



Earth's Place in the Universe

Essential Question: How does the Earth change over time and how do we know?

Unit Summary: The purpose of the unit is to introduce students to some of the ways in which the Earth's surface has changed over time. Students will focus on using patterns to explain and support claims on the changes to Earth's surface.

- **Lesson 1:** The unit begins by exploring plate tectonics and how they have slowly shaped and changed Earth's surface.
- **Lesson 2:** Students investigate the faster changes of weathering, erosion, and deposition on Earth's surface as another piece of evidence to answer the essential question.
- **Lesson 3:** Students learn about the rock cycle, while still seeking to answer the essential question with a different piece of evidence.
- **Lesson 4:** Students explore what the location and composition of rock layers can say about Earth's past and its changes.
- **Lesson 5:** The unit concludes with a brief inquiry into how living things influence Earth's surface.

Lesson 4 of 5: Fossils

Standards 4-ESS1. Earth's Place in the Universe		
Performance Expectations **The lesson outlined in this table is just one step toward reaching the performance expectations listed below** 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.		
Dimension	Name and NGSS code/citation	Specific Connections to Classroom Activity
Science and Engineering Practices	SEP 6: Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation. 	<p>By interpreting the fossil and rock diagrams, students can answer the essential question using constructed explanations with supporting evidence.</p> <p>In Activity 2, students will discover the Law of Superposition through inquiry and construct an explanation utilizing supporting evidence.</p> <p>In Activity 2 during the share-out, teacher promotes listening to peers and identifying evidence/errors in using opinions as evidence by asking "What evidence did X use? Was it good evidence? What other evidence might support/refute X's claim?"</p> <p>In Activity 3, students will analyze a "fossil record" to make claims for what the rock patterns reveal about the Earth and its changes. They will also make claims, supported by evidence, about the Earth's landscape based on the fossil record.</p> <p>In Activity 4, the events in their story should be supported with appropriate evidence.</p>
Disciplinary Core Ideas	The History of Planet Earth (ESS1.C) <ul style="list-style-type: none"> Local, regional, and global patterns of rock 	<p>In Activity 2, students will discover the Law of Superposition through inquiry and construct an explanation utilizing supporting evidence.</p>



	<p>formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.</p>	<p>In Activity 3, students will analyze a “fossil record” to make claims for what the rock patterns reveal about the Earth and its changes. They will also make claims, supported by evidence, about the Earth’s landscape based on the fossil record.</p> <p>In Activity 3, students will use observation and measurement to collect and analyze data on the relative dating of fossils and rock layers.</p> <p>In Activity 4, their story should include inferences with evidence as to Earth’s changes over time and relative age of rock layers.</p>
<p>Crosscutting Concepts</p>	<p>CCC 1: Patterns</p> <ul style="list-style-type: none"> Patterns can be used as evidence to support an explanation. 	<p>In Activity 2, students will analyze multiple figures to identify a common pattern. Then, they will apply this pattern to another set of figures to make claims about those figures.</p> <p>In Activity 3, students will make claims for what the rock patterns reveal about the Earth and its changes.</p> <p>In Activity 4, their story should include a claim with evidence in the form of pattern recognition of the fossils’ locations.</p> <p>In all share-outs, this standard will also be addressed as students argue their claims. Teacher should emphasize the need for supporting evidence and pattern recognition.</p>
<p>Connections to Engineering, Technology, and Applications of Science:</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> Science assumes consistent patterns in natural systems. 	<p>Students will be asked to identify patterns they see in the rock layers and to infer an explanation based on these consistent patterns.</p>	
<p>Connecting to the Common Core State Standards</p> <p>ELA/Literacy – W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1) W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1) W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)</p> <p>Mathematics – MP.2 Reason abstractly and quantitatively. (4-ESS1-1) MP.4 Model with mathematics. (4-ESS1-1) 4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb., oz.; l, ml; hr., min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1)</p>		
<p style="text-align: center;">Suggested Procedure</p> <p>Review Unit Essential Question: How does the Earth change over time and how do we know?</p> <p>Introduce the guiding question: How do fossils help us answer the EQ by teaching us about the past?</p> <p>ACTIVITY 1 (targets SEP 6): THE ENGAGER</p> <p>Print out the fossil pictures from this website: http://www.fossilsforkids.com/Now_and_Then.html. Have students guess what animal they came from. In this activity the purpose is to spark their curiosity around fossils and have them</p>		

practice the skill of stating a claim and providing reasoning for that claim. Have students share out claims and voice differing opinions. If teacher wants, show pictures of what they used to be when alive (on website).

ACTIVITY 2 (targets SEP 6, CCC 1):

Relative Dating (approx. 45 minutes)

1. Provide students with five different figures that show three different pertinent historical people each, stacked analogous to the Law of Superposition (i.e. oldest on bottom and most recent on top). In small groups, students' task is to identify the pattern that relates all the figures (Person who was alive most recently situated on top, and person who was alive in the earliest years on the bottom). Have groups share ideas and identify the pattern with supporting evidence.

Ex. from Wyoming 4th grade history standards (Create examples applicable to your town/state)

	<i>Esther Morris – 1st female Justice of the Peace; died in 1902</i>
	<i>Jim Bridger – Fur trapper; died in 1881</i>
	<i>Jedediah Smith – Explorer; died 1831</i>

2. Working in the same groups, tell students you will be giving them five more figures (this time with rock layers), which they are to use to answer the question: "What do you think of the age of the rocks in these figures based on the last activity?" Students need to have evidence (ex. relate to pattern identified with figures of historical people) to support any claims they make about the rocks.

Ex.



3. After working in small groups, have students share with the class their claim and evidence. Make sure they are connecting to the patterns they discovered in the first part of the activity in order to hit the CCC. Ask another group: "What evidence did this group give for their claim? Is it a good piece of evidence? What other evidence might support/refute their claim?"
4. Open discussion - "What do you think these pictures might tell us about the Earth's surface?"

ACTIVITY 3 (targets SEP 6, DCI ESS1.C, CCC 1):



Fossil Find (approximately two 45 minute sessions)

1. Before class, create six sets of “fossil records” (might vary by class size) vertically on a wall in the hallway/classroom/outside: Place the fossil cards (located in the science kit) in six separate locations, according to color. Cards in each group should be placed several centimeters apart. Using various items such as sidewalk chalk, cones, or paper tents label each “area” with one, two, and three. Make sure each area is separated enough to have its own distinct space.
2. Divide the class into six groups. Present the scenario to the students:
3. Divide students into 6 groups and have one group work at each “fossil record”. Their task is to measure the height of each rock layer in centimeters and identify what fossils are present. **Bonus: Have students convert their measurements to meters to get a more accurate measure of what the layers could look like in real life (math standard connection).**
4. Then, students should answer the following:
 - a) What happened first?
 - b) What claims can you make based on what you see? (i.e. relative time each layer was at the Earth’s surface; abundance of species within each layer; what fossils are present and what that tells us about the Earth at that time)
5. Questions that could be asked in the discussion to guide the learning could include:
 - a. What kind of information can the measurements tell us?
 - b. What do your findings tell us about the Earth and its changes? (Think about the patterns!)

Possible responses: The measurements tell us how far away fossils are from each other, which suggest age difference and length of time the Earth looked a certain way. It would tell how deep the fossils were located and what other plants and animals were living near it. The measurements can give the scientists information about the landscape at the time the animal was living. It can also provide evidence for the ages of the fossils in comparison to each other.

ACTIVITY 4 (targets SEP 6, CCC 1, DCI ESS1.C):

Culminating Activity: What is my story?

1. Students will create their own stories using the knowledge they have gained and pertinent supporting evidence to describe a diagram of rock and fossil layers. This activity has the potential to target a non-fiction writing standard. Students’ stories should include evidence about layering patterns, inferences into the Earth’s landscape with supporting explanations, indications of changes occurring on Earth’s surface as evidenced by the differing layers, and inferences about relative time differences the Earth looked a certain way based on height of layers.
 - *Possible differentiation: Give students print-outs of fossils (consider including the year in which the animal died and the habitat in which it lived) and have them arrange the fossils into layers that make sense; they will write a story explaining the layering and what it tells us about the Earth and the organisms that used to live on it. Alternatively, give students a pre-fabricated set of fossil layers and have them write a story based on those layers.*
2. Either written or orally, students should tell a story of the arrangement of their fossils in terms of layering and why they placed certain fossils in close proximity (Note: there are MANY correct ways to arrange the fossils, but the trilobite and dinosaur should be in the bottom two layers and the human should be in the top two layers; also organisms should be together based on shared habitat.) Students should be able to defend and explain the reason behind their stories. Students should be able to answer questions about the way they sorted their fossils including why they put specific fossils in each layer, rules they followed in creating their fossil record, and why they placed the trilobite where they did.

Argumentation topics: If you found a leaf and a shell in the same layer, what would that tell you about the landscape at that time? (*the wind blew the leaf into the water?*) Would you ever find a human and a dinosaur in the same layer? (**NO! They did not inhabit the earth at the same time. In fact, dinosaurs were gone for more than 60 MILLION YEARS before Humans appeared on earth**)



ACTIVITY 5 (targets CCC 1, DCI ESS1.C):

Ending discussion: Ask kids to discuss or journal in response to the question, “What do fossils teach us about the past? (*Fossils can teach us what the landscape was like at the time. Fossils can really tell us the history of the land*)

SPECIFIC Wyoming Place-based example: What does the presence of coal in Campbell County tell us about the landscape of our past?” Teachers: Embed in the discussion how cause and effect and patterns played a role in the existence of coal in Campbell County and what the presence of coal seams tells us about the past in this area. This would be a great time to revisit the unit essential question: *How does the Earth change over time and how do we know?*

- **Campbell County Coal info:**
 - **Geologic history:** <http://www.wsgs.wyo.gov/energy/coal-geology>
 - **Cross sectional diagrams:** <http://www.wsgs.wyo.gov/energy/coal-prb>
 - **Diagrams, maps, and projects:** <http://www.wsgs.wyo.gov/energy/coal-maps-projects>

Complete any of the suggested readings below:

HM Science textbook B74-80 - “What do Fossils about the Past?”

ReadWorks.org: “Leaping Lizards”, “Fossils and Earthquakes”, “Dig This!”, “Fossils and Dinosaurs The Age of Dinosaurs”

Newsela: “Walking and watching for dinosaur bones in Utah’s desert”, “In Crete, an ancient city is uncovered”, “Woolly mammoth’s rib may explain extinction”, “A tough task: Digging out a mammoth’s tusk”, “Scientists study old bones and learn new things about Native Americans”

The following books are available in your unit reading crate

Fossils, Rocks, and Time by Lucy E. Edwards

Digging in the Sun by Michael Ellis