

# Minerals

## What is a mineral?


### ..... Before You Read .....

<b>What do you think?</b> Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.		
Before	Statement	After
	1. A mineral is anything solid on Earth.	
	2. Some minerals form when water evaporates from Earth's surface.	

### ..... Read to Learn .....

## What is a mineral?

When you woke this morning, minerals probably were not the first things you thought about. But minerals are part of your everyday life.

Minerals make up many of the things you use daily. Deodorant, shampoo, and makeup are made from minerals. Anything made of metal comes from minerals. Your belt buckle, jewelry, and zippers on your clothes came from minerals. The salt you put on food is a mineral. A **mineral** is a naturally occurring, inorganic solid with a definite chemical composition and an orderly arrangement of atoms or ions. 

There is a difference between rocks and minerals. Rocks often contain two or more minerals. A mineral is made of only one substance.

### Naturally Occurring

From the tops of the tallest mountains to the sediments on the seafloor, minerals are everywhere. There are about 4,000 natural minerals on Earth. Only about 30 minerals are common. Ten of these are called the rock-forming minerals. These minerals occur naturally. They are not made in a laboratory. Quartz, feldspar, and olivine are three of the rock-forming minerals.

### Key Concepts

- What is a mineral?
- What are the common rock-forming minerals?
- How do minerals form?

### Mark the Text

**Identify Main Ideas** As you read, underline the main ideas under each heading. After you finish reading, review the main ideas that you have underlined.

### Key Concept Check

**1. Identify** What is a mineral?

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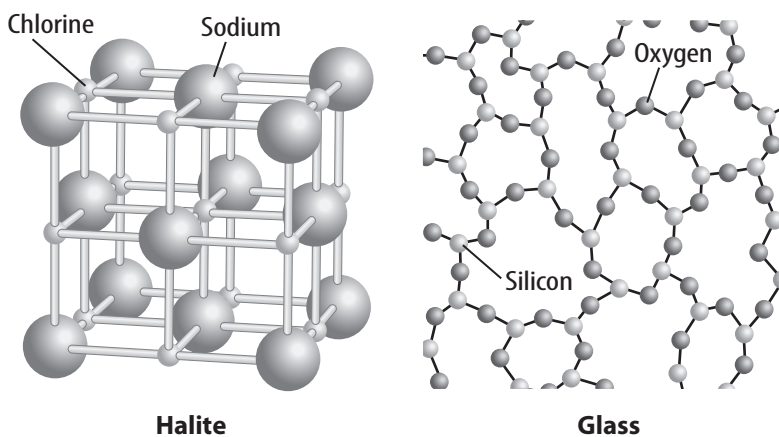
## Definite Chemical Composition

Minerals have a definite chemical composition. For example, the mineral hematite has the chemical formula  $\text{Fe}_2\text{O}_3$ . If you look at the periodic table of the elements, you can see that these symbols represent the elements iron (Fe) and oxygen (O). Any material made of two parts iron and three parts oxygen is called hematite. Some minerals, such as silver (Ag) and sulfur (S), are composed of just one element. These are called native elements. Other minerals, such as potassium feldspar ( $\text{KAlSi}_3\text{O}_8$ ), are made up of many elements.

## Crystalline Form

Scientists often identify minerals by their crystal patterns. Minerals form predictable crystal patterns. The internal arrangement of atoms or ions determines the shape of a crystal. Try to look at salt crystals closely. You might notice that the small salt crystals form cubes. All salt has the same pattern. The pattern is not random.

The salt that you add to food often contains a mineral called halite. The arrangement of atoms in halite is shown in the figure below on the left. The repeating arrangement of atoms in three directions makes halite a crystal. The figure on the right shows the arrangement of the atoms in glass. What differences do you notice? Halite, a mineral, has a cubic, crystal pattern. The silicon and oxygen atoms in glass are not arranged in an orderly, repeating pattern. ✓



## Solid

All minerals are solids but not all solids are minerals. A solid is matter with tightly packed atoms or ions. It has a definite shape and volume. To be a mineral, a solid must have a crystal form. Solids without crystal form, liquids and gases, are not minerals.

### SCIENCE USE V. COMMON USE

#### crystal

**Science Use** a solid of a chemical substance with a regular, repeating arrangement of its atoms

**Common Use** a clear, colorless glass of superior quality

### ✓ Reading Check

**2. Explain** Why is glass not a crystalline form?

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### ✓ Visual Check

**3. Identify** Circle the arrangement of atoms in the figure that makes up a crystalline solid.

## Inorganic

Minerals are inorganic, or not from biological origins. Minerals occur in different environments and can be caused by evaporation. Gypsum forms in an environment where water evaporates. Some minerals form through organic processes. For example, marine organisms can use dissolved solids from seawater to make their shells. 

## The Structure of Minerals

You learned that minerals have definite crystalline forms. The shape of the crystal reflects the internal arrangement of atoms or ions. For example, quartz crystals are long and have pointed ends. Calcite crystals are diamond shaped with sets of parallel sides. 


### Crystal Shape

Minerals occur in many different shapes. Sometimes, when a crystal has time to grow under the right conditions, it forms a characteristic crystal shape. The lead and sulfur ions in galena form cubes. Therefore, a galena crystal has a characteristic cubic shape.

Minerals do not always exist in large, well-developed geometric shapes. Most of the time, minerals grow in tiny clusters. Scientists can see the shape of tiny crystals by using X-ray images.

### Common Minerals

Common rock-forming minerals are combinations of elements that are plentiful in Earth's crust. Oxygen and silicon are the most plentiful elements. Pure quartz is composed of only oxygen and silicon.

Silicates and nonsilicates are the two main families of rock-forming minerals. Quartz ( $\text{SiO}_2$ ) is known as a silicate mineral. A **silicate** is a member of the mineral group that has silicon and oxygen in its crystal structure. Feldspar is the most common silicate mineral in Earth's crust. The nonsilicate family is made up of minerals that do not contain silicon. Halite and calcite are nonsilicates. 

## How do minerals form?

Minerals form in many environments. All minerals form through a process called crystallization. *The process of **crystallization** occurs when particles dissolved in a liquid or in a melt solidify and form crystals.* Mineral crystallization can occur in hot or cool solutions. The chemical and physical properties of minerals can help geologists infer the type of environment where these minerals formed.

### Key Concept Check

**4. Identify** the five main characteristics of a mineral.

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### Reading Check

**5. Explain** What can geologists infer from the shape of a mineral?

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### Key Concept Check

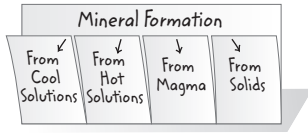
**6. Identify** What are the two main families of rock-forming minerals?

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## FOLDABLES®

Make a vertical four-tab book and label it. Record information on mineral formation under each tab.



### ✓ Reading Check

**7. Describe** How does a vein of gold form?

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### 🔑 Key Concept Check

**8. Identify** the ways minerals can form.

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## Minerals from Cool Solutions

Water from rain or melted snow seeps into the ground or flows over Earth's surface. The water interacts with minerals in rocks and soil. The water dissolves some minerals. It also picks up elements such as potassium, calcium, and iron. These elements become dissolved solids.

Water can hold only a certain amount of dissolved solids. During dry conditions, the water evaporates and the solids crystallize out of the water and form minerals.

Sometimes minerals can crystallize from water in wet environments. For example, seawater can become saturated with dissolved salts. The seawater cannot hold any more salt. Some marine organisms can remove these salts from seawater and form protective shells or build coral reefs.

## Minerals from Hot Solutions

Water on Earth's surface can flow through cracks in the crust into deep and hot environments. Hot-water solutions can contain dissolved solids that eventually form valuable mineral deposits. For example, a vein of gold can form in this way. When the conditions are right, gold crystallizes from the hot-water solution. The gold fills in cracks in the rock and forms a vein. ✓

## Minerals from Magma

As a volcano erupts, it produces molten rock. **Magma** is molten rock stored beneath Earth's surface. When molten rock erupts on or near Earth's surface, it is called **lava** or ash. As lava or ash cools above ground and magma cools underground, atoms and ions arrange themselves and form mineral crystals. Crystals differ in size depending on the cooling rate of the magma, lava, or ash. Small crystals usually form as lava cools quickly. Large crystals sometimes form as magma cools and crystallizes slowly below Earth's surface.

## Changes in Minerals

Some minerals form deep in Earth's crust and mantle. They are stable under high-pressure and high-temperature conditions. Metamorphic activity can uplift minerals from great depths. These minerals become unstable when they are exposed at Earth's surface. These minerals can break down through erosion or when pressure and temperature change. Minerals can be used to interpret the conditions under which they formed. Olivine forms under high temperatures and high pressure. Quartz forms in less-extreme conditions. Olivine and quartz rarely occur in the same rock. ✓🔑

..... **After You Read** .....

### Mini Glossary

**crystallization:** a process that occurs when particles dissolved in a liquid or a melt solidify and form crystals

**lava:** magma that erupts on or near Earth's surface

**magma:** molten rock stored beneath Earth's surface

**mineral:** a naturally occurring, inorganic solid with a definite chemical composition and an orderly arrangement of atoms or ions

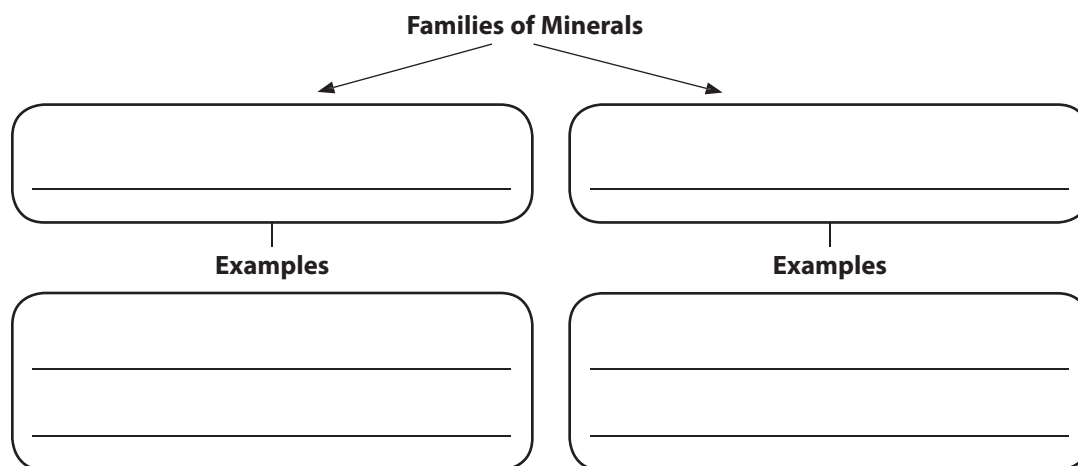
**silicate:** a member of the mineral group that has silicon and oxygen in its crystal structure

1. Review the terms and their definitions in the Mini Glossary. Write a sentence describing how minerals form.

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2. Complete the chart below by naming the two main families of rock-forming minerals. Then give two examples of each.



3. Identify three ways minerals form.

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### What do you think **NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?



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**END OF LESSON**