GHSGT Review: Biology (Day 1)

Prepared by: Jill Tucker

OBJECTIVE: Explain the significance of biology

WHY STUDY BIOLOGY?

Biology is the study of life and living organisms. An organism is a complete, individual, living thing. All organisms are formed from the same basic building block – cells. Most cells are so small that you cannot see them. Cells are not only the structural units of living things, they are the functional units as well. They are the smallest units that carry on the activities of life.

People study biology for a variety of reasons, which include improving the lifespan and health of human beings. This is done through the study of medicine, nutrition, and diseases. People study biology because they are curious about themselves and the world around them.

DIVISIONS OF BIOLOGY

Originally, there were two fields of biology, only botany and zoology. Now there are many.

Anatomy	The study of the external and internal structures of organisms.
Biochemistry	The study of the chemical make-up and processes of organisms.
Botany	The study of plants.
Ecology	The study of how organisms interact with one another and with their environments.
Genetics	The study of heredity, or how traits are transmitted from one generation to another.
Microbiology	The study of organisms too small to be seen without a microscope.
Zoology	The study of animals.

OBJECTIVE: Explain the cellular basis of life.

CHARACTERISITICS OF LIVING THINGS

There are several criteria you must use to determine if something is living or not.

1. ***Organisms are highly organized.*** Every living cell is a highly complex structural and chemical system.
2. ***Organism use energy***. All living things need energy because they are constantly building the substances that they need. The sum of this chemical building up and breaking down is known as metabolism.
3. ***Organisms grow and develop.*** Growth always takes place in a specific way and this is different for each kind of organism.
4. ***Organisms cannot live forever.*** Every organism will eventually die although the lifespan of different organisms is different.
5. ***Organisms reproduce themselves.*** One of the most vital activities of living things is the production of offspring.
6. ***Organisms respond to stimuli.*** Any condition to which an organism responds to is called a stimulus. What an organism does as a result of the stimulus is a response. The ability to respond to stimuli is typical of all living organisms. This property is called irritability.
7. ***Organisms adjust to their environment.*** To survive, an organism must adjust to changes in its environment. Any change in an organism that makes it better suited to its environment is called an adaptation.

THE CELL THEORY

Several scientists, between 1660 and 1830, studied the cell. Three of the scientists' findings are summarized in the cell theory:

1. All organisms are composed of cells.
2. Cells are the basic units of structure and function in organisms.
3. All cells come from preexisting cells.

The virus does not fit this theory. It is a packet of nucleic acid wrapped in a protein coating. It possesses only a few structures of a cell. It relies on cells to help it reproduce. It cannot reproduce on its own.

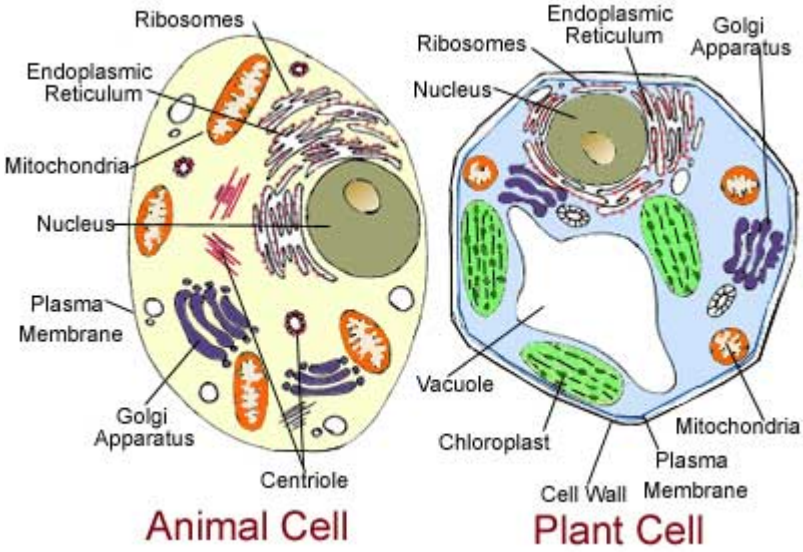
DIFFERENCES IN CELLS

All cells are either prokaryotic or eukaryotic
Prokaryotic cells – small simple cells that lack a nucleus
Eukaryotic cells – larger, more complex cells that have a nucleus

Prokaryotic Cells	Eukaryotic Cells
Lack a nucleus	Have a nucleus
Single-celled only	Single-celled or multicellular
No membrane organelles	Many specialized membrane organelles
Very small size	Relatively large size
Simple internal organization	Complex internal organization
Bacteria only	All cells other than bacteria

STRUCTURE AND FUNCTION OF CELLS

Cells differ in size, shape, and function. But most cells share several common traits. There are two main cell types: Animal and Plant. Both of these cell types have the following **ORGANELLES** (cell structures):



Cellular Structures

Structure	Function
Cell Membrane	Gives cell shape, controls what moves in and out of the cell (selective permeability)
Nucleus	Controls most of the cell's activities
Nuclear Membrane	Surrounds the nucleus and allows materials to move into and out of the nucleus
Nucleolus	Makes ribosomes
Chromosomes	Molecules of DNA, determine what traits a living thing will have
Cytoplasm	Makes up most of the cell; the fluid and organelles located between the cell membrane and the nuclear membrane
Ribosome	Make protein for the cell
Golgi Apparatus	Packages, labels, and ships cell products
Endoplasmic	Membranous tubes which transport materials throughout the cell

Reticulum	
Mitochondria	Produce energy for the cell in the form of ATP molecules
Vacuole	Membranous sac which stores food, water, and minerals
Centrioles	Help during cell division
Lysosomes	Membranous sacs filled with digestive enzymes – digest and recyle cell wastes
Chloroplasts	Site of photosynthesis in plant cells – traps energy in sunlight to make food molecules
Cell Wall	Outer structure in plant cells that surrounds the cell membrane and protects the cell

OBJECTIVE: Analyze the transport of materials through cell membranes.

The Movement Of Materials

Active Transport

- movement of materials across the membrane, from low to high concentration
- energy to power the movement is supplied by ATP from the cell

Passive Transport

- movement of materials across the membrane, from high to low concentration
- powered by kinetic energy

Types of Passive Transport

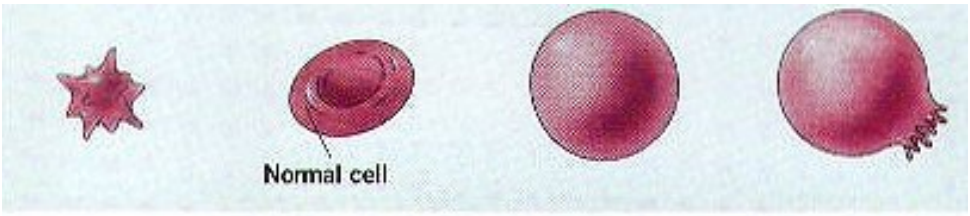
1. Diffusion is the movement of a substance (solutes) from an area of high concentration to an area of low concentration. Diffusion is powered by kinetic energy (the random movement of molecules).

2. Osmosis is a special type of diffusion. In osmosis, solutes are unable to cross the cell membrane. Water then diffuses for the substance. Water molecules move across the membrane from an area of low solute concentration to an area of high solute concentration. Since most of the cell is water, movement of water due to osmosis can change the size of cells.

- **Hypertonic solutions** are solutions where there is a high solute concentration outside the cell. Water moves out of the cell by osmosis, causing the cell to **crenate**, or shrivel up.

- **Hypotonic solutions** are solutions where there is a low solute concentration outside the cell. Water moves into the cell by osmosis, causing the cell to increase in size until it **lyses**, or bursts open.

- **Isotonic solutions** are solutions where there are equal concentrations of solute inside and outside the cell. Water diffuses into and out of the cell at the same rate, and the net diffusion is zero. The size of the cell remains constant.



Hypertonic
The concentration of solutes outside is higher than it is inside the cell.

Isotonic
The concentration of solutes outside the cell is equal to that inside the cell.

Hypotonic
The concentration of solutes outside is lower than it is inside the cell.

Very Hypotonic
This cell has burst due to the large amount of water entering it.

OBJECTIVE: Explain homeostasis.

Changing To Stay The Same

An important property of living things is the ability to maintain a nearly constant internal environment. This is important because cells are extremely delicate. They cannot tolerate a change in temperature and the surrounding concentration of chemicals cannot change much. Cells might shrivel up like raisins or swell and burst. You can compare the maintenance of the cell's environment to that of a greenhouse. The internal environment of a greenhouse is maintained so that the conditions are favorable for plant growth.

Not only do cells have to adjust to a changing environment, but they also have to adjust to the activity of the moment. They may need to produce extra fuel to help your muscles run a race, they may have to make your lungs and heart work harder, and they may have to release extra heat generated by the hard work of these cells.

Keeping this delicate balance is called homeostasis. This is a self-adjusting balance of all the life functions and activities.

OBJECTIVE: Recognize that life has a chemical basis.

Building Blocks of Matter

The building blocks of matter – living and nonliving alike – are called atoms. Atoms are composed of even smaller parts – protons, neutrons, and electrons. There are 92 natural elements found on earth. The rest of the elements on the periodic table are man-made. Elements cannot be broken down chemically into smaller substances.

Atoms join together to form molecules. A molecule is the smallest part of a compound. A compound is when two or more elements chemically combine to form a new substance. The basic materials of living materials are complex compounds.

There are six elements that are especially important to life: carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur (CHNOPS). There are about twenty others that play lesser roles. Iron, iodine and other trace elements make up less than 0.1% of the human body, but must be present for the body to function normally.

Acids and Bases

Acids are compounds that release hydrogen ions (called hydronium ions, H^+) in water and increase the concentration of H^+ ions in the solution. The more H^+ ions there are in a solution, the more acidic the solution is. The fewer H^+ ions there are in a solution, the more basic the solution is. Bases are the chemical opposites of acids. They release OH^- ions or accept hydrogen, H^+, ions (also called hydronium ions).

WATER

Water is an inorganic compound for living organisms. Most cellular activities take place in water solutions. Water is important to living things because it is an excellent solvent and it has a high heat capacity. This means it can absorb and release a great deal of heat without changing temperature. This helps keep organisms from overheating or freezing.

The chemical structure of a water molecule explains its effectiveness as a solvent and its high heat capacity. The single oxygen atom in a water molecule strongly attracts the electrons of the two hydrogen atoms. As a result, the oxygen atom

in a water molecule has a slight negative charge, while each of the hydrogen atoms has a slight positive charge. The opposite charges found at either end of the molecule make water a polar molecule. Polarity makes water an excellent solvent. It attracts other polar molecules as well as ions.

Water has a high heat capacity because water molecules also attract each other. When water is heated, most of the heat energy is used first in breaking the bonds between water molecules. Then only a relatively small amount of heat energy is available to increase the movement of the molecules and raise the water's temperature.

Carbohydrates

Carbohydrates are organic compounds that contain carbon, and hydrogen and oxygen in the same ratio as water. That is, two hydrogens to every one oxygen. Carbohydrates that you are familiar with are sugars and starches, such as glucose and cellulose. Carbohydrates like cellulose are used as structural materials. Carbohydrates like glucose provide quick energy or store energy in cells. The largest carbohydrates are called polysaccharides. These molecules consist of hundreds of monomers of glucose or simple sugars. Plants store food in the form of starch, a polysaccharide of glucose. Animals store excess sugars as glycogen, another polymer of glucose. Cells break down glycogen or starch and energy is released.

Lipids

Lipids are a chemically diverse group of substances that include fats, oils, and waxes. Examples include butter, beef fat, and olive oil. Lipids also contain carbon, hydrogen, and oxygen like carbohydrates, but lipids are more complex than carbohydrates. All lipids are insoluble in water. They serve mainly as storage of energy in living things. They provide the most stored energy and usually have the most calories. Lipids are also part of the cell membrane and thus help regulate what enters and leaves cells. Many lipids have a backbone that is a three-carbon molecule called glycerol to which three fatty acids are attached.

Proteins

Proteins are basic building materials of all living things. Protein molecules contain carbon, hydrogen, and oxygen. But unlike carbohydrates and lipids, they also contain nitrogen, sulfur, and other elements. All proteins are made of monomers (single molecules) called amino acids. Examples of proteins include egg whites, gelatin, and hair. There are 20 amino acids. These amino acids combine to form polypeptides. All proteins consist of polypeptides.

Nucleic Acids

Nucleic acids are a class of organic compounds that carry all instructions for cellular activity. There are two kinds of nucleic acids. Deoxyribonucleic acid, DNA, records the instructions and transmits them from generation to generation. Ribonucleic acid, RNA "reads" the instructions and carries them out.

Example Questions

1. Which of the following processes occurs in chloroplasts?
   a. cell division b. conversion of light energy to chemical energy c. formation of reproductive cells
   d. production of protein

2. What is the basic unit of structure and function in living things?
   a. cell b. organelle c. tissue d. organ

3. Which organelle helps to maintain homeostasis within a multicellular organism through the exchange of materials with other nearby cells?
   a. cell membrane b. mitochondrion c. nucleus d. vacuole

4. In what general way is the fact than an amoeba divides into two related to the healing of skin?
   a. cell originate from cells of like kind b. all cells divide into two or more cell
   c. skin cells produce amoebas when healing d. amoebas may be found in a cut on the skin

5. Which statement best describes active transport?
   a. molecules move very quickly across a membrane
   b. energy is expended to move molecules across a membrane against their concentration gradient
   c. more molecules move across a membrane than in diffusion

d. water molecules stream across a membrane into a concentrated solution

6. An animal cell is placed in a solution of distilled water. If left overnight, this cell will|
   a. shrivel and die
   b. swell and burst
   c. undergo plasmolysis
   d. remain the same, since it has a cell wall

7. What is always found in organic compounds? A. calcium B. carbon C. glucose D. sulfur

8. Both plants and animals need water to live. What common purpose does water serve for plants and animals? A. Both use water for cooling. B. Both get their energy from water C. Both use water to transport nutrients. D. Both extract hydrogen and oxygen from water.