BI 121 Lecture 7

I. **Announcements**
   Exam I one week from today, Oct 29\(^{th}\)!  
   10 am Lab → 5 KLA, 11 am → 129 HUE, AEC, All others here! 
   Discussion + Review, Sunday Oct 27\(^{th}\), 6-7:30 pm, here! Q?

II. **Gastrointestinal Physiology**
   DC Mod 3 pp 17-23, LS ch 15+ 
   A. Organ-by-organ review LS tab 15-1 pp 440-1 +... 
   B. Zymogen? = Inactive precursor LS fig 15-9 p 452... 
   E. 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+...
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
Where does enzymatic digestion of protein begin?
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?
Liver: Amazing Recycling of Bile Salts!

1. Secreted bile salts consist of 95% old, recycled bile salts and 5% newly synthesized bile salts.

2. 95% of bile salts are reabsorbed by terminal ileum.

3. Reabsorbed bile salts are recycled by enterohepatic circulation.

4. 5% of bile salts are lost in feces.

KEY
- Blue arrows: Enterohepatic circulation of bile salts

LS 2012 fig 15-11 p 462
What is the major function of the small intestine?

Absorption!!
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.
<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Enzymes for Digesting the Nutrients</th>
<th>Source of Enzymes</th>
<th>Site of Action of Enzymes</th>
<th>Action of Enzymes</th>
<th>Absorbable Units of the Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Amylase</td>
<td>Salivary glands</td>
<td>Mouth and (mostly) body of stomach</td>
<td>Hydrolyzes polysaccharides to disaccharides (maltose)</td>
<td>Monosaccharides, especially glucose</td>
</tr>
<tr>
<td></td>
<td>Disaccharidases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( maltase, sucrase, lactase )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td>Pepsin</td>
<td>Stomach chief cells</td>
<td>Stomach antrum</td>
<td>Hydrolyzes protein to peptide fragments</td>
<td>Amino acids</td>
</tr>
<tr>
<td></td>
<td>Trypsin, chymotrypsin, carboxypeptidase</td>
<td>Exocrine pancreas</td>
<td>Small-intestine lumen</td>
<td>Attack different peptide fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aminopeptidases</td>
<td>Small-intestine epithelial cells</td>
<td>Small-intestine brush border</td>
<td>Hydrolyze peptide fragments to amino acids</td>
<td></td>
</tr>
<tr>
<td>Fats</td>
<td>Lipase</td>
<td>Exocrine pancreas</td>
<td>Small-intestine lumen</td>
<td>Hydrolyzes triglycerides to fatty acids and monoglycerides</td>
<td>Fatty acids and monoglycerides</td>
</tr>
<tr>
<td></td>
<td>Bile salts (not an enzyme)</td>
<td>Liver</td>
<td>Small-intestine lumen</td>
<td>Emulsify large fat globules for attack by pancreatic lipase</td>
<td></td>
</tr>
</tbody>
</table>
Large Intestine Structure & Function

- Ascending colon
- Ileocecal valve
- Cecum
- Appendix
- Rectum
- Transverse colon
- Haustra
- Descending colon
- Sigmoid colon
- Internal anal sphincter (smooth muscle)
- External anal sphincter (skeletal muscle)
- Anal canal

LS 2012 fig 15-24 p 472
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
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!

1 Capillary

Guyton & Hall 2011 fig 1-2
Harvey Experiments: 1-way system of venous valves!
The Heart

The Living Pump
Human \(\heartsuit\) = 4-chambered box?  
2 separate pumps?

Upper = Atria

Lower = Ventricles

RA

LA

RV

LV

Pulmonary

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

Mom's valve!

Valves must be normal & healthy to work well!

Right AV valve

Left AV valve

Aortic or pulmonary valve

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

Right atrium

Right AV valve

Chordae tendineae

Direction of backflow of blood

Septum

Right ventricle

Papillary muscle

(c) Prevention of eversion of AV valves

● FIGURE 9-4 Heart valves.
Human ♥ = 4 unique valves?
2 valve sets?

Semilunar = Half-moon shaped

1. Pulmonic/Pulmonary
2. Aortic

AV = Atrioventricular

3. R AV = Tricuspid
4. L AV = Mitral/Bicuspid
Mitral and aortic valves.

Figure 9-6

Guyton & Hall
Cardiac Cycle

Systole
Contract & Empty

Diastole
Relax & Fill
Patent or still open!
Foramen ovale!

SI Fox 2009 fig 13.16 p 419

Septal defect in atria
Patent or still open! Ductus arteriosus!
Heart Murmurs? An unusual or extra heart sound lub-dup, lub-dup vs lub-gurgle-dup, lub-swish-dup…

$S_1 = \text{lub} \quad S_2 = \text{dup}$

https://www.thinklabs.com/heart-sounds