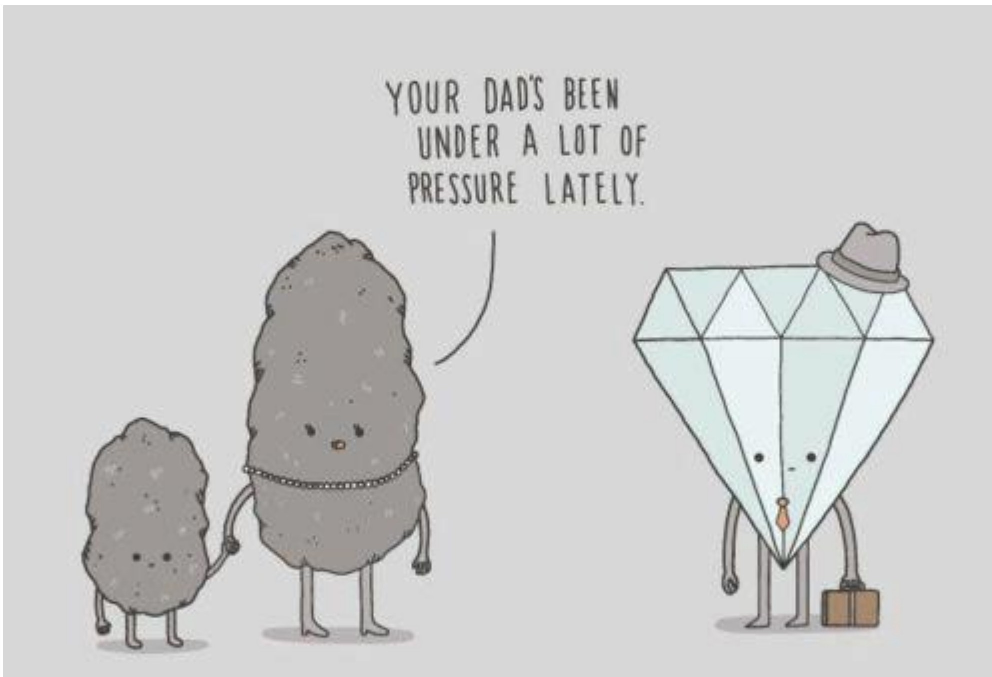
Earth Science 11: Earth Materials



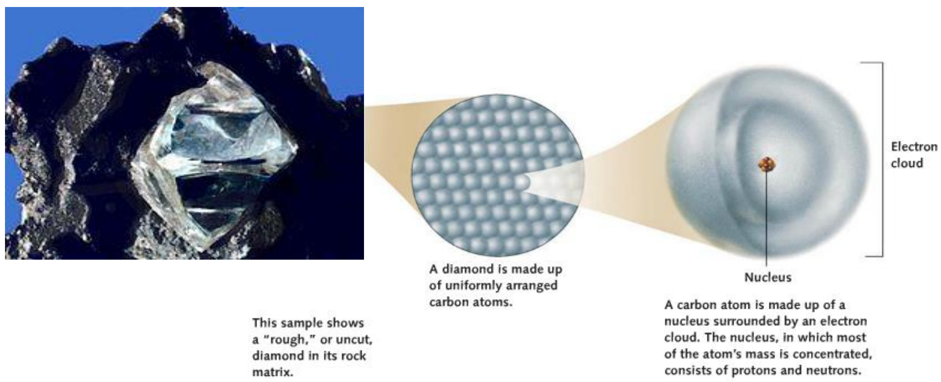
Name: ________________________________

Earth Science 11: Earth Materials: Minerals

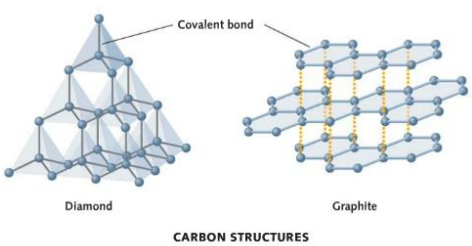
Textbook: Chapter 1

1.1: Matter and Atoms

- Everything with mass and volume is called **MATTER** , which is made up of **ELEMENTS**.
- Elements are made up of particles called **ATOMS**.



- the internal arrangement of atoms in a substance as this determines its properties.



GRAPHITE AND DIAMONDS ARE MADE UP OF CARBON, BUT THE BONDS BETWEEN THE CARBON ATOMS AER DIFFERENT – DETERMINES HOW HARD EACH MINERAL IS

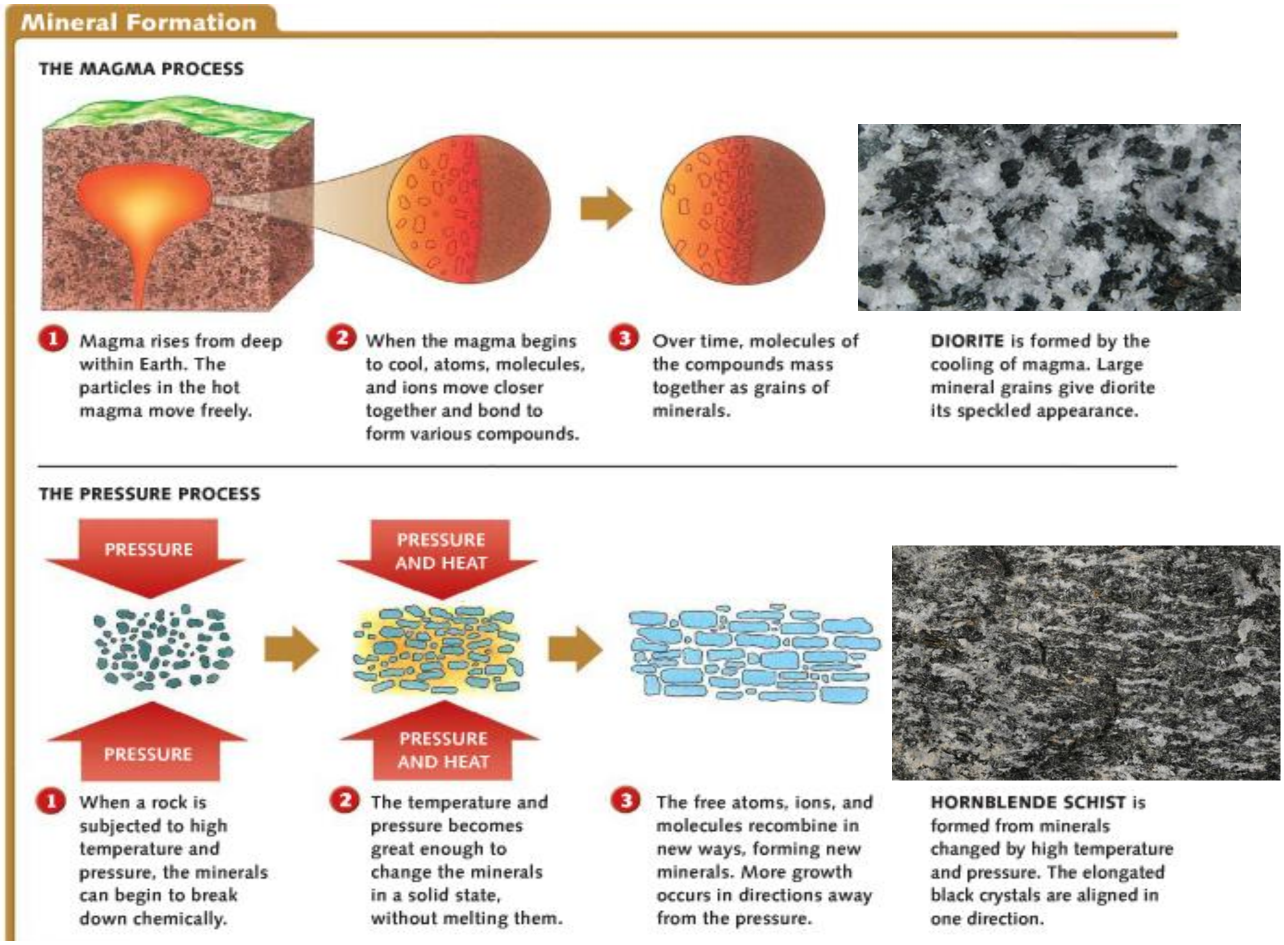
<u>What is a Mineral?</u>

Minerals have the following characteristics:

1. **NATURALLY OCCURING**
2. **SOLID**
3. **DEFINITE CHEMICAL COMPOSITION**
4. **INORGANIC (WAS NEVER ALIVE)**
5. **ATOMS ARRANGED IN AN ORDERLY PATTERN**

Mexico's Cueva de los Cristale

How do Minerals Form?

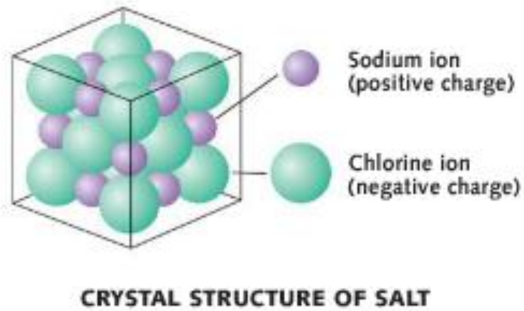


1.4: Properties of Minerals

Use workbook activities 1.1 – 1.5 (pg. 2 – 8) to investigate the properties used in mineral identification.

Structure of Minerals: Crystal Faces

- A crystal is a geometric solid with smooth surfaces called crystal faces.



- Ionic bonding between Na+ and Cl- ions results in a repeating pattern of each sodium ion being surrounded by six chlorine ions and each chlorine ion being surrounded by six sodium ions. Produces a cubic crystal (all Sodium Chloride crystals will have this shape!).
- Each mineral crystal has a unique shape that can be used to identify it.

Are crystal faces always present?

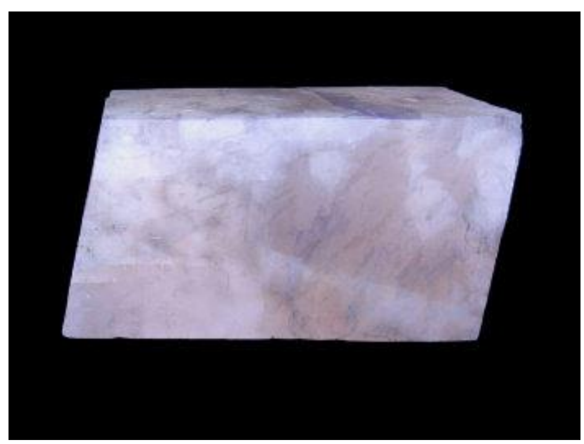
NO, ONLY IF THERE IS ENOUGH ROOM FOR THE CRYSTAL TO GROW WHEN FORMING

Structure of Minerals: Mineral Cleavage

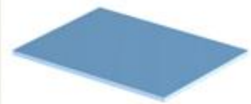
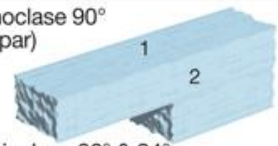
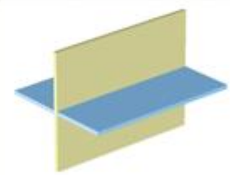
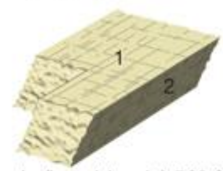
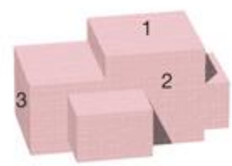
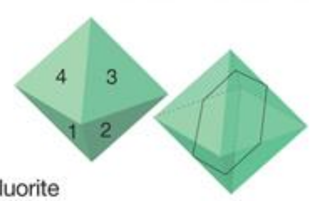
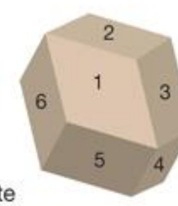
- Cleavage: **TENDENCY TO SPLIT ALONG PLANES OF WEAK BONDING**

Halite (NaCl): Cubic cleavage

Calcite ($CaCO_3$): Rhombohedral cleavage.



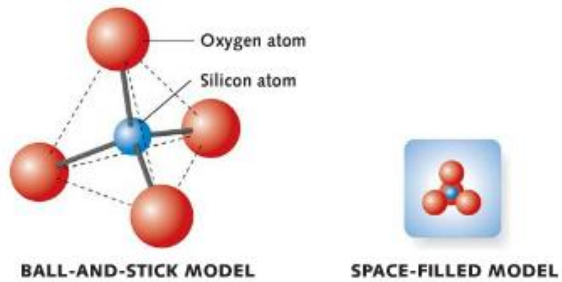
Complete Activity 1.6 (pg. 10 – 11) in your workbook

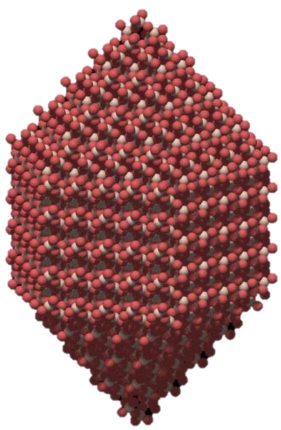
Number of Cleavages and Their Directions	Name and Description of How the Mineral Breaks	Shape of Broken Pieces (cleavage directions are numbered)	Illustration of Cleavage Directions
No cleavage (fractures only)	No parallel broken surfaces; may have conchoidal fracture (like glass)	 Quartz	None (no cleavage)
1 cleavage	**Basal (book) cleavage** "Books" that split apart along flat sheets	 Muscovite, biotite, chlorite (micas)	
2 cleavages intersect at or near 90°	**Prismatic cleavage** Elongated forms that fracture along short *rectangular* cross sections	Orthoclase 90° (K-spar)  Plagioclase 86° & 94°, pyroxene (augite) 87° & 93°	
2 cleavages do not intersect at 90°	**Prismatic cleavage** Elongated forms that fracture along short *parallelogram* cross sections	 Amphibole (hornblende) 56° & 124°	
3 cleavages intersect at 90°	**Cubic cleavage** Shapes made of cubes and parts of cubes	 Halite, galena	
3 cleavages do not intersect at 90°	**Rhombohedral cleavage** Shapes made of rhombohedrons and parts of rhombohedrons	 Calcite and dolomite 75° & 105°	
4 main cleavages intersect at 71° and 109° to form octahedrons, which split along hexagon-shaped surfaces; may have secondary cleavages at 60° and 120°	**Octahedral cleavage** Shapes made of octahedrons and parts of octahedrons	 Fluorite	
6 cleavages intersect at 60° and 120°	**Dodecahedral cleavage** Shapes made of dodecahedrons and parts of dodecahedrons	 Sphalerite	

1.5 Mineral Groups

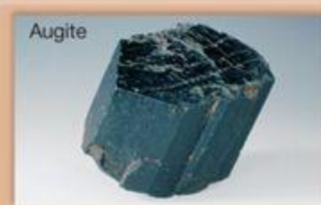
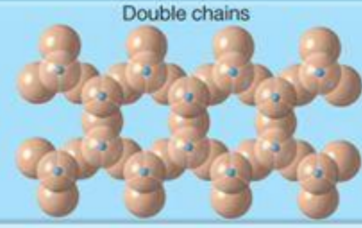
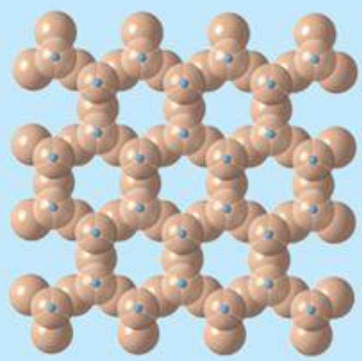
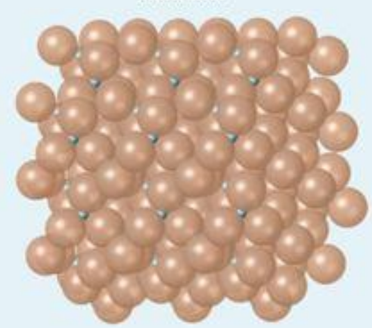
- Minerals composed of **OXYGEN** and **SILICA** are called silicates.
    - More than **90** % of Earth's crust are silicates
- Silica tetrahedrons are the **BASIC BUILDING BLOCKS** of silicates.

SILICA TETRAHEDRON
The arrangement of silica tetrahedra determines many properties of silicate minerals, including cleavage. Several arrangements are shown in the table on page 101. For all but the first arrangement, oxygen atoms are shared by adjacent tetrahedra.





- Arrangement of silica tetrahedrons in a silicate determines many minerals characteristics such as melting point, cleavage, hardness and density.

Mineral/Formula		Cleavage	Silicate Structure	Example
Olivine group $(Mg, Fe)_2SiO_4$		None	Independent tetrahedron 	
Pyroxene group (Augite) $(Mg,Fe)SiO_3$		Two planes at right angles	Single chains 	
Amphibole group (Hornblende) $Ca_2(Fe,Mg)_5Si_8O_{22}(OH)_2$		Two planes at 60° and 120°	Double chains 	
Micas	Biotite $K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$	One plane	Sheets 	
Micas	Muscovite $KAl_2(AlSi_3O_{10})(OH)_2$	One plane		
Feldspars	Potassium feldspar (Orthoclase) $KAlSi_3O_8$	Two planes at 90°	Three-dimensional networks 	
Feldspars	Plagioclase feldspar $(Ca,Na)AlSi_3O_8$	Two planes at 90°		
Quartz SiO_2		None		

Complete Mineral ID Lab (Activity 1.9 pg.13)