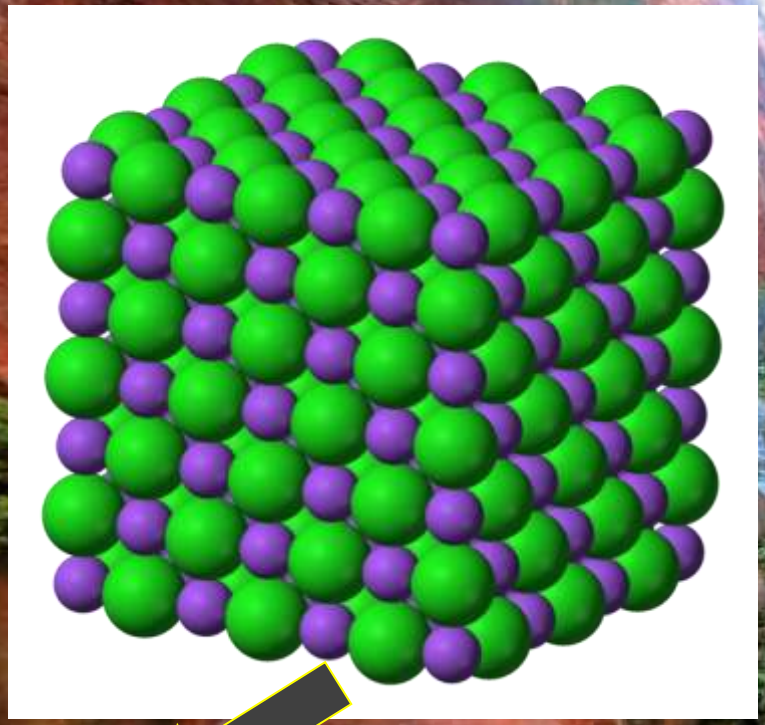
Earth and Space Science

Unit 3– Matter and Minerals (Ch. 2)

Defining a Mineral

- Mineral
  1. Naturally occurring
  2. Generally inorganic solid
     - Exception: calcite from animal shells
  3. Solid Substance
     - Ice vs. Water; Mercury
  4. Orderly chemical structure
  5. Definite chemical composition that allows for some variation



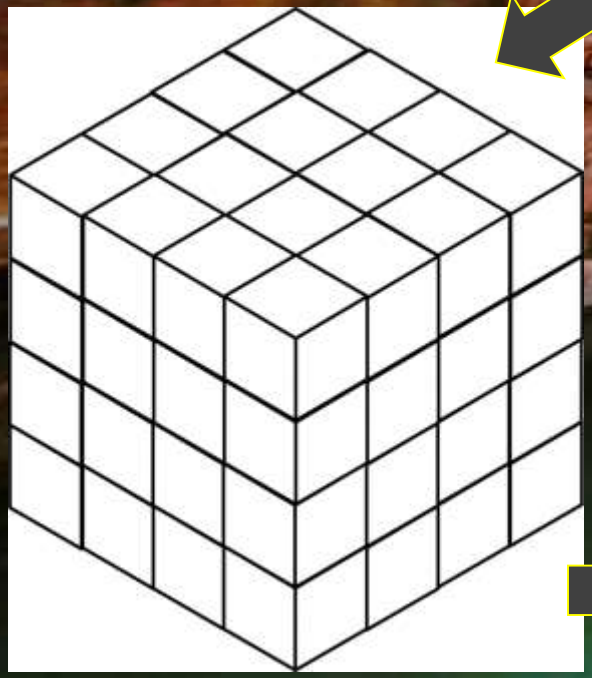


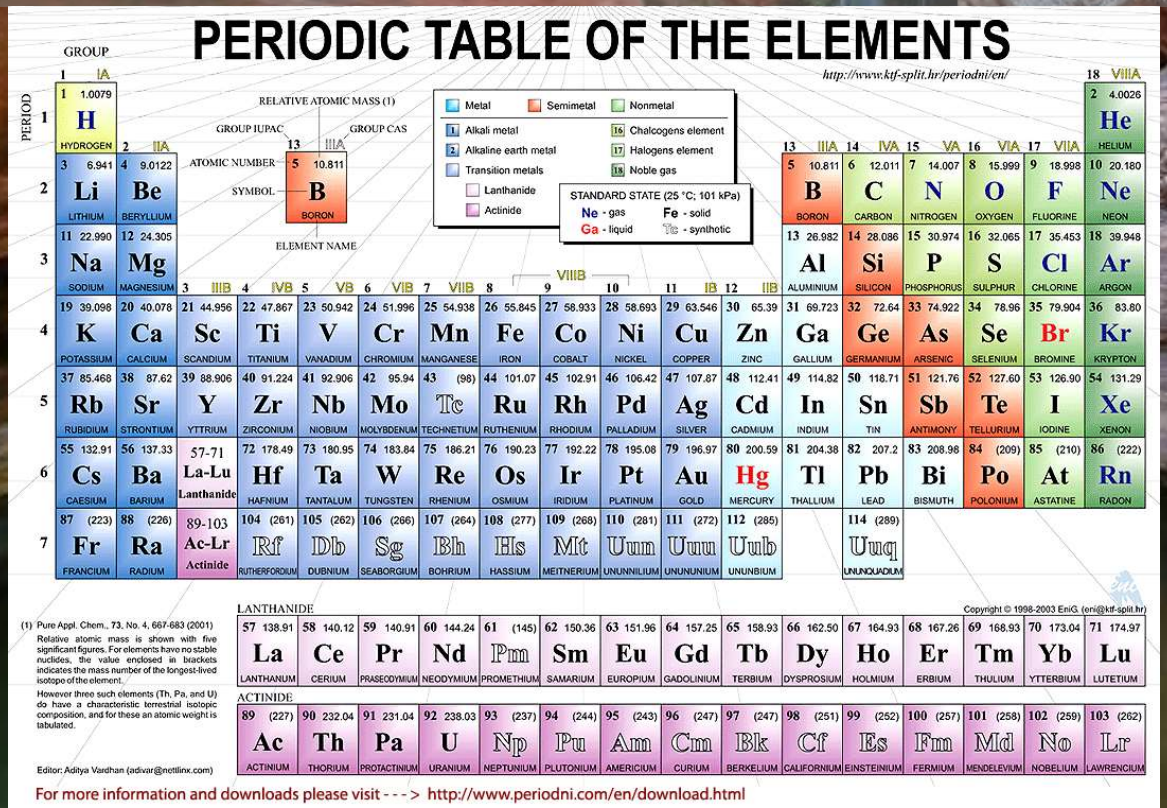

Photo by Dennis Tasa

Defining a Rock

- Rocks are aggregates (mixtures) of minerals
- Most rocks are aggregates of several different minerals
  - Granite
- Some rocks are composed of almost entirely of one type of mineral
  - Limestone

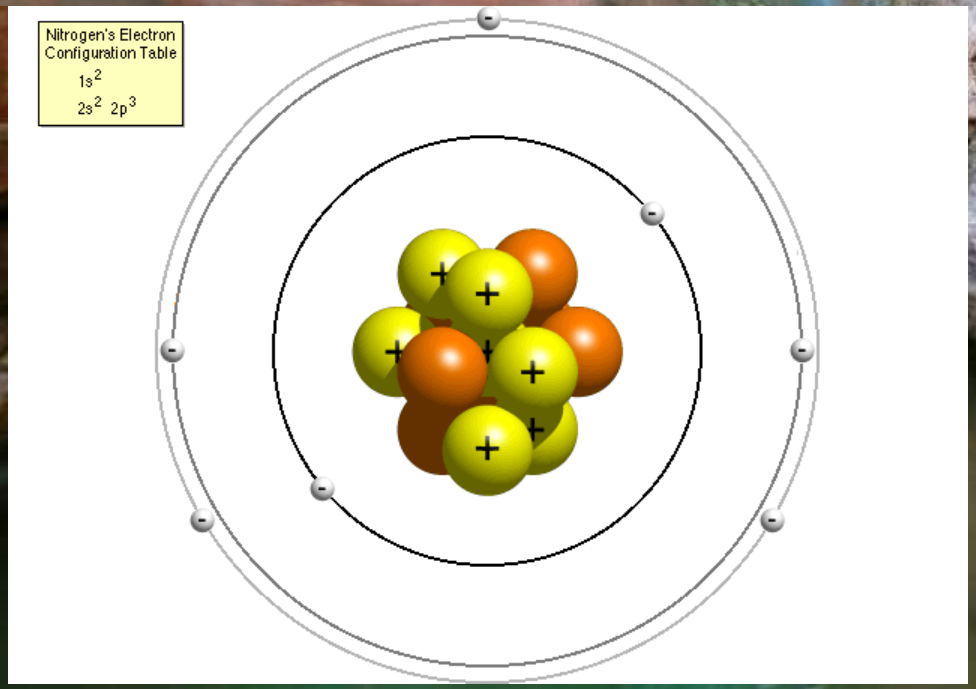
Composition and Structure of Minerals

- Elements
  - Basic building blocks of minerals
  - Over 100 are known



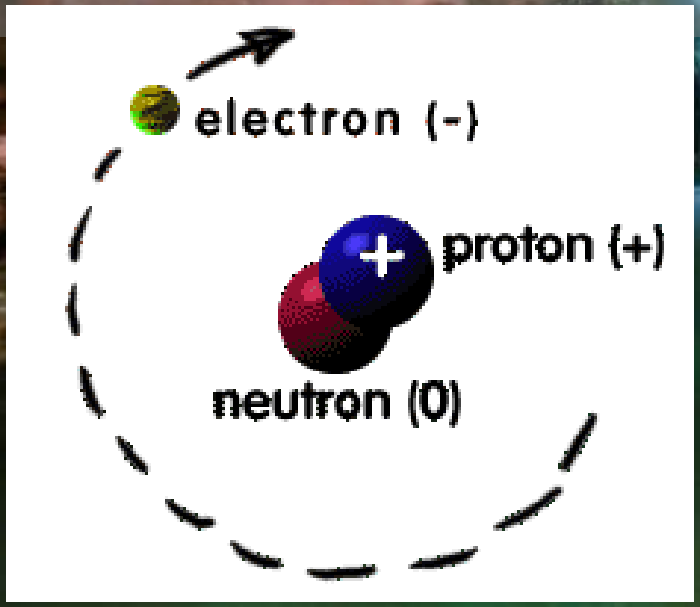
Composition and Structure of Minerals (cont.)

B. Atoms
   1. Smallest particles of Matter
   2. Have all the Characteristics of an element



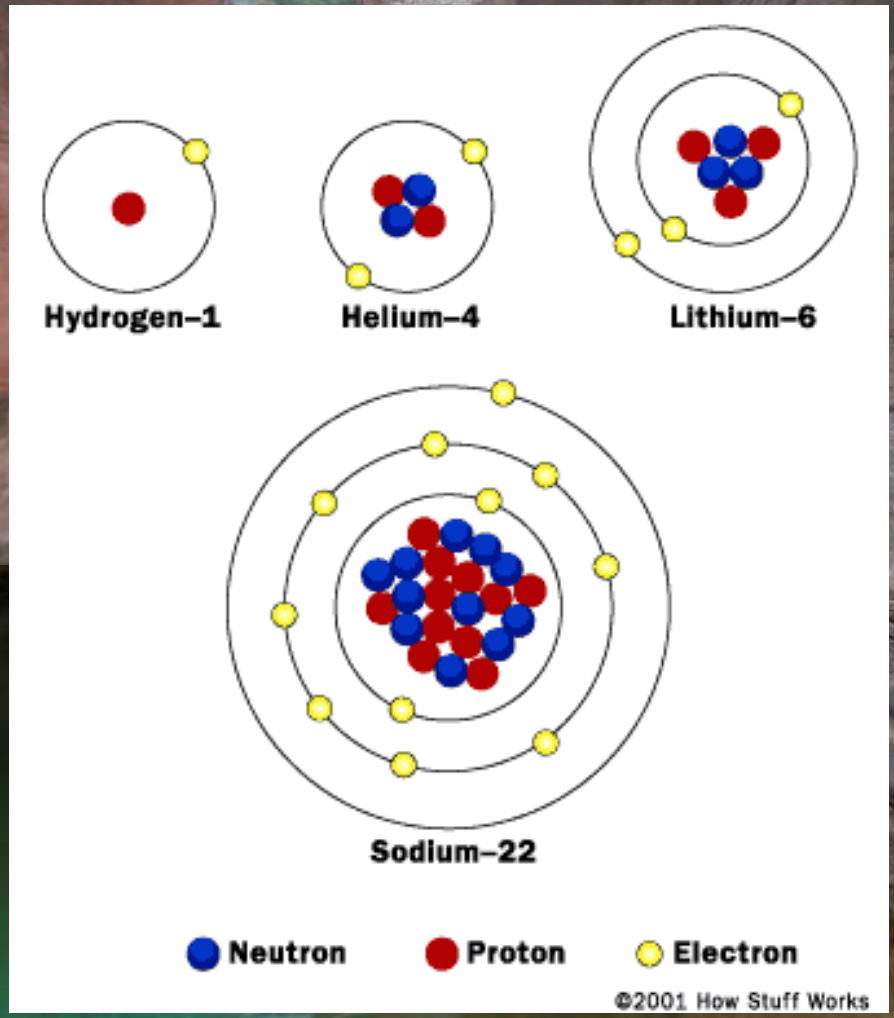
How Atoms are Constructed

A. Nucleus, which contains
   1. Protons – positive electrical charges
   2. Neutrons – neutral electrical charges (no charge)
   3. Only Protons & Neutrons are considered to have mass



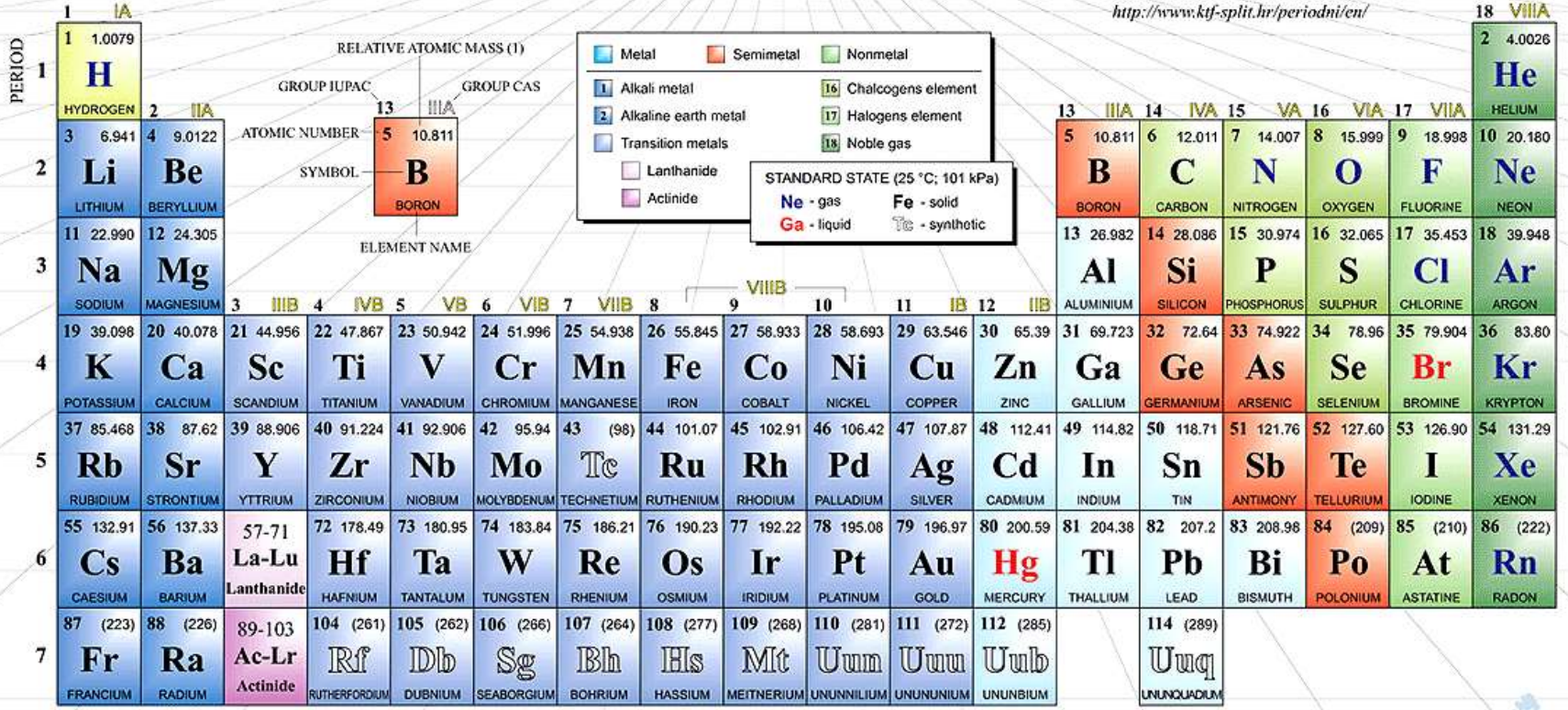
How Atoms are Constructed (cont.)

- Energy levels, or shells
  - Surround nucleus
  - Contain electrons – negative electrical charges
  - Are considered to be massless



PERIODIC TABLE OF THE ELEMENTS

http://www.ktf-split.hr/periodni/en/



LANTHANIDE

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
138.91	140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.04	174.97
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
LANTHANUM	CERIUM	PRASEODYMIUM	NEODYMIUM	PROMETHIUM	SAMARIUM	EUROPIUM	GADOLINIUM	TERBIUM	DYSPROSIUM	HOLMIUM	ERBIUM	THULIUM	YTTERBIUM	LUTETIUM

ACTINIDE

89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
(227)	232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
ACTINIUM	THORIUM	PROTACTINIUM	URANIUM	NEPTUNIUM	PLUTONIUM	AMERICIUM	CURIUM	BERKELIUM	CALIFORNIUM	EINSTEINIUM	FERMIUM	MENDELEVIUM	NOBELIUM	LAWRENCIUM

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(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001)

Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.

However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

Editor: Aditya Vardhan (adivar@nettlinx.com)

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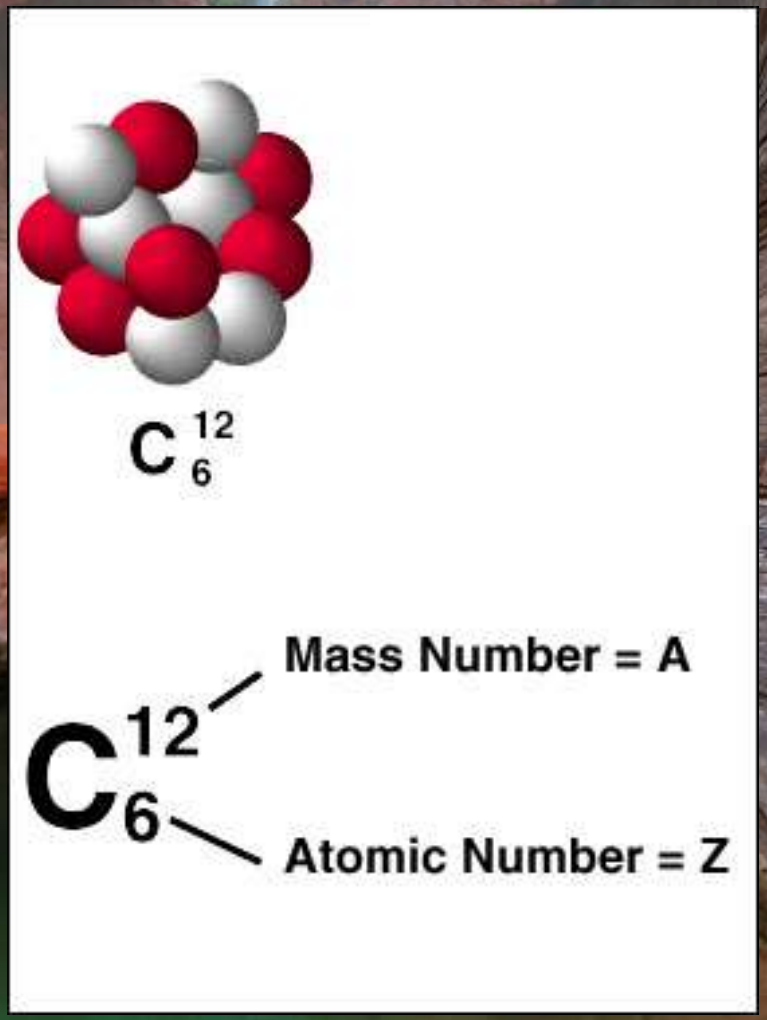
III. How Atoms are Constructed (cont.)

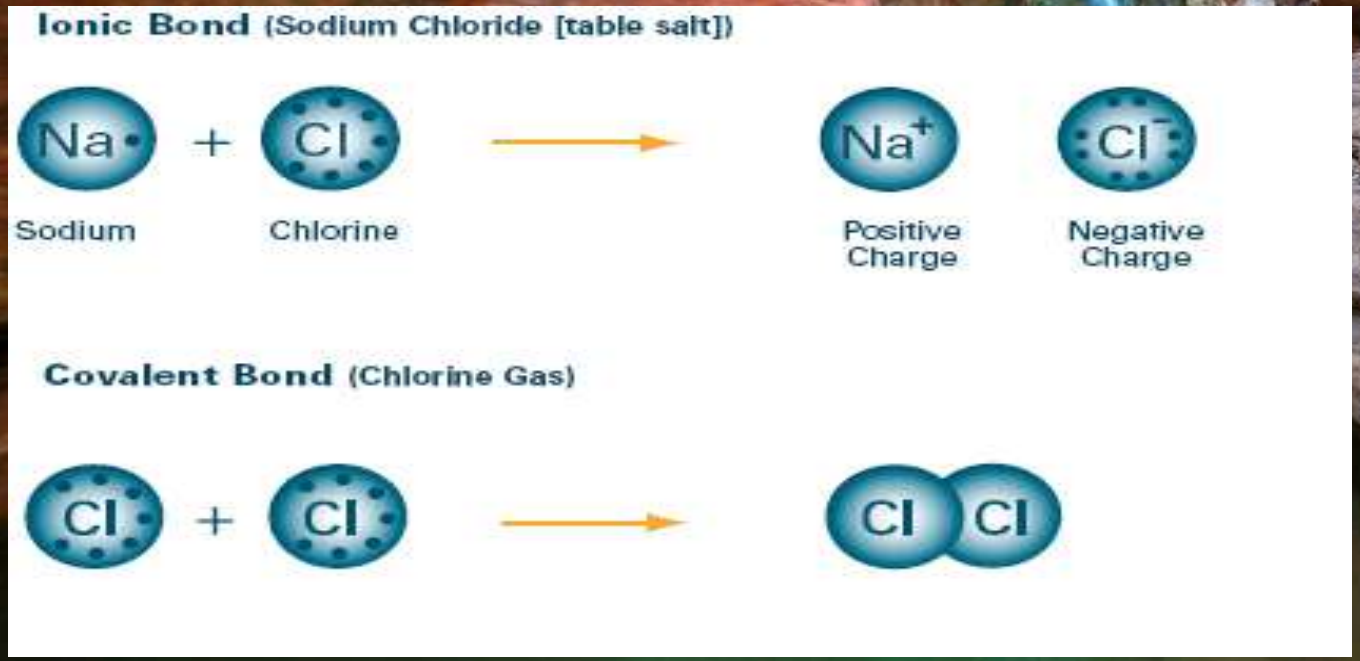
C. Atomic number is the number of protons in an atom's nucleus



III. How Atoms are Constructed (cont.)

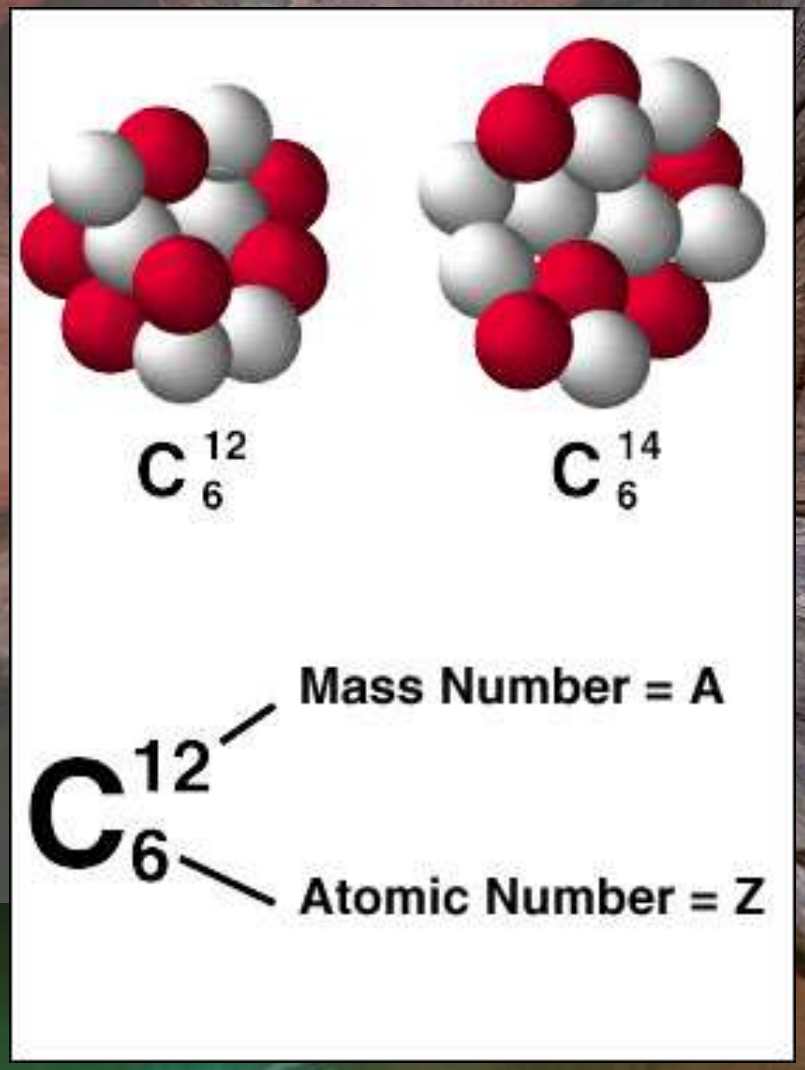
D. Bonding of Atoms

1. Forms a compound with two or more elements
2. Ions are atoms that gain or lose electrons



III. How Atoms are Constructed (cont.)

E. Isotopes
   1. Have varying number of neutrons
   2. Have different mass numbers – the sum of the neutrons plus protons
   3. Many isotopes are radioactive and emit energy and particles



Phases of Matter

Solids - **definite shape and volume**

- Atoms are held close together by strong bonds
- Movement is slow

Liquids - **definite volume, but NO definite shape**

- Bonds are weaker and atoms are spaced farther apart
- They take the shape of container they are in

Gases - **NO definite volume OR shape**

- Bonds are weakest and atoms far apart
- Expand to fill the container they are in
  - Examples - air, oxygen, smoke

Plasma

- Gas like mixture of + and – charged particles
- Movement very rapid
- 99% of mass of our solar system
  - Examples: Sun, Stars and Lightning

IV. Properties of Minerals

A. Optical Properties

1. Luster
2. Color

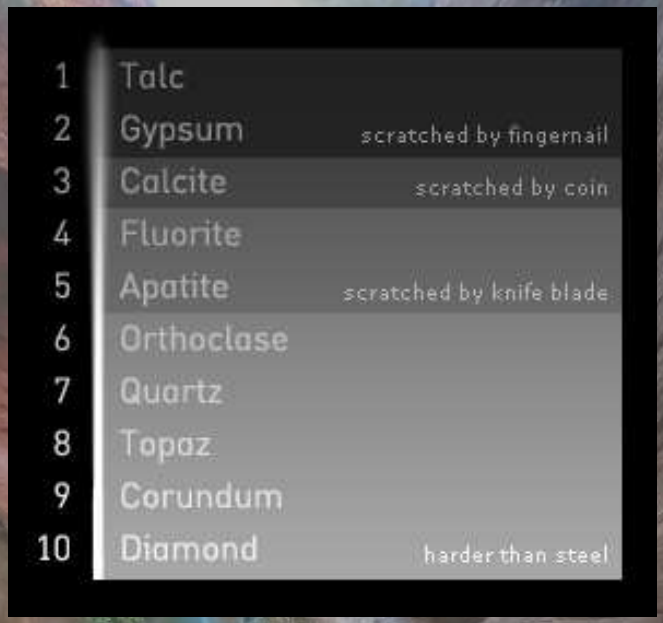
B. Crystal Shape, or Habit

◄ Bladed

Banded ►

C. Mineral Strength

1. Hardness
2. Cleavage
3. Fracture
4. Tenacity

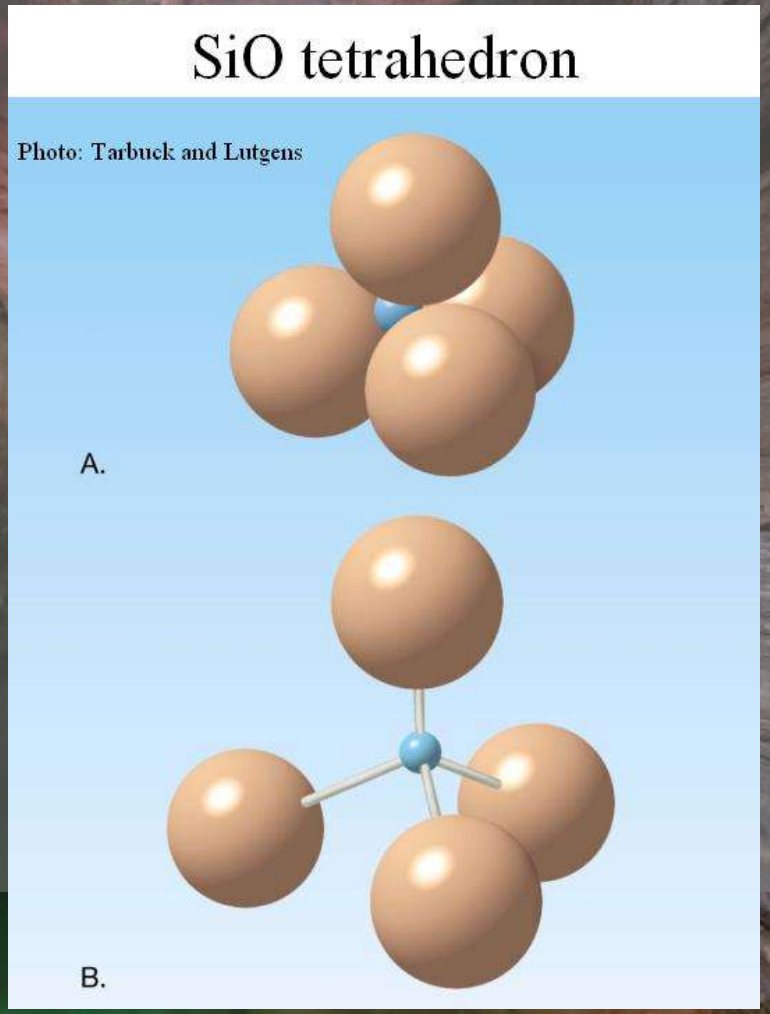


D. Denisty & Specific Gravity

Specific Gravity Measurement

V. Mineral Groups

1. Silicate minerals
   a. Most common mineral group
      a. Contain silicon-oxygen tetrahedron
      b. Crystallize from molten material
      c. Groups based upon tetrahedron arrangement



V. Minerals Groups (cont.)

2. Nonsilicate minerals

- Usually based on the negatively charged ion or complex ion that the members have in common.

a. Major groups

i. Oxides
ii. Sulfides
iii. Sulfates
iv. Halides
v. “Native” elements

VI. Natural Resources

A. Mineral resources

- Renewable vs. Nonrenewable

1. Reserves are already identified deposits
2. Ores are useful metallic minerals that can be mined at a profit
3. Economic factors may change and influence a resource