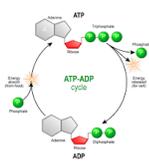


Biology 1: Cells as a System (H.B.2)

H.B.2A

I. Chemical reactions in cells: 4 groups of biological/organic molecules (all contain C, H, O)

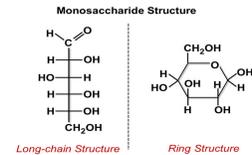
A. Energy - Cells store energy within the bonds of chemical molecules



1. Larger molecules have more bonds, and more potential to release energy
2. Animals get energy from food. Cells undergo respiration to break down food to produce energy.
3. Plants use the sun's energy to make food (photosynthesis)
4. ATP is the cell's preferred source of energy. (Adenosine triphosphate)
 - a) ADP (Adenosine diphosphate) a source of energy, but less
 - b) AMP (Adenosine monophosphate) a source of energy, but less
5. Produced by the mitochondria

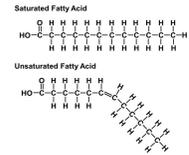
B. Carbohydrates - found in sugars, breads, rice, potatoes, pasta (starchy foods)

1. Building blocks: C, H, O found in 1:1 ratio
2. Saccharides: Mono (1), Poly (many)
3. Begin digestion in the mouth (salivary amylase)
4. Quick source of energy
5. Stored in plastids.

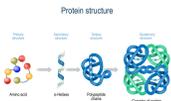


C. Lipids - found in fats and oils (butter), do not dissolve in water (insoluble)

1. Building blocks: Long chains of carbons and hydrogens
2. Fatty acid chains, glycerol
3. Saturated (all single - bonds), Unsaturated (at least 1 double = or triple bond \equiv)
4. Long term source of stored energy
5. Make up cell membranes (phospholipids: hydrophilic heads, hydrophobic tails)



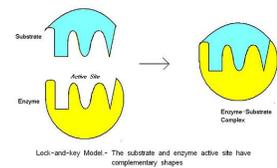
D. Proteins - found in meats, nuts (make up hormones, connective tissues, neurological messaging, immunity, etc.)



1. Building blocks-Long chains of amino acids bound by peptide bonds
2. Different shapes: primary, secondary, tertiary, quaternary (protein folding)
3. Metabolism based on proteins, Cellular communication,
4. Central Dogma: DNA \rightarrow RNA \rightarrow (Amino Acid) \rightarrow Protein
5. Why do cells need to make proteins when we eat proteins?

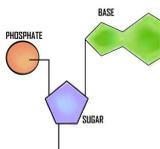
Our food may not contain the exact ratio of amino acids we need, so we eat protein, it is broken down into amino acids, then our cells make the proteins in the ratio we need. (there are only 20 amino acids that make all proteins.)

6. Made by ribosomes
7. Enzymes are proteins that speed up chemical reactions (catalysts)
 - a) end in **-ase** (amylase, lactase, galactase)
 - b) Reduce required activation energy
 - c) Affected by temperature, pH, surface area
 - d) Lock and key model (enzymes are specific)



E. Nucleic Acids - 2 types: Deoxyribonucleic Acid (DNA) and Ribonucleic Acid (RNA)

1. Carries the cell's genetic (hereditary) information.
2. Building blocks-Nitrogenous base, Sugar, Phosphate Group
3. DNA found in cell nuclei (DNA replication)
 - a) Sugar is deoxyribose
 - b) Double-stranded shape (twisted ladder, "double helix")
 - c) Adenine - Thymine, Cytosine - Guanine are the nitrogenous bases (held by hydrogen bonds)
4. RNA leaves nucleus to cytoplasm; Sugar is ribose
 - a) Sugar is ribose
 - b) Single chain
 - c) Adenine - Uracil, Cytosine - Guanine are the nitrogenous bases (held by hydrogen bonds)



H.B.2B

II. Cells are the structural units of all living things.

A. Cell Theory

- a. All living things are made of cells.
- b. Cells are the basic unit of structure of living things.
 - i. Schleiden studied plants, Schwann studied animals
- c. All cells come from pre-existing cells
 - i. Virchow studied cell division

B. Cells have organelles, "tiny organs," that perform functions

- a. Cell Membrane (Plasma Membrane) made of 2 layers of phospholipids positioned tail-to-tail.
 - i. "selectively permeable"
 - ii. Cytoskeleton-fibrous proteins that help cells maintain shape, support, and movement
- b. Nucleus-contains the cell's genetic material
 - i. Chromosomes
- c. Endoplasmic Reticulum (rough ER has ribosomes, smooth ER does not)
- d. Ribosomes-responsible for protein synthesis (some free, some attached to ER)
- e. Golgi complex-collects, packages, modifies cell products such as proteins and lipids
- f. Vesicles-carry proteins from rough ER to Golgi apparatus

C. There are 2 different types of cells.

- a. Eukaryotic Cells have a membrane-bound nucleus and other membrane-bound organelles.
 - i. Plants, animals, protists, and fungi have eukaryotic cells.

1. Plant Cells-have a cell wall made of cellulose that surrounds the cell membrane.

- i. Cell wall is not selectively permeable
- b. Contain all organelles listed in section B, above, plus those below
- c. Central vacuole (large) for water storage
- d. Plastids
- e. Chloroplasts
- f. Mitochondria (few of these in plants)

2. Animal Cells

- a. Contain all organelles listed in section B, above, plus those below
- b. Have no cell wall
- c. Vacuoles (smaller) for water storage
- d. Mitochondria-where respiration occurs, sugar broken down to energy
 - i. If insufficient oxygen, fermentation occurs instead

3. Protist Cells

- a. May be plant-like, animal-like, or fungal-like

4. Fungal Cells

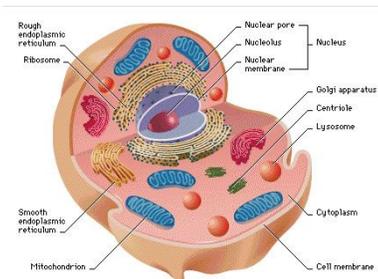
- a. Have cell walls made of chitin
- b. May have several nuclei within a single cell
- c. Do not make their own food, have no chloroplasts

- b. Prokaryotic Cells are much smaller than than eukaryotic cells

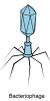
- i. Bacterial cells are prokaryotic cells.
- ii. Do not have mitochondria, but obtain energy from sunlight or chemicals in their environment

D. Viruses: they are not cells.

- a. Non-living particles
- b. Smaller than prokaryotic cells
- c. Have no cytoplasm or organelles
- d. They do not grow or divide
- e. They reproduce after they enter a living cell (a host cell) and use its ribosomes, enzymes, ATP, and other molecules to reproduce.
- f. Viruses can cause disease: common cold (adenovirus), influenza, coronavirus, and HIV



Types of viruses



H.B.2C

III. Cell Transport - the movement of materials into and out of cells in order to maintain homeostasis.

A. Passive transport-no energy required, occurs with the concentration gradient

a. Diffusion - movement of O_2 , CO_2 from high to low concentration (with)

i. Removal of cellular waste

ii. Osmosis - movement of water from high to low concentration (with)

1. Cell in a hypertonic solutions-water moves out (cell shrinks)

2. Cell in a hypotonic solutions-water moves in (cell swells, may burst)

3. Cell in an isotonic solution-water and solutes are balances, no net movement

b. Facilitated diffusion - movement of very small molecules across the cell membrane with assistance

i. Glucose and amino acids move in this way

ii. Uses membrane proteins to help (facilitate) movement, but no energy.

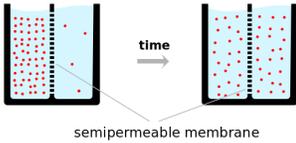
B. Active transport-energy required to "pump" large molecules across the membrane, occurs against the concentration gradient, requires the use of transport proteins

a. Ion Pump - movement of Ca^{+2} , K^+ , Na^+ ions from low to high concentration

b. Phagocytosis - movement that involves the pinching off of cell membrane in order for movement to occur

i. Endocytosis - phagocytosis into a cell

ii. Exocytosis - phagocytosis out of the cell



H.B.2D

IV. Multicellular organization

A. Cells make tissues, which make organs, which make organ systems, which make the organism function

B. Cell cycle

a. Interphase: period of cell growth

i. G1: growth

ii. S-DNA synthesis

iii. G2: growth and preparation for division

b. Mitosis: cell division

i. Prophase-Chromosomes pair up

ii. Metaphase-Chromosomes line up at the equator

iii. Anaphase-Sister chromatids begin to pull chromatids apart

iv. Telophase-Cytoplasm pinches together to form new cells

v. Cytokinesis-Cell plate grows b/w new plant cells; cleavage furrow develops b/w animal cells

c. Cell cycles are regulated by checkpoints (often proteins)

i. Different type of cells divide at different speeds (skin more frequent than bone)

1. Cells in contact with one another stops division

2. Cells don't grow in layers

ii. White blood cells may detect and destroy cells that are dividing out of control

iii. Certain chemicals (carcinogens) and radiation exposure can alter cell regulation.

C. Abnormalities in the cell cycle

a. Cancer is a disease caused by uncontrolled cell division, usually forming a tumor

i. Benign tumors do not separate from the original tumor, don't spread to other parts of the body

ii. Metastatic tumors have cells that can separate and be carried through the bloodstream to other parts of the body.

D. Stem Cells

a. Embryonic Stem Cells: Most multicellular organisms begin from a sperm cell (haploid) and an egg cell (haploid) that fuse to form a zygote (single diploid cell). The zygote divides rapidly to become a ball of cells called an embryo. The cells of the embryo are undifferentiated-no specific type, can become ANY cell type - embryonic stem cells.

i. Embryonic stem cells can be used to test new medications, treat diseases

b. Adult stem cells: some cells remain mostly undifferentiated for many years

i. Can grow into some cell types, not all

ii. Examples: bone tissue from bone marrow cells, spinal cord after injury, cells of the pancreas that produce insulin to treat diabetes

