BI 121 Lecture 7

Put Lab Notebook in box based on your lab time. Thanks!!

I. Announcements
   Exam I one week from today, Oct 23rd!
   Discussion+Review, Sunday Oct 21st, 6-7:30 pm, here! Q?

II. Gastrointestinal Physiology
   DC Mod 3 pp 17-23, LS ch 15+
   A. Central-linking themes: hydrolysis, polymer to monomer
   C. Control + Organ-by-organ review 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

III. 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+...
Polymer to Monomer
(Many to One)

Carbohydrate → Glucose
Protein + Fat

Amino Acids
Fatty Acids + Glycerol
GI-Doughnut Analogy

GI Lumen

Body

Me?
Common Control Mechanisms

1. Local (autoregulation)
2. Nervous (rapidly-acting)
3. Hormonal (slower-acting/reinforcing)
Longitudinal $\rightarrow$ Shortens L

Circular $\rightarrow$ $\downarrow$ d or Width

Body wall

Serosa

Submucosa

Duct of large accessory digestive gland (i.e., liver or pancreas) emptying into digestive-tract lumen

Outer longitudinal muscle

Inner circular muscle

Muscularis externa

Mucosa

Lumen

Myenteric plexus

Submucous plexus
Muscularis Externa
Glands

Serosa
Epithelium
Submucosa
Lumen
Lamina Propria

Longitudinal Muscle
Circular Muscle

Myenteric motor plexus!
Meissner’s sensory & secretory plexus!

H Howard 1990

cf: G&H fig 62-2
# 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. $\text{H}_2\text{O}$, acids, bases+</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>4. Hormones</td>
<td>into <strong>Blood</strong></td>
</tr>
</tbody>
</table>
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

7. **Large Intestine**

*Dehydration*
secretion + absorption
storage + peristalsis
Where does enzymatic digestion of protein begin?
FIGURE 15-7

- Esophagus
- Gastroesophageal sphincter
- Fundus
- Smooth muscle
- Body
- Stomach folds
- Pyloric sphincter
- Pyloric gland area
- Duodenum
- Antrum
- Oxyntic mucosa
Zymogen = an inactive precursor
Why is the *pancreas* so unique?
Endocrine + Exocrine functions; Makes enzymes for digesting all 3 energy nutrients!
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!!
Why Do Some People Have Trouble Digesting Milk?

- Ability to digest milk carbohydrates varies
  - Lactase
    - Made by small intestine
- Symptoms of intolerance
  - Gas, diarrhea, pain, nausea?
- Milk allergy?
- Nutritional consequences
- Milk tolerance and strategies
Ulcer Facts

• Most ulcers are caused by an infection, not spicy food, acid or stress.
• The most common ulcer symptom is burning pain in the stomach.
• Your doctor can test you for *H. pylori* infection.
• Antibiotics are the new cure for ulcers.
• Eliminating *H. pylori* infections with antibiotics means that your ulcer can be cured for good.
Clipping a Duodenal Ulcer

Peering through the pylorus into the duodenum, we see some blood and a vessel sticking out of the wall, just at the front edge of a small but deep ulcer.

In the second photograph, a disposable metal clip is applied to the ulcer. The patient remained well and left hospital three days later.
Time-out for Questions!

+ Brief Break!
Cardiovascular (CV) = Heart + Vessels + Blood!
NB: Figure-8 loop

Pulmonary Systemic

D Chiras 2013 fig 4-1b
Dual Pump Action & Parallel Circulation
Lymphatic System

1. Lymph Nodes
2. Vessels
3. Lymph

No pump!
Lymphatic System
Alternative System of Circulation or Drainage System

Lymph Vessels || Veins
Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm

LS 2012 fig 10-21 p 283
Lymphatics collect run-off & are parallel to venules/small veins!
Microcirculation Exchange: 10 Billion Capillaries!

No cell > 25-50 μ away from a capillary! Like having bus stops @ every other block!

Guyton & Hall 2011 fig 1-2
Harvey Experiments: 1-way system of venous valves!
Skeletal Muscle Pump
The Heart
The Living Pump
Human ❤️ = 4-chambered box? 2 separate pumps?

Upper = Atria

Lower = Ventricles

RA

RV

Pulmonary

LA

LV

Systemic

Primer Pumps

Power Pumps
(a) Location of the heart valves in a longitudinal section of the heart
Heart Valves Ensure Unidirectional Blood Flow!

(b) Heart valves in closed position, viewed from above

(c) Prevention of eversion of AV valves

Mom's valve!

Valves must be normal & healthy to work well!

- Right AV valve
- Left AV valve
- Aortic or pulmonary valve

- Right atrium
- Right AV valve
- Direction of backflow of blood
- Chordae tendineae
- Septum
- Right ventricle
- Papillary muscle

● FIGURE 9-4 Heart valves.
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
Heart Valve Orientation & Scaffolding

- Pulmonary ring
- Aortic ring
- Mitral ring
- Tricuspid ring
- Muscle fiber
FIGURE 9-6
Mitral and aortic valves.

MITRAL VALVE
- Cusp
- Chordae tendineae
- Papillary muscles

AORTIC VALVE
- Cusp
Veins → Atria → Ventricles → Arteries

https://www.nhlbi.nih.gov/health-topics/how-heart-works
Patent or still open!
Heart Valve Orientation & Scaffolding

- Pulmonary ring
- Aortic ring
- Mitral ring
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- Muscle fiber