Lesson: “Where do fallen leaves go?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! You've probably noticed how in the fall season, or in autumn, there are always some trees that drop their leaves. And as you walk down the sidewalk, they make that nice crunching sound as you step on them. Something I've loved to do every year since I was a little kid is to rake up a big pile of those leaves, and then just run and jump in. I do a big leaf jump. But you know, then winter would come, and then spring, and I wouldn't see those leaves on the ground anymore, just grass. I'd totally forget about the leaves that used to be on the ground. But where did they go? Now, I know what you might be thinking. The ones people rake up from their yards, those get put into bags and hauled off to the garbage dump. But forget about the leaves in a yard. I'm talking about the leaves anywhere. I mean, think about the leaves on the forest floor, the ground around the trees. The trees in the forest drop their leaves and there's no one going around raking the forest floor. So shouldn't the forest floor be piling up so thick with leaves by now? I mean, year after year after year of dropping leaves, it should be like hundreds of feet of leaves. That'd be like the most fun leaf jump ever. Where do all those leaves go? Why doesn't the forest floor look like this? What do you think?

EXPLORATION VIDEO 2

So where do all the leaves go when they fall off the trees? Why isn't the forest just piled super high with dead leaves? If you want to find out the answer, you have to actually go in a forest. And what you want to do then is look very closely at the forest floor. Here's a sped-up video showing a leaf after it's fallen to the forest floor. In everyday language, we would say this leaf is *rotting*. It's there, and over time, it breaks down. But when scientists looked more carefully at rotting leaves, they realized a leaf doesn't just somehow break down or rot all on its own. There is something that grows on it, something that's doing the breaking down. It's this stuff. White-colored strings, or threads, that start to grow on the fallen leaves. What are those things? Scientists have discovered that if you look closely at the soil on the forest floor, especially if you dig into it, you can almost always find these white threads growing all over the place. They even move around very slowly, as you can see in this sped-up video. They seem kind of alien until you watch what they can do after it rains. This is a patch of forest floor where there are lots of these white threads growing in the soil. And now, watch what happens if we show it in a sped-up video after it's been raining. Ready? Here we go. Whoa, you see that thing? Here's a view of it from the side. Do you recognize these? Watch what happens. They're mushrooms popping up. So those little white threads we saw, they're the roots of mushrooms. Here's a diagram to help you visualize it. Mushroom roots are spread out within the soil all around the forest floor. Only after it's been raining do the mushroom roots send up the mushrooms themselves, but the mushroom roots are there in the soil the whole time living a secret life. What scientists discovered about mushroom roots is that they poke out from the forest floor and surround dead plant leaves, touching them on all sides. As they do this, the mushroom roots let a liquid flow out, which starts breaking the leaf apart, or decomposing it. Mushrooms are what we call

decomposers, meaning they break dead things apart. Some of that leaf, they suck back in and digest. It's what they eat. But some of it they leave behind as a blackish-brown material. That's what soil is, or the less formal word for that is *dirt*, the stuff that plants grow in. This is hard to see, so let me show you what happens to a bunch of dead leaves in another sped-up video. Let's watch. Here you can see the mushroom roots are growing, and at the end of two weeks, look: the leaves have turned into soil. So that's why we don't see leaves on the forest floor. Mushroom roots eat and digest part of the leaves, breaking them up and turning what's left into soil. And there's not just one kind of mushroom. There are all different kinds of mushrooms. They come in many different colors. They come in different shapes. They come in different sizes. This one is huge. And it's not just leaves that the mushroom roots will break apart and eat. Yes, some types of mushrooms have roots that eat leaves, but other kinds of mushrooms like to eat dead wood. So you'll see them growing on fallen logs like these here. Some mushrooms even decompose the bodies of animals, like these little mushrooms, which are decomposing the body of a dead grasshopper. So mushrooms have these little roots growing everywhere on the forest floor, which go around eating and breaking apart leaves and any dead stuff, like fallen trees. What they leave behind becomes soil. Now think about that. If there were no mushrooms, imagine what the world would look like. Without mushrooms, all the dead leaves really would pile up like this. The world around us would be piled high in fallen trees and dead leaves and dead animals. You wouldn't even be able to walk around. There'd be no decomposition happening, no breaking apart of those things into smaller pieces. In fact, everything under your feet, almost all the soil that you walk over every day, used to be plants and animals that are now decomposed. So say a thank you to the next mushroom you see. Its roots decomposed dead plants and leaves, breaking it down into smaller pieces. And, just as important, that becomes the soil that all the plants around us can grow in. So far, we've just

been talking about mushrooms decomposing dead plants and animals on the forest floor. But there's something in your home that decomposes if you leave it out: your food. All food comes from plants and animals. If you leave food sitting out, it decomposes too. What's going on? Your food isn't sitting on the forest floor where mushroom roots can get to it. So why does it decompose?

EXPLORATION VIDEO 3

Why is it that if you leave food sitting out for a while, it starts to decompose? Like this loaf of bread, or this strawberry. All of our food comes from either plants or animals. But since your food's sitting on a counter and not the forest floor, you'd assume there aren't any decomposers that can get into your house and decompose your food. So what is this stuff growing on your food as it rots? You probably know it's called mold, but you might not have known this. Take a closer look at it. Here's a close-up view of some mold growing on a vegetable. You see that? What's it look like? Looks like mushroom roots a bit, doesn't it? Look even closer under a microscope and you'll see this. See these little things here? They even resemble mushrooms, just microscopic ones. That's because they are mushrooms. Mold is a type of mushroom that grows really well in your house. It's just a really tiny microscopic mushroom. When talking about both mold and ordinary mushrooms, scientists like to use a different word for the whole category of the two of them together, mold and mushrooms. Together they call them fungi, which comes from the Latin word for mushroom. It seems crazy to think there might be tiny mushrooms that can get into your house. But scientists have discovered that floating all around your house are little seeds of these mold mushrooms. They call them spores. And they find them everywhere. You won't even notice these seeds without a microscope, and there's really nothing you can do about them. They're so small that they float around in the air. You've been surrounded by them

your whole life. So when you leave food sitting out for too long, like in this sped-up video, eventually those mushroom seeds will land on it and start to grow mushroom roots. And as they do that, they're breaking it apart, or decomposing it, just the same as if these berries were on the forest floor. If you wait long enough, you'll come back and have a little tiny pile of soil where the berries once were. This is the same idea behind composting. Instead of throwing grass clippings or food scraps in the garbage, some people like to put it in a big pile in their yard where then mushroom roots could decompose it and help transform it to soil. See, check out this compost bin that's been cut in half so that you can see what happens inside it. At the top of the bin, you can see food that someone threw away really recently. At the top are the newer things. But the food at the bottom of the bin has been sitting there for a long time. It doesn't even look like food anymore. Mushroom roots have turned it into soil, which someone can then go use in their garden to grow new plants. So someone wanted the food they threw in this bin to rot and turn into soil. But with most foods that we buy, we don't want them to decompose quickly. We want them to stay fresh on the grocery store shelves and stay fresh after we buy them, so that we've got time before we have to eat them. Because we don't want our food to decompose quickly, we've come up with ways to fight the decomposers to keep the mold, the little mushrooms, from starting to grow so quickly. Decomposers are living things too and they have needs. And if those needs aren't met, they won't be able to live and decompose our food. For example, you know we keep a lot of our food in a refrigerator or in a freezer. So, cold temperatures must have something to do with stopping mold from growing. Of course, 100 years ago, people didn't have refrigerators. What did people use to do to keep food from decomposing? What are some other things that affect how well mold grows? Like, for example, say you are going to go camping for two weeks without a refrigerator, and you wanted to bring

some food along, like some sliced oranges. What might you do to keep the oranges from decomposing?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to make a mold terrarium: a sealed-off container where you can purposely let mold grow on food for several days. Your goal is to run an experiment and find out what conditions help mold to grow and what conditions stop mold from growing. You probably know that if you leave food out at room temperature, mold will start growing just fine—so you'll want at least one mold terrarium just like this. We'll call it the basic mold terrarium. But you'll also want to make a few more mold terrariums so that you can experiment to figure out what conditions make mold grow better and what conditions stop mold from growing. To figure that out, you'll want to try some different growing conditions for your mold plates. So you'll work as a small team to make a mold terrarium that's different from the basic terrarium in just one way. Your team will decide what one condition you want to change about your terrarium and then see what happens. For example, you might be curious about what happens if the mold terrarium were to be kept somewhere really warm, so you put it by a heater. This mold terrarium would be just like the basic terrarium, except for one condition that you're changing: the temperature. You'd be keeping every other condition the same. You'd just be making the temperature warmer. And that way you can find out how warmth affects how mold grows. Or you might have heard that in the olden days, before there were refrigerators, people used to put a lot of salt on their food. So you might decide to see what happens if you add salt to the food in your mold terrarium. If you have a few teams, you can test out a few different ideas and learn what happens under all kinds of different conditions. But even if you only grow a basic mold terrarium,

you'll at least get a great look at what mold looks like and how it grows over time. OK. It's time to get some mold growing. I'll show you how to set it up, step by step.

ACTIVITY STEP 1

Get these handouts. You'll get more supplies later, but first, you need to make a plan. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Form a team with a few friends. Your team will make a mold terrarium together.

ACTIVITY STEP 3

Teams, discuss what you want to test. Write down ideas under question number one and circle your favorites.

ACTIVITY STEP 4

Discuss all together what condition each team wants to test. Remember, your goal is to learn as much as you can about mold. So make sure each team chooses a different condition to test. If two teams want to test the same thing, work together to have one team choose something else. The more conditions that you test, the more you'll learn about mold.

ACTIVITY STEP 5

Now that each group has decided on what to test, fill in question number two.

ACTIVITY STEP 6

Choose a team name and write it on your handout under question number three. This should only take you 20 seconds. Ready? Go.

ACTIVITY STEP 7

Get your supplies. Your team may need other items, too, depending on what you're testing.

ACTIVITY STEP 8

On the label, one of you write your team name, what's being tested, and the date. Then, put it on the bag.

ACTIVITY STEP 9

Work as a team to get each piece of food wet—damp, but not soggy.

ACTIVITY STEP 10

At this point, you have a basic mold terrarium. So now make the change that you and your team decided on earlier, whether that's adding sugar or salt or licking it.

ACTIVITY STEP 11

Move the food so that it's just touching, like this. Then slide the plate into the plastic bag and carefully zip it up. If you don't seal it well, you may end up with fruit flies and bad smells, and you don't want that.

ACTIVITY STEP 12

Watch this whole step before you do anything. Use your heavy-duty tape to seal the bag closed, like this. Use half the strip of tape on one side and then fold it over to seal it. This is an extra layer of protection against flies and any smells.

ACTIVITY STEP 13

Complete number four and number five on your handout. Draw your terrarium and predict what will happen.

ACTIVITY STEP 14

Look at page two of the handout. This is where you'll record what happens to your terrarium. Write down all the foods in your terrarium, like this. This chart will let you see which food gets moldy first and where mold spreads the fastest.

ACTIVITY STEP 15

Today is day one. Make an X to show that you checked for mold. Since there's no mold on any of the food yet, you don't get to fill in any circles.

ACTIVITY STEP 16

For the next 12 days, you'll check for mold. You may have to skip weekends, but that's OK. Just check when you can. Fill in the circles as mold starts to grow. Color the bottom circle when you

first see mold on a food. As the mold grows, color more circles to show how much of the food is covered. OK. Now that you understand how the chart works, go to the next step.

ACTIVITY STEP 17

Set up a bulletin board where you can post the results from each mold terrarium as you go. You can compare the results and figure out which conditions make food mold the fastest and which conditions stop mold from growing. It may take a few days for any mold to show up, but once it does, just wait. Have fun, and stay curious!