Week 9 Lecture 1

Jared Brannan

October 27, 2021

1 Administrative drivel

- exams will be graded by monday at the latest
- Revised paper due Nov, 8th at 11:59pm
  - Turn on tracking for the paper revision!
  - the grade will be no lower than the first grade.

2 Anatomy and Physiology

2.1 Respiratory system

- Breathing – control
- rate control
  - There are monitors on the blood composition (main in the carated artery in the neck)
  - Chemoreceptors in aorta and carotid arteries increase rate when O_2 drops too low, or CO_2 gets too height
  - several other bain areas are also involved
- normal breating – 500 ml in and out (about 1 pint) == "**tidal volume**"
  - *Forced* inhalation can bring in additional air: around 3300mL in males, or 1900 mL in females
  - *Forced* exhalaltion can foce out additional air: around 1000mL in males, or around 700mL in females
  - even after forced exhalation, some residual air remains, stuck in incompressible spaces (e.g. trachea) or in alveoli, holding them open for a total of about 1100-1200mL of space
  - this give the total lung air volume of 3200-6000mL or .75-1.5 gallons
  - O_2 in the blood drops only by about a quarter when it passes through the tissues
- **Respiration**
  - Beathing == pulling air in and out of the lungs
  - **Respiration** == exchanging gases between air and tissues
  - **Respiration** == exchange of gases between air in the alveoli and capillary blood surrounding the alveoli Diffusion driven by difference in concentration between gases in air and gases in blood
  - gases will independently diffuse down their gradients
  - Recall from membranes – O_2 and CO_2 are small and non-poolar so they move through membranes.
- Gas exchange in an alveolus:

  - blood comes from the heart into a capilary surrounding the alveoli, gas exchange ocurs, then blood is sent down a vein to the heart all oxygenated and with less CO_2.
  - There are chemicals inside the alveolus that keeps it from getting stuck in a collapsed position

- Gas transport – oxygen
  - O_2 has low solubility in liquids, and doesnt convert to other molecules (covalent bonds), but loves to bind to hemoglobin once it reaches
    - ie, O_2 is not very reactive with anything in the blood till it gets to the hemoglobin's iron molecule

- clicker q: what is the diaphragm? The muscle below the ribs that is involved in breathing

- Red blood cells AKA erythrocytes
  - concentration of oxygen in the plasma is low, since much of it binds to hemoglobin, allowinng more oxygen to diffuse the plasma from the lungs
  - Each cell carries about 200 million hemoblobin molecules
  - oxygen bind to the **heme** group – it contains Fe^{2+} (iron ions)
    - hence the red color
  - Each hemoglobin can bind $4O_2$.

- as transport – carbon dioxide
  - Higher (but still low) solubility in liquids than oxygen
  - Redily forms *carbonic acid* in water, breaks into H^+ and *bicarbonate* (This is the form that CO_2 is caried in the blood (in the plasma))
  - $CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$
  - CO_2 is combined with H_2O by an enzyme
  - at the lungs, this proocess reverses
  - The H^+ ion tends to interact with hemoglobin to knock off the O_2 from the hemoglobin (from increased Ph)
  - CO_2 can also bind to hemoglobin

- recall, in mitochondra: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 36ATP$
  - O_2 is required to get the most ATP possible, CO_2 is wast product from this process.

- so, aside from breathing, resperation is passive!

- <u>Carbon monoxide</u> poisoning:
  - CO is produced by gasoline engines, power tools,, poorly functioning furnaces / stoves
    - Colorless, odorless – hard to detect
    - preferentially binds to hemoglobin, so not as much O_2 can bind, thus, tissues are deprived of oxygen.

- <u>Diseases</u>
  - Infection and inflamation
    - The lungs are 100% humidity, and warm, which is a perfect place for infectious organisms to thrive
    - Fumes from cars can make O_3, an iritant for tissues, iritating the tissues, stimulating an imune response causing inflamation

  - Problems with air transport (in or out)
    * Constrictions or restrictions
    * choking
  - Problems with gas diffusion
- **Asthma** – inflamation of the bronchioles
  - iritation of the lining of the bronchi, causing the muscles in the walls to constrict, reducing the diameter of the passageway
  - mucus is released