

- Nucleus
 - Usually round, at cell center
 1. double membrane
 2. has large nuclear pores
 3. contains nucleoli - parts to make ribosomes
 4. contains DNA
 - a. in the form of chromatin when cell not dividing (long thin strands)
 - b. in the form of chromosomes when cell dividing (coiled up)
- Organelles (see table in text for summary)
 - Endoplasmic reticulum (ER)
 1. membranous network of channels
 2. rough ER
 - a. has ribosomes (rRNA plus proteins)
 - b. protein and lipid synthesis
 3. smooth ER
 - a. continues processing of rough ER products
 - b. specialized in some cells for lipid synthesis or detoxifying chemicals
 - Golgi complex
 1. stacked membranous sacs
 2. processing, sorting, packaging of ER products
 3. makes vesicles for transport to destinations inside cell, or for secretion
 - Lysosomes
 1. sacs contain digestive enzymes
 - a. recycles material from cell
 - b. breaks down substances brought in by endocytosis
 - Peroxisomes
 1. sacs contain oxidative enzymes used to detoxify harmful substances
 - Mitochondria
 1. double-membraned, makes ATP via cellular respiration
 - a. inner membrane has folds called cristae
 - b. gel inside called matrix
 - Vaults
 1. probably involved in transport between nucleus and cytoplasm
 - Centrosome
 1. found near nucleus
 2. consists of centrioles (protein tubules) surrounded by a centrosome matrix (a cloud of protein)
 3. organizing center for parts of the cytoskeleton
- Cytoskeleton
 - protein filaments running through cytosol
 1. important in movement of cell and within cell
 2. supports cell and organelles
 - cell projections for movement made of microtubules
 1. flagella (on sperm) - one long projection, moves the whole cell
 2. cilia are many small projections that move substances across the surface of the cell
- Inclusions
 - No membrane, temporary storage of products like fat or glycogen

Chapter 4 Tissues

- Four major tissue types

- Epithelial (epithelium)

1. covers and lines body parts (sheets of cells)
2. glandular epithelium
 - a. two major types
 - 1) endocrine glands secrete hormones to blood (no ducts)
 - 2) exocrine secrete products into ducts that open to skin or lumen of organ
 - b. structural classification of exocrine glands
 - 1) multicellular - form a distinctive structure or organ (e.g., sweat, salivary)
 - 2) unicellular - have no ducts but still considered exocrine (e.g., goblet cells)
 - c. functional classification of exocrine glands
 - 1) holocrine - cell accumulates product, cell dies, bursts open and substance secreted (e.g., sebaceous)
 - 2) merocrine - secrete by exocytosis (most glands)
3. epithelial sheets - special characteristics
 - a. continuous sheets of closely packed, tightly joined cells
 - b. have apical (free) and basal surface
 - c. attached to 2-layered basement membrane
 - 1) basal lamina - proteins and polysaccharides secreted by epithelial cells
 - 2) reticular lamina - protein fibers and glycoproteins secreted by underlying connective tissue
 - d. avascular - exchanges occur by diffusion from blood supply of underlying connective tissue
 - e. have nerve supply
 - f. high capacity for regeneration (lots of mitosis)
 - g. basic functions - protection, secretion, absorption

- Connective tissue

1. special characteristics
 - a. made up of living cells plus non-living extracellular matrix
 - 1) -blasts are immature cells that secrete matrix (e.g., fibroblasts, chondroblasts, osteoblasts)
 - 2) -cytes are mature cells that help maintain matrix (e.g., chondrocytes, osteocytes)
 - 3) other cell types include macrophages, plasma cells (secrete antibodies), mast cells (store chemicals that help fight invaders)
 - 4) matrix consists of protein fibers embedded in ground substance (polysaccharides and proteins); supports cells structurally and functionally
 - 5) fibers include collagen (strong, flexible), elastin (strong, very stretchy), reticular fibers (collagen with coating of glycoprotein, forms branching networks that support tissues and organs)
 - b. has nerve supply, except cartilage
 - c. most highly vascular, except cartilage which is avascular, and tendons/ligaments which have a low supply
 - d. functions - support, protection, binding

- Muscle tissue

1. generates force, movement, generates heat
2. three types - skeletal, cardiac, smooth

- Nervous tissue

1. initiates and transmits electrical signals
2. neurons and neuroglia (support cells)

Chapter 11 Muscles

- **Lever Systems**

- A lever is a rigid bar that moves on a fixed point (the fulcrum) when a force is applied to it; the force (effort) applied is used to move a resistance (load)

1. bones = levers
2. joints = fulcrum
3. muscles provide the effort

- Levers operate in one of two ways

1. mechanical advantage
 - a. load is closer to fulcrum, effort farther from fulcrum
 - b. little effort moves a large load over a small distance
2. mechanical disadvantage
 - a. load is farther from fulcrum, effort is closer to fulcrum
 - b. lots of effort moves a load rapidly over a large distance

- Types of levers

1. first-class
 - a. fulcrum between load and effort
 - b. seesaws, scissors, lifting head off chest
 - c. can be mechanical advantage or disadvantage
2. second-class levers
 - a. load between fulcrum and effort
 - b. wheelbarrow, standing on toes
 - c. mechanical advantage
3. third-class levers (most muscles in the body are set up this way)
 - a. effort between load and fulcrum
 - b. tweezers, lifting using biceps
 - c. mechanical disadvantage

- **Arrangement of Fascicles**

- Influences range of motion and power

1. longer fibers can shorten more and have greater range of motion
2. a greater number of shorter fibers means more power

- Types of arrangements

1. parallel (tend to be less powerful)
2. fusiform (nearly parallel)
3. circular
4. convergent
5. pennate (tend to be the most powerful)

- **Group Actions**

- Functional types of muscles

1. prime mover/agonist: the muscle that has the main responsibility for a particular movement
2. antagonist: opposes the action of the agonist
3. synergist: helps the agonist
 - a. add extra force
 - b. stabilize joint and prevent undesired movement
4. fixator: stabilizes prime mover

- One muscle may act as any of the functional types

- Origin and Insertion
 - Origin: the attachment point on the more stationary (less movable) bone, usually proximal
 - Insertion: the attachment point on the more movable bone, usually distal
 - The insertion moves toward the origin when the muscle shortens
- Naming Muscles
 - Names may be based on...
 1. location
 2. shape
 3. relative size
 4. direction of fascicles and fibers
 5. location of attachments
 6. number of origins
 7. action
- Selected Skeletal Muscles (see handouts)

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Page 22 of 58

Chapter 14 General Senses

- Basics
 - Sensation: conscious or subconscious awareness of internal or external stimuli
 - Perception: conscious awareness and interpretation of sensation
 - Components of sensation
 1. stimulus
 - a. a change in the environment capable of activating sensory neurons
 2. transduction
 - a. sensory receptor or sense organ transduces stimulus into a nerve impulse
 3. conduction
 - a. nerve impulse conducted to CNS by afferent fibers
 4. translation
 - a. CNS receives and interprets information
- Sensory Receptors
 - Display selectivity
 1. respond to a particular kind of stimulus
 - Classification by location
 1. exteroceptors
 - a. near surface of body
 - b. sense the external environment
 - c. touch, pressure, vibration, temperature, pain, taste, smell, hearing, vision
 2. interoceptors
 - a. in blood vessels and viscera
 - b. sense internal environment
 - c. stretch, chemical change, pain
 3. proprioceptors
 - a. in muscles, tendons, joints, inner ear
 - b. sense body position and movement
 - Classification by stimulus type
 1. mechanoreceptors
 - a. sense mechanical pressure or stretching
 - b. touch, pressure, vibration, proprioception, hearing, blood pressure
 2. thermoreceptors
 - a. sense temperature
 3. chemoreceptors
 - a. sense chemicals
 - b. taste, smell, changes in body fluids
 4. photoreceptors
 - a. sense light
 5. nociceptors
 - a. sense pain

- Structural classification
 1. free dendritic endings
 - a. mostly sense pain and temperature, itch
 - b. tactile discs are a modified type in the epidermis, sense light touch (adapt slowly)
 - c. root hair plexuses sense movement of hairs (adapt quickly)
 2. encapsulated dendritic endings are enclosed in a CT capsule
 - a. tactile corpuscles - in dermal papillae of hairless skin; sense light pressure, discriminative touch, vibration
 - b. lamellar corpuscles - mainly subcutaneous, some more internal; sense deep pressure, stretch, vibration (adapt quickly)
 - c. bulbous corpuscles - deep skin layers, joint capsules; deep pressure and stretch (adapt slowly)
 - d. proprioceptors - muscle spindles and tendon organs sense stretch; joint kinesthetic receptors in joint capsules sense stretch and pain (includes lamellar and bulbous corpuscles, tendon organs, free dendritic endings)
- Sensory (Ascending) Pathways
 - Signals are carried to reticular formation, cortex, and cerebellum
 1. first-order neurons
 - a. have sensory receptor
 - b. carry signals to brain stem (along cranial nerves) or to spinal cord (along spinal nerves)
 - c. synapse with...
 2. second-order neurons
 - a. carry signals from spinal cord and brain stem in thalamus
 - b. fibers cross over (decussate) in cord or brain stem
 - c. synapse with...
 3. third-order neurons
 - a. signals go to primary somatosensory cortex (postcentral gyrus)

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Page 33 of 58

Chapter 18 Blood

- Blood Basics
 - about 5 liters, about 8% of body weight
 - pH ranges 7.35 - 7.45
 - Is a connective tissue
 1. formed elements
 - a. erythrocytes (RBCs)
 - b. leukocytes (WBCs)
 - c. platelets
 2. matrix is plasma
 - Functions
 1. transport of O₂, CO₂, nutrients, wastes, heat, hormones
 2. protection, from WBCs and other defenses
- Plasma
 - 55% of whole blood
 - 90% water
 - Contains proteins, ions, buffers, respiratory gases, nutrients, wastes, hormones
 - Proteins are functionally important
 1. establish osmotic pressure (holds water)
 2. three main types
 - a. albumins- bind substances for transport
 - b. globulins- bind substances for transport, blood clotting, inactive precursor molecules, antibodies
 - c. fibrinogen- blood clotting
- Formation of Blood Cells (Hematopoiesis)
 - Occurs in red marrow
- Erythrocytes
 - About 45% of whole blood
 - Very small, about 8 μm in diameter, can squeeze through even smaller capillaries
 - About 5 million/mm³
 - Mature cells have no nucleus or other organelles
 - Make ATP anaerobically
 - Live about 120 days, most die in spleen capillaries
 - Contain hemoglobin
 1. carries most of the oxygen
 2. carries some carbon dioxide
 3. helps buffer blood

Chapter 23 Digestive System

- Basics

- Two groups of organs

1. alimentary canal (gastrointestinal or GI tract is a continuous tube with openings at mouth and anus)
2. accessory organs (teeth, tongue, gallbladder, salivary glands, liver, pancreas)

- Digestive processes

1. ingestion (eating)
2. motility (propulsion and mixing)
3. digestion (breaking down food into smaller pieces)
 - a. mechanical - teeth, stomach, small intestine
 - b. chemical - enzymes break down large molecules
4. absorption (small molecules absorbed into blood and lymph)
5. defecation (eliminating wastes)

- Peritoneum

1. covers most organs below diaphragm
 - a. visceral layer
 - b. parietal layer
 - c. peritoneal cavity with serous fluid
2. mesenteries
 - a. fused sheets of peritoneum that connect organs to abdominal wall and to each other
 - 1) mesentery proper - small intestine to posterior abdominal wall
 - 2) mesocolon - large intestine to posterior abdominal wall
 - 3) falciform ligament - liver to anterior abdominal wall
 - 4) lesser omentum - stomach to liver
 - 5) greater omentum - stomach to posterior abdominal wall
3. some organs are retroperitoneal (parts of intestines, pancreas, kidneys)

- Tissues

1. mucosa
 - a. epithelium
 - 1) stratified squamous in mouth, esophagus, anal canal
 - 2) simple columnar in stomach and intestines
 - b. lamina propria
 - 1) areolar connective tissue, lots of capillaries and lymphatic vessels, lymphatic nodules
 - c. muscularis mucosae
 - 1) thin layer of smooth muscle creates folds
2. submucosa
 - a. areolar connective tissue, lots of vessels and nerve fibers
3. muscularis externa
 - a. thicker layers of smooth muscle
 - 1) circular, longitudinal layers
 - 2) nerve fibers
4. serosa (visceral peritoneum)

- intrinsic nerve plexuses (enteric nervous system)

1. network of nerves in digestive tract wall that regulate and coordinate (submucosal and myenteric)
2. influenced by extrinsic autonomic fibers

- Mouth

- Vestibule - area between teeth and lips

- Small Intestine
 - The major digestive organ (most chemical digestion, nearly all absorption)
 - Three parts
 1. duodenum
 - a. retroperitoneal
 - b. receives ducts from pancreas and liver
 - c. most digestion & absorption occurs here
 2. jejunum
 3. ileum
 - a. joins to large intestine at ileocecal valve/sphincter
 - Mucosa
 1. modifications increase surface area available for absorption
 - a. plicae circulares (circular folds) are deep folds of mucosa and submucosa
 - b. villi are large projections of mucosa
 - 1) between villi are intestinal crypts
 - c. microvilli are projections of mucosal cells (brush border, contains enzymes)
 - d. mucus producing cells and enteroendocrine cells
- Pancreas
 - Acinar cells secrete digestive enzymes (for protein, carbohydrates, fat)
 - Duct cells secrete alkaline fluid to neutralize acidity of chyme
 - Pancreatic duct and accessory duct lead to duodenum
- Liver
 - Four lobes (right, left, caudate, quadrate)
 - Made up of lobules
 1. hexagonal arrangement of hepatocytes around a central vein
 2. bile ducts carry bile to larger ducts which eventually fuse to form the common hepatic duct
 3. Kupfer cells are macrophages
 - Bile duct joins with pancreatic duct at hepatopancreatic ampulla (empties into duodenum)
 - Bile is stored in gall bladder
 - Function of bile
 1. emulsify fats (break it up into small droplets to increase surface area available to digestive enzymes)
 2. make products of fat digestion soluble in intestine so they can be absorbed
- Large intestine
 - Parts
 1. cecum (appendix attached)
 2. colon (ascending, transverse, descending, sigmoid)
 3. rectum
 4. anal canal
 - Contains lots of goblet cells, little muscle
 1. muscle arranged in bands
 - a. forms sacs called haustra
 - Functions
 1. absorbs water, electrolytes, vitamins made by bacteria
 2. elimination of wastes