USING FOSSILS TO UNDERSTAND EVOLUTION

BACKGROUND

A **fossil** is the preserved remains, or traces of remains, of ancient organisms. Fossils form over the span of thousands to millions of years. To become a fossil, after an organism dies, it must be quickly covered in sediment to fend off scavengers and predators. Over **time**, layers of sediment cover the organism, become lithified, and harden into rock. The fossils in the photos included in this lesson plan likely formed through a process called permineralization. This process consists of water depositing minerals in the pore space of a bone until it is eventually completely replaced with new minerals. Paleontologists, scientists who study fossils of animals and plants, can use fossils to learn about a **species**' evolutionary history. When sediment is deposited, it is deposited on top of older sediment. This is known as the Principle of Superposition. Due to this ordered stacking of sediment, paleontologists can use the **depth** they find fossils at to relatively date them. This is done by comparing the depth of two fossils, and sometimes the age of one of the fossils is known. Thus, any morphological differences (differences in size, shape, or features) can be said to have occurred at some point between the lifespan of the two fossils in question. This is a tool to study the **evolution** of ancient species. In this lesson plan, your students can experience the excitement of discovering fossils, piecing together the history of a species, and understanding its evolutionary development!

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OBJECTIVE

Students will understand how paleontologists use fossils to understand ancient species' evolution. Students will learn to observe morphological differences among different stages of evolution. Students will infer connections between morphological differences and the depth of fossils to create an evolutionary timeline for a specific species.

KEY VOCABULARY

- **Fossil:** the preserved remains, or traces of remains, of ancient organisms
- **Evolution:** the process by which different kinds of living organisms developed and diversified from their genetic ancestors
- **Time**: continued existence through past, present, and future
- **Depth:** the distance from the top to bottom of an object or location
- **Species**: a group of organisms that can reproduce with one another in nature and produce fertile offspring

NGSS MET:

- MS-LS4-1. 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. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

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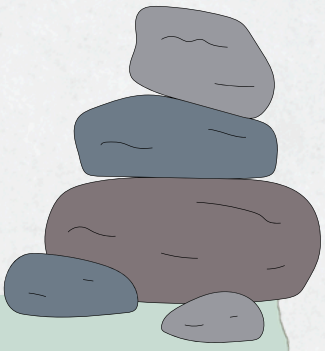
WAYS TO EXPAND THIS LESSON:

- Consider prompting students to draw an image (cross-section) that shows where each fossil was found and at what depth to formalize the depth-time connection.
- Students may draw several versions of their own species to show the evolution of the species throughout time, being sure that each iteration is morphologically different.

MATERIALS:

- Photos of fossils or 3D printed fossils if possible
- Clear tote buckets
- Sand, gravel, or any other material to fill the buckets
- Sharpie or dry-erase marker
- Trowels (1 per 1-2 students)
- Worksheet (3 pages for each student)
- Pencils

TIP: We used pom poms in place of sediment to make for a cleaner exploration!



PREPARATION:

1. Print photos of each series of fossil, cut them out, and laminate. Alternatively, create 3D printed models.
2. Obtain one clear tote bucket for each group of 3-4 students and label each side with even depth measurements from 0 to 1,000 meters, with 1,000 meters at the bottom.
3. Fill the bucket with different types of sediment (sand, gravel, pebbles, clay, etc) and place the fossils in the tote in an ascending order relating to their age, try to evenly space them out (ex. if there are 4 fossils, place them each approximately 250 “meters” from each other). Take one of the fossils from each of the series and rotate them into other groups’ buckets, be sure to place them in a depth that makes sense when compared to the other groups’ fossils.

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TIMELINE AND PROCEDURE:

- 5 minutes - Introduce the lesson, the expected timeline, and gauge students' prior knowledge on the topic of fossils and how fossils are tied to our understanding of evolution.
  - Ask, Who can tell me what a fossil is? How do scientists use fossils? Are fossils and evolution linked or separate ideas?
- 5 minutes - Explain to students that they will be digging for fossils and recording their observations. Model appropriate behavior for digging for fossils and recording their findings.
- 20 minutes - Students investigate their buckets in small groups and record their findings. Students should hypothesize about each fossil, its depth, and their possible connection once they find all the fossils. They should use the sequence and depth to create a timeline of when each feature evolved. Students should prepare to share what they found and their hypotheses.
- 5 minutes - Class share out. Students should realize their species may have a fossil in another group's bucket. With this new information, they should expand their hypothesis.

Note: This lesson typically requires 35 to 45 minutes.

Tip: We conducted an informal assessment pre- and post- completion of the lesson. The assessment strategies we used are listed below:

<u>Pre-Assessement</u>

- Ask students to write down everything they know about fossils and evolution
- As a group, students brainstormed ways fossils can be used by scientists

<u>Post-Assessement</u>

- Students drew a picture demonstrating their own unique species evolving in three steps
- Students created a skit to explain how paleontologists use fossils

Fossil Observations

Name: _____

Draw a picture!

Depth: _____

Observations: _____

_____

_____

Draw a picture!

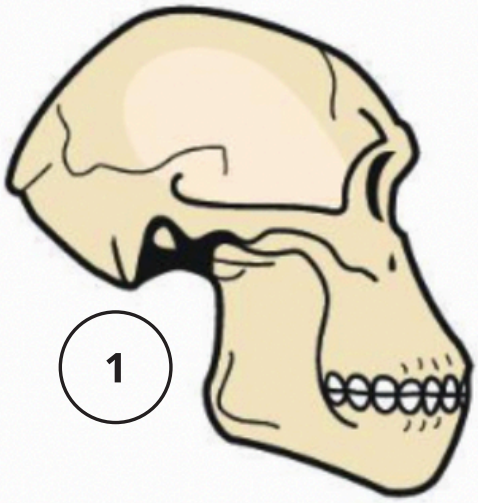
Depth: _____

Observations: _____

_____

_____

Cut and Laminate



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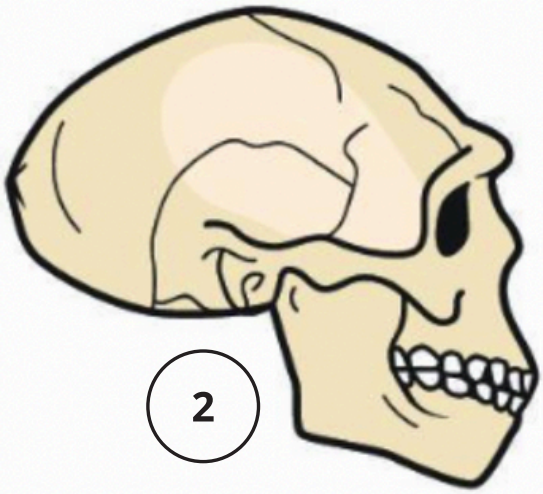

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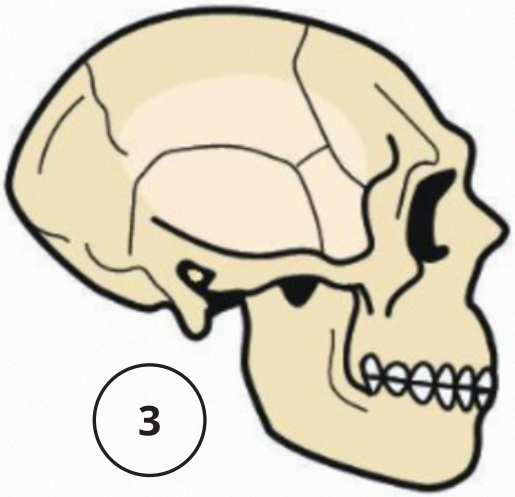

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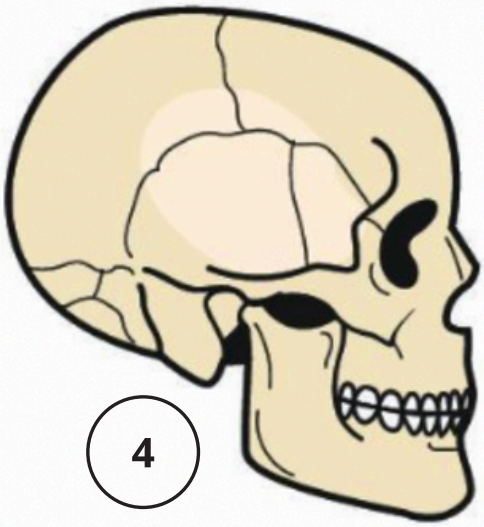

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Cut and Laminate

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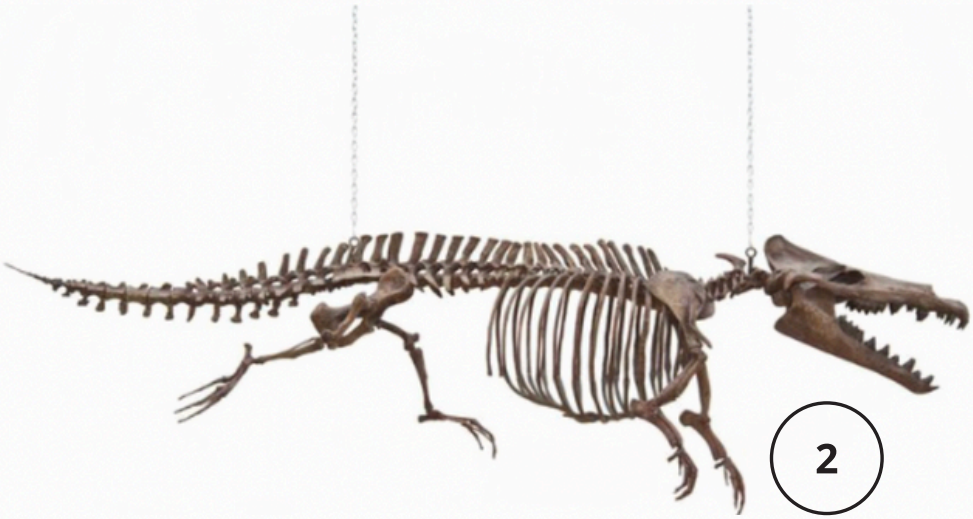

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Note: The photos in this lesson plan display trilobite, horse, human, and whale evolution!

CITATIONS AND ACKNOWLEDGEMENTS

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Photo Citations:

Antrodemus. (2016). Pakicetus, Ambulocetus, Maiacetus, and Dorudon. Twitter. Retrieved from https://twitter.com/Antrodemus/status/698142476641574912.

Fossil Record. (n.d.). Life Science. Retrieved from http://7gradelifescience.blogspot.ro/2014/04/unit-5-evolution.html.

Figure 1 from Fusco et al. – trilobite moult cycle. (2013). PEGE Journal Club. Retrieved from https://pegejournalclub.wordpress.com/2013/04/22/developmental-trait-evolution-in-trilobites/.

Evolution of the Skull. (2023). Brainly. Retrieved from https://brainly.com/question/30527403.

All other graphics were sourced from CanvaPro.