BI 121 Lecture 2

I. Announcements Lab 1 Histology today!
   130 HUE. Fun! Readings: DC, LS, LM? NB: Course website
   UO Biology vs. Blackboard http://blogs.uoregon.edu/bi121/fall-2014/

II. Homeostasis LS ch 1, DC Module 1
   A. What? Maintenance of ECF LS p 8
   B. Where? ECF = Plasma + Interstitium + ? LS fig 1-4 p 8
   C. Homeostatic Balances? LS p 9, DC pp 5-6
   D. Why? Cell survival! LS fig 1-5 p 9, DC p 5
   E. Physiology in the News H₂O? Are we like watermelons?
   F. How are balances maintained? Simplified Homeostatic
      Model cf: LS fig 1-7 p 14; T°C + BP balance e.g. + vs. - FB

III. Cell Anatomy, Physiology & Compartmentalization LS ch 2
   B. Basic survival skills LS ch 1 p 3
   C. Organelles ≡ Intracellular specialty shops
      Endoplasmic Reticulum (ER), Golgi, Lysosomes,
      Peroxisomes & Mitochondria, LS fig 2-1, 2-2, 2-3 pp 20-3
Maintenance of a relative constancy in the Internal environment = ECF = fluid outside of cells

milieu interieur?

100 trillion cells working intimately

Claude Bernard

Walter B. Cannon
Where is extracellular fluid?
Where is extracellular fluid?

As long as between/outside cells, ECF everywhere?

G&H 2011
ICF = Intracellular

ECF = Extracellular

Plasma (within CV System)

Interstitium (eg, between muscle cells)
HOMEOKINESIS?
Dr. Evonuk’s 6 Balances

Metabolic

\[ \text{ANA-} \quad \text{CATA-} \]

\[ \text{O}_2/\text{CO}_2 \]

\[ \text{Ion}^{+/-} \]

\[ \text{H}_2\text{O} \]

\[ \text{pH} \]

\[ \text{ToC} \]

\[ \text{Bicarbonate and pH Balance} \]
No, we’re not watermelons, but H₂O is definitely critical!!

because you’re 98% water.

≠

10-12 gallons

EARTH₂O

100% NATURAL SPRING WATER

NATURAL SPRING WATER
Drink about 1 L per 1000 calories energy expenditure!!

Human \sim \frac{2}{3} \text{H}_2\text{O}
\sim \text{60 – 70}\%$

$= \sim40 – 48 \text{ kg H}_2\text{O}$

$\text{NB: So } 2000 \text{ kcal } \rightarrow$
drink 2000 mL
\equiv 67.63 \text{ fl oz}
\equiv \sim 8 \text{ cups!}$

150 lb /68 kg
Invariably, Negative Feedback
**NB:** Though most often negative feedback, there are exceptions:

Selected +FB eg:

- LH Surge + Ovulation
- Oxytocin + Uterine Contraction
- Blood Clotting Cascade
- cAMP Cascade
- Na+ influx during AP
70% $H_2O$ = 49L

INPUT
- Dietary Drink: 1200 mL
- Dietary Eat: 400 mL
- Oxidation: 400 mL
Total = 2000 mL

OUTPUT
- Urine: 1000 mL
- Sweat + Insensible: 900 mL
- Feces: 100 mL
Total = 2000 mL

ECF = 14L
- Interstitium = 11L
- Plasma = 3L

INPUT + OUTPUT = BALANCE!
Controller = Hypothalamus with Set Point

True Diurnal Variation

Protein Denaturation

Mild Hypothermia

Profound Hypothermia

Set Point

98.6°F

110°F

Temperature (°C):
- Lethal: 42°C
- Lethal: 29°C
- 37°C
- 35°C
- 33°C
- < 30°C

Time of Day:
- 0600
- 1400
- 0600
- 1400
Electrochemical Signal

\[ I' \]

CV Control Center
Brain Stem

\[ C \]

\[ O \]

Electrochemical Signal
eg, Symp Accel N

Baroreceptors/Pressure Receptors
eg, in Carotids & Aorta

\[ R \]

NB: Corrective Change
Opposes Original Input

Seated to Standing

\[ \downarrow \text{BP} \]

\[ I \]

Venous Pooling

\[ \uparrow \text{BP} \]

\[ \uparrow \text{HR} \]

\[ + \]

\[ \uparrow \text{VC} \]
Class Discussion + Break!
HOW BIG? 100 CELLS LENGTHWISE = 1 mm!!

1. **Cell/Plasma membrane**
   - Organelles
   - Nucleus
   - Cytosol

2. **Nuclear Membrane**

$d=10-20$ microns

Cells make up body systems
Cytoplasm = Cell - Nucleus

[Extract nucleus; includes organelles]

Cytosol = Cytoplasm - Organelles

[Extract organelles; complex gel-liquid]
Why Compartments? Advantage?

*Incompatible* reactions can take place *Simultaneously*!!
Basic Cell Survival Skills?
1. Get food
2. Use food
3. Rid wastes
4. Move
5. Reproduce

How to live?

Nucleus or nose?
1 e.g. Cell of 100 Trillion!
Rough & Smooth Endoplasmic Reticulum (ER): Protein & Lipid Synthesizing Factories

1. packages new proteins in transport vesicles
2. stores calcium in muscles

fig 2-2 LS 2012
Electron Micrographs of Rough vs. Smooth ER
Secretion of Proteins Produced by ER
Golgi Complex: Final Processing, Packaging & Distribution

- Transport vesicle from ER, about to fuse with the Golgi membrane
- Golgi lumen
- Golgi sacs
- Vesicles containing finished product
- Golgi complex
Exocytosis: Primary Means of Secretion
Endocytosis: Primary Means of Ingestion
Lysosomes vs. Peroxisomes
Phagocytosis: Cell Eating!

(a) Particle - Surface receptor site - Endocytotic pouch - Endocytotic vesicle

(b) White blood cell - Phagocytic vesicle - Lysosome - Residual body
Film: Neutrophil engulfing bacterium

http://www.hopkinsmedicine.org/cellbio/devreotes/videos.htm

L. Nilsson, Nat Geog 1986
Catalase Enzyme Reaction in Peroxisomes
Neutralize Toxin at Production Site!

\[ 2\text{H}_2\text{O}_2 \xrightarrow{\text{Catalase}} 2\text{H}_2\text{O} + \text{O}_2 \]
Mitochondria: Energy Organelles

Proteins of electron transport system
Intermembrane space
Cristae
Inner mitochondrial membrane
Matrix
Outer mitochondrial membrane
Cristae

fig 2-8 LS 2012