

Define Cell

- * The cell is the basic structural and functional unit of life.
- * Organismal activity depends on individual and collective activity of cells.
- * Biochemical activities of cells are dictated by sub-cellular structure (principle of complementary of structure and function).
 - * Continuity of life has a cellular basis
 - * is the smallest living unit.
 - * over 200+ different cell types!

List the 3 major regions of a generalized or composite cell and indicate the function of each.

1. Plasma Membrane: fragile barrier, is the outer boundary of the cell.
2. Cytoplasm: internal to this membrane, intracellular fluid that's packed with organelles, small structures that perform specific cell functions.
3. Nucleus - controls cellular activities and typically it lies near the cell's center.

Describe the chemical composition of the plasma membrane and relate it to membrane functions.

- * separates intracellular fluids from extracellular fluids
 - * plays a dynamic role in cellular activity
- * Glycocalyx is a glycoprotein area abutting (next to) the cell that provides highly specific biological markers by which cells recognize or another.
 - * differ in the kind and amount of lipids they contain.
- * Glycolipids are found only in the outer membrane surface.
 - * 20% of all membranes lipid is cholesterol.

Compare the structure and function of tight junctions, desmosomes, and gap junctions.

1. Tight Junction: impermeable (not loose) junction that encircles (surround) the cell.
2. Desmosome - anchoring (to be held, surround, or secure) junction scattered along the sides of cells. "strong"
3. Gap Junction - a nexus (connection) that allows chemical substances to pass between cells.

Relate plasma membrane structure to active and passive transport mechanisms. Differentiate between these transport processes relative to energy source, substances transported, direction, and mechanism.

- diffuse directly throughout the lipid bilayer

- diffuse through channel proteins

* facilitated diffusion

- transport of glucose, amino acids, and ions

- transported substances bind carrier proteins or pass through protein channels

* Passive Membrane Transport: Osmosis

- occurs when the concentration of a solvent is different on opposite sides of a membrane

- diffusion of water across a semipermeable membrane

- osmolarity - total concentration of soluble particles in a solution

- tonicity - how a solution affects cell volume

* Passive Membrane Transport: Filtration

- the passage of water and solutes through a membrane by hydrostatic pressure

- pressure gradient pushes solute-containing fluid from a higher-pressure area to a lower-pressure area

* Active transport

- Uses ATP to move solutes across a membrane.

- Requires carrier proteins.

- symport system: 2 substances are moved across a membrane in the same direction

- antiport system: 2 substances are moved across a membrane in opposite directions

- primary active transport: hydrolysis of ATP phosphorylates the transport protein causing conformational change

- secondary active transport: use of an exchange pump (such as the Na⁺ - K⁺ pump) indirectly to

Define membrane potential and explain how the resting membrane potential is maintained.

- voltage across a membrane
 - resting membrane potential - the point where K^+ potential is balanced by the membrane potential
 - ranges from -20 to -200 mV (millivolts)
 - results from Na^+ and K^+ concentration gradients across the membrane
 - differential permeability of the plasma membrane to Na^+ and K^+
 - steady state: potential maintained by active transport of ions
- ** page 3 on generation and maintenance of membrane potential slide, important! ** power point

Describe the role of the glycocalyx when cells interact with their environment.

The glycocalyx enables certain bacteria to resist phagocytic engulfment by white blood cells in the body.

List several roles of membrane receptors and that of voltage-sensitive membrane channel receptors.

- contact signaling: important in normal development and immunity
- electrical signaling: voltage-regulated "ion gates" in nerve and muscle tissue
- chemical signaling: neurotransmitters bind to chemically gated channel-linked receptors in nerve and muscle tissue
- G protein-linked receptors - ligands bind to a receptor which activates a G protein, causing the release of a second messenger, such as cyclic AMP.
 - * operation of a G protein
 - an extracellular ligand (first messenger), binds to a specific plasma membrane protein
 - the receptor activates a G protein that relays the message to an effector protein
 - the effector is an enzyme that produces a second messenger inside the cell
 - the second messenger activates a kinase
 - the activated kinase can trigger a variety of cellular responses

Describe the composition of cytosol; define inclusions and list several types.

cytosol: largely water with dissolved protein, salts, sugars, and other solutes
* inclusions - chemical substances such as glycosomes, glycogen granules, and pigment

Discuss the structure & function of mitochondria

- double membrane structure with shelflike cristae
- provide most of the cell's ATP via aerobic cellular respiration
 - contain their own DNA and RNA

Discuss the structure and function of ribosomes, the endoplasmic reticulum, and the golgi apparatus including functional relationships among the organelles.

Ribosomes

- * granules containing protein and rRNA
 - * site of protein synthesis
- * free ribosomes synthesize soluble proteins
- * membrane-bound ribosomes synthesize proteins to be incorporated into membranes

Endoplasmic Reticulum (ER)

- * interconnected tubes and parallel membranes enclosing cisternae
 - * continuous with the nuclear membrane
 - * 2 varieties - rough/smooth ER

Golgi Apparatus

- * stacked & flattened membrane sacs
 - * functions in modification, concentration, and packaging of proteins
- * transport vessels from the ER fuse with the cis face of the Golgi apparatus to the trans face
- * secretory vesicles leave the trans face of the Golgi stack and move to designated parts of the cell

Compare the functions of lysosomes and peroxisomes

Lysosomes:

- * spherical membranous bags containing digestive enzymes
 - * digest ingested bacteria, viruses, and toxins
 - * degrade nonfunctional organelles
- * breakdown glycogen and release thyroid hormone
 - * breakdown nonuseful tissue
 - * breakdown bone to release Ca^{2+}
- * secretory lysosomes are found in white blood cells, immune cells, and melanocytes

Peroxisomes

- * membranous sacs containing oxidases and catalases
 - * detoxify harmful or toxic substances
 - * neutralize dangerous free radicals
- * free radicals- highly reactive chemicals with unpaired electrons (i.e., O_2^-)

Name and describe the structure and function of cytoskelton elements.

- * The "skeleton" of the cell
 - * Dynamic, elaborate series of rods running through the cytosol.
 - * Consists of micro tubules, micro filaments, and intermediate filaments.

Describe the roles of centrioles in mitosis and in the formation of cilia and flagella.

Centrioles

- * small barrel-shaped organelles located in the centrosome near the nucleus
 - * pinwheel array of 9 triplets of microtubules
 - * organize mitotic spindle during mitosis
 - * form the bases of cilia and flagella

Cilia

- * whiplike, motile cellular extensions on exposed surfaces of certain cells
 - * move substances in 1 direction across cell surfaces.

Flagella

- * when the projections formed by centrioles are substantially longer, they are called flagella.

Ex: sperm "tail".

- * NOTICE that cilia propel other substances across a cell's surface, where a flagellum propels the cell itself. *

Outline the structure and function of the nuclear envelope, nucleolus, and chromatin.

Nuclear Envelope

- * selectively permeable double membrane barrier containing pores
- * encloses jellylike nucleoplasm, which contains essential solutes
- * outer membrane is continuous with the rough ER and is studded with ribosomes
- * inner membrane is lined w/ the nuclear lamina, which maintains the shape of the nucleus
- * pore complex regulates transport of large molecules into and out of the nucleus

Nucleoli (Nucleolus) "little nuclei"

- * dark-staining spherical bodies within the nucleus
- * site of ribosome production

Chromatin

- * threadlike strands of DNA and histones
- * arranged in fundamental units called nucleosomes
- * form condensed, barlike bodies of chromosomes when the nucleus starts to divide

List the phases of the cell life cycle and describe the key events of each phase.

* Interphase

- Growth (G1), synthesis (s), growth (G2)
- mitotic phase-- mitosis and cytokinesis

* interphase

G1 (gap 1) metabolic activity and vigorous growth

G0 - cells that permanently cease dividing

S (synthetic) - DNA replication

G2 (gap 2) - preparation for division

Describe the process of DNA replication

- * DNA helices begin unwinding from the nucleosomes
- * helicase untwists the double helix and exposes complementary strands
 - * the site of replication is the replication bubble
- * each nucleotide strand serves as a template for building a new complementary strand
 - * the replisome uses RNA primers to begin DNA synthesis
- * DNA polymerase III continues from the primer and covalently adds complementary nucleotides to the template
 - * Since DNA polymerase only works in 1 direction:
 - a continuous leading strand is synthesized
 - a discontinuous lagging strand is synthesized
 - DNA ligase splices together the short segments of the discontinuous strand
 - 2 new telomeres are also synthesized
 - this process is called semiconservative replication

Describe gene & genetic code and explain the function of genes

Gene - as a segment of a DNA molecule that carries instructions for creating 1 polypeptide chain.

* the 4 nucleotides bases (A,G, T and C) are the "letters" used in the genetic dictionary, and the information of DNA is found in the sequence of these bases.

Genetic Code-

RNA codons code for amino acids according to a genetic code.