

# Lessons 6–8

## Fossil Evidence

### Prepare

In this set of lessons, students continue to explore the Focus Question for Concept 1: **What do fossils reveal about the past?** In Lesson 6, students observe fossils and analyze and interpret data to describe the past environment of the Florissant area. In Lesson 7, students observe patterns in the kinds of organisms that live in the Florissant area today to recognize that the environment of this area has changed over time. In Lesson 8, students compare the past environment of the Florissant area with the present-day environment to better understand how the environment has changed over time. In a Conceptual Checkpoint, students use fossil evidence to construct explanations about what the environment of another area was like in the past.

### Student Learning

#### Knowledge Statement

Fossils provide evidence of the nature of organisms and environments from long ago.

#### Objectives

- Lesson 6: Observe fossils to learn about the past environment of the Florissant area.
- Lesson 7: Observe organisms that live in the Florissant area today to understand that the environment has changed over time.
- Lesson 8: Compare the past environment of the Florissant area with the present-day environment to explain how the environment has changed over time.

### Concept 1: Fossil Evidence

#### Focus Question

What do fossils reveal about the past?

#### Phenomenon Question

What do fossils found near the butterfly fossil reveal about the Florissant area?

## Texas Essential Knowledge and Skills Addressed

- 3.2D **Analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations.** (Addressed)
- 3.2F **Communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.** (Addressed)
- 3.3A **Analyze, evaluate,** and critique **scientific explanations by using evidence, logical reasoning,** and experimental and observational testing. (Addressed)
- 3.3B **Represent the natural world using models** such as volcanoes or the Sun, Earth, and Moon system **and identify their limitations, including size, properties, and materials.** (Addressed)
- 3.3C **Connect grade-level appropriate science concepts with the history of science,** science careers, and contributions of scientists. (Addressed)
- 3.4 **Collect, record, and analyze information using tools, including** cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, magnets, collecting nets, **notebooks,** and Sun, Earth, and Moon system models; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums. (Addressed)
- 3.9A **Observe and describe the physical characteristics of environments** and how they support populations and communities of plants and animals within an ecosystem. (Addressed)
- 3.9C **Describe environmental changes** such as floods and droughts **where some organisms** thrive and others **perish** or move to new locations. (Addressed)
- 3.10A **Explore how structures and functions of plants and animals allow them to survive in a particular environment.** (Introduced)

## English Language Proficiency Standards Addressed

- 3E Share information in cooperative learning interactions.
- 4A Learn relationships between sounds and letters of the English language and decode (sound out) words using a combination of skills such as recognizing sound-letter relationships and identifying cognates, affixes, roots, and base words.
- 4C Develop basic sight vocabulary, derive meaning of environmental print, and comprehend English vocabulary and language structures used routinely in written classroom materials.

## Materials

		Lesson 6	Lesson 7	Lesson 8
<b>Student</b>	Science Logbook (Lesson 6 Activity Guides A, B, and C)	●		
	Florissant Fossil Photographs (1 set per student pair)	●		
	Science Logbook (Lesson 7 Activity Guides A, B, and C)		●	
	Florissant Organism Photographs (1 set per group)		●	
	Science Logbook (Lesson 8 Activity Guide)			●
<b>Teacher</b>	Butterfly Fossil Photograph (Lesson 2 Resource B)	●		
	Map of the United States	●		
	Past Environment of the Florissant Area Illustration (Lesson 6 Resource B)	●	●	
	Present-Day Florissant Area Photograph (Lesson 7 Resource A)		●	
	Tooth Fossil Photograph (Lesson 8 Resource A)			●
	Mammoth Drawings (Lesson 8 Resource B)			●
	Mammoth Distribution Maps (Lesson 8 Resource C)			●
	Redwood Photographs and Distribution Map (Lesson 8 Resource D)			●
	California versus Colorado Temperature and Precipitation Graphs (Lesson 8 Resource E)			●
	Florissant Area Temperature and Precipitation Graphs (Lesson 8 Resource F)			●
	Anchor chart, anchor model, driving question board			●
	Conceptual Checkpoint Photographs (Lesson 8 Resource G)			●
<b>Preparation</b>	Print Florissant Fossil Photographs (see Lesson 6 Resource A); each student pair will need a set of photographs.	●		
	Print Florissant Organism Photographs (see Lesson 7 Resource B); each group will need a set of photographs.		●	

# Lesson 8

**Objective:** Compare the past environment of the Florissant area with the present-day environment to explain how the environment has changed over time.

## Launch 5 minutes

Display the photograph of the tooth fossil (Lesson 8 Resource A). Tell students that this fossil was also found at the Florissant fossil beds, but it formed a long time after the butterfly fossil.  Explain that this fossil also differs from the butterfly fossil because it is not an impression. This fossil is made of tooth materials from the organism that the fossil came from. 



Have students record on a piece of paper the kind of organism they think formed the fossil. Use a Snowball routine to have students share their responses. During the Snowball routine, invite students to agree or disagree with one another about what kind of organism formed the fossil.

## Agenda

Launch (5 minutes)

Learn (35 minutes)

- Explore Organisms No Longer Found in the Florissant Area (15 minutes)
- Analyze Environmental Conditions (7 minutes)
- Update Anchor Chart (3 minutes)
- Conceptual Checkpoint (10 minutes)

Land (5 minutes)



### Teacher Note

Mammoth tooth and jaw fossils found at the Florissant fossil beds are much younger than the other fossils students have studied from the Florissant area. Paleontologists estimate that mammoths first entered North America 1.5 million to 1.8 million years ago. The mammoth tooth shown in this lesson is estimated to be approximately 50,000 years old (NPS 2015b). Approximately 11,000 years ago, all mammoths became extinct.



### Content Area Connection: Mathematics

Students should realize that the butterfly fossil is nearly flat (two dimensions), and the tooth fossil appears to be solid (three dimensions). Consider connecting these fossils to students' understanding of two- and three-dimensional objects.

► **What kind of organism do you think formed this fossil? Why?**

- *I think the fossil could be a bear tooth. It is shaped like a tooth, and I know that bears live in the Florissant area today.*
- *Maybe it is from a fish. I know fish lived in the Florissant area in the past.*

Reveal that the photograph shows a fossilized mammoth tooth. Then display the mammoth cave drawings (Lesson 8 Resource B). Tell students that humans living 13,000 years ago carved these drawings in rock (Bradshaw Foundation 2011). 🐘



Invite students to Think–Pair–Share in response to the following question.

► **What do you wonder about the fossilized mammoth tooth and the cave drawings?**

- *What is a mammoth? Is it like an elephant?*
- *What happened to the mammoths? I've never seen one before, and I don't think mammoths are still around today.*

Display the mammoth illustration (Lesson 8 Resource B). Explain that this drawing of mammoths is more detailed than the cave drawings. Invite students to share questions they have about mammoths as they observe the illustration.



### Extension

As an extension, consider having students research the Rouffignac cave, also known as the Cave of a Hundred Mammoths, in France. The cave houses more than 250 drawings, engravings, and paintings dating back to the Upper Paleolithic period.

Tell students that in this lesson, they will answer some of their questions about mammoths, examine another kind of organism that no longer lives in the Florissant area, and consider conditions of the past and present to better understand how the environment of the Florissant area has changed over time.



## Learn 35 minutes

### Explore Organisms No Longer Found in the Florissant Area 15 minutes

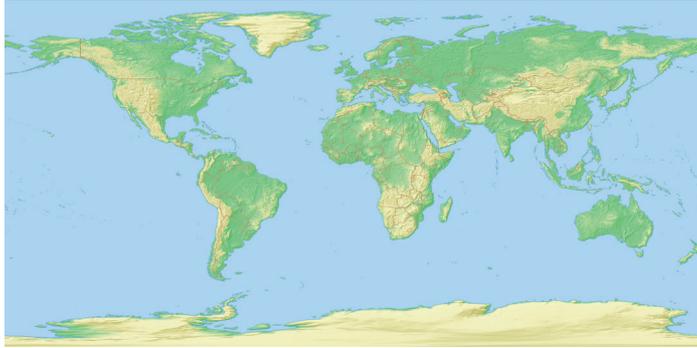
Show students the past mammoth distribution map (Lesson 8 Resource C). Tell students that each red dot on the map indicates a location where a mammoth fossil was found in the United States.



#### ▶ What do you notice?

- *There were mammoths in a lot of places in the United States.*
- *There were mammoths near where we live.*

Show students the present-day mammoth distribution map (Lesson 8 Resource C), and explain that any mammoths alive today anywhere in the world are marked by red dots on the map.



► Compare this world map with the map showing the past distribution of mammoths in the United States. What do you notice?

- *There aren't mammoths anywhere.*
- *It looks like all the mammoths went away.*

Confirm that mammoths are now **extinct**, or no longer in existence. Explain that this means mammoths are no longer found anywhere on Earth. 🗺️ 🐘



### English Language Development

The term *extinct* is used repeatedly in this module. Introduce this term explicitly. Sharing the Spanish cognate *extinto* may be useful (4A).

► What do you think caused mammoths to become extinct?

- *Maybe something like a volcano killed them all.*
- *Maybe their environment changed, and they couldn't get what they needed to survive.*

Explain to students that more than one factor caused mammoths to become extinct. These factors included natural changes in the mammoths' environment and human activity. 🐘



### Teacher Note

Consider asking students to share other organisms they are familiar with that have become extinct.



### Spotlight on Knowledge and Skills

Students should understand that some kinds of plants and animals that were once found on Earth are no longer found anywhere.



### Extension

If time permits, encourage students to research mammoths to learn more about their environment and why they are no longer found on Earth.

Tell students that there is another fossil from the Florissant fossil beds they have not yet observed. Display the photograph of the petrified redwood stump (Lesson 8 Resource D). Explain that the organism that formed this fossil lived around the same time as the butterfly that formed the fossil. Ask students what they notice about the fossil.



*Sample student responses:*

- *It looks like a tree stump.*
- *There are no leaves.*
- *It's brown and gray. It looks old.*
- *It doesn't look like the other fossils we have looked at.*

Tell students that the photograph shows one of about 30 petrified redwood tree stumps at the Florissant fossil beds. Explain to students that this fossil is similar to the mammoth tooth they observed in the Launch, because after the redwood tree that formed this fossil died, it slowly turned into stone over a very long period of time.

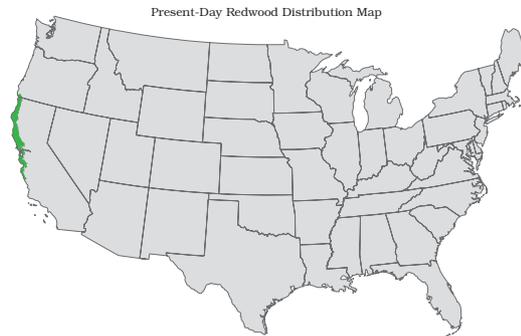


### Teacher Note

The petrified redwood stump was formed through the process of permineralization. During permineralization, a dead organism's organic matter is replaced by minerals over a long period of time. Students should understand that permineralized fossils look different from impressions such as the butterfly fossil. However, students do not need to know the details of the permineralization process.

- ▶ **What does seeing the petrified redwood tree make you wonder?**
  - *How big was the tree that formed this fossil?*
  - *Why did it turn to stone?*
  - *Do redwood trees still live in the Florissant area now?*
- ▶ **How can we determine whether redwood trees live in the Florissant area today?**
  - *We can look for redwood trees in pictures of the Florissant area.*
  - *Maybe we can find a map that shows where redwood trees grow.*

Display the map that shows the present-day distribution of redwood trees in the United States (Lesson 8 Resource D). Explain that redwood trees grow in areas that are green on the map, but they do not grow in areas that are gray. If needed, help students identify Colorado on the map.



► **What do you notice about where redwood trees grow today?**

- *They are only on the west coast of the United States.*
- *Redwood trees are no longer in Colorado.*
- *Redwood trees are in California.*

Display the photograph of the redwood forest (Lesson 8 Resource D). Tell students that this photograph was taken recently in California.



Have students Think–Pair–Share in response to the following questions. 🧑🧑🧑

► **Why do you think redwood trees now live in California but not in Colorado? What conditions do you think might be different?**

- *Redwood trees look really big. Maybe they have more space to grow in California.*
- *Maybe Colorado doesn't have what redwood trees need to grow anymore.*
- *I think the weather in California is different from the weather in Colorado.*

► **How can we find out if conditions in California are different from conditions in Colorado?**

- *We can look up weather data.*
- *Maybe we can compare the average temperature and total precipitation for cities in each area.*



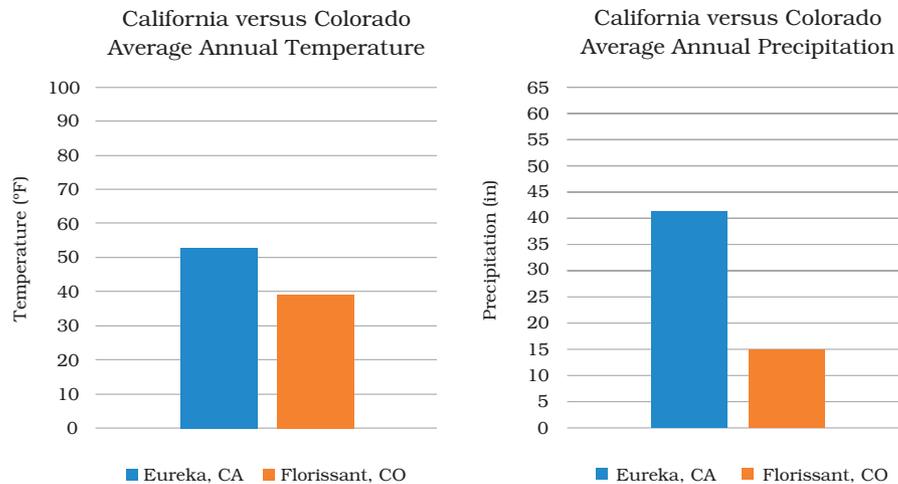
**Differentiation**

If students are deaf or hard of hearing, consider modifying collaborative conversation routines to allow for alternate response techniques. For example, partners write questions and answers to one another on whiteboards or use vibrations or visual signals (e.g., clapping) to communicate.

## Analyze Environmental Conditions 7 minutes

Display the California versus Colorado temperature and precipitation graphs (Lesson 8 Resource E). Tell students that these graphs show the average annual temperature and average annual precipitation for Eureka, California (NOAA NCEI 2019), and Florissant, Colorado (NPS 2017b). Explain that Eureka, California, is one of the areas in California where redwood trees grow today.

Explain that average annual temperature is similar to average monthly temperature, but average annual temperature represents the temperature for an entire year instead of a single month. As needed, also explain that average annual precipitation is about how much precipitation an area can expect to receive each year. 📄



### ► What do you notice?

- *It is warmer in California than it is in Colorado.*
- *It rains more in California than it does in Colorado.*



### Teacher Note

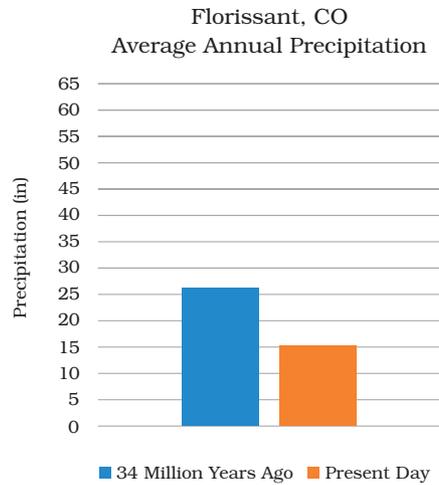
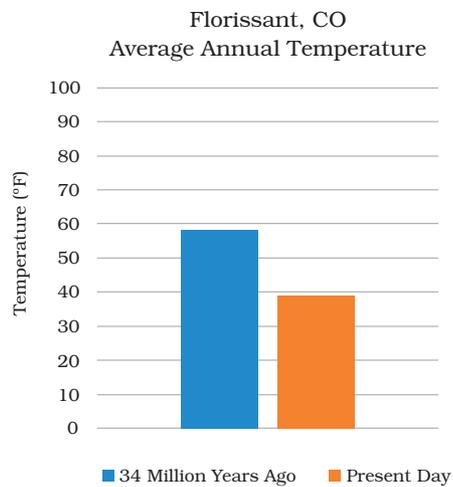
Note that the data on these bar graphs are averages calculated across several years to more accurately represent the conditions for each area.

Explain that average annual temperature indicates about how hot or how cold it usually is in an area and that average annual precipitation indicates about how much precipitation an area receives in a year.

► What do your observations about these graphs and where redwood trees grow make you wonder?

- Do redwood trees need a lot of sunlight and water?
- Do redwood trees die if it is too cold?
- Was it warmer in Colorado when the redwood trees lived there?

Display the Florissant area temperature and precipitation graphs (Lesson 8 Resource F). Tell students that these graphs show the past and present average annual temperature and average annual precipitation for Florissant, Colorado (NPS 2017b). Explain to students that the first bar on each graph represents data for when redwood trees lived in the area 34 million years ago and the second bar represents data for the area now.



Ask students to Think–Pair–Share about what they notice about the graphs.

Sample student responses:

- *It was warmer in the past than it is today. The average annual temperature was about 60 degrees Fahrenheit in the past, but now it is about 40 degrees Fahrenheit.*
- *It was wetter in the past than it is today. The average annual precipitation was about 25 inches in the past, but now it is 15 inches.*
- *The conditions in the Florissant area 34 million years ago were pretty similar to present-day conditions in California.*

Summarize for students that the Florissant area was warmer and wetter in the past than it is today. If needed, point out that the data for 34 million years ago are similar to the present-day data for Eureka, California, where redwood trees live now.

► **Why do you think redwood trees no longer live in the Florissant area?**

- *I think redwood trees need warm temperatures to survive.*
- *There is a lot less precipitation in the Florissant area now than there was in the past. I think redwood trees must need a lot of water.*
- *The redwood trees can get what they need to live in the environment in California but not in Colorado.*

## Update Anchor Chart 3 minutes

Ask students to summarize what they have learned about how analyzing fossils can help people understand where organisms lived in the past.

► **What do fossils reveal about organisms and the areas where they were able to survive?**

- *Fossils tell us where organisms were able to get what they needed to survive in the past.*
- *We can find out what extinct organisms looked like and where they lived.*
- *We can find out whether the same kinds of organisms live in an area now as in the past. Some kinds of organisms may not live in the same area, but they may live somewhere else.*

Build on student responses to summarize that fossils can reveal the kinds of organisms that lived in an area in the past and that the kinds of organisms in an area can change over time. Add this key knowledge to the anchor chart. 

Sample anchor chart:

Survival
<p><b>Fossil Evidence</b></p> <ul style="list-style-type: none"> <li>• Fossils provide evidence about the kinds of organisms that once lived and what their environments were like.</li> <li>• Some environments looked very different in the past from the way they look now.</li> <li>• The kinds of organisms that live in an area can change over time. Sometimes organisms live in new areas, and sometimes they no longer live anywhere on Earth.</li> </ul>

## Conceptual Checkpoint 10 minutes

Tell students that they will use what they have learned about fossils to complete a Conceptual Checkpoint in their Science Logbooks (Lesson 8 Activity Guide). Show students the Conceptual Checkpoint photographs (Lesson 8 Resource G), and direct them to respond to the following prompt.

- Imagine that you are a paleontologist studying fossils at a national park in Wyoming. You find several fossils—a crayfish, four fish, a turtle, and a palm leaf. You determine that the organisms that formed these fossils all lived around the same time.

*Observe the fossils to determine what the environment was like when the organisms were alive. Draw a model of the environment and the organisms that lived there. Be sure to explain what each fossil reveals about the environment.*



### Teacher Note

Use a different color for each addition to the anchor chart to help students keep track of new information (4C).



### Conceptual Checkpoint

This Conceptual Checkpoint assesses students' understanding of the Concept 1 Focus Question: **What do fossils reveal about the past?** Students should use evidence from the photographs to support their models.

#### Evidence

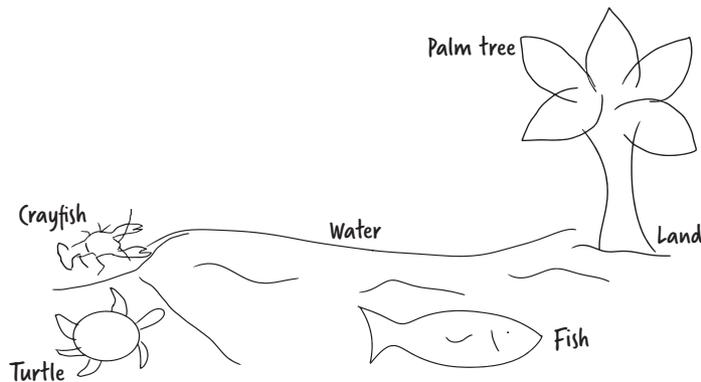
Look for evidence that all students

- develop a model of the past environment that includes the organisms that formed the fossils in the photographs, and
- use the fossils as evidence to support their model (e.g., turtles and crayfish live on land and in water, plants live on land, fish live in water).

#### Next Steps

If students need additional support as they construct their explanations, work with students in small groups to identify connections between the organisms that formed the fossils and their environment. Remind students of how they determined what the past environment of the Florissant area was like based on the fossils they observed in Lesson 6.

Sample student response: 



Crayfish and turtles live in water and on land. Plants grow on land, and fish live in water. This evidence shows that the environment where the organisms lived must have had both water and land.



### Teacher Note

Students may express a variety of ideas about the environment in which the organisms that formed these fossils lived. When assessing students' progress in this Conceptual Checkpoint, focus on students' ability to support their models with evidence rather than on the accuracy of the modeled environments.

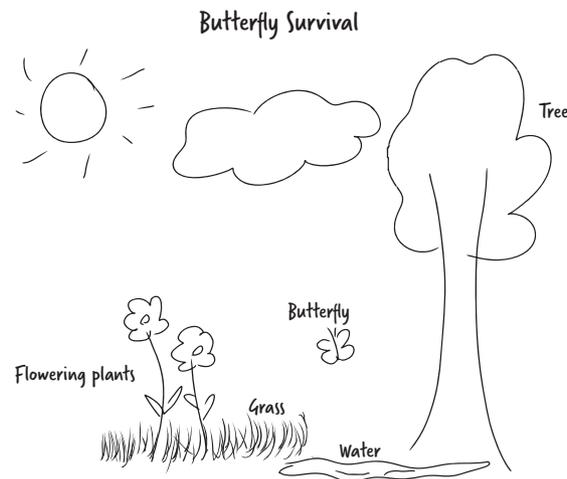
# Land

5 minutes

Display the anchor model. Remind students that the butterfly fossil found at the Florissant fossil beds formed 34 million years ago. Discuss the questions below and update the anchor model to summarize new learning.

- ▶ **What does the fossil reveal about butterflies?**
  - *Butterflies have lived on Earth for a very long time.*
  - *There have been butterflies in the Florissant area for millions of years.*
  
- ▶ **We know that butterflies still live in the Florissant area today. Why do you think butterflies have survived in this area for so long while other kinds of organisms have not?**
  - *Butterflies must be able to survive in a lot of different conditions.*
  - *I think butterflies can survive as long as there are flowering plants. The Florissant area had flowering plants in the past, and flowering plants are still there today.*

Sample anchor model:



Butterflies live in environments that have water and plants such as flowering plants, grass, and trees. Butterflies get what they need to survive from their environment. *Butterflies have lived on Earth for millions of years, so we think they can survive in changing environments, but we're not sure how.*

Direct students' attention to the driving question board. Review whether any questions were answered. Invite students to share new questions they have as a result of new learning. Add these questions to the driving question board.

*Sample questions:*

- *How do butterflies still live in the same area today as they did in the past?*
- *Why do organisms like redwood trees live where they do?*
- *How do butterflies get what they need to survive?*

Build on student responses that refer to an organism's suitability to its environment, and suggest that students next explore the Concept 2 Focus Question: **How do organisms get what they need to survive?**

## Optional Homework

Students research other kinds of organisms that are extinct. Students share their findings with classmates.