**Chemistry of Life**

**The Basics**

I. Elements

A. Substance made of only one kind of atom

1. 92 in the known universe

2. 99% of all living matter is made up of 6 elements

B. *Essential Elements*

Sulfur

Phosphorus

Oxygen

Nitrogen

Carbon

Hydrogen

**(SPONCH)** from least to most abundant

C. *Trace Elements* - needed by living things in small amounts

II. Atoms

A. Subatomic Particles

1. **Proton** – (+), nucleus, mass

a) Defines element

2. **Neutron** – no charge, nucleus, mass

a) Holds nucleus together

3. **Electron** – (-), orbits nucleus, no mass

a) Allows for interactions

b) Arrangement of Electrons

- Orbit around nucleus in shells

- Innermost shell - 2 electrons

- Outer shells - 8 electrons

- Outermost shell = *Valence shell*

**Chemistry of Life**

**The Basics - Continued**

I. Bonding

A. Joining of atoms

1. Formed when atoms give up, gain, or share electrons (electronegativity values)

B. Depends on the number and arrangement of electrons – outer shell (valence)

II. Types of Bonds

A. **Ionic Bonding**

1. Atom **loses** or **gains** one or more electrons

2. It becomes positively or negatively charged (ion)

a) Opposite charges attract

 3. Example: Na+ + Cl- 🡪 NaCl

B. **Covalent Bonding**

1. Atoms **share** one or more pairs of electrons

a) Non Polar – share electrons equally

 - Example: Oil

b) Polar – unequal sharing of electrons

- Slight difference in charge between two poles

- Example: Water

C. **Hydrogen Bonding**

1. Atom or molecule interacts weakly with a hydrogen atom already taking part in a polar covalent bond

a) Slightly charged poles

b) Makes water “sticky”

III. Water

A. Makes up 70% of your body weight

B. Plays an important role in chemical reactions

C. Unique properties - Properties of Water

1. **Polarity**

a) Allows water to form hydrogen bonds with itself and other polar substances

b) Polar = hydrophilic (water-loving)

2. **Universal solvent**

a) Non-Polar = hydrophobic (water-fearing)

 - Will not dissolve in water (repelled)

b) Like dissolves like

 - Water dissolves polar and ionic substances

 3. **Cohesion**

a) Capacity to resist rupturing (sticky)

- Due to hydrogen bonds (polarity)

 b) **Adhesion** – sticks to other polar/ionic molecules

 4. **Surface tension**

a) Prevents water from stretching or breaking easily

5. **High Specific Heat**

a) Amount of heat required to change the temperature of something one degree

b) Requires a lot of heat to raise temperature

c) Organisms are made of mostly water

**Chemistry of Life**

**Macromolecules**

I. Carbon

A. Vitally important to all living things

B. Backbone of life

1. Organic Compounds - Contain carbon

2. Inorganic Compounds - Do not contain carbon

II. Macromolecules

A. **Carbohydrates**

1. Contain C, H, O

2. Sugars & Starches

3. Always found in rings

4. Important source of energy

a) Monosaccharides – 1 ring sugars

b) Disaccharides – 2 sugar rings

c) Polysaccharides – many sugar rings

5. Breakdown of carbohydrates = Hydrolysis (just add water)

6. Formation of carbohydrates = Dehydration Synthesis (water is a byproduct)

B. **Proteins**

1. Contain C, H, O, N

2. Made up of amino acids (a.a.) – 20

a) Amine Group (NH2)

b) Carboxyl Group (COOH)

c) An R Group (side chain)

3. Peptide bonds hold molecule together

4. Major structural & functional component of living organisms

5. Enzymes are proteins

a) Enzymes are catalysts that speed up reactions (breakdown of substances)

b) Substrate is broken down in the active site into products

C. **Lipids**

1. Consist of C, H, O

2. Fats, oils, steroids, phospholipids

a) Triglyceride – glycerol + 3 fatty acid chains

b) Phospholipid – glycerol (phosphate) + 2 fatty acid chains

3. Phosphodiester bond holds molecule together

4. Structural component cell membranes, insulation, energy storage

D. **Nucleic Acid**

1. Consist of C, H, O, N, P

2. Made up of nucleotides

a) 5 Carbon Sugar

b) Nitrogen Base

c) Phosphate Group

3. DNA & RNA