

Fungi in the Forest:

Community Creators



Photo credit: Killbear Provincial Park, NHE Staff.

Fungi have three major roles in keeping our forests healthy: decomposing wood and recycling nutrients back into the soil; decompose rotting; removing diseased and weak trees, and supplying nutrients to healthy trees to help them thrive.

DESCRIPTION

Without fungi, our forests not survive. Fungi have three main roles in forest ecology: rotting wood; parasitizing weak or diseased trees; and forming symbiotic relationships with trees.

Indoor Classroom Teaching/Learning

As a class, students are introduced to the ecological roles of fungi in the forest, relevant vocabulary, and various forms of the fruiting bodies.

Outdoor Classroom Teaching/Learning

In small groups, students search for and record information on four mushrooms.

As a class, students discuss their findings and hypothesize about the role of the fungi they discovered depending on which substrate the fungi were found growing.

Understanding Life Systems: Interactions in the Environment
Lesson for Grade 7 Science and Technology

Learning Environment:

Outdoor Classroom:

- Any forested area close to school

Prep Time: 15 min

Length of Lesson: 1.5 hours

Key Vocabulary: fungi, mushrooms, hyphae, mycelium, gill, pore

Staffing: 1 adult/5 students

Resources:

- 1 copy of the "Mushroom Worksheet" per student
- "Mushroom I.D." Sheet
- Clipboards and pencils (1/student)
- Hand lens - 1 per group
- Field guides: [The Audubon Society Field Guide to North American Mushrooms](#), [Mushrooms of Ontario and Eastern Canada](#) by George Barrons.

Groupings:

- Whole Class
- Small Groups

Teaching/Learning Strategies:

- Socratic dialogue
- Lecture
- Field Trip

Assessment Strategy: Learning Log

EXPECTATIONS

Overall Expectations

- 7s2 2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;

Developing Investigation and Communication Skills

- 7s6 2.1 follow established safety procedures for investigating ecosystems (e.g., stay with a partner, wash hands after investigating an ecosystem);

Understanding Basic Concepts

- 7s13 3.3 describe the roles and interactions of producers, consumers, and decomposers within an ecosystem (e.g. Plants are producers in ponds. They take energy from the sun and produce food, oxygen, and shelter for the other pond life. Black bears are consumers in forests. They eat fruits, berries, and other consumers. By eating other consumers, they help to keep a balance in the forest community. Bacteria and fungi are decomposers. They help to maintain healthy soil by breaking down organic materials such as manure, bone, spider silk, and bark. Earthworms then ingest the decaying matter, take needed nutrients from it, and return those nutrients to the soil through their castings.);
- 7s15 3.5 describe how matter is cycled within the environment and explain how it promotes sustainability (e.g., bears carry salmon into the forest, where the remains decompose and add nutrients to the soil, thus supporting plant growth; through crop rotation, nutrients for future crops are created from the decomposition of the waste matter of previous crops).

BACKGROUND

When we think about living things, we usually group them into either plants or animals. At first glance, fungi or mushrooms might seem to be plants. The mushrooms are stationary; they reproduce by spores, which are much like seeds; and they seem to have roots. But in many ways they are much more like animals: they have no chlorophyll to produce their own food; they actively forage for their food; and they can feel their surroundings. Unlike plants which are producers, fungi are consumers and decomposers in ecosystems.

In fact, fungi is its own kingdom of life! The most fundamental thing that makes a fungus different from a plant or an animal is the construction of cells. Cells are the basic building blocks of life. Every living thing is made up of tiny cells so if every cell is changed a little the compounding of this change can affect how species turns out greatly.

Animal cells, like those of humans, are somewhat round and squishy they kind of bunch together randomly and are held together into their shape by stretchy wrapping called membranes.

Plant cells have hard outer coverings, called cell walls. They are regular shapes and are well ordered. By connecting the cell walls and building stiff structures, plants are formed.

Fungal cells are something else entirely. They grow in long strings one after another - much like a string of beads. They have a hard outer wall like plants, but it is made out of different material. These cells are made chitin, the same material as an exoskeleton of an insect. Fungal cells have pores where they connect so that things can be passed all the way down the line. Individual threads of cells are called hyphae. The fungal cells look much like beads on a string. A bundle of a thousand strands of hyphae is no thicker than a single strand of human hair.

When the hypha bunches together so that you can see it, it's called mycelium. If you feel a piece of a mushroom you will notice it's spongy. This is because it is made of the hyphae threads all bunched together up tight together, much like steel wool.

Mushrooms: The Tip of the Iceberg

However, the mushroom is only a tiny part of a fungus. A mushroom can be thought of as the tip of the iceberg. Most of what makes up a fungus is the long, spreading hypha all throughout the substrate. A

substrate is substance a fungus grows on. This can be something like a rotting log, dirt, or a living tree. The hypha spread out through the substrate looking for nutrients, somewhat like roots.

These networks of hypha can spread for many kilometers and survive for centuries. Sometimes if you poke around in a rotting log you can see the bunched hypha or mycelium running through the wood.

Once a fungus finds nutrients, how does it “eat” it? A fungus does it in very much the same way as a spider digests its food. The tips of the hypha excrete digestive juices which dissolve the food into liquid and they suck it all up through their cell walls like a sponge.

If most of a fungus is hidden in the substrate what is a mushroom for? Why would a fungus go to all the trouble of making this strange and complicated structure if it had all it needs hidden away almost invisible and dissolving its food away contentedly?

Why Mushrooms???

So the question is, why mushrooms? Well the word used for mushrooms, or any of those fungal masses that you see that don't necessarily have a cap and stalk, is **fruiting body**. A mushroom or fruiting body acts like a fruit in a real plant.

The fruiting body contains the seeds for a mushroom which are called **spores**. The spores develop in special cells inside the mushroom and are released when they are ready. Although a spore can be compared to a seed in their function, they are not physically much like a seed at all. Unlike most plant seeds, a spore consists of one single fungal cell. Sometimes the walls of the fungal cell are thickened for protection. The spores can be many different shapes and all sorts of colours. Spores are only single cells so they are very tiny and can't be seen without a microscope.

However, if you collect a large amount of them they appear as dust. One way to do this is to do a spore print by taking off the stem, waiting a couple of hours.

Spores can be many different colours and some mushrooms that at first appear the same can be distinguished by their different coloured spores. Most mushrooms enthusiasts will do a spore print before trying identify a fungus. Spores come in white, yellow, brown, black, pink, and even purple or green.

A mushroom's sole purpose is for reproduction. In order for a fungus to be successful, its fruiting body must do its job. The first way to do this is to produce



Photo credit: Killbear Provincial Park, NHE Staff.

The fruiting bodies of fungi come in a variety of shapes and sizes. Most of the time when we think of fruiting bodies we think of the typical cap shaped mushrooms, but there are many other shapes!

as many spores as possible. The key to spore production is surface area. Spores must be produced on a surface that is exposed to the air so that when the spores ripen they can be carried away in the breeze or distributed by insects or animals. Many mushrooms are built like miniature skyscrapers. The main determining factor of the shape and component of a fungal fruiting body is the maximization of surface area to produce spores while using a limited amount of forest floor to maximum efficiency.

Fungi – Three Vital Roles

Many people think of fungus as something that kills trees and grass, rots your bread and toenails or maybe just something weird that grows on your lawn and tastes good on pizza. However, fungi play three extremely vital roles in the ecosystem. 90% of the **biomass**, the combined weight of all living things, in forest soil is fungi. In other words, if you were to weigh all of the living matter in forest soil, 90% would fungus. The rest is bacteria, small plants, and seeds and such. That's quite large piece of the pie! What's all that fungus doing there? Surely it can't all be killing plants. There are three different roles fungus plays in ecosystems: saprotrophic, parasitic, and mycorrhizal.

Role One: The Great Rotter

Most of the fungi you see in the forest is **saprotrophic** fungi, or **decomposers**. Fungi are some of the best decomposers out there. If it was not for decomposers anything that fell on the forest floor would stay there. The forest would be smothered in dead leaves trees and animals and no nutrients would ever be returned to the earth for new living things. Instead, fungi breaks down dead things and turns it into the best food a plant can get. Fungi is especially good at decaying wood. The hypha wiggle their way all

through the dead matter such as logs and use their digestive enzymes to break down the dead wood and recycle it into nutrients that plants can use.

Wood rotting fungi can be seen throughout the forest as brown and white rot. While we humans cannot break down cellulose and lignin, the main structural components of wood, fungi can.

Brown rot removes the white, pulpy cellulose leaving the brown lignin untouched. While white rot attacks the brown lignin, leaving the cellulose intact, giving the wood a white appearance.

Role Two: Getting Rid of the Weak

Parasitic fungi feed off the energy produced by other living things. An example of parasitic fungi would be the fungal infections you get on your feet. Some mushrooms growing near trees take nutrients from tree roots. These fungi may seem bad; however, in a natural ecosystem their role is important. Just like diseases, parasitic fungus keeps plant and animal populations stable and healthy. Weak individuals are killed or weakened so that they cannot reproduce. As a result the strong pass on their healthy traits.

Role Three: Friend of Trees

Looking at some of the huge, old white pine in the area, people may think that these particular trees effectively used their own roots to take up the water and nutrients necessary for their survival.

However, fungi also have a role here. The last role is the most fascinating – *mycorrhizal* fungi!

Many people believe that forest trees take up water and nutrients through root hairs. This belief is quite wrong. The trees need their associated fungi in order to survive. Each individual tree has hundreds of thousands of kilometres of hyphae associated with its roots. It is these mycorrhizal fungi that supply the tree

with the nutrients and water that it needs for healthy growth.

This is a good arrangement for the trees, but what does the fungi get for their efforts? The trees in exchange give the fungi sugars that are manufactured through photosynthesis in its leaves. Using this sugar for energy, the fungi maintains their presence as a hyphal grid through the soil to supply the trees. Some of these tree sugars are even used to produce fungal fruiting bodies, or mushrooms.

Fungi and the Forest

Without fungi, our forest would not be healthy. Fungi are needed to decompose rotting wood, remove diseased and weak trees, and supply nutrients to healthy trees to help them thrive.

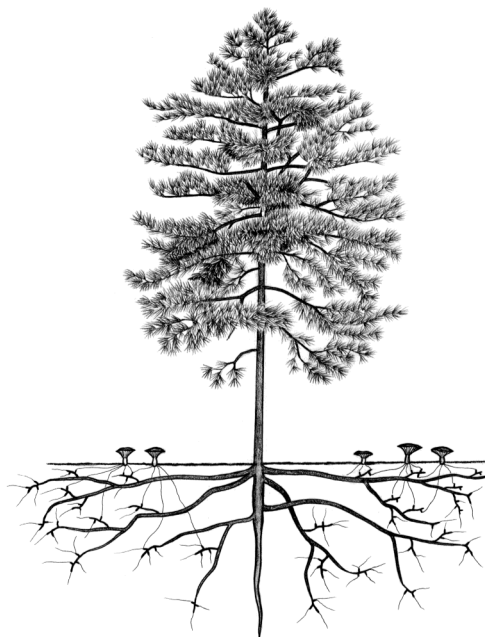


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Pine tree with mycorrhizal fungi - the fungi that help our forest trees survive and thrive!

Each individual tree has hundreds of thousands of hyphae associated with its roots.

DYI.....

The largest mushroom in the world is a parasitic fungus found in Oregon. It is a honey mushroom (*Armillaria ostoyae*) mycelial mat that covers a mountaintop of more than 2400 acres and is possibly 2,200 years old!!

HAVE YOU EVER.....

been walking through the woods at night and noticed something glowing? It could have been "Foxfire" or bioluminescent fungi. We have a species of Honey Mushroom here (*Armillaria mellea*) that can glow in the dark – often found on oak trees. This type of fungi stains the wood bluish-green.

TEACHING/LEARNING

In class teaching/learning (30 min)

1. **Socratic dialogue (15 min):** Introduction to Fungi. Bring in a white button mushroom for each student. Ask: *What do you think that fungi is? How would you define it?* (Kingdom of its own; structure of fungi versus plants and animals at cell level; spore versus seeds). *Why do you think that fungi is important in keeping the forest healthy? Why does the forest need fungi?* (Explain the 3 roles of fungi in the forest - decomposers of rotting wood; parasites of weak and unhealthy; and symbiotic companions of trees.)
2. **Lecture (15min):** Explain the basics of fungi structure: hyphae, mycelium, fruiting bodies (mushrooms), spores.

Outdoor teaching/learning (1 hour)

1. **Field trip (1 hour).** Explain safety guidelines: wear gloves, stay in group, define boundaries, and wash hands after field trip. (*Please note: Some mushrooms are poisonous and contain toxins that attack the liver causing great pain and possible death. Do not eat or taste any mushrooms.*)
2. Divide students into groups of 2 or 3. Give each group a "Mushroom Worksheet" and a "Mushroom I.D. Sheet." Explain that they are to find 5 mushrooms and to fill in worksheet. Mushrooms can be picked - as they are the fruiting bodies, it will not kill the entire organism.
3. As a class. Gather together and have each group present on their most interesting mushroom.
4. Conclusion. Ask students: *Were you surprised by anything when you were looking for fungi? What do you think the ecological role of your fungi might be depending upon the substrate that you found it growing?*

ASSESSMENT ACTIVITY

Learning Log. Students write about significant learnings from the fieldtrip.

EXTENSIONS

Historical Myths. Mushroom legends abound in many cultures. Students can research some of these stories and present to class.

Growing mushrooms. Conduct science experiments on the various environmental factors (substrate, humidity, temperature, and light) to see what type of conditions oyster mushrooms prefer. Mushroom growing kits are available at www.fungiperfecti.com.

Fungi and Restoration. Fungi can be used effectively in projects to restore soil that has been contaminated with oil products, especially wood-rotting fungi. Research the potential of fungi for this use. A good resource is: [Mycelium Running: How Mushrooms Can Help Save the World](#) by Paul Stamets.

Additional Resources

Online:

ON Nature - Nature Notes. Ontario's natural history magazine's companion geared to 10-12 year olds <onnaturemagazine.com/nature-notes>. Relevant to this lesson: 1989 Fungi.

North American Mycological Society - Education Resources. Lesson plans, professional site links, photographs can be found on this site <<http://www.namyc.org/education/index.html>>.

Thanks to:

James Nardi, University of Illinois
Emily Fells, William Beatty School

Made possible with funding from:

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TRILLIUM
DE L'ONTARIO**



17 George Street
P.O. Box 337
Parry Sound, ON
P2A 2X4

Phone: (705)774-0978
Fax: (705)774-0978
Email: education@gbbr.ca

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