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LIVING

# Magic in the leaves

## Fall colours have never ceased to amaze humans, make us wonder why they appear

There is a beautiful Native American legend that talks of hunters in the north sky who killed the Great Bear - represented by the constellation bearing the same name - in autumn, and its blood dripped down over forests coloring the maples red.

Later, as they cooked the meat, fat dripped from the heavens turning the leaves of the aspens and birch yellow.

Quite clearly, the fall colours have never ceased to amaze human beings and to make us wonder why they appear. Together with the cooler air and the dreamy quality of fall sunlight, so different from the light of summer, there's something about fall colours that lifts the spirits and provides a new-found energy.

**Drew Monkman**
OUR CHANGING SEASONS

Red maple

Karl Egressy photo

Maple leaves turning orange.

Karl Egressy photo

Karl Egressy photo

Aspen leaves turn colour.

This year, a spectacular colour show is being predicted, thanks to a relatively wet, cool summer that the trees loved. The foliage is thick, the leaves on most trees are healthy and there is lots of sunshine in the forecast until at least mid-October.

A basic understanding of how and why leaves change colour adds a great deal to our enjoyment of this annual spectacle. There's much more to the story than the leaves simply falling off as a reaction to cold. Colour change and the shedding of leaves are manifestations of a tree's preparation for winter. It is a coordinated undertaking on the part of the entire organism.

The first question to ask ourselves is why trees bother to shed their leaves in the first place? Since winter is a time of drought in which water is locked up in the form of ice, trees are no longer able to take up water through their roots. Because leaves are continually releasing water vapour (think of the high humidity of a greenhouse), trees must therefore get rid of their leaves in order to minimize water loss and desiccation.

However, if the leaves just froze in place and were blown off little by little by winter winds, the results would be disastrous. Snow and ice would build up on the foliage and branches and break off entire limbs.

The tree would also lose the minute but precious quantities of minerals originally obtained through its roots from the soil. These minerals are concentrated nearly entirely in the leaves since this is where most of the tree's chemical activity occurs. The minerals include magnesium (a key building-block of chlorophyll), nitrogen (a part of all proteins), phosphorous, and potassium.

The tree could never afford to lose all of these valuable substances each fall by simply allowing them to fall off with the leaves. This would leave the tree without an adequate supply of minerals to produce enough chlorophyll for its new leaves in the spring. Its still half-frozen roots could never absorb enough new minerals – remember, they are usually present in very small quantities in the soil – to do the job in time.

A complex process has therefore evolved to salvage as much of the mineral content from the leaves as possible and store it in the trees woody tissues before the leaves are lost.

The process of removing minerals begins as soon as the long growing days of June and early July are over, and the days slowly begin to grow shorter. By September, most of the trees have lost their ability to manufacture chlorophyll, since a large proportion of the essential minerals have already been removed by enzymes.

Chlorophyll is the green pigment that captures the sun's energy. Through the process of photosynthesis, it uses sunlight to convert water and carbon dioxide into the sugar-based substances like starch and cellulose that make up the tree's tissues – everything from wood and leaves to flowers and seeds. The tree replenishes the chlorophyll in the leaves all summer long, because it is continually being broken down by the very sunlight it absorbs.

We rarely pause to appreciate just how extraordinary and spiritually enriching it is that all of the plants around us have been created by the interaction of sunlight, water, and an invisible, odourless gas. And, if that's not enough, photosynthesis gives us life-supporting oxygen!

As summer progresses and the leaves produce less and less chlorophyll, colour change slowly becomes apparent.

A similar phenomenon occurs when the grass on your lawn yellows after a few days of being covered with a board or tent. With less and less chlorophyll there to conceal them, other pigments in the leaves gradually become visible. The yellows and oranges come from carotene pigments which have been present in the leaves all along. Leaves also contain another pigment known as tannin. It lingers longest and eventually gives all leaves a dull brown colour.

The stunning reds and purples, however, are a different story. They are produced by anthocyanin pigments which are created by excess sugars in the leaf.

These pigments seem to be brightest in years when there is lots of late summer and fall sunshine, accompanied by cool nights. Small amounts of anthocyanin are also produced even in June and July but are almost immediately destroyed by a special enzyme.

However, the cooler nights of late summer and fall slow the action of the enzyme and allow the red pigments to accumulate. Leaves getting the most sun produce the most sugars, hence the most red. Leaves in the shade are slower to change colour and usually never become as red.

Why evolution has favoured red pigments in only some types of trees is not fully understood. There is some evidence that the red pigments may serve as a sort sunscreen by absorbing sunlight that would otherwise damage the leaf's tissues and impede it from shipping precious minerals back into the woody tissues for storage until spring. Trees that do not produce red pigments may have evolved other, yet unknown, defences against harmful radiation.

The actual shedding of the leaves is achieved by the formation of an abscission layer between the leaf stem and the twig. This corky layer of cells makes it more difficult to transfer in the minerals the leaf needs to make more chlorophyll.

Eventually, the leaf's connection with the twig is broken and it falls off in the wind, rain or simply from the warming effect of the morning sun. You have probably noticed how squirrel nests, made up largely of leaf-bearing twigs nipped off the tree during spring and summer, will hold their leaves for years at a time. This is because the cork layer never had the time to form.

Bright sunny days and consistently cool – but not freezing - nights seem to be the recipe for the best fall colour. A few hard frosts, however, will cause the leaves to wither quickly and drop to the ground.

Frost kills the leaf's tissues and puts an end to the chemical processes that result in good colour production. An extended summer drought runs counter to good colour, as well. Because the tree lacks water for photosynthesis, it can't produce the sugars needed for intense red colours. Under drought conditions, colour change tends to come early and the colours are more muted. An extremely wet fall will also cause muted colours. There is also fear that climate change could put a permanent damper on the colour show. Since it tends to raise temperatures, especially at night, it may result in fall colours that are far less brilliant.

Fall colour follows a predictable timetable. Red and sugar Maples, which provide the most dramatic display of colour, usually reach their colour peak by the first week of October in the northern Kawarthas and at Thanksgiving further south.

What a wonderful coincidence that this special holiday falls precisely when the leaves are adorned in their autumn best. In addition to the intense reds of the red maple and the blazing yellows and oranges of sugar maples, some of the finest colour is provided by the white ash.

Its colour palette ranges from bronze-yellows to wine-purples. More so than any species I know, the leaves positively scintillate in the dreamy fall sunshine. Many of the ash are at or near their peak right now.

As we move into the second half of October, the reds and burgundies of white and red oaks will join the colour parade, accompanied by the bright yellows of aspens and, at month's end, the smoky gold of tamaracks.

Be sure not to miss the colour changes happening in the vines and shrubs as well. Virginia creeper, which loves to spiral over fences and wind up telephone poles, glows with some of the deepest reds. Dogwoods, viburnums, and blackberries provide a stunning display of reds, pinks, burgundies and purples. Staghorn sumac covers nearly all of the colour bases from yellows and oranges to luminous scarlets.

By mid-November, nearly all deciduous trees are leafless. Beech and oak are the last species to shed their leaves. Because they are both primarily southern species, they have an evolutionary history based on a longer growing season.

The leaves therefore tend to fall later. Younger trees and the younger branches on mature trees seem to hold their leaves the longest. They end up getting caught by a hard frost which kills the leaves before the abscission process is complete. The dead leaves often linger on the branches right into early spring.

Although there is spectacular colour to be seen just about everywhere, the Glen Alda area around Chandos Lake is often especially good.

Another beautiful colour drive is Highway 35 to Dorset where you can climb the fire tower and enjoy a wonderful view of the surrounding maple forests.

You can then carry on to Algonquin Park which is world famous for its fall colour. Be sure to take in the view from the observation deck at the visitor centre. To get twice-weekly updates on the progress of the fall colours throughout Ontario, visit www.ontariotravel.net, and follow the link to the Fall Colour Update.

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