"Federation Corner" column
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Fabulous fungus
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As we roll into autumn, I want to remind everyone that fungi are the lifeblood of the forest. Indeed, without fungi, there would be no forests. There are four major roles fungi play in keeping the forest ecosystem healthy: (1) recycling deadwood, returning nutrients to the soil; (2) partnering with roots, to the benefit of both plants and fungi; (3) enhancing soil structure and carbon storage; and, (4) binding soil particles and linking trees

Many people with a bit of woods on their property feel the need to “tidy up” the forest floor, removing dead leaves and fallen branches. They think of these as waste materials which need to be disposed of. In reality, when we remove these food sources, we run the risk of starving our trees. Trees cannot grow on sunlight alone. They also need fertile, healthy soil. So where does healthy soil come from? The mineral components come from weathered rock fragments, but most of the nutrients come from organic matter. The breakdown and decay of dead organic matter like leaves, stumps, and branches is crucial for cycling nutrients and building soil structure.

Did you ever stop to think how something as massive as a 100 year old tree can return to the soil? Animals cannot digest lignin (the complex polymer that gives wood its rigidity). Certain fungi, however, can break down the lignin, providing a feast for a wide variety of soil organisms which further process the detritus, thus setting the stage for new growth and the next generation of plants.

Other types of fungi prefer a living substrate. Mycorrhizae (from myco meaning fungal and rhiza meaning root) form mutually beneficial associations of roots and fungi. There are two types of mycorrhizae, those that grow around the root hairs and those that actually live (partially) inside the root cells.

In both types, the fungus obtain sugars manufactured by the plant, and the plant receives phosphorus, nitrogen, and moisture through the fungus. The millions of tiny fungal threads massively increase the effective surface area of the roots, making them much more efficient at absorbing water and nutrients. Mycorrrhizae also help increase plant resistance to diseases. Some plants just grow better with mycorrhizae, but others depend upon them for survival. For example, this is why pink lady slippers usually die when transplanted from the woods–they cannot survive without their fungi partners.

Some mycorrhizae also produce a protein (called glomalin) that binds soil particles and stores carbon and nitrogen. Binding soil particles into “crumbs” is the basis of good soil structure; a mixture of crumbs and voids which permit air and water to penetrate soil.

In fact, some mycorrhizae create an extensive feeding web that goes far beyond the tree’s roots. This links the soil together, making it less likely to erode. It can also bridge the gap between food sources (or in arid climates) between scarce water sources. Such fungal mats have been found to physically connect trees, allowing them to share resources. Scientists have actually documented food from the mother tree being transmitted to her seedlings.

This can be essential for plant reproduction where light resources are scarce. A seedling may not be able to photosynthesize enough to grow on the shaded forest floor, but with the extra boost it receives by linking into the mycorrhizal mat it can grow and it can afford to wait for an opening in the canopy.

Recent research has also shown that trees (and other plants) communicate chemically. (Trees have had their own social media for millions of years.) When one tree is attacked by a pest, it sends a warning to nearby trees of the same species. I wonder if the fungal mat carries these messages as well as food and water.

“But wait (I hear you ask) aren’t there fungi that parasitize and even kill trees? What good are they?” Indeed, there are some species of fungus that get their nutrients at the expense of living plants. It turns out that fungal pathogens cause the most damage to single-species plantings (monocultures) and thus they are of greater concern in agricultural settings. In the forest, these fungi play the same role that wolves play for caribou. By preying on the sick and weak, the overall population is kept strong. Because of the pressure of predation, the prey population does not multiply beyond the area’s carrying capacity. So, even the parasitic fungi have a job to do.

Interestingly, a particular parasitic fungus is the largest (and possibly oldest) organism alive on the planet today. An Armillaria ostoyae occupies about 2,384 acres of soil in Oregon's Blue Mountains. This is the equivalent of 1,665 football fields, or nearly four square miles. Based on its current growth rate, the fungus is estimated to be 2,400 years old but could be as ancient as 8,650 years. This type of fungus attacks conifers at the roots, causing Armillaria disease.

In addition to all these ecosystem services, fungi are an important component of the forest food web. Soil organisms eat the fungi underground, and several species of ants and termites maintain fungus farms. Some ant and fungus partners have become completely dependant upon each other. Then there are the mushrooms, truffles, and earthstars. These above-ground fungi are actually the fruiting bodies of a much more extensive underground organism. When animals eat the fruiting bodies, they help distribute its spores, seeding a new generation. Thus fungi link the living soil, trees, shrubs, herbaceous plants, insects, people, and other animals together into an inter-dependant ecosystem.

So the next time you walk in the forest, try to imagine the millions of tiny fungal threads inhabiting the soil, dead wood, and roots all around you. Be grateful for this humble organism that stitches the forest together, creating new life from death. Try to imagine what it would be like if we were truly “plugged in” to our environment like the mycorrhizal fungi. We humans are so proud of our electronic communication networks, when all the time, quietly in the dark, a living internet has been there under our feet all along.

The views expressed in this column do not necessarily reflect formal positions adopted by the Federation. To submit an 800-1000 word column for consideration, send as an email attachment to montgomerycivic@yahoo.com