I. **Announcements**: Please check & sign attendance roster. Not on list? See Pat during break/class. *Lab 1 Histology* Thursday, 10 am – 5 pm sections in 130 HUE. Much fun!!

II. **Introduction**: Staff, office hr, required sources, course overview, grading, expectations & success. Q?

III. **Human Physiology** LS ch 1, DC Module 1,
   A. What? cf: Anatomy LS p 1
   B. Where? Body Levels of Organization LS pp 1-6, DC pp 1-5
   C. How? Different Study Approaches LS p 1

IV. **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. How? Simplified Homeostatic Model cf: LS fig 1-7 p 14
      Balances LS p 9, DC pp 5-6
   D. Why? Cell survival! LS fig 1-5 p 9, DC p 5
ANATOMY vs PHYSIOLOGY
STRUCTURE vs FUNCTION
WHAT? vs HOW?
WHERE? vs WHY?
High-Tibial Osteotomy (HTO) to Realign the Joint

1. Oscillating saw cut
2. R plate/scaffolding insert
3. Align, stabilize w/screws & pack defect
Body Levels of Organization

1. Molecular
2. Cellular
3. Tissue
4. Organ
5. System

Entire Organism, like you & me!
Nerve conducts

Connective connects!!

Muscle contracts

Epithelial covers
Epithelial tissue gives rise to glands: (a) exocrine & (b) endocrine

(a) Exocrine gland
- Surface epithelium
- Duct cell
- Secretory exocrine gland cell

(b) Endocrine gland
- Surface epithelium
- Secretory endocrine gland cell
- Blood vessel
Organs are made up $\geq 2$ tissue types

**Organ:**
Body structure that integrates different tissues and carries out a specific function

- **Epithelial tissue**: protection, secretion, absorption
- **Connective tissue**: structural support
- **Muscle tissue**: movement
- **Nervous tissue**: communication, coordination, control
Which body systems?
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?
BI 121 Lecture 2

I. **Announcements** Lab 1 Histology today!
   130 HUE. Fun! Readings: DC, LS, LM? **NB**: UO Biology blog vs. Canvas [http://blogs.uoregon.edu/bi121/fall-2016/](http://blogs.uoregon.edu/bi121/fall-2016/)

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

... Thanks for signing attendance roster & noting late arrival or early departure time!
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
Dr. Evonuk’s 6 Balances

Metabolic

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

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

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

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

\[ \text{pH} \]
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H₂O
~ 60 – 70 %

150 lb /68 kg

= ~40 – 48 kg H₂O

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
Blood Pressure Homeostasis

Venous Pooling

Electrochemical Signal $I'$

CV Control Center

Brain Stem

Baroreceptors/Pressure Receptors eg, in Carotids & Aorta

$\downarrow$ BP $\rightarrow$ $R$ $\rightarrow$ $C$ $\rightarrow$ $O$

Electrochemical Signal eg, Symp Accel N

$\uparrow$ BP

$\downarrow$ BP

Baroreceptors/Pressure Receptors eg, in Carotids & Aorta

$\uparrow$ HR

$\uparrow$ VC

Seated to Standing

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

Short-term vs long-term!
I. **Announcements**
Registered? AEC Notes? **Come to office hr!**

II. **Connections**
Videos + Q about Homeostatic Model for BP

III. **Cell Anatomy, Physiology & Compartmentalization**
LS ch 2

   B. Basic survival skills ch 1 p 3
   C. Organelles ≡ Intracellular specialty shops w/membranes
      1. Endoplasmic Reticulum (ER)
      2. Golgi
      3. Lysosomes
      4. Peroxisomes
      5. Mitochondria.
      LS 2012 pp 20-34
      fig 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8 pp 20-7
      tab 2-1 p 36
   D. What about vaults? LS 2006, p 32
   E. **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

V. **Introduction to Genetics**
LS 2012 ch 2 p 20-1 + Appendix C

   A. What’s a gene? Where? p A-18, fig C-2, C-3
   B. Why are genes important? p A-18
   C. What’s DNA & what does it look like? pp A-18 thru A-20
   D. How does information flow in the cell? fig C-6
   E. How does DNA differ from RNA? pp A-20 thru A-22
   G. How are proteins made? fig C-7, C-9

...Anatomy & Physiology Lab Thurs! Fun again!
How Big? 100 Cells Lengthwise = 1 mm!!

1. Cell Membrane

Organelles
Nucleus
Cytosol

2. Nuclear Membrane

Cells make up body systems

Why Compartments? Advantage?

**Incompatible** reactions can take place

*Simultaneously!!*
1 Sample Cartoon of 100 Trillion (100 x 10^{12}) Cells!

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
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)

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

TRANSPORT VESICLE FROM ER, ABOUT TO FUSE WITH THE GOLGI MEMBRANE

GOLGI SACs

VESICLES CONTAINING FINISHED PRODUCT

GOLGI COMPLEX
Exocytosis: Primary Means of Secretion
**Lysosomes vs. Peroxisomes**

- **Lysosomes** contain hydrolytic enzymes, which break down molecules.
- **Peroxisomes** are involved in oxidative metabolism, converting certain molecules to simpler ones.

![Diagram showing Lysosome and Peroxisome](image)

© Don W. Fawcett/Photo Researchers, Inc.
Phagocytosis: Cell Eating!

(a) Phagocytosis process:
- Particle binds to the surface receptor site.
- Endocytotic pouch forms around the particle.
- Endocytotic vesicle is created.

(b) Labeled diagram:
- White blood cell.
- Phagocytic vesicle.
- Lysosome.
- Residual body.
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

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

fig 2-8 LS 2012
I. **Announcements** Anatomy & Physiology Lab today! Be sure to complete p 3-7 dietary record in LM < lab next wk! Help with estimating serving sizes for Nutrition Lab 3. Q?

II. **Cell Organelle Connections** Little organs or specialty shops!

III. **Physiology News** ♀ vs ♂ Mitochondria; Vaults? Sci News

IV. **Anaerobic vs Aerobic Metabolism Connections**
   - LS ch 2 pp 26-33
   - A. Take-home points + key differences fig 2-15 + vpl
   - B. Few details: Glycolysis, CAC, ETC fig 2-9, 2-10, 2-11, 2-12

V. **Introduction to Genetics** LS pp 20-1 + Appendix C
   - A. What’s a gene? Where? p A-18, fig C-2, C-3
   - B. Why are genes important? p A-18
   - C. What’s DNA & what does it look like? pp A-18 thru A-20
   - D. How does information flow in the cell? fig C-6
   - E. How does DNA differ from RNA? pp A-20 thru A-22
   - G. How are proteins made? Class skit! fig C-7, C-9
4 oz $\rightarrow$ 3 oz

or

equiv 1 c

raw $\rightarrow$ cooked

equiv 1/3 c

equiv 1 oz

equiv 1.5 oz

Deck of Cards

Pumpkin Show at Night

There are 100,000+ lbs of pumpkins, squash and gourds on the street display.
Inside a fertilized egg, with its two sets of chromosomes (blue), the protein ubiquitin (red) tags sperm mitochondria (yellow).

Vaults Hold Cell Mystery

An organelle?...?
AEROBIC w/\(O_2\) = MITOCHONDRION

ANAEROBIC without \(O_2\) = CYTOSOL

1. Immediate/ATP-PC
2. Glycolysis
ATP Supplied

Performance Time

Power Output

ATP-PC/
Immediate

Oxygen
System

15 - 30 s

1.5 – 3 m

> 3 – 5 m

Mitochondria

Cytosol

Glycolysis

Anaerobic

Aerobic

Modified after Mathews & Fox
Cleave One High Energy Phosphate Bond To Do Work!!

7 – 10 KiloCalories/KCal

1. **Synthesis of Macromolecules**
   - Make big things from little things!

2. **Membrane Transport**
   - Move things! Microscopic!

3. **Mechanical Work**
   - Move things! Macroscopic!

Adenosine

\[ P + P + P \rightarrow P_i \]
**Anaerobic vs. Aerobic Metabolism**

**Anaerobic Glycolysis**
"sugar dissolving" without $O_2$. Net of 2 ATP per molecule of glucose.

**Aerobic Metabolism**
+ mitochondrial processing of glucose with $O_2$. Net of 32 ATP per molecule of glucose.
AEROBIC with O₂

ANAEROBIC Immediate/ATP-PC

% AEROBIC (Oxidative Energy System)
- Marathon: 0%
- Cross-Country Skilling: 100%
- 10-K Run: 90%
- 3-Mile Run: 80%
- 2-Mile Run: 70%
- 1-Mile Run: 60%
- Circuit Weight Training: 40%
- Soccer: 30%
- Lacrosse: 20%
- Tennis: 10%
- Basketball: 0%
- Volleyball: 0%
- 200-Meter Dash: 0%
- Football: 0%
- Conventional Weight Training: 0%

% ANAEROBIC (Immediate & Non-Oxidative Energy Systems)
- Marathon: 135:00
- Cross-Country Skilling: 29:00
- 10-K Run: 14:00
- 3-Mile Run: 9:00
- 2-Mile Run: 3:45
- 1-Mile Run: 1:30
- Circuit Weight Training: 0:50
- Soccer: 0:30
- Lacrosse: 0:20
- Tennis: 0:10

PRIMARY FUEL
- FAT, CARBOHYDRATE & PROTEIN (Small Amounts)
- CARBOHYDRATE (Glucose & Glycogen)
- ATP, ADP & Creatine Phosphate (CP)

ACTIVITY

TIME (Min:Sec)

Glycolysis

MITOCHONDRIA

CYTOSOL
Stages of Cellular Metabolism/Respiration

**Anaerobic**
- Glycolysis
- Cytosol

**Aerobic**
- Metabolism
- Mitochondria

**Glycolysis**
- Glucose and other fuel molecules
- Pyruvate

**Pyruvate to acetate**
- Acetyl-CoA

**Citric acid cycle**
- Electrons carried by NADH and FADH₂

**Oxidative phosphorylation**
- (electron transport system and chemiosmosis)

**Matrix**

**Inner Membrane**

fig 2-9 LS 2012
Cashing in electrons at the Electron Transport Chain (ETC) produces an abundance of ATP energy molecules!

Cytosol

Outer mitochondrial membrane

Inner...

fig 2-12 LS 2012
Goals of Aerobic Metabolism

AEROBIC = MITOCHONDRION

w/O₂

CITRIC ACID CYCLE
harvest electrons e⁻ e⁻ e⁻

"cash in"

ELECTRON TRANSPORT CHAIN

for ATP Energy!!
I. **Announcements** Nutrition Analyses this Thursday! Please record diet on p 3-7 LM & begin analysis using [https://www.supertracker.usda.gov/](https://www.supertracker.usda.gov/) Bring flash drive? Q?

II. **Metabolism Connections** Mitochondrial metabolism +

III. **Introduction to Genetics** LS 2012 ch 2 p 20-1 + Appendix C

A. How does DNA differ from RNA? pp A-20 thru A-22
C. How & where are proteins made? fig C-7, C-9
D. Class skit: Making proteins @ ribosomes!

IV. **Nutrition Primer** Sizer & Whitney (S&W) Sci Lib

A. Essential Nutrients: H₂O, ¹ Carbohydrates, ² Fats, ³ Proteins, Vitamins, Minerals; Macro- vs Micro-?
B. Dietary Guidelines: USDA, AICR, Eat Like the *Rainbow*!
D. **Beware of Nutrition Quackery** S. Kleiner & Monaco 1990!

V. **Nutrition in the News** Gain weight by drinking calories?

VI. **Introduction to Digestion** Steps + hydrolysis
What are DNA’s major functions? Heredity + Day-to-Day Cell Function
What does DNA look like? Double-helix!!
Gene = *Stretch of DNA that codes for a protein*

cf: LS fig C-3
What does DNA do, day-to-day?

- **DNA** → **RNA** → **Protein**
  - **Transcription**
  - **Translation** @ ribosomes

- **Replication**

- **Nucleus** → **Cytoplasm**

*cf: LS fig C-6*
DNA vs RNA?

1. Double-stranded
2. Deoxyribose (without oxygen)
3. A, T, C, G
   - Thymine
4. Self-replicative (can copy itself)
5. Nucleus (+mitochondria)

1. Single-stranded
2. Ribose (with oxygen)
3. A, U, C, G
   - Uracil
4. Needs DNA as template
5. 1⁰ Cytoplasm (but Nucleus origin)
6. mRNA, rRNA, tRNA
**Triplets of bases code for amino acids, the building blocks of proteins**

<table>
<thead>
<tr>
<th>DNA code word</th>
<th>mRNA codon</th>
<th>tRNA anti-codon</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAT</td>
<td>AUA</td>
<td>UAU</td>
</tr>
<tr>
<td>ACG</td>
<td>UGC</td>
<td>ACG</td>
</tr>
<tr>
<td>TTT</td>
<td>AAA</td>
<td>UUU</td>
</tr>
<tr>
<td>TAC</td>
<td>AUG</td>
<td>UAC</td>
</tr>
</tbody>
</table>
Translation? Ribosomes Make Proteins

1. Large subunit
2. Small subunit
3. Amino acid
4. tRNA
5. Anticodon
6. mRNA
7. Leader sequence
8. First codon
9. Second codon

Steps 5 through 8 are repeated.
A Polyribosome. Which Way is Synthesis?
 BI 121 Lecture 6

I. **Announcements** Data + Flashdrive for today’s lab! Q?
If you want notebook to study for Exam I on Oct 25th,
turn in prior lecture next Tuesday, Oct 18th. Sample Exam Q.

II. **Nutritional Physiology in the News** Pondering Paleo Nutrition Action Health Letter, Marlene Zuk, U Minnesota + Shake the salt habit! UC Berkeley Newsletter. → Drink Your Calories? PEBB Identifying Nutrition Quackery, Kleiner & Monaco

III. **Nutrition Connections** DC Mod 2, Sizer & Whitney (S&W) Sci Lib
A. Diet & endurance? What’s the best path to losing weight?
B. Low-carbohydrate dieting? What about fasting?
C. Balanced approach, Dr. Sacks AHA NPAM Council

IV. **Gastrointestinal Physiology** DC Module 3 pp 17-23, LS ch 15+
B. How is the gut controlled?
C. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
D. Zymogen? = Inactive precursor LS fig 15-9 p 452...
   http://www.cdc.gov/ulcer Beyond the Basics LS p 456
G. Large intestine? LS fig 15-24 pp 472-4
Pondering Paleo?

Evolutionary Biologist
Behavioral Ecologist
U Minnesota

http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/
More Reasons to Shake the Salt Habit

1. Blood vessel vasodilation w/in 30 min by ingesting 1500 mg Na+!

2. Ca^{2+} excretion↑, bone loss, risk of osteoporosis & fractures.


4. GI cancer risk, inflammation?

UCB Wellness Letter Jun 2011 p 5
Macronutrients & Micronutrients
Essential for Life

**Macronutrients**

H₂O/Water

1⁰ Carbohydrates

2⁰ Fats/Triglycerides/Lipids

3⁰ Proteins

**Sample Food Sources**

Water, other drinks, fruits & vegetables
Grains, vegetables, fruits, dairy products
Meats, full-fat dairy products, oils
Meats, legumes, dairy vegetables

**Micronutrients**

Vitamins (A, D, E, K; C + B)
Minerals (K⁺, Na⁺, Ca²⁺, Mg²⁺, Fe²⁺, Zn²⁺,…)

**NB:** Need only minute quantities!

Vegetables, vegetable oils, fruits, citrus, grains, dairy
Fruits, vegetables, grains, nuts, dairy, meats, processed foods

**Energy nutrients = yield ATP**
1. Vary your veggies. Fill ½ your plate with fruits & vegetables!

2. Focus on fruits. Whole fruit preferable to juice, but any fruit counts! Fill ½ your plate with fruits & vegetables!

3. Make at least ½ of your grains whole grains!

4. Go lean with protein. Keep protein to < ¼ plate! Nuts, beans, peas, seeds, poultry, lean meat, seafood,…

5. Get your calcium-rich foods. Buy skim or 1% milk. Go easy on cheese!

MyPlate launched June 2, 2011
Diet & Health Guidelines for Cancer Prevention

1. Choose a diet rich in variety of plant-based foods.
2. Eat plenty of vegetables & fruits.
3. Maintain a healthy weight & be physically active.
4. Drink alcohol only in moderation, if at all.
5. Select foods low in fat & salt.

And always, remember...

Do not smoke or use tobacco in any form.

American Institute for Cancer Research (AICR)
5 times per wk? ≡ 106,600 calories/yr ≡ ± 30.5 lb fat/yr

Better choices!

**NB:** Each group 500 kcal deficit/day, 16 weeks
Exercise is better than dieting in lowering body fat & preserving muscles!
Dietary Composition & Physical Endurance

eg, Atkins!

High-fat diet

Normal mixed diet

High-carbohydrate diet

~ 1/3 endurance!

Maximum endurance time:

- 57 min
- 114 min
- 167 min
**Negative Effects of Low Carbohydrate**

1. ↑ fatigue/exhaustion central & peripheral!
2. ↓ glucose – brain+spinal cord, rbcs thrive upon.
3. ↓ variety which reduces intake of phytochemicals, vitamins, minerals & fiber.
4. ↑ risk of respiratory infections. + gall stones, ↓ thermoregulation...
To Help Lower Body Wt & %Fat
EXERCISE!! +Minimize These!!

- FAT: 9 Kcal/g
- ETOH: 7 Kcal/g
- CARB: 4 Kcal/g
- PRO: 4 Kcal/g

NB: Minimize not Eliminate!
Moderation not Abstinence!!
60-day Fast???

Lost 60 lb!! Wow!!

Yet

\[
\begin{aligned}
&26 \text{ lb Water} \\
&20 \text{ lb Lean Body Mass} \\
&14 \text{ lb Fat}
\end{aligned}
\]

Fat < $\frac{1}{4}$ total wt loss!
Dr. Sacks’ Conclusions:
We conclude that healthful diets with varying emphases on carbohydrate, fat & protein levels can all achieve clinically meaningful weight loss & maintenance of weight loss over a 2-yr period. The results give people who need to lose weight the flexibility to choose a diet that they can stick with, as long as it’s heart healthy. Such diets can also be tailored for individuals based on their personal & cultural preferences & in this regard may have the best chance for long-term success.
BI 121 Lecture 7

I. **Announcements**  Exam I one week from today, Oct 25th!  
Summary & Review, Sunday Oct 23rd, 6-7:30 pm, here!  Q?


III. **Gastrointestinal Physiology**  DC Module 3 pp 17-23, LS ch 15+ 
B. How is the gut controlled?
C. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
D. Zymogen? = Inactive precursor LS fig 15-9 p 452...
   [http://www.cdc.gov/ulcer](http://www.cdc.gov/ulcer)  Beyond the Basics LS p 456
G. Large intestine? LS fig 15-24 pp 472-4

IV. **Cardiovascular System**  DC Mod 4, LS ch 9, Torstar, G&H+… 
A. Circulatory vs. Cardiovascular (CV)? CV vs. Lymphatic CV Pulmonary & Systemic circuits DC pp23-31+LS p229+ DC fig 4-1 p 24, LS fig 9-2b p 231
B. Arteries, capillaries, veins, varicosities? G&H, Torstar, DC
C. ♥ layers, box, chambers, valves, inlets, outlets 
   LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6
D. Normal vs. abnormal blood flow thru ♥ & CVS LS, Fox+…

---

...Put Lab Notebook in box based on your lab time. Thanks!!
LOWER CARBOHYDRATE
ELIMINATE CALORIES or FOOD GROUPS
ENCOURAGE FASTING

LOWER FAT

ADEQUACY
BALANCE
CONSISTENCY & MODERATION

AHA + DASH + TRADE BOOKS

NOT PEER-REVIEWED = PEER-REVIEWED = TEXTS → RESEARCH

PEER-REVIEWED = PEER-REVIEWED = TRADE BOOKS

TEXTS → RESEARCH

NOT PEER-REVIEWED = TRADE BOOKS
Kleiner's & Monaco's Top 10 Hit List for Nutrition Quackery

1. Treatment based on unproven theory calling for non-toxic, painless therapy.

2. Author's/purveyor's credentials aren't recognized in scientific community.

3. No reports in scientific, peer-reviewed literature but rather mass media used for marketing.

4. Purveyors claim medical establishment is against them & play on public's paranoia about phantom greed of medical establishment.

5. Treatments, potions, drugs manufactured according to secret formula.

6. Excessive claims promising miraculous cures, disease prevention or life extension.

7. Emotional images rather than facts used to support claims.

8. Treatments require special nutritional support including health food products, vitamins and/or minerals.

9. Clients are cautioned about discussing program to avoid negative.

10. Programs based on drugs or treatments not labeled for such use.
With the right food choices, physical activity, and not smoking, we could prevent about ~90% of diabetes, 80% of heart disease & 70% of stroke!
Digestion Steps

1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

Hi gang!!
You need me for digestion!!

\[ \text{H}_2\text{O} + \text{Enzyme} \]
Polymer to Monomer (Many to One)

Carbohydrate → Glucose

Protein + Fat → Amino Acids

Fatty Acids + Glycerol → lipids

…Central-linking theme!!
GI-DONUT ANALOGY

GI LUMEN

BODY
### Gut Secretions

<table>
<thead>
<tr>
<th>Secretion</th>
<th>Release Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mucus</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>2. Enzymes</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>3. H₂O, acids, bases+</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>4. Hormones</td>
<td>into Blood</td>
</tr>
</tbody>
</table>

**Note:** The secretion of hormones into the blood is highlighted to emphasize its importance.
1. **Mouth**

   *Ingestion* entry way
   salivary gland secretion
   mucus + enzymes
   enzymatic digestion: carbohydrate
   mastication = chewing
   deglutition = swallowing

2. **Esophagus**

   *Rapid transit*
   peristalsis
   secretion mucus

3. **Stomach**

   *Mixing* peristalsis
   secretion mucus + HCl
   + enzymes
   enzymatic digestion:
   protein + butter fat!

4. **Liver-Gall Bladder**

   *Emulsification* =
   detergent action of bile
   + secretion

5. **Pancreas**

   *Secretion* mucus + NaHCO₃ + enzymes
   enzymatic digestion:
   carbohydrate, fat, protein

6. **Small Intestine**

   *Absorption*
   Secretion mucus
   + enzymes
   enzymatic digestion:
   carbohydrate, fat, protein
   Peristalsis

7. **Large Intestine**

   *Dehydration*
   secretion + absorption
   storage + peristalsis
What are other accessory organs of digestion, that is, off-shoots of the primary tube?
What is the major function of the small intestine?
Absorption!!
Large Intestine Structure & Function
I. **Announcements** Exam I next session; 10 am & 2 pm lab sections go directly to 5 KLA & 202 CAS. All others here (100 WIL)! Review: Sunday, 6 pm here! Lab notebooks. Q?

II. **Cardiovascular Connections** LS 2012 ch 9, Torstar Books+

III. **CV Physiology in News** AHA + NHLBI websites. Nic? ACSM, AHA, DHHS Healthy people exercise guidelines!

IV. **CV Pathophysiology & Risk Reduction** LS ch 9, 10 +…
   A. AMI, CVA, CVD, PVD, TIA, HTN? + surgical treatments
   B. Atherosclerosis? LS fig 9-27, 9-25, 9-26 pp 266-8
   C. How to minimize risk of CVDs? Treatment triad: Exercise, Diet, Drugs+Surgery
   D. Food choices make a difference? What’s HAPOC?
Cardiac Cycle

**Systole**
- Contract
- & Empty

**Diastole**
- Relax
- & Fill

Diagram showing the cycle with two hearts, one white and one red, indicating the transition between systole and diastole.
Cardiovascular (CV) = Heart + Vessels + Blood!
**NB: Figure-8 loop**

- **Pulmonary**
- **Systemic**

Diagram showing the pulmonary and systemic circuits with key components labeled:
- Capillary beds of lungs where gas exchange occurs
- Pulmonary arteries
- Pulmonary veins
- Vena cavae
- Aorta and branches
- Right ventricle
- Left ventricle
- Arterioles
- Venules
- Capillary beds of all body tissues where gas exchange occurs
- Oxygen-poor, CO₂-rich blood
- Lymphatic Vessel
- Oxygen-rich, CO₂-poor blood

D Chiras 2013 fig 4-1b
Lymphatic System

1. Lymph Nodes
2. Vessels
3. Lymph

No pump!
Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm
Human \(\heartsuit = 4\)-chambered box? 2 separate pumps?

Upper = Atria

Lower = Ventricles

RA

LV

RV

LA

Pulmonary

Systemic

Primer Pumps

Power Pumps
Human $\heartsuit = 4$ unique valves?  
2 valve sets?

**Semilunar** = *Half-moon shaped*

1. Pulmonic/Pulmonary
2. Aortic

**AV** = *Atrioventricular*

3. $\mathbb{R}$ AV = Tricuspid
4. $\mathbb{L}$ AV = Mitral/Bicuspid
How much aerobic?

Continuous exercise
≥ 50% muscle mass
≥ Conversational pace
20-60 min/session
3-5 days/wk

Guidelines: Healthy Adults < 65 yr

Do moderately intense aerobic exercise
30 min/d, 5 d/wk

OR

Do vigorously intense aerobic exercise
20 min/d, 3 d/wk

AND

Do 8-10 strength-training exercises
8-12 repetitions/each exercise, 2 d/wk
59 yr HTN ♀
Treatment Triad

- Exercise
- Dietary Modification
- Drugs/Surgery

NB: Last blasted resort!!
CABG
Coronary Artery Bypass Graft