Properties of Minerals

Reflect

Have you ever gone on a scavenger hunt to look for different rocks? How did you tell the rocks apart? You probably began with their appearances. Some rocks are dark in color, whereas others are so clear you can almost see through them. Some rocks appear shiny when sunlight hits them, while others appear dull.

Different rocks also have different shapes and textures. Some rocks are smooth, whereas others have jagged edges. Some rocks crumble in your hands, while others are so hard you can use them to cut things.

The solid layer of Earth is made up of minerals, and rocks are composed of minerals.
Scientists use these properties to classify, or tell apart, rocks. However, scientists also study what different rocks are made of. Do you know what rocks are made of?

These rocks have very different appearances. What do you think each rock is made of?

Minerals are classified by their properties.
Rocks are made of minerals. *Minerals* are solid, inorganic substances that occur naturally in the topmost layer of Earth, or the *lithosphere*. (An *inorganic substance* is one that has never been alive.) In other words, minerals are not made by humans. There are many different types of minerals, but each type has a unique composition. That is, each type of mineral is made of a particular combination of **elements** that form a unique crystalline structure. (A *crystalline structure* is the arrangement of atoms in a repeating pattern of shapes.) Scientists classify minerals to make them easier to study. Minerals can be sorted into groups based on their physical properties. Remember that a *physical property* is one that you can observe or measure without changing the matter itself.

element – matter made of only one type of atom

What Do You Think?

This photograph contains a collection of different minerals. What physical properties could you use to sort the minerals into different groups to make them easier to study?

Color and Luster

Two important properties of minerals are color and luster. One way that scientists describe a mineral's appearance is its luster. *Luster* is the way that light reflects off an object. (Luster is sometimes referred to as "shine.") There are two main kinds of luster: metallic and *nonmetallic*. A metallic mineral reflects lots of light and appears shiny. A nonmetallic mineral reflects little light and appears dull. You may also hear terms such as *glassy*, *waxy*, *pearly*, or *resinous* to describe luster. These terms fall between the metallic and nonmetallic classifications.

Luster	Description	Image
Metallic	Metallic minerals such as pyrite (right) reflect light.	
Nonmetallic	Nonmetallic minerals such as olivine (right) do not reflect light.	

Luster also describes how much light can pass through a mineral. Minerals through which light passes easily are called *transparent*. You can sometimes see through transparent minerals. In contrast, light does not pass easily through *opaque* minerals. Another way that scientists describe a mineral's appearance is its color. A mineral's color results from the way it absorbs or reflects light. Some minerals are usually the same color. A mineral that contains the element sulfur is almost always yellow. Other minerals can be a range of colors. For example, pure quartz may be colorless, but it can also be white, yellow, purple, green, or pink. Trace elements in the crystalline structure of the arrangement of atoms in a particular piece of quartz determines its color.

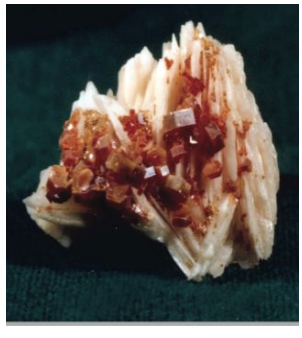
Look Out!

One of the first things you may notice when you see a mineral is its color. However, color is one of the least reliable physical properties for identifying minerals. This is because many minerals can exist as different colors. Additionally, different minerals may be the same color. For example, the minerals crocoite and vanadinite are both orange red in color.

To identify a mineral with confidence, you need to consider properties other than its surface appearance. In the next section, we will explore some of these properties.

The minerals below are different colors, but they are all examples of quartz.

Quartz can be all different colors.



Crocoite is orange red because it contains the element chromium.

Vanadinite is orange red because it contains the element vanadium.

Hardness and Streak

You can use hardness and streak to classify minerals. Scientists often perform tests to identify a mineral's properties. Two common tests used to classify minerals are the hardness test and the streak test.

The hardness of a mineral is its resistance to being scratched. Scientists test a mineral's hardness by scratching it against other minerals of known hardness. The Mohs scale of mineral hardness is a list of ten minerals with known hardness values. They are arranged from softest (talc has a value of 1) to hardest (diamond has a value of 10). Harder minerals can leave a scratch on softer minerals. Quartz (7) will scratch feldspar (6) but not topaz (8). A diamond cannot be scratched by any other mineral.

This table lists the 10 minerals that make up the Mohs hardness scale.

Mohs Hardness Scale		
Mineral	**Hardness**	**Scale**
Talc	1	Soft ↑
Gypsum	2	
Calcite	3	
Fluorite	4	
Apatite	5	
Feldspar	6	
Quartz	7	
Topaz	8	
Corundum	9	
Diamond	10	Hard ↓

You can also test a mineral's hardness by scratching it against other objects of known hardness. For example, if a mineral can be scratched by a steel nail, its hardness is less than about 6.5 on the Mohs scale. If a mineral can be scratched by a penny, its hardness is less than about 3.

Another test used to sort minerals is the color of a mineral's streak. Scientists perform a streak test by grinding a mineral to powder or rubbing it against a hard surface— usually a plate made of porcelain. The streak is the color of the powder left behind. A certain type of mineral may exist in different colors, but the mineral's streak is always the same. Therefore, a mineral's streak does not always match its color.
For example, quartz can be many colors, including purple, pink, or yellow. However, the streak of quartz is always white. So, streak is a more useful property than color for identifying minerals.

Scientists classify rocks based on how they break, also known as cleavage.

Cleavage
Another property that is used to classify rocks and minerals is *cleavage*. Cleavage is how the mineral breaks into flat pieces. These breaks are classified by their quality, the number of surfaces that break, and how the breaks occur. The quality of cleavage is an indication of how smooth the broken surfaces are. Perfect cleavage means the surfaces are perfectly smooth, while poor cleavage means the surfaces are rough.

The number of surfaces that break is another characteristic of cleavage. Many times, a mineral will only break on one surface, but some minerals will break on multiple surfaces.

The final characteristic of cleavage is how the breaks occur. The way the internal atoms and molecules of the rock are organized affects how the mineral will cleave. The shape of the broken pieces is an indication of the internal structure of the rock. The way the breaks occur, the cleavage quality, and the number of surfaces help distinguish between different minerals.

To determine a mineral's streak, you can rub it against a streak plate. Different minerals leave streaks of different colors.

Career Corner: Mineralogist

A **mineralogist** is a scientist who studies rocks, gems, and other minerals. Mineralogists test physical properties such as luster, color, hardness, and streak to identify and classify different mineral samples. They may also perform chemical tests to study the chemical properties of a mineral. A mineralogist may use special equipment such as a microscope to closely examine a mineral's shape and surface. To examine a mineral's chemical composition, mineralogists may use a machine similar to one that takes X-rays of your bones.

Some mineralogists work in the mining industry to identify where minerals are located. Other mineralogists might develop models of how certain minerals are made and used. They might also develop new ways to use minerals for different industries.

Try Now

What are all the ways to identify the physical properties of common, Earth-forming minerals? List and describe each of them below.

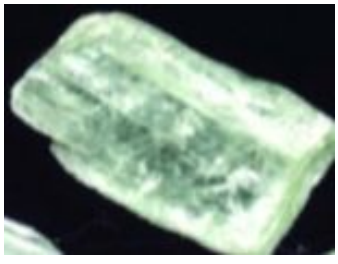
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Properties of Minerals

Here are some physical properties of different minerals.

- Dull luster
- White color
- Partly transparent
- White streak

Look at the four minerals below. Which physical property from the box above best describes each mineral? Write your answer beside each mineral.

Connecting With Your Child

Mineral Collections

To help your child learn more about minerals, help him or her build a collection of minerals from a variety of locations. To do this, take your child to nearby parks, water bodies, hilly or mountainous regions, and other locations that contain rocks. (If your child cannot find pure mineral samples at these locations, he or she can collect different rocks and describe each rock in terms of its physical properties; your child may even wish to conduct research to determine the various minerals that make up each rock.)

After collecting 5–10 different rocks or minerals, your child should begin to describe and classify them. Use the four properties discussed in this companion—luster, color, streak, and hardness—to classify each mineral; your child may also wish to classify the minerals based on where they were found. Encourage your child to use books or online resources to identify the different minerals in the collection.

To determine a mineral's hardness, your child can perform a simplified version of the hardness test. You will need a penny, a steel nail, and a glass plate (such as from a picture frame).

- Your child should first scratch each mineral with the penny. Minerals scratched by the penny have a hardness value of less than 3 (< 3).
- Next, have your child scratch each of the remaining minerals (i.e., those not scratched by the penny) with the nail. Minerals scratched by the nail have a hardness value of 4 or 5 (depending on how easily the nail scratches the mineral).
- Next, your child should use each of the remaining minerals (i.e., the minerals not scratched by either the penny or the nail) to scratch the glass. Minerals that can scratch the glass have a hardness value greater than 6 (> 6).

Here are some questions to discuss with your child:

1. Did any of the locations contain the same minerals? Did any locations contain unique minerals? What might this suggest about how these minerals form?
2. Which property was the most accurate in identifying a mineral? Why?
3. Which property was the least accurate in identifying a mineral? Why?
4. What other physical properties could you use to classify your minerals?