Biology Study Guide

Introduction

This study guide was devised to enable students to review the basic biological concepts that they may need in preparing for the Biology Exit Assessment. It is not intended to be a comprehensive course in biology. The study of biology as in all sciences contains investigations and activities that are integral parts of the courses. As students and teacher use this guide they should be ever mindful of basic scientific principals that require investigation and discovery.

Basic Scientific Principles

Scientific Method

Observe
Define Problem
Formulate **Hypotheses** (Always a statement. Never a question)
Test **Hypothesis** (possible explanation based on research and prior (knowledge)
Collect, Organize, and Analyze **Data** (facts collected during an Investigation. Could be measurements or other observations)
Draw Conclusions
Report Findings

There are variations on this method that all scientists use.

Observations lead to questions. These questions are often how a problem is defined.
Example

Problem: Is growth of spinach plants influenced by light wavelength?
Hypothesis: Spinach growth will be influenced by different wavelengths of light.
Test: Spinach plants will be grown in the following way:

Experimental Group
100 plants grown in red light
100 plants grown in orange light
100 plants grown in yellow light
100 plants grown in green light
100 plants grown in blue
100 plants grown in indigo light
100 plants grown in violet light

Control Group

4. In your experiment identify the following:

Independent variable
Dependent Variable
Controlled variables
Experimental Group or Groups
Control Group

What type of data might you collect as the dependent variable?

Vocabulary List for Introduction

1. Data
2. Hypothesis
3. Variables
4. Controlled Variables
5. Dependent Variables
6. Independent Variables
7. Scientific Methods

1. The Nature of Matter

Matter

All matter in the universe is made up of tiny particles called **atoms**. Atoms themselves are made up of three basic types of subatomic particles.

The three **subatomic particles** are the protons, neutrons, and electrons.

The **protons** have a positive charge and are located in central part of the atom which is called the **nucleus.**

The **neutrons** have no charge and are located in the nucleus along with the protons.

The **electrons** have a negative charge and are located in a region surrounding the nucleus known as the **electron cloud**.

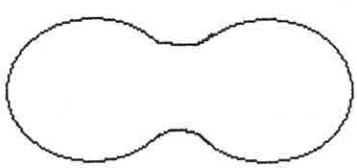
The number and arrangement of the electrons are what gives an atom its **chemical properties** which are the ability to react with other atoms. An example of a chemical property is ability of iron to react with the oxygen in air to form rust.

In **ionic bonding** atoms lose or gain electrons to become positively or negatively charged particles called **ions**. These ions then are attracted to each other because of the opposite charges, forming chemical compounds with new properties. Many ionic compounds exist as crystals that can break apart into separate ions when dissolved in water. An example of a common substance formed by ionic bonding is sodium chloride (NaCl).

In **covalent bonding** atoms share electrons between them. In effect their electron clouds become fused together forming a **molecule** with new properties. An example of a covalent molecule is carbon dioxide (CO_2). In some cases atoms of the same types can covalently bond together to form molecules. Oxygen atoms (O) bond to form oxygen molecules (O_2) or ozone molecules (O_3).

Try These:

1. *Compare and contrast an ionic and covalent bond.*
2. *What type of bonding is depicted by this diagram? Explain.*

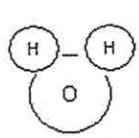


Water

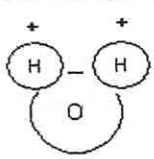
Water is extremely important to life on earth for many reasons. Many different substances can dissolve in it and therefore it is a substance in which the chemical reactions supporting life can occur. It is an excellent absorber of heat energy and allows living cells to remain at stable temperatures despite temperature changes outside the cell. It also moderates the Earth's temperature as large bodies of water absorb or release energy.

Water molecules consist of two hydrogen atoms covalently bonded to an oxygen atom.

Water has the **formula** H_2O and the molecular structure depicted in the diagram at the right.



Water electrons are not shared evenly. This is because oxygen has an extraordinarily large attraction for the shared electron and hydrogen has a fairly weak attraction for the shared electrons. Because of this uneven sharing, the oxygen atom has a partial negative charge and the hydrogen atoms have a partial positive charge giving the water molecule a positive side and a negative



6. nucleus
7. electron cloud
8. chemical properties
9. element
10. chemical compound
11. chemical bonding
12. ionic bonding
13. ion
14. covalent bonding
15. molecule
16. water molecules
17. formula
18. polar covalent
19. nonpolar covalent
20. hydrogen bond
21. cohesive property

2. The Chemistry of Life

The Elements of Life

Most living things are composed primarily of only six elements: carbon (C), hydrogen (H), oxygen (O), Nitrogen (N), sulfur (S), and Phosphorus (P).

Of these elements, carbon is important because it can form millions of large, complex molecules essential to life. These large complex molecules are referred to as **macromolecules**.

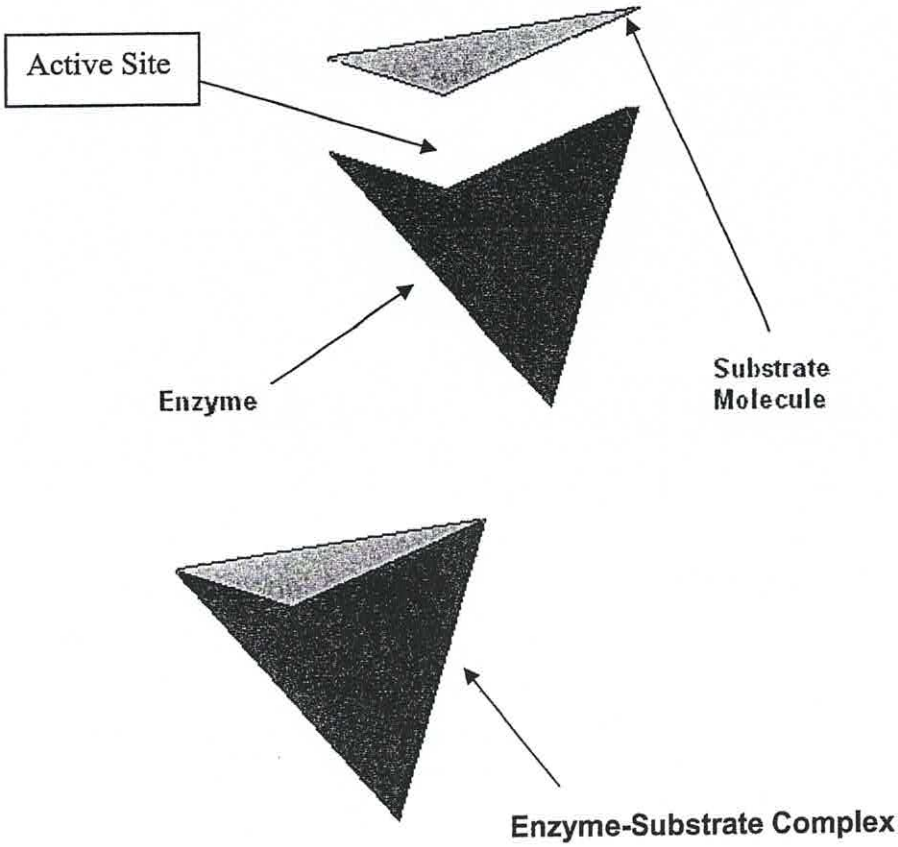
Organic Compounds in Living Things

Four main groups of **organic** (carbon-based) compounds are carbohydrates, lipids, proteins, and nucleic acids.

Carbohydrates are composed primarily of carbon, hydrogen and oxygen and used primarily by living things as a source of energy and for structure.

The simplest carbohydrates are sugars called **monosaccharides**. An example of a monosaccharide is the sugar glucose $C_6H_{12}O_6$.

Monosaccharides can bond together to form larger carbohydrates called **polysaccharides**. An example of a polysaccharide is starch as is found in potatoes or pasta.


Active Site
Enzyme
Substrate Molecule
Enzyme-Substrate Complex
Product Molecules
Enzyme releases products and is once again ready for a new substrate

Vocabulary List for 2. The Chemistry of Life

1. macromolecules
2. C H O N S P
3. organic compound
4. monosaccharide
5. polysaccharide
6. lipid
7. saturated fat
8. unsaturated fat
9. protein
10. amino acid
11. enzyme
12. substrate
13. nucleic acid
14. DNA
15. RNA

The Nature of Matter Web Resources

http://corrosion.ksc.nasa.gov/electrochem_nature.htm

http://www.biology.arizona.edu/biochemistry/tutorials/chemistry/page3.html

http://www.infoplease.com/cig/biology/water.html

3. Cell Biology

The characteristics of life state that an organism must be made of cells, able to reproduce, grow, develop have organization, use energy/ATP, evolve, have heredity, adapt to their environment, and maintain **homeostasis** (stable internal environment).

There are 3 parts to the cell theory: all living things are made of **cells** (smallest units of life), cells are the basic units of structure and function in an **organism** (anything living) and existing cells produce new cells.

An organism is considered to be alive even if it is just made of one cell. This organism would be said to be **unicellular**.

Microscopes