

Fourth Grade Earth Systems

Patterns in the Rocks: Changes in Landscape Over Time

Background Information

Sedimentary rock layers are found in places all around the world. They can provide useful clues to the past. Sometimes a waterway cuts through the layers revealing a geologic record of the past. In other locations, scientists must dig trenches to see the layers. As the lower layers generally formed first, they are the oldest. Fossils within the rocks may allow some layers to be dated with accuracy. In other locations, clues may be sparse.

Searching for patterns in sedimentary rock layers is a bit like solving a puzzle. The picture emerges slowly, and the picture may tell a story. Landscapes are never static; they change over time. Continents move, landforms are raised and lowered, ocean shorelines advance and retreat. Biomes and their living organisms shift with the land.

Performance Expectation

4-ESS1-1 Earth's Place in the Universe: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. <http://www.nextgenscience.org/pe/4-ess1-1-earths-place-universe>

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth • Local, regional, and global patterns of rock 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

Science and Engineering Practices

Constructing explanations for science: Identify the evidence that supports particular points in an explanation.

Crosscutting Concepts

Patterns: Patterns can be used as evidence to support an explanation.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes consistent patterns in natural systems.

Materials

- Student Pages
- Landscape Templates (1 per group)
- Spinners (1 per group)
- Wax Paper (each group needs one square, roughly 4"x4" or larger)
- Plastic Knife (just one if teacher does the cutting)
- Modeling Clay (4-oz stick per group)
- Leaf Models (2 per group)
- Bone Models (2 per group)
- Small Shells (2 per group)
- Colored Sand (3 colors)
- 1 Clear Plastic C

Advanced Preparation

One-at-a-time, pour three types of sand into a clear plastic cup to form three visible layers.

Suggested Implementation

To engage interest and activate background knowledge, begin by showing your cup with three sand layers and the three containers from which you poured. Ask the following:

- **Which layer did I add first? Are you sure? How do you know?**
- **Which layer did I add last? Are you sure? How do you know?**

If a student suspects you did something tricky, you can allow them to come up and try it by pouring sand into a cup in some manner that might give an unexpected result.

Help students form groups of three or four and pass out Student Pages.

Ask for volunteers to read aloud the background information and the Problem statement.

Part One: A Changing Landscape

Pass out the Landscape Templates and spinners. You will need to give each group a number. Have them write it on their Landscape Template.

Give one stick of modeling clay to each group and allow them to follow the directions in their Student Pages.

Students will make eight clay layers. Each represents the landscape at some time in the distant past. Although it would be faster to have students within a group working on multiple layers simultaneously, that might cause misconceptions. Layers of rock form sequentially, one at a time, with the newer forming atop the older. Encourage students to make their model in a similar fashion, at least for the first two or three layers.

After all eight layers are stacked on the Landscape Template, students can apply pressure on the stack by pressing down with a book (protected by wax paper). Discourage students from pounding, standing, or jumping on the stack.

Use a plastic knife to cut their stack into roughly equal halves. Students must put their group number on the top of each half. A toothpick or pencil could be used.

Part Two: Digging into the Past

Each group will exchange half-stacks with two other groups. Now, students may carefully examine their samples, making careful observations and recording their observations on the provided tables. Using the observable evidence, students will attempt to describe the landscape

of each layer of their samples.

Using only their own sample, students will find it difficult to determine many of their layers. If they wish, they may find the group which has the other half of their sample and compare notes. Together, the two groups will have more data and more success. Their instructions don't mention this possibility. Let students think of it themselves.

After each group is finished with both of their half-stacks, it is time to present their findings to the entire class. Begin with the stack created by Group #1. Have the two groups present their findings. Ask the class how they wish to proceed, one group at a time, or one layer at a time. When there are disagreements between the two groups, encourage a debate. Allow other students to suggest alternate interpretations of the data.

When the investigating students have finished their explanations, Group #1 has the option of revealing the correct answers. They may, however, choose to remain silent. In real life, there is nobody to tell scientists what actually happened in the deep past. Some details may remain a mystery.

During presentations, be sure that each student is given an opportunity to explain results from at least two layers.

Depending on available time, either:

- Continue until all the stacks have been discussed, or ...
- Continue until each group has had the opportunity to present once.

In addition, you may wish to have students write a story about how the layers formed in the landscape image provided on their student page.

Debrief Questions

- Which layer formed first, #1 or #8? How do you know?
- Why is it important for scientists to work together and share their data?

Assessment

The following single point rubric can be used to assess student understanding. For each of the four criteria listed below, either circle the proficient description or add notes to a box indicating why the student's performance was either lacking or exceptional.

Areas that need improvement.	Criteria for Proficient Performance	Evidence of exceeding standards. Advanced Performance
Developing Performance	Explained how a model landscape changed over time, layer by layer.	
	Identified evidence from personal observations in support of explanations for each layer.	
	Applied observed patterns to explain which layers were older than others.	

Folded Layers

Ask students to discuss the image of the folded layers on their student sheet and provide an explanation about how the rock formed.



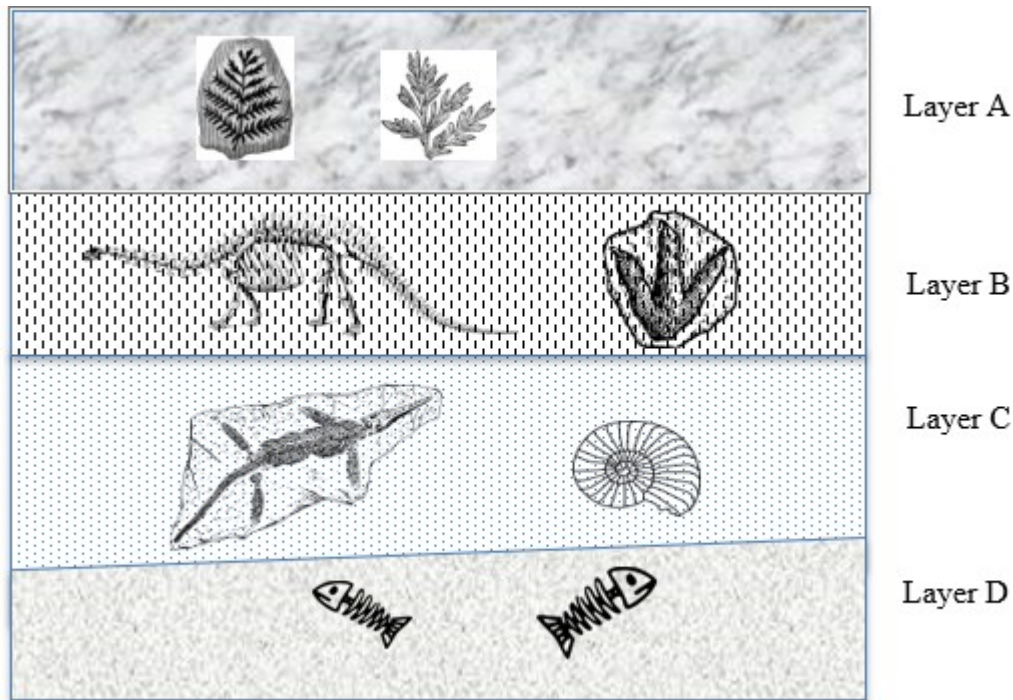
The layers were laid down horizontally in a lake bed or shallow ocean. After the rock was formed, pressure squeezed the layers together causing buckling and folding.

Give each group another half-stick of clay and have them form a “short stack” of two or three layers. They may experiment with ways the stack might be folded to produce a model of this image.

- How might the data be misinterpreted if scientists did not know that the layers were inverted?
- How might scientists know that the layers have been inverted? What clues might they look for?

Fishy Tale

Provide the groups with the following picture. Ask them to use evidence from the diagram to justify relative age of layers and environments that existed for each layer.



Potential Explanations for a Fishy Tale: Layer D should be mentioned as the first layer and it was a water environment, a lake, or an ocean indicated by the fish skeletons. Later the water remained but the animals that lived there were different (Layer C). The creature pictured is a mosasaur. The ocean dried up and the dry land in Layer B was home to dinosaurs. Finally, in Layer A, the youngest layer, ferns and plants were present representing dry land like a forest or woodland.

Extended Challenges

The Mississippian Period is the interval of Earth's [geologic](http://isgs.illinois.edu/outreach/geology-resources/build-illinois-last-500-million-years) history from about 360 to 320 million years ago. During that time, Illinois was located south of the equator and was covered by a warm, shallow inland. <http://isgs.illinois.edu/outreach/geology-resources/build-illinois-last-500-million-years>

1. Rock Hound

Today, Mississippian-age rocks are present in the southern two-thirds of Illinois, where they are over 3,200 feet thick. Mississippian rock resources have been important to the mineral industries and economy of Illinois since the early 1800s. Contact a local stone, sand and gravel or landscape company for free samples of limestone, sandstone, shale, and dolomite, common rocks of Illinois. They might also have fluorite, galena, or sphalerite. Have students choose one of the samples and develop a small poster about its properties, where is it mined in Illinois and how it is used. <http://isgs.illinois.edu/outreach/geology-resources/mississippian-rocks-illinois>

2. Storyboarding Mississippian Habitats

Ask students to investigate the creatures that existed in Illinois 350 million years ago. Using the storyboard template provided below, or one of your own, have them develop a story about life in the Mississippian seas that ends with the development of fossil evidence that will be found by

humans 350 million years later. The Illinois DNR has an excellent publication with information about many fossils. <https://www.dnr.illinois.gov/publications/documents/00000688.pdf> This website has a very nice progression showing how fossils form. <http://www.discoveringfossils.co.uk/what-is-a-fossil/> Alternatively, ask students to work in small groups to develop a diorama of a shallow sea during the Mississippian Period. Crinoids can be made out of chenille stems.



350 million years ago, Illinois was covered in shallow seas. Common rocks of Mississippian age formed at the bottom of the shallow inland sea.

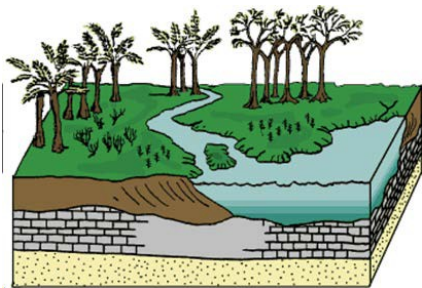
<http://isgs.illinois.edu/outreach/geology-resources/build-illinois-last-500-million-years>

There was a creature that has been found only in Illinois called the Tully Monster, a relative of the lamprey eel. It is the state fossil.

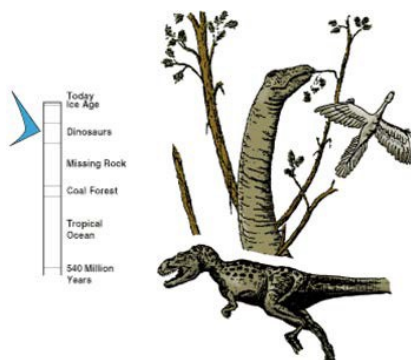


3. Storyboarding Illinois Geology through time

Ask students to investigate the events that occurred in Illinois starting from 350 million years ago. Using the storyboard template provided, or one of your own, have them develop a story about life in Illinois that ends with the development of fossil evidence that will be found by humans 350 million years later.



325 million years ago, the ocean layers were buried. Muddy rivers flowed through woodlands. Trees and other plants were buried and compacted through time and became a major state resource, coal. Folding and faulting rock and bringing some of the ancient ocean rock to the surface in north-central Illinois.



From 250 to 65 million years ago, Illinois was a warm, dry place, a landscape of hills and valleys filled with dinosaurs. A catastrophe killed off the dinosaurs 65 million years ago. We don't find dinosaur fossils in Illinois because water and wind broke up the youngest rocks on top and carried them away so that we see more ancient rock.



Many times during the last 1.8 million years, glaciers ground slowly across Illinois, reshaping the landscape. The last glaciers entered Illinois about 25,000 years ago and covered just the northeastern quarter of the state. The glaciers melted for the last time and left a changed landscape much like the tundra of Canada. Gradually the animals that were here during the ice ages, died out. As the climate warmed, the tundra and spruce forests gave way to oak woodlands and then to great landscapes of prairie.<http://isgs.illinois.edu/outreach/geology-resources/build-illinois-last-500-million-years>

Accommodations

Pinching clay into flat disks requires **fine motor skills**. Students with difficulty can be paired with an appropriate partner.

Reading aloud instructions with students can help those still developing **grade-level reading skills**.

Materials

Modeling clay: Each group needs about four ounces (110 grams). Crayola makes individually wrapped 4-oz packs of reusable modeling clay. Many other types of clay are available but teachers should experiment first before investing in a large quantity if using alternate sources. Some students dislike the feel of modeling clay. Consider offering non-latex lab gloves or plan for students to visit a sink to clean their hands.

Shells: Small shells (less than an inch across) with pronounced ridges work best, such as “Natural Clamrose Sea Shells” from Oriental Trading. Craft stores sell similar items.

Bone models: Look for something less than an inch across. Bone-shaped hard candies can be found at Oriental Trading.

Leaf models: Craft stores often have textured leaf-shaped sequins. Plastic aquarium plants could provide useful leaves. Leaf-shaped wooden blocks are available from Oriental Trading. Try to get something smaller than an inch long.