Minerals and Rocks

Level: Grades 3–5
Facilitator Guide

LESSON DETAILS

Objective: Students will investigate the properties of minerals and rocks to understand their classification and formation processes, focusing on the influence of Earth's various systems.

Standards

NVACSS and NGSS

- **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.
- **5-ESS2-1:** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- **5-PS1-3:** Make observations and measurements to identify materials based on their properties.
- **DCI:** Earth Materials and Systems; Natural Resources
- **SEP:** Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions
- **CCC:** Patterns; Cause and Effect; System and System Models; Stability and Change

Career Readiness

- **1.2.6:** Demonstrate lifelong-learning skills by continually acquiring new industry-related information and improving professional skills.

Materials

- rock and mineral samples (preferably ones that are common and/or important in your area)
- magnifying glasses
- hardness test kits (such as a **Moh's hardness kit** or an **everyday item hardness list** and corresponding materials)
- streak plates
- weak acid in dropper
- sand
- play dough
- sugar cubes
- warm water (preferably dyed blue)
- paper plate
- copies of "Exploring Earth Samples" handout
- copies of "Exploring Earth Samples Table" handout
- copies of "Minerals and Earth Systems" handout
- copies of "Earth Systems" handout

Lesson Summary

After observing and discussing a demonstration illustrating how Earth's materials erode differently when in contact with water, students will examine properties of rock and mineral samples. They will then make observations and conduct tests (i.e., hardness, streak) to practice how scientists identify minerals. After discussing results, the class will develop a definition of a mineral and explore how minerals are different from rocks. They will then consider differences in processes that form rocks and minerals and emphasize the importance and impacts of Earth's systems. To deepen their understanding, students will explore local rocks and minerals and explore their formation, how Earth systems are involved, and practical applications.

Preparation

Before carrying out the **Engage** portion of the activity, construct a model hill. Place a thin layer of play dough on a paper plate, which will act as the base of the hill. (While the play dough used in this lesson can be purchased, this **recipe** offers the option to make your own.) On top of the play dough, stack sugar cubes in a pyramid formation, using at least 9 sugar cubes as the base. Cover the hill with another thin layer of play dough but ensure that there are 1 or 2 cracks in its surface, through which water can flow.

Engage

1. Using the model hill you constructed, carry out a demonstration where water erodes portions of the hill. Pour warm water over the surface, ensuring the water enters the cracks. The water will erode certain portions of the hill but not others.

2. Ask students to describe what they observed. Discuss why certain materials eroded or dissolved faster than others.

   - *Which material do you think was most resistant to water? Why might that be?*
   - *What do think happens to the material that dissolves?*
   - *How do the behaviors of these materials in our model relate to real-world landscapes? How does it relate to the properties of rocks?*

3. Provide students with diverse samples of rocks and minerals. (It is helpful to label each sample with a letter or number for easy reference.)

4. Have them observe the physical properties (color, texture, luster) and use those properties to try to sort the samples into two distinctive groups: minerals versus rocks. As they work, circulate to ask guiding questions that provoke deeper thinking about their choices, such as:

   - *What features make you classify that sample as a mineral?*
   - *Are there any samples that are difficult to categorize? Why?*

5. Once all students have sorted their samples, facilitate a class discussion to explore their reasoning. Share characteristics that define rocks and minerals, and help the class come to a consensus on the categorization of each sample.

Explore

6. Introduce different observations and tests that are used to identify minerals.

   - **Hardness test:** Determines how resistant a mineral is to being scratched.
   - **Streak test:** Reveals the color of a mineral in powdered form.
   - **Reactivity test:** Shows if a rock is reactive to acid.

7. Distribute mineral samples, test materials, and the "Exploring Earth Samples" handouts.

8. Have students make observations and conduct tests for each mineral sample, and record results on a the "Exploring Earth Samples Table" handout .

9. Facilitate a class discussion of their observations and test results. Focus on the process of collecting the data, while also addressing any inconsistencies or surprising findings. Some discussion questions could include:

   - *Which mineral was the hardest? How does hardness help us identify a mineral?*
   - *What does the streak color indicate about the mineral's properties? Why might some minerals have a streak that is a different color than they appear?*
   - *What can the reactivity test tell us about the composition of the mineral? (Repeat the test on a piece of metal and a seashell to help students understand what materials likely react with acids.)*
   - *Why do we use multiple tests to identify minerals?*
   - *Which mineral had the most interesting reaction or properties?*
   - *What might these properties mean for the use of these minerals in everyday life or industry?*

Explain

1. Facilitate a discussion reflecting on what defines a mineral versus a rock, sharing similarities and differences between the two.

   - **Mineral:** A type of natural, non-living solid that has a specific pattern of chemicals in its structure.
   - **Rock:** A solid made up of one or more minerals. Rocks can be different types, like igneous (formed from melted rock), sedimentary (formed from bits of other rocks or materials), and metamorphic (formed from changes in other rocks due to pressure and/or heat).

2. Discuss the different ways rocks are formed, including melting, cooling, sedimentation, burial, metamorphism, and weathering. Especially focus on how other Earth systems are involved (such as water and wind erosion breaking down rocks into sediments).

   - **Geosphere:** Mention the role of plate tectonics in the formation of igneous and metamorphic rocks.
   - **Hydrosphere:** Discuss how water contributes to the weathering and erosion of all rock types and deposition processes that form sedimentary rocks.
   - **Atmosphere:** Explain the impact of weather conditions on erosion and sediment deposition.
   - **Biosphere:** Touch on how living organisms can influence the formation of certain types of sedimentary rocks (e.g., limestone formed from marine shells), and how fungi and plants can break down rocks to form soil and sediment. You could also discuss fossil formation within rocks.

3. Share about some of the rocks and minerals that are mined in Nevada.

   a. Project NVMA's page on **Minerals in Nevada**.

   b. Scroll through the page, and have students share which rocks and minerals they have heard of.

   c. Click on specific examples that interest students, or that are samples that the students tested in **Explore**.

   d. Discuss the information that pops up for each mineral you look at, focusing on their uses. You may also note information about formation processes or how widespread the mineral is mined across Nevada.

4. Encourage students to ask questions based on the discussion and the activities they have completed so far. Use questions to probe their understanding and clarify any misconceptions.

Elaborate

1. Start with a brief overview of a topographic map of your local area or state. Explain key features such as contour lines that show elevation changes, and colors indicating different types of terrain. This introduction will help students come to understand how the physical geography of an area influences the types of rocks found there.

2. Provide each group with a local rock sample along with a simplified map where locations of different rock types are clearly marked with pins or stickers. Each pin or sticker should have a brief description of the rock type found at that location.

3. Each group should match their given rock sample to the corresponding description and location on the map.

4. Facilitate a discussion about each rock as students share their rock and thoughts with the class. Discussion questions could include:

   - *What features of your rock helped you match it with the pins on the map?*
   - *How do you think the geography depicted on the map, like mountains or rivers, influenced the type of rock found at your location?*
   - *How do you think your rock was made?*
   - *Which Earth systems (geosphere, hydrosphere, atmosphere, biosphere) might have interacted to form your rock? How might they have worked together?*
   - *If the area around your rock's location changed (e.g., more rainfall, deforestation), how might the rocks change?*
   - *Why is it important to know about the rocks near us? What can they teach us about Earth?*

Evaluate

1. Provide students with copies of the “Minerals and Earth Systems” and “Earth Systems” handouts.

2. Have students read descriptions of the formation of common rocks and minerals that are mined in Nevada.

3. Use one or two examples to demonstrate how to add the listed rocks and minerals to the Earth Systems Diagram.

4. Have students choose two additional rocks or minerals for which they will identify connections between rocks/minerals and Earth's systems by adding them to the Earth Systems Diagram. You may want to assign specific rocks and minerals to students based on the level of difficulty in describing their formation (see Figure 1).

    a. Students should write the name of each rock or mineral in the circle that identifies the system that has the most to do with its formation.

    b. They should then draw arrows, if needed, to show other systems that are involved in the formation.

    c. Optionally, have them write their reasoning along the arrows.

5. Discuss where students placed each rock or mineral on the Earth Systems Diagram. Figure 1 shows where each rock or mineral could be placed. The focus should be on students being able to justify their answers and make connections between systems.

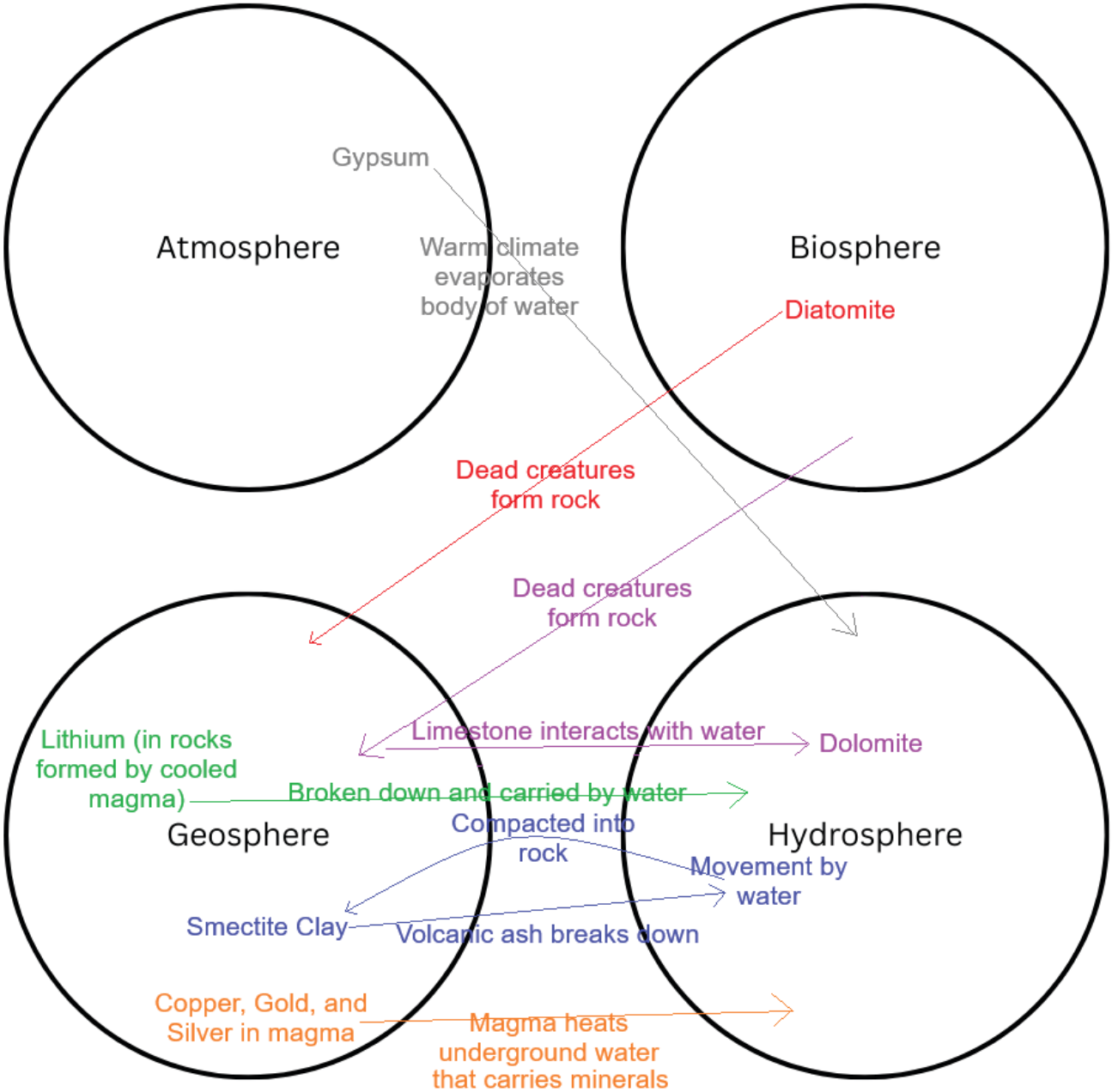

Figure 1. Systems Diagram labeled with rocks and minerals commonly mined in Nevada.

HANDOUTS

Exploring Earth Samples

For each sample, record your observations and mineral test results in the "Exploring Earth Samples Table."

1. Make observations of the color, luster (shine, such as glassy, dull, or metallic), and shapes or patterns you see within each mineral.

2. Hardness Test: Use a Moh's Hardness test kit or objects of known hardness values to scratch the surface of the mineral to determine the hardness.

    a. Begin with the softest object in your hardness kit.

    b. Gently press the selected object against the surface of your sample and attempt to make a scratch.

    c. Carefully examine the surface.

        i. If the object left a scratch, note the mineral's hardness must be equal to or less than the hardness of the object you used. Record the hardness level and move to the next mineral.

        ii. If there is no scratch, use the next hardest object in your kit and repeat the process. Continue until you find a tool that scratches the sample.

3. Conduct the streak test: For any mineral with a hardness less than 6.5, rub the mineral gently across the streak plate and record the color left on the plate.

4. Conduct the reactivity test: Place your sample on a tray and add 2–4 drops of weak acid to the sample. Observe any reaction (bubbling, fizzing, no reaction) and record your observations.

EXPLORING EARTH SAMPLES TABLE

Sample	Color	Luster (Shine)	Shapes/Patterns	Hardness	Streak	Reactivity

Minerals and Earth Systems

Smectite Clay

This mineral is made as volcanic ash breaks down into tiny pieces. These pieces are easily moved by rivers to lakes and oceans, where the clay settles to the bottom. The pieces are compacted to form a rock, bentonite.

Diatomite

This rock is formed from tiny sea creatures that live in oceans. When these creatures die, they sink to the ocean floor and are cemented together to form rock.

Dolomite

This rock can form when a rock called limestone reacts with warm, salty water. The limestone formed when small, shelled sea creatures die and sink to the bottom of sea or ocean.

Copper, Gold, and Silver

These minerals can form when magma (melted rock) under a volcano heats up water deep in the Earth. The hot water can take copper, gold, and silver with it. When the hot water cools, it leaves behind the minerals that it carries.

Gypsum

This mineral forms in places where the climate is warm enough to evaporate shallow lakes or seas. The gypsum is left behind as the water evaporates.

Lithium

Lithium can be found in some types of magma, which hardens to form igneous rocks. These rocks can be broken down into smaller pieces by streams and rivers. These smaller pieces get deposited in other places.

Earth Systems