

2.1 Introducing Microbes as Decomposers



Action Synopsis

Students propose how dead plants disappear over time, then examine mold, and talk about microbes as decomposers.

One Session

1 hour

1. Look at dead plant material and record ideas about what happens to it over time.
2. Discuss decomposition and animal decomposers.
3. Observe mold on plant material.
4. Talk about microbes as decomposers.



examining prior ideas



examining prior ideas



observing & recording



introducing new information

Desired Outcomes

Throughout the lesson, check that students:

- ✓ Are curious and have questions about what happens to plants after they die.
- ✓ Are able to accept that dead plants break down because decomposers use them for food.
- ✓ Begin to see how microbes growing on dead plants can make the plants disappear over time.

What You'll Need



For the class:

- paper grocery bag of dead plant material (see "Getting Ready")
- sheet of newsprint
- copy of *Who Eats What* guide (optional — pages 355–382)

For each pair of students:

- sandwich-size ziplock baggie of moldy squash or pumpkin (see "Planning Ahead," page 171)
- 2 hand lenses

Vocabulary



- BACTERIA** - Living things that have only one cell, and are so small that they can be seen only with a microscope.
- DECOMPOSITION** - The breaking down of dead things into their basic materials by decomposers that use them as food.
- FUNGUS** - An organism that uses other living or dead organisms as food by secreting chemicals that break it down, and then absorbing the substances into its cells.
- HYPHAE** - Threadlike, food-absorbing strands of a fungus.
- MICROBE** - A living thing (or "microorganism") whose individuals are too small to see with the naked eye. Fungi and bacteria are two kinds of microbes.
- MOLD** - A fungus that produces a fuzzy growth.
- SPORES** - Structures that can grow into new individuals, and can often survive harsh conditions.

Getting Ready

- ◆ Gather enough dead plant material outdoors (e.g., fallen leaves, grass clippings, twigs) to fill a paper grocery bag about one third to half full.
- ◆ Decide on pairs of students to work together, or plan to let them choose partners.

Action Narrative

I want you to predict the future of the items in this bag.

Dump the dead plant material out of the paper bag.



Imagine that we put these dead plants on the ground outdoors. Think about what would happen to them over the next few years. Work with a partner to make your predictions. Be specific — mention everything that could happen to them. Will the way they look change? What could cause them to change? Jot down your ideas in your journals. In a few minutes we'll share ideas.

As pairs of students share their ideas, listen to make sure that they understand their task and are being specific. Help them articulate their prior ideas without suggesting possibilities to them. Students will probably need less than five minutes to generate predictions.

Let's hear your thoughts. I'll record a class list.

After a few students share their ideas, ask others to contribute ideas that aren't already on the list. Copy their wording as closely as possible. Treat this as brainstorming, accepting all new offerings and holding questions and comments until later.

What Happens to Plants After They Die?

they rot
they get stepped on and crushed
worms take them underground
they blow away
birds put them in nests
rain and wind rip them into pieces
they turn black
they dissolve and go into the ground
beetles make holes in them
someone rakes them up and burns them
dirt blows over them
they get slimy, smelly, and disgusting



Use students' own language in questions that ask them to elaborate on their suggestions, such as:

What makes a dead leaf "rot"?

Students' responses will tell you whether or not they associate rot with the fungi and bacteria that cause it.

What makes plants "dissolve"?

Students might attribute dead plant disappearance primarily to physical factors (weathering) or to biological processes (animals and microbes using the material as food).

Why do beetles "make holes" in dead leaves?

Students' responses will reveal whether they connect the disappearance of leaf tissue to the insect's need for food.

It is best not to tell students answers or correct their thinking at this stage. The point is for you and them to become aware of their prior ideas, and of how well these ideas explain decomposition. Expect that some students will have elaborate explanations that are contrary to how scientists describe and explain decomposition.



Children's Ideas about Decomposition

When pressed to explain what makes a dead thing disappear, students usually list physical factors that cause it to break up, or say that it happens with nothing more than the passage of time. Consider these fifth and sixth graders' comments:

Dead branches fall off the trees and you step on 'em and they break up.

When it's been dead a long time and gets real old it breaks up and disappears.

The dirt breaks it down. It's something I can't explain in words, but I know about it.

When the rain and wind come the dead plant spreads out into the dirt.

It takes a lot of years for a dead tree to disappear. Just like with a rock, the wind hits it and breaks it down.

When we die they put us in a coffin and bury us, and while we're in the coffin we dissolve.

Some students will mention that bugs eat dead things, but do not necessarily see this as a cause of decomposition. They might also say that things "decay" or "rot away" without realizing that microorganisms cause these processes as they use dead things for food.



The investigations in Modules 1 and 2 give students direct contact with the organisms that cause decomposition. These experiences go a long way toward helping them view decomposition as primarily a biological, rather than a physical process. Expect however, that even once they tune into the world of decomposers, most students will still place too great an importance on the contribution of physical battering and "weathering" to decomposition.

Encouraging students to articulate their ideas and refine their language so that it expresses their thoughts accurately will help them think more clearly about the largely invisible process of decomposition. Teaching that decomposition is simply a matter of organisms eating food lays the groundwork for the central idea of Module 3: that the "stuff" that dead matter was made of never really goes away — it becomes part of the body of its consumer, or is released into the environment and is eventually used by other organisms.

We'll keep this list of ideas up so that we can see how your ideas grow and change after we've had a chance to do some investigations. We'll be studying DECOMPOSITION for a few weeks. Can anyone define decomposition?

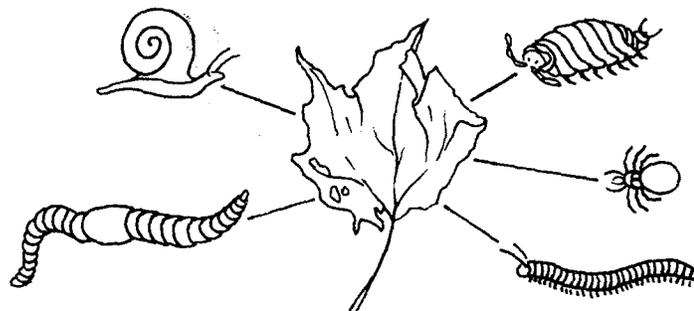
Encourage students to build on one another's ideas to create a definition. Write their definition on the board, and then add and emphasize whatever they have omitted from the following definition: "Decomposition is the natural process of dead things breaking down into the basic materials they are made of, when living things use them as food."

Why is it important to study decomposition?

Students might mention the garbage crisis as a good reason to know more about how things break down. If they know something about nutrient cycling they might say that when dead organisms decompose, they fertilize the soil so new plants can grow. If students have no ideas, explain that decomposition is important to understand because it is nature's way of recycling the materials all living things need to grow and stay alive.

Our definition states that dead things decompose because living things eat away at them. An animal that eats dead things is called a decomposer. What eats dead things like these (leaves)?

If students have experienced Module 1, they'll be familiar with lots of soil organisms that consume dead plants. If not, you might need to mention a few for them, such as earthworms, beetles, and termites. If students mention an animal that you aren't sure is a decomposer, have someone look it up in the *Who Eats What* guide.



I have a kind of decomposer to show you that is quite different from the animals we've mentioned.

Give one baggie of moldy material and two hand lenses to each pair of students.

 **Caution!** Some students may be allergic to molds. During this activity, and throughout this module, have students keep moldy material sealed or covered.



Look closely at this decomposer. Work with your partner and jot down your observations in your journals. In a few minutes we'll share observations.

Encourage students to write adjectives, descriptive phrases, and questions in their journals as they make observations.

What are your observations and questions?

Students will probably recognize the mold, but will have lots of questions and ideas about what they are seeing.

The MOLD you've described is a kind of FUNGUS. The white fuzz you see is called HYPHAE. The hyphae are threadlike strands of a fungus that absorb food. If you see any colored or powdery surface on the fuzz, then you are seeing SPORES, the fungus's way of reproducing.

Can you see how the material the fungi are feeding on would eventually disappear into the body of the fungus?

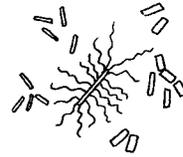
In addition to the mold, there are also BACTERIA on the (pumpkin), but even a whole colony of them are usually too tiny for us to see without a microscope. Fungi and bacteria are called MICROBES because they are so small. They are important kinds of decomposers because they eat things that animals don't eat, and break down small pieces of other decomposers' leftovers even further.

What have you heard about fungi, bacteria, or microbes before?

Most students know that the mushrooms they eat are a kind of fungus. They commonly associate bacteria and microbes with "germs" or disease, although do not necessarily think of them as living things. (Viruses, "germs" that are very different from bacteria and fungi, are in fact not living things — they need to invade living cells to function.)

Students might also confuse microbes with deterioration itself, rather than seeing them as the cause of deterioration.

Facts about Fungi and Bacteria



How many different kinds are there?

Fungi: There are approximately 66,000 different species of fungi classified into five major groups.

Bacteria: About 5,000 species of bacteria have been described, but scientists believe this is only a fraction of the actual number of different kinds of bacteria.

Do they make people sick?

Fungi: Some people are allergic to molds and other fungi. In rare occurrences, some kinds of microscopic fungi can be toxic to humans. Many mushrooms are also poisonous to humans. Some skin infections, such as athlete's foot, are caused by fungi. However, fungi also benefit humans by being a food source (e.g., mushrooms), and by making beverages ferment and bread rise.

Bacteria: Some bacteria cause human diseases such as strep throat, rheumatic fever, whooping cough, leprosy, and cholera. But bacteria also do a lot of good for people. They help digest food inside the stomach, and are used in making foods such as cheese and yogurt.

How do they get around?

Fungi: Fungi produce spores that travel great distances in wind, water, or on animals.

Bacteria: Many species of bacteria can move through water by whipping long strands called flagella. They can also move great distances carried by wind, water, or animals.

How do they reproduce?

Fungi: Fungi produce spores that grow into hyphae, which eventually make fruiting bodies (e.g., mushrooms) that produce new spores. Yeasts reproduce by budding.

Bacteria: Usually bacteria divide to make copies of themselves, although sexual reproduction is also used.

How do they eat?

Fungi: Fungi send out little threads called hyphae. Chemicals come out of the hyphae and break down their food, then the fungi absorb the food into their bodies, although some of it also leaks out into the surroundings.

Bacteria: Decomposer bacteria feed on dead organisms by secreting chemicals into their food source to break it down. In this way they absorb food directly from what they are growing on.

At the end of the period, collect the baggies of mold and throw them away without opening them. Return the dead plants that were in the paper bag to the outdoor area where you collected them.

Ongoing Assessment

Student Reflections



Have students send a C-Mail message or record thoughts in their journals. Optional writing prompts include:

What did I learn about microbes that I never knew before?

What would life as a decomposer be like?

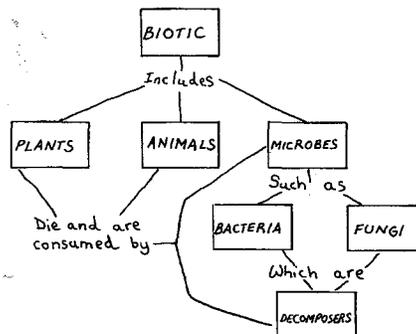
I was surprised to learn that decomposition...

Teacher Reflections

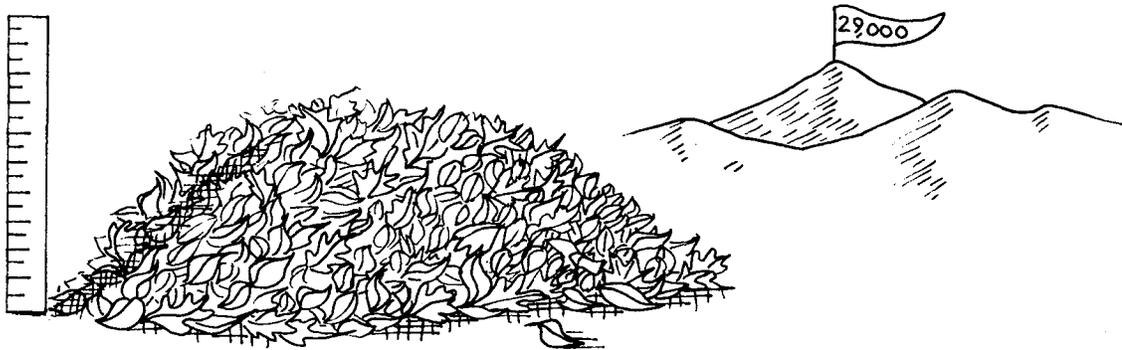
- How detailed and realistic were students' descriptions of what happens to plants after they die?
- Did students name mostly physical or biological causes for changes in dead plants?
- Did students accept that decomposition happens because decomposers eat dead things?
- Did observing molds make students curious? What kinds of questions did they have?
- What ideas do students already have about microbes, and what do they want to know?

Extensions

Concept Maps. Introduce concept mapping to students (see pages 25–27) if they are not already familiar with the process. Select all or some of the concept map cards on pages 43–44, then copy one set of cards for each group of 3–4 students. Help them construct concept maps that display their ideas about decomposition. Have students save their concept maps so that they can compare them to maps they'll make as an extension to Lesson 2.5, to see how their knowledge grows.



Mountains of Leaves. Ask students to measure the height of a stack of a given number of dead leaves from a deciduous tree. Then challenge them to count the leaves on one branch of the tree, and figure out a way to estimate how many branches there are on the tree. Help them multiply these numbers to estimate how many leaves there are per tree. Finally, students can use all of this information to figure out how many trees and how many years it would take to get a stack of leaves as high as different major mountains in the world, if deciduous leaves piled up each year instead of decomposing.



Bacteria and Fungi Festival. Set up stations for learning more about bacteria and fungi. These could include:

#1: *Prevention!* Display containers from foods that are pickled, dried, salted, frozen, vacuum-sealed, candied, smoked, and that say "refrigerate after opening". Challenge students to record how the foods' processing or packaging creates difficult growing conditions for bacteria and fungi.

#2: *Treats from Other Kingdoms.* Set out containers or wrappers from foods that use microbes in their processing, such as vinegar, cheese, mushrooms, bread, yogurt, tofu, wine, and soy sauce. Have students write a menu or recipe using as many of the bacteria and fungi products as possible.

#3: *Spore Patterns.* Select mushrooms from the store whose caps are just beginning to open. Have students cut off a cap and place it facedown on a white piece of paper. Check it in two days to see the dark spores that have fallen on the paper.

#4: *Microscope Slides.* Set up prepared slides (commercially available through science supply catalogs) of fungi and bacteria under a microscope for observation.

#5: *A Cow's Stomach.* Set out a large baggie and an assortment of fresh grass clippings, green leaves, lettuce, and spinach. Have groups of students add a handful of plants to the baggie to create a cow's stomach. Challenge them to figure out how to get all of the air out of the bag, then seal it. This simulates the part of a cow's gut where millions of bacteria can live without oxygen. The bacteria help to break down the stems and other things that cows eat. Watch what happens to the cow's stomach contents after one day, one week, and one month.

Fungus Farmers. Leaf cutter ants grow fungus to eat, just like farmers grow crops. Have students research and make a book showing leaf cutter ants farming fungus.

