Lesson: “Where do fallen leaves go?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hey. It's Esther with the Mystery Science team. Where I live, fall is the most colorful season of the year. That's when the leaves on many trees start to change colors. There are fiery reds, sunshiny yellows, and rich purples. It's beautiful. And even after those leaves fall, they're still pretty amazing. I'm always impressed by just how many leaves get raked up in my neighborhood. The piles can be huge. But they're nothing compared to this leaf pile. A group of friends collected enough leaves to make a pile seventeen feet tall. That's roughly the height of a giraffe. If you've ever been around a big pile of leaves, there's a good chance you've done this: jump. It can be so fun to take a big crunchy jump. Even this dog loves jumping into leaf piles. Eventually though, all the leafy fun comes to an end. Winter arrives followed by spring, and I don't think much about those fallen leaves. But sometimes, I'll spot dead leaves on the ground that are all crumpled up and brown. It's those fallen leaves again. Only now, they're not so colorful. And there are only a few, not like the big piles from before, which made me wonder, where did all those fallen leaves go? Sure. I know some leaves got gathered up and carted away, but there are lots of places where leaves don't get gathered up, like out in the forest near where I live. Leaves fall in this forest every year, and no one is raking them up. So I'm curious, what happens instead? To figure this out, let's back up a bit to when those fallen leaves were still alive and growing. You might already know that for trees to make more leaves, they need

more matter. Matter is anything that takes up space and has weight. And trees can't just make matter. It has to come from somewhere. Trees get most of the matter they need from gas in the air, along with some matter from water and a tiny amount from soil. Then, they use that matter to make things like bark, branches, and leaves, lots of leaves. When all those leaves fall and die, they're still made of matter. They still take up space and have weight. In fact, in an area roughly the size of a football field, thousands of pounds of leaves fall in a forest like this one, and that's just in one year. Imagine all those leaves stacking up year after year after year. Now that's a leaf pile. Yet somehow, the forest doesn't look this way. But why is that? Matter doesn't just disappear. So where do all the dead leaves that fall in the forest go? I'm curious what you think.

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to solve the mystery of the missing leaves. We know that matter can't just disappear. Right? So where did all those fall leaves go? That's what you're going to figure out today. "Breaking news. Another pile of leaves has gone missing." There used to be a leaf pile right here, but now it's gone. We're investigating what happened to it. These organisms were seen hanging around that leaf pile. This makes them suspects. To figure out who is responsible for the disappearance of the leaves, you and your partner will go to the scene of the crime, and you'll interview the suspects one by one to gather clues. You'll learn about why they were hanging out near the pile of leaves to begin with and what they saw there. Just hearing the suspect's stories won't be enough though. To really figure out what happened to these leaves, you'll need to recreate it for yourself. That's why you'll also have your own model leaf pile. A model is a pretend version of something that scientists use when the real thing is too big, small, or complicated to work with. Whatever the suspects tell you they did to the leaf pile, you will

model it with your own mini leaf pile. In the end, you'll be able to see the whole picture and can figure out once and for all what happened and who is responsible for the missing leaves. We'll get you started step by step.

ACTIVITY STEP 1

Today, you'll work with a partner to solve the case. Click the arrow on the right when you're ready to move on.

ACTIVITY STEP 2

Get your supplies. You'll get more supplies later.

ACTIVITY STEP 3

Find these three sheets. These are your suspects. These are your leaves. And this is where you'll put your leaf pile. Cut your suspect cards and leaves out along the dotted lines, like this. Put your suspect cards in a pile to the side, and put your cutout leaves on your leaf pile sheet, like this.

ACTIVITY STEP 4

Lay out your Evidence Board sheets in front of you. Put the sheet with the Suspect 1 box on top of the sheet with the stripes so that it covers the stripes like this. You'll put all of your clues from the suspects on here in the order you talk to them. Altogether, your setup should look like this when you're done.

ACTIVITY STEP 5

The first suspect you're going to talk to is the Red Fox. "You think it was me, huh?" Find the Red Fox suspect card and place it in the Suspect 1 box on your evidence board. Now with your partner, read what the fox has to say. Underline clues the fox gives you about what it did with the leaves. Circle clues the fox gives you about who else they saw near the leaves.

ACTIVITY STEP 6

You read what the fox had to say about the leaves. Here are some clues we found. We learned that the fox didn't eat any of the leaves, but it did break them into smaller pieces as it chased after a mouse. You might have underlined different things than we did. That's okay. Now let's see for ourselves what happened to the leaves. In a minute, you and your partner are going to model the fox crunching the leaves at the scene of the crime. When you do this, rip your leaves in half one at a time like this. Hold your hands over your leaf pile sheet as you rip to make sure all the pieces stay in your pile. I'll put a timer on the screen for ten seconds. Keep going until the timer and the sound of crunching leaves stop. Ready, set, go. Okay. Stop ripping your leaves. Go to the next step.

ACTIVITY STEP 7

You learned that the fox was chasing the Mouse. Let's talk to the Mouse next to hear their story. “Hey, what gives? I'm borrowing here.” Find the Mouse card and put it in the Suspect 2 box on your evidence board. Read the Mouse card with your partner to learn more about what it was doing near the leaf pile. Underline clues about what the Mouse did with the leaves. Circle clues about who else they saw near the leaves.

ACTIVITY STEP 8

You read what the Mouse had to say. They also didn't eat the leaves. They did break some of the leaves while walking and burrowing, though. Now let's see for ourselves what happened to the leaves. In a minute, you and your partner are going to model the Mouse walking and burrowing in the leaves. Just like before, rip your leaf pieces in half. Rip them one at a time and keep going until the timer and the sound of the crunching leaves stop. Ready, set, go. Okay. Stop ripping your leaves. Go to the next step.

ACTIVITY STEP 9

The Mouse mentioned earlier that they were looking for earthworms in the leaves. Let's hear what the Worm has to say next. "What are you doing? Put me back in my dirt." Find the Worm card and put it in the Suspect 3 box on your evidence board. Read what the Worm has to say, underline clues about what happened to the leaves, circle clues about who was near the leaves.

ACTIVITY STEP 10

You heard it straight from the earthworm's mouth. It ate the leaves. Well, at least some of the pieces of broken up leaves. Take a few of your leaf pieces from your leaf pile, about this many, and put them on top of the Worm suspect card like this to show that they ate some of the leaves. They also broke up the leaf pieces even more. Let's model it with your own leaf pile. When the timer starts, rip your leaf pieces in half. Keep going until the timer and the sound of crunching leaves stop. Ready, set, go. Okay. Stop ripping your leaves. Go to the next step.

ACTIVITY STEP 11

You learned one last important clue from the Worm. It rained. Let's see what that would do to the leaf pile. Your teacher may have a model leaf pile and some water set up. If you don't have this set up, that's okay. You can watch the video on the next slide to see what happens.

ACTIVITY STEP 12

Here is our leaf pile, and here comes the rain. Discuss with your partner. What do you notice about the leaf pieces after they've been rained on? How did the leaves change?

ACTIVITY STEP 13

From now on, pretend that all of your leaf pieces are soggy, mushy, and wet, just like the ones you just saw. To help you remember that your leaves were rained on, draw rain clouds above your leaf pile with your blue crayon.

ACTIVITY STEP 14

We heard from the Worm that after it rained, they noticed other living things in the leaf pile as well. Like mushrooms and mold. Let's talk to these Fungi next. "It's a leaf pile party. Woo hoo. Woo hoo." Find the Fungi card and put it in the Suspect 4 box on your Evidence Board. Read the card with your partner. Underline clues about what happened to the leaves. Circle clues about who was near the leaves.

ACTIVITY STEP 15

Turns out that Fungi were feeding on some of the leaf pieces too. This case is starting to come together. Take some of the leaf pieces from your leaf pile, about this many, and put them on top of your Fungi suspect card to show the leaf pieces they consumed. They also broke down the leaf pieces even more. When the timer starts, rip your leaf pieces in half to model the fungi breaking them down. Your leaf pieces are probably getting pretty small, so you can rip more than one at a time. Keep going until the timer and the sound of wet leaves stop. Ready, set, go. Okay. Stop ripping your leaves. Go to the next step.

ACTIVITY STEP 16

We heard from the Fungi that there was one last suspect sneaking around. Bacteria. Let's talk to them now. "Well, by golly. By golly. By golly. You can see us?" Put the Bacteria card in the Suspect 5 box on your evidence board. Read the card with your partner. Underline clues about what happened to the leaves.

ACTIVITY STEP 17

Turns out that some of the leaf pieces became food for Bacteria too. Take most of your remaining leaf pieces, about this many, and put them on top of your Bacteria card. Your leaf pile should now look something like this. The Bacteria also broke down the remaining leaf pieces even more. One last time when the timer starts, rip your leaf pieces in half. Ready, set, go. Okay. Stop ripping your leaves. Go to the next step.

ACTIVITY STEP 18

And that's the end of our suspects. Now get the rest of your supplies.

ACTIVITY STEP 19

Now it's time to look at the clues you've gathered and solve the case. Detectives, it's time to answer the big question. What happened to the leaf pile? Here's a hint. Compare how your leaf pile looks now to how it looked when you started. Discuss with your partner, then answer Question 1 on your Solve the Case worksheet.

ACTIVITY STEP 20

And finally, it's time to answer the other big question. Based on the suspects that you interviewed, who is responsible for what happened to the leaf pile? Use evidence from your evidence board to support your answer. Discuss with your partner, then answer Question 2 on your Solve the Case sheet.

WRAP-UP VIDEO 1

In the activity, you investigated what really happened to a leaf pile that seemed to disappear. Turns out, those dead leaves went through a lot. They were crushed by a fox and a mouse, got soggy in the rain, and became food for multiple suspects. You recreated what happened using paper as a model for the real matter that dead leaves are made of. Now let's see an example of what this process looks like in real life. This sped up video shows what's going on inside a pile of leaves. Check out all the little critters moving around. The earthworms are probably the easiest to spot. As they wiggle by, they drag leaves into the soil like you see here. But worms do

more than move leaves. They also eat bits of them too. And they're not the only ones that eat dead leaves. You might catch a glimpse of millipedes, snails, and pill bugs, just to name a few. These creatures are small, so the bits of leaves they nibble, scrape, and slurp are also small. But here, you can see a leaf getting broken apart piece by piece as it's eaten. Now watch what happens in this area. Notice how these leaves start to look sort of gray and fuzzy? That fuzzy stuff is mold. As you saw in the activity, mold and mushrooms are both fungi. They're fungi structures we can see with just our eyes. But if we use a microscope to zoom even closer to the leaves, we'd find lots of fungi like this hanging out. These teeny tiny fungi are living things too. Give them enough food, like dead leaves, and water, like rain, and those microscopic fungi will thrive and spread. In the activity, you uncovered another microscopic suspect, bacteria. Even though they're too tiny to see with just your eyes, there are definitely lots and lots of bacteria feeding on these dead leaves. After you modeled this in the activity, your paper leaf pile looked like this. But in real life, this looks a little different. Let me show you what I mean. We're starting out with a pile that has some dead leaves, plus some twigs, grass clippings, and a banana peel. After months of fungi, bacteria, worms, and other critters feeding on it, the pile eventually looks like this. I'm curious how this compares to your paper leaf pile in the activity.What do you see happening in real life that matches your model? What's different?

WRAP-UP VIDEO 2

In your model of a leaf pile, the paper leaves got torn into smaller and smaller pieces. Something similar happened to the real leaves in this pile. But this jumble of brown stuff isn't just torn up. A bigger change has happened here, and part of it has to do with the way fungi and bacteria take in food. They don't have mouths to take bites. Instead, fungi and bacteria release special chemicals that change their food. It starts to break apart into smaller and smaller pieces

of matter. Then, the fungi and bacteria absorb or soak up some of those tiny pieces of matter. In the activity, the fungi, bacteria, and worm only fed on the leaves once. But in real life, they're feeding again and again. And in the process, they're breaking the leaves down into even tinier bits of matter. The brown stuff here is the same matter that used to be the leaves and the banana peel and the grass clippings. The matter has just been broken down so much that it doesn't look like the leaves or the peels or grass anymore. There's a word we can use for this change, decompose. When dead things that were once living get broken down, we say they decompose. And it's living things like fungi and bacteria that do the breaking down, along with worms, millipedes, pill bugs, and other creatures. So we can call them decomposers. Decomposers take in matter from dead stuff, and that dead stuff comes from living things, like how fallen leaves come from trees. In a way, you can think of dead leaves as the leftover waste that trees make as they live and grow. And think of all the other living things in a forest. What kinds of leftover waste or dead stuff could they create? That could be food for decomposers too. For instance, how about an oak tree, a mouse, and a fox? What kinds of dead stuff or leftover waste from these living things could be food for decomposers?

WRAP-UP VIDEO 3

An oak tree, a mouse, and a fox can provide decomposers with lots of options for food. For instance, after a fox eats, it will eventually go to the bathroom. Yep. That's fox poop. But you can also think of it as leftover matter from a living thing which is food for decomposers. And someday, when that fox dies, decomposers will feed on its body too. All kinds of living things decompose when they die like this. See those tiny mushrooms? That fungi is growing on and feeding on this dead grasshopper. As they feed, decomposers break down the matter that dead things in waste are made of, just like they did with the leaves. The matter gets broken down into

smaller and smaller pieces, so small they're eventually unrecognizable as the living things they once were. That's another big difference between your model and real life. At the end of the activity, your model showed that matter from dead leaves had been taken in by the worm, the fungi, and the bacteria. But really, it doesn't stop there. For instance, a worm will eventually go to the bathroom. Yep. That's worm poop. That worm waste mixes with the soil where it gets broken down even more by decomposers. And when decomposers die, the matter they're made of gets broken down as well and becomes part of the soil and air. It looks like you've solved the case of the missing leaves. The leaves didn't disappear but they did get broken down again and again. All the suspects played a part. The fox and the mouse got things started when they crushed them with their paws and it was the decomposers that did the rest as they fed on bits of leaves and broke dead matter into smaller and smaller pieces. But that doesn't make them bad guys. In a way, they're really the heroes of this story. Without decomposers, the forest would be a giant pile of dead leaves, plus all the other dead plants, dead animals, and leftover waste that would build up over time. A world without decomposers would be a mess. That's why some people call them nature's cleanup crew. In fact, we can put that cleanup crew to work. Instead of raking up leaves from yards, some people chop them up with a mower, kind of like the fox and mouse crushing leaves with their paws. I do something similar by adding chopped up leaves to my garden then I let decomposers do the rest. As decomposers feed, the broken down matter from the dead leaves ends up going back into the soil and air where it can be reused to help my garden grow. And check this out, some people collect dead leaves as well as food scraps and create piles like these. They make sure conditions are right for fungi, bacteria and other decomposers to thrive. Then, those decomposers break down the waste into valuable matter which gets added back to the soil to help things grow. You might have heard this called compost. Something similar happens with fallen leaves in a forest plus all the other dead stuff

and leftover waste that come from the living things there. The matter they're made of doesn't just disappear. Once it's broken down, that matter goes back to being part of the environment in the soil and in the air where it can be reused by other living things. It's pretty amazing to think that the creepy crawly critters, fungi and bacteria too tiny for us to see play such a huge role in environments. So the next time you crunch through some fallen leaves or drop some leftovers into a compost bin, remember those decomposers that help turn dead things into an essential resource for life. Keep breaking down big questions and stay curious.