computers over time, suggesting ways for participants to assess their true needs against ever faster advances in the consumer market for computers.

This was not a remedial course. The goal of the training was to make women and girls more comfortable, competent, and independent with personal computers (especially computer hardware), less dependent on male gurus for handling common glitches in PCs, and better informed consumers able to choose compatible components and appropriate software. Some participants acquired the rudiments of a marketable skill in computer repair. Each participant took home a computer toolkit. The workshops were geared to women and girls but men and boys were accepted, partly to provide good role models for both boys and girls. The single-sex approach was not an issue.

The courses "sold out" quickly and most participants reported high levels of satisfaction with the instruction and greater comfort with and understanding of computers. *The training demystified computers, and participants reported feeling more relaxed and independent, with a better understanding of how computers work and more confidence, especially about troubleshooting*.

Teachers reported that participating in the workshops gave them more visibility within their schools. Several teachers reported promotions or other upgrades in status, particularly among the teachers who took year-long training at Wheeling Jesuit University. *By learning how to recycle computers at little or no cost, teachers learned how to exploit the rapid turnover in computers in industry to augment computer inventories in underserved inner-city and rural schools*. By becoming more competent and independent with computer hardware, teachers who took the workshops learned enough to help train other teachers, students, and staff members how to deal with computer glitches—an important area of competence in small and rural schools, which are far less likely than large or suburban schools to have computer or network specialists onsite.

The provost of Penn State University established the WISE Institute to recruit and retain women in sciences and engineering. *The idea was that exposing students early on, in a nonintimidating atmosphere, to computer hardware components would reduce attrition rates in computer science and engineering by reducing the gender gap in comfort and expertise with computers*. During 1998–2000, 386 women and girls and 108 men and boys—high school and undergraduate students, teachers, and members of the public—participated in hands-on workshops at five sites: Penn State University Park, Penn State Berks–Lehigh College, Penn State Altoona College, Temple University, and Wheeling Jesuit University.

Project findings suggest that *anxiety about computer hardware does contribute to women's current attrition rates in computer sciences and engineering. This modest intervention can be replicated by even the poorest school district and may help fill the void in technical support*. Such training can be adapted to other institutions and population groups, including undergraduates, teachers (through in-service or preservice training), Scouts, and vocational, technical, and high school students.

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www.psu.edu/dept/wise/wcache.htm	HRD 97-14759 (three-year grant)
Partners: Temple University, Wheeling Jesuit University, and Penn State University's Abington, Berks–Lehigh Valley, Altoona College	
Keywords: demonstration, hands-on, collaborative learning, intervention, industry partners, recruitment, retention, workshop, computer hardware, technical skills, self-confidence, computer science, teacher training, role models	

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003

rp

Summer research projects in computer science

SUMMER RESEARCH PROJECTS IN COMPUTER SCIENCE

WOMEN IN THE COMPUTER SCIENCE DEPARTMENT AT THE COLLEGE OF STATEN ISLAND (CSI) DEVELOPED THIS ADOPT-AN-UNDERGRADUATE MENTORING PROGRAM, PAIRING UNDERGRADUATE WOMEN WITH SUCCESSFUL WOMEN IN INDUSTRY. THEIR PROJECT WAS MOTIVATED BY DATA SHOWING THAT *WOMEN'S PASS RATES IN REQUIRED AND MAJOR COURSES WERE SUBSTANTIALLY HIGHER THAN THOSE OF THEIR MALE CLASSMATES, BUT ALTHOUGH THE WOMEN WERE DOING WELL IN THEIR COURSEWORK, THE NUMBER OF WOMEN TAKING COMPUTER SCIENCE CLASSES ON CAMPUS WAS DISPROPORTIONATELY LOW AND, AS A PERCENTAGE, HAD BEEN DROPPING*.

The pilot project featured closed labs that met six hours a week, review sessions for introductory computer science, workshops for potential female majors about opportunities for women in computing, and the undergraduate mentoring program that encouraged students to complete their major and provided contacts for graduate school or job opportunities. The sample was small and the time frame short, but results were encouraging: The percentage of women majors in computer science increased from 16 (in 1992) to 21 (spring 1993) and then 28 (fall 1993).

With this NSF grant, the college-based program was expanded to Staten Island Technical School (SSTI). *For high school students, research recommended structured labs, group projects, and cooperative learning; formal peer, faculty, and alumni mentoring programs; and positive peer role models—pairing college students with high school students and graduate students with college students*.

Female graduates and alums of CSI gave lectures at the high school, and eight undergraduate women earned stipends for doing summer research with faculty mentors. During the summer of 1995, six students worked independently on mentored research projects, and three worked as a team. Their projects: a mobile robot laboratory, calculus for the blind, estimating robust parameters, multimedia courseware for teaching arithmetic to children, a graduate tracking program for SSTI, and a World Wide Web home page. The students presented their research at an expo at the college attended by SSTI students and their parents.

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http://scholar.library.csi.cuny.edu/wics/nsf_pjct.htm	HRD 94-53139 (one-year grant)
Partner: Staten Island Technical School	
Keywords: demonstration, computer science, mentoring, role models, cooperative learning, peer groups, internships, research experience, career awareness, parental involvement	

003

WCS

Recruiting women into computer science

RECRUITING WOMEN INTO COMPUTER SCIENCE

THIS BOWLING GREEN UNIVERSITY PROJECT USED BOTH INSTRUCTIONAL AND MOTIVATIONAL STRATEGIES TO RECRUIT MORE WOMEN INTO COMPUTER SCIENCE. IT IDENTIFIED POTENTIAL CANDIDATES AMONG FRESHMEN AND SOPHOMORE WOMEN WHO WERE UNDECIDED ABOUT THEIR MAJORS AND INVITED THEM TO EXPLORE COMPUTING CAREERS AND A POSSIBLE COMPUTER SCIENCE MAJOR. IT IDENTIFIED THE FOLLOWING FACTORS AS *CONTRIBUTING TO SUCCESSFUL RECRUITMENT: AN EXPLORATION PROGRAM TAILORED TO THE SPECIFIC CANDIDATE (WITH COOPERATION FROM ADVISERS WHO WORK WITH UNDECIDED MAJORS), PERSONAL CONTACT WITH MEMBERS OF THE COMPUTER SCIENCE FACULTY AND WITH CORPORATE REPRESENTATIVES, VISITS TO BUSINESS WORKPLACES, AND COOPERATIVE EDUCATION ASSIGNMENTS.*

Many computer teachers are unaware of how their behavior and manner of interaction can undermine women students' self-confidence. As part of this project, computer science faculty, admissions personnel, and program advisers from seven Ohio institutions of higher learning and representatives from five corporations participated in two gender equity workshops. The workshops dealt with perceptual bias and stereotypes, language and gender, communication and learning styles, instructional alternatives, a computer science culture more inviting to women, faculty mentoring, and recruitment and retention strategies—including cooperative education.

Studies have shown that *cooperative education—placing students in a series of paid, supervised, and academically relevant work assignments in business and industry—enhances students' personal and professional growth*, making them more mature, self-confident, and independent. Students' interviewing skills improved because they took a co-op preparation course (which covered résumé-writing, interviewing, interpersonal skills, and career information—and interviews for co-op positions).

CODE : U	Bowling Green University
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HRD 94-53702 (one-year grant)	
Keywords: demonstration, computer science, recruitment, role models, field trips, self-confidence, gender equity awareness, teacher training, mentoring, retention, cooperative learning, career awareness, industry partners	

003
div
Improving diversity in the software development community

IMPROVING DIVERSITY IN THE SOFTWARE DEVELOPMENT COMMUNITY

THIS CARNEGIE MELLON UNIVERSITY PROJECT AIMS TO IMPROVE WEB-BASED EDUCATION PROGRAMS IN WAYS THAT IMPROVE DIVERSITY IN THE SOFTWARE DEVELOPMENT COMMUNITY. USING THE COURSES OF CMU SUBSIDIARY CARNEGIE TECHNOLOGY EDUCATION (CTE) AS TEST CASES, THE PROJECT WILL TACKLE RECRUITMENT, CURRICULUM, AND GENDER-EQUITABLE INSTRUCTION.

Recruitment. The project will develop materials to help onsite recruiters locate and enroll women and people of color in Web-based software development courses CTE already offers. The assumption is that the recruiters know their jobs and need only materials and techniques to reach groups currently underrepresented in software development.

Having studied websites and recruitment materials for postsecondary institutions around the country that serve women and people of color, the project is developing content for CTE's home page, course descriptions (in technical and plain English versions), pages about information technology (IT) careers and lifestyle, stories about people in various IT studies and jobs, and links to other helpful sites. There will be a text-only version of the website for vision-impaired users, and the project will draft a booklet for recruiters on effective approaches for recruiting women and people of color.

Curriculum. The project will develop and disseminate ways to make learning materials appeal to and serve the needs of diverse audiences. In exploratory efforts the project assessed some CTE content, tested male and female audiences' emotional and cognitive responses to sample content, then retested the sample content revised to incorporate explanations by analogy. *Project investigators found significant gender gaps in participation and performance and modified the content along the lines the literature suggested would narrow or close those gaps. A key challenge, they find, is determining what, exactly, constitutes a gap between members of different populations. Several gender gaps exist in CTE courses, and not all of them favor men*. Next steps are to analyze the causes for selected gaps and design and test changes in course content.

Gender- and race-equitable instruction. The project is developing a Web course on gender- and race-equitable instruction, intended for two different groups: local CTE instructors who will be meeting students in face-to-face classes and CTE employees who serve as mentors to the instructors. One module will use simulations.

CODE: U	CARNEGIE MELLON UNIVERSITY
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KEYWORDS: DEMONSTRATION, SOFTWARE, RECRUITMENT, GENDER EQUITY AWARENESS, CURRICULUM, WEBSITE, INFORMATION TECHNOLOGY, TEACHER TRAINING	

003
LINK
PipeLINK: young women in computer science

PIPELINK: YOUNG WOMEN IN COMPUTER SCIENCE

"WHAT'S THE GRATEFUL DEAD'S WEST COAST HOTLINE NUMBER?" TWENTY HIGH SCHOOL STUDENTS TRIED ANSWERING THIS AND OTHER QUESTIONS BY CRUISING THE INTERNET IN A COMPUTER LAB AT RENSSELAER POLYTECHNIC INSTITUTE. THE GIRLS WERE PARTICIPATING IN A PROJECT TO GET YOUNG WOMEN TO THINK ABOUT CAREERS IN COMPUTER SCIENCE. *WOMEN HOLD MANY JOBS IN MARKETING, GRAPHIC DESIGN, CORPORATE COMMUNICATIONS, AND PUBLIC RELATIONS, BUT THE HIGH-TECH FIELD DESPERATELY NEEDS MORE WOMEN WITH REAL TECHNICAL EXPERTISE*. GENDER EQUALITY IN THE INFORMATION AGE REQUIRES THAT GIRLS BE EXPOSED TO AND TAUGHT ABOUT COMPUTERS—EDUCATION THAT IS NOT HAPPENING NOW.

The pipeline to computer science shrinks as girls and young women move through school. Half of the high school students majoring in computer science are girls, but only 30 percent of BS or BA degrees in computer and information science go to women, only 28 percent of MS degrees, and only 16 percent of Ph.D.s. To attract girls and women to computer science and keep them there from high school through graduate school, this model project provided computer education for high school girls, research projects for undergraduates, and female role models in computer science for high school through graduate studies. Women further along the pipeline mentored those coming along behind them.

The high school students participated in a two-week computer science program at Rensselaer, where the girls learned about computers (especially enjoying e-mail, the Internet, and the Web), met women working in the field, and saw how many careers and topics there were to explore. Female graduate students and computer science professors visited the high school girls and talked about research and work in their field. Not surprisingly, some topics (such as computer vision, robotics, and sorting animations) were more popular than others.

Local high school students and math and computer science teachers were connected to women at Rensselaer through electronic discussions. PipeLINK provided the electronic network, paying for e-mail accounts for teachers and girls from 16 high schools, as well as for female undergraduates, graduate students, and faculty in Rensselaer's computer science department. Teachers at the high school learned about PipeLINK and electronic mentoring at one of three workshops during the project year. The electronic mentoring was used less than expected partly because of technical problems with the TeaMate system. Teachers thought it would be more effective if an undergraduate visited the high school at least once a week, so the girls had more face-to-face contact.

At Rensselaer, formal programs were held to aid students in transition from one educational level to the next—discussing what computer science majors do and how to adjust to college, options for computer science degrees, how to apply to graduate school, work in industry (with a BS or MS), adjusting to graduate school, doing research, and getting a faculty job. Distinguished computer scientists from academia and industry spoke and held informal discussions with young women studying computer science, encouraging them to take part in undergraduate research projects.

Nine undergraduate women participated in a 10-week summer research program, each working with a faculty or graduate student mentor and in turn serving as teaching assistants and counselors for the high school program. Each undergraduate made a research presentation to the high school students and other undergraduates. The mentors helped the undergraduates prepare their talks, suggesting visual aids when possible. The undergraduates were well prepared and captivated the high school students. At least one undergraduate plans to pursue a Ph.D. because of this experience. They all plan to apply to graduate school.

CODES: H, U, PD	Rensselaer Polytechnic Institute
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www.cs.rpi.edu/~walkere/pipelink	HRD 94-50007 (one-year grant)
Keywords: demonstration, computer science, role models, self-confidence, research experience, role models, mentoring, electronic mentoring	

003

bot

Agents for change: robotics for girls

AGENTS FOR CHANGE: ROBOTICS FOR GIRLS

WHEN THEY WERE FIRST INTRODUCED, COMPUTERS WERE OFTEN VIEWED AS FANCY TYPEWRITERS, SO COMPUTER EDUCATION LARGELY INVOLVED TEACHING KEYBOARDING AND FILE AND DISK MANAGEMENT. AS TECHNOLOGY SHIFTED TO APPLICATIONS, STUDENTS HAD TO LEARN TO USE WORD PROCESSING, SPREADSHEET, AND GRAPHICS SOFTWARE AND INTERNET BROWSERS. BUT *INTERFACE-LEVEL FAMILIARITY WITH APPLICATIONS MAY NOT GIVE STUDENTS ENOUGH BACKGROUND TO BE TECHNOLOGICALLY COMPETENT WITH SOPHISTICATED INFORMATION TECHNOLOGY*. CURRENTLY AVAILABLE HARDWARE AND SOFTWARE WILL SOON BE SUPERSEDED AS INFORMATION TECHNOLOGY SYSTEMS MOVE TOWARD INCREASINGLY INTELLIGENT OR "SMART" TECHNOLOGY, EMBODYING VARIOUS FORMS OF ARTIFICIAL INTELLIGENCE.

This University of Pennsylvania (Penn) project is developing school-based and informal education robotics curriculum and activities to engage middle school girls in advanced IT. The "virtual pet" craze showed that robotics can be approached in an appealing, age-appropriate manner. When Penn's General Robotics and Active Sensory Perception (GRASP) lab suggests to middle school girls that a virtual pet is simply an interactive graphic simulation and that they can create their own, they head for the nearest keyboard.

Visitors to the GRASP lab quickly see robotics as a creative, cooperative, horizon-expanding endeavor aimed at improving people's safety, independence, and quality of life—not the lone scientist toiling at a cluttered workbench. They see a "smart" wheelchair developed to climb curbs, robotics devices for quadriplegics, and small robots being designed to play "robot soccer." A central research theme in the lab is "cooperative robotics": designing robots that can work intelligently and adaptively as partners with each other and with people.

In this project's work with sixth to eighth graders, important concepts in robotics are introduced in lively, even humorous ways. A graduate student in computer science becomes Rosy the Robot, for example. Armed with a list of commands Rosy can carry out and objects she recognizes, students must write a program for her to paint a bookcase. When Rosy does exactly what she is told, with mildly disastrous (but entertaining and instructive) results, students quickly realize that what they take for granted in human perception, action, and communication must be analyzed and specified in great detail for a robot. This simulation is a tool for introducing the programming concepts of functions, loops, logic operators, and conditions.

The project is not about helping students "feel comfortable" with technology or giving them limited-purpose skills such as word processing or multimedia navigation. *As an interdisciplinary, problem-based blend of science, math, engineering, and technology, robotics—the design and study of intelligent, autonomous agents—fits beautifully with current standards-based recommendations for STEM education. Adding robotics to the middle school curriculum does not "push out" other STEM content*. It is a good vehicle for improving pre-college STEM education, providing an entry point for learning appropriate to the new century. It motivates students to study such basic topics as electrical circuits, mechanics, optics, geometry, probability, and statistics. And as students pursue robotics projects, they may well find themselves drawn toward computer science, math, engineering, psychology (perception, human factors), cognitive science, and physics.

Moreover, robotics projects—maybe because they produce new creations that actually do something—are unusually successful in getting students to take ownership of their learning both in and out of school, to set increasingly sophisticated goals for themselves, and to work in a focused, sustained way to achieve an outcome. Introducing robotics in middle school opens an intellectual domain that is not yet effectively represented in the pre-college curriculum. It puts students in productive control of smart technology rather than making them feel that are at its mercy or are locked out of environments that use it. This project will

- Develop a comprehensive series of after-school and summer education programs—some based in the robotics research lab—based on girls' interests and preferences and emphasizing their relationships with mentors and role models.
- Develop and implement a gender-fair, multidisciplinary robotics curriculum for middle schools as a series of project-based learning modules, providing substantial professional development for teachers on both content and gender equity. The curriculum will emphasize *information engineering*—the encoding, transfer, processing, and interpretation of information in interactive technology systems. Core activities will use the Lego Mindstorms Robotics Invention System™—the most readily available, cost-effective, reusable, and robust of the systems evaluated.
- Engage teachers and students in a change process leading to equitable STEM learning environments that support high achievement for underrepresented students.
- Disseminate age-appropriate instructional materials for project-based learning in robotics that can be implemented in both informal and school-based settings.
- Conduct new research on the relative impacts of formal and informal STEM learning programs on achievement and persistence in, and attitudes toward, science and technology—examining the effects of both program characteristics (e.g., single-sex versus mixed-sex, school-based versus informal) and student characteristics (gender, race/ethnicity, prior achievement in math and science, family income level, and urban versus rural).

HOW WELL THESE MIDDLE SCHOOL STUDENTS UNDERSTOOD IT

In a baseline study to probe how much middle school students understood IT systems, the project learned that there was *no difference in boys' and girls' access to and frequency of use of computers and the Internet*. They e-mailed friends, did Internet research, played games, and sought information about personal interests and hobbies. Offline, they played games and wrote reports for school. Most students could describe how to get on and use the Internet and some could describe various button and menu operations at the level of "do this and you'll get that." *Fewer students could describe what was happening outside the room they were working in. Some students made no distinction between the Internet and their browser or service provider—thought the Internet was America Online. Rural students fared somewhat better than urban students but there were no significant gender differences*.

When students were asked to reverse-engineer several mechanical and electronic artifacts, researchers noted when responses attributed (or denied) to an artifact some kind of information processing function (e.g., mentioning sensors that picked up information from the environment or some kind of hardware or program that controlled the artifact's behavior). *Rural students scored significantly higher on the more advanced subscales and a reliable gender difference emerged, with boys scoring higher than girls on two of the information processing subscales*.

Despite concern about the "digital divide," there was reason for optimism. *The gap between girls and boys and between urban and rural students was not as wide as they expected, despite the urban sample's bias toward the low end of the socioeconomic range. For this generation of students, digital technology is not the restricted domain of a few "nerdy" peers, but the sea in which they swim*. These 11- to 13-year-olds do not remember a time when there were no cell phones or e-mail or laptops or digital toys. Most students—male and female, rural and urban—were enthusiastic, confident, and frequent users and consumers of IT products and services. *Reliable differences in understanding that emerged—especially between rural and urban students (who also differ socioeconomically)—were generally contained within a broad middle range. All students knew something but few students were conceptually sophisticated.*

Under current standards for technology education, few if any of the students were achieving the level of skill and knowledge in IT indicated for their grade level. None were able to think productively and robustly about the entities and processes underlying IT. The processes involving encoding, transmitting, receiving, storing, retrieving, and decoding information in technology systems were largely a mystery to them. Many learned to do Internet research in school, but much of what they know was either self-taught or learned informally from peers and relatives. The formal education required to move students from being superficial users and consumers of technology to being problem-solvers and designers has not yet been established in public education.

Even with present-day technology, effective problem-solving, decision-making, and troubleshooting requires behind-the-scenes knowledge and strategies for applying that knowledge to new cases. (For example, to avoid filling a hard drive with large graphics files, girls can't decide to use more economical formats or software that compresses files if they don't understand that a picture exists not as a picture but as a data file.) And as intelligent technology becomes more embedded in "smart" artifacts that do not resemble a desktop computer, students will need a solid base from which to assess novel systems that do not resemble the systems with which they are familiar.

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Partners: Penn's GRASP lab; the Washington (CHAIN) and University City middle school clusters in the School District of Philadelphia	
Keywords: education program, robotics, information technology, engagement, after-school, project-based, research study, gender differences, informal education, teacher training	

003

Sat

Self-authorship and pivotal transitions toward IT

SELF-AUTHORSHIP AND PIVOTAL TRANSITIONS TOWARD INFORMATION TECHNOLOGY

WHAT ARE THE PIVOTAL TRANSITION POINTS IN GIRLS' LIVES THAT DETERMINE WHETHER THEY SEE INFORMATION TECHNOLOGY AS A VIABLE CAREER CHOICE? THIS PROJECT IS GATHERING NEW PRIMARY RESEARCH DATA ABOUT HOW THE TOTAL ENVIRONMENT—IN AND OUT OF SCHOOL, FROM HIGH SCHOOL THROUGH COMMUNITY COLLEGE AND THE UNIVERSITY—HELPS SHAPE GIRLS' PERCEPTIONS OF IT AS FRIENDLY OR UNFRIENDLY TO WOMEN. THE RESEARCH WILL DOCUMENT THE LONGITUDINAL EFFECT OF FAMILY, PEERS, SCHOOL, AND COMMUNITY ON GIRLS' PERCEPTIONS OF IT CAREERS; EXAMINE THE KEY TRANSITION POINTS IN GIRLS' EXPERIENCES WITH TECHNOLOGY; AND DETERMINE HOW THE CHOICE OF A NONTRADITIONAL CAREER IS ASSOCIATED WITH THE DEVELOPMENT OF SELF-AUTHORSHIP (INVENTING ONESELF).

Standard interview and survey techniques will be combined within the framework of self-authorship, with pre- and post-surveys and interviews with individuals and small groups. The project will prepare a videotape documentary and case studies of the longitudinal development of girls' career choices and transitions. It will develop and use group activities using computer programs to stimulate girls' interest in and understanding of IT careers. It will develop and present IT workshops as an incentive for participating students and parents, as another data collection point, and as a model for exploring IT careers.

The project is an interdisciplinary collaboration among faculty experts in gender and science, in quantitative and qualitative social science research methods, and in how information technology affects children, youth, and families. Project advisers include an expert in how college students' and young adults' self-authorship affects their learning capacity, a former school principal and superintendent, an expert in evaluation and data analysis, an expert in educational technology, the director of a state technology workforce, and a communications researcher.

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HRD 01-20458 (three-year grant)	
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Keywords: research study, transition points, workshops, career awareness, information technology, video, survey, environmental factors, self-authorship	

OTHER SCIENCES

003
O
Oceanography camp for girls

OCEANOGRAPHY CAMP FOR GIRLS

OCEANOGRAPHY IS INHERENTLY INTERDISCIPLINARY, REQUIRING A FOUNDATION IN MATH AND A FAMILIARITY WITH BIOLOGY, CHEMISTRY, GEOLOGY, AND PHYSICS, FOUR AREAS OF SCIENCE IN WHICH WOMEN ARE OFTEN UNDERREPRESENTED. THE OCEANOGRAPHY CAMP FOR GIRLS ENCOURAGES GIRLS POISED TO ENTER HIGH SCHOOL TO TAKE MORE MATH AND SCIENCE COURSES AND TO CONSIDER THE SCIENCES AS A CAREER OPTION.

Developed jointly by the University of South Florida's Department of Marine Science and the Pinellas County School System, the camp allows girls to apply the knowledge gained from hands-on activities to a tangible marine environment in their own backyard. They accomplish this bridging through field trips, data-collection cruises aboard a research oceanographic vessel, and extensive lab work and problem solving.

The camp, which at first reached only 30 girls in Pinellas County, later expanded to serve 64 girls from middle schools in six counties—selected from an applicant pool of nearly 300. The project targeted girls of all aptitudes who were entering ninth grade, especially girls from ethnic minorities. The initial target audience was girls leaving seventh grade, but feedback suggested that a year more of maturity, responsibility, and science content (in earth, life, and physical sciences) would enable girls entering ninth grade to benefit more from the camp than girls entering eighth grade. About 23 percent of the residential campers and 29 percent of the commuter campers were African American, Hispanic, Asian, and Native American. The most valuable (albeit labor-intensive) tool for selecting participants was interviews, done in person during school hours or by phone after school.

The project tried both commuter and residential camps and found the residential format to be more effective. In residential camps, participants were more willing to be involved during daytime activities, worked more cohesively as a group, and felt more of a sense of camaraderie, engaging in detailed conversations about their camp experiences. Interviews revealed many girls' hesitation about being away from home for three full weeks, so girls went home Friday evenings and returned to camp Sunday evenings.

The three-week camp was held at USF's College of Marine Science, with room and board provided by Eckerd College, a private four-year school with an excellent undergraduate program in marine science. Groups of 10 girls spent a day at sea aboard *Suncoaster*, an oceanographic research vessel, collecting data about Tampa Bay and adjacent coastal waters. They learned about biological and chemical diversity (including mud-dwelling fauna) through a field trip to Fort DeSoto County Park. At Shell Island, they learned about the biological and physical parameters of a protected habitat, learned to paddle a canoe (a peak experience for many first-timers), and discovered how to observe the sensitive marine habitat of mangrove islands. At Caladesi Island State Park, they learned about the physical and geological parameters of the barrier coastline, from waves and currents to dunes and berms. A beach cleanup effort helped them study the human impact on marine life and provide a community service, counting and estimating the amount of trash and recording data for the state census.

Campers also engaged in group lab activities. Using a wax modeling system, they simulated the geophysical processes affecting plate tectonics, created their own fault lines, and collided wax plates to visualize the geophysical processes underlying an earthquake. To learn lab research methodology, they did small-group experiments and problem solving, working with marine science graduates on such topics as geophysics/plate tectonics, computer modeling in oceanography, marine microbiology, zooplankton ecology, coastal geology/beach mapping, satellite oceanography, and seawater chemistry.

Visits to the Florida Department of Environmental Protection, the Clearwater Aquarium (a facility for the statewide rescue and rehabilitation of marine mammals) and the Florida Aquarium added to their knowledge of career options and the academic preparation needed for science careers. One spinoff of visits to local aquariums was a counselor-mediated discussion on the pros and cons of having animals in captivity, of animal rescue and rehabilitation, of educational missions, and of public versus private funding of such undertakings. Ethics-in-science simulation games such as Fish Banks the final week advanced the discussion.

The middle school participants benefited from real-world environmental studies and awareness, from one-on-one mentoring by career professionals, and from interactions with their peers and with returning camp alum, who were role models. In learning about research, academic requirements, and career options, they also learned that their graduate mentors (accomplished scientists) were "cool" and "fun."

"I learned a lot more than I do in science classes in school," said one camper. Getting dirty was part of what made it a great experience, said another. "It was all girls so we were more intent on doing stuff, rather than how we looked."

Positive media stories brought in additional funding, and the oceanography camp, supported by endowments and local private and business donors, continues as a free camp for local girls. Spinoffs included an oceanography workshop for six secondary-level science educators, with hands-on instruction to broaden their ability to teach math and science through ocean sciences; *Project Oceanography*, a live, satellite-televised marine science education program appropriate for middle school students; and "Making Waves," a multimedia approach to learning that offers teachers and students an insider's view of current ocean science research efforts.

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www.marine.usf.edu/girlscamp	HRD 93-53012, HRD 95-52898, HRD 95-54493, (one-year grants)
Partners: Pinellas County (Florida) School System, Eckerd College, United States Geological Survey, Florida Marine Research Institute, and Center for Ocean Technology	
Product: Information on starting a science camp in your area.	
Keywords; demonstration, oceanography, hands-on, field trips, problem-solving skills, minorities, career awareness, role models	

003

jump

Jump start

JUMP START

ALONG FLORIDA'S SOUTHEASTERN "TREASURE COAST," ATTITUDES TOWARD WOMEN ARE STILL VERY TRADITIONAL, AND THE PROPORTION OF WOMEN ENTERING NONTRADITIONAL SCIENCE AND TECHNOLOGY CAREERS IS EVEN LOWER THAN THE DISCOURAGING NATIONAL AVERAGE. MANY YOUNG WOMEN IN THE AREA DROP OUT OF MATH AND SCIENCE BETWEEN HIGH SCHOOL AND THEIR FIRST TERM OF COMMUNITY COLLEGE. IN THIS PROJECT, AN OCEAN SCIENCE RESEARCH ORGANIZATION TEAMED UP WITH A COMMUNITY COLLEGE AND A LOCAL FLORIDA SCHOOL DISTRICT TO ENCOURAGE YOUNG WOMEN'S INTEREST IN SCIENCE CAREERS.

The idea was to provide girls and women with mentors/role models and hands-on science experiences in the transition from middle school to high school and when they enter college, either directly from high school or as re-entrants to academia. Both projects highlighted oceanography and marine science, which are good vehicles for understanding planetary ecology (including global warming), areas with clear potential to help humanity, and hence appealing to women. This was the first time the Harbor Branch Ocean Institute (HBOI) had used—or even recognized the existence of—gender-friendly instructional techniques.

Science and technology careers for women. Over two years, 24 women participated in the pre-college program, more than half of them 30 or older and re-entering college.

Half the participants experienced a classroom-centered module at Indian River Community College (IRCC), which emphasized assessing the students' interests and capabilities, giving them one-on-one opportunities to listen to and interact with women in different scientific and technological careers, and engaging them in activities that exposed them to technical training programs (such as CAD-CAM and industrial design) in the applied science and technology departments. Participants rated this program highly, especially the guest speakers and opportunities to talk with women from various careers.

The other half experienced a highly hands-on module on the HBOI campus, which emphasized active learning experiences in various lab and field settings and opportunities to interact with women in various careers. The women heard presentations, engaged in group discussions, and got direct experience exploring work in marine science, biomedical marine research (discovering drugs from marine sources), museum collections, aquaculture, and ocean engineering.

To stem a 35 percent dropout rate after year 1, material designed to expose students to the scientific method of problem solving was shifted from the IRCC section to the HBOI section, to make the material less formal and potentially intimidating. The re-entry students especially had been daunted by the unfamiliar technical and scientific terminology associated with an experiment they were to conduct and write up in the IRCC section and doubted their abilities.

Participants found the HBOI program valuable, appreciated how enthusiastic and approachable the guest scientists were, and liked the program's experiential nature. They ended up feeling more comfortable with scientific techniques and technologies and more interested in science and technology. In response to an open-ended question about a hypothetical research problem, at the end of the program, all but two of 21 students gave answers that indicated an acceptable level of understanding.

Participants in both programs wished they had had longer class sessions and more hands-on (experiential) learning. Instructors agreed that longer class sessions would allow more complete instruction, training, and discussion of results and observations, improving learning.

None of the HBOI staff had experience working with older, less traditional re-entry students. Dr. Mimi Bres from Prince George's Community College in Maryland conducted a 4.5-hour workshop on understanding and working with adult learners, recommending that they use a highly interactive informal format. One strategy she used was to frequently stop and ask participants to respond to short written questions (both multiple choice and open ended) and follow that up with a facilitated discussion of answers.

Just We Girls. In the summer of 1998, 27 girls entering ninth grade attended Jump-Start Week for Girls (nicknamed Just We Girls), a weeklong summer program HBOI provided in partnership with the St. Lucie County School District. These pre-camp experiences gave girls practical experiences in skill and content areas in which boys typically had more experience than girls: aquarium setup and maintenance, water testing and chemical analysis, specimen collecting, and computer use. The girls also met with women in science.

To test changes in attitude, boys and girls were asked (in pre- and post-tests) to select five out of 15 problems posed and describe how they would approach them. The problems were of three types: "girl" topics (such as "How do I find out what's wrong when my best friend won't speak to me?"), "guy" topics (such as "How do I find out which fishing lure works best?"), and "scientific" questions (such as "How do I determine whether or not a baby sea turtle will head toward the lights on beachfront condos?"). They hoped the girls would have become comfortable enough with the scientific questions to choose more of them on the post-test than they had on the pre-test. They did not find the striking gender differences they expected. Both boys and girls tended to choose "scientific" questions with an environmental theme; they both also tended to prefer labs and outdoor science to classroom science; and girls were more confident about their abilities than expected.

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HRD 97-10971 (one-year grant)	
Partners: Indian River Community College, St. Lucie School District	
Keywords: education program, community college, oceanography, mentoring, role models, hands-on, career awareness, gender differences, self-confidence	

003

aqu

Marine and aquatic mini-camp

MARINE AND AQUATIC MINI-CAMP

GIRLS' SCIENCE EDUCATION OFTEN STOPS AFTER SECONDARY SCHOOL BECAUSE OF THEIR POOR PREPARATION FOR SCIENCE. GIRLS ARE SOCIALIZED AWAY FROM SCIENCE IN MIDDLE SCHOOL, DON'T GET THE EXPLORATORY EXPERIENCES THEY NEED TO DEVELOP AN INTEREST IN SCIENCE, INSTEAD VIEW SCIENCE AS DULL OR DIFFICULT, AND MAY LOSE WHATEVER INTEREST THEY DID HAVE WHEN THEY STUDY IRRELEVANT SCIENCE TOPICS UNDER UNINSPIRING OR POORLY EDUCATED TEACHERS. TO HELP GIRLS BEGIN TO ACHIEVE THE KIND OF SCIENTIFIC LITERACY NEEDED IN A CHANGING JOB MARKET, THE GULF COAST RESEARCH LABORATORY IDENTIFIED 355 GIRLS AT RISK OF DROPPING OUT OF THE SCIENCE PIPELINE AND PROVIDED THEM WITH A HANDS-ON, FIELD-BASED EXPERIENCE IN 12 TWO-DAY RESIDENTIAL MINI-CAMPS.

The Gulf Coast Research Laboratory, administered by the University of Southern Mississippi, is organized in five research groups: aquaculture, fisheries sciences, environmental fate and effects, biodiversity and systematics, and coastal ecology. In groups of 30, students from Mississippi, Alabama, Louisiana, and northwest Florida were introduced to inquiry- and field-based science activities in four areas: oceanography and hydrologic processes, marine and aquatic fauna, marine and aquatic flora, and beach and barrier islands. By improving their perception of science, the project hopes to get more of the participants involved in science.

Factual knowledge alone is insufficient for maintaining the nation's edge in STEM fields. Motivation and inclusiveness are important for sustaining and growing our STEM workforce. This project hoped that giving these students a positive science experience and a chance to see themselves (however briefly) as part of a community of research scientists helped bring about a realistic change in their academic and career aspirations—at least to the extent of enrolling or re-enrolling in high school science courses.

CODE: H	J.L. Scott Marine Education Center and Aquarium, Gulf Coast Research Laboratory
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Keywords: demonstration, hands-on, exploration-based, oceanography, inquiry-based	

003
RLM
REALM: really exploring and learning meteorology

REALM: REALLY EXPLORING AND LEARNING METEOROLOGY

THIS PROJECT FROM FLORIDA STATE UNIVERSITY'S METEOROLOGY DEPARTMENT AND SCIENCE EDUCATION PROGRAM WILL EXPOSE STUDENTS IN 18 MIAMI–DADE COUNTY PUBLIC MIDDLE SCHOOLS TO INQUIRY-BASED METEOROLOGY, AN EARTH SCIENCE OFTEN NEGLECTED IN MIDDLE SCHOOL. BECAUSE THE PROGRAM IS HIGHLY ENGAGING AND IMMEDIATELY APPLICABLE, IT IS EXPECTED TO SIGNIFICANTLY AFFECT THE PARTICIPATION IN SCIENCE OF GIRLS AND THE AREA'S SIZEABLE AFRICAN AMERICAN AND HISPANIC STUDENT POPULATION.

To help reduce girls' attrition from math and science as they move from middle to high school, the project will develop a supportive learning environment, incorporating collaborative learning and staffing labs and tech rooms with women to help make the subject more attractive to girls. Social and artistic factors will be woven into the program because girls find science content more meaningful when it is good for the world, relevant to their everyday world, and connected to subjects like math and art.

Teachers and alternates from the 18 schools will be given two weeks' intensive training to strengthen their knowledge of content and science pedagogy.

Following in part the model of the Oklahoma mesonet, REALM will establish a network of high-quality weather stations that use professional-grade instruments, including wind sensors robust enough to record highly accurate high-resolution data along Florida's "Tornado Alley." Data loggers will be installed at each station and wireless communications will be used to upload data to a central server in Dade County. All 18 schools will have online access to the data, and because NOAA will also make use of the data, NOAA will have a stake in maintaining access to them.

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www.met.fsu.edu/CUDOS/	HRD 01-14882 (three-year grant)
Partners: FSU's meteorology department and science education program; National Oceanic and Atmospheric Administration; State of Florida Division of Emergency Management	
Keywords: demonstration, parental involvement, meteorology, inquiry-based, African-American, Hispanic, collaborative learning, science clubs, real-life applications	

003
Dig
Girls dig it online

GIRLS DIG IT ONLINE

THIS PROJECT EXPANDS THE INTERNET-ENHANCED LEARNING COMPONENT OF GIRLS DIG IT, A NATIONWIDE GIRLS INC. ARCHAEOLOGY PROGRAM THAT REACHES OUT TO LOW-INCOME GIRLS AND GIRLS OF COLOR IN EARLY ADOLESCENCE (AGES 12 TO 14). THE PROGRAM COMBINES COLLABORATIVE RESEARCH TEAMS AND DISCOVERY-BASED ACTIVITIES THAT TEACH THE PRINCIPLES OF SCIENTIFIC INVESTIGATION WITH ONLINE RESOURCES: AN ELECTRONIC BULLETIN BOARD, AN "ASK THE ARCHAEOLOGISTS" PROGRAM FIELDED BY WOMEN ARCHAEOLOGISTS AND ANTHROPOLOGISTS AT VARIOUS STAGES IN THEIR CAREERS, EXTENDED SEARCHES, LINKS TO "COOL" ARCHAEOLOGICAL RESOURCES, AND A PLACE ON THE WEBSITE WHERE GIRLS CAN PUBLISH EXCAVATION REPORTS.

For the pilot project, six to 12 girls each were selected for four geographically and ethnically diverse sites chosen for their archaeological resources and technological readiness: in Santa Barbara, Cal. (at the site of the Santa Barbara Presidio), in Bloomington, Ind. (a survey and excavation at Lick Creek, site of a 200-year-old African American settlement), in Lynne, Mass. (a simulation of Boston's "Big Dig,"), and in St. Louis, Mo. (a simulated excavation at the White Haven historic site, once the home of Ulysses S. and Julia Dent Grant).

The project's hypotheses—that archaeology would make girls get excited about new technology—was inverted: Girls who had access to Internet technology got excited about archaeology. When the online component was added, many participants who had found the face-to-face program "too much like school" were suddenly quite excited about archaeology—apparently because of their excitement about having access to and support in using online technology. For many girls, the online site—with its accessible and accurate archaeological information—was their first online experience and sometimes their first sustained use of computers.

And the fact that archaeologists study a variety of cultures and rely on physical evidence rather than exclusively on written records ensures that minority participants find themselves represented in the curriculum in ways they may not experience in a typical school curriculum.

Girls used their discussion board extensively, *unlike the program facilitators, who used theirs very little. Staff members were more comfortable getting answers to their questions by phone or e-mail. Unlike the girls, the archaeologists and program facilitators were more comfortable with print than with online documents (including surveys)—unanimously requesting print versions of online materials to use as they viewed the online materials. For adults, online training may be more powerful when conducted in conjunction with face-to-face programs*.

The online/telephone training tested by this project has far-reaching possibilities for implementing programs at distant sites. By using specially created Web pages viewable almost like slides while participants engage in a telephone conference call, training can be delivered at a minimal cost. Face-to-face training can cost as much as $2,000 per participant; telephone-plus-online training may be a cost-effective alternative. But making such training more effective requires certain adjustments: ensuring that call participants find a quiet place to work from, providing print-based materials to supplement online materials, and sending a list of URLs in advance, with instructions on presetting the browser to those pages.

CODES: M, I, PD	Girls Incorporated
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www.girlsinc.org/digit	
HRD 99-08759 (one-year grant)	
Keywords: demonstration, website, exploration-based, manual, mentoring, underprivileged, African-American; Girls, Inc., archaeology, engagement, collaborative learning, internships	

Delivering an Internet-enhanced program creates challenges for youth-servicing organizations. One team, for example, was using computer facilities at a local library, and when they tried e-mailing questions to Ask the Archaeologists, a firewall blocked delivery of the e-mail without alerting the girls that their e-mails went unsent. At another site, the telephone/online staff training could be conducted only in a noisy group office space, seriously compromising the quality of communication.

003

Esys

Earth systems: integrating women's studies

EARTH SYSTEMS: INTEGRATING WOMEN'S STUDIES

HAS THE "MASCULINITY" OF SCIENCE AND SCIENCE EDUCATION KEPT WOMEN, MEN OF COLOR, AND PEOPLE FROM WORKING-CLASS BACKGROUNDS OUT OF SCIENCE COURSES AND SCIENCE CAREERS? HAS SCIENTIFIC INQUIRY AND EDUCATION FAILED TO SITUATE SCIENTIFIC KNOWLEDGE IN ITS SOCIAL AND HISTORICAL CONTEXT? DOES THE SCIENTIFIC ESTABLISHMENT'S INSISTENCE ON THE "PURITY" OF SCIENCE SUPPORT THE CLAIM THAT SCIENTIFIC FINDINGS IMPROVE HUMAN WELFARE?

Earth Systems—the PROMISE project—aimed to create a cooperative, noncompetitive learning environment in which all student voices could be heard and the collaborative production of geological knowledge would be linked to their daily lives through the lens of sociology and feminist theory. Examining the role science plays in shaping definitions of knowledge, power relations, and social inequalities helped students recognize their capacity to act.

In a women's studies classroom, students sit in a circle to decentralize authority. Everyone in the room has a name and a voice, and each is a learner and a potential teacher, contributing to the collaborative construction of knowledge. PROMISE started its earth science course with only a vaguely structured syllabus that would allow for collectively developing course content with the students. Students and teachers alike were immediately made uncomfortable by this departure from traditional education. And while the social science and humanities majors were comfortable sitting in a circle, it made one geology major so uncomfortable she considered dropping the course. In time, everyone became comfortable with the classroom environment and with the "process" method of learning, but in the early days students felt there was too much social context and not enough scientific inquiry. The principal investigators quickly realized *how difficult it was to develop integrated knowledge*.

Not until the last weeks of the course did participants begin to collectively feel the integration of knowledge. They were engaged in an oil-exploration game intended to demonstrate the geological concepts of oil reservoirs and traps. The game was designed to interest students in learning about geology by having them play the role of an independent petroleum company with geologists and economists who needed to make business decisions about where to purchase land and drill for petroleum exploration. But what the students gained was a new understanding of the relationships between natural resources and economic imperatives, as this journal entry shows:

When we first started the game, I had a few unvoiced objections. [I wanted to ask,] what about the environment, ecology, and social consequences of drilling for petroleum? However, these were quickly forgotten as the excitement mounted. Our team wanted to be the first to "strike gold." So we bought information about the land, searched for the best places to drill, bought land, and drilled. We made a profit so we did it again. Soon we were up to $950,000, we were rolling in money and profits were soaring. Could we stop? No! Did I have any reservation about continuing? No. We went absolutely crazy with greed and power. . . . My desire to finish first and make a profit clouded my thinking. Never once did I think about the flora or fauna on top . . . only what was underneath. I looked at risk factors in terms of dollars only, and never once thought of human penalties.

During a weekend excursion into Death Valley to see and experience many of the geological processes and features discussed in class, the students found it easier to understand sedimentary deposits, limestone, sandstone, and basalt, when they were tangible. To reach out and touch rocks that are 1.6 billion years old meant much more than hearing that the rocks existed. On the second day of the field trip, as they entered Mosaic Canyon, they saw faulted, brecciated, polished limestone beautifully displayed in the steep-sided, narrow, curving passage into and through the mountains. They saw how the history and future of a fault cannot be captured by observing a limited rock section. Suddenly and spontaneously, the students began to discuss the unforeseen environmental problems that could result from a spatially limited geological study of a site marked by numerous active faults.

Students began to realize that although we can do little about natural occurrences, we can do something about those who are affected by them. By the end of the course, they had a more complex understanding of the processes that shape scientific inquiry and the uses to which science is put. The project's experience demonstrated that the gap between social and natural sciences can be narrowed.

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HRD 95-55721 (three-year grant)	
Publication: "Feminist Pedagogy, Interdisciplinary Praxis, and Science Education" by Maralee Mayberry and Margaret N. Rees, in National Women's Studies Association Journal, Spring 1997.	
Keywords: demonstration, cooperative learning, sociology, geology, women's studies, feminism	

003

W

Women who walk through time

WOMEN WHO WALK THROUGH TIME

THIS AWARD-WINNING VIDEO WAS DEVELOPED TO SHOW GIRLS AND YOUNG WOMEN THAT EARTH SCIENCE IS A FASCINATING CAREER. "WOMEN WHO WALK THROUGH TIME" SUGGESTS THE IDEA OF WOMEN WALKING THROUGH GEOLOGICAL LAYERS (REPRESENTING TIME) WHILE ENJOYING SUCCESSFUL CAREERS IN EARTH SCIENCE. IT PORTRAYS THREE WOMEN WHO INTRODUCE YOUNG PEOPLE TO THE FIELD, DEMONSTRATE WHAT THEY DO AS EARTH SCIENTISTS, AND ADVISE YOUNG PEOPLE ON HOW TO PREPARE FOR A CAREER IN SCIENCE. THE VIDEO WON A TELLY AWARD FOR HIGH SCHOOL EDUCATION IN 1998.

Earth science is rarely taught in high school, so pre-college students are rarely exposed to earth science mentors of either gender. Few girls are exposed to female role models in the earth sciences or realize the key role geoscientists play in solving environmental problems. Students typically think of science as chemistry, physics, or biology. The video demonstrates earth science's interdisciplinary nature, drawing on math, chemistry, physics, biology, engineering, geography, anthropology, computers—and love of the outdoors.

The 30-minute video is appropriate for students 12 to 18, and older. The allied website features earth science links for girls and young women and information about volcanoes, earthquakes, dinosaurs, minerals, fossils, water, ice, and rock.

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www.mines.utah.edu/geo/video/Video.html	HRD 96-25566 (one-year-grant)
Product: The videotape Women Who Walk Through Time.	
Keywords: dissemination, video, website, earth science, geology, career awareness, role models	

003

ACE

ACES: adventures in computers, engineering and space

ACES: ADVENTURES IN COMPUTERS, ENGINEERING, AND SPACE

THE UNIVERSITY OF TENNESSEE AT CHATTANOOGA, IN PARTNERSHIP WITH GIRLS INC. OF CHATTANOOGA AND THE UTC CHALLENGER CENTER, LAUNCHED ACES TO ENCOURAGE GIRLS TO KEEP STUDYING MATH AND SCIENCE AND TO CONSIDER CAREERS IN SPACE, COMPUTERS, AND ENGINEERING. THE PROGRAM OFFERED 25 MIDDLE SCHOOL GIRLS POSITIVE ROLE MODELS AND POSITIVE HANDS-ON ACTIVITIES,

At a one-week residential summer camp, 25 girls entering seventh and eighth grade are participating in space-related activities at the Challenger Center; hands-on activities in computer science and electrical, mechanical, and industrial engineering; and activities designed to nurture each girl's self-esteem and development as a whole person. Girls Inc. provided leadership for camp counselors, who reduced attitude, behavior, and discipline problems by enforcing rules without alienating the girls.

Engineering activities. *The girls tended to like the hands-on experiments best and the discussion before the activity least*. An industrial engineering activity, for example, introduced systems thinking, product assembly, workstation design, and quality management. Using Lego ZNAP materials (similar to K'nex) and working in teams of six or seven, the girls designed their own assembly environment to build a boat or an airplane. Teams structured themselves to have one inventory person, assemblers (who determined whether to emulate craft, factory, or mass production, introduced through a short lecture on production systems), and a quality person. Teams competed on time to complete each unit, number of units completed within the allotted time, and number of units without quality faults.

An electrical engineering activity familiarized the girls with common circuit elements, circuit schematics, and Ohm's and Kirchoff's laws. In an environmental engineering session, the girls discussed how pollutants and particulates suspended in air reduce visibility and can alter the absorption, scattering, and reflection of colors perceived by the human eye to make up visible light. In a robotic activity—using Lego Mindstorm robotic materials, including a programmable "brick" preprogrammed to drive two motors and a light—students in groups of two designed and built a vehicle that would go forward, stop, turn on a light bulb, spin on one wheel, play an engineering song, and return.

In a mechanical engineering session, teams of two to three girls built experimental bridges using strips of paper, books of like thickness, small paper cups, and pennies. In a civil engineering activity the last night of camp, girls built towers out of standard drinking straws, competing as teams to build the tallest tower that would support a tennis ball for at least 30 seconds. They were given 50 straws, a roll of masking tape, a pair of scissors and a set of instructions about what they could and could not do, in what time frame. In retrospect, the team leaders thought it would be good to start with a slide presentation to help the girls visualize structure building and triangulation.

Computer activities. *The girls liked having something to take home to show their family and friends*. Hands-on experiences with computers, using gender-neutral software, allowed the girls to develop Web pages that reflected their interests, to do simple programming (building a basic user interface form for a program to play Hangman), and to use computer-assisted design (CAD) software—for example, to study perspective using a Lego block from robotics.

Space-related activities. More than three dozen nonprofit, informal Challenger science education centers opened after the 1986 space shuttle tragedy. For this project, the UTC Challenger Center provided student-based space mission simulation programs to reinforce and introduce students to real-world applications of science principles and concepts discussed in their classrooms. Activities included a Mission to Mars activity, with Team A at mission control and Team B "traveling" via a shuttle simulation to a space station on Mars; the design, construction, launching, and testing of rockets, using plastic soda bottles, glue, tape, and construction paper; and the design and construction of a space station on land and under water, using a large container of Quadro (buoyant material similar to PVC) containing various types and sizes of extensions and connectors.

Lightening or varying the mix of camp activities were ice breakers to help the girls get to know each other, craft sessions, team-building activities, and interactions with *role models, who learned the importance of visual aids, to help the girls visualize what they do*. Follow-up activities for the school year involved computer science, product design (the popular design and construction of a container/device to protect eggs from a 3-story drop), industrial engineering, the Discovery Museum, and a field trip. An ACES Fair—featuring hands-on engineering, computer, and space activities—was to be held at selected elementary, middle, and high schools and community centers.

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PARTNERS: GIRLS, INC. AND THE UTC CHALLENGER CENTER	
KEYWORDS: DEMONSTRATION, HANDS-ON, ROLE MODELS, INFORMAL EDUCATION, CAREER AWARENESS, ENGINEERING, COMPUTER SCIENCE, SPACE, FIELD TRIPS	

003

wild

Careers in wildlife science

CAREERS IN WILDLIFE SCIENCE

WHETHER DISSECTING OWL PELLETS, LEARNING ABOUT EDUCATIONAL REQUIREMENTS FOR BECOMING A VETERINARIAN, TEACHING YOUNGER GIRLS HOW ANIMALS COMMUNICATE, OR HELPING HERD FLAMINGOS AT THE BRONX ZOO, THE GIRLS IN THE THREE-YEAR WILDLIFE SCIENCE CAREERS (WSC) PROGRAM ARE BEING EXPOSED TO CAREER OPPORTUNITIES FOR WOMEN IN WILDLIFE SCIENCE.

Using hands-on learning and girls' natural interest in animals, the Wildlife Conservation Society's three-year WSC program promotes enthusiasm for the basic sciences and for careers in wildlife science. Each year, the program recruits 105 Girl Scouts, aged 12 to 14, from the inner city of New York City's five boroughs. It also trains 12 to 15 Girl Scout leaders and parents as leader–mentors, to help with the program and to share information about the Bronx Zoo and wildlife sciences with others in their troops.

As part of the program, each year Cadette and Senior Girl Scouts (aged 12 to 14) attend a three-day winter career workshop at the Bronx Zoo, which gives them an entirely different perspective from their daily urban environment. The zoo—a verdant oasis in the midst of seemingly endless urban sprawl—gives many Girl Scouts their first-ever experience with plants and animals.

Instructors from the zoo's education department give the girls a behind-the-scenes look at various animal exhibits and teach them about different animals' needs, habitats, and behaviors. Girls learn to use scientific equipment such as microscopes, binoculars, range finders, and radio tracking units. They speak with women professionals at the zoo, learning firsthand about careers in conservation (such as primatologist, ornithologist, wild animal keeper, veterinary technician, lab supervisor, media archivist, and field biologist). At a career fair, participants present projects featuring the six clusters of wildlife-related careers: animal care and management, education, exhibit design, field science, wildlife health, and wildlife science park support. The workshops culminate in an overnight at the zoo, where girls eat dinner, observe the habits of nocturnal animals on a night hike, and participate in a wildlife scavenger hunt.

The girls also participate in field experiences at WCS's other living institutions. At the New York Aquarium, they learn about the differences between aquatic and terrestrial animals and go behind the scenes with dolphin trainers. They hit the beach at Coney Island for a hands-on demonstration of plankton sampling. At the Prospect Park Zoo, they practice common field methods used to study primates in the wild. At the Queens Zoo, they learn about domestic and farm animal care and visit a unique bird feeding station in the marsh exhibit.

Before the winter workshops, Girl Scout leaders receive training in leadership and mentoring, gender equity issues, and the importance of wildlife-related careers. Girls 14 to 17 who are interested in developing leadership skills can get training as program aides, helping troop leaders with meetings of younger Girl Scouts and sharing what they have learned about wildlife science. In 2000, WCS trained more than 80 girls as aides. This train-the-trainers model will extend the program's impact.

Girls who have completed aide training and service are eligible for the competitive WSC internships at one of the five New York WSC parks (those mentioned plus the Central Park Zoo and the St. Catherines Wildlife Survival Center), where they are carefully matched with a mentor–supervisor and get work experience, mentoring, and a modest stipend. More than two dozen young women have served as interns, working with professionals in such fields as herpetology, ornithology, publishing, wildlife nutrition, and veterinary pathology.

This project offers inner-city girls an opportunity to learn about fields unknown to them and to experience professional/technical activities firsthand. Their first reaction is to reach out and touch the animals. After being at the zoo and interacting with role models, they become interested in the many kinds of opportunities available at the zoo.

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www.wcs.org	HRD 96-31959 (ONE-YEAR GRANT) AND HRD 97-14791 (THREE-YEAR GRANT)
PARTNERS: BRONX ZOO, GIRL SCOUT COUNCIL OF GREATER NEW YORK	
KEYWORDS: DEMONSTRATION, CAREER AWARENESS, GIRL SCOUTS, TRAINER TRAINING, FIELD TRIPS, HANDS-ON, WILDLIFE SCIENCE, INTERNSHIPS, MENTORING, GENDER EQUITY AWARENESS, ROLE MODELS, INFORMAL EDUCATION	

003
binfo
Bioinformatics for high school

BIOINFORMATICS FOR HIGH SCHOOL

BIOLOGY IS QUICKLY BECOMING AN INFORMATION-DRIVEN SCIENCE, AND THE INTEGRATION OF INFORMATION TECHNOLOGY AND MOLECULAR BIOLOGY HAS CREATED A NEW DISCIPLINE: BIOINFORMATICS. THE ANALYSIS OF DATA ABOUT MOLECULAR SEQUENCES IS CHANGING NOT ONLY THE WAYS BIOLOGISTS APPROACH PROBLEMS BUT THE VERY QUESTIONS THEY ASK—ESPECIALLY ABOUT HOW SCIENTISTS CAN USE THE DATA BECOMING AVAILABLE FROM THE HUMAN GENOME PROJECT AND OTHER DNA DATABASES.

With this project, Immaculata College offered a summer enrichment program on bioinformatics for 16 girls entering senior year of high school. The project targeted minorities and other student groups underrepresented in STEM, from the greater Philadelphia area, including counties in nearby Delaware and New Jersey

In the five-week residential program, students learned about molecular biology, including genetic diseases and evolutionary classification; computer technology, incorporating bioinformatics tools; group processing techniques; and related legal and ethical issues. Guided by educators, students working in problem-based learning groups learned the concepts and gathered the information needed to solve real problems. They used the NSF-funded program Biology Student Workbench, a Web-based computational interface for analyzing genetic data.

Women from industry, government, and education spoke to them, and they took field trips to a science museum, a pharmaceutical company, a university laboratory, the National Institutes of Health, and the Institute for Genomic Research Sequencing Center.

While a fair number of women choose biology as a career, fewer choose computer-related careers. This program was designed to encourage girls interested in biology to consider bioinformatics as a field of study and a profession. When the summer program ended, the students gave presentations in their high school science classrooms and clubs, demonstrating their confidence in what they have mastered and serving as role models for their classmates. At a fall reunion, they shared their peers' responses. The program directors stay in touch with the girls and work with BioQUEST and the Biology Student WorkBench team to encourage replication of the program at other sites nationwide.

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www.immaculata.edu/Bioinformatics/	HRD 00-86360 (one-year grant)
Keywords: demonstration, bioinformatics, biology, information technology, summer program, problem-based, field trips, role models	

003
life
Life science biographies

LIFE SCIENCE BIOGRAPHIES

THE AMERICAN PHYSIOLOGICAL SOCIETY (APS) DEVELOPED CURRICULUM MATERIALS TO HELP SECONDARY SCHOOL BIOLOGY TEACHERS ACQUAINT MIDDLE AND HIGH SCHOOL STUDENTS WITH 20 WOMEN IN SCIENCE AND WITH THE INQUIRY APPROACH TO SCIENCE ACTIVITIES. THE APS DEVELOPED, REVIEWED, AND FIELD-TESTED 20 LEARNING MODULES THAT CAN BE DROPPED INTO LIFE SCIENCE CURRICULA, COORDINATING THEM WITH CURRICULAR GOALS AND PROPOSED NATIONAL STANDARDS FOR INTRODUCTORY BIOLOGY.

Published in one volume as *Women Life Scientists: Past, Present, and Future—Connecting Role Models in the Classroom Curriculum*, these biographies will help middle school life science students and high school biology students view science as an exploratory activity done by real people, including women of color and women with disabilities.

Scientists in physiology, medicine, and public health are physiologist Kim Barrett, reproductive physiologist Betsy Dresser, cardiovascular physiologist Joyce Jones, medical researcher Maria Mayorga, microbiologist Judith Pachciarz, public health physician Sara J. Baker, and AIDS researcher Linda Laubenstein. Betsy Dresser, for example, helps preserve endangered species through in vitro fertilization and embryo transfer. In the Dresser unit, student groups debate the relative merits of preserving endangered species through conservation or through embryo transfer. Sara J. Baker, best known for helping track down Typhoid Mary, reformed public health in the early 1900s. In the Baker unit, students must develop an action plan for tracking down the source of a present-day typhoid epidemic before it becomes widespread.

Scientists in ecology, botany, and animal behavior are behavioral ecologist Jennifer Clarke, marine biologist Sylvia Earle, behavioral ecologist Deborah Gordon, ecologist Rachel Carson, animal behaviorist Dian Fossey, botanist Ynez Mexia, and naturalist Beatrix Potter.

Scientists in molecular biology, biochemistry, genetics, and microbiology are microbiologist/molecular geneticist Alice Huang, molecular virologist Marian Johnson-Thompson, geneticist Mary-Claire King, biochemist and molecular biologist Lambratu Rahman, biohemist Gerty Cori and geneticist Barbara McClintock.

Each module includes a brief biography of a woman of science followed by hands-on (inquiry-based or problem-solving) activities related to the work of the woman profiled. The modules were field-tested with students in middle and high school and community college classrooms and with teachers during workshops held at meetings of the National Science Teachers Association and the National Association of Biology Teachers. These teachers concluded that the units would be appropriate for many ages but especially for students in grades 7–12.

CODES: M, H, I	American Physiological Society
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www.faseb.org/aps and www.the-aps.org/education/k-12misc/ord-wls.htm	HRD 93-53760 (one-year grant)
Publications: Women Life Scientists: Past, Present, and Future (Matyas and Haley-Oliphant, 1997).	
Keywords; demonstration, biology, curriculum, biographies, hands-on, life sciences, inquiry-based	

003

pol

Apprenticeships in science policy

APPRENTICESHIPS IN SCIENCE POLICY

WOMEN TEND TO COME LATE TO THEIR UNDERGRADUATE MAJORS, OFTEN CHANGING MAJORS SEVERAL TIMES AFTER ARRIVING AT COLLEGE. THIS TENDENCY TO DECIDE LATE ON A MAJOR IS ONE REASON MANY WOMEN DROP OUT OF MATH AND SCIENCE, BUT IT COULD ALSO BE ONE WAY THEY ARE DRAWN INTO STEM. WOMEN WHO LEAVE SCIENCE EXPLAIN THAT THEY SEE MOST MATH AND SCIENCE COURSES (EXCEPT FOR PRE-MED) AS NOT BEING PEOPLE-ORIENTED. AMERICAN UNIVERSITY (AU) DESIGNED THIS PROJECT—*A SPRING SEMINAR ON SCIENCE POLICY FOLLOWED BY A SUMMER RESEARCH INTERNSHIP—TO ALTER THAT NARROW VIEW OF SCIENTISTS AS ISOLATED RESEARCHERS, WORKING ALONE, DEALING WITH CONCEPTS BUT NOT PEOPLE*.

The spring seminar on science policy included discussions of science ethics, the environment, space policy, justice, statistics, the information age, and such applications of chemistry and biology as cloning, DNA work, and mad cow disease. The project brought in AU faculty as well as speakers from government and nonprofit organizations working on science and science policy. Students were offered special computer training, especially in the use of databases and statistical software. Each student wrote three papers and participated in a group project.

They then worked fulltime in NSF-funded summer internships in science policy in government, industry, or nonprofit organizations. They were housed together in AU dormitories so they could share experiences.

Several students changed to math or science majors as a result of the project, and others registered for more math and science courses. (AU's math department had already had some success persuading women to select statistics or applied statistics as a second major after they took the one statistics course required for their majors in the social sciences.) Final results won't be known until the students graduate, go to graduate school, or take up their careers. But even if they don't pursue careers in math or science, they will have a better appreciation of how important a solid knowledge of math and science is to concerned citizens and to public servants formulating policy about health, education, the environment, defense, and other critical issues.

CODE: U	American University
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HRD 96-32086 (one-year grant)	
Keywords: demonstration, science policy, internships, research experience, computer skills	

003
H_2O
Splash: the math and pshysics of water

SPLASH: THE MATH AND PHYSICS OF WATER

THIS ACTIVITY- AND TEAM-BASED MODEL PROJECT FOR EIGHTH GRADE GIRLS EXTENDED AND ENHANCED AN NSF-FUNDED FOUR-WEEK SUMMER CAMP (SUMMER SCIENCE SPLASH) THAT IN 1993 HAD SERVED 50 OF THE SAME GIRLS: *ABLE, WELL-MOTIVATED MINORITY STUDENTS WHO, WITHOUT SPECIAL ATTENTION, WERE LIKELY TO LOSE INTEREST IN SCIENCE AND MATH.*

In camp, the students used group discussions, experimentation, and fieldwork to learn about water's physical properties and role in the Northwest ecology, the principles of waves, and issues of water quality. The project provided for 25 of the campers, building on knowledge and skills gained in the camp, to carry out a challenging science project on a water-related issue (for example, stream monitoring, hydroelectric power, and water in weather, avalanches, and marine biology). Teams of two to five students—plus a middle school teacher, a professional mentor, and a Seattle University undergraduate mentor—worked on the science projects together. *The idea was that academic-year reinforcement of the excitement generated by the camp would heighten many students' continuing interest in science*.

The 25 students read, did field work, experimented, held team discussions, built models, and wrote. A curriculum designer helped the teams design projects that were significant but appropriate for the time frame (five months). The students spent time learning about science, interacted with scientists as friends and role models, and gained skills in leadership, teamwork, presentations, and project management. They appreciated being part of a program that stressed cooperation more than competition.

Two students taught a unit on whales in an elementary class. Several teams did stream restoration projects on Bear Creek and North Creek. A team of Native American students took an elementary class on a stream monitoring expedition. One group learned about fractals, programming a IIgs computer and playing a game called Chaos, first with dice and then with the TI-81 graphing calculator, using random numbers. (If the game Chaos is played long enough, the Sierpinski triangle always emerges—an application of the law of large numbers.) One team mentored students at First Place (a school for children who live in shelters), teaching them about Lego-Logo—creating Lego machines, using Lego toys, and instructing a computer to operate them. Other teams studied the space shuttle *Challenger* and how comets travel in space; studied avalanches and went to Snoqualmie Pass to gather data on avalanche conditions; built a model sailboat and tested various sail positions; learned how to use ultrasound; and edited a videotape explaining the entire project. One student won a national award for testing airfoils on a model wind tunnel. Many students were featured on TV or radio and in newspaper and magazine articles.

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HRD 93-53804 (ONE-YEAR GRANT)	
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KEYWORDS: DEMONSTRATION, ACTIVITY-BASED, TEAMWORK APPROACH, WATER, ECOLOGY, HANDS-ON, MATH, PHYSICS, MENTORING, ROLE MODELS	

003
inv
Engaged learning: investigating water quality

ENGAGED LEARNING: INVESTIGATING WATER QUALITY

AT A FOUR-WEEK SUMMER SCIENCE CAMP HELD AT SOUTHERN ILLINOIS UNIVERSITY AT EDWARDSVILLE, HIGH SCHOOL STUDENTS WERE IMMERSED IN RESEARCH ABOUT A SUBJECT OF REAL-LIFE CONCERN—THE WATER QUALITY OF OUR RIVERS AND STREAMS—AND LEARNED ABOUT MATH, PHYSICS, CHEMISTRY, AND ENGINEERING CONCEPTS ON A NEED-TO-KNOW BASIS. THE IDEA BEHIND THIS EXPERIMENT IN "ENGAGED LEARNING" WAS TO MOTIVATE STUDENTS TO LEARN THE SKILLS AND BACKGROUND NEEDED TO COLLECT, ANALYZE, AND INTERPRET DATA.

Under the direction of university faculty, and using labs and equipment not available to them in high schools, the students engaged in empirical research about water quality. To prepare for collecting and analyzing data, students were guided to understand the meaning of accuracy, reliability, replicability of experimental results, and sources of error. They learned about standard deviation, percentage-precision error, average deviation, and rejection quotients, as they relate to accuracy. Math instruction emphasized functions (a key to success in calculus) and the relationship between functional form and the shape of a graph. Students manipulated data on computers to fit curves to the data, producing graphical output, algebraic functions, and correlation statistics.

In an introduction to environmental engineering and wastewater treatment—using math, physics, and chemistry—the students addressed a request for proposal (RFP) from an entity that wanted residential wastewater treated.

CODES: H, U	Southern Illinois University at Edwardsville
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HRD 99-08734 (one-year grant)	
Keywords: demonstration, research experience, water, summer camp, engineering, engaged learning	

They investigated the properties of campus pond water and analyzed its quality, measuring the water for pH, turbidity, total solids, dissolve oxygen, nitrates, phosphates, biochemical oxygen demand, temperature change, and fecal coliform.

003
img
Women's images of science and engineering

WOMEN'S IMAGES OF SCIENCE AND ENGINEERING

HANDS-ON EXPERIENCES WITH STATE-OF-THE-ART IMAGING TECHNOLOGY SERVED AS THE MAGNET TO DRAW FEMALE STUDENTS (AND THEIR TEACHERS) TO THIS PROJECT FROM ARIZONA MIDDLE SCHOOLS, HIGH SCHOOLS, AND COMMUNITY COLLEGES. BY EXPERIENCING HOW SCIENTISTS AND ENGINEERS EXPLORE THE STRUCTURE, PROPERTIES, AND FUNCTIONS OF MATERIALS, PARTICIPANTS WERE BETTER ABLE TO UNDERSTAND CONCEPTS OF PHYSICS, CHEMISTRY, AND BIOLOGY AT THE ATOMIC LEVEL.

Students were able to look through telescopes and charge couple detectors (which make objects appear closer) to see objects in the sky typically studied by astronomers; through magnifying glasses and surveyors' transits at objects the human eye can measure; through optical microscopes and videoscopes at objects too small to be seen unaided; through the electron microscope at submicroscopic objects (smaller than a wavelength of light), such as viruses; and through a scanning tunneling microscope and a transmission electron microscope at nanometer-scale landscapes on the same common objects.

WISE days (women's images of science and engineering) were held Saturdays for middle and high school girls and Fridays for community college students. Cross-discipline activities (e.g., apples, red blood cells, and integrated circuits) gave pre-college students a chance to use microscopy to examine everyday items or items of high interest. The most popular WISE day, on forensic science (crime lab, DNA, murder mystery, fingerprinting—and a pathologist's presentation), became a teacher-driven module the third year; mining and air pollution (acid rain) were also popular. Project-based learning activities for community college students emphasized Web-based research and how to develop Web pages to display project results.

Family nights, held roughly once a month on Friday evenings, sometimes offered hands-on exhibits and activities, sometimes presentations (for example, on "Rainbows, Soap Bubbles, and Peacock Feathers," on iridescence, or a night at the ASU planetarium).

Summer workshops for students and teachers used presentations, guest speakers, group activities, role playing, hands-on lab activities, and journals to cover a range of topics, from women in science and Web page construction to scaling (microscopes to telescopes), photosynthesis, superconductivity, scanning probe microscopy, and high-resolution electron microscopy. Teachers were paid stipends and encouraged to participate in activities for students. At their request, teachers were also given separate two-day, six-hour faculty workshops.

Students and teachers alike preferred hands-on, inquiry-based activities using the various imaging technologies, but they also rated highly a river rafting trip and Web page construction. Of students who participated, 60 percent said they were now more likely to take advanced math and science courses.

CODES: M, H, U, I, PD	Maricopa County Community Colleges
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HRD 95-55733 (three-year grant)	
Partners: Chandler-Gilbert Community College, Willis Junior High School, Arizona State University (and Planetarium), Arizona Science Center.	
Keywords: demonstration, community college, hands-on, workshops, parental involvement, project-based, teacher training, inquiry-based, field trips	

004

Ch

New Dimensions in Diversity

CHAPTER FOUR · NEW DIMENSIONS IN DIVERSITY

"WHEN THOSE WHO HAVE THE POWER TO NAME AND TO SOCIALLY CONSTRUCT REALITY CHOOSE NOT TO SEE YOU OR HEAR YOU, WHETHER YOU ARE DARK-SKINNED, OLD, DISABLED, FEMALE, OR SPEAK WITH A DIFFERENT ACCENT OR DIALECT THAN THEIRS, WHEN SOMEONE WITH THE AUTHORITY OF A TEACHER, SAY, DESCRIBES THE WORLD AND YOU ARE NOT IN IT, THERE IS A MOMENT OF PSYCHIC DISEQUILIBRIUM, AS IF YOU LOOKED INTO A MIRROR AND SAW NOTHING."

—POET ADRIENNE RICH, *INVISIBLE IN ACADEME*

ONE OF NSF'S STRATEGIC GOALS AND THEMES IS "PEOPLE"—ESPECIALLY BROADENING PARTICIPATION IN SCIENCE TO INCLUDE GROUPS TRADITIONALLY UNDERREPRESENTED IN THE ENTERPRISE: WOMEN, CERTAIN MINORITIES, AND PERSONS WITH DISABILITIES. OF COURSE THESE POPULATIONS INTERSECT—HALF OF OUR POPULATION IS FEMALE, HALF OF MINORITIES ARE FEMALE, AND SO ON. JUST AS BEING FEMALE CAN POSE CERTAIN BARRIERS TO THE PURSUIT OF SCIENCE AND MATH, SO ETHNIC AND RACIAL DIFFERENCES AND DISABILITIES CAN POSE BARRIERS. BEING FEMALE AND AFRICAN AMERICAN, OR FEMALE AND NATIVE AMERICAN, OR FEMALE AND HISPANIC, OR FEMALE AND DISABLED, OR FEMALE AND "AT RISK" OR ECONOMICALLY DEPRIVED CAN POSE DIFFERENT CHALLENGES IN ACCESS TO QUALITY EDUCATION AND ENCOURAGEMENT TO REALIZE AN INTEREST IN SCIENCE AND MATHEMATICS.

MANY PROJECTS HAVE ADDRESSED THE COMPLEXITIES OF MULTIPLE DIVERSITIES HEAD ON. THEY USUALLY START BY ASSESSING THE "TARGET POPULATION" AND ITS UNIQUE CHARACTERISTICS, AND THEN DESIGNING A PROGRAM THAT WORKS FOR THAT GROUP, WHETHER IT IS ADDRESSING THE ISSUE OF LANGUAGE LEARNING AND *SCIENCE EDUCATION*, OR LIVING IN A REMOTE RURAL AREA AND *SCIENCE EDUCATION*, OR IN AN INNER CITY AND *SCIENCE EDUCATION*, OR HAVING LIMITED OPPORTUNITIES AND LIMITED FINANCIAL SUPPORT.

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LATINAS EN CIENCIA

LOCATED IN THE HEART OF OREGON'S "SILICON FOREST," THE OREGON MUSEUM OF SCIENCE AND INDUSTRY (OMSI) IS DEVELOPING A PILOT PROJECT TO GIVE HISPANIC GIRLS EARLY EXPOSURE TO HANDS-ON SCIENCE PROGRAMS, BOTH IN AND OUT OF THE MUSEUM. *EARLY PARTICIPATION IN INFORMAL SCIENCE PROGRAMS DOES INFLUENCE CAREER CHOICES, AND OREGON'S HIGH-TECH INDUSTRIES NEED MORE HISPANIC WOMEN IN THE WORKFORCE*.

Latinas en ciencia aims to engage Hispanic girls in science and technology in grades 3–5, before they have formed a decision against that career pathway; to support Latinas' engagement with science and technology from preschool through high school; and to change the museum's internal culture so that it feels more like home for the girls. The outreach program is targeting three communities: a rural town in Washington State (White Salmon), a suburban community south of Portland (Tigard), and an urban community housing center in northeast Portland (Villa Clara Vista).

The museum will pilot an all-school assembly to draw Latinas to the program, a weekly science club to make science fun and accessible, family science nights, community programs, museum field trips, and activities to make girls comfortable with equipment such as microscopes and digital cameras. All activities will be designed to build leadership and strengthen the girls' belief in their own ability to succeed in science and technology.

OMSI will pilot various age-based science programs designed to provide Hispanic girls with continuous science and technology options from preschool through high school, with mentorship opportunities designed to bridge age gaps. For example, girls in grades 3–5 will design science

INFORMAL SCIENCE EDUCATION FOR HISPANIC GIRLS

The Oregon Museum of Science and Industry based its pilot projects on lessons learned during its planning grant activities:

- Latina girls often rule out math, science, technology—and possibly school in general—by middle school. *Advocacy programs for high school girls tend to support the rare Latina girls who have already chosen to be involved in science and have exhibited a level of success. Advocacy programs that begin in middle school must work on issues of self-esteem, leadership, and reversing the notion that science is not for girls. Programs at the elementary school level should excite girls about options in math, science, and technology before barriers to these subjects are internalized*.
- The Latino community is ready to support a project to improve science opportunities for Latinas, but the Spanish-speaking population in the Portland metropolitan area is only in the early stages of creating the community networks needed to support Latina girls in this area. They do not have efficient mechanisms for communicating, sharing resources, and doing program recruitment.
- *Efforts to reach Latinas must concentrate first on the family. Latino family and culture is central to the image Latinas have of themselves and their career options. Latinas are more comfortable and confident in the museum when many Latino families are present. Parents must be comfortable with Latino programs before they will grant permission for their girls to participate*. And family expectations (for example, that girls will baby-sit their siblings) may limits girls' ability to participate in programs outside of school.
- *The ability to succeed in school and in academically based careers is greatly influenced by learning experiences that take place in the home and in preschool through primary grades*. Programs for girls in science must engage and address the learning needs of young girls before grade three science clubs and programs begin.
- Building confidence around science and technology requires familiarity, repeated opportunities, and recognition of successes. *Even highly successful girls tend to doubt their own skills in math, science, and technology. All girls need frequent acknowledgment and praise for their accomplishments and progress*.
- Role models should be provided informally and at many levels. *Girls can picture themselves five years older, but not much more. Girls in grades 3–5 are viable role models for the youngest Latinas, late elementary and middle school girls may respond best to college-age leaders and role models, and high school girls may respond best to young adults and college graduates*.
- *It is important to expose girls of all ages to successful women in STEM careers. Many children from low-income and marginalized communities, especially in rural areas, are not aware of career options beyond waitressing, logging, clerking, and teaching*.

activities for younger students and will be trained to read science books aloud to younger children, while middle school and high school girls will in turn help the younger girls in their museum science clubs. Latinas from grades 3 through 12, along with adult role models from the community, will enjoy overnight Science Camp-Ins at the museum, and middle school girls will work regularly with female museum scientists and other community mentors.

To strengthen parental support for girls engaging in the field, OMSI will hold free monthly Latino family science events, providing bilingual staff and volunteers and other Spanish-language resources. Training will be provided on how to interact with Latino children and families and how to facilitate a parent-based program fostering pre-literacy and science inquiry skills.

Work under the planning grant revealed that *Latinos in the Portland metropolitan area were uncomfortable with the museum setting*. The museum is located in a nonresidential area and first-time visitors often have trouble finding it. *Providing transportation, especially for first-time visitors, made a difference. Bilingual communication is important, and it helps to provide a small "family" room as a comfortable entry point for Latino families to gradually acclimatize to the museum space*.

CODES: I, E, M, H, PD	Oregon Museum of Science and Industry
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HRD 00-86419 (one-year grant) and HRD 99-76572 (planning grant)	
Keywords: demonstration, Hispanics, Latinas, hands-on, engagement, science club, field trips, self-confidence, mentoring, role models, museum, parental involvement, information education	

004
Max
MAXIMA: changing the way children learn science

MAXIMA: CHANGING THE WAY CHILDREN LEARN SCIENCE

USING A MULTICULTURAL, INQUIRY-BASED APPROACH TO ACTIVE LEARNING, MAXIMA, A PROGRAM AT NEW MEXICO STATE UNIVERSITY, IS EXPLORING WAYS TO TEACH MATH AND SCIENCE TO ELEMENTARY AND MIDDLE SCHOOL STUDENTS THAT WILL INCREASE GIRLS' CHANCES OF BECOMING SCIENTISTS. *ALTHOUGH LATINOS ARE THE FASTEST-GROWING POPULATION GROUP IN THE UNITED STATES, ONLY 3.5 PERCENT OF ALL SCIENCE DEGREES ARE AWARDED TO LATINOS. THIS PROJECT IS TARGETED TO LATINAS, WHO ARE THE LEAST LIKELY OF ALL TO PURSUE SCIENCE CAREERS*.

Schools involved in the project serve predominantly Latino students, most of whom get free or reduced-price lunches. Some of the children live in shantytowns with no running water or electricity. Many of their families, despite living in this country for generations, have been trapped in a cycle of poverty that only a successful education can break. And most of the elementary school teachers are Anglo-European women. This project aims to help those teachers move from the realm of good intentions to transformative action.

As a three-year longitudinal study, MAXIMA started with a cohort of about 200 girls in grade 4, whose progress it will follow through grades 5 and 6. All teachers in those grades are involved in the project, and their growth will also be followed. Girls will work both with their regular teachers and with student teachers who have taken MAXIMA's professional development seminar.

Changing teaching norms. One reason for poor academic attitudes and performance in math and science is that elementary teachers are poorly prepared for teaching science, with too little knowledge both of science content and of effective strategies for effectively teaching girls. There is agreement about the need for reform but little guidance about how the average teacher can implement substantive changes in the classroom.

Teachers tend to teach the way they were taught, and teacher education programs have had little or no impact on student teachers' personal philosophies of teaching or learning. Some student teachers resist or struggle with learning to teach for understanding or for diversity, and if student teachers feel they lack the support required to take risks during student teaching, they will fall back on the safe, traditional, teacher-centered norm to which they have become accustomed after 15 or so years of schooling.

Teachers need concrete opportunities to improve their skills and knowledge of content. They need to explore how issues of power and privilege, ethnicity, gender, and voice influence the how, when, and why of what is to be learned. They need concrete examples of how to be more gender-

sensitive and how to meet the needs of an increasingly diverse student population. In math class, for example, as students measure the carpet in the classroom, they might ask how many fathers and mothers have tape measures at home. When space is the topic, they might talk about the first Hispanic astronaut and make students aware of the names of Latino scientists, countering the constant negative images Hispanic boys and girls see of themselves on television. In a unit on architecture, they might take the time to learn and discuss how adobe homes are built. And they must learn to make sure that a shy, quiet Hispanic girl gets the attention she needs.

Summer institutes for professional development. MAXIMA focuses on preparing cooperating and student teachers to conduct hands-on, minds-on activities and on how to make them more gender-inclusive. It also emphasizes *critical discussions of how science knowledge is produced and reproduced, who are (were) the scientists, how their work affects society, and how society determines which scientific work is worth funding. This requires that teachers undergo a very different kind of professional preparation from the kind they have probably had in their content area studies*.

Each year, 36 elementary school teachers attend a two-week summer institute and receive in-school support during the school year. To promote long-lasting change, all teachers from each of the selected schools participate. Participants are immersed in hands-on, minds-on math and science activities eight hours every day, including problem-solving scenarios/learning centers.

Every second evening, teachers develop curriculum collaboratively. Teachers and student teachers work in groups of their choosing, within their school sites, to develop gender-inclusive, inquiry-based lessons. They are responsible for preparing a two-week curriculum unit for their grade level, which they will share with each other.

At the same time, participants learn how to conduct action research projects, which can be tied to the curriculum units they design. They learn to use new technologies, activities, and problem-solving scenarios. Program funding helps pay for school equipment such as kits for building bottle rockets, electricity kits with voltmeters, orange juice clocks, graphing calculators, and heart rate monitors.

To increase opportunities for professional development, student teachers are paired with workshop participants during the school year. To create a community of learners, teachers are offered release time for meetings to share ideas and concerns and to discuss curriculum or action research projects with their peers. They are encouraged to observe each other's classes.

The research component. The research team is observing classes and teachers' meetings, videotaping two classes, and using the videotapes to analyze classroom interactions. Teacher participants themselves can call up a library of video clips to compare what they planned to do in the classroom with what they see themselves doing. Student teachers will be interviewed as the year begins and end and data on students' attitudes and performance in math and science will be gathered through questionnaires, pre- and post-content unit tests of knowledge, and ethnographic interviews with a focus group of 30 students.

MODELING EFFECTIVE TEACHING

Teaching under MAXIMA emphasizes hands-on, minds-on experience in the sciences and making the curriculum more relevant to the lives of the students. Some of the strategies master teachers model in summer institutes and in methods classes for student teachers are

- Using a variety of student-centered teaching and learning strategies
- Monitoring groups for equity (who is doing the talking and using the equipment)
- Assigning tasks equally
- Taping students' learning styles
- Providing opportunities for problem solving
- Encouraging discussions of career options
- Monitoring praise and acknowledging accomplishments
- Accepting more than one right answer
- Implementing wait time and equitable turn-taking
- Encouraging peer tutoring
- Displaying images of men and women from varying ethnic backgrounds in career roles
- Praising and encouraging collaborative learning and avoiding a competitive environment
- Linking careers in science with math, engineering, and technology
- Bringing into the classroom community women successful in STEM-related careers

Early findings. *Teacher participants credit MAXIMA with giving them stronger content knowledge, more enthusiasm, and more skills and effectiveness in the classroom*. They greatly appreciate the time they spend, the community they build, and the ideas and suggestions they get in their monthly meetings, which let them learn from each other and have an active, reflective dialogue about teaching issues and challenges. Most of the teachers are becoming more skilled and comfortable with learning technologies—especially digital cameras, educational software, Internet research tools, PowerPoint, and Excel.

The project has become a recruitment project in terms of encouraging teachers to stay in the profession and to consider teaching math and science-related subject in the upper grades. New Mexico has a shortage of 1,500 teachers a year, and many of the best and brightest (often bilingual and Latino) are recruited by other states that offer higher pay. But some of the teachers involved in the project have chosen to keep working locally so they can remain active in the MAXIMA learning community.

The girls in the project generally like math, science, and technology (with some exceptions, such as division and writing up lab assignments). *Most of the girls like it best when teachers talk less and allow them to do hands-on activities or experiments; when their teachers explain difficult material to them in caring and understandable ways; and when teachers don't spend too much time explaining a concept or problem with which only a few students are struggling. Girls often prefer to work in same-gender groups*, out of impatience with boys, who tend to prefer "messing around" to working. After the institute, many teachers began implementing same-gender groups in science and math. In the first "draw a scientist" test, more than half the girls drew a scientist male in gender but with ambiguous ethnicity. *They are clearly aware of gender differences but are still forming understanding of ethnic identity*. Some did not know what ethnicity or culture meant.

A fourth grade teacher whose students got the highest science scores in the district on the science portion of the Terra Nova test (a national standardized test) credited her participation in MAXIMA as one of the main reasons her students' academic performance improved.

CODE: PD, E, U	New Mexico State University, Las Cruces
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http://education.nmsu.edu/Maxima	HRD 99-06339 (three-year grant)
Partners: The Las Cruces Public School District (serving an urban community) and the Gadsden Independent Public School District (serving a rural community); Mesilla, University Hills, and Valley View elementary schools and Zia and Lynn middle schools; the New Mexico Commission on Higher Education.	
Keywords: demonstration, teacher training, inquiry-based, Hispanic, Latina, constructivism, gender equity awareness, professional development, hands-on, problem-solving skills, research study, gender differences	

004
Rmd
Role models change Hispanic girls' job aspirations

ROLE MODELS CHANGE HISPANIC GIRLS' JOB ASPIRATIONS

TO REVERSE THE TREND IN MATH AND SCIENCE AVOIDANCE THAT CLOSES OFF YOUNG HISPANIC WOMEN'S CAREER CHOICES, THE ES MIJA (ENGINEERING, SCIENCE, AND MATH INCREASE JOB ASPIRATIONS) PROJECT TARGETED 63 HISPANIC GIRLS WITH A SUPPORT SYSTEM TO PROMOTE THEIR RETENTION IN ADVANCED MATH AND SCIENCE COURSES AND TO EXPAND THEIR CAREER OPTIONS. IN PARTNERSHIP WITH THE UNIVERSITY OF TEXAS AT SAN ANTONIO, THE INTERCULTURAL DEVELOPMENT RESEARCH CORPORATION (IDRA) DESIGNED THE MODEL PROJECT TO TARGET SIXTH GRADE GIRLS AND SOME SEVENTH AND EIGHTH GRADERS.

During the year students attended an Expanding Your Horizons conference, participated in monthly ES MIJA Circles and Family Math/Science sessions, attended a summer institute, and visited wetlands and an aquarium in Corpus Cristi.

On average, the girls increased their belief that math and science were useful and that they were good students. Their grades in math and science and their math scores on standardized state tests improved. Surprisingly, their belief that math and science are interesting, that teachers think they are good math students, and that parents think they are good science students *declined* somewhat—*but their level of awareness changed considerably. They were less inclined to believe there are right and wrong answers and are more inclined to believe they could do what they want to do, if they tried hard enough and paid attention*.

Most important, they were able to interact with Hispanic professional women who spoke to and did hands-on activities with the girls, especially an architect who brought in tools, sat on the floor with the girls, got them to draw a floor plan for their ideal house, and made them realize that this kind of career was not beyond them. The confidence of a withdrawn student with limited English went up tenfold after a project to make windmills. She not only did one of the best projects but was willing to speak up, to say something would not work, and was accurate about why. *Cooperative hands-on projects made the girls see that although not all ideas will work, everyone should have a chance to express her ideas*. They became more patient and appreciative of each other.

One teacher reported being criticized by other teachers for "not doing real science," but the project teachers came to realize that making the girls aware that math and science are part of their everyday lives, and motivating them to consider taking advantage of that professionally, was an important preliminary step to successfully teaching them "content."

Participating parents learned firsthand that playing games made it easier to learn math and would sometimes continue playing the games when they got home. Seeing parents interact with other parents, the girls became motivated to interact themselves. One parent said it was "like an awakening." Parents were proud that they had made time for their children—which often meant taking time off from work—and had given them this opportunity.

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HRD 95-53423 (ONE-YEAR GRANT)	
PARTNERS: UNIVERSITY OF TEXAS AT SAN ANTONIO (UTSA) ALLIANCE FOR EDUCATION, HARLANDALE INDEPENDENT SCHOOL DISTRICT (SAN ANTONIO), AND THE BUSINESS COMMUNITY	
KEYWORDS: DEMONSTRATION, INDUSTRY PARTNERS, PARENTAL INVOLVEMENT, HISPANIC, RETENTION, HANDS-ON, ROLE MODELS, SELF-CONFIDENCE, FIELD TRIPS, CONFERENCE	

004
Lim
Biographical storytelling empowers latinas in math

BIOGRAPHICAL STORYTELLING EMPOWERS LATINAS IN MATH

GIRLS AND YOUNG WOMEN LOST TO MATH AND SCIENCE IN THEIR ADOLESCENCE ARE DEPRIVED LATER OF OPPORTUNITIES FOR HIGHER INCOME AND FULFILLMENT. THE RESULTING INEQUITIES ARE ESPECIALLY SERIOUS FOR LATINA STUDENTS. THIS COLLABORATION BETWEEN DETROIT'S SCHOOL OF THE AMERICAS (A BILINGUAL PUBLIC SCHOOL) AND EASTERN MICHIGAN UNIVERSITY BRINGS BOTH RESEARCH AND SCHOOL-SYSTEM RESOURCES TO BEAR ON THE PROBLEM.

The research design, which includes experimental and control groups and pre-and post-testing, will help answer the question *Can poor girls in grades 6 through 8 in a bilingual school develop positive attitudes toward science and math through a combination of transactional writing and storytelling? The storytelling by positive role models explores the lives of women scientists, especially Hispanic women in science. Research shows that*

- *Language is important in teaching math to girls*
- *Linguistic minority students benefit from bilingual math instruction, especially when math teaching stresses communication*
- *Mexican American students learn better through humanized knowledge than through abstract knowledge*
- *Personalized instruction raises Latino scores in math more than standard instruction does*
- *Writing facilitates math teaching and learning for underachievers and their teachers, corresponding to other powerful learning strategies*
- *Minority students benefit from studying the achievements of women and minority scientists and mathematicians*

To recruit Latina women into technical fields, it makes sense to promote math through culturally relevant literacy and storytelling. Hence this project to document the effect of integrating transactional writing (Rose 1989) and biographical storytelling (Daisey 1996) into sixth and eighth grade math classes at an urban middle school populated with Latino students.

In 10 four-hour after-school workshops, 12 teachers will learn through modeling to integrate math concepts, transactional writing, issues related to Latina success in math, oral storytelling, and biographies of Latino mathematicians and local high school Latinas successful in math—as well as Hispanic folk tales about math concepts. They will learn the *five-step learning cycle: engage, explore, explain, elaborate, and evaluate*. Research will focus on poor attitude and lack of achievement.

The idea behind ***transactional writing for mathematics*** *(TRM), or writing to learn, is that the best way to master a field is to write about it. Writing is therapeutic for struggling or underprepared students (reducing math anxiety, boredom, and frustration, for example) and lets strong students be creative*. Using a split-page format, the student solves problems and writes on the left side of the paper, and the teachers comment on errors (and reasons for errors) on the right side of the paper. Both the math and the English/Spanish teacher write comments, and students revise each exercise. *As a result, students become more competent in both language and math, do not feel threatened by technical mistakes, and concentrate more on what they are exploring—revising as many times as necessary to clarify math concepts using language*.

The idea behind **biographical storytelling** is to provide a vicarious introduction to diverse female scientists and mathematicians through biographical reading and storytelling, so girls may realize that what seemed simply the way things are could actually be a social construct, advantageous to some and detrimental to others. *By telling biographies, girls are encouraged to choose rather than simply inherit a story: the storytelling itself affects their imaginations, attitudes, construction of knowledge, and memory of information. And hearing different biographies encourages teachers to have visions of their students that their students may not yet have of themselves*.

DRAW A LATINA AT WORK

Teachers in the project schools often describe the challenge Latino students present. Every year on career day, Latinas in different professions came to school and made dynamic presentations. Students read stories with strong minority characters in sixth grade language arts class. Posters in classrooms and hallways showed famous Latinas in diverse careers. After two years, none of this seemed to have been enough to influence the pictures the eighth graders drew when asked to "draw a Latina at work." Despite teachers' best efforts, "nothing sunk in." *But experiencing a year of biographical storytelling made a remarkable difference in their post drawings*, as this table shows.

WHAT STUDENTS DREW	BEFORE THE PROJECT	AFTER THE PROJECT
Factory/domestic/migrant worker	72%	13%
Semiskilled worker (secretary or clerk)	18%	13%
Professional/technical worker (teacher, scientist, etc.)	8%	70%
Pop singer	2%	4%

After storytelling, fewer students portrayed factory and domestic workers and more students portrayed professional workers. Over and over, *students in an eighth grade class that engaged in biographical storytelling said they had not realized they could aspire to the lives and careers portrayed in the biographical stories they were discussing in class*.

A bilingual sixth-grade math teacher explained that for many Latina students their role model is their mother, but when they heard biographical stories, they realized that they could choose other role models. This teacher was a role model for Latina students; she has heard Latinas talk about how their teacher has both a career and a family, and how maybe they did not need a boyfriend right away. *Ever aware that one encouraging comment from a teacher could change a student's life path, she feared that many girls would be overcome by the pressure to conform to society's expectation and would drop out of school before graduation—but she saw "light bulbs come on" during storytelling. There is a long road between grasping an idea and achieving a goal, but it is no small task to have Latino middle school students realize what is possible for them. Stories have the power to make a difference in their thinking*.

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HRD 99-08749 (one-year grant)
Partner: Detroit's School of the Americas
Useful site: www.sacnas.org/bio/index.html (biography project of the Society for the Advancement of Chicanos and Native Americans in Science, or SACNAS)
Keywords; education program, research findings, transactional writing, storytelling, Hispanic, Latina, bilingual, role models, Mexican-American, after-school, workshops, teacher training, biographies

004
L²
Integrating math and science with Lego Logo

INTEGRATING MATH AND SCIENCE WITH LEGO LOGO

COMBINING LEGO STRUCTURES WITH LOGO PROGRAMMING LANGUAGE ALLOWS CHILDREN—AND TEACHERS—TO CREATE MACHINES OR CREATURES THAT RESPOND TO COMMANDS THEY PROVIDE BY PROGRAMMING A COMPUTER. LEGO LOGO ACTIVITIES THAT INTEGRATE MATH AND SCIENCE WERE THE CENTERPIECE OF PROJECT SAME (SCIENCE AND MATH EQUITY), AN INITIATIVE TO REDUCE EDUCATIONAL INEQUITY, ESPECIALLY FOR HISPANIC GIRLS. THIS UNIVERSITY OF CALIFORNIA AT SANTA CRUZ PROJECT REACHED ABOUT 250 CHILDREN AGED 10 TO 14, IN GRADES 6 THROUGH 9.

In a two-week summer workshop for students and teachers, 48 girls and eight teachers from three schools participated in a Lego Logo lab and a hands-on math design workshop. Working in small collaborative groups—with teachers forming their own cohort—students and teachers learned the Lego Logo design system one week and constructed a final product the next week, for a final technology design fair. In the math design workshop, they carried out various paper engineering and visual math projects and built backdrops and other structures to integrate into their Lego Logo projects. They also visited the labs of four women on Santa Cruz's natural sciences faculty, who talked about the research they were doing.

The idea was that the teachers in the workshop would integrate Lego Logo into their regular class work, with the girls serving as peer experts, but there was strong interest at each school site for more advanced Lego Logo activities—for example, building bridges, area calculators, and shaking tables. A Santa Cruz High School teacher integrated Lego Logo into her ninth grade biology courses. Projects included a composter with automatic temperature regulation.

To encourage Hispanic parents to participate, bilingual assistants were on hand for a series of five Saturday morning parent–daughter math and science workshops and a six-week parent math review class. The theme of the math-and-science workshops was earthquakes, a theme explored with Lego Logo and hands-on activities, with guest speakers from the geology and physics departments. Hands-on interactive activities were also featured in the math review courses, which were designed to help parents learn ways to help their children with math assignments.

CODES: E, M, H	University of California, Santa Cruz
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HRD 94-50077 (one-year grant)	
Keywords: demonstration, hands-on, role models, bilingual, parental involvement Hispanic, math skills, field trips, teacher training	

004
Una
Una mano al futuro: making science accessible to Latinos

UNA MANO AL FUTURO: MAKING SCIENCE ACCESSIBLE TO LATINOS

THE ASSOCIATION FOR WOMEN IN SCIENCE (AWIS) WILL DEVELOP A GUIDE TO MENTORING (UNA MANO AL FUTURO) AIMED AT THE LATINO COMMUNITY. STUDIES SHOW THAT STUDENTS ARE MORE LIKELY TO PURSUE SCIENCE IF THEY HAVE MENTORS, LEARN IN A SUPPORTIVE ENVIRONMENT, AND HAVE OPPORTUNITIES TO EXPLORE POTENTIAL CAREERS. WITH A FOCUS ON REACHING LATINAS IN HIGH SCHOOL, THE GUIDE WILL PROVIDE RESOURCES TO HELP THE GIRLS AND THEIR PARENTS, TEACHERS, AND COMMUNITY CREATE AN ENVIRONMENT IN WHICH THE GIRLS CAN EXPLORE THEIR INTEREST IN SCIENCE AND TECHNOLOGY CAREERS.

For 10 years, AWIS has been establishing and improving community mentoring programs for pre-college, undergraduate, and graduate students, with funding from the Sloan Foundation, NSF, and the NEC Corporation. Earlier projects built on the knowledge and success of the Sloan mentoring program and produced the publication *Creating Tomorrow's Scientists: Models of Community Mentoring*. AWIS will edit and revise its award-winning mentoring books (*A Hand Up: Women Mentoring Women in Science* and *Mentoring Means Future Scientists*) and will produce Spanish-language editions with online companion materials in both English and Spanish.

In developing materials and disseminating them to the Latino community, AWIS will work with two partners: ASPIRA, a nonprofit organization committed to Latino youth issues, and Minority Women in Science. Through its 76 local chapters, AWIS will distribute materials and help plan community-based events to reinforce the material's message.

CODE: H	Association for Women in Science, Inc.
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www.awis.org	HRD 01-20865 (one-year grant)
Partners: ASPIRA; Minority Women in Science (MWIS)	
Keywords: dissemination, publication, Hispanic, Latina, bilingual, mentoring, career awareness, AWIS	

004
Cad
Hispanic girls learn computer-assisted design—and English

HISPANIC GIRLS LEARN COMPUTER-ASSISTED DESIGN—AND ENGLISH

ALTHOUGH CARSON CITY IS NEVADA'S CAPITAL, IT IS A RURAL COMMUNITY WITH A POPULATION JUST OVER 50,000, MUCH OF IT POOR OR NEARLY POOR. ITS MAIN INDUSTRY IS GAMING, BUT IN RECENT YEARS MANY BUSINESSES WITH HIGH-TECH NEEDS HAVE RELOCATED TO THIS PART OF NEVADA, WHERE THEY HAVE DIFFICULTY ATTRACTING QUALIFIED PERSONNEL.

A conversation with a student led technology teacher Anita Brooks to create a program to integrate Hispanic girls into the world of computer technology. A senior enrolled in Brooks's computer-aided drafting class at Carson High School told Brooks that for students like her, for whom English was a second language, learning to use a computer was like earning a third language. Language problems kept the student from being able to apply concepts she understood, despite two hours of work outside the class for every hour of class work. "Sometimes she would just put her head down and cry," says Brooks. Through the Carson City School District, Brooks proposed a small experimental project to recruit Hispanic teenage girls into the computer-aided design (CAD) programs that would prepare them for high-tech jobs.

Carson City GREATS (girls really enjoy advanced technical skills) was launched in September 1999, just as the high school opened its new High Tech Center. The director of the high school's School-to-Careers program arranged for five local businesses to provide internships for five students each semester. Interns worked 90 hours a semester, earning either $6 an hour or half a credit for participating in the project. Girls were to be recruited from CAD courses, but because no girls had signed up for those courses, the bilingual teacher's aide recruited students from the English as a Second Language (ESL) program. Recruitment meant selling the program to the girls' parents, many of whom believed that a woman's place is in the home, a future that did not call for advanced computer classes. She persuaded the parents that the girls needed to study if they were to have a better life.

The girls also enrolled in the school's AutoCAD course and were given remedial instruction in English/language art and math, if needed. In addition to all their other classes, the girls were enrolled in a geographic information systems (GIS) class at 7 a.m. in the High Tech Center's spatial analysis/GIS/CAD technology lab. All instructions and demonstrations were in English, which the aide then translated into Spanish. Lab assignments were given in English. The aide attended a two-day training session in GIS, which made her more confident and productive in the classroom.

The results of the research and education activities were startling. It was assumed that perhaps eight to ten Hispanic girls would be interested in the program, but those estimates were far surpassed. Not only did the girls learn skills that could help them land high tech jobs, but also their confidence levels soared, they became more proficient in English, and during the summer they improved their math, raising their scores on state math proficiency exams. A program through which students could learn in both languages empowered the girls to learn that they had far more ability than they thought they had—which opened the door to more learning. Enrollment in high technology classes increased substantially in 2000–2001.

The girls' comfort zone expanded and, deciding they needed a support group outside the classroom, they started a lunchtime club that would meet weekly to discuss such concerns as how to achieve their career goals without alienating their families. They invited speakers and took field trips, to expand their career horizons, but they also wanted to help Latinas who had just immigrated. For the club to be formally sanctioned on the Carson High School campus, they had to present their club's mission and goals to the entire student council. Twenty of the girls attended the meeting, one presented their proposal, and after asking many questions, the student council unanimously approved the club. Speaking up for themselves before students who barely knew they attended the same school was a monumental achievement for these girls, who had to articulate their desires and answer questions on the fly. They opened lines of communication with the majority population that had not existed before, and in so doing they took the first step in attaining their dreams and broke ground for many girls to come after them.

GREATS gave these girls a true sense of the possible. Before, they had been disenfranchised from learning. Now they are standing up for themselves and asking more from themselves, their counselors, their peers, and their teachers. They are signing up for classes they never would have considered before. They view college as a viable option, which it was not before. And they are advocating for each other as well as for themselves.

The project brought national recognition to the flexibility and untapped resources of GIS as a multilingual tool for teaching. Carson High School and its instructor have become information resources for other institutions interesting in instituting a similar program. The Nevada State Department of Education funded an additional year of the program through the Technology Leadership Challenge Fund. During the summer of 2000, the Carson City GIS Department was a mentoring agency for 10

MASTERING ENGLISH AND TECHNOLOGY

Week 1. No technology content was presented. To break up potential cliques and encourage the girls to be mutually supportive, the class engaged in icebreakers, including a game of human bingo that required the girls to learn pieces of life information about one another. *These lighthearted activities promoted a safety net for the girls and cemented their desire to continue with the class.* After assessments in computer and English proficiency, instruction began.

Week 2. The girls learned basic Windows and printing instructions, then took pictures of each other with digital cameras, opening images from floppy disks and printing the images out—as a way to engage their interest and get them experimenting with file navigation on the network, saving, and document printing.

Weeks 3–9. The girls learned analysis concepts of geographic information systems using ArcVoyager software. Some concepts almost defied translation. Gross national product, for example, is a difficult concept even for native speakers of English. After many tears and much tenderness—with other students helping to translate—the girls experiencing discomfort agreed to remain in the class. *After completing each unit, students were required to apply what they learned with a small project of their own—so the teacher could tell if they really understood what they were doing or were just reading and parroting what they read or saw in the lessons*. During this phase the students were all highly motivated and ready to work, diligently completing all of the assignments and coming in during their breaks to get extra help from the aide.

Week 10. During the first nine weeks, some of the students showed tremendous improvement in verbal and written skills. (One student, who spoke no English when the class started, beckoned the instructor for assistance and said, "Ms. Brooks, I have confusion in my heart," articulating the need for help and showing the courage to seek it in her own words.) But many of the girls, despite becoming more English and technology literate, still refused to speak English outside the classroom. This concerned the staff, because on the job they would have to be able and willing to speak English. Several days were set aside to discuss the girls' concern, and *the girls admitted anxiety about making mistakes in English, concern about being laughed at in the classroom by the Hispanic boys*. Not all the boys would laugh but enough did that they felt humiliated in English-only classes and preferred speaking Spanish. After long discussions about career and cultural issues, the girls were encouraged to get past prior hurts and to start practicing their English skills. To show good faith, the non–Spanish-speaking teacher offered to give a 10-minute lecture in Spanish if they would agree to do three of their four GIS presentations in English.

Weeks 11–18. The girls progressed to ArcView, standard software for the GIS industry, and became responsible for relating what they had learned to a new project. They were learning skills that required they query or narrow down their data. Once they understood the new tools, they were instructed on how to create a layout, show and describe the results of their work, and present their findings. They found this graphic part of the curriculum very satisfying.

ELLIS (English language software). In addition to regular classwork, the girls were encouraged to come in during study period or on their own time to use the English language software procured with the NSF grant. ELLIS is an interactive multimedia platform with microphone and headphones. The students may tape themselves and then hear themselves speaking. Visuals show specifically where points of articulation are so students can see how they should be enunciating. The software provides regular comprehension tests and gives girls feedback on their progress. The aide is there to help with software mechanics, but the students drive their own progress. *Their English skills, both written and spoken, improved markedly.*

girls, who got field experience gathering data for use in Carson City's geographic information system. The girls became a valuable resource for the city agency while amassing valuable workplace skills.

This account is drawn partly from a story by Teri Vance in The Nevada Appeal, *February 12, 2000.*

CODE: H	CARSON CITY (NEVADA) SCHOOL DISTRICT
VALERIE DOCKERY (VDOCKERY@CARSON.K12.NV.US), ANITA BROOKS, GREGORY MARANGI	
HRD 99-08730 (ONE-YEAR GRANT)	PARTNER: CARSON CITY GIS DEPARTMENT
KEYWORDS: DEMONSTRATION, HISPANIC, LATINA, INTERNSHIPS, COMPUTER-ASSISTED DRAFTING (CAD), INDUSTRY PARTNERS, RURAL, BILINGUAL, CLUB, COMPUTER SKILLS, ENGLISH, SUPPORT SYSTEM, ACHIEVEMENT, SELF-CONFIDENCE, FIELD TRIPS, MENTORING	

004

peer

Student-peer teaching in Birmingham, Alabama

STUDENT-PEER TEACHING IN BIRMINGHAM, ALABAMA

IN URBAN DISTRICTS THAT ARE PREDOMINANTLY AFRICAN AMERICAN, MAKING CLASSROOMS GIRL-FRIENDLY MAY BE ONLY A SMALL PART OF WHAT NEEDS TO HAPPEN. FIRST, THE DESPERATE NEEDS OF AFRICAN AMERICAN BOYS AND THE LOW NUMBER OF STUDENTS TAKING ADVANCED SCIENCE MUST BE ADDRESSED. BUT A COMPREHENSIVE STRATEGY FOR INCREASING THOSE NUMBERS OFFERS AN OPPORTUNITY TO INTRODUCE ISLANDS OF SUPPORT FOR MATH AND SCIENCE ACTIVITIES GIRLS WILL ENJOY.

In Birmingham, where more than 90 percent of the students are African American, the Russell Mathematics and Science Center (RMSC) provided outreach to students and in-service training programs for middle and upper elementary school teachers and for adult leaders of girls' organizations. RMSC is a five-year project of the Alabama School of Fine Arts (ASFA), where nearly half the students major in math and science.

In the project's most original training and development activities, *every ASFA student did outreach—presenting a lesson or activity to outside students or adults. RMSC built "presenting" into the curriculum*. Three days a week, teacher–student teams—a teacher–coach and five to seven highly trained and motivated high school students—presented science lessons and labs at after-school sites run by Girls, Inc.

To present a lesson on the basics of electrical circuits, they took strings of Christmas tree lights that kids in the class could cut up and work with in various ways—allowing students to safely handle circuit principles using cheap materials. *The presenters (mostly girls) had to master the material to field questions from the audience, had to think on their feet, and had to pay close attention to girls in the audience to engage their interest in the subject. This peer-to-peer teaching was a hit all over Alabama and developed in the presenters a calm and poise that paid off when they interviewed for scholarships and awards.* Some of them left the math/science program with more than $75,000 apiece in scholarship offers. Over three years, the students presented modern, hands-on science and math instructional demonstrations to more than 800 teachers and 4,500 students a year.

Teachers and students spent most of a year designing a Math and Science Day at a new theme park. They wrote original problems to fit specific rides (calculating and graphing changes in the roller coaster's speed, for example), designed written materials, and advised the theme park on the day's structure. Math and science activities were conducted at every major ride, where a team of RMSC students helped students trying to solve the problems.

In an important series of teacher training workshops on African American scientists, teachers were presented with a biographical sketch of an African American woman and then did lab activities based on the woman's specialty—providing a kit so the teachers could reproduce the lab for 30 students back in their own school. For nutritionist Flemmie P. Kittrell, for example, students determined the iron content of cereals by using a magnet to remove iron filings from iron-fortified cereals; they also determined the protein content of various foods using a biuret solution.

Girls Inc. recruited 100 students for a four-week all-day summer camp. RMSC conducted the exploratory morning programs, designed to build the girls' skill, confidence, and self-esteem: an 80-minute math activity, a short break, and an 80-minute science activity.

CODES: M, H, PD	Alabama School of Fine Arts
Michael J. Froning (asfams@aol.com), Barbara Nunn	
HRD 96-19214 (three-year grant)	
Partners: Russell Mathematics and Science Center, Girls Inc.; VisionLand; and the University of Alabama Psychology Department	
Product: A booklet of problems for the outdoor math and science classes at VisionLand.	
Keywords: education program, African-American, teacher training, after-school; Girls, Inc., hands-on, self-confidence, informal education, role models	

004
Day
Improving science in a Dayton magnet school

IMPROVING SCIENCE IN A DAYTON MAGNET SCHOOL

DUNBAR MAGNET HIGH SCHOOL SPECIALIZES IN THE HEALTH SCIENCES. LOCATED IN DAYTON, OHIO'S, INNER CITY, IT SERVES A STUDENT BODY THAT IS 80 PERCENT MINORITY—MOSTLY AFRICAN AMERICAN. IN 1992, WRIGHT STATE UNIVERSITY (WSU) UNDERTOOK *A MODEL PROJECT TO INCREASE THE NUMBER OF HIGHLY MOTIVATED, ACADEMICALLY COMPETENT YOUNG WOMEN AT DUNBAR WHO WOULD GO ON TO EARN BACCALAUREATE (AND HIGHER) DEGREES IN THE SCIENCES*.

During the school year, the project revised and updated Dunbar's science courses; co-taught (with Dunbar's science teachers) a college-level introductory biology course to facilitate the transition to college (students earning a C or better were eligible for four hours of college credits); offered a course on the health science professions to interest girls in health science–related careers; educated girls about career opportunities and requirements; and *developed collaborative activities between Dunbar science teachers and WSU faculty to reduce the science teachers' sense of isolation*. WSU science faculty and graduate and medical students participated extensively in these activities. Most of the student participants were minority students.

During the summer, selected high school girls from the Dayton area worked as apprentices and had a chance to do seven weeks of research under the close supervision of faculty mentors. Students who had completed a year of math, biology, and chemistry could apply, with preference given to students from economically disadvantaged families who knew no local scientists. Afternoons, students heard presentations by scientists from WSU and the private sector or went on field trips to private research and development laboratories, where they interacted with women and minority scientists.

To strengthen the students' academic background, WSU faculty gave lectures on working with fractions, ratios, and percentages; working with logs and antilogs; performing calculations using mole, molarity, and titrations; understanding the concept of pH and buffers; plotting XY data and finding the best fit using linear regression; and calculating correlation coefficients.

To strengthen the teaching skills of in-service and preservice teachers, the project offered a seven-week summer program to update their knowledge of modern research tools and techniques. The project tried to integrate activities of the teacher participants and student apprentices into a close working relationship with laboratory personnel, including undergraduate and graduate students. Teachers were helped to design simple classroom experiments.

On Fridays, students, teachers, and faculty mentors gathered for informal lunches at which women and minority scientists from the private sector gave talks about their own family and educational background and how they became interested in science. Toward the end of the summer program, parents were invited to hear participants give oral presentations about their accomplishments. Participants also had to submit written reports, with tables and figures, to gain insight into workplace requirements. By summer's end, *all of the students who participated planned to go on to college and to major in math or science*.

CODES: U, H, PD	WRIGHT STATE UNIVERSITY
PREM P. BATRA, NOEL NUSSBAUM, RUBIN BATTINO	
HRD 92-53433 (ONE-YEAR GRANT)	
PARTNERS: DUNBAR HIGH SCHOOL, DAYTON PUBLIC SCHOOL SYSTEM	
KEYWORDS: DEMONSTRATION, AFRICAN-AMERICAN, CURRICULUM, CAREER AWARENESS, RECRUITMENT, RESEARCH EXPERIENCE, FIELD TRIPS, MENTORING, TEACHER TRAINING, PARENTAL INVOLVEMENT	

004

Turn

Turnage scholars program

TURNAGE SCHOLARS PROGRAM

THIS COMPREHENSIVE REGIONAL EXPERIMENTAL PROJECT FOR GIRLS AND WOMEN IS A COLLABORATION BETWEEN THE HISTORICALLY BLACK ELIZABETH CITY STATE UNIVERSITY (ECSU) AND THE ROANOKE RIVER VALLEY CONSORTIUM—FIVE RURAL, ECONOMICALLY DISADVANTAGED, PREDOMINANTLY AFRICAN AMERICAN PUBLIC SCHOOL SYSTEMS. TO OVERCOME MESSAGES OF SCIENTIFIC INFERIORITY THAT MANY STUDENTS RECEIVE BECAUSE OF RACE, GENDER, OR SOCIOECONOMIC STATUS, IT AIMED TO CHANGE SOCIAL, ACADEMIC, AND SCIENTIFIC CLIMATES SO THAT GIRLS' AND WOMEN'S APTITUDE AND INTEREST IN STEM COULD FLOURISH AND AT THE SAME TIME TO LEARN MORE ABOUT HOW INFRASTRUCTURE IN STEM INTERACT WITH GENDER. IT WOULD ACHIEVE THESE GOALS THROUGH STAFF DEVELOPMENT, INNOVATIVE PROGRAMS FOR EIGHTH GRADE GIRLS, MORE PARENTAL INVOLVEMENT IN THE GIRLS' EDUCATION, AND PARTNERSHIPS BETWEEN BUSINESS AND INDUSTRY.

The project trained 300 educators—200 teachers, 50 administrators, 25 counselors, and 25 staff members—in more gender-equitable teaching, in new approaches to multidisciplinary teaching of math and science, and in alternative methods of assessment.

For eighth grade girls there were after-school clubs, a Saturday academy (providing valuable activities for children who had nothing to do and nowhere to go on Saturday), a residential summer enrichment institute at ECSU, and alumni scholars. The girls learned about fitness, nutrition, entrepreneurship, and goal setting. Guest experts demonstrated how to use a stethoscope and spoke about everything from what it takes to be a good nurse to what it takes to start and maintain a business. Simulations, labs, experiments, and other hands-on activities helped them learn the scientific method and the basics of research, including Internet research. They sought answers to such questions as "Can sound be heard in space?" and "What percentage of gum is sugar?" They viewed videos in the *Breakthrough* video series, including "The Path of Most Resistance" (chronicling the rewards and challenges people of color confront in choosing a life in math or science), learned about career planning, reported on African Americans in STEM, and completed career action plans. Field trips and other occasions offered lessons in etiquette and proper mealtime behavior. Parental involvement was encouraged throughout.

In the four-week summer enrichment institute, the girls studied a different theme each week: population ecology/environmental science; space science/astronomy/physics; architectural design and drafting/geometry; and living creatures/biological sciences. They took field trips to the Marine Science Center in Virginia Beach, to the Air and Space Center in Hampton, and to Hampton University.

CODES: M, H, U, PD	Elizabeth City State University
James A. McLean, George Thigpen, Sandra C. Hardy, Cheryl Lewis, Patricia Dobbin	
HRD 95-55817 (three-year grant)	
Keywords: demonstration, after-school, Saturday academies, science clubs, gender equity awareness, constructivism, parental involvement, industry partners, African-American, rural, staff training, summer institute, hands-on, career awareness, field trips	

PROJECT PRISM

TO KEEP GIRLS AND ETHNIC MINORITY STUDENTS—ESPECIALLY NATIVE AMERICAN STUDENTS—IN THE STEM PIPELINE, AND TO RECRUIT MORE WOMEN AND ETHNIC MINORITY PRACTITIONERS INTO THE STEM WORKFORCE, THIS COLLABORATIVE DEMONSTRATION PROJECT AIMS TO PROMOTE SUSTAINABLE REFORM ON GENDER AND CULTURAL ISSUES IN SECONDARY MATH AND SCIENCE CLASSROOMS. AMONG OTHER THINGS, IT AIMS TO DEVELOP A UNIVERSITY COURSE FOR TEACHERS AND STUDENT TEACHERS TO HELP THEM IMPROVE THEIR COMPUTER SKILLS AND TEACHING ABILITIES AND INTRODUCE THEM TO ISSUES OF GENDER, CULTURE, AND SCIENCE.

004

PrSm

Project PRISM

The project's target population is student teachers at Washington State University and Lewis-Clark State College and teachers, counselors, and administrators from eight school districts, five of which serve the Colville Confederated Tribes and CCT secondary students. The project aims to make secondary teachers and counselors more committed to inclusive teaching and curricula and more aware of how gender and cultural issues affect students'—especially girls' and Native Americans'—learning and persistence in STEM classrooms.

Teachers and counselors will participate in interactive in-service development opportunities involving gender, culture, and education. A summer institute will focus on reform in STEM classrooms and curricula. Faculty learning communities will support participants in revision and reform efforts.

All faculty development components will be designed and developed by teams of secondary and university faculty in cooperation with CCT personnel and a CCT advisory council. The project will produce and disseminate manuals detailing what goes on in the faculty in-service workshop, the summer institute, and teaching and curricular reform.

CCT students will learn about STEM careers and the schooling needed for them through field trips, hands-on projects, career planning, and community service projects. The project should add to the knowledge base about which intervention strategies are effective with Native American students, especially girls.

CODES: PD, M, H, U	WASHINGTON STATE UNIVERSITY
SANDRA C. COOPER (SCOOPER@MATH.WSU.EDU), JUDY L. MEUTH	
HRD 01-20884 (THREE-YEAR GRANT)	
PARTNERS: LEWIS-CLARK STATE COLLEGE; COLVILLE CONFEDERATED TRIBES (CCT)	
KEYWORDS: DEMONSTRATION, TEACHER TRAINING, GENDER EQUITY AWARENESS, CURRICULUM, FIELD TRIPS, HANDS-ON, COMMUNITY SERVICE, CAREER AWARENESS, MANUAL, NATIVE AMERICAN, PROFESSIONAL DEVELOPMENT	

004

Feed

Feed the mind, nourish the spirit

FEED THE MIND, NOURISH THE SPIRIT

OVER TWO SUMMERS, 46 NATIVE AMERICAN AND ALASKAN NATIVE GIRLS FROM HIGH SCHOOLS ALL OVER THE COUNTRY GATHERED AT CLARKSON UNIVERSITY, IN POTSDAM, N.Y., FOR A FOUR-WEEK RESIDENTIAL PROGRAM IN MATH AND ENGINEERING DESIGNED TO EMPOWER AND PREPARE THEM TO MAKE INFORMED CHOICES ABOUT COLLEGE AND CAREERS IN SCIENCE, ENGINEERING, AND TECHNOLOGY. THE PROJECT WAS A PARTNERSHIP WITH THE AMERICAN INDIAN SCIENCE AND ENGINEERING SOCIETY.

To show math's relationship to and application in engineering, the math-intensive, hands-on curriculum emphasized major principles in mechanical, civil, and environmental engineering. Classes were held daily in math, computers, logic, problem solving, engineering, and entrepreneurship. The math teacher moved students adroitly from a review of algebraic concepts through geometry and trigonometry functions to calculus—without the girls fully realizing it, so they were not intimidated by the materials.

Cooperative learning was stressed during problem-solving, which integrated math and computers, engineering projects, and entrepreneurship (involving a business plan and a PowerPoint presentation).

- For *mechanical* engineering, the girls worked in pairs to design, build, and demonstrate a model tram that could traverse a sloped string and return to the starting point (40 feet, round trip). They had to accommodate energy and material constraints and were restricted to a one-minute climb.
- For *civil* engineering, three-person teams had to build and demonstrate the load capacity/weight of a 2-foot truss-design model balsa wood bridge, using a computer design program to save time. They competed to build the lightest bridge that would support the heaviest load—after choosing between a Pratt, Howe, or K-Truss or creating their own design.
- For *environmental* engineering, one group studied the environmental review checklist prepared by the St. Regis Mohawk tribe and submitted to the State Department of Transportation in connection with one of two bridges on the Akwesasne reservation that DOT had identified for replacement. They performed a site visit and queried authorities and people affected by the bridge replacement. The *end result was that DOT redesigned the bridge to include a pedestrian walkway*.

Enrichment and leadership classes were held evenings and some weekends, when they went on field trips (one year to Toronto, Ontario, and the next to New York City for the July 4 fireworks), to the theater, to amusement parks, to Native American cultural events, and so on.

The personal development component nurtured students to unexpected levels of accomplishment. When students feel good about themselves and their existence, they are more inclined to succeed academically. Caring staff willingly gave each student time and consideration and the students responded accordingly. Students came to recognize that they were performing well beyond their own expectations and assumed an "I can do this" attitude. Tests administered before and after the camp showed an average 40-point gain in 1997 and 18 in 1998.

CODES: H	CLARKSON UNIVERSITY
JULIUS P. MITCHELL, SUZANNE BENALLY	
HRD 97-10429 (ONE-YEAR GRANT)	
PARTNER: AMERICAN INDIAN SCIENCE AND ENGINEERING SOCIETY (AISES)	
KEYWORDS: DEMONSTRATION, NATIVE AMERICAN, ALASKAN, SUMMER PROGRAM, MATH, ENGINEERING, HANDS-ON, COOPERATIVE LEARNING, PROBLEM-SOLVING SKILLS	

004

N'rich

Math enrichment for Native American girls

MATH ENRICHMENT FOR NATIVE AMERICAN GIRLS

THE MEGA PROJECT (FOR MATHEMATICS ENRICHMENT GIRLS ACADEMY) ENGAGED 26 NATIVE AMERICAN HIGH SCHOOL GIRLS IN SMALL-GROUP COOPERATIVE LEARNING AT A FOUR-WEEK SUMMER MATH ACADEMY AT TURTLE MOUNTAIN COMMUNITY COLLEGE IN NORTH DAKOTA. FOR FOUR WEEKS, GIRLS IN GRADES 10–12 STUDIED ALGEBRA, TRIGONOMETRY, AND CALCULUS IN A LIVELY MATH ENVIRONMENT. THE GOAL: TO PREPARE THEM TO MATRICULATE INTO COLLEGE STEM COURSES.

The math dealt with everyday applications in the students' Native American Ojibwa (Chippewa) culture, with an emphasis on problem-solving activities, data analysis, and mathematical modeling. *Instruction followed the "rule of three" stressed in elementary math reform: every major topic was presented geometrically, numerically, algebraically—and, in this case, culturally*.

Instructors doubled as role models: math professor Bob Megginson is one of only 12 Native Americans in the country with a doctorate in math, and co-instructor Martha Aliaga is a young Latina statistics professor, with whom the girls could relate. (*With role models, younger is better.*) The girls also read biographies of real-life women in STEM careers, from the book *She Does Math!*

The girls were given and learned to use a TI-82 graphing calculator—learning as well such math tools as Mathematica and Lotus 1-2-3. Using computer spreadsheets, they analyzed data they collected in field trips to local cultural sites. Problem solving in teams of two or four, they tried different ways of measuring the four cement Peace Towers. At the native site Anishnabaug they measured the diameter and height of selected trees using surveying equipment. They discovered the relationship between the diameter and the mass of rocks using regression analysis. They managed to solve a tremendously difficult problem about filling a swimming pool with water, when they realized the importance of time and the rate at which the pool is filled. *Students will tackle tough math problems if they see math as an everyday tool with real-life applications*.

With graphing calculators in hand, they made house drawings, complete with round windows and an inclining roof. They wrote fictitious business plans for businesses they thought could survive in the area, using word processing and spreadsheet programs to create a loan application and apply for a $5,000 loan. They became members of the American Indian Science and Engineering Society (AISES), entitling them to four issues of *Winds of Change* magazine.

Follow-up activities one Sunday a month and a summer camp the second year had to compete with opportunities for girls to make money—a priority on a reservation with high unemployment. Although the girls earned $100 a week participating in the project, the tribe's job program paid more, so 17 girls dropped out the second summer.

But the nine girls remaining attended the second summer session, which emphasized probability and statistics applications, starting with the visual representation of data: relative-frequency histograms, stem-and-leaf diagrams, empirical distribution functions and ogives, box-and-whisker diagrams, and scatter plots. Once students had some visual notion of the concepts of central tendency and dispersion, they were taught the numerical measures of those concepts through sample means and sample standard deviations, then proceeded to analyze bivariate data correlation (both as a numerical measure and as a concept) and linear regression. At that point, the notion of probability was introduced as an intuitive extension of the idea of relative frequency. Permutations and combinations were presented, with strong emphasis on the intuitive ideas of these concepts and the differences between them.

The project will provide strong follow-up for these bright students, staying in touch with them through high school, graduation, and college. *To keep them improving and taking higher and higher math courses, everybody—the school, the principal, and their parents—must keep asking, "How are you doing? What classes are you taking?" That is how the next Ph.D.'s will come*.

CODES: H, I, U	Turtle Mountain Community College
Sunil R. Karnawat (karnawat@giizis.turtlemountain.cc.nd.us)	
HRD 95-54495 (one-year grant)	
Keywords: demonstration, Native American, cooperative learning, math, problem-solving skills, real-life applications, parental involvement, role models, field trips	

004
Sis
Sisters in science

SISTERS IN SCIENCE

SISTERS IN SCIENCE WAS AN INTERGENERATIONAL PROGRAM TO FOSTER MORE POSITIVE ATTITUDES TOWARD STEM AMONG FOURTH-GRADE AFRICAN AMERICAN, ASIAN, AND HISPANIC GIRLS AT TWO ELEMENTARY SCHOOLS IN PHILADELPHIA'S INNER CITY—THROUGH GREATER COLLABORATION AMONG SCHOOLS, PARENTS, AND THE COMMUNITY. GIRLS WHO WERE MOTIVATED TO BEGIN WITH WERE MENTORED BY ROLE MODELS AT TWO LEVELS: BY UNDERGRADUATE WOMEN AT TEMPLE UNIVERSITY AND BY RETIRED AND ACTIVELY WORKING WOMEN IN STEM.

In the project's first stage, cooperative learning projects (centered on the urban environment) were emphasized for an hour a week in two mixed-gender classrooms in two model schools. Many of the fourth grade girls also participated in a weekly after-school program, which was co-facilitated by elementary education students at Temple University and a corps of intergenerational volunteers. The after-school program extended classroom activities with field trips, experiential service projects, and artistic experiences that promoted environmental awareness (for example, making paper from recycled paper). *Whereas traditional curriculum tries to transfer answers from teachers to students, the SIS curriculum posed questions to the girls, who, through a process of inquiry, became a community of learners*.

In July, about 65 percent of the girls spent two weeks in a summer camp, exploring the city rivers, taking field trips to area environmental agencies, creating model rivers, and designing plans to prevent the rivers from becoming polluted—*returning often to four themes: systems, models, scale, and constancy/change*. In studying city rivers, for example, students learned about the water cycle (systems), about the three states of matter (liquid, solid, and gas—a lesson fundamental to understanding constancy and change), and about models and scale (by creating their own model rivers). Asking "How do city rivers get clean so that people can drink the water?" they learned lessons in problem solving, technological literacy, participatory citizenship, and communications. Finally, they shared what they learned with their families and other elementary school students.

At first the after-school program met every other week. Changing midyear to a weekly schedule increased the girls' enthusiasm and improved attendance so much that the project was expanded so fifth graders could participate the next year. Although the girls had started the project with positive attitudes toward science, they exhibited a statistically significant (.01) increase in scores on a science attitude survey, higher scores on the math attitude survey, and higher scores on tests of math and science skills.

As a vehicle for Temple University's undergraduate elementary education students to become involved in schools before their student-teaching experience, the project was formally incorporated into the College of Education's science and math methods courses, and students got credit for participating.

Acknowledging gender-related differences in learning style, the SIS program *aimed to create a more positive learning climate for minority girls—for example, making it possible for them to manipulate materials. It also sought to increase the knowledge base and understanding of parental influence on female interest in science and math. It dispelled the myth that parents are unwilling to be involved in educational initiatives*. Although both schools are located in neighborhoods plagued by extreme poverty and limited education and employment opportunities, parents became more involved in their daughters' science and math instruction, both in school and out—and their children's interest and enthusiasm increased as a result. *Involving parents clearly strengthened and sustained the impact of the intervention*.

The project would have benefited from more intensive training of teachers (in the constructivist approach to teaching), more teacher responsibility for implementing activities independent of the project director, and more attention to the transportation needs of older volunteers and flex-time opportunities for working women.

THE PROGRAM EXPANDED

The original project was expanded into a two-year intervention involving 540 girls in fourth and fifth grade in six urban schools. The objective was still to increase the math and science literacy of fourth grade minority girls, to extend the program into fifth grade as the initial cohort advanced in school, to strengthen teacher's professional development, and to get volunteers and families more involved in science and math education for Philadelphia's children.

Teachers participated in an intensive two-week summer workshop in professional development before project activities began and in monthly curriculum planning meetings to familiarize themselves with gender equity issues and useful teaching strategies. *Teachers appreciated a workshop in which project directors worked and talked with them, rather than talking at them. A practicum originally developed by Sisters in Science—which later* *became a collaborative effort with the NSF-funded Collaborative for Excellence in Teacher Preparation—has become a permanent feature of Temple University's preparation for elementary teaching*. Third-year majors in elementary education work at the six project schools (and teach once a week) under a master fourth-grade teacher who has attended the summer Sisters session. Sisters in Science has become a known factor in the Philadelphia public school system. In honor of her work creating the program, in 2000 the Girl Scouts gave a Take the Lead Award in Science and Technology to principal investigator Penny L. Hammrich.

Even if the girls said they wanted to become a doctor, they were often unaware that they needed to take science classes. Their attitudes did not match their understanding of how science courses fit into their eventual career path. Year 1 results were positive; it is too early for longitudinal results (and the project did not include a control group or random sampling). It became evident that because parental behavioral expectations have such important long-term implications for girls' interest and achievement in math and science, and because positive female role models are also important, program interventions must make a conscious effort to provide support for collaboration among schools, parents, and the community as ideas for useful strategies are developed, implemented, and evaluated.

CODE: E, U, I, PD	Temple University College of Education and Center for Intergenerational Learning
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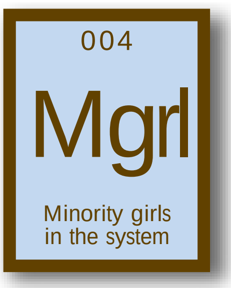
HRD 95-53426 (one-year grant) and 96-19021 (three-year grant)	
Partners: School District of Philadelphia; retirees from area chemical companies; 21st Century Mathematics Center for Urban Schools; Collaborative for Excellence in Teacher Preparation	
Products: a marketable set of activities to be published as a book	
Keywords: demonstration, career awareness, environmental science, curriculum, after-school, multi-generational, industry partners, African-American, Asian-American, Hispanic, role models, mentoring, cooperative learning, mixed-gender, field trips, hands-on, intervention, parental involvement, teacher training, gender equity awareness	



MINORITY GIRLS IN THE SYSTEM

A THREE-YEAR RESEARCH AND ACTION PROJECT CALLED GIRLS IN THE SYSTEM (SUSTAINING YOUTH IN SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS) IS CONDUCTING FIVE SUMMER DAY CAMPS TARGETED TO UNDERPRIVILEGED GIRLS, ESPECIALLY MEXICAN AMERICAN AND NATIVE AMERICAN GIRLS IN GRADES 3–8.

The project is a partnership between the Sahuaro Girl Scout Council (which has significant experience working with girls and minorities) and five departments of the University of Arizona (math, ecology and environmental biology, materials science and engineering, mining & geological engineering, and women's studies). The idea is to get a sense of where the girls are and what influences their decisions and at the same time to move them forward. Each side stretched to accommodate the other's interests, to *strengthen the crucial link (for this target population) between informal and formal education*. The project emphasizes home–community connections, stronger links between informal and formal educators; and links between program components:

- Girls-only (and sometimes mixed-gender) after-school programs and summer programs co-led by Girl Scout troop leaders (informal educators) and regular and student teachers (formal educators)
- Twice-a-year academies for the professional development of informal and formal educators, designed to foster collaboration (by planning how to transform what they learn as adults into a setting with girls), promote mentoring, and integrate gender equity
- Workshops to make parents aware of the importance of math and science courses to their daughters' career decisions and earning power and to make them aware of resources to strengthen their daughters' education
- Mini-grants to initiate adult study groups, events, and presentations
- Research to add to the sparse knowledge base on STEM education for Mexican American and Native American girls

The Girl Scout Council recruits girls, obtains all permissions, and incorporates the informal inquiry-based curriculum into six-week after-school scouting sessions during the year, some of them held on the Tohono O'Odham reservation near Tucson.

The summer camp was set up with six activity areas, each led by one or two adults, preservice teachers and Girl Scout leaders together. Each camp centers on a theme: solar power, rockets, water world, or solving a mystery. Throughout the camp, the girls rotate among stations, working in small groups. Parents came to see what they had done on Friday, *but parents dropping kids off at camp also often stayed to play math games with their children*. Each camp starts and ends with a Girl Scout team-building activity. Native American participants quickly picked up the Girl Scout songs, games, and group exercises.

TEACHERS' ACADEMIES: LEARNING, NOT INSTRUCTION

The project offered academies for professional development twice a year to improve teachers' knowledge of content. Many who attended had missed out on hands-on learning and appreciated the experience, for themselves and their students. *Taking apart and analyzing a telephone and a computer keyboard—activities that emphasized both construction and destruction—advanced their sense of engineering. Formal and informal educators had often never had a chance to test hypotheses, to see their designs work, or to experiment with a home technology such as a microwave oven to increase their understanding of physics. They saw how experiential education could deepen their understanding*. Building a river system really *showed* water's action in making canyons and deltas. Building a tin-can telephone, they tested the difference in performance between Styrofoam and plastic cups and between wire, thread, and fishing line.

They also learned to hold back on "teaching" as "instruction"—and on asking girls the discouraging question, "Are you sure that will work?"—and instead to ask probing questions, to get kids to think about what might happen and thereby to own the activity and desire to learn, to respond to learning cues ("teachable moments"), to not answer their own questions, to be co-participants more than authority figures, and to let the children realize that they too can possess knowledge. Teachers tend to do too much instead of letting kids experiment. Even the principal investigators differed on how much "help" girls need to avoid frustration. *Educators have trouble putting aside their educator and letting girls experience learning, so girls get discouraged and stop participating*.

For the solar power camp, some girls made solar ovens, some explored solar trackers and navigation, and some explored insulation, insulating cardboard "houses" with their choice of various materials (feathers, lard, straw, foil, air, Styrofoam, newspaper, etc.) and testing them by placing hot and cold water bottles inside and recording temperatures over time. *Campers were so enthusiastic about studying solar power that turnout was heavy on Parents' Day*.

For the rockets camp, the girls built rockets using water or air propulsion. Most dramatic were those made from bottles and launched 50 feet into the air using an air pump. Second most dramatic were small rockets with an engine of water and Alka-Seltzer mixed in a plastic film container—which soared up to 15 feet. The mixed-gender water camp explored the concept of buoyancy and other properties of water by making and testing boats. The mystery camp explored activities detectives use in solving mysteries.

After-school troop-based programs also dealt with themes, such as fragrances (exploring the chemistry of perfume, lip balm, and soap) and the senses; various kinds of engineering (for mining engineering, the girls had to extract the yolk from a hard-boiled egg with as little damage to the yolk and eggwhite as possible); math (reducing or enlarging images of themselves and of a piece of furniture); communication (designing a communication system using vibrations); and density (which ended with analyzing the properties of root beer floats).

As part of structural engineering, one troop experimented with adobe. To learn what makes a strong structure, the girls broke into groups to see who could produce the best adobe brick using such ingredients as local soil, sand, cement, grass, and water. The next week the girls chose one brick to copy and all worked together to produce 20 bricks each. Later the girls and their parents used the bricks to construct a bridge in the school cafeteria.

The target, 40 girls per camp, was not quite reached, but there was little attrition: those who came kept coming. Over time, *the girls grew in science and communication skills and self-confidence and were more willing to take risks and make mistakes, to provide answers and lead activities, to recognize and change experimental variables, to estimate, to problem-solve in small groups and to arrive at a consensus about how to work on problems—practicing the social skills needed for collaboration. Many girls reported how much they enjoyed getting dirty, taking things apart, learning to measure, using tools, and thinking about math*.

Some summer camps were mixed-gender to allow educators to study gender interactions with a view to improving their own practices. They found that *girls' experiences were very different in mixed-gender and girls-only settings in terms of access, visibility, leadership, and willingness to be active. In small groups, girls tended to work better with girls only, as boys tended to take over. When the genders did work well together, the boys may have made things more competitive, sometimes became more aggressive during group games, and were more likely to cause behavior problems, if only to get more attention (albeit negative). But gender is not the only important factor: color, ethnicity, and poverty may also affect girls' learning. A girl exposed to robotics may want robotics for Christmas, even though there may be no computer in her home*.

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http://gistem.math.arizona.edu — HRD 99-06152 (three-year grant)

Partners: Sahuaro Girl Scouts Council (Tucson); Southwest Institute for Research on Women

Keywords: education program, after-school, summer camp, hands-on, teacher training, mentoring, gender equity awareness, parental involvement, Girl Scouts, Hispanic, Mexican-American, Native American, underprivileged, informal education, mixed-gender, professional development, research study, inquiry-based, self-confidence, communication skills, experiential learning

004

Eyh

Enhancing Expanding your Horizons

ENHANCING "EXPANDING YOUR HORIZONS"

EVERY YEAR, AT EXPANDING YOUR HORIZONS™ (EYH) CONFERENCES HELD ACROSS THE NATION, GIRLS PARTICIPATE IN HUNDREDS OF HANDS-ON WORKSHOPS DEMONSTRATING HOW MATH AND SCIENCE ARE USED IN VARIOUS OCCUPATIONS, AND ENTHUSIASTIC WOMEN VOLUNTEERS—GRADUATE AND UNDERGRADUATE STUDENTS AND PROFESSIONALS—CONVEY THE MESSAGE THAT "SCIENCE IS WOMEN'S WORK." MIDDLE-SCHOOL GIRLS WHO ATTEND THE CONFERENCES EAT MEALWORMS, CREATE WEB PAGES, EXAMINE THE EARS OF CATS AND DOGS, BUILD ROBOTS, AND MAKE TOWERS OUT OF STRAW. THEY LEARN THAT LIQUID NITROGEN ICE CREAM IS "EXTREMELY COOL." THEY CONNECT WITH STEM PROFESSIONALS AT WORKSHOPS LIKE "IS VETERINARY SCIENCE FOR YOU?"

Designed by women scientists and educators in San Francisco's Math/Science Network in 1974, EYH became the organization's flagship program for encouraging girls' interest in STEM. Dating from 1979, the Fargo–Moorhead EYH conference, coordinated by North Dakota State University (NDSU), is one of the oldest and largest, drawing 800 to 900 participants a year. Right after the conference, participants indicate a strong interest in math and science but then return to environments that may not support that interest. Long-term evaluations showed that the *conference influences their attitudes about taking math and science courses in high school but—as a one-day experience with no follow-up activities—has no discernible long-term effect on their career choices*. This grant supported several follow-up programs in North Dakota.

EYH emphasizes outreach to non-European ethnic groups and to economically depressed communities. Under the NSF grant, *by visiting schools on Indian reservations NDSU increased the number of Native American participants sixfold (from 11 in 1994 to 68 in 1995 and 1996)*.

The project mailed newsletters to all EYH participants, containing information about area women scientists and courses needed for various careers. Those who expressed a strong interest in math and science were invited back the next year to an Enhanced EYH (EEYH). In 1995 and 1996, 47 students from seventh and eighth grade participated in longer, smaller, more rigorous workshops and heard women talk about what made their work as scientists interesting.

Immediate evaluations of the Enhanced EYH program were positive. A longitudinal survey of EYH participants' changing interest in math and science shows that parental *encouragement is important in maintaining high interest*. As a result of this grant, EYH has a permanent home in NDSU's Continuing Education.

After the conference, the project tried three ways of staying in touch with participants electronically: a listserv, a Web page discussion group, and an e-mail mentoring group. Only the mentoring program had any success, because most of these rural students didn't have easy access to computers.

EYH also conducted four-day science workshops on campus for high-school girls and supported 17 college students in campus laboratories for a summer. These women later led EYH workshops and helped with the EEYH program.

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www.expandingyourhorizons.org/ EYH conference sites: www.expandingyourhorizons.org/conferences.html	
HRD 94-50017 (three-year program)	
Partners: American Indian Science and Engineering Society, Math-Science Network	
Keywords: demonstration, hands-on, conferences, minorities, underprivileged, Native American, parental involvement, engagement	

004
SAT
Saturday workshops for middle school girls

SATURDAY WORKSHOPS FOR MIDDLE SCHOOL GIRLS

TO LEARN WHETHER AND HOW SCIENCE, MATH, AND ENGINEERING WORKSHOPS AFFECT MIDDLE SCHOOL GIRLS' ATTITUDES, INTEREST LEVEL, AND KNOWLEDGE OF STEM, THIS MODEL PROGRAM PROVIDED EIGHT HANDS-ON WORKSHOPS FOR 35 GIRLS (77 PERCENT MINORITY) FROM THREE DENVER MIDDLE SCHOOLS WITH SIZEABLE HISPANIC, AFRICAN AMERICAN, AND ASIAN AMERICAN POPULATIONS. THEY COMPARED EVALUATION RESULTS FOR THOSE GIRLS WITH THOSE FOR A CONTROL GROUP OF 24 GIRLS FROM SIMILAR BACKGROUNDS WHO DID NOT PARTICIPATE IN THE WORKSHOPS.

Saturday workshops held at the University of Denver over a nine-month period included various biology and chemistry experiments as well as robotics sessions. Parents of the girls were involved in three of the Saturday workshops and had separate sessions on adolescent development and educational planning, as well as some exposure to STEM activities. Undergraduate student mentors in engineering, biology, and chemistry helped the girls with their projects, and the girls also talked with women mentors in STEM-related careers.

Results from the first year suggested that all of the girls, regardless of group, were persistent in how they approached problems and had high perceived ability and interest in math and science. Because their levels of ability and interest started at a high level, they did not change, *but the girls who took the workshops did know more than the control group about career options in STEM, about what courses they should take in high school as a foundation for science, engineering, and math degrees*, and about how long it takes to complete such degrees. So the program was effective in providing knowledge to girls who were already interested in the subject.

One unexpected result was the positive impact mentoring middle school girls had on the undergraduate student mentors. Another was increased parental involvement the second year, after the project was able to satisfy requests for more parental involvement in hands-on activities—which made it easier for the girls to talk to their parents about their projects. Parental enthusiasm for STEM careers increased—some parents even began to consider STEM careers for themselves—as did the amount of dialogue between parents. Parents also wanted to know more about adolescent development and STEM careers.

CODES: M, U, I	University of Denver
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HRD95-53379 (one-year grant)	
Partners: Cole Middle School and School of the Arts, Hill Middle School, and Smiley Middle School	
Keywords: demonstration, hands-on, minorities, workshops, saturday program, parental involvement, role models, career awareness, research study, mentoring	

004
AsA
The after-school ASSETS project

THE AFTER-SCHOOL ASSETS PROJECT

PILOTED IN 1995, THE ECOLOGY-BASED RIVERGIRLS CAMP WAS ATTENDED BY 45 AFRICAN AMERICAN, NATIVE AMERICAN, AND HISPANIC GIRLS ENTERING SEVENTH AND EIGHTH GRADE IN INNER-CITY ST. PAUL SCHOOLS. MANY OF THE GIRLS CAME FROM LOW-INCOME SINGLE-PARENT FAMILIES. THE SCIENCE MUSEUM OF MINNESOTA DEVELOPED AN AFTER-SCHOOL PROGRAM AS AN EXTENSION OF THE FOUR-WEEK CAMP.

The ASSETS project (after-school success exploring technology and science) enabled 24 of the girls who participated in RiverGirls to engage in two 12-week after-school program sequences that gave them more hands-on experience with science, technology, and tools—and a chance to develop positive relationships with peers and role models who reflected their own cultural identities. The girls' parents were invited to participate in their daughters' museum experience, so they could learn to support their daughters' math and science education.

CODES: M, I	Science Museum of Minnesota
Kathleen Wilhite, Mary Ann Steiner, and Patricia Sorber	HRD 96-32321 (one-year grant)
Keywords; education program, museum, after-school, hands-on, role models, parental involvement, underprivileged, informal education, ecology	

004

swt

Sweetwater girl power

SWEETWATER GIRL POWER

SWEETWATER UNION HIGH SCHOOL DISTRICT, THE LARGEST SECONDARY DISTRICT IN CALIFORNIA, IS LOCATED IN SOUTHERN SAN DIEGO, ALONG THE BORDER WITH MEXICO. IN COLLABORATION WITH UNIVERSITY, BUSINESS, AND COMMUNITY PARTNERS, SWEETWATER DEVELOPED A PROJECT TO BRING ABOUT SYSTEMIC CHANGE THAT WOULD HELP UNDERREPRESENTED MIDDLE SCHOOL GIRLS (MOSTLY ETHNIC MINORITIES) PREPARE FOR TECHNICALLY CHALLENGING CAREERS.

Many of the girls come from homes in which neither parent has a high school diploma. They knew few if any STEM role models and often spoke English as a second language. To capture their interest, Girl Power stressed high-interest, project-based learning. Girls at 11 schools participated in 48 after-school club activities (including an archaeological dig, robot-building, a website competition, an investigation of forensics and other science and math activities, and visits to college campuses, the zoo, and tide pools). Over two years, 85 girls attended special summer classes, and 165 students took part in nine intersession classes. BE WiSE, an organization of local women in science, put on overnight events for 11 middle school girls at local science venues.

Girls from eight sites came to a math/science expo to compete in hands-on events (building catapults, paper towers, or hot-air balloons), a trivia game about women in math and science, and a math/science spelling bee. Women from the local science and business community served as judges, and the girls were given career and other information by local law enforcement agencies, Sea World, and Sky Hunters (which educated them about raptors).

Teachers were offered professional development workshops in up-to-date math and science content, gender equity strategies for the classroom (GESA), hands-on science and math, and counselor training. More than 120 new teachers, 94 veteran teachers, and 12 counselors participated in professional development. Fifteen teachers completed gender equity training, with follow-up peer coaching. A workshop on reducing math anxiety in the classroom was popular.

Everyone benefited. Parents appreciated hearing how science and technology classes could help their daughters prepare for success in the world of the future. The project's strongest outreach to the community was through the San Diego Science Alliance. An Expanding Your Horizons conference is planned for 2002.

Trying to effect systemic change in a district the size of Sweetwater with a small three-year program was highly ambitious and optimistic, especially at a time when state, district, and media were pushing for literacy and a decreased emphasis on science. The project evaluation recommends providing continued professional development in gender equity and effective instructional strategies; providing a more energetic push for reform at higher

STRATEGIES FOR NURTURING GIRLS' INTEREST IN SCIENCE

The Girl Power program stressed four general ways to encourage girls' interest in math, science, and technology classes:

- **Model equity in the academic environment.** This can be done by hanging posters that feature as many girls as boys (and as many women as men), by treating girls equally, by featuring information on careers and colleges, and by making evident math and science's real-life applications. In an equitable environment, teachers use more hands-on lessons, more cooperative groups, and more relevant examples. Teachers and counselors may need extra training.
- **Use appropriate teaching strategies.** The most important strategy for encouraging girls is to include hands-on activities in which boys and girls can participate equally. Girls should get equal hands-on time, for example, rather than simply record information while the boys do all the manipulation. Teachers should call on students randomly, to be sure girls and boys are called on equally and get equally complex questions.
- **Infuse gender equity into the curriculum.** In providing examples, tell how specific women have contributed to science, at the point in the curriculum that is relevant to their accomplishments.
- **Make assessment equitable.** Girls should see models of what is expected and should be allowed some options for how to demonstrate their competence.

(more visible) levels of authority; recruiting teams of at least two committed change agents at each targeted school; and recognizing the successes those change agents achieve with ongoing rewards and public recognition.

CODE: M, PD	Sweetwater Union High School District (Chula Vista, Cal.)
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HRD 98-13908 (three-year grant)	
Partners: National University, San Diego State University, University of California at San Diego, Qualcomm, Proxima, Cisco Systems, the U.S. Navy, Curriculum Advantage, the Tijuana River National Estuarine Research Reserve, San Diego County Water Authority, the San Diego Science Educators Association, KBPO Seek Out Science Program, California Science Project, the Math Renaissance Program, and the San Diego Science Alliance	
Keywords: education program, teacher training, mentoring, science clubs, hands-on, summer camp, parental involvement, after-school, industry partners, minorities, role models, project-based, professional development, gender equity awareness, career awareness, workshops, job shadow, research experience	

004

Grpr

The GREEN project

THE GREEN PROJECT

IN MARCH 1998 A GROUP OF ENVIRONMENTAL SCIENTISTS, MIDDLE SCHOOL CURRICULUM SPECIALISTS, MATHEMATICIANS, MIDDLE SCHOOL TEACHERS, LANGUAGE ARTS SPECIALISTS, AND COMPUTER TECHNOLOGY SPECIALISTS FROM TWO UNIVERSITIES, THREE MIDDLE SCHOOLS, AND AN ENVIRONMENTAL RESEARCH ORGANIZATION LAUNCHED THE GREEN PROJECT (GIRLS READY FOR ENVIRONMENTAL EDUCATION NOW). TO ENCOURAGE MIDDLE SCHOOL GIRLS' PARTICIPATION IN STEM, THE PROJECT PROVIDED SUSTAINED ENRICHING EXPERIENCES FOR SEVENTH AND EIGHTH GRADE GIRLS OF COLOR FROM LOW-INCOME HOMES ON LONG ISLAND. THE SCHOOLS INVOLVED SERVED LOW-INCOME FAMILIES—MOSTLY AFRICAN AMERICAN, SOME HISPANIC.

The project developed interdisciplinary curricula around community-based, environmental social-justice research, with an emphasis on girl-friendly teaching practices and advanced technology. Ecological problems abound in low-income areas, which tend to be close to manufacturing sites, with minimal organized cleanups. On Long Island, where groundwater is drinking water, water is an issue. Once the aquifer is polluted, that water is gone.

Girls' summer camp. To explore stereotypes and self-images, the girls drew what they thought scientists, doctors, engineers, mathematicians, and social scientists might look like; described what they saw themselves doing 20 years later; and discussed negative messages they got about themselves from their family, the media, and society.

They explored Long Island, with field trips to see the animals, plants, and ecosystems in the Pine Barrens (a special fire-climax ecosystem), the Riverhead Foundation Marine Mammal Rehabilitation Facility (a mammal rescue center), Caumsett State Park (to see a coastal freshwater pond and to collect specimens on the beach), Jones Beach (to observe nesting areas and protection strategies for the endangered piping plover and to do an exercise on distilling fresh water from saline water), and to tidal wetlands. They analyzed samples and learned to read maps.

On day 5 they reviewed the negative messages from day 1 against their new self-images. Girls created raps about women in science and watched a video to heighten their awareness of socially constructed, media-influenced notions of beauty and appropriateness.

After-school clubs. Some schools formed reading clubs, and girls read a common list of books, to facilitate discussions of what they were learning about themselves and science. One club read several environmental mysteries and some young adult environmental novels. Sisters in Science, an after-school science club, examined the location of traffic warning signs near its school, where several accidents had involved pedestrians. They plotted the placement of traffic signs, studied legal and technical issues, and made a report to the school.

Parent/daughter technology workshops. At Saturday sessions, girls learned basic computer and Internet skills. In four workshops parents and daughters collaborated on projects, the idea being to break negative stereotypes. Facilitators were technically proficient women from diverse ethnic backgrounds who demonstrated that computers are not just a "guy thing."

Teacher training. Several workshops were devoted to making teachers aware of how stereotypes affect their behavior toward students. *In one exercise, teachers were provided with an excerpt from a conversation in the teachers' lounge. Based on that paragraph, they were asked to write down and discuss any assumptions they made about the child in question and his ethnic and socioeconomic status, home, and school life. After that discussion, they were given a one-page profile of the child, which proved many of their shared assumptions false. Follow-up discussions explored how conscious and unconscious assumptions affect teachers' interactions with students.*

To improve teachers' knowledge base and change the way they presented science, the project offered two week-long training sessions a year, introducing teachers to problem-based experiential learning, gender-friendly teaching, and interdisciplinary approaches to local environmental themes. *Making them more comfortable with technology increased the likelihood they would use technology in class*. (Some didn't know how to use a mouse.) The workshops improved their computer skills; introduced them to geographic information software (GIS), digital cameras, and global positioning systems (GPSs); showed them how to convert GPS locations to GIS mapping software; and taught them how to use the Internet for problem-based activities. *Teachers valued most what they learned about GIS*.

Facilitators from Hofstra and the New York Institute for Technology *modeled interactive, experiential ways of reaching curricular objectives—emphasizing the psyches of adolescent girls from minorities and low-income neighborhoods as well as different learning styles and cognitive processes*. Every day started with a summary of the day's schedule and time to reflect on the process and to ask questions. The Citizens Environmental Research Institute (CERI) showed them how to help make data relevant to their students using GIS—for example, in tracking trends in pollution, reinforcing visually and statistically the prevalence of pollutants locally. CERI conducted one session on how to grow cultures, using a kitchen microwave to disinfect lab equipment.

School teams presented projects on such topics as the consequences of spraying for mosquitoes carrying the West Nile virus. Teachers from one school role-played a public hearing on the placement of a petrochemical plant in a low-income Long Island neighborhood (drawing on articles discussing a similar real-life scenario from "Cancer Alley" in Louisiana).

Teachers were encouraged to incorporate social and community advocacy into project-related lessons but they varied in how fully they integrated such activities. Some class activities were thin in both content and requirements for higher-order thinking and some teachers resisted using the GIS technology and making changes in the classroom. But some teachers clearly benefited from the training, and so did their students. In some classes students discovered, for example, that breast cancer rates were not evenly distributed across the state by race or income and that traffic enforcement around a school serving mainly low-income minority children was not commensurate with enforcement around a school serving upper-income children. As educators, said one teacher, "what we do, how we do it, and who we do it with can and does make a difference in environmental awareness."

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www.greenproject.org	HRD 97-14775 (three-year grant)
Partners: New York Institute of Technology, Uniondale Union Free School District, Hempstead Union Free School District, Citizens Environmental Research Institute (CERI)	
Keywords: education program, after-school, Saturday camp, summer camp, underprivileged, teacher training, gender equity awareness, field trips, clubs, workshops, computer skills, experiential learning, African-American, Hispanic, real-life applications, environmental science, parental involvement	

004
Xsci
A training model for extracurricular science

A TRAINING MODEL FOR EXTRACURRICULAR SCIENCE

THE TOP PROGRAM PRIORITY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (AAAS), A FEDERATION OF SCIENTIFIC AND ENGINEERING SOCIETIES, IS TO IMPROVE STEM EDUCATION FOR YOUTH—AND TO HELP ENSURE THAT THE GREATER PUBLIC (INCLUDING WOMEN, MINORITIES, AND PEOPLE WITH DISABILITIES) SEES SCIENCE AS PART OF THEIR EVERYDAY LIVES. THIS AAAS PROJECT DEVELOPED A PASS-THROUGH TRAINING PROGRAM FOR DELIVERING HANDS-ON EXTRACURRICULAR SCIENCE ACTIVITIES TO MINORITY GIRLS AGED AGE 5 TO 17.

Adapting a training model long used by organizations such as the Girl Scouts, the project targeted community leaders, undergraduate women in STEM majors, and parents interested in encouraging their daughters to take advanced math and science. AAAS staff conducted inquiry-based science and math activities and provided information on STEM careers to 84 staff and volunteers and to 104 parents in seven community-based organizations serving African American and Hispanic students. They trained 120 African American and Hispanic college-age students as mentors and workshop leaders in community-based organizations.

Two products emerged from this project. The 20-page booklet “Stepping Into the Future” (1996) offers one-page profiles of 17 African Americans in science and engineering, describing the kind of work they do and how and where they grew up, often ending with career advice for young people. *In Touch with Girls and Science* (1995), available in both Spanish and English, is an activity book for use with K–12 students in both formal and informal settings, from classrooms to community groups. It contains hands-on activities to spark girls’ interest in science and math—on topics such as electricity and magnetism, our environment, and math in everyday life—as well as mentoring tips, suggestions for motivating girls, references, and resource lists. Other titles in the *In Touch* series cover magnetism, electricity, math, preschool science, and community service learning. Nearly all of the activities use inexpensive, easily obtainable materials.

CODES: E, M, H, U, I	American Association for the Advancement of Science
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HRD 94-50597 (one-year grant)	
Publications: Stepping Into the Future: African Americans in Science and Engineering; In Touch with Girls and Science.	
Keywords; demonstration, hands-on, trainer training, inquiry-based, community-based, African-American, Hispanic, mentoring, biographies, role models, career awareness, bilingual, problem-solving skills	

004
HSg
Bringing minority high school girls to science

BRINGING MINORITY HIGH SCHOOL GIRLS TO SCIENCE

“*IT’S NOT SO MUCH THAT GIRLS ARE NOT NECESSARILY TAUGHT DON’T DO SCIENCE, BUT SCIENCE IS LIKE THROWN IN BOYS’ FACES LIKE, HEY, YOU WILL BE AN ENGINEER AND MAKE LOTS OF MONEY, WHATEVER, BUT GIRLS DON’T HAVE IT THROWN AT THEM IN THAT WAY. AS SOON AS I WAS IN THE PROGRAM, IT WAS HEY! THIS IS WHAT I WANT TO DO. A LOT OF GIRLS WHO ARE NOT EXPOSED JUST DON’T KNOW WHAT SCIENCE AND ENGINEERING ARE ABOUT, SO THERE IS NO REASON FOR THEM TO CHOOSE IT.*”

This pioneering project from George Washington University used computer technology and cooperative learning in a university setting to motivate minority high school girls to keep studying subjects needed for STEM careers. Each year, 25 girls from grades 9 or 10 were selected from the greater Washington, D.C., area to take part in a 10-month program to learn computer skills. Six high school science teachers were selected as mentor/participants.

Working in teams, students and teachers developed computer-aided multimedia instruction in science and technology. The idea was that interacting with female scientists and university professors (role models for careers in science and engineering) in a university setting would raise the minority girls’ sights toward higher education. As they developed skills and confidence in using computers to conduct research, the students also learned about academic and career opportunities available to them and developed a peer network of other young local minority women interested in science and technology.

From 1989 through 1993, 100 girls and 20 high school science teachers participated. The girls flourished in cooperative (as opposed to competitive) environments, craving teamwork and interdependence. Exposure to role models, reliance on peer group mentoring, and living in a university setting had a profound effect on these young women. A 1996 follow-up study comparing the girls who participated in the project with a similar population of girls who did not found that *the project did raise the participants' confidence level and ability to deal with the chilly climate females often encounter in the classroom and workplace*.

CHARACTERISTICS OF EXEMPLARY PROGRAMS FOR YOUNG WOMEN OF COLOR

Among other positive outcomes from this project was a two-day working conference of experts convened in 1991 to identify the characteristics of exemplary programs for young women of color and to produce guidelines for future program planners. Project directors Rachel Heller and Dianne Martin catalogued the essential characteristics of exemplary programs, ranked below in order of importance.

1. follow-up
2. high expectations
3. role models
4. career counseling
5. fun
6. mentoring
7. parental involvement and training
8. partnerships
9. bridge program for pre-college to college
10. cooperative learning environment
11. strong evaluation criteria
12. replicability
13. career-oriented field visits
14. use of computers to improve skills and confidence
15. teacher training for middle and high school teachers
16. student professional development
17. effective participant recruitment efforts
18. bridge activities for grades K–12
19. focus on student interests and past experiences
20. community involvement
21. professional involvement
22. open-ended activities
23. doing "real science"

Follow-up was rated the most important characteristic of an exemplary program, regardless of program design or setting. Learning doesn't happen and then turn off. Participants may have thoughts a few weeks later and want to ask questions or share their thoughts. This doesn't mean a program must go on and on and never die, but the participants need to know they have a way of getting back to you, or getting together, at least for a short time.

Women of color are much more likely than their male counterparts to have been victims of the "tyranny of low expectations." An effective program for young minority women must give special emphasis to high expectations and rigorous standards. One benefit of this kind of program is that it fosters women's self-confidence, mental toughness, and resiliency, preparing them for adversity.

Parental involvement differs from project to project, but this was a residential project that included many Hispanic girls. *Most Hispanic parents were not about to buy into a program that had their daughters staying overnight, so the project had to create an environment that would validate Hispanic parents' opinion that young girls should not stay away from home and yet would allow the girls to participate*. It created a late-evening parent pickup, to accommodate parents' concerns.

Nothing happens in a vacuum. This project worked with minority girls who were going to be sophomores and juniors, but students don't stay one way forever. They grow and their needs change. *Bridge programs are important for transitions, helping take students to the next level*.

In an increasingly complex world, *partnerships* are more important than ever. Most projects need to work with a variety of local groups, because they need help with funding, mentors, expertise, site visits, and so on.

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www.student.seas.gwu.edu/~suleiman/girls	HRD 91-53447 (three-year grant)
Partners: GWU's Department of Engineering and Computer Science; IBM; GWU-ITV. A videotape describing the project was produced in conjunction with GWU-ITV.	
Keywords: demonstration, information technology, cooperative learning, minorities, computer skills, mentoring, teamwork approach, self-confidence, role models, peer groups, conference, parental involvement, Hispanic, best practices	

004

Cos

GEMS: high school girls learn cosmetic science

GEMS: HIGH SCHOOL GIRLS LEARN COSMETIC SCIENCE

BECAUSE INNER-CITY GIRLS FROM LOW-INCOME FAMILIES ARE RARELY EXPOSED TO WOMEN IN SCIENCE, IT'S HARD FOR THEM TO SEE STEM AS RELEVANT TO THEIR LIVES. THE GEMS PROJECT (GIRLS IN ENGINEERING, MATH, AND SCIENCE) *TAPS INTO HIGH SCHOOL GIRLS' NATURAL INTERESTS, USING A MULTIDISCIPLINARY APPROACH TO A HIGH-INTEREST PROBLEM: COSMETIC DESIGN. TO HELP THEM UNDERSTAND THAT A CAREER IN STEM IS POSSIBLE FOR THEM, THE PROJECT SHOWS THEM THAT STEM IS ALREADY IN THEIR LIVES—THEY NEED ONLY EMBRACE IT. WORKING SIDE BY SIDE WITH COLLEGE SCIENCE FACULTY ON REAL PROBLEMS, THE PARTICIPANTS ARE PAID WELL, COUNSELED, AND INTRODUCED TO FINANCIALLY SUCCESSFUL FEMALE ROLE MODELS*.

For four summer weeks, 40 girls come onto the Rutgers University (Camden) campus for three and a half hours a day, to experience anthropology and biography lectures and discussions, luncheon seminars, and experiments in the labs of women science faculty. Participants are from an urban, largely minority population of African Americans, Latinas, and Vietnamese in Camden, N.J. *The project recruits girls earning B grades on the regular college-bound (but not the enriched "honors" or "tech prep") academic track—girls midrange in achievement but with enough maturity, interest, and support to succeed. Grades are used because standardized tests tend to underpredict this population's performance*. These girls normally work during the summer—85 percent of their families are on welfare—*so they are paid a stipend of $12.50 an hour, linking STEM work concretely with economic stability*.

Lectures, discussions, workshops, and lab activities introduce girls to STEM career options. The girls and their families learn what they have to do to enter the higher education system. Project activities aim to boost their self-confidence, convince them that a STEM-related identity is compatible with their identities as women, and engage them in activities that *appeal to their cognitive styles while also introducing them to new ways of thinking*.

Small groups meet in labs for almost two hours a day, four days a week, working on *cosmetic design projects—chosen because the topic generates energy and comfort and is of personal interest. To combat any implicit message of gender stereotyping, before each lab the girls meet first as a large group for a session in "context setting"—anthropological on days 1 to 4 and biographical on days 5 to 11*, to make clear science's relevance in their lives and to give them a broader view of themselves across time and place.

In the anthropology session, *they learn about traditional African and Latin American uses of body ritual and facial and body decoration*—for example, the elaborate facial designs in rites of passage for Yanamamo women in Brazil and the red-ochred plaits that identify Masai—and learn how in these cultures one develops one's "paint" as a rite of passage, developing and making visible a strong personal identity. They learn about forms of ornamentation relevant to group membership, status, and gender role. *Each girl is asked to mentally stand outside her world before she begins assessing the possibilities available to her*. The last morning, they paint their faces to reflect what they know about themselves.

Stories are histories told in a personal way and speak directly to GEMS' cognitive learning style by relating material in intimate, anecdotal, nonthreatening ways. In biography sessions the girls read, view, and discuss the lives of successful women scientists, including Elizabeth Blackwell, Alexa Canady, Mae Jemison, Lynda Jordan, Madam C.J. Walker, Maria Villa-Komoroff, and Chien Shiung Wu. Each student completes a self-assessment of her personality traits to see how she might fit into a STEM career. The girls meet minority women scientists, reflecting on their own goals and ways to foresee and work beyond obstacles to meeting those goals.

Lab experiments (integrating biology, chemistry, biochemistry, and psychophysics) allow them to see how scientists work. All experiments revolve around cosmetics—not how to use them, but how to produce them. In small work groups they learn through discovery about lab safety, microbiology (bacteria), body chemistry (the body's reaction to acids, bases, and pH), hair composition (in relation to dyes and relaxers), polymer chemistry (in relation to hair), and product components (analyzing product composition through chromatography). They actually manufacture lotions and lip balms.

Using spectroscopy, they learn which lipsticks do and do not change when applied to each girl's lips. They measure their own pH, create a solution to match their skin's pH level, alter the pigment's pH, and seek the pigments that change the least for a given pH level (and are thus the most likely to retain their appearance). They select bio-pigments from lipsticks, change the pH, look at the ensuing change, and identify the least reactive of the pigments. As a group, they systematically compare the spectra of each of the eight initial pigments with those of their eight altered versions. In doing so, they learn some basic principles and methodologies of biochemistry. Through discovery learning, they predict what each analysis predicts for each class of lipstick wearer and what action they would therefore take as designers.

The project had planned to mentor 98 girls for two weeks but decided to mentor fewer girls for a month, to give them time to build strong relationships with new people. Most of the girls have never met any women scientists when they start the project. Girls work together in groups of 10, supervised by an undergraduate mentor and a scientist mentor. *Having mentors closer and further in age makes it easier for the girls to see science as a life path for themselves*.

At lunch seminars, they get acquainted with women at various stages of their careers, from high school to undergraduate and graduate school to professional level. *During the school year, the emphasis is on continued mentoring and on community activity: engaging families and other community members in career-planning meetings, making ministers more aware of girls' options, hosting science fairs, providing academic and career counseling, and sponsoring talks by professional and business women, community leaders with charisma and high credibility*.

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Keywords: demonstration, minorities, internships, underprivileged, urban, cosmetics, role models, career awareness, African-American, Hispanic, Latina, self-confidence, mentoring, biographies, hands-on	

004

Fut

Futurebound: minority women in community colleges

FUTUREBOUND: MINORITY WOMEN IN COMMUNITY COLLEGES

TO ADDRESS THE SHORTAGE OF WOMEN IN ENGINEERING, FACULTY AT THE UNIVERSITY OF ARIZONA (UA) AND PIMA COMMUNITY COLLEGE (PCC) ARE RECRUITING STUDENTS WITH THE PROMISE OF RESEARCH INTERNSHIPS, MENTORING, AND SEMINARS. TO START, THE FUTUREBOUND PROGRAM GAVE 45 PCC STUDENTS ONE-ON-ONE MENTORING TO HELP THEM WITH THEIR TRANSFER TO SCIENCE AND ENGINEERING PROGRAMS AT UA.

Nationally, *community colleges are a key entry point into higher education for women and minorities*. This partnership between a university and a community college will develop a comprehensive program to enroll, retain, and graduate more women—especially Hispanic and American Indian women—in tracks leading to BS and graduate degrees in astronomy, biosciences, chemistry, physics, engineering, and related fields. The target group is students underrepresented in science.

Currently only 18 percent of UA engineering students are women, and minority women make up less than 10 percent of the enrollment of most engineering programs. Women—especially minority women—have few mentors and role models in the field and encounter discrimination, pay inequities, childcare problems, and hostile and discouraging environments. This project will build on previous activities by

- Extending previous collaboration between UA and PCC science departments on research internship programs, to highlight the efforts of women (especially minority) students
- Furthering project partnerships between departments in the College of Science and the women's studies department (Southwest Institute for Research on Women)
- Integrating community college–level programs into UA's Women in Science and Engineering (WISE) K–12 and university programs
- Attending more to differences within groups and fields
- Identifying and initiating strategies for long-term institutional change

Futurebound will still rely on WISE for mentoring, peer advising, and career workshops for high school and college students. It will also build on an existing NIH bridge program at Pima CC that offers PCC transfer students in the biomedical sciences a research experience the summer before their transfer to UA.

PCC aims to recruit more female students, strengthen their preparedness and widen their knowledge of career choices, and offer them more mentoring, academic advice, and financial support. It will better coordinate minority and support programs and will improve instructional and support programs by providing more interactive learning, a classroom climate more conducive to learning, and better outreach to high school science teachers.

UA will try to improve student motivation, performance, and financial support, and will foster the use of existing units serving minority and women undergraduates. With the Graduate College and the Women of Color Consortium, it will try to get more women engaged in graduate studies. It will monitor progress by comparing the target group's grade point averages and progress toward BS degrees and graduate work with those of all PCC science and engineering students.

By addressing the needs of minority women and the many intersecting issues that affect women and minorities, and by identifying strategies that encourage these populations to study science and engineering, Futurebound aims to develop a model to encourage more community college students generally to move on to four-year academic institutions.

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Keywords: demonstration, support system, mentoring, community college, research experience, Hispanic, Native American, seminars, engineering, internships, recruitment, retention, role models, career awareness	

004

Leco

Learning communities

LEARNING COMMUNITIES

IN STUDYING WHY 60 PERCENT OF AFRICAN AMERICAN STUDENTS—BUT ONLY 12 PERCENT OF CHINESE STUDENTS—AT THE UNIVERSITY OF CALIFORNIA'S BERKELEY CAMPUS FAILED FRESHMAN CALCULUS, MATHEMATICIAN URI TREISMAN HAD TO THROW OUT MOST TRADITIONAL HYPOTHESES (WEAK ACADEMIC BACKGROUND, POOR MOTIVATION, LOW INCOME, AND LITTLE FAMILY SUPPORT). TO HIS SURPRISE HE LEARNED THAT THE *KEY DIFFERENCE BETWEEN AFRICAN AMERICAN AND CHINESE STUDENTS WAS THE WAY THEY INTERACTED WITH EACH OTHER AND THE UNIVERSITY. AFRICAN AMERICAN STUDENTS DID NOT STUDY TOGETHER; THEY WORKED HARD, BUT THEY STRICTLY SEPARATED THEIR SOCIAL AND INTELLECTUAL LIVES. CHINESE STUDENTS FORMED STUDY GROUPS AND HAD STUDY MATES. THEIR ABILITY TO FORM COMMUNITIES AND TO COLLABORATE WAS A KEY TO THEIR SUCCESS.*

Treisman's work at Berkeley provided the foundation from which two initiatives emerged: the Emerging Scholars program at the University of Texas at Austin and the freshman interest group (FIG) or learning community. The Emerging Scholars program is usually associated with math, and most FIGs are also discipline-oriented. The University of Wisconsin at Stevens Point (UWSP), a regional university with an enrollment of about 8,500, introduced the FIG initiative in 1996–97, and its success was not universal. Among the 1,500 first-year students who enrolled that year, the single STEM-related FIG attracted no women. There was a need for a learning community that targeted women—hence this UWSP project, which distills features from both the Emerging Scholars program and the FIG.

The students most at risk of failure at the university, and most in need of social and academic scaffolding, are the students who arrive at the university with the least cultural capital: those from poor or working-class families, those who are first-generation college students, those who are academically underprepared or have yet to establish firm career goals. Women in Science is a women's learning community designed to provide scaffolding for those students and to counteract the feelings of isolation in male-dominated introductory math and science classes that lead many women to opt out of science.

The Women in Science learning community is interdisciplinary: All women interested in STEM are eligible. It is culturally diverse: The urban areas of Wisconsin and surrounding states have large African American populations, central Wisconsin is home to various Native American nations, and several Hmong communities have grown up in the area. It includes both resident and commuter students, as most UWSP students work to support their education. *Those who also commute to school face such demands on their time—and have such weak ties to the university—that they can begin to drop out almost without realizing it is happening*.

The project enhances classroom instruction with a technology workshop (survival training, to combat technophobia) early in the first semester, mentor-led study groups and peer tutoring, a family open house, and STEM-related student employment. A cohort of first-year students takes several common courses, including a women's studies course with a women-in-science theme; writing and English courses, with the women-in-science theme reflected in reading and writing assignments; and a second-semester environmental history course taught by a female history instructor. *Student schedules are arranged so that all participants who enroll in a STEM course during their first semester are assigned to the same section, to counteract feelings of isolation*. The curriculum is rounded out with field trips, guest speakers, and career information. Students learn about gender issues from guest speakers and are exposed to female role models—senior educators and computing professionals who teach them about their field of expertise. A gender issues workshop is given for STEM faculty, with at least one well-known guest speaker invited to draw and engage a good audience.

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HRD 98-10207 (one-year grant)	
Keywords: education program, African-American, Native American, Hmong, mentoring, peer groups, study groups, women's studies, field trips, career awareness, gender equity awareness, role models, teacher training, calculus, math	

STUDYING STUDENTS STUDYING CALCULUS

What did "studying math" mean for the Black and Chinese students [Uri Treisman studied at Berkeley]? For the Black students it meant this: You wake up in the morning. You go to class. You take notes. You get your homework assignment. You go home. You do your homework religiously and hand in every assignment on time. You put in six or eight hours a week of studying for a calculus course, just what the teacher says, and what happens to you? You fail. An important point here is that the Black students typically worked alone. Indeed, 18 of the 20 students never studied with their classmates. The same pattern occurred among many of the blue collar Whites and rural students.

What about the Chinese students? They studied calculus for about 14 hours a week. They would put in 8 to 10 hours working alone. In the evenings, they would get together. They might make a meal together and then sit and eat or go over the homework assignment. They would check each others' answers and each others' English. If one student got an answer of "pi" and all the others got an answer of "82," the first student knew that he or she was probably wrong but could pick it up quickly from the others. If there was a wide variation among the answers, or if no one could do the problem, they knew it was one of the instructor's "killers."

It was interesting to see how the Chinese students learned from each other. They would edit one another's solutions. A cousin or an older brother would come in and test them. They would regularly work problems from old exams, which are kept in a public file in the library. They would ask each other questions like, "How many hours did you stay up last night?" They knew exactly where they stood in the class. They had constructed something like a truly academic fraternity, not the more typical fraternity: Sigma Phi Nothing.

The Black students, on the other hand, [were not aware of] what other students in the class were doing. They didn't have any idea. For example, what grades they were going to get. The exams were like a lottery: "I got a B," or, "I got a C." They had no idea where they stood relative to their classmates. Moreover, these same students were getting A's in "Study Skills," and F's in the calculus class. What they were taught in "Study Skills" [did not] help them in calculus.

Adapted from "Studying Students Studying Calculus: A Look at the Lives of Minority Mathematics Students in College," by Uri Treisman, *The College Mathematics Journal*, Vol. 23, #5, November 1992, viewable at <www.math.rutgers.edu/~greenfie/teaching/workshops/treisman.html>

004
Scit
Science in the city

SCIENCE IN THE CITY

SCIENCE IN THE CITY, AN INNOVATIVE SCIENCE, MATH, AND TECHNOLOGY PROGRAM, TARGETS GIRL SCOUTS 9 TO 14 WHO LIVE IN HOMELESS SHELTERS AND HOUSING DEVELOPMENTS THROUGHOUT CHICAGO. IT GIVES GIRLS WHO LIVE IN DIFFICULT ENVIRONMENTS A STABLE PLACE TO LEARN, MEET OTHER GIRLS, AND INTERACT WITH SUCCESSFUL WOMEN IN VARIOUS STEM CAREERS. BASED AT THE CHICAGO ACADEMY OF SCIENCES, SCIENCE IN THE CITY IS NOW BEING EXPANDED TO GIVE MORE OF THESE OFTEN PHYSICALLY AND SOCIALLY ISOLATED GIRLS THE MANY OPPORTUNITIES THE PROGRAM AFFORDS.

"I was a Girl Scout myself years ago," says principal investigator Jennifer Blitz, of DePaul University's chemistry department, "and *although I knew from a young age that I wanted to be a scientist, I also remember clearly how difficult it was at the time to find a female scientist to be a role model. While I found my models in science fiction, I think it is much more worthwhile for girls to see actual (women) scientists and learn what they do. If they can relate to a flesh-and-blood person, they might realistically feel that they can become scientists, too*."

This project extends a successful collaboration between female scientist educators and Girl Scouts, an organization that is sometimes the only vehicle for girls in underserved neighborhoods to expand their lives. The academy's Nature Museum is an ideal informal learning institution in which the girls can explore themes experientially and at their own pace. (Science museums and other institutions that stress interactive learning help promote discovery and critical thinking because they are experience-based.)

The Science in the City program offers 12 four-hour workshops on science and environmental learning. Five badge workshops (Weather Watch, Science Sleuth, Computer Fun, Geology, and Ecology) enable Scouts to earn the hard-to-get Animals and Plants badge and Water Wonders badge.

Because few economically disadvantaged girls can go to Girl Scout camp, the program will provide a five-day summer camp experience. The girls will participate in two Science for Families Days, in which girls and adults come together to celebrate learning in hands-on activities and educational scavenger hunts. They will go on field trips, learn about science careers during a shadow day with museum staff, and learn how science affects their everyday lives.

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004
TarG
TARGETS: counseling talented at-risk girls

TARGETS: COUNSELING TALENTED AT-RISK GIRLS

THE INSPIRATION FOR ARIZONA STATE UNIVERSITY'S TARGETS PROJECT FOR "TALENTED AT-RISK GIRLS" CAME FROM BARBARA KERR'S RESEARCH AND CLINICAL EXPERIENCES WHILE WRITING *SMART GIRLS, GIFTED WOMEN*—THE THESIS OF WHICH IS *THAT MOST GIFTED GIRLS ARE TOO WELL ADJUSTED FOR THEIR OWN GOOD. MANY GIFTED GIRLS DO NOT ACHIEVE THEIR OWN GOALS BECAUSE THEIR RESOURCEFULNESS AND EAGERNESS TO PLEASE CAUSES THEM TO COMPROMISE THEIR GOALS MANY TIMES IN THE COURSE OF THEIR DEVELOPMENT. THEY SABOTAGE THEMSELVES BY TAKING LESS CHALLENGING COURSEWORK THAN THEY NEED, BY STOPPING OUT OF EDUCATION OR CAREER PLANS, OR BY LOSING SIGHT OF THEIR GOALS ENTIRELY—AND OFTEN NEVER ASPIRE TO GOALS COMMENSURATE WITH THEIR ABILITIES. THEIR STRONG PRIORITIES FOR MAINTAINING RELATIONSHIPS RATHER THAN ACHIEVING THEIR OWN GOALS MAKES IT INEVITABLE THAT GIFTED WOMEN ACHIEVE LESS THAN GIFTED MEN*.

But some women do achieve their dreams and goals despite societal discouragement. For her book Kerr reviewed the biographies of 33 women judged eminent in their fields—analyzing their lives in terms of their own dreams, not by masculine standards for their professions. As teenagers these 33 women were different from the gifted girls from intact families who are typically the subject of research studies. Few of them were raised in upper middle class environments, and many of them had lost one or both parents or had a parent who was physically or mentally disabled. And though most gifted girls lead placid lives with a playful childhood followed by an involved, well-adjusted adolescence, these eminent women spent an extraordinary amount of time as girls completely alone, often reading by themselves, friendless, sometimes neglected even by their family. Many eminent women had traumatic experiences during their childhood or adolescence. They were often rejected by other people as teens and often experienced disastrous romantic lives. And while most gifted girls are noted for their social skills and charm, for their excellent social adjustment and readiness to adapt to others' needs, eminent women—as adolescents and adults—were often sharp-tempered and sharp-tongued, stubborn in their pursuits and fierce in the defense of their own ideas.

In short, *most of the eminent women Kerr studied had been talented at-risk girls. If so, perhaps the way to identify the gifted girls most likely to achieve their dreams was to look at the troubled brilliant girl who makes A's only in the subjects she cares about deeply and who struggles with many frightening and painful issues—not at the straight-A achiever on the cheerleading squad*. Kerr had discovered the rationale for this project.

The TARGETS project (talented at-risk girls: encouragement and training for sophomores) was initiated in 1992 with no funding. Kerr's team simply contacted high schools, told them the kinds of girls the project wanted to help, and trained counselors in an all-day Friday workshop filled with research-based career and lifestyle counseling techniques. NSF funding allowed ASU to expand the program.

Most career development interventions treat young women's career decisions as being made in isolation from other decisions, such as whether and when to marry or have children. To be effective, vocational planning probably has to take place within the context of life planning, including relationship decisions. And career counseling must include specific powerful interventions aimed at enhancing girls' self-esteem, self-efficacy, and other expectations of success. The women with the greatest need of this kind of intervention may be those talented in nontraditional areas such as STEM but at risk because of poverty, acting-out behaviors, low self-esteem, low self-efficacy, or lack of social support for STEM career goals. In the Southwest, many young Native American and Hispanic girls, and girls living in communities that do not support high aspirations for women, fit this category.

The TARGET intervention included an hour of assessment in the girl's home school, a two-day workshop at ASU, a follow-up one-hour visit at the home school, several pre- and post-tests (e.g., of self-esteem, confidence, personality, values, and vocational interests), and at least one follow-up letter from their career counselor four months after the workshop. The TARGETS workshop involved tests, counseling activities, a guidance laboratory, and activities aimed to raise the girls' sense of purpose, career aspirations, and career identity. Participants met counselors and women scientists who discussed their own career development and encouraged the girls. In a Perfect Future Day exercise, the girls imagined themselves 10 years older, discussed issues that emerged from the experience, and were helped to identify ways of overcoming their own at-risk behaviors as well as environmental barriers to achieving their perfect future day.

Evening and night activities were based on the Math–Science Sleepover developed by Columbia, Mo., Public Schools to encourage girls toward STEM careers (Schroer 1991). Girls spent the night at a residence hall lounge with counselors and with women mentors in nontraditional fields. The second day they worked in a science, design, or computer lab solving real problems and meeting with women faculty. *Changes in their self-esteem, self-efficacy, and hope for the future were striking, given the brevity of the intervention. Said one girl, "this was the first time an adult had taken me seriously."*

WORKSHOPS FOR GUIDANCE COUNSELORS

At the GEMS (girls into engineering, math, and science) workshop, counselors and science educators became more aware of discrimination against women and questioned themselves more about their own attitudes and behaviors. Research articles were gathered in a binder, providing participants with a wealth of information about developing math and science talent in girls and women and about gender-equitable interventions for math and science education for at-risk, minority, and gifted students. Lectures on developing talent in women and on helping adolescents at risk were combined with hands-on experiences in an industrial design studio and a mechanical engineering lab. Enrollment increased from 17 in the summer pilot to 75 in the winter.

Some of the most powerful lessons on counseling minority girls came from the girls themselves. The project investigators had assumed, for example, that girls interested in science would want to be doctors, but rural Navajo girls felt a uniform distaste, even antipathy, toward this career—fearing anatomy classes because of traditional Navajo concerns about seeing or touching the dead. They also assumed that being an accountant would hold little appeal for a lively, sociable girl with math talent, who might prefer being a clinical social worker. But this was not the case for Pima, Navajo, Hopi, and Apache girls. On the reservation, an accountant is a friendly, caring person who often makes "house calls" and who helps the family fill out difficult tax forms resulting in much-needed refunds. A social worker, by contrast, is someone who takes your children away.

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Partners: National Consortium of Specialized Secondary Schools in Math, Science, and Technology; the American Youth Foundation; and 14 Arizona high schools.	
Products: GEMS Resource Guide	
Keywords: professional development, counselor training, intervention, minorities, self-confidence, career awareness, role models, Native American, Hispanic	

004
AT-r
GEOS: encouraging talented at-risk college women

GEOS: ENCOURAGING TALENTED AT-RISK COLLEGE WOMEN

A YOUNG WOMAN TALENTED IN STEM TYPICALLY ENTERS COLLEGE WITH HIGHER GRADES THAN A SIMILARLY GIFTED YOUNG MAN BUT MAY BE LESS WELL PREPARED, HER COURSE WORK HAVING BEEN LESS RIGOROUS. SHE HAS HIGH ASPIRATIONS BUT HER SELF-ESTEEM HAS BEEN DECLINING SINCE EARLY ADOLESCENCE AND IS AT ITS LOWEST POINT EVER. HAVING LOST CONFIDENCE IN HER OWN OPINIONS, SHE TENDS TO AGREE WITH OTHERS SO SHE WILL BE ACCEPTED, IS UNLIKELY TO ASSERT HERSELF IN CLASS, AND DOES NOT STAND UP WELL TO CRITICISM. A C ON HER FIRST MATH OR SCIENCE TEST MAY LEAD HER TO CHANGE MAJORS BECAUSE SHE'S NOT GOOD ENOUGH. ON VOCATIONAL PERSONALITY TESTS, SHE TENDS TO SCORE HIGHER THAN AVERAGE ON SCALES FOR BOTH "INVESTIGATIVE" (IDEA-ORIENTED AND INTELLECTUALLY CURIOUS) AND "CONFORMING" (CONFORMING AND CAUTIOUS).

With a precarious blend of high aspirations and low confidence, of intellectual curiosity and desire to conform, this typical young woman enters an environment that is indifferent, if not hostile, to her intellectual goals. The special mentors who guided her in high school have new students to nurture and in college she is likely to receive little guidance, encouragement, or support. She will be under relentless peer pressure to groom herself for a relationship, find a man, and establish a commitment. Her peers may not even know what her major is or that she was a National Merit Scholar. If she is Navajo, Hispanic, or African American, she may feel isolated, uprooted, and separated from the sources of her strength.

Why do some gifted young women survive the chilly climate of the coed American campus and graduate with their dreams intact? Those who identify with their chosen field, exhibit maturity and leadership, and have access to mentoring and guidance seem to do well. But those qualities are in short supply on the typical college campus.

GEOS (gender equity options in science) extends to at-risk college women some features of Arizona State University's TARGETS program for talented at-risk high school girls. A research-through-service project, GEOS is using results from TARGETS *to improve and expand on the model of the "counseling laboratory" approach*. Over a three-year period, 180 freshmen and sophomore women enrolled at ASU will participate—some as a control group—in multiculturally sensitive career development workshops and mentoring activities. Thirty graduate-level counselors-in-training will be trained in counseling and mentoring women talented in math and science, and 240 STEM faculty will be trained in equity issues and mentoring. (The faculty are members of the Wakonse Fellowship, a consortium of research and teaching universities founded to improve college teaching.)

Some career development workshops and seminars will take place at ASU and some at *rural camps, where the informal atmosphere encourages student–faculty interaction and the natural setting is ideal for hands-on science experiences*. Students will take a series of pre- and post-tests, will get both group and individual counseling, and will be given the results of their personal inventories and a Personal Map of the Future—suggestions for exploring careers in STEM.

The young women will also be invited to an overnight faculty–student mentoring retreat at Saguaro Lake Ranch, a Forest Service facility, where counselors and professors will share informal, woman-friendly science activities with undergraduates. *Overnight activities break down barriers to student–faculty partnerships and help build community support for young women*.

Students and faculty who participate in ASU's career development workshops and retreat will become trainers and leaders at a five-day summer STEM faculty training seminar in Michigan, with faculty GEOS teams from eight universities. Hands-on activities will include identifying examples of resilience in sand dune ecology, developing a mathematical model for water quality management in a new water treatment facility; and learning about woman-friendly technology training at an all-night technology center in the lodge of the Miniwanca educational center.

CODES: U, PD	Arizona State University
Barbara Kerr (bkerr@asu.edu), Sharon Robinson-Kurpius	
HRD 00-80706 (three-year grant)	
Partners: National Wakonse Fellowship for College Teaching Keywords: demonstration, self-confidence, mentoring, intervention, research study, career awareness, teacher training, gender equity awareness, hands-on	

004
Raw
Radio series on Alaskan women in science

RADIO SERIES ON ALASKAN WOMEN IN SCIENCE

PUBLIC RADIO STATION KCAW-FM (“RAVEN RADIO”) PRODUCED A FIVE-PART SERIES PROFILING FIVE ALASKAN WOMEN IN SCIENCE AND TECHNOLOGY. LIKE MANY ALASKANS, THESE WOMEN WERE TOUGH, ADVENTUROUS, AND INDEPENDENT-MINDED. THEY WERE INVOLVED IN DESIGNING THEIR OWN EXPERIMENTS AND DID RESEARCH IN THEIR OWN LABORATORIES OR IN THE FIELD.

Some of the women work in treacherous conditions. Harbor seal researcher Kathy Frost studies seals from an open skiff in Prince William Sound. Arctic biologist Lori Quakenbush studies wildlife on the Arctic Ocean, combatting polar bears and freezing conditions.

For some women scientists, “extreme” conditions are social rather than natural, so their stories include how they overcame obstacles and what kept them interested in their field. Eliza Jones, an Athabaskan linguist, is writing a dictionary of the Koyukon language from her home in Koyuku, a place with no running water, where many people still live traditional subsistence lifestyles.

Geophysicist Amanda Lynch uses the supercomputer in Fairbanks to map climate change in the Arctic. A fit, blonde 20-something, Lynch smashes all stereotypes of physicists and mathematicians, battling the glass ceiling women often face in scientific fields.

Fishery biologist Tory O’Connell is figuring out new ways to estimate fish populations. She uses a submersible to go down 800 feet below the ocean surface to count groundfish. In the O’Connell segment, producers went down in the submersible to demonstrate to listeners how applied science can be both satisfying and nerve-wracking.

Tuning in to the sounds of science, the producers create an audio journey that conveys how interesting and possible science is for women. Two versions of the series were prepared for state and national distribution in 5- and 15-minute segments. The Alaska Department of Education also distributed the series statewide, along with a written curriculum guide. In 1996 the Alaska Press Club awarded the series first place for Health and Science Reporting.

CODES: I, M, H	KCAW-FM Raven Radio
Ken Fate, Lisa Busch	
HRD 95-52947 (one-year grant)	
Partner: Alaska Department of Education	Product: Five-part radio series
Keywords: dissemination, radio, Alaskan, biographies, role models	

004
ACg
Out of the lab: an Alaskan camp for ninth grade girls

OUT OF THE LAB: AN ALASKAN CAMP FOR NINTH GRADE GIRLS

“IF THE PUBLIC COULD BE HELPED TO UNDERSTAND HOW SCIENTIFIC KNOWLEDGE IS GENERATED AND COULD UNDERSTAND THAT IT IS COMPREHENSIBLE AND NO MORE EXTRAORDINARY THAN ANY OTHER FIELD OF ENDEAVOR, THEY WOULD NOT EXPECT MORE OF SCIENTISTS THAN THEY ARE CAPABLE OF DELIVERING, NOR WOULD THEY FEAR SCIENTISTS AS MUCH AS THEY DO.” —JONAS SALK

In conjunction with a public radio program, Sheldon Jackson College and Pacific High school will conduct a residential science camp for ninth grade girls, encouraging participation by girls from underserved populations, such as Alaskan native, low-income, and rural (bush) students. The camp will be held partly on the Sheldon Jackson College campus, in downtown Sitka, near the historic Sitka National Historic Park.

The camp will use Expeditionary Learning School (Outward Bound) techniques: guided questions and challenges posed to encourage students to explore science, with an emphasis on service learning. The girls will learn about scientific method, scientific assumptions, scientific communication, how science affects our culture, and how the media portray scientists. To improve teachers’ scientific literacy, scientists will meet with science educators in a three-day pre-camp workshop to discuss how science is being taught and how science is really done.

This experimental project is the hands-on part of a national radio series on how science is really conducted. The six-hour series, to be produced by public radio station KCAW-FM in Sitka, will examine the sociological world of scientists, from how they get ideas to how Nobel Prize winners are selected—and how those selections affect science. Topics covered will include science and religion, evolution in the classroom, creativity and science, how culture may influence science, the Nobel Prize, science, and the media—and the Carl Sagan effect (why do scientists fear popularizing science and look down on scientists who reach out to laymen?).

Morning lectures will be followed by hands-on lab activities on campus, for the first two or three days. Later in the week, students will camp in an isolated area on Biorka Island (owned and operated by the FAA and a major military communication installation during World War II). In a camp setting, the girls will learn about the area's natural history while working on projects together. On a boat owned by a marine educator, they will explore the local marine environment—including how organisms adapt and evolve in an island environment.

CODES: H, I, U	Sheldon Jackson College
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HRD 00-86366 (one-year grant)	
Partners: Pacific High School, public radio station KCAW-FM, Public Radio International	
Keywords: demonstration, Alaskan, rural, underprivileged, exploration-based, service-learning, hands-on, radio, teacher training	

004
Ap
Appalachian girls' voices

APPALACHIAN GIRLS' VOICES

THE LITERATURE ON ADOLESCENT DEVELOPMENT—BASED LARGELY ON STUDIES OF ADVANTAGED, UPPER-CLASS, MAINLY CAUCASIAN GIRLS—DOCUMENTS GIRLS' LOSS OF VOICE IN ADOLESCENCE. THE RESEARCH IN THE VOICES PROJECT ASKED IF LOWER-CLASS APPALACHIAN GIRLS DON'T LOSE THEIR VOICE AND SENSE OF INDIVIDUALITY WELL BEFORE ADOLESCENCE.

Voices was a three-year research and development program designed to examine factors affecting rural and urban girls' participation in STEM subjects and to increase that participation. The Voices project worked with groups of ethnically diverse middle-school girls and their families, schools, and communities, drawing from urban and rural West Virginia middle schools in McDowell and Kanawha counties.

In the project's first year, Saturday workshops emphasized the math and science in traditionally feminine activities such as food preservation, holiday crafts, quilting, and folk medicine. *Hands-on activities showed the girls that science, math, and technology are not alien, abstract, and "masculine," but part of daily life*. The girls learned to use the Internet and were assigned *advocates* (parents or other adults who worked with them in math and science). The second year, the girls were assigned adult mentors from places such as Union Carbide. The third year, the girls and their mentors designed projects to involve the girls in STEM through community involvement with younger students and through a "virtual scientist" experience (reading a science fiction novel and thinking about women's lives), the idea being to help the girls see themselves as rocket scientists and CPAs, physicists and physicians—anything they want to be.

The project selected participants from all "tracks," including special needs classes, and by selecting a relatively high percentage of African American girls challenged certain assumptions. The research literature contains little indication that key staff might actively resist efforts to increase opportunities for students assumed to be incapable of rigorous academic work. The principal from one urban school chose not to refer any students from the school for testing, so the project worked with students a teacher recommended.

Voices explored *differences between the experience and culture of rural and urban girls, especially in terms of peer status, self-image, and attitudes toward authority. Girls in rural communities may have experience in hands-on learning and craft knowledge that are useful to the practice of science, often encounter less peer pressure against doing science, and may enjoy stronger community support than girls in urban schools*. Rural schools track students on the basis of ability; their assumptions about students' ability to learn are very different, and they provide support for low-track students. Moreover, rural teachers and coordinators live in the community where they work; urban teachers rarely venture into the housing projects where many of their students live. But *girls in rural schools may receive less encouragement to attend college or aspire to a career, may have fewer educational opportunities (advocates had to persuade two rural middle schools attended by project students to introduce or reinstate algebra and pre-algebra), may encounter fewer and less diverse role models, and may receive powerful social messages that limit their aspirations*.

The project expected to find resistance in rural communities to a program that challenges gender norms, but rural communities provided remarkably high levels of support for the program. Parental participation in the *workshops was especially high in rural areas*. The project learned the unexpected advantages of working in a poor rural school district: The enthusiasm and support these communities bring to a project may more than compensate for a lack of in-kind contributions from school districts. *Unfortunately, the Voices program awakened an interest in and enthusiasm for science and math that was not easily transferred to the girls' formal classwork. The program did not anticipate the severe disjunction between the hands-on approach to learning in Voices workshops and the worksheet- and text-based instruction common in the girls' classrooms*. Parents, teachers, and principals (especially at the rural sites) reported positive changes in girls' attitudes, behavior, interest, self-esteem, and (less often) grades—*but the self-confidence and grades of special education students showed the most dramatic improvement*. Parents and teachers looked favorably on the program, an attitude that was sometimes misused: Parents and school personnel sometimes denied girls access to Voices activities as a form of punishment.

CODES: M, I	Appalachia Educational Laboratory
Patricia S. Kusimo (kusimop@ael.org), Robert G. Seymour, Carolyn S. Carter, Pamela B. Lutz, Marian C. Keyes	
www.ael.org/nsf/voices/index.htm	HRD 94-53110 (three-year grant) and HRD 98-15117 (one-year grant)
Partners: Eisenhower Regional Consortium for Mathematics and Science Education; Appalachian Rural Systemic Initiative (ARSI); Black Diamond Girl Scout Council; Educational Resources Information Clearinghouse/Center for Rural Education and Small Schools (ERIC/CRESS).	
Products: Documentary film, videotapes, Voices curriculum projects. Useful reading: The Project Book by Douglas Fleming.	
Keywords: demonstration, intervention, rural, urban, support system, research study, cultural barriers, Girl Scouts, Appalachians, workshops, mentoring, project-based, parental involvement, hands-on, self-confidence, achievement	

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004

AW

Action-WISE in Zanesville, Ohio

ACTION-WISE IN ZANESVILLE, OHIO

WITHIN MUSKINGUM COUNTY, OHIO—WHICH IS PART OF THE FEDERALLY DESIGNATED APPALACHIAN REGION—THE ZANESVILLE CITY PUBLIC SCHOOL DISTRICT SERVES A COMMUNITY OF 27,000, MANY OF WHOM LIVE IN POVERTY, OFTEN IN ONE-PARENT HOUSEHOLDS. FEWER THAN A THIRD OF ZANESVILLE STUDENTS COME FROM COLLEGE-EDUCATED FAMILIES, AND FEWER THAN 45 PERCENT OF THEM PASS THEIR PROFICIENCY TESTS ON THE FIRST TRY. IN 1995 FIVE TEACHERS FROM GROVER CLEVELAND MIDDLE SCHOOL, CONCERNED THAT BRIGHT AND CAPABLE GIRLS WERE LOSING INTEREST IN MATH AND SCIENCE, BANDED TOGETHER IN A PILOT PROJECT TO IMPROVE GIRLS' ATTITUDES TOWARD SCIENCE. *AFTER 54 GIRLS (A THIRD OF THEM STUDENTS OF COLOR) HAD A CHANCE TO VISIT LOCAL WOMEN SCIENTISTS AT THEIR WORKSITES AND INTERACT WITH THEM AT MONTHLY SEMINARS, THE GIRLS STOPPED THINKING SCIENTISTS WERE ALL "GEEKY GUYS." THE OHIO DEPARTMENT OF EDUCATION NOMINATED THE PROJECT FOR A "BEST PRACTICES" AWARD.*

In a four-partner collaboration between the Zanesville schools, a two-year technical college (Muskingum Area Technical College, or MATC), a four-year private college (Muskingum College), and an international wildlife research and conservation center (The Wilds), this Action-WISE project expanded the number and grades of students involved in that project, strengthened the curriculum, and expanded the project calendar. Roughly 700 elementary students, 240 middle students, 100 high school students, and 56 educators (who took a graduate course in gender equity) benefited.

Students benefited from monthly seminars and informal discussions with women in STEM-related careers, took field trips, and engaged in hands-on activities. In summer science camps, students learned math, biology, chemistry, physics, and geology in the course of solving environmental problems. Science, math, and computer labs at both colleges, regional field sites, and the diverse habitats at The Wilds gave students ample opportunity to explore. Undergraduate women served as lab assistants and mentors for the middle and high school girls. Few of the girls had been exposed to college, so most field trips were tied to a college visit.

Students enjoyed math activities and the Equate math game; conservation medicine and disease transmission activities; studies of the human skin; a tour of the Texas Longhorn Cattle Ranch and a discussion of food and food distribution; donning and doffing MATC's hazardous materials suits and self-contained breathing apparatus; tree identification and a nature scavenger hunt; testing water quality and seining for fish in local state parks; identifying plants, including medicinal plants; learning about animal behavior and doing field observations at the Wilds; learning about microbiology (culturing organisms and analyzing results) at Muskingum College; following a nature trail for the handicapped at Flint Ridge State Memorial; and doing electrical engineering lab activities at MATC.

K–12 teachers who served and supported the project benefited as if they were co-participants with the school-age girls. Having never scaled trees or studied astronomy themselves, for example, they said they grew with every experience they offered their students. Their enthusiasm for the project drew more teachers to it. Teachers valued working outside their grade levels, working with outside organizations, having access to sophisticated laboratories, and networking and exploring possibilities for further development. There was true collaboration among the partners. And sixth grade teachers were able to acquire science equipment they could not get with district funds.

CODES: E, M, H, I	Muskingum Area Technical College
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www.zanesville.k12.oh.us/grover/wise/index.html	HRD 97-14792 (three-year project)
Partners: Zanesville City School District, Muskingum College, and The Wilds (an international wildlife research and conservation center)	
Science links: www.zanesville.k12.oh.us/html/ScienceLink.html	
Keywords: education program, underprivileged, field trips, role models, teacher training, gender equity awareness, hands-on, career awareness, summer camp, mentoring	

004
HOs
Hands-on science in rural Virginia middle schools

HANDS-ON SCIENCE IN RURAL VIRGINIA MIDDLE SCHOOLS

GIRLS ARE OFTEN DISCOURAGED IN SUBTLE WAYS FROM PURSUING AN INTEREST IN SCIENCE. OVERCOMING SUCH BARRIERS WAS THE GOAL OF THIS PROJECT FOR MIDDLE SCHOOL GIRLS—AND THEIR MATH AND SCIENCE TEACHERS—IN RURAL AND ECONOMICALLY DEPRESSED COUNTIES OF FAR WESTERN VIRGINIA. FIFTEEN MIDDLE SCHOOL TEACHERS FROM SIX SOUTHWEST VIRGINIA COUNTIES SPENT A WEEK LEARNING ABOUT GENDER EQUITY AND PREPARING FOR HANDS-ON ACTIVITIES AT A GIRLS' SUMMER DAY CAMP. MEMBERS OF A TEACHERS' WORKING GROUP HAD MET BEFOREHAND BY PHONE, FAX, E-MAIL, AND ELECTRONIC CHAT ROOM TO REVIEW HANDS-ON SCIENCE MODULES.

The following week, those teachers helped 22 middle school girls engage in hands-on math and science activities. The camp gave the girls a chance to conduct simple experiments and to use math and physics to solve real-life problems. At companies in the Blacksburg area, including a biotechnology firm, they talked with female scientists. They were up to their knees in a creek, collecting and identifying creatures to assess the health of the stream.

Each afternoon the teachers discussed group dynamics, gender equity, and plans for the next day. Each day a different woman from the Virginia Tech faculty ate lunch with the girls and teachers, to help put a human face on becoming a scientist and to give teachers a chance to interact with role models they could invite to give talks or science demonstrations at their schools.

Part of the idea of SAGE-VA (the science and gender equity program of western Virginia) was to establish a collaborative network among middle school teachers, university professors, and community organizations interested in getting middle school girls to pursue STEM education and careers. It helped solidify collaboration between classroom teachers in isolated parts of Virginia and scientists and science educators at Virginia Tech.

Teachers got hands-on experience with teacher-tested approaches to "discovering" math and science as well as a chance to exchange ideas and experiences with teachers from other schools. "We can compare what we do and how we do it, and that can make our teaching more relevant," said one teacher. "And best of all, these are real activities. The kids are really going to love it."

CODES: M, I, PD	Virginia Polytechnic Institute and State University (Virginia Tech)
Ruth G. Alscher (ralscher@vt.edu) Lori S. Marsh, Julie Grady, Susan C. Eriksson, Katherine Cennamo, Carol J. Burger	
www.chre.vt.edu/rebecca/sage-va/mission.html	HRD 97-10645 (one-year grant)
Partners: Giles, Montgomery, Roanoke, Washington, Wise, and Wythe counties; Virginia Space Grant Consortium	
Keywords: education program, engagement, hands-on, real-life applications, teacher training, rural, gender equity awareness, role models, support system	

004

Sc's

Science connections

SCIENCE CONNECTIONS

THE PLUS CENTER (PROMOTING LEARNING AMONG THE UNDERREPRESENTED IN SCIENCE) AT THE COLLEGE OF ST. SCHOLASTICA OFFERS WEEKLONG AND MONTHLONG SUMMER SCIENCE PROGRAMS FOR GIRLS THAT EMPHASIZE GENDER EQUITY AND REGULAR INTERACTION WITH FEMALE ROLE MODELS IN SCIENCE. *BUT THE ENTHUSIASM GIRLS DEVELOP DURING SHORT-TERM ENRICHMENT PROGRAMS IS RARELY SUSTAINED IN THEIR HOME AND SCHOOL ENVIRONMENTS. THIS IS ESPECIALLY TRUE IN RURAL COMMUNITIES, WHERE GIRLS HAVE LITTLE EXPOSURE TO FEMALE ROLE MODELS AND ARE UNLIKELY TO RECEIVE STRONG PARENTAL SUPPORT FOR SCIENTIFIC PURSUITS—AND WHERE TEACHERS ARE RARELY FAMILIAR WITH COOPERATIVE ACTIVITY-BASED LEARNING AND LACK EVEN THE RUDIMENTARY SUPPLIES AND EQUIPMENT NEEDED FOR HANDS-ON ACTIVITIES.* ONE PURPOSE OF THE PLUS PROGRAMS IS TO *OVERCOME TWO STEREOTYPES: THAT WOMEN CAN'T DO SCIENCE OR, IF THEY DO, THEY MUST BE NERDS.*

Students and parents had rated FAST Camp (a weeklong summer enrichment camp for sixth and seventh grade girls) highly, and the girls appeared to be highly motivated to continue math and science studies after camp. But despite strong encouragement, only eight of 122 FAST camp graduates actually participated in a follow-up summer enrichment experience when they reached eighth, ninth, or tenth grade. The single follow-up session the PLUS Center provided was not enough to counter the peer pressure and lack of support these students experienced after their initial summer experience was over.

To prevent these leaks from the science and math pipeline, St. Scholastica involved teachers, families, and scientists in Science Connections, a model program designed to give girls enrichment opportunities that would *sustain their interest in science during the impressionable middle school years*. The two-year program let sixth graders from the summer camp continue to be involved with a peer group and with role model scientists and activities until they entered the eighth grade (when the PLUS Center has programs geared to eighth grade students). Each year, 25 participants—sixth and seventh grade girls (from predominantly low- and middle-income rural or minority families) who had already participated in the weeklong science enrichment program—participated in a monthly series of Saturday Science workshops during the school year and a Summer Science Weekend.

Activities at the Saturday Science workshops featured, in turn, "MacGyver" problem-solving, a FAST Camp reunion, careers, kitchen science, computers, snow science, chemistry, and ecology. In the "kitchen science" workshop, students and parents made ice cream in ziplock bags, using milk, which launched a discussion of what the salt does and how recipes might freeze differently, depending on the ingredients (variables). In a milk chemistry experiment, they added food coloring and dish detergent to whole milk at room temperature, creating a reaction that surprised and baffled both students and parents. In the ensuing discussion of variables, they discussed what might happen if the experiment were repeated with skim milk or buttermilk—and were sent home with an assignment to repeat the experiment comparing different kinds of milk products at different temperatures.

At the end of each workshop, the girls received a science or math puzzle (from Marilyn Burns's books and the EQUALS book *Math for Girls*) to work on over the month; there was a drawing for a small prize from among those with correct responses. Families received two AAAS publications ("Science Books and Films" and "Sharing Science with Children") that suggest home activities. Teacher and parental involvement were emphasized as a vital link in the support network for each girl.

The Summer Science Weekend began with a chemistry magic show that included experiments with dry ice, helium, indicator solutions, and so on. Saturday morning problem-solving activities were followed by "What's My Line?" featuring eight female scientists who brought along one piece of equipment they use regularly. Saturday afternoon water activities included the "Lake Superior Game," in which a bucket of water representing Lake Superior gradually becomes polluted and depleted as the game progresses, with game cues such as this:

> I am a sixth grader…. I go fishing with my friend. When we clean our fish we dump the guts in the lake instead of wrapping them up and throwing them away. We think this is okay because they are biodegradable. [Add one unit of color.]

The PLUS Center has developed a consortium of local educational institutions and community partners to expand and maintain a pipeline of youth and family programming for grades 4 through 12 (while improving teacher training) and to produce systemic reform in STEM education. Many PLUS programs serve primarily students of color and low-income youth, many from rural communities. Survey results indicate that 76 percent of Plus Center alums have graduated from high school, 63 percent of those graduates have gone on to postsecondary education, and of those who have declared a major, 68 percent have selected majors in math and science-related fields.

CODES: M, I	The College of St. Scholastica
Ann Sigford (iastaff@stfO.css.edu)	
www.css.edu/PLUS	HRD-95-54497 (one-year grant)
The "Lake Superior Game," available from the University of Minnesota Sea Grant Extension Program, could probably be adapted to other bodies of water.	
Keywords: demonstration, support system, workshop, summer camp, hands-on, parental involvement, role models, rural, activity-based, cooperative learning, teacher training, underprivileged	

004
Mit
Master It: a program for rural middle-school girls

MASTER IT: A PROGRAM FOR RURAL MIDDLE SCHOOL GIRLS

MASTER IT (MATHEMATICS AND SCIENCE TO EXPLORE CAREERS INVESTIGATING TOGETHER) IS A PROJECT TARGETED AT RURAL KANSAS MIDDLE SCHOOL GIRLS WHO HAVE COMPLETED GRADES 7 AND 8. EACH YEAR 48 GIRLS (HALF FROM EACH GRADE) ARE SELECTED TO PARTICIPATE IN A ONE-WEEK SUMMER RESIDENTIAL PROGRAM FOLLOWED BY FOUR SATURDAY ACTIVITIES DURING THE SCHOOL YEAR. ACTIVITIES INCLUDE HANDS-ON INVESTIGATIONS OF MATHEMATICAL AND SCIENTIFIC CONCEPTS LED BY WOMEN PROFESSIONALS IN INDUSTRY OR ON THE UNIVERSITY FACULTY. THE PROJECT ALSO PROVIDES FOR CAREER DISCUSSIONS, FIELD TRIPS TO CORPORATE PARTNERS, AND ASSERTIVENESS AND SELF-ESTEEM TRAINING.

The point is to make rural girls aware of how math and science are applied in everyday life and in various workplaces, to acquaint them with female role models in nontraditional careers, to show them the importance of continuing to take advanced math and science classes in high school, and to set up a support network among peers and professionals. The girls maintain an ongoing dialogue with each other, the project staff, and women in industry through a group e-mail that is distributed to all participants. The project hopes that as the girls become more confident about their math and science knowledge, while networking with successful professional women, they will lean increasingly toward pursuing careers nontraditional to women, such as physics, engineering, and computer science.

Designed collaboratively by faculty at Emporia State University and by representatives from private and public Kansas institutions to keep young women in the math and science pipeline, Master It provides *a framework for developing programs for rural girls that other universities or community organizations can use in rural settings, where corporate partners might not be nearby.*

CODES: M, H, PD	Emporia State University
Marvin Harrell (harrellm@emporia.edu), Elizabeth G. Yanik	
HRD99-08757 (one-year grant)	
Keywords: education program, hands-on, self-confidence, role models, career awareness, real-life applications, support system, field trips, industry partners, rural	

004
Tt
Training trainers in rural youth groups

TRAINING TRAINERS IN RURAL YOUTH GROUPS

GIRLS IN RURAL AREAS ARE AT A DISADVANTAGE IN ACQUIRING SCIENTIFIC LITERACY AND POSITIVE ATTITUDES TOWARD MATH AND SCIENCE; THEIR GEOGRAPHIC ISOLATION AND HARSH ECONOMIC REALITIES LIMIT THEIR EXPOSURE TO FEMALE ROLE MODELS IN STEM FIELDS AND TO THE KINDS OF HANDS-ON EXTRACURRICULAR SCIENCE ACTIVITIES THAT HELP YOUTHS BECOME COMFORTABLE WITH MATH AND SCIENCE. THIS “GET SET, GO!” PROJECT GAVE RURAL GIRLS IN IOWA GREATER EXPOSURE TO ROLE MODELS AND TO OUT-OF-SCHOOL LEARNING ACTIVITIES IN A COOPERATIVE, HANDS-ON FORMAT.

The project used a pass-through train-the-trainer model developed for Girl Scouts by the AAAS, adapting it to comply with national 4-H guidelines and incorporating a gender equity training component. The 4-H organization and program, one of the most gender-equitable delivery mechanisms for informal education, emphasizes experiential learning for rural youth aged 9 to 19. There are roughly 5.5 million 4-H members nationwide, 52 percent of whom are girls. By providing mixed-gender activities that expose both girls and boys to female role models in STEM, the project hoped to reduce STEM gender stereotypes.

The project trained trainers from adult youth group leaders and university students (all women), who in turn trained other volunteer Girl Scout and 4-H youth leaders: high school volunteers were trained to lead activities for (and train trainers from among) middle-school youth; and middle school girls were trained to lead hands-on sessions for groups of elementary school children.

CODE: I, PD, E, M, H, U	Iowa State University (ISU)
Krishna S. Athreya (ksathrey@iastate.edu), Mary A. Evans	HRD 94-53140 (three-year grant)
Partners: ISU Program for Women and Science and Engineering; Western Triad Science and Mathematics Alliance (WTSAMA); ISU Extension Science, Engineering, and Technology Youth Initiative; Moingona Girl Scout Council; Selzer-Boddy, Inc.; ISU Research Institute for Studies in Education (RISE)	
Keywords: demonstration, trainer training, gender equity awareness, resource center, parental involvement, support system, experiential learning, Girl Scouts, 4-H, rural, industry partners, community college, role models, hands-on, career awareness, cooperative learning	

004

Oh

Opening the horizon: science education in rural Ozarks middle schools

OPENING THE HORIZON: SCIENCE EDUCATION IN RURAL OZARKS MIDDLE SCHOOLS

SCIENCE IS NOT HIGHLY VALUED IN SOUTHWEST MISSOURI, WHERE EDUCATING WOMEN IN THE SCIENCES IS A LOW PRIORITY. AS A CULTURAL REGION, THE OZARKS TEND TO UNDERVALUE WOMEN'S CONTRIBUTION TO SOCIETY, AND THERE IS AN UNSPOKEN BUT OBVIOUS BIAS AGAINST WOMEN WORKING OUTSIDE THE HOME, ESPECIALLY IN WHAT ARE TYPICALLY PERCEIVED TO BE MALE OCCUPATIONS. *ENCOURAGING GIRLS IN THE OZARKS TO CONSIDER SCIENCE OR MATH AS CAREER OPTIONS CHALLENGES REGIONAL STEREOTYPES ABOUT WOMEN'S ROLE IN SOCIETY. THIS PROJECT AIMS TO INOCULATE MIDDLE SCHOOL GIRLS WITH THE SCIENCE BUG AND IMMUNIZE THEM AGAINST PEER PRESSURE THAT MIGHT DISSUADE THEM FROM PURSUING THEIR INTEREST IN SCIENCE. IT AIMS TO GIVE TEACHERS THE SUPPORT AND RESOURCES THEY NEED TO PRESENT SCIENCE AND MATH IN A WAY THAT WILL GET STUDENTS HOOKED FOR LIFE.*

Opening the Horizon (OTH) is a significant outreach effort to keep rural middle school girls in the region interested in math and science. *Combining hands-on science for students with distance learning and professional development for teachers*, this three-year project will engage up to 200 middle school girls and 30 science teachers from 26 Ozarks counties—as well as the girls' parents, school administrators, and local and regional communities—in an active, positive, and self-sustaining program to encourage scientific literacy, curiosity, and opportunity.

OTH was launched after an existing program, Expanding Your Horizons (EYH), had for six years successfully drawn 200 middle school students (mostly girls) from southwest Missouri to a one-day hands-on science experience. But whereas EYH targeted mainly girls from urban schools, OTH targets students in rural schools and their teachers, who may have neither the time nor the resources to teach science in such a way that students are likely to be drawn to careers in science.

Project components include kickoff and closing conferences each year at Southwest Missouri State University (SMSU) and Drury University (both in Springfield) for girls, their parents, and teachers; three Saturday workshops run simultaneously at five college sites closer to

the girls' homes; college student mentors for the girls; and distance learning course for middle school teachers. Women on the faculty at SMSU and Drury will run the program, with site directors at the other college sites.

Teachers will be recruited for a three-credit-hour graduate course (through SMSU, which will waive all tuition) on women in STEM. Among other things, they will work through exercises in the book *Women Life Scientists: Past, Present, and Future* (Matyas and Haley-Oliphant 1997) to see how female role models can be incorporated into classroom curricula. After researching women scientists, they will develop lessons for their classroom. Meeting at the site closest to them, they will take advantage of the distance education network already in place.

At a workshop featuring hands-on exhibits of curricular models and materials provided by about 25 vendors, teachers will have access to curricular materials, supplies, and equipment that many rural school districts cannot afford. They will be asked to inventory the basic science equipment and library resources in their schools, complete an equipment checklist, and indicate the equipment they need most urgently. In small groups they will discuss such topics as barriers for girls interested in science and how to tie workshop objectives to the Missouri state science standards. During the year they will remain in touch with other science teachers in the region and with faculty women in the sciences at participating colleges and universities.

Participating teachers will help recruit four students from sixth grade, two from seventh, and two from eighth. *Students who receive letters of acceptance will also get a bracelet of "UV beads," which appear white under indoor lighting but reflect visible colors under ultraviolet light. An activity sheet will suggest ways for them to experiment with the beads—for example, placing them under a piece of plastic wrap on which various types of sunscreen are smeared to test the sunscreen's effectiveness. This will give parents a chance to see the kinds of activities their daughters will experience in the OTH workshops—as well as science's relevance to their everyday life*.

Undergraduate math and science students will serve as facilitators for group activities and as mentors to a team of five to eight girls, maintaining close contact by phone and by e-mail throughout the year. The OTH experience will give student teachers and undergraduate education majors some student exposure to group facilitation of hands-on science activities.

The kickoff conference will provide a chance to get acquainted and a nurturing environment in which to experience the beauty, wonder, and excitement of science and math. Interdisciplinary hands-on activities at the conference and school-year workshops will emphasize the environment as a global system of interdependent parts. The subtheme the first year is pollution.

Students and teachers will work with thematic kits and other resources typically not funded in these rural areas and will engage in activities from the book *Whizbangers and Wonderments: Science Activities for Young People*. They will get basic instruction in report writing and in the use of computers and the library. During the school year, participants will keep in touch through distance learning workshops (for teachers), student–mentor e-mail, and postings on the project website.

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HRD 00-02129 (three-year grant)	
Partners: Drury University, College of the Ozarks, Crowder College, Southwest Baptist University, the West Plains and Mountain Grove campuses of SMSU, and Walnut Grove Junior/Senior High School (among others).	
Keywords: education program, rural, hands-on, distance learning, teacher training, conferences, workshops, mentoring, role models, parental involvement	

004

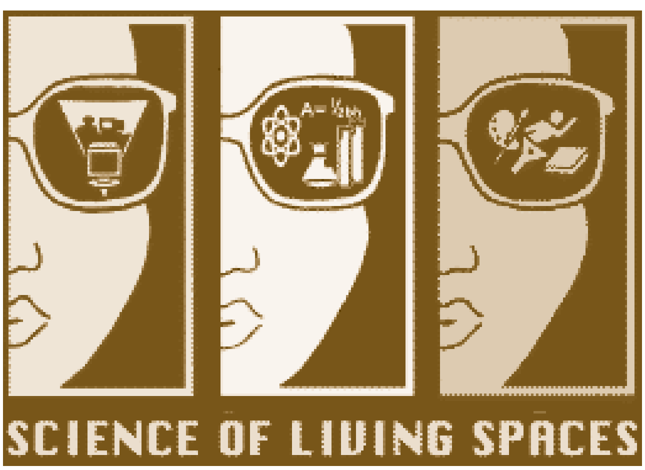
sls

The science of living spaces

THE SCIENCE OF LIVING SPACES

THE SCIENCE OF LIVING SPACES PROJECT GREW OUT OF CHRISTOPHER NEWPORT UNIVERSITY'S INTEREST IN BOTH K–12 SCIENCE EDUCATION AND WOMEN IN MATH AND SCIENCE. THE PROJECT'S CORE COMPONENT WAS AN INTENSIVE THREE-WEEK SUMMER SCIENCE CAMP IN WHICH 24 RURAL MIDDLE SCHOOL GIRLS, LIVING IN CNU'S DORM ROOMS DURING THE WEEK, WERE IMMERSED IN A TREMENDOUS VARIETY OF HANDS-ON SCIENCE AND MATH TOPICS. THERE WAS ALSO A YEAR-LONG FOLLOW-UP PROJECT, TEACHER INVOLVEMENT, UNDERGRADUATE MENTORS, AND TRAINING FOR ALL STAFF AND PARENTS INVOLVED WITH THE PROJECT.

The girls' days were packed with participatory sessions led by female scientists, including a veterinarian, a NASA chemist, two physicists from a Department of Energy accelerator research lab, and members of the Society of Women Engineers. For a session on greenhouse gases, for example, the girls measured methane and toured a greenhouse; for chemistry and food they created baking powder and ice cream; for dinosaurs and speed they measured leg length, stride length, and speed; for computers and ethics, they discussed medicine, privacy, artificial intelligence, and the future; for statistics and ethics, they learned about descriptive statistics and its misuses; for digital signals they learned about electronic circuits and logic testing.



In more intensive technology sessions, the girls made a working lamp, built a working Lego robot arm, and learned about the then-new World Wide Web. The summer schedule included science across the curriculum (in physical education, linguistics, and art), careers, ethics, and self-esteem building—and was rounded out with field trips to NASA Langley, CEBAF (now Jefferson Labs), the Virginia Living Museum (a plant and animal museum), Richmond Science and Math Center (role playing as scientists in a simulated control lab and as astronauts in simulated space), Busch Gardens (to examine the physics of amusement park rides), and Colonial Williamsburg (to examine women's early roles).

By all measures, the program succeeded: 94.5 percent of the parents reported greater awareness of the factors that influence their daughters' selection of careers in STEM, and 96 percent of the girls said they liked science more because of the project and were very to extremely interested in taking more science and math courses.

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www.pcs.cnu.edu/~lambert/SLS/sls.html	HRD 94-53678 (one-year grant)
Partners: School systems in Isle of Wight and Charles City counties, Virginia	
Publication: The Science of Living Spaces: Women in the Environment of the 21st Century, an evaluation and guide book (ERIC document ED417929).	
Keywords: demonstration, rural, living spaces, field trips, hands-on, problem-solving skills, teacher training, parental involvement, barriers, self-confidence, summer program	

004

Lab

Laboratory science camp for dissemination training

LABORATORY SCIENCE CAMP FOR DISSEMINATION TRAINING

FROM ITS BEGINNINGS A DECADE AGO AS A SIX-DAY SUMMER PROGRAM SERVING 60 ECONOMICALLY DISADVANTAGED GIRLS FROM RURAL MAINE, THE KIEVE SCIENCE CAMP FOR GIRLS HAS TRANSFORMED THE LIFELESS STUFF OF SCIENCE TEXTBOOKS INTO CHALLENGING ADVENTURE. THE PROGRAM HAS GROWN INTO A 10-WEEK SUMMER PROGRAM SERVING MORE THAN 250 GIRLS AND WOMEN A YEAR, FROM ALL OVER THE COUNTRY, IN BOTH THE RESIDENTIAL PROGRAM AND VARIOUS WILDERNESS SETTINGS.

When this information-dissemination project began, the camp provided fourth, fifth, and sixth grade girls from six resource-poor Maine communities with a residential experience in experiential science education and other activities requiring cooperation and risk taking. The camp hoped to have a ripple effect on science education in those six districts.

The camp's collaborative learning environment also provided professional development for teachers and a model for staff from other camps. By providing training, skills, materials, and professional development incentives, the science camp project also prepared parent–teacher "dissemination leadership teams" from rural Maine districts to be advocates and agents of change in local education—to help dispel the notion that science is a male pursuit.

In this project, 24 adults (parents, teachers, and leaders from other science camps) observed and participated in the camp and attended four seminars to prepare them to return to their communities as advocates for gender equity and experiential science education. *Observing underprivileged girls from upper elementary and middle school get a hands-on STEM experience in a supportive atmosphere—and engage in authentic relationships with adult role*

HANDS-ON, MINDS-ON CAMP ACTIVITIES

For many girls, the residential experience is a first time away from home—a challenge in itself—a chance to live, learn, and have fun with girls and women who are serious about science. At an age when peer pressure often deters girls from developing or acknowledging a serious interest in science, becoming part of such a community can be a turning point.

Camp activities emphasize group work, problem-solving, exploration, discovery, and healthy risk taking—in five core activities: the ropes course, engineering, rocketry, Lake Day, and the Otter Island adventure. For this project, pre- and post-assessments of relevant science concepts and skills measured what participants learned from the camp experience—and whether what they thought they could do was close to what they actually did. The results were generally very positive: The girls gained in skills, knowledge, and confidence.

In the *ropes course*, the girls learn that they can accomplish physical challenges that at first seemed beyond reach. *The ropes course becomes a metaphor for any learning that at first seems difficult, or even impossible. Girls and teachers learn that—given skills, techniques, tools, support, encouragement, time, and the chance to try, fail, and try again—they can succeed in the classroom, on the water, or crossing a high wire. They do more than they think they can do. They learn why goal setting is important, learn to cheer themselves on and to be good team members, and leave with higher aspirations*.

In *engineering*, the girls design and build a machine or a structure that incorporates motion using *gears*, a *pulley*, or a *belt drive*. They learn that there are no right answers, only good solutions. For girls and teachers who rarely use tools and materials to solve a problem, this is an entirely new kind of educational experience, but 98 percent of the girls learned to name and identify all three mechanical systems.

On *Lake Day*, girls and teachers learn about the water cycle process, why fresh water is limited, and how human actions affect the quantity and quality of the water in Damariscotta Lake. They learn how to identify a watershed area using a topographical map and explore the lake habitat, taking a hands-on approach to learn about the lake's plants and animals. Before the camp, few girls knew what a watershed was; after two weeks they could tell you.

In *rocketry*, girls and teachers who typically have little direct experience with physical science explore gravity, friction, and air pressure before building rockets. Their initial anxiety gives way to confidence in their ability to discover and understand—in this case, what forces allow flight to occur, how each part of a rocket is related to flight and aerodynamics, and what everyday items can serve as rocket components. They learned both the names of rocket parts and the principles underlying rocket flight.

Many of these girls had never been on a boat or a coastal island and had never hiked, carried equipment, or taken a detailed look at the world at their feet. On an overnight *camping trip,* 30 girls explored *the marine environment of Otter Island* and learned about how various types of marine organisms adapt to island life.

models who encouraged them to take risks and undertake challenges—was far more persuasive than reading about theories of change. Gender equity training has a greater impact on teachers and parents when course work is integrated with observations of equitable teaching and learning. Seeing a successful science camp in action is a pivotal experience for those trying to replicate the experience.

Actively involving parents and school board members in the dissemination of support for hands-on science and gender equity helped broaden support for science education locally and helped create a shared sense of vision and purpose. The science camp was to be a catalyst for reshaping the local school district's elementary science program. The connection forged between teachers and girls, the project hoped, would help keep the girls from losing the confidence they'd gained in camp. A mentoring project was developed to support camp alumnae as they moved to middle or high school, where social and peer values often inhibit their participation in math and science.

The camp activities are replicable. Engineering and rocket-building activities require only inexpensive, easily available materials. Many group-building and trust activities are not site-dependent and can easily be replicated elsewhere. Doctors, foresters, farmers, oceanographers, and midwives (to use examples from Kieve) can visit any camp or classroom, bringing along the tools of their trade and answering questions, just as they did at Kieve. Two new science camps for underprivileged Maine children—Tanglewood (4-H) and Camp Susan Curtis (community-based, tuition-free)—opened their doors modeled on Kieve. Twenty-five Maine women who work in science, math, or technology were trained and have mentored 50 camp alumnae. Other camps, many out of state, have shown an interest in a similar program.

CODES: E, I, PD	Kieve Affective Education
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www.kieve.org	HRD 94-50531 (one-year grant)
Products: Girls and Women Seizing Science Together: A Kieve Science Camp for Girls Training Manual and Guide, a 10-minute video.	
Keywords: dissemination, seminars, self-confidence, teacher training, parental involvement, underprivileged, rural, professional development, mentoring, summer camp, hands-on, role models	

004

rurW

Science for all: opening the door for rural women

SCIENCE FOR ALL: OPENING THE DOOR FOR RURAL WOMEN

MONTANA STATE UNIVERSITY (BOZEMAN) DEVELOPED THIS PROJECT TO INCREASE THE NUMBER OF RURAL AND NATIVE AMERICAN HIGH SCHOOL GIRLS WHO PURSUE OR BECOME MORE INVOLVED WITH SCIENCE OR ENGINEERING. THE PROJECT PROVIDED INTENSIVE EDUCATIONAL EXPERIENCES FOR TEACHERS AND FACULTY AND SUPPORTIVE ACTIVITIES FOR STUDENTS AT MSU AND IN BOZEMAN, ESPECIALLY AT RURAL AND RESERVATION MIDDLE AND HIGH SCHOOLS. TRAINING AND DEVELOPMENT OPPORTUNITIES INCLUDED A SUMMER SHORT COURSE, A FACULTY INSTITUTE, A FRESHMAN SEMINAR, SCHOLARSHIPS AND FELLOWSHIPS, MINI-GRANTS TO IMPLEMENT IDEAS GENERATED IN THE SHORT COURSE AND FACULTY INSTITUTE, AND ONLINE COUNSELING AND MENTORING FOR TEACHERS, COUNSELORS, AND TRIBAL FACULTY.

Summer short course. Each year the project staff presented a weeklong summer course on "female friendly" science teaching. From 1997 through 1999, 53 teachers, 31 counselors, and 17 administrators from reservations and other Montana rural schools studied why women are underrepresented in science and what they could do to help reverse that trend. They also interacted with national experts on science and gender issues and spent time learning about computers.

Faculty institute. In conjunction with the short course, 51 faculty members from MSU-Bozeman and 21 from three tribal colleges attended a three-day faculty institute on gender, science, and engineering. Several joint sessions allowed middle and high school teachers and counselors to interact with the college faculty. Moving the institute from MSU to one of the tribal colleges opened fresh dialogues between faculty at the MSU and tribal college campuses.

Follow-up surveys suggested that *participants in the short course and faculty institute changed their mentoring and teaching strategies, becoming more sensitive to strategies to help women and minorities succeed. Using female and minority role models was found to be especially effective, but participants were also receptive to changes in assessment, content, lab activities, approaches to problem solving, small group work, and other classroom discussions*.

Freshman seminar. *Two cross-disciplinary seminars on science, technology, and society for students entering MSU-Bozeman provided "survival training" for women and minorities going into the sciences, showed women's place in the science majors, and provided nonmajors with better tools for understanding science and engineering*. Aided by students awarded fellowships for their research assistance, a faculty team designed the seminar to show that science is interesting, socially valuable, relevant to women's lives, and an enterprise to which women and minorities can and do contribute.

Mini-grant program. Participants in the short course and faculty institute were awarded 48 mini-grants ($5,000) to develop, test, and implement activities to get more female participation in math and science in their departments or schools. Grants were awarded to support one or more of seven goals:

- To balance gender/cultural content in the curriculum
- To improve communication styles
- To promote collaborative learning styles
- To recognize the value of diversity for scientific progress and problem solving
- To present scientific instruction in a real-world context
- To assess student learning in a way that encompasses students' individual experience
- To provide support for girls, young women, and minority students in science, math, and engineering

Final reports on the mini-grants were full of success stories, and two of the projects had a noticeable impact on teaching strategies in science and engineering courses at MSU-Bozeman. First, physics faculty used external experts to assess gender equity in collaborative small-group learning activities in a large lecture class. *They found that the group's gender composition significantly affected women's, but not men's, participation. Women's participation was best in single-sex or gender-balanced groups*.

Second, a chemical engineering professor and an education professor investigated how new instructional methods affected an introductory chemical engineering course. Their finding that *changes in teaching strategies made the class a more positive experience for students, especially young women*, was shared with other engineering faculty. A mini-grant also helped create the first lab-based chemistry course at a tribal college.

Many of the mini-grant activities were designed to reach beyond the isolation of the rural and reservation classroom to the community, to research facilities, and to local women professionals. Such projects helped educate the community and get them involved in support for women's participation in STEM careers. For example, 600 trees were planted to help reestablish vegetation and reduce erosion in the Teton River watershed (with support for a follow-up count). Many projects resulted in more positive attitudes toward computers and computer research and more parents wanting their children to attend college.

Changes in teaching made MSU women studying science or engineering more confident and involved in their course work and more enthusiastic about pursuing STEM careers. Women involved as scholars, mentors, and fellows were particularly affected by the project. The availability of the mini-grants led to many activities outside the classroom in rural and reservation middle and high schools and had a direct impact on course content and teaching approaches. It is too soon to tell how big a difference the project will have in the long run on young women's expectations, their preparations for college-level science and engineering, and their retention rates once on campus.

MIDDLE SCHOOL GIRLS WIN AWARD, APPEAR ON 'OPRAH'

On February 11, 2002, a team of Native American middle school girls from the Crow Agency appeared on the Oprah Winfrey show. Concerned about the severe housing shortage on their reservation, Montana-Lucretia Birdinground, Kimberly Duputee, Omney Sees the Ground, Brenett Stewart, and their coach, science teacher Jack Joyce, had found a way to build low-cost houses out of straw and stucco concrete. They had tested the straw with thermometers, blowtorches, and hoses to determine its energy efficiency and its resistance to fire and water. For their efforts, they won the Bayer/NSF Award's Columbus Foundation Community Grant. With community volunteers, the team planned to build a straw-bale community center on the Crow Reservation.

The girls did their science project as part of their science class, but for two years they had been enthusiastic participants in the NSF mini-grant-funded science club for girls at Pretty Eagle School—a rural K–8 school with only 140 students, all of whom are bused to the school, some as far as 55 miles. The science club brought in monthly speakers (Native American and female role models), and the girls made two campus visits to MSU-Bozeman, four hours from their school, to observe labs and interact with women undergraduates and science and engineering faculty. At a club-hosted technology evening to which the girls could bring their mother, grandmother, or aunt, the women surfed the Web—the first time many of them had touched a computer.

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HRD 96-18855 (THREE-YEAR GRANT)	
PARTNERS: BLACKFEET COMMUNITY COLLEGE, DULL KNIFE MEMORIAL COLLEGE, LITTLE BIG HORN COLLEGE	
KEYWORDS: DEMONSTRATION, SUMMER PROGRAM, TEACHER TRAINING, GENDER EQUITY AWARENESS, ELECTRONIC MENTORING, SCHOLARSHIPS, RURAL, NATIVE AMERICAN, SELF-CONFIDENCE, FELLOWSHIPS, MENTORING, MINI-GRANTS, OPRAH WINFREY, INDUSTRY PARTNERS	

004
IE
Internet explorers

INTERNET EXPLORERS

DO YOU KNOW WHY THE *TITANIC* SUNK? IF YOU'RE NOT SURE, CHECK THE ANSWER ON ONE OF THE STUDENT-CREATED PAGES OF THE INTERNET EXPLORATIONS WEBSITE. UNDER THE INTERNET EXPLORERS PROJECT, HIGH SCHOOL GIRLS WHO HAD COMPLETED THEIR JUNIOR YEAR SPENT EIGHT SUMMER WEEKS ON THE IOWA STATE UNIVERSITY CAMPUS RESEARCHING PROGRAMMING METHODS AND DEVELOPING HANDS-ON MATH, SCIENCE, AND ENGINEERING ACTIVITIES FOR MIDDLE SCHOOL GIRLS. DIRECTED BY FIVE WOMEN IN GRADUATE SCHOOL, 20 HIGH SCHOOL GIRLS FROM RURAL AND MINORITY BACKGROUNDS COMPLETED A SOPHISTICATED COMPUTER PROJECT ADDRESSING THE NEED TO INTEREST RURAL GIRLS IN MATH AND SCIENCE BY ENGAGING THEM IN INFORMAL MATH AND SCIENCE ACTIVITIES IN A SELF-PACED, NONCOMPETITIVE ENVIRONMENT.

After grant funding ended, the program continued providing summer internships for high school seniors. Every summer, interns design web pages on dozens of science-related topics—from spiders and rainbows to tsunamis and jet engines—to interest girls of middle school age in science and engineering. Web pages of interest to students and teachers alike answer such questions as why things glow in the dark, what lupus is, how airplanes fly, how boats float, how a camera works, how plastics are made, what microwaves are, how caves form, how shampoo gets to the store, how eggs are formed, how we predict weather, how the dinosaurs died, and why the great ship *Titanic* went under. If there's not enough to keep you fascinated on this website, check out its links to other science websites.

CODE: H, M, I	IOWA STATE UNIVERSITY
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HRD 96-31837 (ONE-YEAR GRANT)	
www.eng.iastate.edu/explorer	
KEYWORDS: EDUCATION PROGRAM, WEBSITE, SUMMER PROGRAM, RESEARCH EXPERIENCE, HANDS-ON, RURAL, MINORITIES, INTERNSHIPS	

004
Jsun
Jump for the sun

JUMP FOR THE SUN

"A MAMA ALWAYS EXHORTS HER CHILDREN, AT EVERY OPPORTUNITY, TO JUMP FOR THE SUN.
THEY MAY NEVER REACH THE SUN, BUT AT LEAST THAT WAY THEY GET THEIR FEET OFF THE GROUND." — ZORA NEALE HURSTON

The comprehensive Jump for the Sun project was a collaboration between a university, a large public school district, and a museum in a heavily rural area that was suddenly becoming a major tourist attraction. *One part of the project changed the way Coastal Carolina University (CCU) taught science to early childhood and elementary education students—which is important because teachers' attitudes about math and science profoundly affect how they teach and whether their students become interested in math and science. Another part of the project, targeted at middle school girls and teachers, demonstrated that middle school girls engaged in inquiry-based science can get very excited about it*.

Changes for undergraduates. The project changed the way CCU teaches biology and physics survey courses to preservice teachers. Physics 102, for example, is an introductory physical science course required of all CCU elementary science majors. Traditionally taught in a standard lecture-laboratory format, this course romped quickly through the physical sciences (physics, chemistry, geology, and astronomy) to prepare students to teach these subjects in grade school. Most students came to the course fearful of physics and science in general and left knowing only a series of loosely connected facts, despite ample research documenting the inadequacy of such an approach for teacher training. New standards emphasize that students learn both content and process skills.

The project redesigned Physics 102 and Biology 211, introducing hands-on, inquiry-based teaching techniques—with minimal lecturing and maximum group work and small group discussions—so student teachers would be better prepared to teach to the new science standards and to improve student attitudes toward science. Separate lectures and laboratories were replaced by block scheduling, with the class meeting three times a week for two hours. During this two-hour block, students worked in groups on curricular materials (*Powerful Ideas in Physical Science* and *Physics by Inquiry*) designed by physics education researchers and adapted for use at CCU. These materials led students to explore concepts (through experimentation, theory building, analysis, and conclusion drawing) and to master process skills (such as graphing, math, and equation building), emphasizing the computer as a learning tool.

Meanwhile, the course instructor learned about using interactive techniques, establishing a learning community in the classroom, and acknowledging *women's ways of knowing: viewing the teacher as midwife rather than banker (drawing knowledge out rather than depositing it*).

Students' initially responded negatively, feeling there was too little lecture and review time and no feeling of closure on the subject; because the learning was self-directed, students weren't sure they were learning what they were supposed to learn. The second time the course was offered, *class goals were posted at the beginning of each session, students were asked to come to a consensus about their ideas before starting a unit, and, as a class, they later summarized their findings. Student attitudes toward the class improved dramatically*.

Education majors did just as well on the post-course content exam in biology as a control group of 111 students, which was encouraging since Bios 211 (the experimental course) covered less content because of the techniques used: active learning, inquiry, and discussion. Students said the biggest benefit of group work was that if someone didn't understand how the teacher explained a subject, someone in the group would be able to explain it—so they had a chance to teach one another. Group work allowed quiet students to participate and helped material "stick" better than it did with lectures—although it also allowed the group to get off-task.

The students—who were largely unaware of differences in male and female pay or biases in books, movies, and the classroom—were overwhelmingly positive about gender equity assignments such as analyzing a textbook, looking at toys geared to girls/boys, and observing other teachers in the classroom.

Changes at the middle school. Some of the CCU education majors observed Jump for the Sun at the local middle school, where a problem-solving approach to learning made girls more mature, confident, and positive about math and science. Field trips and hands-on experiences were integrated with the content, providing opportunities to talk not only about content but also about issues of everyday life. In a unit on pollution, for example, the girls interviewed the faculty to see who drove cars to school and who carpooled, with whom. They made pragmatic recommendations about who could carpool, recognizing that teachers who didn't have the same schedules couldn't carpool. In another lesson, a trip to the cemetery led them to discover that yellow fever had killed many children during a certain period in the 1800s, when even cemeteries in North Carolina were segregated by race. This led to a discussion about race as a social construct, not a scientific concept—all from visiting a cemetery and being touched by the babies buried there.

An inquiry-based life science room was built in the Children's Museum of South Carolina and outfitted with microscopes, posters, hands-on specimens, tables, and live creatures. NSF funds were used to train and pay 15 middle school children to work at the museum on Saturdays, helping younger children and parents fully use the resources and equipment. Grant funds were used to run a science club for the participants who worked at the museum, who learned about such things as hurricanes, volcanoes, and extracting DNA from an onion using everyday kitchen utensils. These middle school students learned about science and math, encountered female role models, and had opportunities to connect, build community, construct their own learning, and help protect the environment.

Parents attending special workshops on raising daughters read *Raising Daughters* by Jean and Don Illium and *The Heart of Parenting* by John Gottman and learned to become better listeners—less reactive and confrontational with their daughters, more understanding, and more likely to ask questions in ways that spark discussion instead of yes/no responses.

CODES: M, U, I, PD	Coastal Carolina University

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HRD 95-53411 (one-year grant), 96-19217 (three-year grant)

Partners: Children's Museum of South Carolina, Horry County Schools

Keywords: education program, museum, rural, hands-on, role models, inquiry-based, curriculum, collaborative learning, gender equity awareness, teacher training, self-confidence, parental involvement

004

Sum

Summer camp for rural high school girls

SUMMER CAMP FOR RURAL HIGH SCHOOL GIRLS

THE NORTHWEST CENTER FOR RESEARCH ON WOMEN (UNIVERSITY OF WASHINGTON) PUT TOGETHER THIS COMPREHENSIVE PROGRAM TO ENCOURAGE RURAL HIGH SCHOOL GIRLS' MATH AND SCIENCE ACHIEVEMENT. THE GIRLS ATTENDED A TWO-WEEK RESIDENTIAL SUMMER CAMP; THE TEACHERS, A ONE-WEEK SUMMER INSTITUTE; AND COUNSELORS AND PRINCIPALS, A THREE-DAY WORKSHOP FOR COUNSELORS. EACH SCHOOL-BASED GROUP PARTICIPATED IN ACTIVITIES DURING THE SCHOOL YEAR, INCLUDING A LONG-TERM RESEARCH PROJECT AND AN INTERNET SCIENCE CLUB. THE PROJECT SERVED 73 GIRLS FROM 16 RURAL WASHINGTON HIGH SCHOOLS, 35 HIGH SCHOOL MATH AND SCIENCE TEACHERS, AND 19 COUNSELORS AND PRINCIPALS.

Summer camp on ecosystems. At camp, the girls learned about aquatic (lake and river) and terrestrial (forest, wetland, and grassland) ecosystems and became more knowledgeable about their local watershed. They conducted hands-on experiments in science laboratories and in the field, led by female scientists, researchers, and high school teachers. They engaged in trust-building and challenge exercises, including a knot-tying activity to practice how to give and receive feedback within a mentoring relationship.

They were matched with graduate scientists in a field in which they showed interest and were in touch with their scientist mentors throughout the year, as they worked on long-term research projects with their school team. Their long-term research projects were on topics such as deer behavior, the health of lakes and rivers, rain, runoff, tree growth, and whaling rights. (Their research notes are posted on the project website.) Working on the project taught them about forming plans, doing fieldwork, and putting information together and presenting it to others. Students on the deer project, for example, took pictures, videotaped, and interviewed hunters, conservationists, and residents about deer behavior, gathering material for their presentations as they worked. A cyberspace science club ("Soaring") helped them develop communication and science research skills. They also got pre-college counseling and a workshop on writing résumés.

Summer institute for teachers. Teachers participated in a weeklong summer institute taught by university faculty in biology, chemistry, and physics. Master teachers designed model lessons that integrated physics, chemistry, and biology through the question "What is necessary for life?" The open-ended, experiential lessons emphasized the scientific process and modeled various methods of measuring and recording data. Teachers could take home write-ups of the lessons and had time to adapt a lesson or unit of their own. They also got six hours of Internet training, fall and spring follow-up meetings, and at least one site visit.

The workshop for counselors and principals gave participants a concrete, realistic framework for understanding how careers are chosen and how girls might be helped to succeed in STEM fields. Counselors learned about group process so they could facilitate a support group for girls in the project.

Two curricula are available from the program: an inquiry-based curriculum in aquatic and terrestrial ecosystems from the girls camp and a curriculum the university faculty created for the teachers, integrating chemistry, biology, and physics.

CODES: H, I, PD	The Northwest Center for Research on Women, University of Washington
Angela Ginorio (ginorio@u.washington.edu)	Project directors: Jane Bierman and Katie Frevert
http://depts.washington.edu/rural/RURAL or contact (nwcrow@u.washington.edu) or rural@u.washington.edu	HRD 94-50053 (three-year grant)
Partners: Zymogenetics, Norcliffe Foujndation, Haas Foundation. Science at home (activities involving photograms, natural fragrances) and Science in the lab (master teachers' lesson plans on radishes, temperature, and brine shrimp) are available online at http://depts.washington.edu/rural/RURAL/resources/resources.html	
Keywords: demonstration, rural, summer program, teacher training, hands-on, mentoring, role models, science club, career awareness, inquiry-based	

004

Pass

College studies for women on public assistance

COLLEGE STUDIES FOR WOMEN ON PUBLIC ASSISTANCE

“WOMEN'S VENTURES” HELPED WOMEN ON PUBLIC ASSISTANCE PURSUE CAREERS IN SCIENCE AND TECHNOLOGY. A COLLABORATION BETWEEN TWO- AND FOUR-YEAR COLLEGES AND UNIVERSITIES IN THE CINCINNATI AREA AND THE MAIN ORGANIZATIONS OFFERING WORKFORCE DEVELOPMENT PROGRAMS FOR WOMEN ON PUBLIC ASSISTANCE, *THIS DEMONSTRATION PROJECT SET OUT TO PROVE THAT THIS SEGMENT OF THE POPULATION—HISTORICALLY VIEWED AS UNABLE TO COMPETE IN MAINSTREAM SOCIETY—COULD COMPETE AND BE INTEGRATED INTO STEM CAREERS*. ITS GOAL WAS TO RECRUIT, PREPARE, AND ENROLL 50 MINORITY/LOW-INCOME WOMEN INTO A TWO- OR FOUR-YEAR COLLEGE PROGRAM.

To prepare the women for college, the program offered special classes to strengthen their math, science, and reading skills and to help them develop good study habits, time management skills, and personal support systems. (They especially wanted help with math.) Employers provided co-op work experiences and insights into the types of careers available to the women and the training necessary for them. Professional women provided mentoring on multicultural and gender issues. Case managers provided counseling, follow-up, and help with career plans, childcare, and support services. Participating schools provided on-campus contact people to help with admissions, registration, and class scheduling.

The project was 70 percent successful in meeting its objectives. Of the 50 women it recruited—80 percent black and 17 percent white—7 out of 10 were receiving some form of public assistance. Median income was $420 a month, often from Aid to Families with Dependent Children.

Of the 42 women who enrolled in a college program, 72 percent enrolled in science, 24 percent in engineering, and 2 percent in math. *At project evaluation, 48 percent of the participants had grade point averages between 2.5 and 3.5—and 31 of the 42 women who had enrolled were still in college. Financial concerns were the main reason for not completing course work*.

CODE: U	Cincinnati Institute for Career Alternatives
Betty J. Warren	
HRD 94-53725 (one-year grant)	
Partner: Consortium for Adult Education,	
Products: OMI College of Applied Science, University of Cincinnati College of Evening and Continuing Education, College of Mount St. Joseph, Cincinnati State Technical and Community College, Xavier University	
Keywords: demonstration, community college, recruitment, underprivileged, welfare, science skills, support system, work experience, career awareness	

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004

RE-e

Re-entering the workforce

RE-ENTERING THE WORKFORCE

LITTLE ATTENTION HAS BEEN PAID TO ENCOURAGING WOMEN WHO HAVE DROPPED OUT OF THE WORKFORCE—FOR CHILDCARE AND OTHER REASONS—TO RE-ENTER ALONG CAREER PATHS IN SCIENCE AND TECHNOLOGY. IN OCTOBER 1994 THE WOMEN IN SCIENCE SECTION OF THE NEW YORK ACADEMY OF SCIENCES HELD A ONE-DAY WORKSHOP ON THE SUBJECT. THE PARTICIPANTS DISCUSSED SURVIVAL TACTICS, TIME MANAGEMENT, TARGETING YOUR CAREER SEARCH, AND FINANCING COLLEGE EDUCATION, WITH MANY PERSONAL STORIES ABOUT “HOW I DID IT.”

Women who re-enter, retrain, and change fields several times during their career learn that re-entry is a process of self-development, self-growth, education, and re-education. It helps to see re-entry as a stepwise process, a series of tasks that can be managed, not a formidable group of problems. Cognitive psychologist and re-entry specialist Pamela E. Kramer advised participants that women *who feel traumatized by getting back into the classroom in science and technology need to factor into the equation what research tells us: Men tend to overestimate their abilities and women tend to underestimate theirs. Acting as self-confident as you would like to feel will stand you in good stead and most women will very shortly discover that they are academically stronger than many of the men in their classes. Know that women tend to be more easily discouraged by an average grade (a C, for example) than men are*, re-entering women were told. If you get a D on that first exam, don't quit—you may learn that a particular teacher gives an average grade of D on that first exam.

The women learned that if they had majored originally in history and now wanted to be electronic engineers, they might have to redo a good deal of their undergraduate degree, but for most fields it was unnecessary to redo a whole degree—and they should not do so if they didn't have to.

They were advised to go back to school as consumers, asking the schools what support systems they offered: Childcare? Special networking? Counseling? Job counseling and job placement? Peer support groups? It was particularly *critical to find a group to study with*, and not to sit struggling alone with calculus or differential equations on the kitchen table late at night. If a school didn't offer study or support groups, they should form their own. They should find a mentor, and find friends. They should not let what might seem a chilly classroom climate—especially for women and minority students, especially in engineering and the physical sciences—deter them. Dig deeper, use their social skills, and they *could* negotiate this environment. They should also consider attending institutions that offer work internships through cooperative education programs, so they could earn money and get job-related experiences while attending college.

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www.nyas.org	HRD 93-53679 (ONE-YEAR GRANT)
PARTNERS: AWIS, METROWOMEN CHEMISTS	
KEYWORDS: DISSEMINATION, WORKSHOP, CAREER AWARENESS, SELF-CONFIDENCE, RE-ENTRY, SUPPORT SYSTEM, PEER GROUPS, STUDY GROUPS, MENTORING, INTERNSHIPS	

004
gold
Project GOLD: girls with disabilities online

PROJECT GOLD: GIRLS WITH DISABILITIES ONLINE

GIRLS WITH DISABILITIES ENCOUNTER MORE NEGATIVE ATTITUDES FROM THEIR PEERS THAN DO BOYS WITH DISABILITIES AND TEND TO BE VICTIMIZED BY OVERT AND SUBTLE FORMS OF "EDUCATION TOWARD PASSIVITY." BARRIERS OF GENDER AND DISABILITY BLOCK THEM FROM PURSUING STUDY AND CAREERS IN STEM IF THEY ASSUME THEIR OWN PASSIVITY AND INCOMPETENCE AND POSTPONE IMPORTANT ACADEMIC DECISIONS. STUDENTS WITH DISABILITIES CAN PERFORM WELL IN A RIGOROUS SCIENCE CURRICULUM IF SIMPLE MODIFICATIONS ARE MADE AND IF THEY HAVE LEARNED TO BE AUTONOMOUS AND ADVOCATES FOR THEMSELVES.

The University of Minnesota General College, the Minnesota State Department of Education, the Minneapolis Public Schools, the St. Paul Public Schools, and the Parents Advocacy Coalition for Equal Rights collaborated on this experimental project to *identify key age-appropriate skills, processes, and activities through which to remove barriers to girls with disabilities (grades K–8) participating in STEM classes, activities, and careers*. Removing those barriers requires building their self-confidence, providing experiences to strengthen their understanding of concepts, and developing appropriate curriculum and individualized education plans.

The project targeted girls in elementary and junior high school, when girls must make so many decisions—including whether to take advanced math—that enable them (or not) to pursue rigorous secondary and postsecondary courses of study. It stressed computer-based technologies that support the development of self-determination (including assertiveness, creativity, self-advocacy, and the ability to make decisions), so that even severely disabled girls could undertake demanding courses of study leading to career options in STEM, making them more autonomous in their education, social lives, and decision-making.

The project emphasized

- Aggressive training in state-of-the-art and emerging adaptive computer technologies (15 student–adult pairs were helped to attend the annual Closing the Gap Conference)
- Peer training and interaction with mentors and role models
- Immersion in opportunities to interact through telecommunications with mentors, school personnel, and other girls with disabilities
- Training for school-based personnel to accommodate students with disabilities early on in STEM courses and co-curricular activities
- Aggressive dissemination of more positive images of the futures of girls with disabilities

Workshops helped build the 30 participants' self-confidence and improve their understanding of concepts. A component was added to encourage parents to help the girls become self-advocates. A two-day summer camp was added to allow the girls to spend a day at the Minnesota Zoo, speaking behind the scenes with women naturalists, including a physically disabled zoo intern. The second day, a geometry scavenger hunt doubled as a tour of the University of Minnesota campus, with the girls photographing art and architecture that used various forms of geometry.

The project was unable to overcome one important problem: Most of the girls did not own computers or adaptive equipment and had only limited access to such equipment in the schools. Without home computers they were often unable to communicate with the other girls or with mentors in the ways the project expected them to.

Project GOLD opened the girls' eyes to options they hadn't realized were available to them. One parent reported that her daughter, who had always expected to live with her parents for life, was now talking about living outside of home after high school. Teachers reported that *the project changed the transition from school to work for many girls, broadening the range of vocational opportunities they were considering. The adults and undergraduates who worked on the project spoke differently now—both about students and to students. They did not assume that a person is not disabled because there are no visible signs of disability*. They consider multiple approaches in their teaching. Most of the girls involved in the project had been told not to pursue math or science because of their disabilities, but the project found that *many of the girls, given appropriate accommodations and environment, could become competitive with students who did not share their disabilities*.

HOW CHALLENGED SCIENTISTS SUCCEED

In *The Challenged Scientists: Disabilities and the Triumph of Excellence* (1991), R.A. Weisgerber identified certain common patterns found in many children with disabilities who later become scientists. These children tend to have been

- Encouraged by a parent or teacher to pursue science, engineering, or mathematics
- Exposed to key mathematical and scientific ideas in an exciting hands-on context
- Mentored by a practitioner
- Helped by special programming (e.g., clubs or summer programs) that addressed their needs in a positive way; allowed to take risks in learning skills
- Knowledgeable about their real limits, without imagining barriers that didn't exist
- Around key adults who looked beyond stereotypes of passive incompetence
- Introduced to computers and given needed equipment
- Given support for persistence.

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http://cap.umn.edu	HRD 94-53092 (three-year grant)
Partners: The University of Minnesota General College, the Minnesota State Department of Education, the Minneapolis Public Schools, the St. Paul Public Schools, and the Parents Advocacy Coalition for Equal Rights. The University of Minnesota's Computer Accommodations Program, a partnership of Academic & Distributed Computing Services and Disability Services, helps university students, staff, and faculty with disabilities access computers and information by using adaptive technology.	
Keywords: demonstration, disabled, self-confidence, barriers, computer skills, mentoring, role models, staff training, peer groups, co-curricular, workshops, summer camp	

004

Mc

Math camp for deaf high school girls

MATH CAMP FOR DEAF HIGH SCHOOL GIRLS

GIRLS WHO ARE DEAF RARELY PURSUE CAREERS IN STEM BECAUSE THEY ARE NOT ENCOURAGED TO DO SO. TYPICALLY THEY ARE NOT EVEN ENCOURAGED TO TAKE MATH AND SCIENCE COURSES IN HIGH SCHOOL BUT ARE URGED TO TAKE VOCATIONAL EDUCATION INSTEAD. THIS PROJECT WILL FOR THE FIRST TIME INTEGRATE DEAF HIGH SCHOOL GIRLS INTO A SUCCESSFUL, WELL-ESTABLISHED SUMMER MATH PROGRAM AT A UNIVERSITY. SUMMER MATH PROGRAMS OFFERED TO HIGH SCHOOL GIRLS AT U.S. COLLEGES HAVE PREVIOUSLY BEEN CLOSED TO DEAF STUDENTS.

The National Technical Institute for the Deaf—a college of the Rochester Institute of Technology—will train Mt. Holyoke's faculty and staff in strategies for deaf education to, and will provide support services (including sign-language interpreters) for, the deaf students. In Mt. Holyoke's successful four-week Summermath program, students take three 90-minute classes a day in basic math and computer (SuperLogo) concepts and skills. They work in pairs and small groups, applying math concepts to practical problems. The teacher serves as facilitator and guide, rather than as lecturer and expert.

The project aims to improve the deaf students' confidence and problem-solving abilities and better prepare them for postsecondary programs in STEM. The eight initial students are expected to become role models for other deaf high school girls. The project should also change adult perspectives on career opportunities for young deaf women.

CODES: H, I, U	Rochester Institute of Technology (National Technical Institute for the Deaf)
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Partner: Mt. Holyoke College	Keywords: demonstration, hearing-impaired, deaf, summer program, self-confidence, problem-solving skills, role models

004

FOR

FORWARD
(and deaf access)

FORWARD (AND DEAF ACCESS)

ADVANCED DEGREES ARE OFTEN THE KEY TO PROFESSIONAL SUCCESS AND CAREER FLEXIBILITY, BUT FEW COLLEGE GRADUATES ARE AWARE OF THE DOORS SUCH DEGREES OPEN OR ARE PREPARED FOR THE CHALLENGES OF GRADUATE SCHOOL. *RELATIVELY FEW WOMEN—AND EVEN FEWER DEAF AND HARD-OF-HEARING WOMEN—GO ON TO GRADUATE SCHOOL IN STEM DISCIPLINES*. FOR STUDENTS FROM GALLAUDET UNIVERSITY (THE ONLY LIBERAL ARTS UNIVERSITY FOR DEAF AND HEARING-IMPAIRED STUDENTS) AND THE NATIONAL INSTITUTE FOR THE DEAF, THE CHALLENGES OF GOING ON TO GRADUATE SCHOOL ARE CONSIDERABLE.

To begin with, *for someone whose primary language is signing, the Graduate Record Exam is a test written in a non-native language*. Asked why they were not applying for graduate school, Gallaudet students expressed three main concerns: finding a graduate school with a sizeable community of deaf students (so they wouldn't be socially isolated), fear of being rejected by the graduate school, and fear of not being good (or prepared) enough for research and work in a hearing environment, especially when there is little access to sign-language interpreters to help with day-to-day lab routines. The rapid development of computer and communication technologies could enable more equitable access to STEM fields, but these technologies are not yet fully integrated with modes of communications currently used by students with hearing problems.

A collaboration between several institutions, FORWARD aimed to improve instruction, increase enrollments, promote teamwork through computer networks, and bridge the gap between undergraduate and advanced degrees in STEM fields. *It was targeted especially to deaf and hard-of-hearing women (and their teachers and counselors), women at women's colleges or traditionally black universities, and nontraditional students (those returning to school after several years). The various components could be viewed as steps leading to a STEM career*.

FORWARD graduate-planning workshop. Targeted to male and female juniors and seniors considering graduate school, this spring workshop drew 32 students the second year, more than double the attendance the first year. Half the students learned about it through e-mail. The simple, intense 24-hour training helped students re-evaluate their personal and career objectives. Highlight of the Friday evening program was a presentation on learning styles. Participants were given a workshop binder containing information they don't normally have as undergraduates, on choosing and applying to a graduate program, getting financial support, gaining workplace and research experience, writing résumés and proposals, and mentoring, plus URLs of useful websites and material about deaf role models and women in STEM fields. The workshop made the daunting task of applying for graduate school seem more approachable, unveiling the mysteries of the process and helping them see their options. It helped to hear about people's personal experiences in grad school.

Forward research competition. This summer research opportunity challenged nine first-year woman graduate students early in their graduate career with developing, implementing, and documenting a research activity. It was easier to attract industrial support if they called the research internships "apprenticeships," which industry felt more comfortable with.

Forward seminar. This yearlong, project-centered, multi-institutional, interdisciplinary science and engineering seminar ("A Walk on the Moon") gave participants direct experience solving interdisciplinary problems, collaborating electronically in workgroups, implementing and evaluating strategies in the research environment, and building confidence in their ability to manage a successful career in STEM. Electronic networks linked students, faculty, and mentors on issue-focused collaborative projects. Research methods were blended with technical project activities so students could experience doing STEM as it is actually practiced, actively conferring with distant team members. Participants were engaged in reporting on both broad and narrow issues, both professional and personal concerns, and both technical and human details of implementation.

Planning for the seminar took place at the Oshkosh Curriculum Institute. *One of the best project outcomes was the collaboration and network developed among the principal investigators at various institutions. Mirroring today's multidisciplinary, team-centered workplace, the seminar used open-ended case studies to engage student teams in seeing new solutions and applying technical knowledge to create new products—in emulating the work needed for preproduct development*. The textbooks used were *Consider a Spherical Cow* by John Harte and *Environmental Problem Solving* by Isobel Heathcote. The case-study-leading-to-a-proposal format led students through the steps needed for creating technical proposals, a key ingredient in technical communication and professional development. Students were to analyze the case study, determine the problem in need of a solution, evaluate the community response, write a proposal, determine the proposal's technical viability, model, determine the human resources needed, develop teamwork strategies, conduct an assessment, and write a report.

DEAF ACCESS

Several initiatives were developed to provide support services for interpreters and deaf students and to make STEM activities more accessible to deaf students. Every five years Gallaudet Research Institute surveys institutions of higher learning to evaluate how accessible they are to deaf students and students with other disabilities. Steps were taken to simplify access to information about STEM academic departments, financial aid services, and offices and programs for students with disabilities. The project also developed brochures highlighting the personal, academic, and professional stories of deaf people successful in various STEM fields.

Technical interpreting. Access to classroom instruction most often happens through a sign-language interpreter, and STEM classes are challenging for even the best-trained interpreters. They are exhausting for the student trying to follow both what the teacher is demonstrating and what the interpreter is trying to sign. Inadequate interpreting services in advanced STEM classrooms severely limit deaf students' access to advanced learning. To disseminate a common sign language vocabulary between interpreter and deaf students, the idea was to develop Web pages summarizing strategies for technical interpreting, providing an overview of engineering specialties, explaining important vocabulary, and providing short videos with signs for common advanced technical terms. Technical interpreting workshops would help interpreters improve their technical signing skills and techniques.

Videoconferencing relay service. With relay services for personal videoconferencing, sign-language interpreters could be available anywhere. This part of the project was to use videoconferencing stations to facilitate interactions between researchers and deaf students. Readily available low-cost systems such as CU-SeeMe could be used to convey technical advice or to conduct job interviews with foreign applicants. It is important to develop more "deaf friendly" software tools for collaboration—more visual software, with more signing content—and to investigate ways to capture faster/real-time signing speeds with video.

FORWARD mentoring network. Considerable time was spent developing a network of scientists and alumni with disabilities to mentor participating students, and mentoring was one aspect of the project the students appreciated most. The workshop helped them evaluate who their current mentors are (they learned they should already have about 15 mentors), explore what areas of support were lacking in their lives, and understand how to interact with a mentor. By highlighting the importance of interactive video teleconferencing, videos, and online communications generally, the project opened up new possibilities for linking professors, students, and mentors across time and space.

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HRD 97-14729 (THREE-YEAR GRANT)

PARTNERS: GALLAUDET UNIVERSITY (H. DAVID SNYDER, CHARLENE SORENSEN, DEPARTMENT OF CHEMISTRY AND PHYSICS), SMITH UNIVERSITY (ILEANA STREINU, COMPUTER SCIENCE), NATIONAL TECHNICAL INSTITUTE FOR THE DEAF (HARRY LANG), HOOD COLLEGE (ELIZABETH CHANG, MATHEMATICS), HAMPTON UNIVERSITY (JALE AKYURTLU, CHEMICAL ENGINEERING), MENTORNET (CAROL B. MULLER), DUKE UNIVERSITY (MARTHA ABSHER), AND TUSKORARA INTERMEDIATE UNIT (CAROL O'CONNER)

USEFUL LINKS: www.student.seas.gwu.edu/~forward
www.agnesscott.edu/lriddle/women/alpha.htm

KEYWORDS: EDUCATION PROGRAM, TEACHER TRAINING, MENTORING, RESEARCH EXPERIENCE, DEAF, HEARING-IMPAIRED, AFRICAN-AMERICAN, SCHOLARSHIPS, WORKSHOP, INDUSTRY PARTNERS, INTERNSHIPS, APPRENTICESHIPS, SEMINARS, COLLABORATIVE NETWORK, VIDEOCONFERENCE, BROCHURES, ROLE MODELS, SELF-CONFIDENCE

005

Ch

Changing the Learning Environment

CHAPTER FIVE · CHANGING THE LEARNING ENVIRONMENT

"THE WORLD CANNOT AFFORD THE LOSS OF THE TALENTS OF HALF ITS PEOPLE IF WE ARE TO SOLVE THE MANY PROBLEMS WHICH BESET US." —ROSALYN YALOW, NOBEL LAUREATE 1977

TO ACHIEVE LASTING CHANGE, A LIMITED PROJECT MUST REACH ALL "PARTS OF THE SYSTEM"—THE PEOPLE (STUDENTS, TEACHERS, PARENTS, COUNSELORS, ADMINISTRATORS, FACULTY, MENTORS AND INDUSTRY ROLE MODELS), THE PEDAGOGY (HOW MATERIAL IS TAUGHT), THE COURSE CONTENT (WHAT IS TAUGHT, WHEN), AND ORGANIZED SOCIAL SUPPORT NETWORKS. MANY PROJECTS REACHED FOR THIS IMPACT WITHIN THREE YEARS AT THE MAXIMUM AWARD LEVEL ($900,000).

ALSO INCLUDED HERE ARE WORKSHOPS OR CONFERENCES LOOKING AT SYSTEMIC AND SOCIETAL ISSUES, OR CONDUCTING STUDIES ACROSS INSTITUTIONS, OR INITIATING A PROGRAM ACROSS INSTITUTIONS IN ORDER TO EXAMINE ITS IMPACT WITHIN VARIED ENVIRONMENTS. SOME EFFORTS SOUGHT TO AFFECT POPULATIONS WITHIN A STATE (FOR EXAMPLE, PRE-SERVICE TEACHERS IN SCHOOLS OF EDUCATION), OR TEACHERS FROM MANY STATES WHO SPECIALIZE IN ONE DISCIPLINE (FOR EXAMPLE, TEACHERS OF COMPUTER SCIENCE IN HIGH SCHOOL), OR A COMMON GRADE LEVEL (FOR EXAMPLE, AN ONLINE COURSE FOR MIDDLE SCHOOL TEACHERS). NSF ALSO FUNDED STUDENT SUPPORT SYSTEMS THAT TRANSCEND ONE SETTING AND ONE GEOGRAPHIC LOCATION—FOR EXAMPLE, MENTORING PROGRAMS USING THE INTERNET.

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005
wrks
What works in programs for girls

005
c+c
Connections: curriculum, career, and personal development

WHAT WORKS IN PROGRAMS FOR GIRLS

PARTICIPANTS AT A TWO-DAY WORKSHOP AT SANTA CLARA UNIVERSITY SHARED WHAT THEY'D LEARNED ABOUT WHAT WORKS—OR DOESN'T—IN PROGRAMS TO MOTIVATE HIGH SCHOOL GIRLS TO PERSIST IN SCIENCE, MATH, AND TECHNOLOGY. WORKSHOPS LIKE THIS HELP EDUCATORS REALIZE THEY ARE NOT ALONE AND GIVE THEM A CHANCE TO SHARE EXPERIENCES, PROJECT IDEAS, AND ADVICE ABOUT SETTING UP APPROPRIATE LEARNING ENVIRONMENTS.

Best practices for such programs, the participants found, include

- *Setting up a safe, comfortable, yet challenging environment for problem solving*
- *Including a project with tangible results that the girls can take away with them (something physical, like a bridge, or virtual, like a website they can connect to from home to show parents and friends their accomplishments)*
- *Finding ways to bolster girls' self-efficacy, a key to persistence in STEM*
- *Helping girls envision technologically related careers as part of their "possible selves"*

To address the difficult problem of assessing programs, participants developed draft assessment tools aimed at tracking girls' participation in STEM and began work on assessing self-efficacy. Any program to encourage girls' persistence can use the project's online survey capabilities. Local programs register through the website and are issued a program ID and password that participants in the program can use to complete the online surveys. The project hopes to follow up with each participant for several years, tracking their persistence in STEM and providing data on the nationwide impact of such programs. The project website also provides useful links to STEM programs for girls.

CODES: H, PD	SANTA CLARA UNIVERSITY
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http://www.scu.edu/SCU/Projects/NSFWorkshop99/	
HRD 98-77037 (ONE-YEAR GRANT)	
KEYWORDS: DISSEMINATION, RESEARCH STUDY, PROFESSIONAL DEVELOPMENT, WORKSHOPS, BEST PRACTICES, ONLINE SURVEY, WEBSITE	

CONNECTIONS: CURRICULUM, CAREER, AND PERSONAL DEVELOPMENT

A PARTNERSHIP BETWEEN NORTHEASTERN UNIVERSITY (NEU) AND THE BOSTON-AREA PATRIOTS' TRAIL GIRL SCOUT COUNCIL, CONNECTIONS ENCOURAGES YOUNG WOMEN FROM MIDDLE SCHOOL THROUGH COLLEGE TO PURSUE TECHNICAL MAJORS AND CAREERS. THE SCOUTS BRING TO THE PROJECT THEIR EXPERTISE IN ALL-GIRL PROGRAMS AND GENDER SENSITIVITY. NEU, WITH ITS SIGNATURE COOPERATIVE EDUCATION PROGRAM, BRINGS EXPERTISE IN CAREER TRAINING AND STEM EDUCATION. THE PROJECT WILL REACH OUT TO IMMIGRANTS AND OTHER GIRLS WHO HAVE NOT PARTICIPATED IN SCOUTING OR BENEFITED FROM ALL-GIRL PROGRAMS.

Connections come through contact with one or more mentors, use of a structured e-mail communication and support network, and participation in regularly scheduled after-school and summer activities that connect curriculum, career, and personal goals. Middle school girls learn how important what they are learning is for high school; high school girls learn what STEM careers involve through their interactions with college women, faculty, and professionals in the field; and college women become career-ready and have a clearer understanding of their professional opportunities.

NUE faculty, staff, and students team with girls in Boston Girl Scout troops, their troop leaders, and their teachers in after-school activities and summer day camp programs at Computer Clubhouses at NEU and at the Patriots' Trail Scout site.

College participants are housed together on one floor of a residential hall, surrounded by peers with similar interests, and benefit from study groups and priority access to the Connections computer lab. *They can also participate in Math Excel, a program for NEU freshmen with demonstrated math ability. Twice weekly for a quarter, Math Excel students work in groups on challenging math problems related to their calculus course—a process that more closely resembles how most scientists and engineers work than the classroom usually does. This is a substantial time commitment but most students find the intense group work productive and enjoyable, and the challenge helps them do better in all their courses.* Participants can also find work as a computer lab assistant or work weekly with middle and high school students. And Connections provides workshops on such issues as career and time management, interviewing, and negotiation.

E-mentoring allows women of high school age and older to be in touch by e-mail with one or more professional mentors (whom they can question about careers). Undergraduates also share their knowledge of college life and majors in STEM with Boston-area high school girls. Everyone is welcome at Connection social activities, which give participants a chance to meet face to face, but registering with Connections is required to participate in e-mentoring.

Activities for senior Scouts (grades 9–12) emphasize after-school troop activities, summer camp at NEU, mentoring, and summer co-op work. High school participants can participate in an e-mentor group, have access to a computer lab with state-of-the-art computer software, and visit NEU for Connections-sponsored events.

Activities for middle school Scouts (grades 5–8) emphasize after-school troop activities, summer camp, and Connections tutoring and mentoring. Girls in this age group play with cool computer software and engineering toys at the Connections computer clubhouse; learn how to program a robot using Lego's Mindstorms software; explore bugs, plants, and the like with a microscope that shows the objects on a computer screen; can learn hands-on about engineering and science in the Connections Build It! series; and can attend special events at NEU.

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www.mcs.csuhayward.edu/~mega/mc2001/mc2001.html	HRD 98-13896 (one-year grant)
Partners: Patriots Trail Girl Scout Council, Girl Scouts of the USA, Boston computer Museum, NEU's Colleges of Engineering and Arts and Sciences, Department of Cooperative Education, and Office of Residence Life.	
Keywords: education program, Girl Scouts, career awareness, cooperative learning, mentoring, support system, problem-solving skills, electronic mentoring, summer camp, after-school, hands-on	

005

A

The Athena project

THE ATHENA PROJECT

THIS COLLABORATION—WOMEN HELPING WOMEN AT DIFFERENT STAGES OF THEIR EDUCATIONAL AND PROFESSIONAL DEVELOPMENT—HELPED MORE THAN 100 GIRLS FROM FIVE MIDDLE SCHOOLS IN CALIFORNIA'S RIVERSIDE AND SAN BERNARDINO COUNTIES. THE ATHENA PROJECT PROVIDED AN EDUCATIONAL SUPPORT STRUCTURE FOR GIRLS IN MIDDLE AND HIGH SCHOOL, PROFESSIONAL DEVELOPMENT FOR MATH AND SCIENCE MAJORS AT THE UNIVERSITY OF CALIFORNIA AT RIVERSIDE (UCR), AND MENTORSHIP AND OUTREACH PROGRAMS. AS PART OF WOMEN-TO-WOMEN COUNSELING, COLLEGE UNDERGRADUATES MENTORED MIDDLE SCHOOL GIRLS, WHILE STAFF TEACHERS AND UNIVERSITY FACULTY MENTORED THE UNDERGRADUATES.

The project provided financial, academic, and mentoring support for math and science majors considering a teaching career. Data on factors that turn girls away from math and science were collected on both participants and members of a control group. University student affairs officers and department chairs in math, chemistry, physics, and biology helped recruit undergraduate women who might pursue careers in teaching, aiming to help them earn a California teaching credential or an advanced degree in STEM fields. These "Athena leaders" were advised to take certain math and science education courses and were steered into campus math and science clubs.

The Inland Area Math and Science Projects—to which roughly 3500 math and science teachers belong—hosted a four-week summer institute that brought together Athena leaders, professors, public school teachers, and county educators, strengthening participants' teaching skills and mastery of content (in the context of equity, diversity, and content standards). *As a result of the project, UCR added two classes to its undergraduate curriculum: mathematics education and liberal studies mathematics*.

Teamed with project teacher–mentors from the school sites to which they were assigned, the Athena leaders were paid a stipend for participating. They were also given eight college credits, professional books and videos, access to UCR's professional math and science resource center, an e-mail account, videos, and several professional books:

- *Biographies of Women Mathematicians and Related Activities* by Teri Perl. 1978.
- *By Nature's Design* by Diane Ackerman, Neill Williams, and Path Murphy. 1993.
- *Classifying Fingerprints: Real World Mathematics Through Science* by Nancy Cook. 1995.
- *Complete Origami* by Eric Kenneway. 1987.
- *Get It Together: Math Problems for Groups Grades 4–12* by Tim Erickson. 1989.
- *Great Ideas I Stole from Other People* by Pam Clute. 1997.
- *The History of the Cross in Religious and Political Symbolism* by Lynda J. Gettig. 1989.
- *Measuring Earthquakes* by Nancy Cook. 1995.
- *Multiculturalism in Mathematics, Science, and Technology: Readings and Activities* by Claudette Bradley and Julia Hernandez. 1993.
- *Plotting Pictures: Coordinate Graphing and Number Skills* by Paula Rozell. 1995.
- *She Does Math: Real Life Problems from Women on the Job* by Marla Parker. 1995.

After the summer institute, the Athena leaders practiced their newly acquired ideas and skills teaching, tutoring (there was more demand than the project could satisfy), and mentoring seventh and eighth grade girls at nine sites through Expanding Horizons, a U.C. extension program. They helped the girls improve their computer skills, arranged field trips to places like the Jet Propulsion Laboratory and the Los Angeles Museum of Technology (partly to see female role models on the job), talked with parents, and generally took charge of presenting math and science positively to the middle school girls. Influenced by the enthusiasm of Athena participants, the entire class at one school set a goal of trying to qualify for NASA's summer space camp in Alabama. Several career awareness activities were provided for the middle school girls and their parents, including math and science parent nights (attended by more than 2,000) and occasional radio programs.

This ambitious project encountered scheduling conflicts on overlapping summer projects and a delay in second-year implementation because of a state mandate requiring anyone having contact with students to pass a Justice Department background check and a TB test (with unclear instructions about who was to receive the information). The project also learned that it takes substantial effort to develop true collaboration between institutions, with the school districts playing an active collaborative role.

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HRD 96-19060 (three-year grant)	
Keywords: education program, professional development, mentoring, role models, teacher training, career awareness, support system	

005

after

What works in after-school science

WHAT WORKS IN AFTER-SCHOOL SCIENCE

AFTER-SCHOOL LEARNING—AS OPPOSED TO CHILD-MINDING OR PURE RECREATION—IS A NEW AND GROWING EDUCATIONAL FIELD. AFTER-SCHOOL EDUCATION CAN PROMOTE POSITIVE BEHAVIORS THAT FACILITATE ACADEMIC, VOCATIONAL, AND SOCIAL SUCCESS, AND INCREASING NUMBERS OF INFORMAL, OUT-OF-SCHOOL PROGRAMS TRY TO ENGAGE AND SUSTAIN GIRLS' INTEREST IN STEM. AFTER-SCHOOL EDUCATION IS THE SUBJECT OF MUCH CURRENT RESEARCH BUT NONE OF IT HAS PROBED THE SPECIFIC NEEDS OF GIRLS, ESPECIALLY NOT IN TERMS OF ENGAGING AND SUPPORTING THEIR INTEREST IN STEM. WE DO NOT KNOW WHICH PROGRAMS SUCCEED IN DOING SO AND WHICH DO NOT.

We are moving toward a technology-based economy in which women are an increasing part of the workforce. In this project, three national nonprofit organizations experienced in bias-free after-school programs are organizing a working conference to create a research/action agenda to inform the development of STEM programs free of biases (against gender, race, ethnicity, and disability) that have contributed to educational inequality. Roughly 40 researchers, practitioners, and policymakers were to attend a multidisciplinary conference to be held at AAAS headquarters in Washington, D.C., on September 23–24, 2002. Results will be disseminated through journals and other publications, websites, listservs, and conferences of professional associations.

CODE: I, E, M, PD	Educational Equity concepts, Inc.
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HRD 01-14741 (one-year grant)	
Partners: American Association for the Advancement of Science, Academy for Educational Development	
Keywords: dissemination, after-school, informal education, engagement, best practices, conference, action plan, policy, resource center	

005
Bug
BUGS: outdoor learning labs

BUGS: OUTDOOR LEARNING LABS

BUGS (BRINGING UP GIRLS IN SCIENCE) HOPES TO ENGAGE FOURTH AND FIFTH GRADE GIRLS IN DENTON, TEX., IN SCIENCE THROUGH A HIGH-INTEREST CURRICULUM OF ENVIRONMENTAL SCIENCES STUDIED IN AN OUTDOOR LEARNING LAB. WITH SUPPORT FROM PARENTS AND MENTORS, 30 GIRLS ARE PARTICIPATING IN A YEARLONG AFTER-SCHOOL SCIENCE LAB AT SAM HOUSTON ELEMENTARY SCHOOL.

This University of North Texas (UNT), project is using Passow and Frasier's culturally fair matrix to identify gifted students among Denton's culturally diverse and often economically disadvantaged population. (Busing was one of the first problems the project had to address.) It has identified both participants and a contrast group for purposes of evaluation and has planned a series of educationally sound field trips to encourage the contrast group's participation.

The program will use six units (animal studies, land and water, microworlds, ecosystems, experiments with plants, and floating and sinking) from the Science, Technology, and Children curriculum. The STC curriculum is designed to make science relevant, interesting, and challenging and to foster the development of scientific reasoning and scientific attitudes such as curiosity, flexibility, respect for evidence, and sensitivity to living things.

Each learning/mentoring/support team will include a fourth or fifth grader, a female high school student from the Texas Academy of Mathematics and Science (who will be paid a stipend), and a woman from the University of North Texas faculty. Parents can participate in workshops about educational and career opportunities.

Participants in the BUGS after-school program will later attend a two-week summer program at the Elm Fork Environmental Education Center (the public education branch of UNT's environmental programs), where they will explore water in its journey from a waterfall through a river to a pond; native plants and animals in their natural habitat, a wetland; and the stories contained in rocks, minerals, and soils. Elm Fork will develop environmental science learning kits for the project, with technological assistance from the Texas Center for Educational Technology, for eventual dissemination nationwide in English and Spanish.

The girls will team with a computer pen pal at a distant site, to work together on science experiments using two-way audiovisual desktop conferencing tools, electronic chat rooms, and a project website. This will allow students with special needs at distant sites to be mentored and to participate in the outdoor lab by way of a virtual field trip. These distant students—students with emotional and behavioral problems from a school in Wichita Falls, Tex.; students from a school district in Bernalillo, N.M., that serves many Hispanic and Native American students; and students from a rural school district in Decatur, Tex.—will be able to take electronic "field trips" developed from activities videotaped during the first year of the BUGS project.

CODES: E, I, U	University of North Texas
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HRD 01-14917 (three-year grant)	
Partners: Sam Houston Elementary (Denton Independent School District), Texas Academy of Mathematics and Science, American Association of University Women, Elm Fork Enviornmental Educational Center, and Texas Center for Educational Technology.	
Keywords: demonstration, outdoors, mentoring, distance learning, parental involvement, achievement, after-school, environmental science, underprivileged, workshops, career awareness, summer program, videoconference, website, field trips	

005
eq
Gender equity training in teacher education

GENDER EQUITY TRAINING IN TEACHER EDUCATION

THIS THREE-YEAR PROJECT MADE TEACHER EDUCATORS AND TEACHER EDUCATION INSTITUTIONS NATIONWIDE MORE ATTENTIVE TO GENDER EQUITY ISSUES IN PRESERVICE (STUDENT) TEACHER EDUCATION. AT A FIVE-DAY SEMINAR, EIGHT NATIONALLY RECOGNIZED INSTRUCTORS OFFERED SESSIONS ON VARIOUS ASPECTS OF GENDER EQUITY IN STEM COURSES, PROVIDING PARTICIPANTS WITH MATERIALS, RESOURCES, AND TEACHING ACTIVITIES. THE 61 PARTICIPATING TEACHER EDUCATORS COULD NOW INCORPORATE GENDER EQUITY INTO THE MATH, SCIENCE, AND TECHNOLOGY METHODS COURSES THEY TAUGHT AT 40 COLLEGES AND UNIVERSITIES IN 28 STATES.

Teacher educators learned, for example, that *at the elementary level, where many teachers are not comfortable with math and science, it is important to help teachers understand their dislike of math and science so they don't transfer it to the girls in their classes. At the secondary level, where teachers like a subject and want to teach it, it is harder to get them to consider gender. It helps to convey that a "math and science for all" mentality—cultivating students instead of weeding them out—and instructional strategies that emphasize cooperation and integration over competition, help all children, not just girls and minorities*.

All participants received a grant of $750 for a gender equity project. Whether they worked on their action research projects alone or in small teams seemed to make no difference in the results. Participants posted their activities weekly on an active listserv and shared with their peers what they had learned and achieved, in bimonthly newsletters, frequent personal communications, and a three-day follow-up meeting.

Evaluation showed that *85 percent of the educators became more equitable in their teaching behavior (men changing more than women). The percentage of course syllabi containing gender equity nearly tripled*. The group collectively taught gender equity to about 5,000 preservice teachers and 5,000 others during the project period (1993–96), wrote about 40 publications on gender equity, and made about 250 presentations.

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HRD 92-53182 (three-year grant)	
Partner: The Center for Advanced Study in Education (CUNY)	
Publication: *Gender Equity Right from the Start* by Jo Sanders, Janice Koch, and Josephine Urso (Lawrence Erlbaum Associates, 1997). Easy-to-use teaching activities and many suggestions for research projects.	
Keywords: teacher training, gender equity awareness, seminar, research project, evaluation, resource guide	

005
WS
Washington State gender equity project

WASHINGTON STATE GENDER EQUITY PROJECT

AFTER DECADES OF WORK IN GENDER EQUITY, WE KNOW WHAT CAUSES THE GENDER GAP IN STEM EDUCATION, AND WE KNOW STRATEGIES TO CLOSE IT. BUT EDUCATORS ARE NOT SUFFICIENTLY AWARE OF THE NEED FOR ACTION OR KNOWLEDGEABLE ENOUGH ABOUT STRATEGIES THAT WORK. THE WASHINGTON STATE GENDER EQUITY PROJECT WAS UNDERTAKEN TO HELP TEACHER EDUCATORS AND OTHERS ACHIEVE SUSTAINED STATEWIDE CHANGE IN GENDER EQUITY EDUCATION FOR PRESERVICE (STUDENT) TEACHERS.

The project goal was to transform the state's teacher education establishment—colleges and universities that certify new teachers, the state education agency, and state professional associations in math, science, and teacher education—by incorporating gender equity into existing instruction, policy, and procedures.

A collaboration among 11 organizations (including seven colleges and universities that collectively certify nearly 80 percent of the state's new teachers), the project is run by a steering committee that meets twice a year in person and twice by videoconference. A team formed at each organization to undertake a gender equity needs assessment.

A five-day seminar taught by national leaders was held in Port Ludlow in July 2000, with expenses paid for three members from each team. Participants valued networking, discussions, and interactive sessions, finding the material on networking, women's ways of knowing, and relevant gender issues most helpful. They viewed time and overloaded work schedules as the biggest obstacle to quickly implementing gender equity strategies. A second workshop was held at Central Washington University in 2001.

The project expects to reach nearly 6,000 student teachers—two thirds of those in the state. The test will be whether significant statewide increases in the number of girls taking regular and advanced electives in math, science, and technology are noticeable within five to ten years.

CODE: U, PD	Washington Research Institution
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http://www.wri-edu.org/equity/wash	HRD 98-14070 (three-year grant)
Partners: State Board of Education, Office of the Superintendent of Public Instruction, Washington Education Association, Washington Association of Colleges for Teacher Education, Washington Science Teachers Association, and Washington State Council of Mathematics [(agencies and associations)]. Central Washington University, Eastern Washington University, Heritage College, St. Martin's College, Seattle Pacific University, Seattle University, University of Puget Sound, University of Washington, Washington State University, and Western Washington University.	
Keywords: education program, teacher training, gender equity awareness, seminar, policy, best practices, workshops	

005

Hou

Equity initiatives in Houston

EQUITY INITIATIVES IN HOUSTON

WITH TEACHERS' NEEDS AND GENDER EQUITY IN MIND, THIS COLLABORATIVE DEMONSTRATION PROJECT SET THREE MAJOR GOALS: IMPROVING THE CLASSROOM CLIMATE FOR GRADES K–12 SO GIRLS HAVE THE SAME OPPORTUNITIES TO SUCCEED IN MATH AND SCIENCE AS BOYS; CHANGING AND IMPROVING THE QUALITY OF INSTRUCTION IN ELEMENTARY MATH AND SCIENCE CLASSES TO SUSTAIN GIRLS' INTEREST; AND PROVIDING MIDDLE AND HIGH SCHOOL GIRLS WITH MEANINGFUL MENTORING RELATIONSHIPS AND ACADEMIC AND CAREER INFORMATION. TO CREATE A MORE POSITIVE SCHOOL ENVIRONMENT, THE PROJECT TRIED TO STRENGTHEN TEACHERS' KNOWLEDGE OF STEM SUBJECTS, PROMOTE EQUITABLE CLASSROOM PRACTICES, AND GIVE GIRLS ACCESS TO ROLE MODELS WITH WHOM THEY COULD READILY IDENTIFY.

Equitable classroom practices institute for K–12 teachers and administrators. *Although K–12 teachers were responsive to this institute, the project learned that teachers were more receptive to institutes that emphasize a particular content area into which are incorporated topics such as equitable classroom practices, classroom management, and curriculum modifications for diverse learners. Participants were more confident about their ability to effect change in their own classrooms*—by paying attention to seating arrangements and the gender composition of work groups, for example, by emphasizing cooperative learning and small group activities, and by incorporating material about women and minorities in science—*than in their ability to reach their colleagues*. It was important to give them a safe environment in which to discuss what can be controversial issues.

Science and math institute for elementary school teachers. Teachers showed significant gains in math knowledge both years the science and math training for elementary school teachers was offered, and the institute produced several leaders from among the participants. *One key to the institute's success was the emphasis on integrating math with science and children's literature (to teach measurement, estimation, and judging whether something is reasonable)*. This approach sat well with participants, who were typically K–5 teachers who have to teach multiple subjects, so that *integrating math and science content was a palatable approach to teaching subjects they often don't feel comfortable teaching*. (The first day of the institute some participants were clearly upset about taking a math test, while others had no problem with it. One participant said that the institute was fun, except for the tests, but *even the tests reminded them how much children internalize grades and use them to judge their own worth.)*

Curriculum specialists responsible for K–12 math and science explained that *district elementary students had the skills to perform rote measurement routines, but not the conceptual framework needed to succeed at estimating and judging the reasonableness of answers based on measurements*. The topic of measurement is often taught as paper-and-pencil exercises, which do not give a student the manipulative experiences and analytical challenges needed to perform at higher cognitive levels. The staff decided to direct teacher development activities at improving the math and teaching skills needed to teach measurement and estimation to elementary students. Student-centered inquiries (for example, using manipulatives) were modeled throughout the institute. The teachers were treated as a community of learners responsible for their own learning, with a wealth of experience to contribute. Participants in one institute had more difficulty adapting activities for lower or higher grade levels, so the institute brought K–5 teachers from the year before to answer questions, share classroom management strategies, and explain how they had created and adapted activities in their classrooms.

In 2000 the project began emphasizing the use of new technologies to support instruction and, because some participants were unsure even how to use a computer mouse, offered both high-tech and low-tech presentations to minimize intimidation. Participants helped take the material into new areas.

Mentoring for girls in secondary schools. Teachers sponsored girls' science clubs at secondary schools. More than 700 girls participated over three years—double what the project expected. Club sponsors were given a handbook suggesting how to work with professional mentors and suggesting appropriate resources and activities for club meetings that mentors did not attend. Club sponsors earned a stipend and field trips were subsidized.

The sponsors engaged club members in mentoring relationships with women in professional STEM fields. Finding and recruiting adult mentors from academia and local industry was time-consuming, but once they were found, they usually agreed readily to participate—partly because their commitment was limited to meeting with girls six times a year. Most participants said the best thing about the science clubs was meeting with the mentors. The mentors were surprised at how responsive the girls were.

Reassessing district needs. *As an outgrowth of collaboration on this project, representatives from eight colleges and universities in the Houston area worked together with project staff for four months assessing critical district needs in Houston's middle school science and math education. In 1998–99, the new Texas Essential Knowledge and Skills (TEKS) became the mandated formula for K–12 instruction in Texas's public schools. Previously, science was taught "pancake style," layering ninth grade physical science on top of eighth grade earth science on top of seventh grade life science. Under the new guidelines, concepts from life, earth, and physical science were to be integrated at all levels under more unifying themes, such as "systems" and "patterns of change." Novice and veteran alike were being asked to integrate concepts and subject matter that many teachers were not prepared to teach or even interested in teaching*.

District middle school teachers needed help figuring out how to provide inclusive, effective instruction that met the diverse needs of English-as-a-second-language students and academically gifted students and how to include special education students in a science lesson. The teachers wanted to know more about project-based learning and how to design projects that meet the TEKS standards, encourage higher-level thinking, integrate technology, and use alternative methods of assessment.

CODES: E, M, H, U, PD	William Marsh Rice University
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www.bioc.rice.edu/precollege	HRD 96-19163 (three-year grant)
Partners: Houston Independent School District, Texas Higher Education Coordinating Board, Howard Hughes Medical Institute, and many Houston area employers who granted release time for mentors to work with students.	
Products: Handbook for Mentors, Handbook for Club Sponsors.	
Keywords: education program, teacher training, gender equity awareness, role models, mentoring, support system, project-based, career awareness, cooperative learning, professional development, curriculum, science clubs, field trips	

005

Sb

WISE women at Stony Brook

WISE WOMEN AT STONY BROOK

THE INTELLECTUAL AND SOCIAL CLIMATE IN WHICH GIRLS AND WOMEN WORK HAS A STRONG INFLUENCE ON THEIR EDUCATIONAL AND CAREER DECISIONS. ESTABLISHED IN 1993 WITH NSF SUPPORT, WISE (WOMEN IN SCIENCE AND ENGINEERING) IS A COMPREHENSIVE PROGRAM TO ENCOURAGE WOMEN WITH A TALENT FOR, OR INTEREST IN, MATH, SCIENCE, OR ENGINEERING.

Faculty women from many disciplines have initiated several projects under the WISE umbrella. *Instead of dwelling on what is wrong with girls who do not pursue math and science, the WISE projects have encouraged systemic change—to make what educators teach more interesting and equitable*. The WISE projects have strengthened the pipeline of women going into STEM studies and careers by holding their interest through the crucial junior high to early college years and beyond. Most WISE projects at the State University of New York at Stony Brook *emphasize small-group activities and a team approach to research because women tend to learn and perform better where there is frequent interaction and socialization and often avoid careers in math and science because they view them as solitary*.

Pre-college projects. The first WISE Stony Brook projects focused on the transition from middle school and high school to the first year of college, reaching out to challenge girls who showed academic promise or interest in math or science, to support them in a positive women-to-women climate, and to sustain their interest, curiosity, and achievement in STEM studies.

Edith Steinfeld's model project targeted *middle school girls* in three Suffolk County school districts. It provided campus-based, community-based, and school-based activities year round for 100 girls a year, as well as teacher training for 16 advisers at eight middle schools. Parents were fully involved in program design and activities.

Girls participated in weekly or biweekly after-school science clubs at their local schools and science and career fairs and special summer programs at the university. The sixth and seventh graders also participated in a tenth grade symposium, so they could hear about the older students' research. School-year activities took them to Stony Brook's Marine Sciences Research Center, its Center for High Pressure Research, and Brookhaven National Laboratory.

In Wendy Katkin's project, each year 90 *high school students* and 18 teachers were bused to Stony Brook, the Brookhaven National Laboratory, or the Cold Spring Harbor Laboratory, where they met women working in various scientific fields. After participating in various hands-on activities, they were gradually engaged in research on topics ranging from recombinant DNA, material science, and superconductivity to radiation health and physics. *Students learned what science is by working in labs with scientists and with equipment they would normally not have had access to*.

The tenth graders learned how to use the Internet and to make scientific presentations. Eleventh graders worked on semester-long activities. Seniors had the option of doing lab research under a scientist's supervision, taking an introductory math or science course at the university, or participating in a study of gender issues in science. The summer between their sophomore and junior years, the students lived on campus two weeks, doing more fieldwork and visiting the New York Botanical Gardens, the Museum of Natural History, and Stony Brook's marine sciences research vessel. Their social time together helped them become a cohesive group.

Graduates of the WISE high school program have gone on to prestigious colleges and universities, often earning scholarships and entrance into special programs based on their achievements in the WISE program. Almost 40 percent of WISE graduates are studying the physical sciences, engineering, computer science, or math in college. Another 40 percent are studying the biological sciences, intending to do scientific research and go on to professional or graduate school.

WISE college projects. The WISE college program started as a mentoring program, each year pairing senior college students with 15 (later 35) freshmen women talented in math and science, chosen at random from entering students who scored 600 or better on their math SATs. The belief was that with older students as mentors and role models, younger students would be less likely to drop out of a field or switch to other majors because of rigorous programs or the pressure of surviving in a male-dominated field. The project hoped to engage undergraduate women in the excitement and challenge of math, physics, or engineering before they made decisions that would shape their subsequent educational and professional careers.

To supplement the students' regular academic program, the project began (with NSF funding) to offer participants *small study groups, close academic advising by faculty, a strong mentoring system, social support among WISE participants, an orientation to the university's science research milieu, and scholarships for their first year at Stony Brook. It created courses to teach them critical skills and expose them to a range of scientific disciplines. It offered them individual and group research opportunities. By supporting young female students and making them "feel more like a person than like a number," the program hoped to help students who chose science or engineering to stay the course—not to fall through the cracks, as female math and science students in large colleges so often do.*

The young women took coed classes, and the program reviewed their academic records and tried to place them at the right level in their courses. Girls routinely underestimate their ability in such subjects as math and physics, subjects traditionally viewed as men's turf. Every single one of the first 15 women in the program placed herself in math classes one or two levels lower than she could handle, despite having had four years of high school math and science and a 90+ GPA. The 13 students who were persuaded to take higher level math courses earned A's and B's. The two who decided to stay two levels behind made a C and a D—probably more out of boredom and laziness than for lack of ability. "Women sell themselves short," says principal investigator Wendy Katkin. "The program recognizes their potential and tries to develop it."

The program continued when the grant ended. Only 50 students a year are accepted, so WISE gives students all the benefits of both a small community and a major university. Participants are part of a diverse, close-knit community, mingling with women from many different cultures. Most WISE women dorm together in Whitman College Residence Hall (where WISE students have priority), making study sessions and hanging out together that much easier. WISE's smallness makes connections easier.

WISE women do research earlier, get better grades, and earn more academic honors than other undergraduates. Networking within WISE has led many of our students to summer internships, scholarships, and employment. The point of entry into research is often a summer internship at Brookhaven National Laboratory.

THE FOUR-YEAR WISE WOMEN PROGRAM

The first WISE college program attended to first-year students. The next emphasized helping participants in years two through four further develop their quantitative and leadership skills and develop a sense of identity as members of a college of women scientists. Overall, the WISE student is expected to take the following courses:

Year one. Fall and spring semesters of freshman year, WISE students are grouped together in classes emphasizing research opportunities on campus and introducing students to research in different scientific fields:

- *Becoming a Scientist*, an introduction to Stony Brook with a special WISE section emphasizing research and other opportunities in STEM.
- *Introduction to Research*, in which students do hands-on research in a physical, social, and life science and in engineering, working in small groups with other WISE women—on projects ranging from "Long Island Vowels" (linguistics) to "Let's Make Diamonds" (geology, high-pressure research). *Experiencing this highly rated course causes one in seven women to change her intended major after discovering an interest in a subject or methodology*.
- *Two semesters of math and two semesters of science*.

Years two to four. After freshman year WISE undergraduates take the following courses:

- *The Social Dimensions of Science*, a course (developed with NSF support) that examines how social, cultural, political, and economic factors such as gender shape the way science is carried out. Students develop case studies, working with women researchers from Brookhaven National Laboratory
- Either *Mathematics Problems and Games* or *Connections in Science*, which emphasizes physics' importance to all the sciences.
- *Professional Development Seminar*, a course designed to bridge the gap between college and beyond, to explore the range of options in a field and how best to present oneself, in person and on paper, to graduate programs, fellowship committees, and prospective employers. Guest experts discuss résumé preparation, interviewing skills, business etiquette, and salary negotiation.
- *An advanced math or computer science course*, because women in science tend to meet only the minimum math and computer science requirements.
- *Senior honors thesis/design project*, satisfied through successful completion of a yearlong independent research project culminating in a substantial research paper or project design.

Students are also expected to attend three or more monthly evening programs a year and to play an increasing role in planning sessions and leading discussion groups.

CODES: M, H, U, PD | State University of New York, Stony Brook

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www.wise.sunysb.edu | HRD 94-50018, HRD 98-10258 (one-year grants); HRD 94-50023 (three-year grant)

Partners: SUNY's WISE program, Marine Sciences Research Center, and Center for High Pressure Research (Department of Earth and Space Science); Brookhaven National Laboratory (a DOE facility); Cold Spring Harbor Laboratory; Brentwood, Longwood, Three Village, and Riverhead school districts; the Board of Cooperative Educational Services (BOCES); the New York Hall of Science.

Keywords: education program, teamwork approach, after-school, science clubs, research experience, hands-on, field trips, mentoring, role models, study groups, internships, scholarships, career awareness

005

Get!

Get set, go!

GET SET, GO!

WORKING WITH TEACHERS, PARENTS, AND COMMUNITY SCIENCE MUSEUMS AND CENTERS, GET SET, GO! ENCOURAGED MIDDLE SCHOOL GIRLS' ACTIVE PARTICIPATION IN SCIENCE. THE WESTERN TRIAD SCIENCE AND MATHEMATICS ALLIANCE (WTSAMA) AT WAKE FOREST UNIVERSITY COLLABORATED ON THIS PROJECT WITH OTHER ORGANIZATIONS, INCLUDING 12 NORTH CAROLINA MIDDLE SCHOOLS.

Summer teachers institute. Forty-two experienced teachers committed themselves to activities designed to change awareness, expectations, and everyday practice among teachers, parents, and school administrators: gender equity training (GESA and Equals), EDC's "Equitable School Walk" and other awareness-raising activities, hands-on activities, and a mock Parent Night. They saw, and were given lab time to test and develop, family math and science activities. They shared strategies for recruiting and involving students in after-school science clubs. Veterans of earlier institutes returned to share their experiences—and to remain engaged.

Support personnel—including media center specialists—were encouraged to attend part of the institute, because of their instrumental role in *developing unbiased school resources*. Teachers and media specialists were encouraged to work together to evaluate science texts and other library resources for gender bias and stereotyping.

Teachers provided *feedback about the training as "a plus and a wish"—balancing praise with criticism*. A video gave them a clearer idea of what gender bias looks like, and time in the library gave them a rare, welcome opportunity to learn about hands-on activities. They wished for less initial paperwork, a copy of everyone's activities, and more time in the library.

Saturday science symposia. Students learned about academic opportunities at monthly Saturday symposia held at various colleges and universities. Women who apply science in their everyday work, often in untraditional occupations, sent the message to students that science is for everyone and can be found everywhere. After a presentation, participants broke into "role alike" breakout groups for students, parents, and teachers. Topics ranged from meteorology to forensic science, with special sessions on the science of Christmas trees; the physiology and nutritional needs of horses, sheep, skunks, and opossums; and how to grow and water gardens in a space station.

Undergraduate and graduate students facilitated hands-on activities for students. Parents learned about gender equity and inquiry-based science, enjoyed hands-on activities (sometimes from *WonderScience*), and took some activities home to do with their children. Teachers acquired activities, strategies, and tools to use in their science classes.

LESSONS LEARNED

Provide time for teachers to research resources. Teachers need experience with, information about, and materials for hands-on activities and typically have little time to search for them. It is important to designate time during an institute for teachers to research curricula and hands-on activities for their classrooms. It's worthwhile having project staff do the legwork of finding resources that teachers at the institute can review and order.

Explicitly communicate underlying principles and strategies, as those participating may not easily make connections. It is important in a hands-on session to make one or two key scientific concepts or processes explicit enough for deep understanding and not just do activities for activities' sake. Whether practicing strategies to accommodate diverse learning styles, modeling a parent night program, or conducting a hands-on activity, three steps will make principles more accessible to teachers: (1) *Do the activity*, (2) *tell teachers what you did* (this step is often skipped) and (3) *have them reflect on how they can apply that in their own classes or schools*. Similarly, on parent nights: (1) Do the activity, (2) explain to parents what concept or skill is being developed, and (3) explain why that is important for the education of their children (especially girls).

Coach role models. Scientists unaccustomed to speaking to middle school students must be told in advance that the science content is less important than how a scientist's experiences prepared her for her career in science. In connection with guest lectures, explicitly discuss gender equity issues, what courses students should take (starting in middle school), how girls can pursue viable careers in science, and how math and science are important to informed citizens.

Anticipate transportation problems. Attendance was lower when students and teachers left at noon and teachers remained for afternoon sessions. When teachers were adjourned at noon along with parents and students, attendance improved. *Teachers were the driving force in getting students to and from events*.

Give both teachers and students incentives to participate in Saturday activities.

Encourage sustainable use of dissemination funds. One way to get community support for science clubs is to have Parent–Teachers Associations give a "science shower," encouraging parents and others in the community to provide as science gifts items on the science teachers' list of needed equipment and supplies.

Incorporate an explicit and continuing emphasis on gender equity. Information and research about gender equity issues should be systematically disseminated to participating schools. Teachers could meet for a swap-and-share session at the end of each academic year to share what classroom practices work.

Improve science displays. Classroom science displays seldom represent people, much less a diversity of people, and schools rarely have science displays in the hallways.

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HRD 94-53136 (three-year grant)	
Partner: North Carolina State Department of Public Instruction Products: Resource bibliography and A to Z lists for parents nights and after-school clubs.	
Keywords: demonstration, teacher training, gender equity awareness, hands-on, parental involvement, after-school, science clubs, engagement, Saturday symposias, inquiry-based, role models, conference, SMART	

Fall teachers' conference. Most of the 123 teachers who attended this conference were still active at the end of the school year. It succeeded partly because *it was planned by teachers for teachers, who valued the ideas generated and shared, the free handouts and door prizes they could use in their classes (not novelty materials that don't fit in the curriculum), and the new contacts and resources. The conference strengthened their knowledge of content and helped them devise activities to make science less intimidating for girls—with the unexpected consequence of making the teachers feel more professional*.

Parent nights. Parent nights worked best when held in conjunction with other parent events, such as PTA/PTO meetings and holiday concerts and festivals.

Women's studies in after-school science clubs. One school kicked off its after-school club by having girls examine gender bias in their textbooks, using a checklist provided at the institute. Many teachers used Operation SMART program strategies and activities learned at the institute. The clubs that succeeded covered a wide range of topics and provided a variety of activities, including field trips and workplace visits. Women scientists (recruited by a women scientists advisory team) were partnered with each school, and teachers were encouraged to regularly involve various scientists with their after-school group.

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tri

Triad Alliance science clubs

TRIAD ALLIANCE SCIENCE CLUBS

A SAN FRANCISCO PROJECT BROUGHT MIDDLE SCHOOL GIRLS, TEACHERS, AND SCIENTISTS (HENCE TRIAD ALLIANCE) TOGETHER IN A NETWORK OF SCHOOL-BASED GIRLS' SCIENCE CLUBS. THE AIM OF THE TRIAD PROGRAM WAS TO INTEGRATE PROFESSIONAL DEVELOPMENT AND ACADEMIC ENRICHMENT THROUGH THE LENS OF GENDER EQUITY.

The project built on a process of science education reform initiated at the University of California at San Francisco in 1987 by Bruce Alberts, a professor of biochemistry and biophysics and president of the National Academy of Sciences. The mission at the core of the volunteer program was to improve science instruction for all students in San Francisco's K–12 public schools. Most programs involve an integrated community of scientists and educators. A districtwide partnership (between UCSF and the San Francisco Unified School District) produced both the Triad project and City Science, another NSF-supported effort at systemic change in teaching.

Triad developed and sustained science clubs in four middle schools the first year, eight the next, and twelve the third and fourth years. Overall, 32 teachers and 49 scientists conducted enrichment activities with more than a thousand girls, with 12 to 45 girls (30 average) attending each club meeting. Indeed, more schools, girls, teachers, and scientists wanted to participate than the program could support.

To increase girls' self-confidence, assertiveness, and commitment to science, *the project aimed to strengthen girls' skills in specific areas: persistence through frustration, resilience in the face of failure, familiarity with tools, the confidence to explore, and the ability to defend their position with evidence*. Activity-based science clubs were held twice a month at sponsoring teachers' schools for one academic year, co-sponsored by two scientists and one or two science teachers. Guided by the adults, at these meetings girls explored natural phenomena, asked questions, used tools, and conducted scientific investigations.

For the first three years, all participants in the Triad science clubs were girls. In 1997–98, three schools piloted mixed-gender clubs with both male and female sponsors. With the support of parents and the principal, at one school a Triad teacher and a humanities teacher placed about 60 students in single-sex science/math and language arts/social studies courses. *In the single-sex groups it appears that students are more willing to talk with teachers about sexual harassment and other sensitive issues, boys are more on task, and girls participate more*.

The program was well received at schools with many at-risk students, including one school with many low-income Asian newcomers and another with many low-income African American and Hispanic students. At one school 90 girls showed up for the first meeting. When NSF funding ended, adult participants accepted a two-thirds reduction in stipend, the program and training were streamlined, and with support from the school system the clubs kept going in several schools.

The Triad project required a substantial time commitment and had the most clearly integrated goals for students, teachers, and scientists. Through an equitable framework for science teaching, the project set these *goals for teachers: to learn to encourage all student voices, to maintain high expectations, to delegate responsibility, and to be explicit about equity*. Teachers and scientists were selected through a competitive application process, received a stipend for sponsoring a club, and had a budget for supplies. Scientists attended a scientist orientation series. Teachers and scientists attended fall and spring retreats and five two-hour after-school professional development seminars.

Everybody benefited. Parents were happy about the Triad project, which improved public relations for both schools and science departments. Triad funds made it possible for science departments to buy up-to-date materials, which encouraged teachers to do more hands-on science activities. In the all-girls environment, girls became more confident and developed stronger leadership and more interest in science. Girls and scientists developed a strong rapport, and the girls became more skilled in setting up and doing experiments. Preliminary evidence suggests that their attitudinal changes persisted in mixed-gender settings.

Women teachers became better at communicating, mentoring, and problem-solving and came to understand more deeply the nature of science and scientific research and how science research contributes to society. Teachers uncredentialed in science experienced an even more pronounced gain in skills and teaching methods. With the luxury of access to scientific expertise and input from three competent adults in preparing club lessons, teachers could adapt hands-on lessons for their regular classrooms. *Working with female scientists demystified the scientific world for teachers, allowing teachers to imagine themselves as scientists, which motivated them to encourage more girls to become scientists*.

Participation in Triad revitalized teachers' work, making them more aware of new ways of teaching science. They began making more consistent use of gender-equity techniques already familiar to them and also learned new strategies—such as *grouping students by gender, allowing wait time with a slow responder before asking someone else to answer a question, alternating calling on girls and boys, and asking girls more open-ended, higher-order questions*. They wanted to develop tools to analyze their own teaching practices and to evaluate how those practices affected girls' achievements in science. To move student thinking from questions about the mechanics of physical activities to the underlying concepts, for example, they had to develop questioning skills or rethink the structure of the activity.

Women scientists came into the program to mentor girls and to gain teaching experience, which required developing new skills and problem-solving strategies. Classroom management was a challenge for them, both frustrating and rewarding. More than half said Triad made them more confident and better prepared to handle group situations and more than three quarters returned for multiple years. Many reported that the training Triad had provided was highly regarded by new employers and was instrumental in landing them academic positions in universities. They felt Triad had improved their teaching skills, confidence, teamwork, and comfort with leadership.

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HRD 93-55871 and HRD 98-13926 (three-year grants)	
Partner: San Francisco Unified School District	
Product: Textbook for a methods course on equitable science teaching	
Keywords: education program, teacher training, gender equity awareness, self-confidence, professional development, science clubs, mixed-gender, hands-on, problem-solving skills, school-based, activity-based, parental involvement	

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Ct

An education coalition in Connecticut

AN EDUCATION COALITION IN CONNECTICUT

UNITED CONNECTICUT FOR WOMEN IN SCIENCE, MATHEMATICS, AND ENGINEERING WAS A COALITION TO UNITE CONNECTICUT'S EDUCATION PROGRAMS (K–16), COMMUNITY GROUPS, AND BUSINESSES IN WORKING TOWARD ATTRACTING AND KEEPING GIRLS AND WOMEN IN STEM STUDIES AND CAREERS.

The project established a clearinghouse of information on Connecticut's gender equity programs, increased public awareness of gender equity issues, informed some of Connecticut's urban middle school girls about STEM careers, and increased their confidence about pursuing them. Professional women networked in a newly created chapter of Association for Women in Science. The project also provided training in gender-equitable teaching strategies for Connecticut math and science teachers and student teachers, K–16.

The project felt more sustained impact through its mentoring activities and information dissemination, which continued after the grant ended, than through its in-class programs, which did not. It published a resource guide on gender equity in Connecticut as well as tip sheets for parents (in Spanish and English) and for teachers and mentors on how to encourage girls in STEM.

CODES: E, M, H, U, PD	Connecticut Pre-Engineering Program, Inc.
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HRD 94-50026 (three-year grant)	
Partners: AWIS, St. Joseph College, Wesleyan University Women in Science, Westover School, Connecticut Department of Higher Education, Fairfield County Community Foundation, Inc., Greater Bridgeport Area Foundation, Phoenix Life, and many Connecticut public schools.	
Keywords: dissemination, recruitment, retention, resource center, gender equity awareness, teacher training, mentoring, resource guide, bilingual, parental involvement	

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in-gr

InGEAR: blending gender equity and institutional reform

INGEAR: BLENDING GENDER EQUITY AND INSTITUTIONAL REFORM

BY CHANGING THE WAYS TEACHERS K–12 LEARN TO TEACH MATH AND SCIENCE, THIS THREE-YEAR PROJECT AIMED TO CHANGE THE WAYS GIRLS LEARN MATH AND SCIENCE. PERMANENT CHANGES WERE NEEDED IN GEORGIA'S MATH, SCIENCE, ENGINEERING, AND EDUCATION DEPARTMENTS TO GIVE GEORGIA GIRLS AND BOYS EQUAL ACCESS TO GOOD STEM EDUCATION AND EQUAL ENCOURAGEMENT TO EXPLORE STEM-RELATED CAREERS.

Teacher preparation programs—including instruction in science, engineering, and math—needed to be reformed and redesigned so that teachers entering K–12 classrooms knew how to interest girls in STEM. The project emphasized integrating gender equity and reform (hence InGEAR)—equipping faculty and teaching assistants with positive intervention strategies to support gender equity.

Georgia Tech led the project, working in collaboration with four universities: Clark Atlanta University, Georgia Southern University, Georgia State University, and the University of Georgia. The University of Georgia took the lead in developing a toolkit of materials for the five institutions, with website links to profiles of women in STEM.

InGEAR was not primarily a research project, but each partner undertook an institutional self-study. According to the Report on the Status of Women at Georgia Tech, for example, GT had increased the number of female students and faculty and had improved the "campus climate" for women, but much remained to be done. Many improvements in gender equity had come about through deliberate, systemic efforts: changing the makeup of Student Services personnel (and hiring a director of diversity programs), establishing a women's resource center, offering a series of gender equity workshops, and holding a women's leadership conference. Such institution-wide efforts attested to GT's commitment to diversifying its student body to meet future workforce demands. GT compared favorably with its benchmark institutions in the number of women hired as assistant professor but lagged behind them in the number of women who became associate and full professors.

Several factors kept female faculty's retention and promotion rates low. The *tenure and promotion process did not recognize different career trajectories and rates of advancement, and both men and women viewed institutional practices and processes as unnecessarily political and arbitrary. Moreover, inattention to family-friendly policies (especially about maternity leave and onsite daycare) significantly affected all faculty who hoped to balance family and career. And despite important improvements, women at GT still faced specific institutional barriers and difficulties, there was no institutional mechanism for tracking and responding to their concerns across constituencies, and there were no procedures for dealing with sexual harassment or the subtler, more pervasive forms of gender harassment: casual (and deliberate) sexist comments, personality-based performance evaluations, differential workloads, or male-focused performance expectations.*

Although teacher preparation programs did not undergo the full redesign the project had hoped for, professional development activities at Georgia Southern University, Georgia State University, and the University of Georgia led many teachers to modify the content of their courses and created a critical mass of faculty who consider gender equity a priority. At Georgia State, graduate research assistants (most of them doctoral students in the school counseling program) took David and Myra Sadker's training in how to use INTERSECT, an instrument for observing classroom interactions. *Instructors who were observed and debriefed (by their choice) about their classroom interactions showed more gender-equitable behavior afterward. Those who were observed but not debriefed did not show a change in behavior. Conducting the observations and debriefings profoundly changed the graduate assistants, who became acutely aware of subtle but pervasive gender discrimination in the classroom and in themselves and others.*

CODES: PD, U	GEORGIA INSTITUTE OF TECHNOLOGY (GEORGIA TECH) RESEARCH CORPORATION
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HRD 94-53106 (THREE-YEAR GRANT)	
PARTNERS: CLARK ATLANTA UNIVERSITY, GEORGIA SOUTHERN UNIVERSITY, GEORGIA STATE UNIVERSITY, UNIVERSITY OF GEORGIA, GEORGIA INITIATIVE IN MATHEMATICS AND SCIENCE (GIMS), AMERICAN ASSOCIATION OF UNIVERSITY WOMEN	
www.coe.uga.edu/ingear (INGEAR TOOLKIT OF CURRICULUM MATERIALS AND RESOURCES) www.academic.gatech.edu/study/report.htm (REPORT ON THE STATUS OF WOMEN AT GEORGIA TECH)	
KEYWORDS: DEMONSTRATION, TEACHER TRAINING, GENDER EQUITY AWARENESS, INTERVENTION, RESEARCH STUDY, RESOURCE CENTER, RETENTION, ADVANCEMENT, ACHIEVEMENT, BARRIERS	

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gms

GEMS: learning gender equity online

GEMS: LEARNING GENDER EQUITY ONLINE

THIS COLLABORATIVE PROJECT IS RESEARCHING HOW TO DESIGN EFFECTIVE ONLINE DELIVERY OF GENDER EQUITY TRAINING IN MATH AND SCIENCE TEACHING AND HOW THIS LEARNING AFFECTS PARTICIPANTS' ATTITUDES AND PRACTICE. MAKING A DISTINCTION BETWEEN AN EQUITABLE COURSE AND A COURSE THAT TEACHES ABOUT EQUITY, GEMS (GENDER EQUITY IN MATH AND SCIENCE) ASKS: HOW MUCH CAN TEACHERS LEARN ABOUT EQUITY ONLINE? CAN THEY LEARN MATERIAL WITH A HIGH AFFECTIVE CONTENT ONLINE? WHAT ROLE DOES FACILITATION PLAY? DO MEN AND WOMEN BEHAVE DIFFERENTLY IN AN E-COURSE?

Working in collaboration with several partners, Education Development Center (EDC) will identify factors of course design and delivery that help improve attitudes and practices. The research centers on "Engaging Middle School Girls in Math and Science," a nine-week online course developed by EDC's WEEA Equity Research Center. Because learning styles could affect the design of software and how participants interacted with the material and each other, they added the capacity to take the Myers–Briggs test online, offering online feedback to those who take the test. Each partner agreed to recruit a cohort of participants (mostly middle school teachers), offer them the course, and participate in listserv discussions with GEMS staff and advisers. The project hopes to build a community of math and science teachers trained in gender equity who support each other as they translate a critical framework into strategies and activities for classroom change. It also hopes to develop leaders, build on current networks, and encourage sharing and community building—linking professionals in math and science, gender equity, and educational technology.

Moving the courses from the Web Board system originally used onto a Blackboard platform resolved students' problems navigating the system but required presenting the course content in different ways. Participants adapted easily and were soon communicating more actively than they had in earlier sessions, but they remained uncomfortable with the technology and often preferred hand-holding—someone walking them through the process over the phone—to receiving (and taking time to read) instructions by e-mail or in a chat room.

A number of teachers had trouble accessing and using the course technology, sometimes because low-end computers cannot open PDF documents and sometimes because America Online did not allow them to. Technology challenges both in schools and at home raised concerns that technologies used to present online courses may inadvertently lock out certain groups or individuals. Some people dropped the course out of frustration with slow technology.

At home or at school, participants often had trouble finding time to participate. At school, most of them do not have personal computers for their use alone, often have to compete with students for use of computers, and rarely have release time for the course, which they must fit into an already full schedule. At home, their computers may pose technical challenges, or they may have trouble finding time. Women tend to use the Internet late in the evening, after they've put their children to bed. Such a gender-related trend could affect how heavily women might participate.

Training in both facilitation and the use of technology is critical, and a separate online course was developed for facilitators, but some of them had problems with such tasks as registering the participants. *And skill at onsite facilitation did not necessarily travel well to the online environment, which requires that facilitators be more directive*.

CODES: PD, M	Education Development Center (EDC)
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www.edc.org/GDI/gems/aboutgems.htm	HRD 00-02126 (three-year grant)
Research partners: TERC Inc. (Cambridge), WestEd (Oakland), Eisenhower National Clearinghouse (Ohio State), Intercultural Development Research Association (San Antonio, Tex.), and WEEA Equity Resource Center (EDC, Gender and Diversities Institute).	
Products: Creating the Gender and Science Digital Library (housing the Learning Matrix), an interactive, self-guided professional development system and online community to improve student outcomes in science.	
Keywords: research study, online course, gender equity awareness, teacher training, collaborative network, EDC; TERC Inc.	

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COU

Counseling for gender equity

COUNSELING FOR GENDER EQUITY

AAUW'S 1992 REPORT *HOW SCHOOLS SHORTCHANGE GIRLS* INCREASED INTEREST IN PROGRAMS TO ENGAGE GIRLS AND WOMEN IN MATH AND SCIENCE—FOR EXAMPLE, IN SUMMER CAMPS FOR GIRLS, TEACHER WORKSHOPS ON EQUITABLE EDUCATION, AND ACTIVITIES FOR GIRLS AND THEIR PARENTS. BUT SCHOOL COUNSELORS HAVE NOT BEEN INCLUDED TO ANY GREAT EXTENT IN THESE ACTIVITIES, ALTHOUGH THEY SERVE AS GATEKEEPERS FOR STUDENT PARTICIPATION IN ELEMENTARY SCIENCE AND TECHNOLOGY ACTIVITIES AND IN UPPER-LEVEL ADVANCED COURSES. COUNSELORS ARE AN IMPORTANT SOURCE OF INFORMATION ABOUT CAREERS, SCHOLARSHIPS, AND INTERNSHIPS BUT, LIKE THE REST OF US, THEY SOMETIMES MISS OPPORTUNITIES TO MOTIVATE GIRLS AND OTHER UNDERREPRESENTED STUDENTS IN AREAS WHERE THEY ARE NEEDED THE MOST.

This three-year project to provide training in gender-balanced education to Virginia school counselors featured an annual summer institute for 50 Virginia school counselors, mini-grants for school-based equity projects for girls, and in-service programs in Virginia school systems. The project also supported production of a resource-rich website and six video programs on gender-fair counseling and learning for a PBS series broadcast as part of a distance learning program through PBS's Adult Learning Service and the Virginia Department of Education Hour.

Developed for K–12 counselors by the Virginia Space Grant Consortium in collaboration with Virginia Tech, the project was selected for inclusion in the Annenberg/CPB Math and Science Project's *Guide to Math and Science Reform*.

At summer institutes on gender equity, counselors learned strategies for gender-fair counseling and learning, working with national figures such as David Sadker (co-author of *Failing at Fairness: How Our Schools Cheat Girls (and Boys)*, Roberta Furger *(Does Jane Compute? Preserving Our Daughters' Place in the Cyber Revolution)*, and Christine Darden *(Females and Engineering)*. They learned about cultural and sex-role biases and stereotypes and classroom diversity, the decoding of classroom interactions, gender-biased issues in career information and exploration, why girls avoid technology courses, and how to guide them to opportunities in technology.

The project opened counselors' eyes and gave them the tools to provide leadership for girls in their schools. "The subtle gender bias was overwhelming to me," said one participant. "As I began to analyze my own behaviors, I was shocked to find how my perspective may have been a limiting factor to female students. I really feel an obligation to bring more awareness to my faculty as well as a commitment to stress the importance of science and math to students and parents." Mini-grants for school-based equity projects allowed them to act on what they learned.

Codes: PD		Old Dominion Research Foundation
Mary L. Sandy (msandy@odu.edu), Carol J. Burger	http://genderequity.vsgc.odu.edu	HRD 97-14637 (three-year grant)
Partners: Virginia Space Grant Consortium, Virginia Polytechnic Institute and State University (Virginia Tech), Eisenhower Regional Math & Science Consortium, Public Broadcasting Service, Virginia Tech Continuing Education Department, Virginia Tech Center for Organizational and Technological Achievement, and 16 Virginia school systems, American Association of University Women (AAUW), Eisenhower National Clearinghouse.		
Publications: "Counseling Our Future Workforce," and A Guide to Gender Fair Education and Science and Mathematics by Mary Sandy and Carol Burger. Videos include Leadership Strategies for Gender Fair Counseling and Learning: Conversations with Drs. David Sadker and Sue Rosser (1999), Guidance Counselors Share Strategies for Encouraging Girls in Science, Math, Engineering and Technology in Their Schools (2000), and Counseling Girls to Bridge the Technology Gap (2001).		
Resources for counselors: http://genderequity.vsgc.odu.edu/1links.html		
Keywords: professional development, retention, counselor training, gender equity awareness, career awareness, scholarships, internships, website, video, distance learning, school-based		

005

ntrd

Training trainers to encourage nontraditonal jobs

TRAINING TRAINERS TO ENCOURAGE NONTRADITIONAL JOBS

ROUGHLY HALF OF YOUNG WOMEN WORK IN JOBS PAYING AN AVERAGE $338 WEEKLY, WHILE 60 PERCENT OF YOUNG MEN WORK IN JOBS PAYING AN AVERAGE $448. THIS $110 WAGE DIFFERENTIAL REFLECTS THE DIFFERENT KINDS OF WORK MEN AND WOMEN DO. YOUNG WOMEN WORK IN A NARROW RANGE OF OCCUPATIONS—REPRESENTING ONLY 1 PERCENT OF YOUNG PEOPLE EMPLOYED AS AUTOMOBILE MECHANICS, FOR EXAMPLE, 4 PERCENT OF AIRLINE PILOTS AND NAVIGATORS, AND 10 PERCENT OF ELECTRONIC TECHNICIANS. THE SCHOOL-TO-WORK OPPORTUNITIES ACT REQUIRES ALL STATES TO SET GOALS FOR PREPARING WOMEN FOR NONTRADITIONAL EMPLOYMENT. *WOMEN IN NONTRADITIONAL JOBS—DEFINED AS "OCCUPATIONS IN WHICH FEWER THAN 25 PERCENT OF THE WORKERS ARE WOMEN"—EARN HIGHER WAGES THAN WOMEN EMPLOYED IN TRADITIONALLY FEMALE OCCUPATIONS*.

The strategy of this school-to-work project was to saturate North Carolina's education system with school-to-work and gender equity workshops through a train-the-trainer model. The project's emphasis was on training teachers and counselors how to prepare girls for such nontraditional careers as electrician, computer network engineer, and automotive technician. In July 1998 the Institute for Women in Trades, Technology & Science (IWITTS) held a demonstration train-the-trainer workshop in Greensboro for 32 teachers (of math, science, technology, and vocational education), guidance counselors, and school-to-work coordinators.

To infuse gender equity into its train-the-trainers program, IWITTS developed a training video, "Futures: Preparing Young Women for High Skilled, High Wage Careers," related printed material, and Internet support strategies (especially a listserv) to be used with trainees and to disseminate the project's products and methods. Participants found the video particularly helpful. The video combines acted vignettes and interviews with real-life teachers, students, and parents to communicate practical strategies for getting female students interested in traditionally male-dominated classes and school-to-work activities, keeping them involved, and easing their integration into the workplace through *work-based learning experiences such as internships, job shadowing, cooperative education, apprenticeships, and school-based enterprises*.

After the train-the-trainer workshop the participants felt well equipped to train their peers and to work with students. They developed leadership teams and training plans. *The strategies they found most useful: showing videos of women in nontraditional jobs; touring technical colleges, technical training programs, and labs/technology classes; presenting career information; providing girls with female mentors and role models; engaging girls' interest through hands-on activities; eliminating harassment in the classroom and giving boys and girls equal attention in class; and preparing girls with realistic expectations and coping strategies. The most important thing they took away from the training was awareness:* Even if they were doing the right things, they learned that other teachers weren't necessarily doing the same things, so they needed to intervene back at school.

In some cases the participants' training plans were put on hold because of time (and scheduling) barriers, changes in school priorities, and lack of administrative support. Most of the participants who responded to follow-up questions reported that they had shared resources with their peers and had provided informal training at their schools. Some had also presented at conferences and in distance learning opportunities. Only three participants made formal presentations to parent groups, but most of them discussed the project and its impact on their daughters informally with parents, who were highly supportive.

The low response rate to a post-project questionnaire makes it difficult to draw conclusions, but the participants who responded had positive things to report:

- The number of girls who selected traditionally male career majors increased dramatically—from 20.4 percent in 1998 to 49.6 percent in 1999.
- Counselors and coordinators who responded reported more girls enrolling in work-based learning activities—an increase from 18.8 percent of enrollment to 41.8 percent over one year. Responding vocational/technology teachers reported work-based activities increasing from 0 to 50 percent of enrollment for the same period.
- Responding vocational/technology teachers reported an increase in female students enrolled in nontraditional career courses—from 14.5 percent to 26.1 percent over a year.

Overall, it seemed that *counselors/coordinators and vocational/technology teachers were able to make more effective use of the project materials and strategies than math and science teachers were. Math and science teachers had little previous experience with work-based learning activities for students, and with the current stress on end-of-year testing it was very difficult for them to deviate from "just teaching the basics" in their classrooms. In future projects of this type, it might be wise to give math and science teachers extra administrative support so they feel freer to make changes in their classrooms, such as bringing in female role models to speak about their nontraditional careers.*

CODES: PD, H		INSTITUTE FOR WOMEN IN TRADES, TECHNOLOGY & SCIENCE
DONNA MILGRAM (DONNAM@IWITTS.COM)	www.iwitts.com/html/wt.html	HRD 97-10975 (ONE-YEAR GRANT)
PARTNERS: NORTH CAROLINA'S SCHOOL-TO-WORK OFFICE; NORTH CAROLINA DEPARTMENT OF PUBLIC INSTRUCTION GENDER EQUITY COORDINATOR		
PRODUCTS: THE VIDEO FUTURES: PREPARING YOUNG WOMEN FOR HIGH SKILLED, HIGH WAGE CAREERS, A FACILITATOR'S GUIDE, AND RELATED PRINT MATERIALS. FACT SHEET ON SCHOOL-TO-WORK AND NONTRADITIONAL EMPLOYMENT: http`://www.iwitts.com/html/stw_fact_sheet.htm		
KEYWORDS: TEACHER DEVELOPMENT, GENDER EQUITY AWARENESS, TRAINER TRAINING, SCHOOL-TO-WORK, VIDEO, INTERNSHIPS, JOB SHADOW, COOPERATIVE LEARNING, APPRENTICESHIPS, CAREER AWARENESS, FIELD TRIPS, MENTORING, ROLE MODELS, HANDS-ON		

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wtcc

WomenTech at community colleges

WOMENTECH AT COMMUNITY COLLEGES

THIS DEMONSTRATION PROJECT BY THE NONPROFIT INSTITUTE FOR WOMEN IN TRADES, TECHNOLOGY & SCIENCE (IWITTS) WAS A COLLABORATIVE EFFORT TO RECRUIT AND RETAIN MORE WOMEN IN STEM COURSES AT THREE COMMUNITY COLLEGES: COMMUNITY COLLEGE OF RHODE ISLAND (CCRI), NORTH HARRIS MONTGOMERY COMMUNITY COLLEGE DISTRICT (NHC, IN HOUSTON, TEX.), AND COLLEGE OF ALAMEDA (COA, IN ALAMEDA, CAL.). EACH COLLEGE TARGETED SIX TO TWELVE TECHNOLOGY PROGRAMS IN WHICH WOMEN WERE UNDERREPRESENTED.

For these colleges, the idea of recruiting women into tech courses would require more than a change in the schools' meagre marketing budgets. It would require a change in the institutional culture. Only one of the colleges actively marketed its school to prospective students and it was difficult to tell from its marketing materials how long it would take a student to complete a tech program, what the course prerequisites were, and how best to meet them.

The project developed publicity materials, a prototype "community college WomenTech page" for all three colleges, and additional marketing collateral. CCRI and NHC developed colorful brochures and full-color WomenTech posters and flyers for distribution on or near campus. CCRI developed a WomenTech page for its course catalog as well as Womentech buttons and a flyer for its Career Expo. Each college incorporated a WomenTech Career Expo into its annual recruiting efforts and sometimes lesser versions elsewhere—such as a WomenTech registration table during registration week and a WomenTech booth at a shopping mall Career Expo.

CCRI and NHC's college websites provided links to special WomenTech sites, giving the WomenTech project more visibility. Each WomanTech website has about 30 pages of content, with such features as biographies of women who are graduates of the technology programs, user-friendly information about the programs, answers to frequently asked questions

(FAQs such as "Am I too old to start a tech career?"), links to support services and to relevant websites about women or minorities, and e-mail lists developed to recruit women.

Two years and four months into the project, *CCRI had increased female enrollment in its technology programs by 92 percent—from 39 women to 76—in the year and a half of project implementation*. Women enrolled in programs ranging from electronics to telecommunications, computer, and networking technology. *Data on the other two colleges were hard to come by. Indeed, gender-disaggregated data collection quickly became part of the project strategy*. Only one of the three colleges collected data by gender and by program area, none collected data on who finished college, and there was little tracking of how graduates were placed and at what average wage—figures that would help them sell their tech courses.

Many women don't come to college with the wiring, tool, and computer experience men have. CCRI developed an experimental six-week Tech Readiness class (for men and women), a bridge for students new to computing, which is now part of its regular offerings. Because poor math skills are a problem for many students, CCRI offered a math for technology course for the first time in 2002, the result of an unprecedented dialogue between the math and engineering/technology departments.

In February 2002 IWITTS launched WomenTechWorld.org, an on-line community for women technicians and students in technology, which got up to 11,500 hits a week. On its interactive website are biographies, news stories, a bulletin board, and FAQs. E-mentoring has been delayed by software problems. WomenTechTalk is a new national e-mail discussion group for "techie" women.

SELECTED LINKS FOR 'TECHIE' WOMEN

Women in technology websites	www.womentechworld.org/links.htm#wtw
Women in technology listservs	www.womentechworld.org/links.htm#wtl
Minorities in technology websites	www.womentechworld.org/links.htm#mtw
Girls in technology websites	www.womentechworld.org/links.htm#gtw
SPECIALTY SITES FOR TECHIE WOMEN	
Association for Women in Aviation Maintenance	www.awam.org/
BinaryGirl.com	www.binarygirl.com/home.shtml
Construction Construction tradeswomen	hometown.aol.com/catstep16/myhomepage14profile.html
Female role models	www.genderequity.org/index.html
Greasergrrls (women motor enthusiasts)	www.greasergrrls.com/
Lady Auto Mechanics Club	www.ladyautomechanics.com/
National Association of Women in Construction	www.nawic.org
National Electrical Contractors, Women's Page	www.necanet.org/about/members/women.htm
Society of Women Engineers	www.swe.org
TechDivas	www.techdivas.com
Webgrrls	www.webgrrls.com/explorer.htm
Women Chemists Committee	membership.acs.org/W/WCC/
Women in Animation	women.animation.org/
Women's Automotive Association International	www.waai.com/
Women in Aviation Resource Center	www.women-in-aviation.com/
Women in Cable & Telecommunications	www.wict.org/
Women in the Construction Trades	www.expage.com/page/firewomen
Women in Engineering Programs and Advocates Network	www.wepan.org
Women in Technology International	witi.com/
Work4Women	www.work4women.org/

CODE: U | INSTITUTE FOR WOMEN IN TRADES, TECHNOLOGY & SCIENCE

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www.womentechworld.org | www.ccri.cc.ri.us/WomenTech/index.shtml | www.northharriscollege.com/womentech | HRD 99-06114 (THREE-YEAR GRANT)

PARTNERS: COMMUNITY COLLEGE OF RHODE ISLAND; NORTH HARRIS MONTGOMERY COMMUNITY COLLEGE DISTRICT (HOUSTON, TEX.); COLLEGE OF ALAMEDA (CAL.); TECH CORPS (A NATIONAL PROGRAM TO BRING TECHNOLOGY INTO SECONDARY SCHOOLS).
MAKING MATH AND TECHNOLOGY COURSES USER FRIENDLY TO WOMEN AND MINORITIES, AN ANNOTATED BIBLIOGRAPHY AND LINKS, CAN BE DOWNLOADED FROM (www.iwitts.com/biblio.pdf)

KEYWORDS: DEMONSTRATION, COMMUNITY COLLEGE, RECRUITMENT, RETENTION, WEBSITE, BIOGRAPHIES, TECHNOLOGY

005

mnt

Mentoring teams of teacher trainers

MENTORING TEAMS OF TEACHER TRAINERS

UNDER THE TEACHER EDUCATION MENTOR PROJECT, SIX EDUCATION PROFESSORS AND THE PROJECT DIRECTOR SERVED AS MENTORS FOR TEAMS FROM SEVEN UNIVERSITIES NATIONWIDE. THE GOAL WAS TO PROMOTE CHANGE IN EDUCATION PROFESSORS AND IN THE CULTURE OF COLLEGES OF EDUCATION, ESPECIALLY IN PROGRAMS TRAINING STUDENT TEACHERS IN MATH, SCIENCE, AND TECHNOLOGY EDUCATION—TO EXPAND THE POOL OF INSTRUCTORS QUALIFIED TO HELP K–12 TEACHERS NURTURE FEMALE TALENT AND PERSISTENCE IN SCIENCE.

The change agents were part of the institution because each of the seven institutions formed an internal team: the education dean and/or department chair, professors, students, university administrators, and/or cooperating school teachers. Each team assessed the need to improve or integrate material on gender bias in STEM methods and other education courses into their university's teacher education program. "What I think was most surprising to me was the subtle and deeply entrenched bias that seems to occur in a small rural community," said a principal. "Cultural and racial biases are easy to distinguish and articulate. Many people who are born, raised, and work within a very traditional sex-role context have difficulty recognizing subtle sex-role biases."

Special expertise and experience were transferred on the job. An external mentor—expert in math, science, or technology education *and* gender issues—worked with each team. The external mentors formed their own team, guided by the project director. To become effective advocates for change in their departments, colleges, and field placement schools, team leaders attended a seminar about institutional change, gender issues, and leadership. Empowered in content and process, they developed a mutual support group.

Just-in-time learning and ad hoc problem-solving were available at all times from a wide network. All team members exchanged messages about progress on an electronic listserv, sharing ideas, resources, opportunities, feedback, and support. Mentors had a separate listserv. In the first two years the pyramid-style network reached dozens of faculty members, hundreds of student teachers, and, indirectly, dozens of K–12 schools and thousands of K–12 girls and boys—numbers that will increase with time.

The project has been a catalyst for change. Six colleges and universities reported changing the curriculum across courses to include gender equity in more coordinated ways. Three institutions reported greater consideration of gender equity in hiring, promotion, and tenure. Most (79 percent) of those involved reported major positive changes in how they themselves addressed gender equity in their classes. "At the beginning of this project," said one teacher on an equity team, "we felt we were pretty much aware of gender equity issues. Wow, were we wrong! We became more aware of gender equity issues in our teaching methods, our instructional materials, our terminology, and our classroom management."

CODES: U, PD	WASHINGTON RESEARCH INSTITUTE
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PUBLICATION: FAIRNESS AT THE SOURCE: ASSESSING GENDER EQUITY IN TEACHER EDUCATION FOR COLLEGES AND UNIVERSITIES, BY JO SANDERS. WASHINGTON RESEARCH INSTITUTE, 2000.	
KEYWORDS: PROFESSIONAL DEVELOPMENT, MENTORING, TEACHER TRAINING, RETENTION, GENDER EQUITY AWARENESS, SUPPORT SYSTEM, CURRICULUM	

005
cde
Coding student teachers' classroom interactions

CODING STUDENT TEACHERS' CLASSROOM INTERACTIONS

GENDER EQUITY HAS BEEN DIFFICULT TO INCORPORATE EFFECTIVELY INTO TEACHER TRAINING PROGRAMS. TOO STRONG AN EMPHASIS ON IT AND PARTICIPANTS SEE THE ISSUE AS A JOKE IN POLITICAL CORRECTNESS; TOO SUBTLE AN EMPHASIS (EMBEDDING EQUITY ISSUES IN CURRICULUM DEVELOPMENT OR CLASSROOM MANAGEMENT, FOR EXAMPLE) AND ALL BUT THE MOST INTUITIVE PARTICIPANTS CAN MISS ITS PRESENCE AND IMPLICATIONS. IN THIS THREE-YEAR PROJECT, THE UNIVERSITY OF DELAWARE (UD) STUDIED THE IMPACT ON HIGH SCHOOL SCIENCE TEACHING PRACTICES OF INCORPORATING GENDER EQUITY TRAINING INTO SECONDARY SCIENCE EDUCATION.

Experienced teachers involved with the project acted as "cooperating" (supervising) teachers for 20 of the student teachers ("grant teachers"). A contrast group of 39 "nongrant" student teachers was supervised by experienced but "nongrant" teachers, not associated with the project. Over three years, researchers observed and coded the classroom interactions of all 59 student teachers. Grant student teachers were also coded by their cooperating teachers, who sat and talked with them about what they saw.

The lessons were coded for the type and number of teacher interactions with students, questions asked by the teachers and by the students, type of teaching activity and time spent in that activity, and types of materials used. Observers noted the number and type of questions and the sex of the students answering the questions. (The study collected data on teacher-student interactions and on patterns of teacher questioning and student–teacher interactions.) Questions were coded as *knowledge-level questions* (for example, "What is a hermaphrodite?" or "What is the atomic weight of carbon?"), as *upper-level (higher order) questions* ("explain in terms of chemical bonding why ice, the solid, is less dense than water, the liquid"), as procedural questions ("Is this right?" "Will this be on the test?") and as nonacademic questions or instructions ("Please open your book" or "Are you still on the debate team?").

One goal of gender-sensitive teacher education programs is graduates who ask students of both genders both knowledge questions and upper-level questions. This is what the project found, on average:

- There were significant differences in how teachers in the two groups interacted with their students.
- For both grant and nongrant student teachers, *the majority of student–teacher interactions were knowledge-level questions* (61 percent for grant, 82 percent for nongrant student teachers). Girls were asked 63 percent of those questions in the grant classes and only 43 percent in the nongrant classes.
- In more than 75 hours of classroom observations, girls received no upper-level questions from nongrant student teachers—but *in more than 50 hours of observations in nongrant classrooms, observers recorded only five upper-level questions of any students. (It is a major concern that nearly the ONLY questions coded were knowledge-level questions and these were asked of only a small group of students.*) In grant classes, girls and boys answered the same number of upper-level questions—which accounted for 26 percent of teacher–student interactions. (This is atypical.)
- *There was a significant difference between the two groups in terms of student teachers asking knowledge-level and higher-level questions*. In the grant classes, 31 percent of the student teachers' questions to students were coded upper level, compared with only 1 percent of questions in the nongrant classes. There was no significant difference in procedural interactions.
- Before coding the student teachers' lessons, *the cooperating teachers believed that their student teachers were gender-sensitive and that they were asking a balanced mixture of procedural, knowledge, and upper-level questions of both boys and girls. After less than 30 minutes of coding, they realized how inaccurate their initial perceptions were. Their student teachers were asking mostly knowledge-level questions, were using target students, and were not, overall, gender-sensitive.*
- *The cooperating teachers needed to document these interactions. Teachers rarely recognize inequitable teaching practices. These cooperating teachers' initial perceptions were that the student teachers' performance was satisfactory. This perception changed only after they became engaged in data collection*.
- *By discussing the pattern of classroom interactions with the student teachers, the cooperating teachers in the grant classrooms were able to begin to influence their questioning patterns*.
- For student teachers in the nongrant classes, whose interactions were observed and coded by researchers from the university, *getting only quantitative data from university observers was not compelling enough for student teachers to revise their questioning patterns*.

Preservice and beginning teachers initially define good teaching in terms of classroom management and disciplinary procedures, and often rely on *teaching activities that keep their classes orderly and on task*. Student teachers may focus on male target students to increase order and control in their classes and may be reluctant to use cooperative learning groups, lab activities, and discussions, or to wait longer for student answers, as those practices may produce less order in their practicum classes. *After a while, they enter a stage of focusing on their teaching. Finally, their attention moves away from themselves toward their students' learning. What their peers and their students say about their teaching influences neophyte teachers as they move through these stages. "Cooperating" or supervising teachers strongly influence the next generation of teachers because they interact daily with student teachers. The cooperating teachers who coded and discussed the student teachers' interactions with their students strengthened the neophyte teachers' gender-equitable teaching*.

Interviewed the summer after student teaching, the student teachers who had had constant quantitative feedback about their interaction patterns said they had been surprised by many of their patterns. One of them had sensed that three boys were dominating his class but didn't realize that one boy (M) dominated as much as he did. After the UD supervisor and cooperating teacher both noted the same thing, he realized that M got attention for comments and behavior designed to "get the teacher off track." All three boys took advantage of the student teacher's "global questioning" strategy by calling out answers to get attention. After this was pointed out to him, the student teacher ignored the group's off-task behavior and called-out comments and the boys gave up the behavior because it no longer got them the attention they wanted. *The interacting code gave him a good frame of reference for improving*.

Another grant teacher said that every two weeks or so her cooperating teacher coded her and then discussed what she saw. She would say, "Ok, you didn't really seem to call on Paul today. . . . You need to work on that." Discussing this kind of detail helped the student internalize the ideas of gender equity.

There is a balancing act between the real and perceived needs of the student teachers and cooperating teachers. Student teachers see the methods class and student teaching as critical (perhaps too critical) to their teaching career. They fear that a bad relationship with, and a poor recommendation from, their cooperating/supervising teacher will be devastating to their career, destroying their chances for a good teaching job. *Many student teachers seem to perceive student teaching more as a final exam than as a learning experience. Cooperating teachers, on the other hand, want students to see the big picture and profit from their own experiences. They see student teaching not as a test but as a period of challenge and growth. This difference in perception between the two led to considerable anxiety, which was not allayed by knowing each other ahead of time*.

Currently, preservice students and cooperating teachers do not perceive each other as colleagues but as the expert doling out good advice and the novice asking for quick answers. Students want time away from the cooperating teachers to vent their frustrations without fear of reprisals (perceived or real). At no time during focus groups did the student teachers discuss continuing to learn or improve their teaching skills after the student teaching experience; they just wanted to get through it with top marks. *Teacher training should find ways to put preservice students and cooperating teachers on a learning curve together—helping model for students the importance of lifelong learning. It should find ways to acknowledge that they will not be fully trained when they leave student teaching, and that the methods course and seminar merely give them exposure to critical methods and skills.*

CODING EXPERIENCED TEACHERS, TOO

Most teachers who supervise student teachers have several years' teaching experience and may have completed their studies before gender equity was incorporated into teacher education. So it is important to observe and code classroom interactions of both experienced and new teachers. One cooperating teacher wrote in her diary, after being observed:

> *I had a real awakening. . . . I was showing a film, stopped, turned the projector off, and answered [a student's] question, and when the whole thing was over, [the observer] said to me, 'Did you realize that you never called on the right hand side of the room?' And I would have sworn that I had called on the right hand side of the room, but I hadn't. And then when the next class came in, I really became aware of the fact that I was standing by the projector and the projector was cutting that side of the room off. They might as well have gone on home. . . . I don't know how many years I did that without knowing. . . .I'll bet it was a long, long time. As a teacher, I learned a lot about my attitudes, who I call on, why I call on them. [I think] it was more than a gender equity thing. It's an overall equity thing. . . .the realization that you categorize students. . . .that you put them in little boxes.*

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Articles include: Johnson, Ellen, Borleske, Barbara., Gleason, Susan, Bailey, Bambi, & Scantlebury, Kathryn. 1998. Structured observation—A tool for increasing equity. A guide to coding classroom interactions. The Science Teacher, 65 (3), 46-49. Bailey, Bambi, Scantlebury, Kathryn, & Johnson, Ellen. 1999. Encouraging the beginning of equitable science teaching practice: Collaboration is the key. Journal of Science Teacher Education, 10 (3), 1-14.

Keywords: professional development, research study, teacher training, gender equity awareness

005
new
New courses to draw women into science and engineering

NEW COURSES TO DRAW WOMEN INTO SCIENCE AND ENGINEERING

TO MAKE SCIENCE AND ENGINEERING MORE WELCOMING TO WOMEN AND MINORITIES, TEXAS A&M UNIVERSITY HAS BEEN WORKING ON SYSTEMIC CHANGE IN ENGINEERING EDUCATION. ITS MAIN EFFORT IN THE FIRST AND SECOND YEAR OF THE CURRICULUM HAS BEEN TO CREATE *INCLUSIVE LEARNING COMMUNITIES—COMMUNITIES OF STUDENTS*, FACULTY, AND INDUSTRY WITH COMMON INTERESTS WHO WORK AS PARTNERS TO IMPROVE THE EDUCATIONAL EXPERIENCE. TO MAKE WOMEN MORE COMFORTABLE IN THE STEM ENVIRONMENT, THIS PROJECT DEVELOPED NEW CURRICULA AND IS CONDUCTING A SURVEY OF THE CAMPUS CLIMATE FOR WOMEN IN SCIENCE AND ENGINEERING.

Introduction to Women's Studies: The History of Women in Science and Engineering, which fulfills a three-hours humanities requirement, was introduced in 1995. Team-taught by seven people, it combines history and hands-on lab experiences designed to give first-year students—male and female, working in teams—more sense of belonging, comfort, and confidence.

A new junior-year course, Women in Organizations, covers the social structure of gender and knowledge, access and opportunities, the law, politics, and unwritten policies—fulfilling a three-hour social science requirement. Two new graduate seminars were offered on university teaching and research in STEM fields. One emphasizes career strategies and choices; the other, networking, personal interactions, and teaching and presentation techniques. A faculty workshop was given to heighten awareness about gender issues and to improve classroom instruction and personal interactions with students.

Codes: U, PD	Texas A& M University, Texas Engineering Experiment Station
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HRD 94-53680 (one-year grant)	
Keywords: demonstration, learning communities, survey, women's studies, hands-on, self-confidence, curriculum, career awareness, teacher training, gender equity awareness	

WOMEN'S STUDIES AND SCIENCE: CAN WE TALK?

005
talk
Women's studies and science: Can we talk?

ALTHOUGH AMERICA PRODUCES MANY OF THE WORLD'S GREAT SCIENTISTS, MOST OF AMERICA'S POPULATION IS NOT HIGHLY LITERATE IN SCIENCE. WOMEN, ESPECIALLY, "CHECK OUT" OF SCIENCE MUCH TOO SOON. THE PROJECT WOMEN AND SCIENTIFIC LITERACY ARGUED THAT IT WAS TIME TO MAKE SCIENCE MORE ATTRACTIVE TO WOMEN BY EXPANDING AND TRANSFORMING THE CONTENT AND TEACHING METHODS OF THE SCIENCE CURRICULUM IN HIGHER EDUCATION, WITHIN HUMANITIES AND SOCIAL SCIENCE COURSES AS WELL AS TRADITIONAL SCIENCE DEPARTMENTS.

The project's main goal was to bridge the gulf between science and women's studies by incorporating feminist science studies into science and nonscience courses, thereby setting up an interdisciplinary vocabulary among students, whether science majors or not. Feminist science studies have made us aware of the costs of excluding women and other marginalized groups from full participation in science, of the historical uses of science to justify inequalities, and of which areas of scientific research are studied and which are not. But while feminist science lies at the heart of this project, its *main thrust is to improve scientific literacy. It takes up the challenge posed by biologist Anne Fausto-Sterling, to break the cycle of reproducing a world "in which science seems an illegitimate place for women and gender studies seems an inappropriate enterprise for scientists.*"

With leadership from AAC&U's Program on the Status and Education of Women, this initiative brought together 10 competitively chosen colleges and universities in a three-year curriculum and faculty development project. These schools were to make science more central to women's studies courses, to create two-way streets between undergraduate science departments and women's studies programs, and to foster systemic curriculum changes to improve the quality and scope of science teaching and learning.

Faculty development was important at all 10 sites, but models for faculty development differed greatly. At the University of Arizona (Tucson), for example, more than 100 faculty and hundreds of students participated in seminars, colloquia, and conferences. At Greenfield Community College, faculty attended teaching and assessment workshops and talked about what good teaching was and whether reaching female students was different from reaching male students. At Bates College, faculty participated in seminars and retreats, presenting changes in their syllabi at one and discussing assessment at another. Combining summer reading groups with curriculum development was effective at the University of Rhode Island, where about 200 people attended a spring conference on "Diversifying the Culture and Curriculum of Science, Engineering, and Women's Studies."

Curriculum development, *to change both content and pedagagy, often emphasized connecting the subject matter to students' personal lives, developing practical applications of what students were learning, offering student-led discussions in which the student (not the teacher) was the classroom authority, building a caring and respectful community of learners, and developing classroom practices that featured hands-on science, problem solving relevant to students' lives, collaborative learning groups, journal keeping, and a more constructivist approach to teaching and learning*.

At the University of California at Long Beach, for example, two new education courses were introduced (Women in Science and Science and Society) and a third (Issues in Women's Health) was heavily revised. A Gender and Science course being offered at St. Lawrence University is being team-taught by women from the science faculty and from women's studies. Courses developed or revised at Portland State University were Experimentation: Texts and Test Tubes; The Politics of Gender; and Science, Gender, and Social Context. Portland State's course Biopolitics analyzes how gender relations affect the policy and politics of research and technology that affect women's reproductive health. At Rowan University, the new course Physics of Everyday Life emphasizes active learning and power shared between students and faculty. Digital Computer Design, which was previously standard lectures and labs, now includes computer simulations and each student is required to design, build, and test digital circuits. The University of Illinois at Chicago planned a multidisciplinary masters program in Women's Health Studies and is turning a lab program, Working with Chemistry, into a lab manual with an emphasis on action, reflection, and collaboration. The University of Rhode Island's new course, Women and the Natural Sciences, asks, How has science studied women? Who are the women scientists? And how is science socially constructed?

The project supported the development of various resources—including bibliographies, sample syllabi, and research on the effects of curricular change on all students, with particular attention to women. As completed, they will be made available on AACU's website. Selected syllabi for feminist science studies can be found at <www.aacu-edu.org/womenscilit/syllabi.cfm>.

Assessment. The feminist model for assessment focuses on improving learning and teaching by being student-centered, using multiple quantitative and qualitative methods of assessment, viewing achievement from many perspectives. Feminist assessment asks such hard questions as "Who has the power to determine the questions? What methods are most appropriate to embrace the many voices and ways of speaking? What methods help reveal the unspoken?" Because assessment can be used politically and may injure those taking part, participants expect to be part of the assessment process from the beginning to the end of the project. Each site was committed to developing its own assessment design to demonstrate that they take the task of refoming curriculum seriously.

Changing the way courses are conducted is a slow, complex task, but evidence is building that many faculty members are interested in collaborating on teaching and research in science and gender and that busy faculty can find time to work with each other to develop interdisciplinary courses—and enjoy the process.

Most sites tried to get student assessments of new courses and modules. At Bates College, four focus groups were conducted to learn more about student experiences in introductory science courses. *Both male and female students said they didn't get enough feedback on exams, women felt more intimidated than men did in large classes, women were more interested than men in having courses demonstrate practical applications of science in their lives, and more women than men failed to see the connection between labs and class content*.

To help faculty in their work, the project developed a national advisory board, two national conferences on curriculum and pedagogical development, a newsletter filled with curricular examples and resources, a moderated e-mail discussion list, and annotated bibliographies. As follow-up to an initial conference, participants communicated with each other through the project listserv (SCI-LIT), problem solving and sharing resources. Each of the 10 participating institutions was encouraged to set up a campus-based listserv.

CODES: U, PD — Association of American Colleges (AAC&U)

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www.aacu-edu.org/womenscilit and www.aacu-edu.org/publications/index.cfm — HRD 95-55808 (three-year grant)

Partners: Association of American Colleges and Universities (AAC&U); participating institutions (Barnard College, Bates Colleges, California State University at Long Beach, Greenfield Community College, Portland State University, Rowan College of New Jersey, St. Lawrence University, University of Arizona, University of Illinois at Chicago, and the University of Rhode Island); Project Kaleidoscope; National Council for Research on Women; Association for Women in Science; and National Women's Study Association (Science and Technology Task Force).

Products: Caryn McTigue Musil, ed., Gender, Science, and the Undergraduate Curriculum: Building Two-Way Streets (Washington, D.C.: AACU, 2001). Frequently Asked Questions About Feminist Science Studies, the Fall 1999 issue of On Campus With Women, was devoted to the project.

Keywords: demonstration, recruitment, retention, women's studies, feminism, professional development, curriculum, seminars, conferences, hands-on, collaborative learning, constructivism, gender equity awareness, teacher training

005
cng
Changing faculty through learning communities

CHANGING FACULTY THROUGH LEARNING COMMUNITIES

THE DWIGHT LOOK COLLEGE OF ENGINEERING AND THE COLLEGE OF SCIENCE AT TEXAS A&M ARE USING LEARNING COMMUNITIES TO CHANGE EACH FACULTY MEMBER'S KNOWLEDGE, PERSONAL VISION, COMMITMENT, AND INTERACTIONS WITH STUDENTS. THE FACULTY IS THE MOST CRITICAL INGREDIENT IN LEARNING ENVIRONMENTS ON UNIVERSITY CAMPUSES, *AND DEVELOPING MORE LEARNER-CENTERED EDUCATIONAL ENVIRONMENTS REQUIRES HELPING FACULTY DEVELOP THE FRAMES OF MIND AND INTERPERSONAL SKILLS ESSENTIAL TO A GOOD LEARNING ENVIRONMENT*.

Changing how women are treated, how the classroom is managed, how classes are taught, and how graduate students are mentored depends on the cumulative efforts of many faculty members.

To create more inviting and welcoming learning environments, it is not enough to bombard faculty members with messages such as "Be inviting!" or "Be welcoming!" Instead, it is important to identify how the faculty needs to change, to nurture those changes in all faculty members, and to convince all faculty members that they must practice new ways of teaching to create a welcoming learning environment.

As faculty members develop a stronger personal vision, work to realize that vision, invite students' intellectual development, and articulate the mental models they want students to master, the project should observe changes in attitudes about learning, teaching, and the role of women and minorities in STEM. The project should also see more faculty participating in project-sponsored workshops and faculty learning communities and should see more women enrolled and retained in both undergraduate and graduate studies in physical sciences and engineering.

CODES: PD, U	Texas A&M University (Texas Engineering Experiment Station)
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HRD 01-20825 (three-year grant)	
Partners: Dwight Look College of Engineering; Texas A&M College of Science	
Keywords: demonstration, learning communities, survey, women's studies, hands-on, self-confidence, curriculum, career awareness, teacher training, gender equity awareness	

005
eng
Making engineering more attractive as a career

MAKING ENGINEERING MORE ATTRACTIVE AS A CAREER

THE ENGINEERING INDUSTRY MUST RECOGNIZE DIVERSITY AS A PRODUCTIVITY ISSUE, CONCLUDED A CONFERENCE HELD IN 1998—NOT JUST FOR EQUITY'S SAKE, BUT TO IMPROVE PRODUCTIVITY AND PROFITABILITY AND TO BETTER REFLECT IDEAS AND PERSPECTIVES IN THE MARKETPLACE. CONFERENCE PARTICIPANTS GENERALLY AGREED THAT WOMEN'S *COMPETENCE AS ENGINEERS IS NO LONGER BEING QUESTIONED*—THAT IT IS TIME TO ADDRESS *WHY ENGINEERING-RELATED LEARNING- AND WORKPLACES ARE NOT ATTRACTIVE TO WOMEN AS THEY ARE CURRENTLY ORGANIZED AND MANAGED*. CONFERENCE FINDINGS WERE SUMMARIZED IN TERMS OF ROOT CAUSES AND BEST PRACTICES.

Low expectations for women. *Culturally based values and understandings that affect men and women from infancy on perpetuate certain beliefs: that men are smarter, more committed, and harder workers, and "belong" more in the workplace, and that mathematical talent—the basis for all science and technical fields—is more innate than learned and is gendered (a belief common in the United States but not everywhere). Cultural values shape and can inhibit girls' and women's beliefs in their own ability and their behaviors when confronted with discriminatory practices and with sexual harassment*. Even when women themselves do not recognize discrimination's presence, it marginalizes and demoralizes them.

Except for Howard University, universities lag behind industry in mandating diversity as a goal. Best practices: Organizational leaders must value—not just tolerate—inclusive practices and a diverse labor force. Leaders must see themselves as teachers and active participants in change. Management must understand and address the gender inequity embedded in standard institutional practices and must act on that understanding with rigorous evaluation, discussion, and action plans.

Unreconciled demands of the workplace and family life. The inability to balance work, family life, and community services causes many women to leave engineering, but growing demands in the workplace and at home are also a problem for men. *Industry has taken the lead on developing policies and procedures to address these issues. Universities lag behind. Best practices—such as telecommuting, flex time, rewards for time spent in community* *service, and clock stoppage (stopping the "tenure" clock for family and other responsibilities and extending the probationary period)*—should be incorporated into university practices.

A disjointed pipeline. The academy and industry have not coordinated efforts to attract girls into the engineering curriculum and women into the profession. Many excellent programs have not yet been exported. Industry looks to academe to provide solutions, especially in pre-college areas. *Best practices: Develop a shared, holistic understanding of how education and work reinforce each other and how both must be reformulated to develop the skills and attitudes needed to succeed in school and work*.

A silent profession. *The public does not understand, and the media misrepresent, engineering as a profession and the role engineers play in society*. Many young people don't know what scientists, engineers, and other technical workers really do, the problems they address, or the creativity and uncertainty involved in their work.

Best practices: Develop and promote the image of engineering as a broadly applicable, socially conscious, people oriented, and high paying career—through pre-college programming, public relations efforts, and day-to-day interactions with people outside the profession. Educate editors, publishers, producers, reporters, and media researchers about engineering's role in the world and the distinctions between engineering and science disciplines.

A communication gap between sectors. Many universities have developed strong theoretical and research-based models of root causes for failure to recruit and retain women in engineering, and strong support programs, but much of this information has not breached the walls of industry or is considered irrelevant. At the same time, academics typically don't share the pragmatic mentality of their colleagues in industry.

At the conference, industry participants were amazed at how much time it takes to make a change in academia, while university participants were surprised at industry's lack of access to the "standard literature" and to common knowledge about gender socialization, education, and work bias. Both groups were unaware of how each approaches the problems of underrepresentation. *Best practices*. Form alliances between industry and academia and develop a common language and set of assumptions among engineering employers, educators, and researchers. Lack of a common language means that mutual problems are too often left unexplored and transferable solutions are left unexploited.

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www.engfnd.org/pastconf/8azpre.html (conference program)	HRD 98-05158 (one-year grant)
Partners: International Society for Optical Engineering (SPIE), Texaco and Texaco Foundation, TRW and TRW Foundation, Women in Engineering Program Advocates Network (WEPAN), Society of Women Engineers (SWE).	
Publication: Proceedings: Tackling the Engineering Resources Shortage: Creating New Paradigms for Developing and Retaining Women Engineers (The International Society for Optical Engineering, 1999).	
Keywords: dissemination, engineering, conference, advancement, best practices, policy, publication	

005

impr

Improving the climate in physics departments

IMPROVING THE CLIMATE IN PHYSICS DEPARTMENTS

TEAMS OF WELL-RECOGNIZED WOMEN PHYSICISTS CARRIED OUT SITE VISITS TO PHYSICS DEPARTMENTS IN 12 PUBLIC AND PRIVATE RESEARCH UNIVERSITIES TO IDENTIFY PROBLEMS COMMONLY EXPERIENCED BY WOMEN FACULTY AND STUDENTS, TO RECOMMEND INTERVENTIONS FOR COMMON PROBLEMS, AND TO ADDRESS OR SUGGEST SOLUTIONS TO PROBLEMS SPECIFIC TO THE DEPARTMENTS VISITED.

The visits showed that *the climate for women in physics departments—ranging from welcoming to hostile, but often "chilly"— varies greatly from one institution to another*. The study found that *as the proportion of female physics faculty and students increases, the climate generally improves*.

Female faculty and students faced a number of hurdles. In a few departments, teams learned about cases of sexual harassment; in others, senior women on the faculty had become isolated from important decision-making. But the most common problems came from an accumulation of "small indignities" (such as demeaning comments, requests to take on secretarial duties, and exclusion from departmental social activities) that erode self-confidence and self-esteem.

Since most of the departments visited had one or at most two women on the faculty, female students lacked role models, so teams often recommended hiring additional women faculty. Other team suggestions included better communication between women and the department chair, efforts to develop a stronger sense of community within the department (one more welcoming to women), and including more women as colloquium speakers—to serve as role models and give students advice on such issues as how to combine family and career.

Some issues related to the department climate were not gender-specific: *poor teaching, poor mentoring, the autocratic attitudes of departmental chairs and senior professors, and the faculty's inattention to and lack of respect for physics students*. Many students felt their faculty mentors were neither well informed nor sufficiently helpful about their own students' career development.

Each team provided a written report to the physics department visited with specific suggestions. Six-month follow-up reports from the departments showed that many of the suggestions had been adopted. A later poll showed that many departments had hired new female faculty members and made other major reforms. In most cases, the climate for women had improved considerably.

The principal investigators concluded in 1994 that to *improve the climate in physics departments, the faculty must be genuinely concerned about providing a welcoming and supportive environment for their colleagues and students. Constructive attitudes, a caring approach, open communication channels, and goodwill can go a long way toward creating successful students and faculty members—both male and female*.

In another part of the project, the American Institute of Physics (AIP) conducted a national survey of undergraduate and graduate physics students to learn how male and female students rated the environment of their physics departments. AIP's 1993 report concluded that there *were very few gender differences in the responses from undergraduates. At the graduate level, only a third of the graduate students rated their department as encouraging self-confidence. More males than females reported good collegial relationships with their advisers. Compared with U.S. males, proportionately fewer non-U.S. males and U.S. females reported that their advisers treated them like colleagues*.

The site-visit program is still active. Visits have been made to 24 colleges and universities, with one return visit after a 10-year interval. As more women enter the field of physics, the climate for women should continue to improve.

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Partner: American Physical Society	
Products: Two reports on the climate in physics departments. For more information, contact Sue Otwell (otwell@aps.org)	
Keywords: research study, site visits, physics, intervention, barriers, self-confidence, role models, mentoring, departmental climate, survey, gender differences, publication	

005

phy

Why do some physics departments have more women majors?

WHY DO SOME PHYSICS DEPARTMENTS HAVE MORE WOMEN MAJORS?

IN 1998, WOMEN EARNED MORE THAN HALF THE BACHELOR'S DEGREES AWARDED IN THE LIFE SCIENCES, 40 PERCENT OF THOSE GRANTED IN MATHEMATICS, BUT ONLY 19 PERCENT OF THOSE AWARDED IN PHYSICS. THAT 19 PERCENT IS DOUBLE WHAT IT WAS 25 YEARS AGO, BUT PHYSICS STILL LAGS BEHIND THE OTHER SCIENCES IN ATTRACTING WOMEN TO THE FIELD AND KEEPING THEM THERE.

Despite several national initiatives and many informal and formal departmental efforts to draw more women and other underrepresented groups into physics, in some schools as many as 40 percent of the physics majors are women and in others the proportion is well below the national average.

To learn what works in attracting and retaining women as undergraduate majors in physics, a team at Colorado College is studying 10 undergraduate physics departments with average to heavy participation by women. The schools selected—both public and private—offer a bachelor's degree in physics but no graduate degrees. At least two of them are historically black.

The project's goals are to

- Study some of what the physics community has tried, to learn what works to get more women majoring in physics
- Investigate the unusual success some primarily undergraduate institutions have had in cultivating women physics majors
- Identify common errors in programs and practices that could be corrected if they were recognized and understood
- See whether and how innovations in physics teaching have improved the climate for women
- Communicate project results back to the physics community

The study team—two physics professors, one social science professor, and one student assistant—are collecting demographic information about the faculty and students in each department. In a two-day site visit to each department they will visit classes and labs and interview students, faculty, and administrators. They will investigate the departmental climate, the quality of teaching and advising, the style of classes, and other factors that have been said to make some physics departments more comfortable for women. Departments in which women's participation is high will be compared with those in which it is average, to determine what works to keep participation high. Results of the study will be published in a peer-reviewed journal and publicized in talks, journal articles, and on the Web, in hopes that the physics community will evaluate and improve its efforts to draw women into the field.

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HRD 01-20450 (one-year grant)	
Keywords: research study, best practices, physics, academic environment, recruitment, retention, systemic reform, publication, site visits	

005

pers

Gender and persistence

GENDER AND PERSISTENCE

THIS STUDY EXAMINED THE RELATIONSHIP BETWEEN GENDER AND PERSISTENCE, WITH ATTENTION TO STUDENTS' IMAGES OF SCIENTISTS AND ENGINEERS, THEIR ATTITUDES TOWARD GENDER EQUITY, AND THEIR PERCEPTIONS OF THE CLASSROOM CLIMATE FOR DIVERSITY. IT LOOKED AT THREE DIFFERENT MEASURES OF STUDENTS' PERSISTENCE: STUDENTS' INTENTION TO STAY IN THEIR MAJOR, TO GO ON FOR A GRADUATE DEGREE, AND TO HAVE A LONG-TERM CAREER IN SCIENCE OR ENGINEERING.

Athough there is a significant relationship between gender and persistence—with women being less likely to say they intend to persist—the reasons for this are unclear and depend on the kind of persistence being measured. The relationship disappeared when the study considered the students' images of scientists and engineers. *Those who had positive images of scientists and engineers were more likely to say they would persist, whether they were men or women. Positive attitudes toward gender and racial equality as well as positive classroom experiences also improved the odds of students having high degree aspirations.*

And *when they controlled for field of study, gender was no longer related to any of the three measures of persistence. Students' intentions to stay in their major were related to their attitudes toward gender equity and to their field (biology or engineering, in this study), but not to their gender. Students' intentions to get a graduate degree were related to their images of scientists and engineers and their field, but not to gender*. In other words, for students in this study, several components of persistence were statistically significant beyond a simple relationship between gender and persistence.

Knowing this fruitfully complicates our understanding of why women are underrepresented in science and engineering and points toward more specific ways of promoting women's participation. Intervention programs may need to differ depending on both the targeted field and the level (majors, graduate study, careers).

Programs to increase the percentage of women among *tenure-track engineering faculty* may differ significantly from programs to increase the percentage of women among *tenure-track biology faculty*. *Engineering majors can get well-paying jobs in the private sector with only an undergraduate degree, but in biology graduate and postdoctoral study are needed to get well-paying jobs in the private sector*. Many contemporary programs—and research projects—are not designed to consider how different fields of study require differing length of training and career structures for professional practice.

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Publication: Women, Science, and Technology by Mary Wyer, Mary Barbercheck, Donna Giesman, Marta Wayne, and Hatice Orun Ozturk. New York: Routledge, 2001.	
Keywords: education program, research study, gender equity awareness, retention, gender differences, biology, engineering	

005

tutor

Tutorials for change

TUTORIALS FOR CHANGE

THIS PROJECT WILL PRODUCE ONLINE TUTORIALS DIGESTING RESEARCH ON GENDER'S ROLE IN STEM CAREERS. SUCH TUTORIALS DO NOT CURRENTLY EXIST. SCIENCE-BASED INFORMATION ABOUT INADVERTENT BIAS IN EVALUATIONS OF MEN AND WOMEN IS AVAILABLE IN TECHNICAL SOURCES BUT IS UNKNOWN TO MOST STUDENTS AND EDUCATORS. THIS PROJECT WILL PRODUCE A SUITE OF 15-MINUTE TUTORIALS THAT CAN BE INCORPORATED INTO WORKSHOPS, BRIEFINGS, CLASSROOM DISCUSSIONS, WEBSITES, AND ONLINE COURSES AIMED AT THOSE STUDYING WOMEN'S UNDERREPRESENTATION IN STEM. THE CONTENT, DRAWING ON MANY RESEARCH FINDINGS AND RESULTS, WILL REPRESENT A SUBSTANTIAL (AND ACCESSIBLE) COMPLEMENT TO THE MANY BRIEFINGS AND REPORTS THAT SUMMARIZE MAINLY STATISTICS.

Virginia Valian is uniquely qualified to prepare the tutorials, as the author of *Why So Slow?*, a thoroughly researched and persuasive explanation of women's slow advancement in the professions. A cognitive psychologist who has developed new courses on gender, Valian is a popular presenter on the topic. She has already developed a website for prospective graduate students in Hunter College's master's program in psychology.

The tutorials will be developed as PowerPoint slides with voiceover narration and annotated bibliographies. They will be mounted on Hunter's server, available to anyone with access to the Web. Each will include a questionnaire for site visitors to fill out (voluntarily), an opportunity to e-mail Valian queries and comments, and questions and answers drawn from those e-mailed messages.

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HRD 01-20465 (ONE-YEAR GRANT)	
KEYWORDS: DISSEMINATION, ONLINE TUTORIALS, GENDER EQUITY AWARENESS, BIBLIOGRAPHY, RESEARCH FINDINGS, CAREER AWARENESS, QUESTIONNAIRE	

005

@risk

Preparing at-risk undergraduates for graduate school

PREPARING AT-RISK UNDERGRADUATES FOR GRADUATE SCHOOL

IN 1989 BAYLOR COLLEGE OF MEDICINE CREATED SMART, A 10-WEEK SUMMER MEDICAL AND RESEARCH TRAINING PROGRAM THAT, EVERY YEAR SINCE, HAS GIVEN ASPIRING SCIENTISTS FIRSTHAND EXPERIENCE IN LAB SETTINGS AND OPPORTUNITIES TO ATTEND RESEARCH SEMINARS AND OTHER EDUCATIONAL ACTIVITIES. THROUGH BAYLOR'S GRADUATE SCHOOL OF BIOMEDICAL SCIENCES, UNDERGRADUATES FROM ALL OVER THE COUNTRY—MANY OF THEM WOMEN AND MINORITIES—GET A CHANCE TO LEARN ABOUT SUCH SUBJECTS AS BIOENGINEERING, BIOPHYSICS, AND COMPUTATIONAL BIOLOGY.

In 1996, an NSF grant funded this add-on to SMART, a model project providing additional experiences and opportunities for eleven women (seven from minorities). The participants were all undergraduates in Houston colleges, candidates for doctoral studies who were considered at risk—earning C's in science courses or taking fewer science courses than normal. Participants did lab research (10 of them with female mentors) on projects that ranged from analyzing mouse embryos to measuring stress on muscle fibers. They could attend a daily seminar series and talks on such basics as how to apply to graduate school. During the school year they could keep working in a lab and could attend the national AAAS meeting.

The project also developed a SMART prep course for the Graduate Record Exam (GRE). The study section had decided to eliminate funding to send the women to a commercial prep course, so the project leaders developed a course themselves. They analyzed commercial materials, selected the most effective parts from different resources, and created skills workshops targeted at different areas of the GRE. *After investing 40 to 60 hours in the pilot prep course, 10 women raised their scores from 30 to 50 percentile points*. The mean increase was 371 points, with a median of 420. Seven of the 10, some with scores as low as the 20th percentile, raised their analytical scores to above the 90th percentile. Five participants got official GRE scores consistent with or better than their scores on their final practice exam.

The most important effect of the SMART GRE Prep Course was to increase the participants' confidence. Two of the women have entered graduate programs and two have entered law school. The Prep Course has been continued through funding from an NIH Initiative for Minority Student Development. And *now that Baylor College of Medicine realizes that the skills tested on the GRE can be taught, it places less weight on GRE scores in admissions decisions.*

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www.bcm.tmc.edu/smart	HRD 96-31519 (one-year grant)
Partners: Rice University, Texas Southern University, University of Houston	
Product: SMART GRE Prep Course	
Keywords: demonstration, research experience, seminars, GRE prep course, conferences, self-confidence	

005

GRE

Testing campus-based models of GRE prep courses

TESTING CAMPUS-BASED MODELS OF GRE PREP COURSES

BAYLOR COLLEGE OF MEDICINE, WHICH DEVELOPED THE SMART GRE PREP COURSE UNDER A PREVIOUS NSF GRANT, IS LEADING THIS EFFORT TO IMPROVE, TEST, AND EVALUATE COURSES TO PREPARE STEM MAJORS AT FIVE WOMEN'S COLLEGES FOR THE GRADUATE RECORD EXAM. USING MATERIAL FROM THE SMART COURSE, THE FIVE SITES WILL PROVIDE NEW MATERIALS AND APPROACHES TO TESTING THE COURSE IN VARIOUS CONTEXTS.

All partner institutions have a copy of the draft guidebook for the SMART GRE prep course. The project is analyzing the skills tested on each GRE question answered by the students, to develop tools for analyzing their strengths and weaknesses and preparing individualized study plans for the GRE exam. It is developing verbal exercises for students with scores below 400 on the verbal section of the GRE, and female-friendly logic problems, portraying women and minorities in leadership roles.

Data from preliminary regression analysis suggest a strong positive correlation between a student's undergraduate grade point average (GPA) and her GRE score on both an initial and final diagnostic exam. Regression analysis revealed no correlation after the prep course, which suggests *that the course will help all students, regardless of incoming GPA, improve their GRE scores.*

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HRD 00-80662 (three-year grant) and 99-06394 (planning grant)	
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Product: Draft 175-page guidebook for developing and conducting GRE prep courses	
Keywords: demonstration, GRE prep course, evaluation, manual , research study	

005

Jr.

Retaining graduate students and junior faculty

RETAINING GRADUATE STUDENTS AND JUNIOR FACULTY

FEW INTERVENTIONS TO SUPPORT AND RETAIN WOMEN IN SCIENCE AND ENGINEERING HAVE TARGETED GRADUATE STUDENTS AND JUNIOR FACULTY, DESPITE SIGNIFICANTLY HIGHER ATTRITION RATES FOR FEMALE DOCTORAL STUDENTS THAN FOR MALE CANDIDATES AND DESPITE THE PERSISTENTLY LOW NUMBER OF WOMEN ON STEM FACULTIES. MOREOVER, NO INTERVENTIONS AIMED AT SUPPORTING WOMEN GRADUATE STUDENTS IN STEM FIELDS HAVE BEEN DESIGNED BY WOMEN WITH DOCTORATES—AN IMPORTANT FLAW, AS MIT'S 1999 STUDY FOUND THAT DISCRIMINATION "*DID NOT LOOK LIKE WHAT WE THOUGHT DISCRIMINATION LOOKED LIKE.*"

The women's studies program at Iowa State University hosted a conference *on The Retention of Women Graduate Students and Early Career Academics in Science, Mathematics, Engineering, and Technology* in October 2002. This regional conference brought together scientists and women's studies scholars—two groups that seldom interact yet have much to learn from each other. The conference explored feminist science studies (the interaction between women's studies and science fields), feminist critiques of science, and the experiences of women graduate students and faculty in science fields.

Papers were invited on

- Rethinking strategies for retention of women graduate students and junior faculty in science and engineering
- Re-evaluating the work done in scientific fields (publishing, negotiating the workload, classroom climate, grants, fellowships, postdoctorates, salaries, promotions, and support)
- Transforming the culture and organization of science
- Understanding and changing the structure of higher education
- Issues for underrepresented groups of graduate students and faculty women in science (especially women of color, international women, and women with disabilities)

Five to seven people from about 20 Midwestern land-grant colleges and universities were invited to participate—women's studies faculty, women doing research on women in STEM fields, and faculty and graduate students in science and engineering. These teams exchanged relevant research findings on the barriers to graduate and faculty women's full participation in science and engineering and collaborated on developing potential retention strategies for their universities. Each team was expected to construct a plan of action for its own institution, to implement it in the months after the conference, and to report on it at a follow-up forum a year later. Conference proceedings and follow-up activity are being disseminated on the Web and in print.

CODE: PD	Iowa State University
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HRD 00-94556 (one-year grant)	
Keywords: dissemination, retention, advancement, intervention, feminism, best practices, research findings, barriers, action plan, professional development	

005

shh!

Breaking the silences

BREAKING THE SILENCES

SCIENCE OFTEN OPERATES UNDER UNACKNOWLEDGED RULES, NORMS, AND EXPECTATIONS. AND THE INTENSE POWER IN FACULTY–STUDENT RELATIONS CAN LAST WELL BEYOND GRADUATE SCHOOL. MANY GRADUATE WOMEN ARE KEENLY AWARE OF, AND ARTICULATE ABOUT, THE CULTURE AND INSTITUTIONAL PRACTICES OF SCIENCE BUT ARE RELUCTANT TO SPEAK UP ABOUT THEM. THIS FACULTY–STUDENT RESEARCH AND ACTION PROJECT AT THE UNIVERSITY OF ARIZONA WAS DESIGNED TO BREAK THOSE SILENCES.

One of their first discoveries was that *graduate education is structured less around the classroom than around a protégé–master model*. In this one-to-one model, interpersonal communication and relationships are central, and social markers of gender, class, ethnicity, and sexuality are ubiquitous—but talking about interpersonal communication, relationships, and social markers is forbidden.

They came to realize that graduate education is unique, with a "student" clearly subordinate to the faculty and in search of training from them, yet leaving school as a "colleague" to the very same faculty. Undergraduates learn about science and might even learn how to do experiments and interpret data, but graduate students learn how to "be" a "scientist." For this, they must learn to present themselves as credible professionals—network, design and carry out research projects, choose interesting and productive research topics, give talks, discuss science with colleagues, procure grants, publish results, recruit and motivate good students. So *what began as a study of women's experiences in graduate education became a look at scientists as knowledge-makers,* who value *not* talking about and *not* recognizing the social world they create, maintain, and reproduce. *How does this culture function? How does it reinscribe particular notions of gender, race, and class with the next generation of aspiring scientists*?

Phase I, an institutional analysis, used questionnaires and interviews to determine how gender dynamics are "operationalized" in graduate education and what roles are played by male and female graduate students, post-docs, faculty, and department heads. Who determines the shaping of everyday science? The running of labs? The research questions asked? The methodologies employed? How do the power dynamics shape the participation of the different groups and in what ways?

Phase II featured a facilitated conversation between 20 faculty and 20 female graduate students about the strengths and limitations of graduate education for women, with an emphasis on gender issues. Four departments (math, chemistry, molecular and cellular biology, and ecology and evolutionary biology) were chosen because they had supportive chairs and represented different forms of research. *It was important to the success of this part of the project—especially to student frankness—that students and faculty communicated through the facilitators and that participants' identities remained anonymous to the other group*. In a framework developed by Mary Wyer at Duke, two facilitators met separately with two faculty groups and two student groups in 20 two-hour sessions.

Student experiences varied somewhat (often shaped by lab groups and departments) but *students were astonished at how similar some experiences were across departments*. Persistent student issues were the lack of, and the need for, greater communication between faculty and students. There was departmental variation but *on the whole students felt there were not enough occasions for faculty–student interactions. Overall, they did not believe faculty cared*.

Faculty viewed their relationships with their students as particular and idiosyncratic. Anecdotes students offered as symptomatic of larger currents in graduate education were usually said by faculty to reflect problems of individuals. Students tended to view becoming a scientist or mathematician as a particular, constructed, and sometimes arbitrary process. They were interested in challenging and reinterpreting who could be a good scientist. Faculty tended to see the process as natural, involving the growth and maturation of something already inside the students in incipient form—a growth on which they had only limited influence. Their understanding of what happens often left little room for criticism in the sense that it emphasized a "stay if you fit in, leave if you don't" perspective. To faculty, a student should be able to tell that s/he is "cut out to be a scientist" if graduate education seemed to come easy, be reasonable and rational. If not, the student was not meant to be a scientist.

Powerful insights came from an exercise in which each group was invited to name the unwritten rules governing graduate education. Students developed an extensive set of rules that demonstrated their commitment to being "good" and competent scientists—for example, don't complain, even about real problems; don't have a personal life; pretend to be like your adviser; being a woman is a liability; you don't have input, even on decisions that affect graduate school (even when asked); don't exhibit "feminine" behaviors.

Students questioned the necessity and efficacy of many of these rules. Why must you work all the time? Why are research positions seen as a more "valuable" career track than teaching positions? Why are certain behaviors not allowed? Why is scientific culture silent on issues of gender? Why can you not have a personal life? Students consistently challenged the lists of rules and through that critiqued the scientific culture's prototype of the ideal "scientist." *The students were willing to follow rules to do science; what they challenged was whether all of the rules defined by contemporary scientific culture produced good science—or, more important, whether not following those rules always produced bad science*. They saw phase III as a place to envision a different scientific culture, one not hostile to their identities as women, one structured to create imaginative, empowered, and productive graduate student experiences.

In phase III, a subset of the faculty and students came together for an extremely successful open dialogue, aimed at re-envisioning graduate education, which highlighted the importance of communication as a way of clearing each group's misperceptions of the other. Demonstrating that faculty and students could develop an open, honest, and constructive dialogue, this group developed constructive recommendations for change, posted at <http://w3.arizona.edu/~ws/science/nsf>.

This project personally transformed many of the participants, but translating the recommendations into institutional change and transforming others within their departments proved difficult—because not all members of each department participated in the whole experience. A one-hour seminar or forum that brings faculty and students together does not recreate the process. *To transform a department is extremely difficult because it requires breaking silences that have developed historically within the culture of science*. Change requires concentrated work within a few departments, involving a significant number of faculty and graduate students, and in some cases all faculty.

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HRD 95-53439 (one-year grant)	
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Project summaries and recommendations: http://w3.arizona.edu/~ws/science/nsf	
Keywords: demonstration, research study, questionnaires, gender dynamics, systemic reform, culture of science	

005
crep
Creeping towards inclusivity

CREEPING TOWARD INCLUSIVITY

A NEW YORK ACADEMY OF SCIENCES CONFERENCE ON WOMEN IN SCIENCE HELD IN 1972 SET FORTH GOALS FOR *ACCELERATING WOMEN'S SUCCESS IN SCIENCE*. A FOLLOW-UP CONFERENCE IN 1998 ASSESSED PROGRESS MADE AND RECOMMENDED WAYS TO ACCELERATE IT BASED ON RESEARCH AND "BEST PRACTICES" FOUND IN CORPORATE, GOVERNMENT, AND ACADEMIC INSTITUTIONS. *FOR ALL THEIR DIVERSITY, THE PARTICIPANTS AGREED THAT PROGRESS HAD BEEN MADE BUT HAD NOT GONE FAR OR FAST ENOUGH. AS NOBEL LAUREATE DUDLEY HERSHBACH PUT IT, "WE ARE CREEPING TOWARD INCLUSIVITY IN SCIENCE*."

More women are enrolling in science and engineering studies, for example, but they drop out at proportionately higher rates than men do. Self-interest, civil rights legislation, and competition for talented women have compelled measurable progress in government and the private sector but the *elite colleges and research universities have proven virtually impervious to change.* Science and society require the broad talent and wisdom that can be ensured only by increasing diversity in the workforce and workplace. And the shared perspective of the conference was that *diversity doesn't just happen; it must be abetted by substantive changes in the attitudes, policies, and practices that inform how we educate the workforce and how the science workplace is managed*.

Some problems and solutions might lie in the institution of science itself. Aggressive, competitive behavior may be an asset in academia, but *in industries that require increasingly complex teams seeing long-term projects through to fruition there will be more need to form collaborative relationships between departments and disciplines. Can the scientific community nurture and develop a sense of cooperation and collaboration in a culture of competition*?

The workplace needs more women scientists and technologists but *many women drop out because they find the workplace incompatible with their needs and priorities—the work itself based on male ways of doing science, with other styles denigrated as unscientific*. If higher salaries, increased prestige, elevated status, and more challenge are not what women value most, organizations hoping to attract women may have to design incentives women find rewarding, such as collaborative effort, a supportive workplace, quality of life, and a better "fit" between their professional and personal life.

Harvard University's Project Access reported differences between what men and women mean by "good science"—not so much in ways of thinking or methods of inquiry as in ways of behaving and of organizing scientific work. Science is a social system, and understanding these differences in social modes or styles is important in understanding the participation and performance of women and other underrepresented groups in science.

Inclusion has to do with economics, said Roberta Gutman (Motorola). The number of women vice presidents at Motorola had risen from two in 1989 to 43 in 1998, while Harvard's chemistry department had only one tenured woman on its faculty—and only 7 percent of the professionals in the 25 top-ranked university chemistry departments in the country were women.

Recruiting women is not enough, said Mary Mattis (Catalyst)—it's what you do with them when you get them. Representing the government, Beverly Hartline said it was little steps that would drive women's opportunities to higher levels. *To retain women and minority professionals, what makes a difference is collegiality, credit for contributions, supportive mentoring and recognition by peers and senior colleagues (regardless of gender), opportunities for advancement, visibility, and leadership, and a balance between career, family, and personal life*.

Women often delay publishing their research until they have the "whole picture," said Cynthia Friend, a Harvard chemistry professor, *so they tend to publish less often than men do, which reduces their chances for promotion and tenure. She urged women to publish data that is "interesting" and provokes questions instead of waiting until they have all the answers*.

Countering academic resistance to change are such support systems for early-career women scientists as the Clare Boothe Luce Program, which funds about 60 tenure-track positions at colleges and universities around the country. Another tactic for fostering change, said Lilian Shiao-Yen Wu (from IBM's Thomas J. Watson Research Center), could be to devise a system for ranking and rating academic institutions and departments for climate and policies on promoting women's retention and advancement.

That *progress for women scientists and engineers is slowest in academia* is a critical issue for the future of science, as many participants noted. *Women are opting out of a university system that they find oppressive, with ethics, values, styles, and behaviors incongruent with theirs, with funding and job constraints that prolong the time it takes to complete a doctorate or that relegate young scientists to underpaid and powerless postdoctoral positions.*

Women more than men are choosing to work outside the academy. It's no longer a matter of figuring out how women (and others who have been excluded) can be made to "adjust" to an alien environment. Participants at the conference envisioned a scientific enterprise inviting to everyone with the talent and desire to participate. *This is not a woman problem but a problem for science and engineering*. So long as women's talents and abilities are not fully used, our scientific and technical enterprises lose and our economy is diminished.

CODE: PD	New York Academy of Sciences
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HRD 97-29416 (one-year grant)	www.nyas.org
Partners: Avon Products, the Radcliffe Public Policy Institute, Catalyst, Inc., Claire Boothe Luce Program of Henry Luce Foundation	
The full proceedings of the conference (Women in Science and Engineering: Choices for Success, edited by Cecily Cannan Selby) can be ordered at (www.nyas.org/books/vols/toc869.html).	
Keywords: dissemination, conference, advancement, best practices, policy, systemic reform, retention, support system, professional development, publication, action plan	

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Equity, science careers, and the changing economy

EQUITY, SCIENCE CAREERS, AND THE CHANGING ECONOMY

ACHIEVING EQUITY FOR WOMEN WILL REQUIRE FUNDAMENTAL CHANGE IN THE ORGANIZATION OF THE SCIENTIFIC WORKPLACE, CONCLUDED SPEAKERS AT A SYMPOSIUM RADCLIFFE'S PUBLIC POLICY INSTITUTE HELD IN 1995 ON *SCIENCE CAREERS, GENDER EQUITY, AND THE CHANGING ECONOMY*.

Even though women represented an increasing percentage of the American workforce, they remained underrepresented in the sciences. Scientific careers remained synchronized to traditional work patterns, making it difficult for women responsible for childcare or eldercare to pursue careers in science. And for girls and women (especially women of color), there were far too few female models of success in science.

Meanwhile, *although the annual number of science engineering doctorates had increased about 40 percent over 20 years, the likelihood of pursuing traditional research careers at major universities had been declining*. Science and engineering students who wanted academic positions, faced with reduced prospects for careers in research universities, were frustrated and disappointed, especially in the field of physics. Clearly *graduate education should be reshaped to reflect the reduced likelihood of finding positions in university research*.

CODE: PD	Radcliffe College
Paula Rayman (rayman@radcliffe.edu), Catherine D. Gaddy	HRD 95-52991 (one-year grant)
Partners: Radcliffe's Public Policy Institute; the Commission on Professionals in Science and Technology; AAAS.	
Science Careers, Gender Equity, and the Changing Economy, Report of Conference Proceedings (Radcliffe Public Policy Institute, 1999).	
Keywords: dissemination, policy, gender equity awareness, role models, publication, advancement, career awareness, conference	

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Balancing the equation

BALANCING THE EQUATION

ALTHOUGH WOMEN HAVE MADE SIGNIFICANT HEADWAY IN SUCH DISCIPLINES AS LAW AND MEDICINE, THEIR ADVANCES IN MORE TECHNICAL FIELDS HAVE STAGNATED—EVEN ERODED—IN RECENT YEARS, ACCORDING TO "BALANCING THE EQUATION: WHERE ARE WOMEN AND GIRLS IN SCIENCE, ENGINEERING, AND TECHNOLOGY?"

This publication from the National Council for Research on Women (NCRW) reports, for example, that there has been a marked decline in women's participation in college-level computer sciences—from 37 percent of undergraduate degrees in 1984 to fewer than 20 percent in 1999. And while women made up 46 percent of the workforce in 1996, they held only 12 percent of the science and engineering jobs in the nation's businesses.

There would be no shortage of scientists and engineers in this country if women and minorities were encouraged to move into this part of the workforce. Change is possible, but complex. NCRW's report recommends that colleges and universities *design curricula that take an interdisciplinary approach to learning and demonstrate the real-world relevance of coursework, since both approaches have been shown to boost female enrollment and* *retention*. It recommends that institutions *do away with "gatekeeping" courses intended to weed students out of computing, physics, and engineering and replace them with courses that invite students into those disciplines. Programs shown to improve women's enrollment and retention, notes the report, also generally benefit their male* counterparts. What's good for women and girls is good for men and boys, and does not help one gender at the expense of the other.

NCRW is a working coalition of 77 U.S. research centers with connections to more than 1,500 organizations and networks worldwide concerned with improving the status of women and girls. This report was initially to be a special edition of *Issues Quarterly* (IQ), a publication NCRW launched in 1994.

CODES: U, PD	NATIONAL COUNCIL FOR RESEARCH ON WOMEN
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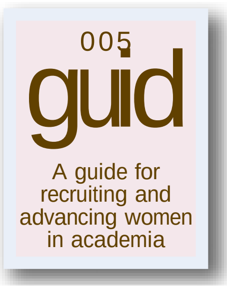
www.ncrw.org	HRD 97-32530 (ONE-YEAR GRANT)
PUBLICATION: BALANCING THE EQUATION: WHERE ARE WOMEN AND GIRLS IN SCIENCE, ENGINEERING, AND TECHNOLOGY?	
KEYWORDS: DISSEMINATION, POLICY, GENDER EQUITY AWARENESS, ROLE MODELS, PUBLICATION, ADVANCEMENT, CAREER AWARENESS, CONFERENCE	



A GUIDE FOR RECRUITING AND ADVANCING WOMEN IN ACADEMIA

THE COMMITTEE ON WOMEN IN SCIENCE AND ENGINEERING (CWSE), NATIONAL RESEARCH COUNCIL, OF THE NATIONAL ACADEMY OF SCIENCES, HAS RESEARCHED THE BEST POLICIES AND PROGRAMS ACADEMIC INSTITUTIONS HAVE IMPLEMENTED TO RECRUIT, RETAIN, AND ADVANCE WOMEN IN SCIENCE AND ENGINEERING IN ACADEMIA. THE GUIDE IS A PRACTICAL TOOL FOR REPLICATING SUCCESSFUL PROGRAMS AT OTHER ACADEMIC INSTITUTIONS.

CWSE used formal and informal networks to identify the most successful programs for each level: recruiting undergraduates; reducing attrition during freshman and sophomore years; recruiting, retaining, and advancing graduate students; and encouraging the transition to postdoctoral fellowships. The guide was prepared for college and university presidents, deans, provosts, and other administration officials, department chairs, faculty, and others who want to draw more women into science and engineering.

The committee got in touch with granting organizations, disciplinary societies, academic administration societies, faculty groups, and nonprofit advocacy organizations. It reviewed programs from public and private organizations of all sizes.

Programs were asked to provide data on how much women's participation increased as a result of their programs. Once it identified the most successful programs, the committee made site visits to interview students, faculty, and administrators involved in those programs—to learn what they did and how they did it. In describing effective practices, the guide identifies no institution by name.

The Academy has disseminated tens of thousands of previous NAS guides worldwide. *On Being a Scientist* (a guide to science ethics) has been reprinted in several languages. The committee' guide was modeled on the NAS guide to mentoring (*Advisor, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*), on which many faculty mentoring programs are based.

CODES: U, PD	NATIONAL ACADEMY OF SCIENCES
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www.nationalacademies.org AND www.nap.edu	HRD 93-54094 (THREE-YEAR GRANT) AND 01-20774 (ONE-YEAR GRANT)
A GUIDE FOR RECRUITING AND ADVANCING WOMEN SCIENTISTS AND ENGINEERS IN ACADEMIA WAS SCHEDULED FOR PUBLICATION IN LATE 2002. ALL ACADEMY PUBLICATIONS CAN BE ORDERED OR READ FREE ON THE NATIONAL ACADEMY PRESS WEBSITE (www.nap.edu).	
KEYWORDS: DISSEMINATION, RECRUITMENT, ADVANCEMENT, RESOURCE GUIDE, RETENTION, SITE VISITS, BEST PRACTICES, MENTORING, ROLE MODELS	

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Achieving success in academia

ACHIEVING SUCCESS IN ACADEMIA

HOW MANY WOMEN TEACH ENGINEERING COURSES? HOW MANY TEACHING ASSISTANTS ARE WOMEN? VERY FEW, AND IN SOME MAJORS AND INSTITUTIONS, NONE. YET RESEARCH INDICATES THAT UNDERGRADUATES BENEFIT SIGNIFICANTLY FROM FEMALE MENTORS. TO BEGIN TO ADDRESS THIS PROBLEM, THE WOMEN IN ENGINEERING PROGRAMS & ADVOCATES NETWORK (WEPAN) HELD AN ENERGIZING, THOUGHT-PROVOKING THREE-DAY SEMINAR AND E-MAIL DISCUSSION GROUP ON "ACHIEVING SUCCESS IN ACADEMIA," WITH A FOCUS ON NAVIGATING THE TENURE TRACK.

In June 1997, 34 nontenured tenure-track faculty and 28 graduate students pursuing careers in academia—nearly a quarter of them women of color—came to the Crystal City Marriott in Arlington, Va., from 29 U.S. institutions to learn how to succeed in academia from deans, tenured faculty, and other experts. Participants valued the rare opportunity to interact and form networks with other women—colleagues or mentors. "What an incredible experience it is to be in a room with 62 other female engineering faculty and Ph.D. students" said one of them.

Difficulties women face in pursuing a graduate degree or tenure include *being accepted and mentored by senior male colleagues and balancing work and family. Conference participants concurred that to succeed, it is imperative to develop relationships with effective mentors, advisers, and colleagues, to become knowledgeable about the politics of your institution, to have a support system, and to work hard*. Do all that and you can overcome the challenges of being a woman in a traditionally male field and have a rewarding and diverse career. But to increase technical women's clout in academia, it is important to get more women on the faculties of engineering departments.

On a scale of 1 to 5, participants rated the conference 4.6 overall (very effective). Most highly rated were talks on navigating the tenure track, strengthening research grant proposals (private and federal), and dealing with tough times. (Some said more specifics on negotiating start-up packages, balancing teaching and research, managing graduate students and teaching assistants, and handling problems with students—such as slacking and cheating—would have been helpful.)

Judging from evaluation responses, participants valued speakers who frankly shared their personal experiences, speakers who reaffirmed that the road may be hard but is drivable, and speakers who believe women can write the book rather than read the old one. They welcomed the shift in tone halfway through from a rather negative picture of the field to a much more positive tone. They liked a balance between networking opportunities and professional/personal presentations. They liked getting some perspective on their careers, hearing new tips and strategies for achieving success, learning what to ask for and how to maneuver the system effectively. They wanted to know what issues their peers were facing. And they wanted clear handouts.

CODE: PD	STEVENS INSTITUTE OF TECHNOLOGY
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HRD 95-54196 (ONE-YEAR GRANT)	
PARTNER: WOMEN IN ENGINEERING PROGRAMS & ADVOCATES NETWORK (WEPAN)	
KEYWORDS: DISSEMINATION, ENGINEERING, ADVANCEMENT, MENTORING, CONFERENCE, SUPPORT SYSTEM, POLICY, ROLE MODELS, CAREER AWARENESS, BEST PRACTICES, PROFESSIONAL DEVELOPMENT	

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coll

Collaborating across campuses

COLLABORATING ACROSS CAMPUSES

THE COMMITTEE ON INSTITUTIONAL COOPERATION'S WOMEN IN SCIENCE AND ENGINEERING (CIC WISE) INITIATIVE ADDRESSED THE GOAL OF ACHIEVING GENDER EQUITY IN STEM ON 15 PARTICIPATING CAMPUSES BY ENLARGING THE POOL OF UNDERGRADUATE WOMEN PURSUING GRADUATE STUDIES IN STEM (PARTLY BY PROVIDING THEM WITH STRONG ROLE MODELS), BY INCREASING THE NUMBER OF WOMEN WHO PURSUE FACULTY CAREERS AND WHO ADVANCE THROUGH THE FACULTY RANKS, AND BY IMPROVING THE EDUCATIONAL CLIMATE FOR ALL WOMEN IN SCIENCE, ENGINEERING, AND MATHEMATICS.

Over three years, 553 STEM women and men participated in three student leadership conferences designed to help women develop the leadership and survival skills needed to succeed in academic environments. Participants reported gaining confidence, a sense of community, useful strategies, and the motivation to pursue their academic goals.

More than 200 faculty members and professional administrators attended "Best Practices" professional development workshops designed to help participants identify, adapt, and institutionalize best practices for recruiting, retaining, and advancing women in STEM. The emphasis was on how to transfer a successful project to a new institution and on how to provide the sustained support needed to fully implement the project on a new campus. Information about program content, climate, management, infrastructure, finances, and assessment was provided in enough detail so that attendees could adapt these programs on their own campuses. Workshops addressed classroom climate, undergraduate research and living/learning programs, mentoring, and staff development in WISE offices and provided vital networking opportunities across campuses. Most survey respondents reported taking action on return to campus by communicating ideas, initiating new programs, or expanding old ones. Some lacked authority to do so, and many reported that WISE-related work was just beginning on their campuses.

Travel grants of $250 from the CIC (matched by the institutions) were awarded to 412 students (20 percent of applicants) to help them present research findings at scientific conferences. *Presenting posters and papers at professional conferences is important to professional socialization in STEM disciplines but the cost of attending such meetings often prevents students from participating*. Travel grant recipients reported gaining confidence, exposure, and expanded networks. For some, it led to publication or to postdoctorate or faculty positions. *Women need to be visible at all major scientific conferences, both to benefit individually and to help erode stereotypes*, said many grant recipients.

There is strong evidence that all three activities of the CIC WISE initiative benefit both individuals and (most) institutions. How much the initiative affects a campus depends on the extent to which participants return to implement programs (the multiplier effect) and the institution's capacity to support the growth of WISE activities. Even low levels of participation can reap big returns in a "fertile" institution, whereas individuals returning to "arid" institutions rarely increase campus capacity. Progress toward institutionalizing WISE differs at various CIC institutions. Four participating campuses seem to be operating on a stable footing, and most are working toward institutionalization. Three have shown only minimal progress.

The CIC WISE panel coordinated activities across the CIC and promoted efforts on individual campuses. Conducting these activities through a consortium of similar institutions made them more effective, visible, credible, and accountable in ways not possible if the campuses had acted independently. *The advantages of a consortium appear to have been achieved: to bring new partners up to speed, to make WISE issues more visible, to leverage success through combined institutional support, and to achieve cooperation in a competitive environment*. The consortium and its activities have strong support from provosts and deans, who recognize how important it is to address the shortage of women in science.

CODES: U, PD	UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN
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www.cic.uiuc.edu/third_level/diversity_wise.html	HRD 95-55812 (THREE-YEAR GRANT)
PUBLICATIONS: BEST PRACTICES GUIDEBOOKS (EDITED BY JANE Z. DANIELS) ON THE CLASSROOM, ON UNDERGRADUATE RESEARCH AND LIVING/LEARNING PROGRAMS, AND ON MENTORING PROGRAMS; DEGREES EARNED BY CIC WOMEN IN SCIENCE, ENGINEERING, AND MATHEMATICS: BASELINE DATA 1966–1995 BY JESSE L. M. WILKINS AND JEAN E. GIRVES; AND EVALUATION OF THE OUTCOMES BY DIANNE BOWCOCK AND OTHERS.	
KEYWORDS: DEMONSTRATION, GENDER EQUITY AWARENESS, RECRUITMENT, RETENTION, WORKSHOP, PROFESSIONAL DEVELOPMENT, RESOURCE CENTER, LEADERSHIP SKILLS, SELF-CONFIDENCE, BEST PRACTICES, ADVANCEMENT, SCHOLARSHIPS, ROLE MODELS	

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The team approach to mentoring junior eaconomists

THE TEAM APPROACH TO MENTORING JUNIOR ECONOMISTS

ESTABLISHING MENTOR RELATIONSHIPS IS MORE DIFFICULT FOR FEMALE THAN FOR MALE ECONOMISTS, PARTLY BECAUSE OF THE LIMITED POOL OF SENIOR WOMEN IN THE FIELD WITH TIME TO SPARE FOR MENTORING. A ONE-ON-ONE MALE–FEMALE MENTORING RELATIONSHIP CAN BE MORE DIFFICULT THAN A SAME-SEX RELATIONSHIP, PARTLY BECAUSE WOMEN HESITATE TO APPROACH MEN ABOUT GENDER-RELATED CONCERNS; BOTH FEMALE REQUESTS AND MALE RESPONSES MAY BE MISCONSTRUED. MOREOVER, *TRADITIONAL MENTOR RELATIONSHIPS ARE HIERARCHICAL, AND THERE IS SOME EVIDENCE THAT WOMEN—ESPECIALLY WOMEN OF COLOR—LEARN BETTER FROM THEIR PEERS*. THIS PROJECT TESTED THE RELATIVE EFFECTIVENESS OF A TEAM APPROACH TO MENTORING (COMPARED WITH A ONE-ON-ONE APPROACH) TO HELP 40 NONTENURED FACULTY WOMEN MOVE TOWARD TENURED POSITIONS IN ECONOMICS.

At a two-day workshop designed to jumpstart the development of mentoring relationships, eight teams of nontenured faculty were matched with eight senior economists—tenured faculty women. The senior economists would not be overburdened with the attention the eight women needed because the other team members would help provide it. *The aim of the team mentoring was to help junior economists reach the rank of associate professor by teaching them the tricks of the trade about writing grant proposals, conducting publishable research, and earning the credentials needed for promotion into the upper ranks of major Ph.D.-granting institutions*.

During the workshop (held at a 1998 meeting of the Allied Social Science Association), the teams rotated from small-group sessions to large-group sessions and back again. In the small-group sessions, one junior woman would summarize the work of another and the whole team would discuss it. The senior woman listened and provided more political than technical advice.

In the larger group sessions, two teams met to discuss the tricks of the trade. The four "CCOFFE klatches," as they were called (creating career opportunities for female economists), discussed doing research and publishing the results, grant writing, networking, and balancing personal and professional lives. By the end of the two-day period, each junior economist had heard valuable career information and guidance from all of the senior economists and with the help of their teams had developed short- and long-term action plans for gaining tenure.

The corporate world has successfully used teams to improve productivity, and schools have used cooperative learning groups to improve classroom performance. Cooperative learning groups share their resources and expertise to achieve a common goal that each member is equally responsible for. Did the team approach to mentoring work?

Project evaluators compared the progress of participants in the team approach with that of "matched pairs" in a control group of junior economists similarly situated in the profession, at similar points in the tenure process, with similar levels of achievement. Participants in the CCOFFE workshop made significantly more progress, publishing almost twice as many articles as women in the control group, making presentations at almost twice as many conferences, and being awarded more grants. The test will be whether the CCOFFE participants will be disproportionately awarded tenure in the coming years.

CODE: PD	Denison University
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HRD 97-10136 (one-year grant)	
Partners: The American Economic Association's Committee on the Status of Women in the Economics Profession (CSWEP), Allied Social Science Association`	
Keywords: dissemination, teamwork approach, mentoring, economics, workshop, advancement, cooperative learning, professional development	

APPENDIX

AAAS	American Association for the Advancement of Science
AAC	Association of American Colleges
AACU	Association of American Colleges and Universities
AAUW	American Association of University Women
ADVANCE	NSF pgoram: Increasing the Participation and Advancement of Academic Science and Engineering Careers
AIP	American Institute of Physics
APS	American Physiological Society
APS	American Physical Society
AWIS	Association for Women in Science
AYF	American Youth Foundation
CAD/CAM	computer aided design/computer aided manufacture
CAWMSET	Commission on the Advancement of Women and Minorities in Science and Engineering Technology (1999–2000)
CSWEP	The American Economic Association's Committee on the Status of Women in the Economics Profession
CWSE	Committee on Women in Science an Engineering
DNA	deoxyribonucleic acid
DOE	Department of Energy
DOT	Department of Transportation
EHR	NSF's Directorate for Education and Human Resources
ESL	English as a Second Language
ETS	Education Testing Service
FAA	Federal Aviation Administration
FIPSE	Department of Education, Fund for the Improvement of Post Secondary Education
GDSE	NSF program Gender Diversity in STEM Education (2003–present)
GIS	geographic information systems
GPS	global positioning systems
GRE	Graduate Record Exam
HHMI	Howard Hughes Medical Institute
HRD	Division for Human Resource Development in NSF's Directorate for Education and Human Resources
HOV	high occupancy vehicle lane
HTML	HyperText Markup Language
ISP	Internet service provider
IT	information technology
LEF	limited English Proficiency
MWIS	Minority Women in Science
NAP	National Academic Press
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCRW	National Council for Research on Women
NCSSMST	National Consortium of Specialized Secondary Schools in Math, Science, and Technology
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council at the National Academy of Sciences
NSF	National Science Foundation
OERL	Online Evaluation Resource Library sponsored by NSF
PDF	Publication data format
PGE	NSF program for Gender Equity in Science, Mathematics, Engineering and Technology (1999–2002)
PI	Principle Investigator
POWRE	NSF program Professional Opportunities for Women in Research and Education
PTA/PTO	Parent Teacher Association/Organization
PWG	NSF Program for Women and Girls (1993–1999)
SACNAS	Society for the Advancement of Chicanos and Native Americans in Science
SAT	Scholastic Achievement Test
S&E	Science and engineering
SECME, Inc.	Southeastern Consortium for Minorities in Engineering
SEM	Science, engineering, and mathematics
SPIE	International Society for Optical Engineering
STEM	Science, Technology, Engineering, and Math
SWE	Society of Women Engineers
TIGR	The Institute for Genomic Research
TWOWS	Third World Organization of Women in Science
URL	uniform resource locator
WEPAN, Inc.	Women in Engineering Program Advocates Network, Incorporated
WIE	Women in Engineering
WISE	Women in Science and Engineering
WISH	Women in Science and History

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