

Lesson: “How could a lizard's toes help it survive?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hey, it's Esther from the Mystery Science team! Do you like to climb? Maybe you've climbed to the top of a jungle gym, or maybe you've tried this. It's a sport called bouldering. Finding a path up the walls takes problem-solving and strength. Just look at this one-handed grab. And if you live in an apartment like I do, maybe you've seen window washers at work. They can climb an entire building using ropes and harnesses. But some animals take climbing to another level. Watch how this gecko crawls straight up a wall. It can even climb up smooth glass. Clearly, it doesn't need ropes and a harness like people do, and there aren't any bumps to grab onto like when these kids climb. So how do geckos do this? Take a closer look at the bottom of a gecko's foot. See how its toes spread out wide? And check out all the tiny ridges. Those are special scales with fuzzy parts that help a gecko grip and stick to surfaces as it climbs. Some other kinds of lizards have a similar trait. You can observe that they have toes with special scales that grip too. Having lots of these toe scales can be really important for a lizard. Climbing is more than a fun sport for them. It can be a matter of life and death. Think about that for a moment. How could being a good climber help a lizard survive?

EXPLORATION VIDEO 2

I want to tell you a real story about some lizards that might give you more ideas about climbing and survival. This little lizard is called a green anole. They love to eat insects. They'll hunt for insects down on the ground at the base of trees, and they'll climb up into the trees to hunt some more. Check it out. This is what the bottom of a green anole's toes look like. They've got those special toe scales to help them climb. Green anoles like to live in warm places with lots of plants, places like the US state of Florida. That's where this story takes place. And just over here is the country of Cuba. It's home to a different kind or species of lizard, the brown anole. It's too far for a little lizard to swim between Cuba and Florida, so the brown anoles here and the green anoles here lived separately for many, many years. Until one day, some brown anoles took an accidental trip. They probably climbed into cargo boats in Cuba and ended up sailing to Florida. Lucky for the brown anoles, their new home in Florida looked like a great place to be. It turns out, they also like warm places with lots of plants and eating insects. But scientists were worried. Green anoles were used to a specific environment. That's the place they live. And now brown anoles are suddenly part of that environment. Both species will need food and space and ways to stay safe. Will both be able to survive there? What might be some problems with green anoles and brown anoles living in one place?

EXPLORATION VIDEO 3

With green anoles and brown anoles suddenly sharing the same environment, there could be lots of potential problems. Since brown anoles also eat insects, maybe they'll eat a lot. There might not be enough left for the green anoles to eat. Or maybe they'll both want the same warm leafy spots. The green anoles and brown anoles might end up fighting for space. Well, it turns

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out, one surprising thing that can happen is that brown anoles will sometimes eat little green anoles. Yikes. If the brown anoles eat all of them, maybe there won't be any green anoles left. But wait, Remember how green anoles will climb up trees to hunt insects? Brown anoles don't climb as much. They tend to stay closer to the ground. So if a little green anole comes face to face with a hungry brown anole, it might be able to escape by quickly climbing high. Good news for green anoles. Right? Except there's another twist in this story. In a group of green anoles, no two are exactly alike. They all have little differences. You probably know that these small differences are part of nature. You can find them with all kinds of living things, like how each zebra has a unique pattern of stripes, or how some flamingos are slightly taller or slightly shorter. When there are differences in traits between living things of the same species, you can call that variation. With green anoles, one trait that varies is the number of toe scales each one has. Some have lots of toe scales, which help them climb really well. These excellent climbers can go higher. Others have enough toe scales to be good climbers, but some have fewer toe scales. Those green anoles are not so good climbers. In a moment, you're going to play a game where you'll study a group of green anoles and count each one's toe scales. Then you'll see what happens to them when brown anoles arrive. But first, I'm curious what you think happens next. The green anoles have different numbers of toe scales, which make some better climbers than others. Which ones do you think the brown anoles are most likely to catch?

ACTIVITY INTRODUCTION VIDEO 1

In today's activity, you're going to play a game called Lizard Island. Some green anoles were living on the island when the brown anoles arrived. We're going to play this game to see what happens to the green anoles when the brown anoles are introduced. But before we introduce the brown anoles, we'll need to count the toe scales of the green anoles that are there. Now if



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you're working alone or with a small group, use the Small Group Instructions linked below this video. If you're in a class, I'll walk you through the game step by step. Are you ready?

ACTIVITY PART 1 STEP 1

Get your first set of supplies. When you're done with this step, click the arrow on the right.

ACTIVITY PART 1 STEP 2

On your card is a close-up of your lizard's big toe. Count the toe scales to figure out how well your lizard climbs. We've drawn lines for you pointing to each toe scale. Write numbers next to the lines as you count, like this. Count carefully. The number you get may not be the same number of the person sitting next to you.

ACTIVITY PART 1 STEP 3

Now you're going to notice as you count the scales that not everyone's lizard has the same number of scales. Some of them have 19 to 22 scales. Those are the Good Climbers. But some of them have 18 or fewer toe scales. Those are the Not-So-Good Climbers. And then some of you lucky lizards have 23 or more scales. Those are the Excellent Climbers. Go ahead now. At the bottom of the card, circle what kind of a climber your lizard is based on its toe scales.

ACTIVITY PART 1 STEP 4

Raise your hand if your lizard is an excellent climber. Have someone count the hands.

Remember this number for the next step.

ACTIVITY PART 1 STEP 5

Record the number of excellent climbing lizards here. This helps you remember how many excellent climbing lizards there were before any brown anoles arrive.

ACTIVITY PART 1 STEP 6

Raise your hand if your lizard is a good climber. Have someone count the hands. Record that number on your “How Many Lizards?” sheet.

ACTIVITY PART 1 STEP 7

Raise your hand if your lizard is a not-so-good climber. Have someone count the hands. Record that number on your “How Many Lizards?” sheet.

ACTIVITY PART 1 STEP 8

Now that you and everyone else in your class has counted the toe scales, you know how many lizards are excellent climbers, how many are good climbers, and how many are not-so-good climbers. We're going to find out how many lizards are in each group and make a graph from the numbers. Scientists often use numbers to make a graph. For example, this is a graph showing what kinds of pets are most popular. A graph changes a set of numbers into a picture or a pattern. This pattern can help you understand the numbers in a new way. So let's try this for our lizard groups. Go to the next step.

ACTIVITY PART 1 STEP 9

Now that you know how well all the lizards can climb, make a graph from the numbers. Color in one box for each excellent-climbing lizard. Do the same for the good and not-so-good climbers.

ACTIVITY PART 1 STEP 10

This is what our graph looked like. Yours probably looks similar. Each box stands for one green anole. Discuss these questions, and watch the next video to see what happens.

ACTIVITY INTRODUCTION VIDEO 2

OK. It's time to find out what happened to the green anoles when the brown anoles arrived. First, let's look at the group of green anoles that are the not-so-good climbers. The not-so-good climbers had a hard time getting away from the brown anoles. They just couldn't climb high enough or quickly enough. Many of them got eaten by the brown anoles. You'll find out exactly how many lizards in your class got eaten in just a minute. But let's find out about the other lizards too. What about the group of green anoles that are the good climbers? Well, they were better at getting away from the brown anoles, but a few still got caught. OK. And what about the group of excellent climbers? They climbed high and fast and almost all of them got away. OK. So let's get back to the game and see what this does to our graph.

ACTIVITY PART 2 STEP 1

OK, now we're going to take away some lizard cards, since some of the lizards got eaten. We'll start with the not-so-good climbers. If your lizard is a not-so-good climber, stand up and count

off like this: 1, 2, 3, 4, 5, 6, 7, 8, and so on. Now, everybody remember your number when you count off. When you're done, go to the next slide.

ACTIVITY PART 2 STEP 2

Take away the cards for all the not-so-good climbing lizards except numbers 5 and 10. Those lizards didn't get eaten. If your lizard got eaten, quickly draw a sad face on your card. Then hand it in to your teacher. Your lizard is no longer in the game. But don't worry, you'll get another lizard soon.

ACTIVITY PART 2 STEP 3

OK, now we're going to take away some good climbers. Even though they could climb pretty well, remember brown anoles still ate some of the good climbers. Good climbers, stand up and count off. Remember your number, and go to the next slide when you're done.

ACTIVITY PART 2 STEP 4

OK, now take away all the odd-numbered lizards. Those lizards got eaten. Only the even-numbered lizards survived. If your lizard got eaten, quickly draw a sad face on your card, then hand it in to your teacher. Your lizard is no longer in the game. But don't worry, you'll get another lizard soon.

ACTIVITY PART 2 STEP 5

Brown anoles caught very few of the excellent climbers. Excellent climbers, stand up and count off. Remember your number. And when you're done, go to the next slide.

ACTIVITY PART 2 STEP 6

OK, now take away cards 5 and 10. Those poor lizards got eaten. But the rest survived. If your lizard got eaten, quickly draw a sad face on your card. Then hand it in to your teacher. Again, your lizard is no longer in the game. But don't worry.

ACTIVITY PART 2 STEP 7

The brown anoles ate lots of green anoles! But the better climbers got away. Discuss.

ACTIVITY PART 2 STEP 8

Everyone who still has a lizard card, stand up and find a partner who also has a lizard card. If there's a lizard with no partner, your teacher will give a lizard card to one more person so that everyone has a partner.

ACTIVITY PART 2 STEP 9

If you don't have a lizard card anymore, join one of the pairs. Make groups of four: two people with lizard cards, and two without. If you don't have enough people, that's OK. You can have a group of three, as long as you have two lizard cards.

ACTIVITY PART 2 STEP 10

Each "Adopt a Lizard" card stands for a lizard parent. Now get a "Baby Lizard" card for each person in your group, even people who have parent lizard cards. So, groups of four need four Baby Lizard cards.

ACTIVITY PART 2 STEP 11

Now your group will figure out what the babies of those lizard parents are like. The babies will be like both the mother lizard and the father lizard. On the Baby Lizard cards, do steps one, two, and three. You're going to write in the number of toe scales each parent has. Add those numbers together, and then divide that by two. The answer tells you how many toe scales the babies will have.

ACTIVITY PART 2 STEP 12

Now you know how many toe scales your baby lizard has. Figure out what kind of climber the baby lizard is. Is it an excellent climber, a good climber, or a not-so-good climber? Circle the answer.

ACTIVITY PART 2 STEP 13

Hand in all the parent lizard cards now. The parent lizards have died of old age, leaving only baby lizards on the island. Once all the parent lizard cards are handed in, go to the next step.

ACTIVITY PART 2 STEP 14

Now, let's see if the baby lizards are different from the original parent lizards. Raise your hand if your baby lizard is an excellent climber. Write down the number of hands raised on the Baby Lizards side of this sheet too.

ACTIVITY PART 2 STEP 15

Count the good and the not-so-good climbers, and write those numbers on the “How Many Lizards” sheet too.

ACTIVITY PART 2 STEP 16

Make a graph of the baby lizards, just as you made a graph before.

ACTIVITY PART 2 STEP 17

What happened after the brown anoles arrived? Compare the two graphs and discuss.

WRAP-UP VIDEO 1

When the real brown anoles ended up in Florida, scientists weren't sure what would happen. Some worried that the green anoles already living there wouldn't survive. But in the activity, you saw that the green anoles did survive on Lizard Island, at least some of them. At the end of the game, these were the green anoles living on Lizard Island. This is our graph. Yours might look a little different. It shows the green anoles organized into three groups based on how many toe scales each one has. When you compare those groups to the graph of the original green anoles, you discovered something had changed. Among the original green anoles, we'll call them Generation 1, there was a pretty equal number of excellent climbers, good climbers, and not-so-good climbers. But among the baby green anoles, we'll call them Generation 2, the number of excellent climbers and good climbers has increased, and the number of not-so-good climbers has decreased a lot. But why is that? You know that babies or offspring inherit traits from their parents. Let's say you've got two green anoles with fewer toe scales. They're both

not-so-good climbers. If they have babies together, their babies will inherit a similar trait. They'll have fewer toe scales and be not-so-good climbers too. At least that's what would happen if the parents weren't eaten first. You saw that the original not-so-good climbers were easier for the brown anoles to catch. I'm going to cross out the boxes on our graph for each one that got caught in Generation 1. So even though we started with lots of not-so-good climbers, most of them didn't go on to become parents. They got eaten. That meant their traits of having fewer toe scales didn't get passed down to Generation 2. Most of the green anoles that did survive were the ones with more toe scales. The brown anoles couldn't catch them all. Because they survived, they were the ones that had offspring and passed on their traits. So, it makes sense that almost all the new babies in Generation 2 are better climbers with more toe scales too. They inherited that trait from their parents. Now imagine playing one more round of the game with the green anoles in Generation 2. The brown anoles eat the ones that are easier to catch, but some green anoles are able to escape. Check it out. These are the survivors. They had the chance to grow up, and now they can become parents. The babies that they have together will be Generation 3 on Lizard Island. Let's see if we can make a prediction about this next generation. Think about how many toe scales they'll likely have. Do you think most of the green anoles in Generation 3 will be excellent climbers, good climbers, or not-so-good climbers?

WRAP-UP VIDEO 2

Maybe you predicted that most of the green anoles in Generation 3 will be in the excellent climbers group. The graph for that generation might look something like this. Looking back at Generation 2, you probably noticed that almost all of the good climbers got eaten by brown anoles. They couldn't climb as high or as fast as the excellent climbers, so they were easier to catch. That means most of the parents are from the excellent climbers group, and they passed



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on their traits to Generation 3. From Generation 1 to Generation 3, there were more and more excellent climbers among the green anoles on Lizard Island. It became much more common for green anoles to have lots of toe scales. The graphs are evidence of that trait being passed down over time. If you've done our lesson on pet pigeons and dogs, this idea of traits being passed down might sound familiar. In that lesson, you saw how people selected specific traits so those traits will be passed down to more offspring over time. For instance, here's a group of ancient wolves, the ancestors of today's dogs. They have small natural variations in their traits. These two are a little bit furrrier than the others, so people might choose them to be parents because they want more pups to inherit that trait and be a bit furrrier too. Then people kept choosing the furrriest parents to have offspring, so the trait got passed down over generations. And after many, many years, it got more extreme. Today, there are dogs that have the trait of being extra, extra furry. This process of people choosing traits to be passed down is called artificial selection. On Lizard Island, there weren't any people selecting traits, but the trait of having lots of toe scales became much more common over time, so a kind of selection was happening. Instead of people doing the selecting, this kind of selection depends on survival. Think about the green anoles and their environment on Lizard Island. What changed in the green anole's environment? What helped some green anoles survive after the change?

WRAP-UP VIDEO 3

At the start of the game, before the brown anoles were there, the green anoles on Lizard Island could survive on the ground and in the trees. Both were good places to find food and space, but then their environment changed. The brown anoles arrived. Now being able to climb was essential to survival, and small differences in the number of toe scales became a big deal. Green anoles with more toe scales were better able to survive because more toe scales made



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them better at climbing. And because they survived, it was mostly green anoles with lots of toe scales that went on to have babies. So that trait was more likely to be passed down to future generations. That's a process called natural selection. People didn't select that trait. This wasn't artificial selection. Instead, selection was based on survival and sort of happened naturally. You saw natural selection happening on Lizard Island. Although Lizard Island is a game, something similar happened with the real green anoles in Florida. Today, there are places in Florida where green anoles and brown anoles do live together. Scientists there have been studying the toe scale traits of these green anoles for many years. Like you, they carefully counted toe scales. They've discovered that the green anoles living with brown anoles tend to have larger toes with lots of scales. It's a trait that's been passed down over many generations of green anoles that were better able to survive. It's natural selection in action. The brown anoles still spend most of their time on the ground, but the green anoles now spend most of their time higher up in the trees. In the trees, they can find the food and space they need away from the brown anoles. For these lizards, having more toe scales is key to survival. It's a physical feature that makes it possible to live in an environment with brown anoles. It's an adaptation. You can probably think of other animals with adaptations that help them survive, like how a giraffe's long neck helps it reach food on high branches, or how looking like the leaves in its environment helps this katydid hide from hungry birds. Adaptations can also be behaviors. Every winter, these geese fly to warmer areas where they can better survive for the season. So take a closer look at the animals near you. Whether it's big ears, a long thin beak, or tiny toe scales, how might certain traits help them survive? Have fun and stay curious.