



UF

College of Education  
UNIVERSITY of FLORIDA



FLORIDA  
MUSEUM

Engaging K-12 Students in  
Integrated STEM via  
3D Digitization, 3D Printing  
and Paleontology



## **AUTHOR**

Rachel Brown

## **LESSON TITLE**

Oklahoma Underwater

## **GRADE LEVEL**

8th Grade Science

## **TIME FRAME**

4-7 50 minute periods

Class Trip All Day

## **DRIVING QUESTION**

How has the landscape and living things in Oklahoma changed over time? Geomorphology is the study of the physical features of the surface of the earth and their relation to its geological structures.

## **LEARNING GOALS**

Students will learn about the landscape of Oklahoma from millions of years ago. Students will explore types of fossils from millions of years ago and will realize that most fossils are invertebrates that lived in the sea. Why? How?

## **COLLABORATIONS**

Students will work in groups of 3 to excavate fossils from sand. Once they are excavated, they will analyze the fossils and make observations about them. The goal is to begin conversations

about the type of life that lived during certain times in the geologic time period. I will also be collaborating with paleontologist from the Sam Noble Museum of Natural History in Norman Oklahoma.

## STEM INTERGRATION

Students will be immersed in to 3D printing.

## ASSESSMENT

Students will create a fossil using the 3D printer. Using their fossils, they will layer their fossils using the geologic time based on information they've read. They will be assessed by being able to layer their fossils in chronological order. Students will also be assessed formatively using Kahoot on their vocabulary. Another formative assessment is to make observations while students are labeling places on their Oklahoma map where certain fossils were formed and found.

**Crosscutting Concepts** - The crosscutting concept of finding patterns can assist students in analyzing and interpreting data of the fossil record that documents the existence, diversity, extinction, and change of life forms throughout the history of life on Earth, under the assumption that natural laws and processes (e.g. weathering, erosion, and deposition) operate today as in the past. These patterns will be found in comparing like organisms from the time period which shows that Oklahoma was once covered by sea and that invertebrates like corals, brachiopods, molluscs, and other invertebrates lived in Oklahoma. Patterns might also be detected by studying the organisms and their numbers found in fossils that occurred after catastrophic events, thus identifying cause and effect relationships.

**Engineering Practices**- Students will construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's geological history.

## ANCHORING EVENT & PROCEDURE

Student will see what it is like to be a paleontologist and will be a fossil hunter for the day!

### DAY 1: 5E Lesson Plan & Pre-test

**Engage** - Students will use their knowledge of fossils to go on a "pretend" dig in a particular place in Oklahoma. Students will use tools that scientist (paleontologist) really use in the field. (ex: trowel, screwdriver, paint or toothbrush). Paleontologists study the record of life on Earth left as fossils. This lesson will focus on sea fossils for my students. Paleontological research includes working out the relationships between extinct animals and plants and their living relatives. Focus of interest will be from Bartlesville, which a place where we will take a field-trip. The fossils that come from Bartlesville are from the Pennsylvanian Sub-Period (323-299 Mya) in the Carboniferous Period (359-299 Mya) during the Paleozoic Era (541-252 Mya). Read (<https://ucmp.berkeley.edu/carboniferous/carboniferous.php>) for more context.

## Day 2 & 3

**Explore** - \*Note: My class actually did this after day 4 due to scheduling constraints. This is where the students will make or download 3D models of their fossils that were found. Students will use their skills to make actual full-scale models of their fossils using TinkerCAD (<https://www.tinkercad.com>) a free resource for constructing 3D models online! So, there will be some accurate measuring involved and students will put their fossil in chronological order based on the fossil record. If this is not something you have time for 3D models can be analyzed, downloaded, and printed from free 3D model repository sites such as Morphosource (<https://www.morphosource.org>), Sketchfab (<https://sketchfab.com>), or Digimorph (<http://www.digimorph.org>). We will focus on how those fossils formed and will use models to help students to understand that process. Invertebrates will be the focus. Common kinds of invertebrate fossils from Oklahoma are featured at the Sam Noble Museum (<https://samnoblemuseum.ou.edu/common-fossils-of-oklahoma/invertebrate-fossils/>) and include molluscs (snails, bivalves and cephalopods), arthropods (trilobites), echinoderms (sea urchins and crinoids), brachiopods, and cnidarians (corals).

Some examples we used here:

Crinoid: <https://sketchfab.com/models/4fb8e49c73534645a23f9ec812d6fe11>

Trilobite: <https://sketchfab.com/models/064e595dc6a147aca9cdeb8aa6494999>

Brachiopod: <https://sketchfab.com/models/848d9635c2a442988719ff6e60f97f2d>

## Day 4

**Explain** - We will use maps of Oklahoma and find where their fossils have been found in Oklahoma. Connections will be made that Oklahoma was once covered in water because all of their fossils are of sea life. I will focus on their vocabulary here and students will be making connections between prehistoric life and life today (climate change, rise and fall of sea-level, tectonic movement). This is the website I will use to show images of how the landscape has changed over time that is specific to Oklahoma:

<https://samnoblemuseum.ou.edu/common-fossils-of-oklahoma/how-paleontologists-tell-time/>

For teachers anywhere on the globe this website resource is a fantastic way to illustrate the changing landscape over the last 700 Million years and you can even plug in your school's address to highlight place-based learning: <http://dinosaurpictures.org/ancient-earth/#0>

I am collaborating with a paleontologist at the Sam Noble Museum who will be working through a teaching program. They loan out fossils from the museum and we will be able to get some of the real fossils as well. Planning a field trip here if possible.

The fossil record documents Earth's history by organizing the location and placement of fossils that have been discovered in strata of sedimentary rock. These fossils have been placed in chronological order with older rock in bottom layers and newer rock in upper layers of undisturbed rock (The Law of Superposition).

## Day 5

**Elaborate** - I would like to skype a professional paleontologist and explain how those types of fossils were found in Oklahoma using any type of graphics, videos, Google Earth (show where fossils have been found) and real fossils. I would also love to take them on a fossil hunt in Oklahoma. I am planning on using the Sam Noble Museum as resource. They do a lending program that will send out some of their fossils and we can keep them for up to 2 weeks. I would definitely use this program to help with the explore or elaborate part of the lesson. For teachers in other states viewing/printing out free 3D replicas and contacting the idigfossils team composed of educators and professional paleontologists would be a great alternative!

**Assessment:** Post-Test

## STANDARDS

### NEXT GENERATION SCIENCE STANDARDS (NGSS)

<b>Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. 3-LS4-1</b>	
<b>Science Practices</b>	<b>Connection to the Lesson</b>
<p>Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)</p> <p>Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)</p>	<p>Constructing Explanations and Designing Solutions</p> <p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p>
<b>Disciplinary Core Ideas</b>	<b>Connection to the Lesson</b>
<p>LS4.A: Evidence of Common Ancestry and Diversity</p> <p>The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)</p>	<p>Students will make/analyze models of the fossil record in Oklahoma and make inferences of the relative age of the fossils in their models according to the Law of Superposition and reflection in the geologic record.</p>

Crosscutting Concepts	Connection to the Lesson
<p>Patterns can be used to identify cause and effect relationships. (MS-LS4-2), Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1), Cause and Effect: Phenomena may have more than one cause, and some cause and effect relationships in systems (MS-LS4-3)</p>	<p>By reviewing the chronological order of fossils as well as the paleogeographic location of Oklahoma, students can make connections to patterns they see in distribution and fossil characteristics.</p>

### OTHER STANDARDS:

Oklahoma Frameworks (MS-LS4-1) Students who demonstrate understanding can: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth, under the assumption that natural laws operate today as in the past. (MS-LS4-2) Students who demonstrate understanding can: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer ancestral relationships. MS-ESS1-4 Students who demonstrate understanding can: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s geologic history.

## KEY ACADEMIC TERMS

1. Paleontology
2. Excavation
3. Pennsylvanian Era
4. Brachiopods
5. Horned Coral
6. Trilobites
7. Cephalopods
8. Fossils
9. Geologic Time
10. Organisms
11. Fossil Record
12. Geomorphology

## PRIOR KNOWLEDGE

Students should have basic understanding of maps and the difference between land and sea. They should have some prior knowledge of what a fossil is and how they are formed. They should also be able to have some skills of collaborating with other students.