1. Textbook pages that you can skip in Chapter 48
   fig. 48-2
   insect trachea: p. 853
   birds: pp. 854-856
   tidal breathing: pp.856-857 + Fig. 48.11

2. Roadmap of the lecture
   * limits to gas exchange
   * the law of diffusion and respiratory adaptations
   * fish:
     • anatomy of gills
     • counter-current
   * humans:
     • anatomy of the lung
     • respiratory adaptations
     • gas transport in the blood
       • biochemistry of hemoglobin
       • binding curve
       • pH regulation of binding curve
       • adaptation to high altitudes
       • myoglobin
       • transport of CO2
     • control of ventilation rate: chemosensors

3. Study guide
   After studying for this lecture, you should be able to:
   • Explain how the efficiency of oxygen diffusion is affected by the surface area and the concentration gradient
   • Explain respiratory adaptations in terms of the law of diffusion and the parameters that affect the rate of diffusion
   • Explain how a counter current is useful to maximize gas exchanges
   • Describe the anatomy of the human lungs
   • Describe the respiratory adaptations in humans
   • Know the composition and role of hemoglobin (Hb)
   • Draw the binding curve of oxygen to Hb, and be able to correlate the curve to the binding or release of oxygen in different parts of the body
   • Draw how the binding curve changes with pH; explain if this corresponds to a greater or lower affinity of oxygen for Hb. Explain how this effect helps the body.
• Compare and contrast the adaptations to high altitudes done by animals who live at high altitudes (llamas) vs animals who don’t (humans)
• Know the three ways CO2 can be transported in the blood
• Discuss why CO2 is released from the blood in the lungs
• Discuss how the rhythm of ventilation is controlled
• Answer the following questions:
  • What are alveoli?
  • Is counter-current an adaptation in mammals? Explain
  • What is positive cooperativity?
  • What is the Bohr effect?
  • Is the binding of oxygen by Hb better or worse when the binding curve is shifted to the right? To the left?
  • Does myoglobin bind oxygen better or worse than hemoglobin?
  • What is carboxyhemoglobin?
  • What is diphosphoglyceric acid? What does it do?
  • Where is hemoglobin located? Where is myoglobin located? Where is carbonic anhydrase located?
  • Where are chemosensors located?
  • Is the rate of ventilation more sensitive to CO2 or O2?