☺ The Big Picture: A Review of General Biology ☺

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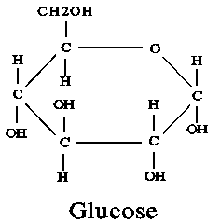
**Cells and Their Processes**

### Organic Compounds

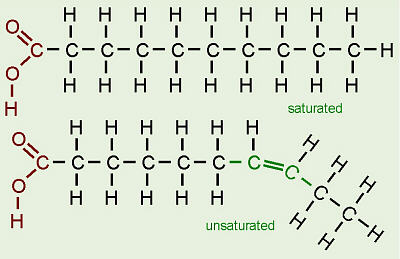
* A compound is a combination of 2 or more atoms
* An organic compound is a compound that contains carbon atoms that have combined with each other
  + Carbon can bond to a number of different atoms so carbon can form many different types of compounds
* An inorganic compound is a compound with no combination of carbon atoms
* 6 most common elements in organic molecules: SPONCH-sulfur, phosphorus, oxygen, nitrogen, carbon, hydrogen

*The Four Types of Organic Compounds (The Molecules of Life)*

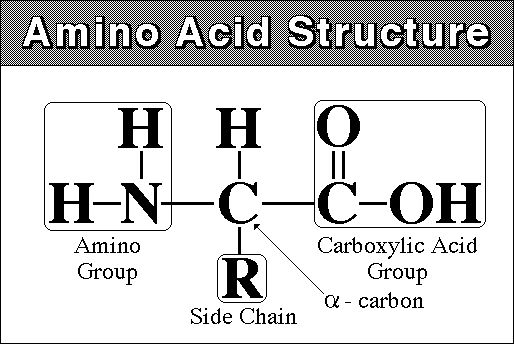
* Carbohydrates: Sugars used for short term energy; Made of monosaccharides



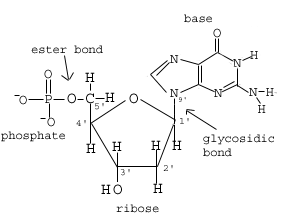
* Lipids: Fats and oils used for long term energy; Made of fatty acids



* Proteins (also called a polypeptide): Made up of amino acids; used for construction materials and chemical reactions in the body
  + Enzymes: Special types of proteins that speed up chemical reactions in the body but are not changed by the reactions



* Nucleic acids: DNA and RNA; contains genetic information; made up of nucleotides

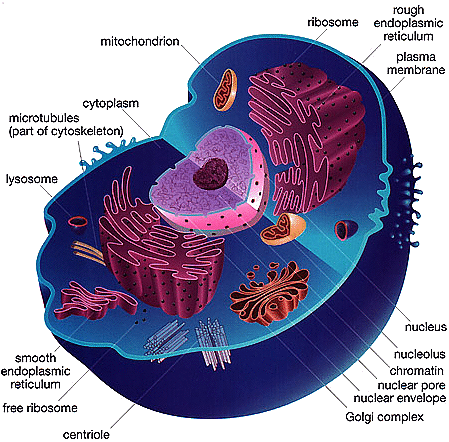


### Cells

* A cell is the smallest unit that is alive and can carry on all the processes of life
* Cells make up organisms (living things)
  + Unicellular organisms are made up of 1 cell
  + Multicellular organisms are made up of many cells
* Cells contain organelles, which are specialized compartments that carry out a specific function
* Types of cells
  + Eukaryotic cells contain a nucleus, such as animal and plant cells
  + Prokaryotic cells contain no nucleus, such as bacteria

*Animal Cells*

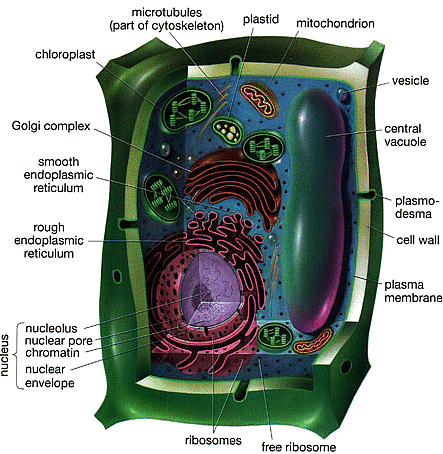
* Usually round



* Organelles include
  + nucleus: controls cell activities
  + cell membrane: controls what enters and leaves the cell and also protects the cell
  + endoplasmic reticulum (ER): tunnels for compounds to move through the cell
  + Golgi body: processes and stores protein
  + Ribosomes: make proteins
  + Mitochondria: Makes energy for the cell
  + Lysosome: Has enzymes that digest waste and old organelles
  + Cytoplasm: Fills the empty space of the cell
  + Vacuole: Stores food, water, and waste
  + Centrioles: Help in cell division and is only found in animal, not plant, cells

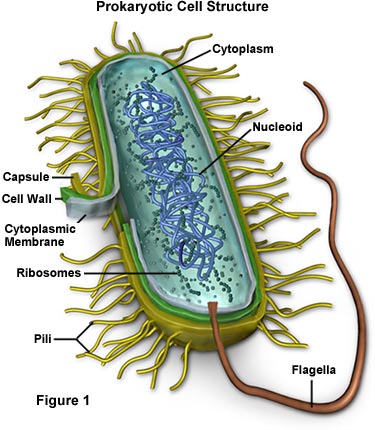
### Plant Cells

* Usually square

**A typical plant cell**   


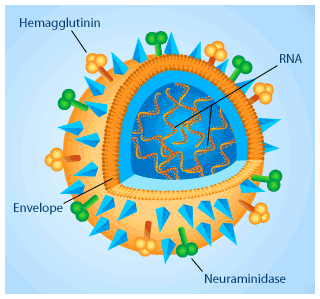
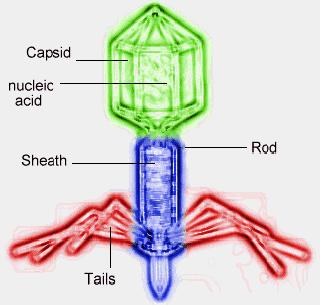
* Organelles include
  + Everything that an animal cell has plus more
  + Chloroplast: Traps sunlight to make food for the plant
  + Cell wall: Protects the cell

### Bacterial cells



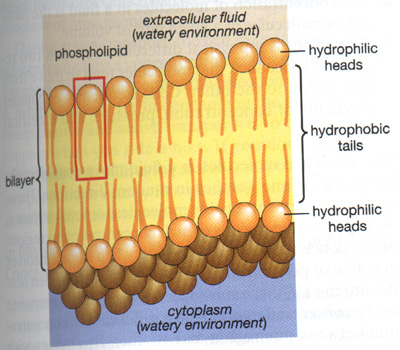
* Smaller and simpler than plant or animal cells
* Bacteria are unicellular
* No nucleus
* Have a single closed loop of DNA, cell wall, cell membrane, cytoplasm and ribosomes
* Some have a capsule (shell for protection), pili (short hair like structures to hold onto host cells), and flagella (whip like structure for movement)

*Viruses*



* Noncellular entities with a simple structure and cannot reproduce on their own
* Much smaller than a bacterial, animal or plant cell
* Parts of a virus
  + Nucleic acid inside the virus – can be either DNA or RNA
  + Capsid: protein coat to protect the nucleic acid inside the virus
  + Spikes: help the virus to attach to host cells
* There is much controversy on whether viruses are alive or not because they cannot reproduce on their own—They do not have the organelles needed to reproduce
  + Viruses must invade a living cell and use the cell’s tools to reproduce
  + Host cell: An animal, plant or bacterial cell that is invaded by a virus
  + Viruses harm and/or kill the host cell that they infect

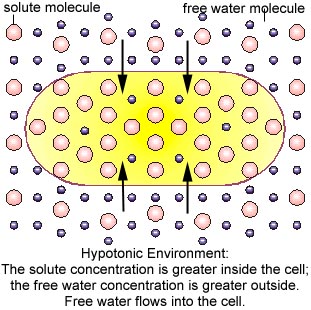
### Cell membrane



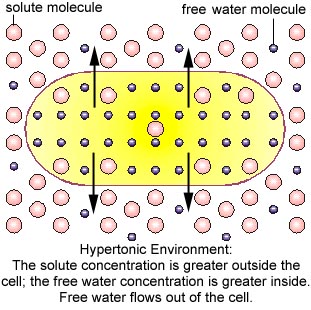
* Made up of molecules called phospholipids
* Phospholipid bilayer is the 2 layers of phospholipids that make up the cell membrane
* Cell membrane is fluid, which means that it is constantly flowing and moving over the cell
* Cell membrane is selectively permeable, which means that it allows small compounds, but not large ones, to pass right through
* There are different ways that materials are transported across the cell membrane



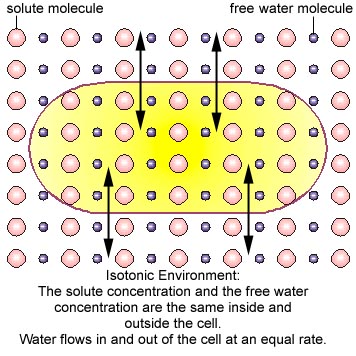
* + Passive transport: requires no energy
    - Diffusion: compounds move from high to low concentration
    - Osmosis: diffusion of water
  + Active transport: requires energy
    - Endocytosis: large compound are brought into the cell
    - Exocytosis: large compounds are exported out of the cell
* Types of solutions
  + Hypotonic solutions cause water to move into the cell so the cell swells up



* + Hypertonic solutions cause water to move out of the cell so the cell shrivels up



* + Isotonic solutions cause no net movement of water into or out of the cell



*Photosynthesis*

* Process by which organisms use energy from sunlight to make their own food (glucose)
* Glucose is a simple sugar
* Photosynthesis occurs in the chloroplasts of plant cells and some bacteria
* Chloroplasts have a green pigment called chlorophyll
* Steps of photosynthesis
  + 1. Light reaction: chlorophyll in the chloroplasts absorbs sunlight
  + 2. Dark reaction: The energy from the sunlight is used to make glucose
* Light energy is completely changed into chemical energy (glucose)
* Chemical equation for photosynthesis

6CO2 + 6H2O + light energy 🡪 C6H12O6 + O2

#### Cellular Respiration

* Process that breaks down glucose in order to make energy for an organism
* ATP: compound that stores energy in an organism
* Occurs in the mitochondria of the cell
* Two types of cellular respiration
  + Aerobic respiration: requires oxygen to occur
    - Mostly happens in animals and plants
    - There are 3 steps in aerobic respiration
      * Step 1 is glycolysis: glucose is cut in half
      * Step 2 is the citric acid cycle: glucose halves get electrons chopped off of them
      * Step 3 is the electron transport chain: electrons combine with oxygen and are used to make a lot of ATP
    - Chemical equation for respiration

C6H12O6 + O2 🡪 6CO2 + 6H2O + ATP energy

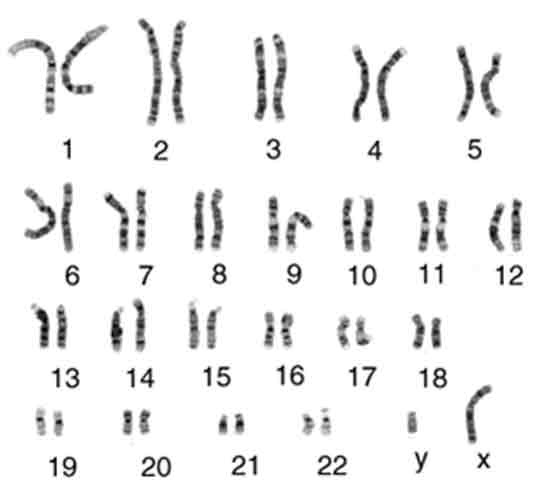
* + - Aerobic respiration is the opposite of photosynthesis
  + Anaerobic respiration: does not require oxygen to occur
    - Mostly happens in bacteria and yeast
    - Also called fermentation
    - Makes less ATP than aerobic respiration

### Chromosomes

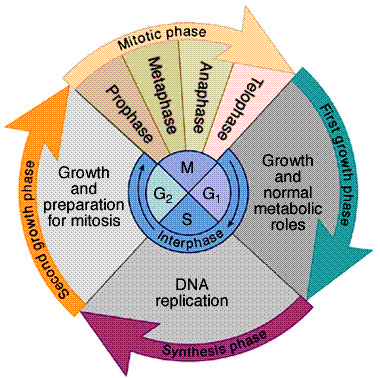
* DNA strands in the nucleus that contain the directions on how to make and keep an organism alive
* Made up of genes, which are traits of an organism
* Cells will die if their DNA is damaged or removed
* Humans have mostly diploid cells, which means that we have 2 of each type of chromosome
  + Homologous chromosomes are 2 of the same type of chromosome
  + We have 23 types of chromosomes but…
  + We have 46 chromosomes in all,

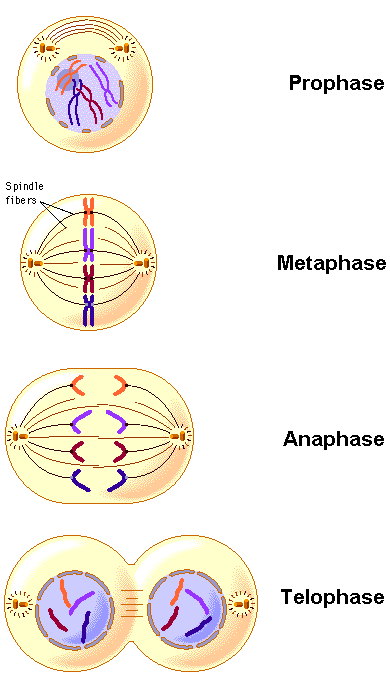
23 chromosomes from mom + 23 chromosomes from dad

* Human gametes (sperm and egg cells) are haploid cells, which means that they have 1 of each type of chromosome
  + Sperm and egg cells have 23 chromosomes in all
* Autosomes: Chromosomes that do not determine gender
* Sex chromosomes: Chromosomes that determine gender
  + Girls are XX, Boys are XY
* Karyotype: ordered picture of an organism’s chromosomes
  + Healthy individuals have 2 of each type of chromosome
  + Individuals with Down Syndrome have three #21 chromosomes



### Cell Cycle

* The cell cycle is the phases in the life of a cell
  + M phase: Mitosis (cell division) occurs
  + G1 phase: Cell grows
  + S phase: DNA synthesis (chromosomes are copied)
  + G2 phase: Cell grows
  + M phase begins again
* Chromosomes must be copied before mitosis so that new cells receive the same chromosomes found in the old cells

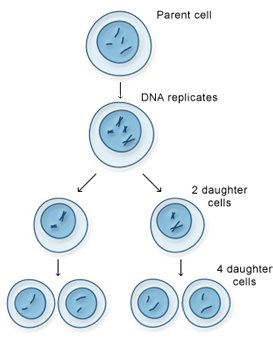
 *Mitosis*

* Division of a cell into 2 identical cells
* Before mitosis: Chromosomes have copied themselves
  + - Sister chromatids: original chromosome and its exact copy are attached to each other
* Phases of mitosis
  + 1. Prophase: Nuclear membrane falls apart and spindle fibers start to form
  + 2. Metaphase: Sister chromatids line up along the middle of the spindle fibers
  + 3. Anaphase: Sister chromatids separate and move to opposite ends of the cell
  + 4. Telophase: Spindle fibers break down and new nuclear membrane forms around each set of chromosomes
    - Cytokinesis occurs when the cytoplasm actually divides, forming two new cells

**Genetics**

### Meiosis

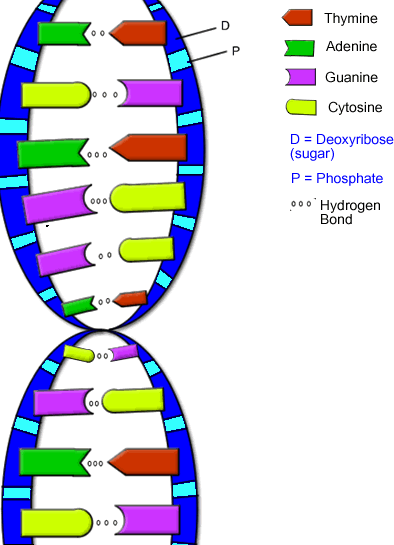
* Cell division that produces gametes (sex cells), such as sperm and egg cells
* Fertilization: Process of an egg and a sperm cell combining to produce a zygote
  + Zygote: Baby that is only 1 cell big
  + Egg cell (23 chromosomes) + sperm cell (23 chromosomes) = baby (46 chromosomes)
* Steps in meiosis



* + 1. Before meiosis:
    - 2 chromosomes of the same type come together to make a chromosome pair
    - Each chromosome doubles
    - This gives 4 chromosomes stuck together
  + 2. Meiosis I: Chromosome pairs separate into two new cells
  + 3. Meiosis II: Each chromosome separates from its copy into 4 new cells
* In meiosis, one cell becomes four cells but in mitosis, one cell becomes two cells

### DNA

* Deoxyribonucleic acid
* Makes up the chromosomes in the nucleus and never leaves the nucleus
* A chromosome is a chain of different genes
* DNA has a double helix shape



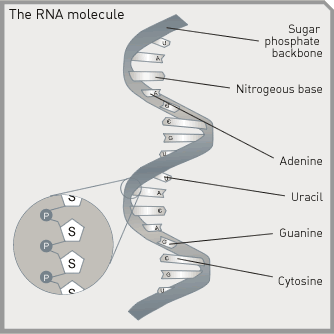
* Has four types of bases: adenine (A), guanine (G), thymine (T), cytosine (C)
* A binds T and G binds C
* DNA is complementary, which means that the bases on one strand match up to the bases on the other strand
  + For example: Strand 1: ATG CCT GAC

Strand 2: TAC GGA CTG

* Semi conservative replication is the process by which DNA copies itself and each new piece of DNA is made up of 1 old strand and 1 new strand

### RNA

* Ribonucleic acid
* RNA is a copy of DNA that goes out into the cytoplasm to tell the cell what to do in order to stay alive

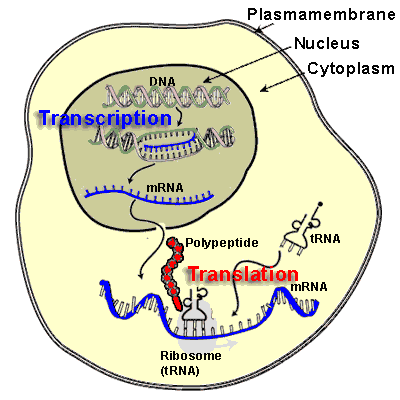


* RNA is single stranded and has uracil (U) rather than thymine (T)
  + U binds A and G binds C
  + If the DNA is ATG CCA AAG

Then the RNA will be UAC GGU UUC

### Using DNA to make protein

* 1. Transcription: DNA in the nucleus is used to make messenger RNA (mRNA)
  + DNA has all the directions the cell needs to live
* 2. RNA moves out into the cytoplasm
  + RNA carries the directions to other parts of the cell
* 3. Translation: The RNA attaches to a ribosome and directs the production of a protein
  + Proteins do all the work in the cell
  + Every 3 bases in RNA is called a codon and codes for 1 amino acid



### Mutations

* A mutation is a change in a gene or chromosome
* If the mutation happens in a body cell, it only affects the organism that carries it
* If the mutation happens in a sex cell, it can be passed on to offspring
* Mutations can be
  + harmful if they reduce an organism’s chances for reproduction or survival
  + helpful if they improve an organism’s chances for survival
  + neutral if they do not produce an obvious changes in an organism
  + lethal if they result in the immediate death of an organism
* Mutations can occur spontaneously or be caused by a mutagen, which is a factor in the environment like UV and chemicals

### Mendelian Genetics

* Gregor Mendel is an Austrian monk credited with beginning the study of genetics
* Genetics is the study of heredity
* Humans have 2 genes for every trait
  + Alleles: Different forms of a single trait, like blue and brown are two eye color alleles
* Dominant gene: “Stronger” of 2 genes and shows up in the organism
  + Represented by a capital letter
  + B is the dominant gene for brown eyes
* Recessive gene: “Weaker” of 2 genes and only shows up when there is no dominant gene present
  + Represented by a lowercase letter
  + b is the recessive gene for blue eyes
* Homozygous (purebred): When 2 genes are alike for a trait
  + BB is homozygous for brown eyes, bb is homozygous for blue eyes
* Heterozygous (hybrid): When 2 genes are different for a trait
  + Bb is heterozygous
* Mendel’s law of segregation states that the 2 genes we have for each trait get separated from one another when we make egg and sperm cells
* Mendel’s law of independent assortment states that the gene for one trait is inherited independently of the genes for other traits
  + Only true when the genes are on different chromosomes

### Punnett Squares

* Punnett squares are charts that are used to show the possible gene combinations in a cross between 2 organisms

\* Let’s say that B is the dominant gene for brown eyes and b is the recessive gene for blue eyes\*

* Genotype: The genes of an organism (Bb)
* Phenotype: The physical appearance of an organism (Brown eyes)

Parents Parents Bb

## Offspring genotype

25% BB

50% Bb

25% bb

## Offspring phenotype

75% Brown eyes

25% blue eyes

## Offspring genotype

50% Bb

50% bb

## Offspring phenotype

50% Brown eyes

50% blue eyes

Bb x bb Bb x Bb

Bb

bb

Bb

bb

B b

b

b

BB

Bb

Bb

bb

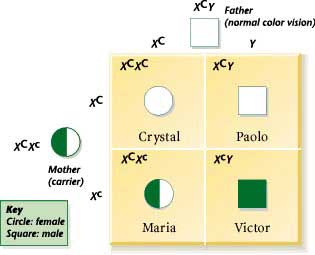
B b

B

b

### Human Genetics

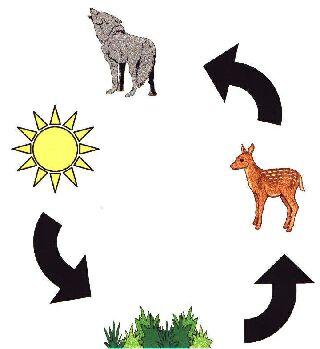
* Multiple alleles are three or more alleles that exist for a single gene
  + For example, A, B, and O are the multiple alleles for blood type
  + The possible blood types are A, B, AB, and O
    - You can be A+ or A-, B+ or B-, AB+ or AB-, O+ or O- depending on whether your blood cells have a special Rh protein
* Codominance occurs when 2 dominant genes are expressed and both genes are seen in the organism
  + AB blood is codominant, a cat with black and white spots is codominant
* Incomplete dominance occurs when 2 dominant genes are expressed and blended together in the organism
  + If the red flower color gene (R) is mixed with the white flower color gene (W) then the offspring will be pink (RW)
* A polygenic trait is a trait that is controlled by more than one pair of genes, like skin color
* A sex-linked trait is a trait that is found on the X chromosome, such as colorblindness
  + Females are XX so have 2 copies of sex-linked traits
  + Males are XY so have 1 copy of sex-linked traits



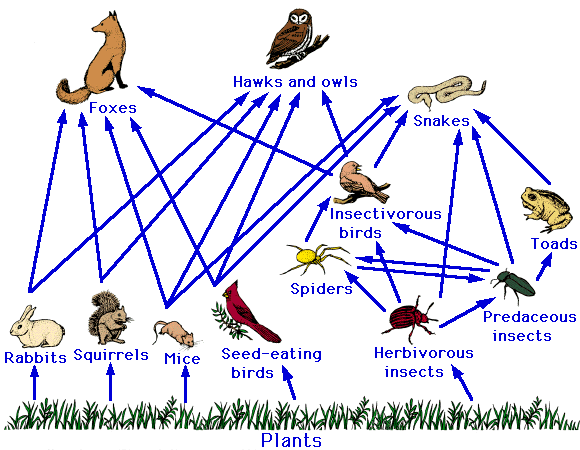
**Ecology**

*Ecology*

* Ecology is the study of how organisms fit into their environment
* A community is the organisms that live in a particular environment
* A habitat is the physical location of a community
* An ecosystem is a collection of organisms and their physical environment
* The diversity of an ecosystem is a measure of the number of species living there
* There are different feeding groups of organisms
  + Autotrophs: Organisms that make their own food, like plants and some bacteria
  + Heterotrophs: Organisms that cannot make their own food, like
    - Herbivores: Eat plants
    - Carnivores: Eat meat
    - Omnivores: Eat plants and meat
* There are different factors is an ecosystem
  + Abiotic factors are nonliving things
  + Biotic factors are living things, such as
    - Producers: Organisms that take in energy from their surroundings to make their own food
    - Consumers: Organisms that eat other organisms for energy
    - Decomposers: Special type of consumer that eats waste products and dead organisms for energy
* There are different trophic levels in a food chain
  + A trophic level is a feeding level in an ecosystem
  + A food chain is a lineup of organisms that shows who eats who



* + 1st trophic level is usually a producer
  + 2nd trophic level is a primary consumer
  + 3rd trophic level is a secondary consumer
  + 4th trophic level is a tertiary consumer
  + and so on
  + Last trophic level is a decomposer
* Every time an organism eats, it obtains energy from its food
  + So energy is transferred from the 1st to the 2nd to the 3rd trophic level and so on (but some of this energy does get lost along the way)
  + Energy pyramid: Picture showing how much energy is transferred to the different trophic levels in a food chain
* A food web is a network of connected food chains



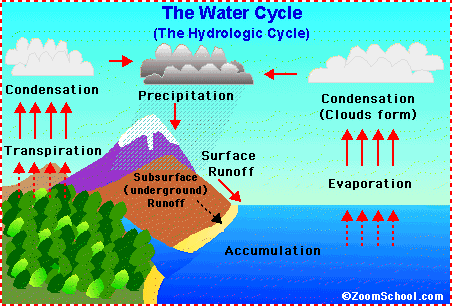
### Cycles of Matter

* Water, nitrogen, carbon, and oxygen are recycled in the environment through cycles
* The nitrogen cycle
  + Nitrogen in the atmosphere is taken in by bacteria that live in plant roots
  + The nitrogen is passed onto the plants and any animals that eat the plants
  + Once the plant or animal has died, decomposers (bacteria) again take up the nitrogen in the dead material and send it back to the atmosphere

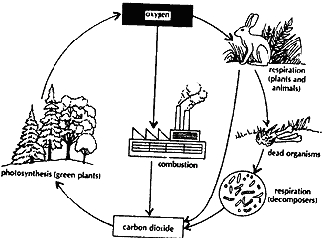


##### The water cycle

* + Precipitation, such as rain and snow, fall to the earth
  + The water either
    - seeps into the ground for plants to use and the plants give off excess water back to the atmosphere through transpiration
    - or runs off the land to lower-lying bodies of water where it evaporates back into the atmosphere



* *The oxygen-carbon cycle*
  + Carbon dioxide from the atmosphere is taken in by plants who use it during photosynthesis and release oxygen back into the atmosphere
  + Oxygen in the atmosphere is taken in by animals and plants who use it during respiration and release carbon dioxide back into the atmosphere



### Interaction in an environment

* Each organism has a niche, or role, to play in its environment
* Competition is a struggle between organisms for resources, such as food, water, shelter
* Predators are organisms that catch, kill, and eat other organisms called prey
* Symbiosis is a close relationship between 2 organisms in which one organism lives near, on, or even inside another organisms and in which at least one organism benefits
  + There are three types of symbiosis
  + 1. Commensalism is when one of the 2 organisms benefits from the symbiosis
  + 2. Mutualism is when both organisms benefit from the symbiosis
  + 3. Parasitism is when one organism benefits (parasite) and the other organism is harmed (host) from the symbiosis
    - The parasite feeds on the host while it is still alive, weakening but not killing it
* An adaptation is a change in the behavior or physical characteristics of a species that make it better suited to its environment
* Populations of organisms increase and decrease due to overpopulation of a competitor or predator, disease, lack of food or water or shelter, and extreme weather
* Ecosystems are constantly changing due to changing populations of organisms, changing weather, natural disasters, and human activity
* Every time a change occurs, the balance of the ecosystem has to be readjusted

**The Theory of Evolution**

### Evolution

* Evolution is a change in a species over time
* The theory of evolution was stated by Charles Darwin and is based on natural selection
* Natural selection states that organisms with traits well suited to an environment are more likely to survive and produce more offspring than organisms without these favorable traits
* Biodiversity: Organisms become very different from each other as they evolve and become better suited to their environments
* The theory of evolution is supported by evidence that includes
  + Adaptations: structures and behaviors that organisms have evolved in order to survive better in their environments
  + The fossil record which is information about all known fossils
  + Comparative anatomy which is when the bodies of different organisms are compared to see if they are related
    - Homologous structures are body structures on different organisms that are similar
    - Vestigial structures are body structures that may have served a purpose in ancient ancestors but no longer are functional in current organisms
  + The fact that all vertebrate embryos look very similar as they develop before birth
  + The fact that the DNA of closely related organisms looks very similar

Types of Natural Selection

* + - Stabilizing selection: favors average individuals in a population
    - Directional selection: favors one of the extreme variations of a trait
    - Disruptive selection: favors individuals with either extreme of a trait

Speciation

* Speciation is the evolution of a new species that occurs when members of similar populations no longer breed with each other to produce fertile offspring
* Occurs when a group of organisms have a reduced gene pool and/or can no longer can breed with members of their original population
  + - Gene pool: all the alleles of a gene present in the population
    - Any change in the gene pool will cause evolution to happen
* There are several reasons why similar populations no longer breed, creating new species

1. Geographic isolation: when a physical barrier (lava from volcanic eruptions, sea level changes, etc.) divides a population

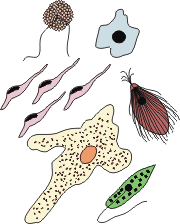
* Makes the gene pool smaller and each new smaller population adapts to its own environment, creating new species

1. reproductive isolation: when organisms no longer breed with each other to produce fertile offspring because

* the genes of the populations becomes too different and fertilization cannot occur

**Taxonomy**

* Taxonomy is the science of classifying living things
* Organisms are organized into 7 different levels of taxonomy (King Philip came over for good spaghetti)
  + 1. Kingdom – most broad
  + 2. Phylum
  + 3. Class
  + 4. Order
  + 5. Family
  + 6. Genus
  + 7. Species – most specific
* Closely related organisms have more levels of taxonomy in common than unrelated organisms
* There are six kingdoms of living things (Archie eats pretty fantastic apple pies)
  + 1. Archaebacteria: bacteria that live in extreme environments
  + 2. Eubacteria: common bacteria
  + 3. Protista: Single-celled organisms

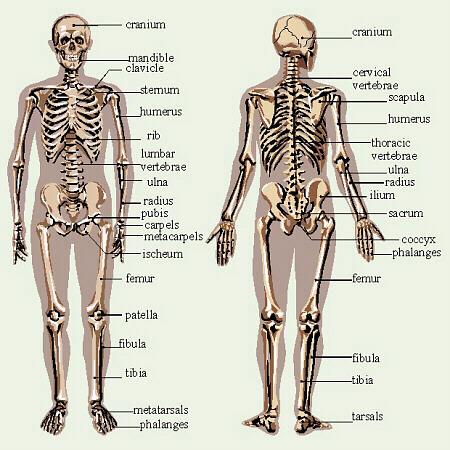
Pictures of protists:

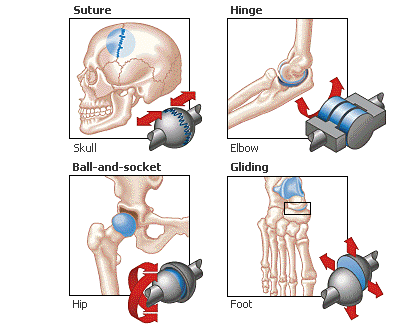
* + 4. Fungi: Mushrooms, yeasts, molds
  + 5. Animalia: animals
  + 6. Plantae: plants
* Every organism has a unique two-word scientific name that is written in Latin
  + The first word is the genus, the second word is the species (Humans are *Homo sapiens)*
* Some scientists prefer to organize organisms into domains rather than kingdoms
  + There are three domains (Archie eats eels)
  + 1. Archaea: Bacteria that live in extreme environments
  + 2. Eubacteria: Common bacteria
  + 3. Eukarya: Organisms whose DNA is in a nucleus

**Anatomy and Physiology**

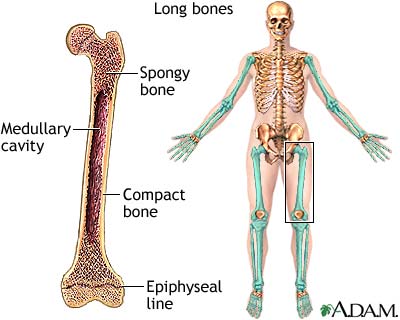
*Skeletal System*

* Functions
  + Provides a framework for the tissues of your body
  + Protects your internal organs
  + Provides attachment points for muscles
  + Stores minerals
  + Produces blood cells

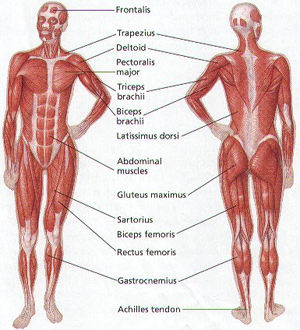


* Made up of
  + Axial skeleton: skull, vertebral column, sternum, ribs
  + Appendicular skeleton: arms, legs, shoulders, pelvis
* Ligaments: tough band of connective tissue that attaches one bone to another bone
* Tendons: thick bands of connective tissue that attach muscles to bones
* Joints: where two or more bones meet
  + Ball and socket joint: allows movement in all directions
  + Pivot joint: allows bones to twist around each other
  + Hinge joint: allows back and forth movement
  + Gliding joint: allows bones to slide past each other

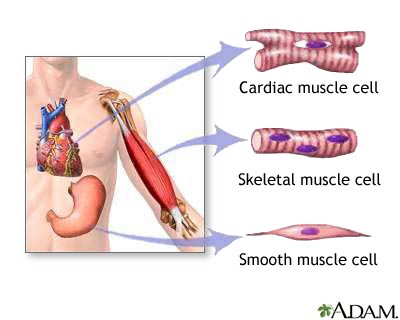
* 2 types of bone tissue
  + Compact bone: hard and found on the outside of bones
  + Spongy bone: soft with holes and is found on the inside of bones



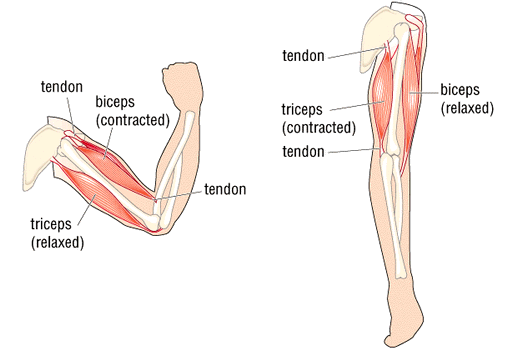
### Muscular System



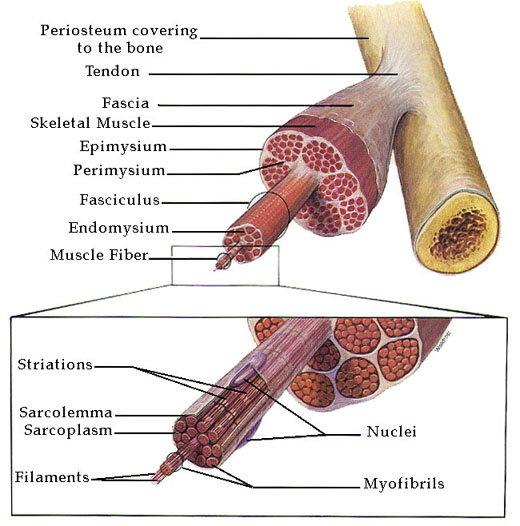
* Muscles can be
  + Voluntary: under conscious control
  + Involuntary: not under conscious control
* Three types of muscles



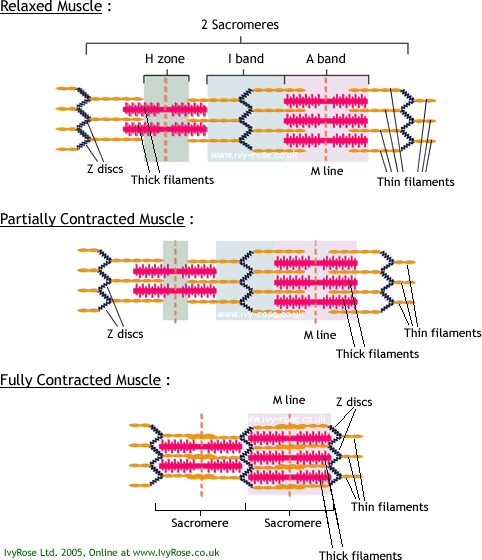
* + Smooth muscle: squeezes and exerts pressure on the space inside a tube or organ to move material through it (involuntary)
  + Cardiac muscle: make up the heart (involuntary)
  + Skeletal muscle: attaches to and moves bones (voluntary)
* Skeletal muscles work in opposing pairs (one muscle contracts while the other relaxes)



* Skeletal muscles are made of the following pieces
  + Skeletal muscle is made of bundles of muscle fibers
  + Muscle fibers are made of myofibrils
  + Myofibrils are made of filaments

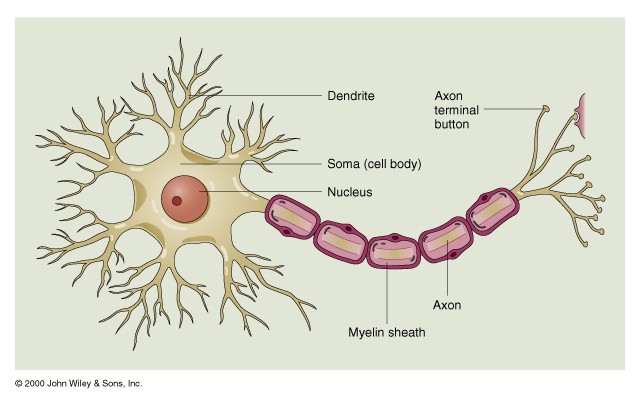


* + Myofibrils are divided into sarcomeres
  + Sarcomeres are made of myosin and actin proteins
* Sliding filament theory: actin filaments in sarcomeres slide toward one another, shortening the sarcomeres in a fiber, causing the muscle to contract

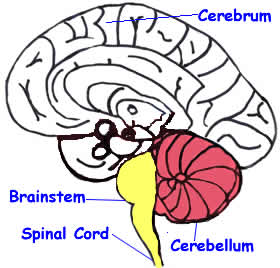
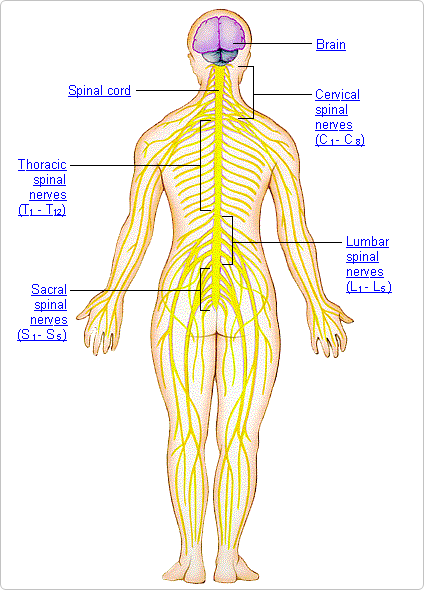


### Nervous System

* Function: allows the body to response to internal and external stimuli
* Neuron: cell that conducts impulses through the nervous system
  + Made up of a cell body, dendrites (receives impulses), and an axon (carries impulses away from the cell toward other cells)



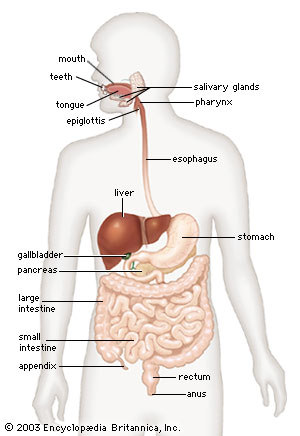
* 3 types of neurons:
  + Sensory neurons carry impulses from the body to the spinal cord and brain
  + Interneurons are found within the brain and spinal cord
  + Motor neurons carry the response impulses away from the brain and spinal cord to a muscle or gland
* Parts of the nervous system



* + Central Nervous System: brain and spinal cord
    - Brain: made up of the cerebrum, cerebellum and brain stem
  + Peripheral Nervous System: all the nerves in the rest of your body
    - Made up of the somatic and autonomic nervous system
      * Somatic nervous system: voluntary (you decide whether you want to move body parts controlled by this system, like your skeletal muscles)
      * Autonomic nervous system: involuntary (the impulses that travel through this system are not under your control, they automatically happen, like muscles that help you breath)
        + Autonomic nervous system is made up of the sympathetic system (controls internal functions during stress) and the parasympathetic system (controls internal functions during rest)
* Control of the body is done by the nervous system and the endocrine system (release hormones into the bloodstream to control bodily functions)
* Negative feedback control: hormones, or their effects, are fed back to inhibit, or stop, the original signal
  + Once homeostasis is reached, the signal is stopped and the hormone is no longer released

### Digestive System

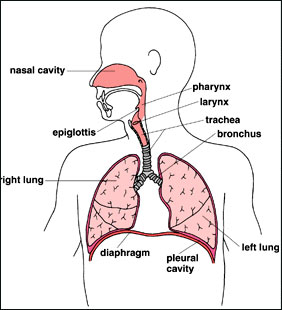
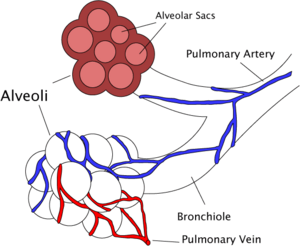
* Function: to break apart the food you eat into smaller parts so that it can be used as energy for your body



* Digestion (The path food takes when you eat)
  + Mouth: mechanical (teeth) and chemical (saliva) digestion
    - Saliva contains the enzyme amylase that begins the chemical breakdown of starch
  + Esophagus: muscular tube that connects your mouth to your stomach
  + Stomach: Physical and chemical digestion
    - Stomach contains hydrochloric acid that lowers the pH of the stomach so that the enzyme pepsin can chemically break down protein
  + Small intestine: mechanical digestion completed; chemical digestion of proteins, carbohydrates, and fats completed; digested nutrients enter the bloodstream through the villi in the small intestine
    - Pancreas secretes enzymes to the small intestine to chemically break down fats, proteins, and starch
    - Liver produces bile (that is stored in the gall bladder) which is secreted into the small intestine to chemically break down fats
    - Starches are digested to monosaccharides; fats are digested to fatty acids; proteins are digested to amino acids

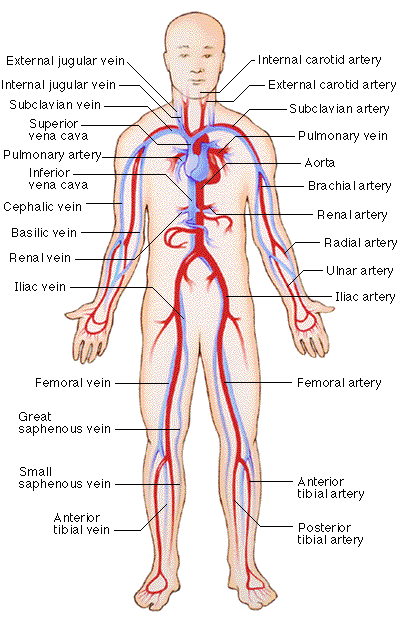
### Respiratory System

* Functions:
  + Breathing
  + respiration (the process of gas exchange)
* The path air takes during respiration
  + Taking air into your body through your nose or mouth
  + Air flows into the pharynx (throat) and moves through the larynx
  + Air travels down the trachea (windpipe) to the lungs
  + In the lungs, each bronchus branches into bronchioles which branch into alveoli covered in capillaries
  + In the alveoli covered with capillaries, oxygen and carbon dioxide are exchanged by diffusion between the air and the blood
  + Once oxygen from the air diffuses into the blood vessels surrounding the alveoli, it is pumped by the heart to the body cells, where it is used for cellular respiration
  + Carbon dioxide from the body diffuses from the blood into the air spaces in the alveoli
  + During exhaling, this carbon dioxide is removed from the body

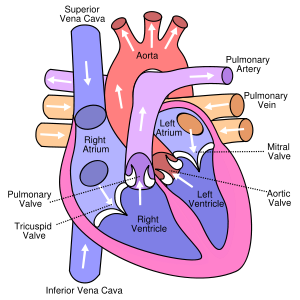
 

### Circulatory System

* Blood is composed of
  + Red blood cells: transport oxygen to parts of the body using the hemoglobin protein
  + White blood cells: defend the body against disease
  + Platelets: needed for blood clotting
  + Plasma: the liquid portion of the blood
* Blood types: A, B, AB, O
  + Determined by antigens (proteins) on the surface of red blood cells
* Three types of blood vessels
  + Arteries: carry blood away from the heart; large
  + Veins: carry blood toward the heart; large
  + Capillaries: connect arteries to veins; very small



* Heart: muscle needed to pump blood to all parts of the body
  + Two upper chambers: left and right atria (atrium is singular)
  + Two lower chambers: left and right ventricles
  + Blood enters the heart through the atria and leaves the heart through the ventricles



* How blood travels through the heart
  + Right atrium: receives oxygen-poor blood from the head and body
  + Left atrium: receives oxygen-rich blood from the lungs
  + The two atria fill with blood and then contract, pushing the blood into the ventricles
  + Right ventricle: pushes the oxygen-poor blood out of the heart toward the lungs
  + Left ventricle: pushes the oxygen-rich blood out of the heart toward the rest of the body
  + The two ventricles fill with blood from the atria, then contract at the same time, pushing blood out of the heart
  + Valves in the heart prevent blood from flowing in the wrong direction
* Kidneys: filter the blood to remove nitrogenous wastes from it, thus maintaining homeostasis of body fluids
  + The waste fluid is urine and is excreted from the body
  + Bladder: makes urea (main substance in urine)
  + Liver: filters harmful substances from the blood(ex.Alcohol)

