

Lesson 3

Butterfly Fossils

Prepare

Lesson 3 begins with students revisiting the butterfly fossil they were introduced to in Lesson 2. This butterfly fossil becomes the subject of further study and the source of student-generated questions that are geared toward understanding how fossils can provide information about the organisms that formed them. As students begin to explore what a fossil is, they attempt to match a clay fossil model with the plastic butterfly that formed it by using patterns in measurements and other observations.

Student Learning

Knowledge Statement

Fossils provide information about the organisms that formed them.

Objective

- Lesson 3: Analyze and create clay fossil models to understand how fossils form.

Texas Essential Knowledge and Skills Addressed

- 3.2B **Collect and record data by observing and measuring using the metric system and recognize differences between observed and measured data.** (Addressed)

Concept 1: Fossil Evidence

Focus Question

What do fossils reveal about the past?

Phenomenon Question

What can we learn by studying fossils?

- 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)

English Language Proficiency Standards Addressed

- 3E Share information in cooperative learning interactions.
- 5F Write using a variety of grade-appropriate sentence lengths, patterns, and connecting words to combine phrases, clauses, and sentences in increasingly accurate ways as more English is acquired.

Materials

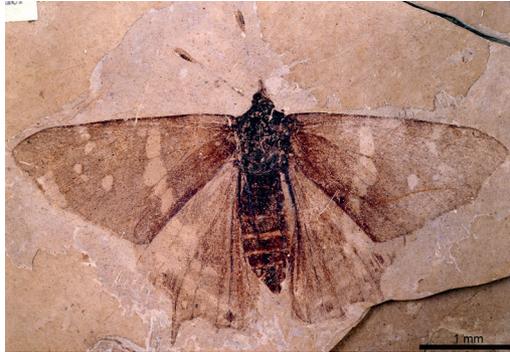
		Lesson 3
Student	Science Logbook (Module Question Log, Lesson 3 Activity Guides A and B)	●
	Compare Fossil with Clay Fossil Model (1 per group): prepared clay fossil model, ruler	●
	Make Clay Fossil Models (1 per group): approx. 0.1 pounds of modeling clay, plastic bag, plastic butterfly, book or other heavy object, ruler	●
Teacher	Clay Fossil Model Preparation: approx. 0.1 pounds of modeling clay (per fossil), book, plastic butterfly	●
	Butterfly Fossil Photograph (Lesson 2 Resource B)	●
	Butterfly Fossil Measurements (Lesson 3 Resource B)	●
Preparation	1 Day Before: Prepare clay fossil models for students to observe (see Lesson 3 Resource A).	●
	Prepare bags of modeling clay and select plastic butterflies for students to use to make clay fossil models (see Lesson 3 Resource A).	●

Lesson 3

Objective: Analyze and create clay fossil models to understand how fossils form.

Launch 3 minutes

Display the butterfly fossil photograph (Lesson 2 Resource B). Remind students that fossils are the remains or impressions of organisms that lived long ago.



- ▶ How do you think this fossil formed?
 - *I think the butterfly got stuck in the rock.*
 - *Maybe the butterfly was pushed into the rock.*

Agenda

Launch (3 minutes)

Learn (37 minutes)

- Compare Fossil with Clay Fossil Model (22 minutes)
- Make Clay Fossil Models (15 minutes)

Land (5 minutes)

Tell students that this butterfly fossil is an impression of a butterfly on a piece of rock. Explain that the fossil formed when a butterfly was buried by material such as rock. Over millions of years, the matter that made up the butterfly dissolved and left an empty space in the rock in the shape of the butterfly. 

Tell students that **paleontologists** are scientists who study fossils. Explain that fossils can be fragile, so paleontologists often take photographs of the fossils they find so that they can study them further and share them with peers without risking damage to the fossils.



English Language Development

The terms *impression* and *paleontologist* are used repeatedly in this module. Introduce these terms explicitly. Sharing the Spanish cognates for *impression* (*impresión*) and *paleontologist* (*paleontólogo*) may be useful.

Tell students that in this lesson, they will learn more about fossils as they explore the Phenomenon Question **What can we learn by studying fossils?** Instruct students to record this question in the Module Question Log of their Science Logbooks. 

Learn 37 minutes

Compare Fossil with Clay Fossil Model 22 minutes

Divide the class into small groups, and display one of the prepared clay fossil models.   Explain that each group will investigate a clay fossil model to learn more about what a fossil can reveal.

Distribute a clay fossil model to each group. Invite students to observe their clay fossil model. Then use a Quick Write to ask students to record in their Science Logbooks (Lesson 3 Activity Guide A) what they notice about how their clay fossil model compares with the butterfly fossil they observed in the Launch.



Teacher Note

The butterfly fossil is an example of a mold fossil. Mold fossils usually form when an organism is covered by sediment after it dies. The organic matter that makes up the organism dissolves over time, leaving a detailed mold of the organism in the sediment. Mold fossils can also form when an organism makes an impression in sediment but leaves (or is removed) and the impression is filled in by another material. It is not necessary for students at this level to understand the details of fossil formation. It is enough for students to understand that fossils provide evidence of the organisms that formed them.



Teacher Note

In subsequent lessons, continue directing students to record new Phenomenon Questions in their Module Question Log.



Teacher Note

The size of small groups will vary depending on class size. Consider the number of materials available when determining group size for this activity (3E).



Teacher Note

The sample student responses throughout this lesson are based on the yellow butterfly included in the module kit. If using the kit, consider creating the clay fossil models for this activity (see Lesson 3 Resource A) by using the yellow butterfly. If sourcing plastic butterflies from somewhere else, measure the plastic butterflies beforehand to ensure that the fossil measurements differ from those of the selected plastic butterfly.

- ▶ **What differences do you notice between the butterfly fossil in the photograph and your clay fossil model?**
 - *The fossil in the photograph has lines and shapes that are easier to see.*
 - *They both look like butterflies, but they don't look exactly the same. The one in the photograph looks like a real butterfly.*
 - *The fossil model is made of clay. The butterfly fossil formed in rock.*
 - *The clay fossil model looks clean and new. In the photograph, the rock is broken and more faded. I think the real butterfly fossil is a lot older.*

Confirm with students that there is evidence to support the idea that both the clay fossil model and the butterfly fossil in the photograph were formed by butterflies. If students discuss the age of the fossil in the photograph, remind them that the butterfly that formed this fossil lived approximately 34 million years ago. 📅

- ▶ **Do you think the same butterfly formed both the butterfly fossil in the photograph and your clay fossil model? Why or why not?**
 - *No, I think they were formed by different butterflies. They look similar, but the shapes are a little different.*
 - *Yes, I think both the clay fossil model and the fossil in the photograph were formed by the same butterfly. They both have wings and a thin body.*
- ▶ **What other information can we gather to determine whether the same butterfly formed both?**
 - *We can count the number of stripes on the wings and compare them.*
 - *We can measure different parts of the butterflies and see if the measurements are the same.*

If students do not suggest taking measurements, explain that scientists often collect data such as measurements to learn more about what they are studying. Suggest that students measure the clay fossil model and the butterfly fossil in the photograph to learn more about them and to determine whether they were formed by the same butterfly.

Work with the class to brainstorm a list of measurements they should take, such as wingspan, body length, body width, length of one wing, and width of one wing. Prompt students to record the list in their Science Logbooks (Lesson 3 Activity Guide A). 🧑🧑🧑🧑



Teacher Note

Consider using the class timeline to remind students of when the fossil formed.



Differentiation

Students may benefit from observing the clay fossil model or the butterfly fossil photograph as they brainstorm what they would like to measure (e.g., wingspan, body length).

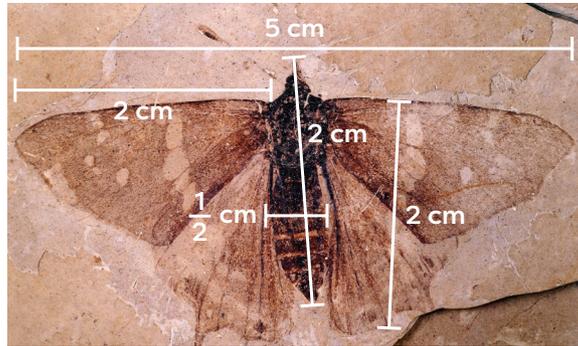


English Language Development

The discussion in this activity involves the word *measurement*. English learners may benefit from additional scaffolding in the form of sentence frames. Consider using guiding questions and sentence frames such as the ones below to scaffold conversations (5F).

- The measurement of my height is _____.
- The measurement of the length of my pencil box is _____.
- _____ is a unit we can use in measurement.

Then show students the photograph of the butterfly fossil with its measurements marked (Lesson 3 Resource B). Explain that paleontologists measured the butterfly fossil and that this photograph shows the measurements they made. Work with students to identify the parts of the butterfly that were measured so that all students can use the same language when discussing each part. Allow students time to update the list of measurements they should take in their Science Logbooks (Lesson 3 Activity Guide A).



Next, direct students' attention to the first data table in their Science Logbooks (Lesson 3 Activity Guide A). Work with students to record the butterfly parts chosen to be measured in the column titled Part of Butterfly. Then provide students time to record measurements for each part of the butterfly fossil shown in the photograph (Lesson 3 Resource B) in the Fossil column of their data tables. 📄

Explain that students will now measure their group's clay fossil model for comparison. Distribute a ruler to each group. Model for students how to use a ruler to measure the wingspan of their clay fossil model. Tell students to place the zero end of the ruler on the outer edge of one wing. Without moving the zero end of the ruler, adjust the other end so that it lays across the wingspan and touches the outer edge of the other wing. Help students record the measurement of the wingspan to the nearest half centimeter in the Clay Fossil Model column of their data tables. 🌱 Then direct students to work with their groups to record measurements for the remaining butterfly parts listed in their data tables.

After students have recorded measurements, remind them that scientists often also note qualitative observations when gathering evidence and collecting data. Model a qualitative observation for students (e.g., point out that each wing on the clay fossil model has one long extension on the bottom, but that the wings on the fossil do not). Have students record this observation in the section titled



Teacher Note

For consistency in measurements, consider defining the width and the length of each part of the butterfly with students.



Content Area Connection: Mathematics

Students will need explicit instruction on how to translate this skill to measuring to the nearest half centimeter. Consider providing students with a ruler template that has only whole and half centimeters marked to help them relate this task to reading fractions on a number line.

Other Observations in their data tables. Then direct students to work with their groups to record any other qualitative observations they notice. 

Sample student response:

Measurements		
Part of Butterfly	Fossil	Clay Fossil Model
Wingspan	5 cm	$5\frac{1}{2}$ cm
Body length	2 cm	2 cm
Body width	$\frac{1}{2}$ cm	$\frac{1}{2}$ cm
Length of one wing	2 cm	5 cm
Width of one wing	2 cm	2 cm
Other Observations		
Fossil	Clay Fossil Model	
<ul style="list-style-type: none"> ▪ No extensions on wings ▪ Rough inside body ▪ Wings with only one big part ▪ No lines coming out of head ▪ No legs 	<ul style="list-style-type: none"> ▪ One extension on each wing ▪ Smooth inside body ▪ Wings broken into two parts ▪ Long lines coming out of head ▪ Lots of legs 	

After a few minutes, have students make a claim about whether the same butterfly formed both the butterfly fossil and the clay fossil model. Students should record their claims along with evidence and reasoning in their Science Logbooks (Lesson 3 Activity Guide A). 



Differentiation

Some students may find it beneficial to include a sketch of the shape of each butterfly in the Other Observations section.



Differentiation

If students have difficulty making claims, then remind them to refer to the observations and measurements they recorded. Consider inviting students to work in their groups to write claims on whiteboards before sharing with the class. Discuss the qualities of a strong claim by highlighting similarities and differences between claims and drawing attention to claims that are supported by measurement data (3E).

► **Did the same butterfly form the butterfly fossil and the clay fossil model?**

- *The butterfly fossil and the clay fossil model were formed by two different butterflies.*

Evidence	Reasoning
<ul style="list-style-type: none"> ▪ <i>The length of one wing on the clay fossil model is 5 cm, and the length of one wing on the fossil is only 2 cm.</i> 	<ul style="list-style-type: none"> ▪ <i>If the wings are different lengths, they must not have come from the same butterfly.</i>
<ul style="list-style-type: none"> ▪ <i>The clay fossil model has wings broken into two parts. The fossil has wings with only one big part.</i> 	<ul style="list-style-type: none"> ▪ <i>Since the wings are different shapes, the clay fossil model and the fossil must have been formed by butterflies with different-shaped wings.</i>

Confirm with students that the evidence they gathered indicates that the same butterfly did not form both the butterfly fossil in the photograph and the clay fossil model.

► **Why did we measure the fossil instead of just using what we saw?**

- *If we had not measured the fossils, it would be harder to know if they were the same.*
- *The measurements were most helpful for figuring out that the fossils were formed by different butterflies.*

Next, discuss the limitations of the clay fossil models as a class. Explain to students that the clay fossil models were made by pressing a plastic butterfly into a ball of modeling clay to form an impression. Remind students that the butterfly fossil in the photograph formed when a butterfly left an impression in rock over millions of years. Explain that because fossils take so long to form, it is not possible for a real fossil to be made in the classroom. Emphasize that the materials they used to create the clay fossil models are not the same as the materials that form a real fossil and that this is a limitation of the model.

Tell students they will now continue their investigation of fossils by trying to identify the plastic butterfly that was used to make the clay fossil models they observed during this activity.

Make Clay Fossil Models 15 minutes

Show students the plastic butterflies they will use to make their clay fossil models. Tell students that one of the plastic butterflies was used to create the clay fossil models they observed during the previous activity. Distribute a different plastic butterfly to each group.

► **How do you think we can find out which plastic butterfly was used to make the clay fossil model?**

- *We can take measurements again. We can compare the measurements of each butterfly with the measurements of the clay fossil model to find out which one was used to make the model.*
- *Maybe we can make our own clay fossil models with the plastic butterflies. Then we can measure and compare the two impressions.*

Distribute a ball of modeling clay to each group. Allow students a few minutes to work in their groups to make their own clay fossil models by flattening their ball of modeling clay by using a book or other heavy object and then pressing their plastic butterfly into the modeling clay to form an impression.



Safety Note

This investigation poses potential hazards. To minimize the risk, review these safety measures and look for evidence that students are following them (3.1A):

- Students must not place modeling clay in their mouths.
- Students must wash their hands after the investigation is complete.

When students are finished, draw their attention to the second data table in their Science Logbooks (Lesson 3 Activity Guide B). Ask students to record the parts of the butterfly they measured in the previous activity in the first column and the measurements they made of the original clay fossil model in the second column. Then provide time for students to take measurements of the new clay fossil model they created. Students should record these measurements in the third column of their data tables. Encourage students to also record other observations.

Sample student response:

Measurements		
Part of Butterfly	Original Clay Fossil Model	New Clay Fossil Model
Wingspan	$5\frac{1}{2}$ cm	5 cm
Body length	2 cm	2 cm
Body width	$\frac{1}{2}$ cm	$\frac{1}{2}$ cm
Length of one wing	5 cm	$3\frac{1}{2}$ cm
Width of one wing	2 cm	$2\frac{1}{2}$ cm
Other Observations		
Original Clay Fossil Model	New Clay Fossil Model	
<ul style="list-style-type: none"> ▪ One extension on each wing ▪ Smooth inside body ▪ Wings broken into two parts ▪ Long lines coming out of head ▪ Lots of legs 	<ul style="list-style-type: none"> ▪ No extension wings ▪ Rough inside body ▪ Short, wide wings ▪ Short lines coming out of head ▪ Lots of legs 	



Check for Understanding

As students collect quantitative and qualitative data for the new clay fossil model, look for them to record accurate measurements and descriptive observations.

Evidence

Look for evidence that all students

- accurately measure each part of the clay fossil model to the closest half centimeter and
- describe relevant qualitative observations, such as distinguishing features.

Next Steps

Consider pairing groups having difficulty measuring with successful groups. For groups that record minimal qualitative observations, ask follow-up questions such as these: What else do you notice about the clay fossil model? How is this clay fossil model different from the original one?

After all groups are done recording measurements and other observations, invite students from each group to share their new clay fossil model measurements with the class. Students should also describe the color (or other distinguishing feature) of the plastic butterfly they used to create their new clay fossil model to help distinguish between them. Record the measurements for each clay fossil model in a class table.

Sample class table:

Class Clay Fossil Model Measurements				
	Butterfly 1 (red)	Butterfly 2 (yellow)	Butterfly 3 (dark green)	Butterfly 4 (blue)
Wingspan	5 cm	$5\frac{1}{2}$ cm	5 cm	5 cm
Body length	2 cm	2 cm	2 cm	2 cm
Body width	$\frac{1}{2}$ cm	$\frac{1}{2}$ cm	$\frac{1}{2}$ cm	$\frac{1}{2}$ cm
Length of one wing	$4\frac{1}{2}$ cm	5 cm	4 cm	$3\frac{1}{2}$ cm
Width of one wing	2 cm	2 cm	2 cm	$2\frac{1}{2}$ cm

Prompt students to make and record a claim with evidence in their Science Logbooks (Lesson 3 Activity Guide B) about which plastic butterfly was used to create the original clay fossil model. Encourage students to refer to both the measurements for the original clay fossil model in their Science Logbooks and the measurements on the class table as they make their claims.

Sample student responses: 

- *I think Butterfly 2 was used to create the original clay fossil model because the measurements for that clay fossil model all matched the original one.*
 - *It must have been the yellow butterfly because only the clay fossil model created by using the yellow butterfly had the same wingspan as the original clay fossil model.*
- ▶ **What did our clay fossil models tell us about the plastic butterflies that formed them?**
- *We could measure the size of the plastic butterflies.*



Teacher Note

Responses may vary depending on the plastic butterfly chosen to create the original clay fossil models (5F).

- *We could see the shape of the plastic butterflies.*
- *We could figure out which plastic butterfly formed which clay fossil model.*

Guide students to understand that fossils reveal information about the organisms that formed them, such as the organism's size and body shape.

Land 5 minutes

Show students one of the fossils listed for their region (Lesson 4 Resource B).  Inform students that fossils like this one have been found in their region.

► What questions do you have about this fossil?

- *What organism formed this fossil?*
- *What other fossils are found in our region?*
- *What was the environment like when the fossil formed?*

Tell students that over the next few lessons, they will learn more about fossils and what they can reveal as they explore the Phenomenon Question **What can fossils reveal about our region?**

Then allow students a few minutes to any record questions they still have about fossils in their Science Logbooks (Lesson 3 Activity Guide B).

Sample student responses:

- *I know there are dinosaur fossils too. Did butterflies live at the same time as dinosaurs?*
- *Why are there still butterflies on Earth but not dinosaurs?*
- *Where are fossils found?*
- *What else was found near the butterfly fossil?*

Optional Homework

Students ask a family member about fossils they have seen and discuss what kinds of organisms formed those fossils. Students record their family member's responses to share with the class.



Teacher Note

Use Lesson 4 Resource A to determine the region where students live. Then choose a relevant regional fossil from Lesson 4 Resource B to show during this Land.

All the fossil specimen photographs in this resource represent a kind of fossil found in the region. However, differences in past environmental conditions throughout what is now the United States resulted in varying amounts of well-preserved fossils in each region. Therefore some photographs show well-preserved specimens found near the region to better illustrate the organism's unique structures.