Chapter 22: Introduction to Oxygen and Carbon Dioxide Physiology

1. External (Organismal) Respiration
   A. exchange of O\textsubscript{2} and CO\textsubscript{2} between external environment and mitochondria
      a. Ventilation -> Diffusion -> Circulation -> Diffusion

2. Cellular Respiration
   A. production of ATP
      a. Glycolysis
      b. Mitochondrial respiration

Respiratory Systems

Dalton’s Law (Fig 22.1)

Composition of Dry Air

1. At sea level, atmospheric pressure = _____ mmHg
2. O\textsubscript{2} is _____ of the atmosphere?
3. P_{oxygen} is _____ mm Hg
4. At 6000 m, where the atmospheric pressure is half that at sea level, P_{oxygen} is ___
Gas Diffusion: Henry's Law

1. Gases dissolve in liquids
   A. in proportion to their partial pressures
   B. Depending on their solubilities in the specific fluids
   C. depending on the temperature.
   D. Other solutes will also affect the amount of dissolved gas

Solubilities of Gases

1. \( \text{CO}_2 \) (30x) > \( \text{O}_2 \) (2x) > \( \text{N}_2 \)
2. 30 times more \( \text{CO}_2 \) than \( \text{O}_2 \) can be dissolved per unit volume of liquid
3. But present as 0.03% of atmosphere

1. Temperature (Fig. 22.2)
   A. Solubility decreases with increasing temperature
2. Salinity (Fig. 22.2)
   A. Solubility decreases with increasing salinity
3. Gases don't interfere with the solubility of other gases
4. Effect of temperature on \([\text{O}_2]\) in air, freshwater, seawater (Table 22.1)
Diffusion of Gases

1. Gases diffuse from regions of higher partial pressure to regions of lower partial pressure
2. The function of a water beetle's bubble as a gill: O₂ levels in the atmosphere, water, and bubble gas—and O₂ diffusion (Fig. 22.3)
   A. Bubble of O₂ in 100% O₂ water
   B. Bubble of air in O₂-free water
   C. Bubble of air in normal water

Diffusion of Gases

1. Figure 22.4 The principles of gas diffusion are vital knowledge for scuba divers
2. Diffusion in air 10,000 x faster than in water at the same partial pressure
3. Different dimensions in respiratory organs

Figure 22.5 Replacement of air with water in the interstitial spaces of beach sand can cause anoxia in a sea turtle nest because diffusion is far slower through water than through air
1. Box 22.1. Over What Distance Can Diffusion Meet the O₂ Requirements of Tissues?
A. Respiration by diffusion alone is possible only if distances covered are < 1 mm.
B. Larval versus adult anchovies

Figure 22.6 Convective transport
1. Gas transport is enhanced by convective movement (bulk flow)
   A. Directional movement rather than random diffusion of molecules.
   B. Unidirectional flow
   C. Tidal flow
2. Box 22.2. Induction of Internal Flow by Ambient Currents

Figure 22.8 The concept of the physiological oxygen cascade is based on an analogy with a cascade along a mountain stream (Part 2)
Figure 22.7 Convection and diffusion alternate in transporting \( O_2 \) from the atmosphere to the mitochondria in a person.