Session 2.

Every Rock Tells a Story

Every rock has a story to tell if you know how to read it. Within the unique composition and arrangement of materials of different rocks, you can find patterns that are evidence of the processes that formed them—processes that represent chapters in the Earth's history. In this session we will focus on discerning events in the Earth's past from rock clues. This session begins a multi-part investigation into the kinds of stories rocks can tell.

The Video

What can an unusual rock structure tell us about the Earth's past? During this session, we join Dr. Carol de Wet as she investigates the rock pinnacles located in a Pennsylvania quarry. Her investigation takes her from the quarry to the laboratory, and uncovers secrets embedded in the rock that not only tell us about the geologic history of the area, but also provide evidence that supports a once-revolutionary scientific theory that has forever changed our perception of how the Earth "works"—tectonic plate theory. As we come to understand the story told by the rock pinnacles in the quarry, we learn how one kind of rock forms.

Throughout the video we observe elementary school children being interviewed as they explore their ideas about rock formation and the stories that rocks can tell. We also visit Laurie Wicks' third-grade class in Middletown, Delaware, and watch her students conduct a fossil investigation. We listen as the students theorize about how fossils form and the kinds of rocks in which they are likely to be preserved.

Learning Goals

During this session you will build understandings to help you:

- Appreciate that rocks are evidence of the basic processes that have transformed the Earth over billions of years
- Describe the stories that fossils and layered rocks tell
- Relate the positions of continents and ocean floors to the overall structure of tectonic plates

On-Site Activities

Getting Ready (60 minutes)

Activity One—Problem Set and Reading Discussion (20 minutes)

1. In small groups, review the answers from the problem set for Session 1.
2. With a partner, review and discuss the concept maps you made for the question "What is soil?"
3. Referring to the Ault article ("Concept Mapping as a Study Strategy in Earth Science") and your journal entry, share your alternative patterns for cross-linking key concepts for one area of your concept map. With a partner, discuss how this restructuring affects your thinking about soil.
4. Using what you already know about rocks, discuss with a partner how that knowledge might connect to your concept map from Session 1, soil. Think about what you know about rocks. Discuss how or where this topic might connect to your concept maps.

Activity Two—Rock Stories and Classification (20 minutes)

1. To prepare for today's session, you were asked to think about the kinds of stories rocks can tell, to find an interesting rock, and to write about the ideas and questions you have about your rock. In a small group, share what you have written.
2. Make a collection of all of the rocks you and your group members brought to the session. Give each rock an identifying name or number. Observe all of the rocks carefully with a magnifying glass or hand lens and record their properties (you may wish to wet the rocks to make the colors more vivid). Finally, consider the properties of each rock, and theorize how each rock sample may have formed.
3. Referring to the properties of rocks as a basis for classification, sort all of your rocks into groups. Make a chart that identifies the criteria used to assign rocks to each group and record each rock into the chart.

Activity Three—Stories Fossils Tell (20 minutes)

1. In a small group, share your ideas about fossils. What is a fossil? How does a fossil form? Through group consensus, come up with a definition for the word "fossil." Discuss whether each of the following is considered a fossil. Why or why not?
   a. A dinosaur imprint preserved in rock
   b. A dinosaur bone, embedded in rock, but not changed into rock
   c. Coal
   d. A shark's tooth that has changed to stone over millions of years
   e. A mammoth, frozen into ice for millions of years
2. Working alone, carefully examine one of the fossils in the pictures included at the end of this session's materials, and write down what you observe. What organisms appear to be related to your fossil? Compare your fossil with the group's rock samples. Does the fossil look like any of the rock samples? Can you tell how or where the fossil may have formed?
3. Predict how and where you think your fossil formed. Write down your ideas.

On-Site Activities, cont'd.

Viewing the Program (60 minutes)

As you watch the video, think about the following focus questions:

1. What kinds of stories about the Earth can rocks tell?
2. Most of the students who were interviewed mention Pangaea, a super-continent that once existed. Do you agree or disagree with their ideas about how this occurred?
3. In Laurie Wicks' classroom, students theorize about the kinds of rocks in which fossils form. As you watch, think about how your ideas and the ideas typical of your students compare to those of Laurie's third graders.

Going Further (60 minutes)

1. As a whole group, talk about the significance of layers in rocks. Examine your group's rock samples again, and revisit the ways you grouped them.
   a. Did the group have any layered rocks? If so, did your group use layering as a criterion for classification? If not, do so now.
   b. Do any new ways to classify the rocks come to mind? Reclassify the rocks to reflect any new ideas.
   c. Discuss the different places on Earth where rocks form. Where do layered rocks form?
   d. Have any of the questions you had about your rocks been answered? If so, what have you learned?

   Hold on to the rocks, your unanswered questions, and your classification schemes for future sessions.
2. With a partner, discuss how Dr. de Wet used the characteristics of the rock pinnacles to make inferences about how they formed. Look at your fossil pictures again. Can you infer anything new about them? Think back to Laurie Wicks' students theorizing about the kinds of rocks in which fossils can form. In what kind of rock do fossils form? Add any new ideas to your predictions about how and where your fossil formed.
3. Check the key included at the end of this session's materials to confirm the identity of your fossil. Use this knowledge to consider possible environments in which your fossil formed. Compare your prediction to what you now know. Then, with a partner, discuss the story your fossil specimen told you.
4. Reconvene the whole group, and revisit the questions and answers about fossils considered during Activity Three in Getting Ready. Which of these questions were most perplexing and why? Come to a consensus, as needed, on the definition of "fossil." Finally, based on what you have learned in this session, talk about what fossils tell you about the Earth's history.
5. During the student interviews, the children spoke of the ancient super-continent Pangaea. How do your ideas and the ideas typical of your students compare to the ideas of the children being interviewed? Do you agree or disagree with their ideas? Why? Discuss your reasoning with your group.

Note: See the *Earth and Space Science* Web site to learn more about Pangaea (A Closer Look: Pangaea) at www.learner.org/channel/courses/essential/earthspace/session2.

Between Sessions

Homework (* = required)

* Reading Assignment

Driver, R., et al. "Rocks: Materials and Their Properties." *Leeds National Curriculum Support Project, Part 3*, Leeds City Council and the University of Leeds, U.K. (1992).

Read the research summary for "Rocks." Be prepared to discuss the ideas expressed by the authors that you think are most useful in teaching about rocks.

* Problem Set

(Suggested answers are listed in the Appendix.)

1. Explain how a typical sedimentary rock forms in a water environment.
2. Describe how the size and shape of sediment grains affect their transport and sorting.
3. What evidence do we have for the movement of tectonic plates? Explain how we know that tectonic plates move. Research "global positioning system" (GPS) technology. How does it work? What can we learn about plate tectonics by using GPS technology?

* Ongoing Concept Mapping

Develop a concept map for the concept "sedimentary rocks." Reflect on the video and other session activities to identify key concepts to include in your map. Be sure to incorporate what you have learned about fossils in your map.

Guided Journal Entry

It is difficult to visualize and understand how sediments deposited by water and wind can turn into hard rock. Imagine that you are in the position of having to explain this process to someone who is not familiar with how this occurs. How would you explain it? In your journal, write about how you would go about doing this. Then, choose someone to explain it to. Start by having this person share his or her ideas about sedimentary rocks and their formation. Write about the experience, noting the initial ideas of the person and any part of the conversation that you found particularly interesting or surprising.

Note: See the *Earth and Space Science* Web site to learn more about sedimentary rocks (A Closer Look: Sedimentary Rocks) at www.learner.org/channel/courses/essential/earthspace/session2.

Guided Channel-Talk Posting

During this session, we explored the value of reading rocks. By understanding how rocks form, we can gain insight into the Earth's past environments. Despite this, rocks are rarely taught in this context in elementary school. Why is that? We all remember learning about the three types of rocks in school—memorizing their names and reciting their definitions without real understanding. How can you engage elementary school students in learning about rocks in a way that will be meaningful? Discuss this in your Channel-Talk posting for this session. Be sure to share any experiences you've had.

Suggestions for Textbook Reading

- Composition of sedimentary rocks
- Erosion, deposition, and lithification
- Clastic, chemical, biochemical, and organic sedimentary rocks
- Sedimentary structures
- Fossils and fossilization
- Formation of sedimentary rocks
- Rocks as indicators of geologic history
- Pangaea
- Sedimentary environments
- The fossil record

Between Sessions, cont'd.

* Preparing for the Next Session

For "Getting Ready"

In this session we focused on the stories a rock can tell about the Earth's past. We also learned about tectonic plates and the relative position of continents, and that at one point in the Earth's history the continents were assembled to form a giant super-continent. How is it possible that continents could group together and then move apart? Write a possible explanation for the movement of continents. Include a diagram as part of your explanation.

Materials Needed for Next Time

Facilitator**:**

- Slinkys (1 per pair)
- Silly Putty (1 container per pair)

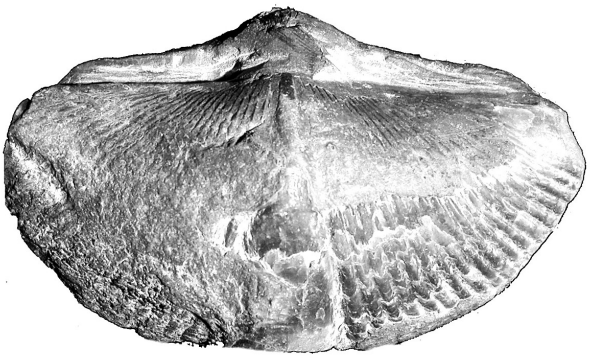
All participants:

- Your explanations and diagram for continent movement

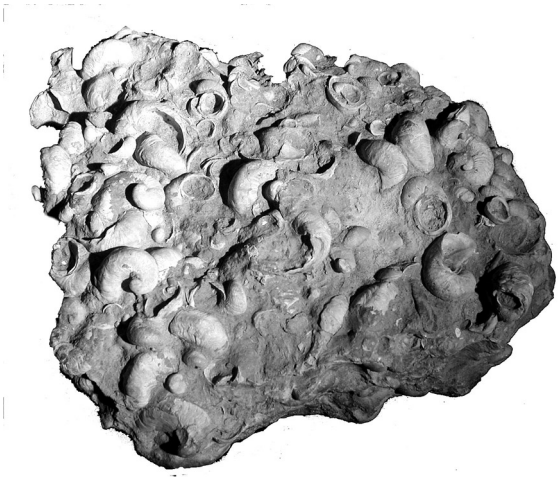
Graduate Credit Activities

Continue your work on the annotated bibliography and action research project.

Fossils

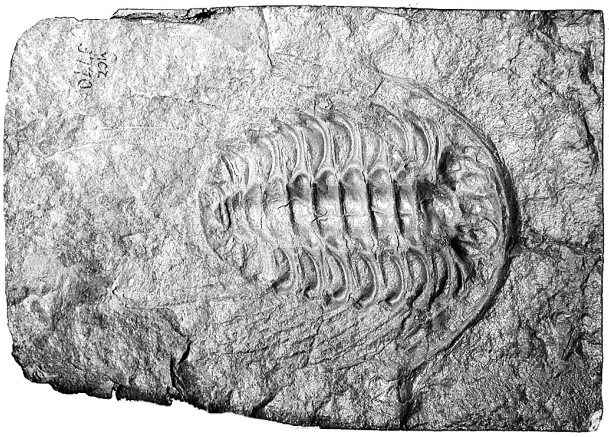


Fossil A



Fossil B

Fossil C



Fossil D

Fossils Key

Fossil A: Brachiopod

Fossil B: Oyster

Fossil C: Scallop

Fossil D: Trilobite

Notes