

## Lesson 6. How Did Anoles Evolve Stickier Feet?

The “ <i>Big Idea</i> ”	Natural selection is the scientific explanation for how and why animals and plants change over time.
Investigation Question	How did anoles evolve stickier feet?
Summary	<p>Students are introduced to the case of anoles who are experiencing the city encroach on their rural habitat. Scientists have found evidence that, after many generations, the anoles living in the city now have feet that are better at sticking to harder, shinier surfaces.</p> <p>After they look at a video describing the case, students are presented with three explanations for these changes that are flawed in some way, and are asked to agree or disagree and explain their position.</p> <p>The activity concludes with a summary of the weaknesses of each preconception and a statement of the scientific explanation of adaptation of urbanized anoles by natural selection.</p> <p>At the end, students revisit the long ago and nowadays scenarios from L1 and reflect on their initial ideas about a possible mechanism for change over time. They decide if their ideas have changed and revise their explanations as needed.</p>
Materials	<p>For the class</p> <ul style="list-style-type: none"> <li>● <a href="#">A Lizard’s Tale video</a></li> <li>● Signs posted in each corner of the classroom: strongly agree, agree, disagree, strongly disagree</li> <li>● Slide deck for this lesson</li> </ul> <p>For each student</p> <ul style="list-style-type: none"> <li>● Notebook, pages 3 and 13</li> </ul>

### Lesson Description and Rationale

In the last class, students studied evidence that showed that individual radish plants with a beneficial or advantageous trait variant (e.g., lots of hair) can become more and more numerous over several to many generations and eventually individuals with this trait variant dominate the population.

Today students extend their understanding of natural selection in the context of the case of a small forest lizard called an anole that, due to human construction projects, finds that its territory now includes the city. What changes do scientists who study anoles observe and how do we explain changes over time (over many generations) in the case of anoles in the city?

You will show a 5-minute video that presents the case of anoles that are now living in the city. How do we explain the changes scientists are observing? Using a “4 corners” activity, students are given some flawed explanations, each of which is a well-documented type of mistaken preconception. Students are challenged to decide if there’s a problem with the explanation and where the problem lies. Some examples of these preconceptions are intuitive beliefs that organisms change because they need to in order to survive; or that a trait variant changes as the organism matures; or that individuals transform and get new body parts or traits. The rationale for having students encounter incorrect explanations is to help them identify any of their own misunderstandings and solidify their understanding of the scientific explanation for change over time, which they should now be able to call natural selection.

At the end, students are invited to look back at their explanation for change over time in the L1 long ago and nowadays scenarios. Students have a chance to revise those ideas now that they have constructed an accurate explanation of natural selection and learned about common inaccurate preconceptions. This class provides you with a formative assessment, as student responses will provide you with evidence to judge how well the class understands natural selection.

By the end of this lesson, students will be able to distinguish between the scientific explanation of natural selection and some common (unscientific) explanations that are not supported by data.

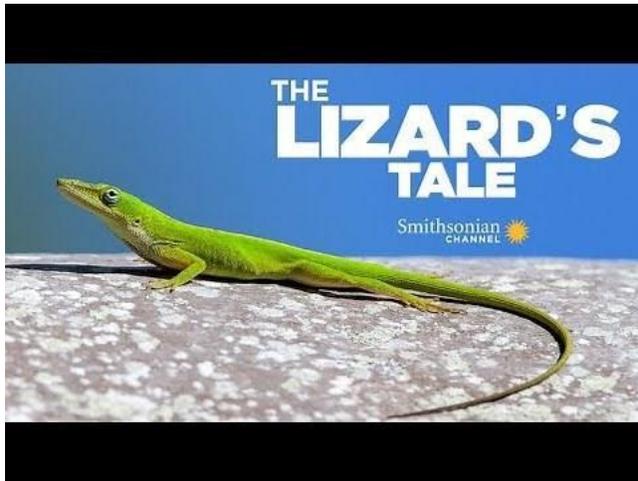
### Learning Targets in this Lesson

- Natural selection explains how and why anoles’ feet changed over time.
- It is easy to misunderstand natural selection.

Sequence of Experiences		
<b>1. Introduction</b>	All class	5 Minutes
<b>2. View Anole Video</b>	All class	10 Minutes
<b>3. Anoles “4 Corners” Activity</b>	All class	15 Minutes
<b>4. Make Meaning</b>	All class	10 Minutes
<b>5. Reflection: Have My Ideas Changed since Lesson 1?</b>	Individual	5 minutes
<b>6. Wrap Up</b>	All class	2 Minutes

### Preparation

- Preview the video, *A Lizard’s Tale*. Watch the first 5 minutes.  
<https://www.youtube.com/watch?v=1SYjXFJULNU>



## [The Lizard's Tale 107: Anoles In The City](#)

Preview the four “4 Corners” statements. Each one is problematic in some way. Be sure you understand why each statement is flawed and know how to revise the statement to make it accurate (consistent with natural selection). Look at classroom examples of student responses to help you anticipate what you may hear in your class discussion. Make sure you can quickly explain natural selection in an accurate way- some animals survive and reproduce better than others and over time their traits become better represented in the population.

Note: Examples of what students have actually said:

1. Um, I think it's actually like, you know how some animals have stuff like, like I think the leopard and the zebra have the stripes and the spots that camouflage into the --- so they can get their food. Well, I think it's like these. They grow bigger feet so they can climb and get food.
2. So the anoles move to the city and they're getting bigger toe pads and longer legs and then there are barely no more anoles with small toe pads and short legs.
3. They're changing as they get older. The ones that are like the ones that change could help them survive better.
4. Because like...if some of them, like, survived and ran a lot their legs and toe pads are gonna get bigger. But some might not have survived but almost survived, like they got an injury on their leg but still survived. So like their legs are still small.

### The Lesson

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#### 1. Introduction (5 Min)

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Explain that today the class will see a short video describing some really interesting findings about how small lizards called anoles – that used to live in natural forests – changed over many

generations when their habitat expanded to include the city. We are going to investigate the question: What happened to anoles when the surfaces they had to climb up and down were no longer tree bark but now include painted concrete, metal poles, and other hard surfaces?

Then, tell students the class will use a “4 corners” activity to explore some possible explanations for the changes – explanations that may be unscientific or incorrect in some way.

Finally, say that the class will see if we can agree if natural selection can explain the changes in anoles’ leg and toe pad characteristics after they had lived in cities for many generations, or if there is another explanation.

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## 2. View Anole Video (10 Min)

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Show the class the first 5 minutes of a Smithsonian video that tells about what happened to animals called crested anoles when they moved from life in the forest to life in the city.

<https://www.youtube.com/watch?v=1SYjXFJULNU>

- *Is there anything about this video you don’t understand and would like to clear up before we go on to the next activity?*

Address students’ questions before you move on.

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## 3. Anoles “4 Corners” Activity (15 Min)

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Project a slide with the following question and read the question aloud.

- *How would you explain the observation that after anoles had lived in the city for several generations, many anoles had longer legs and larger toe pads with more ridges than the same kind of anole living in forests?*

*Take 3 minutes to turn and talk to a partner and see if you can agree what happened.*

After three minutes:

*Now, I’m going to show you a possible explanation for the city anoles’ longer legs and wider toe pads with more ridges. Look and listen carefully and think about whether you agree with the explanation or not.*

*You’ll notice I’ve put signs in 4 corners of the classroom.  
Strongly agree, Agree, Disagree, Strongly Disagree*

*After I read the explanation, decide whether you strongly agree, agree, disagree, or strongly disagree with it. When I tell you to, move to your corner. I'll ask someone from each corner to explain reasons for their choice.*

*After we have heard from the corners, you'll have a chance to change position.*

Project the first explanation and read it aloud. Ask students to move to the corner with the sign that best matches what they think.

When students have moved to their corners, ask some students to explain their reasoning. This is a time to elicit student ideas and a time to build on students' ideas while encouraging them to challenge aspects of them. This is also a time for students to discuss amongst themselves. Based on this discussion, students may wish to change corners. This is ok.

During this discussion, it is ok to reinforce nuggets of a natural selection explanation, including ideas like individuals with advantageous traits live longer, have more babies, and their relative numbers increase and begin to dominate the population. You can also encourage students to make connections to the story of the piloses.

*Note: Try to take advantage of the distribution of students. Some discussions might be most interesting between those that somewhat agree and somewhat disagree, and other discussions might be more interesting to focus on those that strongly agree and strongly disagree. Try to get students to engage with one another.*

Repeat for each of the 3 explanations.

Explanation #1: The urban (city) anoles *needed* longer legs and wider toe pads to be better at climbing hard surfaces to capture food, so their legs and toe pads changed. (preconception: need)

Explanation #2: The urban anoles with shorter legs and less sticky toe pads could not climb as high for food but when they got older, their legs got longer and toe pads wider. (preconception: development/aging)

Explanation #3: When anoles found themselves in the city, their legs and toe pads changed and they were able to keep getting food, staying healthy and having babies. (preconception: transformation)

Wrap up the "4 corners" activity incorporating the points students make. The goal is to end with the class coming to consensus that the best explanation is natural selection. Some important ideas to highlight include:

- The legs don't get longer and toe pads stickier just because the anoles needed to climb on harder surfaces.
- The toes don't change because these anoles grew up/became adults.
- The legs and toe pads cannot just transform because there is a problem.

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#### 4. Make Meaning (10 Min)

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Gather students for discussion.

The purpose of this discussion is to reflect on the disagreements that the students had. Even if the class eventually came to agree on an explanation, there were disagreements. The reason there was disagreement is that many of these flawed explanations seem reasonable but do not reflect how natural selection actually works.

*Note: You may need to ask students to recount the Piloses story and ask how this is similar to the anoles story.*

Ask students to write an answer to the question on page 13 of the student notebook: Imagine that the city anoles were taken back to the forest to live. If you looked at their legs and feet after many generations, what do you think you would observe?

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#### 5. Reflection: Have My Ideas Changed since Lesson 1? (5 Min)

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*In Lesson 1, you looked at 4 populations of animals whose traits have changed over a long time. You wrote your ideas about how this happened in your notebooks. You have now seen that the same mechanism can explain every case you have studied since then.*

*Have your ideas about how change happened changed since Lesson 1?*

Have students turn to page 3 in their notebooks and reread their initial ideas about how animals' characteristics or traits change from generation to generation. Ask them to find the space provided and write down how they think the change happened **now**.

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#### 6. Wrap Up (2 Min)

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*Today you learned about anoles living in the city. You have heard some explanations for changes in the characteristics of their toe pads in the population over time. We have agreed that the best explanation is the process we call natural selection.*

*Note: if you are only doing lessons 1-6 of this curriculum, please do the "wrap up" activity, which can be found in the unit supplementary materials or on this link*

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