Basic Chemistry Review

Atomic Structure

- The center of the Atom is called the **Nucleus**
  - It is about 100,000 times smaller than the entire atom
  - It makes up 99.9% of the mass of the atom

In the Nucleus

- There are two **Subatomic Particles**
  - 1. Proton: Which is a positively charged particle
  - 2. Neutron: Which is a neutrally charged particle
    - » These 2 subatomic particles are nearly equal in mass

Is that it??

- There is one final subatomic particle in an atom
- This is called an **Electron**
- **Electrons** have a negative charge
- They are also **not** located IN the nucleus
- They travel throughout the atom at high speeds
- The **potential energy** that a molecule possesses is directly related to the electron's energy level

Electron Shells

- An electron's energy level is correlated with its average distance from the nucleus
  - Electrons exist only at **fixed levels of energy potential called shells**
  - Electrons in the first shell have the lowest potential energy (closest to the nucleus)
    - Electrons in the second shell have more potential energy
      - Electrons in the third shell have even more energy
- An electron can change which shell it occupies if it gains/loses exactly the amount of energy required

Balanced Equations

- The Law of Conservation of Matter told us that energy CAN NOT be created or destroyed.
  - This is true at all times… Even when considering chemical equations.
- For this reason the **Reactants** in a chemical equation must always equal the **product**
  - This means you MUST have the same number of elements on either side of the **yields arrow** ()

The Rules of Balancing Equations

- You are not allowed to change the atoms within a compound, you can only change the amount of the compound
  - Meaning, you can NOT change the small numbers (subscript) but you can add big numbers in front of the compound
- IE: $C + H_2O + N_2 \Rightarrow CH_4 + N_2O_2$
- Balanced: $C + \underline{2}H_2O + N_2 \Rightarrow CH_4 + N_2O_2$
  - Adding the 2 in front of the H2O is saying that you are adding two molecules of water which balances the equation

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

	Left hand side	Right hand side
C	1	1
H	4	2
O	2	3

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

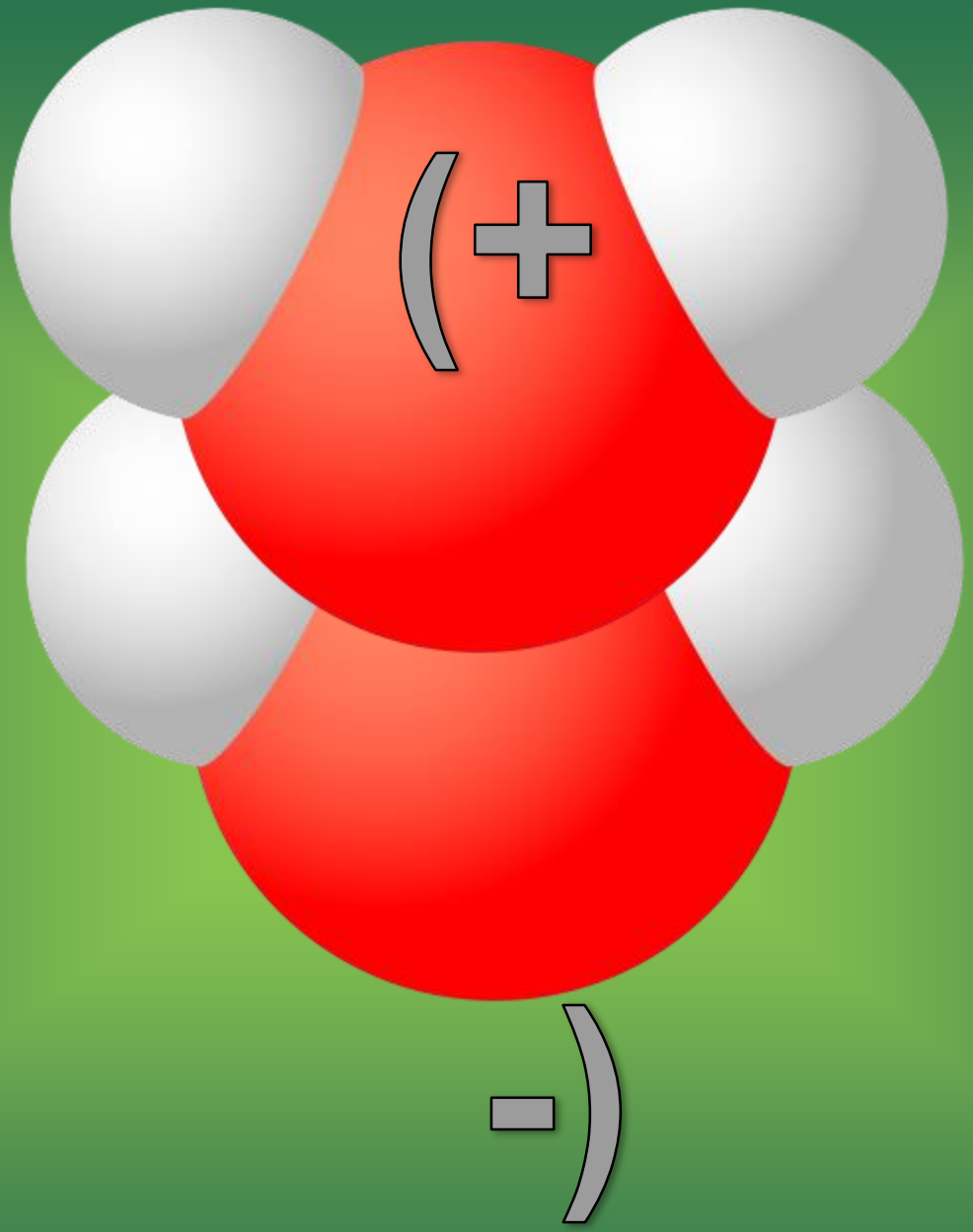
	Left hand side	Right hand side
C	1	1
H	4	4
O	4	4

Properties of H_2O

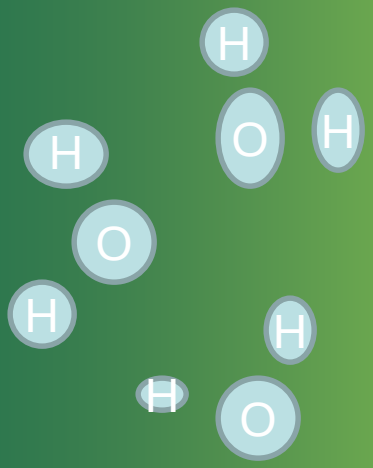
- Hydrogen bonds: Because water is a polar molecule it can form hydrogen bonds
- This allows water to have certain properties:
  - **Cohesion** is the attractive force between molecules of the same substance
    - This allows water to stick to itself
      - This is why water beads on a window
      - This is why some organisms can stand on top of water
  - **Adhesion** is the attraction between molecules of different substances
    - This allows for water to stick to other things
      - This is why water moves up the xylem of a plant

Van Der Waals Forces

- When molecules are close together, a slight attraction can occur between the positively and negatively charged regions of nearby molecules
  - This does not require the molecules to have a specific or complete charge
    - THIS HAPPENS WITH WATER



Evapotransperation



Atomic Number

- The number of protons not only tells you what the positive charge is, it also tells you of the atoms atomic number.
- Its atomic number tells you what **Element** the atom is
- Remember** An **Element** consists of entirely ONE type of atom
  - -Change the # of protons & you change the type of atom (which changes the element)

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Periodic Table of Elements

- Why do we need one?
- What is the point of classifying things?
- Does it speed things up?
- Do you think it was easy to make?

Periods & Families

- The periodic table is a useful tool that organizes all of the chemical elements known to man.
- It tells us the atomic #, atomic mass, and electron "orbits" of each element
- It is also arranged specifically into **periods and families** that tell us things about the elemental behavior
- **The Period** is the horizontal row on the table and shows important relationships of behavior such as the relationship between *transition metals*
- **The Family** (also called group) is the vertical column in the table and shows electron activity and behavior (most important of the 2)

Isotope

- When you change the number of **Neutrons** in an atom you get what is called an

Is an ATOM with the same

number of Protons

but a different

number of

ISOTOPE

NEUTRONS

Isotopes & a Mass Number

- Every element on the periodic table has a specific **Mass Number**
- This number indicates the mass of the atom
- The mass comes primarily from the protons & neutrons in an atom
- Therefore, having a different number of neutrons (Isotope) will change the mass number
- Isotopes are represented by adding the mass number to the atom symbol

Numbering & Isotopes

Radioactive Isotopes

Radioactive Isotopes

- Many isotopes are unstable in their natural forms
- This instability can make radioactive material hazardous to living material
  - It can cause changes (mutations) in DNA that can lead to cancer
- If used correctly, however, radioactive isotopes have very important uses
  - Chemical tracers, military tracers, chemotherapy, carbon dating

Radioactive Isotope Chemical Tracer

Military Tracer

Chemo Therapy

Carbon 14 Dating

Types of Bonds

- When elements join together they form molecular compounds that are hooked together by bonds
- Atoms always want to satisfy their outermost “ring or orbit”
  - For this class we will consider only the first 2 “orbits.” The first orbit wants 2 electrons and the second wants to form 8.
- There are three types of bonds:
  - Covalent Bond
  - Ionic Bond
  - Hydrogen Bond

Covalent Bonds

- Covalent bonds are reasonably strong bonds in which two or more elements **share electrons.**
  - They do this as a way of **satisfying** their outermost ring of electrons.
  - Usually, covalent bonds **Require energy** to form & **Release energy** when broken
    - If this happens it is termed an **endergonic reaction**
    - For example, H_2O is a covalent bonding of Oxygen and 2 Hydrogen molecules

Covalent bonding

Ionic Bonding

- Is the **strongest bonding** in which one or more elements take an electron from another molecule
- Once the electron is taken, the additional electron causes a negative charge on the molecule doing the taking
- The molecule that lost the electron has a positive charge due to the missing electron
- For this reason the opposite charges cause a strong molecular binding
  - IE Table Salt, $Na^{+}Cl^{-}$, is an ionic bond

Ionic Bonding

Calcium DiChloride

Hydrogen Bonding

- Is the **Weakest** form of bonding that occurs as an interaction of a hydrogen atom with an electronegative atom, such as nitrogen, oxygen or fluorine
- This should not be confused with a covalent bond to hydrogen.
- This weak bond can occur spontaneously and breaks apart very easily

Potential of Hydrogen

- **pH = Potential of Hydrogen**
  - **Amount of H^+ ions present in a solution**
  - **However, the measurement formula for pH is actually $^-$log function (algebraic function)**
    - **This means the more H+ ions present in a solution, the lower the pH score**
    - **The pH scale, like the metric system, is a base 10 scale. This means there are 10 units between each # on the pH scale**
      - **IE: The difference between 4 and 5 on the pH scale is 10 H^+ ions**

Acids & Bases

- Acids are solutions that contain **higher levels of H+ ions** than are present in pure water
  - Remember, the pH scale is a $^{-}$log function meaning that the higher the # of H^{+} ions the lower the pH scale score
    - This means ACIDS have a pH score of less than 7.
- Pure water has a pH of 7 and is considered to be **Neutral**
- Bases are solutions that lack H^{+} ions and instead have high concentrations of OH^{-} ions
  - This causes bases to have a low potential of hydrogen and therefore a high pH scale score
    - This means bases have a pH score of more than 7.