

Unit 6 - Minerals

I. Properties of Minerals

When looking at different substances, to determine which is a mineral, you need to become familiar with the characteristics of a mineral.

A mineral is a naturally occurring, inorganic solid that has a crystal structure and a definite chemical composition.

A. Characteristics of Minerals

For a substance to become a mineral, it must have these five characteristics:

1. Naturally Occurring: it must be formed by processes in the natural world.

EX: The mineral quartz forms naturally as molten material cools and hardens deep beneath Earth's surface.

- a. Materials made by people, such as plastic, glass, brick, or steel are not minerals.

2. Inorganic: minerals cannot form from materials that were once part of a living thing.

EX: Coal forms naturally in Earth's crust.

But geologists do not classify coal as a mineral because it comes from the remains of plants that lived long ago.

3. Solid: A mineral is always a solid with a definite volume and shape.

4. Crystal Structure: The particles of a mineral line up in a pattern that repeats over and over again.

- a. The repeating pattern forms a crystal: a solid in which the atoms are arranged in a repeating pattern.
- b. A crystal has flat sides called faces.

5. Definite chemical structure: A mineral always contains certain elements in definite proportions.

- a. Almost all minerals are compounds.

EX: The mineral quartz has one atom of silicon for every two atoms of oxygen.

- b. Each compound has its own properties or characteristics, which usually differ greatly from the properties of the elements that form it.

- c. Some elements occur in nature in a pure form, and not as part of a compound with other elements.

EX: Copper, silver, & gold are also minerals.

- d. Almost all pure, solid elements are metals.

B. Identifying Minerals

Each mineral has characteristic properties that can be used to identify it. These properties can be observed, but others need to conduct a test to be observed.

1. Color: an easily observed physical characteristic, but color alone often provides too little information to make an accurate identification.

EX: Gold, pyrite, and chalcopyrite are all gold in color, yet only one is the real thing.

Malachite is always green; azurite is always blue.

2. Streak: the color of a mineral's powder.

a. You can observe a streak by rubbing a mineral against a piece of unglazed porcelain tile.

b. Even though the color of the mineral may vary, its streak doesn't vary.

EX: Although pyrite has a gold color, it always produces a greenish-black streak.

Real gold, on the other hand, produces a golden yellow streak.

3. Luster: the way a mineral reflects light on its surface.

a. Minerals containing metals are shiny.

EX: Galena has a bright, metallic luster
Quartz has a glassy luster.

b. Other terms used to describe luster are earthy, waxy, and pearly.

4. Density: the mass of an object in a given space ($\frac{\text{mass}}{\text{unit volume}}$)

a. No matter what the size of a mineral sample, the density of that mineral always remains the same.

b. You can compare the density of 2 mineral samples of about the same size by picking them up & hefting them; or feel their weight in your hands.

EX: If you have equal size samples of low-density quartz and high-density galena, the galena will be almost three times as heavy as quartz.

c. Heft only provides a rough measure of density.

To measure density, use the formula,
 $\text{density} = \text{mass} \div \text{volume} \quad (D = \frac{m}{V})$

5. Hardness: one of the best clues is the mineral's hardness.

Mohs hardness scale: a scale ranking ten minerals from softest to hardest; used in testing the hardness of minerals.

a. Hardness can be determined by a scratch test.
A mineral can scratch any mineral softer than itself, but can be scratched by any mineral harder than itself.

6. Crystal Systems: The crystals of each mineral grow atom by atom to form that mineral's crystal structure.

a. Geologists classify these structures into six groups based on the number and angle of the crystal faces.

EX: Halite's crystal structure is cubic.

Quartz's crystal structure is hexagonal.

7. Cleavage and Fracture:

Cleavage is a mineral's ability to split easily along flat surfaces.

a. Whether a mineral has cleavage depends on how the atoms in its crystals are arranged.

EX: Mica separates easily in only one direction (forms flat sheets).

b. Most minerals do not split apart evenly instead, they have a characteristic type of fracture.

Fracture is the way a mineral looks when it breaks apart in an irregular way.

EX: Quartz has a shell-shaped fracture
Pure metals, like copper and iron, have a hackly fracture - they form jagged points.

8. Special properties: Some minerals can be identified by unique physical properties.

EX: Magnetite has magnetism

Fluorite has fluorescence.