



Fungus Among Us

from *The Science of Air Teacher's Guide* and for *Mr. Slaptail's Secret*

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BioEdSM

Teacher Resources from the
Center for Educational Outreach at
Baylor College of Medicine

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Indoor Air Pollution

Environment and Health Basics

Secondhand smoke is also called environmental tobacco smoke (ETS).

Exposure to ETS is sometimes called involuntary or passive smoking.

ETS contains more than 4,000 substances, several of which are known to cause cancer in humans or animals.

Children are particularly vulnerable to the effects of ETS because they are still developing physically, have higher breathing rates than adults, and have little control over their indoor environments.

Exposure to ETS can cause asthma in children who have not previously exhibited symptoms, and trigger asthma attacks or make symptoms more severe in those already diagnosed with asthma.

Asthma is the most common chronic childhood disease, affecting, on average, 1 in 13 school-aged children.

<http://www.epa.gov/smokefree/>

The “environments” in which we spend the most time are our homes, schools and offices. And although we tend to associate air pollution with outdoor environments, in many cases, levels of contaminants are higher indoors. Energy-efficient designs can cause certain substances in the air to become concentrated inside buildings. The Environmental Protection Agency (EPA) estimates that 30% of all buildings and homes in the U.S. contain enough pollutants to affect people’s health. For example, indoor air pollutants can be responsible for allergic reactions, infectious diseases, chronic irritation of parts of the airways, and toxic reactions (including damage to tissues and organs, such as the liver, central nervous system and the immune system).

Air pollutants are carried into our airways and lungs when we breathe. Our respiratory systems have a variety of defense mechanisms against pollutants. For example, particles can be filtered out in the passages of the nose. When particles are inhaled into the lungs, some are trapped in mucus and transported into the esophagus; others are surrounded and destroyed by special cells. Sneezing and coughing help prevent irritating gases and dusts from entering the rest of the respiratory system. Some gases that are inhaled into the lungs and absorbed into the bloodstream can be detoxified by the body.

Despite all of these defense mechanisms, some pollutants enter and remain in the body. Those that stay within the lungs can cause ongoing or periodic irritation. Materials absorbed into the bloodstream can be carried to other parts of the body, where they can damage organs, such as the kidneys or liver.

Prevention is the best way to avoid the build-up of harmful airborne substances in our indoor environments. Careful use of pesticides, cleaning compounds and other chemicals in the home reduces our exposure to potentially toxic gases and vapors. Maintaining cooling and heating systems properly, making sure that sufficient fresh air flows into buildings, and eliminating damp places where mold and bacteria grow all contribute to a healthier indoor environment.

COMMON INDOOR AIR POLLUTANTS

- Particles and chemical by-products of combustion (heating, cooking or smoking)
- Mites and parts of dead insects, like cockroaches
- Mold spores
- Animal dander
- Formaldehyde (chemical used in building materials, fabrics and foam insulation)
- Household chemicals (cleaners, pesticides, paints, etc.)
- Personal care products (hairspray, acetone in products like nail polish remover, etc.)
- Lead dust (from old paints)



Fungus Among Us

Environment and Health

CONCEPTS

- Fungi grow from spores.
- Fungi spores are present almost everywhere.
- Molds and other fungi grow in damp places.

OVERVIEW

Students will grow and observe bread mold and other kinds of common fungi.

SCIENCE, HEALTH & MATH SKILLS

- Predicting
- Observing
- Recording qualitative data
- Drawing conclusions

TIME

Preparation: 10 minutes

Class: One session of 20 minutes to set up cultures; daily 10-minute observations for 3–7 days; concluding session of 30–45 minutes to make final observations

MATERIALS

Teacher (see Setup)

- Transparency of “Common Bread Mold” student sheet
- Bread mold, *Rhizopus stolonifer* (optional, order from a science educational supply company)

Each group will need:

- Piece of old bread (see Setup)
- Pipet or dropper

Each student will need:

- Clear resealable plastic bag, 4 in. x 6 in. (or small jar or plastic container)
- Hand lens (magnifier) or 6 microscopes
- Disposable plastic gloves (optional)
- Copy of the student sheets

The old saying, “There’s a fungus among us,” contains an element of truth. There are at least 100,000 different fungus species, and members of the fungus kingdom (collectively known as fungi) are found almost everywhere.

Fungi, along with some bacteria and other organisms, are the decomposers of our world. They break down the remains of dead plants, animals and other living things and, in the process, obtain the energy they need to grow and reproduce.



Unit Links

Mr. Slaptail’s Secret
Science box, p. 20

Explorations
Let’s Talk About Indoor Air, pp. 2–3

Fungi are essential for the continued recycling of nutrients into the soil and the release of carbon dioxide into the air. However, fungi also can be a nuisance to humans. For example, fungi do not discriminate between fruits in a natural setting (such as those that have fallen on the ground) and fruits in the refrigerator. Many fungi

attack living organisms and are sources of disease in both plants and animals. Fungi grow especially well in damp places and can attack cloth, paint, paper, leather, cable insulation and even photographic film. The various fuzzy-looking fungi that grow on damp surfaces often are called molds.

Fungi spread by producing spores—tiny particles that can remain suspended in the air for long periods of time. The powdery appearance and bright colors of many kinds of molds actually are caused by the spores they have produced. Some fungi, such as yeasts, are one-celled organisms. Most, however, consist of mats of slender tubes or hyphae (singular, hypha). In some fungi, the hyphae are loosely packed and easy to see. In others, the hyphae are packed so densely that the structure appears solid. Mushrooms, the spore-producing parts of some fungi, are good examples of structures composed of these tightly packed filaments.

Inside buildings, fungi can grow in damp places, such as basements, shower curtains, food storage areas and window air-conditioning units. The spores produced by molds can contribute significantly to indoor air pollution and can trigger allergic reactions in some individuals. Fortunately, indoor air pollution from mold spores can be controlled by keeping humidity levels low (below 30%), by improving ventilation, and by keeping damp areas clean.

Bread mold (*Rhizopus stolonifer*) is a common fungus that is easy to grow and observe. In this activity, students also may see greenish colonies of *Penicillium* (the fungus that produces the antibiotic, Penicillin) and other related fungi.



SAFETY

While common molds that grow on bread generally are harmless, some students may be allergic to the spores they produce. Therefore, have your students observe the molds without opening the sealable bags or other containers in which they have been grown. Wear disposable plastic gloves if you plan to handle mold samples for demonstration purposes. Pour diluted chlorine bleach (10%) into the bags containing mold samples before disposal.

SETUP

A day or two before you plan to begin this activity, ask each student or group of students to bring a piece of bread to class (bakery-type or “natural” bread without preservatives works best). As an alternative, you may want to consider baking bread or having students bake bread at home with a parent as part of this activity (see p. 5–6 for recipes).

If you do not wish to grow bread mold in the classroom, pure cultures can be purchased. (See “Obtaining Fungi,” right sidebar.)

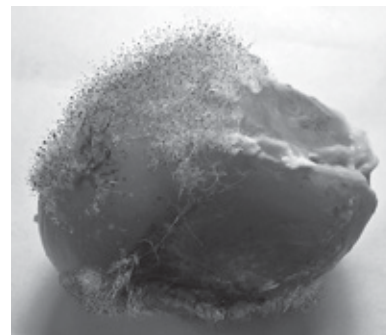
PROCEDURE

Part 1. Getting started

1. Hold up a piece of bread and ask the students if they know who or what might use it for food. Prompt them to consider all the possibilities. Follow by asking if they ever have seen a rotten apple, moldy slice of bread, etc. Point out that when something is rotting, other living things are using that object for food. Ask, *How do you think these living things spread from place to place?* Remind the students of the particles they observed in the “Make a Dust Catcher” activity. Mention that some of the tiniest particles in dust are produced by organisms as a means of spreading to other places. Tell students they will be able to observe some living things that spread in this way.
2. Have Materials Managers pick up materials for all members of their groups. Have each student label a container with a piece of tape on which the student has written his/her name.
3. Direct the students to examine their bread samples with a magnifying glass, and draw or describe what they predict will happen to the bread in the first space on the “Bread Mold Observations” sheet. In the second space, have students draw or describe the bread as it appears at the beginning of the investigation.
4. Each student should place the bread in his/her container and add a few drops of water. Store the containers in a dark corner or cupboard.

Part 2. Observations

1. For the next 3–7 days, have students observe their cultures



Rhizopus stolonifer (Black bread mold) is most commonly found growing on bread surfaces and on soft fruits, such as tomatoes (above). Because its spores are common in the air, this mold can be grown within a few days by keeping moistened pieces of bread in an enclosed, humid environment.

OBTAINING FUNGI

It is easy to obtain pure cultures of many kinds of common, non-pathogenic (non disease-causing) fungi. In addition to bread mold (*Rhizopus stolonifer*), other interesting members of this kingdom, including penicillin mold (*Penicillium notatum*), yeasts (*Saccharomyces sp.*) and common black mildew (*Aspergillus niger*), can be purchased on petri dishes (covered, clear plastic dishes) or in test tubes from commercial science educational supply companies.

Continued



A SOURCE FOR MEDICINE

Cyclosporin, a “wonder drug” developed in 1979, comes from a fungus that lives in soil. This medicine is given to organ-transplant patients so that their immune systems will not attack and destroy the new tissue.

USES OF FUNGI

- Yeasts (tiny one-celled fungi) are used for baking and the production of beer.
- Many fungi are sources of antibiotics and other medicines.
- Some kinds of fungi inhabit the roots of trees, crops and other plants, and help the plants take up nutrients from the soil.

QUESTIONS FOR STUDENTS TO THINK ABOUT

- Where can we find molds and other fungi in the natural world?
- What would happen if there were no fungi?
- What can we do in our homes to limit mold growth?

(with and without a hand lens) at one- or two-day intervals. Do not allow students to open the containers in which molds are growing. Some breads may grow mold in as little as 24 hours; others may require seven days or more.

2. Have students record their observations on their data sheets.

Part 3. Final observations

1. When all or most cultures (some breads treated with preservatives may not grow mold within the time allotted) have visible molds, instruct students to make their final observations.
2. As a class, decide how many different kinds of molds are present on the bread samples. Have students make a list of the characteristics they use to distinguish one mold from another. Prompt them to think about whether some molds seem to grow on certain types of bread. Ask, *How did the mold get to the bread?* (Spores were present in the air and landed on the bread.)
3. One fungus that will be present is bread mold. It consists of dark gray threads forming a loose, tangled mat that may reach a centimeter in thickness. Find several samples of bread mold from the class’s cultures, and give a container with bread mold to each group (see Safety, p. 3).
4. Have students observe the bread mold inside their containers with their magnifying glasses. They will be able to see the individual threads with small dark dots at the ends. The dots are the spore-producing parts of the fungus. (The actual spores are very tiny.) If you have access to microscopes, place a few strands of the bread mold (using forceps or tweezers) under microscopes for students to observe. Students will be able to see the tubular structure of the filaments (hyphae), the round, dark heads that produce spores and, depending on the magnification, some of the tiny, round spores. Project a transparency of the “Common Bread Mold” page to help students spot the different parts.
5. Conclude by leading a class discussion of the role of molds in causing indoor air pollution. You may wish to refer to the story, *Mr. Slaptail’s Secret*, in which Rosie, one of the characters, is allergic to mold spores.

VARIATIONS

- Have students invent names for the different kinds of molds they grew and create a key to identify each one.
- Make one or more kinds of bread with your students. Try using a recipe with baking soda for leavening, and compare the results with a recipe that uses yeast (a fungus). Mention that, in both cases, the bubbles in the dough are caused by carbon dioxide gas being released into the dough.



BREADS

Soda Bread

6 cups all-purpose flour
2 teaspoons baking powder
2 teaspoons baking soda
2 teaspoons salt
3 cups buttermilk (or add 2–3 tablespoons vinegar to 3 cups of milk, stir and use as buttermilk)

Optional: Mix 1 cup raisins or chopped nuts into dry ingredients.

Preheat oven to 375°F. Stir flour, baking powder, baking soda and salt together in a large bowl. Add buttermilk and stir to moisten the dry ingredients. Form the dough into a ball and knead several times. Shape the dough into two round loaves about $1\frac{1}{2}$ inches thick on a greased cookie sheet. Cut an “x” on the top of each loaf. Bake for 40 minutes.

BREADS

No Knead Bread

$1\frac{1}{2}$ cups milk	$1\frac{1}{2}$ cups water
$\frac{1}{2}$ cup vegetable shortening	3 packages dry yeast
$\frac{1}{4}$ cup sugar	3 eggs
2 tablespoons salt	$9\frac{1}{2}$ cups flour

Preheat oven to 350°F. Scald milk by bringing it just to the boiling point in a large, heavy pan. Add shortening, sugar and salt to hot milk. Let milk begin to cool and add water. When mixture becomes lukewarm, add yeast and mix well. Blend in the eggs and add half of the flour. Mix thoroughly. Slowly add the remaining flour. When the dough becomes too stiff to stir with a spoon, place it on a floured surface and knead briefly to blend ingredients. Shape into three loaves and place in greased loaf pans. Cover with a clean cloth and let rise for one hour, away from drafts. Bake for 45 minutes.



PAN

Pan de Soda

- 6 tazas de harina
- 2 cucharaditas de polvo de hornear
- 2 cucharaditas de bicarbonato de sodio
- 2 cucharaditas de sal
- 3 tazas de suero de leche (o añadir 2–3 cucharas de vinagre a 3 tazas de leche entera y mezclar)

Opcional: Se puede mezclar 1 taza de pasitas o nueces picadas con los ingredientes secos.

Precalente el horno a 375°F. Mezcle la harina, el polvo de hornear, el bicarbonato y la sal en un recipiente hondo. Vierta la leche sobre estos ingredientes. Amase todo rápidamente y forme una bola. Divida la masa en dos y forme dos círculos en una bandeja de horno engrasada. Aplaste el pan un poco con las manos. Con un cuchillo corte una cruz sobre la superficie de cada pan. Hornee por 40 minutos.

PAN

Pan Fácil

- | | |
|---------------------------|---------------------------------|
| 1½ tazas de leche | 1½ tazas de agua |
| ½ taza de manteca vegetal | 3 paquetes de levadura para pan |
| ¼ taza de azúcar | 3 huevos |
| 2 cucharas de sal | 9½ tazas de harina |

Precalente el horno a 350°F. Caliente la leche en una cazuela. Cuando la leche esté casi al punto de ebullición, añada la manteca, el azúcar y la sal. Deje que la mezcla empiece a enfriar y vierta el agua. Cuando la mezcla esté tibia, añada la levadura y revuélvala bien. Añada los huevos y la mitad de la harina y mezcle nuevamente. Poco a poco añada el resto de la harina. Cuando ya no se pueda revolver con una cuchara, ponga la masa sobre una superficie harinada y amase suavemente para terminar de mezclar los ingredientes. Forme la masa en tres panes y coloque cada uno en un molde engrasado. Déjelos reposar tapados con un paño durante una hora. Hornee por 45 minutos.

Bread Mold Observations



Observaciones de Moho

Name/Mi nombre _____

**My Prediction/
Mi Predicción**

Day/Día _____

Day/Día _____

Day/Día _____

Day/Día _____

Day/Día _____



Common Bread Mold

Moho de Pan

