

## **Waco Mammoth National Monument**

### **Asynchronous Lesson Plan**

#### **3rd – 5<sup>th</sup> Grade**

#### **Science**

#### **Background:**

##### **What is a fossil?**

Fossils are comparable to puzzles, making paleontologists puzzle masters. Their job is to piece together fossils to help reimagine their living existence. **Fossils** are the remains or traces of once-living animals and plants that lived long ago. Remains are also called body fossils such as bones, teeth, and shells. These remains are covered by Earth for thousands and millions of years forming hardened rock. Paleontologists use tools to uncover and remove fossils from all over the earth.

##### **How are fossils made?**

Partial and complete insects may be trapped in the hardened resin of some plants called amber. Less often remains can be preserved in tar, by freezing and mummification. The most common form of preservation is when a species dies in a, aquatic environment and becomes buried under mud. Sediment builds up over time covering the bones or shells hardening them into rock.

##### **The Rock Cycle**

The Rock cycle relates three rock groups – igneous, sedimentary, and metamorphic to each other through processes like weathering, transportation, and deposition. Igneous rocks are formed from cooling of volcanic material called magma. Sedimentary rocks are best for understanding Earth history. They are found at the Earth's surface and as layers are added, they record information about the environment, collecting evidence of the past. Metamorphic rocks are a result of the alteration of the other rock types beneath the Earth's surface formed by heat and pressure creating a layered appearance.

##### **Geologic Time Scale**

Geologists study rocks and use a rock record to track the age of fossils based on the layers of rock that are routinely found in across the world. They discovered fossil species followed one another in a predictable order and any time period in the past could be identified by the fossils left behind.

**Lesson Overview:**

This lesson will focus on how students will observe and identify how living and nonliving factors interact within an ecosystem. Environmental changes can affect organisms within an ecosystem, and these changes impact organisms in ways where some may thrive while others may perish. Students can apply what they know about the ecosystems for each habitat to predict what the ecosystems might have been in the past based on the observations of species found.

**Lesson Objectives:**

Students will be able to:

- Recognize relationships, systems, and cycles within environments.
- Analyze data to make reasonable predictions of how changes in environments can affect the organisms living in them.
- Identify fossils as evidence of past living organisms and the nature of the environment they lived in using models.
- Describe environmental changes such as floods and droughts where some organisms thrive, and others perish or move to new locations.

**Essential Question(s):**

- What can Columbian mammoth fossils teach us about the past?
- What can fossils of plants and animals tell paleontologists about ancient environments?
- What happens to an organism when its environment changes?

**State and National Standards:**Texas Essential Knowledge and Skills for Science

(2.9) Science. The student understands the basic needs of organisms and how their environment affects their growth and behavior. The student is expected to:

(B.) Identify factors in the environment, including temperature and precipitation, that affect growth and behavior such as migration, hibernation, and dormancy of living things.

(3.9) Science. The student knows that organisms have characteristics that help them survive and can describe patterns, cycles, systems, and relationships within the environments. The student is expected to:

(C.) Describe environmental changes such as floods and droughts where some organisms thrive and others perish or move to new locations.

(5.7) Science. Students explore how the Earth’s surface constantly changes and how this leads to the formation of sedimentary rocks, fossil fuels, and certain landforms. Students also learn about alternative energy resources and fossils. The student is expected to:

(D.) Identify fossils as evidence of past living organisms and the nature of the environments at the time using models.

**National Standards:**

- [NPSS-3-LS4-1](#)

Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

- [NGSS-3-LS4-3](#)

Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

**Pre-Visit Resources:**

- [Fossils \(U.S. National Park Services\) \(nps.gov\)](http://www.nps.gov/grca/naturescience/fossils.htm)  
<http://www.nps.gov/grca/naturescience/fossils.htm>

**Pre-Assessment Lesson Procedure: (This lesson is targeted for One-45-minute class period)**

1. Initiate a class discussion with open-ended Questions
  - a. Do you know of any plants and animals that existed many years ago but don’t exist today? (Answers may vary)
  - b. How do we know they existed? (Answers may vary)
  - c. How do paleontologists identify fossils?
2. Pass 1 Dig Deep Student Handout to each student and direct them to fill in the “What do you KNOW” and “What do you WANT to know” portion of the “Fossils” KWL chart. (Ask for volunteers to share their understanding and questions)
3. Students will answer the Guided Questions on the worksheet as they take a [Virtual Tour](#) of Waco Mammoth National Monument.
  - a. How many mammoths were discovered? Why do you think they were not all found at the same time? (Hint: Why are the fossils found in different levels of sediment?)
  - b. What additional species were unearthed in the dig shelter?
  - c. Why do you think the fossils were all found in the same ravine? What do you think caused them to perish?
  - d. How old were the fossils and how do we know?
4. Advise students they will now identify fossils and make inferences about their past environments.

**Lab Procedures:**

1. Hand out 1 “Prepared Dig station tub” to each group of 4 students.
2. Advise students they will observe a collection of fossils in their prehistoric habitat to determine their species name, estimation of age, and the ecosystem their dig station represents.

3. Students will record their observations and answer questions as they complete the activity.
4. Students will return fossil cards to their original location in the tubs.

**Post-Assessment:**

1. Students will complete the “Learned” portion of the KWL chart by answering the following questions.
  - a. How can paleontologists use fossils to explain how an organism died and identify organisms it interacted with during its existence?
  - b. How can investigating fossils like the Prehistoric Columbian mammoths of Waco teach us about the environment they once lived in?

**Additional Resources:**

<http://pubs.usgs.gov/gip/fossils/contents.html> Fossils, Rocks and Layers (Online Book)

[Legends of Learning](#) game on Fossils to reinforce their understanding of Fossil Evidence

**Pre- Assessment Lesson Procedure: (This lesson is targeted for One-90-minute block or Two-45-minute class periods)**

**DAY 1**

1. Initiate a class discussion with open-ended questions
  - a. Do you know of any plants and animals that existed many years ago but don't exist today? (Answers may vary)
  - b. How do we know they existed? (Answers may vary)
  - c. How do paleontologists identify fossils?
2. Pre-Assessment Activity 1: Prompt students to share their thoughts and what can be inferred about the presented image.
  - a. Ask students to discuss the following questions:
    - i. Explain what it is and how do they know.
    - ii. What clues do they observe that help them identify the specimen?
    - iii. Is it possible to determine the age of the specimen?
    - iv. What behaviors can we predict the species exhibited? (Carnivore/Herbivore, Territorial/Peaceful, Land/Water/Air Species)
2. Pass 1 Student “Dig Deep” Worksheet to each student and direct them to fill in the “What do you KNOW” and “What do you WANT to know” portion of the “Fossils” KWL chart. (Ask for volunteers to share their understanding and questions)
3. Students will answer the Guided Questions on the worksheet as they take a [Virtual Tour](#) of Waco Mammoth National Monument. (Student computer access is necessary for this activity)
  - a. How many mammoths were discovered? Why do you think they were not all found at the same time? (Hint: Why are the fossils found in different levels of sediment?)
  - b. What additional species were unearthed in the dig shelter?
  - c. Why do you think the fossils were all found in the same ravine? What do you think caused them to perish?
  - d. How old were the fossils and how do we know?
4. Frontload Vocabulary with one of the following activities:
  - a. Option (a.) Students will demonstrate prior knowledge as they complete a vocabulary card sort or flashcard slides and direct students to record their definitions.

## **DAY 2**

1. Advise students they will identify fossils and make inferences about their past environments.
2. Set up prepared dig station tubs at designated work areas spread throughout the classroom.
3. Students will observe 3 separate collections of fossils in their prehistoric habitats to determine their species name, estimation of age, and the ecosystem their dig station represents.
4. Direct students to dig for fossil samples, record their observations and answer questions in the student handout.
5. Remind students to return fossil cards to their original placement before switching stations.
6. Allow students 10 minutes per station using a timer and direct students to switch stations or swap tubs when their time is up. (Continue the rotations until all students have visited each station.)
7. Allow students to compare their answers with the identification key as they complete the activity.

### **Wrap-up:**

1. Ask students to give an example of a consequence of a change in the environment. (Various answers will be given)
  - a. Demonstrate a “flood” by pouring a pitcher of water into a separate dig station and/or removing/introducing an organism to the ecosystem.
2. Ask students what might mammoths have done differently, if possible, to survive in this now altered environment?

### **Post-Assessment:**

1. Students will complete the “Learned” portion of the KWL chart by answering the following questions.
  - a. How can paleontologists use fossils to explain how an organism died and identify organisms it interacted with during its existence?
  - b. How can investigating fossils like the Prehistoric Columbian mammoths of Waco teach us about the environment they once lived in?

### **Additional Resources:**

<http://pubs.usgs.gov/gip/fossils/contents.html> Fossils, Rocks and Layers (Online Book)

[Legends of Learning](#) game on Fossils to reinforce their understanding of Fossil Evidence

**Pre-Assessment Lesson Procedure: (This lesson is targeted for 135 minutes or Three-45-minute class period)**

## **DAY 1**

1. Initiate a class discussion with open-ended questions
  - b. Do you know of any plants and animals that existed many years ago but don't exist today? (Answers may vary)
  - c. How do we know they existed? (Answers may vary)
  - d. How do paleontologists identify fossils?

3. Pre-Assessment Activity 1: Prompt students to share their thoughts and what can be inferred about the presented image.
  - a. Ask students to discuss the following questions:
    - i. Explain what it is and how do they know.
    - ii. What clues do they observe that help them identify the specimen?
    - iii. Is it possible to determine the age of the specimen?
    - iv. What behaviors can we predict the species exhibited? (Carnivore/Herbivore, Territorial/Peaceful, Land/Water/Air Species)
4. Pass 1 Student “**Dig Deep**” Worksheet to each student and direct them to fill in the “What do you KNOW” and “What do you WANT to know” portion of the “Fossils” KWL chart. (Ask for volunteers to share their understanding and questions)
5. Students will answer the Guided Questions on the worksheet as they take a [Virtual Tour](#) of Waco Mammoth National Monument. (Student computer access is necessary for this activity)
  - a. How many mammoths were discovered? Why do you think they were not all found at the same time? (Hint: Why are the fossils found in different levels of sediment?)
  - b. What additional species were unearthed in the shelter?
  - c. Why do you think the fossils were all found in the same ravine? What do you think caused them to perish?
  - d. How old were the fossils and how do we know?
6. Frontload Vocabulary with one of the following activities:
  - a. Option (a.) Students will demonstrate prior knowledge as they complete a vocabulary card sort or flashcard slides and direct students to record their definitions.

## **DAY 2**

1. **Distance Learning Video** - Can be done live (Synchronous) or pre-recorded (Asynchronous). See [webpage](#) for more details.

## **DAY 3**

1. Advise students they will identify fossils and make inferences about their past environments.
2. Set up Prepared Dig station tubs at designated work areas spread throughout the classroom.
3. Students will observe 3 separate collections of fossils in their prehistoric habitats to determine their species name, estimation of age, and the ecosystem their dig station represents.
4. Direct students to dig for fossil samples, record their observations and answer questions in the student handout.
5. Remind students to return fossil cards to their original placement before switching stations.
6. Allow students 10 minutes per station using a timer and direct students to switch stations or swap tubs when their time is up. (Continue the rotations until all students have visited each station.)
7. Allow students to compare their answers with the identification key as they complete the activity.

## **Wrap-up:**

1. Ask students to give an example of a consequence of a change in the environment. (Various answers will be given)
  - a. Demonstrate a “flood” by pouring a pitcher of water into a separate dig station and/or removing/introducing an organism to the ecosystem.
  - b. Ask students what mammoths might have done differently, if possible, to survive in this now altered environment.

## **Post-Assessment:**

1. Students will complete the “Learned” portion of the KWL chart by answering the following questions.

- a. How can paleontologists use fossils to explain how an organism died and identify organisms it interacted with during its existence?
- b. How can investigating fossils like the Prehistoric Columbian mammoths of Waco teach us about the environment they once lived in?

**Additional Resources:**

<http://pubs.usgs.gov/gip/fossils/contents.html> Fossils, Rocks and Layers (Online Book)

[Legends of Learning](#) game on Fossils to reinforce their understanding of Fossil Evidence

### Pre-Assessment Activity 1: Prior Knowledge Discussion

**Materials:** Printed or project the following image on the board.

**Directions:**

1. Prompt students to share their thoughts and what we can infer about the presented image.
  - a. Ask students to discuss the following questions:
    - i. Explain what it is and how do they know.
    - ii. What clues do they observe that help them identify the specimen?
    - iii. Is it possible to determine the age of the specimen?
    - iv. What behaviors can we predict the species exhibited? (Carnivore/Herbivore, Territorial/Peaceful, Land/Water/Air Species)

What information can we gather from this picture?





**Pre-Assessment Activity 2: Vocabulary Card Sort**

Teacher Copy Instructions: Print on card stock, cut along borders, and sort vocabulary cards. Direct students to match the vocabulary word with definitions and images.

	<p><b>To break down into smaller parts.</b></p>	<p><b>Decay</b></p>
	<p><b>A trace or preserved part of an animal or plant that lived in the past.</b></p>	<p><b>Fossil</b></p>
	<p><b>A depression or mark made by pressure.</b></p>	<p><b>Imprint</b></p>
	<p><b>A limited definition of something that can help us understand its structure or how it works</b></p>	<p><b>Model</b></p>
	<p><b>A living thing such as a plant or animal.</b></p>	<p><b>Organism</b></p>
	<p><b>To last or retain certain characteristics over a long period of time</b></p>	<p><b>Preserved</b></p>
	<p><b>The process of breaking down rocks into smaller pieces by water, wind, gravity, and ice.</b></p>	<p><b>Weathering</b></p>
	<p><b>Small pieces of rock or sand are broken down by weathering and deposited on land or at the bottom of a body of water</b></p>	<p><b>Sediment</b></p>

## **Teacher Copy of Dig Deep Lab Directions:**

### **Materials:**

Fossil Card Printable  
Plastic Tubs  
Sand, Gravel, or Pebbles  
Student Handout

### **Optional Substitute Materials:**

Wood, plastic or rubber bugs and animals, mineral rocks, shells, fake plants (ferns, seaweed, cactus)

### **Pre-Lab Preparation**

1. Cut and laminate the following fossil images.
2. Using a Permanent Marker, assign numbers to the back of each fossil card.  
**Example:** Assign #1 to identify the fossil buried at the deepest layer and the highest number representing the fossil found at the shallowest layer.
3. Place related images in Labeled tubs of sand.

### **Lab Procedures**

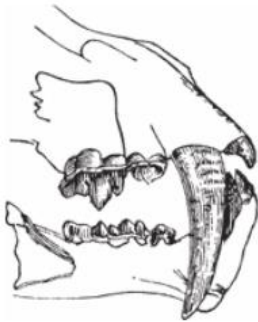
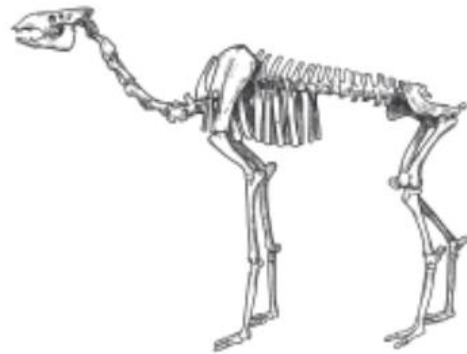
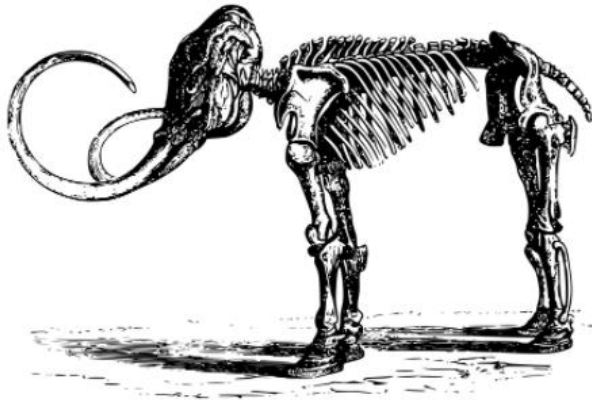
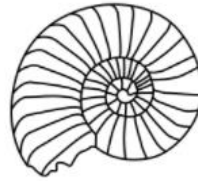
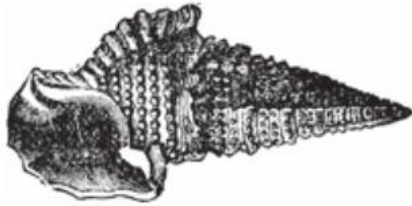
1. Provide 1 tub to each group of 4 students.
2. Provide 1 Student answer sheet to each student.
3. Direct students to dig for fossil samples, record their observations and answer questions in the student handout.
4. Return fossil cards to their original placement.
5. Allow students 10 minutes per station using a timer and direct students to switch stations or swap tubs when their time is up.

### **Post-lab Instructions**

1. Compare their data to the key as a class, discuss, and direct students to complete the “Learned” portion of their KWL chart.

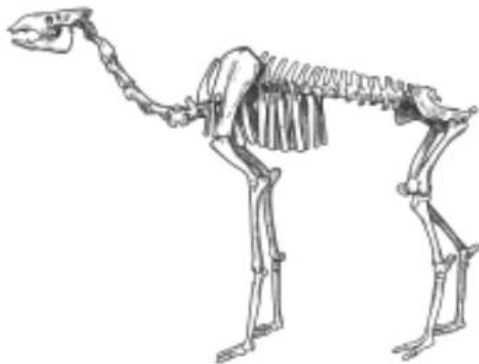
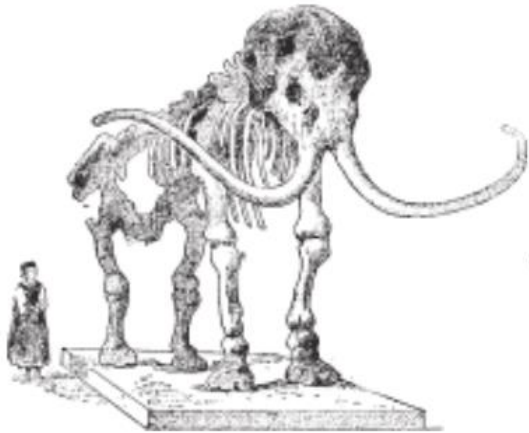
## Waco Mammoth National Monument Fossils

Directions: Print and cut out on card stock paper.



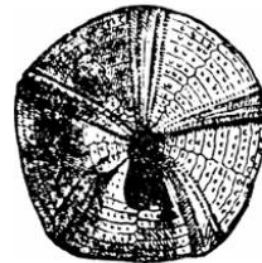
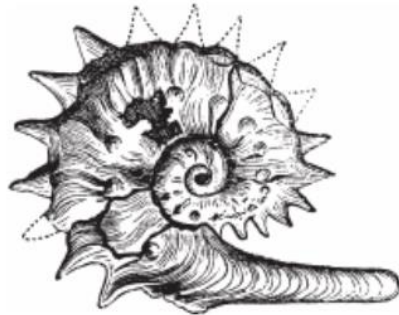
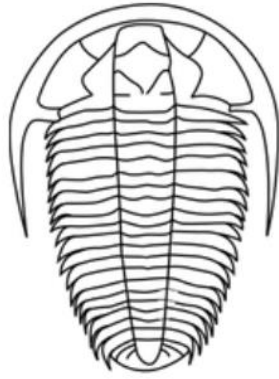
## North American Fossils

Directions: Print and cut out on card stock paper.



**Seafloor Fossils**

Directions: Print and cut out on card stock paper.



**Dig Deep Student Handout**



Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Pre-Assessment: "FOSSILS" KWL**

What do you <b>KNOW</b> ?	What do you <b>WANT</b> to know?	What did you <b>LEARN</b> ?

**Virtual Tour Guided Questions:**

1. Do all organisms undergo fossilization? Why or why not? \_\_\_\_\_  
\_\_\_\_\_
2. Why do you think these fossils were found at different times? (Hint: Why are the fossils found in different levels of sediment?) \_\_\_\_\_  
\_\_\_\_\_
3. What additional species were unearthed in the dig shelter? \_\_\_\_\_  
\_\_\_\_\_
4. What can we learn about the prehistoric environment these organisms once lived in? How can we know? \_\_\_\_\_
5. What tools are used by paleontologists to excavate fossils? \_\_\_\_\_
6. What do paleontologists do with fossils after they have been removed from the ground? \_\_\_\_\_
7. What is the estimated age of these fossils and how do we know? \_\_\_\_\_  
\_\_\_\_\_

**Part I. Dig Deep Station Activity**

1. Identify the difference between a body fossil and a trace fossil? \_\_\_\_\_  
\_\_\_\_\_
2. Give an example of a fossil and a non-fossil? \_\_\_\_\_
3. What are some common places fossils can be found? \_\_\_\_\_
4. How do you think fossils are made? Does every organism that dies become fossilized? \_\_\_\_\_  
\_\_\_\_\_
5. What type of rocks can fossils usually be found in? \_\_\_\_\_
6. How can we explain the reason for why fossils are found in different rock layers? \_\_\_\_\_  
\_\_\_\_\_

**Part II. Ecosystem Word Bank: Dessert, Forest, Ocean, Tundra,**

1. Based on the depth of your fossils, list the fossils in order from oldest to youngest. \_\_\_\_\_  
\_\_\_\_\_
2. Based on fossil evidence, identify which ecosystem dig station #1 belongs to. \_\_\_\_\_
3. What is necessary for fossilization to occur? \_\_\_\_\_
4. Identify one change in an ecosystem that could affect an organism's survival. \_\_\_\_\_  
\_\_\_\_\_
5. How would it be possible to find fossil evidence of a fish in a desert location? What would it tell us about the land during its lifespan? \_\_\_\_\_  
\_\_\_\_\_



**Dig Deep Student Handout ANSWER KEY**

**Pre-Assessment: “FOSSILS” KWL**

What do you <b>KNOW</b> ?	What do you <b>WANT</b> to know?	What did you <b>LEARN</b> ?
Answers will vary	Answers will vary	Answers will vary

**Virtual Tour Guided Questions:**

1. Do all organisms undergo fossilization? Why or why not? **No, less than 1/10<sup>th</sup> of all animal species become fossils. The bones must be buried quickly in an oxygen-free environment and protected from scavengers.**
2. Why do you think these fossils were found at different times? (Hint: Why are the fossils found in different levels of sediment?) **Each fossil species perished at different times causing them to be buried in different layers of earth.**
3. What additional species were unearthed in the dig shelter? **A saber-toothed cat, western camel, dwarf antelope, American alligator, giant tortoise.**
4. What can we learn about the prehistoric environment these organisms once lived in? **How can we know? We can learn about their diet, the climate, other species living in their habitat by studying their fossils and surroundings.**
5. What tools are used by paleontologists to excavate fossils? **Brushes, chisels, rock hammers, spoons, spatulas, goggles, helmets**
6. What do paleontologists do with fossils after they have been removed from the ground? **Maintain careful records by measuring, mapping, drawing sketches, taking pictures, and protect with fossil jackets, collecting rock samples, etc.**
7. What is the estimated age of these fossils and how do we know? **Around 10,000 years old. We can examine the sediment that surrounds the fossil and compare evidence with other discoveries.**

**Part I. Dig Deep Station Activity**

1. Identify the difference between a body fossil and a trace fossil? **Bones, teeth, and shells are called body fossils. Preserved evidence of traces of organisms are trace fossils.**
2. Give an example of a fossil and a non-fossil? **Shells on a beach or a skeleton of a recently deceased animal.**
3. Where are some common places fossils can be found? **Ocean beds, River valleys, cliffs, hillsides, deserts, rock quarries**
4. How do you think fossils are made? Does every organism that dies become fossilized? **When organisms die and are buried quickly in mud and silt.**
5. What type of rocks can fossils usually be found in? **Sedimentary rock**
6. How can we explain the reason for why fossils are found in different rock layers? **Organisms perish at different times in history**

**Part II. Ecosystem Word Bank:**

1. Based on the depth of your fossils, list the fossils in order from oldest to youngest. **Answers will vary based on teacher placement of fossil cards in each ecosystem.**
2. Based on fossil evidence, identify which ecosystem dig station #1 belongs to. **North America**
3. What is necessary for fossilization to occur? **An oxygen-free environment**

4. Identify one change in an ecosystem that could affect an organism's survival. **A change in climate, food and water resources, natural disaster, human impact.**
5. How would it be possible to find fossil evidence of a fish in a desert location? What would it tell us about the land during its lifespan? **What is now known as a desert ecosystem once was an aquatic environment. The climate changed causing the area to dry up.**