Cardiovascular System

Structures of blood vessels
3 layers:

1. Tunica externa

Composed of collagen fibers, blood vessels

2. Tunica media

Elastic tissue, **smooth muscle**

3. Tunica intima

Endothelial lining, subendothelial membrane(basement membrane), elastic membrane(in arterial circulation).

3 types of arterial vessels

1. Elastic arteries(conducting-near the heart)
2. Muscular arteries(distributing)

Less elastic tissue, more muscle tissue

3. Arterioles

- Feed into capillary beds

3 types of capillaries

1. Continuous

- Most common in body

2. Fenestrated

- Located in kidneys

3. sinusoid

- Enabling full cells to pass through
- Located in bone marrow, spleen

Capillary beds and microcirculation

- The site of capillary exchange
- Microcirculation is the travel of blood through arteriole, capillary, and venule
- Precapillary sphincters contract to prevent blood from flowing through full capillary bed to allow blood to flow straight throw

Veins & Venules

- Blood reservoir
- Valves prevent backflow of blood
- A lot of veins are close to muscles to help push blood towards the heart
- The pressure made when you beath has the same effect
- Little elastic/muscular tissu

Blood flow: volume of blood passing through something in a given time

- Things that regulate it:
- Pressure gradient, and resistance(opposition to flow)

- Things that cause resistance
- Viscosity
- Vessel length
- **Vessel diameter**: small changes in radium have a big impact on blood pressure
- Blood pressure: force exerted of blood on blood vessels
- ★ Will be a question on calculating MAP= Diastolic pressure+pulse pressure/3

Regulation of blood pressure
2 main variables

1. Cardiac output
2. Peripheral resistance

- Short-term
- ➔ Neural control
- Vasomotor tone: blood vessels stimulated by SNS to constantly contract slightly
- Baroreceptors: monitor blood pressure, stretch to stimulate medulla
- Chemoreceptors: detect changes in gases, decrease in O_2 or high CO_2, signal increase in BP
- Hormones: ex. norepinephrine/epinephrine, ADH
- ➔ Hormonal controls
- Long-term regulation
- Renal control: adjust salt/water content
- ➔ Renal control, which changed blood volume

Capillary exchange
3 exchange mechanisms

1. Active transport(large compounds)
2. Diffusion(solute)
3. Bulk flow

- At arteriole end, things leave. At venule end, things(waste) are taken up
- It happens as a result of hydrostatic and osmotic pressure
- The net of these two forces is the net filtration pressure(NFP)
- In arteries NFP is positive, so things are pushed out. In veins, the NFP is negative, so stuff is pulled in

Lymphatic System

2 primary roles

1. Returning fluid to circulation since more blood is pushed out then in(comparison between NFP in arteries and veins)
2. Immune cell patrol and development

- Lymph capillaries converge into lymph nodes where immune cells mature
- Immune cells filter the blood and exist via efferent vessels
- Fewer efferent to slow down blood to give time for it to be filtered
- ★ Know how to label lymph node (afferent/efferent vessels, sinuses, germinal center)

Respiratory System

- ★ Know how to label trachea
- Increases surface area to increase the efficiency of gas exchange
- Type II cells: release surfactant(breaks surface tension in alveolar fluid)
- Macrophages help to clean up the bacteria in alveoli

Pulmonary pressures

- Lung collapsing forces

1. Natural elastic recoil of the lungs
2. Surface tension of alveolar fluid

- Gas exchange occurs in an aqueous solution(water)
- Breaks up the attraction between water so it doesn't exclude the air

- Lung expanding forces

1. Elasticity of chest wall
2. Surface tension of intrapleural fluid

- Transpulmonary pressure(Intrapulmonary-intrapleural)
- Must be above zero or else the lungs will collapse
- Breathing is controlled by changing pressures to force of air in or out of the lungs
- Quiet breathing/inspiration: diaphragm lowers so lungs expand, external intercostal muscles are also involved
- Quiet exhalation: elastic recoil of the lungs
- Forced exhalation/inhalation: add other muscle groups, abdominal
- Pulmonary ventilation

3 factors hinder the ability to ventilate lungs

1. Resistance: opposing the flow of air in lungs
2. Alveolar surface tension: surfactant helps reduce it. Can be dangerous in premature babies cause they don't have surfactant
3. Lung compliance: ability of lungs to stretch

Lung capacity

- ★ Know the chart

- Terms: inspiratory/expiratory reserves, residual volume(amount of air always there)
- Anatomical dead space: doesn't participate in gas exchange
- Alveolar dead space: alveoli that are filled with air but don't participate in gas exchange. Ex. when you have a blood clot that prevents blood from reaching alveoli

Gas Exchange

- Dalton's law of partial pressure-not too important to know
- Alveolar composition due to gas exchange, humidification of air in conducting zone, mixing of alveolar air with atmospheric air with each breath.
- ★ Know pressures of CO_2 and O_2 at tissues and alveoli
- Driven by pressure gradients
- Fast, and exchange happens quickly so that blood can move through past and get enough O_2
- Respiratory membrane:
- Thin membrane(easier transport)
- Massive SA so a lot of transport can happen
- Ventilation-perfusion coupling
- Alveolar perfusion: blood flow into an alveolar capillary bed
- Ventilation: air flow into an alveolus
- Goal: match ventilation with perfusion
- Hemoglobin
- Binding of an O_2 molecule increases its affinity for more O_2
- Factors that affect how it binds/holds on to oxygen
- Temperature
- CO_2 levels
- pH

They decrease affinity so that it will come off easier

- ★ Know Bohr(low pH, decreases affinity) and Haldane effect(.....)