

Lesson 1. What's The Story of How Plants and Animals Change Over Time?

The “ <i>Big Idea</i> ”	In a population of plants or animals, physical traits may change over time.
Investigation Question	What's the story of how plants and animals change over time?
Summary	Students examine images that depict small populations of animals as they appeared “Many hundreds of years ago” and “Nowadays.” Students use these images as evidence that traits may change over time. They develop and voice their <i>initial ideas</i> about what might have happened between the animals' appearance and situation hundreds of years ago and their appearance and situation nowadays. The explanation of how these changes might have happened is what we call “the missing middle” of the change-over-time scenario.
Materials	<p>For the class</p> <ul style="list-style-type: none"> ● Slide deck for this lesson <p>For each group of students</p> <ul style="list-style-type: none"> ● A picture of a species many hundreds of years ago and a picture of the species nowadays <p>For each student</p> <ul style="list-style-type: none"> ● Notebook, pages 2 and 3

Lesson Description and Rationale

Adaptation by natural selection is a fundamental concept in biology. It helps to explain the existence of species' physical traits. It also explains the observation that populations of plants and animals have changed over many generations in concert with changes in their environments. Furthermore, it accounts for the emergence and continuing evolution of new species. Faced with evidence of change over time, the question is “How does this happen?” The answer lies in the **mechanism of natural selection**, the focus of this unit.

Note: Several weeks prior to this lesson, the class may have completed the orpeds writing activity designed to elicit students' ideas about the natural selection mechanism prior to instruction.

In this lesson, students work in small groups of 3-4 students, looking at two-panel drawings that depict populations of animals “many hundreds of years ago” versus “nowadays.” Students look for what's different between many hundreds of years ago and nowadays and then think about what might have happened in between those times that would explain the changes – they propose a “missing middle.” Students will share these initial ideas in an all-class discussion.

Note: These examples are designed to help students understand that traits in animal populations do change over time. The examples are presented as fact; in later lessons students will gather evidence of trait change over time in several organisms, both plants and animals.

The “missing middle” of these scenarios: Recognizing that traits of animals many years ago were not the same as they are nowadays is an important step before moving on to explain *how* changes might happen. This lesson focuses on eliciting students’ own initial ideas about the “missing middle” events in the scenarios. The following lesson will address concepts that underpin the explanation of how populations change over time, known as natural selection. Lesson 2 will build on this lesson’s foundation and highlight variation, a critical factor in natural selection.

Learning Targets in this Lesson

- A population is a group of individuals of the same kind in the same environment.
- A trait is a feature or characteristic of an animal or plant such as coloration, leg length, tail length.
- Traits of individuals within a population can change over time.

Sequence of Experiences		
1. Introduce Evolving Minds Unit	All class	5 Minutes
2. Many Hundreds of Years Ago and Nowadays Activity	Small groups	15 Minutes
3. Record Initial Ideas About Change Over Time	Individual	5 Minutes
4. Make Meaning	All class	10 Minutes
5. Wrap Up	All class	2 Minutes

Preparation

- Make sure there is a notebook for each student
- Preview the 4 many hundreds of years ago and nowadays scenarios
- Plan how you will assign students to small groups and post a list of these assignments
- Prepare 1 enlarged copy of the assigned 2-panel scenario for each small group

Note: If the enlarged copies of the cane toad, guppies, owls, and soapberry bugs scenarios are not provided, use the links below to print and enlarge each scenario. Be sure there’s an enlarged image for each group’s assigned scenario.

https://www.evolvingmindsproject.org/files/ugd/cc79a9_7155f1ca31b84aeea42721b3a8aa88bf.pdf

The Lesson

1. Introduce Evolving Minds Unit (5 Min)

Explain that the class is about to start a new science unit called Evolving Minds and this unit is about how plants and animals may change over time. Each lesson begins with a question to investigate followed by activities that will help the class figure out an answer to the question.

2. Many Hundreds of Years Ago and Nowadays Activity (15 Min)

Ask students to open their science notebooks to page 2.
Tell the class that today's investigation question is:

- What's the story of how plants and animals change over time?

Introduce the term "population."

We call a group of the same kind of animal living in the same place or habitat a "population."

Note: You may want to ask students for a few other examples of populations. If you do so, keep this very brief!

Project the two-panel cane toad story and have students find the same 2-panel image in their notebooks.

On the left, you'll see a group of cane toads. This is a population of cane toads a very long time ago. There are 6 individual cane toads shown in this population.

Point out that over many, many hundreds of years the environment where the cane toads lived changed. Nowadays cane toads are a bit different. Point to the "nowadays" panel on the right.

Look carefully at the images of cane toads in their environment many hundreds of years ago and a population of cane toads nowadays. Can you spot any differences in the two scenes?

Give students a minute to look for the changes.

Listen for ideas about changes in the cane toads' *environment* and in cane toads' characteristics or *traits*.

This is a good time to introduce the term “trait.” A trait is a feature or characteristic of part of a plant or an animal in a population.

Someone just mentioned that nowadays that most cane toads have longer legs than cane toads did many years ago. The length of legs is what we call a “trait.” Can you spot another cane toad trait?

Note: Students are looking only at physical traits that they can observe. They cannot see behaviors or behavioral traits.

Other traits students might notice are coloration, length of forelegs or arms, and eye size. Keep this interaction short - seconds not minutes!

Assign students small groups of 3-4. Give each group a copy of one of the two-panel scenarios.

We noticed that nowadays there is a snake in the habitat with the toads. We also noticed that many hundreds of years ago, the toads mostly had shorter legs and nowadays the toads mostly have longer legs! Now it is your turn to work in groups to see what you can notice about other populations nowadays and many hundreds of years ago!

Describe the activity.

Post or project the questions below.

Each group has one “many hundreds of years ago” and “nowadays” population of animals. A few groups may have the same scenario. You’ll have about 7 minutes to discuss answers to these 3 questions with your group:

- *What looks different about the animals’ **environment**?*
- *What looks different about the **animals** over time?*
- *What do you think happened that resulted in these changes?*

3. Record Initial Ideas About Change Over Time (5 Min)

To help get ready for discussion, look at page 3 in your notebook. Take 2-3 minutes to answer the 3 questions in the space provided.

4. Make Meaning (10 Min)

Gather the class in a discussion circle. Ask students to bring their notebooks to use as a reference.

The purpose of this discussion is to hear what changes students noticed, and to **elicit** their initial ideas about the natural selection process or mechanism for change over time, prior to instruction. *It is not the time to teach!*

Note: 1. Observing that traits of animals many years ago were not the same as they are nowadays is an important step before moving on to explain how changes might happen.

2. In the lessons that follow, students will encounter numerous examples of natural selection and will have time to figure out what's the same about the process in each scenario. They will begin to generalize that the explanation is always the same, thus arriving at the mechanisms of differential survival and differential reproduction that underlie natural selection.

Someone from each group will share their change-over-time scenarios and ideas. Use the following prompts to keep the reporting short and to preserve time for group discussion. You will want to move through this sharing/reporting briskly, so that you can devote as much time as possible to the discussion.

Tell us:

- The name of your group's animals
- How the environment changed and how this was a problem for the animals many hundreds of years ago
(We noticed snakes – predators – came into the cane toads' territory and we think they began to eat the cane toads.)
- What looks different about the "nowadays" population from the population "many hundreds of years ago?"
(Most cane toads nowadays have longer legs than cane toads did many years ago.)

Note: When we say “cane toads have longer legs than they did many hundreds of years ago,” we want to be clear that we are referring to a population of cane toads many generations later, not the same group of individuals whose legs became longer. A slight rewording can make it clear we are talking about different groups of toads. While this is not a time to correct students’ ideas about change over time, it is ok to correct misunderstandings related to the set up of this activity.

*Students may or may not notice that leg lengths are not exactly the same. This distinction is not important now but the variation will be the focus of a Lesson 2. This is why we say “**most** cane toads nowadays have longer legs.”*

The discussion question is, “What do you think happened in the “missing middle”?”

We know the beginning (many hundreds of years ago) and the end (nowadays). What happened in the middle - How do you think the change happened?

Note: Emphasize that this is a time for ideas and all ideas are welcome and valuable.

Time permitting: You may want to model a change over time scenario by returning to the example (cane toads) you used to kick off the activity.

As the students listen, ask them to think about how the story is similar or different from their own.

After groups have shared, ask if there is anything that’s **the same about all these scenarios**. (For example, students might suggest that: a change in the environment and change in traits go together; some changes put the individual animals at risk; animals long ago with traits that helped them deal with the risk were like these animals now.)

5. Wrap Up (2 Min)

Summarize today’s science lesson:

Today, we learned about how the traits of populations change over time. We have looked carefully at examples that tell us that populations of living things have not always been exactly like they are now. We looked at “long ago” as the start of a scenario and “nowadays” as the end. The middle of the scenario is missing and you had a chance to imagine what might have happened in the missing middle.

Explain that in the lessons that follow, the class will be gathering evidence to describe the missing middle.