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ABSTRACT

This digest presents instructional strategies to accommodate visually impaired students in science classrooms and provides classroom examples for physical science, chemistry, and biology courses. The article concludes that prospective science teachers must become skilled in using resource materials and adaptive technologies that facilitate the accommodation of visually impaired students over the longer term. (Contains 19 references.) (YDS)

Science Instruction for Students with Visual Impairments ERIC Digest

By

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The preponderance of visually oriented and visually complex concepts and information in science classrooms poses significant challenges to learning among visually impaired students. Without systematic instructional attention to these challenges, science may seem inaccessible to many students with visual impairments. Unfortunately, Stefanich and Norman (1996) found that most science teachers and college science educators have little or no direct experience in teaching disabled students and often hold stereotypical views of what students with disabilities can and cannot do (p. 51). Nevertheless, 69.8% of those surveyed did not believe that it is unrealistic to expect a blind student to become a chemist (p. 18). How, then, can teachers help students with visual impairments reach their potential in science? Here the term *visual impairment* refers to *an impairment in vision that, even with correction, adversely affects a child's educational performance* (See *IDEA's Definition of Disabilities* at http://www.ed.gov/databases/ERIC_Digests/ed429396.html. For *An Overview of the Individuals with Disabilities Education Act Amendments of 1997* (P.L. 105-17), please see http://ericec.org/digests/e576.html.).

Suggestions for the Classroom

Students with visual impairments have the same range of cognitive abilities as other students, but instruction typically relies very heavily on vision. To accommodate visually impaired students, teachers should consider the following suggestions offered by the American Association for the Advancement of Science (AAAS, 1991), Cetera (1983), Dubnick (1994), Lunney and Morrison (1981), Smith (1998), Smith, Polloway, Patton, and Dowdy (1998), Wohlers (1994), Ricker (1981), and Ricker and Rodgers (1981).

- Translate course syllabi and materials into Braille and adaptive electronic media.
- Allow presentations to be audiotaped.
- Encourage direct conversation and speak directly to visually impaired students in a normal tone of voice.
- Refrain from using vague phrases, and be specific when giving directions.
- Provide large print copies of written materials for students with partial visual impairments. As far as possible increase visual contrast of written materials.
- Provide a wide range of hands-on learning experiences.
- Use real objects so that the student can experience them by touch.
- Allow students to explore in their natural environment.
- Supply students with tactile diagrams and graphs (by outlining with liquid glue).
- Use appropriate scale whenever possible.
- Orient visually impaired students by familiarizing them with emergency exits, chemicals, glassware, equipment, extinguishers, emergency showers, and eye sprays. This orientation might be best achieved by partnering visually impaired students with class volunteer s.
- Use Braille labels on chemicals and reagent containers.
- Keep laboratory aisles cleared, and do not leave doors half-open.
- Instruct other students in class to yield the right of way to visually impaired students whether or not they are using long canes.
- Provide ample space for the guide dog, if one is involved, and keep other students from harassing the dog.
- If possible, provide laboratory assistants or class volunteers who are willing to work with visually impaired students, reading directions or procedures, and guiding them through activities.

Provide assistive technologies whenever possible. Examples of assistive technologies recommended by AAAS (1991) include talking thermometers, voltmeters, timers and calculators, glassware with embossed numbers, sandpaper labeling for poisonous chemicals, and computers with voice or Braille output. Light probes and special adapters that transform visual and digital signals into audio outputs are also suitable for assisting visually impaired student in science laboratory settings. For more ideas regarding use of assistive technologies, from Braille generating software, scanners, Braille printers and embossers, screen-reader software, speech synthesizers, and closed circuit television, see Kumar, Ramasamy, and Stefanich (2001).

Classroom Examples

Physical Science

Wagner (1995b) described how to prepare tactile measuring tools for visually impaired students by photocopying sections of a meter scale onto transparencies, and pasting the cut sections into a meter long scale, and using staples or glue to emboss each centimeter marking. Here is a procedure for determining mass using a modified lever balance (cited in Carin, 1993): Cut out the bottom of the two pans of a lever balance making rings suitable for holding paper or plastic cups. Add a tactile balance indicator. Materials to be weighed automatically center in the cups, thus reducing discrepancies caused by relative positioning. Also, substances weighed can be kept in the cups, an added convenience in transferring materials. This modified balance could be used to verify that the mass of 50 ml of water is approximately 50 grams, and to understand the relationship between mass, volume and density of water.

Chemistry

Wohlers (1994) has suggested that computer interfaced instrumentation provides tools for mass-volume measurements, and talking calculators facilitate calculations. Qualitative identifications of certain non-hazardous materials could be made using the sense of smell (Keller, Jr., 1981). Chemical reactions involving colors can be identified using a colorimeter interfaced with a computer programmed to convert color signals into Braille outputs. Also, light probes interfaced with Braille computers can be used as detectors for determining end-points in volumetric analyses. Similarly, modified ultra-violet and infrared spectrophotometers can be used for chemical characterization.

Biology

Tactile modifications of preserved specimens and humanely prepared living organisms (e. g., live Cray fish with rubber tubing carefully placed over their pincers) could form excellent hands-on specimens in biology (Malone & DeLucchi, 1979). Ricker and Rodgers (1981) suggested modifying chromosome kits with "pop-it beads" using readily available tactile markers for teaching cell division. The suggested tactile markers include small plastic strips of various sizes and shapes to represent color codes, and holes to represent relative positions of chromosomes. Abruscato (1996) recommended the following activity to enable students with visual impairments to observe fish in an aquarium: Place inside the aquarium a slightly smaller plastic aquarium with drilled-in holes which functions like a sieve. As the student slowly lifts the inner aquarium and drains off the water into the larger aquarium, the fish will be trapped in the bottom of the inner aquarium. Now by the sense of touch the student can explore the fish. Supervision might be required in order to make sure fish are properly handled.

Over the Longer Term

According to the Working Conference on Science for Persons with Disabilities (Egelston-Dodd, 1995) "science faculties tend to be uninformed and often lacking in willingness to make accommodations for students with disabilities" (p. 95), and teacher education programs fail to provide field experiences in teaching students with disabilities. Both inservice and preservice teachers must become aware of the needs of students with visual as well as other disabilities (Lang, 1983; Stefanich & Norman, 1996). Prospective science teachers must become skilled in using resource materials and adaptive technologies that facilitate the accommodation of visually impaired students.

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Web Resources

Strategies for Teaching Students With Visual Impairments http://www.as.wvu.edu/~scidis/vision.html

Science Educational Information and Students With Print Disabilities http://dots.physics.orst.edu/~gardner/ScienceEd.html

American Foundation for the Blind: http://www.afb.org

National Federation of the Blind: http://www.nfb.org

American Council of the Blind: http://www.acb.org

National Association for Visually Handicapped http://www.navh.org

Blindness Resource Center: http://www.nyise.org/blind.htm

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