BI 121 Lecture 2

I. **Announcements**  Lab 1 Histology today!

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
  - ANA-
  - CATA-

- Water ($H_2O$)

- Ion +/- ($ToC$)

- $O_2$/$CO_2$

- pH

- Salt

- Electricity
No, we’re not watermelons, but H$_2$O is definitely critical!! because you’re 98% water.
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H\textsubscript{2}O
≈ 60 – 70 %

= ~40 – 48 kg H\textsubscript{2}O

NB: So 2000 kcal →
drink 2000 mL
≡ 67.63 fl oz
≡ ~ 8 cups!
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
INPUT
- Dietary Drink: 1200 mL
- Dietary Eat: 400 mL
- Oxidation: 400 mL
Total: \( \text{2000 mL} \) ➔ BALANCE!

OUTPUT
- Urine: 1000 mL
- Sweat + Insensible: 900 mL
- Feces: 100 mL
Total: \( \text{2000 mL} \) ➔ BALANCE!

\[ \text{ICF} = 35 \text{L} \]
\[ \text{ECF} = 14 \text{L} \]
- Interstitium: 11 L
- Plasma: 3 L

\[ 70\% \text{ H}_2\text{O} = 49 \text{L} \]

\[ 70 \text{ kg} \]
Controller = Hypothalamus with Set Point

True Diurnal Variation

Protein Denaturation

Mild Hypothermia

Profound Hypothermia

0600 1400 0600 1400

Time of Day

98.6°F 110°F

37°C

35°C

33°C

< 30°C

29°C

Lethal

Lethal
Venous Pooling

Baroreceptors/Pressure Receptors eg, in Carotids & Aorta

NB: Corrective Change Opposes Original Input

Seated to Standing

Electrochemical Signal

CV Control Center Brain Stem

Electrochemical Signal eg, Symp Accel N

BARORECEPTORS/ PRESSURE RECEPTORS

Seated to Standing
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?
fig 2-1 LS 2012

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

**Rough ER**: Protein-synthesizing machinery

**Smooth ER**: Involved in lipid synthesis and the transport of molecules between compartments

1. Packages new proteins in transport vesicles
2. Stores calcium in muscles

fig 2-2 LS 2012
Electron Micrographs of Rough vs. Smooth ER

- Rough ER lumen
- Ribosomes
- Smooth ER lumen
Instructions for building proteins leave the nucleus and enter the cytoplasm.

Proteins (colored strands) are assembled on ribosomes attached to the ER or free in the cytoplasm.

1. Rough ER
2. Transport vesicles
3. Golgi complex
4. Secretory vesicles
5. Secretion (exocytosis)
6. Lysosome

fig 2-3 LS 2012
Golgi Complex: Final Processing, Packaging & Distribution

- Transport vesicle from ER, about to fuse with the Golgi membrane.
- Vesicles containing finished product.
**Exocytosis: Primary Means of Secretion**
Endocytosis: Primary Means of Ingestion
Lysosomes vs. Peroxisomes

- Lysosomes contain hydrolytic enzymes.
- Peroxisomes are involved in oxidative enzymes.
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://devreotes.johnshopkins.edu/videos

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

$$2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$$
Mitochondria: Energy Organelles