

Lesson 10

WHAT ARE THE PHYSICAL PROPERTIES OF MINERALS? SC.4.E.6.2, SC.4.E.6.1

INTRODUCTION

Key Concept

Minerals are solid, naturally nonliving material that form in nature and are made up of one thing. Their ordered atomic structures are what give minerals their unique physical properties to help you identify them. There are several properties used to classify different minerals. Two or more minerals together make rocks—minerals are the “building blocks” of rocks!

What I Am Going to Learn

- How to identify physical properties of minerals
- How to identify the three categories of rocks
- How to recognize the role of minerals in the formation of rocks

Scientific Vocabulary

As you read, it is important to understand the scientific vocabulary in this lesson.

Geology is the study of Earth and how it formed. It is the study of rocks in Earth’s crust.

The **rock cycle** is the process through which rocks form.

Magma is a hot fluid below or within Earth’s crust.

Molten means reduced to liquid form by heat.

Lava is molten rock from a volcano or the surface of Earth.

Weathering is the wearing down or breaking of rocks.

Igneous rock is formed by the cooling and solidifying of molten material.

Sedimentary rocks are made from bits and pieces of sediment, such as crushed up shells and dead animals and plants. They form from erosion, depositing of pieces by wind or water, and pressure over time.

WORDS TO KNOW

geology
 rock cycle
 magma
 molten
 lava
 weathering
 igneous rock
 sedimentary rock
 metamorphic rock
 strata
 fossil

Metamorphic rock is a type of rock formed when other types of rocks are subjected to high heat or pressure.

Strata means a collection of layers.

A **fossil** is the preserved remains or traces of an ancient organism.



THINK ABOUT IT

Have you ever found a fossil? How do you think it formed?

GUIDED INSTRUCTION

Rocks are formed through a continuous process known as *the rock cycle*. This cycle involves the transformation of existing rocks into new rock types through various geological processes. There are three main types of rocks.

Igneous Rock

Molten rock exists deep within Earth. This molten rock is also known as *magma* or *lava*. When magma erupts onto the surface of Earth, it becomes lava. When this magma cools and hardens, it transforms into igneous rock. As the magma cools, the minerals within it crystallize, forming igneous rock. Igneous rock can form mountain ranges, volcanoes, and the ocean floor.

Sedimentary Rock

Weathering is the wearing down or breaking of rocks. Rocks are broken down by physical and chemical weathering processes into smaller fragments called *sediment*. Sediment consists of pieces of rock, minerals, sand, gravel, clay, and fossils, the remains of plants and animals. Sediment is transported by wind, water, or ice. Over time, sediments accumulate in layers of soil or at the bottom of oceans, lakes, or other bodies of water. The weight of these layers compacts the sediments and minerals cement the particles together, forming sedimentary rocks. Sandstone, limestone, and shale are some common examples.



Sedimentary Rock

Metamorphic Rock

Metamorphic rock forms when different types of rocks are subjected to high heat, high pressure, or hot mineral-rich fluids deep within Earth. The heat and pressure cause the minerals in the rock to recrystallize, forming new mineral combinations. Fossils are also occasionally found in metamorphic rock.

As stated earlier, the rock cycle is a continuous process. Igneous rocks can weather and erode, becoming sediments that form sedimentary rocks. Sedimentary rocks can be buried deep

underground and subjected to heat and pressure, transforming them into metamorphic rocks. Metamorphic rocks can also be melted by extreme heat, forming new magma that cools and solidifies into igneous rocks, and the cycle continues. This ongoing transformation results in the vast diversity of rocks on Earth and strata, or layers of rock in the ground.

Minerals are naturally occurring solid substances. They form over long periods of time through natural processes like cooling magma, weathering and erosion, or immense heat and pressure. They have distinctive physical properties. You can identify them with these physical properties.

- **Hardness** – This refers to a mineral's resistance to scratching. Geologists use a standardized Mohs scale (from 1 to 10) to compare the hardness of minerals. Talc, the softest mineral, has a hardness of 1, while diamond, the hardest, has a hardness of 10. Scratching a harder mineral with a softer one will leave a mark on the softer one, not the other way around.
- **Color** – While color can be a helpful clue, it is not always reliable for identification because some minerals can have a variety of colors. For example, quartz can be clear, white, pink, or even purple. However, some minerals have very distinctive colors.
- **Luster** – This describes how light reflects off the mineral's surface. Luster takes on different forms.
 - » **Metallic** – Shiny and reflective, like the surface of a metal
 - » **Glassy** – Shiny and smooth, like glass
 - » **Greasy** – Shiny with a greasy or oily appearance
 - » **Pearly** – Shiny with a soft, pearly sheen, like the inside of an oyster shell
- **Cleavage** – This refers to the way a mineral breaks along specific planes or directions. Imagine a bar of soap—it tends to break cleanly in certain directions.
- **Streak Color** – This is the color of the powder left behind when a mineral is scratched across a streak plate (an unglazed porcelain tile). This property can be very helpful for identification because it is often more consistent than the overall color of the mineral itself.

Mohs Scale of Mineral Hardness



MODEL IT

Observe several minerals closely, noticing their color and luster. If possible, use a Mohs Scale to estimate their hardness. Consult a mineral identification chart and match your observations with descriptions and images of known minerals.

1. Imagine you visit a planet with a very active volcanic surface. Based on what you know about rock formation, what type of rock would you expect to find most there? Why?

2. Scientists have discovered a rock layer containing many seashells. However, the rock is located high up in a mountain range, far away from any ocean. What type of rock is this most likely to be, and how might it have formed in this location?

3. You have three rock samples: one is smooth and glassy, another is rough and gritty, and the third has a layered appearance. Without any testing, can you guess in which category each rock might belong and why?

Sample	Appearance	Category	Reason
A	smooth and glassy		
B	rough and gritty		
C	layered appearance		

INDEPENDENT PRACTICE

DIRECTIONS

Read each question carefully. Decide which choice is the best answer. Mark your answer.

1 You can scratch a mineral with a penny. What does this indicate about the hardness of the mineral?

- A. It is very soft.
- B. It is moderately soft.
- C. It is moderately hard.
- D. It is very hard.

2 The chart below shows some physical properties of four common minerals.

Mineral	Color	Luster	Cleavage	Streak Color
A	White	Glassy	Uneven	?
B	Gold	Metallic	None	Gold
C	Black	Glassy	Smooth	Black
D	Pink	Glassy	Uneven	Red

Which mineral is **most likely** to leave a red streak color when scratched across a streak plate?

- F. Mineral A has an unknown streak color, so we cannot be certain.
- G. Mineral B has a gold streak color listed, so it can be eliminated.
- H. Mineral C has a black streak color listed, so it can be eliminated.
- I. Mineral D has a red streak color listed, making it the most likely answer.

3 What does a shiny mineral that reflects light like a mirror likely have?

- A. glassy luster
- B. pearly luster
- C. greasy luster
- D. dull luster

4 Which of the following statements about cleavage in minerals is true?

- F. All minerals have perfect cleavage in multiple directions.
- G. Cleavage describes how easily a mineral breaks along smooth, flat surfaces.
- H. Minerals with good cleavage always have a metallic luster.
- I. Cleavage is not a useful property for identifying minerals.

- 5 A mineral is black and leaves a black streak color when scratched on a streak plate. What could this mineral be?
- A. quartz, because it is white and clear
 - B. mica, because it has a pearly luster
 - C. pyrite, because it has a metallic luster
 - D. hematite, because it matches the black color and streak
- 6 Granite is a type of igneous rock. What is the **most likely** role minerals played in the formation of granite?
- F. Minerals provided the heat needed to melt the rock.
 - G. Minerals dissolved in water and cemented sediments together.
 - H. Minerals crystallized as molten rock cooled and hardened.
 - I. Minerals were broken down by weathering and erosion.
- 7 Why are minerals important for understanding the formation of rocks?
- A. Minerals make up a very small percentage of most rocks.
 - B. The type and properties of minerals present influence the overall properties of the rock.
 - C. Minerals are all formed in the same way, regardless of the rock type.
 - D. Minerals are not essential components of all rocks.
- 8 Which type of rock is **most likely** to contain fossils of ancient sea creatures?
- F. igneous rock
 - G. sedimentary rock
 - H. metamorphic rock
 - I. all of them
- 9 A rock has a layered appearance and is formed from compacted pieces of shells and sand. What type of rock is this?
- A. sedimentary rock
 - B. igneous rock
 - C. volcanic rock
 - D. metamorphic rock
- 10 Both granite and marble are hard rocks, but granite is formed from cooled magma, while marble is formed from limestone. What type of rock are both granite and marble?
- F. igneous rock
 - G. sedimentary rock
 - H. metamorphic rock
 - I. volcanic rock