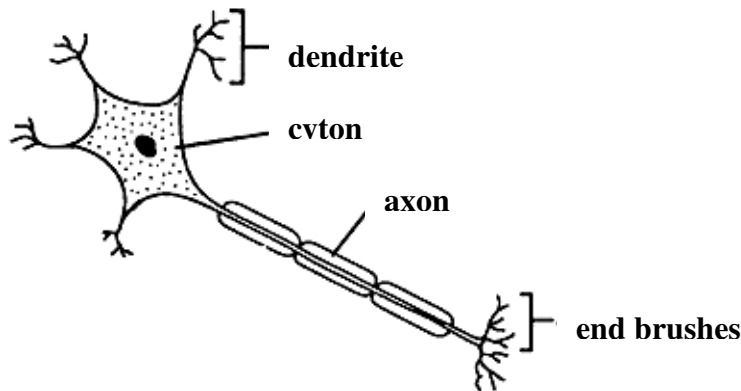


UNIT ONE: Similarities and Differences Among Living Organisms

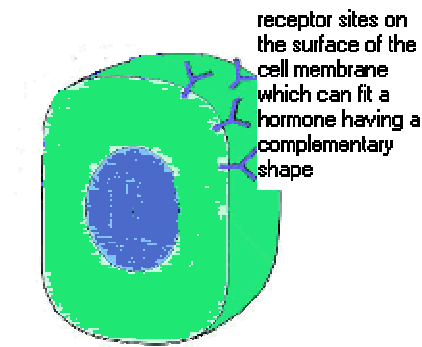
A. All living things must maintain homeostasis.

B. Homeostasis the ability of an organism to maintain a stable internal environment even when the external environment changes

1. To maintain homeostasis, organisms carry out the same basic life functions:
 - a. **nutrition** provides the body with the materials and energy needed to carry out the basic life of cells. **Autotrophs** make their own food, while **heterotrophs** eat other organisms.
 - b. **excretion** the removal of all the wastes produced by the cells of the body
 - c. **transport** process in which substances pass into or out of a cells and circulate within the organism.
 - d. **respiration** organisms get energy by breaking the bonds of sugar molecules. The released energy is used to make a molecule of **ATP**, which gives all organisms their energy.
 - e. **growth** an increase in the size or number of cells
 - f. **synthesis** a life process that involves combining simple substances into more complex substances
 - g. **Regulation:** coordination and control of other life functions.
 - 1). A **stimulus** is a change in the environment that you **respond** to.
 - 2). A **neuron** is a nerve cell.



- 3). An **impulse** is the electrical signal carried by the nerves. Neurotransmitters are chemicals that help carry the impulse.
- 4). A **hormone** is a chemical signal secreted by different glands in the body. Examples of hormones include **insulin**, **adrenaline**, **testosterone** and **estrogen**
- 5). **Receptor molecules** are proteins on the surface of the cell membrane that receive signals from the nervous and endocrine system. These are needed for your cells to communicate and work together.



- h. **reproduction** the process by which organisms produce new organisms of the same type
2. All life processes make up an organism's **metabolism**.
 3. Failure to maintain homeostasis causes disease and death.

C. Classification-

1. Organisms are classified mostly by evolutionary history. Those with common ancestors are grouped together.
2. **Kingdoms** are large groups of related organisms (fungi, bacteria, protists, animals, plants).
3. A **species** is able to successfully reproduce amongst its members.
4. A scientific name is made up of an organism's *Genus* and *species*.

D. Chemistry

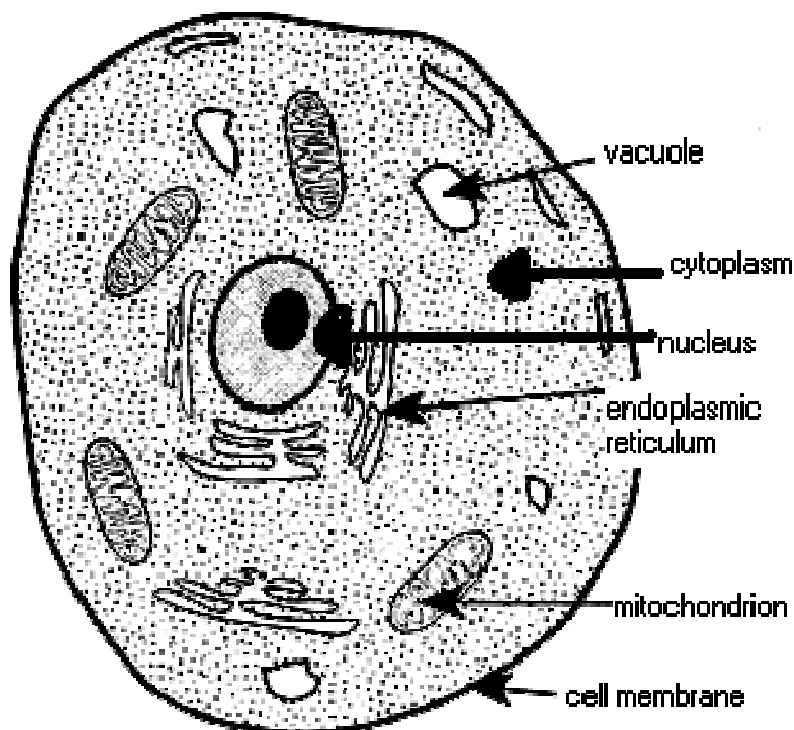
1. The most common elements in living things are (in order) Carbon, Hydrogen, Oxygen and Nitrogen (CHON).
2. **Organic Compounds** have Carbon AND Hydrogen (ex: $C_6H_{12}O_6$ is organic, H_2O , CO_2 , and NO_3 are not). Organic molecules are also larger than inorganic molecules.
3. **Carbohydrates** are sugars and starches. All carbohydrates are made from simple sugars (like glucose) and they supply energy.
4. **Lipids** store energy and include fats, oils and waxes. They are made from fatty acids and glycerol.
5. **Proteins** are made from **amino acids**. **Proteins** also make hormones and many body and cell structures, so *as far as your body is concerned, proteins are by far the most important of these three organic molecules*.
 - a. It is the **SHAPE** of proteins and how they fit together that determines what proteins can do.
 - b. Four specific jobs of proteins:
 - 1) make **enzymes**
 - 2) make **receptor molecules** on the cell membrane. These are used to receive chemical messages (like hormones).
 - 3) make **antibodies**
 - 4) make **hormones**
6. **pH**: The pH scale measure the strengths of **acids** and **bases**. A low pH (0-6.9) is a acid, a high pH (7.1-14) is a base, and 7 is neutral (water).

E. Organization:

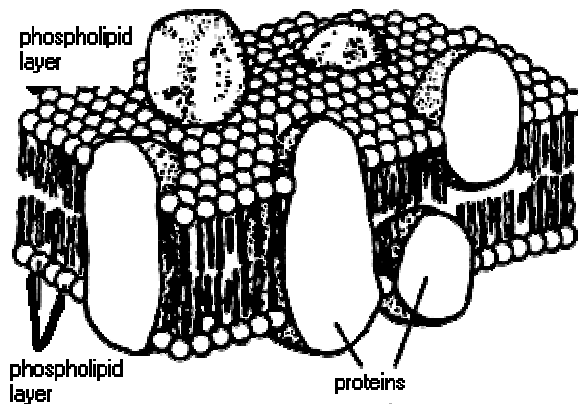
1. Cells are **specialized** into tissues.
 - a. **Tissues** are groups of cells specialized to do certain jobs. Examples of tissues include muscle tissue and nerve tissue.
 - b. **Specialization** or **differentiation** occurs because only some genes in the nucleus of a cell are “turned on”. Almost every cells has a complete set of genes, but on those needed for the cells particular job are active. So while a red blood cell has all the genetic information needed to make nerves cells, bone cells and skin cells, all those genes are turned off, and only the red blood cell genes are turned on.
2. **Tissues** work together to form **organs** (heart, lungs, kidney).
3. **Organs** work together in **organ systems** (digestive system, nervous system, etc).

F. Cells- Cells are the basic unit of life. All living things (except viruses) are made of cells.

1. **Cell theory** (all living things are made of cells).
2. **Organelles** structures within the cell that carry out specific functions
 - a. **cell wall** rigid structure that encloses the cells of plants
 - b. **nucleus** a large structure within a cell that controls the cell's metabolism and stores genetic information, including chromosomes and DNA
 - c. **chloroplast** the green organelle that contains chlorophyll; where photosynthesis takes place
 - d. **cytoplasm** the jellylike substance that is between the cell membrane and the nucleus and that contains specialized structures
 - e. **ribosome** one of the tiny structures in the cell that is the site of protein production
 - f. **vacuole** storage sacs within the cytoplasm of a cell that may contain either wastes or useful materials, such as water or food
 - g. **mitochondria** pod shaped organelles that contain enzymes used to extract energy from nutrients
 - h. **cell membrane** *the thin boundary between the cell and its environment*



3. **The cell membrane** is made of lipids and proteins. It shows selective permeability – that is only some molecules can pass through it (typically small molecules like water and oxygen). Large molecules (like starch or protein) need to be moved by active transport.



a. **Diffusion:** movement of molecules from high concentrations to low concentrations. Requires no energy (passive transport).

b. **Active Transport** requires the use of energy, usually moving molecules from a low concentration to a high concentration (against the flow of diffusion).

c. **Osmosis** is the diffusion of water into or out of the cell. If water diffuses into the cell, the cell swells (get larger) and may burst. If it loses water (being put in salt water for example) it will shrivel up.

1). **NOTE:** Students often assume cells have a cell wall OR a cell membrane. ALL cells have a cell membrane, including those with cell walls (plants, fungi, some bacteria and protists). The cell wall is mostly for protection; the cell membrane is needed to control movement into and out of the cell. The animal kingdom is the only kingdom that completely lacks cell walls.

G. Multicellular Organism Digestive System:

1. **Food is broken down so that it is small enough to enter the body tissues/cells.**
2. The digestive system is a one way passage through the body that includes the **mouth, stomach and intestines.**
3. Food is moved through the digestive system by muscular contractions (peristalsis).
4. Food is broken down mechanically and chemically.
5. Undigested food is eliminated as solid waste. *This is not excretion.*

H. Multicellular Organism Transport/Circulatory System.

1. Moves material (water, nutrients, hormones, wastes) through the body.
2. **Red blood cells** carry oxygen. **White blood cells** fight disease.
3. **Plasma** is the fluid of the blood. It transports everything *except oxygen*.
4. **Platelets** clot the blood.

I. Multicellular Organism Respiratory System:

1. Physical respiration (breathing) provides oxygen needed for chemical respiration (which releases energy from sugar).
2. The **diaphragm** is the muscle that allows breathing to occur.
3. You breathe faster when CO₂ builds up in the blood (not when you need oxygen).
4. The **alveoli** are very important because it is here that the oxygen enters the blood and CO₂ leaves. The alveoli look like microscopic sacs surrounded by capillaries.

J. Multicellular Organism Excretory System:

1. Removes metabolic waste from your body.
2. Your body excretes **salt, water, urea and CO₂**.
3. **Lungs** excrete CO₂ and water and the skin excretes sweat.
4. The **kidneys** filter waste from blood and reabsorb nutrients.
5. The **liver** filters toxins and dead red blood cells from the blood.

K. Multicellular Organism Skeletal Muscle System

1. **Skeletal Muscle System** the body system that contains the bones, provides shape and support, and protects internal organs. Muscles only pull and must work in pairs.

L. Multicellular Organism The Nervous System

1. The nervous system regulates your body along with the endocrine system.
2. The **spinal cord** controls reflexes and brings impulses from the nerves to the brain.

M. Multicellular Organism Endocrine System:

1. Regulates body along with nervous system. Slower but with longer lasting effects.
2. The **pancreas** makes **insulin** which controls blood sugar.
3. Adrenal glands make **adrenaline** when the body is under stress.
4. **Testosterone** (male), **estrogen** and **progesterone** (female) are the sex hormones.
5. Hormone levels are controlled by **feedback**; a cycle in which the output of a system either modifies or reinforces the first action taken by the system

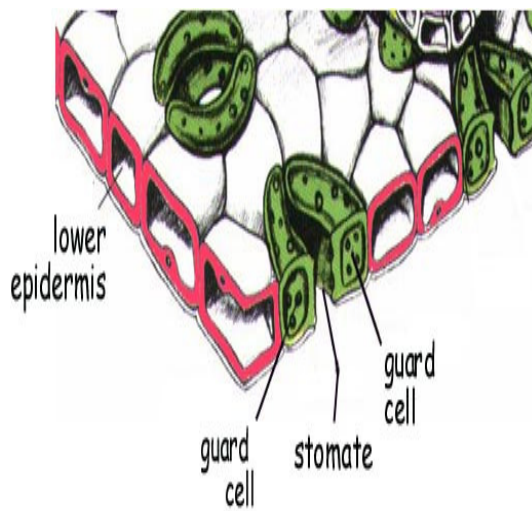
N. Interaction between Systems:

1. Different systems of the body work together to maintain homeostasis. *Ex. Nutrients from the digestive system are transported to cells by the circulatory system. Wastes from respiration are removed by the excretory system. The nervous and endocrine systems work together to control the body.*

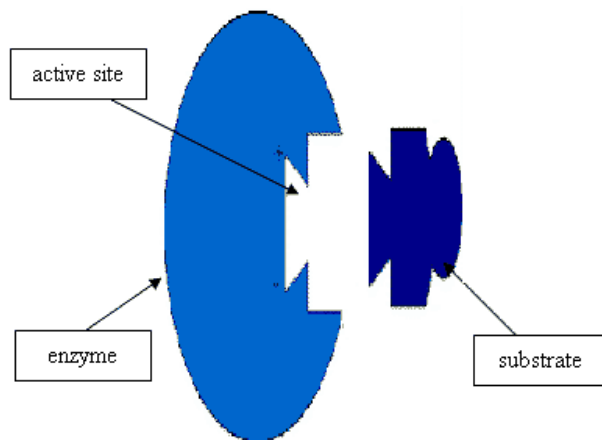
UNIT TWO: Homeostasis in Organisms

A. Homeostasis

1. **Photosynthesis** is carried out by plants, and algae (autotrophs). It takes the radiant energy of the sun and puts it in the bonds of sugar molecules. Photosynthesis occurs in the chloroplast of plant cells.
 - a. Plants have **stomates**, small holes in their leaves that let them exchange the gasses used in photosynthesis. **Guard cells** open and close the stomates.



2. Living things use energy produced by **Aerobic respiration** which requires oxygen, and **anaerobic** (no oxygen) respiration. **Aerobic** (no oxygen) respiration yields more ATP (energy) for a molecule of sugar than **anaerobic** (no oxygen) respiration.
 - a. When humans are forced to get energy from anaerobic respiration, we produce lactic acid that damages muscles (“the burn” you feel during exercise).
3. **Photosynthesis and Aerobic Respiration are opposite reactions!** They are also important in cycling oxygen, carbon, hydrogen and water through the environment.
4. These two chemical reactions (photosynthesis and respiration) use **enzymes** which are **catalysts** – they affect the rates of chemical reactions.
 - 1) **lock and key model** – one type of enzyme fits one type of molecule. Change its shape and the enzyme will no longer work.



- 2) **very high temperatures** cause proteins and enzymes to lose their shape so that they no longer work properly.

B. Immune System:

1. The job of the immune system is to protect the body against **pathogens**; an organism that invades the body, causing disease
 - a. Types of pathogens include viruses, bacteria, and parasites.
2. **White Blood Cells** are the main components of the immune system. Different w.b.c's have different roles.

3. **Antigens** cause an immune response. **Antibodies** are proteins made by white blood cells to attack antigens. *Each antibody attacks a specific antigen as determined by its shape.* (see page 2 for proteins).
4. A **vaccine** is an injection of a dead or weakened pathogen. This causes the body to make antibodies against that pathogen.
 - a. Vaccines only prevent diseases. They are not cures.
5. **Antibiotics** are drugs used to stop infections by **bacteria**. Ineffective against viruses.

C. Diseases and Disorders: a condition, other than injury, that prevents the body from working as it should

1. Diseases and disorders and how its disrupts homeostasis.
 - a. (AIDS, cold, flu, chicken pox) viruses
 - b. (strep throat, food poisoning, syphilis) bacteria
 - c. (athlete's foot, ringworm) fungus
 - d. (tapeworm, leeches) parasites
 - e. (Down's Syndrome, sickle cell) genetic disorders
 - f. (lead poisoning, radiation) environmental toxins
 - f. (heart attack, diabetes) organ malfunction
 - g. (smoking, drug use, exposure to sun) high risk behavior

UNIT THREE: Genetic Continuity

A. Humans have 46 chromosomes, or 23 homologous pairs.

B. Chromosome pairs carry alleles for the same trait. We all have two alleles for each gene one from each parent.

C. While genes determine our traits, the environment can affect expression of genes.

D. Each chromosome has hundreds or thousands of genes. Each gene codes for a particular protein

E. DNA is made of 4 bases: ATCG. A three letter **codon** represents a specific amino acid. Ex. CAU is histine. These amino acids are assemblies into proteins.

F. Base pairs: A matches up with T, C matches up with G (in RNA, A-U and C-G)



G. RNA carries the genetic code to ribosomes. The ribosomes then synthesize protein (see page 2 for more about proteins).

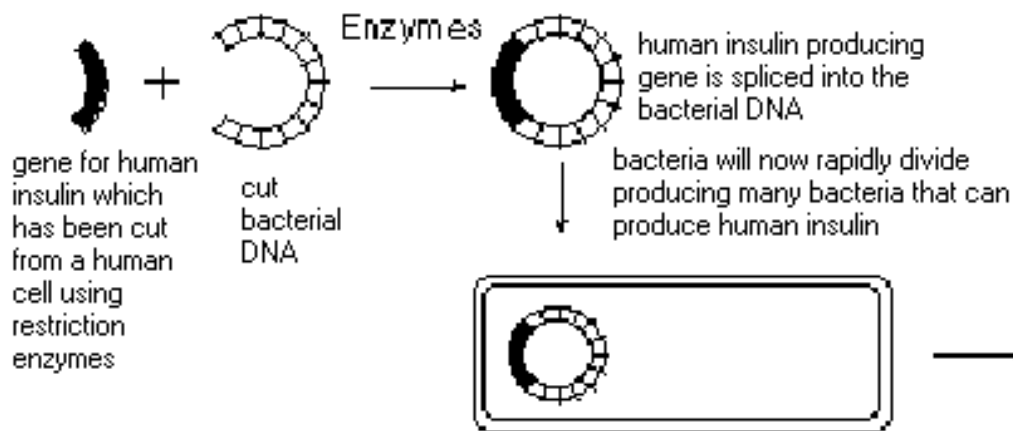
H. Changes to DNA are called **mutations**. They can only be passed on if they occur in reproductive cells (sperm or egg).

I. All cells in the body contain the same genes. Only some of these genes are turned on (that is, your eye cells contain the instructions on how to make bones, but only the genes to make new eye cells are actually turned on). We do not yet know exactly why this happens.

J. Selective breeding produces animals and plants with desired traits (disease resistance, larger fruit, more meat or milk, specific colors).

K. Genetic engineering or gene splicing inserts genes of one organism into the genes of another. Enzymes are used to cut and copy the DNA segments. Bacteria are often used because they have no nucleus protecting their DNA and they reproduce very quickly, allowing large amounts of medicine (insulin) to be made.

a. The example of gene splicing: **The gene to make human insulin was inserted into bacteria. These bacteria can now make insulin that is exactly the same as human insulin. This insulin is used by diabetics. This is safer than the cow and sheep insulin that were used in the past.**



L. New technologies ex. (**electrophoresis** a tool that allows scientists to separate DNA according to size) are making it easier to diagnose and treat genetic disease, though we cannot yet cure them.

UNIT FOUR: Reproduction and Development

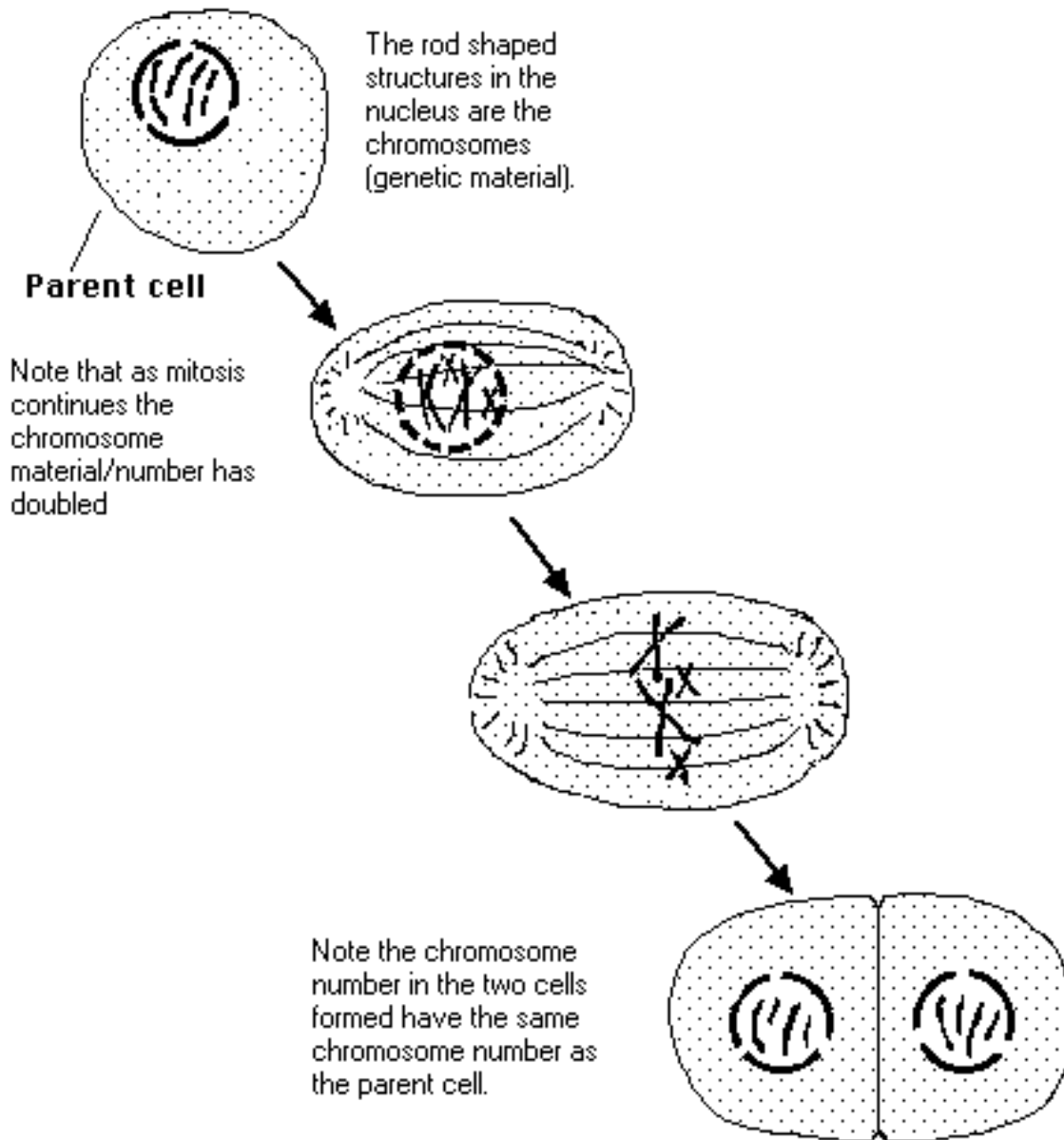
A. Asexual reproduction: a method of reproduction in which all the genes passed on to the offspring come from a single individual or parent

1. Advantages: faster, easier
2. Disadvantage: no variety. Offspring are the same as parent.

B. Sexual reproduction: a method of reproduction that involves two parents to produce offspring that are genetically different from either parent

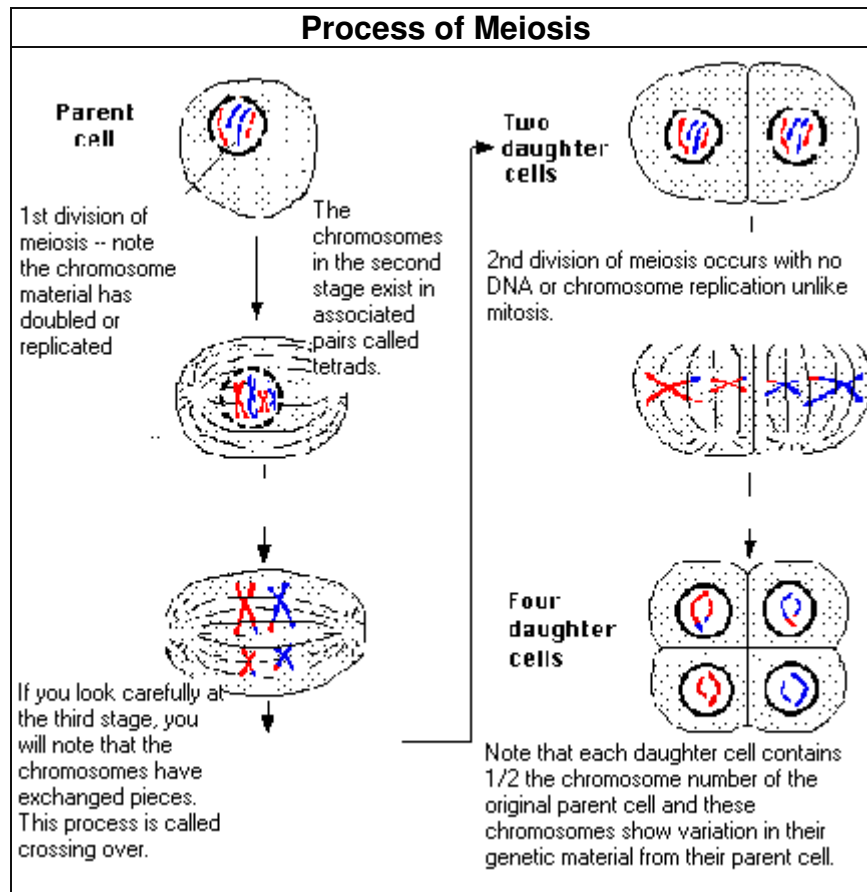
1. Advantage: variety
2. Disadvantage: more time, effort and risk.

C. Mitosis: the process that divides the cell's nucleus into two, each with a complete set of genetic material from the parent cell



1. Asexual
2. One division produces two identical, diploid ($2n$) cells.
3. Chromosome number in the daughter cells is **the same** as in the parent cell.
4. Large organisms use mitosis for growth and healing. Simple organisms use it to reproduce.

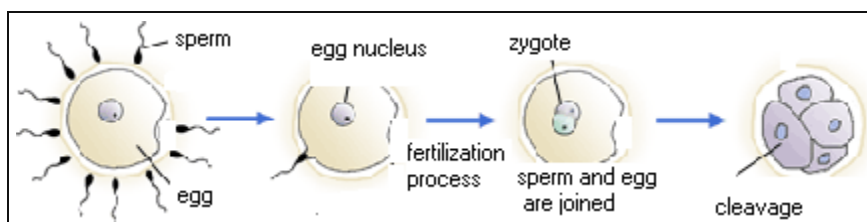
D. Meiosis: the process that results in the production of sex cells (sperm and egg)



1. Sexual reproduction
2. One cell divides *twice* to make four **DIFFERENT** cells.
3. All 4 cells have half the number of chromosomes found in the parent cell.
4. Makes **gametes** (sex cells). In humans 4 sperm cells or 1 egg and three non functioning cells are produced each time meiosis occurs.
5. Separates pairs of **homologous chromosomes** so that offspring get one chromosome of each pair from a different parent.

E. Fertilization occurs in the **oviduct**. A fertilized egg is called a **zygote** and has a normal number of chromosomes.

F. The fetus develops in the uterus. Cells divide without becoming larger (cleavage). After a few days, cells begin to **differentiate** – that is they start to form different types of cells (nerve, skin, bone, etc). At this stage the embryo is very vulnerable to alcohol, drugs, etc because the important organs and systems are just starting to develop See page 2 for more on differentiation.



UNIT FIVE: Evolution

A. Basically states that modern species evolved from earlier, different species and share a **common ancestor**.

B. Charles Darwin proposed that **natural selection** is the mechanism that causes species to change. The basic steps in natural selection are:

1. Overproduction of offspring.
2. Competition for limited resources.
3. Survival and reproduction OR death.

C. Organisms that are **better adapted to their environment and able to reproduce successfully are considered “fit”**. Unfit organisms die, and their traits are eventually removed from the gene pool.

***NOTE:** Evolutionary fitness has nothing to do with physical fitness. Stronger is not always better.*

D. Evolution is usually driven by a change in the environment.

E. To evolve, variations must exist in a species BEFORE the environment changes. They do not get a trait just because it is needed.

F. Variations exist primarily as the result of sexual reproduction and mutation.

G. Species with more variation are better able to survive environmental changes.

H. Evolutionary change can occur slowly **or** happens in quick spurts.

I. Creation of new species can occur if species are separated by geography such as water or land features.

J. Evidence in support of evolution comes from the fossil record, genetics, biochemistry, anatomy and embryology.

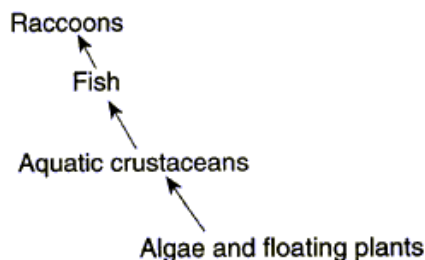
UNIT SIX: Ecology

A. Ecology: the study of how living things interact with one another and with their environment

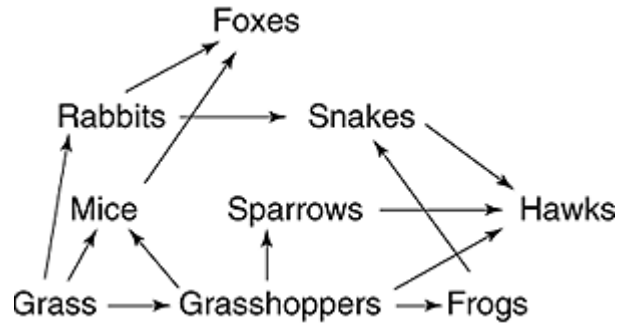
B. Organisms live in **habitats** and are organized in by **population, community, ecosystem, biosphere**

C. Organisms interact with their environment by

1. **food chains:** a representation that identifies the specific feeding relationships among organisms



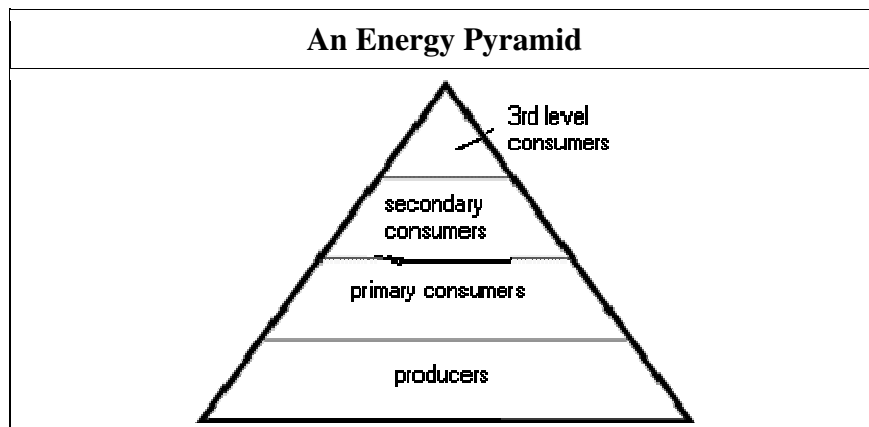
2. **food webs:** a representation of many interconnected food chains that shows the feeding relationships among producers, consumers, and decomposers



- a. **producer:** an organism that makes its own food from light energy and inorganic materials
- b. **consumer:** an organism that obtains its energy from producers
- c. **omnivore:** feeds on both plants and animals
- d. **herbivore:** an organism that eats only plants
- e. **carnivore:** an organism that survives by eating animals
- f. **predator:** an animal that hunts and kills other animals for food
- g. **parasite:** an organism that survives by living and feeding on other organisms
- h. **decomposer:** an organism, generally a bacterium or fungus, that consumes dead organisms and organic waste

D. Energy is needed to keep an ecosystem going. The energy comes from the sun and is made usable by **producers;** (plants and other **autotrophs;** an organism that produces its own food; the source of energy for all other living things on Earth)

E. Energy is passed on to other organisms in the form of food. Since all organisms must use energy for their own needs, most energy is lost before it can be passed to the next step in the food chain. As a result, organisms high on the food chain have less energy available to them and must have smaller populations. This is represented in the form of an **energy pyramid** a diagram showing how food energy moves through the ecosystem



F. Environmental factors (air, water, light, temperature, pH, food, predators etc) determine which organisms can live in an ecosystem and how large the population can get.

1. The maximum size of a population is called the **carrying capacity.**

G. There are many roles in an ecosystem (**niche**), but **competition** between species usually results in only one species occupying a niche at any one time. Often, organisms with similar needs will divide resources to reduce competition (ex: birds eat insects during the day, bats eat them at night).

H. Communities change over years by **ecological succession**: the process by which an existing community is replaced by another community

UNIT SEVEN: Human Impact on Ecosystems

A. Human action (development, industrialization, pollution, farming, over hunting, overgrazing, clear cutting, introduction of foreign species, soil erosion) often has negative consequences for the ecosystem (and humans too).

B. The negative effects humans have had on the environment are all mostly due to the increasing human population which leads to **pollution** (a harmful change in the chemical make up of the soil, water, or air)

C. Biodiversity refers to the variety of life on earth. As habitats are lost and species become extinct, biodiversity is reduced. This is bad because **1)** ecosystems with low diversity take longer to recover from environmental changes and **2)** we use organisms for many things such as food and medicine; by reducing biodiversity we are losing potentially valuable resources.

D. Actions being taken by humans to reduce or repair damage to the environment include:

1. Recycling wastes
2. Conserving available resources **nonrenewable**; any resource, such as fossil fuels and minerals, that cannot be replaced and **renewable**; resources, such as our food supply and solar energy, which, given time, can be replaced
3. Using cleaner resources (ex: solar over fossil fuels)
4. protection of habitats and endangered species
5. use of biological controls instead of pesticides and herbicides
6. Farming native plants (ex: cocoa in the rainforest)
7. Planting trees to replace those cut down.
8. Rotating crops or planting cover crops to reduce soil loss.

E. Human Activities and their negative effects on the environment

1. **acid rain**; rain that is more acidic than normal
2. loss of habitat (ex: **deforestation**; forest destruction that results from human activity)
3. **loss of diversity**; human activities that destroy habitats resulting in fewer species
4. **global warming**; a increase in Earth's average surface temperature caused by an increase in greenhouse gases such as carbon dioxide (CO₂)
5. loss of **ozone layer**; the layer of ozone gas in the upper atmosphere that protects Earth from some of the sun's radiation
6. **introduced species**; when biodiversity is decreased when people import and release a species from environment into another.
7. **industrialization**; the process of converting an economy into one in which large scale manufacturing is the primary economic base

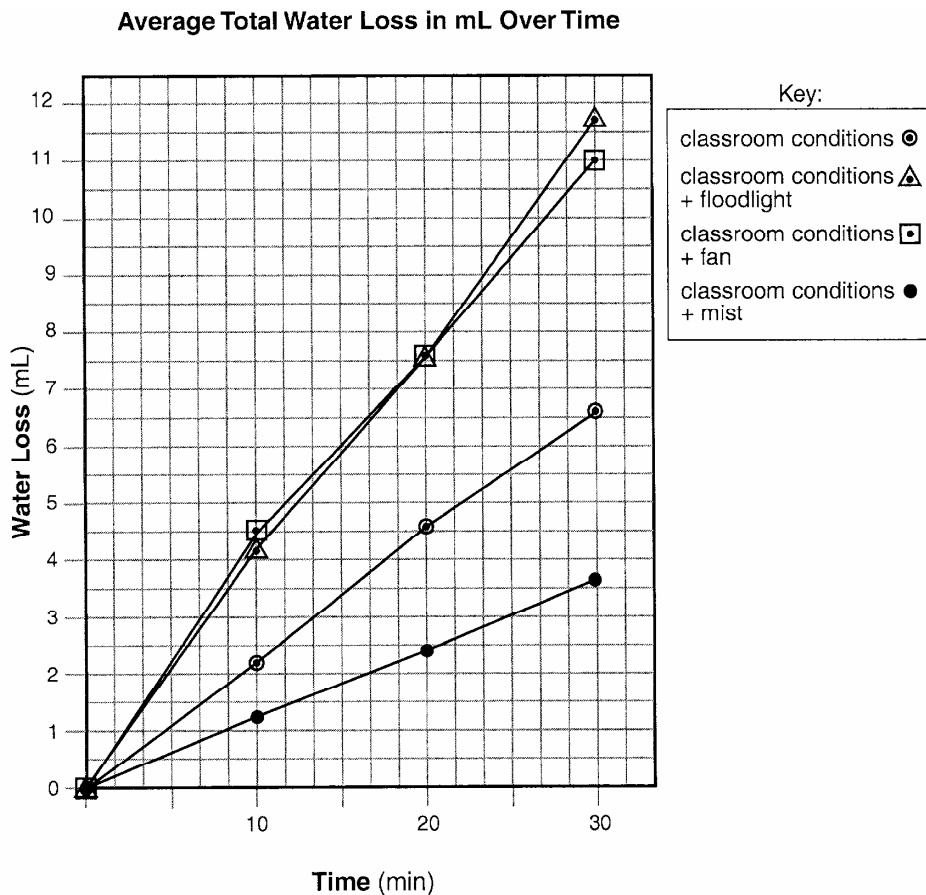
UNIT EIGHT: Scientific Inquiry and Skills

A. Terms:

1. **Observation:** What is seen or measured.
2. **Inference:** A conclusion based on observation or evidence.
3. **Hypothesis:** An untested prediction. A good hypothesis states both cause and effect (“**If then**” statement).
4. **Theory:** A broad explanation of natural events that is supported by strong evidence.

B. Graphing

1. Title your graph
2. Dependent variable on the vertical (up and down) axis
3. Independent variable on the horizontal (across the bottom) axis
4. Scale for both axis is appropriate and scaled at even intervals taking up most of the graph space
5. Points are plotted accurately and does not go beyond graph paper



C. Controlled Experiment: Compares the results of an experiment between two (or more) groups.

1. **Experimental group:** Group being tested or receiving treatment. (ex: new drug)
2. **Control group:** “Normal” group. Should be identical to experimental group in every way except *one*: it does not receive the treatment (i.e.: no drug, or given the original drug or a *placebo*).

3. **Placebo:** A sugar pill or other “fake” treatment give to the control group so subjects do not know which group they are in.
4. **Independent Variable:** Variable that is being tested (ex: new drug). In a graph the independent variable is always plotted on the X axis.
5. **Dependent Variable:** Variable that is measured at the end of an experiment; the results (ex: does patient get better?) The dependent variable is always plotted on the Y axis.

D. Characteristics of a good experiment.

1. **Can be repeated by anyone and get the same results.**
2. **Have large sample size/many test subjects.**
3. **Are performed for longer periods of time.**
4. **Test only one variable.**
5. **Are peer reviewed** – examined by several scientists to determine its accuracy.
6. **Does not have to agree with the hypothesis.** A scientist’s guess is allowed to be incorrect – and usually is.
7. **Is objective** – the experiment and conclusion are fair and **unbiased**. Fact and opinion are not mixed.

E. Laboratory Review STATE Required Labs

Lab 1 Diffusion Through A Membrane

Concepts You Must Know

- a) **The dialysis bag is the “cell”**
- b) **Diffusion moves material from high to low concentration, spending no energy**
- c) **Only small molecules will go through the membrane...(starch can not)**
- d) **Benedict’s solution tests for sugar...heat it and it turns red (positive for glucose)**
- e) **Iodine or Lugol’s solution tests for starch...turns blue / black in starch**
- f) **Water is used as a control for the indicators**
- l) **Starch WILL NOT diffuse out of the cell because it is too big and not permeable**
- h) **The dialysis plastic "cell".... represents cell membrane**
- g) **The diffusion of water is osmosis**
- j) **The "cell" should turn blue/black indicating that the iodine diffused into the "cell" and detected the presence of starch inside the "cell"**
- k) **Test the water outside the "cell" for glucose...Benedict's will turn red after heating if it detects the presence of glucose outside the "cell".**
- i) **Iodine (starch indicator) is in water in beaker (outside the cell)**

Lab 2 Relationships and Biodiversity

Concepts You Must Know:

- a) Organisms with similar structural or molecular similarities may be related.
- b) In order for a species to be successful and survive it must contain variety (diversity)
- c) Proteins and enzymes are produced as a result of an organism's genetic code sequence.

The DNA code is transmitted from DNA-----> mRNA ----->tRNA

- d) Base pair codes are as follows:

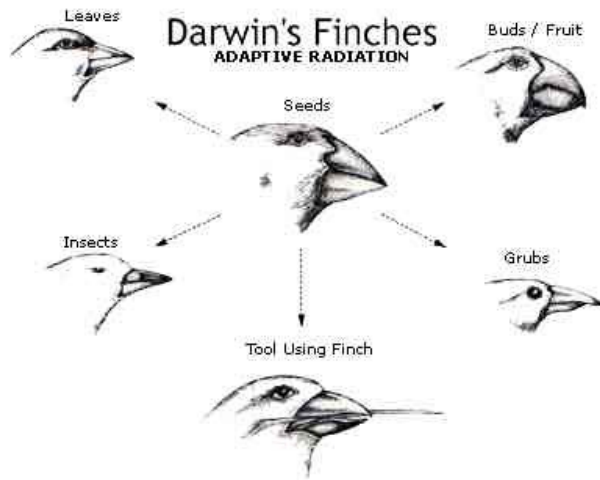
DNA	A----T	"always tired"
	C----G	"constantly grumpy"
m and t RNA	A-----U	"always ugly"
	C-----G	"constantly grumpy"

- e) Amino acids are the building blocks of proteins
- f) Molecular similarities are the most important evidence of closely related organisms.
- g) Organisms evolve much like the branches growing on a tree
- h) Biodiversity ensures genetic variation.
- i) Biodiversity increases stability in an ecosystem.
- j) Endangered species hold medicinal, agricultural, ecological, commercial and aesthetic value. They must be protected for future generations.

Lab 3 Darwin's Finches Adaptive Radiation

Concepts You Must Know:

- a) Certain adaptations give some organisms an advantage to survive.
- b) The environment "naturally selects" which organisms are best suited (fittest) to survive and reproduce.
- c) Those organisms that survive and reproduce pass these favorable traits on to the next generation. This gives their offspring an advantage to survive.
- d) Competition for resources (food, water, mates and territory) stimulates the struggle for survival.



Lab 4 Making Connections

Concepts You Must Know:

- a) Resting pulse rates vary with individuals.
- b) By collecting data scientists can help to answer questions they have proposed.
- c) Pulse rate increases under physical or emotional stress.
- d) Increase in activity produces muscle fatigue.
- e) Use the Scientific Method to solve a problem that you have postulated

Check out my website

<http://www.kenton.k12.ny.us/84220424135419470/site/default.asp>

for

Powerpoints, Lab Review, and notes. Also
www.regentsprep.org is another good website for review
materials including old exams with answer keys.

Good luck!!!