

Section 2

Rock and Mineral Resources

Key Concept Minerals and ores are important sources of materials that are used to make common objects.

What You Will Learn

- Minerals are naturally formed, crystalline solids that form in a variety of environments.
- Ore is mined to remove rocks and minerals from Earth so that the rocks and minerals can be used to make a variety of objects.

Why It Matters

Many of the objects you use every day are made from minerals.

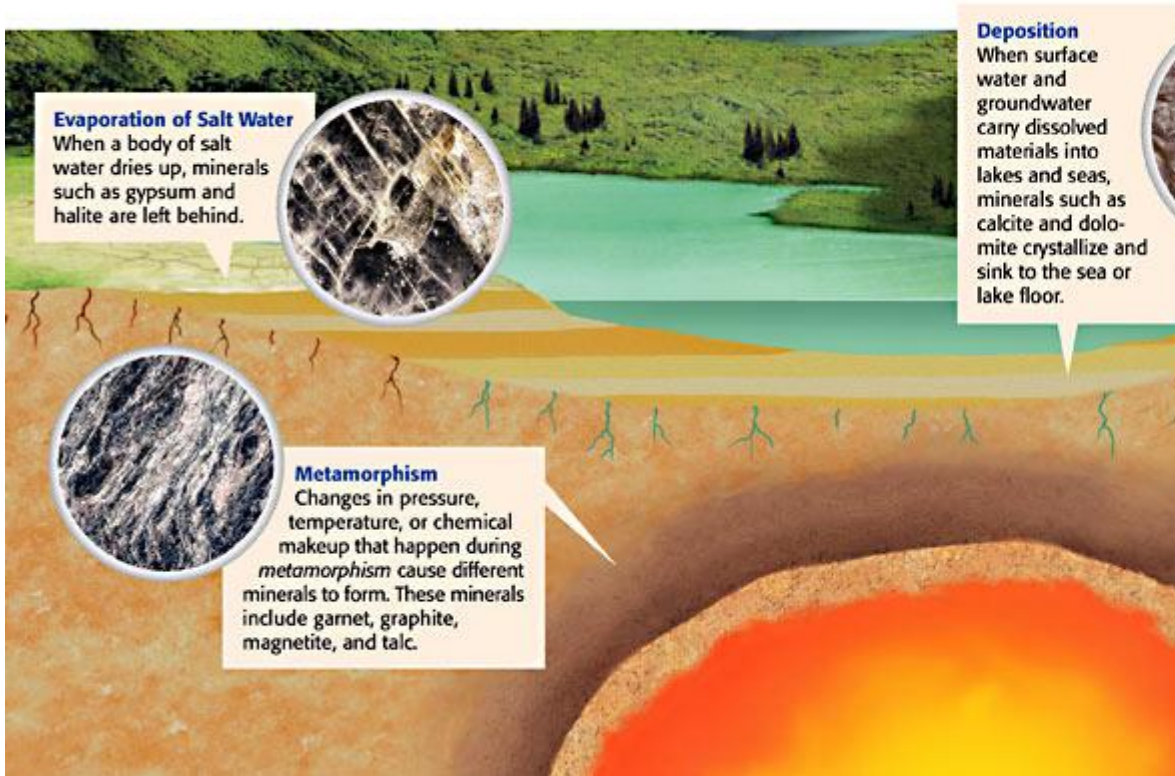
You use things made from minerals every day. For example, the fluoride in your toothpaste comes from the mineral fluorite. But what are minerals? Are minerals the same as rocks?

Minerals and Rocks

A **mineral** is a naturally formed, usually inorganic solid that has a crystalline structure. Minerals form in a variety of environments in Earth's crust, as shown in **Figure 1**. Different minerals form in these environments depending on the physical conditions and the chemicals present. Most minerals form very slowly. Some minerals take millions of years to form.

Rock is the natural material that makes up most of the solid part of Earth's surface. A rock may be a collection of one or more minerals. A rock can also include solid, nonmineral material such as coal or volcanic glass.

Figure 1 How Minerals Form



Standards Check List five ways that minerals form.

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Characteristics of Minerals

So, what makes a mineral a mineral? Geologists use five main characteristics to identify a mineral.

- Geologists define minerals as being naturally formed. If a diamond is made in a laboratory, it

is called a *synthetic diamond* to distinguish it from a naturally formed mineral.

- Minerals are also solids. So, the ice in a glacier is a mineral, but liquid water is not a mineral.
- Minerals usually form by inorganic processes. In other words, they are usually not formed by or from living things. Coal is not a mineral because it forms from the remains of plants.
- Minerals are crystals. Crystals are solids whose particles, such as atoms or ions, are arranged in repeating and regular geometric patterns. Volcanic glass is not a mineral because the atoms in glass are not arranged in any pattern. In other words, volcanic glass is not crystalline.
- Minerals have consistent chemical compositions. For example, every sample of the mineral fluorite is made of calcium and fluorine atoms. The chemical composition of minerals is what makes some of them valuable resources.

Mining

Many kinds of rocks and minerals are mined from the ground so they can be made into objects we need. Geologists use the term **ore** to describe a deposit that is large enough and has enough of the desired material to be mined for profit. Rocks and minerals are removed from the ground by one of two methods—surface mining or subsurface mining. The method miners choose depends on how close to the surface the ore is located.

Standards Check Why do we mine rocks and minerals?



Surface Mining

If ore is found at or near the surface of Earth, surface mining is used to remove the ore. Types of surface mines include open-pit mines, quarries, and strip mines.

Open-pit mining is used to remove large, near-surface deposits of valuable minerals such as gold and copper. As shown in **Figure 2**, ore is mined from the top down in an open-pit mine. Explosives are often used to break up the overlying rock and the ore.

The ore is then loaded into haul trucks and transported from the mine for processing. Quarries are open pits that are used to mine building stone, crushed rock, sand, and gravel. Coal that is near the surface is removed by surface coal mining. Surface coal mining is sometimes known as *strip mining* because the coal is removed in strips that may be 50 m wide and as long as 1 km.



Figure 2 In open-pit mines, the ore is mined downward in layers. The stair-step excavation of the walls keeps the sides of the mine from collapsing. Giant haul trucks (inset) are used to transport ore from the mine.

Subsurface Mining

Subsurface mines are used when ore is too deep within Earth to be surface mined. As shown in **Figure 3**, subsurface mining requires that tunnels be dug into the ground horizontally or at an angle. If a mineral deposit extends deep within Earth, however, a vertical shaft is sunk. This shaft may connect tunnels that intersect the ore at different levels. Iron, coal, and salt can be mined in subsurface mines.

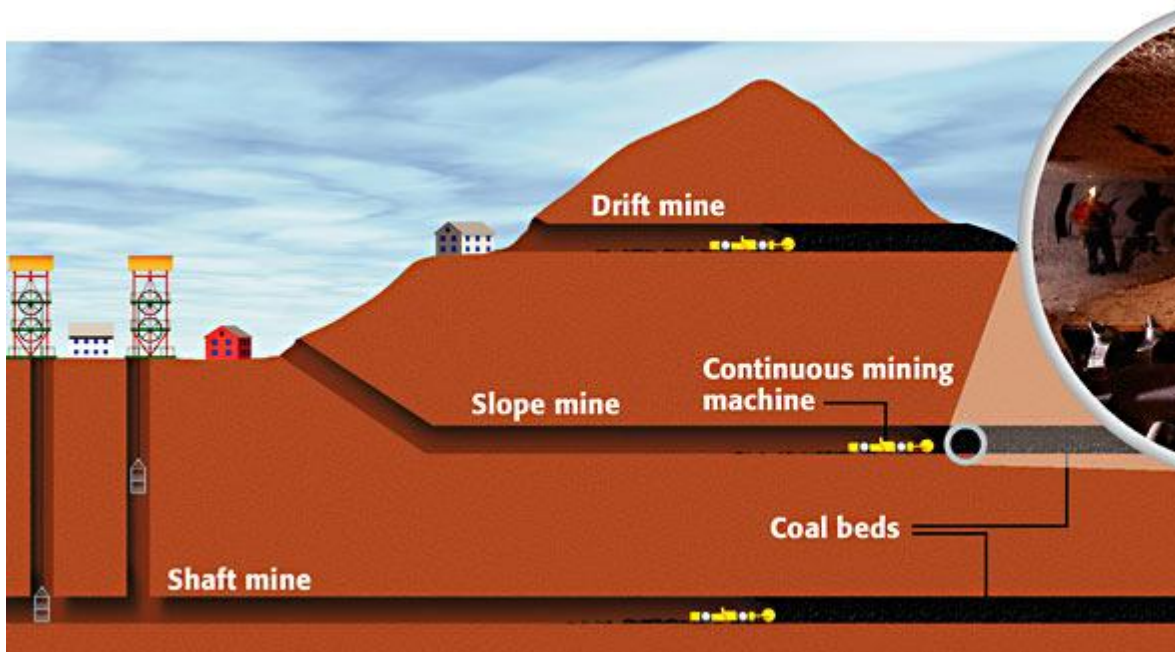


Figure 3 In subsurface mining, machines such as continuous mining machines (inset) are used to extract ore and load it onto conveyors or shuttle cars.

Responsible Mining

Mining gives us resources we need, but it may also create problems. Mining can destroy or disturb the habitats of plants and animals. Also, waste products from a mine may get into water sources and pollute surface water and groundwater.

The harmful effects of mining can be reduced by returning the land to its original state when mining is completed. The process by which land used for mining is returned to its original state or better is called *reclamation*. Reclamation of land used for mining has been required by law since the mid-1970s. Another way to reduce the harmful effects of mining is to reduce our need for the resources being mined.

Making Common Objects

As shown in **Table 1**, materials from Earth are used to make many common objects. Some minerals, such as diamonds, can be used as they are. But most materials, such as bauxite, must be processed. Bauxite is used to produce the metal aluminum.

Table 1 Common Uses of Minerals and Rocks	
Material	Uses
Copper	electrical wire, plumbing, coins
Diamond	jewelry, cutting tools, drill bits
Galena	lead in batteries, ammunition
Bauxite	aluminum cans, foil, appliances, utensils
Gold	jewelry, computers, spacecraft, dentistry
Gypsum	wallboards, plaster, cement
Halite	salt for nutrition, highway de-icer, water softener
Quartz	glass, silicon for computer chips
Silver	photography, electronic products, jewelry
Sphalerite	zinc for jet aircraft, spacecraft, paints

Metals

Some minerals or products obtained from minerals are metals. Metals have shiny surfaces, are opaque to light, and are good conductors of heat and electricity. Some metals and mixtures of metals are strong and do not rust. Other metals can be pounded or pressed into different shapes or stretched thinly without breaking. These properties make metals useful in aircraft, automobiles, computers, and spacecraft.

Figure 4 shows some parts of a bicycle that are made from metals.
Figure 4 Some Materials Used in the Parts of a Bicycle Frame



Nonmetals

Other minerals and materials are nonmetals. Nonmetals have shiny or dull surfaces, may be translucent to light, and are good insulators of heat and electricity. Nonmetallic minerals are some of the most widely used minerals. For example, calcite is a major component of cement. Cement is used in roads, buildings, bridges, and other structures. Sand is a source of silica, which has uses that range from making glass to producing computer chips. The mineral gypsum is shown in **Figure 5**. Gypsum is used to make fertilizer, plaster board for construction, and plaster of Paris.



Figure 5 This gypsum rose is one form of the mineral gypsum.

Standards Check List two nonmetallic minerals and a common object that can be made from each of the minerals.



Section Summary

- A mineral is a naturally formed, inorganic solid that has a definite crystalline structure and a consistent chemical composition.
- Environments in which minerals form may be located at or near Earth's surface or deep below the surface.
- Two types of mining are surface mining and subsurface mining.
- Two ways to reduce the harmful effects of mining are through the reclamation of mined land and the recycling of mineral products.
- Both metals and nonmetals are used to make common objects.

