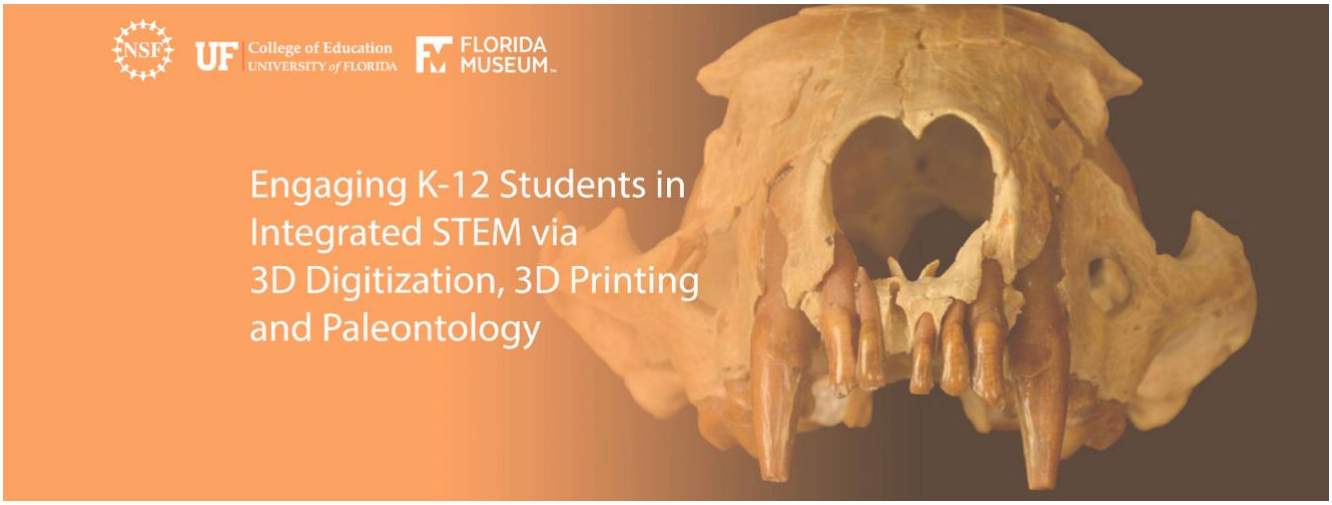

AUTHOR (S)

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LESSON TITLE

Fossils in Oklahoma: Investigating the Law of Superposition

GRADE LEVEL

6th-8th Grade

TIME FRAME

2-3, 45 minute class periods

DRIVING QUESTION

What is the geologic history of Oklahoma?

LEARNING GOALS

Students will use small scale models of the layers of earth to analyze the fossil record of organisms in Oklahoma. They will construct scientific explanations based on the Law of Superposition and make assumptions about the geologic history of Oklahoma.

ANCHORING EVENT

The anchoring event for this lesson is the geologic time scale activity. Students will work in groups of 2-3 to attempt to understand relative and exact dating. Students will order their geologic time scale events based on which events happened first to last. Then students will place the cards on the class geologic time scale. The teacher will allow students to work on their own and then place a master set of cards on the scale so that students can see the events in the correct order. This activity will allow

students to understand the magnitude of time that they are working with in order to understand how the earth changes within that time.

Additionally, the teacher will introduce the 3D printer and allow students to observe the process of printing fossils. The fossils are printed early so that they will be ready for the project later on in the week. This will peak student's interest and have something to look forward to the rest of the project.

COLLABORATIONS

Students will work in groups of 2-3 to create their project. Within these groups, students will research the main concepts such as trilobites and cephalopods to understand what the organisms are and where they are commonly found in Oklahoma. Once students have conducted research using the website (https://samnoblemuseum.ou.edu/common-fossils-of-oklahoma/invertebrate-fossils/), they will work together to develop a model of the layers using their supplies and the 3D fossils that have been printed for their use.

STEM INTEGRATION

This project incorporates STEAM concepts in the following ways. Learning the geologic time scale allows students to understand how the earth changes over time as well as how layers of the earth tell us about time. Students use the technology of chromebooks for research and 3D printers. Students will use art and engineering to create their own Law of Superposition project and insert their 3D printed fossils (scaled down to fit in a project) according to their research on the organisms.

ASSESSMENT

Students will develop their own model of the Earth's layers and design the law of superposition. They will incorporate their fossils found in Oklahoma into the layers to design which fossils are youngest-oldest. These projects will be based on research previously done on their own in class.

Formative: A formative assessment will be done to answer the driving question in class by the teacher asking a series of questions to the students such as:
Where did you put your fossils in the layers?
How do we know which fossil is older based on where it is in the layers?
Why do we think the older layers are on the bottom?
What kind of organisms are these fossils?
What can we infer about the geologic history of Oklahoma based on these organisms?

Summative: The teacher will grade projects based on the accuracy of the placement of fossils within the layers.

The assessments follow SEP by allowing students to investigate on their own and make assumptions based on their knowledge. It allows students to create models to investigate a large-scale concept on a smaller manageable scale (CCP). In addition, both assessments allow the teacher to determine if students understand the DCI - The geologic time scale interpreted from rock strata provides a way to

organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale

PROCEDURE

Engage: Students will begin the lesson on the first day by participating in the geologic time scale activity. Students will order their geologic time scale events based on which events happened first to last. Then students will place the cards on the class geologic time scale. The teacher will allow students to work on their own and then place a master set of cards on the scale so that students can see the events in the correct order. This activity will allow students to understand the magnitude of time that they are working with in order to understand how the earth changes within that time.
Explore: Students will be given a variety of topics to explore on the chromebooks. They will research brachiopods, trilobites, and cephalopods using the Sam Noble Research database. Students will be given guidelines of the research such as finding the age, size, diet, habitat, and period which the organism lived. Students will report this information on the research guide provided here and a link to an online version in the materials section.

Organism Research Guide

Organism	Research	Sketch of Organism
Organism name: Scientific Name:	Age: Size: Diet: Habitat:	
Organism name: Scientific Name:	Age: Size: Diet: Habitat:	

Organism name: Scientific Name:	Age: Size: Diet: Habitat:	

Explain: Once research is completed, students will begin the process of making their models. Students will be given the following materials:

Soils: 3-5 different types
3D printed organism (scaled down): 1 trilobite & 1 cephalopod per group
2 Liter clear bottle - 1
Sharpie - 1

Students will cut the top off of their plastic bottle and remove any additional wrapping around it. They will begin filling in the layers using the soils into the bottle. Students will determine a "timeline" for their project and place their fossils in to their layers based on their age from the research they have done. They will label the timeline with the sharpie on the outside.

Elaborate: Students will make connections from their models to the layers that they see in Oklahoma. As they put together information, students will be asked to elaborate on the fossils they have researched, specifically how organisms who lived underwater are found in a landlocked state. This can be done in a class discussion or as a way of answering the formative questions from above. The teacher will lead the discussion back to the geologic time scale done at the beginning of the lesson.

Evaluate: Students will be evaluated on research, modeling, and their elaborated thoughts answered in class.

STANDARDS

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Insert your performance expectation here: MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

Science Practices	Connection to the Lesson
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)	**Students will make models of the fossil record in Oklahoma and understand how the layers of earth correlate to the age of the fossils in them. Students will then think critically to elaborate on how layers build on each other and will continue to do so.**

Disciplinary Core Ideas	Connection to the Lesson
The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)	**Students will make 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.**
Crosscutting Concepts	**Connection to the Lesson**
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4)	**The student's small-scale models will allow them to visualize the layers and make assumptions of the dates of their fossils relative to each of the layers.**

CCSS STANDARDS

List relevant CCSS state standards for the intended grade level for math and/or language arts.
http://www.corestandards.org/Math/
http://www.corestandards.org/ELA-Literacy/

OTHER STANDARDS

Oklahoma Academic Science Standards (OASS)

- 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-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.

RESOURCES & MATERIALS

- Sam Noble Museum Fossil Database
  http://samnoblemuseum.ou.edu/common-fossils-of-oklahoma/invertebrate-fossils/
- Organism Research Guide:
  https://docs.google.com/document/d/1T3063XWaKH3Wyw5Fu8RHsXNsxXBJZAteB7CUmzQo-AM/edit?usp=sharing
- Example 3D Specimens
- Cephalopods
  *Nautilus: https://sketchfab.com/3d-models/nautilus-27879a30c57844d0978df8f1fae2ec74
  *Goniatite: https://sketchfab.com/3d-models/cephalopoda-agathiceras-ciscoense-pri-76762-420b54e055f445c6a988296c9d2cb0d8
  *Ammonite: https://sketchfab.com/3d-models/cephalopod-perisphinctes-sp-a57e4e04cbf845d89e3d7d331e5d3cce
- Trilobites

*Oklahoma Trilobite Cluster: https://sketchfab.com/3d-models/trilobites-homotelus-bromidensis-pri-45505-50a3bb6c86e04834aa1d72d4b39ae9a9
*_Flexicalymene meeki_: http://www.digimorph.org/specimens/Flexicalymene_meeki/
*_E. crassituberculata_: https://sketchfab.com/3d-models/trilobite-e-crassituberculata-pri-49811-03f611a973144635b4a9019afe7393f0?ref=related

- Echinoids
  *_Phymosoma texanum_: https://sketchfab.com/3d-models/echinoid-phymosoma-texanum-pri-76726-57316149d2f14a149045e91cb029a384
  *_Eupatagus antillarum_: https://sketchfab.com/3d-models/echinoid-eupatagus-antillarum-pri-76727-a5e8a8be4d12487cb7428cb3b4e7d7ef
  *Encope tamiamiensis: https://sketchfab.com/3d-models/echinoid-encope-tamiamiensis-pri-44095-d56af9d635064c7e833db35dad6a2f69

KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

1. Geologic Time Scale
2. Law of Superposition
3. Intrusion
4. Sedimentary rock
5. Fossil
6. Paleontology
7. Brachiopods
8. Trilobites
9. Cephalopods
10. Absolute Date
11. Relative Date

PRIOR KNOWLEDGE

Students begin this lesson with thorough knowledge of the rock cycle and plate tectonics. Students in this lesson know how rocks change from one to the other and can recognize rock layers. Additionally, students understand how earth's tectonic plates have shifted over millions of years and how evidence from the fossil record supports this.