Is There A Fungus Among Us?

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Grade Level:
1 through 4

Discipline:
Life Science (Mycology)

Goals:
To introduce students to terms associated with fungi
Observe and conduct experiments with fungi
Discuss the role of fungi and yeasts in nature and their use
Provide a historical background of fungi and plant diseases
Discuss the scientific method and safe laboratory practices

Objectives:
Identify the various parts of some fungi
Grow fungi in the classroom
Create graphs documenting fungal growth
Maintain a journal
Identify components of the scientific method
Write a poem incorporating some mycology terminology

Background:
The understanding of the role of fungi in the drama of human existence began in the mid 19th century. A blight of potatoes spread across Europe in 1845. During the decade of the 1840's, the blight of potatoes resulted in the starvation of one million Irish peasants. Scientists of that era debated whether the fluffy fungus found on the rotted potato leaves and vines was the cause of the disease or a product of the dead plant. In an important experiment, a German botanist, Anton deBary, proved that the fungus contributed to the blight. The blight was named ***Phytophthora infestans*** by deBary. ***Phytophthora*** comes from the Greek (***phyto*** = plant and ***phthora*** = destroyer), and the species name, ***infestans***, refers to the infection. The disease is also known as late blight, and it sometimes attacks tomatoes in the backyard garden. The study of fungi was recognized as a new scientific discipline, now known as mycology.

In spite of the problems caused by plant pathogenic fungi, the fungi are necessary for our survival. Saprophytic fungi decompose dead plants and waste produced by our society. Other fungi add flavor to our food, such as flavoring different cheeses their flavor. It is the fungi that give different types of cheeses its flavor. The related yeasts ferment grape juice and grain extracts into wine and beer, whereas others are used to make bread. In bread making, the desired product is carbon dioxide gas and flavors, instead of alcohol. When grown in culture, some soil-borne fungi produce powerful antibiotic drugs such as penicillin and streptomycin. The mycorrhizal fungi coexist with tree roots and aid the trees by providing them with nutrition. In the fall, some mycorrhizal fungi produce mushrooms. Some mushrooms are delicious to eat, while others contain toxic poisons.

The fungus ***Sclerotium rolfsii*** is a common plant pathogen that is easy to grow. This fungus is ideal to work with in the classroom since it will quickly grow on many things and and does not produce spores that may cause allergies. As the fungus grows, students can record the growth of the fungus and observe how the fungus seeks out food. Students can watch the fungus decompose plant tissue. Cool temperatures will slow down the fungus. By placing growing cultures of the fungus in a refrigerator, students will learn why we store food in cold locations. Instead of mushrooms when the food supply is gone, this fungus produces sclerotia. The sclerotia function in the same manner as seeds. This fungus is also found sometimes in the home garden rotting the lower stems and leaves of many vegetables.

Introduction to the World of the Fungi - Lesson 1. Science
Materials: mushrooms and moldy foodstuff
Approximate time: 45 minutes

Mushrooms from the store or wild mushrooms, moldy food (such as cheese or fruit) can be brought into the classroom for examination. Learn how the fungus got on the food. Determine what the fungus is doing. Introduce students to the function of fungi in our world. Begin the process of identifying the parts of the fungus, such as mycelium and spores. Provide examples of both fungi and non-fungal items. Ask them if they can identify a fungus. Let them explain the characteristics that they used in their identification.

During this lesson, prior knowledge of the students should be assessed by asking them what they know about fungi. Create a list of their responses and a list of questions they would like answered. Additional questions should be added during the entire unit and used as part of the final evaluation.

Parts of the Fungi Lesson 2. Science
Materials: Store-bought, fresh mushrooms, and a heavy-duty plastic knife for each group
Approximate time: 45 minutes

During this lesson, students will have the opportunity to dissect a fresh mushroom. The students will learn the parts of the mushroom such as the cap, gills, stem, and mycelium. The function of each part will be explained. The cap or the top of the mushroom protects the gills. The gills are the structure that produce the spores, and the spores are similar to seeds. Although they are microscopic, they can produce a new mushroom under the right conditions. The spores germinate into mycelia which are root-like threads that usually grow underground, similar to a root.

The Spores of the Mushroom Lesson 3. Science/Art
Materials: mushrooms collected from outside, knife, white paper, and black paper
Approximate time: 45 minutes

This lesson is a follow-up to the previous lesson. Spores are microscopic, but in large numbers they can be seen. The spores are released from the gills. A spore print can be made from a fresh mushroom cap with gills. This demonstration should be performed in September when wild mushrooms can be found outside. The common, white, store-bought mushrooms are not the best choice for this demonstration because they have been bred for taste, not spore production. Later in the fall, unusual mushrooms can be purchased in specialty food stores, and sometimes they will produce good spore prints.

Procedure: A sharp knife is used to cut off the stem close to the lower surface of the gills. Place the mushroom cap, gill side down, on two pieces of paper. One half of the mushroom cap

should be over white paper, the other half over black paper. Cover the mushroom cap and paper with a bowl or box. Let it remain undisrupted overnight. Next day, remove the mushroom cap to see the spore print. Spores come in many colors: white, olive, cream, yellow, brown, and black. To preserve the spore prints, the paper can be taped together and sprayed with lacquer to preserve them.

The Role of Temperature in Growing a Fungus Lesson 4 and 5
Science/Journal Writing
Approximate time: 45 minutes
Materials: petri plates, squash slices, thermometer, sclerotia of the fungus ***Sclerotium rolfsii,*** and access to a freezer and a refrigerator.

This lesson will introduce students to the process of growing a fungus and the influence of temperature on its growth. The students will have the opportunity to infect a piece of plant tissue (known as the substrate), with sclerotia of a fungus, (known as the inoculum). The students can observe the growth of a fungus.

Procedure: Place small slices of a squash in a petri plate. Carefully place two sclerotia of the fungus on the center of the squash slide. Cover the plate and leave it at room. In three days, the fungus should be growing over the surface of the squash. This can be done on a Friday, so that the students can observe the new fungal growth on Monday.

On Monday, place some of the plates in areas of different temperatures, such as in a freezer, in the refrigerator, at room temperature, and on top of the refrigerator near the warm coils. Tell students that they are going to conduct an experiment and introduce them to the scientific process. Ask the question, "How will different temperatures affect the growth of the fungus?" Ask the students to make an educated guess, a hypothesis. What do they think will happen to the fungus? These questions should be written and answered in the student's journal.
This experiment will dramatically show the role of low temperatures in delaying the growth of fungi and show why we store perishable food items in the freezer or refrigerator.

Recording Data Lesson 6. Science/Math
Approximate time: 45 minutes on the first day, 20 minutes during the experiment for recording data
Materials: worksheets, rulers, and thermometers

This lesson will introduce students to the concept of recording data and making accurate scientific observations. Students will measure the diameter of the fungal colony on the squash slice. The diameter of the colony should be recorded on the worksheet everyday for a week or until the fungus colonizes the whole squash slice. Observations of the squash slice should continue to determine what the fungus does to the squash.

Procedure: Record the temperature of the freezer, refrigerator, room temperature, and warm location. Have students measure the size of the fungal colony in their petri plate using a ruler calibrated in centimeters. After the students have measured their colonies, record the data for each location and make a graph. The graph should have four lines, one for each of the different temperatures. The size of the fungal colony is plotted on the Y-axis and the time in days is plotted on the X-axis.

Table 1. Size of Fungal Colonies in mm

Time	Warm Area	Room Area	Refrigerator	Freezer

Day 1				
Day 2				
Day 3				
Day 4				
Day 5				

Writing A Scientific Report Lesson 7. Science/Language Arts
Approximate time: 30 minutes per day until reports are complete
Materials: worksheets

This lesson will introduce students to the methodology of writing a report.

Procedure: Have the students write a brief report. Review the hypothesis (what do you think will happen?). Complete the remainder of the report consisting of the materials and methods (how did you do the experiment?), results (what happened?), data (graphs), and conclusion (what did we learn?)

The Yeasts Lesson 8. Science
Approximate time: 1 hour
Materials: 2-liter soda bottle, sugar, package of yeast, water, and a balloon

This lesson will demonstrate the production of carbon dioxide gas by yeast as they consume sugar. This same gas is produced by yeasts in bread dough. Without it, bread would not have its characteristic texture and good flavor.

Procedure: Add 1 cup of warm water to the soda bottle and pour in 2 tablespoons of sugar. Dissolve the sugar in the water. Then add one package of yeast (available at grocery stores). Place the balloon over the top of the soda bottle.

As the yeast digests the sugar, it gives off carbon dioxide gas as a waste product of respiration, just as we exhale carbon dioxide. This gas is trapped by the balloon. The balloon will fill with gas after approximately 1 hour.

Historical Background of the Irish Potato Blight Lesson 9.
Social Studies/Language Arts
Approximate time: 45 minutes

This lesson will reinforce concepts learned while working with the fungi. It will show how fungi have affected human behavior.

Procedure: Locate Ireland on the world map, and identify the continent. Discuss the dependency of the Irish on the potato. Explain what happened when the potato crop was killed by the late blight fungus year after year. Ask the students to think about the situation today. Could something similar happen to us? What would happen if farmers could not use fungicides? Write a story about a fungus that can cause problems today and how it might affect us.

A Poem -- Cinquain Lesson 10. Language Arts
Approximate time: 30 minutes

This lesson will enable students to use their new vocabulary in the process of writing poems. A Cinquain has five lines, such as:

big
white puff
has no scent
delicious treat don't refuse
puffball

Procedure: The class can create one Cinquain together and then write one individually.

A Card Game Lesson 11. Language Arts
Approximate time: 45 minutes
Materials Needed: Set of thirty cards consisting of 15 with pictures and 15 with categories. The game cards should be constructed by the students

This lesson will stress recall skills.

Procedure: Distribute a game copy to each group.
Directions:

1. Place the 15 picture cards face down.
2. Stack the 15 category cards.
3. Players spin the spinner to determine order of participation. The player with the lowest number goes first.
4. First player picks card off the category deck. Player attempts to select a picture card that matches the category card. The player gets to keep cards that are correctly matched.
5. The player with the most card wins.

Evaluation: Students will select and answer four questions from the list they created in lesson one. Their questions and answers will be recorded in an 8-page booklet that they will make.

Advanced References:

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Miller, O.K. Jr., Mushrooms of North America. E.P. Dutton, New York, NY. 1987.

Schuman, G.L. Plant Diseases: Their Biology and Social Impact. APS Press, St. Paul, MN. 1991.

Annotated Bibliography:

Ardley, N. The Science Book of Thing That Grow. This book contains several experiments that demonstrate how plants, yeast and fungi grow, seeds germinate, and description of a spore print. Numerous safe and easy experiments are described.

Frahm, A. The True Book of Bacteria. This book serves as an introduction to biology for young readers. It explains the biology of bacteria, discusses the history of their discovery, and explains about their control. Included is a list of questions that can be used for further research.

Perry, P. Mushrooms. This is an excellent reference on mushrooms for the young reader. It explains how mushrooms grow, how to make a spore print and how to identify some common mushrooms.

Selsam, M.E. More Potatoes. This book provides a description of a research project into the life cycle of the cultivated potato from the farm to the dinner table. It made for enjoyable reading.

Van Cleave, J. Biology for Every Kid. This book contains numerous experiments that are easy to perform. It includes an application to join the Janice Van Cleave Science Club at no cost.

Acknowledgments:

American Business Directory

American Mushroom Institute, Kennett Square, PA.