Lesson 2.2
Exploring Rock Formation and Environment
In this lesson, students collect data about rock samples, read about the rock types they’ve observed, and use the Simulation to consider the question *How do rocks provide information about what an environment was like in the past?* To collect data about how sedimentary rocks differ, students observe two rock samples, conglomerate and sandstone, and record their observations. Students share preliminary ideas about where the rocks may have formed. Next, they read about those kinds of rock in *Fossil Hunter’s Handbook* to add to their initial ideas. Then, students complete an activity in the Sim, through which they construct the idea that different sediment builds up in different environments, therefore, different rocks form in different environments. The purpose of this lesson is for students to construct the idea that sedimentary rock can form from different sediments and to start to consider how this information could help them learn about what the environment of a place was in the past.

**Anchor Phenomenon:** A rocky outcrop in Desert Rocks National Park has a fossil in it.  
**Investigative Phenomenon:** There are different kinds of sedimentary rock.

**Students learn:**

- Geologists can use differences between rocks to figure out what environment they formed in.
- Geologists use reference books for many purposes, including to help them identify types of rock.
Gathering Information About Sedimentary Rock

Students read about conglomerate and sandstone in Fossil Hunter’s Handbook.

Instructional Guide

1. **Introduce the activity.** Explain that in this activity students will use the reference book to learn more about what kinds of environments these rocks formed in.

2. **Project Rock Sample Observations with names.** Explain that rock sample 1 is called conglomerate and rock sample 2 is called sandstone.

   **Rock Sample Observations**

   ![Rock sample 1 conglomerate](image1)
   ![Rock sample 2 sandstone](image2)

3. **Distribute Fossil Hunter’s Handbook to pairs.**

   You will read about conglomerate and sandstone in the reference book to find out more about what makes them different and what the environments are like where they form.
Earth’s Features
Lesson Guides

Lesson 2.2
Activity 2

4. **Model using the index to find the page number for conglomerate.**

   Many reference books have an index at the back of the book. Looking up key words in the index is a useful way to find information quickly. As you search for information about different types of rock, using the index will be helpful.

   Let’s look up the word *conglomerate* in the index to find out which page it is on. You will need to find the page for sandstone on your own.

   Model turning to the index to find the page number (page 34) for *conglomerate*, and have students do the same.

5. **Students read.** Give students time to read the pages about conglomerate and sandstone.

6. **Students record information on notebook page 28. Reading About Sedimentary Rocks.** Have students turn to page 28 in the notebook. Explain that students should now record information about what makes these two rocks different and what it can tell us about the environments in which they formed.

7. **Discuss conglomerate and sandstone.** When students have finished writing, regain attention and discuss the questions on page 28.

   What makes conglomerate different from sandstone?

   If students don’t bring it up, ask them how the sediment that makes up each rock is different.

   The size of the sediment that makes up a sedimentary rock helps geologists identify the kind of rock it is, which helps them figure out the environment in which it formed.

   What environments can these different rocks form in?
   
   [Sandstone can form in rivers, beaches, lakes, or the shallow part of the ocean. Conglomerate forms along river channels.]  

Teacher Support

**Rationale**

**Pedagogical Goals: Firsthand and Secondhand Investigation**

What students read in the reference book, *Fossil Hunter’s Handbook*, is likely to confirm some of the important ideas they discovered through rock observations. In particular, students should learn that rocks can differ based on the size of the sediment they are made of. Reading this information secondhand directly after investigating this in a firsthand way by observing the rock samples will help students solidify their understanding of these ideas. It also models the scientific practice of gathering evidence from more than one source.
Instructional Suggestion

Providing More Experience: Characteristics of Reference Books
Depending on the needs and experience of your students, they may benefit from a more in-depth discussion of the characteristics of reference books. Gather a variety of reference books and ask students to work in small groups to look through the books and make observations about how they are organized, what kind of information they contain, and what text features are present. Make a class chart of these characteristics and reflect on the usefulness of the various reference materials in particular situations.

Possible Responses

What are the differences between sandstone and conglomerate?
Answers will vary. A typical response might be:
Sandstone is made of sand, a medium-sized sediment.
Conglomerate is made of pebbles, larger rocks, and sand.

What environments do sandstone and conglomerate form in?
Sand piles up in rivers, beaches, lakes, or a shallow part of the ocean. Over time, the sand turns into sandstone in these environments.

The sediment that makes up conglomerate piles up along river channels. Over time, the sediment turns into conglomerate in this environment.
## Investigating Rock and Environments

Students investigate in the Sim to understand the connection between sediments, rock formation, and environments.

### Instructional Guide

1. **Introduce notebook page 29.** Have students turn to notebook page 29, Investigating Rock and Environments in the Simulation.

   You have been observing rocks as geologists do. We know that geologists can observe different types of rock and infer what environment they formed in. We can’t see what Earth was like when our rock samples formed, but we can use models to observe rocks forming. Let’s use the Sim as a model to further investigate different environments and the rocks that form in these environments.

2. **Review instructions for completing the table and the questions.**
   
   - Step 1: Load Mode 2 using the menu in the upper left-hand corner of the Sim.
   - Step 2: Without changing the sea level, move time forward at least three times. Watch carefully to see what happens in each environment.
   - Step 3: Observe the sediment that builds up and what type of rock is formed in each environment.
   - Step 4: Record your observations in the table below.
   - Step 5: Answer the questions at the bottom of the page.

3. **Go to the Student Apps Page and select Earth’s Features and then the Simulation.** Highlight key features and remind students that for them to see sediment build up and rock to form they need to move time forward. Draw students’ attention to the three environment labels.

4. **Introduce and demonstrate loading Mode 2 of the Sim.**
5. **Distribute digital devices.** Distribute one digital device to each pair of students and have them access the *Earth’s Features* Sim via the Student Apps page. Remind students they will be using Mode 2 of the Sim for this activity.

6. **On-the-Fly Assessment: Students investigate using the Sim.** Give students 10 minutes to gather and record information in their tables, and to answer the questions.

7. **Collect digital devices.** Ask students to make sure that their digital devices are turned off.

8. **Have students share responses.**

   - What do you notice about the sediments that build up in different environments? [Different sediments build up in different environments.]
   - What do you notice about the rocks that form in different environments? [Different rocks form in different environments.]

9. **Focus on calcium carbonate and limestone.** Refer to students’ responses about which kinds of sediment built up in each environment, and point out that sand and clay are likely familiar. Ask if students have ideas about what calcium carbonate is, what it comes from in the shallow ocean, and where they could learn more about it. If no one suggests looking for information in *Fossil Hunter’s Handbook*, suggest this.

   - Have students use the index to figure out what page has information about limestone [page 35].
   - Give students time to read page 35.
   - Ask where calcium carbonate comes from. [The shells of some organisms.]
   - Point out the shells in the image and explain that many organisms in the shallow ocean environment have calcium carbonate shells or skeletons. These include macroscopic organisms like corals and shellfish and also microscopic organisms.
   - Point out how these organisms, over really long timescales, have a profound effect on the environment, because their skeletons and shells can eventually form layers of rock.

10. **Ask students to turn to page 42 in *Fossil Hunter’s Handbook*.**

    - The reference book gives some additional information about environments you worked with in the Sim as well as photographs that can help you understand what the environments are like.

Give students a few minutes to look at the photographs on pages 42–50 to get more information about the environments.
11. **Add to the Environments chart.** Ask students what new environments they came across in this lesson [Deep Ocean, Shallow Ocean, Lake, and River]. Record the new environments on the chart.

   We now know that the environments that we have been recording on this chart have something in common: They are all environments in which sediment builds up. Sediment does not build up everywhere, so sedimentary rock does not form everywhere.

   Add “Where Sediments Build Up” to the title of the chart.

12. **Ask students to discuss why sediment builds up in different environments.**

   We know that different sediments build up in different environments, but why? Turn to a partner and discuss your ideas. Why do you think that different sediments build up in different environments?

   Accept all answers. Let students know they will continue to think about this question in the next lesson.

### Embedded Formative Assessment

**On-the-Fly Assessment 5: Ideas About Rocks and Environments**

**Look for:** This Simulation activity is an opportunity to informally assess students’ emerging understanding that different sedimentary rock forms in different environments and has sediment of different sizes. Using what they experienced in the observations and reading, as well as their experience in the Sim, students should be able to respond that different sediment builds up in different environments and that because of this, different rock forms in different environments. Students will continue to work with the idea of different sediment types through the rest of Chapter 2.

**Now what?** For students who are not yet demonstrating understanding that different sedimentary rock forms in different environments, use pages 42–50 of *Fossil Hunter’s Handbook*. You can ask students to read the entries for beach, deep ocean, and river channel. Ask what is different about each entry and then ask what is different about the sediment that builds up in each environment. You can guide students toward describing that each is a very different environment and that different sediment builds up in each environment. Using the rock samples from earlier in the lesson, you can help students connect the differently sized sediment to different sedimentary rock forming. For students who need further guidance, you can provide more explicit modeling and instruction in Lesson 2.3 as students continue to construct and reflect on these ideas.

### Teacher Support

**Background**

**Technology Note: Mode 1 and Mode 2 in the Simulation**

The *Earth’s Features* Sim contains two modes, Mode 1 and Mode 2. Students will be directed to use the mode that is most useful for the investigation they are conducting. The two modes differ in the type and amount of sediment and rock layers in each location, as well as the initial sea level. Prior to this lesson, students have used Mode 1, which allows...
them to more easily observe that sediment deposition and rock formation occur only underwater. In this lesson, students use Mode 2, which has a high sea level and a single sediment layer in all three locations. This mode allows students to observe sediment deposition and rock formation in three different environments simultaneously.

Background

Science Note: About Depositional Environments
Students should learn from the activities in this lesson that different sediment builds up in different environments. Typically, those environments are environments with water. This is because water carries sediment and deposits it in various locations. Faster-moving water can carry sediments of a variety of sizes, small and large. As water slows, the larger sediments are deposited because the water is no longer able to sustain the mass of those sediments. This results in different sediment being deposited in different environments, commonly referred to as depositional environments. For instance, gravel can be deposited in stream channels with fairly fast-moving water; the water moves fast enough to carry sand, silt, and other sediments, but not fast enough to carry denser pieces of gravel. Therefore, those sediments are deposited. In an environment with very slow-moving water, such as a floodplain, the water can only carry very small sediments, such as silt or clay, and cannot carry larger sediments, such as sand or gravel (which will likely have already been deposited in a faster-moving water environment upstream). As the water slowly moves over a floodplain, silt or clay can be deposited.

Rationale

Pedagogical Goals: Student Recall of Specific Rocks and Environments
In this lesson, students learn that sediment builds up in different environments with water and that as a result, different types of sedimentary rock form in different environments. Students will use this understanding to make inferences about the past environments of Desert Rocks National Park. Although students will need a general understanding of the relationship between sediment, rock, and environment, they are not expected to memorize the different kinds of sediment, the environment in which specific sediment (e.g., silt) piles up, or the environment in which certain rock (e.g., siltstone or sandstone) forms. Some students may learn some of these associations, especially those depicted in the Simulation (e.g., sandstone forms on a beach; mudstone forms in the deep ocean), but this knowledge is beyond the expectations for the unit. The Environments chart is intended to be an aid for remembering the names of various environments so that students can more easily use these names in their discussions when they need to.

Background

Science Note: Simplification in the Simulation
A key purpose of the Sim is to show the relationship between sediment, rock, and depositional environment. The Sim provides students with a few examples of sediment, kinds of rock, and common environments in which those sediments build up and those rocks form. The Sim does not show all the environments in which each kind of sediment can build up or each kind of sedimentary rock can form. By simplifying in this way, students are exposed to the general understanding that different sediments build up in different environments and that different sedimentary rock forms in different environments.

Instructional Suggestion

Providing More Support: Using Tables
At this point in the unit, students have used tables several times to record information from books. In this activity they use a table to organize information from the Sim. If students need more support in using the table on page 29 of the
In Investigation Notebook, consider asking/reviewing what information should go in each column and each row. Point out how the column headers and the environments in the first column indicate where to put information about the sediment and rock for each environment.

**Background**

**Science Note: About Calcium Carbonate and Limestone**

Limestone primarily forms in shallow marine environments because this is where marine organisms with calcium carbonate shells and skeletons live. Coral skeletons and the shells of various shellfish contain calcium carbonate that can turn into limestone over time. However, marine algae and microscopic organisms, on or in the seafloor or floating in the water, are also important sources of the calcium carbonate that forms limestone. The fossiliferous limestone pictured in *Fossil Hunter’s Handbook* is only one kind of limestone, one that is rich in fossils of the shells and skeletons of calcium carbonate forming-organisms. Some other kinds of limestone include chalk, which forms from the shells of microscopic organisms and is much finer grained, and travertine, which forms at the mouth of hot springs and in caves, when water containing calcium carbonate evaporates and leaves the calcium carbonate behind.

**Instructional Suggestion**

**Going Further: How Organisms Affect Their Environments**

The formation of rock from the shells and skeletons of living organisms is only one of many ways that living organisms can affect their physical environment. Furthermore, it is a unique example in that the timescale over which those organisms affect their environment extends long after the organisms die. In many cases, organisms affect their environments while they are living. You could invite students to brainstorm other ways that living organisms affect their physical environments. It might be useful to start by thinking about ways that humans affect their physical environment, and then to expand to the effects of other living things. Examples might include human actions that pollute the water and air, plant roots that stabilize soil and sediments, beavers that build dams and affect the flow of rivers, or hooved organisms that erode hillsides.

**Assessment**

**Assessment Opportunities: Assessing Student Understanding That Living Things Affect Environments**

This activity can be used to assess student understanding of the idea that living things can affect the physical characteristics of their environment. If you would like to assess student understanding of this idea, you might spend more time in step 9 of this activity, inviting students to brainstorm different ways that living things can affect their environments. See the Going Further note above for some examples and suggestions. Look for whether students can name some specific ways in which organisms can cause changes to their physical environments. If students have trouble with this idea, consider taking students on a walk around the school to look for evidence of living things affecting the physical characteristics of the environment. They might observe tree roots causing the sidewalk to buckle, a person driving a car and polluting the air with exhaust, or a person or animal digging or burrowing into the ground. When you return to the classroom, have students recall the examples they observed and then ask if they have other ideas about how living things affect their environments.
Possible Responses

**What students should do and notice:**
Students should load Mode 2 of the Sim and move time forward multiple times without changing the sea level. Students should notice that different kinds of sediments build up and different kinds of rock form in each of the three environments.

**Table Responses**

- In a beach environment, sand builds up and sandstone forms.
- In a shallow ocean environment, calcium carbonate builds up and limestone forms.
- In a deep ocean environment, clay builds up and mudstone forms.

**What do you notice about the sediment that builds up in different environments?**
Different sediment builds up in different environments.

**What do you notice about the rocks that form in different environments?**
Different rocks form in different environments.
Reading About Sedimentary Rocks

Read the sections on sandstone and conglomerate in Fossils Hunter’s Handbook and answer the questions below.

1. What are the differences between sandstone and conglomerate?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

2. What environments do sandstone and conglomerate form in?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Investigating Rock and Environments in the Simulation

1. Load Mode 2 using the menu in the upper left-hand corner of the Sim.
2. Without changing the sea level, move time forward at least three times. Watch carefully to see what happens in each environment.
3. Observe the sediment that builds up and what type of rock is formed in each environment.
4. Record your observations in the table below.
5. Answer the questions at the bottom of the page.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Sediment that builds up</th>
<th>Rock that forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>beach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>deep ocean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shallow ocean</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What do you notice about the sediment that builds up in different environments?

___________________________________________________________________
___________________________________________________________________

What do you notice about the rocks that form in different environments?

___________________________________________________________________
___________________________________________________________________
Leer acerca de rocas sedimentarias

Lee las secciones acerca de arenisca y conglomerado en el Manual del buscador de fósiles y responde las preguntas debajo.

1. ¿Cuáles son las diferencias entre la caliza y el conglomerado?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

2. ¿En qué ambientes se forman la caliza y el conglomerado?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Investigar rocas y ambientes en la simulación

1. Carga Mode 2 (modo 2) usando el menú en la esquina superior izquierda de la simulación.
2. Sin cambiar el nivel del mar, mueve el tiempo hacia delante por lo menos tres veces. Observa cuidadosamente para ver qué sucede en cada ambiente.
3. Observa el sedimento que se acumula y qué tipo de roca se forma en cada ambiente.
4. Apunta tus observaciones en la tabla siguiente.
5. Responde las preguntas en la parte inferior de la página.

<table>
<thead>
<tr>
<th>Ambiente</th>
<th>Sedimento que se acumula</th>
<th>Roca que se forma</th>
</tr>
</thead>
<tbody>
<tr>
<td>playa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>océano profundo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>océano poco profundo</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¿Qué notas sobre el sedimento que se acumula en diferentes ambientes?
___________________________________________________________________
___________________________________________________________________

¿Qué notas sobre las rocas que se acumulan en diferentes ambientes?
___________________________________________________________________
___________________________________________________________________