

TTCD Lesson Plan (24): Mushrooms

Unit: Mushrooms	Grade(s): All	Class Size: 1-30	Lesson Duration: 1 hour	Location(s): Classroom
Topic(s):	Mushrooms, Decomposition, Plant Communication			
Student Prerequisites:	Lesson on composting			
Essential Questions:	What is a mushroom? What role do mushrooms play in the ecosystem? How do mushrooms break down organic material into nutrients plants can use? How do mushrooms help plants communicate?			
Student Objectives:	Students will learn what fungi is. Students will build upon the previous lesson on composting to describe how mushrooms break down organic material. Students will participate in an experiment to inoculate mushrooms, deepening their understanding of the ways in which mushrooms grow. Students will learn the important role of mushrooms in the ecosystem as communicators. Students will understand how all life forms, including human life, are connected through ecosystems on which they depend for their well-being and survival.			
Standards:	Supports NGS Standards: 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. Relevant NGS Disciplinary Core Ideas LS2.A: Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as			

	these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. Cultural Standards E.1: Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them by: recogniz[ing] and build[ing] upon the inter-relationships that exist among the spiritual, natural and human realms in the world around them, as reflected in their own cultural traditions and beliefs as well as those of others; E.2: Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them by: understand[ing] the ecology and geography of the bioregion they inhabit;
Local Context:	If teaching this lesson in the Spring, late Summer, or Fall, begin the lesson by going on a nature walk with the students. Bring a mushroom ID book with you to point out a couple of local fungi, making sure to specify what is edible and non-edible. Consider identifying the walk you will take and the mushrooms you will ID prior to taking the students out with you.
Vocabulary:	Fungi: Fungi are simple organisms, or living thing, that are neither a plant nor an animal. When there is more than one fungus they are called fungi. Some familiar fungi are mushrooms, molds, mildews, truffles, and yeasts. Mushroom: The visible reproductive structure, or fruiting body, of some fungi. Instead of producing seeds like the fruits of plants, mushrooms produce millions to trillions of microscopic spores. Mycology: The study of fungi, including yeasts, molds, mildews and mushrooms Ecosystem: An ecosystem is a community of living organisms (plants, animals, and microbes) interacting with each other and their physical environment (like water, soil, and sunlight) in a specific area. Decomposition: the process of breaking down or being broken down into simpler parts or substances especially by the action of living things (as bacteria or fungi) Symbiotic Relationship: A symbiotic relationship is any type of a close and long-term biological interaction, between two organisms of different species. Mycelium: A fungus generally consists of a mass of threadlike strands. This mass, called the mycelium, is the main body of the fungus. The mycelium absorbs nutrients and water, eventually leading to the formation of fruiting bodies like mushrooms.

Dena'ina language words:	
Materials:	The following materials are specified per student. Alternatively, you could pair students together with one kit. Alternatively, you could do one demo jar per class. € ~¼ cup of used coffee grounds (should be able to procure for free from a local coffee shop – these should be grounds brewed in the last 24 hours for ideal results) € 100ml (60g) Blue-grey mushroom grain spawn (available online: https://urban-farm-it.com/products/blue-grey-oyster-mushroom-grain-spawn?_gl=1*1sps3rb*_up*MQ..&gclid=Cj0KCQiA6LyfBhC3ARIsAG4gkF_UCz9FBeS2A5mtC9rgxi62ZS4aqLZlf-WJntHmqxSiulVg_TJUFnMaAiUOEALw_wcB) € A 32 oz glass jar with metal lid (sanitized) (lid needs 2x 1cm holes drilled/punched into it) € 70% Isopropyl alcohol wipes (available at pharmacies and online) € Micropore tape (available at pharmacies and online) € A large metal spoon € Print page 2 of this document for students: https://thinktv.pbslearningmedia.org/resource/ed908c89-de69-4140-82fb-921928bb6fe1/but-why-adventures-northeast-nature/ € Projector access to play videos.
Instructor Prep:	Sterilize the equipment for the experiment: • Wash your hands with soapy water, dry. • For the glass jar and metal lid, either wash and dry using a one-step cleanser and sanitizer like this (https://arcticbrewingsupply.com/collections/cleaners-and-sanitizers/products/one-step-cleanser-and-sanitizer) or wash jars and lids in hot soapy water. Shake off excess water and place on a baking tray. Place in a pre heated oven at 180C for 15 minutes. Remove the tray from the oven and allow the glass jar to cool before using. • Metal spoon: either wash and dry using a one-step cleanser and sanitize or submerge in boiling water for a couple of minutes. Allow to cool before using. • Work surface: Spray work surface with a regular antibacterial spray and wipe with kitchen roll. Then wipe down with an alcohol wipe. This experiment requires follow up feeding of coffee grounds to the mushroom spawn. Decide what style of experiment you want to do – one jar for each student, students paired up, students in small groups, the instructor does one demo for the class. If you are not in the school every day, consider conducting your own mushroom growing experiment at home or bring the demo you start in the class home with you to have a successful model to bring back weeks later. Alternatively, see if maintenance of the mushrooms plants can be maintained by the school staff. Check ahead of time.
Introduction:	Explain that today we are going to be learning about fungi.

Ask students: Does anyone know what fungi is? Can anyone give me an example?

Fungi are simple organisms, or living things, that are neither a plant nor an animal. When there is more than one fungus they are called fungi. Some familiar fungi are mushrooms, molds, mildews, truffles, and yeasts.

Fungi have a root like structure, kind of like trees, called **mycelium**. Can everyone repeat that word? A fungus generally consists of a mass of threadlike strands. This mass, called the mycelium, is the main body of the fungus. The mycelium absorbs nutrients and water, eventually leading to the formation of fruiting bodies like mushrooms.

Play this short video for students as an introduction to fungus:

<https://thinktv.pbslearningmedia.org/resource/ed908c89-de69-4140-82fb-921928bb6fe1/but-why-adventures-northeast-nature/> and print out page 2 of this pdf for students to fill out during the video:

<https://thinktv.pbslearningmedia.org/resource/ed908c89-de69-4140-82fb-921928bb6fe1/but-why-adventures-northeast-nature/>

As we learned from the video, fungi break down organic material, putting nutrients back into the soil. What word would you use to describe this?

Decomposition!

As a review, ask the class, why is decomposition important for soil?

Decomposition breaks down dead organic matter, releasing essential nutrients and carbon back into the soil, which are then available for plant growth and overall ecosystem function.

In addition to being critical to the ecosystem as a decomposer, mushrooms also act as communicators in their environments. Let's find out how! Watch this video:

<https://www.youtube.com/watch?v=iMMkEXvkMUU>

The relationship between trees and mushrooms is known as a **symbiotic relationship**! A symbiotic relationship is any type of a close and long-term biological interaction, between two organisms of different species. We are going to be learning about one type of symbiotic relationship called mutualism, the kind mushrooms have with trees. Can anyone guess what that means?

A mutualistic symbiotic relationship is one where one organism benefits from the association while not harming the other organism. Trees and mushrooms (fungi) often have a mutualistic relationship, where both benefit, with the fungi helping trees absorb water and nutrients from the soil, while the trees provide the fungi with sugars produced through photosynthesis. Some other examples of symbiotic relationships include Bees and flowers: Bees collect nectar from flowers, providing them with food, and in the process, they pollinate the flowers, helping them reproduce. Anyone seen the movie, "Nemo"? Clownfish and sea anemones have a symbiotic relationship where

	the anemone protects the clownfish from predators, while the clownfish provides nutrients and helps clean the anemone.
Activity	1. Spoon the ¼ cup coffee grounds into your jar. 2. Open the bag of spawn and tip 60 grams into the jar and mix into the coffee grounds. Close the lid and cover the two holes with micropore tape. This allows the mixture to breath and stops bacteria and mould from entering the jar. Wipe the outside of the jar with an alcohol wipe. (Clean hands, sterile equipment, and sterile work surface are key at this stage.) 3. Provide a warm dark space for the mushrooms spawn to develop its root structure (mycelium). Now place the jar in a warm (18-20C) dark place. 4. Check your jar daily for signs of colonization. The coffee grounds will turn white and fuzzy when colonizing (likely 2-8 weeks). 5. When your grounds are completely white it's time to add another ¼ cup of recently used coffee grounds. Clean your hands and sterilize your equipment and work surface. Use an alcohol wipe to clean the outside of the jar before you open it. Spoon the grounds into the jar and level it off, do not mix into the existing grounds. 6. Close the lid, clean the outside of the jar with an alcohol wipe, and put the jar back in its warm dark place. Continue this process until the coffee reaches the neck of the jar. You need to leave a little gap between the bottom of the neck and the lid. 7. Blue and fuzzy means mould! The odd speck should be fine. 8. When the jar is completely white and fuzzy it's time to grow some mushrooms. Remove the lid of the jar, place in a bright and cool location (away from direct sunlight) and cover with a damp kitchen roll. Spray the kitchen roll with water daily to keep it damp. The drop in temperature, light and humidity will encourage the mushrooms to grow. Tiny mushrooms will appear and these are known as pinheads. When the mushrooms grow you can remove the kitchen roll. Mist as required to add a little humidity, you don't want the jar to fill with water so mist lightly. 9. The mushrooms are ready to harvest when the heads start to flatten out. Use your hands to twist off the full cluster of mushrooms. It should come off in one clump and not leave any stalks behind. 10. Mushrooms will produce a second and even a third harvest. Cover again with damp kitchen roll and repeat as above..
Wrap-Up:	Create four signs with a piece of construction paper: one reads 'PLANTS,' one reads 'ANIMALS,' one reads 'FUNGI,' and one reads 'ALL.' Tape each sign in a different part of the room where students can move to. • Gather students in the middle of the room. Explain that there are different types of organisms on Earth, such as plants, animals (including humans), and fungi. Each group has characteristics that are unique to them as well as characteristics that are shared.

	• State the following characteristics of organisms (see page 4), one-by-one: ○ I am a living being – ALL ○ I make mushrooms – FUNGI ○ I grow and change throughout my life – ALL ○ I help trees communicate underground - FUNGI ○ I have muscles that help me move - ANIMALS ○ I am known as a decomposer - FUNGI ○ Humans can eat me, but some of my family members are toxic – ALL ○ I can (safely) eat plastic - FUNGI ○ I usually use photosynthesis to make food – PLANTS • Students will decide which organism the characteristic belongs to by moving to the corresponding sign. Once all students have moved, reveal the correct answer. <i>Evidence of learning:</i> Students reflect on what they know about plants, animals, and fungi to move to the correct space in the room. Ask the class, what surprised you most about fungi? Ask the class, what do you think is the most important feature of fungi? Any relevant answer could work here. Students could say fungi as sources of food, tree communication, fungi as decomposers.
Lesson Adaptations:	Consider starting the mushroom inoculation project weeks earlier at home so you have a finished version to share with the class and everyone can try eating a mushroom. Consider bringing in a hot plate or stove to cook up some mushrooms for the students to try.
Extensions:	1. Consider doing the drawing exercise on page 6 of this booklet, asking students to compare mushrooms communities to their school community: a. Page 6: https://assets.vermontpublic.org/files/butwhy/2-October-But_Why_Mushrooms_Lesson_Plan.pdf 2. Expand the lesson plan on mutualistic symbiotic relationships to learn about all symbiotic relationships. Play this video and end it at minute 1:59: https://www.youtube.com/watch?v=EnB0Ly7RAFM a. Ask the class to give out examples of mutualistic, parasitic, and commensalistic relationships – they can even be a made-up example of relationships between the students. For example: two students trading one part of their lunch each day would be a mutualistic relationship because both parties benefit.
Reflections:	How did it go? What did students understand most/least? What could change about instruction or lesson plan?

Resources Used:	Fungi Web of Life: Educator's Guide How To Grow Mushrooms in Coffee Grounds Oyster Mushroom Spawn Ordering But Why: Mushrooms Lesson Plan and Packet Exercises Symbiotic Relationships of the Sea YouTube Video: What is symbiosis? But Why Video: Introduction to Mushrooms YouTube Video: How Trees Talk to Other Trees with the Help of Mushrooms
------------------------	---