Revealing the Chemistry of Fall's Foliage: What is Really Causing All Those Colors?

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Most hikers take the time to appreciate autumn foliage as leaves change from their bright green to the signature yellows, oranges, and vermilion that New Englanders enjoy every October, but few take the time to think about why the leaves change so drastically. We may see the bright colors of autumn and think that it is some excessive waste of resources just for a pretty color show at the end of the season, but in reality, it is a fascinating chemical process that has nothing to do with our viewing pleasure. The three major pigments that make up the leaf colors in autumn are chlorophyll, carotenes, and anthocyanins, each playing an important role in the tree's survival!

Photo credit: Trace Mansfield

Chlorophyll is responsible for the various shades of green seen in leaves from the summer to the start of fall. Chlorophyll is the pigment responsible for absorbing most of the light that the tree uses for photosynthesis. Being the tree's primary light absorbing compound, the tree makes lots of chlorophyll, dominating the color profile of the leaf for most of the year.

Carotenoids are responsible for the oranges and yellows we see as the leaves begin to change. If carotenoid sounds familiar, that is because of the pigment's prominence in its orange vegetable namesake. In leaves, carotenoids act as an accessory pigment, meaning they broaden the range of light wavelengths that the tree can use for photosynthesis. When the tree recognizes that it's time to lose its leaves for the winter, it stops producing chlorophyll, which breaks down quickly much like a piece of tissue paper left in the woods. In this analogy, carotenoids are more like cardboard, they break down, but much more slowly than chlorophyll. After the tree stops producing chlorophyll, all of the green pigment left in the leaf quickly breaks down, revealing the orange and yellow carotenoids that were hidden all summer long!

Photo credit: Trace Mansfield

Anthocyanins generate the signature crimsons and purples of fall and are unique in that they do not exist in the leaf until autumn. Anthocyanins require a lot of energy to produce, but play an incredibly important role in defending the tree against pests. Most insects, specifically aphids, do not have red light receptors in their eyes, meaning that once the tree fills its leaves with anthocyanin, they look completely black and diseased to the aphids. As a result, the aphids won't lay their eggs on the leaves, ensuring the tree gets a head start in the spring and does not have to share its sap with baby aphids.

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This week, when you're walking through the forest admiring the fall foliage, take a minute to think about the complex processes that created that change.

The Discover the Power of Parks Program is a collaboration between the New Hampshire Department of Natural and Cultural Resources – Division of Parks and Recreation, Student Conservation Association's New Hampshire Conservation Corps, AmeriCorps, and Volunteer NH.