How Do Trees Without Leaves Make New Leaves in the Spring?

Regular readers will not be surprised when I write about something in Nature that I find "amazing" since I find most everything about nature amazing. Here is yet another "amazing" Nature story.

We all know that deciduous trees (those that lose their leaves in the fall) put out new leaves in the spring. We know that plants do not get most of the materials they need to grow directly from the soil. We know that the way green plants grow is to carry out photosynthesis using energy from sunlight, water from the soil, and carbon dioxide from the air, and that it is the green material chlorophyll that makes it possible for the leaves to take these raw materials and convert them into new plant material.

The primary products of photosynthesis are carbohydrates, molecules made up of carbon, hydrogen and oxygen, the carbon and oxygen from the carbon dioxide and the hydrogen from the water wind up as atoms in the carbohydrate molecules, and the oxygen atoms in the water become molecular oxygen, a by-product of photosynthesis.

There are several types of carbohydrate molecules. Those that are considered structural carbohydrates make up plant cell walls in tree trunks, limbs, stems and leaves and include celluloses and lignin. Non-structural carbohydrates are smaller molecules and include sugars and starches. All carbohydrates are composed of the same basic building blocks produced in photosynthesis. Structural material (e.g. cellulose) can be made from the non-structural materials (e.g. sugars and starches) in the plant's cells.

When a tree begins to produce the first small leaves of spring, where does the material for these first leaves come from? Before there are any leaves, no photosynthesis can occur and thus no carbohydrates are being produced. So how can a tree without leaves make leaves?

The answer is that some of the smaller carbohydrate molecules such as sugars and starches were stored in the tree, mainly in the roots, during the previous summer and fall, and it is these stored non-structural carbohydrates that travel up the tree and out into the buds to become the first green leaves of spring. And for species that bloom early in the spring, much of the material of the blooms also comes from this same source of stored sugars and starches.

This process is not unique to trees either. Similar processes occur in all other perennial deciduous plants including grasses, forbs and shrubs.

This also explains why droughts during the summer and fall limit the amount of sugars and starches produced (remember, water is essential for photosynthesis), but the effect may not be obvious in the plants until the following spring.

It is important to note that photosynthesis is the source of energy that makes all of our lives possible. The raw materials for photosynthesis, carbon dioxide and water, are low energy compounds that cannot be used by plants or animals to maintain life. Only when energy from the sun is captured to make high energy compounds (carbohydrates), using chlorophyll as the catalyst, do we have an energy source that can sustain plant and animal life on Earth.

It is always fascinating to think about how a plant, with no brain or nervous system, manages to carry out different activities in different seasons. In spring sugars and starches are moved from the roots to the buds to make new leaves and blooms. Then during the summer and fall, the plant manufactures excess sugars and starches, some to be used to mature seeds and some to be stored in the roots for use next year. In late fall, the chlorophyll in the leaves degrades and the fall colors show up and later the leaves fall off.

Of course the timing of all of these different activities may be triggered by changes in temperature and/or daylight time, but the response of the plants to this trigger is programmed into the arrangement of four different nucleic acids along the DNA chain.

So everything you had for breakfast this morning either came directly from a plant via photosynthesis (the carbohydrates) or via subsequent conversion to fats and proteins either in the plant or, if you ate an animal product, in the animal that ate the plants.

And when you take a deep breath, it is only because of photosynthesis that there is oxygen in the air.

Until next time…

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