Why Leaves Change Color

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Fact Sheet
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Autumn in the Northeast and Midwest can be a spectacular season of bright blue skies, cool temperatures, and brilliant leaf color. Over 170 million acres of land in the twenty Northeastern states are covered with trees and forests, giving us plenty of opportunity to enjoy fall color. These forests are a mix of conifers (cone-bearing trees such as pine, spruce, and hemlock) and deciduous trees (trees that lose their leaves each year such as maple, oak, birch, and aspen.)

You may have noticed that leaf color varies every year. Leaf color is most spectacular when the right combination of factors are present. Scientists don't fully understand all of the complicated interactions that cause the best display of leaf color, but they do know that leaf pigments, length of night, the type of tree, genetic variation, and the weather all play a role.

Where Do Leaves Get Their Autumn Colors?
Tree and plant leaves contain pigments that give them their color. Three pigments are involved in fall color:

- Chlorophyll — gives leaves their green color.
- Carotenoids — provide the yellow, orange, and brown colors
- Anthocyanins — give the red and purple colors. In contrast to the other two pigments, anthocyanins are produced in the autumn, in response to bright light and excess plant sugars in the leaf cells.

During the growing season, most tree leaves are green because they are full of chlorophyll. Plants use chlorophyll to capture sunlight for photosynthesis, the process that enables them to manufacture their own food. The amount of chlorophyll is so high during the summer that the green color masks all other pigments present in the leaf. As the days grow shorter in the fall, chlorophyll production slows down and eventually stops. The carotenoids and anthocyanins that are present in the leaf then become visible.

Do Different Kinds of Trees Turn Different Colors?

Certain colors of leaves are characteristic of particular species of trees.

- Oaks turn red, brown, or russet;
- Hickories turn golden bronze;
- Dogwood turns purplish red;
- Beech turns light tan;
- Red maple turns brilliant scarlet;
- Sugar maple turns orange-red;
- Black maple turns glowing yellow;
- Sourwood and black tupelo turn crimson;
- Aspen, birch, and yellow-poplar turn golden yellow.

Leaves of some species such as the elms simply shrivel up and fall off, exhibiting little color other than brown.

The timing of the color change also varies by species. Sourwood in southern forests can become vividly colorful in late summer while all other species are still green. Oaks put on their colors long after other species have already shed their leaves. These differences in timing among species seem to be genetically inherited. The timing of color change for certain species appears to be consistent regardless of local weather patterns or changes in latitude

Why Are Some Autumns More Colorful?

Temperature and moisture greatly influence autumn color. Since each of these vary greatly, no two autumns are ever alike. A succession of warm, sunny days and cool, but not freezing nights seems to bring about the most spectacular color displays. Since carotenoids are always present in leaves, yellow and gold colors are fairly constant from year to year. In order for the brilliant scarlet, purple and crimson colors to develop, bright sunlight in the early fall is needed. Bright sunny days increases food production in trees and plants. These sugars are trapped in the leaves spurring the production of anthocyanin pigments, providing the red tints to fall foliage.

The amount of moisture in the soil also affects autumn color. A late spring, or a severe summer drought, can delay the onset of fall color by a few weeks. A warm period during fall lowers the intensity of autumn color. Trees defoliated by insects during the growing season may also show less fall color.

Why Do Leaves Fall?

Deciduous trees drop their leaves in order to survive the harsh conditions of winter. Stems, twigs, and buds are equipped to survive extreme cold. Tender leaf tissues however, would freeze in winter, so plants must either protect their leaves or shed them.

The evergreens — pines, spruces, and hemlocks – are able to survive winter because they have developed a way to protect their foliage. Their needle-like or scale-like foliage is covered with a heavy wax coating and the fluid inside their cells contains substances that resist freezing.

Fallen leaves are not wasted, they decompose and restock the soil with nutrients. The rich layer of decomposing leaves protects the roots of other plants on the forest floor and absorbs and holds rainfall. Imitating nature by mulching with shredded leaves provides similar benefits for trees and shrubs in the home landscape.

Where and When is the Best Time to See Fall Color?

Generally, peak colors develop in late September for the Northern States and can extend from October through early November in the Mid-Atlantic and Southern Midwestern states. The National Forest System lands, State Forest and county lands provide ample opportunities for driving, hiking, and recreating in areas surrounded by fall color. For updates on fall color as well as scenic drives, call the USDA Forest Service's Fall Color Hotline: 1-800-354-4595.

For more information:
— Autumn Colors - How Leaves Change Colors
— Why Leaves Change Color

On-line Publications and Other Info. |St. Paul Field Office