Lesson 7. Can Miroungas and Piloses be Related?

The "Big Idea"	The selective survival and reproduction of animals with certain sets of trait variants over multiple generations can lead to the emergence of populations that are so distinct from the original population that we classify them as a new species. Despite these species looking very different, they share a common ancestor: species that look different can therefore be related.
Investigation Question	Can miroungas and piloses be related?
Summary	Students review the cases they have encountered so far to identify similarities and differences. Though the environmental change may be different, they note that the mechanism of change is the same in each. They watch a video of a new storybook that describes how part of a population changes when isolated from the rest; it evolves into a separate species. Note that this lesson ends before students have a chance to discuss these events; this discussion kicks off Lesson 8.
Materials	For the class ● Video - *How Piloses Evolved into Miroungas:* https://youtu.be/1Ab82hpvwYU ● Slide deck for this lesson For each student ● Notebook pages 14 - 16

Lesson Description and Rationale
By now students are familiar with multiple examples of populations (piloses, radishes, anoles) where the distribution of trait variants in the population has changed over time through the process of adaptation by natural selection.

Today, the lesson begins with an opportunity for students to review the piloses, radishes, and anoles cases and compare and contrast the stories. Through this analogical reasoning they will come to see that the mechanism of natural selection is the same in each case. This foundation of understanding will place students in a strong position for engaging with the next big idea: the same process that can lead a species to have specialized traits ("adaptation by natural selection") can also lead to the evolution of entirely new species from older ones ("speciation by natural selection"). Two entirely different species can therefore be related!

To set the stage for this insight, students watch a video of a storybook, *How Piloses Evolved into Miroungas*. It starts with a population of piloses and tells us that they are related to animals called miroungas. Their habitats and behaviors are different, and they don't look at all like each

other. In fact, if the two groups ended up in the same place, they are so different they could not have offspring together. How could two species that are so different be related?

The storybook starts: a group of desert-living piloses was separated from the larger population by a storm that swept them away to an island where food was abundant only in deep water.

At this point in the story, students stop for a short activity: they study drawings of piloses (taken from the storybook) and discuss with a partner which traits they think would help or hinder piloses swimming in deep water where there is lots of food.

The video of the storybook resumes and concludes. The lesson prepares students to consider what features of the miroungas speciation story are the same and different from all the natural selection stories they have explored to this point.

Learning Targets in this Lesson

- A large environmental change may divide a group of animals.
- Over many generations the traits in two isolated populations may change so much that they are very different from each other.
- Groups of animals that look very different from each other are related if they have the same ancestors.

Sequence of Experiences		
1. Introduction	All class	2 Minutes
2. Analogize Across Natural Selection Cases	All class	8 Minutes
3. View First Part of the *How Piloses Evolved into Miroungas* Video	All class	6 Minutes
4. Which Piloses Will Be More Successful in Deep Water? Activity	Individual & Small groups	10 Minutes
5. Watch Second Part of the *How Piloses Evolved into Miroungas* Video	All class	8 Minutes
6. Wrap Up	All class	1 Minute

Preparation

- Preview the miroungas storybook video
- Review the table at the end of this lesson, which provides sample responses for the analogical reasoning review at the beginning of the lesson

The Lesson

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1. Introduction (2 Min)

Remind students that

In our last class, we considered the case of the anoles in the city. In the 4 corners activity we thought carefully about possible explanations for how changes in the urban anoles' feet had happened. We agreed with scientists that over many generations in the city, anoles with larger, more-ridged toe pads lived longer, had more babies, and their numbers increased so that there were more of them in the population.

Remind students that they are now familiar with several examples of populations where the proportion of individuals with a particular trait variant has changed over some period. Tell students that today they will begin by reviewing what all these examples have in common.

Tell students they will get to hear a new story that stars two populations of animals, piloses and miroungas, that look very different from each other. The question is, although they look very different, could piloses and miroungas be related?

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2. Analogize Across Cases of Natural Selection (8 Min)

Have students turn to page 14 in their Notebooks. Project the slide showing the following table and explain that

We have observed in our study of piloses and radishes and anoles that the proportion of individuals in a population that have a particular trait variant has changed over time. These organisms are very different but scientists tell us that the change stories are the same in all three. We'll go row by row through this table and see for ourselves.

Ask

- *Were there trait variants in all three populations?*
- *What about the environment: what's the same in all three cases?*
- *How about the populations: what's the same?*
- *What about beneficial trait variants: what's the same?*
- *What about less beneficial trait variants: what's the same?*
- *What about traits in the offspring: what's the same?*

	Piloses	Radishes	Anoles
Variation in traits	Yes	Yes	Yes
Environment	Hotter, drier, food underground	Predators (caterpillars) arrived	New city environment
Population changes	More piloses with thinner noses	More plants with hairier leaves	More anoles with larger, stickier toe pads
Beneficial trait variants	Thinner noses able to get food more easily – more healthy offspring	Hairier plants not eaten by caterpillars – more healthy offspring	Wider stickier toepads able to climb slippery surfaces – more healthy offspring
Less beneficial trait variants	Thicker noses not able to get in tunnels - few or no offspring	Non-hairy plants eaten by caterpillars - few or no offspring (seeds)	Smaller less sticky toepads less able to get around and find food - few or no offspring
Offspring's traits	Traits like their parents (apt to have thinner noses)	Traits like their parents (apt to have more hairs)	Traits like their parents (apt to have wider stickier toe pads)

Note: 1. This review should take no longer than 8-10 minutes. Try to keep students moving quickly through their responses.
2. By making the analogies across cases, the key goal is for students to realize that the process by which all species evolve specialized traits over time is the same. It happens by natural selection.
(In fact the process is called "adaptation by natural selection," and, confusingly, can be described as producing "adaptations").

Ask students

- *Is the explanation of the change in traits the same for all the plants and animals?*

  - Yes.
  - What is the same:
    There is variation

A change in the environment presents a problem
Beneficial trait variants lead to differential (not a student word) survival and lots of offspring
More and more individuals with the beneficial trait result in the population
Harmful trait variants lead to few or no offspring
Offspring tend to inherit similar traits as their parents (and become next generation adults).

- *Do you think that this process could explain <u>any</u> changes we observe in <u>any</u> population of organisms?*

Listen for ideas that include:

- Conclusion: Yes, the explanation was the same in the cases we have studied.
- Because of this, we can say that the same mechanism, called natural selection, can explain other cases too.

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3. Watch the First Part of the *How Piloses Evolved into Miroungas* Video (6 Min)

Introduce the video:

So far, we've talked about natural selection in the one population, for example, all the piloses in the desert. Now, what if, over time, a population was split into two groups by a big change in the environment? Could this separation eventually lead the two different groups to have bodies that are so different that they couldn't make babies/have offspring together? Could it be that they become so different that scientists view the two groups as different species and give them different names? Let's explore these questions.

Play the beginning of the storybook video *How did Piloses Evolve into Miroungas?* Stop when a group of piloses has been swept away by the torrential rains and end up on an island surrounded by deep water wherein lies most of their food. The video will indicate when it is time to press pause.

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4. Which Piloses Will Be More Successful in Deep Water? (10 Min)

Show students the drawings of a sample of piloses from the original population and explain that they will make a prediction about which piloses might be better able to survive in the new environment. Students can see images of the piloses on page 15 in their notebooks.

These piloses – that used to live in the desert – now faced a big problem: most of their food was in deep water. I want you to look at the six individuals. Their traits vary. Some trait variants may be helpful/beneficial in deep water, and some may not. We will focus on

three traits: tails, trunks, and feet. You may look at others if you wish. Which trait variants do you think would make it easier to get food in the deep water?

Ask students to record their ideas on page 16 in their notebooks. After 4 minutes, have students take 2 minutes to compare notes with a partner.

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5. Watch the Second Part of the *How Piloses Evolved into Miroungas* Video (8 Min)

Show students the rest of the video.

> *Note: Unlike the pattern in most of the lessons, lesson 7 ends here and Lesson 8 begins with a Make Meaning discussion of the miroungas story. Then students start to consider what kinds of evidence - fossils - scientists use to figure out a story like the miroungas.*

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6. Wrap Up (1 Min)

Today you compared the cases of piloses, radishes and anoles and decided that the mechanism of natural selection was the same in each case. You decided that the mechanism of natural selection could explain any changes in any population of organisms when the environment changed.

You also heard how a new species, the miroungas, arose over many many generations. In our next lesson we'll discuss the miroungas story and how it is similar or different to other stories we have considered. We will also begin to think about the kinds of evidence that scientists use to figure out if two different kinds of organisms (species) are related.