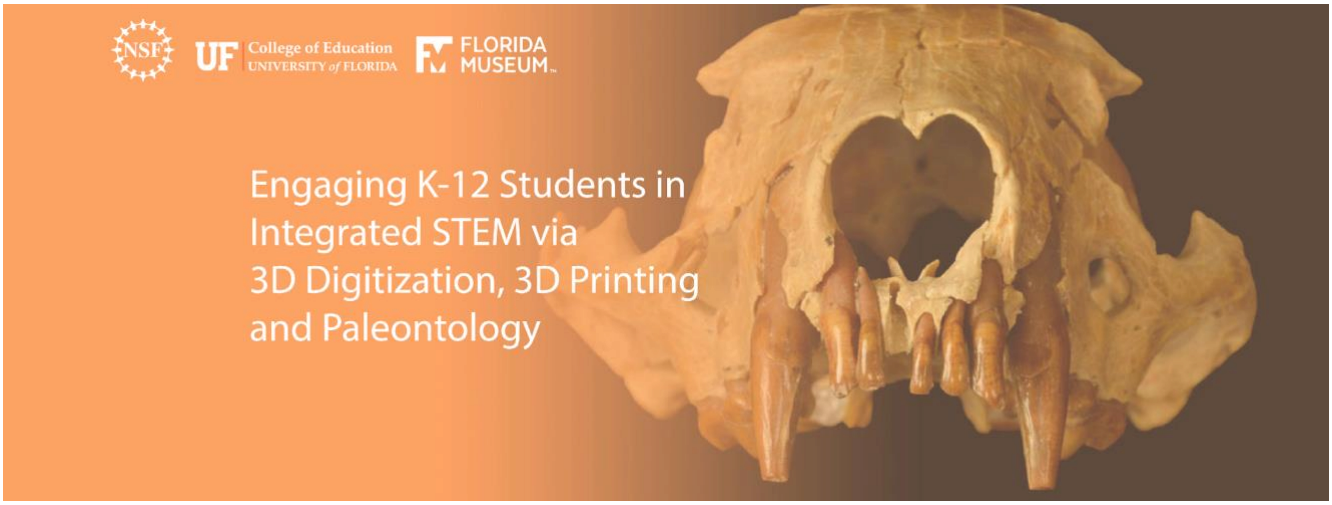

AUTHOR (S)

Brenda Paul

LESSON TITLE

Why is that fossil THERE?

GRADE LEVEL

6th-8th Grade

TIME FRAME

1-2 45-minute class periods

DRIVING QUESTION

How can fossils be found in environments different than where the organism lived?

LEARNING GOALS

- Make connections between fossil characteristics and environmental needs of the organism
- Make connections between geologic process and changes in an environment over time

ANCHORING EVENT

Show students this YouTube video about tree fossils that were discovered in Antarctica: Scientists Discover Ancient Tree Fossils in Antarctica. Then, discuss with students what Antarctica looks like using the Antarctica Photo Gallery and compare it to the places where you would normally find trees.

COLLABORATIONS

Students will work in groups to complete the station questions while analyzing the fossils, environments, and geologic processes.

Ideally, students should be grouped based on strength, with each group including:

- writing strength
- technology strength
- critical thinking strength

STEM INTEGRATION

- **Science:** Students will make connections between geologic process and changes in an environment over time.
- **Technology:** Students will use digital resources (google maps/google tour) to explore the fossil locations and research the geologic history of the area.
- **Engineering:** Students will make experience the benefits of utilizing 3D printed items.

ASSESSMENT

- Students will be assessed based on their answers to the questions at each station.

PROCEDURE

Introduction

Introduce the lesson using the "Anchoring Event" activity:

- Show students this YouTube video about tree fossils that were discovered in Antarctica: Scientists Discover Ancient Tree Fossils in Antarctica. Then, discuss with students what Antarctica looks like using the Antarctica Photo Gallery and compare it to the places where you would normally find trees.
- Distribute the worksheet that accompanies the stations. Verbally, answers the questions together using the information from the video. Focus on the *how* for the final question.

Stations/Work Session

Set up stations around the room. Each station should be equipped with:

- the printed slide for the station (make sure to print either the iPad or non-iPad version, depending on your device) Attached in resources below.
- the corresponding 3D printed fossil

Divide students into small groups of between 3 and 4 students (stations can be duplicated if necessary, for larger classes).

As a group, students should complete the Fossil Station Questions handout. **Note: the stations do not need to be completed in a particular order*.

- Station 1: Mt. Everest, Himalayan Mountain, Tibet/Nepal, Snail (gastropod, *Bellerophon randerstonensis)*, 326-359 mya
- Station 2: Grand Canyon, Kaibab Plateau, Arizona, Horn Coral (*rugosa*), 250 mya

- Station 3: Mt. Charleston, Nevada, Shell (brachiopod, *Spiriferid Brachiopod*), 248 to 545 mya
- Station 4: Floyd County, Georgia, Trilobite (*Elrathia antiquate*), 500 mya

Extension
Students who complete the stations should select the location and fossil most interesting to them. Students should do additional research on the fossil they selected and create a presentation about the fossil.

STANDARDS

Middle School

NEXT GENERATION SCIENCE STANDARDS (NGSS)

MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Insert your performance expectation here:	
Science Practices	**Connection to the Lesson**
Constructing Explanations and Designing Solutions 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-ESS2-2)	Students will analyze a given fossil as well as the location at which the fossil was found. Students will then research geologic events to determine the cause of the change in environment.
Disciplinary Core Ideas	**Connection to the Lesson**
ESS2.B: Plate Tectonics and Large-Scale System Interactions Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)	Students will analyze a fossil found in a given environment that is different from the environment the organism would have lived in. Students will then connect geologic processes that have occurred resulting in the changed environment, such as plate tectonics.
Crosscutting Concepts	**Connection to the Lesson**
Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.(MS-ESS2-1)	Students will analyze a fossil found in a given environment that is different from the environment the organism would have lived in. Students will then connect geologic processes that have occurred resulting in the changed environment, such as plate tectonics.

CCSS STANDARDS

CCSS.ELA-LITERACY.RI.5.7

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

CCSS.ELA-LITERACY.RI.6.7

Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

CCSS.ELA-LITERACY.RI.7.10

By the end of the year, read and comprehend literary nonfiction in the grades 6-8 text complexity band proficiently, with scaffolding as needed at the high end of the range.

CCSS.ELA-LITERACY.RI.8.10

By the end of the year, read and comprehend literary nonfiction at the high end of the grades 6-8 text complexity band independently and proficiently.

OTHER STANDARDS

21st Century Skills

Use Systems Thinking

Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

RESOURCES & MATERIALS

Introduction/Anchor

Video: Scientists Find Ancient Tree Fossils in Antarctica

Antarctica Photo Gallery

Printables (see end of resource section)

Station PowerPoint - iPad version (includes QR codes), non-iPad version (includes tiny urls)

"Fossil Station Questions" Student Worksheet

Google Tour Link:

https://tourbuilder.withgoogle.com/tour/ahJzfmd3ZWItdG91cmJ1aWxkZXJyEQsSBFRvdXIYgICgpta0sQkM

Station 1

3D print from: https://www.thingiverse.com/thing:1692561

Research Links:

- https://www.geolsoc.org.uk/Plate-Tectonics/Chap3-Plate-Margins/Convergent/Continental-Collision
- https://pubs.usgs.gov/gip/dynamic/himalaya.html
- https://www.youtube.com/watch?v=PDrMH7RwupQ&t=10s

Station 2

3D print from: https://www.thingiverse.com/thing:163793

Research Links:

- https://www.nps.gov/grca/learn/nature/geologicformations.htm
- https://watershed.ucdavis.edu/education/classes/ecogeomorphology-grand-canyon-2016/flogs/tectonic-evolution-colorado-plateau-and-grand-canyon-0
- https://youtu.be/-v_RLRT9930

Station 3

3D print from: https://www.thingiverse.com/thing:180190

Research Links:

- https://www.unlv.edu/news/article/my-nevada-5-dramatic-events-shaped-our-land
- http://www.sierrahistorical.org/geology-of-the-sierra-nevada/
- https://www.youtube.com/watch?v=9sP2M0D9Gow

Station 4

3D print from: https://www.thingiverse.com/thing:182328

Research Links:

- http://www.georgiasfossils.com/1-georgias-oldest-fossils.html
- http://www.gly.uga.edu/railsback/GAGeology.html
- http://www.ucmp.berkeley.edu/arthropoda/trilobita/trilobitalh.html
- https://youtu.be/WxK1RWvEKEU

Additional Resources

Plate Tectonics Map: https://geology.com/plate-tectonics.shtml

The Role of Plate Tectonics in Mountain Building: http://hyperphysics.phy-astr.gsu.edu/hbase/Geophys/platemt.html

Fossil Station Questions Worksheet

As you go through each station, answer the questions about each fossil and the location in which it was found. Use the google tour, the information provided at each tour location, and the research links to expand your information.

Be sure to use scientific vocabulary in your explanations!

Station 1

Location: Mt. Everest, Himalayan Mountains, Tibet/Nepal
Fossil: Snail (gastropod, *Bellerophon randerstonensis)*

1. Describe the environment in which the fossil was found.

2. Describe the environment you would expect to find the fossil in when it was a living organism?

3. Describe the geologic processes (including plate tectonics) that changed the organism's environment to the current environment. Use the websites provided at the station for additional research.

Station 2

Location: Grand Canyon, Arizona
Fossil: Horn coral (*rugosa)*

1. Describe the environment in which the fossil was found.

2. Describe the environment you would expect to find the fossil in when it was a living organism?

3. Describe the geologic processes (including plate tectonics) that changed the organism's environment to the current environment. Use the websites provided at the station for additional research.

Station 3

Location: Mt. Charleston, Nevada
Fossil: Shell (brachiopod, *Spiriferid Brachiopod*)

1. Describe the environment in which the fossil was found.

2. Describe the environment you would expect to find the fossil in when it was a living organism?

3. Describe the geologic processes (including plate tectonics) that changed the organism's environment to the current environment. Use the websites provided at the station for additional research.

Station 4

Location: Floyd County, Georgia
Fossil: Trilobite (Elrathia antiquate)

1. Describe the environment in which the fossil was found.

2. Describe the environment you would expect to find the fossil in when it was a living organism?

3. Describe the geologic processes (including plate tectonics) that changed the organism's environment to the current environment. Use the websites provided at the station for additional research.

Google Tour Link

https://tinyurl.com/ybmnkllt

Station 1

- Location: Mt. Everest, Himalayan Mountains, Tibet/Nepal
- Fossil: Snail (gastropod, *Bellerophon randerstonensis)*
- Age: 326-359 million years ago
- Background Information and Research Links & Videos:
  - **https://tinyurl.com/jgommgg**
  - **https://tinyurl.com/y9tohge6**
  - **https://tinyurl.com/yckfosbd**

Station 2

- Location: Grand Canyon, Kaibab Plateau, Arizona
- Fossil: Horn Coral (*rugosa*)
- Age: 250 million years ago
- Background Information and Research Links & Videos:
  - **https://tinyurl.com/ju67btd**
  - **https://tinyurl.com/ycbktd8m**
  - **https://tinyurl.com/y9doqrox**

Station 3

- Location: Mt. Charleston, Nevada
- Fossil: Shell (brachiopod, *Spiriferid Brachiopod*)
- Age: 248-545 million years ago
- Background Information and Research Links & Videos:
  - **https://tinyurl.com/y7dv3hmm**
  - **https://tinyurl.com/y8tg8cnj**
  - **https://tinyurl.com/ybuyeqpg**

Station 4

- Location: Floyd County, Georgia
- Fossil: Trilobite (Elrathia antiquate)
- Age: 500 million years ago
- Background Information and Research Links & Videos:
  - https://tinyurl.com/yd5s8neg
  - https://tinyurl.com/7wo68lq
  - https://tinyurl.com/y7mwzn7e
  - https://tinyurl.com/yckfhq4t

Google Earth

- Make sure you have the "Google Earth" app on your iPad
- For each station you will search for the location listed at the station
- Make sure to explore the location once you get there!

Station 1

- Go to in Google Earth: Mt. Everest, Himalayan Mountains
- Fossil: Snail (gastropod, *Bellerophon randerstonensis)*
- Age: 326-359 million years ago
- Research Links & Videos:

Station 2

- Go to in Google Earth: Grand Canyon, Arizona
- Fossil: Horn Coral (*rugosa*)
- Age: 250 million years ago
- Research Links & Video:

Station 3

- Go to in Google Earth: Mt. Charleston, Nevada
- Fossil: Shell (brachiopod, *Spiriferid Brachiopod*)
- Age: 248-545 million years ago
- Research Links & Video:

Station 4

- Go to in Google Earth: Floyd County, Georgia
- Fossil: Trilobite (Elrathia antiquate)
- Age: 500 million years ago
- Research Links & Videos:

KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

- **Pangaea -** ("all land") the single huge supercontinent that existed 245 million years ago, when all of Earth's continents were joined together.
- **seafloor spreading -** the process by which new oceanic crust forms when magma rises up and solidifies at the mid-ocean ridges. The newer crust pushes the older crust out to each side, which is why the age of the sea floor increases with distance away from the mid-ocean ridges.
- **subduction -** the process by which one tectonic plate sinks below another, returning to the mantle, where the rock is re-melted. Subduction takes place at convergent plate boundaries. Oceanic crust, which is denser, will always subduct under the less dense continental crust.
- **tectonic plates -** large pieces of the lithosphere that slowly move on top of the asthenosphere. There are seven primary plates and many smaller ones. The seven primary plates are the African Plate, Antarctic Plate, Eurasian Plate, Indo-Australian Plate, North American Plate, Pacific Plate, and South American Plate.
- **convergent plate boundaries -** where two tectonic plates move toward each other
- **divergent plate boundaries -** where two tectonic plates move away from each other
- **transform plate boundary -** where two tectonic plates slip past each other, moving in opposite directions
- **fossil -** mineralized or otherwise preserved remains or traces (such as footprints) or impressions of animals, plants, and other organisms
- **convection currents-** movement within hot fluids, when the heat source is on the bottom, such as in a boiling pot of soup on the stove. Convection currents happen because the hotter material is less dense and rises; when it reaches the surface, it cools and becomes less dense, so it sinks. This rising and sinking creates a circular motion within the fluid.
- **tectonic plate boundary-** a place where two tectonic plates meet
- **fault** – occurs where once continuous section of rock has been displaced due to tectonic activity or massive rock movement.
- **uplift** – elevating the Earth's crust vertically due to tectonic activity. Usually associated with mountain building events and produce earthquakes.

PRIOR KNOWLEDGE

Students should have an understanding of the theory of plate tectonics, including types of plate boundaries and convection currents.