Lesson: “Will a mountain last forever?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! You're looking at Mount Everest, the tallest mountain in the world. Mount Everest and the surrounding Himalayan mountains are so tall that astronauts can see their snow-capped peaks all the way from space. Part of what makes mountains so impressive is that they're solid rock all the way through. Like look, this isn't a mound of individual rocks piled up really high. This mountain is one single solid rock. Mountains are like walls of vertical rock going straight up into the sky, but will these mountains always be there? Do mountains last forever? You might think well, yeah, why not? But let me tell you a story, a story about a man-made mountain, a pyramid. You know, one of these things, like the kind built by the ancient Egyptians. The Egyptians lived right here, but our story actually takes place on the other side of the world here in the jungles of Central America. The people over here made a type of pyramid too, a people called the ancient Mayans. This is the Mayan's most well-known pyramid. It's a great temple called Kukulcan, about 100 feet tall. Now pyramids, unlike mountains, are not one solid piece of rock. Instead, they're built up layer by layer, brick by brick using stone bricks that have been chiseled by hand. About 1,000 years ago, the Mayan people abandoned the use of their pyramids. They actually left them, and they went to live in other places. Most of their pyramids became long forgotten. In fact, hundreds of years later, people didn't know many of the pyramids were even there anymore. They were lost in the jungle. What happened to the

pyramids? How could something that big go missing? About 100 years ago, local residents were traveling through the jungle and noticed this. Do you see it? It's a giant hill covered in trees. There aren't many hills around here, so that's kind of weird. The residents who noticed got interested, so they went closer to check it out. When they got to the base of the hill, this is what they saw. They noticed that, weirdly, the trees had been growing in a pile of rocks. So they started removing the trees, and when they did, here is what they saw. This. Look at that. It's the steps of a pyramid. Once they finished removing all the trees, this is what was revealed. It was one of the ancient Mayan pyramids. It's so cool. So what happened? Well, here's a close up of one of the trees before they removed it. What do you think is going on here? What do you think happened to this pyramid?

EXPLORATION VIDEO 2

The pyramid's bricks used to look nice and straight, but now they're crooked, and some have crumbled. What happened? It seems like the trees were breaking the bricks. Is that really possible for plants or trees to break something as strong as rock? That sounds crazy. Roots aren't that tough, are they? But let me show you something. Here's a whole bunch of solid rock. It's what used to be a lava flow. But the lava cooled, and so now it's solid rock. And it's tough. You would think that it would be here forever. But if you look closely, as it cooled it left some little cracks. Those are its weak spots. Seeds can land in the cracks. And when those seeds get rained on, they grow. Let's look more closely. Imagine a seed that's fallen in the crack of a rock. Now let's imagine the seed grows a little root, like that. And the root will grow. And it'll grow and grow until it fills up the crack. Notice that the root didn't just get longer. It got wider, too. Now, the root doesn't just stop there. It keeps growing. As the root grows bigger, it pushes outwards like this until, eventually, crack, it breaks the rock, making the crack wider and deeper. Eventually,

that section of rock will even split off entirely creating a new chunk of rock. What you just saw here, scientists have a name for this. They call it root wedging because a root wedges itself into the crack and widens the crack. So does this explain how large Mayan pyramids could have become hidden in the jungle? Well, think again about what was found. It was a forest of trees growing on top of a pile of rocks. And when they removed the trees, the inner layer of the pyramid was underneath. So now you can understand what happened. Between every brick is a crack. That's a perfect opportunity for a seed. When the Mayans were around, they probably kept their pyramids looking very nice, sweeping away any seeds that might have fallen into the cracks. But when the Mayans left their pyramids behind, the jungle took over. The surrounding trees dropped their seeds into the spaces between every brick. And the roots grew and grew, breaking up the outer layer of the pyramid. That's why when the Mayan pyramid was rediscovered it looked like this—just a pile of rocks with trees growing out of it. Now that we know this is what happens lots of other Mayan pyramids are being rediscovered. Hike around the jungles of southern Mexico, and you might even be the person who rediscovers one of the old pyramids. The first clue is to look for a pile of rocks with trees growing out of it. Now, you may not be planning any trips to the jungles of southern Mexico soon. Still, you can actually see root wedging happening in your neighborhood. You don't have Mayan pyramids in your neighborhood, but you do have sidewalks. Sidewalks don't last forever. If you look around, you can almost always spot at least one section of sidewalk where there's a small crack that's started to form. Just look for the plant or tree that's causing it. It's root wedging. Like, check this out. Can you tell what's going on here? This tree's roots were so powerful that they actually broke apart this section of sidewalk, just the same as if someone had tried to destroy it with a jackhammer. Isn't that incredible? And look at this. Here's a brick wall that's been cracked, just like the Mayan pyramids. So root wedging, it's one way that a large slab of rock, like a mountain

or a pyramid, gets broken down into smaller pieces. But it's not the only way. In fact, one of the most common ways involves something totally other than roots. Consider again this solid slab of rock, like this lava rock, which left some cracks in it as it cooled. Seeds aren't the only things that can fall into those cracks. You see, as it rains water seeps into the cracks, too. And that alone can cause problems. Water? Yeah, you heard me right, water. Let's look more closely. Here's some rainwater in a crack. Now, by itself, the water doesn't seem like much. But as the year goes on, winter approaches. And you know what happens to that water as winter approaches. It freezes. Well, something special happens when water freezes. Do you know what? I'll give you a hint. Have you ever heard not to put a can of soda in the freezer? Why do people say that? Don't put a can of soda in the freezer.

EXPLORATION VIDEO 3

Most things when they get cold, they actually contract or get smaller. But water is weird. Water expands or gets bigger when it freezes. And soda is mostly water. So when you put a can of soda in the freezer, the liquid inside freezes and gets bigger until it splits the can open like this. It can even explode like this one. If your soda's in a glass bottle instead of a can, that's even worse. You don't want glass flying everywhere. So don't put cans or bottles in the freezer, that's why you hear that. But what does this have to do with rocks? I bet you can guess. As rainwater freezes in the crack of a rocky surface, the water expands, which pushes the rock apart—crack. We call this—you want to guess? Ice wedging, because the ice wedges itself into the cracks and widens them, just like plant roots. So both root wedging and ice wedging can split a big rock into smaller rocks. Ice wedging is even more powerful than root wedging. The cracks get deeper and wider even more quickly with ice. Look at this. Here's a rock that has been broken up because of ice wedging. You see all the cracks? Here's another one. And look, this used to be

just one rock, but it got broken down into smaller rocks, into individual pieces. Ice wedging and root wedging break rock down into smaller pieces. If you walk around at the top of a mountain, you might expect to see only solid rock, but think about it, on the top of the highest mountains it's often cold, right? Rainwater will freeze. In summer, it might melt, but in winter, it will freeze again. And after all that freezing and melting, the top of a mountain will start to look like this. The surface of the mountain becomes a bunch of smaller broken up rocks, not all one solid piece. Here's another example of a mountain top. You see how jagged and cracked all the rocks are? So what do you think? Will a mountain last forever? Well, look at this. This isn't quite as tall as a mountain, but it's still a giant rocky hill. Look at all those splits and cracks. In a few more centuries, as more roots take hold and more water freezes in the cracks, this whole hill will probably split and fall apart into the sea. So we've solved the mystery—mountains don't last forever. Root wedging and ice wedging breaks them apart. Soon, we're going to do the activity. I want to get you thinking about what happens to the rocks next. You see, once rocks break away from a solid mountain, that's just the beginning of their story. Some of the rocks will tumble down the entire mountainside. They'll get washed away by rainstorms, rolling farther downhill. Maybe they'll fall into a river where they'll get tumbled along, crashing against other rocks. On this long journey, do the rocks get changed in any way? How could we investigate? How could we find out? What happens to a rock once it's broken away from the mountain and now begins to tumble downhill? Try to think of some experiments you can do to figure out the answer to that question.

ACTIVITY INTRODUCTION VIDEO

In this activity, you're going to use sugar cubes in an experiment to see what happens as rocks tumble down a mountain. Let me explain. In your class discussion, you did something that

scientists do all the time. You talked about how you can experiment to figure something out. How could you figure out what happens to a rock when it tumbles downhill? What are some things you could do? Maybe you thought about comparing the rocks that you find up here to the ones that you find down here after they roll down. Hmm, that would let you see if the rocks at the bottom were different from the ones at the top. But it would be nice to see what actually happens as the rocks are rolling down. Well, then, maybe you could experiment by rolling real rocks down the side of a mountain, like this. That looks like fun. It would be a lot of work. You'd have to find a mountain, you'd have to climb to the top, and, you know, it might be dangerous for anyone down below. This doesn't seem like the greatest idea. So, maybe you thought about putting rocks in a can and then shaking them so that they bounce around just like rocks rolling downhill. That's a great idea. We'll do something like that in class today, except instead of using real rocks, we're going to use these—sugar cubes. Sugar cubes are hard like rocks and they have sharp corners and edges, just like the rocks you'd find at the top of a mountain. So we'll see what happens to them after a little bit of shaking—and then after a whole lot of shaking. Are you ready to start the activity? I'm going to show you what to do, step by step.

ACTIVITY STEP 1

Find a partner to work with. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Get your supplies. Each group needs these.

ACTIVITY STEP 3

Take a sugar cube and complete questions number one and number two. You can draw the whole cube or just one side.

ACTIVITY STEP 4

Each of you choose one sugar cube and color the edges, like this. As you do this, work over the plate so you don't get sugar everywhere. And you're just going to color two of the sugar cubes, not all five.

ACTIVITY STEP 5

Count how many edges a sugar cube has. Write the answer in question number three.

ACTIVITY STEP 6

Decide who'll be the Shaker and who'll be the Counter for the first trial. You're going to switch roles after each trial. This should only take 10 seconds to decide who's going to do each role, so decide now.

ACTIVITY STEP 7

Shaker: put one colored cube and all of the plain cubes in the container. Leave one colored cube on the plate. Close the container. Make sure that lid's on tight.

ACTIVITY STEP 8

Do the first trial now. Shaker: shake the container 40 times, counting out loud.

ACTIVITY STEP 9

Shaker: open the container and put the cubes on the plate. Both of you: write down how the cubes have changed.

ACTIVITY STEP 10

Counter: on the colored cube you shook, count how many edges have any color left. Both of you, right down the result.

ACTIVITY STEP 11

Shaker: put the cubes you just shook back into the container. Make sure the lid's on tight.

ACTIVITY STEP 12

Switch jobs and finish the data sheets, including questions five through 10. When the class is done, discuss the question on the next slide.

ACTIVITY STEP 13

Discuss this question as a class.

ACTIVITY STEP 14

Discuss this question as a class.