

September 11th

Tissues:

Cells that are similar in structure and perform common functions

- DO NOT CONFUSE TISSUES AND ORGANS

4 basic tissue types

Epithelial, Connective, Muscle and, Nerve tissue

1. **Epithelial Tissue** kidney gut

Disguising characteristics

Polarity

Specialized contacts

Supported by connective tissue

Avascular, but innervated

Regeneration

Cell Shape

Squamous - flat (skin)

cuboidal - medium hexagon shape (kidney)

columnar - large hexagon shape (gut)

Layers

Simple epithelia - one layer

Stratified epithelia - multiple layers

Stratified epithelia

Involve two or more layers of cells

More durable than simple because protection is their major role

New cells regenerate from basal cells

Stratified squamous epithelium

most widespread

located in areas of high wear and tear

Keratinized cells found in skin non keratinized cells found in moist areas

Classification of epithelia

Stratified cuboidal epithelium

Quite rare

Found in some sweat and mammary glands

Mainly only two cell layers thick

Stratified columnar epithelium

Limited distribution throughout the body

Small amounts found in pharynx, male urethra, and lining some glandular ducts

Usually occurs at transition areas

Only apical layer is columnar

Stratified epithelial tissue

- Traditional epithelium

Forms lining of hollow urinary organs

Basal layers are cuboidal or columnar

Ability of cells to change shape - if needed can be stretched to allow for increased flow of urine

Glandular Epithelia

Gland

One or more cells that makes and secretes an aqueous fluid called secretion

Classified by:

Relative number of cells forming the glands

Unicellular ex. goblet cells

Multicellular ex. salivary

Site of product release

Endocrine: internal secretion - hormones

Ductless Glands - secretions are not released into a duct, they released into the surrounding fluid which is then picked up by the circulatory system

Exocrine: external secretion -sweat

Secretions are released onto body surfaces such as skin or into body cavities

More numerous than endocrine glands

Secrete product into ducts

Exocrine Glands can be unicellular or multicellular

Unicellular exocrine glands

The only important unicellular glands are mucous cells and goblet cells

Found in epithelial linings of intestinal and respiratory tracts

All produce mucin, a sugar protein that can dissolve in water to form mucus, a slimy protective, lubricating coating

Multicellular exocrine glands

Are composed of a duct and secretory unit

Usually surrounded by supportive connective tissue that supplies blood and nerve fibres

Classified by:

Mode of secretion

Merocrine: most secrete products by exocytosis as secretion are produced(sweat)

Holocrine: accumulate products within, then rupture(sebaceous oil glands)

Apocrine: accumulate products within, but only apex ruptures, conversional if it exist in humans if so possibly mammary glands

2. Connective Tissue

Connective tissue is the most abundant and widely distributed of primary tissues

Major functions are binding and support protection, insulating, storing reserve fuel, and transported substances(blood)

Four main classes

-connective tissue proper

-cartilage

-bone

-blood

Structural Elements of Connective Tissues

“Blast” cells

-immature form of cells that actively secrete ground substances and ECM fibres

- fibroblasts: found in connective tissue proper

-chondroblasts: found in cartilage

-osteoblasts: found in bone

Hematopoietic stem cells found in bone marrow

“Cyte” cells

-mature, less active form of “blast” cells that now become part of and helps maintain health of matrix

Loose Connective Tissue

AREOLAR CT: gel-like matrix with all 3 fiber types; cells = fibroblasts, macrophages, mast cells, & some WBCs

Description: loose arrangement of fibers; reservoir of water & salts but is also a prime site of edema during inflammatory reaction

Location: widely distributed under epithelia of body

Function: cushioning of organs, immunity (macrophages) & inflammation; fluid reservoir

ADIPOSE TISSUE: areolar CT modified to store nutrients; adipocytes

Description: fat-filled adipocytes with displaced nuclei; do not reproduce; scanty matrix

Location: under skin, around kidneys & eyeballs, in bones & within abdomen, in breasts; 18% of average wt (15%

♂ & 22% ♀)

Function: fuel reservoir, insulation, supports & protects organs

RETICULAR CT: like areolar CT, but only reticular fibers

Loc: lymphoid organs (lymph nodes, bone marrow, spleen)

Fcn: fibers form soft internal skeleton that supports free blood cells

DENSE CT

(fibers are the predominant element!!)

DENSE REGULAR CT: bundles of collagen fibers running parallel to direction of Pull white, flexible tissue with great resistance to tension

Location: tendons, ligaments, also aponeuroses

Function: attachment with strength

DENSE IRREGULAR CT: same as regular, but collagen bundles thicker & arranged irregularly

Location: dermis, submucosa of digestive tract, fibrous capsules of organs & joints

Function: withstand tension exerted in many directions; strength

ELASTIC CT: like dense regular CT, but a very high content of elastic fibers; found in some very elastic ligament

Types of Connective Tissues

CT proper loose connective tissue

Areolar connective tissue

- Most widely distributed CT
- Supports and binds other tissues
- High regenerative capacity
- Contains fibroblasts that secrete loose arrangement of mostly collagen fibers
- Loose fibers allow for increased ground substance, which can act as water reservoir by holding more interstitial fluid
- Macrophages and fat cells are contained in spaces

Adipose tissue

White fat

- Similar to areolar tissue but greater nutrient storage
- Cells are called adipocytes
- Scanty matrix
- Richly vascularized
- Functions in shock absorption, insulation, and energy storage

Brown fat

- Use lipid fuels to heat bloodstream rather than to produce ATP, as does white fat

Plasma Membrane

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Cell Junctions

Tight Junctions

- impermeable junctions
- form continuous seals around the cell
- prevent molecules from passing between cells

Cell Junctions

Desmosomes - structural integrity

-rivet like cell junction formed when linker proteins of neighbour cells interlock like the teeth of a zipper

-also "give" between cells reducing possibility of tearing

- if we did not have enough desmosomes, it depends on the tissue

Gap Junctions

-formed by transmembrane proteins

-allow small molecules to pass from cell to cell, ex. simple sugars

-allow electrical signals to be passed from cell to cell

Cell junctions maintain selective permeability of PM

-many substances must constantly move across the plasma membrane

-the plasma membrane is selectively permeable

- two essential ways substances cross the plasma membrane

Passive and Active transportation

Passive Transport

Passive transport: movement of molecules across the cell membrane from an area of high concentration to low concentration(with concentration gradient)

Require no energy (ATP)

Three main types

Simple diffusion

Osmosis

Hydrostatic pressure: outward pressure exerted on cells side of membrane caused by increased volume of cells

Osmotic Pressure inward pressure due to tendency of water to be pulled into a cell with higher osmolarities

Facilitated diffusion

Active Transport

Active Transport: energy is used to move molecules across the cell membrane from an area of low concentration to an area of high concentration(against concentration gradient)

Require energy(ATP)

Two main types

Active Transport (ion pump)(solute pumps) - pump ions across selectively permeable membrane from an area of low to high concentration with the use of energy

Antiporters

- transport one substance into cell while
- transporting a different substance out of cell

Symporters

- transport two different substances in the same direction

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Vesicular Transport

Endocytosis - transport into cell

phagocytosis - "cell eating" membrane projections called pseudopods form a vesicles(phagosome) around solid particles and bring them into the cell

pinocytosis - "cell drinking" cell membrane infolds and intakes extracellular fluid to get dissolved solute within it, forms a vesicles and brings it into the cell

-receptor mediated - involve endocytosis and transcytosis of specific molecules. Extracellular substances bind to specific receptor proteins, enabling the cell to ingest and concentrate specific substances in protein-coated vesicles. Substances may be released inside the cell or digested in a lysosome.

Exocytosis - transport material from within the cell to the external environment using secretory vesicles

examples of substances exocytosed, hormones, mucus, cellular waste.

Protein on vesicles called v-snare finds and hooks up to target t-snare proteins on membrane - docking process triggers exocytosis

Neuron Processes

- armlike processes that extend from cell body
- cns contains both neuron cell bodies and their processes
- pns contains chiefly neuron processes

-Tracts

-bundles of neuron processes in cns

-Nerves

-bundle of neuron processes in pns

-two types of processes

-dendrites - motor neurons can contain 100s of these short, tapering, diffusely branched processes, receptive region, convey incoming messages toward cell body as graded potentials, in many brain areas finer dendrites are highly specialized to collect information.

-axon - conduction region, generates nerve impulses and transmits the along axolemma(neuron cell membrane) to axon terminal, carries many conversations with different neurons as the same time, axons rely on cell bodies to renew proteins and membranes, quickly decay if cut or damaged, axons have efficient internal transport mechanisms, movement occurs in both directions anterograde - away from cell body and retrograde - towards cell body

Structure of a motor neuron

-3 functional regions(plasma membrane very important in all regions)

- 1.receptive region
- 2.conducting region
- 3.secretory region

Neuron Processes

myelin sheath

-composed of myelin, a whitish, protein-lipid substance

-function of myelin

-protect and electrically insulate axon

-increases speed of nerve impulse transmission

-myelinated fibers: segmented sheath surround most lng or large-diameter axons(~150m/s)

-Nonmyelinated fibers: do not contain sheath(0.5-10m/s - depending on diameter)

-conduct impulses more slowly

Myelination in the PNS

- formed by schwann cells
 - wraps around the axon in jelly roll fashions
 - one cell form one segment of myelin sheath
- outer collar of perinuclear cytoplasm(formerly called neurilemma); peripheral bulge containing nucleus and most of cytoplasm
- plasma membranes have less protein
 - no channels or carriers, so good electrical insulators
- interlocking proteins bind adjacent myelin membranes
- myelin sheath gaps
 - gaps between adjacent schwann cells
 - sites where axon collaterals can emerge
 - formerly called nodes of Ranvier
- nonmyelinated fibers
 - thin fibers not wrapped in myelin; surrounded by Schwann cells but no coiling; one cell may surround 15 different fibers

-myelin sheaths in the CNS

- formed by processes of oligodendrocytes, not whole cells
- each cell can wrap up to 60 axons at once
- myelin sheath gap is present
- no outer collar of perinuclear cytoplasm
- thinnest fibers are unmyelinated, nut covered by long extensions of adjacent neuralgia

- white matter: regions of brain and spinal cord with dense collections of myelinated fibers
 - usually fiber tracts
- gray matter: mostly neuron cell bodies and nonmyelinated fibers

Membrane potential

- like all cells, neurons have a resting membrane potential
- unlike most other cells, neurons can rapidly change resting membrane potential
- neurons are highly excitable

Types of Muscle Tissue

- skeletal

- cardiac
- smooth

Only skeletal and smooth muscle cells are elongated and referred to as muscle fibers

Skeletal Muscle

- Skeletal muscle tissue is packed into skeletal muscles: organs that are attached to bones and skin
- skeletal muscle fibers are longest of all muscle and have striations(stripes)
- also called voluntary muscle: can be consciously controlled
- contract rapidly; tire easily; powerful
- key word for skeletal muscle: skeletal, striated and voluntary

Cardiac muscle

- cardiac muscle tissue is found in only heart
 - makes up bulk of heart wall
- striated
- involuntary: cannot be controlled consciously
 - contracts at steady rate to heart's own pacemaker, but nervous system can increase rate
- key words for cardiac muscle: cardiac, striated and involuntary

Smooth muscle

- smooth muscle tissue is found in walls of hollow organs
 - ex. stomach , urinary, bladder and airways
- not striated
- involuntary: cannot be controlled consciously
- key word for smooth muscle: visceral, nonstriated, and involuntary

Characteristics of muscle tissue

- all muscle share four main characteristics:
 - Excitability - can receive and respond to stimuli
 - Contactability - shorten when stimulated
 - Extensibility - can be stretched
 - Elasticity - ability to recoil to resting length

Muscle Functions

4 important functions

1. Produce movement, responsible for all locomotion and manipulation ex. Walking, running, digesting, pumping blood
2. Maintain posture and body position
3. stabilize joints
4. generate heat as they contract

Connective Tissue Sheaths

- each skeletal muscle, as well as each muscle fiber, is covered in connective tissue
- support cells and reinforce whole muscle
- sheaths from external to internal
 - epimysium: dense irregular connective tissue surrounding entire muscle
 - perimysium: fibrous connective tissue surrounding fascicles(group of muscle fibers)
 - endomysium: fine areolar connective tissue surrounding each muscle fiber

Attachments

- muscle span joints and attach bones
- muscle attach to bone in at least two places
 - insertion: attachment to moveable bone
 - origin: attachment to immovable or less movable bone
- attachments can be direct or indirect
 - direct(fleshy): epimysium fused to periosteum of bone or perichondrium or cartilage
 - indirect:connective tissue wrappings extend beyond muscle as ropelike tendon or sheelike aponeurosis

- skeletal muscle fibers are long, cylindrical cells that contain multiple nuclei
- Sarcolemma: muscle fiber plasma membrane
Sarcoplasm: muscle fiber cytoplasm

Myofibrils

- myofibrils are densely packed, rodlike elements
 - single muscle fiber can contain 1000s
- accounts for ~80% of muscle cell volume
- myofibril features
 - striations
 - sarcomeres
 - myofilaments
 - molecular composition of myofilaments

Striations: stripes formed from repeating series of dark and light bands along length of each myofibril

A bands: dark region

- h zone: lighter region in middle of dark A band
- m line: line of protein(myomesin) that bisects H zone vertically

I bands: lighter region

- z disc(line): coin shaped sheet of proteins on midline of light I band

Sarcomere

- smallest contractile unit of muscle fiber
- contains A band with half an I band at each end
 - consists of area between z disc
- individual sarcomeres align end to end along myofibril, like boxcars of train

Myofilaments

- orderly arrangement of actin and myosin myofilaments within sarcomere
- actin myofilaments: thin filaments
 - extend across I band and part way in A band
 - anchored to Z discs
- myosin myofilaments: thick filaments
 - extend length of A band
 - connected a M line
- sarcomere cross section shows hexagonal arrangements of one thick filament surrounded by six thin filaments

Molecular composition of myofilaments

- thick filaments; composed of protein myosin that contains two heavy and four light polypeptide chains
 - heavy chains intertwined to form myosin tail
 - light chains form myosin globular head
 - during contraction heads link thick and thin filaments together forming cross bridges
- myosin are offset from each other resulting in staggered array of heads at different points along thick filaments
- thin filaments: composed of fibrous protein actin
 - actin is a polypeptide made up of kidney shaped G actin globular subunits
- g actin subunits linked together to form long, fibrous F actin
- two f actin strands twist together to form a thin filament
- tropomyosin and troponin regulatory proteins bound to actin

-other proteins help form the structure of the myofibrils

Elastic filament: composed of protein titin

–holds thick filaments in place; helps recoil after stretch; resists excessive stretching

Dystrophin

-Links thin filaments to proteins of sarcolemma

Nebulin, myomesin, C proteins bind filaments or sarcomeres together

-Maintain alignment of sarcomere