3-1 Chemistry of Life

I. Characteristics of Matter

-mass and volume

A. **Atoms**-basic building blocks

B. **Elements**-consist of only one type of atom

C. **Compounds and Molecules**-specific ratio of elements, fills the outer shell

D. **Molecular Compounds**-sharing of electrons

E. **Ions**-gain or lose electrons to become charged

F. **Ionic Compounds**-transfer of electrons

II. **Mixtures**-a combination of substances in which individual substances retain their own properties.

-can be solids, liquids, or gases or any combination of them

A. **Solutions**-two or more substances are mixed evenly.

B. **Suspension**-formed when a liquid or a gas has another substance evenly spread throughout it.

-substances in a suspension will eventually separate

III. **Organic Compounds**-always contains carbon and hydrogen and usually are associated with living things.

-can contain hundreds or even thousands of atoms that can be arranged in many ways

A. **Carbohydrates**-supply energy for cell processes.

-ex. sugars and starches

B. **Lipids**-release even larger amounts of energy than carbohydrates.

-do not mix with water

-ex. fats and oils

C. **Proteins**-made up of amino acids.

-building blocks of many structures in organisms

-enzymes regulate nearly all chemical reactions in cells

D. **Nucleic Acids**-large organic molecules that store important coded information.

-**DNA** (deoxyribonucleic acid) is found in all cells, and directs the activities of cells

-**RNA** (ribonucleic acid) is needed to make enzymes and other proteins

IV. **Inorganic Compounds**-made from elements other than carbon and hydrogen.

-contain fewer atoms than organic molecules

- one of the **most** important inorganic compounds for living things is water

A. **Importance of Water**

1. Living things are composed of more than 50% water.

2. We can only live a few days without water.

3. All the chemical reactions in living things take place in water solutions and use water to transport materials.

B. **Characteristics of Water**

1. Water molecules are like magnets. This creates a force called surface tension.

2. Water heats up slowly, acts as an insulator, and helps to keep the temperature of a cell constant.

3. Bodies of water freeze from the top down.

3-2 Moving Cellular Materials

I. **Passive Transport** – movement of substances through the cell membrane without the use of energy. Cells use three types of passive transport.

A. **Diffusion** – molecules move from areas of high concentration to areas of low concentration. When the molecules of one substance are spread evenly throughout another substance, **equilibrium** occurs and diffusion stops. When equilibrium is reached, molecules continue to move and maintain equilibrium.

B. **Osmosis** – the diffusion of water through a cell membrane (ex. carrot sticks).

C. **Facilitated Diffusion** – some molecules are so large that they need help to travel through the cell membrane. These molecules must use transport proteins to enter the cell. Glucose molecule.

II. **Active Transport** – energy is required to move materials through a cell membrane. This process also involves transport proteins.

A. **Endocytosis** – the process of taking substances into the cell by surrounding it with the cell membrane. The cell membrane encloses the item in a sphere called a **vesicle**. Vesicles are transport and storage structures in a cell's cytoplasm (ex. bacteria).

B. **Exocytosis** – the contents of a vesicle may be released by fusing with the cell membrane and then exiting the cells (ex. stomach lining).

3-3 Energy for Life

I. **Trapping and Using Energy** – the total of all chemical reactions in a cell is called **metabolism**. The chemical reactions of metabolism need **enzymes**. Enzymes break large molecules into smaller ones and vice versa.

A. **Photosynthesis** – living things are divided into two groups: producers and consumers. Producers can make their own food, consumers cannot. During photosynthesis, producers use light energy to make sugars, which can be used as food.

$6CO_2 + 6H_2O + \text{light energy} \xrightarrow{\text{chlorophyll}} C_6H_{12}O_6 + 6O_2$

carbon dioxide — water — sugar — oxygen

B. **Producing Carbohydrates** – chlorophyll and other pigments are used to capture sunlight. The captures sunlight energy is used to drive chemical reactions during which the raw materials, carbon dioxide and water, are used to make sugar and oxygen.

C. **Storing Carbohydrates** – excess sugar is changed and stored as starches or used to make other carbohydrates. Plants use these carbohydrates as food for growth, maintenance, and reproduction.

D. **Respiration** – chemical reactions that required oxygen to break down food molecules into simpler substances and release their stored energy.

E. **Breaking Down Carbohydrates** – respiration of carbohydrates begins in the cytoplasm of the cell. The carbohydrates are broken down into glucose molecules. Each glucose molecule is broken down into smaller molecules. This breakdown occurs in the mitochondria of the cell.

F. **Fermentation** – when cells do not have enough oxygen, they use this process. The breakdown of glucose occurs in the cytoplasm, not in the mitochondria. The reactions in the cytoplasm reduce wastes such as lactic acid, alcohol, and carbon dioxide. For example, yeast cells use fermentation to break down sugar in bread dough. They produce alcohol and carbon dioxide as wastes. The carbon dioxide waste is a gas that makes bread dough rise before it is baked. The alcohol is lost as the bread bakes.