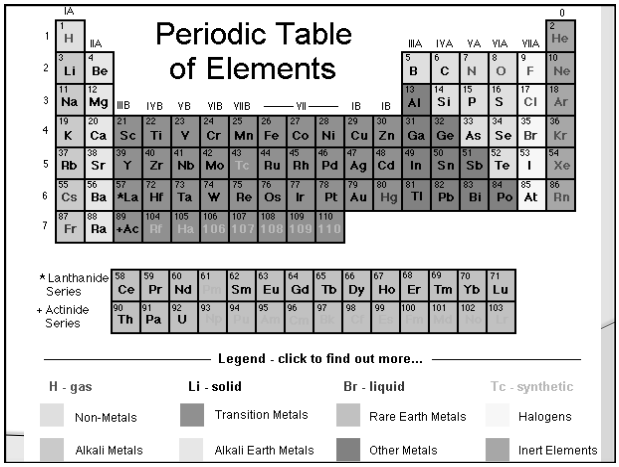
Basic Chemistry:

ELEMENTS AND ATOMS

I. ELEMENTS & ATOMS:

- **Matter = Anything that takes up space and has mass**
- **Element** = A substance that cannot be broken down into simpler substances
  - Periodic Table – lists all known elements
    - 1-92 occur in **nature** (natural elements)
    - 93 and above are **synthetic** (man-made)
- Element names are abbreviated using ~~chemical symbols~~ (N, C, Ca, Fe, Cl)

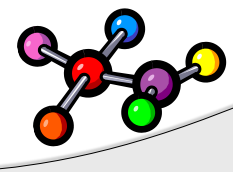


Natural elements

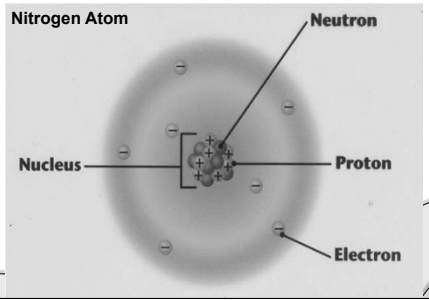
- **25** are essential to living things
- Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), make up 96% of human mass

Trace elements

- Found in very **small** amounts but are **essential** to proper cellular activities
  - **Ex: iron, magnesium, iodine**

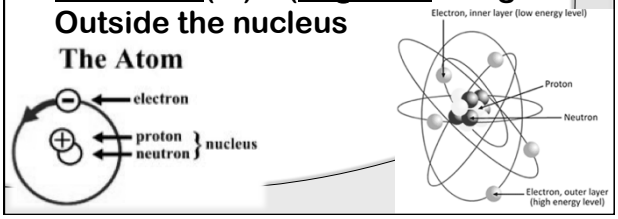


- **ATOMS = Basic Building Blocks of all matter.**
  - Smallest particle of an element that has the characteristics of that element



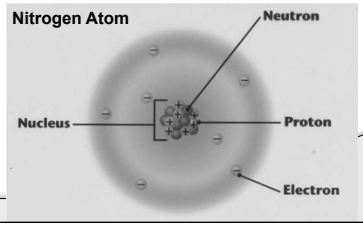
3 Subatomic particles make up an atom:

1. **Protons** (P) = **positively** charged particles. In the nucleus
2. **Neutrons** (N) = no charge (**neutral**). In the nucleus
3. **Electrons** (e-) = (**negative** charge. Outside the nucleus

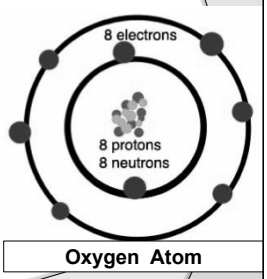


2 parts of an atom:

1. **Nucleus** = Center of atom; contains **protons** & **neutrons**
2. **Electron cloud/energy levels** – around the nucleus

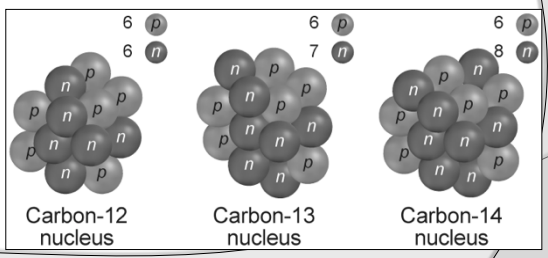


- Atoms contain an equal number of **protons** and **electrons** so the overall charge of an atom is **zero**.



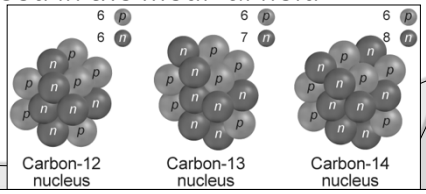
II. ISOTOPES:

- **Isotopes** = Atoms of the same element that have different numbers of **neutrons**



II. ISOTOPES:

- Named by their **mass numbers**
  - C-12 = (**6 N** + 6 P)
  - C-13 = (**7 N** + 6 P)
  - C-14= (**8 N** + 6 P) → Radioactive (nuclei break apart)
    - Used in the medical field



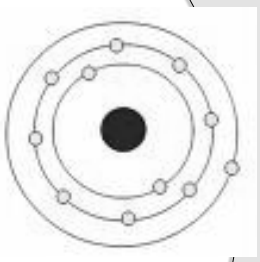
III.ATOMIC NUMBER & MASS NUMBER:

- **Atomic Number** = number of **protons** and/ or **electrons** of an atom
  - Ex: Na-23 contains 11 electrons and 11 protons
- **Mass Number** = the **sum** of protons and neutrons of an atom
  - **Mass Number = # of protons (P) + # of neutrons (N)**

IV.ENERGY LEVELS & DIAGRAMING ATOMS:

- **Energy levels** = regions around the **nucleus** where electrons travel. Also known as electron shells.
  - 1st energy level can have **2** electrons
- **Octet Rule** = Each energy level the first can have up to **8** electrons

- What atom is represented in this picture?

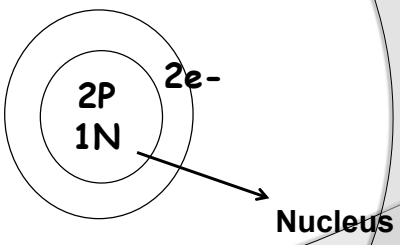


Sodium (Na)

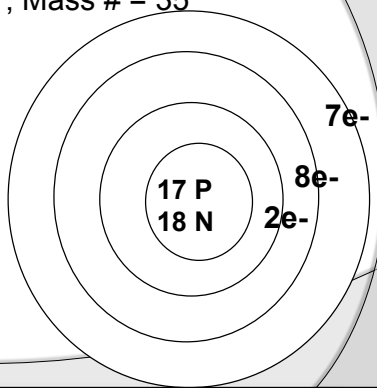
- How do you know?

Sodium's atomic number is 11 so it has 11 e-

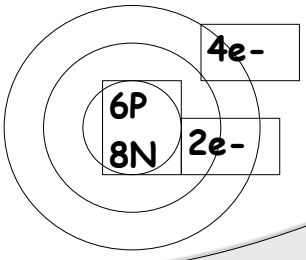
Ex: **Helium** (He)
Atomic # = 2; Mass # = 3



Ex: (Cl)
Atomic # = 17; Mass # = 35

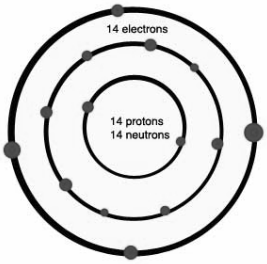


Ex: **Carbon** (C)
Atomic # = 6; Mass # = 14



What are Valence Electrons?

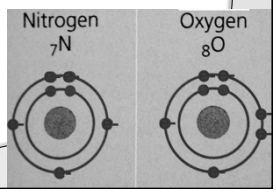
- The electrons in an atom's outmost shell



- Outer most shell is also known as the valence shell

I. COMPOUNDS & BONDING:

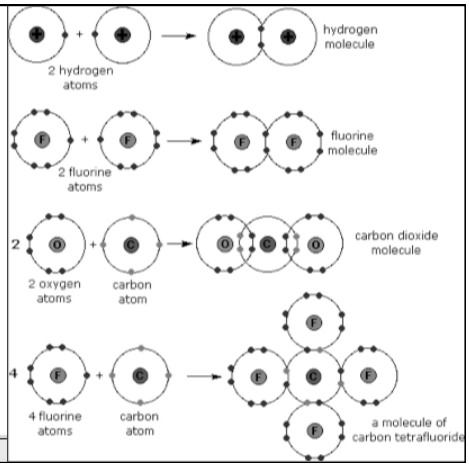
- **Compound** = a substance made of chemically combined elements.
- Atoms bond to form **stable compounds**
  - Atoms need **8 e-** in *OUTER* energy level to be stable;
    - Exception: hydrogen needs 2 e-
- Open bonding sites (electrons) encourage **bonding**



I. COMPOUNDS & BONDING:

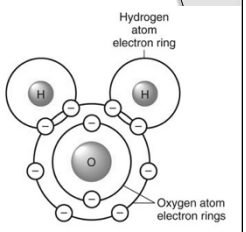
- Elements can combine in two ways:
  1. **Covalent Bonding:**
     - Covalent bonds **SHARE** electrons to fill their outer energy level
       - The positively charged nucleus is **attracted** to the negatively charged electrons
     - Water, sugars, fats, and proteins are **covalent molecules**

Examples of Covalent Bonding



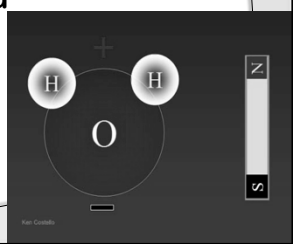
I. COMPOUNDS & BONDING:

- **Molecule** = a group of covalently bonded atoms with **no** charge
  - Ex: H_2O → 2 hydrogen atoms + 1 oxygen atom
  - Oxygen needs **two** electrons to become stable
  - Each hydrogen needs **1** electron to fill orbital
- Therefore, they **SHARE**!!



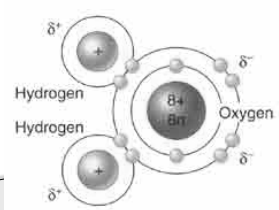
II. POLAR Covalent Bonds

- **Polar** = unequal distribution of charge
- Each molecule has a **positive** end and a **negative** end



II. WATER IS POLAR

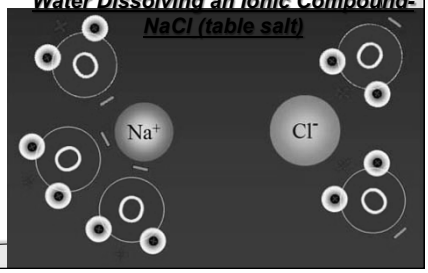
- Ex: Water (H_2O) molecule --> Oxygen is much stronger and therefore has a stronger **negative charge** than the hydrogen's positive charge



II. WATER IS POLAR

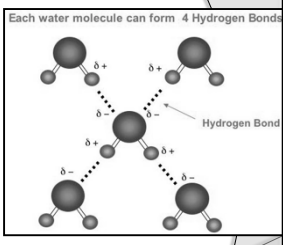
- Because of water's polarity, it can **dissolve** many ionic compounds and other polar compounds such as **sugars**

Water Dissolving an Ionic Compound- NaCl (table salt)



II. WATER IS POLAR

- The water molecules also **adhere** to each other because of **polarity** (unequal distribution of charge)
- The attraction of opposite charges forms a **weak** bond called a **hydrogen bond**
  - This keeps large molecules **together!** (Ex: proteins)



III. UNIQUENESS OF WATER- due to its polarity!

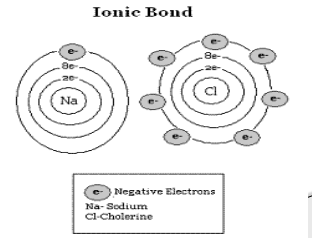
1. **Cohesion** = the attraction between like molecules
   - **Surface tension** results from the cohesive properties of water.
   - The polarity of water cause the surface layer of water molecules to act like a stretched film over the surface of the water **(surface tension)**
     - Ex: water striders

III. UNIQUENESS OF WATER- due to its polarity!

2. **Creeps up in thin tubes (Capillary action)**
   - The polarity of water allows **plants** to get water from the **ground**
     - Water creeps up tubes in plant roots and stems

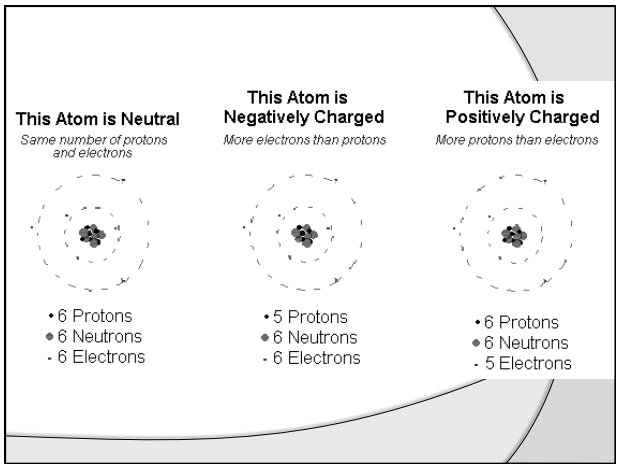
I. COMPOUNDS & BONDING:

2. **Ionic Bonding:**
   - **Transfer** of electrons creating ions that attract each other = **Ionic Bond**

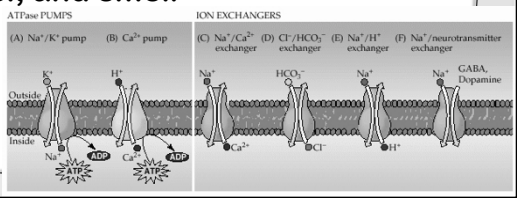


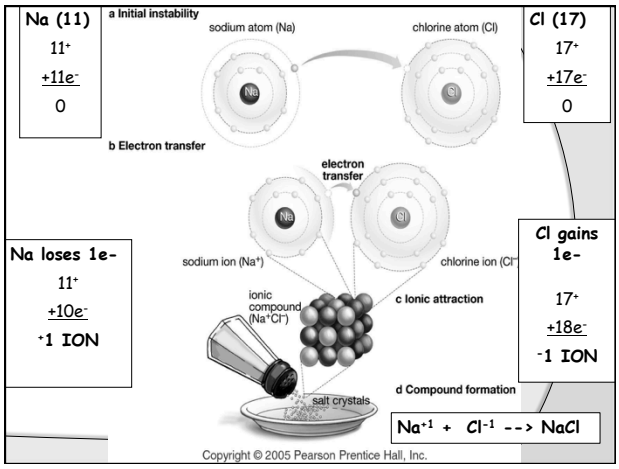
Ionic Bonding:

- **Ions** = charged atoms because they have **gained** or **lost** electron(s)
  - Cations - Atoms that **lose** electrons become more **positive**
  - Anions- Atoms that **gain** electrons become more **negative**
  - Atoms gain/lose electrons efficiently



- **Ions in living things:**
  - **Include- <u>sodium</u>, potassium, calcium, chloride, carbonate ions**
  - **Help maintain <u>homeostasis</u> as these ions travel in and out of cells**
  - **Help transmit <u>signals</u> among cells that allow you to see, taste, hear, feel, and smell**





Dissecting an Element:

<u>In a neutral atom the following is true:</u>

- **Number of Protons = Atomic Number**
- **Number of Electrons = Atomic Number****
- **Number of Neutrons + Number of Protons = Atomic Mass****
- **Number of Neutrons = Mass Number - Atomic Number**

<u>For Krypton:</u>

- **Number of Protons = Atomic Number = 36**
- **Number of Electrons= Atomic Number = 36**
- **Number of Neutrons = Mass Number-Atomic Number: 84 - 36 = 48**

Ions

An ion is an atom with a positive or negative charge. This means it has either more or less electrons than protons.

- **Kr+ is a positively charged Krypton ion**
- **It lost an electron to become positive**
- **It has 36 protons, and <u>35</u> electrons**

- **Kr- is a negatively charged Krypton ion**
- **It gained an electron to become negative**
- **It has 36 protons and <u>37</u> electrons**

-
-
-

Ion Practice

Mg-

Atomic number =

Mass number=

Protons =

Electrons =

Neutrons=

Valence electrons=