

Minerals

Objectives

- **Describe** the structure of minerals.
- **Describe** the two major groups of minerals.

I. Mineral Structure

A. A **mineral** is a naturally formed, inorganic solid that has a definite crystalline structure.

B. You can tell whether an object is a mineral by asking four questions.

- Is it a nonliving material?
- Is it a solid?
- Does it have a crystalline structure?
- Is it formed in nature?



I. Mineral Structure

- To understand what a crystalline structure is, you need to know a little about the elements that make up a mineral.

C. **Elements** are pure substances that cannot be separated or broken down into simpler substances by chemical means.

Periodic Table of the Elements

Legend:

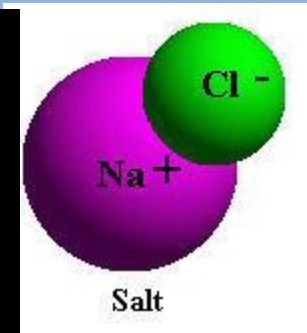
- hydrogen
- alkali metals
- alkali earth metals
- transition metals
- poor metals
- nonmetals
- noble gases
- rare earth metals

1 H																	2 He														
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne														
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar														
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr														
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe														
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn														
87 Fr	88 Ra	89 Ac	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Unn																						
																		58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
																		90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

I. Mineral Structure

D. **Atoms and Compounds** Minerals may be either elements or compounds.

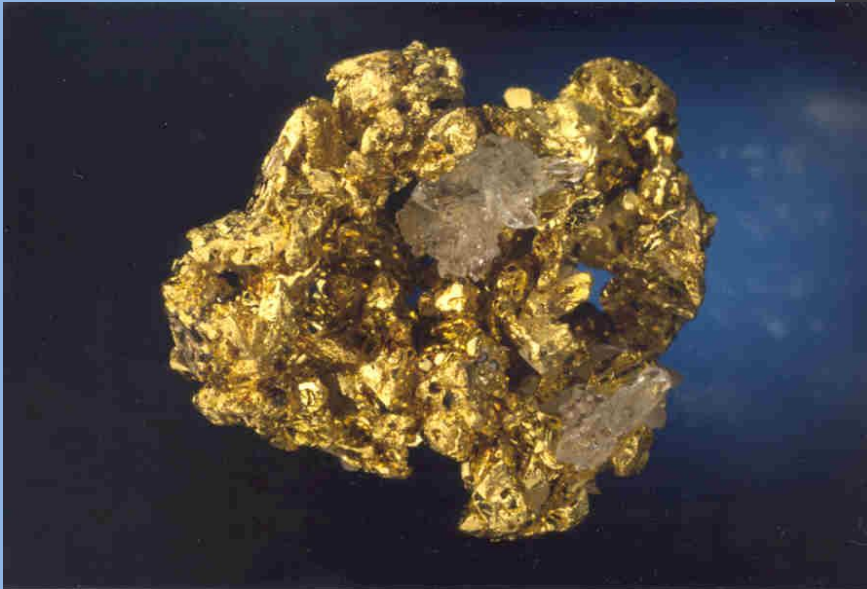
E. A **compound** is a substance made of atoms of two or more different elements joined by chemical bonds.



I. Mineral Structure

F. A mineral that is composed of only one element is called a **native element**.

G. Gold and silver are examples of native elements.



II. Identifying Minerals

- You can determine the identity of a mineral by noting different properties.

A. **Color** Minerals display a wide variety of colors, and often the same mineral can be found in many different colors.

- Because of this, color is usually not the best way to identify a mineral.



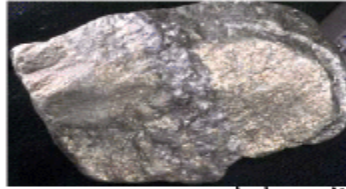
II. Identifying Minerals

B. The way a mineral reflects light is called **luster**. There are three types of mineral luster:

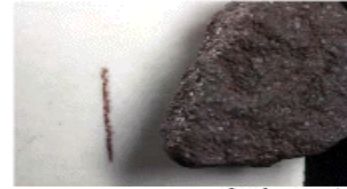
- **Metallic**
- **Submetallic**
- **Nonmetallic**

Mineral Luster

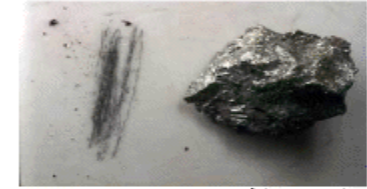
Metallic



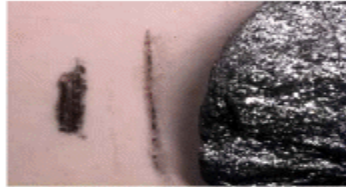
chalcopyrite



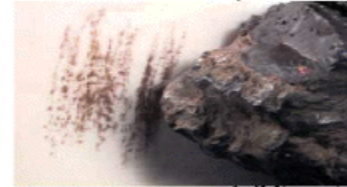
earthy hematite



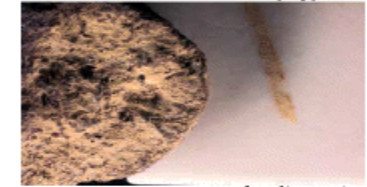
shiny pyrite



specular hematite



dull limonite



earthy limonite

BELOW all NON-METALLIC

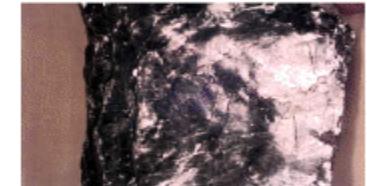
Shiney



apatite



calcium plagioclase

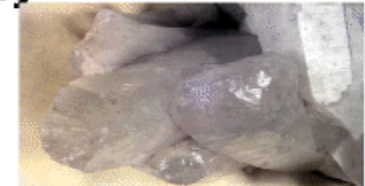


biotite

Glassy



quartz



quartz

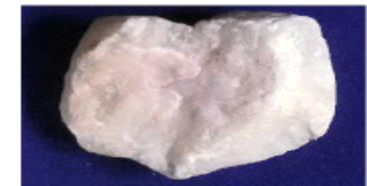
Earthy



kaolinite



bauxite



gypsum

II. Identifying Minerals

- C. The color of a mineral in powdered form is called the mineral's **streak**.
- A mineral's streak can be found by running the mineral against a piece of unglazed porcelain called a streak plate.
 - The color of a mineral's streak is not always the same as the color of the mineral sample.



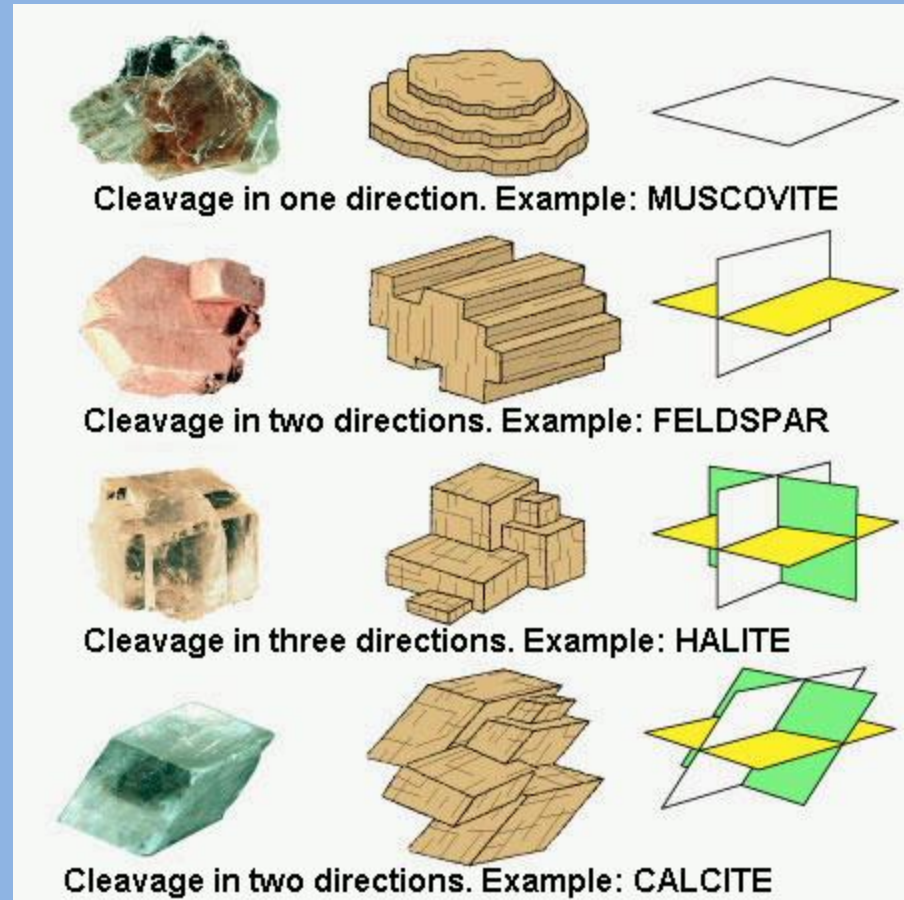
Streak plate test comparison of hematite and pyrite.

II. Identifying Minerals

- Different types of minerals break in different ways.

D. **Cleavage** is the tendency of some minerals to break along smooth, flat surfaces.

E. **Fracture** is the tendency of some minerals to break unevenly along curved or irregular surfaces.



II. Identifying Minerals

F. A mineral's resistance to being scratched is called **hardness**.

- To determine the hardness of minerals, scientists use Mohs hardness scale.

Mohs Hardness Scale

A mineral's number indicates its relative hardness. The scale ranges from 1, which is the softest, to 10, which is the hardest. A mineral of a given hardness will scratch any mineral that is softer than it is.



1

Talc



2

Gypsum



3

Calcite



4

Fluorite



5

Apatite



6

Orthoclase



7

Quartz



8

Topaz



9

Corundum



10

Diamond

MINERALS

HARDNESS

COMMON TEST

Diamond

10

Scratches all common material

Corundum

9

Topaz

8

Quartz

7

Feldspar

6

Scratches a knife blade
or window glass

Apatite

5

Fluorite

4

Scratched by knife blade
or window glass

Calcite

3

Scratched by copper coin

Gypsum

2

Talc

1

Scratched by finger nails

II. Identifying Minerals

G. Density is the measure of how much matter is in a given amount of space. Density is a ratio of an object's mass to its volume.

- Different minerals have different densities.

Mineral	Density (g/cm ³)
corundum	4.0
galena	7.6
hematite	5.3
quartz	2.7

Special Properties

Special Properties of Some Minerals



Fluorescence

Calcite and fluorite glow under ultraviolet light. The same fluorite sample is shown in ultraviolet light (top) and in white light (bottom).



Chemical Reaction

Calcite will become bubbly, or "fizz," when a drop of weak acid is placed on it.



Optical Properties

A thin, clear piece of calcite placed over an image will cause a double image.



Magnetism

Both magnetite and pyrrhotite are natural magnets that attract iron.



Taste

Halite has a salty taste.



Radioactivity

Minerals that contain radium or uranium can be detected by a Geiger counter.

III. Formation of Minerals

A. Minerals form in a variety of environments in the Earth's crust. Each environment has a different set of physical and chemical conditions that determine the minerals' properties.



B. **Evaporating Salt Water**
When a body of salt water dries up, minerals such as gypsum and halite are left behind.



III. Formation of Minerals

C. Metamorphic Rocks When changes in pressure, temperature, or chemical makeup alter a rock, metamorphism takes place.

D. Minerals that form in metamorphic rock include calcite, garnet, graphite, hematite, magnetite, mica, and talc.



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III. Formation of Minerals

- E. **Limestones** Surface water and groundwater carry dissolved materials into lakes and seas, where they crystallized on the bottom.
- F. Minerals that form in this environment include calcite and dolomite.



III. Formation of Minerals

G. Hot-Water Solutions Groundwater works its way downward and is heated by magma, and then reacts with minerals to form a hot liquid solution.

H. Dissolved metals and other elements crystallize out of the hot fluid to form new minerals, such as gold, copper, sulfur, pyrite, and galena.



III. Formation of Minerals

I. **Pegmatites** As magma rises upward from the Earth's crust, it can form teardrop-shaped bodies called pegmatites.

J. Many gemstones such as topaz and tourmaline, form in pegmatites.



III. Formation of Minerals

K. Plutons As magma rises upward through the crust, it sometimes stops moving before it reaches the surface and cools slowly, forming millions of mineral crystals.



J. Eventually, the entire magma body solidifies, forming minerals such as mica, feldspar, magnetite, and quartz.

IV. Mining

- A. Many kinds of rocks and minerals must be mined to extract the valuable elements they contain.
- B. Geologists use the term **ore** to describe a mineral deposit large enough and pure enough to be mined for profit.
- C. Rocks and minerals are removed from the ground by one of two methods.



V. Mining

D. Surface Mining When mineral deposits are located at or near the surface of the Earth, surface-mining methods are used to remove the minerals.

E. Types of surface mines include open pits, surface coal mines, and quarries.



V. Mining

F. Subsurface Mining methods are used when mineral deposits are located too deep within the Earth to be surface mined.

G. Subsurface mining often requires that passageways be dug into the Earth to reach the ore.



VI. The Use of Minerals

- A. Metallic Minerals** are good conductors of heat and electricity. They can be processed for various uses, including building aircraft, automobiles, and communications and electronic equipment.
- B.** Examples of useful metallic minerals include gold, silver, and copper.



VI. The Use of Minerals

C. Nonmetallic Minerals are good insulators of electricity. They have uses that range from glass-making to producing computer chips.

D. Calcite, one nonmetallic mineral, is a major component of concrete, which is used in building roads, buildings, bridges and other structures.



VI. The Use of Minerals

- E. Gemstones** are highly valued for their beauty and rarity, rather than for their usefulness.
- F.** Important gemstones include diamond, sapphire, ruby, emerald, aquamarine, topaz, and tourmaline.

