AUTUMN COLORS-HOW LEAVES CHANGE COLOR



The "Indian summer" days of autumn, when the days are clear and sunny and the nights cool and crisp, provide an almost irresistible lure to those who enjoy the outdoors. This type of weather is also the most favorable for a spectacular show of autumn colors, making this season of the year still more delightful.

Scientist don't yet fully understand all of the complicated actions-and even more complicated *inter*actions-involving pigments, sunlight, moisture, chemicals, hormones, temperatures, length of daylight, site, genetic traits, and so on that make for a perfect autumn color display. As research probes deeper and deeper into the basics of life, and more and more answers will be forthcoming.

But full understanding is not necessary to the enjoyment of the lovely days of autumn in forest, city, and countryside. Americans are blessed with many opportunities to see this yearly splendor.

The roads, trails, lakes, streams, and recreation areas of the National Forests are available for your pleasure.

The forest roadsides of autumn attract by far the greatest number of sightseers. But trails, often winding deep into forest solitude, offer special closeness to nature for hikers, backpackers, and horseback riders.

Streams and lakes add special enchantment in the fall for fishermen and boaters, and colorful backgrounds for photographers. The surfaces of quiet forest lakes double the colorful mantle of their surrounding hills.

Hunting in eastern forests often coincides with the peak of the color season, and the pleasure of just being out-of-doors in the golden days rivals the thrill of the hunt.

And even along city streets the colors blaze forth,

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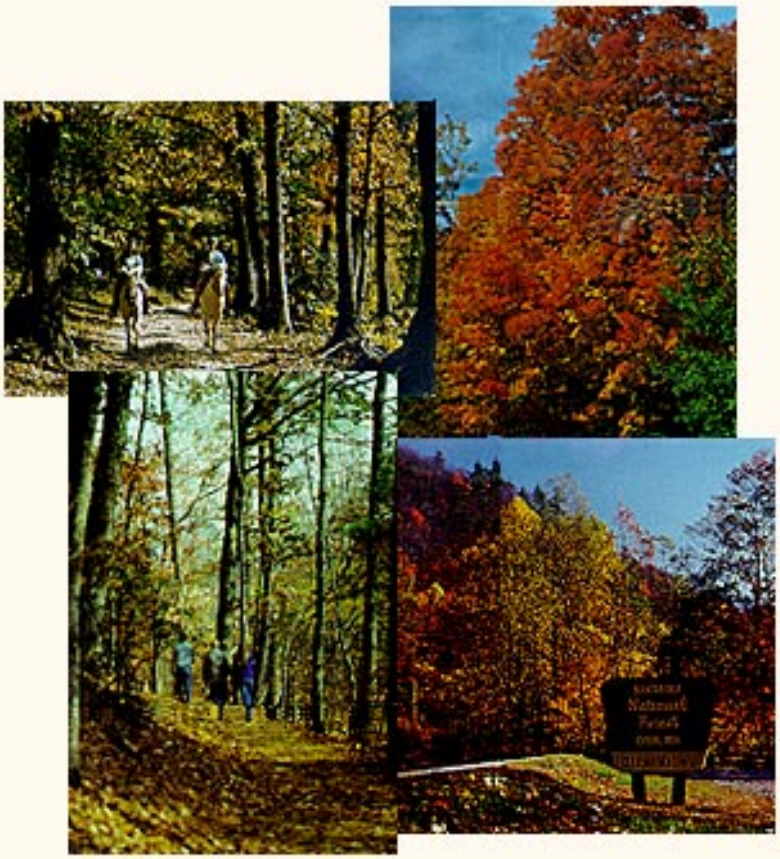
delighting residents of towns fortunate or farsighted enough to have retained some trees.



"Sweet and smiling are thy ways,
Beauteous, gold Autumn days."

Will Carleton



Each acres of 191 million on National Forest lands belongs to the people of the United States. Together, these acres represent a great treasury of natural resources.

National Forests provide a variety of uses, products, and pleasures for people. They were originally established to protect watersheds, and they still do. But in addition, these forest lands are now rich in timber, wildlife, forage, and recreation opportunities.

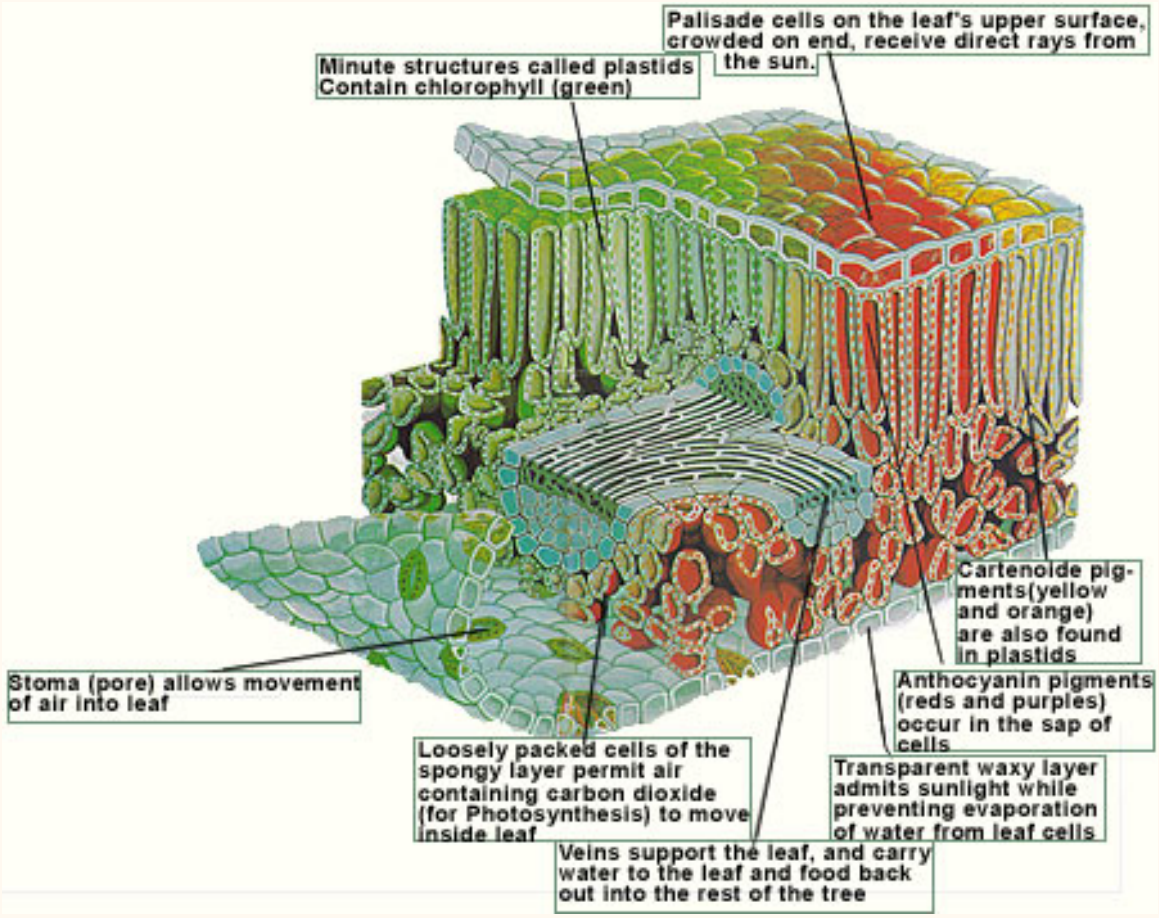
These and other uses are directed by the Forest Service, U.S. Department of Agriculture.

Specialists in many fields coordinate and balance these uses so that one doesn't interfere with another, and so that all Americans will receive maximum benefits throughout the years.

In addition, Forest Service research strives to find new and better ways of managing and using forests and their products. Also, through cooperation with State and with private owners of forestland, and Forest Service encourages the practice of good forestry throughout the Nation.

HOW LEAVES CHANGE COLOR

Click on HERE or on image for fuller rendition of illustration below. (It will be worth the wait — 34 seconds on 28.8 kbs)



A GREEN LEAF IS GREEN because of the presence of a group of pigments known as *chlorophylls*. When they are abundant in the leafs cells, as they are during the growing season, the chlorophylls' green color dominates and masks out the colors of any other pigments that may be present in the leaf. Thus the leaves of summer are characteristically green.

The chlorophylls have a vital function: they capture some of the sun's energy and utilize it in the manufacture of the plant's food - simple sugars which are produced from water and carbon dioxide. These sugars are the basis of the plant's nourishment-the sole source of the carbohydrates needed for growth and development.

In their food-manufacturing process, the chlorophylls themselves break down and thus are being continually "used up." During the growing season, however, the plant replenishes the chlorophyll so that the supply remain high and the leaves stay green.

But as autumn approaches, certain influences both inside and outside the plant cause the chlorophylls to be replaced at a slower rate than they are being used up. During this period, with the total supply of chlorophylls gradually dwindling, the "masking" effect slowly fades away. Then other pigments that have been present (along with the chlorophylls) in the cells all during the leaf's life begin to show through. These are *carotenoids* they give us colorations of yellow, brown, orange, and the many hues in between.

The reds, the purples, and their blended combinations that decorate autumn foliage come from another group of pigments in the cells called *anthocyanins*. These pigments are not present in the leaf throughout the growing season as are the carotenoids. They develop in late summer in the sap of the cells of the leaf, and this development is the result of complex interactions of many influences - both inside-and outside the plant. Their formation depends on the breakdown of sugars in the presence of bright light as the level of a certain chemical (phosphate) in the leaf is reduced.

During the summer growing season, phosphate is at a high level. It has a vital role in the breakdown of the sugars manufactured by chlorophyll.

But in the fall, phosphate, along with the other chemicals and nutrients, moves out of the leaf into the stem of the plant. When this happens, the sugar-breakdown process changes, leading to the production of anthocyanin pigments. The brighter the light during this period, the greater the production of anthocyanins and the more brilliant the resulting color display that we see. When the days of autumn are bright and cool, and the nights are chilly but not freezing, the brightest colorations usually develop.

Anthocyanins temporarily color the edges of some of the very young leaves as they unfold from the buds in early spring. They also give the familiar color to such common fruits as cranberries, red apples, blueberries, cherries, strawberries, and plums.

In our autumn forests they show up vividly in the maples, oaks, sourwood, sweetgum, dogwood, tupelo, black gum and persimmon. These same pigments often combine with the carotenoids' colors to give us the deeper orange, fiery reds, and bronzes typical of many hardwood species.

The carotenoids occur, along with the chlorophyll pigments, in tiny structures - called plastids - within the cells of leaves. Sometimes they are in such abundance in the leaf that they give a plant a yellow-green

color, even during the summer. But usually we become aware of their presence for the first time in autumn, when the leaves begin to lose their chlorophyll.

Carotenoids are common in many living things, giving characteristic color to carrots, corn canaries, and daffodils, as well as egg yolks, rutabagas, buttercups, and bananas.

Their brilliant yellows and oranges tint the leaves of such hardwood species as hickories, ash, maple yellow-poplar, aspen, birch, black cherry, sycamore, cottonwood, sassafras, and alder.



In late summer the veins that carry fluids into and out of the leaf are gradually closed off as a layer of special cork cells forms at the base of each leaf. As this cork layer develops, water and mineral intake into the leaf is reduced, slowly at first, and then more rapidly. It is during this time that the chlorophyll begins to decrease.

Often the veins will still be green after the tissues between them have almost completely change color.



Individual leaves, even of the same species, turn color in many different ways.

These maple leaves show both a complete change across an entire leaf (top), and partial change (bottom), with blocks of tissues turned brilliant red while adjacent areas still remain green.

Or, each leaf may be two or more colors at the same time. The yellow from the carotenoid pigments blends with the red from the anthocyanins.



When conditions of temperature, moisture, and the amount and strength of sunlight are all in the right combinations, we will be treated to spectacular fall colorations.

The entire trees blaze forth in vivid hues, along city streets as well as across the open countryside.







Occasionally clusters of leaves, or leaves of entire branches, will be in full autumn dress ahead of others on the same tree.

Certain species almost always lead off the autumn color display. On a yellow-poplar, a single leaf turns to clear yellow in late summer, hinting of the color season still weeks away.

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