

# Biology Top 101



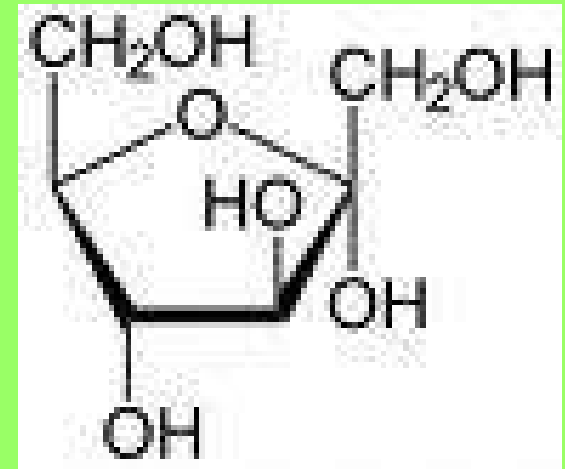
# Organic Compounds

- All living things are made of organic compounds.
- Contain the element Carbon
- Carbohydrates, Proteins, Lipids, Nucleic Acids



# Carbohydrates

- Monomer-  
monosaccharide
- Function- energy source  
and structure
- Tests: glucose-Benedicts  
starch- Iodine
- Ex. Cellulose, glycogen,  
starch



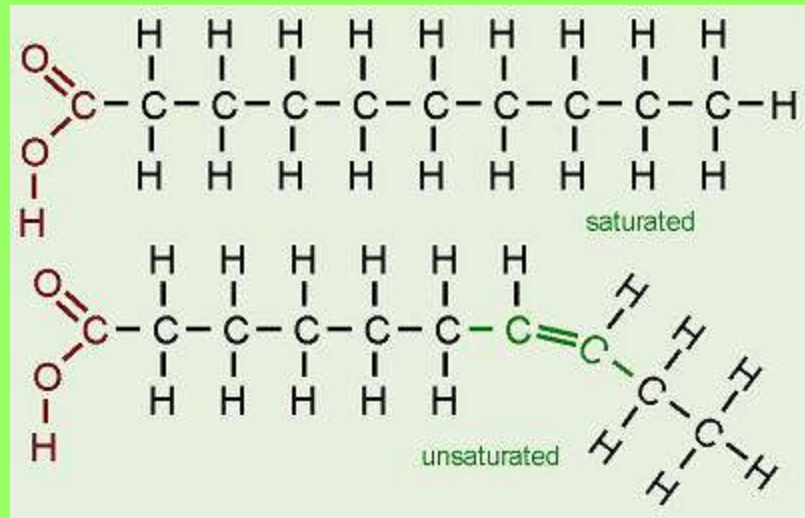
fructose

# Lipids

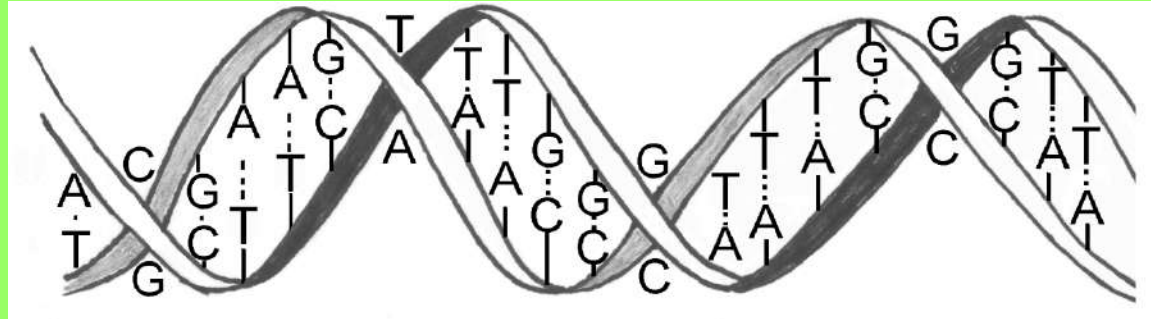
- Made of fatty acids and glycerol
- Function- energy storage and insulation
- Tests: brown paper test
- Examples: fats and steroids



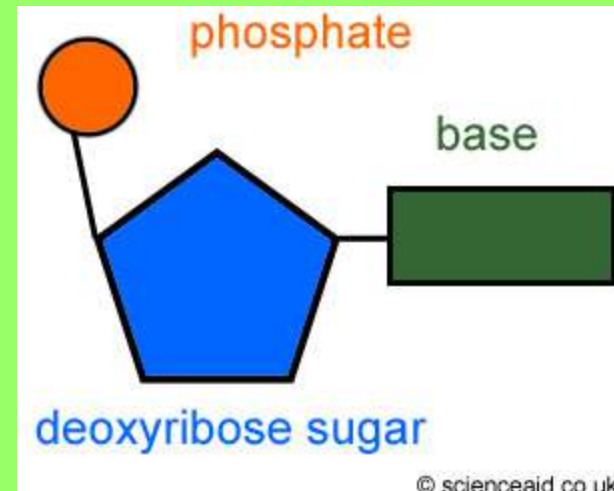
Lipid vs. water



# Nucleic Acids

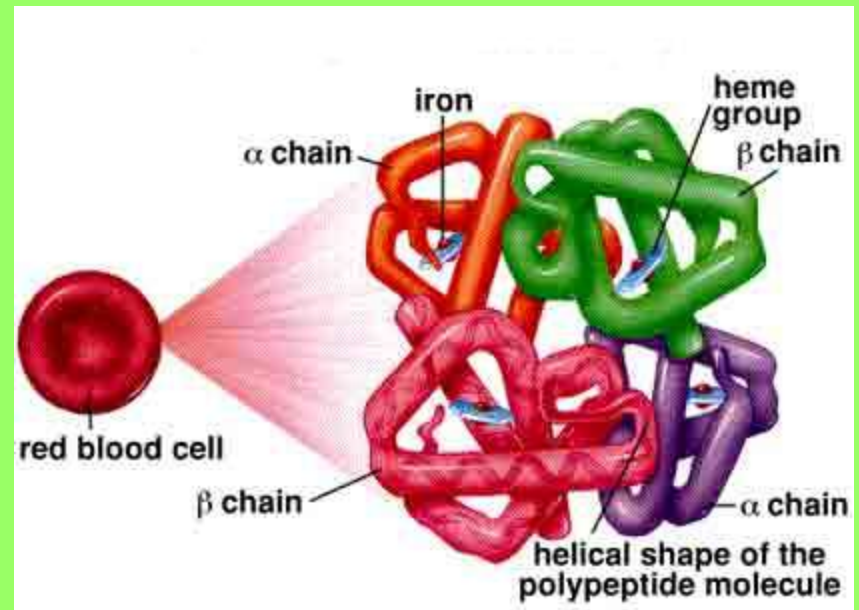


- Monomer- nucleotide
- Function- carry genetic information
- Ex. DNA and RNA



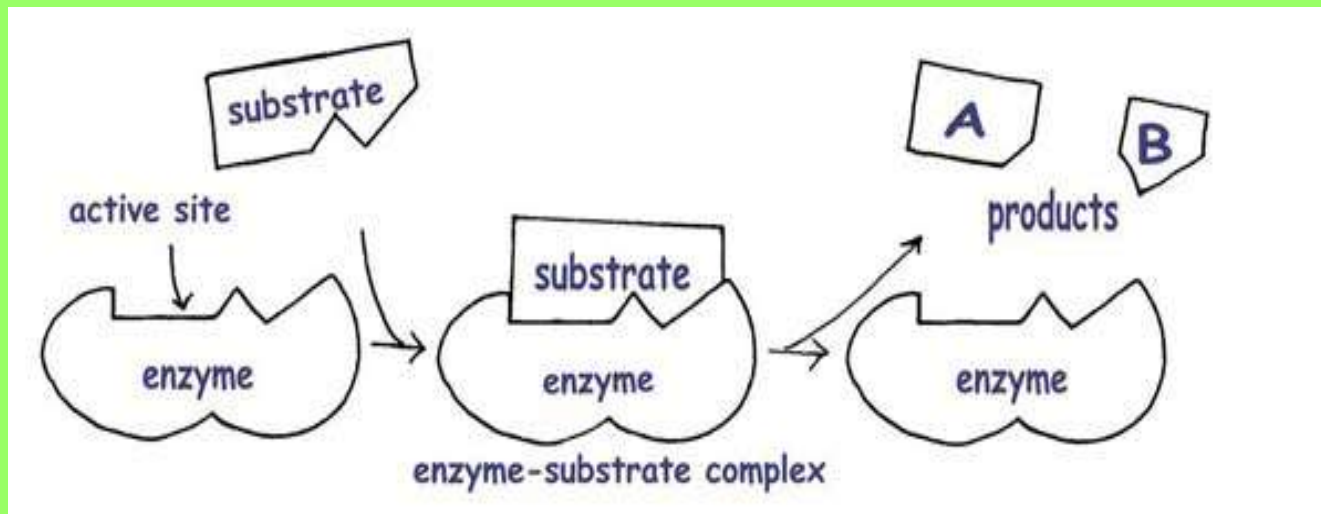
# Proteins

- Monomer- amino acids
- Function- building and repairing cells, communication, transport, and regulation
- Tests- Biurets
- Examples: enzymes, hemoglobin



# Enzymes

- Catalysts in living things
- Specific to a particular substrate
- Reusable
- Affected by temperature and pH

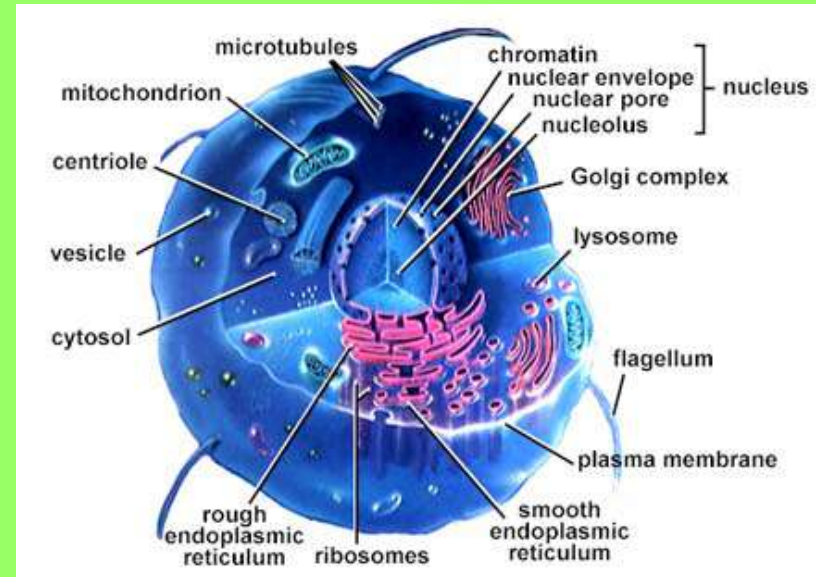
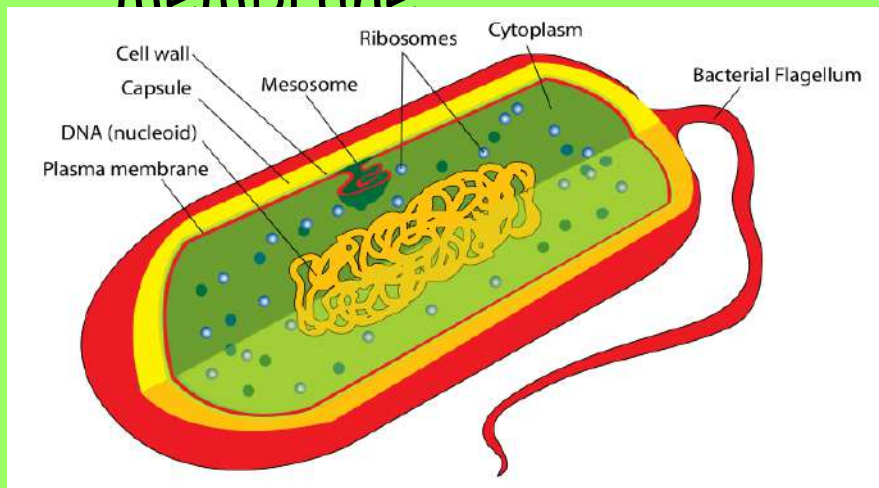




# Cells

## Prokaryotes

- Simple, no membrane bound organelles
- Bacteria only
- One circular chromosome
- Includes: chromosome, ribosomes, and plasma membrane



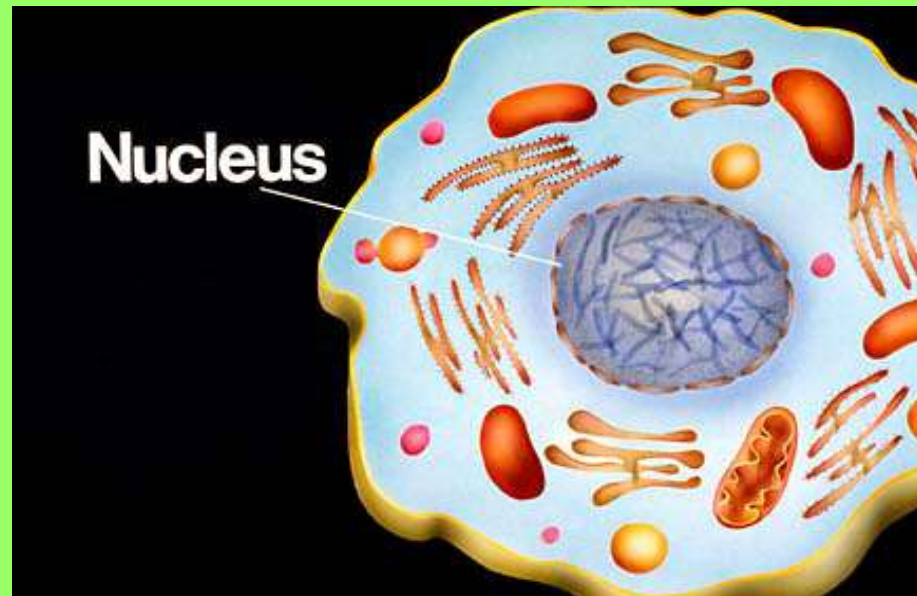
## Eukaryotes

- Membrane bound organelles
- Plants and Animals
- True nucleus containing chromosomes



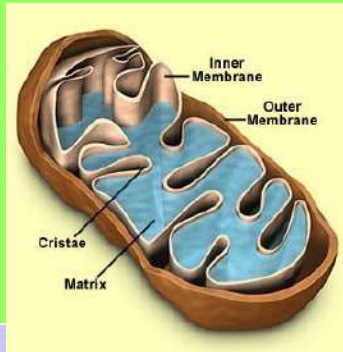
# Nucleus

- "Control Center"
- Contains chromosomes

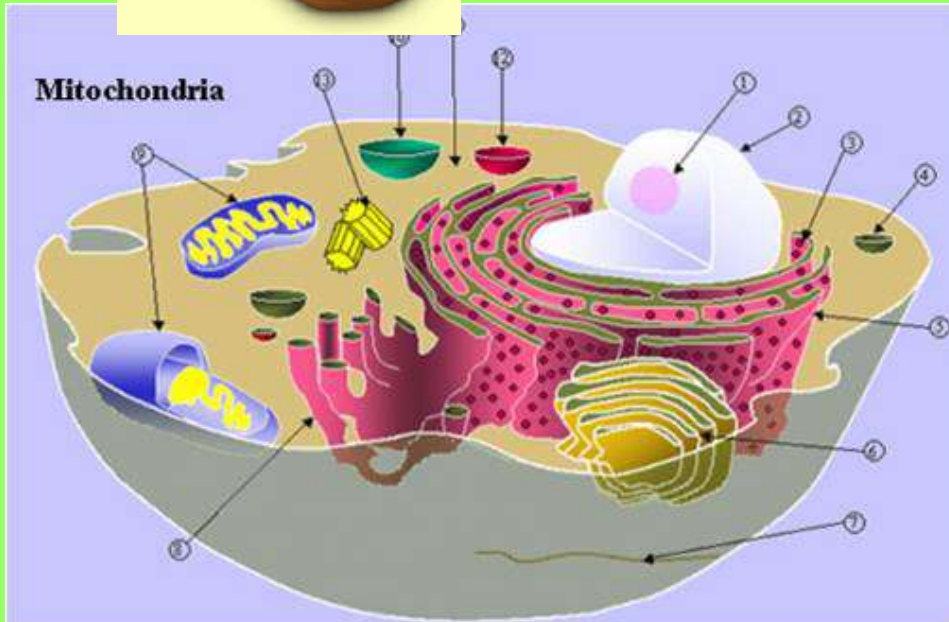


# Mitochondria

Singular: Mitochondrion

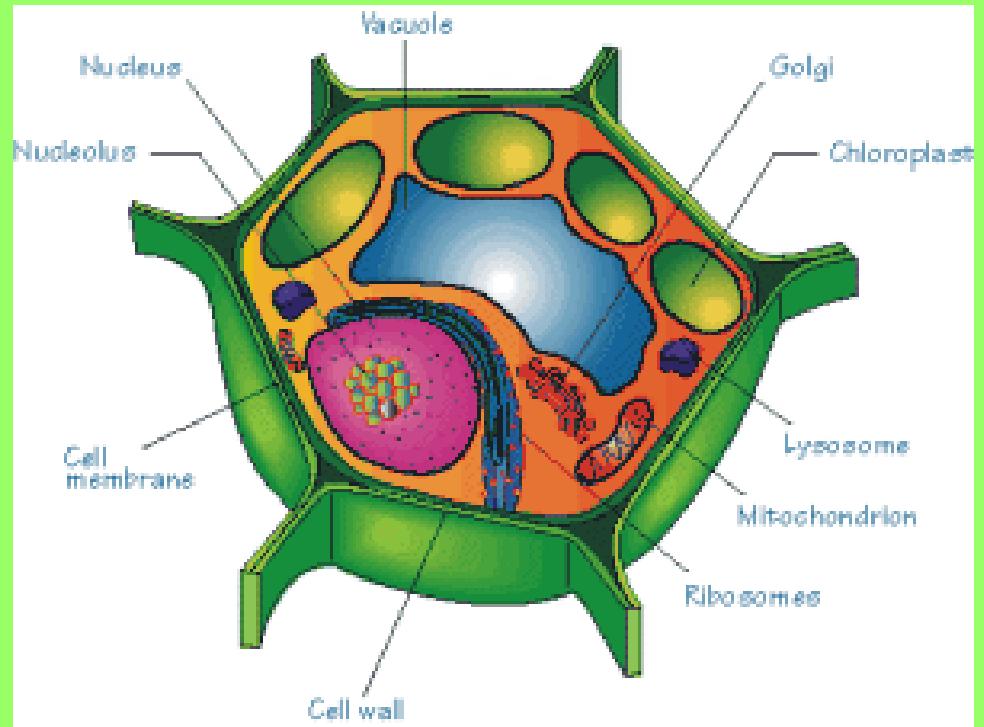


- "Powerhouse" of the cell
- Produces energy in the form of ATP
- Site of Aerobic respiration



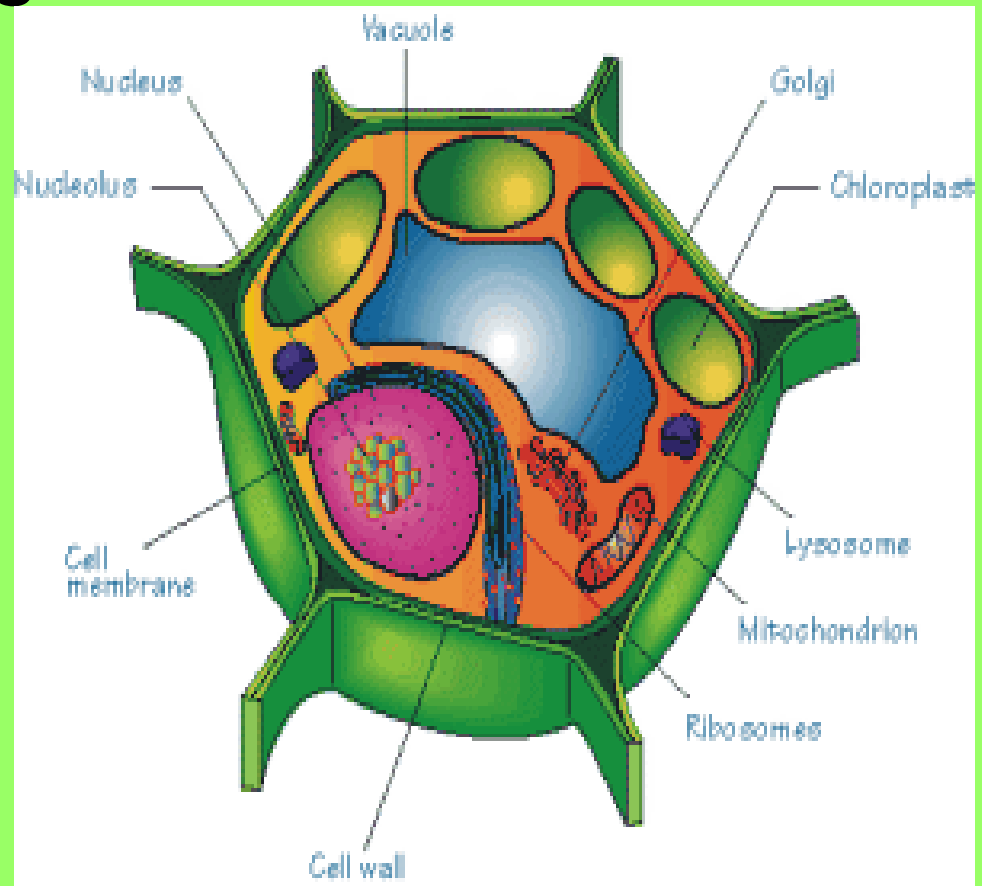
# Chloroplast

- Site of photosynthesis
- Plant cells **ONLY**
- Contains the pigment chlorophyll



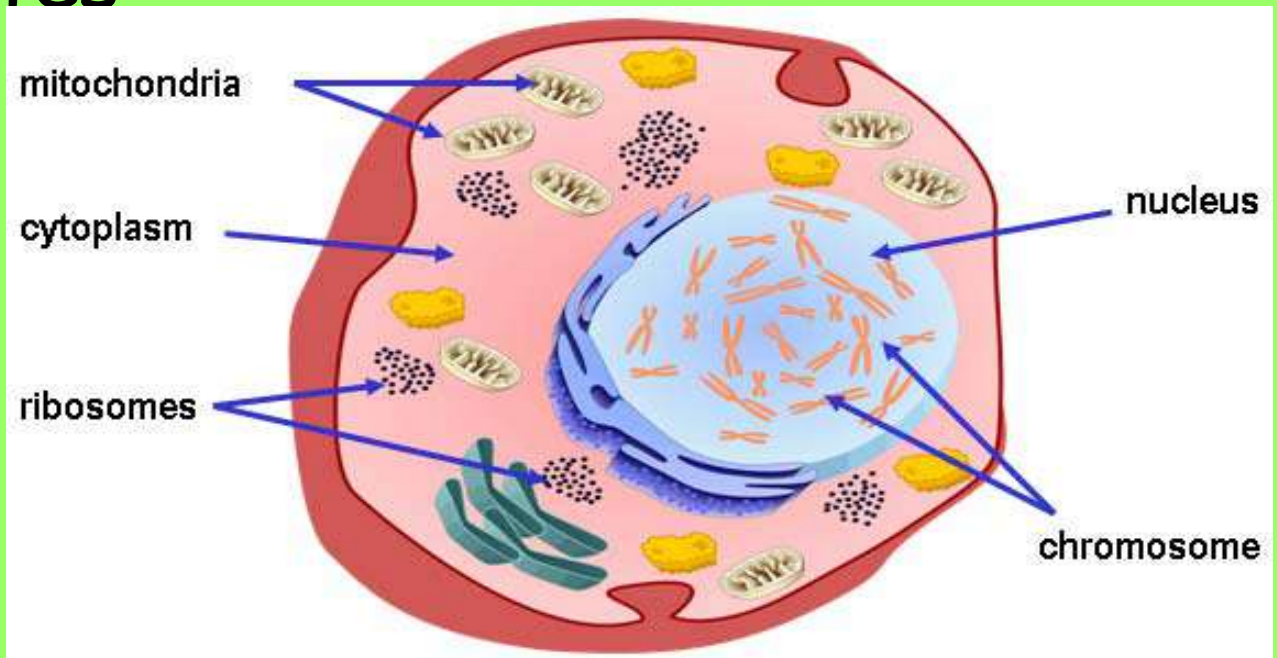
# Vacuole

- Storage of excess materials
- Plant cells usually contain one large vacuole



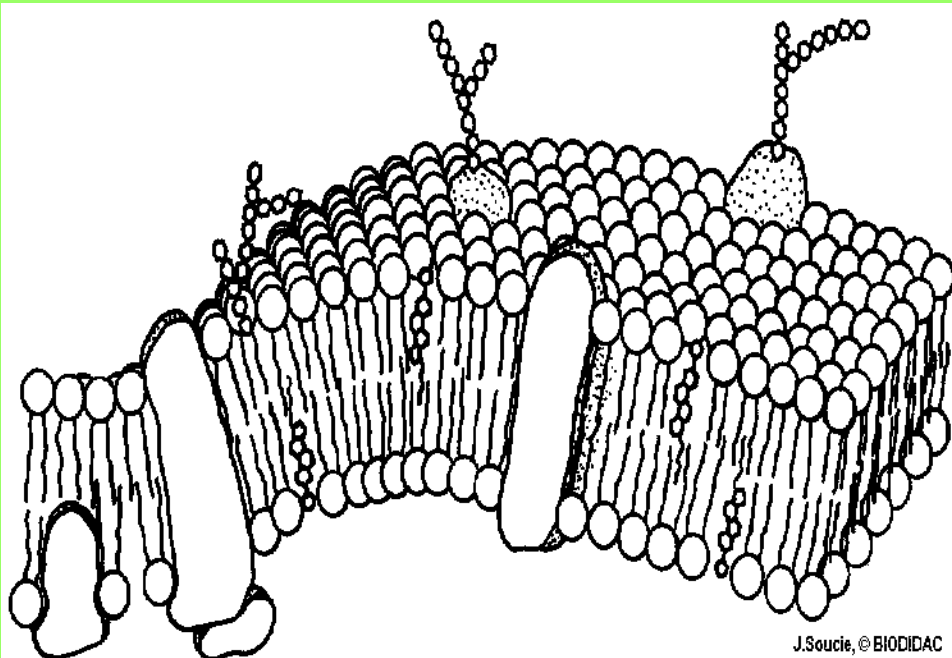
# Ribosomes

- Proteins are synthesized
- Found in both prokaryotes and eukaryotes



# Plasma Membrane

aka: Cell Membrane



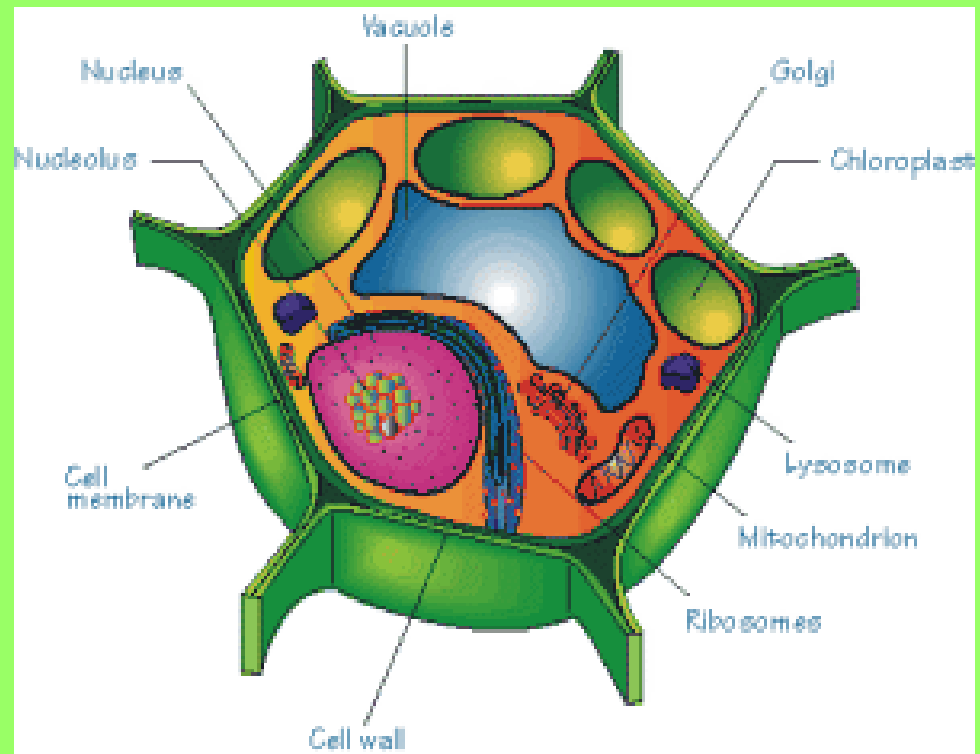
J.Soucie, © BIODIDAC

- Surrounds the cell
- Regulates what enters/leaves the cell
- Helps maintain homeostasis
- Made of phospholipids with embedded proteins



# Cell Wall

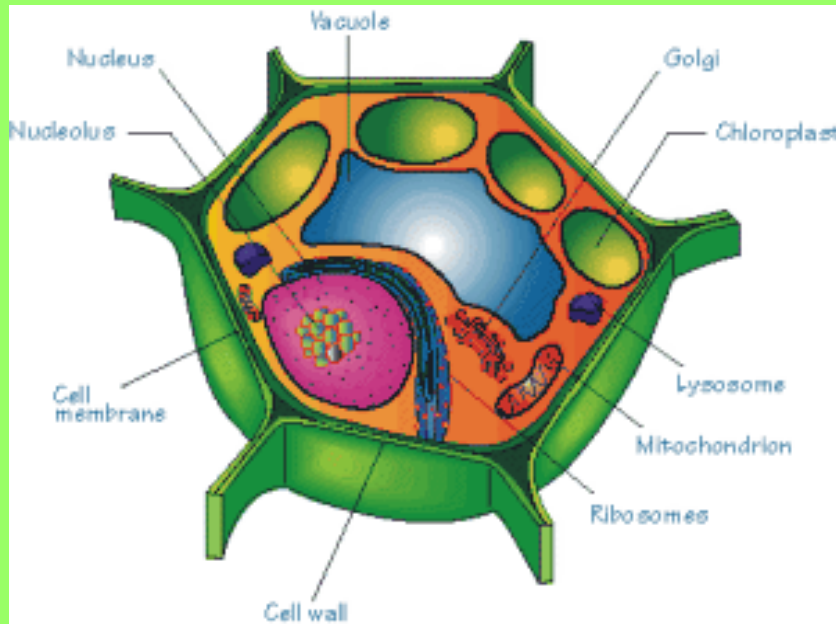
- Plant cells **ONLY**
- Surrounds cell and provides support and protection.
- Made of cellulose



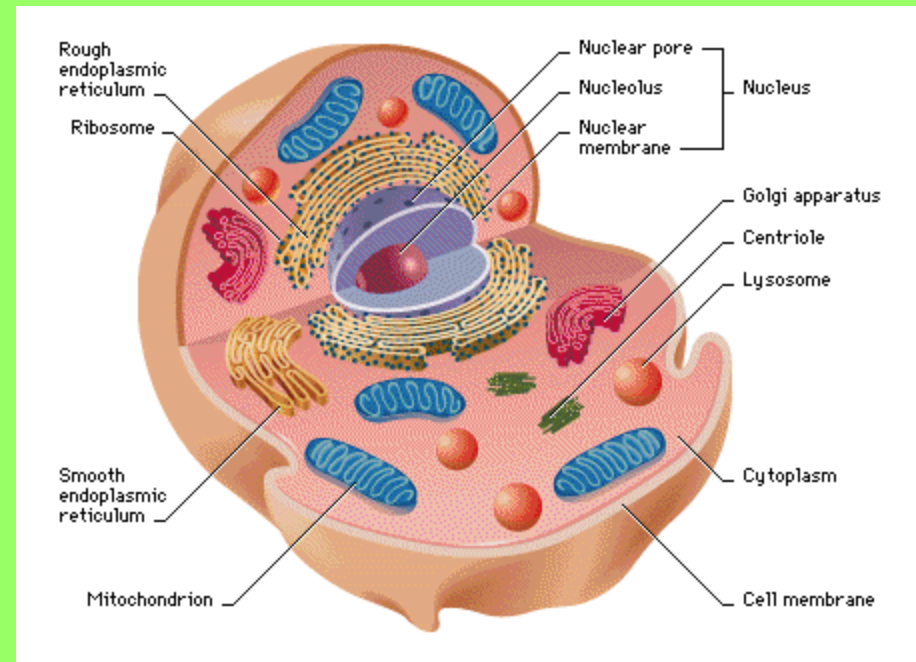
# Eukaryotes

## Plant

**Cell wall**  
**Chloroplast**  
**Large central vacuole**



## Animal



# Cell Organization

Cell



Tissue



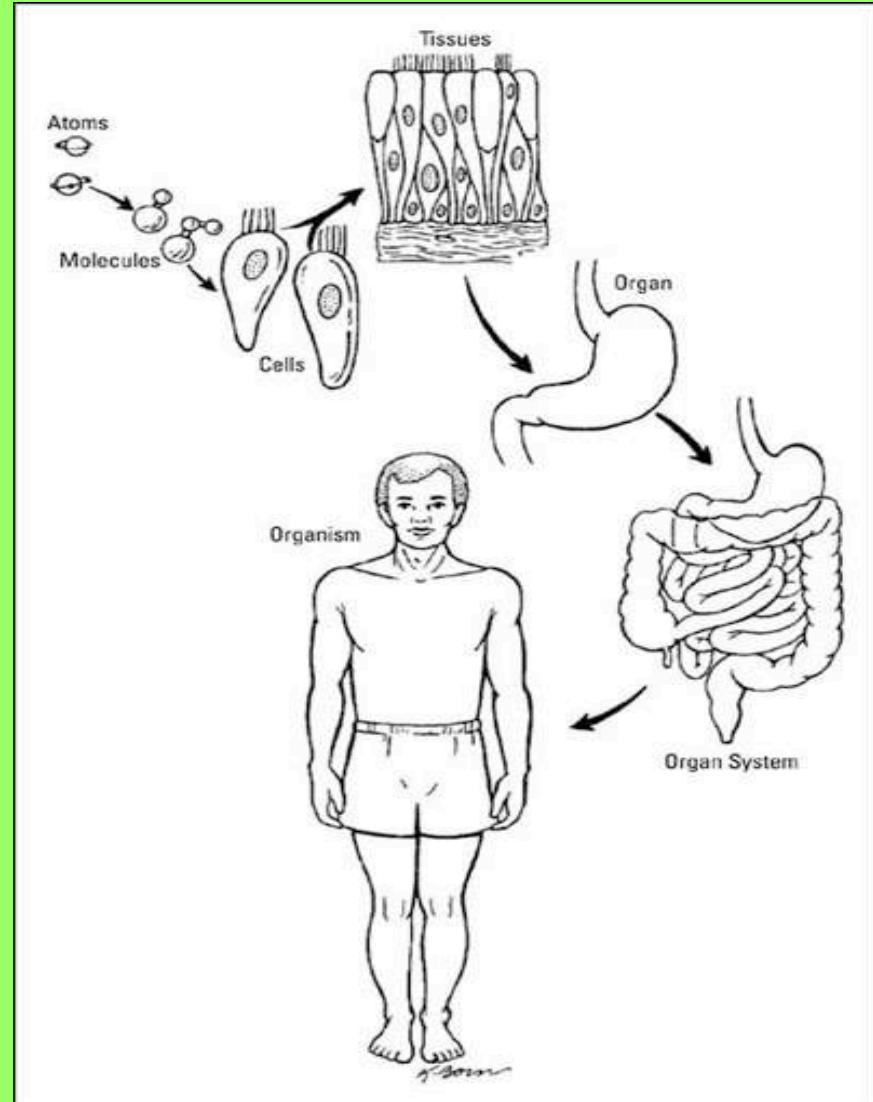
Organ



Organ System

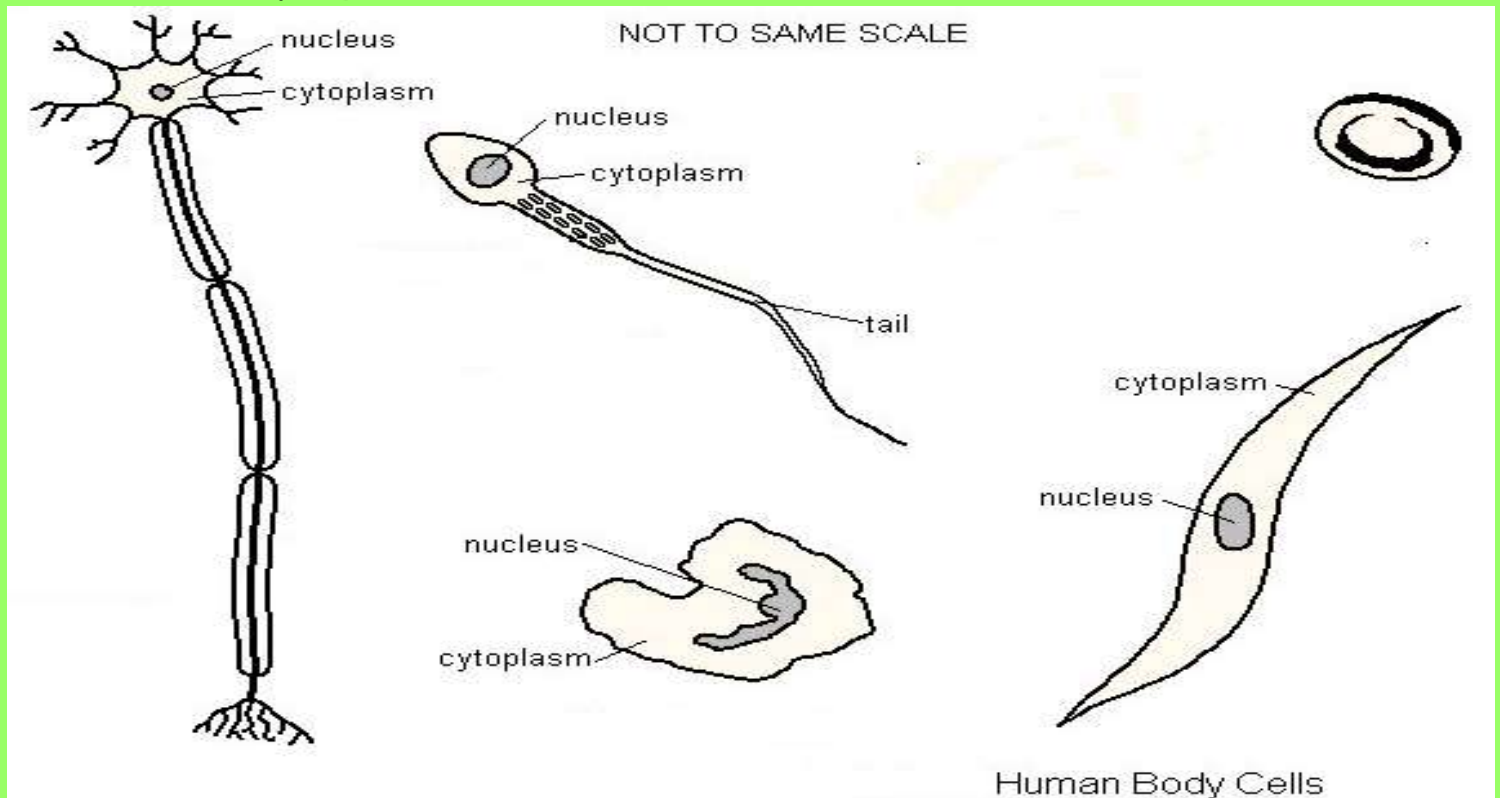


Individual organism



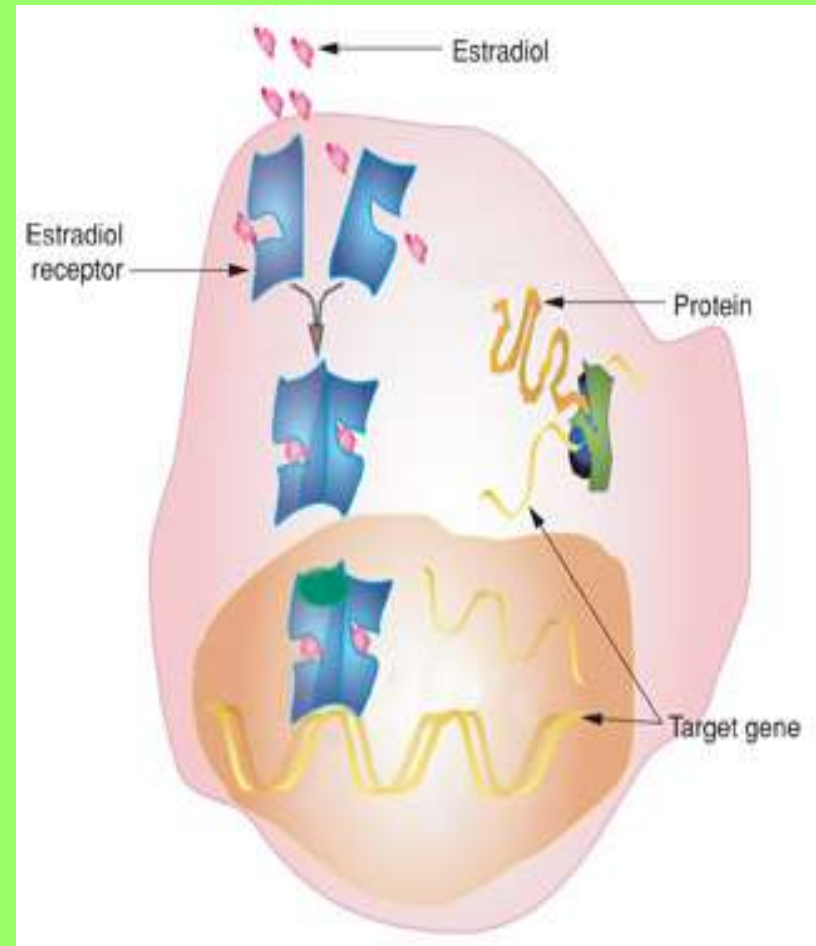
# Cell Specialization

- cells develop to perform different functions
- Regulated by genes



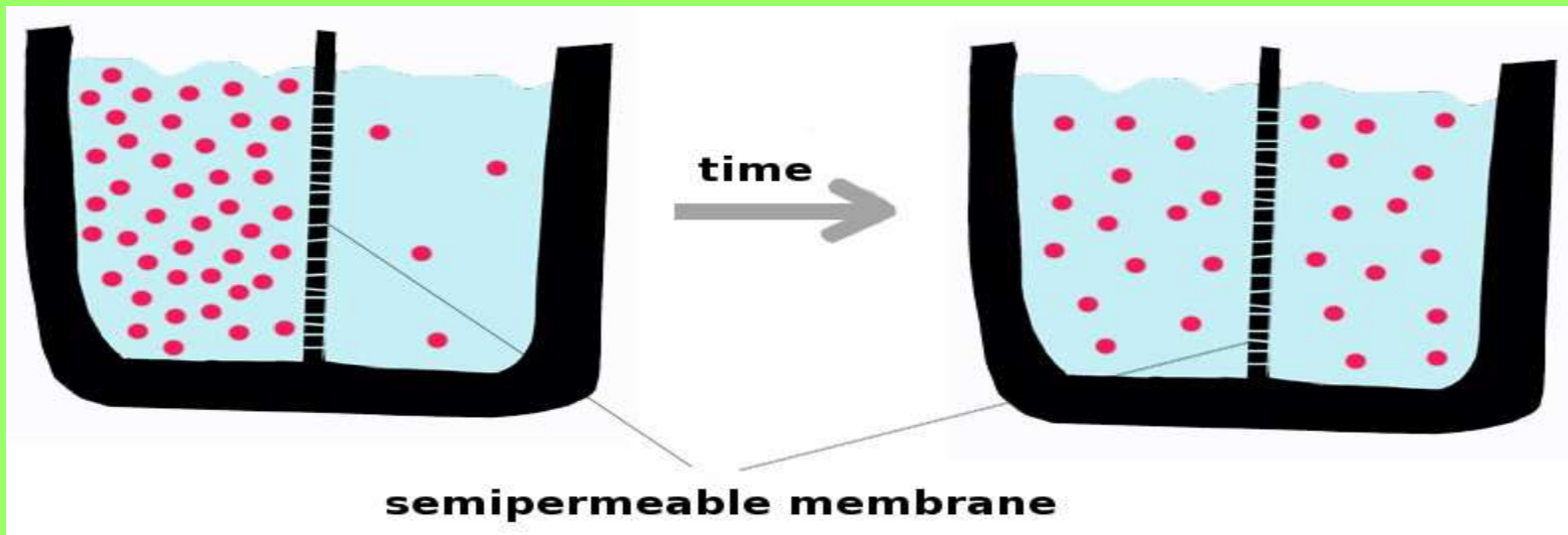
# Cell to Cell Communication

- Chemical Signals (hormones) can be sent from one cell to another
- Receptor proteins on the plasma membrane receive the signal



# Diffusion

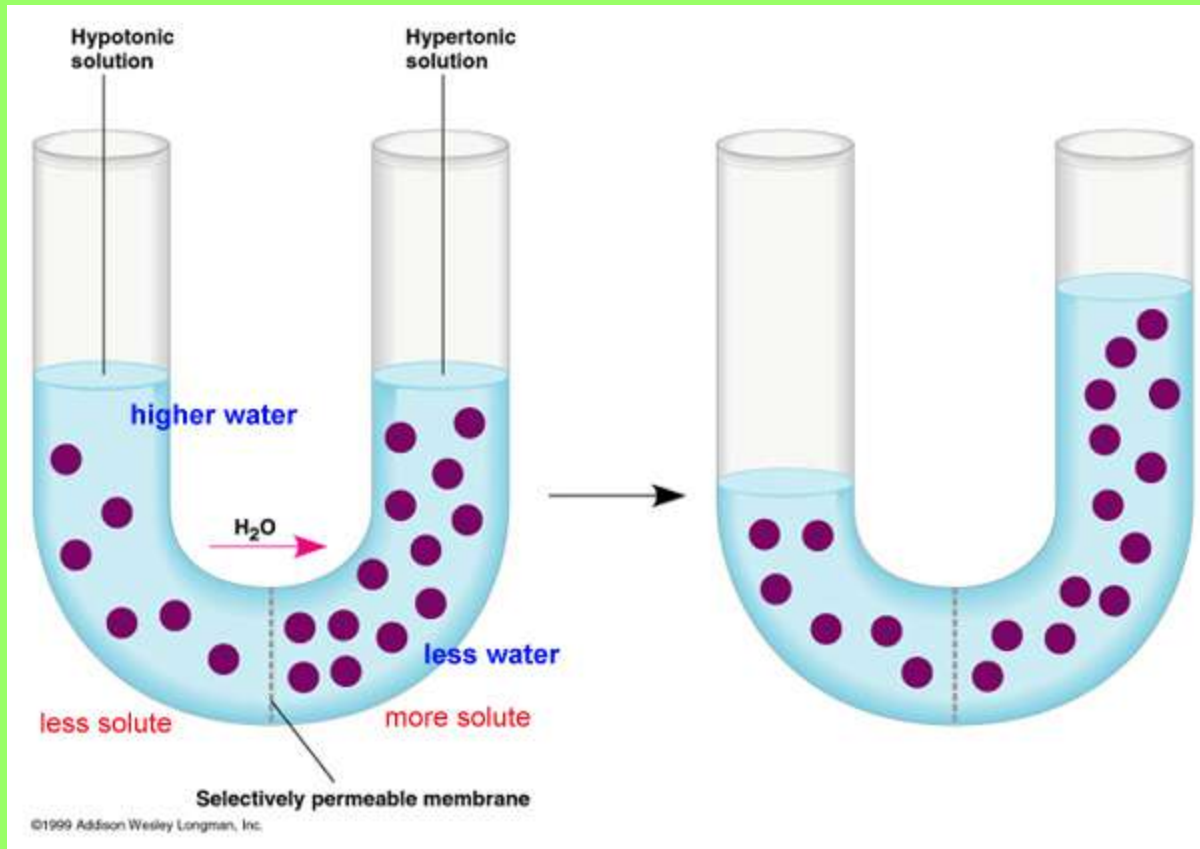
- Form of passive transport (NO ENERGY NEEDED) across a membrane
- Solutes move from high concentration to low concentration





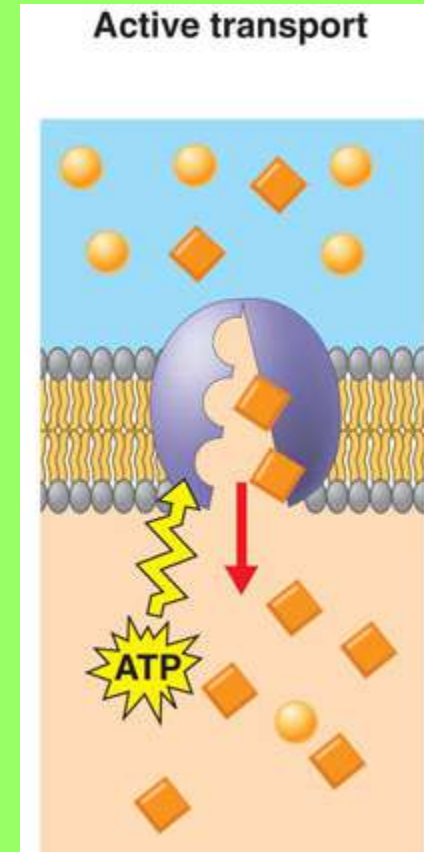
# Osmosis

- Diffusion of water (also passive transport)

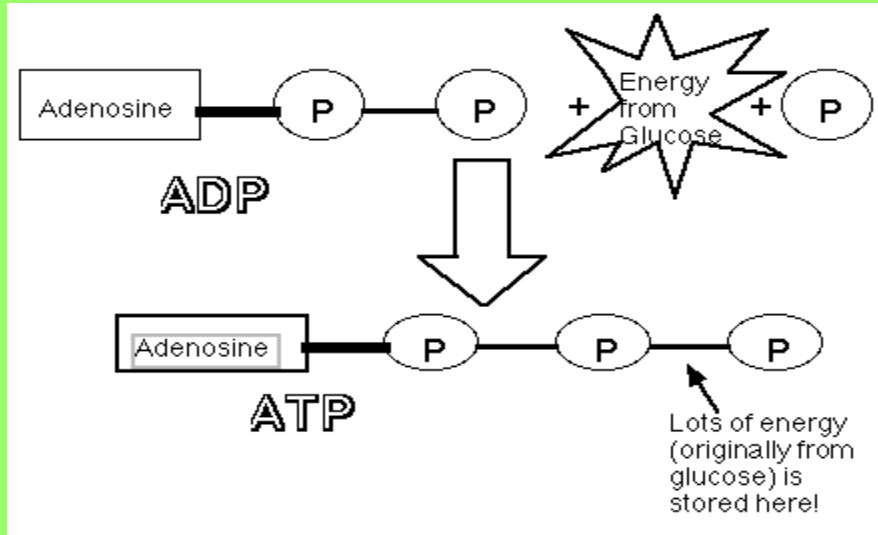


# Active Transport

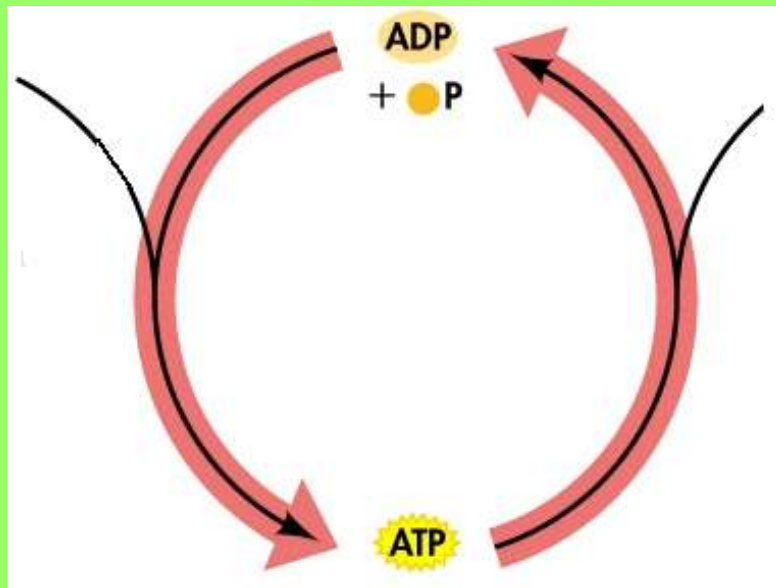
- Particles moving against the concentration gradient which **REQUIRES ENERGY (ATP)**
- Low concentration to high concentration



# ATP

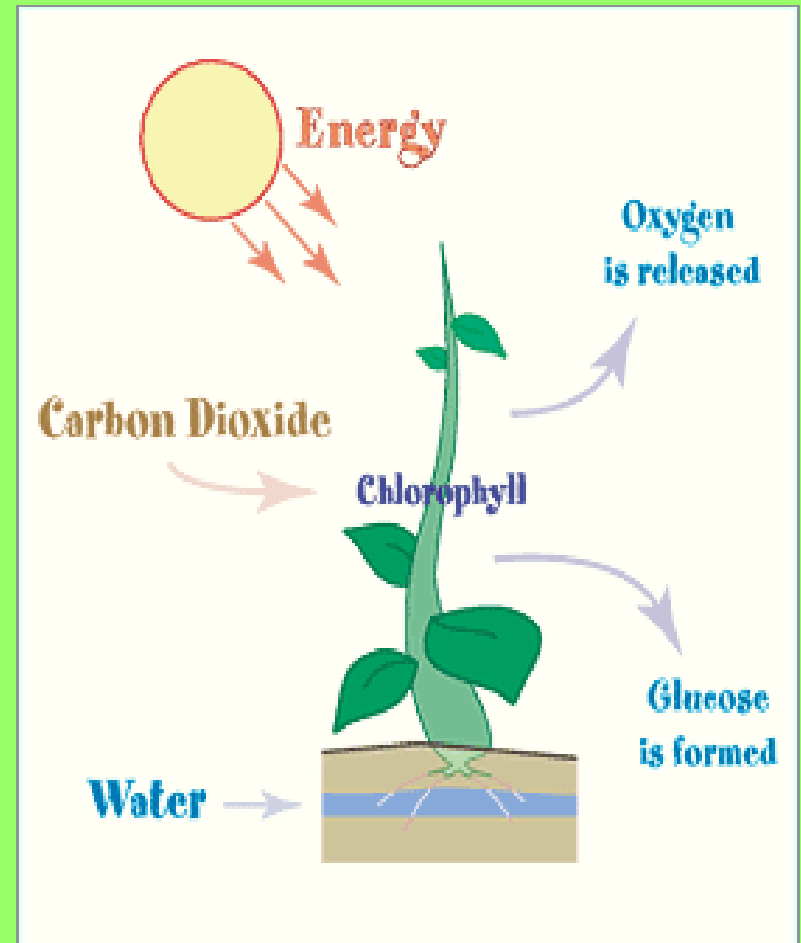


- Energy storing molecule
- Can be used for quick energy by the cell
- Energy is stored in the phosphate bonds



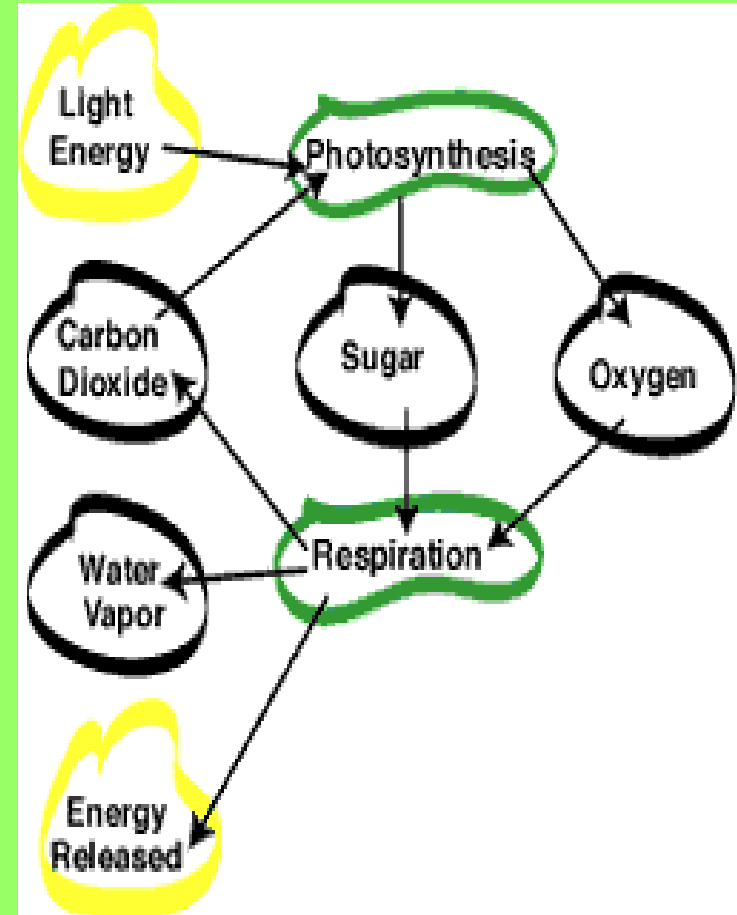
# Photosynthesis

- Water and Carbon Dioxide used to produce Glucose and Oxygen
- $H_2O + CO_2 \rightarrow C_6H_{12}O_6 + O_2$
- Occurs in the chloroplast



# Aerobic Respiration

- Used to release energy (ATP) for cellular use
- $C_6H_{12}O_6 + O_2 \rightarrow H_2O + CO_2$
- Occurs in the mitochondria



# Anaerobic Respiration

aka Fermentation

- Does not require Oxygen
- also used to release energy, but not as efficient as aerobic respiration (less ATP)
- Products include  $CO_2$  and lactic acid or alcohol
- Two Types: Alcoholic Fermentation and Lactic Acid Fermentation





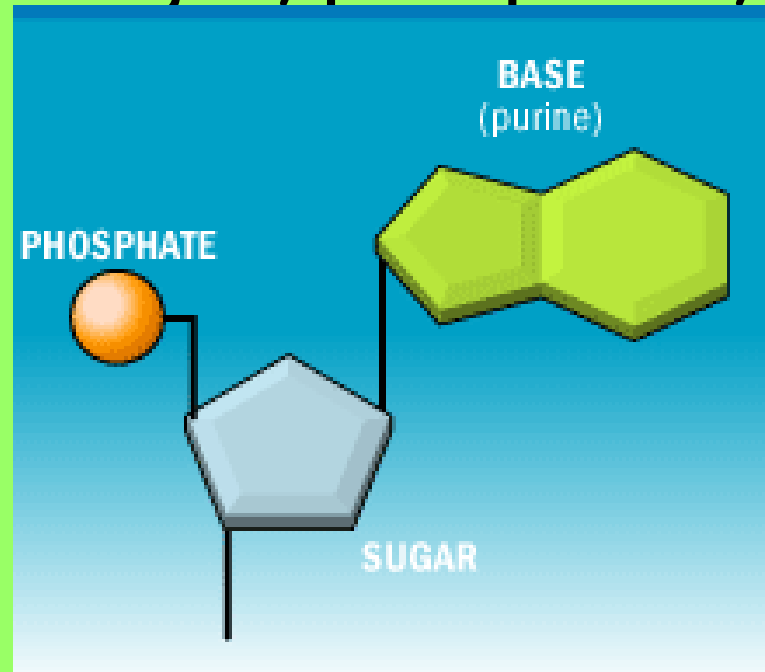
# Autotroph vs. Heterotroph

- Obtain energy from the environment
  - Photosynthesis or chemosynthesis
  - "Producers"
- Obtain energy from other living things
  - "Consumers"



# DNA / RNA

- Carry genetic information
- Made of a chain of nucleotides
- Nucleotides contain a sugar, phosphate, and a nitrogen base



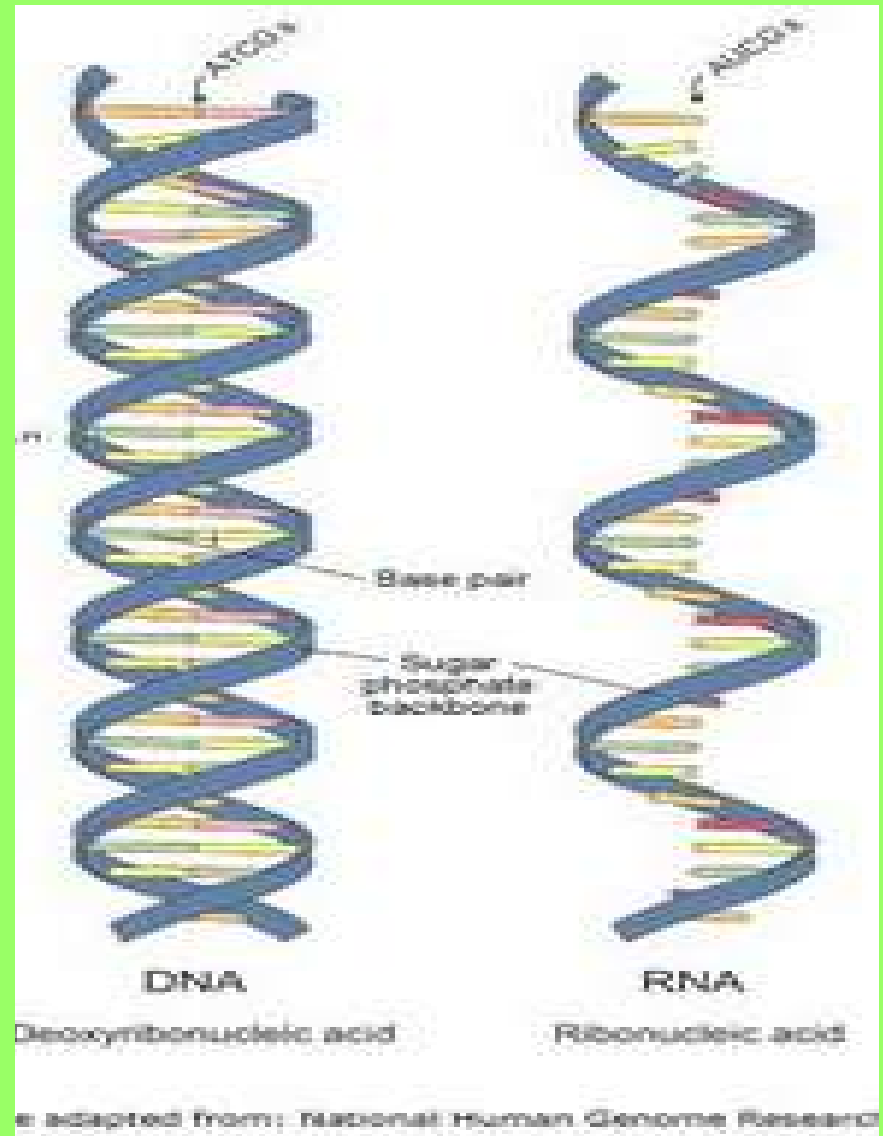
# DNA / RNA

## DNA

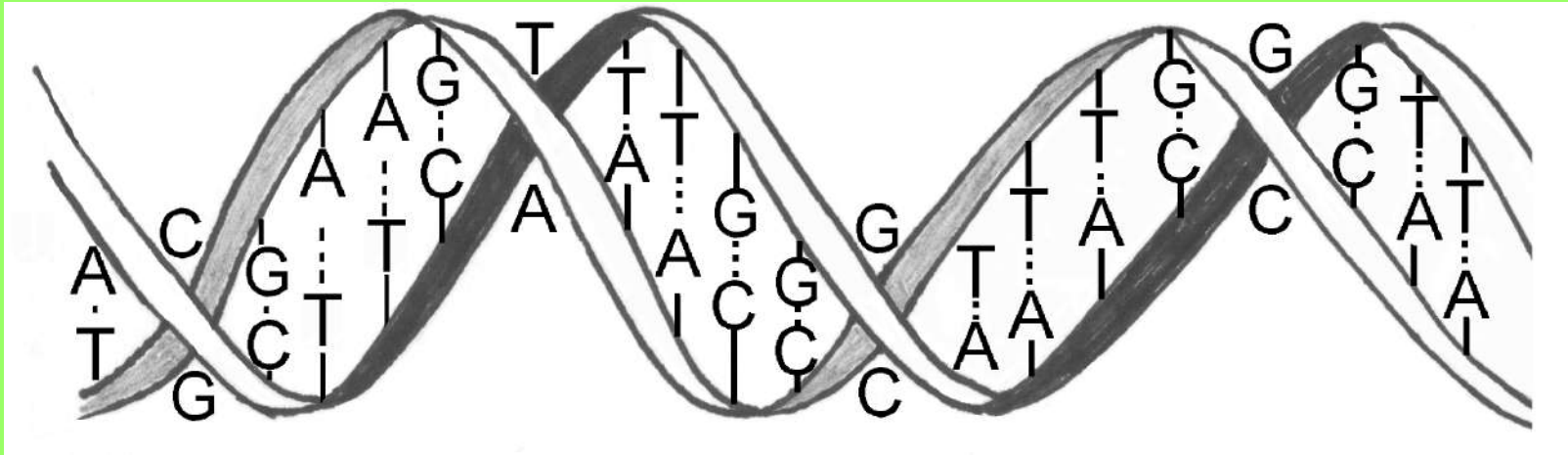
- Double stranded
- "Double Helix"
- Four base pairs: *ATGC*
- Sugar is Deoxyribose
- Found in nucleus

## RNA

- Single stranded
- Four base pairs: *AUCG*
- Sugar is Ribose



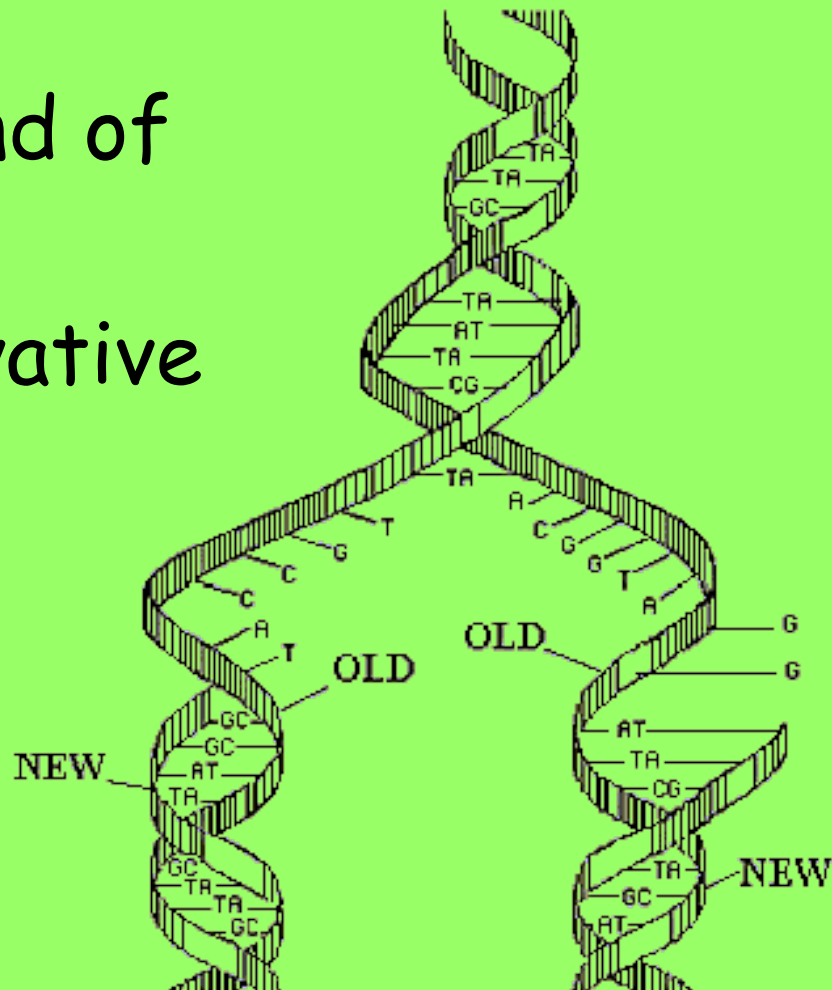
# Base Pair Rule



- In DNA,  
Adenine always pairs with Thymine, and  
Guanine always pairs with Cytosine

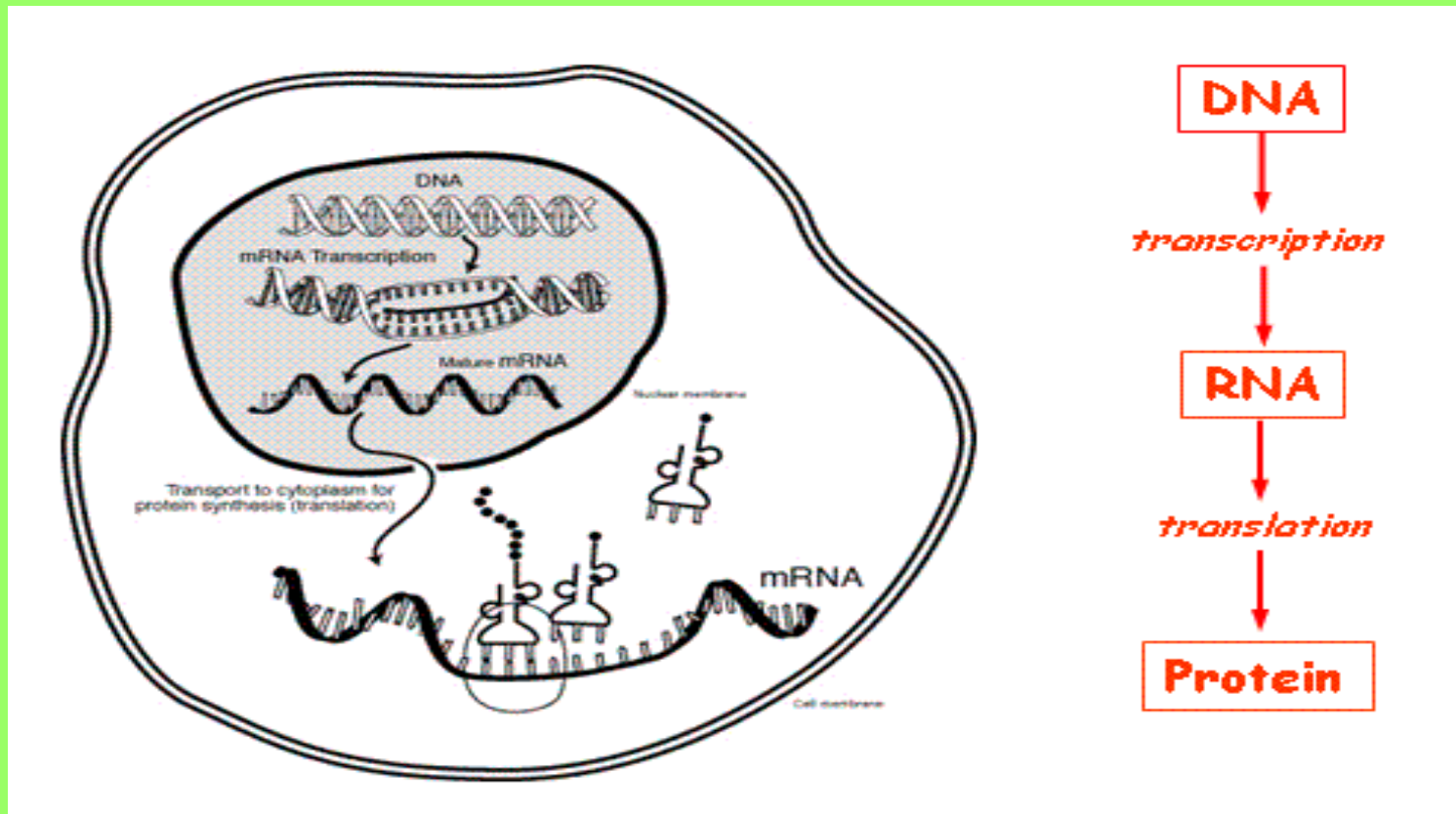
# Replication

- Making of an identical strand of DNA
- "semi" conservative



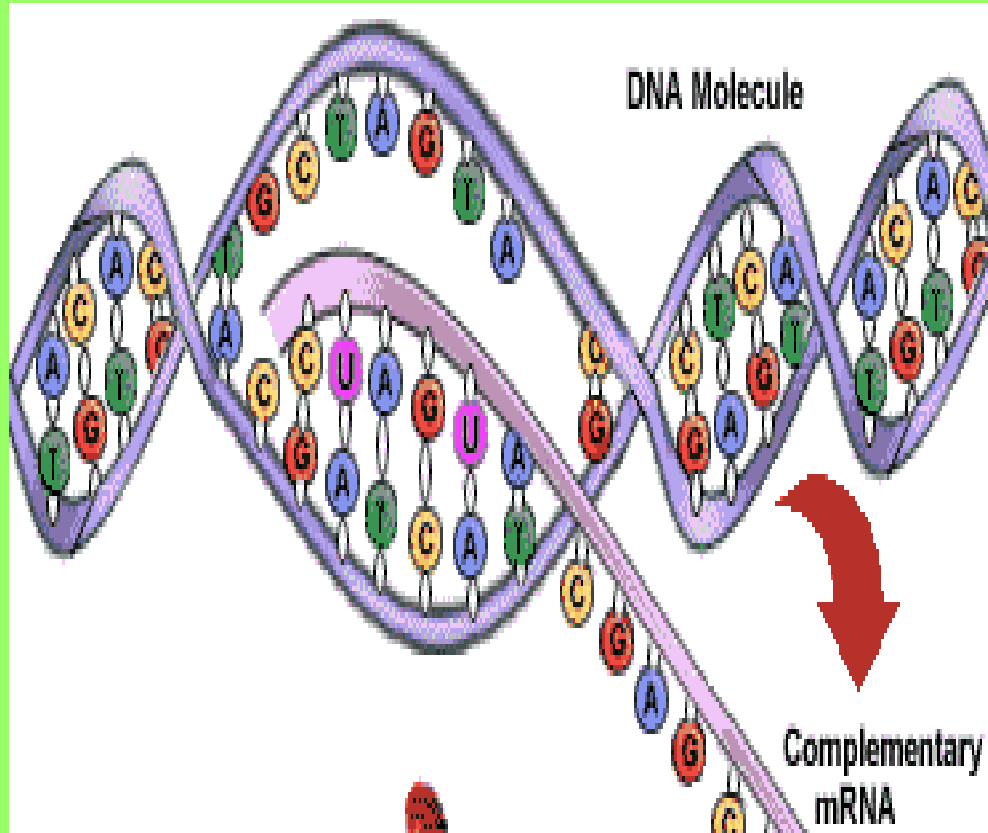
# Central Dogma

DNA → RNA → protein → trait





# Transcription



- DNA → mRNA
- Occurs in nucleus
- Complementary mRNA strand is produced from a segment of DNA

# Translation

- Connects amino acids in the correct order to make a protein
- Occurs in the cytoplasm within the ribosomes

A- amino acid

B- tRNA

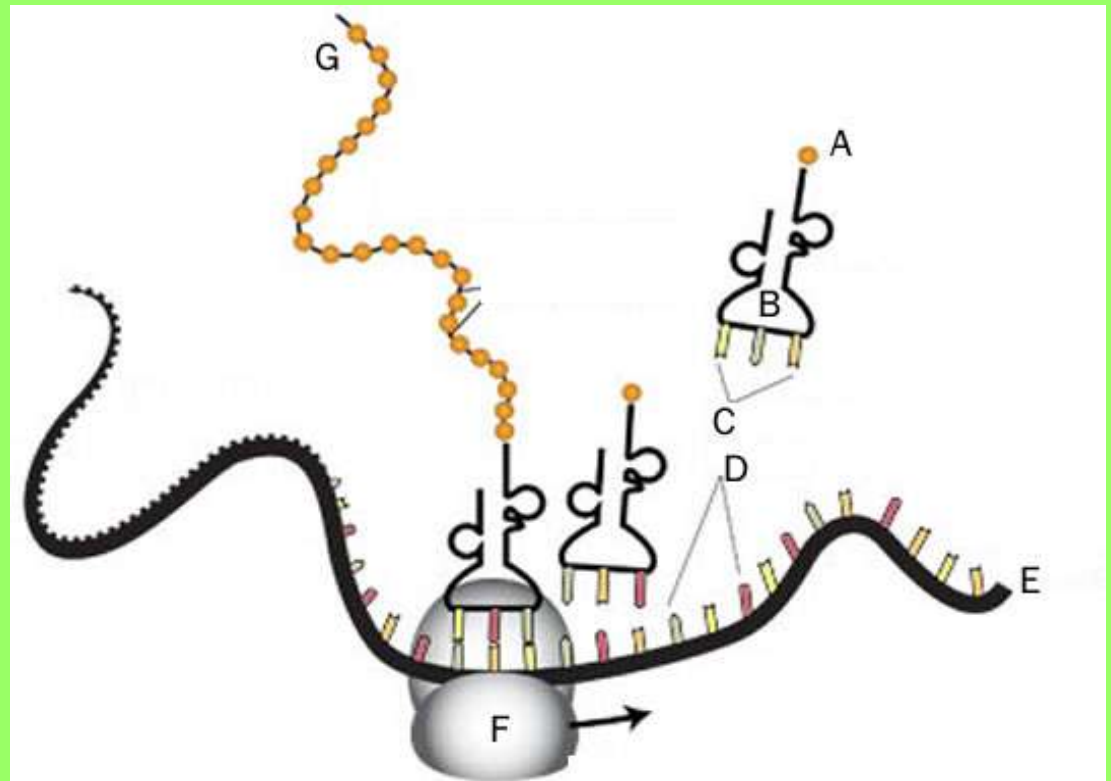
C- anticodon

D- codon

E- mRNA

F- Ribosome

G- polypeptide



# Codon

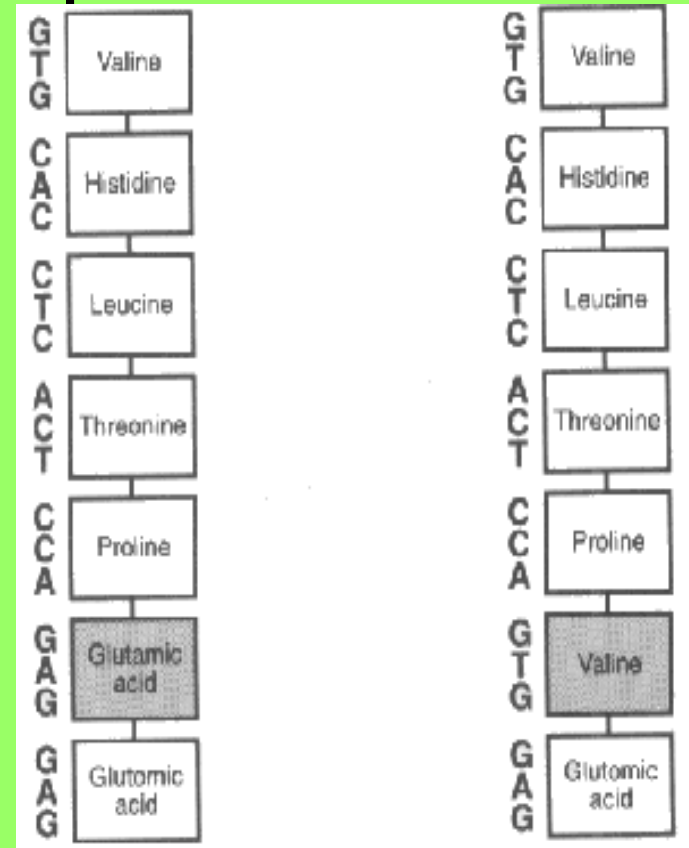
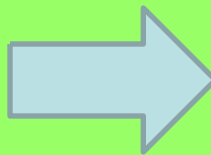
- Sequence of three mRNA nucleotides that code for an amino acid

First Letter	Second Letter				Third Letter
	<b>U</b>	<b>C</b>	<b>A</b>	<b>G</b>	
<b>U</b>	phenylalanine	serine	tyrosine	cysteine	<b>U</b>
	phenylalanine	serine	tyrosine	cysteine	<b>C</b>
	leucine	serine	stop	stop	<b>A</b>
	leucine	serine	stop	tryptophan	<b>G</b>
<b>C</b>	leucine	proline	histidine	arginine	<b>U</b>
	leucine	proline	histidine	arginine	<b>C</b>
	leucine	proline	glutamine	arginine	<b>A</b>
	leucine	proline	glutamine	arginine	<b>G</b>
<b>A</b>	isoleucine	threonine	asparagine	serine	<b>U</b>
	isoleucine	threonine	asparagine	serine	<b>C</b>
	isoleucine	threonine	lysine	arginine	<b>A</b>
	(start) methionine	threonine	lysine	arginine	<b>G</b>
<b>G</b>	valine	alanine	aspartate	glycine	<b>U</b>
	valine	alanine	aspartate	glycine	<b>C</b>
	valine	alanine	glutamate	glycine	<b>A</b>
	valine	alanine	glutamate	glycine	<b>G</b>

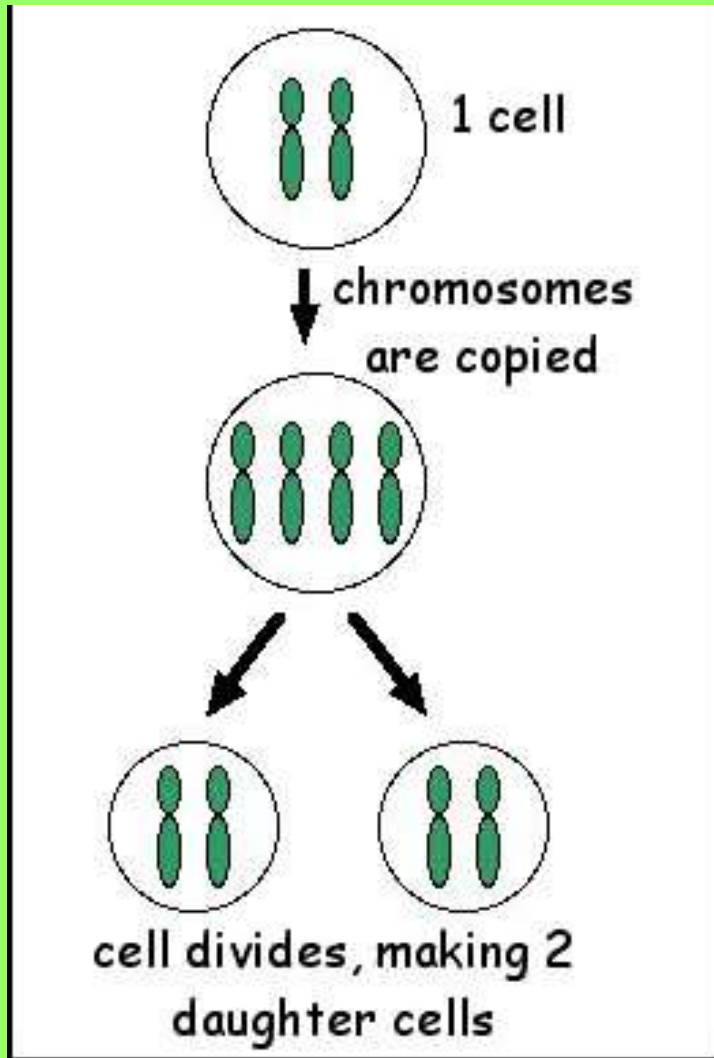
# Mutations

- Change in DNA code
- May cause a change in protein produced
- NOT always harmful

Sickle Cell Mutation



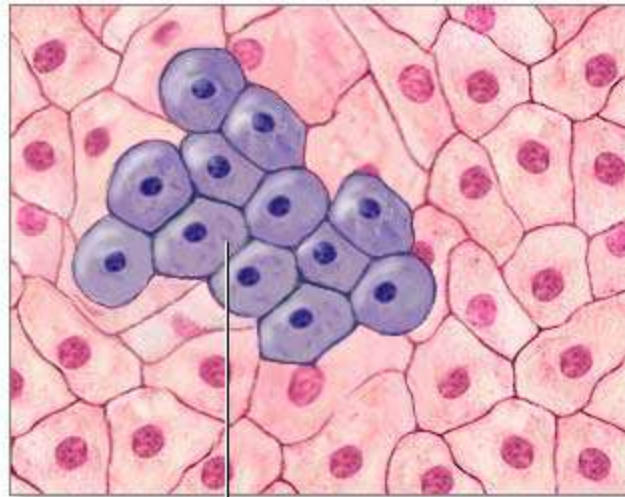
# Mitosis



- Cell division
- Produces two identical diploid daughter cells
- Occurs in body cells to grow and repair

# Cancer

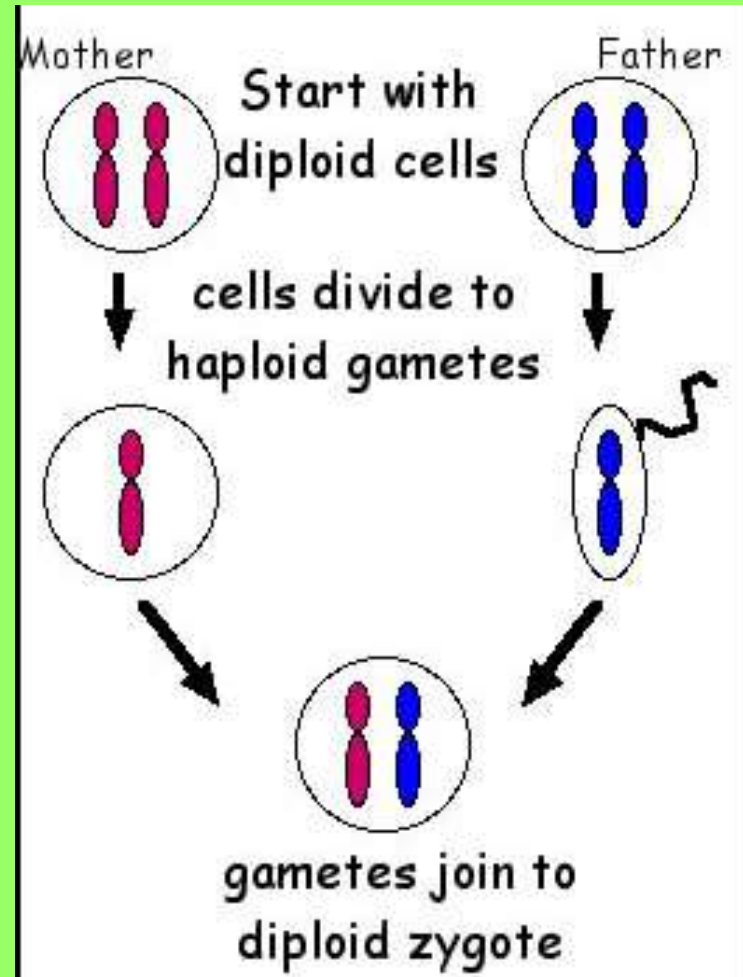
- Error in cell growth with causes uncontrolled cell growth
- Has environment and genetic variables



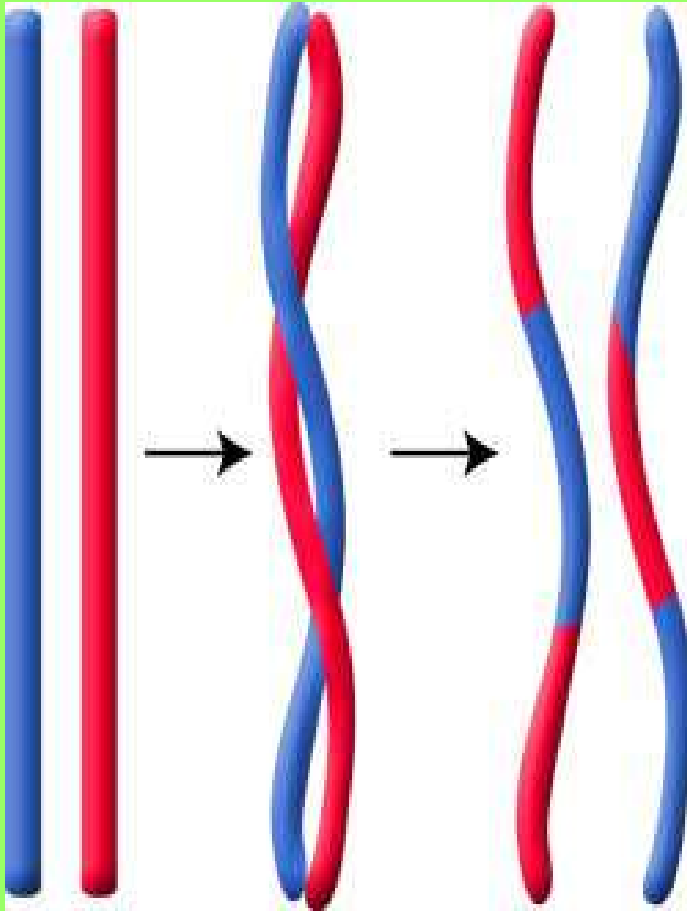
Proliferation of cancer cells

# Meiosis

- Cell division
- Produces four different haploid daughter cells (gametes)
- Occurs in sex cells to form gametes



# Crossing Over

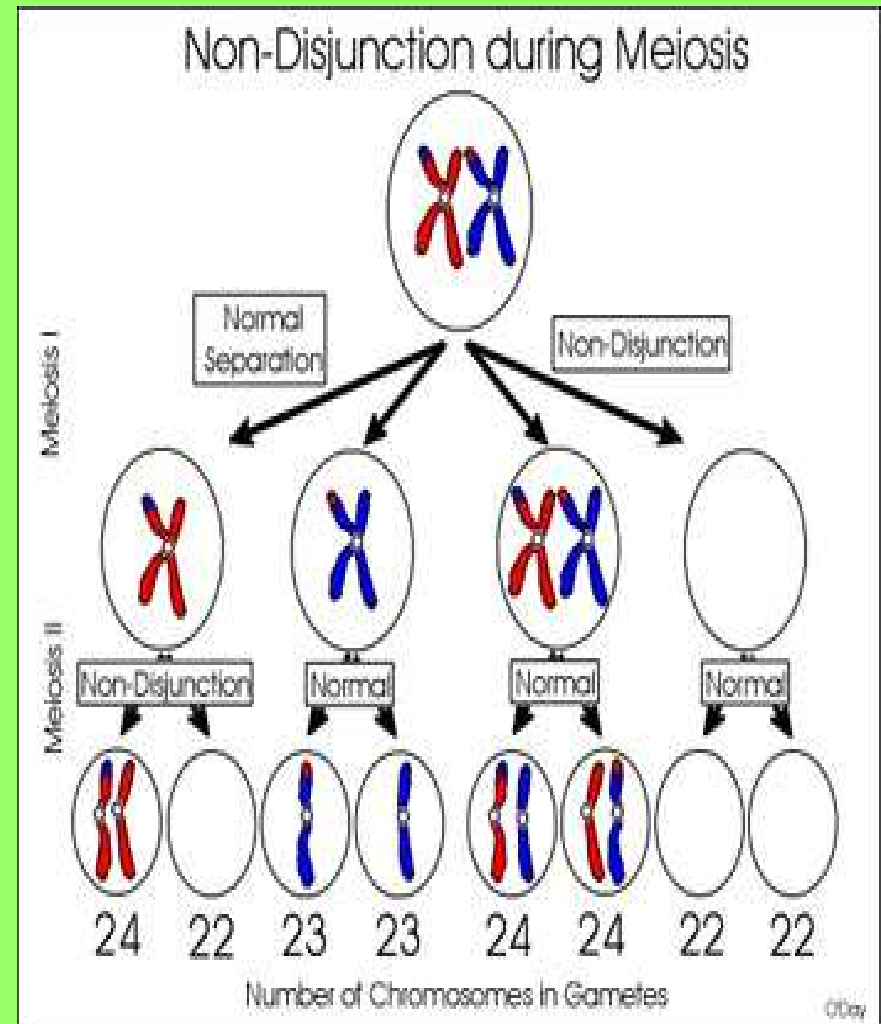


- Homologous chromosomes exchange parts of their DNA
- Creates variation in gametes



# Nondisjunction

- Homologous chromosomes fail to separate during meiosis
- Can lead to Down Syndrome, Turners Syndrome, and Klinefelters Syndrome



# Asexual vs. Sexual Reproduction

## Asexual

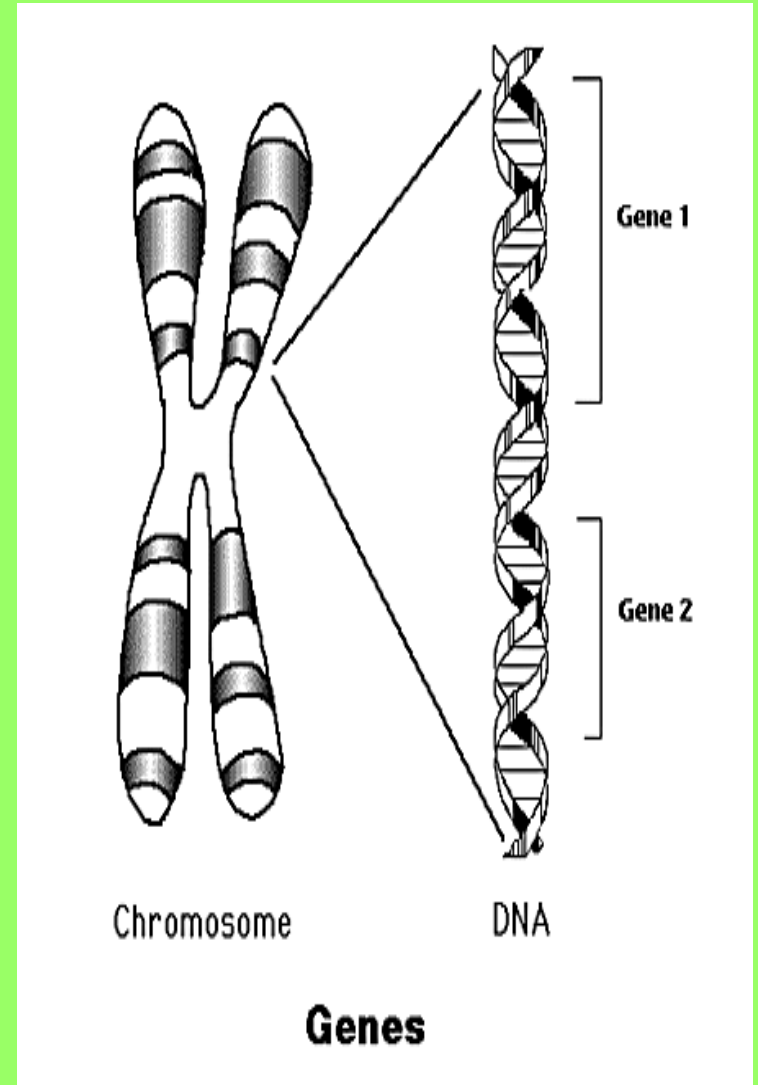
- One parent
- Identical offspring
- Variation only thru mutations
- Examples: budding, fragmentation, fission

## Sexual

- Two parents
- Offspring different from parents
- More variation
- Fertilization (fusion of gametes)

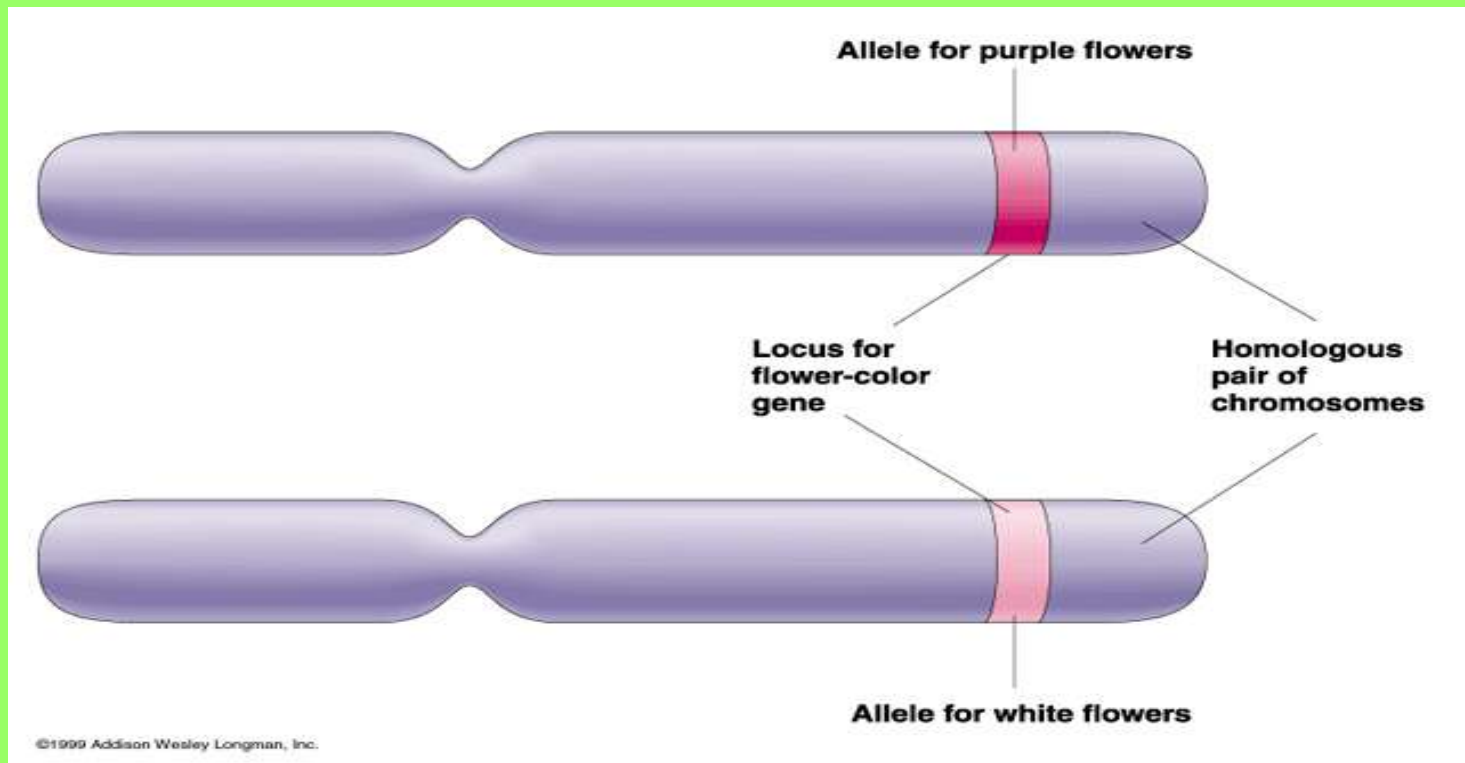
# Inheritance

- Traits are specific characteristics inherited from parents
- Genes are the factors that determine traits
- The different forms of a gene are called alleles



# Dominant/Recessive Alleles

- Dominant alleles are expressed, if present, and recessive are hidden



# Genotype





actual alleles an individual has for a trait

## Homozygous

- Both alleles are the same
- Ex. BB or bb

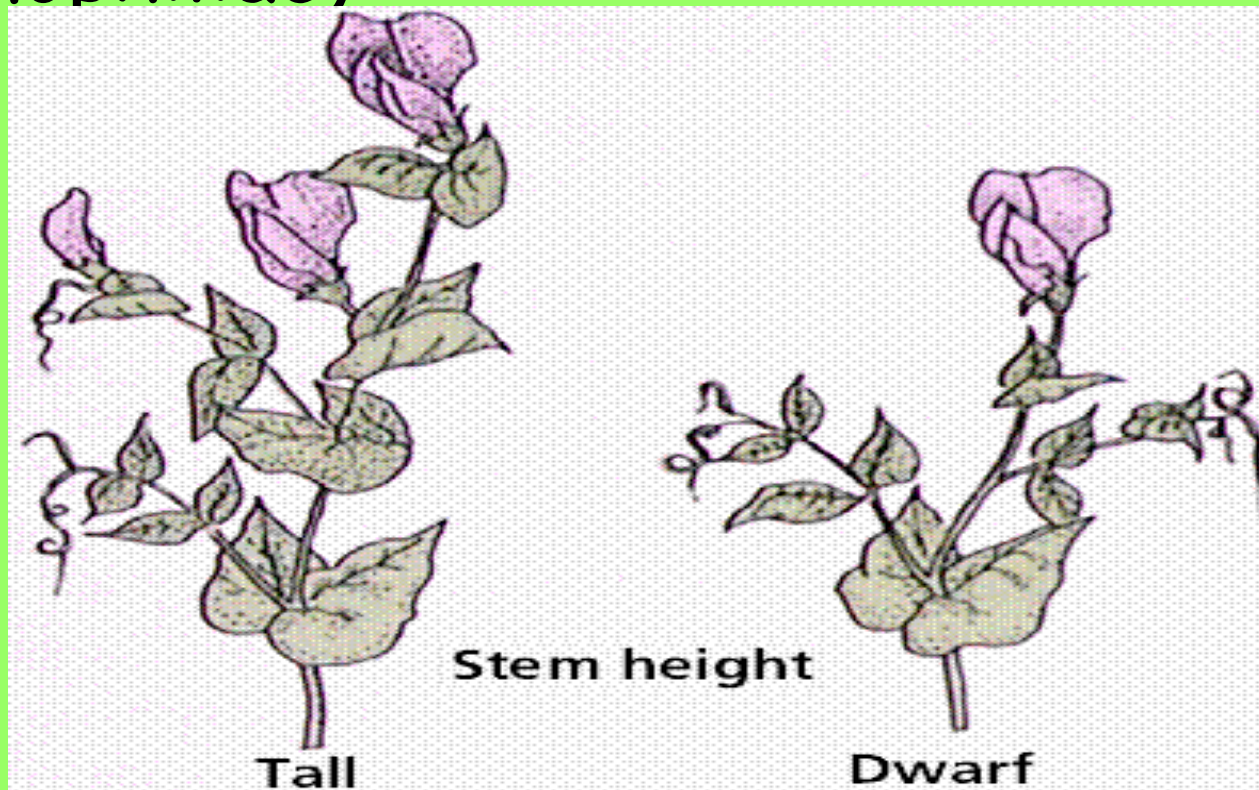
## Heterozygous

- Both alleles are different
- Ex. Bb

		pollen ♂	
		B	b
pistil ♀	B	 BB	 Bb
	b	 Bb	 bb

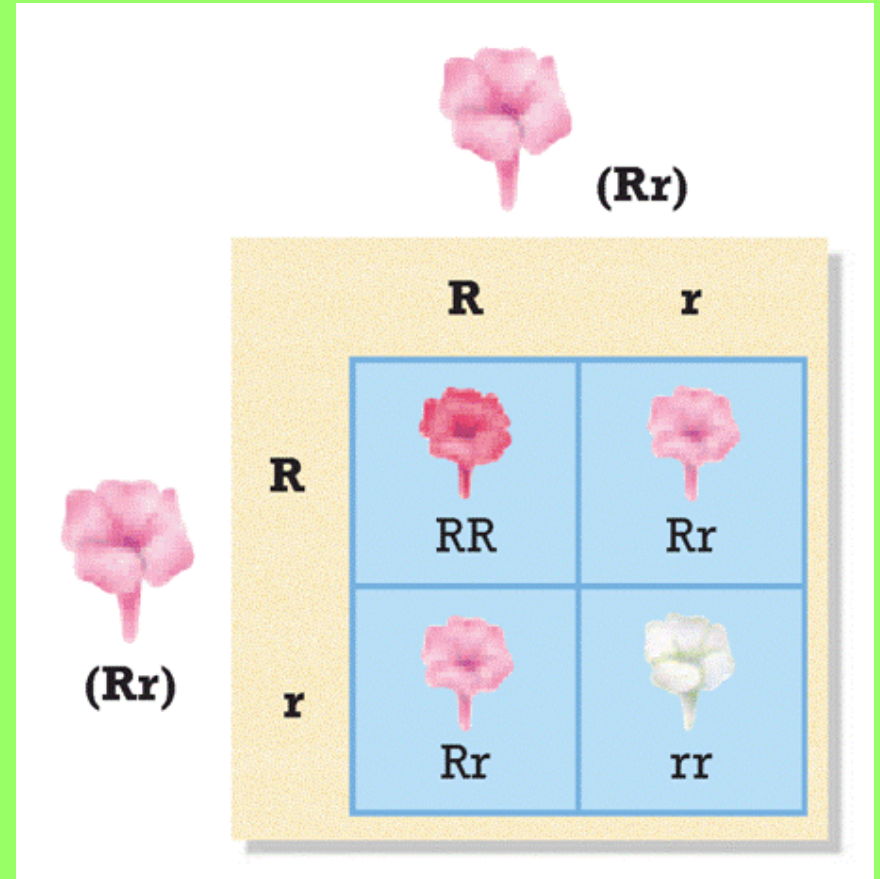
# Phenotype

- The actual characteristic displayed by the individual (ex. brown eyes, Hemophiliac)



# Incomplete Dominance

- Heterozygote shows a blending of the dominant and recessive phenotypes



# Codominance

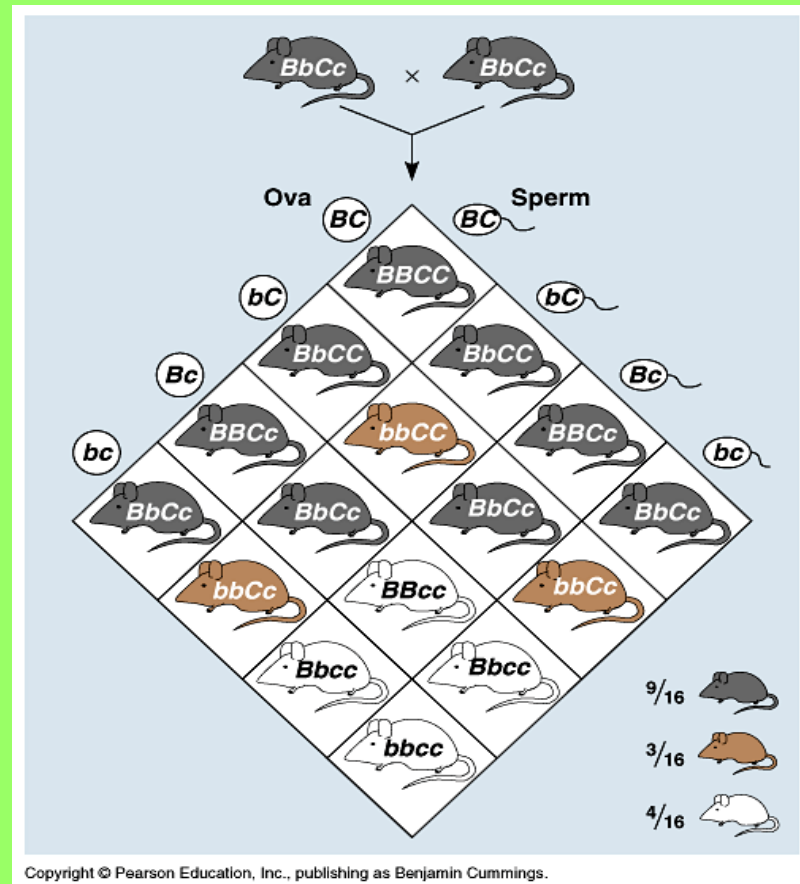
- Heterozygote expresses BOTH dominant and recessive traits
- Ex. Roan animals





# Polygenic Traits

- Traits are influenced by more than one gene
- Ex. skin color



# Multiple Alleles

- More than two alleles for a trait (an individual still only inherits two)
- Ex. Blood Type ( $I^A, I^B, i$ )

type A =  $I^A I^A$  or  $I^A i$

type B =  $I^B I^B$  or  $I^B i$

type AB =  $I^A I^B$

type O =  $ii$

# Sex Linked Traits

- Sex Chromosomes
  - Female = XX
  - Male = XY
- Sex linked traits are carried on the X chromosome
- Ex. Hemophilia, red-green colorblindness

	$X^B$	$X^b$
$X^B$	$X^B X^B$	$X^B X^b$
Y	$X^B Y$	$X^b Y$

1/2 of the females will be carriers

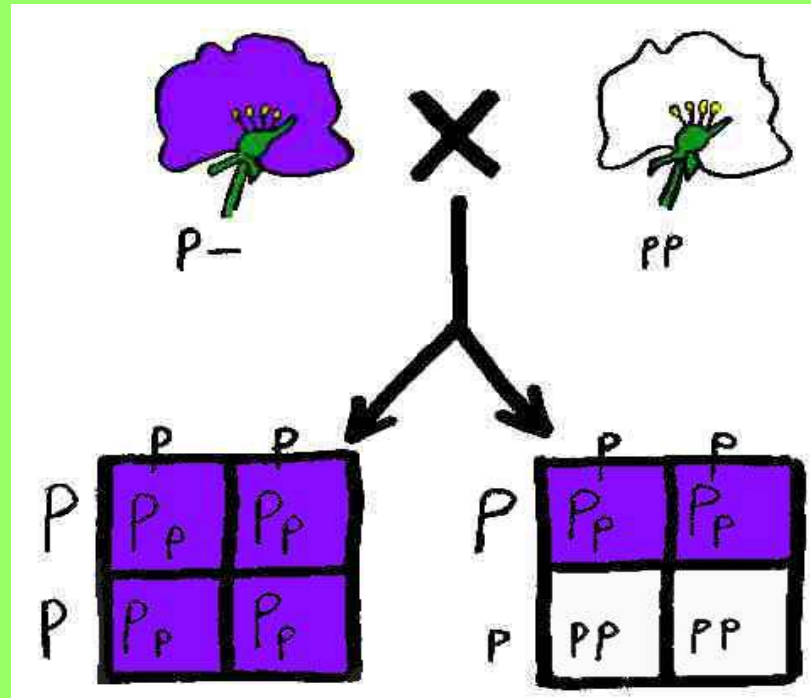
1/2 of the females will be normal

1/2 of the males will be normal

1/2 of the males will be colorblind

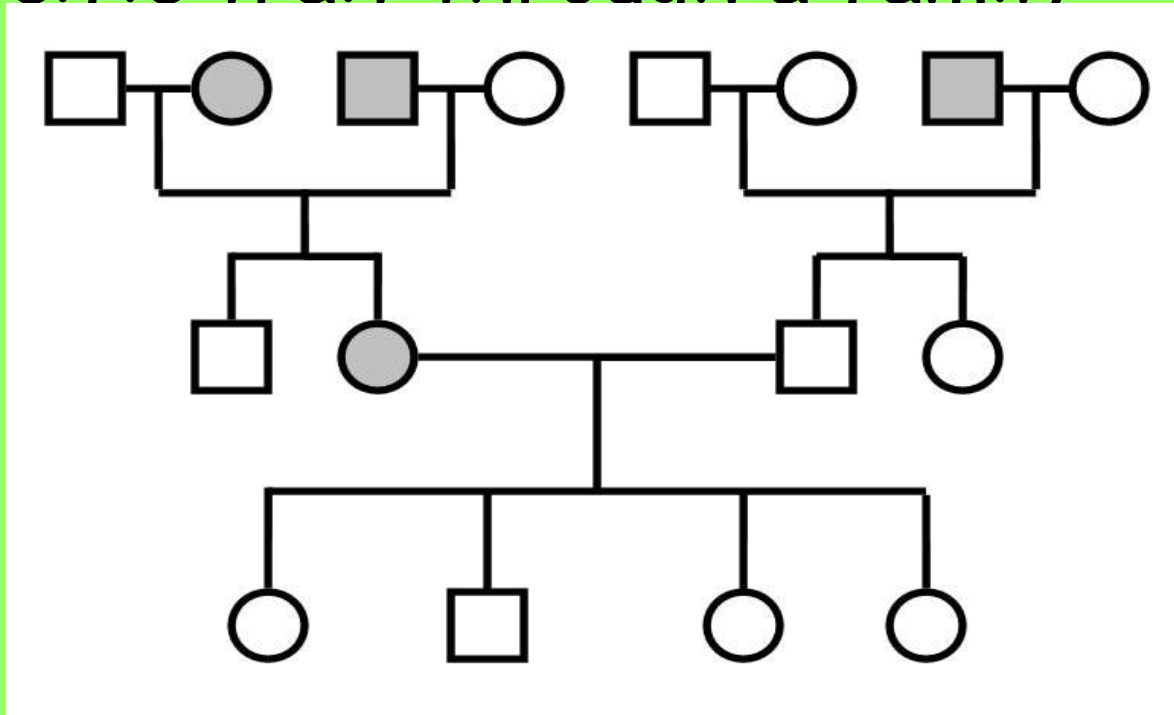
# Test Cross

- used to determine the phenotype of an unknown dominant individual
- uses a homozygous recessive individual as the "test"



# Pedigree

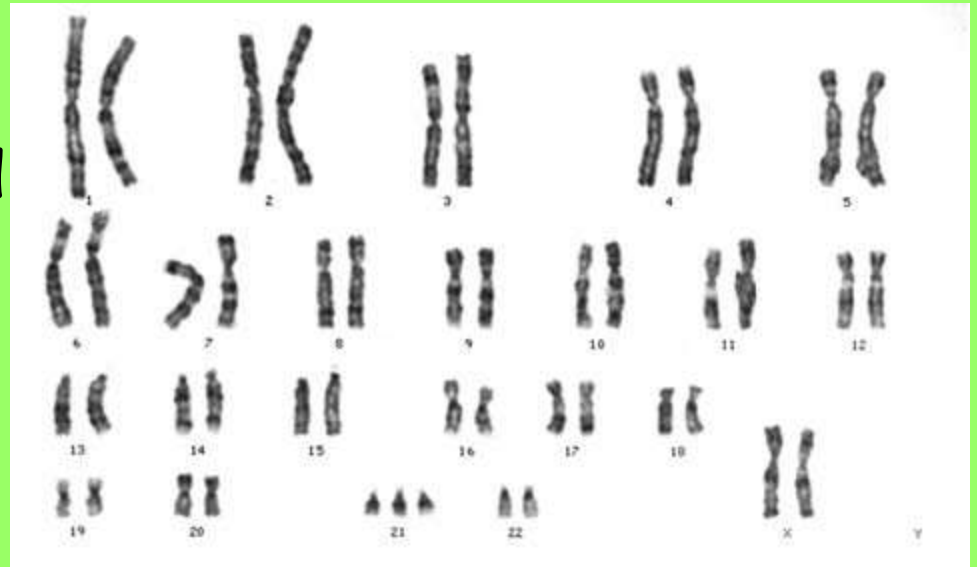
- similar to a family tree
- Shows pattern of inheritance of a specific trait through a family



# Karyotype

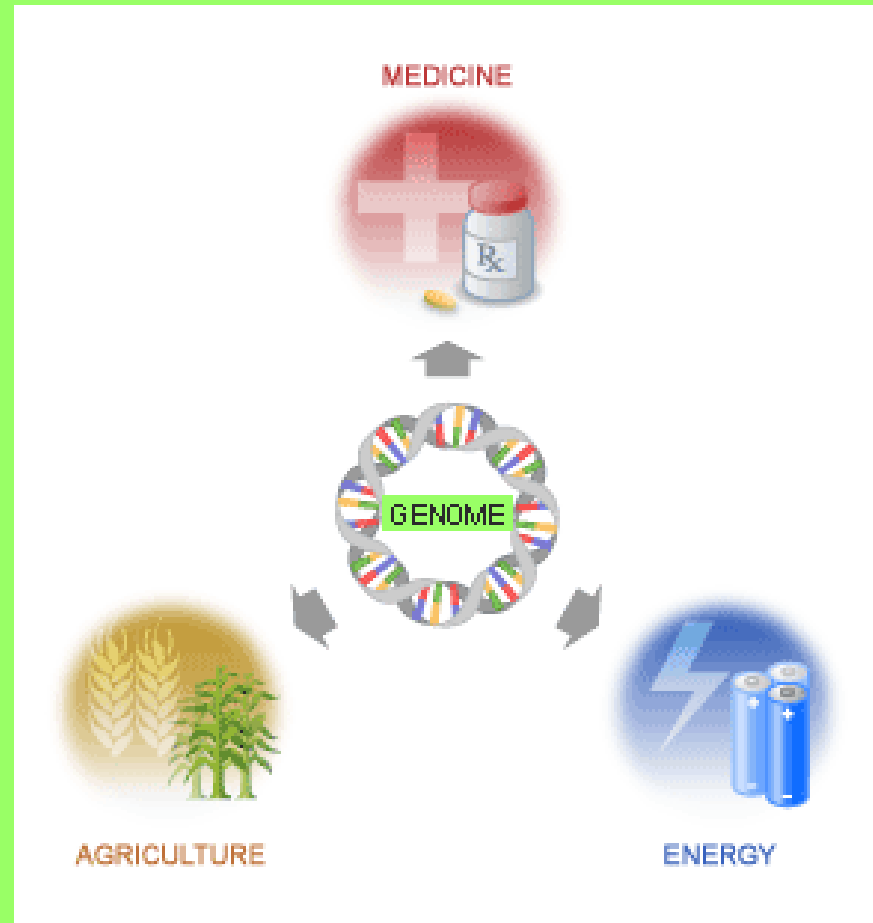
- Picture of someone's chromosomes
- Can detect chromosomal disorders

Ex. Down Syndrome,  
Klinefelter's Syndrome, and  
Turners Syndrome



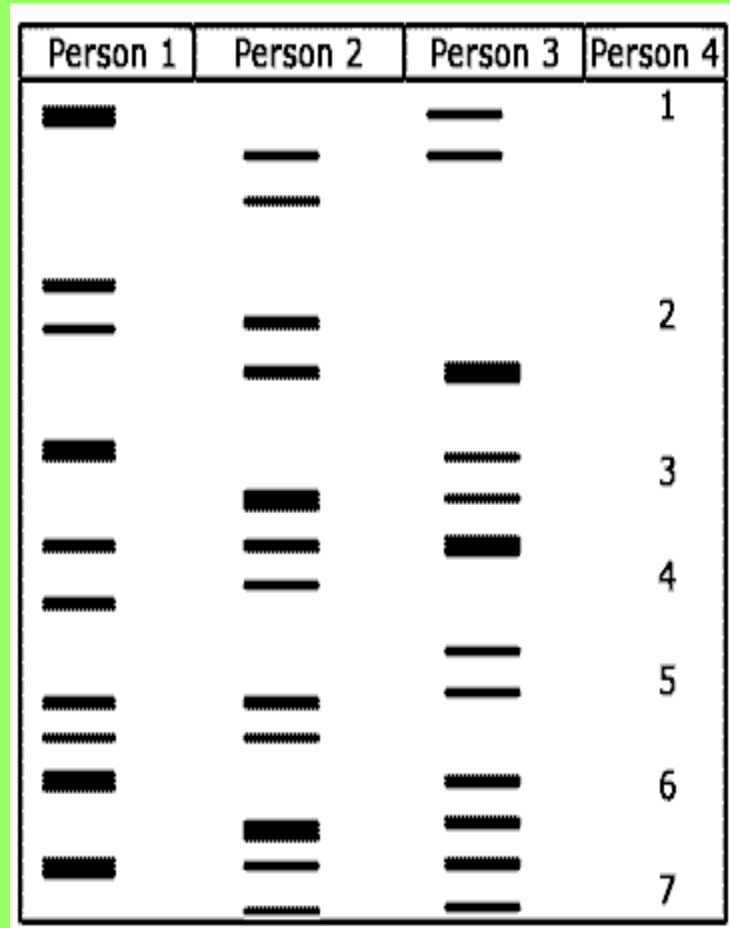
# Human Genome Project

- Sequencing of human DNA
- Being used to develop gene therapies



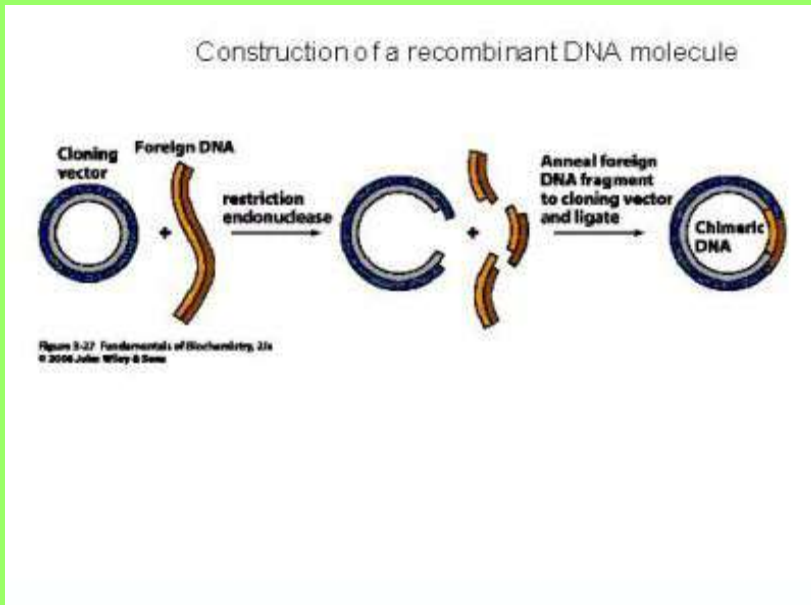
# Gel Electrophoresis

- Technique used to separate molecules (DNA or proteins) based on their size
- Sometimes called a DNA fingerprint
- Used to analyze and compare DNA





# Recombinant DNA



- Cell with DNA from another source
- Bacteria used to produce human insulin
- Human gene inserted into bacterial plasmid

# Transgenic Organism

- An organism with a gene from another source
- used to improve food supply, research, and healthcare



# Clone

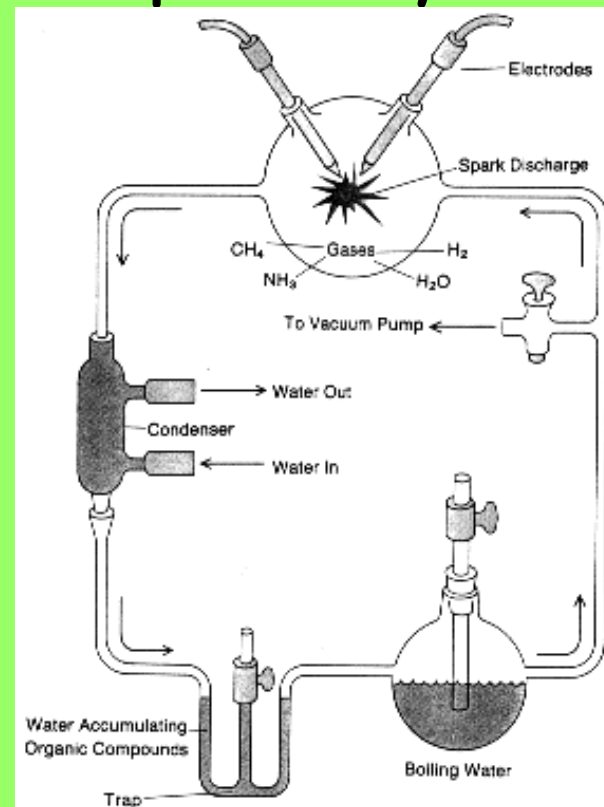
- An organism made from one cell of another organism
- A genetically identical copy



# Origin of Life

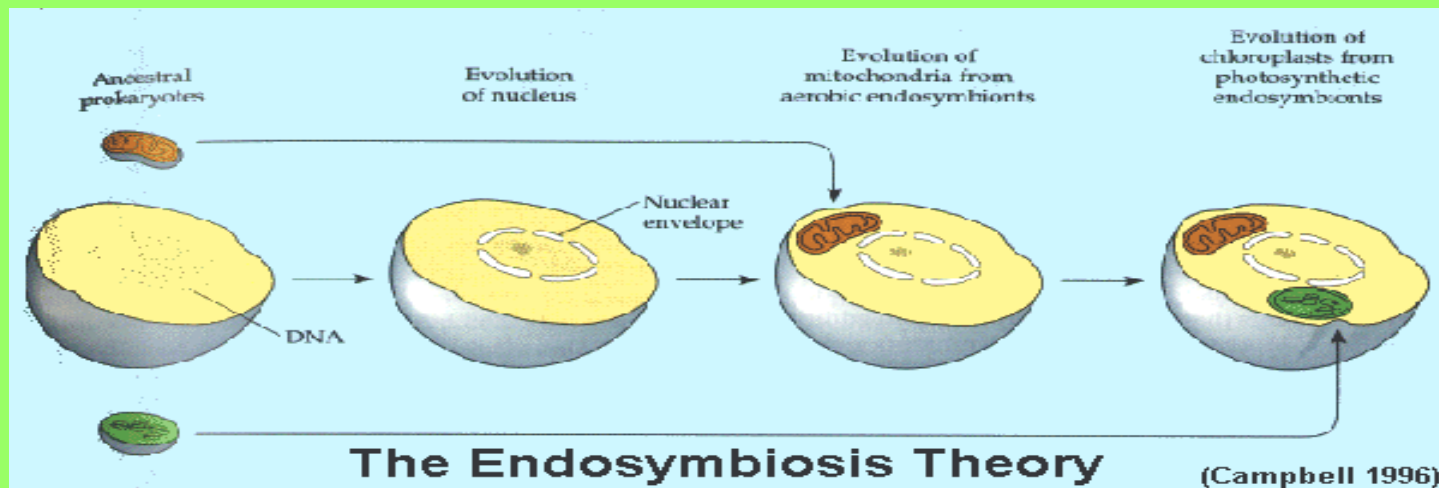
- Abiotic earth **LACKED** Oxygen
- Early organisms anaerobic prokaryotes

Miller and Urey  
Experiment recreating  
The abiotic atmosphere



# Endosymbiotic Theory

- Eukaryotic cells evolved from prokaryotes
- Early prokaryotes engulfed other prokaryotes and developed symbiotic relationships
- Evidence includes mitochondria and chloroplast have prokaryotic type DNA





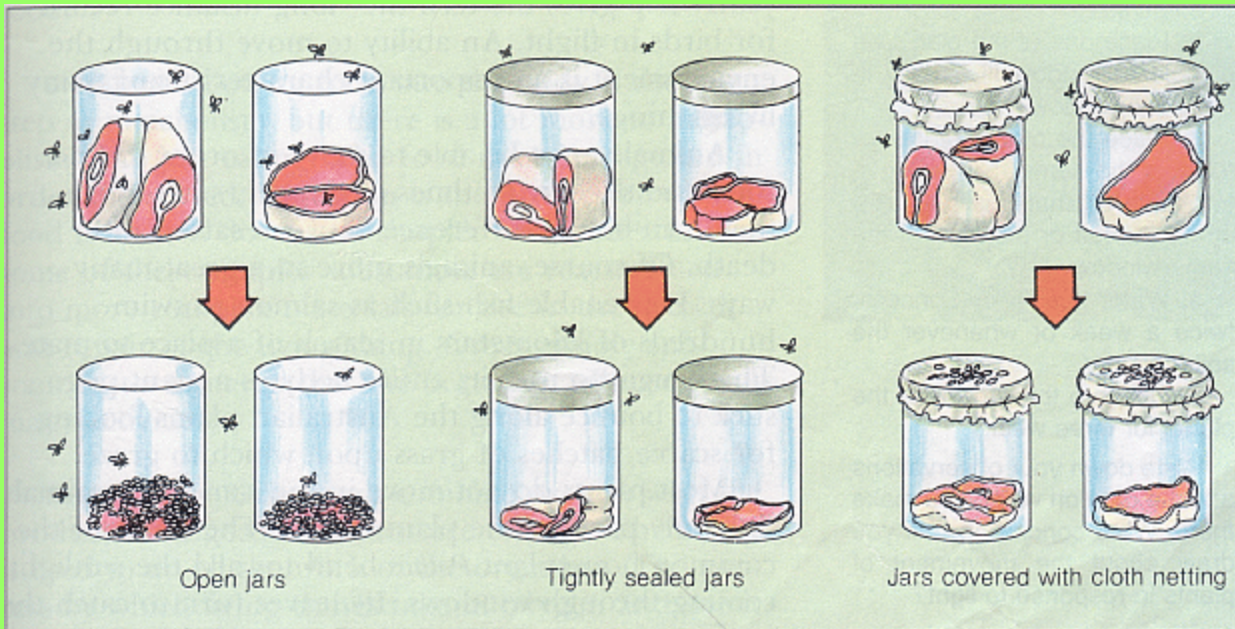
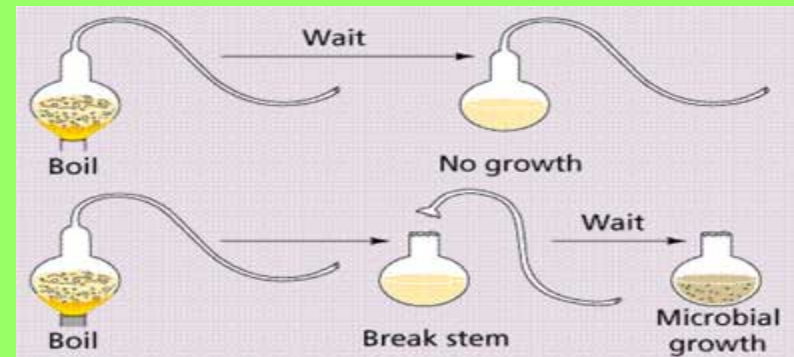
# Abiogenesis

Living from non-living or spontaneous generation

Disproved by Redi and Pasteur's experiments

# Biogenesis

Living from Living



# Natural Selection

- Theory of Evolution
- Fit organisms survive, reproduce, and pass on traits

Requirements:

- Variation
- Competition



LIGHT FORM  
OF THE PEPPERED MOTH



DARK FORM  
OF THE PEPPERED MOTH

298

The Evolution Connection

# Adaptations

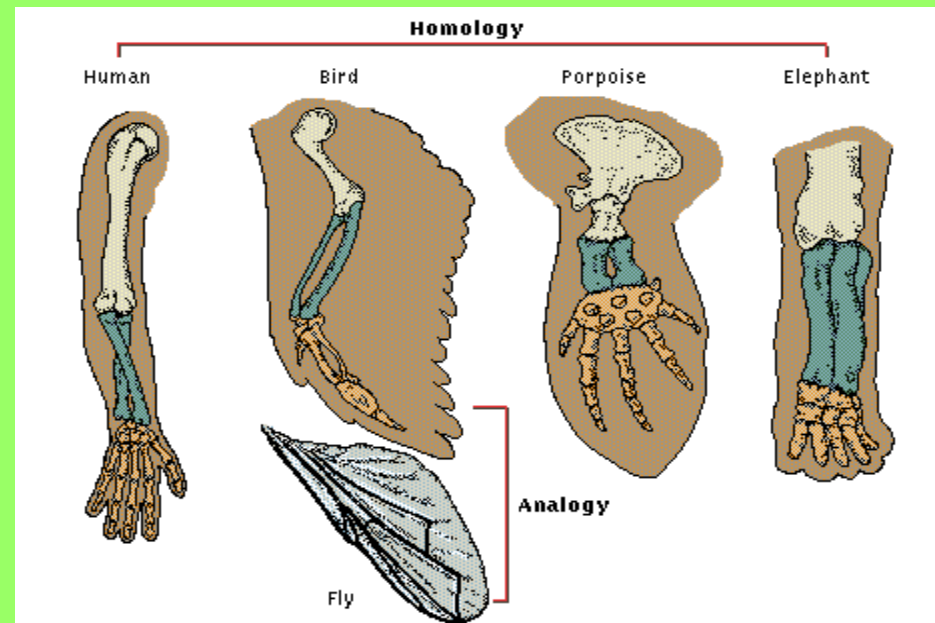
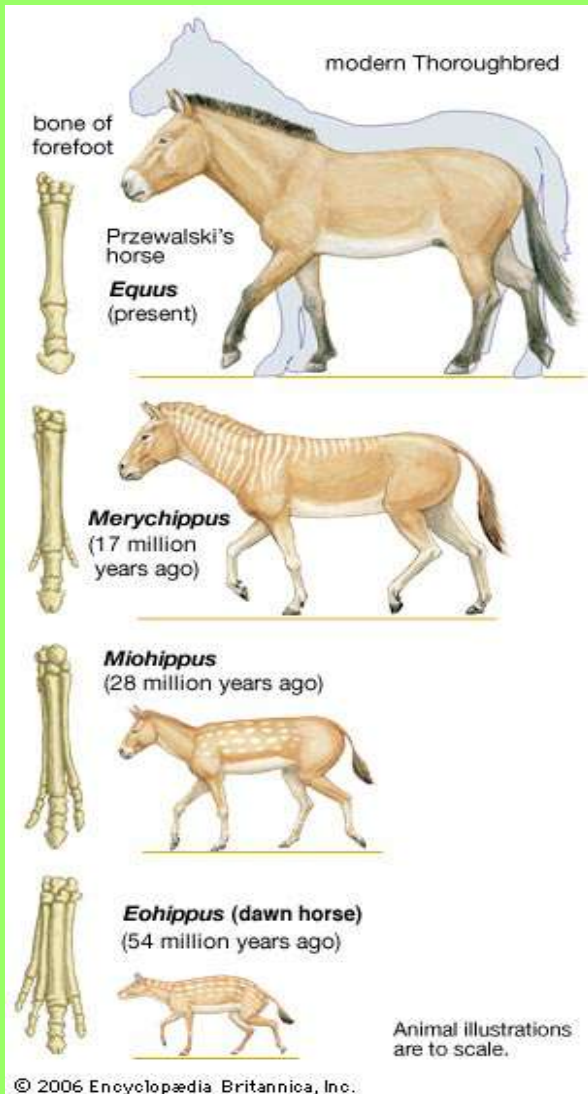


- Trait that increases survival
- For Example,
  - Beaks that make it easier to eat insects
  - Bright flowers to attract pollinators
  - Vascular tissue in plants to adapt to life on land



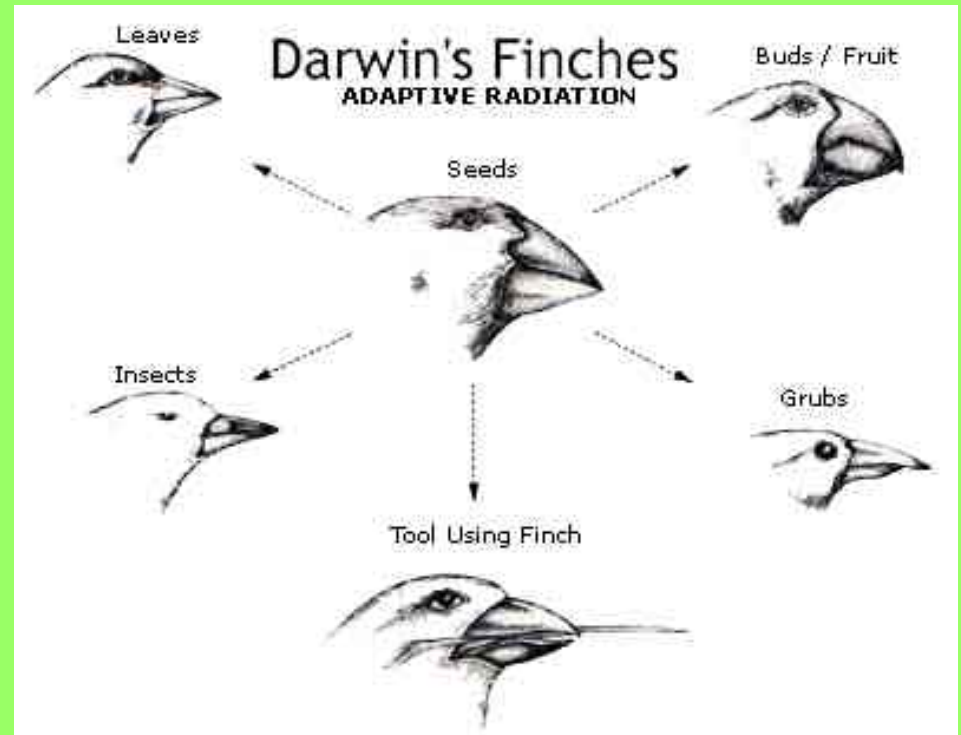
# Evidence for Evolution

- Fossil Record
- Biochemical Similarities
- Shared anatomical structures



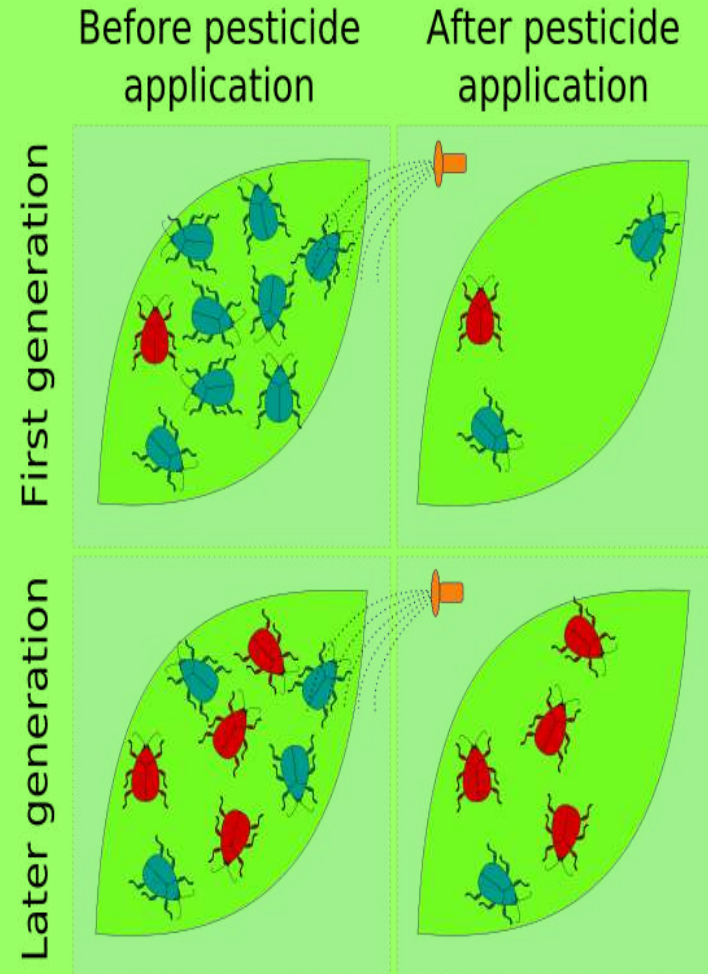
# Speciation

- Evolution of a new species
- must be isolation between populations



# Antibiotic and Pesticide Resistance

- Populations will eventually become resistant to pesticides and antibiotics with overuse



# Coevolution

- Two organisms evolve in response to each other

Ex. Flowering plants and their pollinators



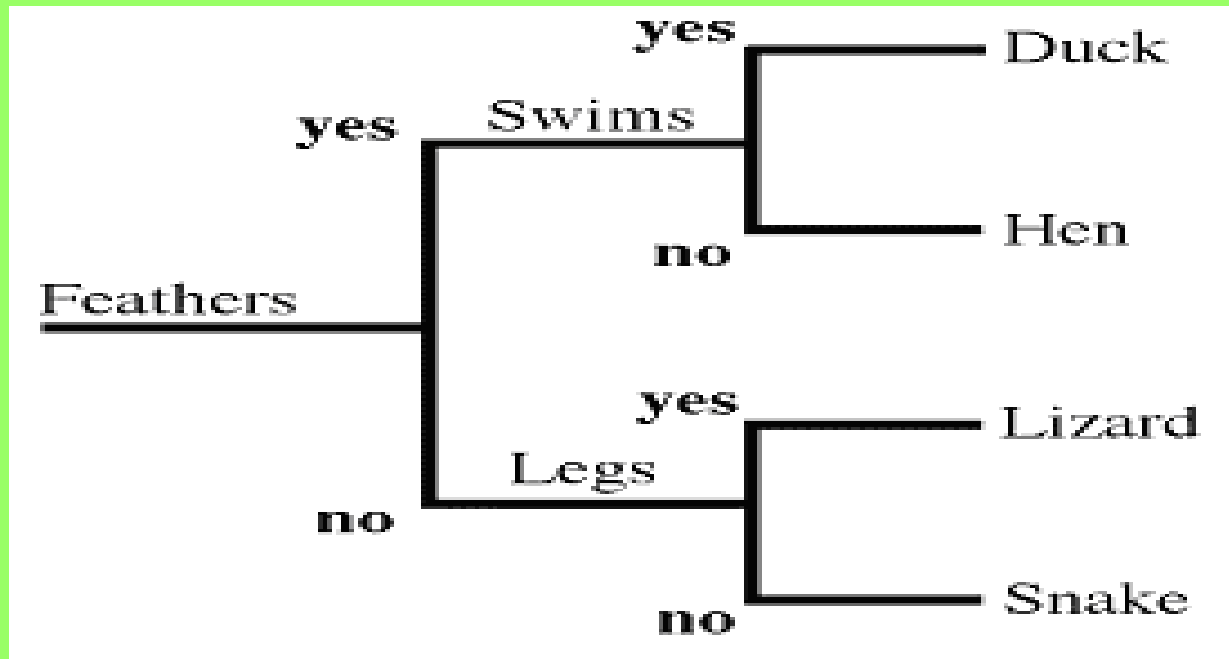
# Binomial Nomenclature

- Two word naming system
- Scientific name
- Uses *Genus* and *Species* names
- Ex. Dogs: *Canis familiaris*

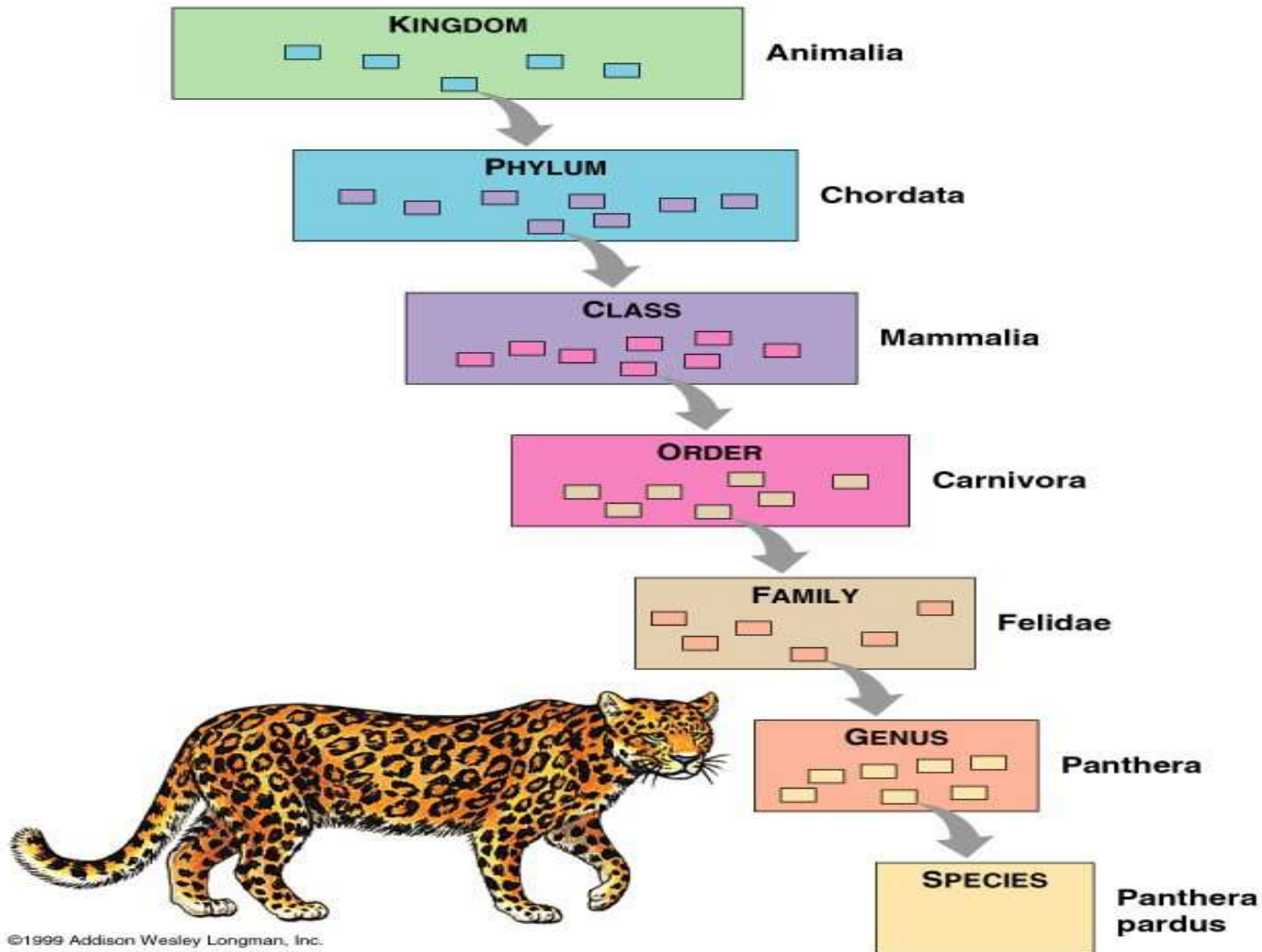


# Dichotomous Keys

- Used to identify organisms
- Paired set of questions with two choices

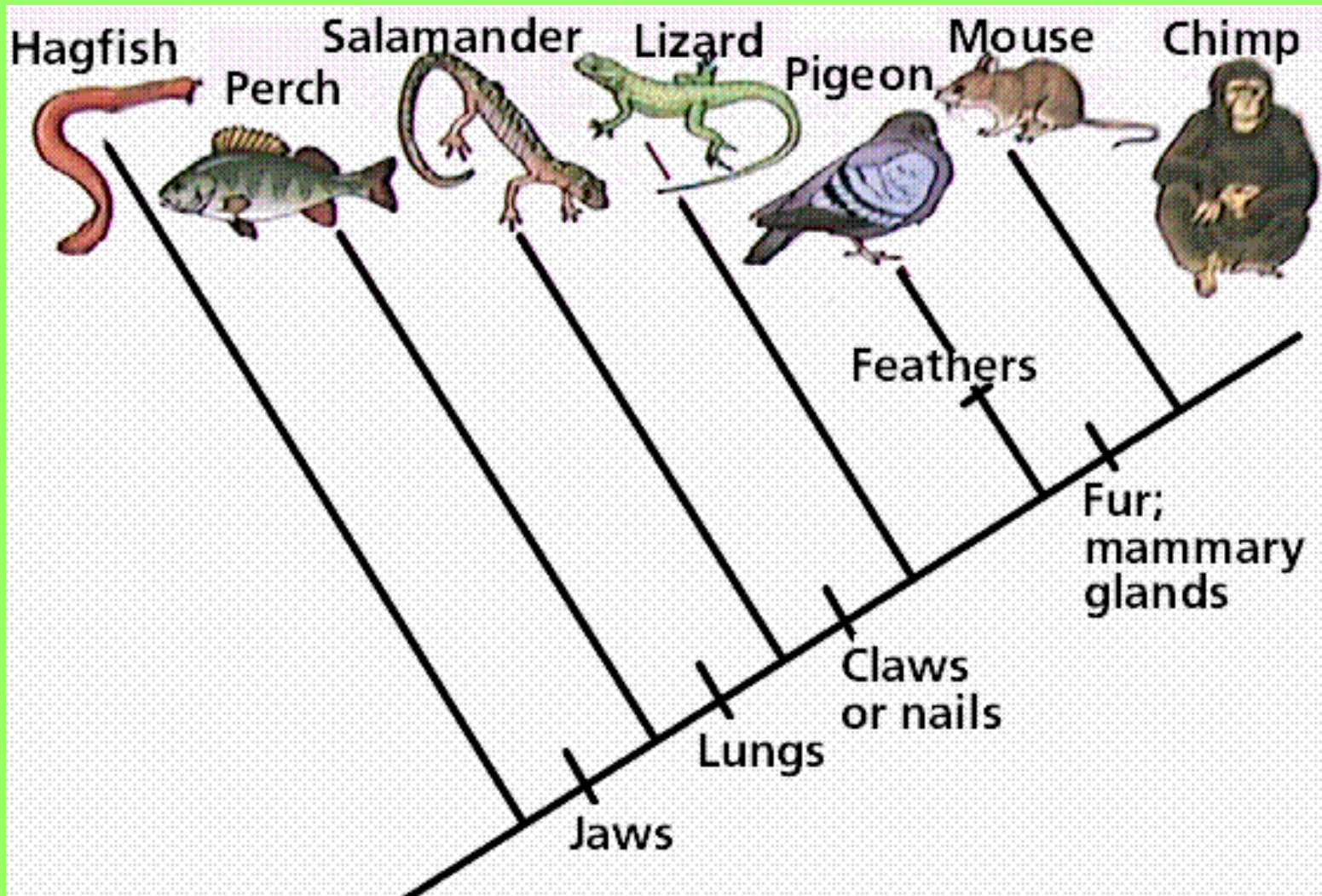


# Levels of Organization





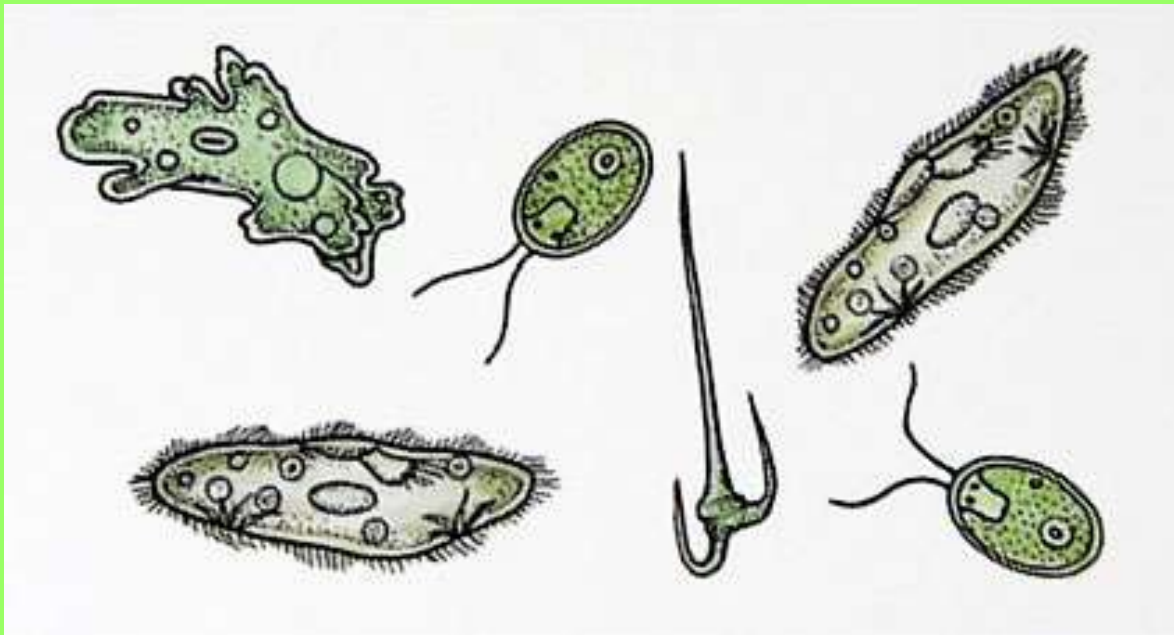
# Phylogenetic tree





# Protists

- Unicellular Eukaryotes
- Can be autotrophic or heterotrophic
- Reproduce mostly asexually



# Fungi

- Multicellular eukaryotes (yeast are the only unicellular fungi)
- Heterotrophs
- Reproduce asexually and sexually



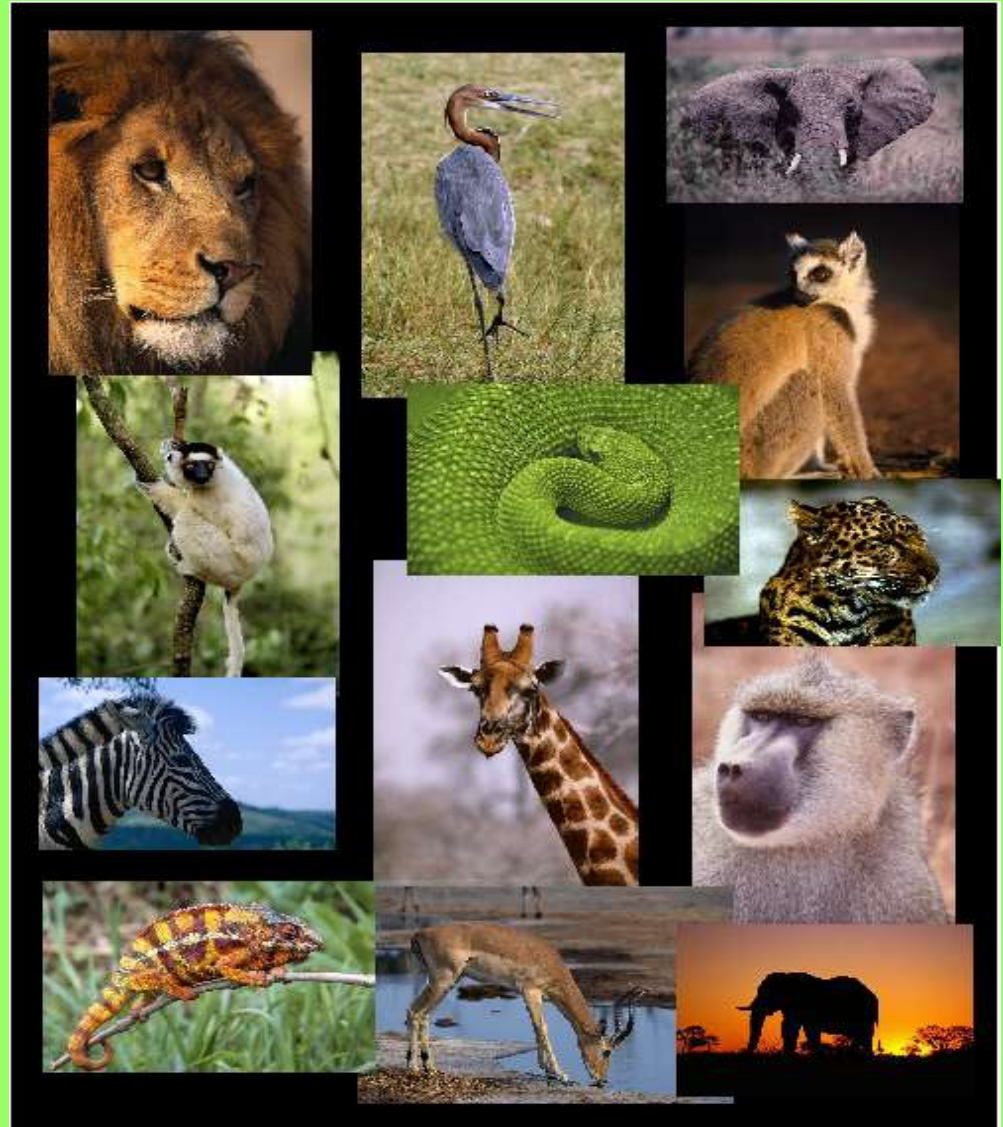
# Plants

- Multicellular eukaryotes
- Autotrophs
- Reproduce sexually and asexually



# Animals

- Multicellular eukaryotes
- Heterotrophs
- Reproduce sexually and asexually





# Non Vascular Plants

- Also called Bryophytes
- No true roots or vascular tissue causing them to be small in size
- Must live in moist environments
- Reproduce with spores



Ex. Mosses, liverworts

# Gymnosperms

- Non-flowering vascular plants
- Reproduce with cones that contain seeds
- Ex. Conifers (pine trees)



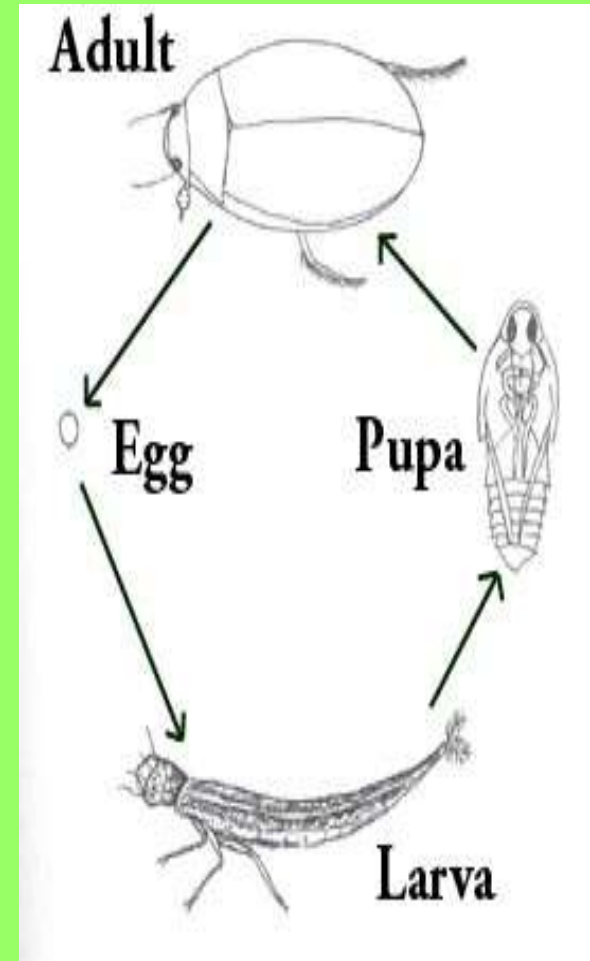
# Angiosperms

- Flowering vascular plants
- Flower is main reproductive organ
- Seeds are enclosed within a fruit
- Ex. Deciduous plants



# Insects

- Transport through open circulatory system
- Exchange gases through spiracles and tracheal tubes
- Most reproduce sexually with internal fertilization
- Develop through metamorphosis





# Annelids (segmented worms)

- Transport through closed circulatory system
- Exchange gases through moist skin
- Reproduce asexually and sexually with internal fertilization



# Amphibians

- Transport through a closed circulatory system involving a three chambered heart
- Gas exchange in young with gills, adults lungs and moist skin
- Reproduce sexually with external fertilization
- Develop through metamorphosis

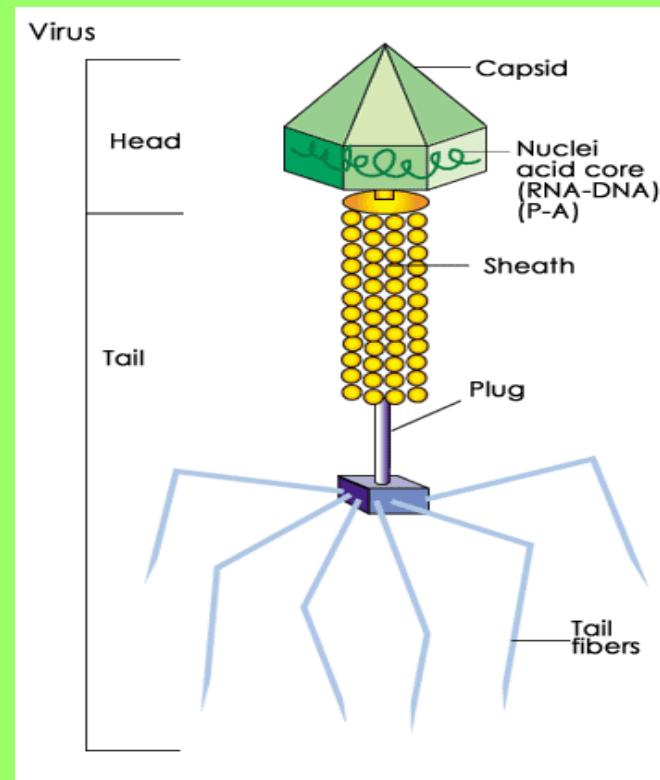


# Mammals

- Transport through closed circulatory system involving a four chambered heart
- Gas exchange through lungs
- Reproduce sexually with internal fertilization
- Young develop in a uterus and exchange nutrients and oxygen through the placenta (placental mammals)

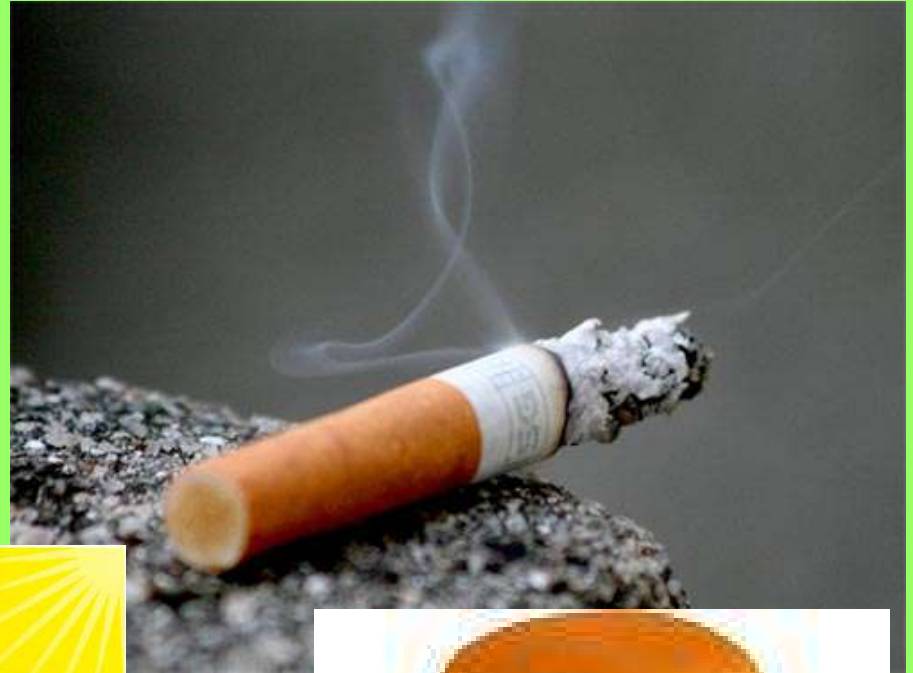
# Viruses

- Not considered living things
- Pathogens that can mutate to resist vaccines
- Ex. HIV, Influenza, Smallpox



# Genetic Disorders and the Environment

- Many diseases have both genetic and environmental factors
- Ex. Cancer, diabetes, PKU



# Immune Response

## B-cells

Fight antigens in body fluids

B-cells make antibodies

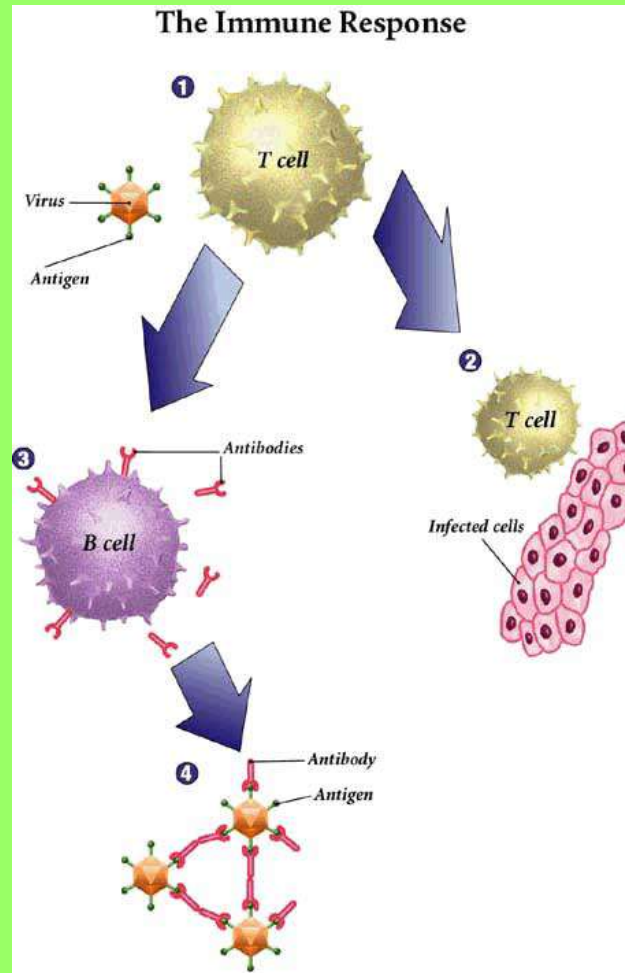
Make memory cells after exposure to antigen

## T-cells

Fight pathogens inside living cells

May help B-cells to make antibodies

Make memory cells after exposure to pathogen



# Immunity

## Passive Immunity

Antibodies are introduced into the body

Short term

Such as mother transfers antibodies to infant through breast feeding

## Active Immunity

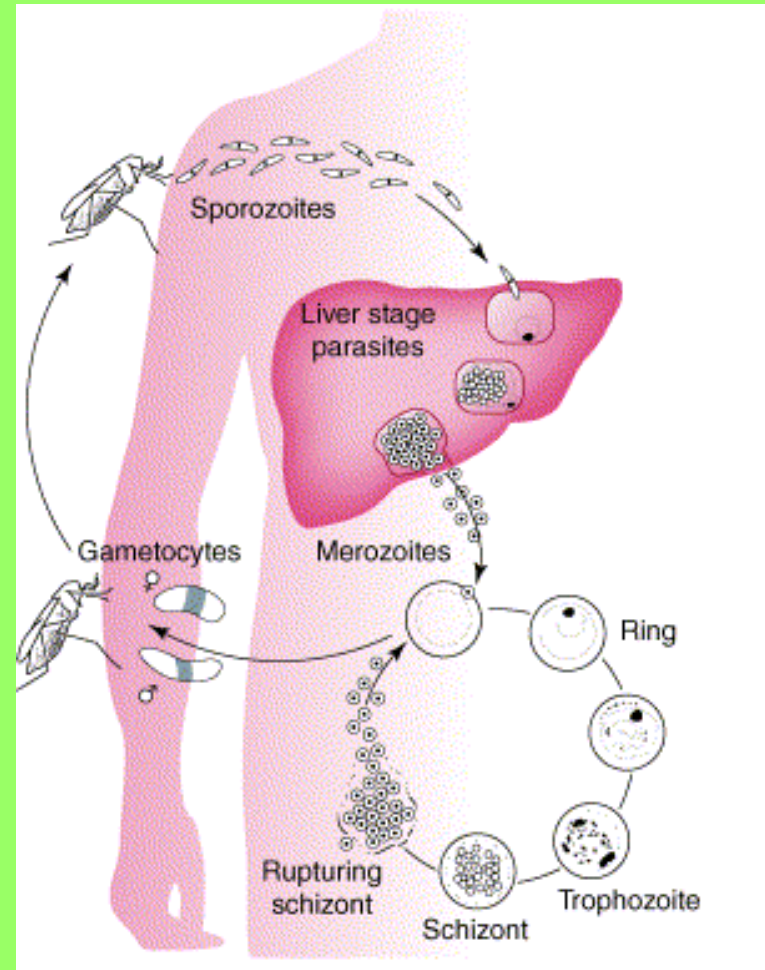
Antibodies are acquired when an immune response is activated in the body

Long term

Ex. Vaccines are weak/dead antigens that are introduced to the body

# Parasites

- Lives on or within a host
- Benefits while causing harm to the host
- Ex. Plasmodium causes malaria (genetic influence-carriers of sickle cell are resistant to malaria)





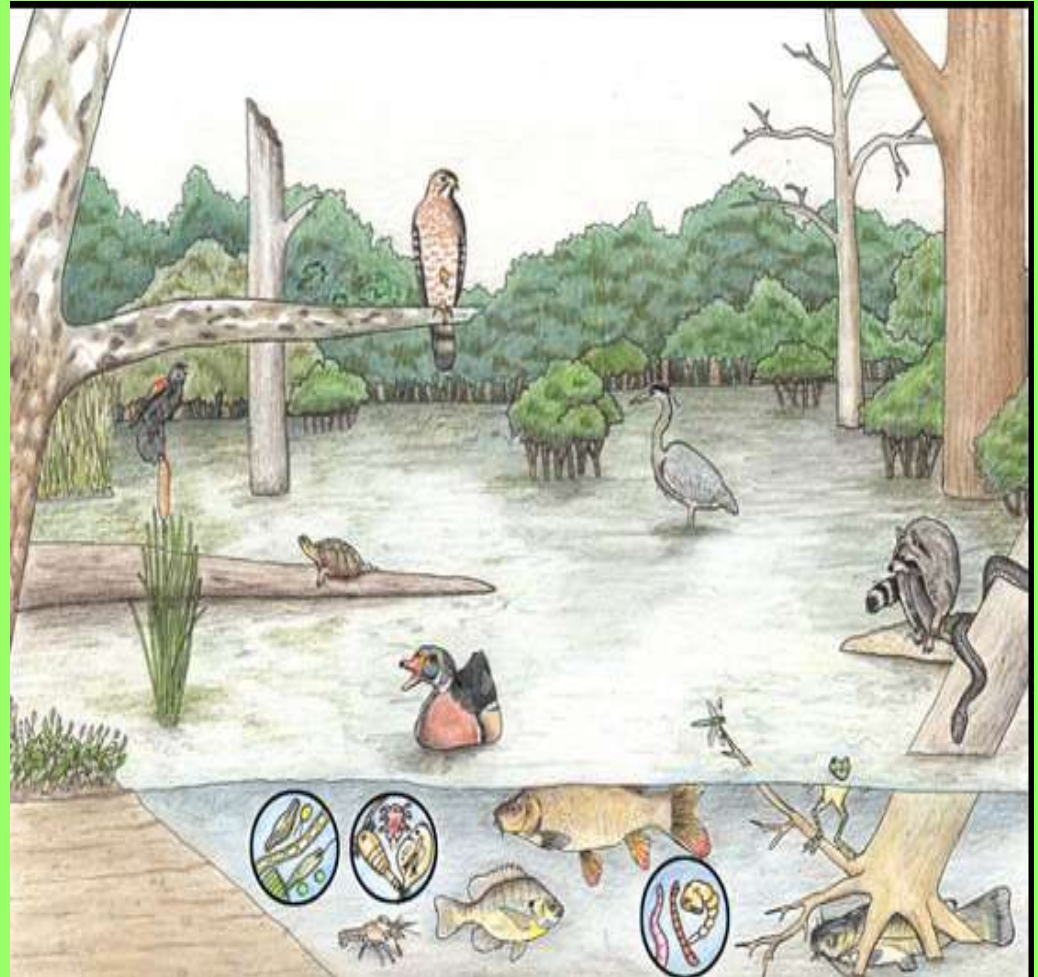
# Toxins

- Chemical that causes harm to the body
- Can be man-made or produced by microorganisms
- Ex. Mercury and Lead



# Ecosystems

- Collection of abiotic (nonliving) and biotic (living) factors in an area
- Together they influence growth, survival, and productivity of an organism



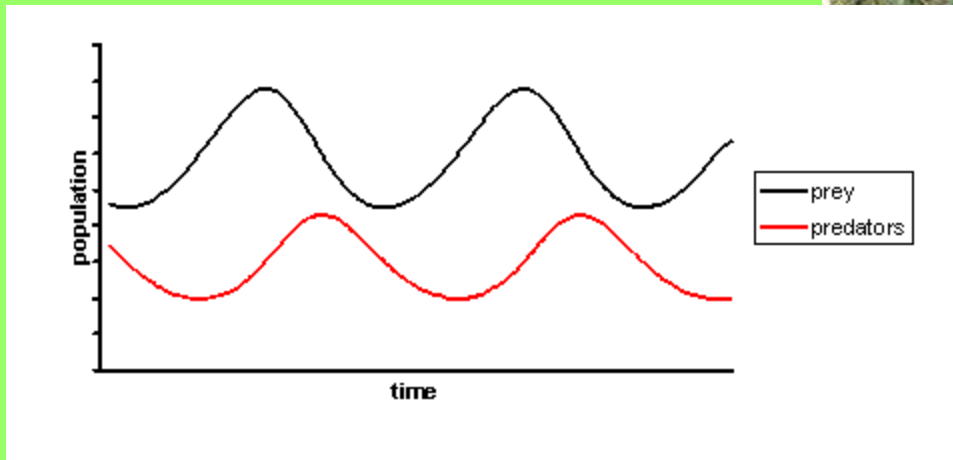
# Symbiotic Relationships

- Relationship between two organisms in which one benefits
- Types:
  - Mutualism (+,+)
  - Parasitism (+,-)
  - Commensalism (+, 0)



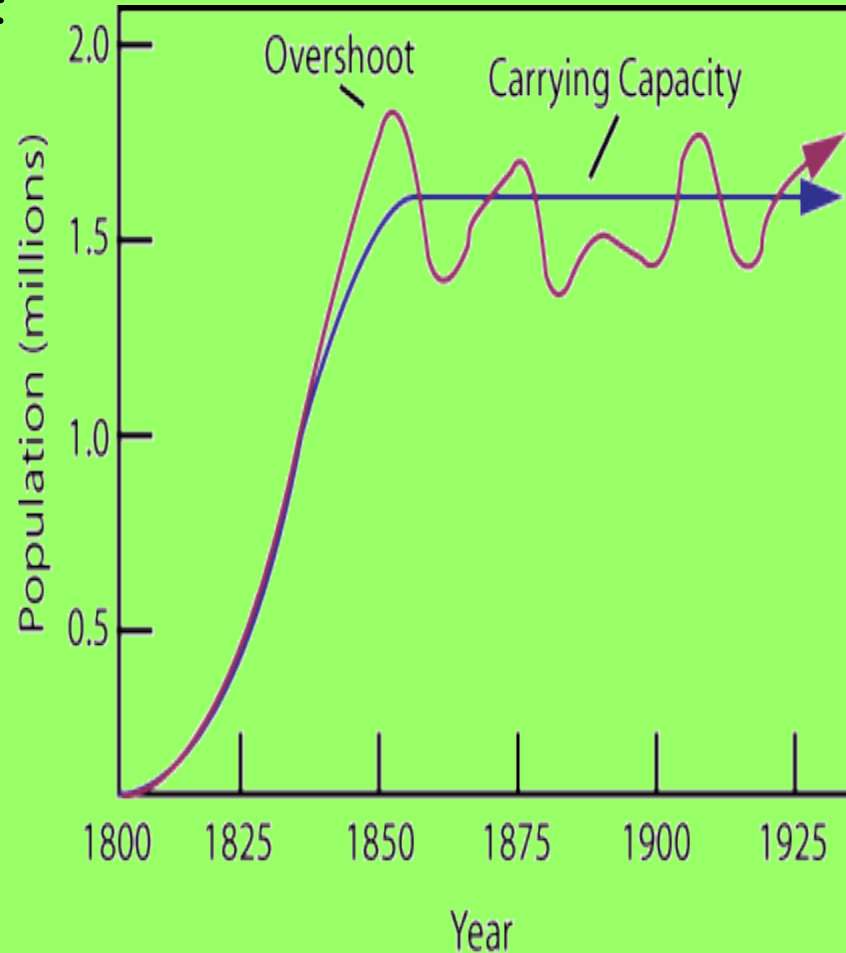
# Predation

- Predator eats prey
- Evolve in response to one another



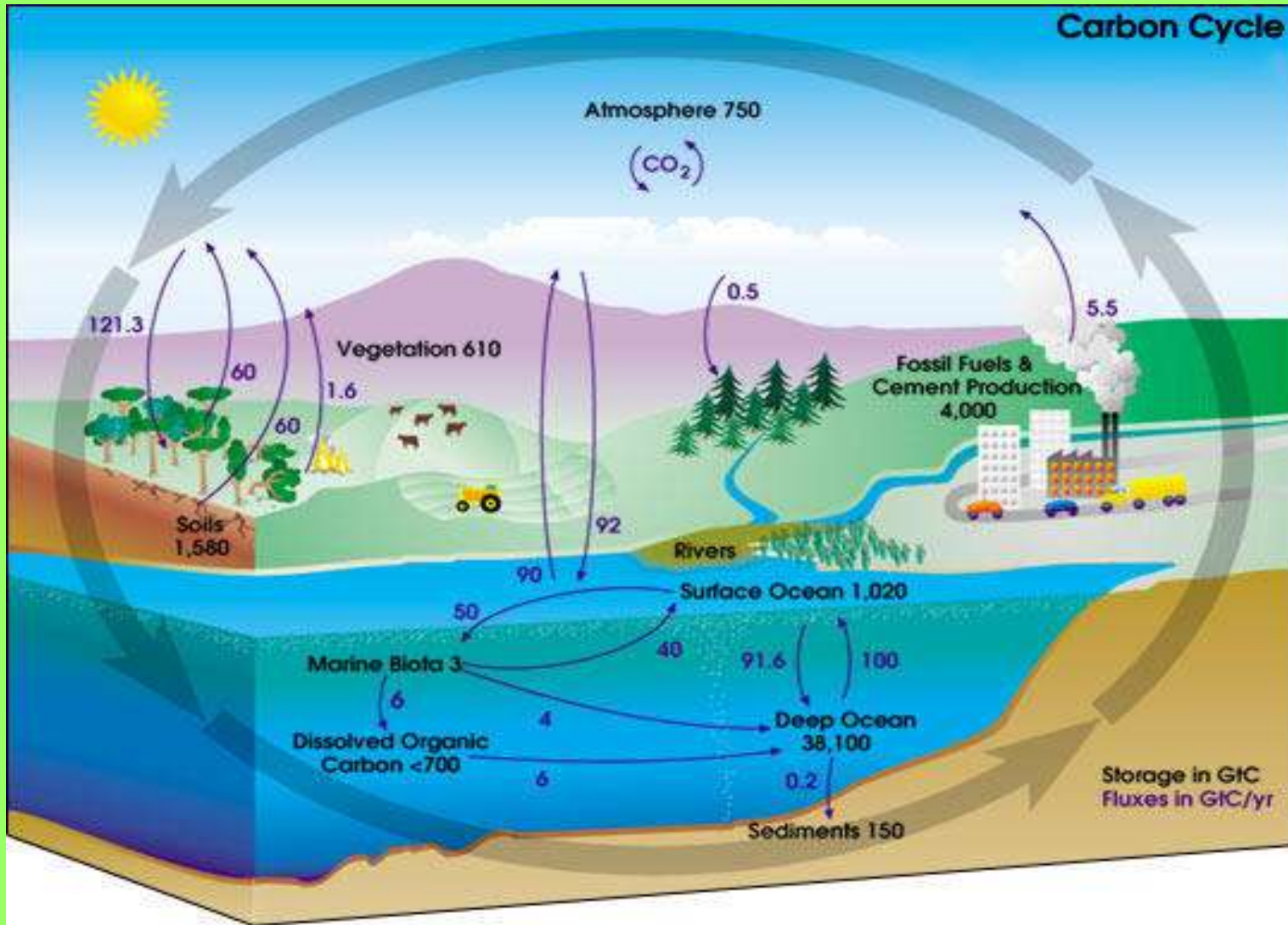
# Carrying Capacity

- Maximum number of individuals that an ecosystem can support
- Limiting factors:
  - Food availability
  - Competition
  - Disease
  - Predation
  - Natural Disasters



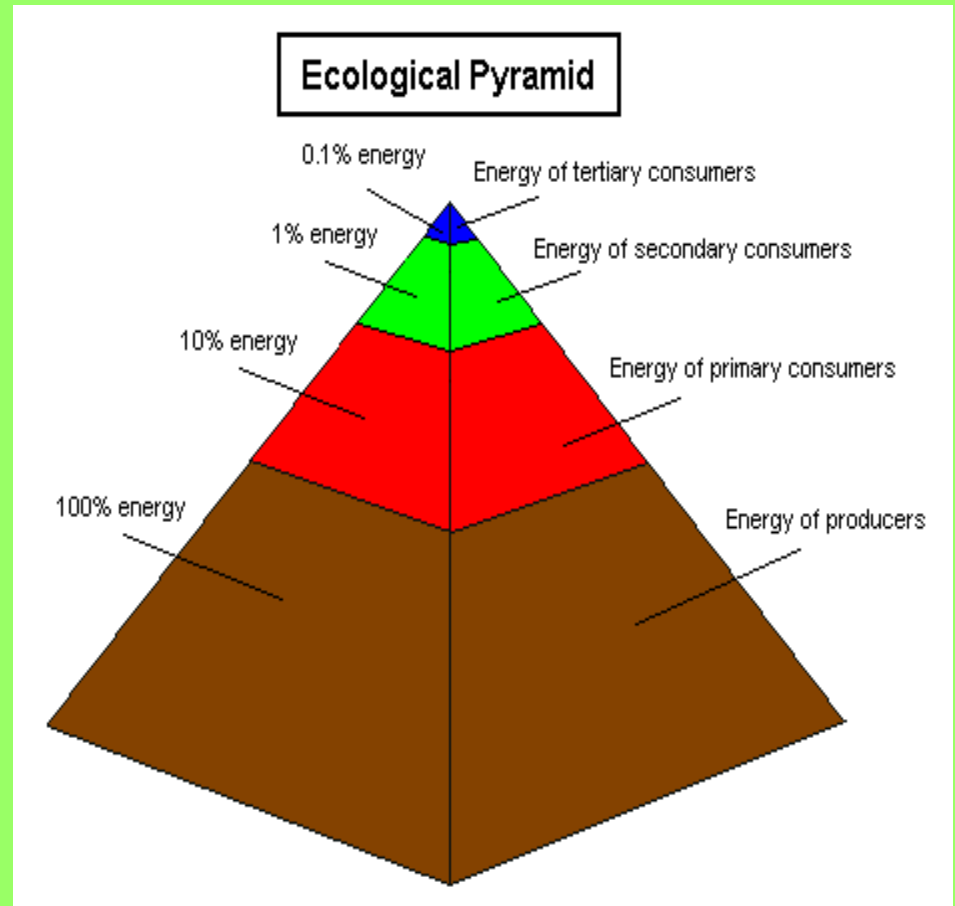


# Carbon Cycle



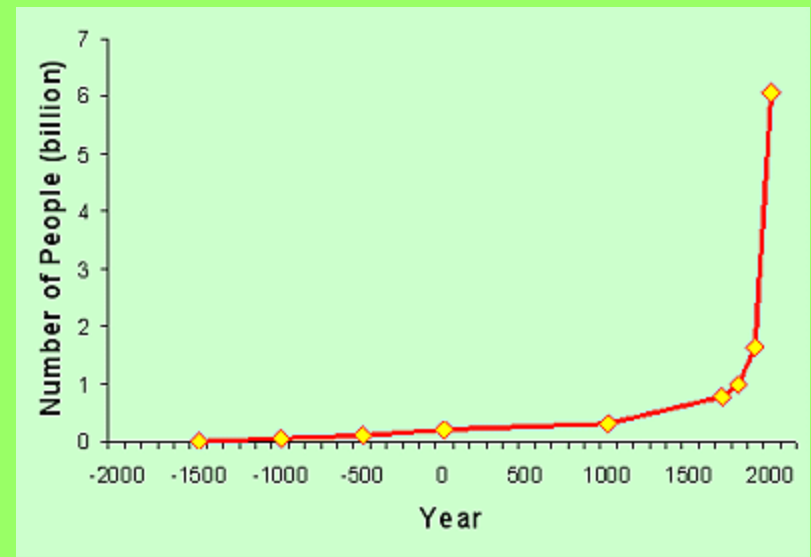
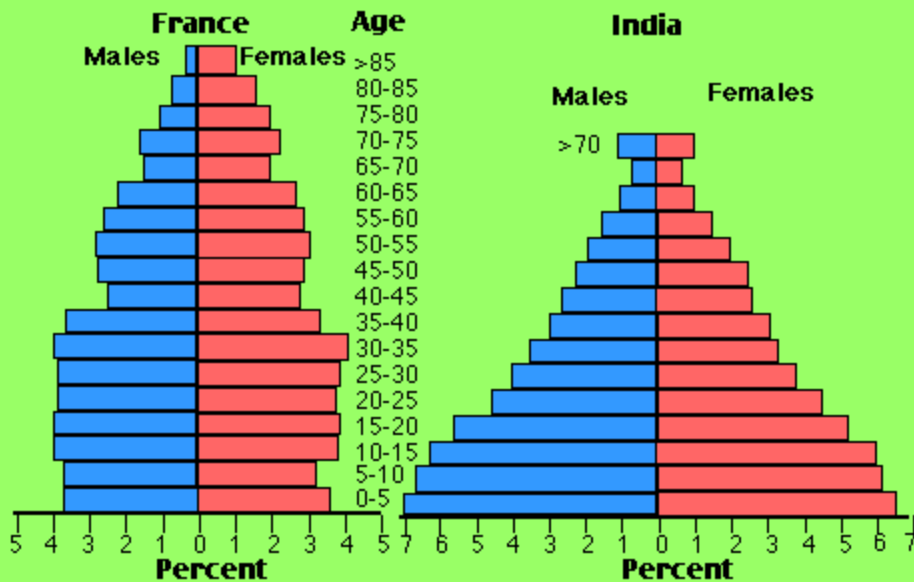
# Trophic Levels

- Steps in a food chain/web
- Energy passes from one organism to another
- About 10% of the energy at one level passes to the next



# Human Population

- Growth= birth rate-death rate





# Human Impacts

## Positive

Reforestation  
Cover Cropping  
Recycling  
Sustainable practice

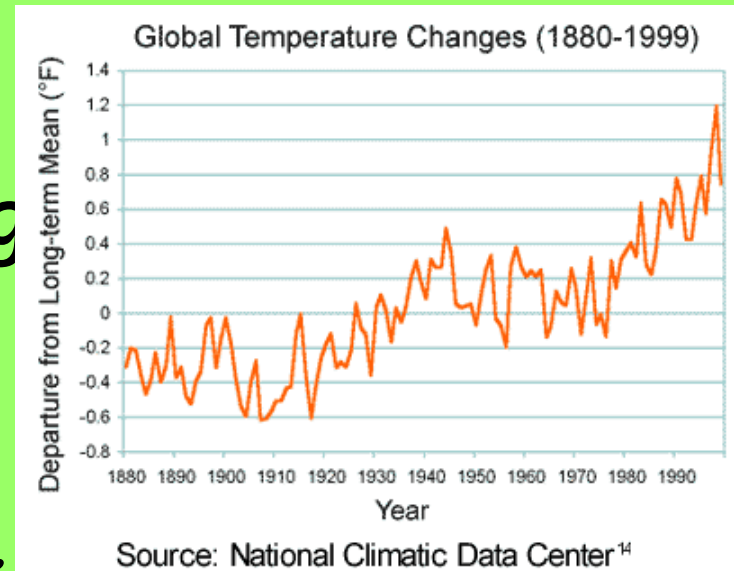
## Negative

Acid Rain  
Deforestation  
Habitat Destruction  
Invasive Species  
Ozone depletion from the  
release of CFCs

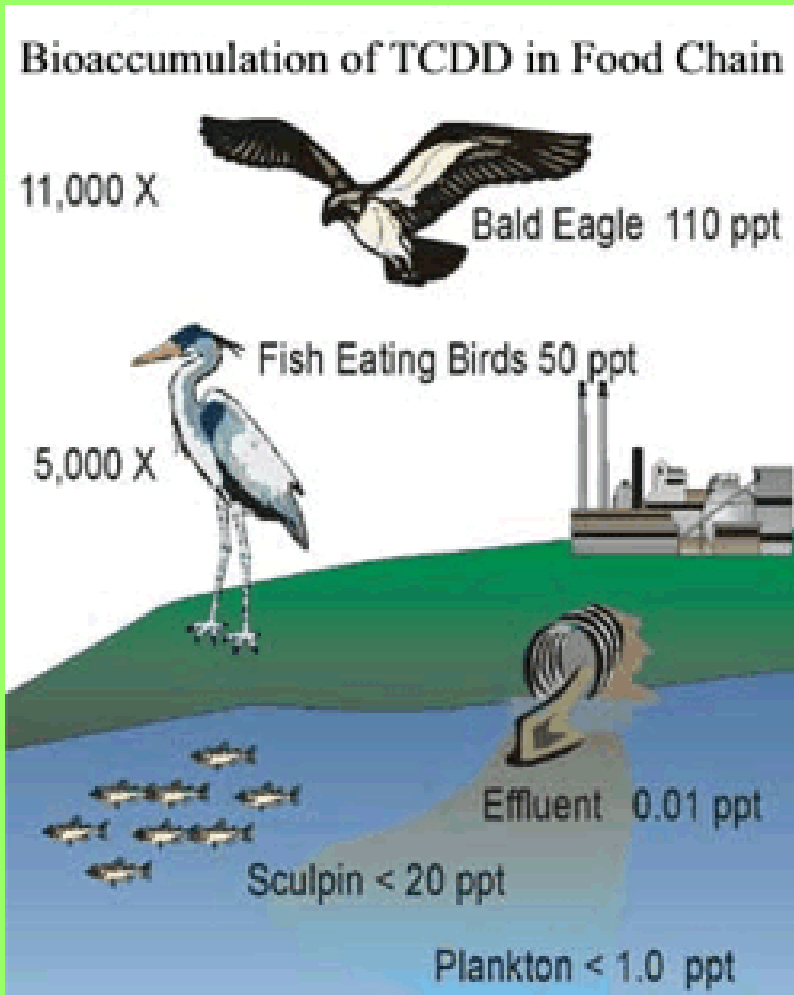


# Global Warming

- Increase in the average temperature of the earth
- Caused by the release of too much  $CO_2$  into the atmosphere which amplifies the greenhouse effect
- Burning of fossil fuels, volcanic eruptions



# Bioaccumulation



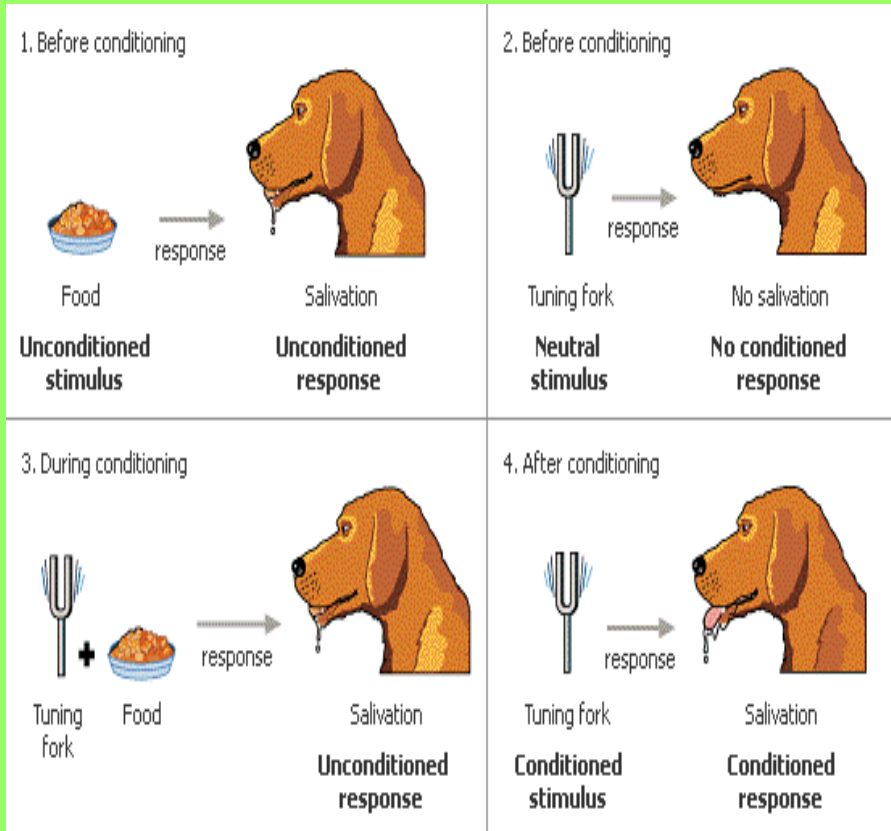
- An increase in environmental toxins at higher trophic levels
- Ex. DDT and birds of prey

# Innate Behavior

- Behaviors an animal is born with
- Includes suckling, migration, hibernation
- Ex. weaving of spider webs



# Learned Behavior



- Behavior an animal acquires during its lifetime
- Includes
  - Habituation
  - Conditioning
  - Trial and error

# Social Behavior

- Communication between individuals of the same species
- Can be courtship, territorial or chemical (pheromones)

