

Lesson 8. What Gives Us Evidence that Different Types of Organisms are Related?

The “Big Idea”	<p>1. A natural selection story about a trait change in a population of one species (adaptation) is essentially the same as a story that results in a new species (speciation).</p> <p>2. Fossils that formed thousands of years ago provide evidence of organisms that lived a long, long time ago.</p>
Investigation Question	What gives us evidence that different types of organisms are related?
Summary	Students discuss the miroungas story then transition to looking at the kind of scientific evidence that supports such a story. They learn how fossils are formed, then apply what they have learned to decide what parts of present-day organisms might become fossilized.
Materials	<p>For the teacher</p> <ul style="list-style-type: none"> ● Short reading on how fossils are formed ● Copies of the Miroungas Storybook (for reference if needed) <p>For the class</p> <ul style="list-style-type: none"> ● Slide deck for this lesson <p>For each small group</p> <ul style="list-style-type: none"> ● Sets of pictures of modern animals and plants <p>For each student</p> <ul style="list-style-type: none"> ● Pictures of how fossils are formed (Notebook Page 16)

Lesson Description and Rationale

By this point in the unit, students have made sense of several stories of how changes in the environment lead to changes in populations of organisms over time. From these stories, students have synthesized their understanding to deduce the mechanism of natural selection.

Today, students address multiple questions. In Part A, as students make sense of the miroungas history, they recall and revisit the investigation question from Lesson 7:

Can two really different organisms—like piloses and miroungas—be related?

The first part of this lesson highlights the parallels between speciation and adaptation. That is, students will do a “compare and contrast” activity and learn that a natural selection story that results in a new species (e.g., miroungas) is essentially the same as a natural selection story that leads to a specialized trait in one species (e.g., piloses).

In Part B, they begin to think about the kind of scientific evidence that supports an evolutionary story like that of the miroungas. They travel much further back in time and start to consider what fossils can tell us about the history of living things.

In Part B, students address the different investigation question

What gives us evidence that different types of organisms are related?

As part of investigating this question, students first learn how fossils are formed and conduct an activity in which they decide what parts of present-day organisms might one day get preserved in a fossil.

Note: This lesson is the first of three lessons that focus on the importance of fossils in providing evidence that different kinds of organisms are related.

Because both parts of this lesson are important, do not rush students through any part of the lesson. If necessary, the lesson could be broken after the compare-and-contrast discussion of miroungas at the end of Part A.

By the end of this lesson, students will understand that (i) adaptation and speciation are both the results of natural selection, and (ii) fossils show us something about the history of ancient organisms. They will be able to imagine what parts of present-day organisms might become fossilized in the future.

Learning Targets in this Lesson

- A natural selection story about a trait change in a population of one species (adaptation) is similar to a story about changes that result in a new species (speciation).
- Fossils provide evidence of species that lived a long, long time ago.
- Hard structures like bones or leaf skeletons are the parts of organisms that are most likely to remain and become fossils.

Sequence of Experiences		
Part A		
1. Introduction	All class	1 Minute
2. Make Meaning of Miroungas	All class discussion	20 Minutes
Part B		
3. Introduce Pilosa Fossil	All class	3 Minutes
4. Learn How Fossils are Formed Video	All class	7 Minutes
5. Predict What will Fossilize Activity	Small groups	10 Minutes
6. Make Meaning	All class	5 Minutes
7. Wrap Up	All class	2 Minutes

Preparation

- Review the video which provides a brief but accurate description of how fossils are formed. <https://www.youtube.com/watch?v=sgPnnzouOog>

VIDEO SUMMARY (for teachers not students!): A fossil is evidence of a plant or animal that lived a very, very long time ago. A fossil begins when a plant or animal dies in a swamp, river, lake, or ocean where clay, silt, mud, or sand can quickly bury the remains. Most of the animal or plant quickly rots away. More mud and sand and gravel pile on top of the buried remains. The layer becomes thicker and thicker, and the fossils are pushed deeper and deeper under Earth's surface. Slowly, tiny particles of matter in the water fill up tiny spaces in what is left of the plant or animal. Finally, the substances harden into rock in the shape of the animal or plant remains. Pressure eventually turns the surrounding mud and silt into rock as well.

- Make sure you have enough copies of pictures of modern plants and animals to hand out 1 per team

The Lesson—Part A

1. Introduction (1 Min)

We have explored the stories of many organisms and how their populations changed when the environment changed. We learned that natural selection explains how the changes came to be.

Today, we will discuss the story of the miroungas. We'll see how this story is similar to the stories for radishes, piloses and anoles - and how it is different. Then we will act like

scientists ourselves and begin to learn about the kinds of evidence scientists use for a story like the miroungas where a new species emerges.

NOTE: If you did not finish the miroungas story video in L7, please view the story video from the beginning again. Please do not re-start half way through.

2. Make Meaning of the Miroungas Story (20 Min)

The purpose of the discussion is for students to recap the evidence presented in the miroungas story in Lesson 7. It is also to understand that a natural selection story that leads to a new species (speciation - miroungas) is essentially the same as a natural selection story that leads to a trait change within a population of one species (adaptation - piloses).

Ask students:

- *What do you notice is the same between this story and the piloses story we explored before?*

NOTE: First ask for similarities, then ask for differences.

Listen for student ideas about similarities and add them to a chart:

Similarities:

- In both stories, the population long ago included individuals with differences in their traits. They did not all look exactly the same.
- In both stories, some animals had trait variants that made it easier to reach food and some animals had trait variants that made it difficult to reach food.
- In both stories, some animals lived longer and had more babies than other animals.
- In both stories, each population looked different than how it looked in the past.

Next, ask students

- *What did you notice that's different?*
- *How do you think the miroungas story is different from the stories of piloses?*

Listen for student ideas about differences and add them to a chart:

Piloses	Miroungas
<ul style="list-style-type: none"> - Fewer generations passed. - The animals were never separated. - All the piloses could still have babies with the other piloses--even if their noses looked different. - Piloses nowadays and piloses a long time ago only looked different in one way: their noses. - The population of piloses changed over many generations, but they are all still piloses 	<ul style="list-style-type: none"> - More generations passed. - The environmental change meant that miroungas were separated from the rest of the piloses population. - The animals on the island were completely separated from the animals in the desert, so eventually animals in one group could not have babies with the animals in the other group. - Much more has changed! The animals nowadays and the animals a long time ago look different in three ways! Their feet, noses, and tails all look different! - A whole new species emerged!

Return to the question

- *Can two really different species of animals like piloses and miroungas be related?*

Ask for a show of hands for students who agree, and who disagree. Most students will respond yes to this question.

NOTE: If you need to break this lesson into two parts, THIS IS A GOOD STOPPING POINT.

The Lesson—Part B

3. Introduce Pilosa Fossil (3 Min)

Explain to students that the class is now moving on to the (other) main question for today. Today's investigation question is

- *What sorts of evidence tell us that different kinds of organisms are related?*

Project the image of a fossil pilosa.



Ask students to imagine a scientist came to an island and saw miroungas swimming in the water. Ask:

- *What if they dug up something like this from under layers of dirt on the island?*
- *Is this evidence to suggest that miroungas evolved from a different animal?*

Explain that the class will come back to these questions at the end of the lesson, but now the class will start by learning how fossils form by watching a short video and thinking about whether fossils can provide evidence about the past.

4. Learn how Fossils are Formed (7 Min)

Tell students that learning how fossils are formed can help them understand what fossils can tell them. Reassure students that, when watching the video, they should focus on understanding how fossils are made, not the vocabulary. Tell students that, after the video, you'll ask them to use their own words—not the words in the video—to explain how fossils are made.

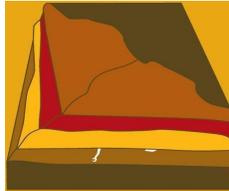
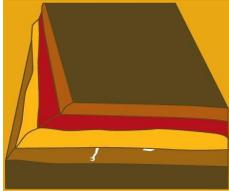
Show students the following youtube video on how fossils are formed:

- <https://www.youtube.com/watch?v=sgPnnzou0og>

Next, project this series of pictures from the slides. Ask volunteers to share how fossils are formed, so that students briefly review the information presented in the video.



NOTE: It is NOT necessary for students to memorize all the details of how fossils are formed, nor to memorize vocabulary, e.g., "lithification," associated with the process.



Listen for student ideas

- Becoming a fossil begins when an organism dies in or near water where mud, sand can quickly bury it.
- Most of the animal or plant quickly rots away.
- Tiny bits of stuff in the water fill up tiny spaces in what is left of the plant or animal.
- The bits of stuff harden into rock in the shape of the animal or plant remains.
- A fossil can show us what organisms looked like long, long ago.

5. Predict what will Fossilize (10 Min)

Divide students into small groups and distribute a set of pictures of present-day organisms to each group. Explain that students will imagine what fossils of these organisms might look like many thousands of years in the future. Given what they have just learned about how fossils are formed, they will decide which parts would remain as fossils.

<Picture set includes squirrel, oak leaf, fish, snail, mouse, clam, fern >

Ask students:

Imagine the plant (or animal) in the picture died, fell into water and was covered by water and sand or mud for thousands of years. What parts of the plant or animal do you think might remain? Why?

Give them 5 minutes to think and discuss, then ask for volunteers to share their ideas. Listen for ideas about the soft parts of the plant or animal disintegrating and the hard parts (for example, bones, teeth, veins of leaves, stems) remaining.

6. Make Meaning (5 Min)

Purpose of the discussion: to consolidate student understanding of how fossils are formed and relate this process to the miroungas story.

Remind students of the questions for today:

- *Earlier in the lesson, we wondered: Can two really different species of animals like piloses and miroungas be related?*
- *We also wondered: What sorts of evidence tell us that different kinds of organisms are related? Can a fossil from mirounga island tell us anything about the history of the miroungas?*

Ask students:

- *Do you think that the fossil we saw could have been a fossil pilosa? Why do you think so?*
- *Could it be evidence to tell us that piloses and miroungas are related?*

Listen for student ideas:

- This could be evidence that a pilose was once on the island long ago, we know that the mirounga ancestors were piloses that were washed away
- Even though in the story there were no piloses on the island with the miroungas nowadays, the fossil looks a little like a pilosa.

7. Wrap Up (2 Min)

Today, we found out that the process of “natural selection” that leads a species like the piloses to have a beneficial trait or “adaptation” like a skinnier trunk (a trait that works well in their environment) is the same process that can result in an entirely different species like miroungas. This happens in a new environment over a long, long time. New species evolve when a population is somehow split into two groups that are prevented from having babies together.

We found out how fossils are formed and discussed whether a fossil of one of the piloses, found on mirounga island, could be evidence that piloses and miroungas were related long ago. In the next lesson we'll explore some real fossils and wonder about what the environment was like in the ancient times when they lived.