Unit 2: Chemistry

Unit Overview:

This unit will focus on basic chemistry and some of the major process of organic chemistry (dehydration synthesis, hydrolysis, and enzyme action) that help form carbon based matter. The students will have the opportunity to view, first hand through three investigative laboratory experiments, the value of pH, the form and function of macromolecules, and the importance of enzymes in a living system.

Unit Objective(s):

- Identify the atomic properties of matter
- Differentiate between the two basic types of chemical bonds.
- Understand the concept of pH
- Be able to differentiate between inorganic and organic molecules.
- Recognize the structures and functions of different types of bio-molecules such as carbohydrates, lipids, proteins, and nucleic acids
- Identify the properties of enzymes
- Investigate and identify the effects of enzymes on food molecules

Skills attained:

- Correctly identify the pH of various unknown substances and determine if they are and acid or base.
- Differentiate among the four major groups of organic molecules based on their atomic and molecular characteristics.
- Differentiate between hydrolysis and dehydration synthesis.
- Determine how variables (heat, pH, and amount of substrate) can influence enzyme action.

Unit Topics*:*

- Basic Chemistry (Parts of the atom, chemical bonding, and chemical reactions)
- Lab Safety.
- pH (Acid-Base determination)
- Organic Chemistry (Carbon and the compounds it makes)
- Enzymes (Form and function of enzymes).

Unit Vocabulary: (proton, neutron, electron, atomic number, atomic mass, covalent bond, ionic bond, pH, acid, base, proteins, carbohydrates, lipids, amino acids, glycerol, fatty acids, nucleotides, nucleic acids, end groups, dehydration synthesis, hydrolysis, respiration, substrate, enzyme, and activation energy.)

Procedure:

Before handing out the worksheets to the students it is recommended that you go over each one to make sure the information in each activity was covered in the class lecture or any reading assignment that you might have given. As the class leader, it is up to you to make modifications to the assignments as you see fit. Questions may be left out if you feel they are inappropriate for one reason or another. The worksheets and labs were designed to cover the full scope of each of the units. Just as in different biology textbooks, emphasis may be given to certain areas more so than others. The activities in this book tend to float down the middle of the road. If you feel a need to add to the activities, Xerox a copy and then add your material to it before running off the class copies. It is also recommended to make a dry run through each of the labs. This will give you an idea of how smoothly it will go in class. Problems that students might encounter will become visible and you can direct them away from them is your pre lab discussion. It will also give you an idea of how much class time will be needed to complete it. Never hand out a lab without first going over the basics of it in detail. This will save you a lot of time as the lab progresses in class. The labs may run from a little less than a regular 55 minute period to half of a 90 minute block period. You may want to add extension material to the labs as additional practice.

Please feel free to e-mail me with ideas or problems that you may encounter.

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1. Assign the worksheet on Basic Chemistry. Make sure the students have the periodic table available to them. It is important that they become familiar with and use this table as much as they can.

2. Conduct Lab #5 Using an Acid-Base Indicator. Before beginning emphasize laboratory safety. This could be done as a pre lab exercise the day before the lab. The materials used in this lab can be changed based on availability. The method of pH measurement can also be changed if the appropriate materials are available. pH paper is usually available in most schools.

3. Assign the worksheet 2: Organic Chemistry.

4. Have the students complete the Lab #6 Macromolecules. This lab is designed to emphasize the idea of dehydration synthesis and hydrolysis. The students must understand that in order for the building blocks (monomers) to become attached to each other a molecule of water must be lost. This loss of water allows the 2 molecules to connect. Keep a close watch on how the students cut out and use the paper models. Emphasize the reading of the directions before any cutting occurs. Remember you

cannot un cut paper.

5. Conduct lab #7 Enzyme Concentrations. This lab needs a lot of preparation and time to complete. You will need to produce enough small round pieces of filter paper produced by a

hole-punch. The directions must be explained very carefully before you start. It would be a good idea for you to run through the experiment first to get the feel. The more you run through it the easier it becomes. It may benefit your students if you let them run it through 2 times or so. Accuracy is important. Be careful using hydrogen peroxide. Students should wear goggles to prevent any from getting into their eyes.

Materials list:*(Test tube rack, 10 test tubes per group, lemon juice, coke, starch, orange juice, pH paper, salt water, vinegar, goggles, aprons, scissors, cardboard, medicine cups for dilutions, forceps, hydrogen peroxide, paper towels, metric rulers, hole punch, clear vials, filter paper ,and clock with a second hand)*

Content Background:
Lab Safety

- Students must wear protective glasses and aprons.
- Remove all books and other materials from the lab area.
- Work in groups of 2.
- No horseplay will be permitted.
- Never empty any material in the sink. Place it in the clearly marked disposal area in the class.
- Never mix any chemical with out the proper directions.
- Point all open test tubes away from the face.
- Read all directions
- Clean up your area.

Basic Chemistry

Basic chemistry is important in helping students understand the various cellular reactions taking place in an organism's body. The atomic number refers to the number of protons found in an atom. Under certain circumstances it may also refer to the number of electrons contained by that atom. The atomic mass refers to the combined mass of an atoms protons and neutrons. It is important to emphasize that it is the electrons that cause atoms to react with each other. **Valence electrons**: These electrons occupy the last energy level of an atom. It is here where atoms come in contact with each other. It stands to reason that chemical bonds will occur here in any chemical reaction. The maximum number of valence electrons any atom can contain is 8. Any number less than 8 will allow that atom to act as a donor or recipient of electrons to become stable. Atoms that give electrons will become + ions and have a + charge, while atoms that receive electrons will become a negative ion with a - charge.

Chemical Bonding: Atoms will interact with each other depending on their incomplete valence shell. Covalent bonds have the atoms share these electrons and make a much more stable bond. Ionic bonds are formed when one element takes the electron from the other forming ions; one positive and the other negative. Ionic bonds are much weaker than those of the covalent variety. **Chemical Reactions**: The combination of 2 or more elements forming a different product or products. Each reaction contains reactants and products. The reactants are written on the left side of the equation, while the products are written on the right side. The reactants and products must contain the same number of atoms making the reaction balanced.
Example: Sodium contains 1 electron in its outer shell. So sodium will react with any chemical that needs 1 electron. Chlorine has 7 in its outer shell. It needs 1 to make the desired 8. So it will react with sodium forming NaCl. One atom of sodium connected to one atom of chlorine. To determine the atomic mass of a compound, the mass of each atom must be added together for the entire compound. Example: H_2O: Hydrogen has an atomic mass of 1. Since there are 2 of them in the compound the mass of 2 must be added to the mass of Oxygen which is 16. The result is 18 for water.

pH

pH is the measure of Hydrogen ions in solution. It is the concentration of these H+ ions that make a solution either and acid or a base. Water is the key to determining pH. Water has the ability to split into two distinct ions H+ and OH-. If these two ions are in balance the solutions is said to be neutral. Distilled water is neutral since each molecule of water that splits forms one H and one OH. If this balance is upset and there is more H than OH the solution is considered acidic. If the opposite occurs, more OH than H the solution becomes basic. The pH scale is set up with water in the center at 7 and any thing less than that to zero is an acid. Above 7 is considered a base. pH is a very important variable in chemical reactions of the body and the environment. Enzymes and other chemicals are drastically influenced by a solution's pH. Many times the reaction will not work because the pH is not correct. The pH scale is arranged like that of the metric system in that as we move from one value to another we increase or decrease the value by ten times. So the

difference between a pH of 4 and 5 is ten times. A difference between a 4 and 6 is 100 times

Organic Chemistry

Organic chemistry is the backbone of biology. Dehydration synthesis is a universal process where by the building blocks are joined together to form larger more complex molecules through enzyme action and the loss of water. Hydrolysis is the opposite breaking down these larger molecules using enzymes and the addition of water. The end groups are specific molecules attached to the main organic molecule changing its function. The amino group (NH_2) and the carboxyl group (COOH) are the main ones for the student to learn. The amino group is found in proteins and is the key indicator of their building blocks amino acids. The carboxyl group is found in all organic acids. All organic compounds are constructed of smaller units called monomers. Carbohydrates are produced by adding monosaccharides together to form disaccharides and then polysaccharides. The monomers of proteins are the amino acids, while the fats are glycerol and three fatty acid molecules. Nucleotides form the nucleic acids.

Lecture Support:

Lecture is a very important part of imparting your knowledge to your students. The lessons contain a framework of material essential to the units being covered. If you show the information on an overhead or through a power point demonstration without added material the students will be missing material. It is important that you read the content background presented in these lessons to become thoroughly familiar with the subject matter. Along with your text book it is an invaluable tool. As you lecture ask questions that will make the students think. Make sure they are all taking notes in one form or another. The method I use is to boot up the power point presentation on the computer and copy the text box on the left. I then transfer this material to a word document. On the document I will blank out word(s), sentence(s) or whole paragraphs then Xerox it as notes to be filled in during the lecture. Make sure you require each student keep a notebook.

1. Present the lesson on Basic Chemistry. Read the above notes on basic chemistry and preview the lesson's notes. Make sure you give ample examples for each of the slides in this lesson. It would be a great idea to hand out a periodic table to each student. They can write on it while following the section on the electrons and chemical bonding.

2. Present the lesson on Organic Chemistry. Organic chemistry is the backbone of biology. Students must understand this in order to understand the basic principles of biology. Spend some time working with the students making sure they understand how organic chemicals are produced and destroyed. Read over the worksheet and familiarize yourself with the answers. The end groups (amino, and carboxyl) are important to learn. You may use some of these questions in your lecture. Also read the chapter in your assigned textbook for further examples and ideas.

3. Present the lesson on enzymes. This is a short lesson but a very important one. The students must understand that enzymes are proteins and can be changed by many environmental variables: temperature, chemicals, pH, etc. to mention a few. The main purpose of enzymes is to lower the activation energy of chemical reactions. This will allow them to react faster. Enzymes do not have to be present in living tissue to work. They are found in many over the counter products like clothing detergents. Read over the worksheet and familiarize yourself with the answers. You may use some of these questions in your lecture. Also read the chapter in your assigned textbook for further examples and ideas.

Assessment: *(Unit 2 Test, All worksheets and Labs may be used as an assessment)*

Homework: You may assign questions at the end of the chapter, vocabulary word definitions, or selected readings from the text book as appropriate homework assignments.