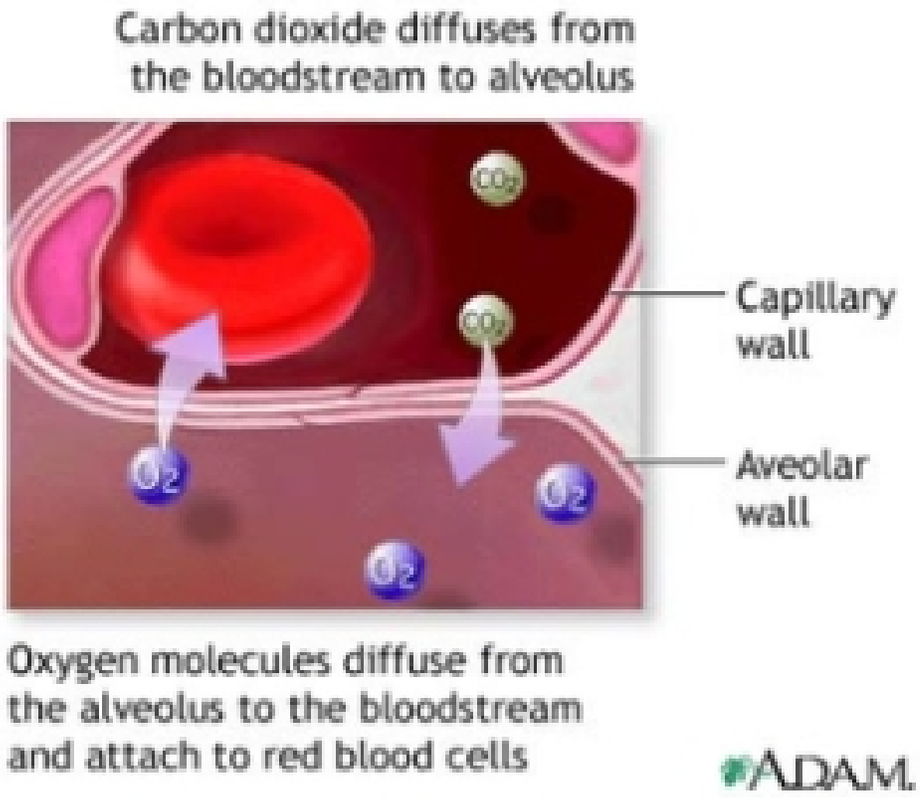
Respiratory System

- Exchange between air and blood (capillaries) takes place in the alveoli filled with alveolus
- Alveolus surrounded by capillaries for CO_2/O_2 exchange
    - CO_2 from cells → into capillaries → alveolus → outside
    - O_2 from air → capillaries → cells (simple diffusion)



- Conducting zone has NO alveoli, therefore no gas exchange (Bronchi)
- Respiratory zone has alveoli and gas exchange by simple diffusion (Bronchioles)
- Respiratory membrane is where gas exchange occurs
    - Wall of alveolus → epithelial cells
    - Wall of capillaries → endothelial cells
    - Extracellular/interstitial fluid is between the two walls
- Diaphragm relaxes during expiration and contracts during inspiration
- As the diaphragm goes down, thoracic cavity size increases and pressure decreases (contraction)
- When diaphragm goes up, thoracic cavity size decreases and pressure increases (relaxation)
- Atmospheric pressure is 760mm Hg
    - Alveolar pressure must be greater than 760mm Hg for expiration (gas to exit lungs - expiration)
    - Alveolar pressure must be less than 760mm Hg for inspiration (gas into lungs - inspiration)
- F (air flow)= Δ P (change in pressure)/R (resistance to airflow)
- If R (resistance) increases, then F (air flow) will decrease
- Tidal volume is 500mL → volume of air moving in and out during normal breathing
- Anatomical dead space is 150mL → volume of conducting respiratory passages
- Alveolar air space is 350mL → 500-150=350, or what reaches alveoli
- Most important gases: nitrogen (more abundant) and oxygen (more important)
- Partial pressure of oxygen in venous blood is 40mm Hg
- Partial pressure in alveoli is 104mm Hg (or answer closest to 100mm Hg he said)
- Since CO_2 has a lower partial pressure gradient, it is easier for CO2 to diffuse and move because it requires a lower pressure to get the amount of diffusion
    - Change in pressure of oxygen is 60mm Hg and change in pressure for carbon dioxide is 5mm Hg (20 times more soluble membranes than oxygen)

- Equilibrium is at 104mm Hg, when the blood leaving the capillaries has the same pressure of the alveoli (or previous tissue) → slide titled "partial pressure gradients" with picture

- $CO_2 + H_2O \leftarrow \rightarrow H_2CO_3 \leftarrow \rightarrow H+ + HCO_3-$
    - If more H+ (more acidic), reaction goes to the left
    - If more CO_2, reaction goes to the right
    - CO_2 most important stimulus for breathing
    - CO_2 mainly travels to the lung in the form of bicarbonate (bicarbonate is main form of transporting in the plasma)
- Respiratory center → medulla oblongata
    - Inspiratory innervated by diaphragm, expiratory is abdomen
- Blood pH regulated by H_2CO_3 - HCO3- buffer system
- Peripheral chemoreceptors: stimulated by increase in CO_2
- Central chemoreceptors: stimulated by increase in H+

Renal Physiology

- Blood pH (long term) depends on H+ and bicarbonate
- Nephron is the functional unit of the kidney
- Two main types of nephrons: cortical (85%) and juxtamedullary (15%)
- Flow through cortical:
    - Glomerular (Bowman's) capsule →proximal convoluted tubule → descending limb of the loop of Henle (LOH) → ascending limb of LOH→ distal convoluted tubule (DCT) →collecting ducts
- Flow through juxtamedullary:
    - Glomerular (Bowman's) capsule → proximal convoluted tubule → descending LOH → thin ascending tubule → collecting ducts
- Glomerulus is the vascular part of nephron
- Convoluted is tightly coiled tube, not straight
- Proximal convoluted tubule has most mitochondria, helping with primary active transport of solutes/water (main absorb/reabsorption)
- Distal convoluted tube is the second chance for reabsorption
- Filtrate contains plasma NOT red blood cells because they are too big
- Amino acids → secondary active transport
- Glucose → secondary active transport
- Electrolytes → primary active transport (Na+)
- If Net Filtration Pressure (NFP) is less than 10 → reduced filtrate, less urine
- Low BP is stimulus for secretion of renin → helps convert angiotensinogen from liver to angiotensin I → becomes angiotensin II with ACE (angiotensin converting enzyme) → stimulates ADH secretion
- ADH and aldosterone are synergistic

- Aldosterone causes epithelial cells of kidney to reabsorb sodium → leads to water retention and increase in BP
- Bladder is made of smooth muscle
- Detrusor muscle is the stronger muscle in the bladder

Gastrointestinal Physiology

- Mucus secretes into the lumen and reduces friction
- Increased parasympathetic → Increased secretion of enzymes → increased movement
- Muscularis externa: external longitudinal muscle contracts and pushes stuff through and the circular muscle will cause the lumen to get smaller if it contracts
- Plexus is a group of nerves
- Myenteric nerve pleux: major nerve supply that controls GI tract mobility
- Chemical digestion begins in mouth with salivary amylase
- Stomach has 3 muscle layers!! Other GI has 2 smooth muscle layers
- Chief cells → produce pepsinogen (inactive) and HCl converts to pepsin in stomach because HCl lowers the pH in stomach
- Pepsin starts digestion of proteins
- Parietal cells → secrete HCl
- G Cells (enteroendocrine cells) →secrete gastrin (in stomach)
- Gastric phases:
    - Cephalic →food not in stomach yet, but we smell or think of food which causes secretion of saliva
    - Gastric → ingesting food into stomach, gastric secretion increased
    - Inhibitory/Enterogastric Reflex → emptying the stomach, sphincter relaxes, gastric secretion is decreased
- Bile is produced from some cholesterols
- CCK and secretin: go to blood to stomach to decrease parietal and chief cell activity → this will decrease gastric secretion
- CCK also stimulates the release of bile in gallbladder
- Secretin also tells pancreas to release pancreatic juices (contains bicarbonate)
- Trypin becomes trypsinogen from enteropepitdase
- Carb absorption: glucose is secondary active transport on apical border and facilitated on nasal border
- Perstalsis is stimulated by parasympathetic activity
- Digestion of fats is in the duodenum
- Bile is made in liver and stored in gallbladder
- Bile is made mostly of cholesterol and water