CALIFORNIA Standards Preview

Standard Set 4. Earth Sciences

4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept:

4.a. *Students know* how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

4.b. *Students know* how to identify common rock-forming minerals (including quartz, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.

Genre	Comprehension Skill	Text Features	Science Content
Nonfiction	Compare and Contrast	• Diagrams • Labels • Captions • Glossary	Rocks and Minerals

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California Science

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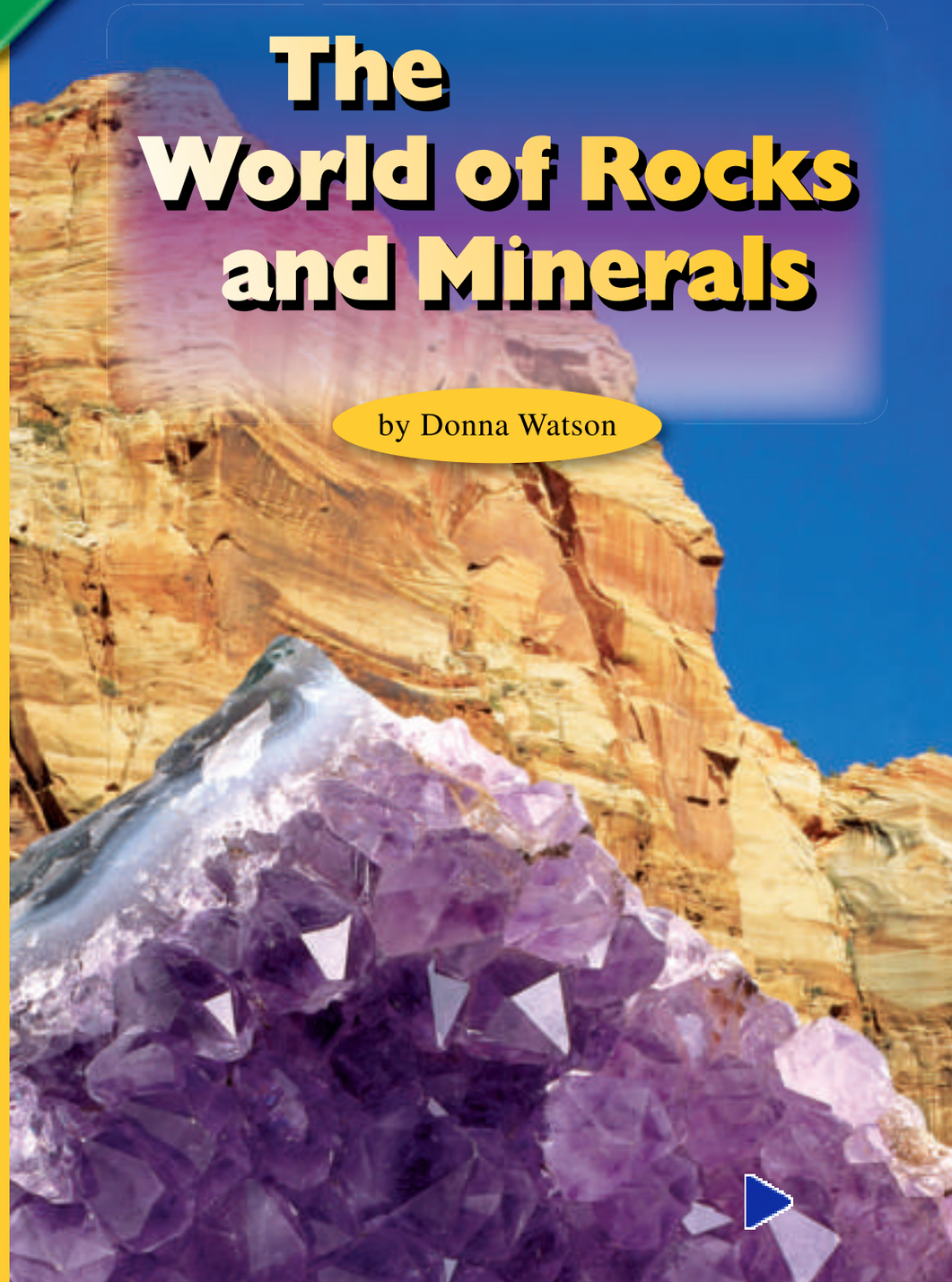
Earth Sciences

The World of Rocks and Minerals

by Donna Watson



Vocabulary

cleavage
igneous
luster
metamorphic
mineral
ore
rock cycle
sedimentary
streak

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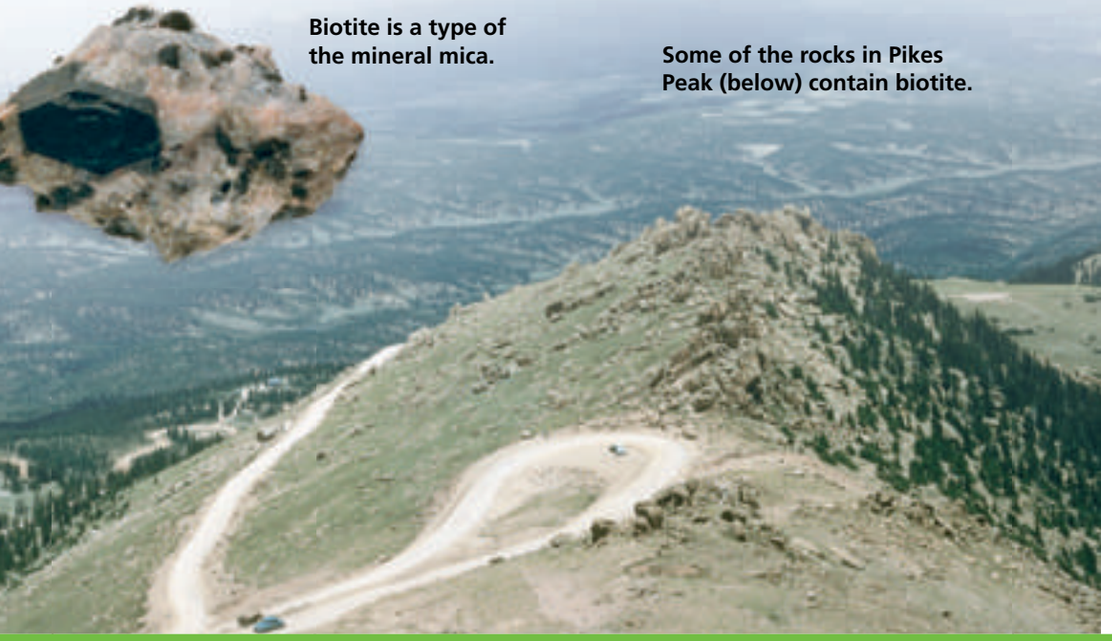
Minerals All Around

You use minerals all the time. You use them when you write with a pencil, which contains the mineral graphite. Talcum powder, which you rub on your hands before doing gymnastics, is also a mineral. You are even walking on minerals when you walk down the sidewalk! What are minerals? **Minerals** are natural, nonliving solid crystals that make up rocks.

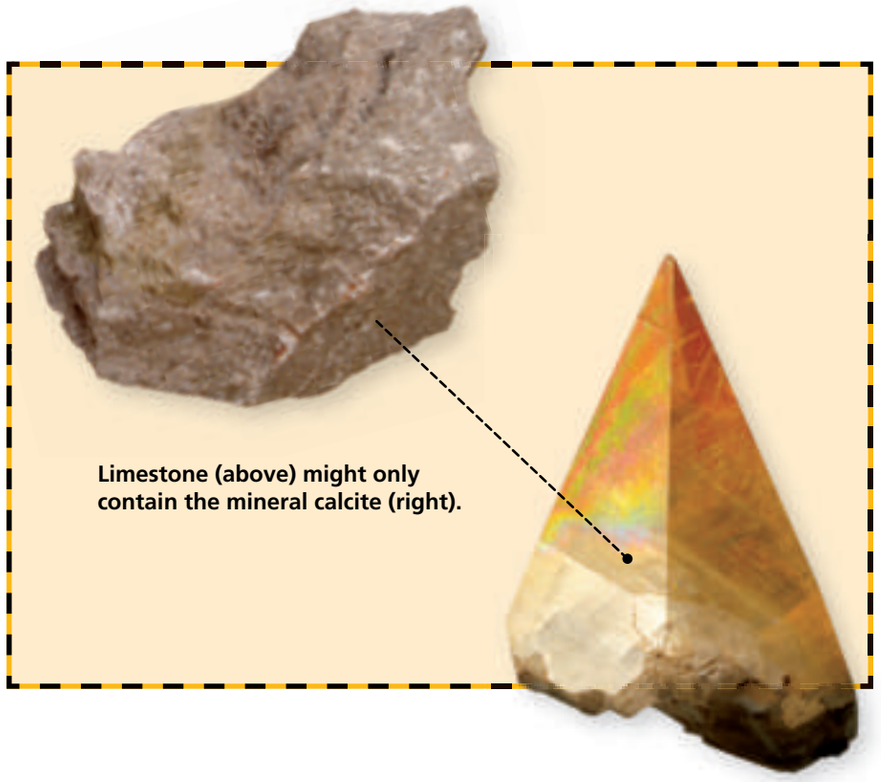
No matter where a mineral is located, it will always have the same chemical makeup as minerals of the same type. Biotite is a type of the mineral mica. A sheet of biotite could be found in the Black Mountains of North Carolina. Or a small chip of biotite could be found on Pikes Peak, Colorado. But both would have the same chemical properties.



Biotite is a type of the mineral mica.

Some of the rocks in Pikes Peak (below) contain biotite.

Scientists have found over 3,000 different minerals. But most of Earth's crust is made up of only a very few minerals. These minerals are called the "rock-forming" minerals. Some rocks are made up of just a single mineral. For example, some limestone is made up of only the mineral calcite. But most rocks are made up of different minerals combined. You will always find the same combination of minerals when looking at a certain type of rock. For instance, slate is always made with quartz and mica.



Limestone (above) might only contain the mineral calcite (right).

Identifying Minerals

Each mineral has specific properties or characteristics. Scientists use these properties to figure out what mineral something is. Some of the properties tested are color, luster, hardness, streak, cleavage, and crystal shape.

Color

The easiest mineral property to find out is color. But usually color is not enough to determine the identity of a mineral. For example, there is more quartz in Earth's crust than any other mineral. Pure quartz is clear. But there is also purple quartz, which has bits of iron in it and is known as amethyst. Rose quartz has manganese and titanium in it.

In the same way, the mineral calcite can be many colors, including white, pink, or yellow. It can also be colorless. So scientists need to use properties other than color to find out what mineral something is.

Quartz (below) has a clear color. Purple quartz (right) is called amethyst.

Luster

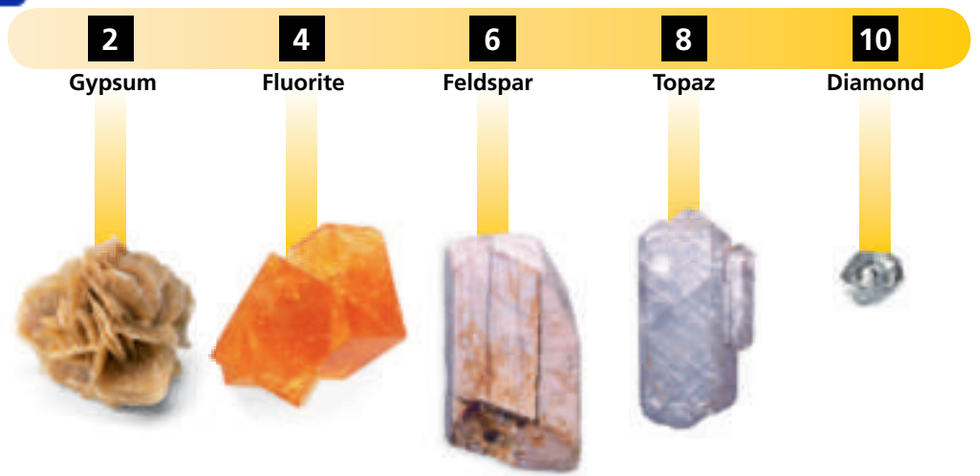
Luster is the property of how a mineral reflects light. Luster can be glassy, having a look like glass. Luster that looks like polished metal is called metallic. Minerals can also have a greasy, waxy, silky, dull and chalky, or pearly luster.

Hardness

A mineral's hardness is found by seeing how easy or hard it is to scratch. Scientists use the Mohs scale, which uses numbers from 1 to 10, to rank hardness. The softest mineral, talc, has a hardness of 1. Diamond, with a hardness of 10, is the hardest mineral.

Any mineral can scratch another that ranks below it on the scale. For example, feldspar has a hardness of 6-6.5. Mica has a hardness of 2-2.5. If you rub feldspar and mica together, the feldspar will scratch the mica. You can use your fingernails to scratch some minerals.

These five minerals are examples of some of the ranks on the Mohs scale.



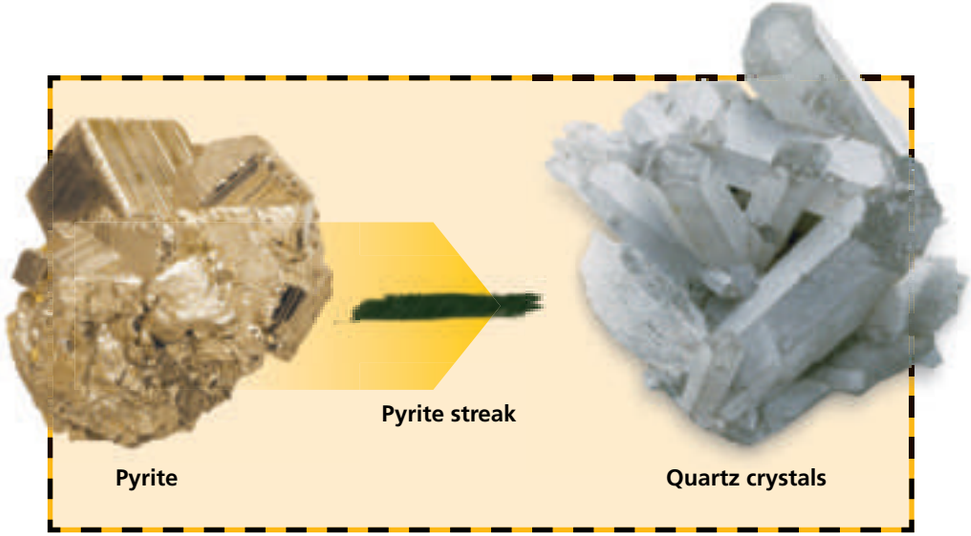
Streak

As you know, some minerals come in many different colors. But a mineral will always leave the same streak, no matter the color. **Streak** is the color of the powder that a mineral leaves when it is scratched across a special plate. It can be different from the color of the mineral that makes it. For example, pyrite is gold. But its streak is greenish black.

Crystal Shape

Minerals do not always have a shape that is easy to see. But when you can see the shape of a mineral's crystals, it can help you tell which mineral it is.

Crystals are grouped by their shapes and angles. There are six types, or classes, of crystals. Quartz has crystals that look like a six-sided prism with a pyramid at each base. Galena's crystals are cube-shaped.



Cleavage

Minerals that break along smooth, flat surfaces have **cleavage.** Topaz has perfect cleavage. It breaks into parts with perfectly smooth surfaces. Quartz has no cleavage. It usually breaks into pieces that look like the inside of a seashell.

Other Properties

There are even more ways to identify some minerals. Pyrrhotite and magnetite are attracted to magnets.

Different minerals feel different when you touch them. Talc can feel greasy or soapy. Kaolinite feels smooth. Other minerals may feel sandy, powdery, or sticky.

Minerals may have memorable smells or tastes. Pyrite smells like rotten eggs. Halite tastes salty.

Other minerals can be identified using chemical tests. You can make calcite bubble by placing a drop of vinegar on it.

Magnetite attracts nails and other metal objects. This helps us identify it.

Rocks and Minerals As Resources

One reason we study rocks is because they contain many valuable resources. An **ore** is a rock rich in valuable minerals that can be removed from Earth's crust. Ores are mined to get the minerals from them.

Iron ore is one of the most plentiful and useful of ores. The metal iron is taken out of iron ore after the ore is mined. Iron is used to make steel. Beams in tall buildings, cars, pots, and pans are all made with steel.

Two other important mineral ores are graphite and calcite. Graphite is a black or gray mineral. It is used in pencils, as you already know. It is also used to make lubricant. Calcite is used in cement.

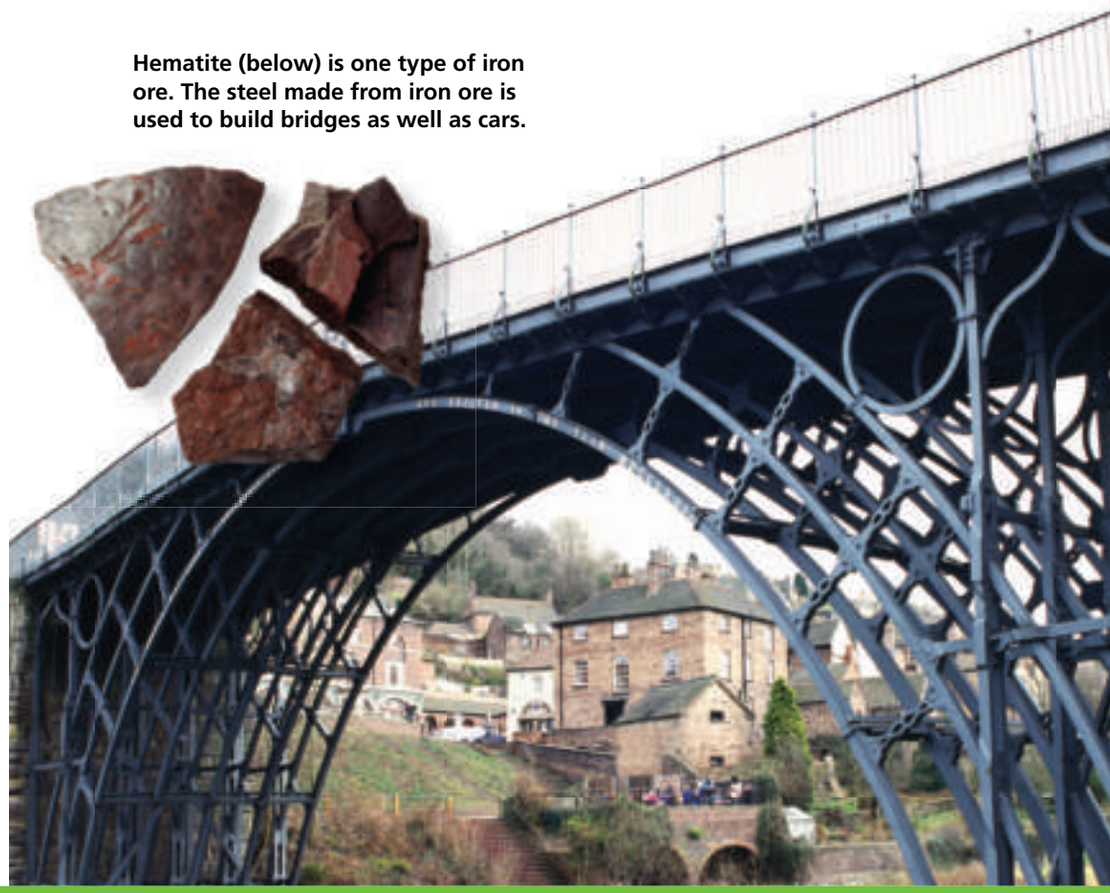
The steel used to build parts of cars comes from iron ore. Pencils contain graphite.

Hematite

The most important source of iron ore is hematite. Hematite is made of iron and oxygen. About seven-tenths of hematite is pure iron. It can come in many forms. One form has shiny gray six-sided crystals, while another form has reddish brown coarse grains. Red-colored hematite is used to make red paint. Hematite can also be used to polish glass.

Hematite has been found all over California. It can sometimes be seen on Earth's surface where it turns the soil red. It is often found near silver mines and in quarries.

Hematite (below) is one type of iron ore. The steel made from iron ore is used to build bridges as well as cars.

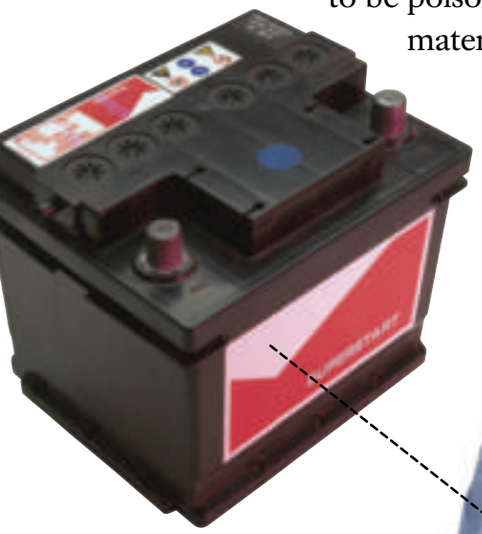


Galena and Lead

Galena is the most common source of the metal lead. It is a gray mineral with a metallic luster. People have been getting lead from galena for about 5,000 years. There are two major sources of galena in California. One source is near Darwin, in Inyo County. The other is Tuolumne County's Jamestown mine.

Lead is a dense, blue-gray metal. It can be easily shaped and pulled into wires. One of lead's most important uses is as a part in car batteries. In the past it was used to make parts of buildings. It is still used to make parts of roofs. It is also used to shield people from radiation.

Lead was once used in paint and in fuels. But it was found to be poisonous to people. This is why other materials are now used instead of lead for certain things.



Lead is an important part in car batteries (left). It is found in galena (below).

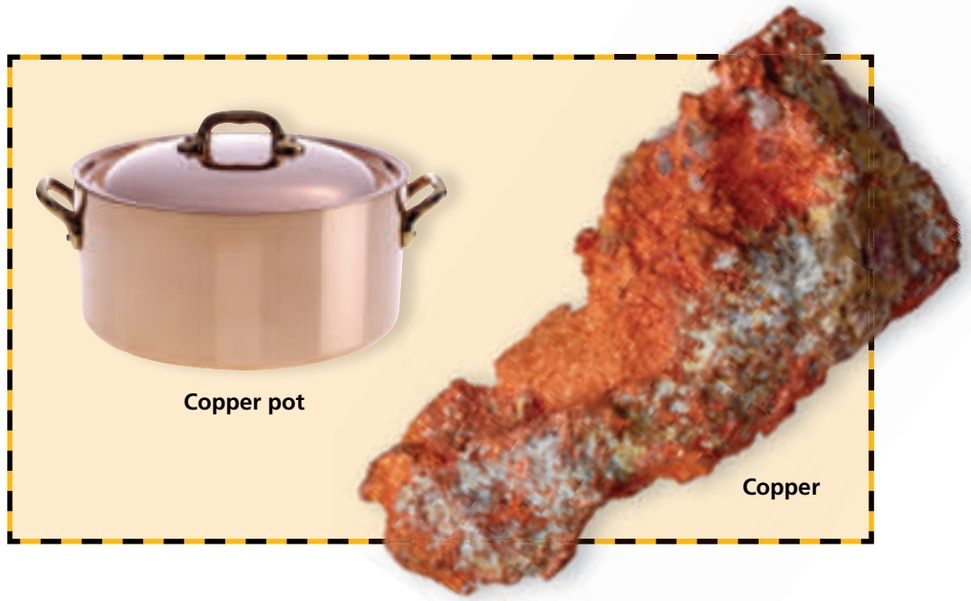
Copper

People have used copper for thousands of years. It is a shiny metal that is easy to shape and make into wires.

Rocks that formed from lava often turn out to be copper ores. People crush the rocks to get the copper. Chalcopyrite is a common copper ore.

Copper is often used in electrical wires. This is because electricity flows though it well. Copper wires are found in motors, generators, and many other devices that use electricity. Copper is used to make pots, pans, coins, and musical instruments. When mixed with other metals, it can form bronze and brass.

In the 1800s, copper was mined in California in many places. It was mined around Placerville in El Dorado County and near Clark Mountain in the Mojave Desert. Today there is a large copper mine near Salt Lake City, Utah.



Copper pot

Copper

Using Tables to Identify Minerals

When scientists want to identify a mineral, they first observe all its properties. Then they may look at a table. The table shows the properties of many minerals. Use the table below to identify the minerals on the next page.

Mineral	Color	Luster	Hardness	Streak
Copper	*copper red*	*metallic*	*2.5-3*	*copper red*
Galena	*lead-gray*	*metallic*	*2.5*	*gray*
Hematite	*silver-gray or red*	*metallic or nonmetallic*	*5-6*	*reddish brown*
Mica	*dark brown, black, or silver-white*	*pearly*	*2-2.5*	*white*
Pyrite	*gold*	*metallic*	*6-6.5*	*greenish black*
Quartz	*clear (may be colored by impurities)*	*glassy*	*7*	*white*

This mineral's color and streak are the same.

This mineral has a metallic luster and a lead-gray color.

This mineral can have a metallic or a nonmetallic luster.

This mineral is softer than every other mineral listed in the table.

This mineral has a gold color.

This mineral is harder than every other mineral listed in the table.

Igneous Rock

One way scientists classify rocks is by how they form. Rock that exists deep beneath Earth's surface can become so hot that it melts. This molten rock is called magma. When magma cools, new rocks will be formed. **Igneous** rocks form from this molten rock. The word *igneous* comes from Latin. It means "fire."

Igneous rocks can form deep underground and at Earth's surface. These rocks are usually hard. They have interlocking crystals instead of layers.

The molten rock in this volcano is called magma.

Lava

When a volcano erupts, lava can burst onto Earth's surface. Lava is the name given to molten rock after it reaches the surface. Once lava is on the surface, it cools quickly. It may only take a few days to become solid igneous rock.

Mineral crystals form as lava cools. When lava cools quickly, mineral crystals do not have much time to form. This causes only very small crystals to form. Rhyolite is a light-colored igneous rock that is made up of quartz and other minerals.

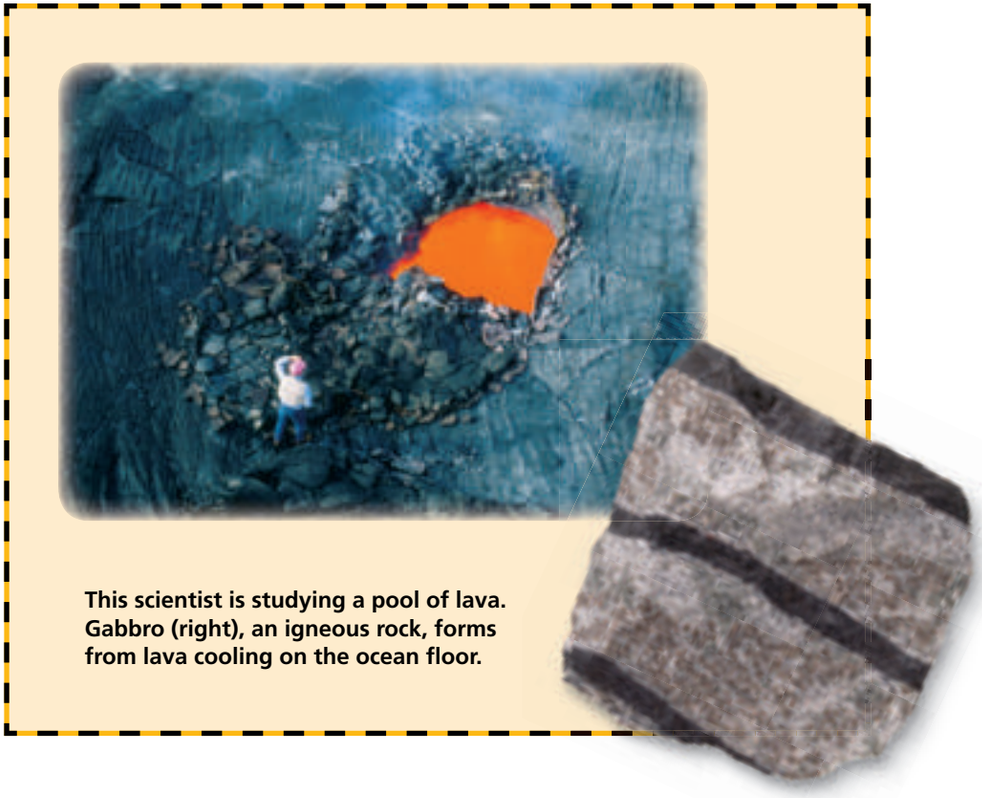
Some lava cools in water. Basalt is an igneous rock. Its color can be either dark green or black. It often forms under the ocean. Ocean water cools lava very fast.

Igneous rock forms following a volcanic eruption (left). Basalt (below) is one type of igneous rock.

Magma Cooling Underground

Sometimes magma cools off and forms rock when it is beneath Earth's surface. This magma rises slowly toward the surface, sometimes forming cracks along the way. While the magma is rising, it may melt the rock around it.

Slowly the magma cools. The slow cooling allows big crystals to form. Eventually the magma hardens into igneous rock. The magma beneath Earth's surface can take more than a million years to become rock.



This scientist is studying a pool of lava. Gabbro (right), an igneous rock, forms from lava cooling on the ocean floor.

Types of Igneous Rock And Their Uses

Igneous rock formed beneath Earth's surface forms rock such as granite. Large crystals of quartz, feldspar, and mica are found in granite. Gabbro and diorite are two other rocks that form from magma when it slowly cools.

Igneous rocks are very hard, which gives them many practical uses. Granite is probably the most well-known igneous rock. It is often used to construct buildings. Many schools have granite foundations. Sometimes granite is crushed into smaller rocks, or gravel, and used for roads and driveways.

The igneous rock granite (left) is used to build many things. Sometimes it is crushed to make gravel (below).

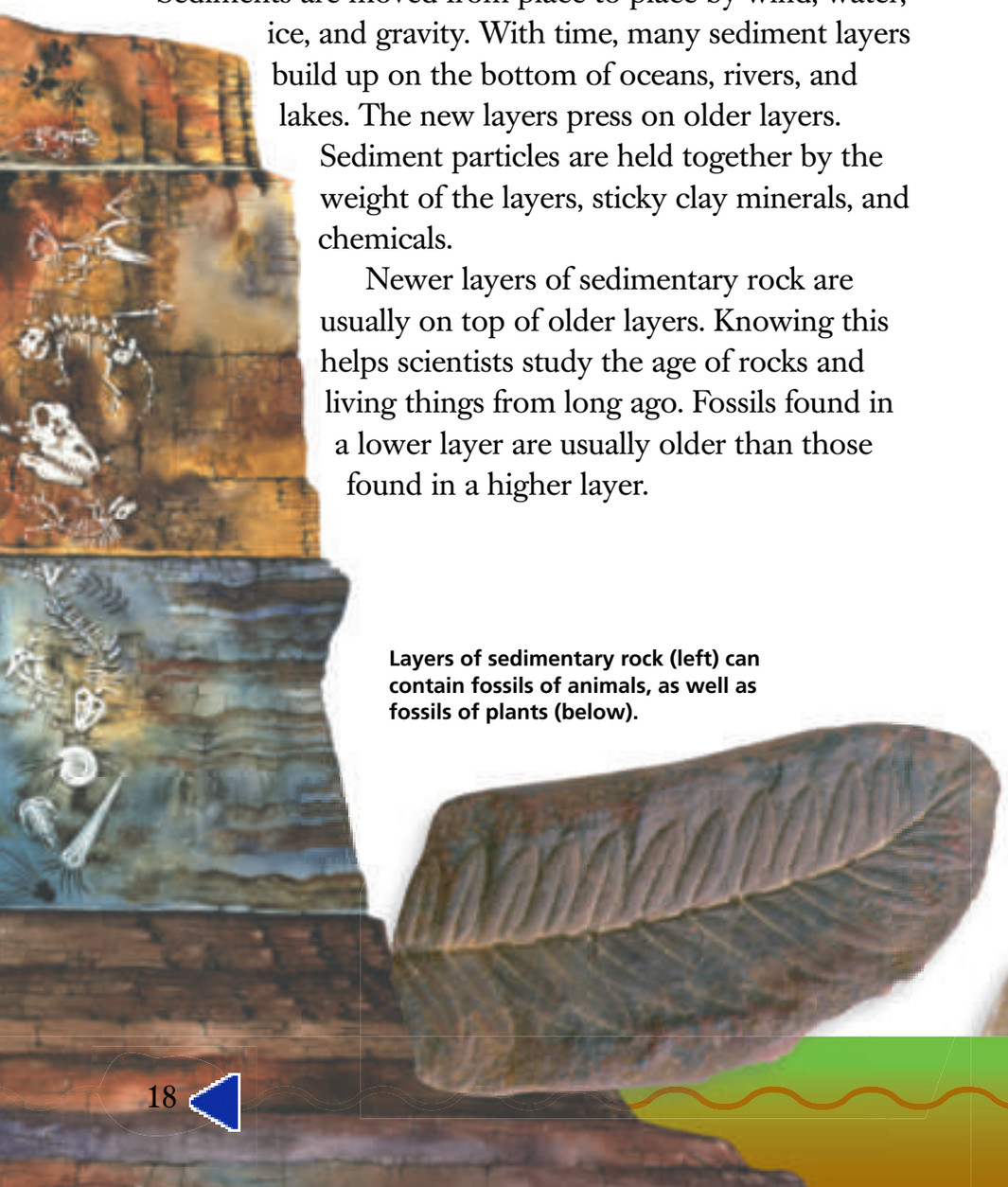
Sedimentary Rock

Sedimentary rocks form when layers of sediments settle on top of one another and harden. Sediments are made up of soil, shells, bits of rock, and dead plant and animal matter.

Sediments are moved from place to place by wind, water, ice, and gravity. With time, many sediment layers build up on the bottom of oceans, rivers, and lakes. The new layers press on older layers.

Sediment particles are held together by the weight of the layers, sticky clay minerals, and chemicals.

Newer layers of sedimentary rock are usually on top of older layers. Knowing this helps scientists study the age of rocks and living things from long ago. Fossils found in a lower layer are usually older than those found in a higher layer.



Layers of sedimentary rock (left) can contain fossils of animals, as well as fossils of plants (below).

Types of Sedimentary Rock And Their Uses

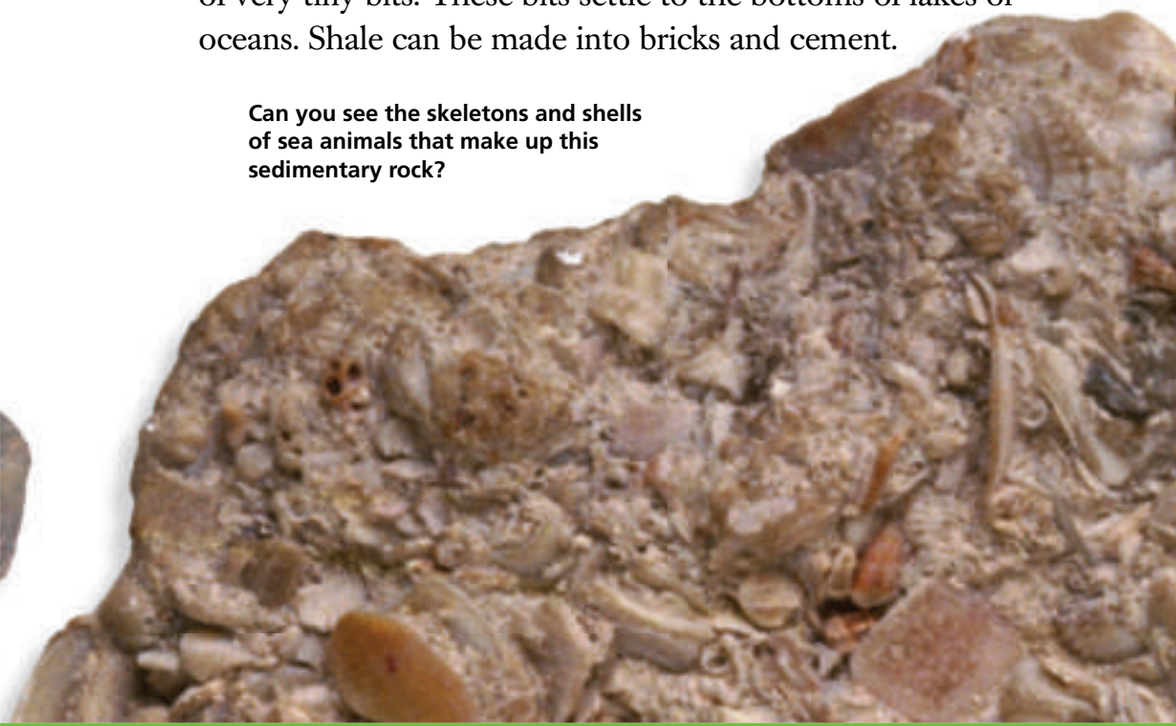
Sedimentary rocks are usually soft and layered. Their layers can contain broken bits of older rocks. Materials in the sediment are used to classify sedimentary rock.

Limestone can form from pieces of the hard skeletons and shells of sea animals that lived long ago. The pieces are held together by dissolved minerals. Limestone is used to make cement and steel.

Sandstone, which is used to build homes, is a sedimentary rock. Sandstone can form from pieces of minerals and tiny grains of rock.

Sedimentary rock such as shale or sandstone is made up of very tiny bits. These bits settle to the bottoms of lakes or oceans. Shale can be made into bricks and cement.

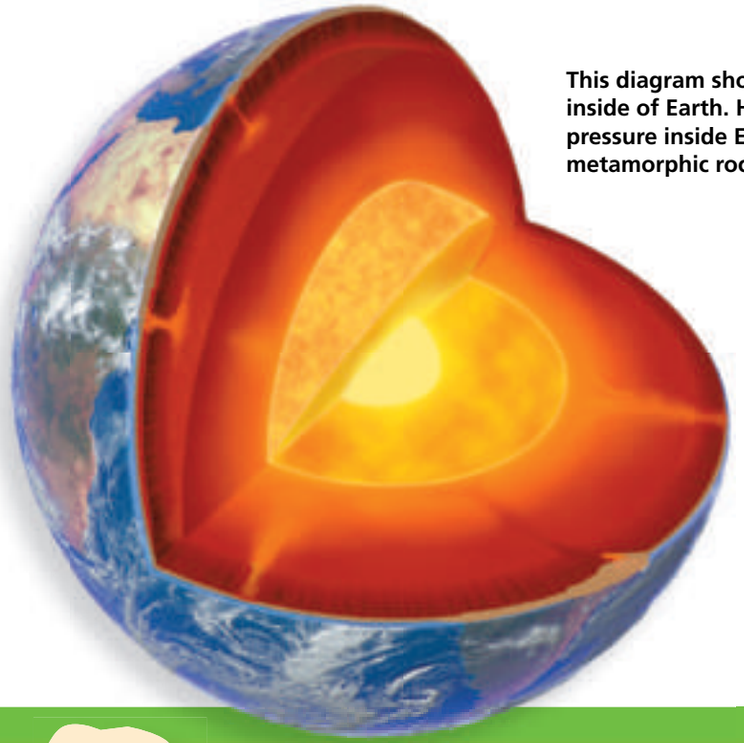
Can you see the skeletons and shells of sea animals that make up this sedimentary rock?



Metamorphic Rock

It is very hot deep inside Earth. There is also a lot of pressure. The weight of rocks presses down on rocks below them. This heat and pressure can change how the particles in the rock are arranged. It changes the properties of the rock. When this happens, **metamorphic** rock forms. *Metamorphic* means "change in form." Metamorphic rocks change from igneous, sedimentary, or other metamorphic rocks.

There are many ways metamorphic rock can change as it forms. The mineral crystals in the rocks can be changed by heat and pressure. They can change size and shape. The chemicals in the rock can even form new minerals.



This diagram shows the inside of Earth. Heat and pressure inside Earth make metamorphic rocks.

Types of Metamorphic Rock And Their Uses

Metamorphic rocks are usually hard. Heat and pressure can make the rock particles form into layers. Because of this, some metamorphic rocks chip into flat sheets or slabs.

Slate is one type of metamorphic rock. It starts as shale, which is a sedimentary rock. Slate is often used to make roof tiles because of its strength.

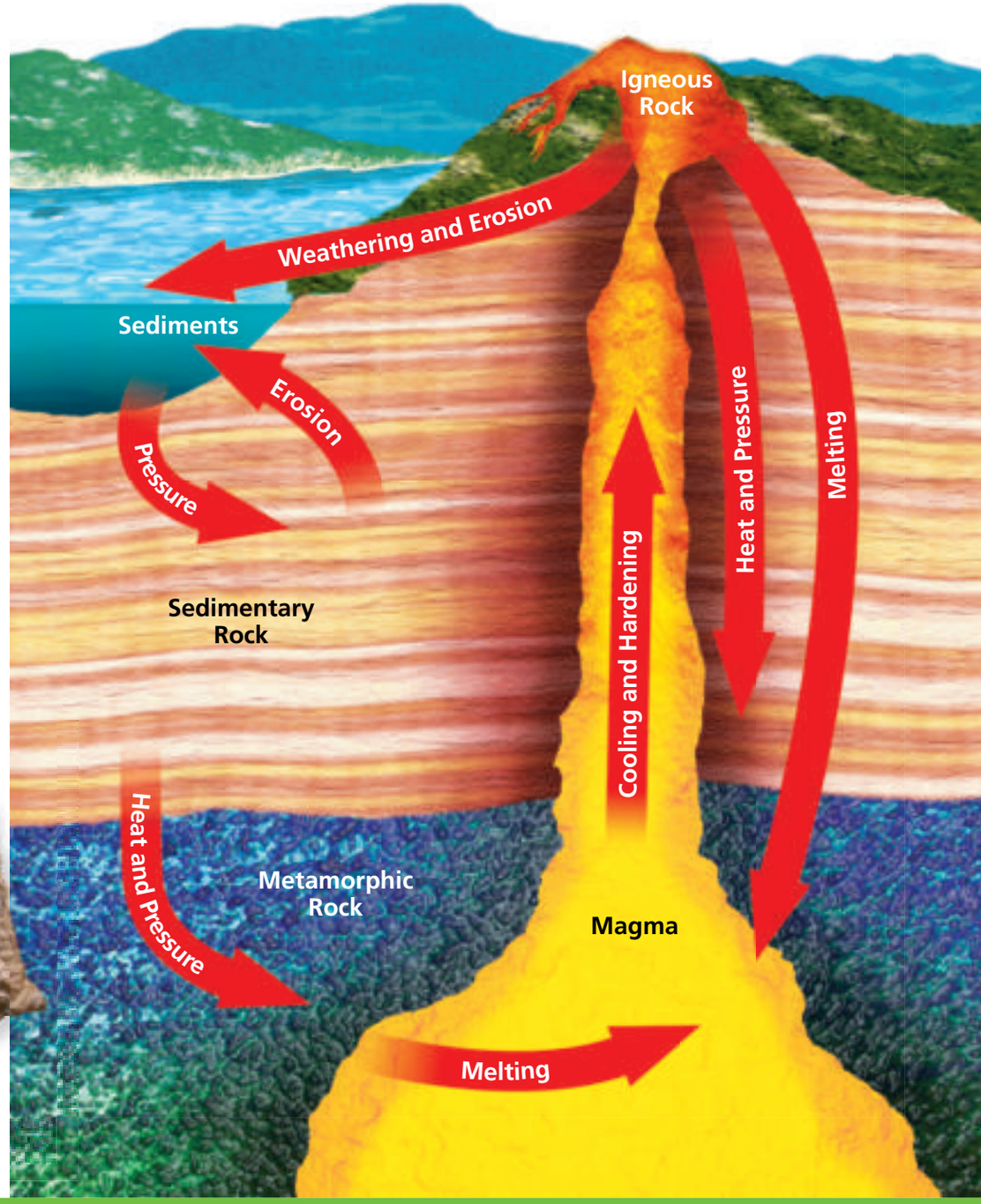
The igneous rock granite often becomes gneiss under heat and pressure. Limestone and dolomite can change into marble, a very strong and beautiful rock used in construction and in sculpture.

Reviewing The Rock Cycle

You have learned that any type of rock can change into metamorphic rock. In fact, all types of rock are changing all the time. The recycling of old rock into new is an ongoing process called the **rock cycle.** Rocks can change from one kind to another in any order. But sometimes they stay the same for millions of years.

Look at the diagram of the rock cycle on page 23. Some rocks go through the whole rock cycle. Other rocks, such as those deep in Earth's crust, may never reach the surface. Or sedimentary rock may change into igneous rock, but never become metamorphic rock.

Igneous rock (left) can change into sedimentary rock (right) during the rock cycle.



Glossary

cleavage property of minerals that break along smooth, flat surfaces

igneous type of rock that forms from molten rock

luster property of a mineral that describes how the mineral reflects light

metamorphic type of rock formed when heat and pressure change the properties of rock

mineral a natural, nonliving, solid crystal that makes up rocks

ore a rock rich in valuable minerals that can be removed from Earth's crust

rock cycle the process that recycles rock into new types of rock

sedimentary type of rock that forms when layers of sediments settle on top of one another and harden

What did you learn?

1. Name two places in the United States where biotite can be found.

2. What is the most common mineral in Earth's crust?

3. What is molten rock called when it is beneath Earth's surface? What is it called when it reaches the surface?

4. **Writing in Science** Write a summary of the types of identification tests used for minerals. Make sure to include main ideas and significant details.

5. **Compare and Contrast** Compare and contrast the three types of rock, including the manner in which each is formed, their properties, and their uses.