I. **Announcements** Q from last time? **Come to office hr!**

II. **Connections** Homeostatic model: BP regulation

III. **Cell Anatomy, Physiology & Compartmentalization** LS ch 2
   B. Basic survival skills ch 1 p 3
   C. Organelles ≡ Intracellular specialty shops LS pp 21-34
      1. Endoplasmic reticulum (ER) fig 2-1, 2-2, 2-3
      2. Golgi complex fig 2-3, 2-4
      3. Lysosomes fig 2-5, 2-6
      4. Peroxisomes fig 2-6
      5. Mitochondria fig 2-8 LS 2012 pp 20-34, tab 2-1 p 36
   D. **Physiol News** Moms eggs execute Dad’s mitochondria?

IV. **Anaerobic vs Aerobic Metabolism Overview** Many sources! Mathews & Fox 1976...LS 2012 pp 26-33, fig 2-15 p 33
   A. ATP-PC Immediate, Glycolytic & Aerobic Energy Systems
Blood Pressure Homeostasis

Venous Pooling

Electrochemical Signal $I'$

CV Control Center
Brain Stem

Baroreceptors/Pressure Receptors
e.g., in Carotids & Aorta

Seated to Standing

$\downarrow$ BP

$\uparrow$ BP

Baroreceptors/Pressure Receptors
eg, in Carotids & Aorta

NB: Corrective Change $\Delta$ Opposes Original Input $I$

Short-term vs long-term!

$\downarrow$ HR

Venous Pooling

$\uparrow$ VC

Electrochemical Signal e.g., Symp Accel N
How Big? 100 Cells Lengthwise = 1 mm!!

1. Cell Membrane

2. Nuclear Membrane

Cytoplasm = Cell - Nucleus

[Extract nucleus; includes organelles]

Cytosol = Cytoplasm - Organelles

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

*Incompatible* reactions can take place

*Simultaneously!!*

...gobble! gobble!

Lysosome

DNA

Nucleus
Basic Cell Survival Skills?
1. Get food
2. Use food
3. Rid wastes
4. Move
5. Reproduce

Nucleus or nose?

How to live?
1 Sample Cartoon of 100 Trillion (100 x 10^{12}) Cells!

**Rough & Smooth Endoplasmic Reticulum (ER): Protein & Lipid Synthesizing Factories**

**Rough ER**

- Ribosomes
- Sacs

**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

- **Rough ER lumen**
- **Ribosomes**
- **Smooth ER lumen**

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fig 2-2 LS 2012
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.

1. Rough ER
2. Transport vesicles
3. Golgi complex
4. Secretory vesicles
5. Lysosome
6. Secretion (exocytosis)
7. Lysosome
Golgi Complex: Final Processing, Packaging & Distribution

Fig 2-4 LS 2012
Exocytosis: Primary Means of Secretion
**Endocytosis: Primary Means of Ingestion**

- Forming endocytic pouches
- Intracellular endocytic vesicle

Endocytic vesicle
Lysosomes vs. Peroxisomes
Phagocytosis: Cell Eating!
Film: Neutrophil engulfing bacterium

http://devreotes.johnshopkins.edu/videos
Catalase Enzyme Reaction in Peroxisomes
Neutralize Toxin at Production Site!

\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]
I'm the Mighty Mitochondrion. I give the cell energy.
Mitochondria: Energy Organelles
Mom's eggs execute Dad's mitochondria

In "Hamlet," Rosencrantz and Guildenstern deliver a letter to the rulers of England that carries the ill-fated duo's own death sentence. Perhaps Shakespeare knew a bit about reproductive biology.

Scientists have now found that during a sperm's creation, its mitochondria—energy-producing units that power all cells—acquire molecular tags that mark them for destruction once the sperm fertilizes an egg. This death sentence, a protein called ubiquitin, may explain why mammals inherit the DNA within mitochondria only from their mothers, a bi-species mitochondrial inheritance. Sperm mitochondria sometimes avoid destruction when two different species of mice mate, and Schatten's team has shown this also holds true in cattle. It's hard to understand how an egg distinguishes between paternal mitochondria of closely related species, says Schon.

When paternal mitochondria escape destruction in normal mating, the resulting embryo may suffer. Schatten notes that a colleague has found sperm mitochondria in some defective embryos from infertility clinics.

Inside a fertilized egg, with its two sets of chromosomes (blue), the protein ubiquitin (red) tags sperm mitochondria (yellow).

I need a break

but I'd rather have a breakthrough.
MITOCHONDRIUM

AEROBIC

\text{w/O}_2 \quad = \quad \text{MITOCHONDRIUM}

ANAEROBIC

without \text{O}_2 \quad = \quad \text{CYTOSOL}

1. Immediate/ATP-PC
2. Glycolysis
WOW!

I’M CHAMP!

https://jissn.biomedcentral.com/articles/10.1186/s12970-017-0173-z
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3407788/
ATP Supplied

- **Performance Time**
  - **Power Output**
  - **Oxygen System**
    - Immediate: 15 - 30 s
    - 1.5 - 3 m
    - > 3 - 5 m

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Cytosol → Mitochondria

**Anaerobic**

**Glycolysis**

**Aerobic**

Modified after Mathews & Fox
ATP = Adenosine Tri Phosphate
The Common Energy Currency or the Cash Cells Understand!!

Adenosine

Phosphates

High Energy Phosphate Bonds