

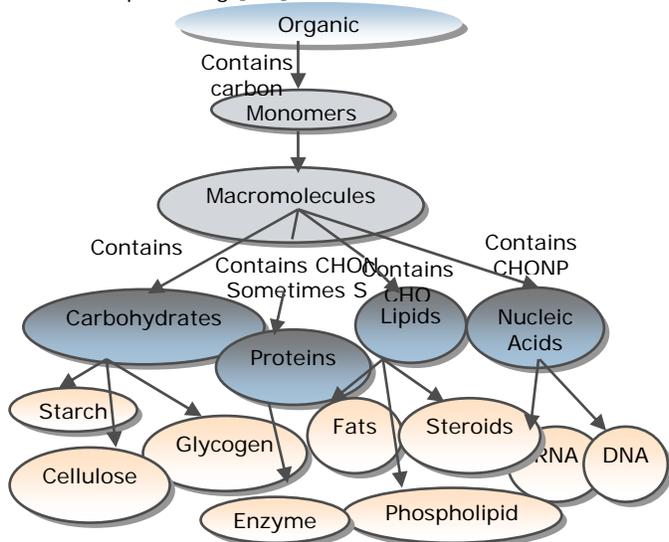
Biology, 1 of 6

01: The Science of Biology

- **Characteristics of life**
- Organization:** all lives are well organized
- Energy use:** all lives need energy to support
- Reproduction:** all lives should be able to reproduce itself
- Growth:** all lives grow and develop.
- Response to stimuli:** all lives can respond to internal or external stimuli
- Homeostasis:** all lives have the ability to maintain a relatively stable internal environment—self-regulation
- **Basic Theory of modern biology**
- Cell Theory**
  - Cell is the building unit of all living organisms.
  - All cells come from pre-existing cells
  - All metabolism occur in cells of the body—cells are functional unit for all lives
- Gene Theory**
  - All genetic information is stored in DNA – genes
  - Genes control most, if not every, aspects of an organism
  - The DNA language can be transcribed into RNA language and then translated into protein language for its final function
- Homeostasis**
  - All living organisms have the ability to maintain a relatively constant internal environment
  - Purpose: to ensure proper function of the body

02: Chemical Basis of Life

- Atoms:**
- o electrons: both energy and substance particles
  - o neutrons
  - o protons
- Molecules:**
- o Formed by atoms
  - o Joined by chemical bonds
  - o molecular formula and structure formula
- Chemical Bond:**
- Ion bond:** ion bond forms when atoms lose or gain electrons.
- Covalent bond:** Covalent bonds form when atoms share electrons, very strong bonds. The major one in organic chemicals.
- Hydrogen bond:** Weak electrical attraction between the positive end of one molecule and the negative end of another
- Buffers:** solutions which resist change in pH upon addition of small amounts of acid or base.
- pH:** pH represents the concentration of hydrogen ions [H+] in solution.  $pH = -\log [H^+]$

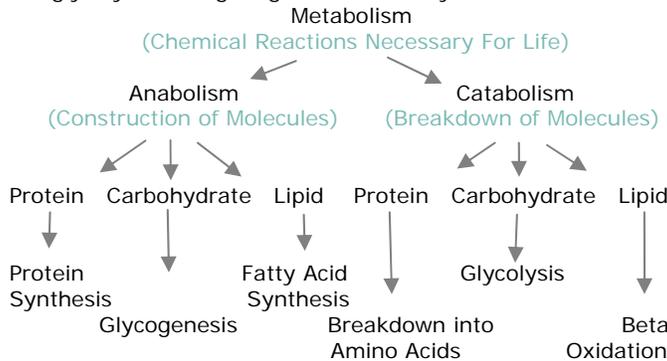


03: The Cell

- Cell organelles and their functions:**
- **Nucleus:** the control center
    - o Holds all of cell's genetic information
    - o Makes decisions about cell needs
  - **Ribosome:** the factory
    - o Synthesizes proteins
  - **Rough Endoplasmic Reticulum**
    - o Edits and finalizes proteins made by ribosomes.
  - **Smooth Endoplasmic Reticulum**
    - o Synthesizes carbohydrates and lipids.
  - **Golgi Apparatus:** the post office
    - o Tags and ships packages to their destinations
  - **Mitochondria:** the power house
    - o Produces ATP for the cell's activities.
  - **Lysosome:** the recycling center.
    - o Recycles waste and foreign bacteria.
- The cell membrane:** lipid bilayer which envelops the cell. For Protection, Communication, and Selective Exchange
- Passive Transport**
- o Does not use energy
  - o Osmosis, diffusion, facilitated diffusion
  - o Natural movement from high concentration to low concentration.
- Active Transport**
- o Uses energy
  - o Movement from against natural diffusion
- Prokaryotes**
- Examples: bacteria, microscopic organisms
  - Structure: DNA, ribosomes, and cell membranes.
  - Except for ribosomes, prokaryotes **DO NOT** have organelles.
- Eukaryotes**
- Animals: with organelles and cell membranes
  - Plants: with organelles and cell membranes like animal cells, but also have chloroplasts and cell walls.

04: Cellular Respiration

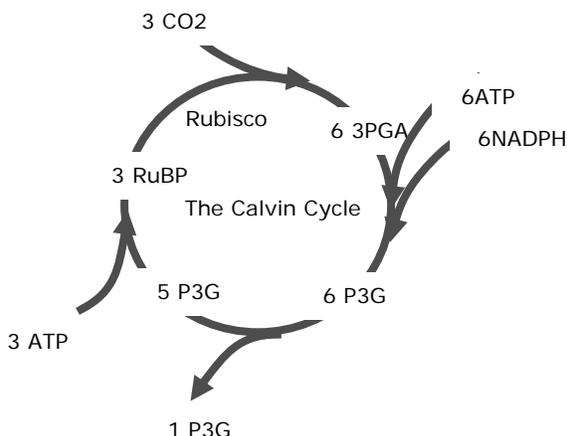
- Aerobic Respiration**
- **Glycolysis**
    - o Glucose is broken down into pyruvate.
    - o 2 ATP produced.
  - **Krebs Cycle**
    - o Acetyl CoA (made from pyruvate) runs a cycle of reactions, regenerating at the end of each cycle.
    - o All of the electrons are passed to NADH and FADH<sub>2</sub> (electron carriers).
    - o 2 ATP produced.
  - **Oxidative Phosphorylation**
    - o 32 ATP produced.
- Anaerobic Respiration**
- **Glycolysis:** Glucose is broken down into pyruvate; 2 ATP produced.
  - **Fermentation:** Pyruvate is broken down into ethanol or lactic acid. Glycolysis intermediates produced to allow glycolysis to begin again immediately.



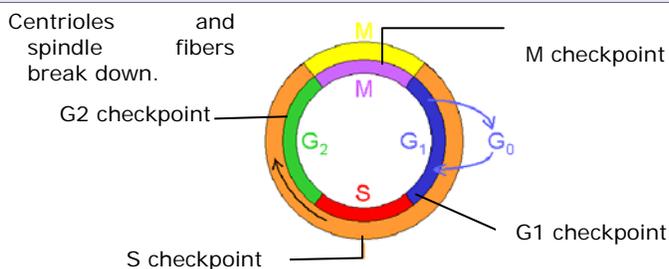
Biology, 2 of 6

05: Photosynthesis

- **Chloroplast:** An organelle in plant cells where photosynthesis occur.
- **Photophosphorylation:** a process that ATP is generated via light reactions in photosynthesis.
- **Light Reaction:** The first phase of photosynthesis which light is harvested and the electron transfer occurs, ATP, NADPH and oxygen is generated.
- **Dark Reaction:** The second phase of photosynthesis where carbon dioxide is fixed and carbohydrates are generated by consuming ATP and NADPH.
- **Chloroplasts:** These are organelles which allow the organism to perform photosynthesis, obtaining energy from sunlight.
- **Chlorophyll:** Proteins found in chloroplasts which have the ability to absorb sunlight for photosynthesis.

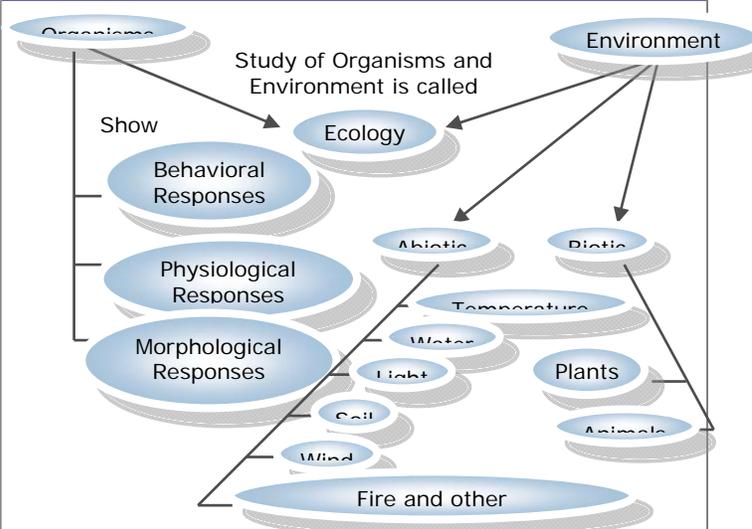


06: The Cell Cycle



- **Prophase**
  - Chromosomes condense and become visible.
  - Nuclear envelope breaks down.
  - Centrioles take positions on opposite sides of nucleus.
- **Metaphase:**
  - Chromosomes line up single-file in the middle of the cell.
  - Spindle fibers from the centrioles attach to each side of the centromeres of the chromosomes.
- **Anaphase:**
  - Sister chromatids are pulled apart to become individual chromosomes.
  - Chromosomes move until they reach centrioles on opposite sides of cell.
- **Telophase:**
  - Chromosomes dissolve.
  - Nuclear envelopes re-form around both sets of chromosomes.

07: Introduction to Ecology

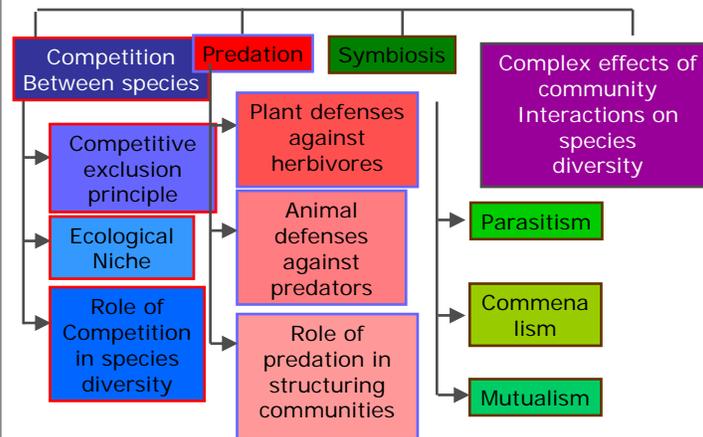


- **Biosphere:** The entire portion of the earth that is inhabited by life. The sum of all the planet's ecosystems.
- **Biomes:** The world's major communities classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment.
- **Community:** A group of populations living in the same area.
- **Population:** A group of individuals in a particular geographic area that belong the same species.
- **Producers:** They are primarily green plants that bring energy into the system by capturing sunlight.
- **Consumers:** An organism in an eco system that lives by eating other organisms.
- **Food Web:** A complex interaction of feeding relationships.
- **Chemical Cycling:** Nature's way of allowing life on Earth access to limited resources by continually transferring the energy from one form to the next.

08: Communities, Ecosystems, and Biomes

- **Primary Succession:** An event in which life begins to exist where no life existed previously.
- **Secondary Succession:** The change in composition of the species which live in an area.
- **Aquatic Ecosystems:** Most of life on Earth lives in the oceans, a poorly understand system of oceans, lakes, streams, rivers, and estuaries.
- **Terrestrial Biomes:** The group of ecosystems which share the same climate, flora, and fauna.

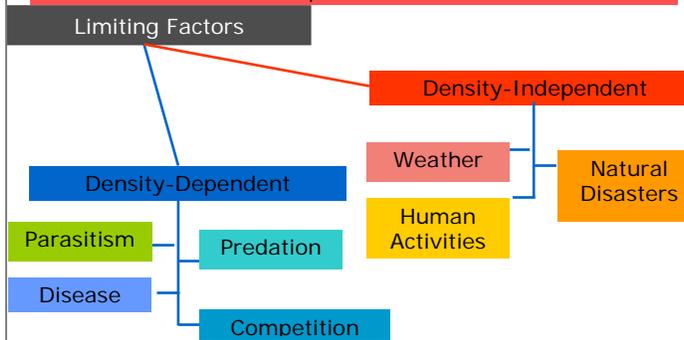
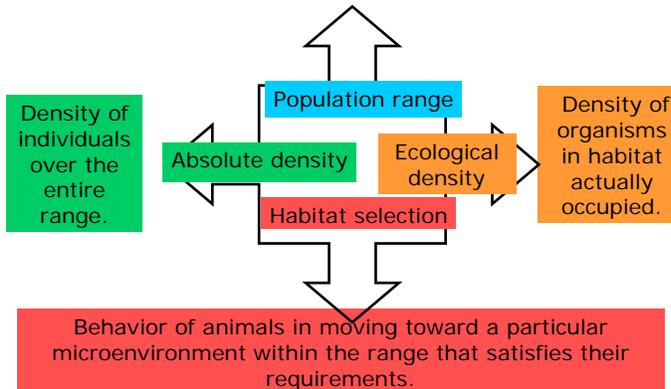
Community Interactions



09: Population Ecology

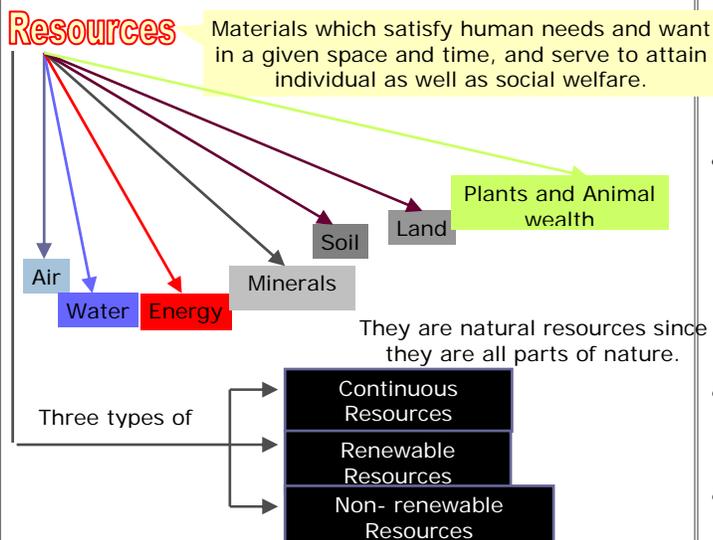
- **Population:** It is a group of individuals of a given species inhabiting a specific geographic area and exhibiting a characteristic density and dispersion.
- **Population Density:** Individuals per unit area or volume.
- **Dispersion:** The pattern of spacing for individuals within the boundaries of the population.

Geographic limits within which a population lives.



10: Conservation Ecology

- **Reforestation:** It is the development of a forest in a deforested area to ensure a sustained yield.
- **Conservation:** It is the safeguarding, maintaining or protecting and wise management of natural resources.



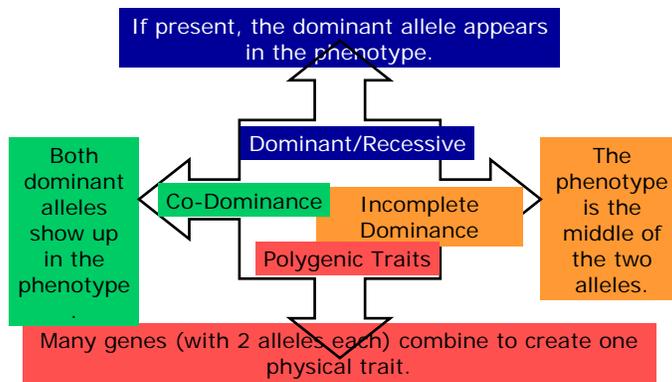
- **Resources:** They are materials which satisfy human needs and wants in a given space and time and serve to attain individuals as well as social welfare.
- **Non Renewable resources:** There is no known process by which they can be renewed quickly. They are available in fixed quantities and too much exploitation would mean their end. Ex: Minerals, ground water.

11: Genetics

- **Chromosome:** where the cell nucleus pack its long stretch of DNA molecule into, it is the functional unit for heredity
- **Meiosis:** A reproductive process which produces two unique haploid cells from one cell. These unique haploid cells are gametes, sex cells for reproduction.
- **Haploid:** Describing a cell which has one entire set of the organism's chromosomes.
- **Diploid:** Describing a cell which has two entire sets of the organism's chromosomes.
- **Cross:** The parents which reproduce together.

**Aa x aa**

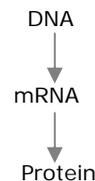
	<b>A</b>	<b>a</b>
<b>a</b>	Aa	aa
<b>a</b>	Aa	aa



12: Nucleic Acids

- **DNA**
  - Is the cellular genetic material
  - Contains two strands based on base pairing between A and T, C and G.
  - The two strands are anti-parallel and form double helix structure
- **RNA Classes:**
  - mRNA: Copies information from DNA through base-pairing mechanism
  - tRNA: carries amino acids to protein synthesis sites
  - rRNA: component for ribosome
  - ncRNA: regulate cellular processes

• **The Central Dogma**

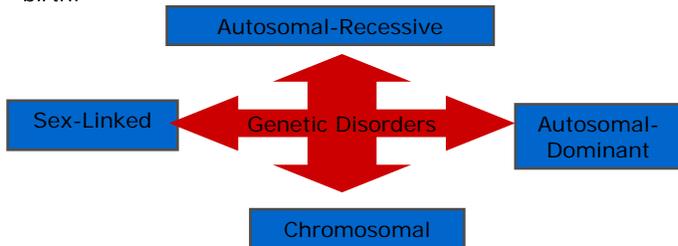


- **Transcription:** RNA polymerase reads DNA and produces pre-mRNA. The pre-mRNA is edited via splicing of exons together to form the mature mRNA which leaves the nucleus to enter the cytoplasm.
- **Translation:** Ribosomes read the mRNA script and tRNA's bring amino acids in order to produce the final gene product, proteins.
- **Causes of Mutation**
  - Errors during DNA replication
  - DNA damage
  - Chromosome errors

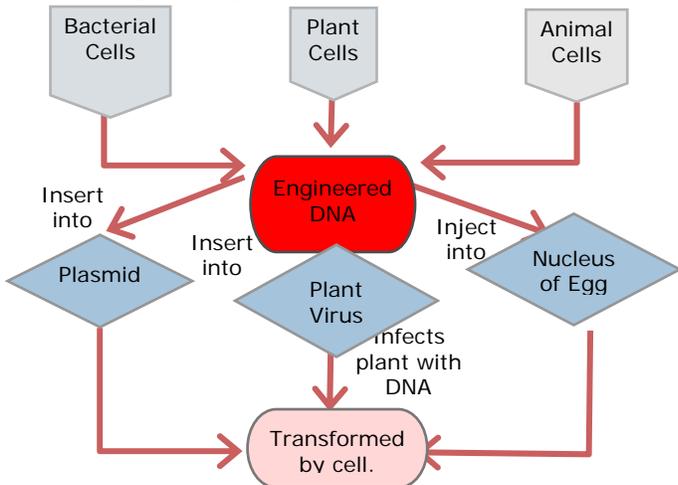
Biology, 4 of 6

13: The Human Genome

- **Autosomal Chromosomes:** Chromosomes that code for the regular human traits.
- **Sex Chromosomes:** Chromosomes that determine sex.
- **Genetic Disorder:** A disease or sickness caused by DNA at birth.



Genetic Engineering



14: Evolution

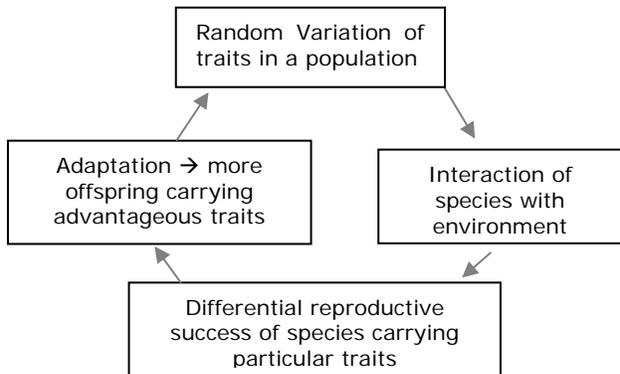
**Heritable Adaptation:** Any inherited trait that ultimately leads to a reproductive advantage of a species.

**Punctuated Equilibrium:** Evolutionary changes occur relatively quickly followed by long periods of stabilization.

**Natural selection:**

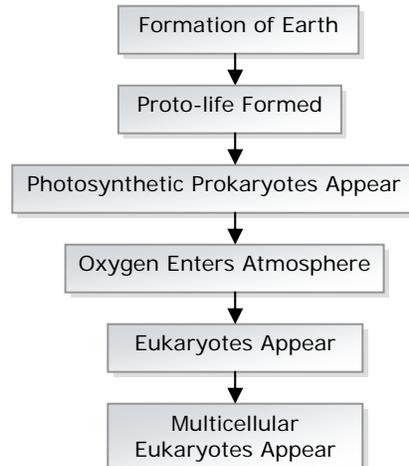
-Natural Selection is a result of a species interaction with the environment, with "selection" being determined by whichever species lives long enough to propagate and thereby be successful.

-Survival of the "Fittest". Fit refers to best fit to environment.



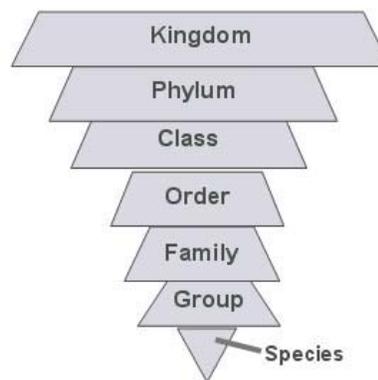
15: Evolutionary History

- **Precambrian Time:** 99% of Earth's history. All of the life history events above happened during this time. Oxygenation of the atmosphere, the first life forms, etc. All life was aquatic.
- **Paleozoic Era:** The first invertebrates and vertebrates. Insects, plants, and reptiles appeared. First movement of organisms onto land.
- **Mesozoic Era:** "The Age of Reptiles." Reptiles became dominant. Mammals appeared. Dinosaurs became extinct.
- **Cenozoic Era:** "The Age of Mammals." Mammals became dominant. Glaciers melted. The climate warmed. Humans appeared.



16: Classification

- **Taxonomy:** The discipline of studying and classifying organisms.
- **Animalia:** A kingdom which includes heterotrophic consumers such as herbivores, carnivores, omnivores, and detritivores.
- **Binomial Nomenclature:** A standard way to refer to the scientific name of an organism by using the genus and species.
- **Phylogeny:** The process of classifying and organizing organisms based on evolutionary relationships.



Five Kingdom System

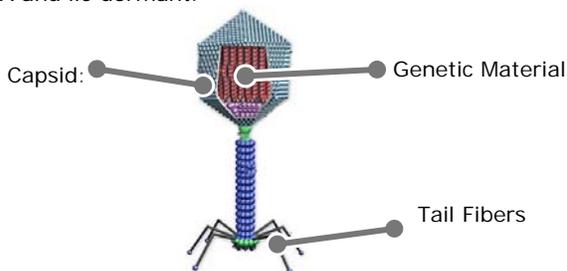
Monera | Protista | Fungi

Plantae | Animalia

Biology, 5 of 6

17: Bacteria and Viruses

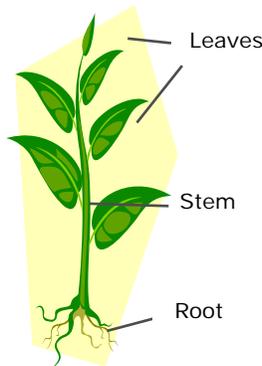
- **Bacteria:** smallest and simplest organisms, scientifically called prokaryotes.
- **Binary Fission:** Asexual reproduction of prokaryotes.
- **Conjugation:** A method of transferring DNA from one bacteria to another using a sex pilus.
- **Transformation:** A method of transferring DNA in which a bacteria picks up DNA from another dead bacteria and integrates the foreign DNA as its own.
- **Transduction:** A method of DNA transfer in which a virus accidentally picks up DNA from one bacteria and injects it into another.
- **Obligate Anaerobes:** bacteria which are unable to grow in the presence of oxygen,
- **Facultative anaerobes:** bacteria which can grow with or without oxygen
- **Aerobic:** bacteria which require oxygen to grow.
- **Lytic Cycle:** A viral life cycle which takes over and kills a host cell in order to make more viruses.
- **Lysogenic Cycle:** A viral life cycle which integrates viral DNA into host DNA in order to be replicated with the host DNA and lie dormant.



18: Plants

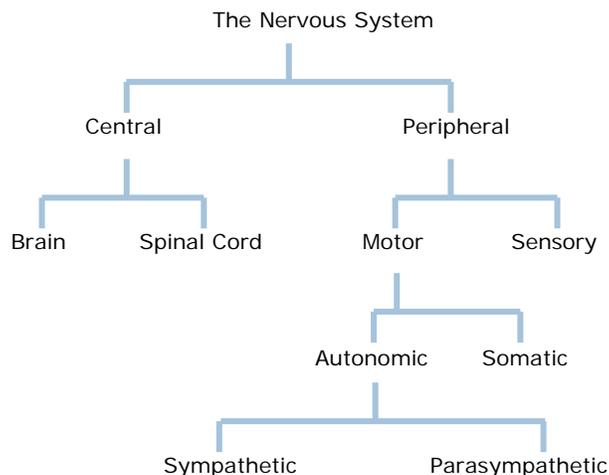
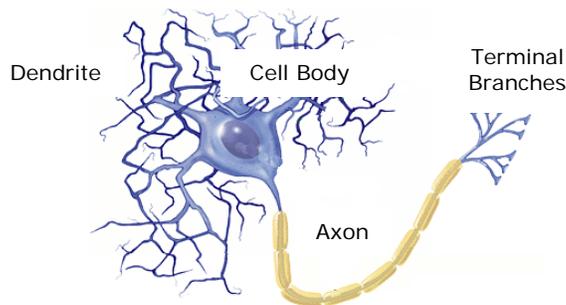
- **Transpiration:** Evaporation via the stomata on the lower surface of leaves pulls up water/minerals from roots. This force makes water to go upwards from root to leaves.
- **Differences between a plant cell and an animal cell**
  - Cell wall: plants have a protective layer of cellulose around the cell membrane known as the cell wall.
  - Large central vacuole: This large organelle maintains the structure of the plant cell by giving a water-filled support.
  - Chloroplast: This organelle allows plants to perform photosynthesis, to absorb sunlight to produce energy.

- ❖ **Root**
  - Usually under the ground
- **Function**
  - Anchor plants to soil
  - Absorb and transport nutrients
- ❖ **Stem**
  - The part of a plant from which shoots and buds arise.
- **Function**
  - Structural support
  - Growth through increase in diameter and elongation
  - Transport of fluids between the roots and the leaves.
- ❖ **Leaves**
  - Photosynthesis: to obtain food from light
  - Transpiration: pulling water up from the roots.

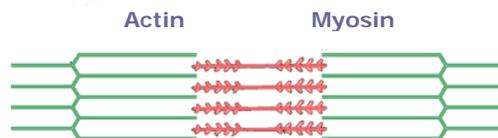
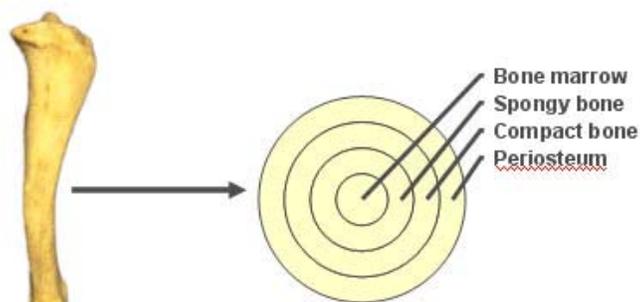


19: The Nervous System

- **Neurotransmitter:** Biological particles which the branches release when an action potential reaches them. Neurotransmitters carry information to the next neuron.



20: The Skeletal, Muscular, and Integumentary Systems



**Skeletal Muscle**

- Attached to bones
- Has stripes = striated
- Powers voluntary movement

**Smooth Muscle**

- Used in intestines
- Not striated
- Powers involuntary movements

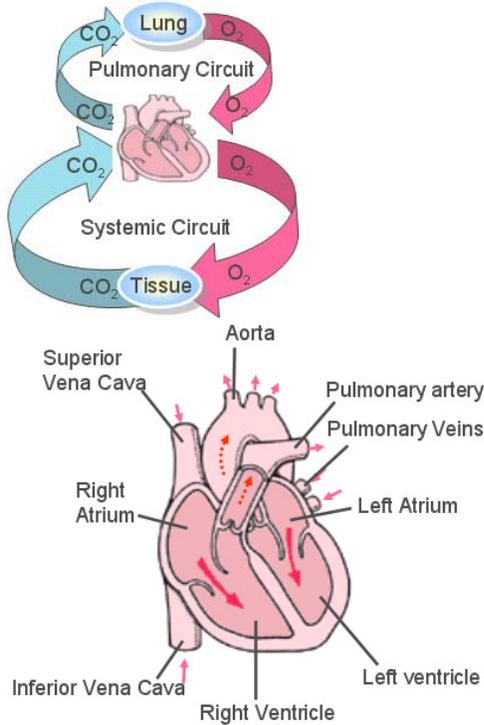
**Cardiac Muscle**

- Found only in the heart
- Striated
- Powers the heartbeat

Biology, 6 of 6

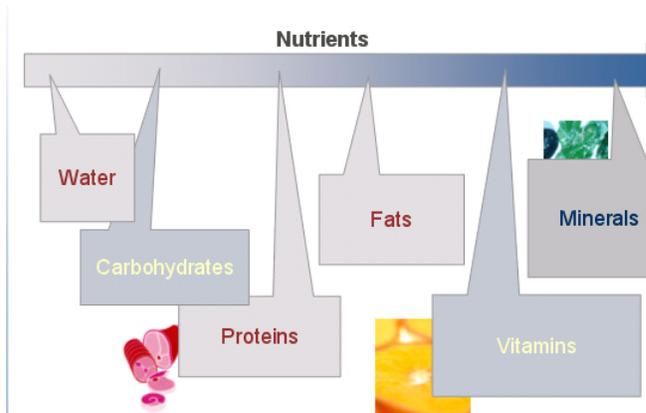
21: Respiratory and Circulatory Systems

- **Respiratory System:** An organ system designed to pick up needed gas and release waste.
- **Circulatory System:** An organ system designed to deliver oxygenated blood through all of the body's cells.



22: The Digestive and Excretory Systems

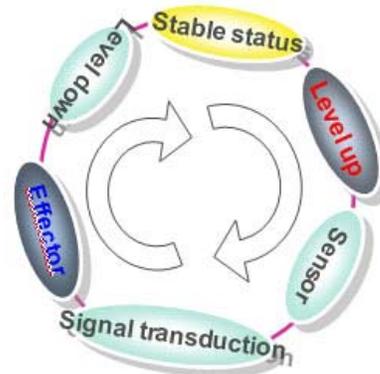
- **Ingestion:** The mouth mechanically breaks down food. The esophagus pushes food down with peristalsis.
- **Digestion:** The stomach stores the food and releases enzymes to break it down. The liver releases bile to help with digestion of large fats. The pancreas releases enzymes to help the small intestine digest food.
- **Bladder:** The storage zone for urine, filtrated waste, to leave the body. enzymes to activate digestion overall.
- **Absorption:** The small intestine takes in food molecules into the blood. The large intestine absorbs water.
- **Elimination:** The waste leaves through the rectum.
- **Skin:** Excretes urea through the surface.
- **Lungs:** Excretes carbon dioxide.
- **Liver:** Detoxifies dangerous compounds.
- **Kidneys:** Filters the blood, keeping necessary amounts of minerals and water while discard extraneous amounts.



23: Endocrine and Reproductive Systems

Endocrine System	vs	Nervous System
Slow Response		Fast Response
Hormones		Electrical Impulses
Long-lasting Effects		Short-lasting Effects

- **Hypothalamus:** controls pituitary to release hormones.
- **Pituitary Gland:** signals other glands to release hormones. Growth hormone.
- **Thyroid:** Releases thyroxine to control metabolism.
- **Parathyroid:** Releases parathyroid hormone to regulate levels of calcium.
- **Adrenal:** "Flight or Fight" response.
- **Pancreas:** Release insulin/glucagon to regulate blood-glucose levels.
- **Gonads:** Release testosterone, estrogen, to stimulate reproductive system changes.
- **Homeostasis:** When the stable status of a body is disrupted, the organ systems sense the change, and by activating signals such as through the nervous or endocrine systems, effectors are activated which returns the body back to the original state.



24: The Immune System

- **Humoral Immunity:** B cells become plasma cells and memory B cells. The plasma cells release antibodies into the blood to kill the pathogen cells. Memory B cells remember the specific antibody needed to defend against the same pathogen.
- **Cell-Mediated Immunity:** Helper T cells bind to already infected body cells and then activate killer T cells. Killer T cells bind to the infected cell and destroy its membrane to kill the infected cell.
- **Physical/Chemical Barriers:** The skin and hair in ears and nose prevent pathogens from entering the body. Chemicals such as saliva, sweat, and oil contain enzymes which destroy pathogens before they spread.
- **Inflammatory Response:** Kills any pathogens in area of damage.

		Function
Macro phages	Phagocytes	Ingest and destroy foreign invaders.
B Cells	Plasma Cells	Produce antibodies and release them into blood.
	Memory	Remember specific pathogens.
	Helper T	Activate Killer T Cells
T Cells	Killer T Cells	Destroy infected cells of the body

