

## **SUMMARY NOTES ON MINERALS, ROCKS, AND RESOURCES**

Mineral - any naturally occurring, inorganic solid with distinct physical and chemical properties

Facts about minerals:

All minerals are composed of elements

- a. element - a substance made up of only one type of atom - a pure substance
- b. there are over 100 types of elements on Earth - only a few are common
  - 1) oxygen and silicon are the most common by mass, oxygen and potassium by volume
2. Minerals are homogeneous - the same throughout - uniform
3. No 2 different minerals have completely identical mineral properties
4. Most rocks have a number of minerals in common - a limited number of minerals are commonly found in many different rocks

B. Mineral Properties - there are 7 used in mineral identification

1. Hardness - a mineral's resistance to being scratched - NOT brittleness
  - a. the Scale of Hardness - a way of arranging minerals from softest to hardest by assigning a number to them - they range from 1 to 10
  - b. soft - the mineral can be scratched with your fingernail
  - c. medium - the mineral cannot be scratched by your fingernail but the mineral will not scratch a glass plate
  - d. hard - the mineral will scratch a glass plate

Luster - the way a mineral's surface will reflect light -

- a. metallic - the surface looks like metal
  - metallic minerals usually have a higher than average density, too
- b. non-metallic - the surface doesn't look like metal
3. Streak - the color of the powdered mineral sample
  - a. it's a useful property for minerals with a metallic luster
4. Cleavage - the tendency of a mineral to break along planes of internal atomic weakness which produce shapes with flat, shiny sides

fracture - the tendency of a mineral to break along planes of internal atomic weakness which produce shapes with jagged, uneven, non-flat sides p. 49 4.5

5. Specific Gravity - the ratio of the density of a substance to the density of water
- it's basically the same property as density
  - it can be used to distinguish between metallic and non-metallic lusters

Crystal Shape - a regularly shaped solid formed by an ordered pattern of atoms

- certain minerals form in shapes that are unique to that mineral

Color - the least useful and least reliable mineral property

- many minerals come in more than one color
- totally different minerals can have the same color
- some minerals don't have any color

NOTE: all mineral properties, except color, depend on the internal atomic arrangement of atoms or elements - how the atoms or elements are put together. Color is the only mineral property that depends on composition - what the mineral is made of rather than how it's put together.

C. Rocks - any collection of 1 or more minerals

Facts about rocks:

- Most rocks have a number of minerals in common
- Most rocks are heterogeneous - a mixture of different minerals
- Rocks are divided into 3 major classes on the basis of a genetic classification system  
a system of classification based on how something forms - a system based on origin
- Structure ( how a rock is put together), composition (what a rock is made of), and texture (grain size) are used to determine the environment in which a rock forms

D. Igneous Class - rocks formed from the cooling and solidification of molten materials

There are 2 sub-classes of igneous rocks:

- Intrusive/plutonic sub-class - molten materials cooled and solidified beneath the Earth's surface
  - magma - molten rock beneath the Earth's surface
  - coarse texture - large, easily visible, interlocking mineral grains

- 1) such rocks have a “speckled” appearance
- c. all such rocks form at a low rate of cooling (cooled over a long period of time) and under high pressures
- 2. Extrusive/volcanic sub-class - molten materials cooled on or above the surface of the Earth
  - a. lava - molten rock flowing on the surface or flying through the air
  - b. fine texture - small, invisible, interlocking mineral grains
    - 1) such rocks have a dull, uniform color and appearance
  - c. glassy texture - no individual mineral grains of any size - amorphous
    - 1) non-vesicular - massive, solid glass (regardless of color)
    - 2) vesicular - full of gas pockets or holes
  - d. all such rocks form at a high rate of cooling (cooled quickly) and under low, atmospheric pressure

Grain size in all igneous rocks depends on 3 factors:

- 1. Cooling Time - as cooling time increases, grain size increases
  - 2. Pressure/Depth of Formation - as the pressure/depth of formation increases, grain size increases
  - 3. Original Temperature of Molten Body - the higher the temperature of the original molten body, the longer it takes to cool and the larger the mineral grains
- felsic - contains a lot of aluminum - light colored and low density  
 mafic - contains a lot of iron and magnesium - dark colored and high density

E. How to identify a rock as igneous in origin:

- 1. Usually polyminerallic - composed of more than one mineral with a speckled look
- 2. Have interlocking mineral grains - fit together like pieces in a jig-saw puzzle
- 3. Have a spongy, porous appearance
- 4. Usually are made of hard minerals - will scratch a glass plate

F. Sedimentary class - rocks formed from the accumulation of pre-existing rock fragments and/or organic materials

pre-existing rock fragments = sediments produced by weathering

There are 3 sub-classes of sedimentary rocks:

- 1. Clastic sub-class - pre-existing rock fragments are lithified or bonded together

- a. the pre-existing rock fragments (sediments) are inorganic and land derived
  - b. the five rock types are differentiated on the basis of grain size
  - c. conglomerate and breccia have the greatest range of particles sizes
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- 2. Chemical sub-class - rocks formed from ions that are dissolved in sea water
  - a. they have a crystalline texture - small, interlocking grains - a smooth feel
  - b. they can form from the precipitation of ions (ions of opposite electrical charge combine to form a mineral grain) or as evaporates (deposits left behind when ancient oceans evaporate)
  - c. the three rock types are differentiated on the basis of composition
  - d. these are commonly monominerallic - composed of only one mineral type
- 3. Organic sub-class - rocks formed from biologic products or processes
  - a. these have a bioclastic texture - rough and containing biologic remains
  - b. there are only 2 - coal and limestone

G. How to identify a rock as sedimentary in origin:

- 1. they commonly look like sediments - the clastic sub-class, especially
- 2. they form in thick layers on the floor of a large body of water
- 3. the grains may be rounded or scratched - the clastic sub-class, especially
- 4. they may contain **fossils** - the organic sub-class
- 5. the chemical sub-class is an exception to #'s 1&3, above

H. Metamorphic class - rocks that have been changed by the action of heat, pressure, or interaction with chemical agents

NOTE: any class of rock can become metamorphic - even one type of metamorphic rock can be changed into another type of metamorphic rock  
 while heat is commonly involved in the metamorphic process, it is **never** enough to cause melting (melted rocks are igneous, not metamorphic)

There are 2 sub-classes of metamorphic rocks:

- 1. Regional sub-class - formed by the action of heat and pressure acting over wide geographic areas - mountain building episodes
- 2. Contact sub-class - formed at the interface of molten and non-molten rock

- a. heat and chemical interaction cause the non-molten rock to change - “baked”
- b. this sub-class is found separating igneous and sedimentary rocks - igneous, contact metamorphic, sedimentary is the order in which they’re found

Metamorphic rocks have 2 different textures, foliated and non-foliated

- 1. foliation - an alignment of mineral crystals - this alignment is seen in 2 forms:
  - a. thousands of paper-thin layers, one on top of another - slate, phyllite, and schist
  - b. banding - separate light and dark colored layers - gneiss
- 2. non-foliation - no alignment of crystals - a massive, uniform appearance

During the metamorphic process, 4 things can happen to the parent rock - the rock

before it undergoes metamorphism

- 1. the grains may become intergrown - they’re squeezed together - margins become indistinct
- 2. the density increases - any porosity in the parent rock is squeezed out or existence
- 3. the hardness increases
- 4. recrystallization - one mineral grain grows in size at the expense of surrounding mineral grains - garnets are an example
- 5. NOTE: the elements in the parent rock do **not** change during metamorphism - the metamorphic “offspring” has the same chemical composition as the “parent”

I. How to identify a rock as being metamorphic in origin:

- 1. color banding - alternating layers of different colored minerals - “stripes”
- 2. foliation - thousands of paper-thin layers, one on top of another
- 3. distorted structure - wavy bands of alternating minerals

J. The Rock Cycle - all rocks have come from other rocks - any rock can become a member of any other rock class

Igneous rocks - weathering & erosion - sediments - deposited, buried, compacted, & cemented -formed sedimentary rocks - heat & pressure - formed metamorphic rocks - melted - formed igneous rocks

While this is the **probable** path rocks take through the cycle, there are other, **possible**

paths

#### K. Rock Distribution

1. Sedimentary rocks are found between mountain ranges as a thin, veneer covering igneous bedrock
2. Non-sedimentary rocks are found in mountain ranges, volcanoes, and underlying the thin veneer of sedimentary rocks

#### L. Natural Resources - substances that come from the Earth - not distributed evenly

1. As the need for resources grows, they may become scarce - especially non-renewable resources like fuels and strategic metals
2. Scarcity leads to:
  - a. prices of the resource to rise
  - b. substitutes for the resource to be found
  - c. new ways of dealing with what we have - recycling, for example
3. Fossil fuels are a particularly important type of non-renewable resource
  - a. in the United States, petroleum is a particular problem
  - b. we must import over half of what we use yearly and we (USA) have only 3% of the world's reserves
  - c. a small number of nations around the Persian Gulf control over 50% of the world's reserves of oil
  - d. petroleum is used to manufacture: plastics, synthetic fabrics, medicines, insecticides, fertilizers, and detergents
  - e. economic and political decisions are influenced by our need for resources which we don't have