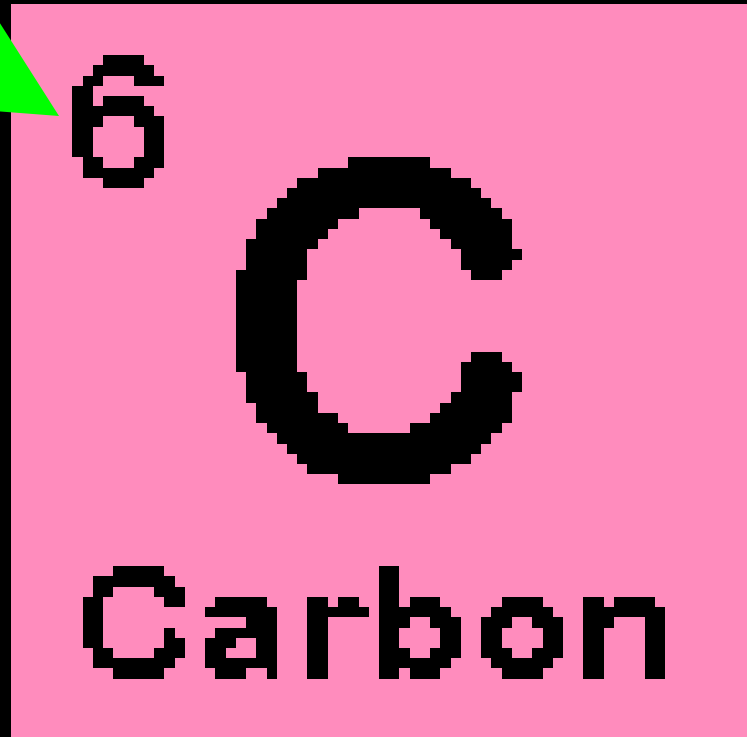


Warm-up Week 5 Day 1

Draw a complete Carbon Atom.

Label:

- Nucleus
- Protons (P^+)
- Neutrons (N^0)
- Electron Cloud
- Electrons (e^-)
- What would you add/remove to turn this into a Carbon $+2$ Ion?



“Minerals”



Chapter 2, Section 2

Gypsum Photo from MII, courtesy of the Smithsonian Institution

Minerals.

1. Natural
2. Solid
3. Orderly, crystalline structure
4. Definite chemical composition
5. “Inorganic”
 - No Carbon



How Minerals Form.

4 processes:

1. Crystallization from magma
2. Precipitation
3. Changes in pressure & temp^o
4. Hydrothermal solutions

Crystallization from Magma.

- As magma cools, elements combine to form minerals.



Precipitation.

1. Water evaporates
2. Dissolved substances react
3. Changes in water temp^o can make dissolved substances precipitate



Pressure and Temp°.

- **Crystals form due to environmental changes.**
 - Temp°
 - Pressure.



Encarta Encyclopedia, Photo
Researchers, Inc./Tom McHugh/CA
Academy of Science

Hydrothermal Solutions.

1. Water & dissolved particles
2. Very Hot!
3. Come into contact with existing minerals...
4. Chemical reactions!
5. New minerals!

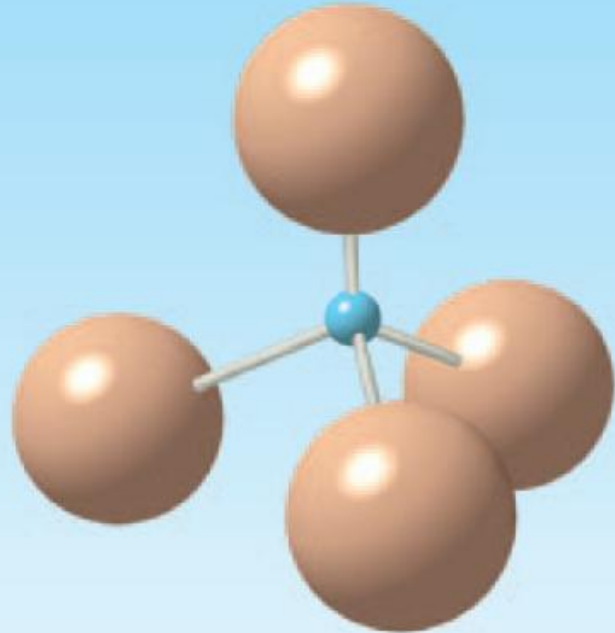
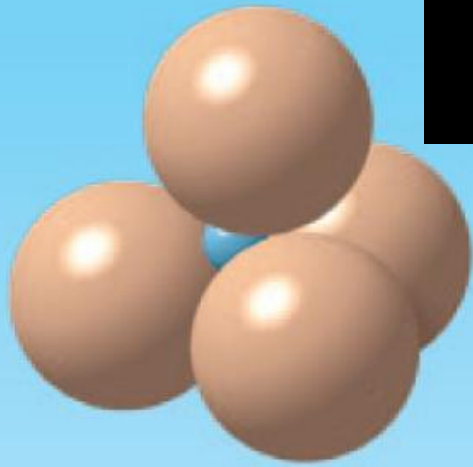


Mineral Groups.

Classification due composition.




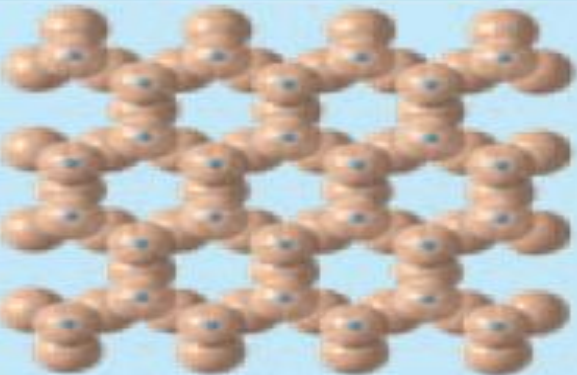
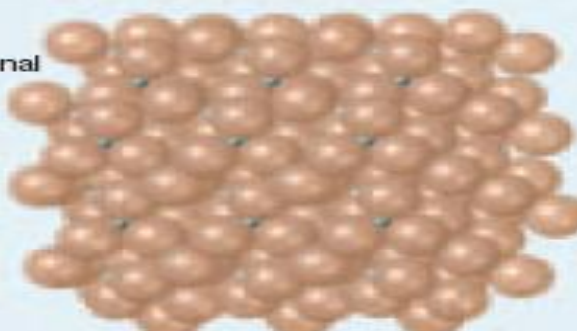
- 1. Silicates (Si)**
- 2. Carbonates (C)**
- 3. Oxides (O)**
- 4. Sulfates and Sulfides (S)**
- 5. Halides (Halogen ion⁻)**
- 6. Native Elements (pure)**

Silicates



Silicon + Oxygen → Silicon-oxygen Tetrahedron

Silicate Minerals

Mineral		Idealized Formula	Cleavage	Silicate Structure
Olivine		$(\text{Mg, Fe})_2\text{SiO}_4$	None	Single tetrahedron 
Pyroxene group (Augite)		$(\text{Mg, Fe})\text{SiO}_3$	Two planes at right angles	Single chains 
Amphibole group (Hornblende)		$\text{Ca}_2(\text{Fe, Mg})_5\text{Si}_6\text{O}_{22}(\text{OH})_2$	Two planes at 60° and 120°	Double chains 
Micas	Biotite	$\text{K}(\text{Mg, Fe})_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$	One plane	Sheets 
	Muscovite	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$		
Feldspars	Orthoclase (Potassium feldspar)	KAlSi_3O_8	Two planes at 90°	Three-dimensional networks 
	Plagioclase	$(\text{Ca, Na})\text{AlSi}_3\text{O}_8$		
Quartz		SiO_2	None	

Common nonsilicate mineral groups.			
Mineral Group	Name	Chemical Formula	Economic Use
Oxides	Hematite	Fe_2O_3	Ore of iron, pigment
	Magnetite	Fe_3O_4	Ore of iron
	Corundum	Al_2O_3	Gemstone, abrasive
	Ice	H_2O	Solid form of water
Sulfides	Galena	PbS	Ore of lead
	Sphalerite	ZnS	Ore of zinc
	Pyrite	FeS_2	Sulfuric acid production
	Chalcopyrite	CuFeS_2	Ore of copper
	Cinnabar	HgS	Ore of mercury
Sulfates	Gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Plaster
	Anhydrite	CaSO_4	Plaster
	Barite	BaSO_4	Drilling mud
Native elements	Gold	Au	Trade, jewelry
	Copper	Cu	Electrical conductor
	Diamond	C	Gemstone, abrasive
	Sulfur	S	Sulfa drugs, chemicals
	Graphite	C	Pencil lead, dry lubricant
	Silver	Ag	Jewelry, photography
	Platinum	Pt	Catalyst
Halides	Halite	NaCl	Common salt
	Fluorite	CaF_2	Used in steel making
	Sylvite	KCl	Fertilizer
Carbonates	Calcite	CaCO_3	Portland cement, lime
	Dolomite	$\text{CaMg}(\text{CO}_3)_2$	Portland cement, lime

Carbonates



Contain C, O, and metallic element(s).

Oxides



- **Oxygen + other element(s)**
- **usually metals**

Sulfates & Sulfides.



Gypsum Photo from MII, courtesy of the Smithsonian Institution

Contain the element sulfur.

Halides.



“Halogen” ion + other element(s)

Halogen = F, Cl, Br, I, At

Native Elements.



Native Copper Photo from MII, courtesy of the Smithsonian Institution

Group of minerals that exist in relatively **pure form**

Assignment.

- SA 2.2 (pg. 44-49)
- #1-5, 7 (pg. 49)

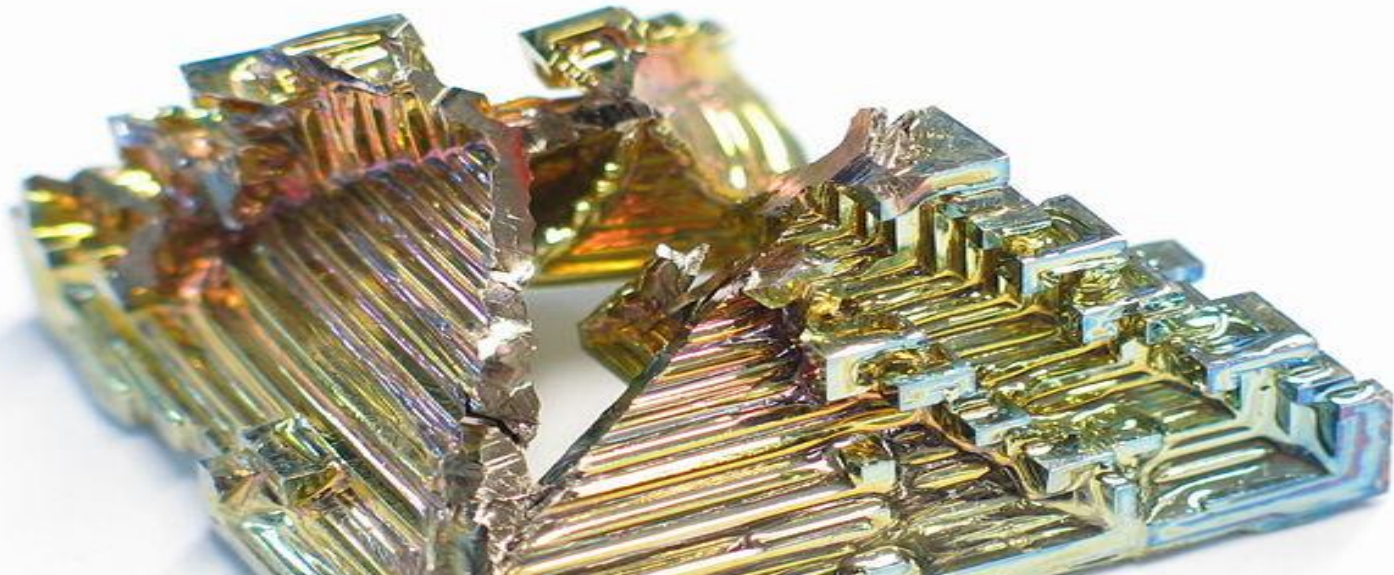
Crystal Systems Lab.

- Take 5 minutes to read the lab.
- Overview.
- 5 minutes to answer Pre-lab #1-4
- Procedure: 30min
- Analysis & Conclusion #1-3: 10min

- Total Time: 1hr.

Crystal.

- Substance with atoms packed ordered, repeating 3-D pattern.
- 3800+ minerals on Earth
- Distinct crystal forms!

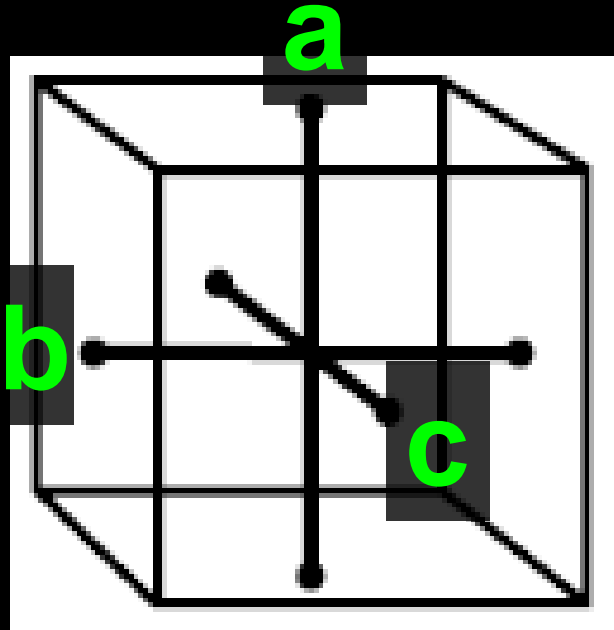


6 Crystal Systems.

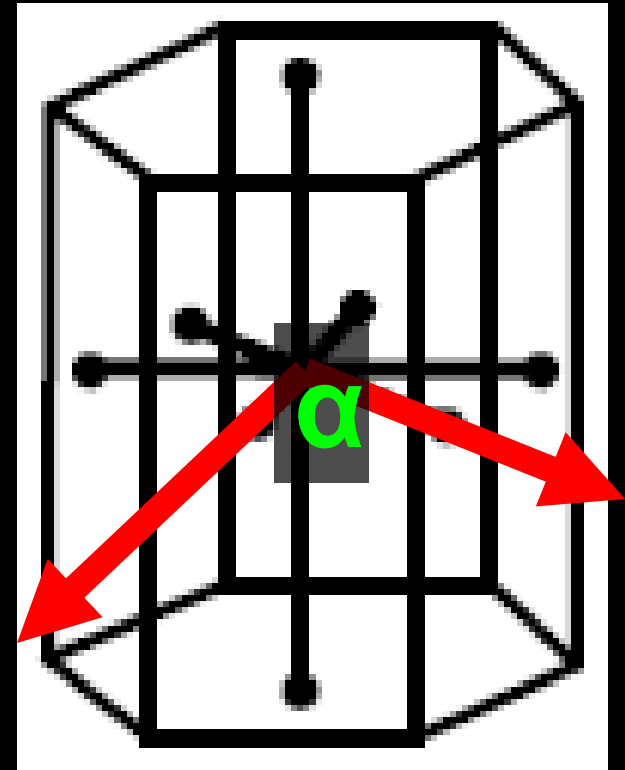
1. Cubic
2. Tetragonal
3. Hexagonal
4. Orthorhombic
5. Monoclinic
6. Triclinic

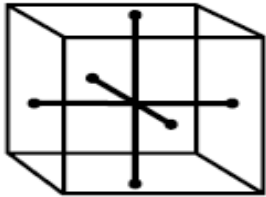
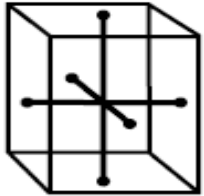
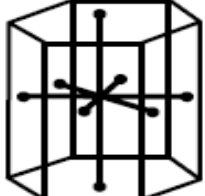
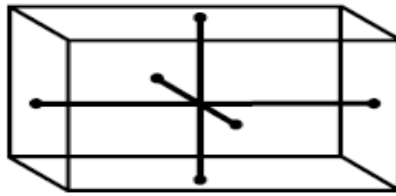
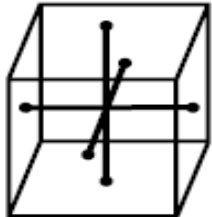
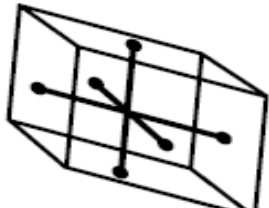


Multiple Axes.



- a, b, c
- Angles of Intersection
- α , β , γ



System Name	Description	Typical Forms
Cubic Model ____	1 All crystals in the cubic system have three axes that are all the same length. The axes intersect at 90° angles.	$a = b = c;$ $\alpha = \beta = \gamma = 90^\circ$ 
Tetragonal Model ____	2 All crystals in the tetragonal system have three axes that intersect at 90° angles. Two of the axes are the same length.	$a = b \neq c;$ $\alpha = \beta = \gamma = 90^\circ$ 
Hexagonal Model ____	3 All crystals in the hexagonal system have four axes. Three of the axes are the same length and intersect at 60° angles. The fourth axis is longer or shorter than the other three.	$a = b \neq c;$ $\alpha = \beta = 90^\circ;$ $\gamma = 120^\circ$ 
Orthorhombic Model ____	4 All crystals in the orthorhombic system have three axes. Each axis is a different length. The axes intersect each other at 90° angles.	$a \neq b \neq c;$ $\alpha = \beta = \gamma = 90^\circ$ 
Monoclinic Model ____	5 All crystals in the monoclinic system have three axes each of which is a different length. Two of the axes in these crystals intersect at a 90° angle. The third axis intersects the other two at an angle greater than 90°.	$a \neq b \neq c;$ $\alpha = \beta = 90^\circ \neq \gamma$ 
Triclinic Model ____	6 All crystals in the triclinic system have three unequal axes that make oblique angles with each other.	$a \neq b \neq c;$ $\alpha \neq \beta \neq \gamma \neq 90^\circ$ 

Contact Goniometer.

- **Measures:**
 - Angles
 - Between adjacent surfaces
 - α, β, γ

