

# SECTION 3 The Formation, Mining, and Use of Minerals

## BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do minerals form?
- How are mineral resources used?

## How Do Minerals Form?

Different minerals form in different environments. The table below shows five ways that minerals can form.

Process	Description	Minerals that form this way
Evaporation	When a body of salt water dries up, minerals are left behind. As the water evaporates, the minerals crystallize.	gypsum, halite
Metamorphism	High temperatures and pressures deep below the ground can cause the minerals in rock to change into different minerals.	garnet, graphite, magnetite, talc
Deposition	Surface water and ground water carry dissolved minerals into lakes or seas. The minerals can crystallize on the bottom of the lake or sea.	calcite, dolomite
Reaction	Water underground can be heated by hot rock. The hot water can dissolve some minerals and deposit other minerals in their place.	gold, copper, sulfur, pyrite, galena
Cooling	Melted rock can cool slowly under Earth's surface. As the melted rock cools, minerals form.	mica, feldspar, quartz



**Describe** As you read this section, make a chart showing the uses of different rock and mineral resources.

## TAKE A LOOK

**1. Identify** Give three minerals that form by metamorphism and three minerals that form by reaction.

Metamorphism:

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Reaction:

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## How Are Minerals Removed from the Earth?

People mine many kinds of minerals from the ground and make them into objects we need. Some minerals have more useful materials in them than others. An **ore** is a rock or mineral that contains enough useful materials for it to be mined at a profit.

There are two ways of removing ores from Earth: surface mining and subsurface mining. The type of mining used depends on how close the ore is to the surface.

**SECTION 3** The Formation, Mining, and Use of Minerals *continued*

**SURFACE MINING**

People use surface mining to remove ores that are near Earth’s surface. Three types of surface mines include open pits, surface coal mines, and quarries.

Open-pit mining is used to remove large, near-surface deposits of gold and copper. Explosives break up the rock layers above the ore. Then, trucks haul the ore from the mine to a processing plant. ✓

Quarries are open mines that are used to remove sand, gravel, and crushed rock. The layers of rock near the surface are removed and used to make buildings and roads.

Strip mines are often used to mine coal. The coal is removed in large pieces. These pieces are called *strips*. The strips of coal may be up to 50 m wide and 1 km long.

✓ **READING CHECK**

**2. Identify** Give two minerals that are mined using open-pit mining.

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✓ **READING CHECK**

**3. List** Give three resources that can be mined using subsurface mining.

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**TAKE A LOOK**

**4. Identify** What are three kinds of tunnels used in subsurface mining?

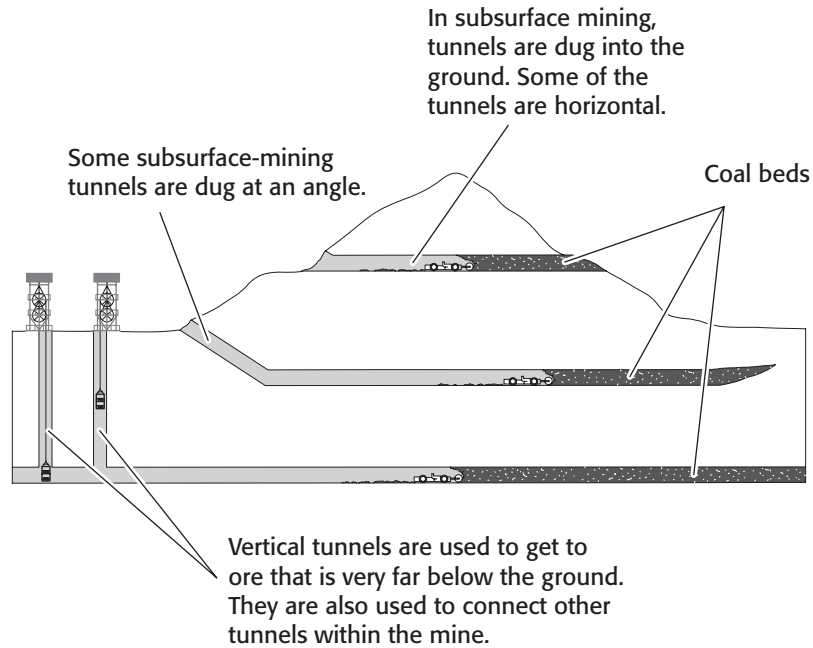
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**SUBSURFACE MINING**

People use subsurface mining to remove ores that are deep underground. Iron, coal, and salt can be mined in subsurface mines. ✓



**SECTION 3** The Formation, Mining, and Use of Minerals *continued*

**RESPONSIBLE MINING**

Mining can help us get the resources we need, but it can also create problems. Mining may destroy or harm the places where plants and animals live. The wastes from mining can be poisonous. They can pollute water and air. ✓

One way to reduce these problems is to return the land to nearly its original state after mining is finished. This is called **reclamation**. Since the mid-1970s, laws have required the reclamation of land used for mining.

Another way to reduce the problems with mining is to reduce our need for minerals that are mined. For example, when you recycle materials made from minerals, you reduce the need for further mining. If you recycle the aluminum in your soda can, less aluminum has to be removed from the Earth. ✓

**How Are Minerals Used?**

We can use some minerals just as they are. However, most minerals must be processed before they can be used. The table below shows how some common minerals are used. The figure on the next page shows some of the processed minerals that are used in a bicycle.

Mineral	Uses
Bauxite (aluminum ore)	source of aluminum for cans, foil, appliances, and utensils
Copper	electrical wire, plumbing, coins
Diamond	jewelry, cutting tools, drill bits
Galena (lead ore)	source of lead for batteries and ammunition
Gold	jewelry, computers, spacecraft
Gypsum	plaster, cement, wallboard
Halite	table salt, road salt, water softener
Quartz	glass, source of silicon for computer chips
Silver	photography, electronic products, jewelry
Sphalerite (zinc ore)	jet aircraft, spacecraft, paint

 **READING CHECK**

**5. Describe** What are two problems with mining?

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 **READING CHECK**

**6. Explain** How can recycling help reduce the problems with mining?

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**TAKE A LOOK**

**7. Identify** Give two uses for the mineral silver and two uses for the mineral bauxite.

Silver:

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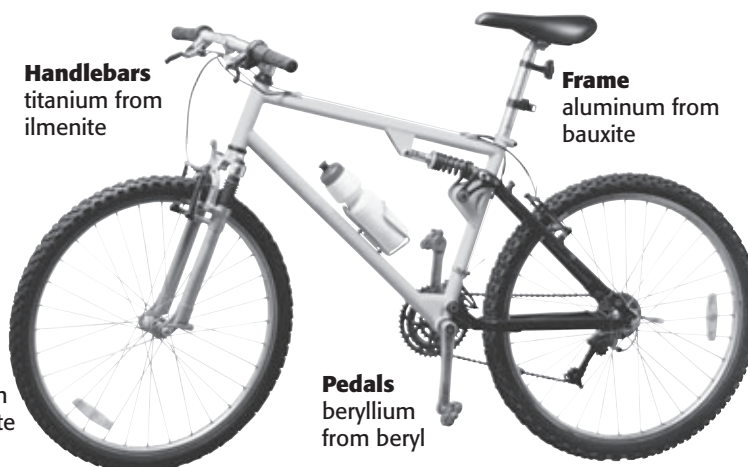
Bauxite:

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**SECTION 3** The Formation, Mining, and Use of Minerals *continued*

**Minerals Used in the Parts of a Bicycle**



**TAKE A LOOK**

**8. Identify** Name four minerals that are used in the parts of a bicycle.

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**Spokes**  
iron from magnetite

**Handlebars**  
titanium from ilmenite

**Frame**  
aluminum from bauxite

**Pedals**  
beryllium from beryl

**METALLIC MINERALS**

Many minerals contain metals. Many of the features of metals make them useful in aircraft, automobiles, computer parts, and spacecraft. All metals have the features given below:

- Metals have shiny surfaces.
- Light cannot pass through metals.
- Heat and electricity can pass through metals easily.
- Metals can be rolled into sheets or stretched into wires.

Some metals react easily with air and water. For example, iron can react with oxygen in the air to produce rust. However, many of these metallic minerals can be processed into materials that do not react with air and water. For example, iron can be used to make stainless steel, which does not rust. Other metals do not react very easily. For example, gold is used in parts of aircraft because it does not react with many chemicals.

Many metals are strong. Their strength makes them useful in making ships, automobiles, airplanes, and buildings. For example, tall buildings are too heavy to be supported by a wooden frame. However, steel frames can support skyscrapers that are hundreds of meters tall.

*Critical Thinking*

**9. Infer** Electricity can pass through metals easily. How does this make metals useful in computers and other electronic appliances?

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**SECTION 3** The Formation, Mining, and Use of Minerals *continued***NONMETALLIC MINERALS**

Many minerals also contain nonmetals. Some important features of nonmetals are given below:

- Nonmetals can have shiny or dull surfaces.
- Light can pass through some kinds of nonmetals.
- Heat and electricity cannot pass through nonmetals easily.

Nonmetallic minerals are some of the most widely used minerals in industry. For example, the mineral calcite is used to make concrete. The mineral quartz is used to make glass. Quartz can also be processed to produce the element silicon, which is used in computer chips. ✓

**GEMSTONES**

Some nonmetallic minerals are considered valuable because of their beauty or rarity. These minerals are called *gemstones*. Important gemstones include diamond, ruby, sapphire, emerald, topaz, and tourmaline.

Color is the feature that determines the value of a gemstone. The more attractive the color, the more valuable the gemstone is. The colors of many gemstones are caused by impurities. An *impurity* is a small amount of an element not usually found in the mineral. For example, rubies and sapphires are both forms of the mineral corundum. Rubies look red because they have chromium impurities. Sapphires look blue because they have iron impurities. ✓

Most gemstones are very hard. This allows them to be cut and polished easily. For example, corundum (rubies and sapphires) and diamond are the two hardest minerals. They are also some of the most valuable gemstones.

 **READING CHECK**

**10. Identify** Give two nonmetallic minerals that are used in industry.

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 **READING CHECK**

**11. Explain** What gives many gemstones their color?

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Diamonds are some of the most valuable gemstones. They are used in jewelry and in other items, such as this scepter.

# Section 3 Review

## SECTION VOCABULARY

<b>ore</b> a natural material whose concentration of economically valuable minerals is high enough for the material to be mined profitably	<b>reclamation</b> the process of returning land to its original condition after mining is completed
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**1. Define** Write your own definition for ore.

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**2. Describe** Fill in the spaces in table to describe metals and nonmetals.

Type of material	Main features	Common objects made from it
metal	has shiny surfaces does not transmit light transmits heat and electricity easily can be rolled into sheets or stretched into wires	
nonmetal		

**3. List** What are three ways minerals can form?

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**4. Identify** Give three types of surface mines and an example of the kind of material that each is used to mine.

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