1. Respiration (Ch 20-21)

http://eebweb.arizona.edu/eeb_course_websites.htm

Housekeeping, 05 March 2008

Upcoming Readings
Wed 05 Mar: Ch20, 21 (respiration)
LAB Wed 05 Mar: Dickinson reading on website
Fri 07 Mar: Ch 21
Mon 10 Mar: Ch 21, 22
Wed 12 Mar: Ch 23 (circulation)
LAB Wed 12 Mar: no reading
Fri 14 Mar: EXAM TWO (through respiration)
SPRING BREAK

Lab discussion leaders: 05 March
1pm - Julia, Matt C.
3pm - Dalziel, Nick

Lab discussion leaders: 26 Mar
1pm - Vangie & Christina
3pm - Prasun & Ajay
The Edges of Life – 7pm at Centennial Hall

Wednesday, March 5
Life’s Technological Edge: The Singularity is Near: When Humans Transcend Biology
Ray Kurzweil, via Teleportec Teleporter
Founder, Chairman and Chief Executive Officer, Kurzweil Technologies
Humanity is on the edge of a vast transformation, when what it means to be human will be both enriched and challenged. Inventor and futurist Ray Kurzweil will introduce this radically optimistic singularity, an era when we break our genetic shackles to create a nonbiological intelligence trillions of times more powerful than today. In this new world, humans will transcend biological limitations to achieve entirely new levels of progress and longevity.
This lecture co-sponsored by: UA College of Engineering and UA College of Science

These do not count as physiology lectures.
Species differences in Cl⁻ affinity and in electroregocity of SLC26A6 mediated oxalate/Cᵢ⁻ exchange correlate with the distinct human and mouse susceptibilities to nephrolithiasis

Jeffrey S. Clark, David H. Vandevoorde, Maria N. Chernev, John F. Hemington, Andrew K. Stewart and Steve L. Alper

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Vertebrate Respiration
Gas transfer

1. **Breathing** (supply air or water to respiratory surface)

2. **Diffusion** of \( \text{O}_2 \) & \( \text{CO}_2 \) across resp. epithelium
   (humans = 50-100\(^2\) m \( \text{SA} \))

3. **Bulk transport** of gases by blood

4. **Diffusion** across capillary walls (blood \( \longrightarrow \) mitochondria)
Lung Anatomy

**Nonrespiratory**
- Trachea ->
- Bronchi ->
- Bronchioles ->

**Respiratory**
- Terminal bronchioles ->
- Respiratory bronchioles ->
- Alveoli

- Cilia and Mucus

(Eckert, 13-21)
Gas Diffusion Barriers:

Hill et al., 2004, Fig. 20.4

(Eckert, 13-22)
Lung Ventilation

- Small mammals with greater per gram $O_2$ needs and therefore greater per gram respiratory surface area?

- Dead Space (anatomic and physiological)

Swan (Eckert, 13-24)
Mammalian Ventilation

- lungs are elastic bags
- suspended in pleural cavity within thoracic cage (ribs and diaphragm define, fluid lines)
- low volume pleural “space” between lung and thoracic wall
- negative pressure to inflate lungs (increase volume)
- pneumothorax
Mammalian Ventilation

Expiration usually passive

(Eckert, 13-28)

(Eckert, 13-30)
Mammalian Lung

Alveoli and Capillaries

Bird Lung Ventilation
Unidirectional!!
Bird Ventilation

- Lung volume changes very little, air sacs instead.

Knut Schmidt-Nielsen 1972

Mammal Lung
Alveoli

Bird Lung
Parabronchi
Frog Ventilation

- **Positive pressure** ventilation

1. Into mouth *(buccal cavity)*

2. Close nares, open glottis and force air into lungs by raising buccal floor

*(Eckert, 13-33)*

Pulmonary **Surfactants**

- **Reduce** liquid surface tension in alveoli

- Allows for **compliance** and low-cost expansion of lung

- **Lipoproteins**

- keep alveoli from getting stuck closed
  
  *Atelectasis* = collapsed lung

- **premature** babies may need **artificial surfactant**
Panting Dogs?

Figure 17. As the total respiratory ventilation (abscissa) increases in the panting dog, the dead space ventilation increases rapidly. The alveolar ventilation, however, does not increase until the total ventilation exceeds about 200 liters per minute. In extreme panting the respiratory frequency (f) is decreased as tidal volume (Vt) is increased (figure at top of graph). (From Hald, 1966.)

Fish Gill

FISH GILL Scanning electron micrograph of gill filaments of a sturgeon (Acipenser transmontanus). White arrows show the direction of water flow and black arrows the direction of blood flow. The bar in the lower left corner represents 0.05 mm. (Burggren et al. 1978; courtesy of Warren W. Burggren, University of Massachusetts)
(a) Two types of convective transport

- Unidirectional flow
- Tidal flow

(b) Calculation of the rate of convective gas transport

\[ C = \text{Total concentration of gas in flowing fluid (mol/L)} \]
\[ F = \text{Flow rate of fluid (L/second)} \]

\[ \text{Rate of convective gas transport} = C \times F \]

Hill et al., 2004, Fig. 20.3