

Histology-study of tissues=group of related cells that perform a specific function

I. Epithelium

A. Functions

1. **secretion**

- a. serous membranes
- b. glands

Endocrine -ductless	Hormones	Exocrine - ducted
pancreas	insulin, glucagon	pancreas-juices
adrenal	cortex-aldosterone, cortisol medulla- epinephrine, norepinephrine	liver-bile
thyroid	thyroxine (T4), triiodothyronine (T3), calcitonin	lacrimal-tears
pituitary	anterior-LH, GH, MSH, TSH, FSH, PrL, ACTH psterior-stores ADH and oxytocin	salivary-saliva
kidney	renin, erithropoiten	kidney-urine
testes	testosterone	mammary-milk
ovaries	estrogen, progesterone	sebaceous-oil
hypothalamus	ADH, oxytocin, releasing factors, inhibiting factors	sudoriferous-sweat
parathyroid	PTH	goblet cells-mucus

2. **absorption**

- a. small intestine can absorb drugs or nutrients
- b. can absorb drug many ways
 - 1. IV
 - 2. Aerosol
 - 3. Topical
 - 4. Oral
 - 5. Rectal
 - 6. IP
 - 7. IM

3. **protection**

against microbes, friction, drying out

B. Characteristics

- 1. **avascular**- no blood vessels
- 2. surface attached to basement membrane (b.m. made of collagen)
- 3. free surface-skin exposed to environment
- 4. outer layer dead-continuously replaced by mitosis, takes abuse from environ
- 5. cells touch each other

C. Types of epithelium

1. **squamos**- thin, flat cells

a. **simple squamos**

1. Function- **gas exchange**
2. Found in alveolar walls

b. **keratinized stratified squamos**

1. Function- **protection, waterproofing, prot from drying out**
2. Found in skin
3. **Desmosomes**- remnants of cytoskeleton-anchor cells as sheets

c. **non-keratinized stratified**

1. Needs to be moist, found where friction can happen
1. Function- **protection from microbes, sharp food, friction**
2. Found in lining of mouth, esophagus, pharynx, and vagina

2. **columnar**

a. **simple ciliated columnar**

1. Contain goblet cells-produce mucus
1. Function- **remove mucus from lungs**
2. Found in trachea and bronchiol tree, uterine lining

b. **simple non-ciliated columnar**

1. Function- **absorption of nutrients and vitamins, reabsorp of water**
2. Found from lining of stomach to anus

c. **stratified columnar**

1. Function-**protection**
2. Found in ducts-ex: pancreatic

d. **pseudostratified ciliated columnar**

1. All cells attached to basement membrane
2. Found in:
 - a. airway
 - b. nasal passage (nasal pharynx behind nasal passage)
 - c. sinuses-spaces in bone
 - d. lungs

3. **simple cuboidal**

A. Found in:

1. collecting ducts of renal pyramids of kidneys
2. thyroid follicles
3. ovaries

4. **transitional**

- A. Cells pile up when contracted and stretch to one layer when filled
- B. Found in bladder and ureter

II. **Connective Tissue**

A. Space b/t cells full of matrix

B. Matrix can be liquid, gooey, semisolid, or solid

C. Contains cells such as:

1. **fibroblasts**-make collagen, involved in scar formation
2. **mast cells**- related to basophil-WBC-immune response, allergies
3. **macrophages**-related to monocytes, healing cells
4. **plasma cells**- related to lymphocytes

D. Contain dif fibers-collagen and elastin

E. Types of connective tissue

1. **loose**

a. **areolar** (prepared by fixing, mounting, and staining)

1. Protection b/c gooey enhances strength
2. Contains fibers (elastin, collagen) and cells randomly arranged
3. **Fibroblasts-cells** with tiny dots
4. **Hydroscopic** (can store water) b/c contains:
 - a. hyaluronic acid
 - b. chondroitin sulfate
 - c. dermatin sulfate
 - d. keratin sulfate
3. Found in:
 - a. hypodermis of skin
 - b. surrounding nerves and blood vessels
4. Function-holds together fatty tissues, protects nerves and blood vessels, acts as shock absorber

b. **adipose**

1. 2 types of fat:

a. **Brown fat**- non-shivering thermogenesis

1. Found in buttocks, inner thigh, and mediastinum

b. **Yellow/ White fat**- functions:

1. insulation
2. protection/cushioning-esp. with ladies
3. long-term energy storage

2. Cells=**adipocytes**

3. Contains lipid droplets/inclusions-push away nuclei/cytoplasm
4. Areolar found in between
5. Found in:
 - a. yellow bone marrow
 - b. surface of heart and kidney
 - c. hypodermis
 - d. fat pad of eyeball
6. Function-synthesis and hydrolysis of lipids

c. **reticular**

1. Makes up **stroma**-framework of organ
2. Contains collagen-tensile strength- and elastin-elasticity
3. Function-supports organs
4. Found in:
 - a. liver
 - b. spleen
 - c. red bone marrow
 - d. lymph nodes
 - e. holds smooth muscles together

2. **dense**

a. **regular**

1. Sheets of collagen parallel to each other-tensile strength
2. Cells in b/t fibers=fibroblasts
3. Found in tendons-muscle to a/t- and ligaments-bone to bone (ex: coxal bone)

A. **aponeuroses**= sheet of **tendons**

b. **irregular**

1. Irregular, randomly arranged collagen fibers and some elastic
2. Found in:
 - a. dermis
 - b. dura mater
 - c. surrounds lymph nodes
 - d. surrounds liver and testes
 - e. joint capsules
 - f. surrounds heart valves

c. **elastic**

1. Contains elastic fibers-squiggly- provides elasticity to organs
2. Found in:
 - a. trachea
 - b. bronchiol tree,
 - c. walls of arteries
 - d. lungs

3. **cartilage**

- a. matrix-semi-solid-flexibility and strength, maintains organs's shapes
- b. avascular
- c. 3 types:

1. **hyaline**

A. **Chondrocytes in lacunae**

B. found in:

- a. Costal cartilage
- b. Nose
- c. Trachea
- d. Ends of long bones, at a joint=articulation
- e. Bronchiol tree

2. **fibrocartilage**

A. **Chondrocytes in lacunae**, contains fibers=collagen

B. found in:

1. pubic symphysis,
2. intervertebral disks-shock absorber
3. meniscus of knee

3. **elastic cartilage**

A. Mainly elastic fibers

B. found in pinna of ear/auricle and epiglottis

4. **bone**

- a. vascular
- b. solid matrix- **calcium phosphate** (rigid), water, and protein
- c. crush bone to view it on slide

- d. Contains **osteons**
 - 1. **Osteocytes in lacunae**
 - 2. Matrix binds osteocytes in concentric rings called lamellae
 - 3. **Central canal**
 - A. provides ECF for lamellae through **canaliculi**
 - B. Contains blood vessels-artery, vein, and lymph vessel
- e. functions
 - 1. Calcium bank
 - 2. Provides lever system (skeleton)
 - 3. Protection

5. blood

- a. **RBC-erythrocytes**
 - 1. 5,000,000 cells/mm cubed
 - 2. Use **hemoglobin** to transport oxygen
- b. **WBC-leucocytes**
 - 1. 5-10,000 cells/mm cubed
 - 2. Defense functions
- c. **platelets-thrombocytes**
 - 1. 250,000 cells/mm cubed
 - 2. clotting cells-can't reproduce b/c not real cells

III. Muscle Tissue

Type of muscle	location	shape	striated or no	vol or no	cause of contraction	multi-nucleated or no	special stuff
skeletal	on skeleton	cylindrical	striated	vol	motor neurons	multi	t-tubules myoglobin
visceral smooth	digestive organs and uterus	spindle	no	invol	stretching peristalsis oxytocin	mono	no t-tubules or myoglobin
multi-unit smooth	iris, airway, blood vessels	spindle	no	invol	motor neurons ADH, angiotensin seratonin norepi- nephrine	mono	no t-tubules or myoglobin
cardiac	heart	interbranched cylinders	striated	invol	intrinsic rhythm norepi- nephrine ACH	mono	interbranching intercalated disks t-tubules myoglobin

Shayna Goodman

Muscle info:

A. Skeletal

1. Red b/c of **myoglobin**-pigmented protein
 - a. function of myoglobin-oxygen attaches to it
 - b. imp't b/c now always have oxygen in blood even b/f exercising
2. **T-tubules=transverse tubules**
 - a. infolding of cell membrane-cut across membrane- increases surface area
3. In wrapping=membrane so cells don't touch

B. Cardiac

1. Has **intercalated disks**
 - a. thickening of cell mem where one cell ends and next starts
 - b. special gap junctions
2. Cells touch each other. Smooth cells also touch each other.

C. Muscle tissue characteristics

1. Excitable
2. Extendable
3. Contractile
4. Conductive

IV. Nervous Tissue

A. Neuroglia-support, protect, and nourish neurons, hold brain tog

1. Do not conduct nerve impulses=action potentials

B. Neurons- dendrite(s), cell body, and axon

1. Conduct **action potentials**
 - a. electrochemical waves that propogate (self-generate) along neurons
 - b. uni-directional flow
2. 3 types of neurons
 - a. **unipolar**-one projection-splits into dendrite and axon
 1. most abundant of **sensory neurons**
 - b. **bipolar**-2 projections-axon and dendrite
 1. associated with **special senses**
 - c. **multipolar**-many dendrites
 1. association neurons=**interneurons**
 2. most abundant of **motor neurons**

Senses-help detect changes in environment

Special senses	General senses
olfactory	touch -light and heavy
vision	temp -hot and cold
gustation	proprioception - muscle sense
audition	nociception -pain detection
equilibrium	

Extra nervous tissue info:

- A. **Dendrites** carry info to cell body, **axon**- carries info away
- B. Nerve cells communicate with each other via **neurotransmitters**
- C. Axons of **presynaptic neuron** releases neurotransmitters which land on dendrites of **postsynaptic neuron** telling it to pass on action potential. Drugs can interfere with neurotransmitters (ex: LSD)

V. Bone

A. Introduction-cells leave somites in neck region to form muscle, skeleton, and dermis cells migrating to skull=osteoblasts. They start producing bone matrix, so bone grows above brain. Each bone starts from one cell. Grow until meet each

B. 2 types of formation

1. Intramembranous bone

- a. ex: frontal, parietal, occipital
- b. starts off as pinpoint and grows=**ossification**-process of forming bone. Grow until touch. Then form sutures and stop.
- c. **periosteum**=membrane that surrounds bone. Ossification occurs b/t membranes.

1. 2 layers:

A. **Osteogenic**-contains osteoblasts, touches bone

B. **Fibrous**-connective tissue on outside

- d. **spongy bone** (cancellous bone) appears first. Then fills with bone matrix to become **compact bone**.

2. Endochondrial bone

- a. starts off as hyaline cartilage.
- b. ex: long bones of body-femur, tibia, fibula, humerus, radius, ulna
- c. chondrocytes expand and hydrolyze matrix. Then programmed cell death.
- d. periosteum surrounds space. **Osteoblasts** found there. Start to produce bone matrix. **Spongy bone** starts to form. Osteoblasts leave periosteum and keep producing bone matrix, replacing cartilage-starts off as **primary ossification center** in middle.
- e. Osteoblasts produce **secondary oss centers** at prox and distal ends. Matrix replaces cartilage. Bone growth occurs at junction of new matrix and hyaline cartilage.
- f. Spongy bone remains until **growth plates** where growth occurs as ppl grow.
- g. Bone grows in width b/c osteoblast keep producing bone matrix, creating space inside bone=**marrow cavity**. **Osteoclasts** in **endosteum** surrounding marrow cavity produce osteoclasts that hydrolyze bone, so bone grows in width, but has space in center. Blood-forming tissues invade marrow cavity.

C. Parts of a bone

- 1. **Proximal epiphysis**
- 2. **Growth plate**
- 3. **Diaphysis**
- 4. **Distal epiphysis**
- 5. **Hyaline cartilage**- protects ends of long bones from friction
- 6. **Spongy bone**-prod first, deep in epiphysis, keeps bones light, space for marrow
- 7. **Compact bone**- circumference of bone
- 8. **Periosteum**
- 9. **Marrow cavity/medullary cavity**
- 10. **Endosteum**

D. Things necessary for bone growth:

1. Hormones:
 - a. growth hormones
 - b. estrogen
 - c. progesterone
 - d. testosterone
 - e. calcitonin
 - f. T3
 - g. T4 (thyroid hormones=metabolism)
2. Vitamins A, D, and C
3. Elements-calcium and phosphates
4. Exercise

E. **Osteoporosis**- bone wasting, lose bone mass b/c no estrogen and progesterone. (Also can lose bone mass from outer space.)

F. Bone fractures

1. 6 types
 - a. **Greenstick**-incomplete break on convex surface of bone
 - b. **Fissured**-incomplete longitudinal break
 - c. **Comminuted**- complete break, many fragments
 - d. **Transverse**-complete break cutting bone transversely
 - e. **Oblique**-complete break at angle (not right angle to longitudinal)
 - f. **Spiral**-complete break, but twisted (on diagram, bottom bones will be twisted to indicate spiral break)
2. Can be dangerous b/c bone is vascular, so fragment can cause heart attack
3. **Embolus**=foreign object in bloodstream
 - a. blood clot
 - b. bone fragment
 - c. clump of fat
 1. Red marrow replaced by yellow as age-losing ability to replace red blood cells
 2. Yellow marrow=fat
 - d. air bubble
 - e. mass of bacteria/fungi
 1. Can be caused by **endocarditis**=inflammation of inner valve of heart and mass of bacteria can sit on top, break free and cause heart attack

VI. **Calcium Regulation**- b/t 2.1 and 2.6 mM

A. **Hypocalcemia**

1. Stresses
 - a. lack of calcium in diet
 - b. calcium loss due to kidney disease
 - c. vit-D deficiency=**Rickette's**
2. Goal-increase calcium level b/c need it for:
 - a. skeletal muscle function
 - b. heart function
 - c. nerve transmission
3. Symptom-**hyporeflexia**

4. Response

a. Parathyroid releases **PTH**

1. Stimulates **osteoclasts** to hydrolyze bone matrix, releasing calcium from calcium phosphate
2. Inhibits **osteoblasts** in periosteum from making bone matrix
3. Activates **vit-D** to stimulate gut to increase calcium absorption

b. eat s/t w/ calcium, drink milk

B. Hypercalcemia

1. Stress-too much calcium in diet-drank too much milk, ate too many bones
2. Symptom-**hyperreflexia**-leads to kidney stones
3. Goal-decrease calcium level, store it as bone

3. Response

a. thyroid releases **calcitonin**

1. Stimulates **osteoblasts** to produce more bone matrix
2. Inhibits **osteoclasts** from hydrolyzing bone