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ANP 1105

Topic(s) 1 & 2

Structural Organization of the Human Body

Atom: Smallest particle of an element w/ all the properties of an element.

Molecule: Smallest amount of a substance that can exist individually

Organelle: Composed of molecules - ex: Nucleus

Cell: Fundamental structural & functional unit of a living 'thing': Vary in size/shape.

Tissue ⟶ Groups of similar cells with common functions.

1. Epithelium 2. Muscle 3. Connective Tissue (CT) 4. Nervous Tissue

Organ: Structure composed of at least 2, usually 4 tissue types; that performs a specific function for the body.

Organ System: Organs that work closely w/ one another to accomplish a common purpose.

<u>Cells are the basic unit of life</u>

Epithelial cells: Cells that connect body parts, form linings, or transport gases.

Skeletal Muscle cells: Cells that move organs and body parts.

Fat cell: Cells that store nutrients

Macrophage: Cell that fights diseases

Nerve cell: Cell that gathers information and controls body functions

Sperm: Cell of reproduction

Nucleus → Control center of the cell. Contains the genetic inheritance for that cell in the form of instructions for all possible proteins that the cell can make.

Plasma membrane → Encloses the cell, separating the intracellular fluid from the extracellular fluid. It is also selectively permeable (semi).

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Cytoplasm → Fills the space between the nucleus and the plasma membrane. Organelles are a part of the cytoplasm.

The cytoplasm consists of 3 components:

1) Cytosol: Vicious fluid in which other components are suspended; composed of water plus proteins, salts, sugars and other solutes.
2) Organelles: Structures that carry out the metabolic activities of the cell such as protein synthesis, ATP production, digestion.
3) Inclusions: Cell-type dependant; may be storage forms of important molecules. Ex: lipid droplets (fat cells)

Organelles & their functions:

Mitochondria: They are organelles that act like a digestive system which takes in nutrients, breaks them down, and create energy rich molecules for the cell. The biochemical processes of the cell are known as cellular respiration.

Ribosome: Ribosomes are a cell structure that makes protein.

Rough ER: Main function is to produce proteins

Smooth ER: The main function of the smooth ER is to make cellular products like hormones and lipids.

Golgi Apparatus: A major function is the modifying, sorting and packaging of proteins for secretion. It is also involved in the transport of lipids around the cell, and the creation of lysosomes:

Peroxisome: Break down fatty acids to be used for forming membranes and as fuel for respiration; and transfer hydrogen from compounds to oxygen to create hydrogen peroxide and then convert hydrogen peroxide into water.

Lysosome: One of the key organelles involved in digestion and waste removal is the lysosome

The cytoskeleton provides structural support, permits shape changes and allows movement.

1. Microfilaments: Strands made up of spherical protein subunits called actin. They have roles in cell movement, muscle contraction, and cell division.
2. Intermediate filaments: Tough, insoluble protein fibers - composed of tetramer fibrils. The most important function of intermediate filaments is to provide mechanical support for the plasma membrane where it comes into contact with other cells or with the extracellular matrix.
3. Microtubules: Hollow tubes of spherical protein subunits called tubulin. Main function is to help support and give shape to the cell. They also serve a transportation function, as they are the routes upon which organelles move through the cell.

Histology: The study of tissues & their cellular organization.

Tissues: Groups of structurally similar cells that perform common/related functions.

- Epithelial → covering
- Connective → support
- Muscle → movement
- Nervous → control (regulation)

1) **Epithelial tissue**

A sheet of cells that cover the body's surface or lines a body cavity.

Functions: Protection (skin), absorption (GI Tract), filtration (kidney), excretion (kidney), secretion (glands), sensory reception (taste buds).

Characteristics:

Polarity: Epithelial cell polarity is characterized by cells with apical and basolateral membrane domains separated by adherens and tight junctions

Specialized contacts: Tight junctions & desmosomes

Supported by CT: Basement membrane is composed of basal lamina sitting on top of a reticular lamina.

Innervated but avascular: even though epithelium is avascular (contains no blood vessels), it's still innervated (supplied by nerve fibers)

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Regeneration: High regenerative capacity because its apical surface is exposed to the environment and in order to replace cells that are damaged or lost the epithelial cells undergo mitosis frequently .

Simple squamous epithelium: Thin & permeable - filtration, diffusion.
e.g. endothelium and in kidney and lungs

Simple cuboidal epithelium: Secretion & absorption
e.g. kidney tubules, small glands

Simple columnar epithelium: Digestion & secretion
e.g. digestive tract

Pseudostratified (ciliated) columnar epithelium: Single layer - e.g respiratory tract where cilia and mucus secretion are local specializations - but has the appearance of a stratified epithelium.

A **stratified squamous epithelium** consists of squamous (flattened) epithelial cells arranged in layers upon a basal membrane. They are found in nearly every organ system where the body comes into close contact with the outside environment – from the skin to the respiratory, digestive, excretory and reproductive systems. They also protect the body from desiccation and water loss.

Transitional epithelium (stratified epithelium that is a mix of columnar and squamous cells): Lines the bladder, an organ that has to fill - the basal layers are cuboidal in shape and the apical layers become increasingly flattened & squamous - like a filling.

Gland: One or more cells that make & secrete a particular product.

1) **Endocrine glands:** lose their ducts during development. They secrete hormones into the interstitial fluid. Products are called hormones.
2) **Exocrine glands:** retain the connecting cells, which form a duct that transports secretions to the epithelial surface.
   e.g mucus, sweat, liver
   a) **Unicellular exocrine glands**
      - No ducts
      - Goblet cells (digestive & respiratory tracts)
   b) **Multicellular exocrine glands**
      - Epithelium derived duct
      - Secretory cells

- Surrounded by supportive CT which brings blood vessels & nerves

Secretory method:

Merocrine/eccrine: exocytosis // most common type.

e.g. pancreas, salivary glands, most sweat glands.

Holocrine: cell rupture; only sebaceous glands.

Apocrine: cell apex pinches off with secretory product.

Connective Tissue (CT):

Structural elements in the Connective Tissue:

a) Ground substance: interstitial fluid + cell adhesion proteins & proteoglycans
   - Fibronectin, laminin - helps attach CT elements
   - Proteoglycans: a compound consisting of a protein bonded to glycosaminoglycan groups

b) Fibers:
   - Collagen fibers: high tensile strength
   - Elastic fibers: elastin has coiled structure to allow stretch + recoil
   - Reticular fibers: thin collagen protein; fine network to support blood vessels, soft tissues.

Cells 

Blasts are actively dividing/synthesizing cells during growth & repair.

Cytes primarily provide a level of maintenance.

TISSUE TYPE	"BLAST"	"CYTE"
CT proper	fibroblast	fibrocyte
Cartilage	chondroblast	chondrocyte
Bone	osteoblast	osteocyte
Blood	hemocytoblast	RBCs, WBCs, platelets

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Types of Connective Tissue (CT)

1) **Mesenchyme:** first tissue formed from mesoderm germ layer - mesenchymal cells + fluid ground substance & fine fibrils.
2) **Connective Tissue Proper**
   a) **Loose CT:** Three types:
      - **Areolar CT:** the function is to cushion organs, immunity & inflammation and for a fluid reservoir. They are widely distributed under the epithelia of the body. Loose arrangement of fibers; reservoir of water & salts but is also a prime site of edema during inflammatory reactions. It is a gel like matrix with all 3 fiber types;
      - **Adipose Tissue:** fat-filled adipocytes with a displaced nuclei; they do not reproduce; the function is a fuel reservoir,provides insulation and supports & protects organs. It is found under the skin, around kidneys, eye balls.
      - **Reticular CT:** Alike to areolar CT although composed of reticular fibers. They are found in the lymphoid organs (lymph nodes, bone marrow) - and their main function - fibers form soft internal skeleton that supports free blood cells.
   b) **Dense CT:** Three types:
      - **Dense regular CT:** main function is attachment with strength, found in tendons, ligaments also aponeuroses.
      - **Dense irregular CT:** main function is to withstand tension exerted in many directions, found in the dermis, submucosa of digestive tract, fibrous (made of fibers) capsules of organs & joints.
      - **Elastic CT:** alike dense regular CT although has a very high concentration of elastic fibers; found in some elastic ligaments.

Cartilage CT → avascular, collagen fibers (can have elastic fibers), up to 80% H_2O.

Bone CT → calcium salts give hardness & strength for support & protection of softer tissue.

- **Osteoblasts:** cells that form new bone, come from the bone marrow, 1 nucleus.
- **Osteocytes:** a bone cell, formed when an osteoblast becomes embedded in the matrix it has secreted.
- **Osteoclasts**: are the cells that degrade bone to initiate normal bone remodeling and mediate bone loss in pathologic conditions by increasing their resorptive activity.

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Blood CT → classified as CT because it consists of cells. Surrounded by nonliving fluid matrix, blood plasma. Fiber components are soluble protein molecules.

Topic 2 Part 1

The **fluid mosaic model** describes the structure of the plasma membrane as a mosaic of components —including phospholipids, cholesterol, proteins, and carbohydrates—that gives the membrane a fluid

Phospholipid bilayer → The fundamental structure of the plasma membrane is a phospholipid bilayer which act as a barrier and carry out other specific roles in the cell.

1. Integral membrane proteins - span PM (transmembrane); hydrophilic & hydrophobic regions; channels, carriers.
2. Peripheral proteins: attached to integral proteins, can be enzymes, involved in attachment functions, shape changes.
3. Cytoskeleton: anchors to the plasma membrane
4. Glycocalyx: mix of carbohydrates attached to lipids and proteins on outer face - ‘sugar coat’ on plasma membrane; allows the cells to recognize one another.
5. Cholesterol: reduce general membrane fluidity & stabilizes its structure - 20% of membrane lipid - too much causes to lose its flexibility.

Functions of the Plasma Membrane Proteins:
Transport, intercellular joining, enzymatic activity, cell-cell recognition, receptors for signal transduction, attachment to ECM (extracellular matrix)

Tight junctions: Fusion of adjacent plasma membrane to prevent passage of molecules.

Desmosomes: anchoring junctions; molecular linking of cells to resist mechanical stress plaque, linker protein (cadherins), keratin filaments. They are found in tissues that experience

intense mechanical stress, such as cardiac muscle tissue, bladder tissue, gastrointestinal mucosa, and epithelia.

Gap Junctions: molecular channels between cells to allow passage of cytoplasmic molecules. Each set of six connexins is called a connexon and forms half of the gap junction channel. Therefore, one gap junction channel is composed of 2 aligned connexons and 12 connexins. Electrically-excitable tissues → used to transmit signals between different parts of cell. Signals are generated by opening or closing of ion channels at one point in the membrane, producing a local change in the membrane potential.

Functions of the Plasma Membrane:

1. Effective barrier between the intracellular and extracellular fluids.
2. Selectively permeable
3. Allows the cell to respond to changes in the extracellular fluid.
4. Site of cell-to-cell interaction & recognition.

Transport types across the Plasma Membrane:

A. Passive Processes

- Diffusion: tendency of molecules or ions to scatter evenly throughout the environment. Kinetic energy is directly proportional to the rate of diffusion.
  The higher temperature = higher kinetic E.

Plasma Membrane is a hydrophobic barrier: to transverse the PM a molecule must be lipid-soluble or have access to a channels or transporters.

- Simple diffusion → no carriers needed if it is lipid soluble. Has to be non-polar: ex: O2, CO2, fats, urea, alcohol.
- Facilitated diffusion → water soluble substances require help to transverse the PM. Not ATP-Requiring, limited by carrier/chanel saturation, movement down concentration gradient, can be inhibited by certain substances.

1) **Carrier-Mediated Facilitated Diffusion:** lipid-insoluble molecules too large to pass through the membrane pores/channels. Glucose!
2) **Channel-Mediated Facilitated diffusion:** selective due to pore size & charges of the amino acids that line the channels. Some are always open (leakage channels), opening

of others is regulated (gated channels). Movement is always down the concentration gradient, can be inhibited and can show saturation & usually is very specific.

Active Transport: requires a carrier: combines specifically & reversibily w/ a substance. Unlike facilitated diffusion, solute pumps move substance AGAINST concentration gradient.

a) Symport: Na & Amino acids or glucose, Na,K, 2Cl cotransporter.
b) Antiport: Na/K ATPase

Primary active transport - the Na/K pump:

- [K+] 10-20x higher inside cell than outside. [Na+] higher outside than inside.
- Gradient essential to maintain normal cell function/responsiveness/volume
- Maintenance of this gradient is challenged by:
    a) Slow leakage of K+ and Na+ along their concentration gradient
    b) Stimulation of muscle & nerve cells.
- Na/K ATPase functions continuously to maintain Na+ & K+ gradients
- 3 Na ions are pumped out for every 2 K ions pumped in moving against CG.

Secondary active transport [antiporter]: cotransport of amino acids, ions:

- Transport of a solute is NOT coupled directly to energy-yielding reactions
- e.g transport of an ion or amino acid as Na leaks back into the cell along its concentration gradient

Vesicular Transport:

a) **Exocytosis:**
    - Secretion of hormones, neurotransmitters, mucus, ejection of waste.
    - Substance is enclosed in a vesicle, vesicle proceeds to PM, fuses with the PM, ruptures, releasing content outside of cell.
b) **Endocytosis:**
    - Large particles that can enter a cell; ATP-requiring, energy for vesicle movement.
    - Vesicle encloses substance; pinches off & moves into the cytoplasm where contents may be digested; may also traverse cell to exit at the other side.

- Receptor-mediated endocytosis: also called clathrin-mediated endocytosis, is a process by which cells absorb metabolites, hormones, proteins – and in some cases viruses – by the inward budding of the plasma membrane (invagination).

Osmosis: unassisted diffusion of a solvent such as water through a specific channel protein (aquaporin) or through the lipid bilayer.

- Polar - but small enough for most pores.

Osmolarity: total concentration of solute particles in a solution.
Tonicity: ability of solution to change the shape of a cell bathed by that solution - key particles are nonpenetrating solute particles. Usually described as hypertonic, hypotonic, isotonic.

Neuron Cell Body

- Large, spherical nucleus, granular cytoplasm
- Contains Nissl bodies - these granules are of rough endoplasmic reticulum (RER) with rosettes of free ribosomes, and are the site of protein synthesis.

Neuron Processes

A) Dendrites (Receptive region):
    - Short, tapering, branched, extensions, usually hundreds/cell body. Enormous SA for reception from other neurons. Conduct impulses towards the cell body. Short distance, graded potentials.

B) Axon (Impulse generating and conducting region):
    - Arises from axon hillock, rate of conduction increases with the axon diameter.
    - Axon has the same organelles as the cell body, although no Nissl bodies ; axons quickly degenerate if cut.

Anterograde transport refers to motion from the center of the cell to the periphery, and is accomplished by the motor protein kinesin. (Mitochondria, cytoskeletal elements)
Retrograde transport shuttles molecules/organelles away from axon termini toward the cell body. (primarily organelles to be degraded/recycled)

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Fundamental Principles of Electricity:

Voltage: electrical potential energy due to seperation [PM] of oppositely-charged particles (ions) [-70mV for many neurons]

Resting Membrane Potential (RMP): all cells polarized; value of RMP is cell-type dependent (negative) -70mV for a neuron usually.

Current: flow of electrical charge

At rest - the membrane is somewhat permeable to K but only slightly permeable to Na.
The K+ will leave the ion - as it flows out the inside of the cell becomes increasingly negative to an extent where the electrical potential draws the K+ back into the cell at the same rate it leaves due to the concentration gradient.

Channels in the Plasma Membrane:

1. Passive or leaky channels: always open
2. Active or gated channels: signal required to open/close
    a) Chemically-gated: neurotransmitter / hormone
    b) Voltage-gated: change in membrane potential that form ion channels that are activated by changes in the electrical membrane potential near the channel.

Neurons and muscle cells communicate by changing membrane potentials

1) **Graded potential:** short-lived depolarization or hyperpolarizations; current decreases with distance traveled. Graded because magnitude is determined by strength of stimulus.

2) **Action potential:** a brief reversal of membrane potential; total amp ~100mV (-70→30)

- Cells w/ excitable membranes (neurons/muscle cells) can generate action potentials; in neurons, only axons can generate action potentials.
- Voltage gated channels on axons open & close in response to local currents (graded potentials)

Generating of an Action Potential:

- Transient increase in Na+ permeability
- Restoration of Na+ impermeability
- Transient increase in K+ permeability

Depolarization phase

- Increase in Na permeability
- Decrease in Na permeability; as the membrane potential passes 0 mV, inside positivity resists further Na entry
- Na gates begin to close; turning point in spike
- Cell will now begin to repolarize

Repolarization phase

- K+ leaves cell along electrochemical gradient & repolarizes cell
- Slow gates: so slow that they don't close quick enough

Hyperpolarization phase

- Na/K+ pumps quickly restore ion gradients across membrane

Resting state: voltage-gated Na+ & K+ channels closed; normal leakage
Local depolarization: voltage-gated Na+ channels open (fast activation gates)
Both Na gates must be open for entry; closure of either gate stops Na entry.

Propagation of an Action Potential:

- AP must traverse length of neuron to signal next neuron
- Propagation rather than conduction of an AP - The action potential generated at the axon hillock propagates as a wave along the axon. The currents flowing inwards at a point on the axon during an action potential spread out along the axon, and depolarize the adjacent sections of its membrane.
- Unidirectional: moving or operating in a single direction.

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Threshold and the All-or-None phenomenon:

At threshold, outward K+ current = inward Na+ current (~20mV of depolarization)

An action potential occurs when the membrane depolarises to a certain threshold, if this threshold is not reached the action potential will not be triggered.

Absolute & Relative Refractory Periods:

Absolute RP: Na+ gates open & second depolarization impossible.

Relative RP: Na+ gates close but K+ gates open; can only be stimulated by a very strong stimulus (greater than the threshold); a means of increasing frequency when incoming stimulus is strong.

Myelin Sheath:

- White, lipid-protein; insulates/protects peripheral nerves
- Increases up to 150X rate of impulse propogation
- Schwann cells: membranes < 25% protein

Node of Ranvier: a gap in the myelin sheath of a nerve, between adjacent Schwann cells.

Myelinated Neuron: A neuron in which the axon is enveloped by a layer of Schwann cell membranes (myelin sheath). Some neurons in CNS are myelinated (oligodendrocytes)

The Synapse: junction between 2 neurons or neuron + effector

Two types of synapses

1) **Electrical synapses:**
    - Much less common, like gap junctions. Direct current flow via gap junctions
    - Rapid transmission (electrically-coupled) neurons can be synchronized
    - Primarily embryonic, also eye movement; in non-nervous tissue, found in cardiac & smooth muscle where can synchronize contractions.
2) **Chemical synapses:**
    - Release and binding of neurotransmitters
    - Composed of the axonal terminal and receptor region.

Mechanics of Synaptic movement:

Initiation:

- Ca++ gates open in presynaptic terminal
- Neurotransmitter release, Neurotransmitter binds to postsynaptic receptors
- Ion channels open in postsynaptic membranes

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Termination (3 options):

i) Degradation by enzymes of postsynaptic membrane (acetylcholine)

ii) Reuptake by presynaptic terminal (norepinephrine)

iii) Diffusion away from synaptic site (nitric oxide)

Synaptic delay

Synaptic communications slowest step of neurotransmission - why?

Time required for Neurotransmission release, diffusion & receptor binding 0.3-0.5ms

Postsynaptic Potentials

- Channels respond to chemicals rather than changes in membrane potential
- Channels mediate local changes in membrane potential: graded according to the amount of NT (= number of channels opened)

EPSPs:

- Neurotransmission binding
- Membrane depolarization; opens one channel for both Na & K -- electrochemical gradient for Na is steeper than for K+.

IPSPs:

- Neurotransmission binding
- Membrane hyperpolarization by including permeability to K or Cl

Summation of Postsynaptic Neuron:

- Single EPSP cannot generate an action potential

Two types of summations (EPSPs & IPSPs):

1) Temporal
2) Spatial

Axon hook = Neural integrator

Most effective synapses: closest to axon hillock

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Topic 2 Part 2

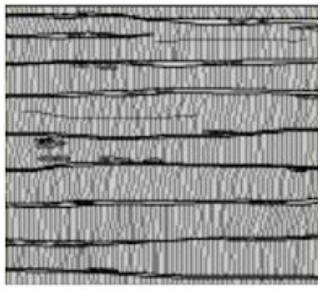
Common features of muscle cells: elongated cells = muscle ‘fibers’.

Prefix “myo-” refers to muscle

Prefix “sarco-” refers to flesh

The muscle contractions depend on actin & myosin myofilaments

Skeletal muscle

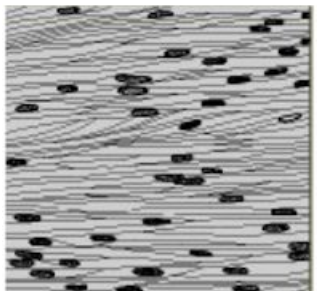


- Attaches to and cover bone structure
- Longest muscle fibers, striated (straight lines) and voluntary
- Can contract rapidly; tires easily & requires rest
- Strong and adaptable
- 40% of body mass

Cardiac muscle

- Only in the heart
- Striated & involuntary
- Pacemaker sets rate of contraction
- Neural input can change rate

Smooth muscle



- Walls of hollow visceral organs
- Nonstriated, involuntary
- Slow, sustained contractions

Muscle functions

1) Generate movement: locomotion, manipulation, blood flow & pressure.

2) Maintain posture: constantly working against gravity
3) Stabilize joints: e.g shoulders, knees when moving parts of the skeleton
4) Generate heat: maintenance of body temperature

Functional Characteristics: Excitability, Contractility, Extensibility, Elasticity

The **sarcoplasm** is the cytoplasm of striated muscle cells; it contains large sums of glycogen, myoglobin, myofibrils, extensive sarcoplasmic reticulum; T tubules

Every muscle cell contains myofibrils and it carries out 80% of the cell volume.

Endomysium: a layer of areolar connective tissue that wraps each muscle fiber.

→ Thin connective tissue investing each muscle cell

Perimysium: connective tissue that wraps bundles of muscle fibers - bundles → fascicles

Epimysium: connective tissue that wraps the entire muscle

Sarcomeres extend from one Z disc to the next Z; created the name striated muscle.

Myofilaments

a) Actin: thin filaments - across I band & partly into the A band.
b) Myosin: thick filaments - entire width of the A band

Zones & Lines

- Z Discs → composed largely of alpha-actinin and anchors thick filaments via titin
- H Zone → area with no thin filaments
- M Line → fine strands connecting adjacent thick filaments

Sarcomere: Contractile unit of muscle

Sarcolemma: Plasma membrane of the muscle cell

Tendon: Cordlike extension of CT beyond muscle - attaches it to bone

Fascicle: A discrete bundle of muscle cells

Sarcoplasmic Reticulum (SR)

- Role is to regulate intracellular Ca++
- Storage depot for Ca++
- Release when muscle stimulated to contract

T Tubules (transverse) → <u>Present in cardiac & skeletal muscle only</u>

- Function is to conduct impulses from the surface of the cell (sarcolemma) down into the cell to the Sarcoplasmic Reticulum (SR).

Triad → 3 structures: 2 terminal cisternae & 1 T-tubule

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Muscle fibers shorten due to the sarcomeres shortening; individual filaments remain the same length.

The thin filament slides over the thick filament.

- **Relaxed:** only a slight overlap of thin & thick filaments
- **Contracted:** thin filaments penetrate more deeply into A band - Z discs are pulled towards the thick filaments.

How does sliding occur?

- A stimulus → contract
- Myosin cross bridges attach to the actin
- Deattaches & re-attaches numerous times to pull thin filaments toward centre of sarcomere.
- Muscles shorten as this process occurs simultaneously in all sarcomeres

Neuromuscular junction & nerve stimulation

- Skeletal muscles are stimulated by motor neurons of the somatic NS
- Motor end plate: events at the nerve-muscle synapse identical to those in the nerve-nerve synapse.

depolarizing—make the inside of the cell more positive—or hyperpolarizing—make the inside of the cell more negative—depending on the ions involved.

Dendrites contain voltage-gated ion channels giving them the ability to generate action potentials.

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Review for Midterm 1

Structural Organization of the Human Body

1.1. Describe the levels of structural organization that make up the human body

- organelles, cells, tissues, organs, organ systems, organisms

1.2. Cells: summarize the major organelles and structures found in body cells

1.3. Tissues: describe the different tissues of the human body

Cellular Physiology of Nerve and Muscle

2.1.Membrane Transport:

2.1.1. Describe the structure of the plasma membrane

2.1.2. Describe and differentiate among the various types of transport across the plasma membrane

2.1.3. Describe osmosis and explain its role in fluid homeostasis

2.2. Neurons:

2.2.1. Identify the different regions of the neuron and associate each region with the functions of reception,
propagation and transmission of nerve impulses

2.2.2. Explain the phenomena (diffusion of ions, types of ion channels) that are responsible for the electrical
activity of neurons (resting membrane potential and action potential)

2.2.3. Describe the factors that influence propagation of the action potential along an axon

2.2.4. Explain the mechanisms of synaptic transmission (synapse, post-synaptic potentials, synaptic
integration)

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Terms:

Selectively (semi) permeable → This means it can allow some substances to cross while restricting the movement of others.
Desmosomes → A specialized adhesive protein complexes that localize to intercellular junctions and are responsible for maintaining the mechanical integrity of tissues
Avascular → contains to blood vessels
Innervated → supplied by nerve fibers)
Endothelium → refers to cells that line the interior surface of blood vessels and lymphatic vessels, forming an interface between circulating blood or lymph in the lumen and the rest of the vessel wall.
Secretion → refers to the methods used by organisms to actively move molecules manufactured within a cell to the space outside of the cell.
Mammary gland → a gland located in the breasts of females that is responsible for lactation, or the production of milk. Both males and females have glandular tissue within the breasts; they are exocrine glands.
Proteoglycans → a compound consisting of a protein bonded to glycosaminoglycan groups, present especially in connective tissue.
Molecular Sieve → is a material with pores (very small holes) of uniform size. These pore diameters are similar in size to small molecules, and thus large molecules cannot enter or be adsorbed, while smaller molecules can.
Adipocytes → also known as lipocytes and fat cells, are the cells that primarily compose adipose tissue, specialized in storing energy as fat.
Scanty → small or insufficient in amount, size or extent
Interstitial Fluid → a filtrate of blood - contains salts, sugars, amino acids, vitamins, hormones, metabolites, gases such as O_2 and CO_2, etc

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Hydrostatic Pressure → the pressure that is exerted by a fluid at equilibrium at a given point within the fluid, due to the force of gravity.
Vesicle Docking → docking is the process during which the vesicle and presynaptic membrane line up in a fusion-ready state. Following docking, the membranes fuse to create a small opening which grows larger until the vesicle membrane collapses into the presynaptic membrane and exocytosis occurs.
Amitotic → relating to or denoting the division of a cell nucleus into two parts by constriction without the involvement of a mitotic apparatus.
Refractory → resistant to a process or stimulus.
Contractile → capable of producing contractions
Osmolarity → the concentration of a solution expressed as the total number of solute particles per liter.
Oligodendrocytes → type of large glial cell found in the central nervous system. Oligodendrocytes produce the myelin sheath insulating neuronal axons (analogous to Schwann cells in the peripheral nervous system), although some oligodendrocytes (called satellite oligodendrocytes) are not involved in myelination.
Propogation → the action of widely spreading and promoting an idea, theory, etc.

adipocytes

lipid storage cells

adipose tissue

specialized areolar tissue rich in stored fat

areolar tissue

(also, loose connective tissue) a type of connective tissue proper that shows little specialization with cells dispersed in the matrix

chondrocytes

cells of the cartilage

collagen fiber

flexible fibrous proteins that give connective tissue tensile strength

connective tissue proper

connective tissue containing a viscous matrix, fibers, and cells.

dense connective tissue

connective tissue proper that contains many fibers that provide both elasticity and protection

elastic cartilage

type of cartilage, with elastin as the major protein, characterized by rigid support as well as elasticity

elastic fiber

fibrous protein within connective tissue that contains a high percentage of the protein elastin that allows the fibers to stretch and return to original size

fibroblast

most abundant cell type in connective tissue, secretes protein fibers and matrix into the extracellular space

fibrocartilage

tough form of cartilage, made of thick bundles of collagen fibers embedded in chondroitin sulfate ground substance

fibrocyte

less active form of fibroblast

fluid connective tissue

specialized cells that circulate in a watery fluid containing salts, nutrients, and dissolved proteins

ground substance

fluid or semi-fluid portion of the matrix

hyaline cartilage

most common type of cartilage, smooth and made of short collagen fibers embedded in a chondroitin sulfate ground substance

lacunae

(singular = lacuna) small spaces in bone or cartilage tissue that cells occupy

loose connective tissue

(also, areolar tissue) type of connective tissue proper that shows little specialization with cells dispersed in the matrix

matrix

extracellular material which is produced by the cells embedded in it, containing ground substance and fibers

mesenchymal cell

adult stem cell from which most connective tissue cells are derived

mesenchyme

embryonic tissue from which connective tissue cells derive

mucous connective tissue

specialized loose connective tissue present in the umbilical cord

parenchyma

functional cells of a gland or organ, in contrast with the supportive or connective tissue of a gland or organ

reticular fiber

fine fibrous protein, made of collagen subunits, which cross-link to form supporting “nets” within connective tissue

reticular tissue

type of loose connective tissue that provides a supportive framework to soft organs, such as lymphatic tissue, spleen, and the liver

supportive connective tissue

type of connective tissue that provides strength to the body and protects soft tissue