Lincoln High School
SCIENCE DEPARTMENT

*Name:*_____

Final Exam/Regents Review Packet

Scientific Method

Vocabulary

- **Hypothesis**- an educated guess; when forming a hypothesis make sure to have an "if … then" statement
- **Control group**- the group in the experiment that you are **NOT** changing
- **Experimental group**- the group in the experiment that you **ARE** changing
- **Independent variable**- the variable that is changed by the person performing the experiment
- **Dependent variable**- influences of the change made by the person performing the experiment.

Example:

You are performing the experiment that will test the effect of light on the amount of plant growth. Design an experiment that will test the effect of light on the amount of plant growth.

Hypothesis- If I place the plants in the light, then it will grow more.
Control group- the group of plants that I place in the dark
Experimental group- the group of plants that I place in the light
Factors (variables) kept the same- each plant in both groups were the same type of plant, the same soil, and were watered the same amount each day.

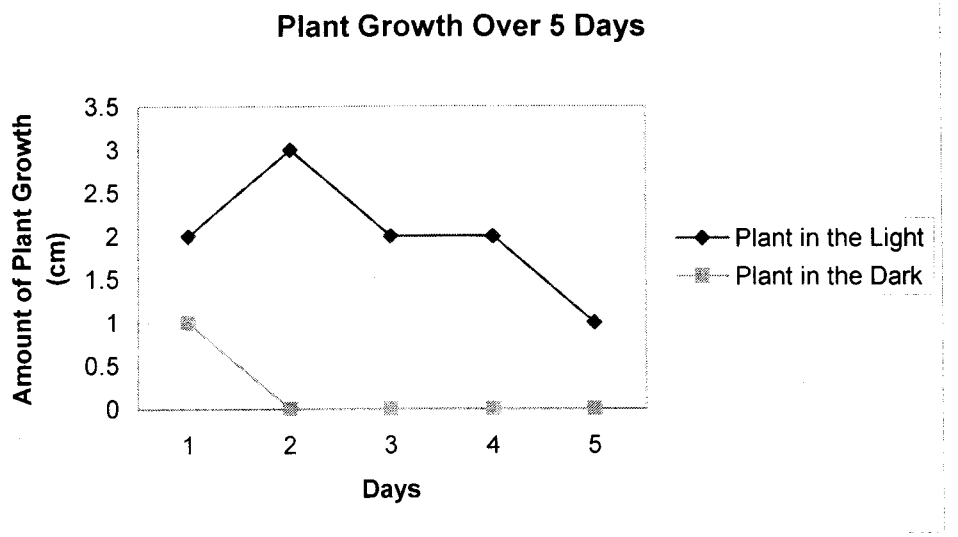
In this experiment, I choose to have five plants in each of the two groups. The data table below shows the average height increase over five days.

Data:

Days	Plant in the Light	Plant in the dark
1	2	1
2	3	0
3	2	0
4	2	0
5	1	0

After I got my data, I plotted a graph showing the two plant growths on one graph. In my graph, my **independent variable** is the amount of days that I did the experiment for and my **dependent variable** is the amount of height that grew over those five days.,

** Remember, you can only test ONE thing in an experiment and an experiment Is considered only when it is done thousands of times.**



Independent Variable- Days
Dependent Variable- Amount of Plant Growth

Remember, when plotting a graph, make sure there is even spacing between the lines. For example, on the graph above, the y-axis is going up by .5 cm. It continues that the entire way up the graph.

8 Life Functions

Life Processes	
Digestion	breakdown of food to simpler molecules which can enter the cells
Circulation	the movement of materials within an organism or its cells
Movement (locomotion)	change in position by a living thing
Excretion	removal of waste products by an organism (wastes may include carbon dioxide, water, and urea in urine and sweat)
Respiration	process which converts the energy in food to **ATP** (the form of energy which can be used by the cells)
Reproduction	the making of more organisms of one's own kind
Immunity	the ability of an organism to resist disease causing organisms and foreign invaders
Coordination	the control of the various activities of an organism (mostly involves the nervous system and endocrine glands in complex animals)
Synthesis	the production of more complex substances by combining two or more simpler substances

Cells and Organelles

Organelles:

1. **Nucleus**- controls the organelles in the cell; DNA is found here
2. **Ribosome**- makes proteins from the information in the DNA
3. **Mitochondria**- burns food for energy (ATP)
4. **Vacuole**- stores food, water and waste
5. **Cell membrane**- controls what goes out and comes into the cell; receptors are located here that allows the cells to communicate
6. **Cytoplasm**- jelly like layer where the organelles are

Organelles ONLY found in plants:

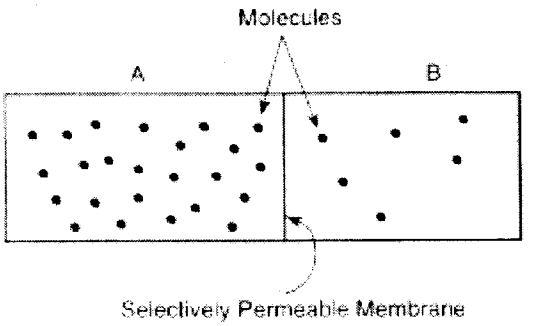
1. **Cell wall**- maintains the shape of the plant
2. **Chloroplasts**- plant makes its own food through the process of photosynthesis

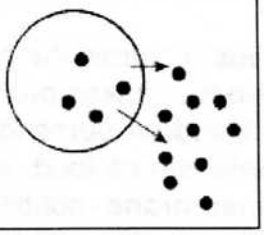
Differences between a plant and animal cell:

Plants cells have:

- Cell wall
- Chloroplasts (chlorophyll)
- Large central vacuoles

Cell Membrane (2 Types of Transport):

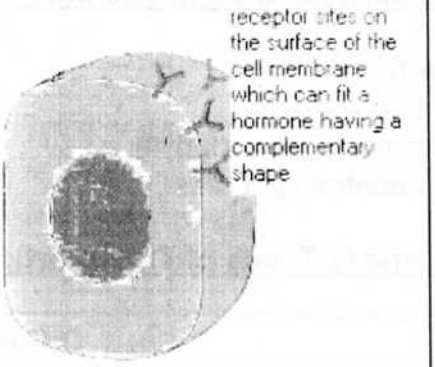
Diffusion	
Diffusion or **passive transport** is the movement of materials from a region of higher to a region of lower substance concentration. The diagram at the right shows the movement of molecules from higher concentration on side A to a lower concentration on side B.	

Active Transport	
In **active transport**, molecules move from a region of lower concentration to a region of higher concentration. As this process does not naturally occur, the cell has to use energy in the form of ATP to make active transport occur.	

** Remember, the ATP gets made in the mitochondria through the process of cell respiration**

Receptors:

- Receptors are very specific (just like enzymes)

Cell Membrane Receptors	
Many cell membranes have **receptor molecules** on their surface. These receptor sites play an important role in allowing cells and organs to communicate with one another.	

CELL RESPIRATION AND PHOTOSYNTHESIS

Photosynthesis:

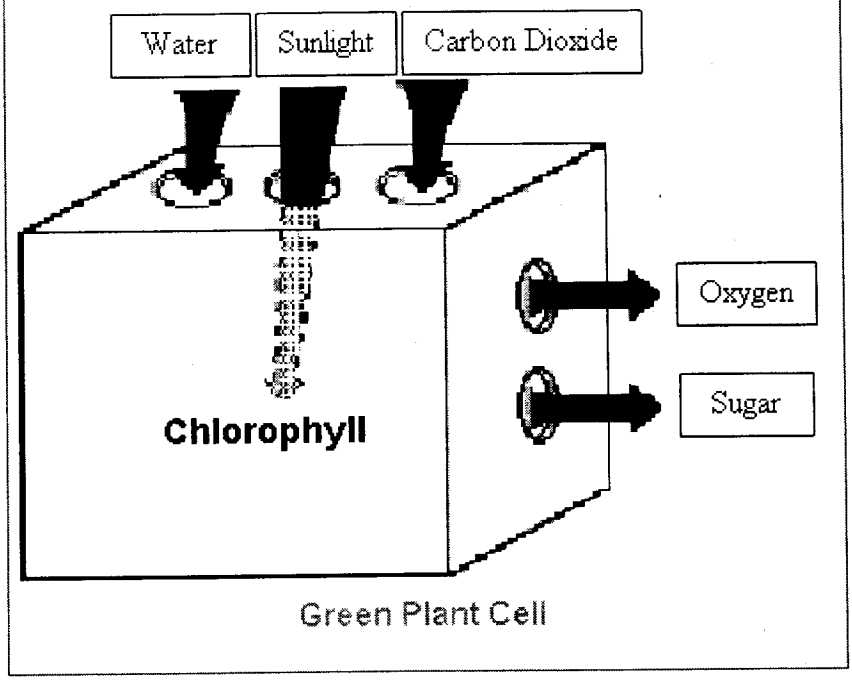
- Energy from the sun is converted into sugar
- This process occurs ONLY in plant cells in the chloroplast

EQUATION FOR PHOTOSYNTHESIS

Use/raw materials products/made
Carbon dioxide + water + sunlight -> Glucose + Oxygen

A Representation of Photosynthesis

Plants use water and the energy provided by sunlight to combine carbon dioxide into glucose sugar with oxygen being released as a waste product.



Cell Respiration:

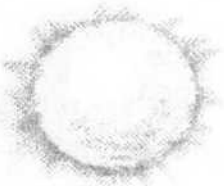
- Food that is eaten is converted into usable energy ATP
- This process occurs in the mitochondria of all cells including plant cells

EQUATION FOR CELL RESPIRATION

Use/raw materials products/made
Glucose + Oxygen -> Carbon dioxide + water + ATP (energy)

THINK OF PHOTOSYNTHESIS AND CELL RESPIRATION AS OPPOSITES

Photosynthesis and Respiration: What's the Connection?

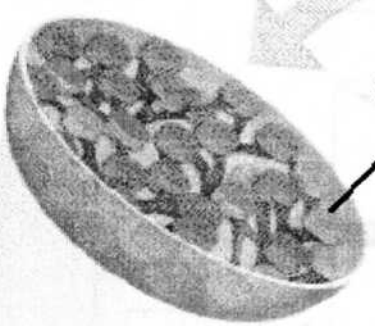


Photosynthesis
Light energy, carbon dioxide, and water are used to make glucose in chloroplasts. Oxygen is released.

ATP

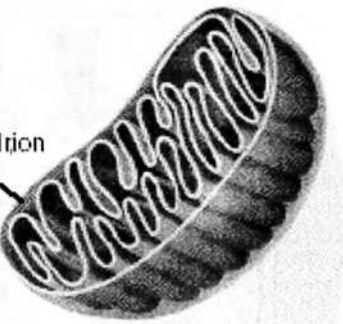
Light Energy

$CO_2 + H_2O$



Chloroplast

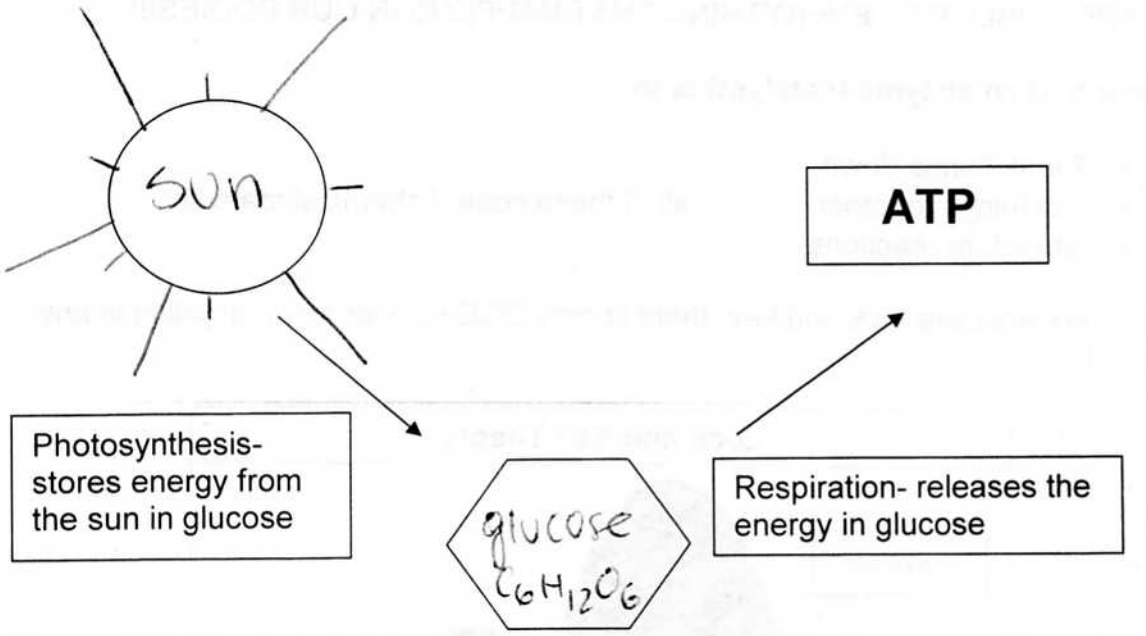
Mitochondrion



$C_6H_{12}O_6 + O_2$

Cellular Respiration
Oxygen and the energy in glucose are used to make ATP. ATP is a molecule that stores energy in a form that cells can use. ATP is produced by mitochondria. Carbon dioxide and water are also released. Cellular respiration occurs in both plant and animal cells.

Flow of Energy



Compare Photosynthesis and Cell Respiration

Cell Respiration

Glucose + Oxygen -> Carbon dioxide + water + ATP (energy)

Photosynthesis

Carbon dioxide + water + sunlight -> Glucose + Oxygen

THEY ARE EXACT OPPOSITE OF EACH OTHER!!!!

ENZYMES

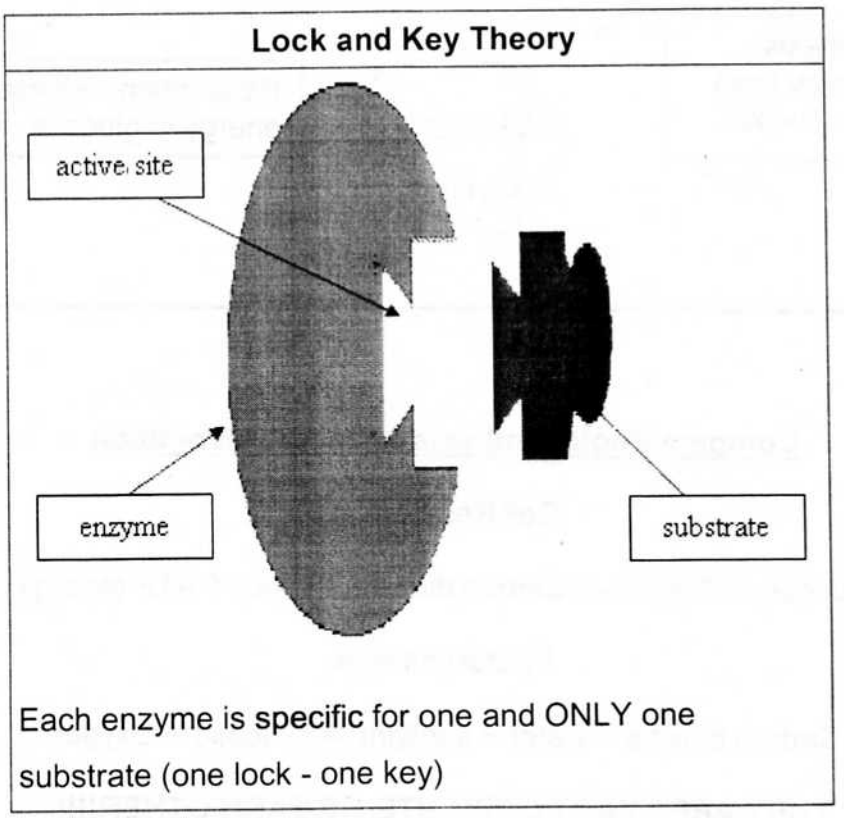
RESPONSIBLE FOR EVERYTHING THAT HAPPENS IN OUR BODIES!!!

The job of an enzyme (catalyst) is to:

- Break things down
- Put things together
- Speed up reactions

all of these control chemical reactions

Enzymes work like lock and key, there is only ONE specific key that will fit in any given lock.



Enzymes are greatly affected by:

- pH {1-6 is acidic (vinegar); 7 is neutral (water); 8-14 is basic (milk)}
- temperature

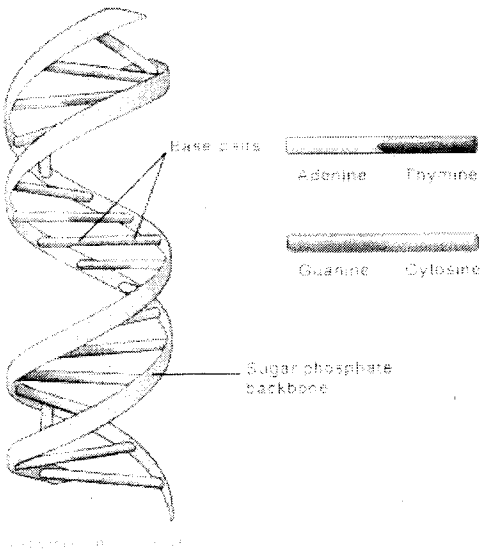
Both of these things "denature" the enzyme. This means that the enzyme's shape changes and the substrate cannot fit. Imagine melting a lock and then trying to fit in the key, it just is not going to fit.

Remember some enzymes work better in higher temperatures or in different pH.

DNA

Structure and Function:

- DNA is located in the nucleus of the cell
- Contains the information of your body (like an instruction manual)
- DNA looks like a twisted ladder or "double helix"
- The bases in a DNA molecule are A (adenine), T (thymine), G (guanine) and C (cysteine)



** Remember, in DNA A always pairs with T and G always pairs with C. These are called complementary base pairs.

Replication:

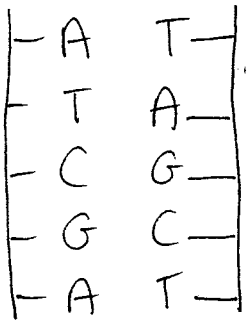
- Replication is when DNA makes an exact copy of itself
- This occurs during the processes of mitosis and meiosis
- The DNA is opened up and the complimentary bases (matches) are found.

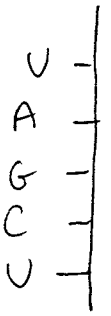
Protein Synthesis

- Remember DNA is our instructions manual so proteins are made by reading the information in the DNA
- DNA is too important to leave the nucleus so a "messenger" must come and get the information needed to make the proteins (mRNA)
- The messenger then goes to the ribosome. The ribosome speaks a different language than the DNA so tRNA must translate it.
- The ribosome reads in three letter words and then it is translated into actual amino acids.

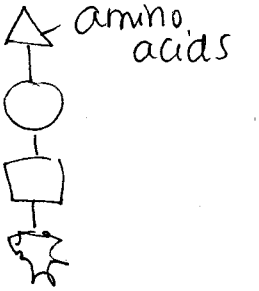
EXAMPLE OF HOW THE DNA IS READ

DNA -> **mRNA** -> **Protein**





mRNA



Nucleus

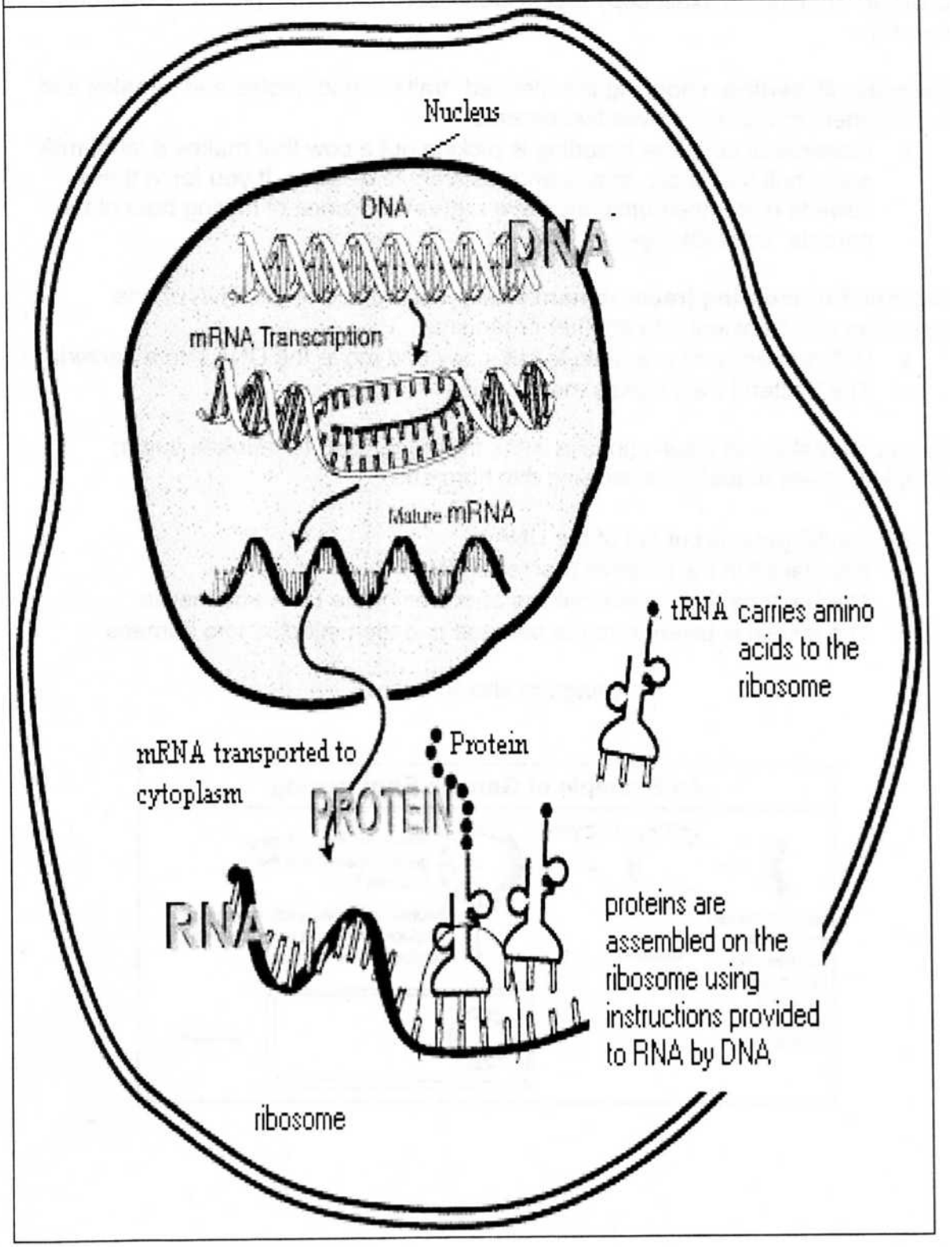
DNA base

DNA bases are read

Ribosomes

where amino acids are put together

Illustration of Protein Synthesis



Biotechnology

Cloning- making an exact copy that is identical to the parent (involves only one parent)

Selective Breeding- choosing the "desired" traits in both males and females and forcing them to mate (involves two parents)

- Example of selective breeding is picking out a cow that makes a lot of milk and a bull that is big, strong and resistant to disease. If you force these cows to mate, their offspring have a greater chance of having both of the parents "desirable" genes.

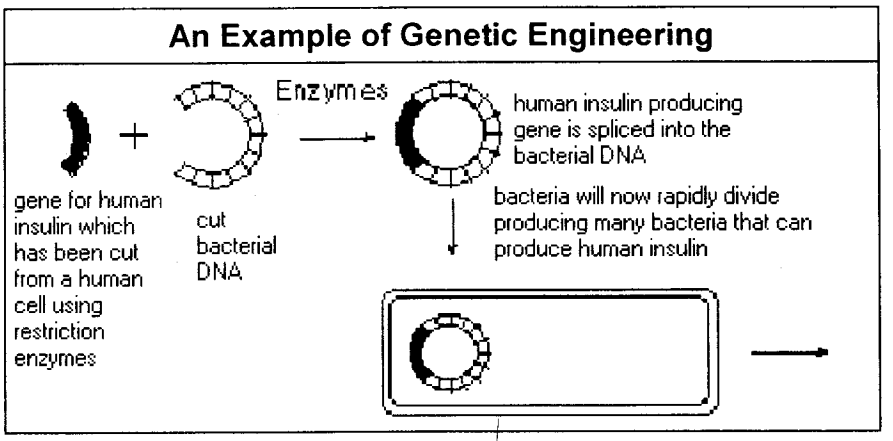
Genetic Engineering (recombinant DNA)- cut a piece of the DNA of one organism and transfers it to another organism.

- Different enzyme are used to cut, copy and move the DNA into a bacteria
- The bacteria then makes more copies

Example- making of insulin (insulin is the hormone used to regulate sugar; people that are diabetic are missing this hormone)

- Insulin gene is cut out of the DNA.
- It is placed in the plasmid (bacterial DNA)
- The bacteria then make millions of copies of the DNA and insulin
- The insulin is taken from the bacteria and then injected into humans

(diagram shown below)



Reproduction and Development

Two types of Reproduction:

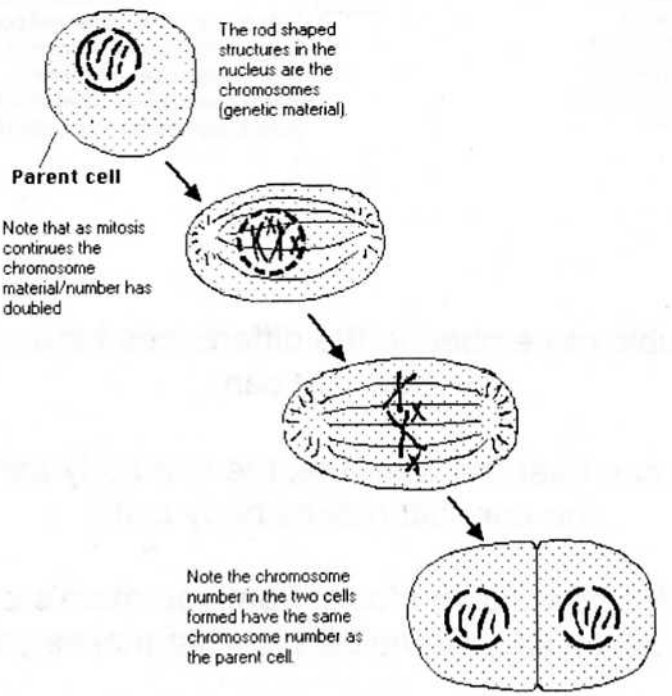
- **Asexual reproduction**- involves only one parent and is an exact copy
  - Uses mitosis to reproduce
- **Sexual reproduction**- involves two parents; half of the information comes from one parent, the other half comes from the other parent
  - Uses meiosis to make the sex cells so they can reproduce

Points of Comparison:

1. Number of cell divisions
2. Exchange of genetic material between chromosomes
3. Number of Functioning cells produced from original
4. Genetic Make up of final cells produced
5. Function of cells produced in multi-cellular organism

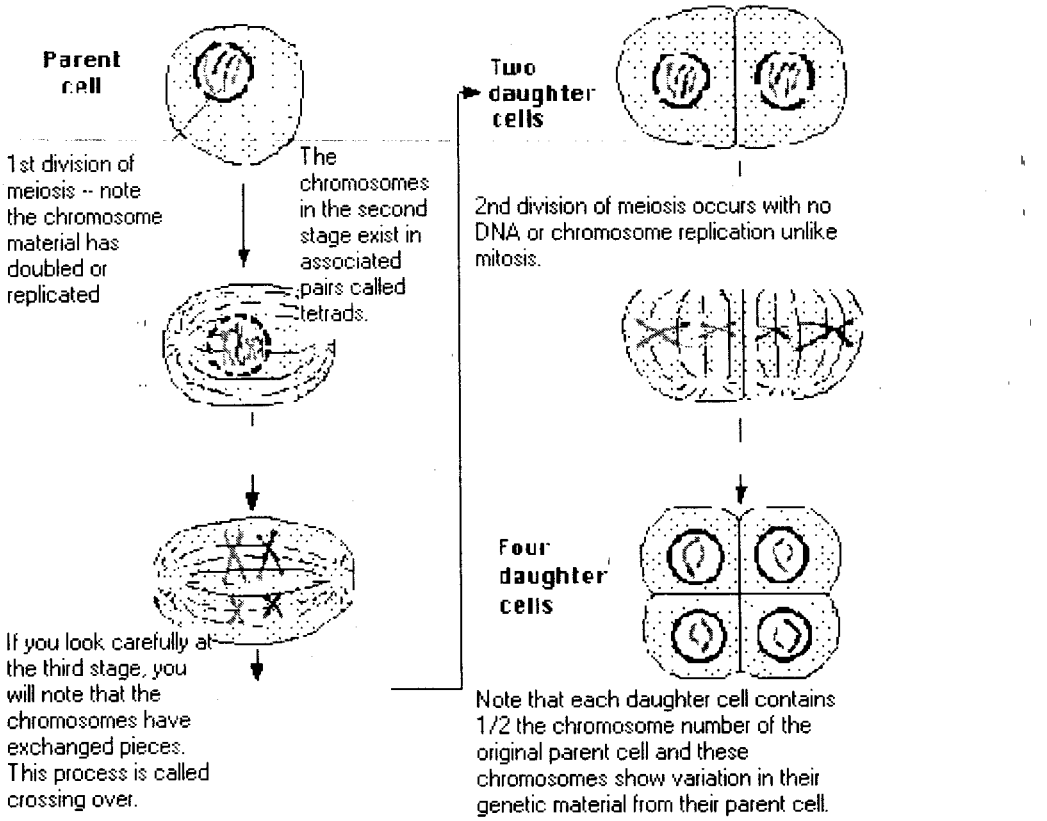
Mitosis (same # of chromosomes)

1. Only **one** cell division
2. No exchange of genetic materials
3. **Two cells** produced from the original
4. All of the cells are **identical** to each other
5. Mitosis of cells is completed by **BODY CELLS** to
   i. Grow
   ii. Repair
   iii. Replace



Meiosis (half the # of chromosomes)

1. **Two** cell divisions
2. Exchange of genetic material which causes variation
3. **Four cells** produced from the original
4. All cells are **NOT identical** to each other
5. Meiosis is completed in order to make new **SEX CELLS** (egg and sperm cells)

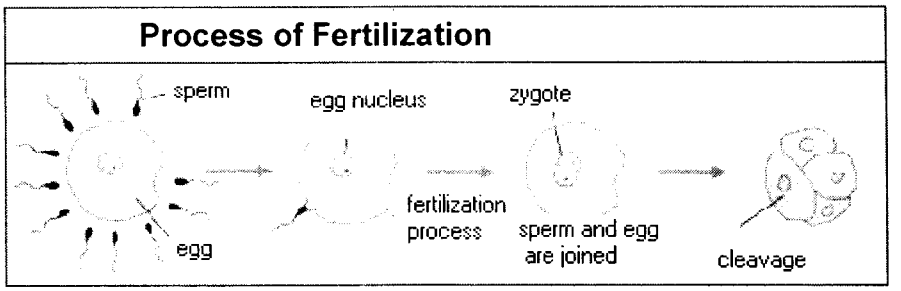


If you have trouble remembering the differences between the two this is how you can:

MITOSIS (you can hear the word toe, toe is a body part so mitosis is the one that makes body cells)

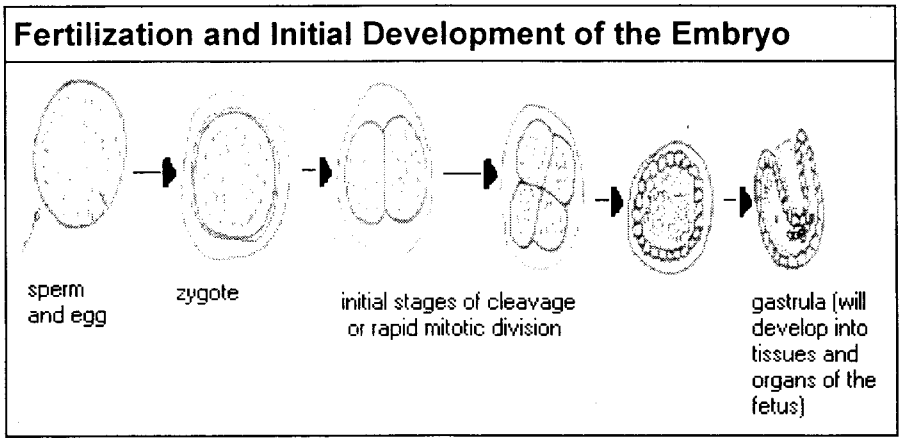
MEIOSIS (ME, how did you form, from you mom's egg and your dad's sperm cell uniting, so meiosis is what makes your sex cells)

Fertilization- when the egg and the sperm meet



Development- when the 1 cell becomes 2, 2 cells become 4, 4 cells become 8

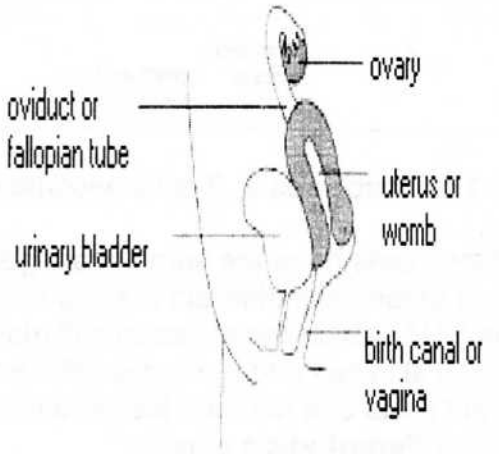
- Remember all of these cells have the same exact genetic information
- What makes each of these cells different is because each cell reads a different part of the DNA, which means each cell makes different proteins.
  - For example, a skin cell and a muscle cell have the same DNA but reads different parts of it to make the proteins that it needs
  - This is called **differentiation** of cells



Systems of the Body

Reproductive System:

Female Reproductive System



Female Reproductive System Structures

1. **ovary** -- (females have two of these) -- produce female gametes or eggs and the hormone estrogen

2. **oviduct (fallopian tube)** -- carries the egg away from the uterus

-- internal fertilization normally occurs here

3. **uterus** -- implantation and development of the embryo and fetus before birth occurs here

4. **vagina** or **birth canal** -- entry point for sperm from the male and exit tube for the baby when it is born

Respiratory System- taking oxygen into the lungs and releasing carbon dioxide

- This system uses a lot of diffusion
  - Diffusion of oxygen **INTO** the blood
  - Diffusion of carbon dioxide **OUT** of the blood and into the lungs

Circulatory System- delivery of materials all around the body

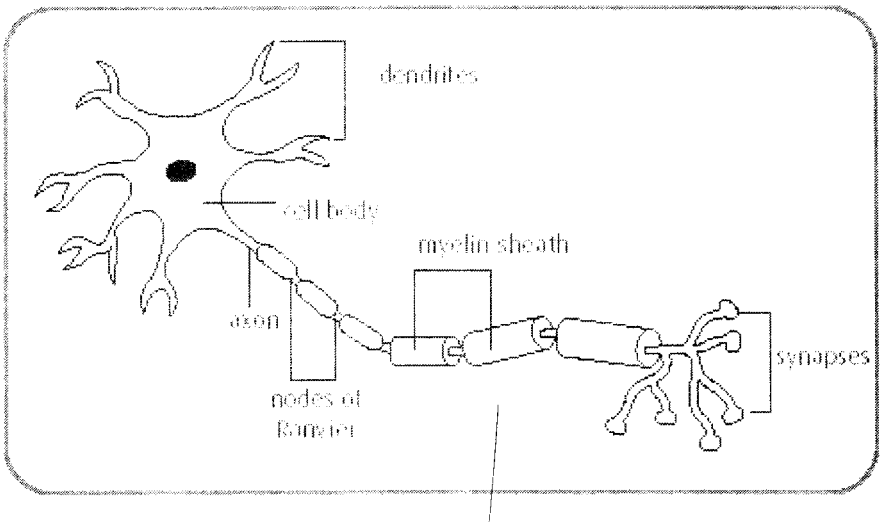
- Main components are the heart (responsible for the pumping of the blood) and the blood (carries the materials needed by the body)
- Works closesly together with the lungs to delivery oxygen to the cells
  - Mitochondria need oxygen so they can perform cell respiration

Digestive System- where food is broken down into smaller pieces so the body can use them

- This system uses a lot of enzymes to break down their food
  - Enzymes found in the mouth are called salivary amalyase and break down starch
  - Enzymes found in the stomach work at a low pH (very acidic)
- This system uses diffusion
  - Food is broken down and diffused into the blood
  - The blood then brings that food to the cells so cellular respiration can occur
    - Turning food into energy (ATP)

Nervous System-controls and coordinates activities of the body

- This system uses a lot of receptors
  - Synapse (end of the cell in the picture) secretes a lot of signals to go to the next cell
  - The signal keeps going until the brain tells it to stop



Immune System- fight off foreign substances (antigens) in the body

- Uses white blood cells (two types)
  - One type is responsible for the killing of the antigen
  - One type is responsible for remembering how to kill the antigen so that if it enters the body again, it can be killed immediately
    - This is why we never get the same cold twice
  - Our body builds up antibodies which help fight the antigen
- Vaccinations (weakened form of the virus)
  - Our body takes the weakened form of the virus and remembers it so if it enters our body, it knows how to kill it.
  - The immune system builds up antibodies from the weakened form

** Remember, our BODY make antibodies, antigen is the harmful substance

Feedback Mechanisms and Maintaining Homeostasis

- Think of feedback and homeostasis as our bodies "tug of war" with each of the systems (when one systems pulls really far one way, another system has to pull it back to the middle

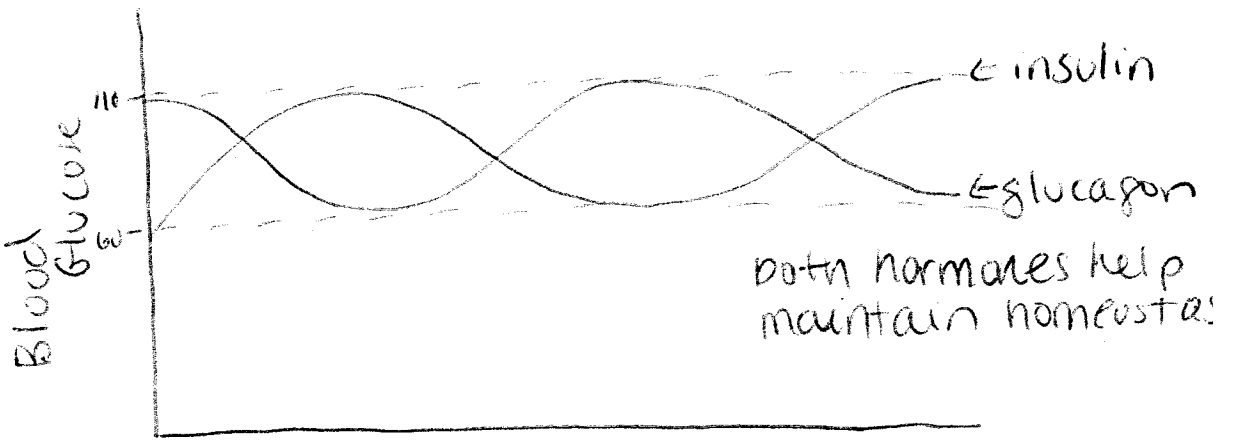
- Homeostasis is your body's way of maintaining balance.

- When your hungry, your stomach growls. It growls because there is not enough glucose in your body to make energy for your body.

- When you run, you start to breathe heavy. Your breathing heavy because your body needs more oxygen to break down more glucose for energy in cellular respiration.

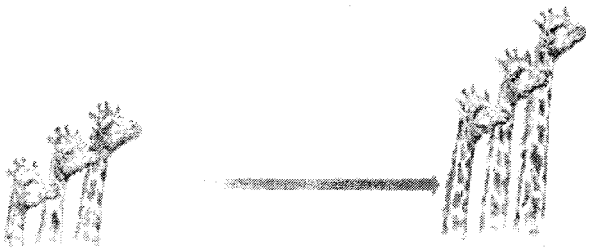
- The pancreas makes two hormones: insulin and glucagon. When your body needs to take glucose out of the blood and store it (after you each a big mean) it uses the hormone glucagon. When your running a race, and you need more energy and more glucose in your blood, your body makes insulin.

Insulin and Glucagon Regulating Blood Sugar



Evolution- change in a species over time

- As a species changes, **natural selection** chooses which organisms will live and which ones will die. **(survival of the fittest)**
- **Variations**-changes or mutations in the DNA
  - If the change was a "good" change for the organism, the organism survived and reproduced. (adapted to its environment)
  - If the change was a "bad" change, the organism died or became **extinct**
  - These "change" are in their DNA and get passed on to their offspring.

An Example of Variation Driving Natural Selection	
Natural selection favors longer necks better chance to get higher leaves. Favored character passed on to next generation.	
	
Original group shows variations, different neck sizes	After many generations, the group shows a general increase in neck length because it is more beneficial to have longer necks.

Evolutionary Tree:

- Evolutionary trees are trees that show ancestral relationships
- The oldest members of the tree are found at the bottom of the tree and the newest or present day members are always found at the top
- The bottom organism is known as the **common ancestor**.
- The common ancestor has similar DNA to every single member of the tree
- If a branch of the tree does not make it to the top, this means that the organism died out (it was unsuitable for the environment, could not survive)

Ecology

Abiotic vs Biotic Factors

- Abiotic factors are nonliving things in an ecosystem (water, soil, temperature)
- Biotic factors are the living things in an ecosystem (grass, fish, deer)

Vocabulary

- **Niche**- an organisms role in the environment
- **Population**- all the members of one species in an area
- **Community**- all the members of the different interacting species in an area
- **Ecosystem**- all the members of a community plus the abiotic (physical) factors influencing them
- **Biosphere**- entire region of the earth where living things may be found

Feeding Relationships:

1. **Producers/autotrophs (autotrophic nutrition)**- makes its own food through the process of photosynthesis (plants)
2. **Consumers/heterotrophs (heterotrophic nutrition)**- must eat to obtain energy (grasshoppers, humans)
3. **Herbivores**- plant eaters (panda)
4. **Carnivores**- meat eaters (snakes)
5. **Scavengers**- eat dead organisms (vultures)
6. **Decomposers**- break down organisms and place the nutrients back into the soil (fungi, bacteria)

Relationships that Exist in Nature:

Predator-prey

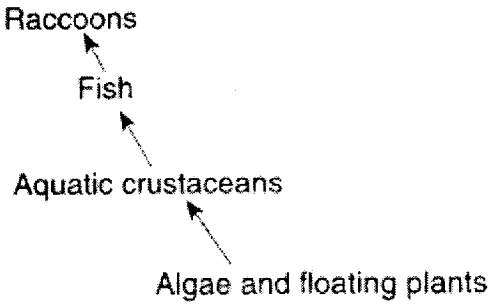
- Predator is the one the eats the prey
- Prey runs away from the predator
- Examples
    - Snake (predator); mouse (prey)
    - Hawk (predator); snake (prey)
    - Lion (predator); deer (prey)

Parasite-host

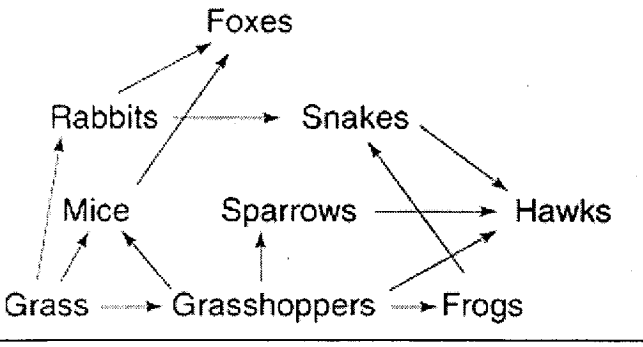
- Parasite lives off a living organism
- Host is negatively affected by the parasite
- Examples
    - Leeches (parasite); humans (host)
    - Ticks (parasite); deer (host)

Energy Flow:

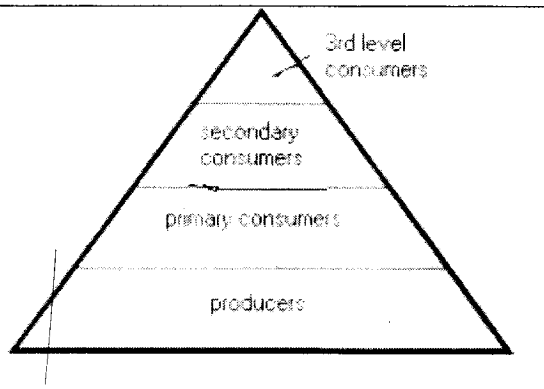
- **Food chain**- flow of energy that is in linear form (in a line)
  - Energy flows from the producers all the way up to the consumers

	- The algae and floating plants are the **producers.** - The aquatic crustaceans are the **primary consumers**, which eat the producers. - Fish are **secondary consumers** eating the primary consumers.

- **Food web**- similar to a food chain but shows more then one flow of energy
  - Energy flows the same way through a food web

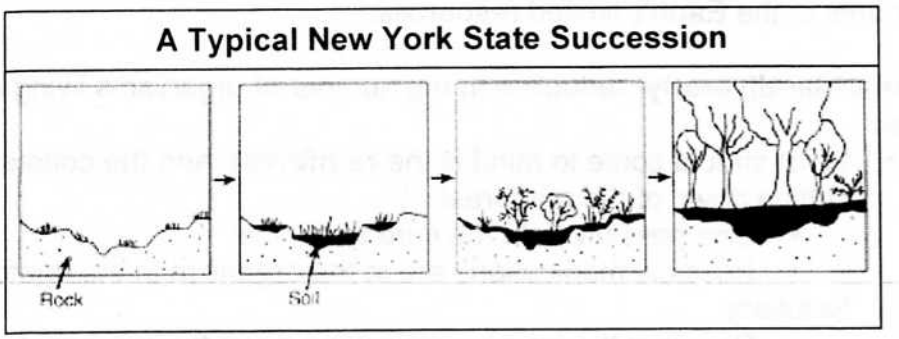
- Energy flow in a food web also starts with the producer (grass) - It continues to flow through the various levels of consumer organisms as in a food chain.	

Energy Pyramids:

• Producers are always found at the bottom of the pyramid • As you move up the levels, only 10% of the energy is brought to the next level ○ Example: when a snake eats a mouse, only 10% of the mouse's energy goes on to the snake; 90% of the energy was used for the mouse to run, eat, digest etc. • Producers have the most energy	

Succession:

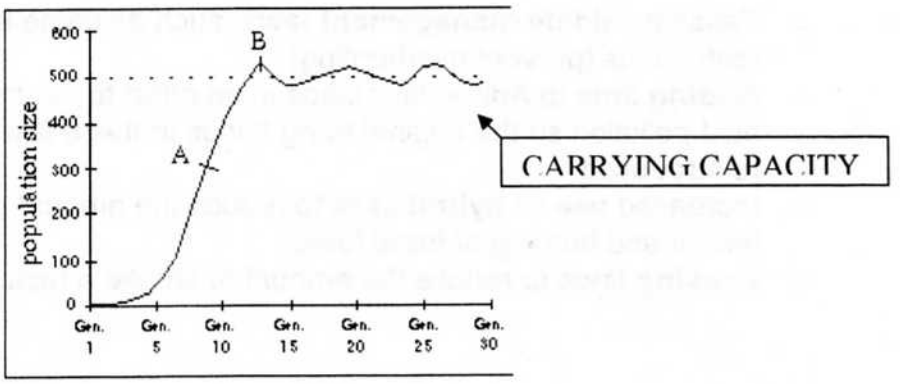
- How an ecosystem changes over time
- Succession often happens after a fire has burned down a forest; it takes almost 150 years for it to go back to the way it was before the fire burned it down.



- In the picture, first the land starts out with rock
- The rock breaks down to make the soil
- The soil is where little plants and shrubs start to grow
- Eventually bigger trees and plants will start growing

Competition- fighting for a resource (food, water, space)

- In the graph below, A shows an increase in the amount of organisms in a population
- When the graph gets to B, it starts to wave the line because there is not enough resources to maintain a population bigger then 500



Human Impact on the Ecosystem

Negative Influences:

- **Population Growth**- our increasing population is using excessive amounts of the Earth's limited resources.

- **Loss of biodiversity**- reduction in the number of organisms living in an area
  - What should come to mind is the **rainforest**, and the constant cutting down of the rainforest
    - Can possibly hold the cure to cancer
    - Possible medications are in the organism in the rainforest
  - Solutions
    - Preserve the land by not cutting down the rainforest
    - Posing strict laws on hunting and deforestation

- **Pollution**- land, air, and water pollution.
  - Water pollution- acid rain (air pollution goes into the air and comes back down to the earth when it rains, this rain ends up in our ponds and lakes)
  - These include the addition of **greenhouse gases** mostly due to the burning of fossil fuels and **depletion of ozone layer** (increase sun burn in people)

Positive Influences:

- Passing **wildlife management laws**, such as game laws and catch restrictions (prevent overhunting)
- **Adding lime** to Adirondack lakes in an effort to neutralize their acid pollution so the original living things in these lakes can be reintroduced.
- Increased **use of hybrid cars** to reduce the amount of exhaust going into the air and burning of fossil fuels
- **Passing laws** to reduce the amount of smoke a factory can produce