GAS TRANSPORT IN THE BLOOD
Section 5, Part B

CARBON DIOXIDE TRANSPORT

CO₂ is an end product of cellular metabolism of glucose.

1. \( R = .8 \)
2. unless breathing CO₂, all CO₂ in venous, arterial blood and alveolar gas originates from the cell
3. CO₂ diffuses out of the cell into the blood stream and then to the lungs

A. CO₂ transport in plasma -
1. CO₂ will dissolve in plasma -
2. CO₂ will slowly react with water -
   a. \( \text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^- \)
   b. \( \text{H}^+ \) is buffered by plasma buffering systems
3. CO₂ will react with free amino groups -
   a. \( \text{R}^-\text{NH}_2 + \text{CO}_2 \leftrightarrow \text{R}^-\text{NHCOO}^- + \text{H}^+ \)

B. CO₂ transport in the erythrocyte
1. CO₂ will dissolve within the red blood cell (RBC)
2. CO₂ will combine with hemoglobin (Hb) to form carbamino compounds
   a. \( \text{R}^-\text{NH}_2 + \text{CO}_2 \leftrightarrow \text{R}^-\text{NHCOO}^- + \text{H}^+ \)
   b. an increase of CO₂ will cause an isohydric effect -
   c. the pressure of O₂ on the heme inhibits CO₂ from attaching to the NH₂ site (Haldane effect)
3. CO₂ reacts more rapidly in the RBC because of the enzyme carbonic anhydrase (CA)
   a. \( \text{H}^+ \) formed are quickly buffered by Hb
   b. \( \text{HCO}_3^- \) form a weak ionic relationship with \( \text{K}^+ \)
   c. \( \text{HCO}_3^- \) diffuses out of the RBC -
   d. \( \text{Cl}^- \) moves into the RBC (Hamburger phen.) -
   e. \( \text{HCO}_3^- \) then forms a weak ionic bond with \( \text{Na}^+ \) in plasma
   f. as the CO₂ concentration falls in the plasma the reaction will reverse in direction
4. most of the buffering occurs in the RBC
5. 2/3 of CO₂ is carried in the plasma

C. CO₂ dissociation curve
1. the solubility coefficient (Cs) for CO₂ in blood at 37° C is 0.063 vol%/torr
   a. if \( \text{PaCO}_2 \) is 40 torr then: \( 40 \text{ torr} \times 0.063 \text{ vol%/torr} = 2.52 \text{ vol%} \)
2. most CO₂ is carried as \( \text{HCO}_3^- \) and must first pass through the RBC
3. at a \( \text{PaCO}_2 = 40 \text{ torr} \), total \( \text{CO}_2 = 48.5 \text{ vol%} \) (\( \text{PaO}_2 =100 \))
4. at a \( \text{PvCO}_2 = 46 \text{ torr} \), total \( \text{CO}_2 = 52.2 \text{ vol%} \) (\( \text{PaO}_2 = 42 \))

D. body stores of CO₂
1. CO₂ stores are the largest of any gas in the body
2. normally CO₂ production is offset by CO₂ elimination
3. CO₂ compartments
   a. body fluids - 50 ml of CO₂ per 100 ml of fluid -
   b. bone contains more than 100 vol% of CO₂
4. as hypoventilation occurs, CO₂ reservoirs fill
5. as hyperventilation occurs, CO₂ reservoirs are depleted -