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)

https://www.youtube.com/watch?v=B658Yn3lNYc
Homeostasis or Homeokinesis?

https://www.khanacademy.org/partner-content/mit-k12/chem-and-bio/v/homeostasis
Dr. Evonuk’s 6 Balances

Metabolic

$\text{H}_2\text{O}$

$\text{pH}$

$\text{ToC}$

$\text{O}_2/\text{CO}_2$

Ion$^+/-$

$p\text{H}$
No, we’re not watermelons, but H₂O is definitely critical!!
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H$_2$O
~ 60 – 70 %

150 lb /68 kg

$\approx 40 - 48$ kg H$_2$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
70% $\text{H}_2\text{O}$

$= 49\text{L}$

ICF = 35L

EG

ECF = 14L

Interstitium = 11L

Plasma = 3L

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

BALANCE!
Controller = Hypothalamus with Set Point

True Diurnal Variation

- Protein Denaturation
- Mild Hypothermia
- Profound Hypothermia
- Set Point: 37°C (98.6°F)
- Lethal: 42°C (110°F)

Time of Day

https://www.khanacademy.org/partner-content/mit-k12/chem-and-bio/v/homeostasis
Venous Pooling

Electrochemical Signal

Baroreceptors/Pressure Receptors eg, in Carotids & Aorta

NB: Corrective Change Opposes Original Input

Seated to Standing

↑ BP

CV Control Center
Brain Stem

Electrochemical Signal eg, Symp Accel N

↑ HR

↑ VC

Ef

E

C

O
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

Smooth ER:
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

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.

Ribosomes

Rough ER

Transport vesicles

Smooth ER

Golgi complex

Secretory vesicles

Lysosome

Secretion (exocytosis)

fig 2-3 LS 2012
Golgi Complex: Final Processing, Packaging & Distribution
Exocytosis: Primary Means of Secretion
**Endocytosis: Primary Means of Ingestion**
Lysosomes vs. Peroxisomes
**Phagocytosis: Cell Eating!**

(a) Illustration of the process of phagocytosis:
- Particle binds to the surface receptor site.
- Surface receptor site invaginates to form an endocytotic pouch.
- Endocytotic pouch forms an endocytotic vesicle.

(b) Detailed view of a white blood cell showing:
- Phagocytic vesicle
- Lysosome
- Residual body

Fig 2-7 LS 2006
Film: Neutrophil engulfing bacterium

http://devreotes.johnshopkins.edu/videos

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

$2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

Catalase
Mitochondria: Energy Organelles

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