Why Leaves Change Color In The Fall?

By George Plohn, who besides being a professional translator is also a chemical engineer

While leaves changing color in the fall is wonderful to watch, it does beg the question, “Why do leaves change colors in the fall?” What causes lush green leaves to suddenly change into bright yellow, orange and red leaves? And why trees change colors differently year to year?

Fall foliage is a phenomenon that affects the normally green leaves of many *deciduous trees* by which they take on, during a few weeks in the fall season, various shades of red, yellow, purple, black, orange, pink, magenta, blue and brown colors. Deciduous means "falling off at maturity" or "tending to fall off", and it is typically used in order to refer to trees that lose their leaves seasonally.

When leaves appear **green**, it is because they contain an abundance of the green pigment *chlorophyll*. Plants use the pigment chlorophyll to absorb the solar energy they need to perform photosynthesis, converting carbon dioxide from the air and water from the soil into sugars (glucose) and oxygen. There is so much chlorophyll in an active leaf that its green color masks the color of other pigments that are also in those leaves. Light intrinsically regulates chlorophyll production, so as autumn days grow shorter, less chlorophyll is produced. The decomposition rate of chlorophyll remains constant, so the green color starts to fade from leaves.

At the same time, surging sugar concentrations cause increased production of anthocyanin pigments. Leaves containing primarily anthocyanins will appear **red**. Carotenoids are another class of pigments found in some other leaves. Carotenoid production is not dependent on light, so levels aren't diminished by shortened days. Carotenoids can be orange, yellow, or red, but most of these pigments found in leaves are **yellow**. Leaves with good amounts of both anthocyanins and carotenoids will appear **orange**. Leaves with carotenoids but little or no anthocyanin will appear yellow. In the absence of these pigments, other plant chemicals also can affect leaf color. An example includes tannins, which are responsible for the **brownish** color of oak leaves.

Temperature also affects the rate of chemical reactions, including those in leaves, so it plays a part in leaf color change. However, it's mainly the light levels that are responsible for fall foliage colors. Sunny autumn days are needed for the brightest color displays, since anthocyanins require light. Overcast days will lead to more yellows and browns.

Eastern Canada and the New England region of the United States are famous around the world for the brilliance of their "fall foliage," and a seasonal tourist industry has grown up around the few weeks in autumn when the leaves are at their peak.

But eventually, the autumn leaves must fall. By the end of summer, they may be damaged by insects, disease or general wear and tear. They are equipped to self-destruct, isn’t nature wonderful? At the point where a leaf stem meets a twig or branch there is an array of cells called the abscission layer. As autumn days shorten, this layer begins to choke off the veins that move water into the leaf and food into the tree. Once the leaf is completely choked off, the layer becomes dry and flakey and, through decomposition, detaches the leaf from the tree.

Nature abhors waste, so it is no surprise that though leaves may fall to earth, they still have not outlasted their ecological role. As they decompose, their nutrients trickle into the soil and feed future generations of plant and animal life. In nature, nothing goes to waste!

Evergreens, on the other hand, trees that keep their leaves year-round instead of losing them all at once, have the ability to absorb light and water and hold both in reserve to

draw on when those vital resources are not available so that they grow and have a constant supply of energy that keeps them fully stocked with leaves all year long. They originated in cold, northern climates where the growing season (spring/summer) is very short. In order to survive in the shorter growing seasons, trees needed to gather light all year long. The only way to do this was to gather light for photosynthesis in the winter. Their leaves are much smaller than leaves on deciduous trees, and they have a wax-like coating that helps retain water and the fluids inside the cells contain chemicals that resist freezing. Evergreen needles are actually regular leaves that are rolled up very tightly. This shape is an adaptation that allows evergreens to conserve water necessary for photosynthesis. So then, let's look around and enjoy the view!