Fall Foliage: When Plants Reveal All Their True Colors

Most plant leaves appear to us in varying shades of green because they contain lots of a plant pigment called chlorophyll. Chlorophyll plays the vital role of capturing the energy contained in sunlight and transforming it into carbohydrates, such as sugars and starches. In the process, it releases oxygen. It isn't an overstatement to say that all life on earth depends on this beautiful green pigment!

Chlorophyll appears green to us because it *reflects* green wavelengths of light. Chlorophyll *absorbs* light in the red and blue parts of the spectrum — colors of light plants need to grow, bloom, and produce fruit and seeds. Plants really don't need much green light, so it's reflected rather than absorbed by the chlorophyll molecule. And because it's reflected we get to enjoy an infinite range of green hues in the gardens and fields and forests around us!

Hidden Hues Revealed

Chlorophyll isn't the only pigment contained in plant foliage, but it dominates. Other pigments, such as the yellow and orange carotenoids, are masked in most plants by the strong presence of chlorophyll.

However, come autumn, as the growing season winds down, chlorophyll's dominance wanes. The shortening days (or, more accurately, the lengthening hours of darkness) trigger plants to begin entering dormancy. One manifestation of this process is that chlorophyll begins to break down and the plant reabsorbs some of the elements it contains, such as nitrogen. No longer dominating the scene, the scarcity of chlorophyll allows the yellow and orange carotenoid pigments to take center stage and show their "true colors."

Carotenoid pigments include the familiar carotene — which gives carrots their signature orange color — as well as other pigments in shades of yellow and orange. All told, there are more than 600 types of carotenoids, including beta-carotene, a pre-curser to the vitamin A our bodies need. In plants, carotenoids may play an important behind-the-scenes role by acting as antioxidants, deactivating free radicals and helping prevent plant cell damage. They are believed to do the same in the human body, exhibiting important cancer-fighting properties. Compared to chlorophyll, carotenoid pigments take more time to break down, so their colors become visible in fall foliage.

Other pigments that make a showing in fall are the anthocyanins. These deep red pigments are responsible for the red hues of apples, cranberries, and strawberries, for example. They aren't hidden by chlorophyll's summertime dominance, however. Rather, these pigments are produced within plant foliage from a reaction between sugars trapped

in the leaf and certain molecules present in the leaf sap, resulting in a display of leaf colors that ranges from bright red to purple.

Weather Matters

Predicting the exuberance of the upcoming fall foliage display is a common topic of discussion among locals at general stores throughout Vermont, and it's likely the same wherever foliage colors brighten moods (and bring tourists) before the gray, pre-snow days of late fall (aka "stick season") arrive in earnest.

Fall foliage colors are influenced by a variety of factors, and theories abound about how and when one can predict fall color intensity. The formula for optimal color seems to involve a moist spring; a sunny but not-too-hot summer; and warm, sunny autumn days with cool — but not freezing — nights. Old timers might give a wink and add that one might want to add a bit of luck, and maybe even a touch of magic, to the formula.