I Development of the Atomic Theory:

1. The Beginning of Atomic Theory:

1. Democritus in 440 BC, called the smallest particle an atom

1. He said an atom was tiny and hard and made of a single material.

b. He was right,,,sort of….An atom is the smallest particle into which an element can be divided.

2. Dalton's Atomic Theory Based on Experiments: (almost right)

1. All substances are made of atoms which cannot be created, divided or destroyed

2. Atoms of the same element are exactly alike,and atoms of different elements are different.

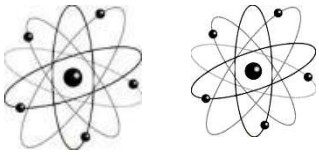
3. Atoms join with other atoms to make new substances.

C. Thomson's Discovery of Electrons:

1. In 1879 he discovered there are small particles INSIDE the atom.

2. He discovered negative charged particles called electrons

D. Rutherford's Atomic "Shooting Gallery":



1. He shot + particles at gold foil, and some of them bounced back instead of going through.

2. This showed that there was a tiny, extremely dense, positively charged part in the center, a nucleus.

3. He calculated the nucleus was 100,000 times smaller than the diameter of the atom.

E. Where are the Electrons?:

1. Bohr Model:

   a. Electrons move around the nucleus in definite path.

   b. Paths are called energy levels, or shells or orbital paths.

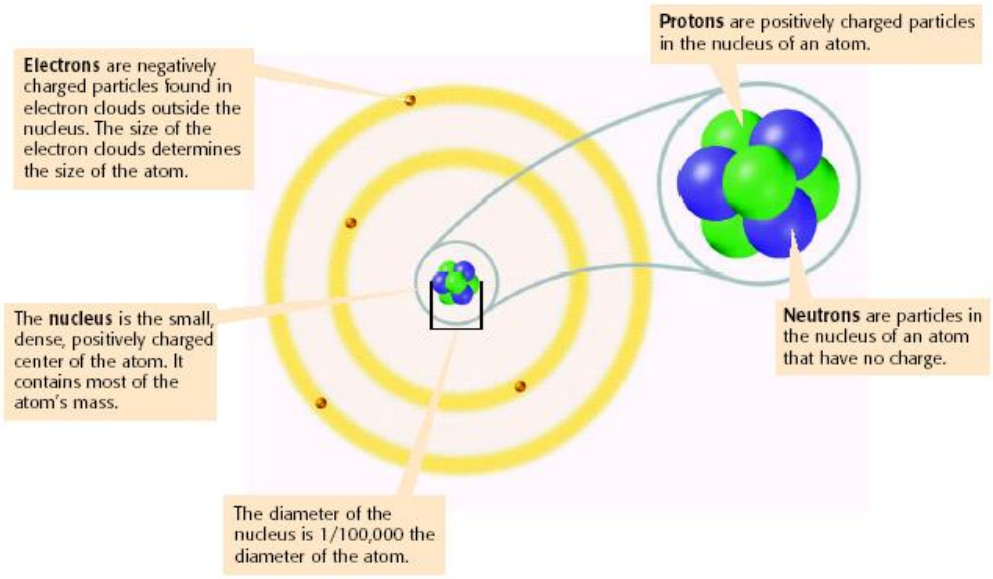
2. Electron Cloud Model:

   a. Electrons do not travel in definite paths.

   b. Electrons surround the nucleus in a cloud.

II The Atom: (has a diameter of about 0.00000003cm.)

1. What is an Atom Made Of?



a. Proton:
- + charged particle in the nucleus
- Each one has a mass of 1 atomic mass unit

b. Neutron: (in the nucleus)
- Has no electrical charge.
- It is a little more massive than a proton.
- But it's mass is still about 1 amu.

c. Electron:
- has a negative electrical charge.
- It orbits around the nucleus.
- It takes more than 1800 electrons to equal the mass of one proton. (mass = 0)

2. How Do Atoms of Different Elements Differ?

a. Atomic Number – the number of protons in the nucleus of an atom.

b. All atoms of an element have the same atomic number.

c. Atomic Mass Number – is the number of the protons and neutrons in an atom.

Element	P	N	E	A. #	A. Mass
Hydrogen	1	0	1	1	1
Helium	2	2	2	2	4
Carbon	6	6	6	6	12
$Carbon^{14}$	6	8	6	6	14
Nitrogen	7	7	7	7	14
Oxygen	8	8	8	8	16

d. Carbon ^{14} is an isotope of carbon.

* An isotope of an element has the same number of protons as the element but..
* different number of neutrons

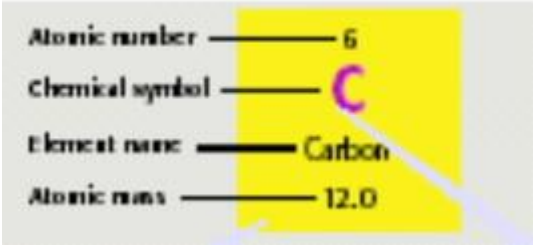
I Arranging the Elements:

A. **Discovering a Pattern:**

1. Dmitri **Mendeleev** discovered a **pattern** to the elements.
2. He arranged the elements in order of **atomic mass** 1869
3. He saw a **pattern** that repeated every 7 elements.
4. Periodic means **happening at regular intervals**
5. With this table, he could predict **undiscovered** elements.

B. **Changing the Arrangement:**

1. A few elements did **not** fit into Mendeleev's table.
2. Henry Moseley determined the **number** of **protons** in an atom.
3. All elements **fit** into table when arranged by **atomic number** 1914
4. Each element is in its own "box" on the table.
   a. Each element is represented by a **symbol**
   b. Atomic Number is the number of **protons** in the element's **nucleus**
   c. Atomic Mass is the number of **protons** & **neutrons** in the element's nucleus.



D. Decoding the Periodic Table:

1. Element names come from many sources such as scientist names and countries, states, places
2. Examples:
   Mendelevium- after Dimitri
   Polonium- after Poland
3. Periods: The 7 horizontal rows in the periodic table.

a. Each periodic number tells you the number of energy levels in an atom.

b. Properties such as conductivity and reactivity gradually change from left to right.

c. For example, the atoms of all elements in period 3 all have 3 energy levels (shells) of electrons

4. Groups: 

a. The 18 vertical columns in the periodic table.

b. A group is also called a family.

c. Elements in the same group have similiar chemical and physical properties.

d. Within groups 1-2, 13-18, elements have the same number of electrons in their outer energy level

e. These outer electrons are called valence electrons and are important in the forming of bonds to create compounds

f. Elements in groups 3 - 12 do not follow this rule.

g. Another exception is the element Helium, which is found in group 18 and only has **2** electrons.

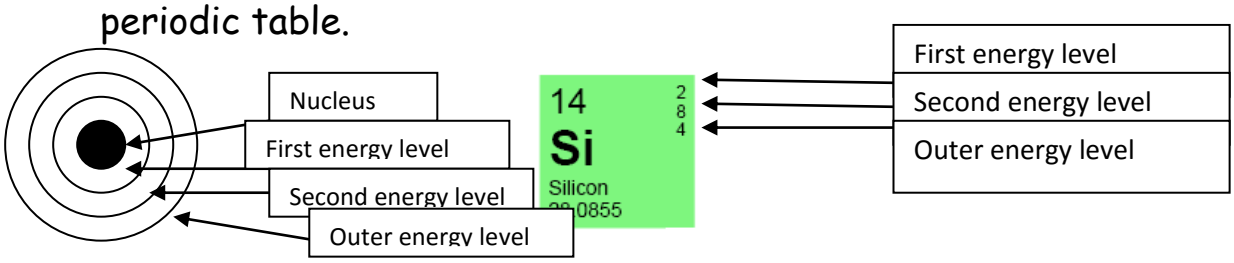
II Atom Diagrams

A. What is an Atom Diagram, aka Bohr Model?

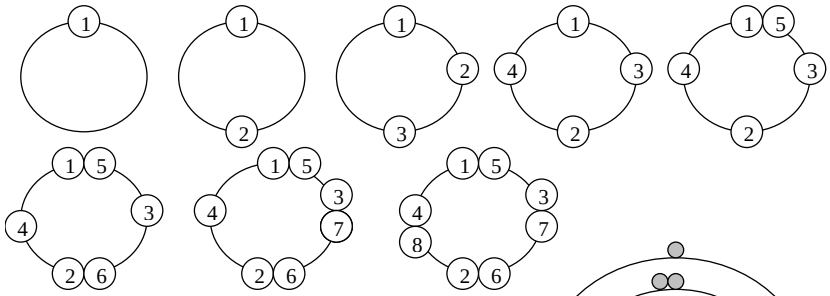
1. Atom diagrams help us visualize atoms that are too small to be seen.
2. These models also help us understand how atoms combine to form compounds.
3. Remember, the electrons do not actually travel in these circular orbits (energy levels) but are thought to be found as an electron cloud.

B. Drawing atom Diagrams:

1. Determine the number of protons, neutrons, and electrons
2. Determine the number of energy levels (AKA shells)
   a. Period (row) number= the number of energy levels
3. Find the number of electrons in each energy level by looking at the periodic table.



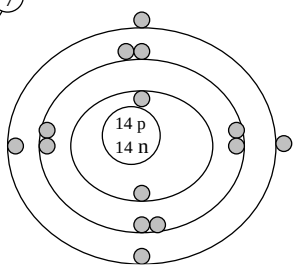
4. Draw the diagram starting from the first energy level (inside)
   a. Electrons should be filled in on top, bottom, right, left one at time and repeated until all electrons are placed in each energy level.
   b. DO NOT randomly space the electrons!

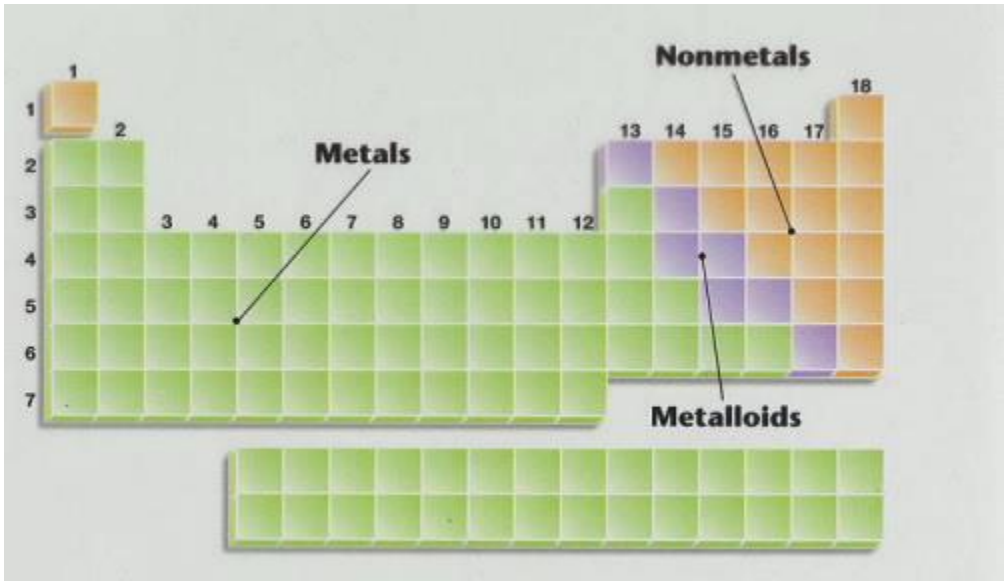


14 Si Silicon 28.0855 2 8 4

Silicon would be drawn like this:

-Atomic # 14 = 14 protons, 14 electrons
-Atomic Mass = 28
-Number of neutrons = 28-14 = 14 n
-2, 8 and 4 are the electrons in Silicon's three energy levels.





C. The Periodic Table and Classes of Elements:

1. Elements are classified as metals, Nonmetals, and metalloids.

2. Metals: most elements are metals. (about 80%)

a. They have 3 or fewer electrons in their outer energy level.

b. Examples: K (potassium Au (gold)
Fe (iron) Hg (mercury) Pb (lead)

b. Characteristics:
Most are solid at room temperature.
Luster- shiny
Malleable- bendable
Good conductors- of electricity and heat
Ductile- drawn into a wire
Dense- mostly solid
They give up their outer electrons when making a compound.

3. Nonmetals: few elements are nonmetals. (about 20%)

a. They have 5 or more electrons in

their outer energy level (or shell).

f. Examples: He (helium) N (nitrogen) Ne (neon) Ar (argon)

c. Characteristics:

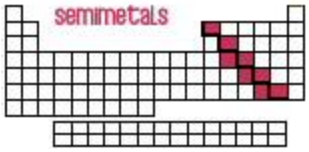
More than 1/2 are gasses at room temperature.

If solid→brittle→don't bend

Bad conductors - of heat and electricity (insulators)

They gain or share their outer electrons when

making a compound.



4. Metalloids:

a. They border the zigzag line (stair step) on the table.

b. Examples: B (boron) Si (silicon)

As (Arsenic) Sb (Antimony) Ge(germanium)

Te (tellurium) Po (Polonium)

d. Characteristics:

They have properties of both metals & non metals.

Semi-conductors, not good, not bad

Some are shiny

Some are dull

II GROUPING THE ELEMENTS:

A. Group 1 (IA) : Alkali Metals:
   1. Have 1 electron in outer shell, so they lose it easily in compounds.
   2. Properties:
      a. Most chemically reactive of all metals.
      b. Soft, silver low density, shiny
      c. React with water so stored in oil.
   3. Examples: Na Li K

B. Group 2 (IIA): Alkaline-Earth Metals:
   1. Have 2 electrons in outer shell, & they can give both up fairly easily.
   2. Properties:
      a. less reactive than alkali metals.
      b. silver , good conductors , higher density , shiny
      c. Compounds are mostly white (chalk, sheet rock)
   3. Examples: Ca Mg Be

C. Group 3-12 (IB-VIIIB): Transition Metals:
   1. They have 1 or 2 electrons in outer shell, they don't give them up as easily.
   2. Properties:
      a. less reactive than Groups IA and IIA
      b. shiny, good conductors , higher density & melting points
      c. Compounds are colored (rust, iron oxide)
      d. **Examples: Fe Hg Au**

4. Lanthanides & Actinides:

   a. In 2 rows on the bottom so

      table is not too wide.

   b. Lanthanides are shiny & reactive metals.
   c. Actinides are radioactive (unstable)

      and any after Atomic # 92 are manmade

D. Group 13 (IIIA) : Boron Family:

1. They have 3 electrons in their

   outer shell.

2. One metalloid and 4 metals
3. Properties: reactive solid
4. Aluminum:

   a. 3rd most abundant element in earth's crust.

   b. Found only in ores (compounds).

   c. Shiny, lightweight, good conductor
   d. Used in cars, foil, cans

5. Boron: the only metalloid in this group
   a. Used in eyewash and pyrex

E. Group 14 (IVA) : Carbon Family:

1. They have 4 electrons in outer shell.
2. 2 metal, 2 metalloids, 1 nonmetal
3. Common property: solid
4. Carbon:
   a. Very important in living things.
   b. 80% of all compounds have C
   c. Found in: protein gasoline carbohydrates

5. Silicon:
   a. 2nd most abundant element in earth's crust.
   b. Found in sand (silicon & oxygen) SiO_2
   c. Used in computer chipis as semiconductor.
6. Other members: Ge Sn Pb

F. Group 15 (VA) : Nitrogen Family:

1. They have 5 electrons in outer shell.

2. 2 nonmetals, 2 metalloids, 1 metal.

3. Nitrogen:
   a. 78% of our air.
   b. Colorless, tasteless, odorless
   c. nonflammable

4. Other members: As Sb Bi P

G. Group 16 (VIA): Oxygen Family:

1. They have 6 electrons in outer shell.

2. 3 nonmetals, 2 metalloids

3. Oxygen:

   a. 21 % of our air.
   b. most abundant element in earth's crust
   c. Needed for life.
   d. In the air: Oxygen = O_2 Ozone = O_3
   e. Oxygen compounds are called oxides

   Water: H_2O Hydrogen Peroxide: H_2O_2

4. Sulfur:

   a. sulfuric acid – used a lot in the chemical industry.

5. Other members: Se, Te, Po

H. Group 17 (VIIA) : Halogens:

1. They have 7 electrons in outer shell, so

   they only need 1 more for a complete shell.

2. Most chemically active of nonmetals.

3. Properties:

   a. react violently with alkali metals
   b. never alone in nature
   c. poor conductors

4. Chlorine:

   a. Most common halogen.
   b. Green, poisonous gas
   c. Kills bacteria.

5. Uses:

   a. Fluorine: in toothpaste (fluoride)
   b. Iodine: in hospitals as disinfectant
   c. Chlorine: treat water

I. Group 18 (VIIIA) : Noble Gases:

1. They have 8 electrons in outer shell, so

   the outer shell is full.

2. All are gases and nonmetals.

3. Properties:
   odorless colorless not reactive (inert)
4. Helium:
   a. Less dnese than air, used in blimps
5. Other members: Kr, Ne, Ar, Xe, Rn
6. Many used in lighting

J. Hydrogen:

1. **Has only 1 electron, but**

   groups do not match, so set apart.

2. **Most abundant element in the universe**

3. **Found in stars**

4. **Properties: odorless, colorless, less dense than air**

   explosive reactions with oxygen

Small Review:

Ptable is a chart of elements arranged in rows called periods in which the number of pronts increases from left to write

It is also arranged in columns called groups or familes

Elements are classes as metals, metalloids, or nonometals