BI 121 Lecture 7

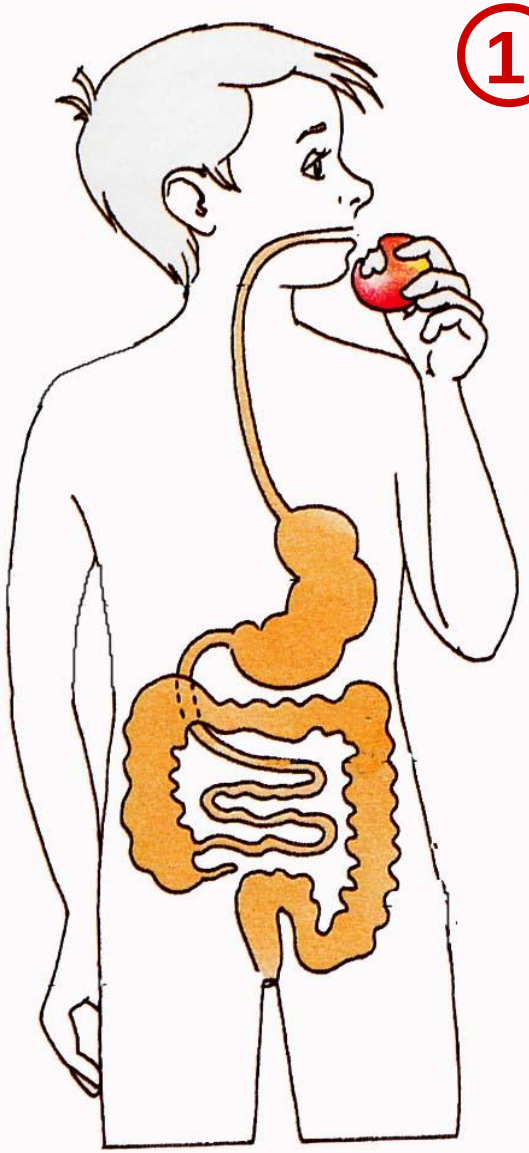
…Put Lab Notebook in box based on your lab time. Thanks!!

I. ***Announcements*** Exam I one week from today, Oct 24th!
Summary & Review, Sunday Oct 22nd, 6-7:30 pm, here! Q?

II. ***Gastrointestinal Physiology*** DC Module 3 pp 17-23, LS ch 15+
- A. GI = Donut? GI secretions: What? Where? Why? LS p 438
- 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...
- E. Accessory organs? Pancreas, Liver, Recycling! pp 457-63
- F. Small intestine? Ulcers? LS fig 15-20,15-22 pp 467-8
  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+…

Digestion Steps

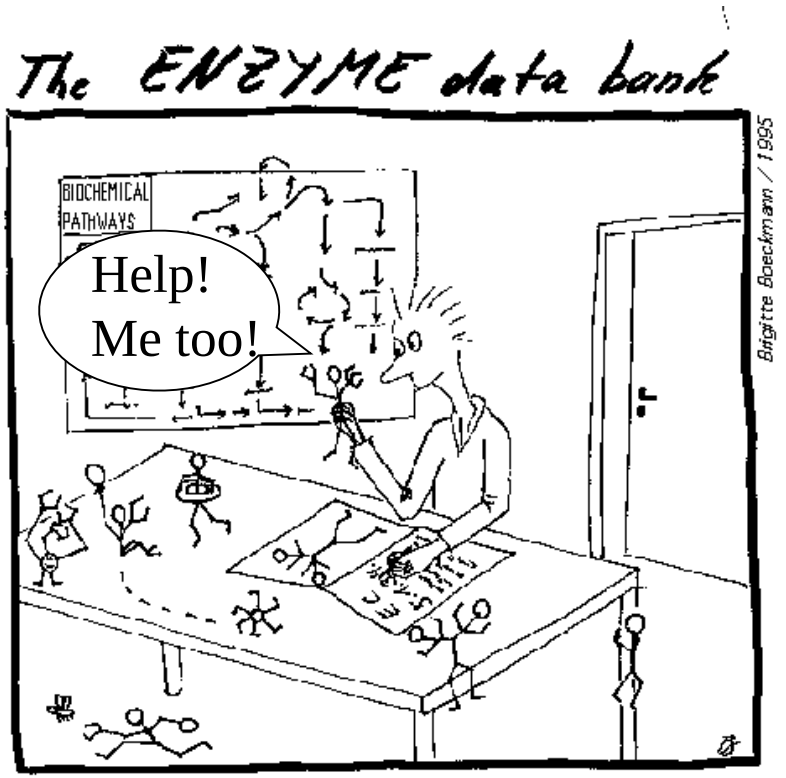


1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

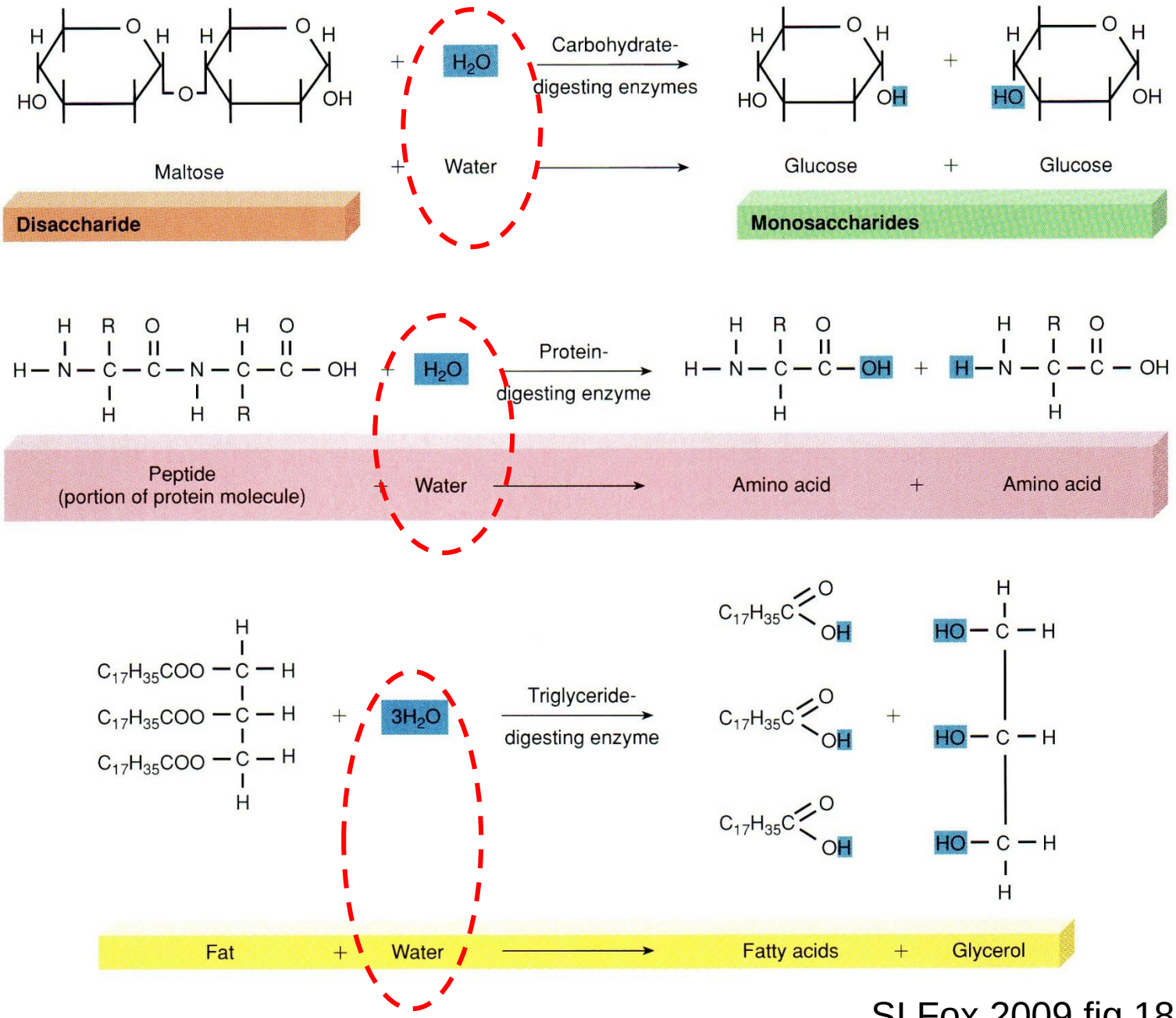
SOURCE: Dr. Eugene Evonuk, 1989. *cf*: L Sherwood, 2012 pp 437-8.

Hydrolysis of Energy Nutrients

+

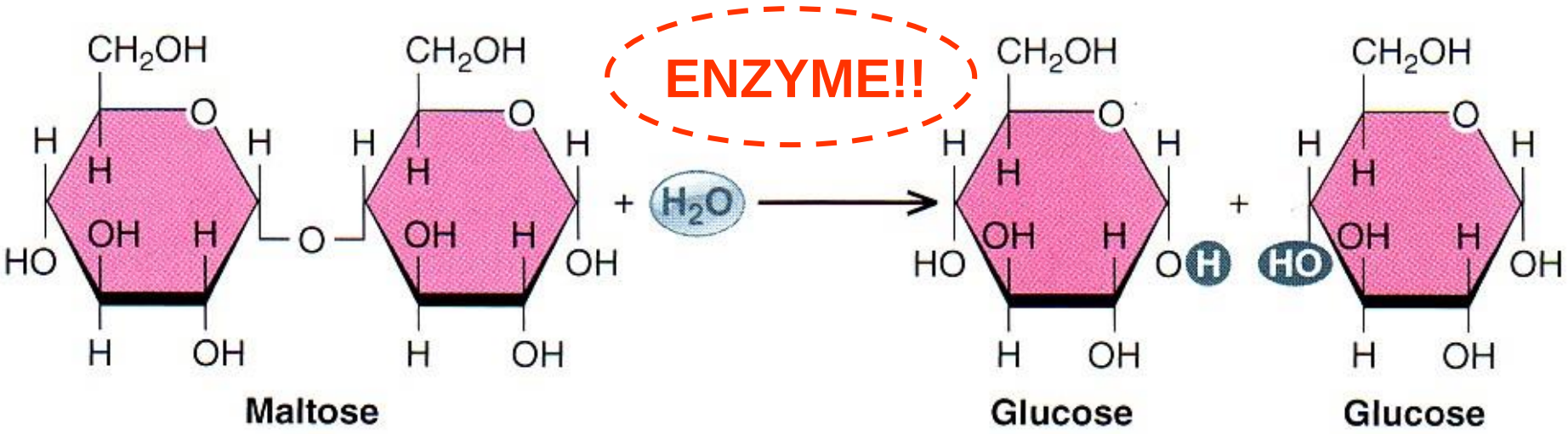


H_2O + Enzyme



SI Fox 2009 fig 18.1 p 614

What's missing?



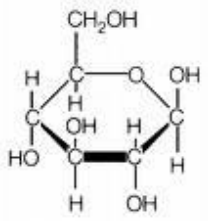
● **FIGURE 15-1 An example of hydrolysis.** In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of H_2O at the bond site.

LS 2012 fig 15-1 p 438

Polymer to Monomer (Many to One)

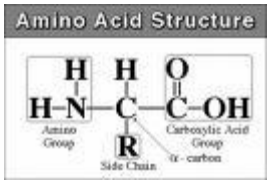
…Central-linking theme!!

Carbohydrate

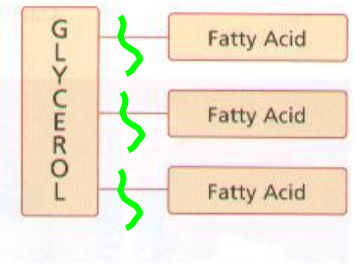


Glucose

Protein
+
Fat

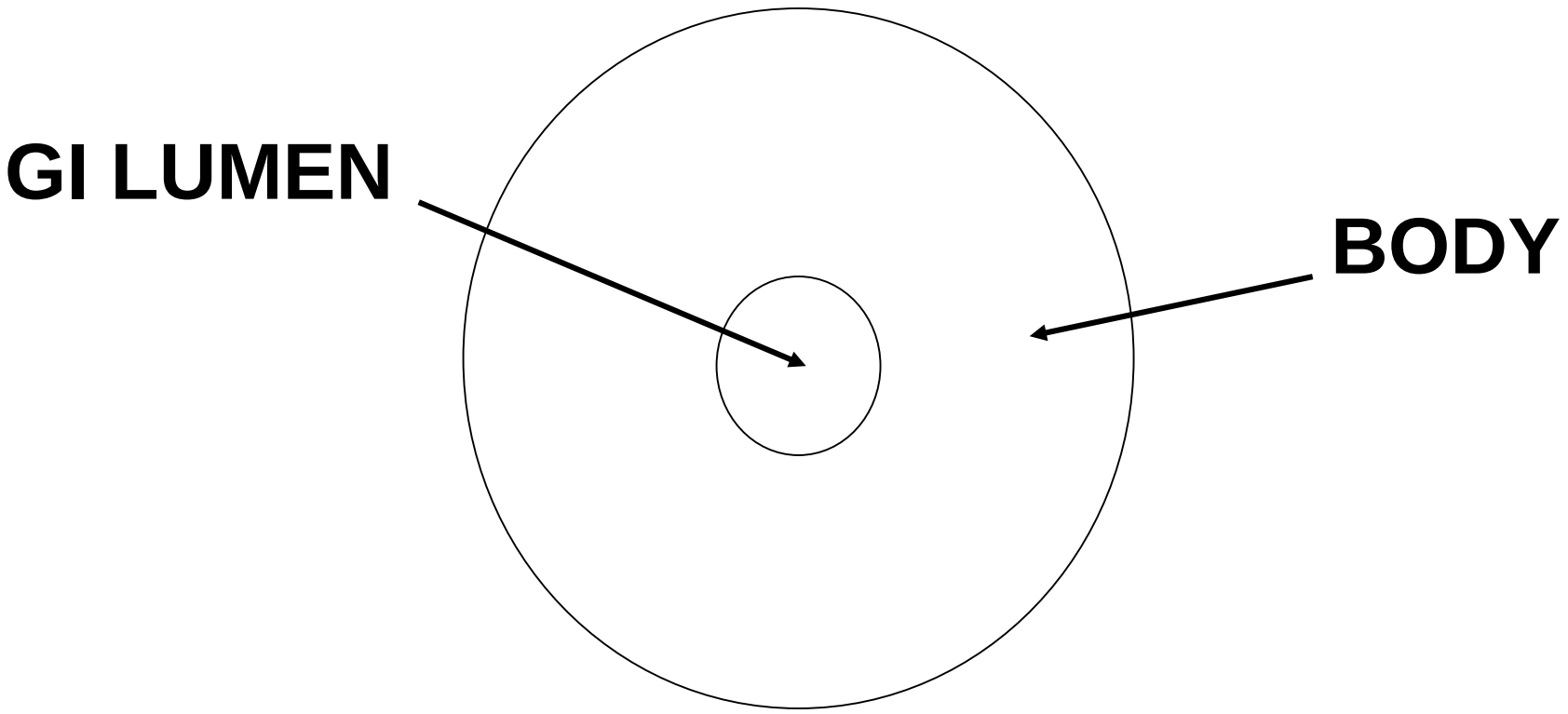


Amino Acids



Fatty Acids
+
Glycerol

GI-DONUT ANALOGY

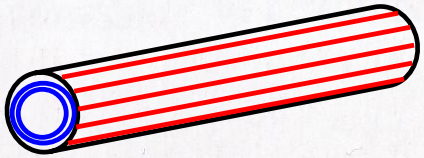


Common Control Mechanisms

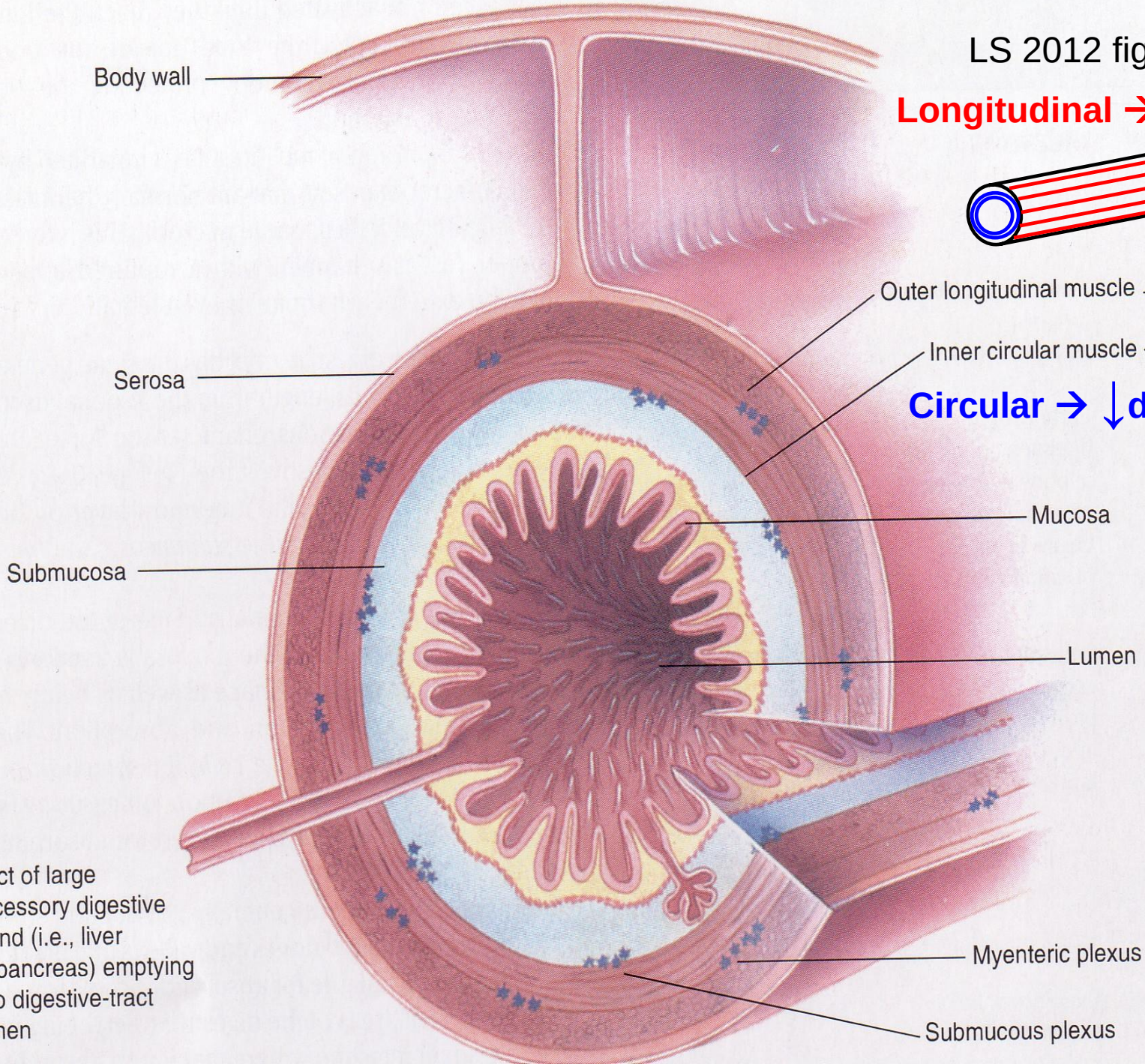
1. **Local (autoregulation)**
2. **Nervous (rapidly-acting)**
3. **Hormonal (slower-acting/ reinforcing)**

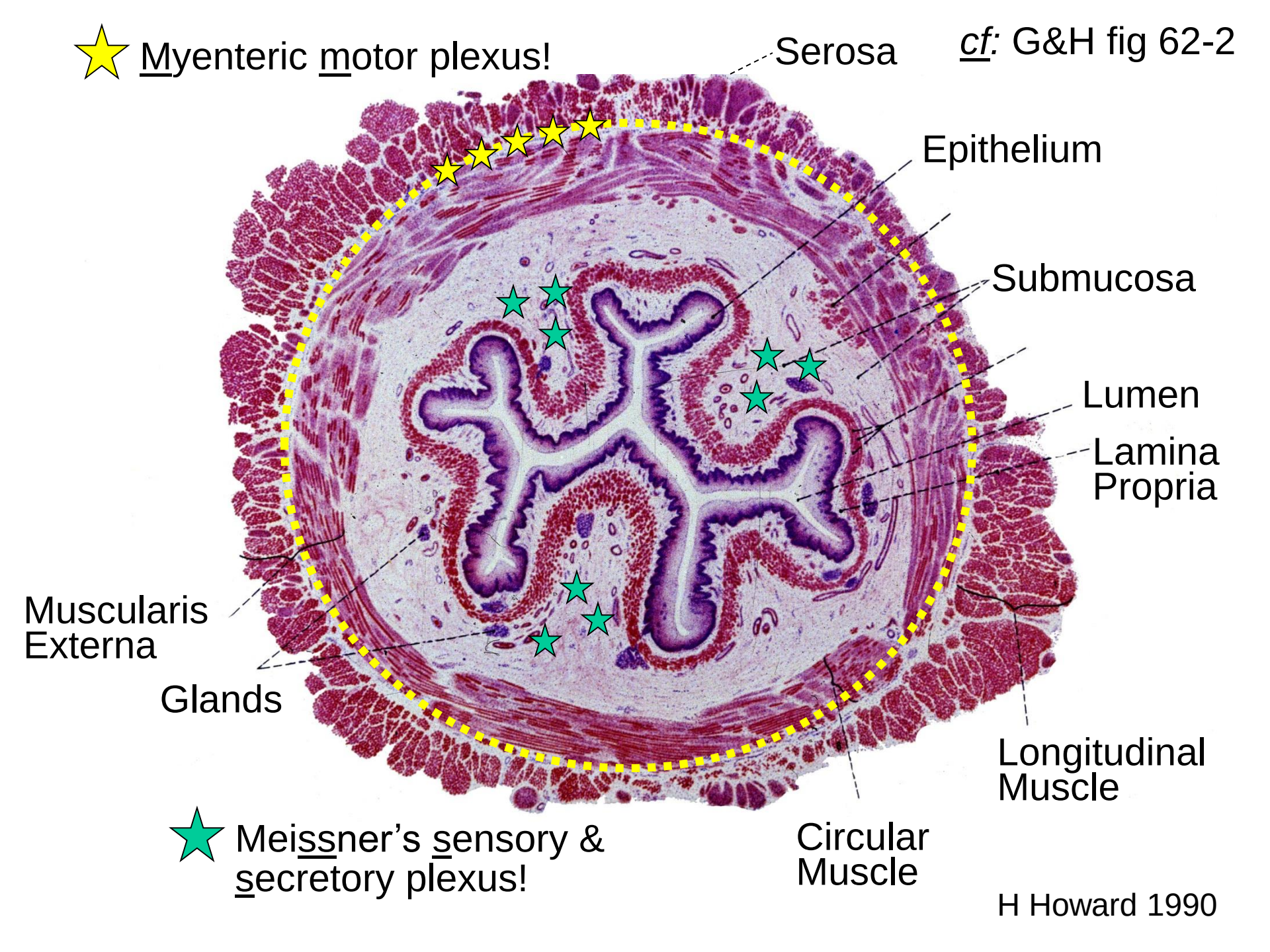
LS 2012 fig 15-2 p 442

Longitudinal → Shortens L



Circular → ↓d or Width




Myenteric motor plexus!
Serosa
cf: G&H fig 62-2
Epithelium
Submucosa
Lumen
Lamina Propria
Muscularis Externa
Glands
Longitudinal Muscle
Circular Muscle
Meissner's sensory & secretory plexus!
H Howard 1990

Gut Secretions

Secretion	***Release Site***
1. Mucus	**into GI Lumen**
2. Enzymes	**into GI Lumen**
3. H_2O, acids, bases+	**into GI Lumen**
4. Hormones	**into Blood**

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

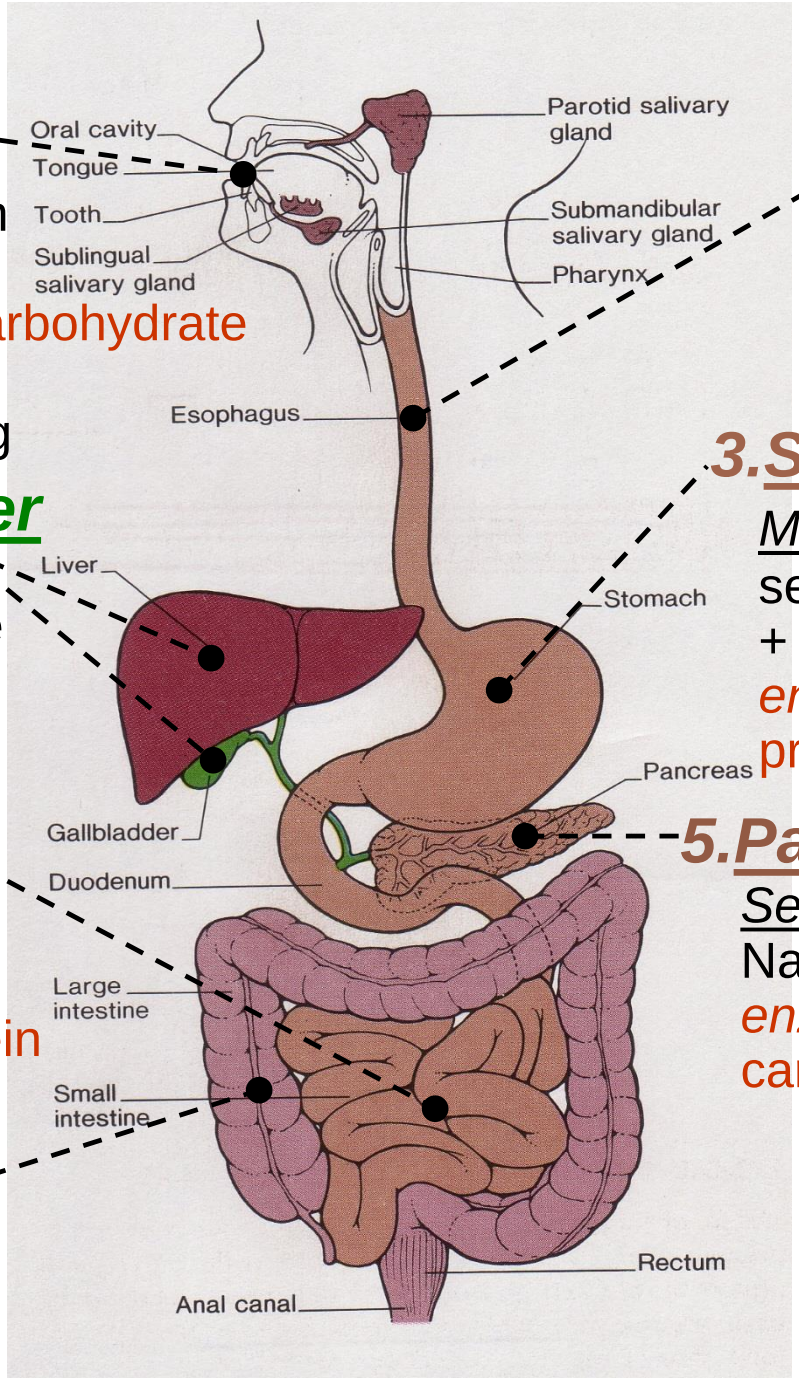
Secretion mucus +
$NaHCO_3$ + enzymes
enzymatic digestion:
carbohydrate, fat, protein

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?

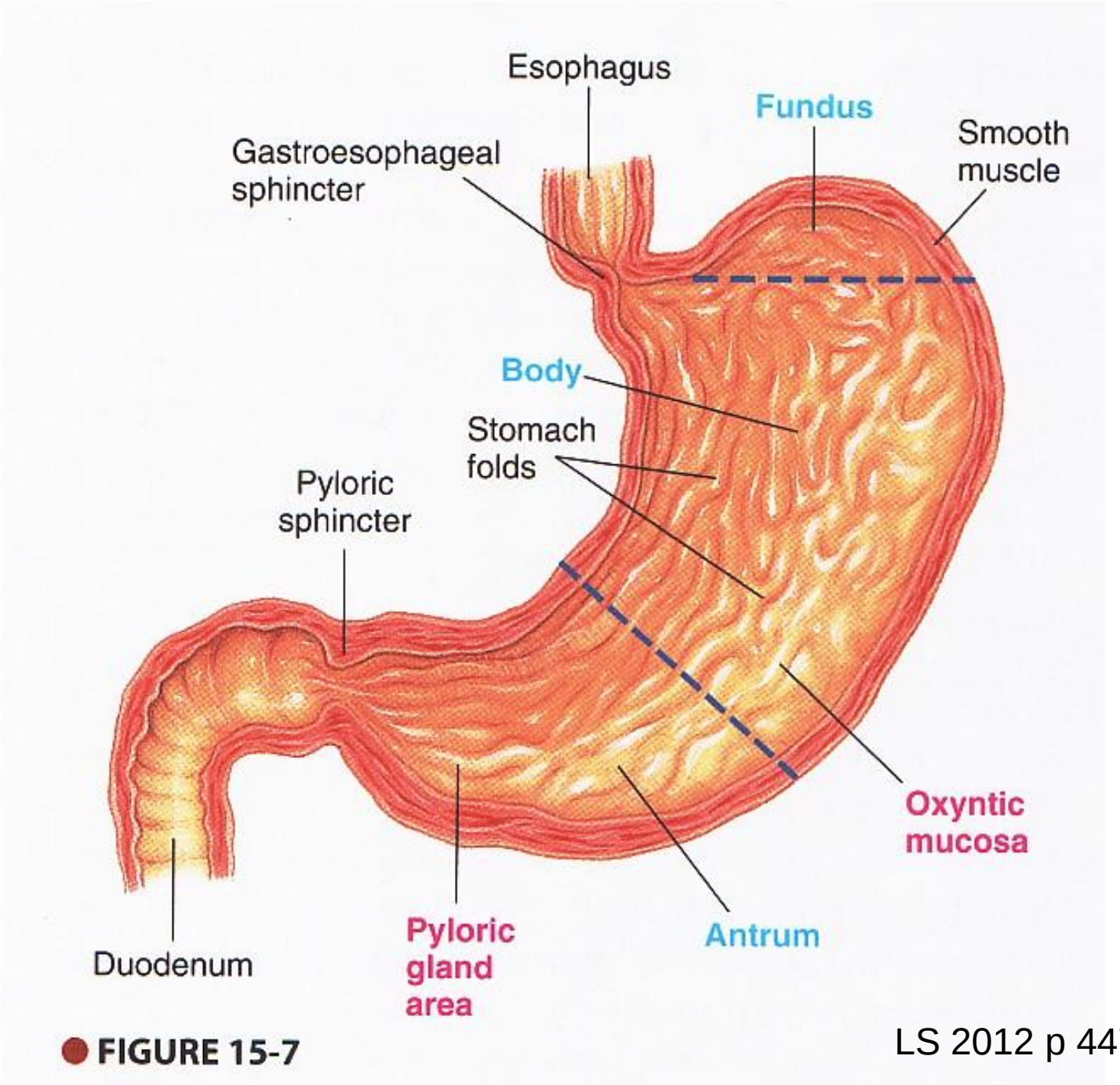
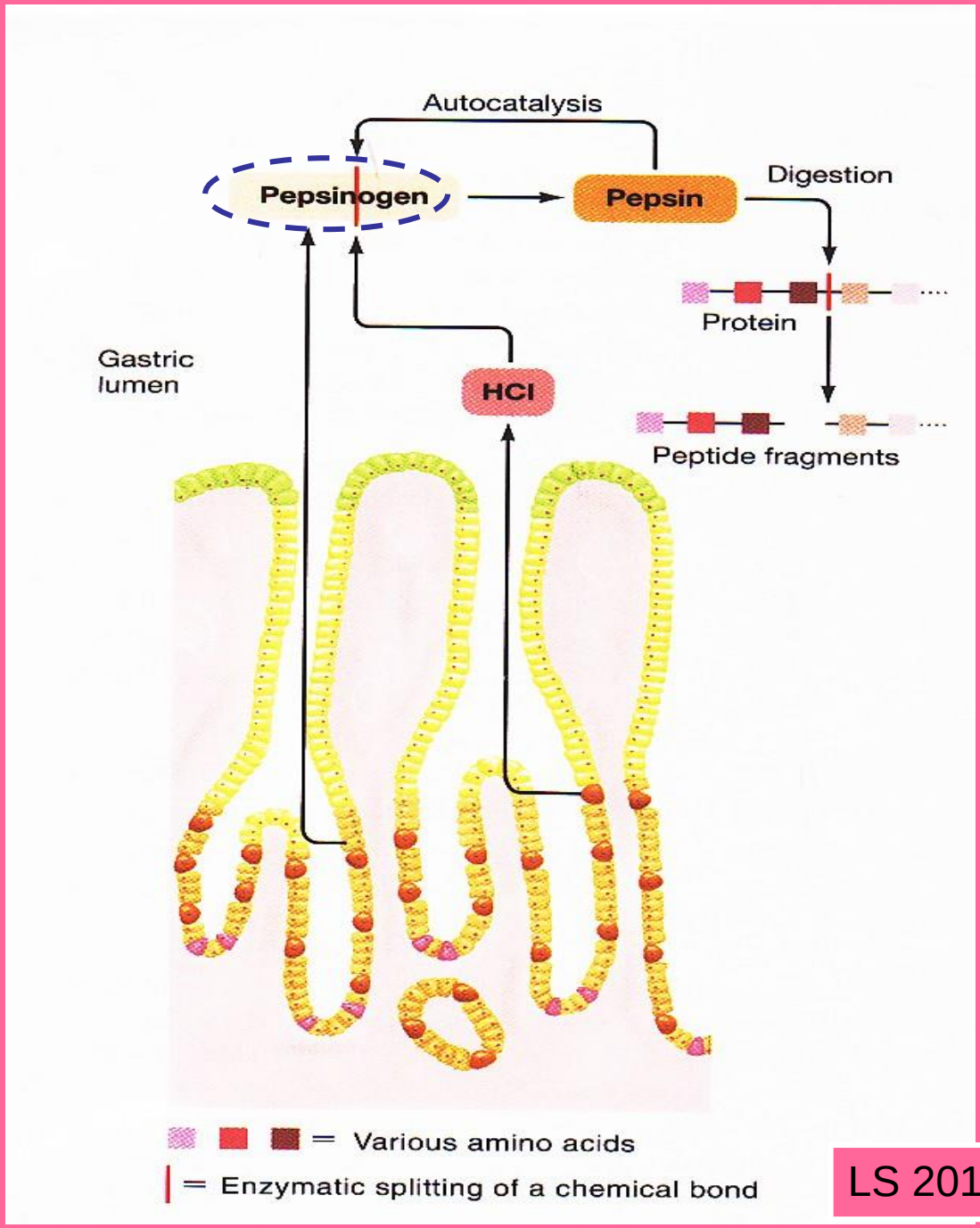


FIGURE 15-7

LS 2012 p 447

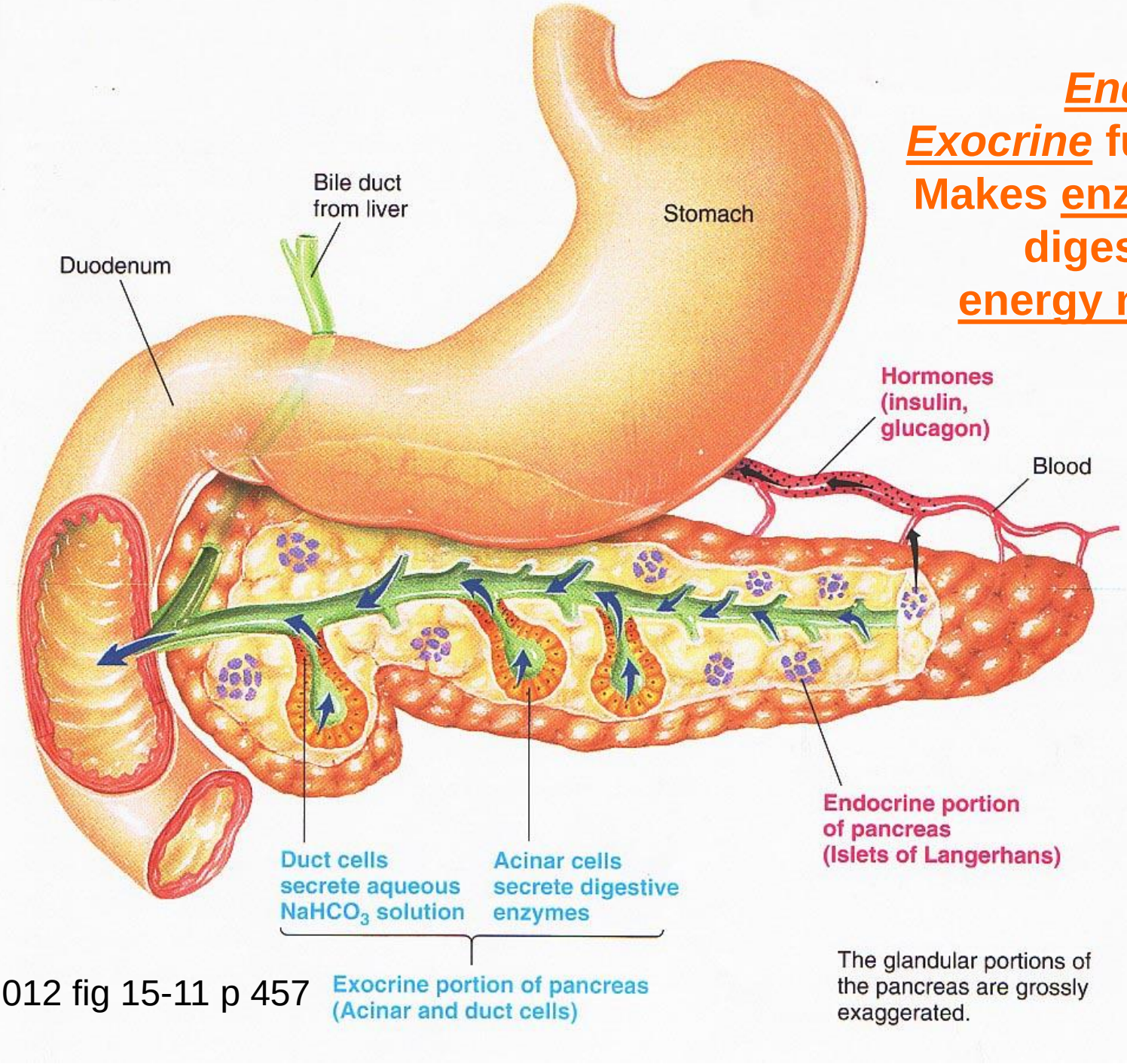
Zymogen= an inactive precursor



LS 2012 fig 15-9 p 452

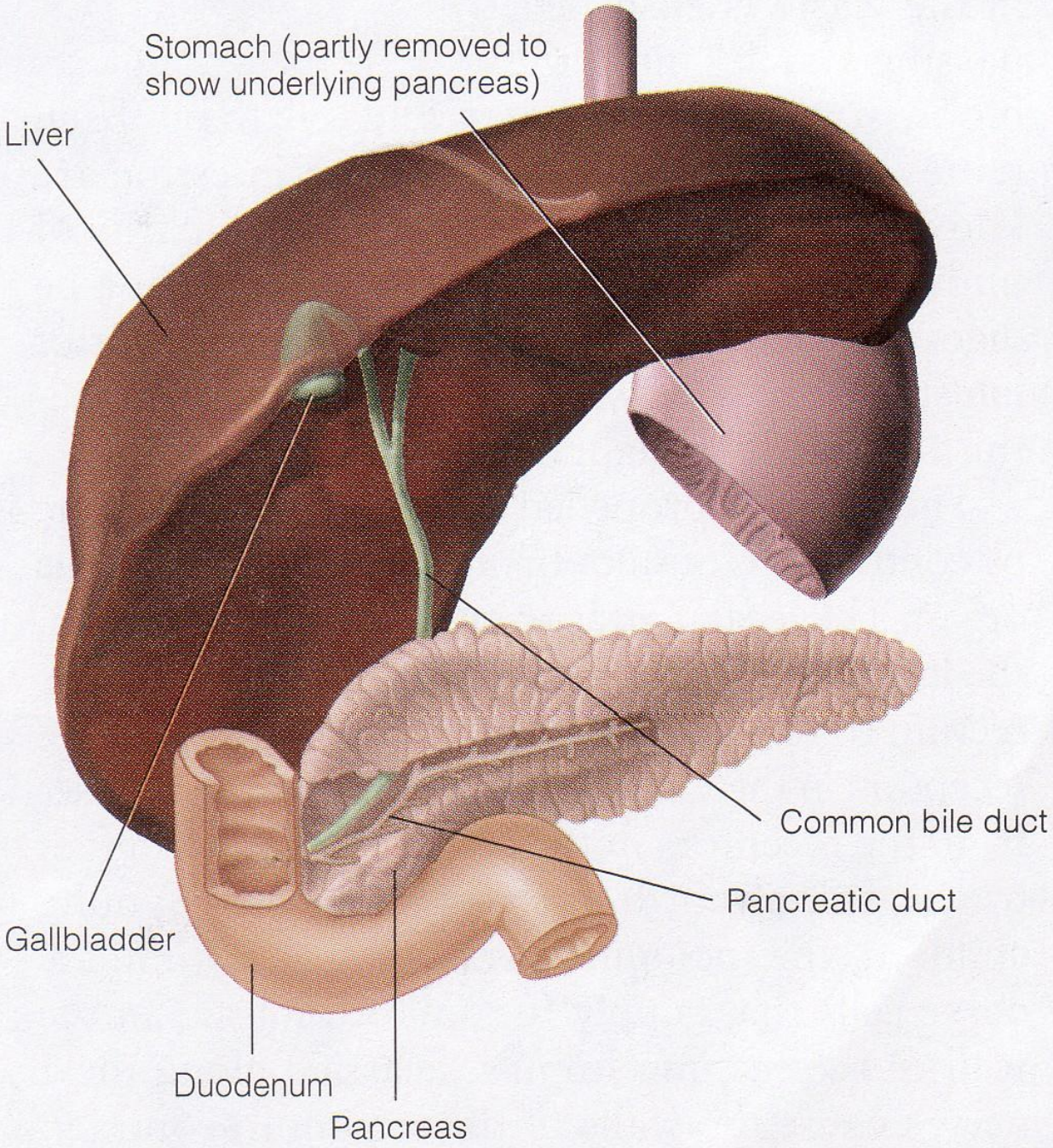
Why is the *pancreas* so unique?

Endocrine + _Exocrine_ functions; Makes enzymes for digesting all 3 energy nutrients!



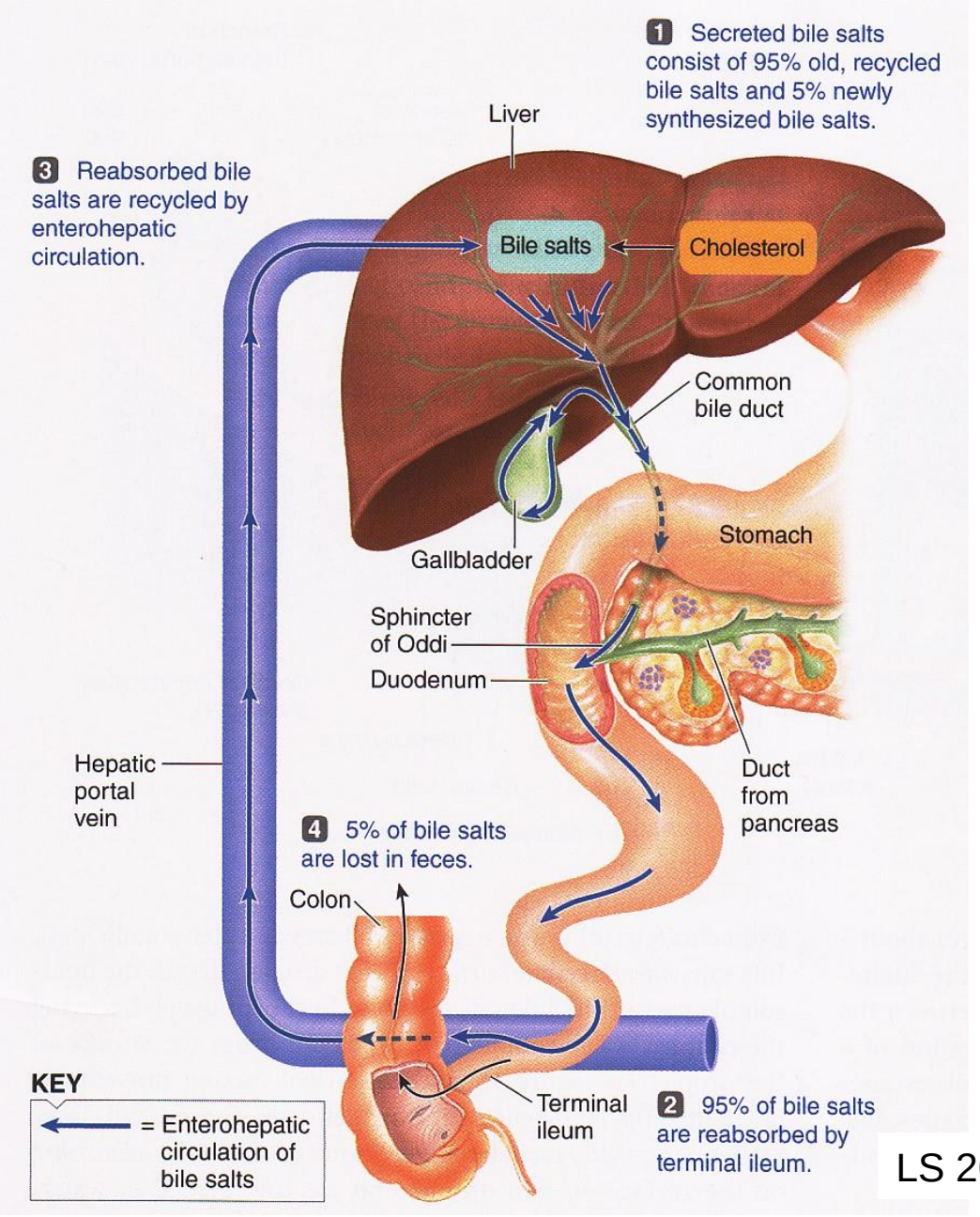
LS 2012 fig 15-11 p 457

What are other *accessory organs* of digestion, that is, off-shoots of the primary tube?


Stomach (partly removed to show underlying pancreas)
Liver
Common bile duct
Pancreatic duct
Gallbladder
Duodenum
Pancreas

DC 2003

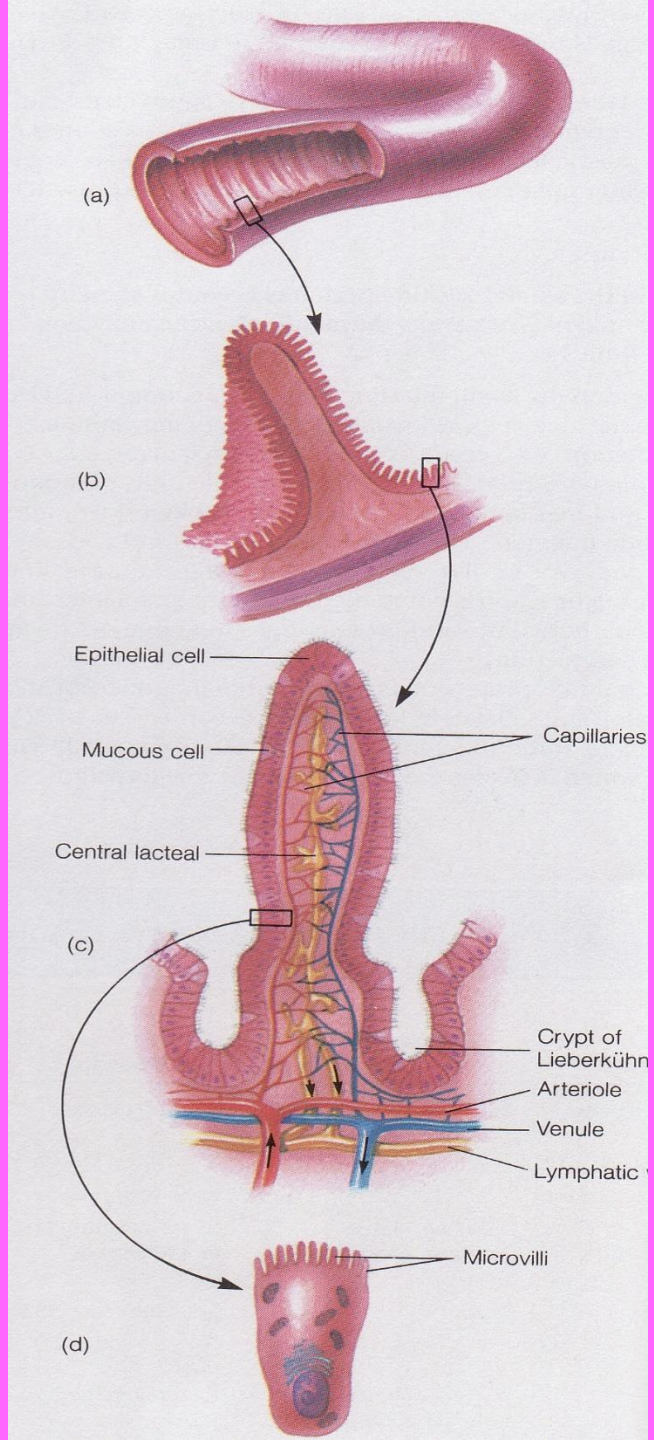
Liver: Amazing Recycling of Bile Salts!



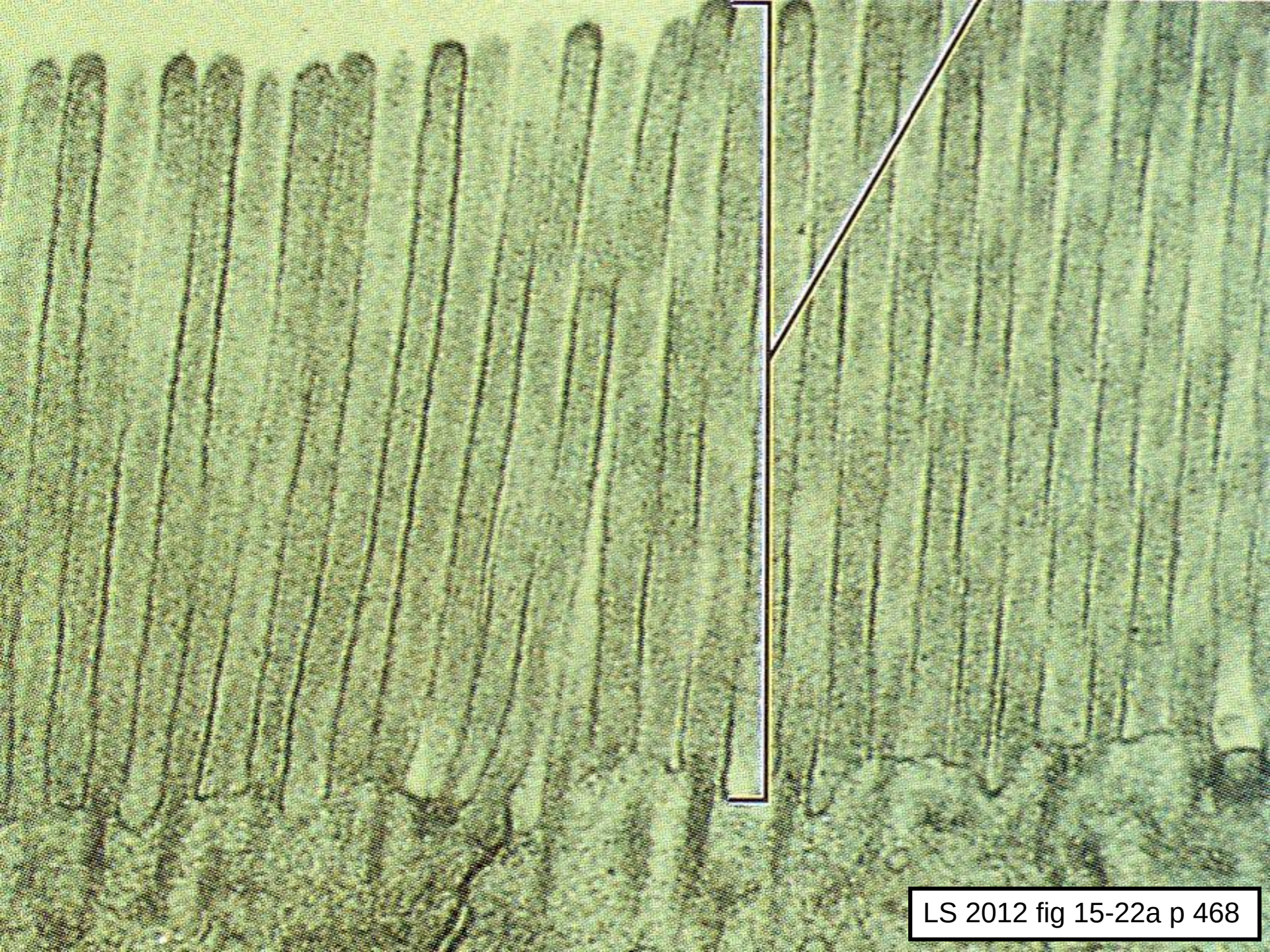
LS 2012 fig 15-11 p 462

What is the *major function* of the small intestine?

Absorption!!



LS 2012 fig 15-20 p 467



LS 2012 fig 15-22a p 468

http://www.cdc.gov/ulcer/

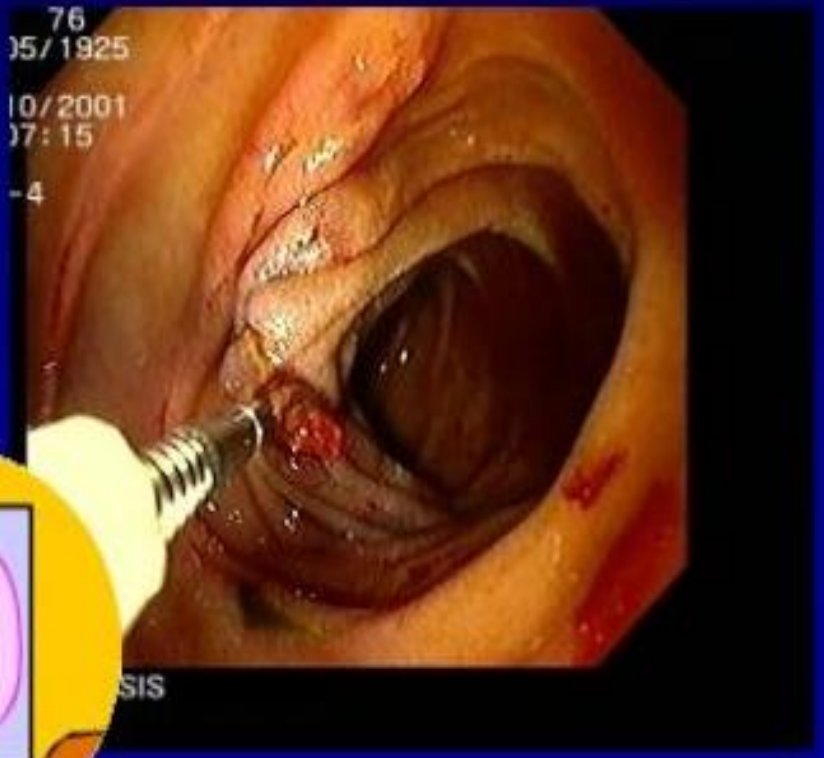
Ulcer Facts

- 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.

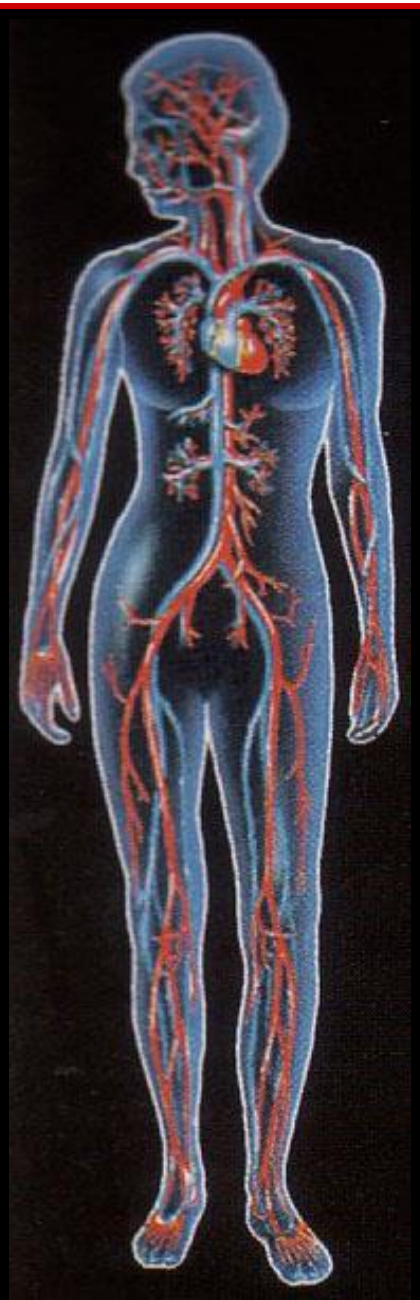
Clipping a Duodenal Ulcer

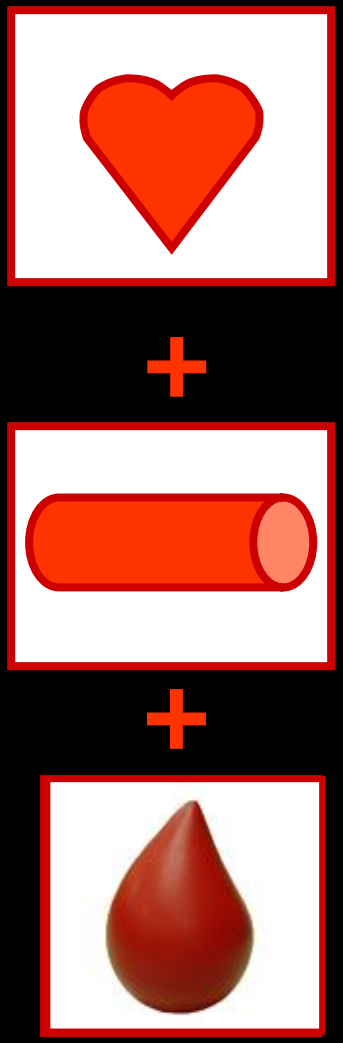
Peering through the pylorus into the duodenum, we see some blood and a vessel sticking out of the wall, just at the front edge of a small but deep ulcer.

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



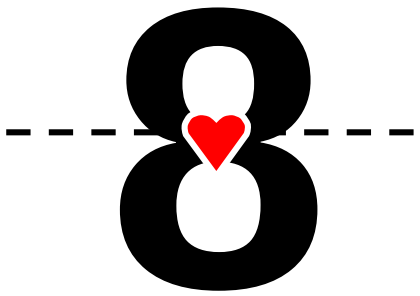
Cardiovascular (CV) = Heart + Vessels + Blood!



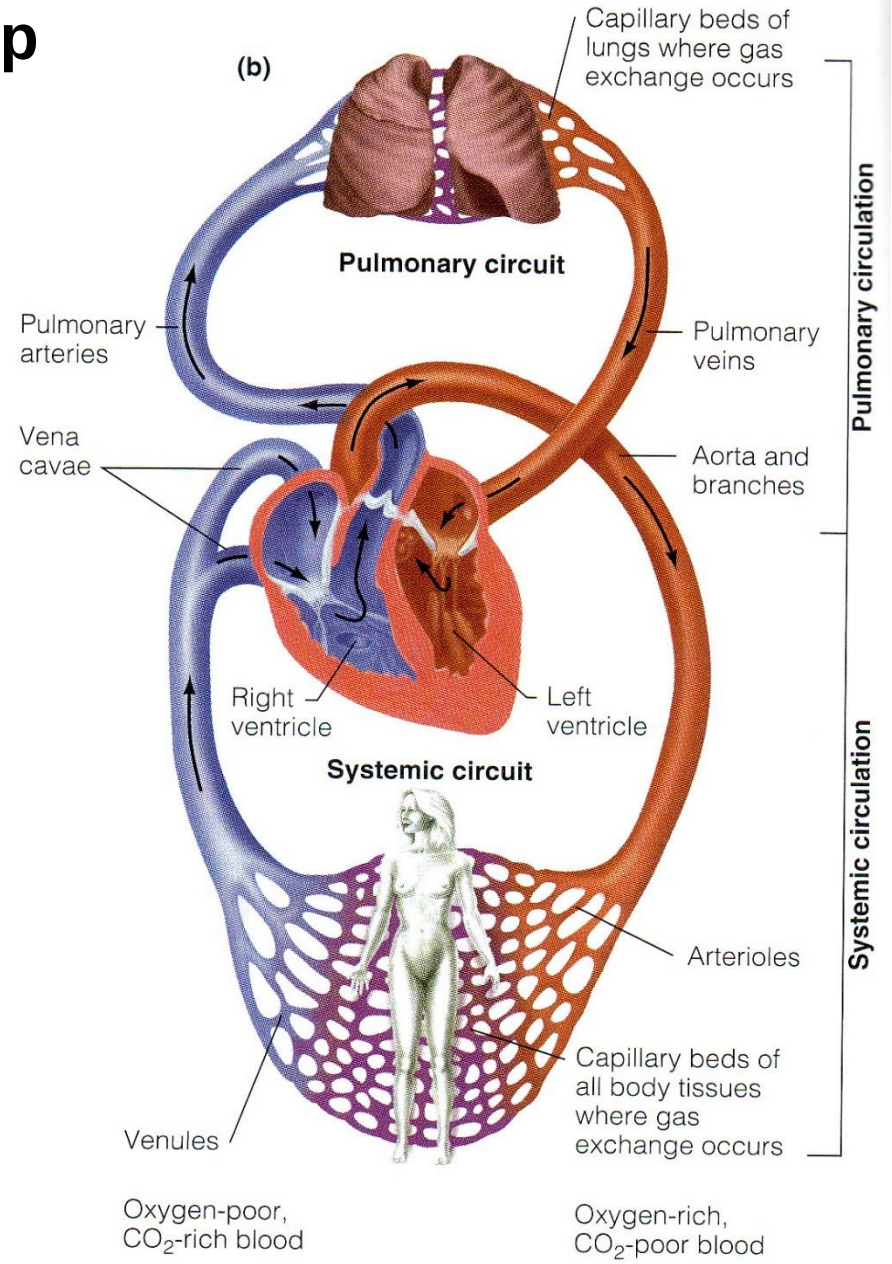


NB: Figure-8 loop

Pulmonary

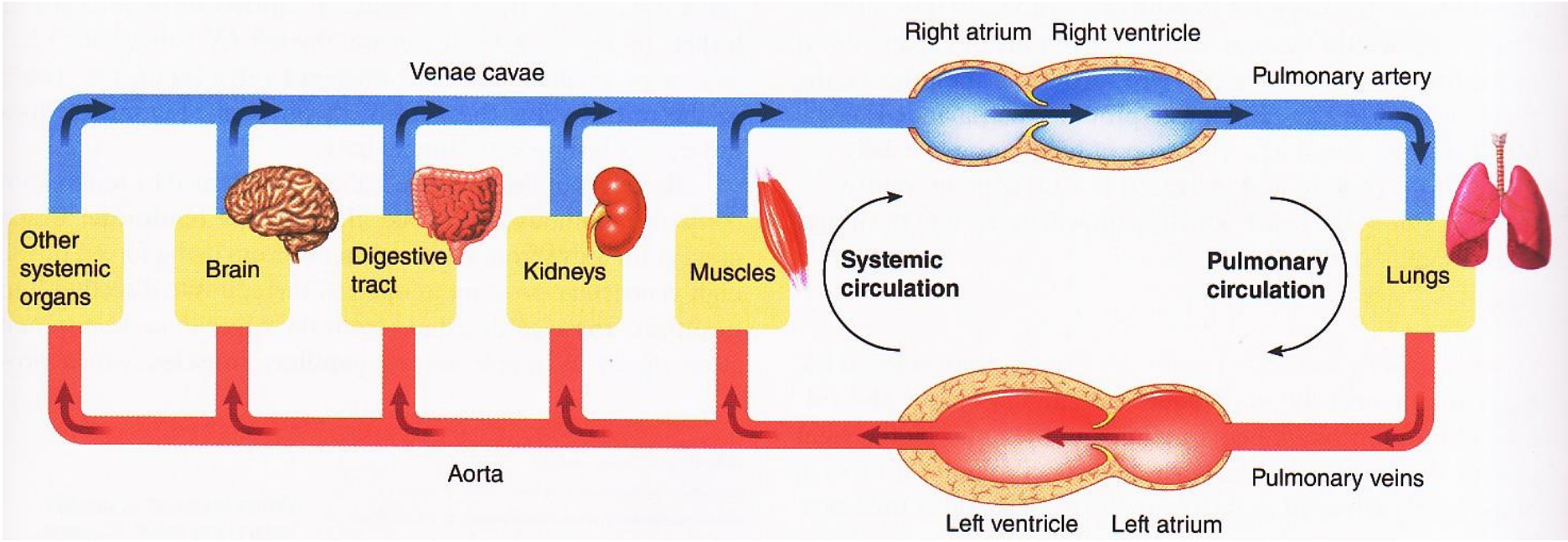


Systemic

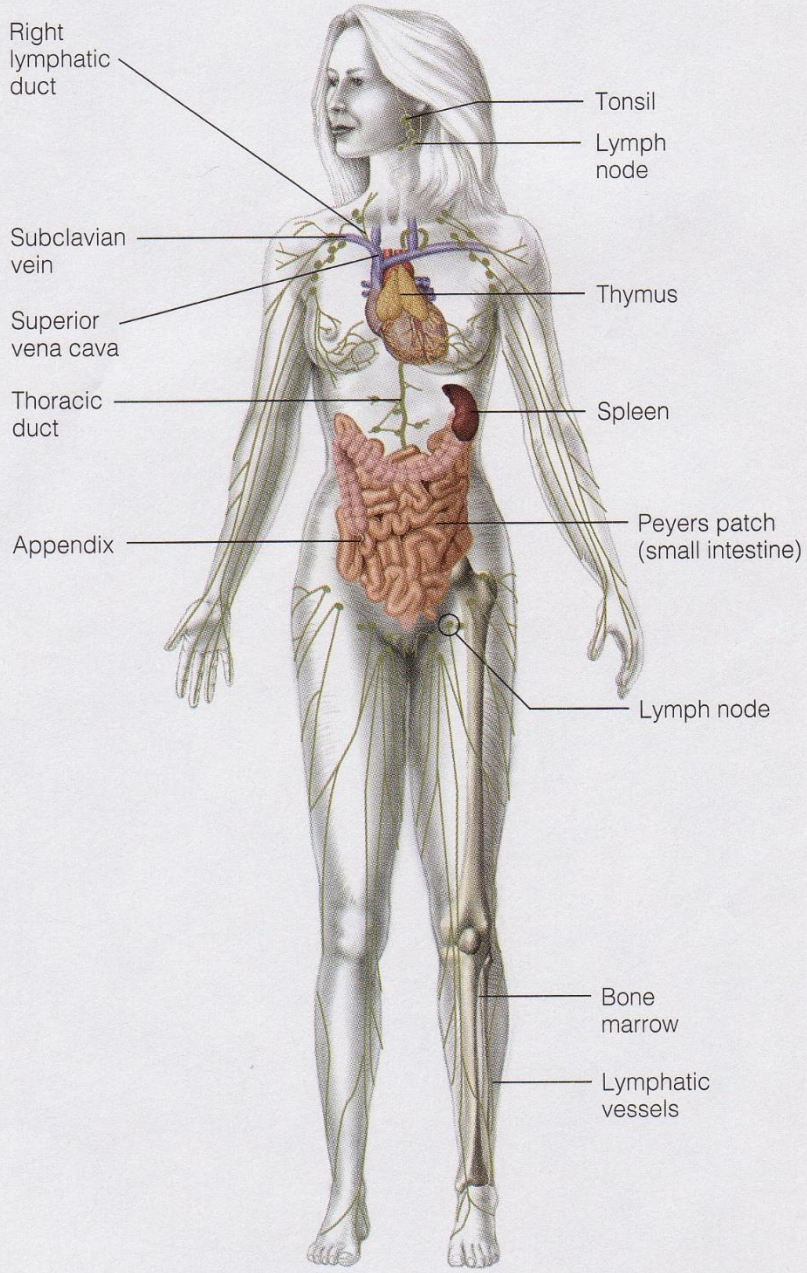


D Chiras 2013 fig 4-1b

Dual Pump Action & Parallel Circulation

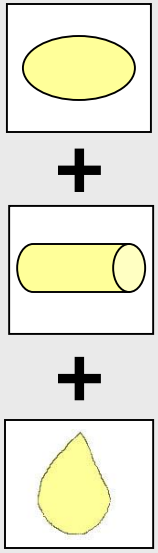


LS 2012 fig 9-2b p 231



Lymphatic System

1. **Lymph Nodes**
2. **Vessels**
3. **Lymph**



No pump!

DC 2003

Lymphatic System

Alternative System of Circulation

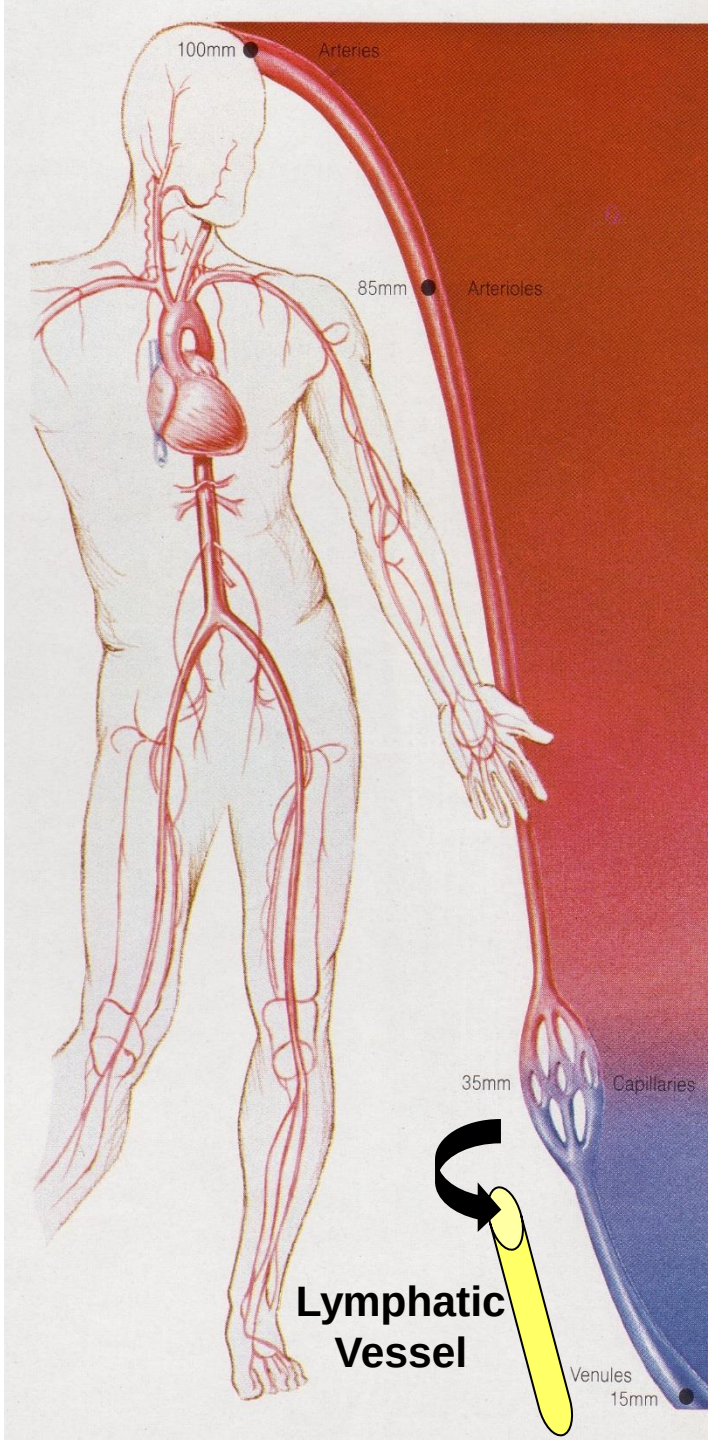
or

Drainage System

Lymph Vessels || ***Veins***

Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm

LS 2012 fig 10-21 p 283

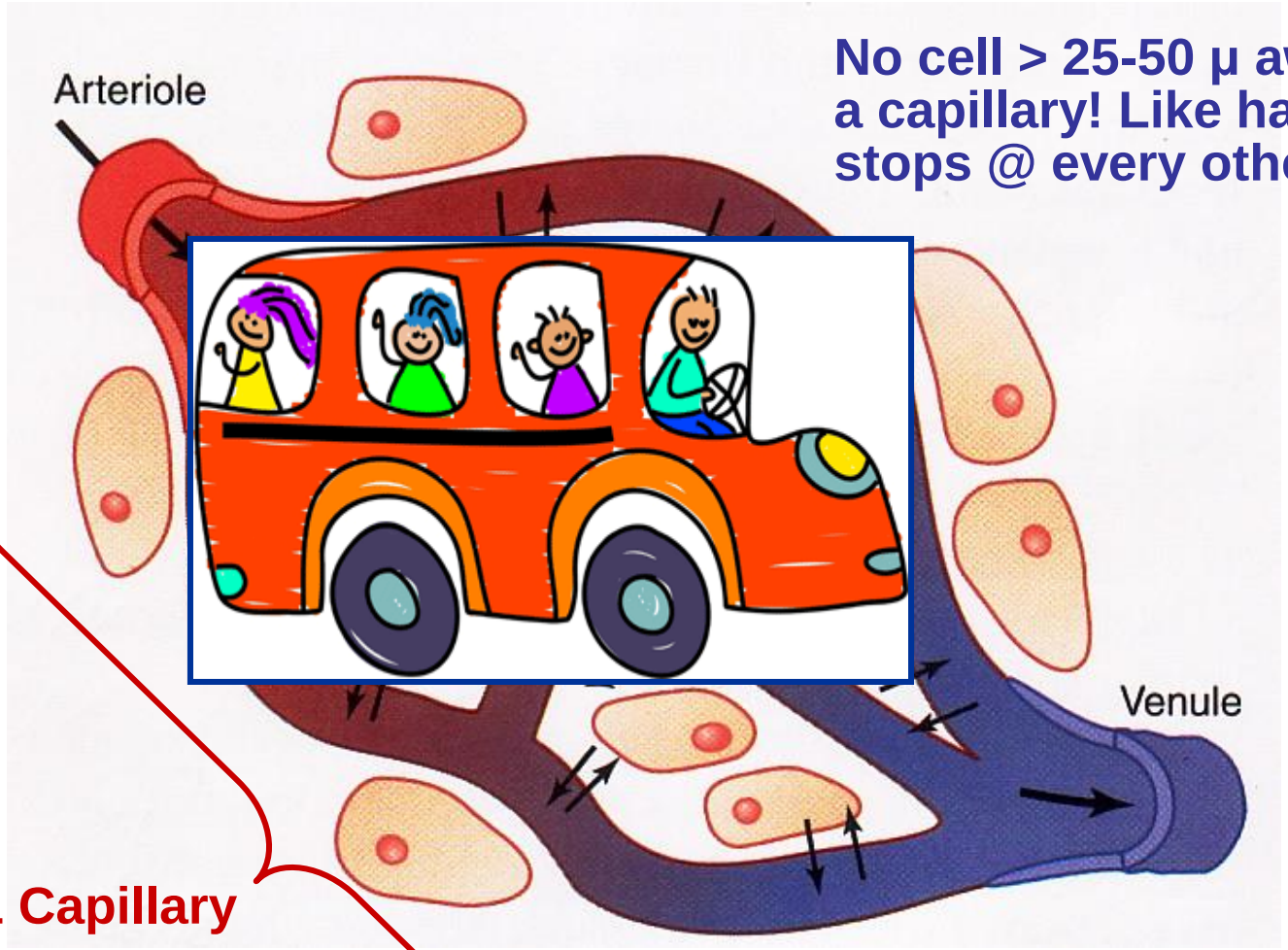


Lymphatics collect run-off & are parallel to venules/small veins!

Torstar Books 1984

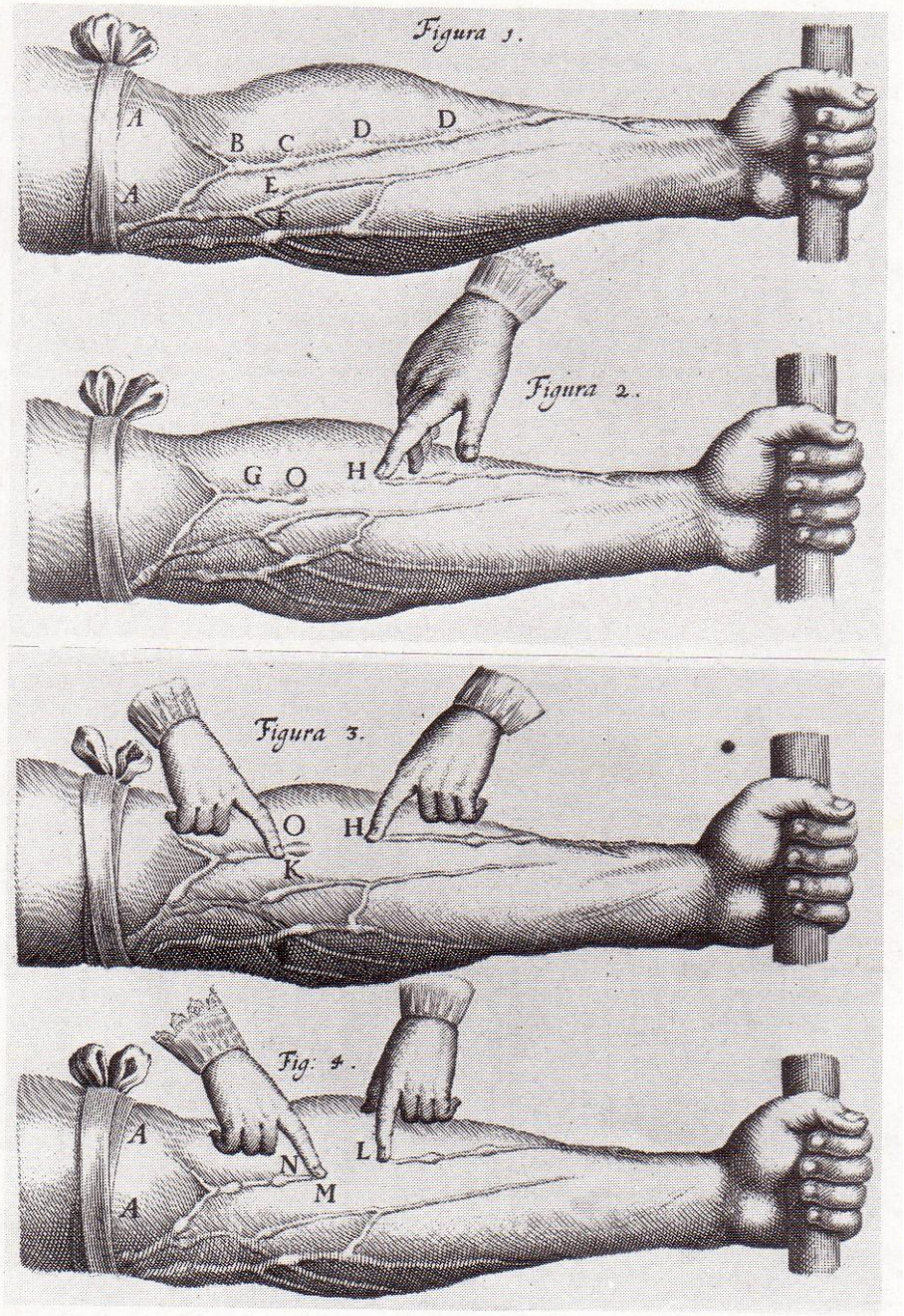

Torstar Books 1984

Microcirculation Exchange: 10 Billion Capillaries!



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

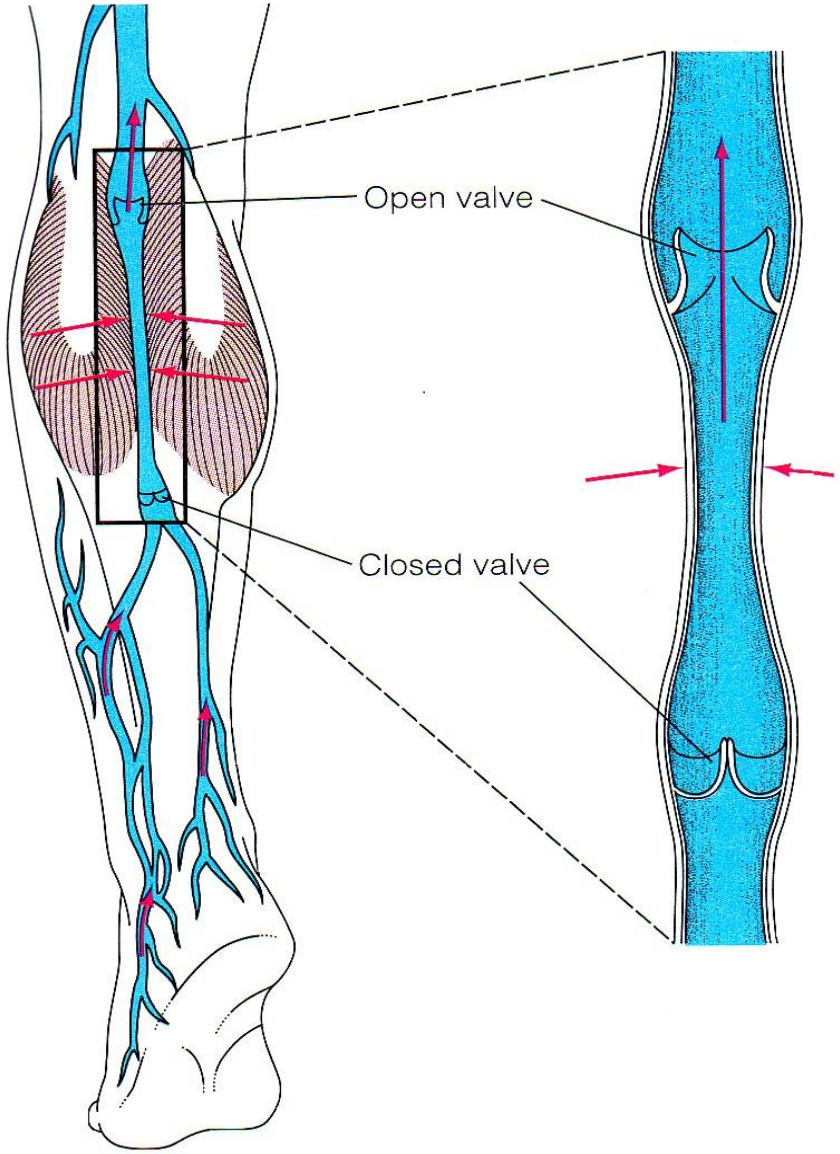
Guyton & Hall 2011 fig 1-2



Harvey Experiments: 1-way system of venous valves!

Torstar Books 1984

Skeletal Muscle Pump

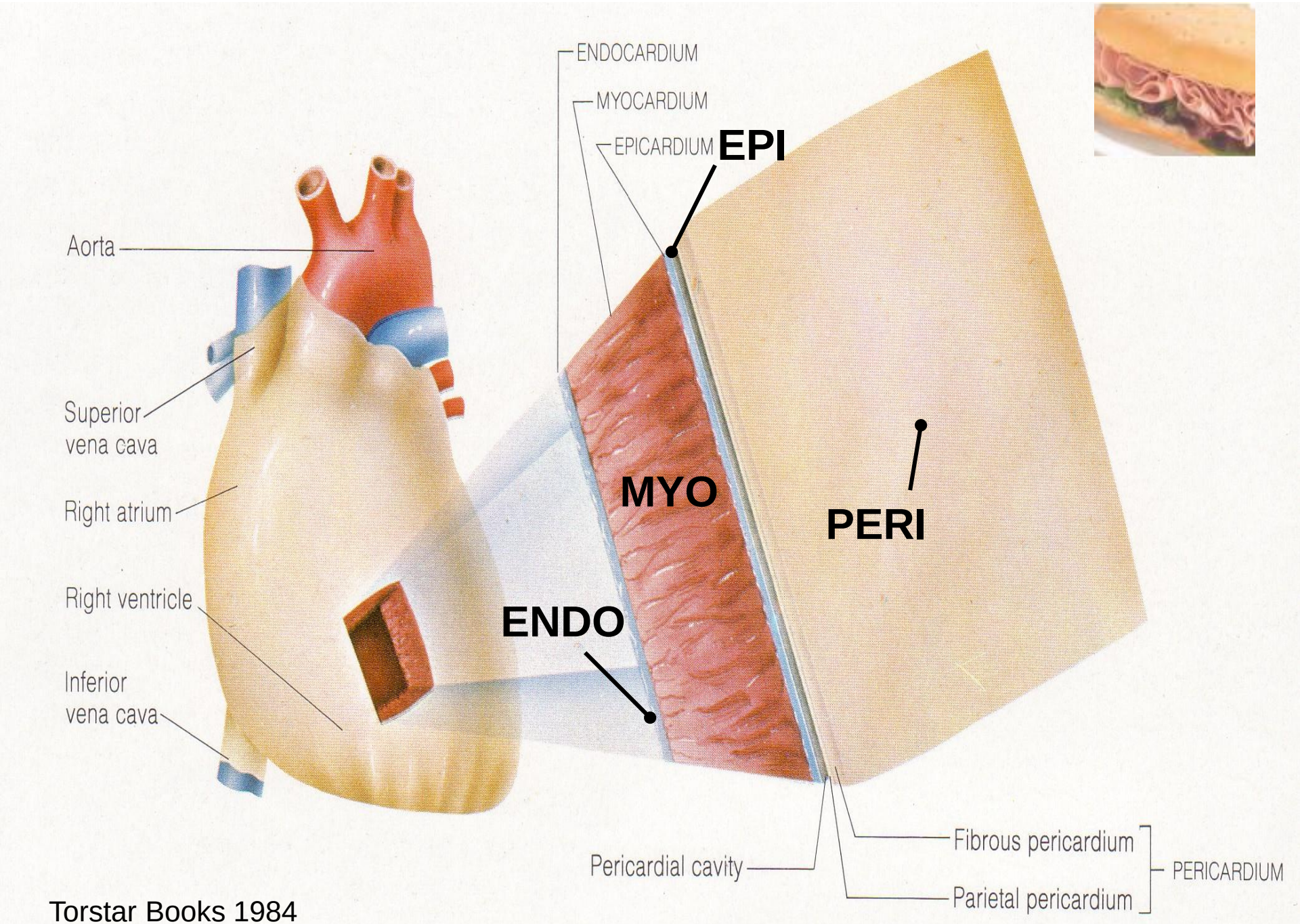


LS 2006

DC 2003

The Heart

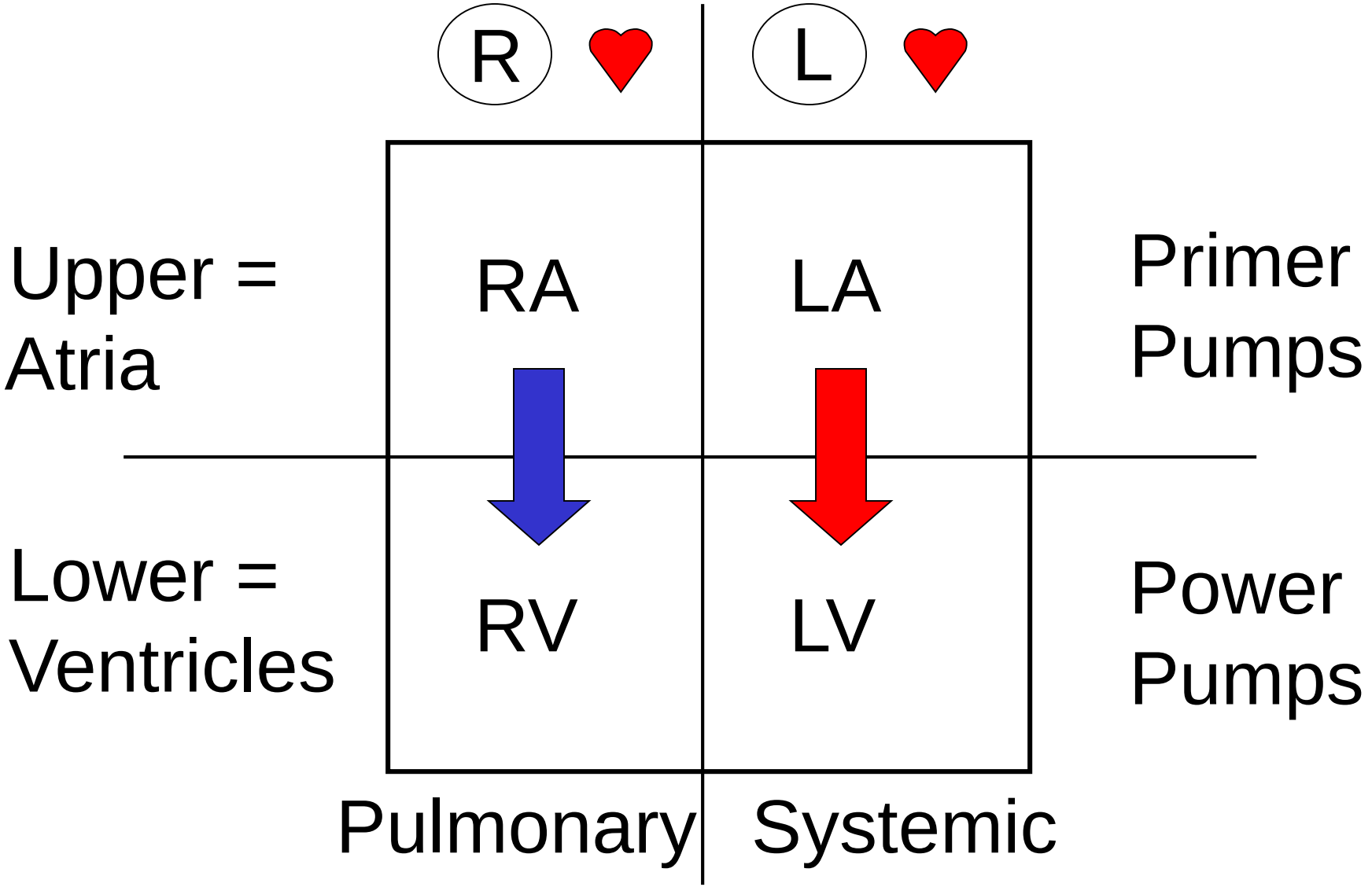
The Living Pump

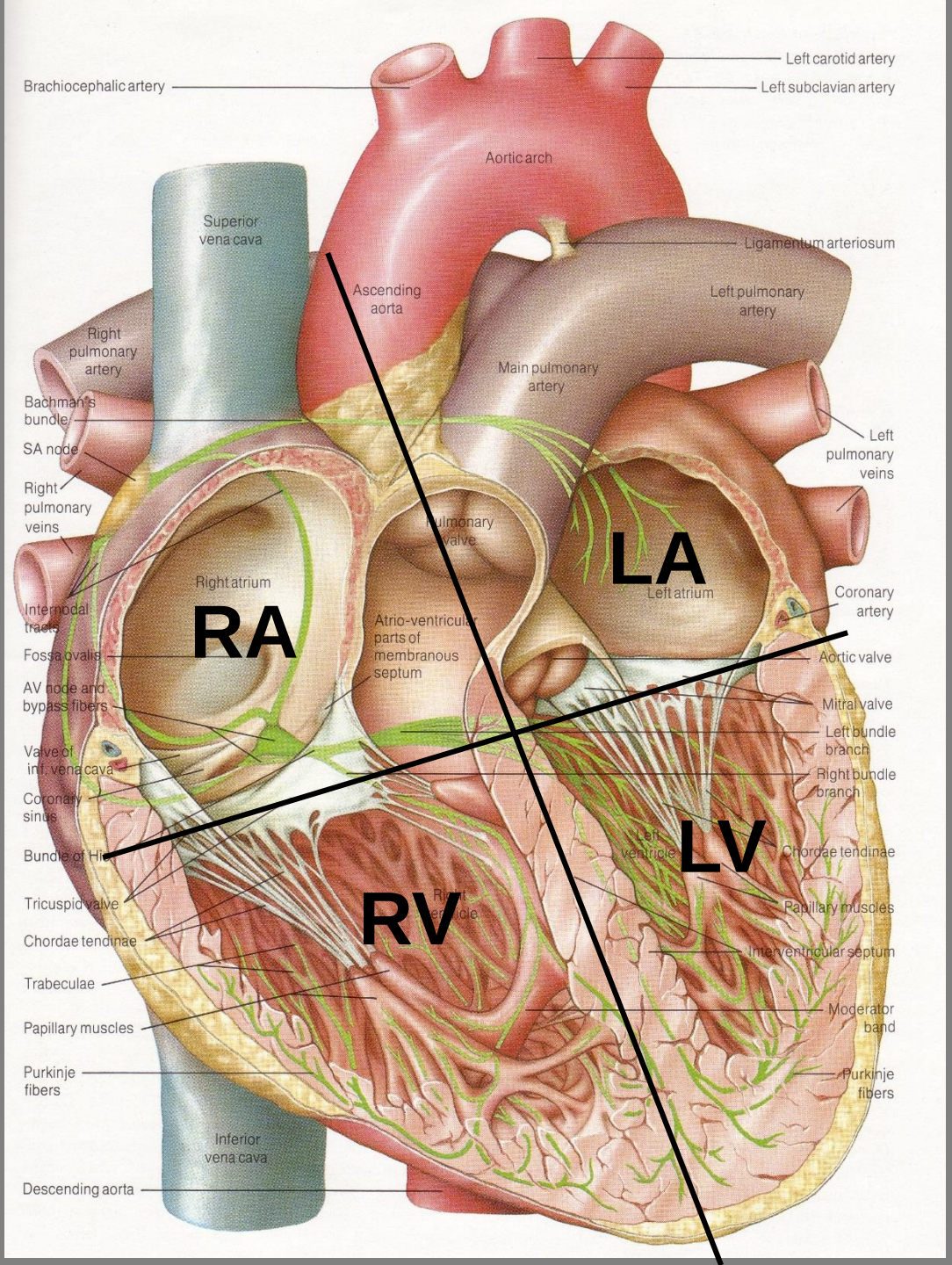


Torstar Books 1984

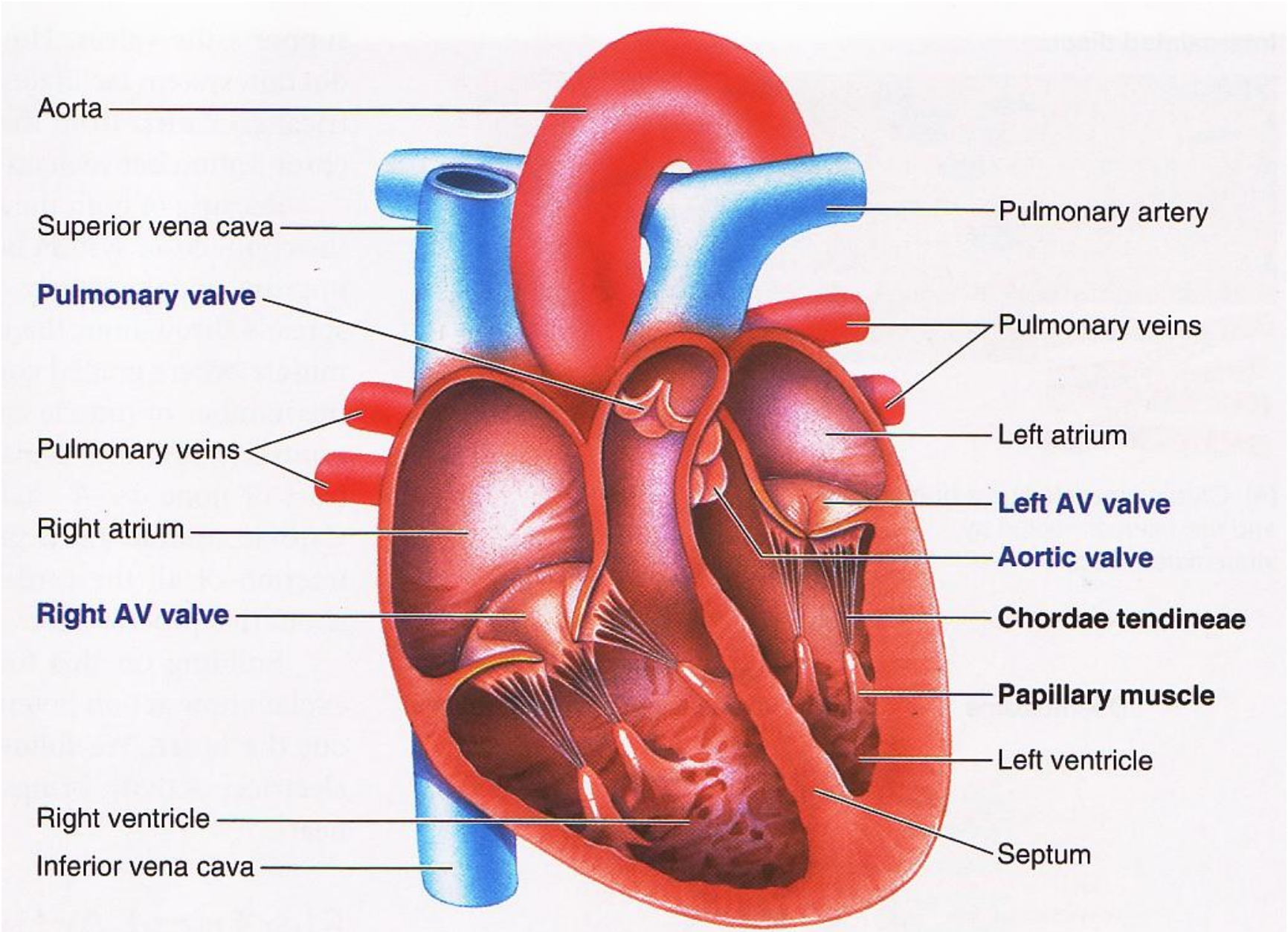
Human ♥ = 4-chambered box?

2 separate pumps?





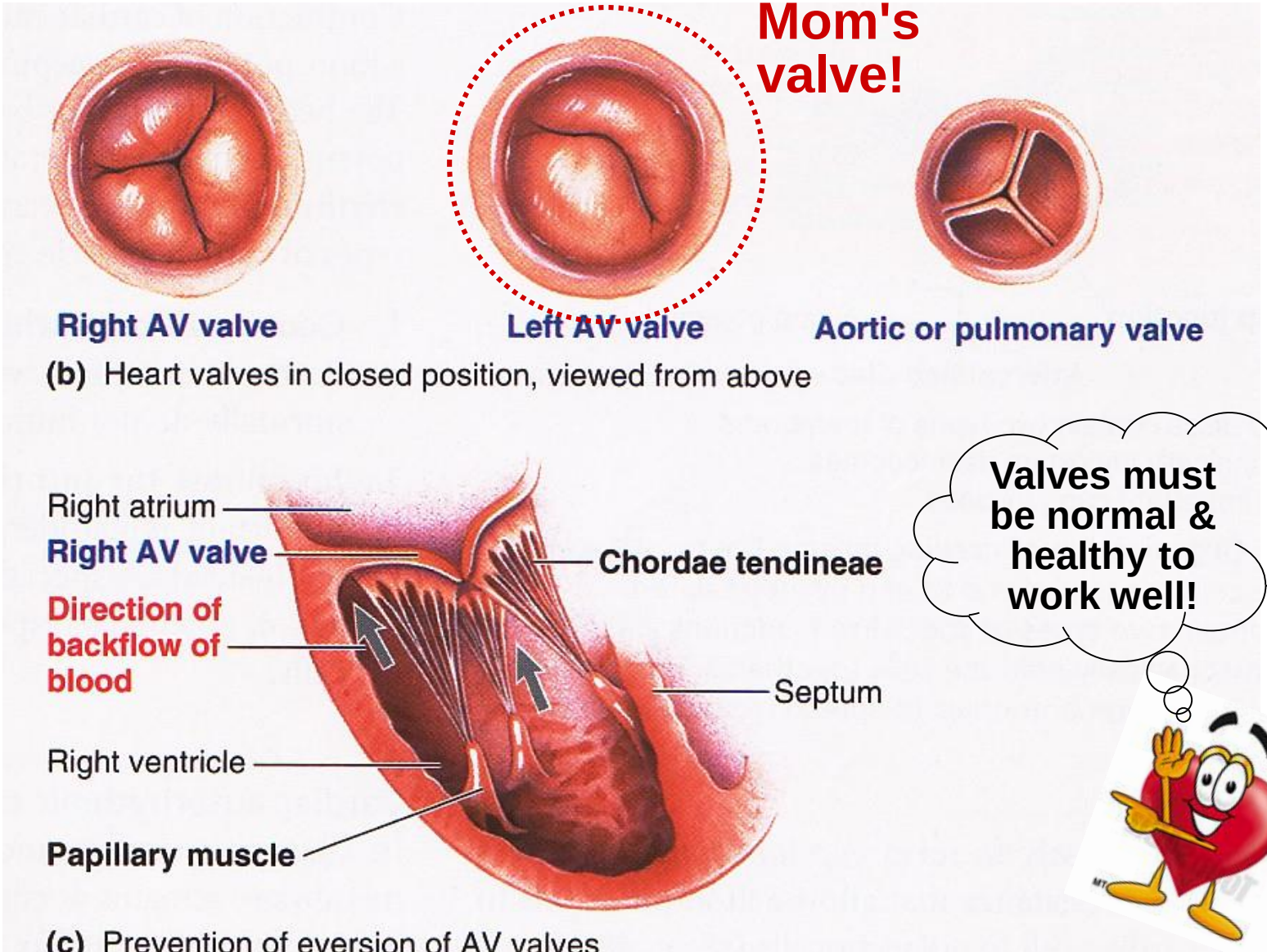
Torstar Books 1984



(a) Location of the heart valves in a longitudinal section of the heart

LS 2012 fig 9-4a p 233

Heart Valves Ensure Unidirectional Blood Flow!



● FIGURE 9-4 Heart valves.

LS 2012 p 233

Human ♥ = 4 unique valves?
2 valve sets?

Semilunar = *Half-moon shaped*

More rigid

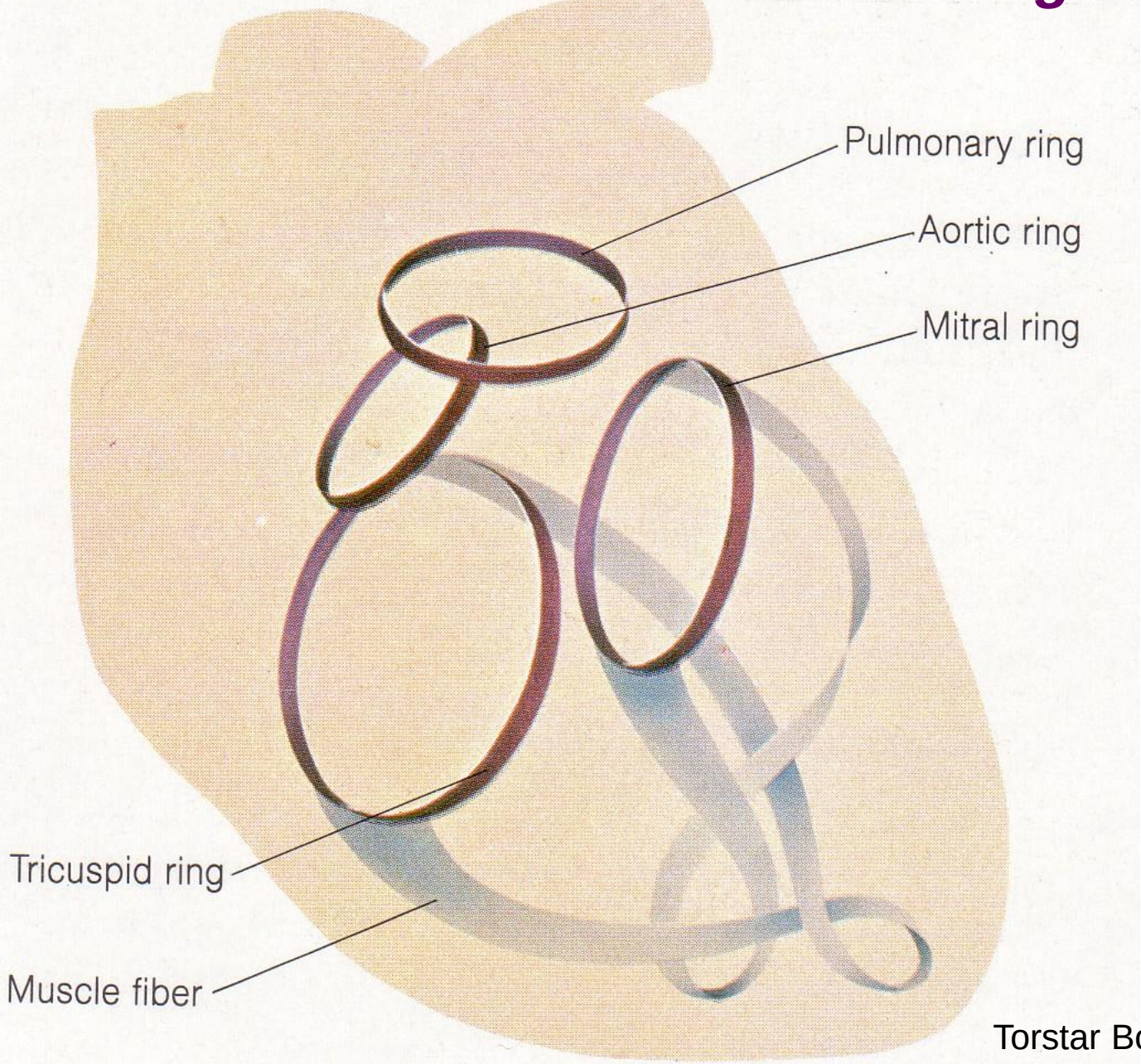
1. Pulmonic/Pulmonary
2. Aortic

AV = *Atrioventricular*

More flimsy

3. (R) AV = Tricuspid
4. (L) AV = Mitral/Bicuspid

Heart Valve Orientation & Scaffolding



Torstar Books 1984

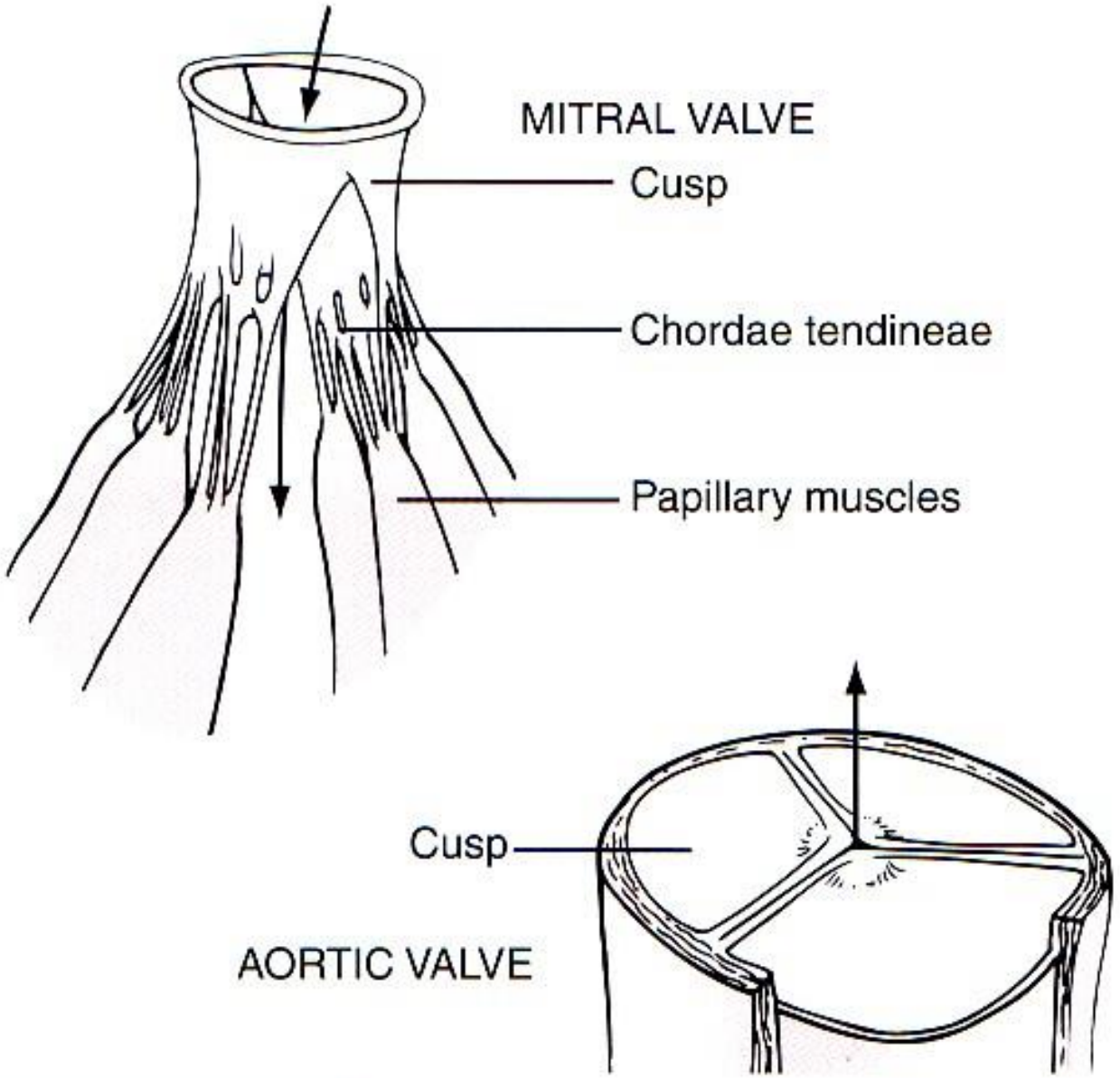
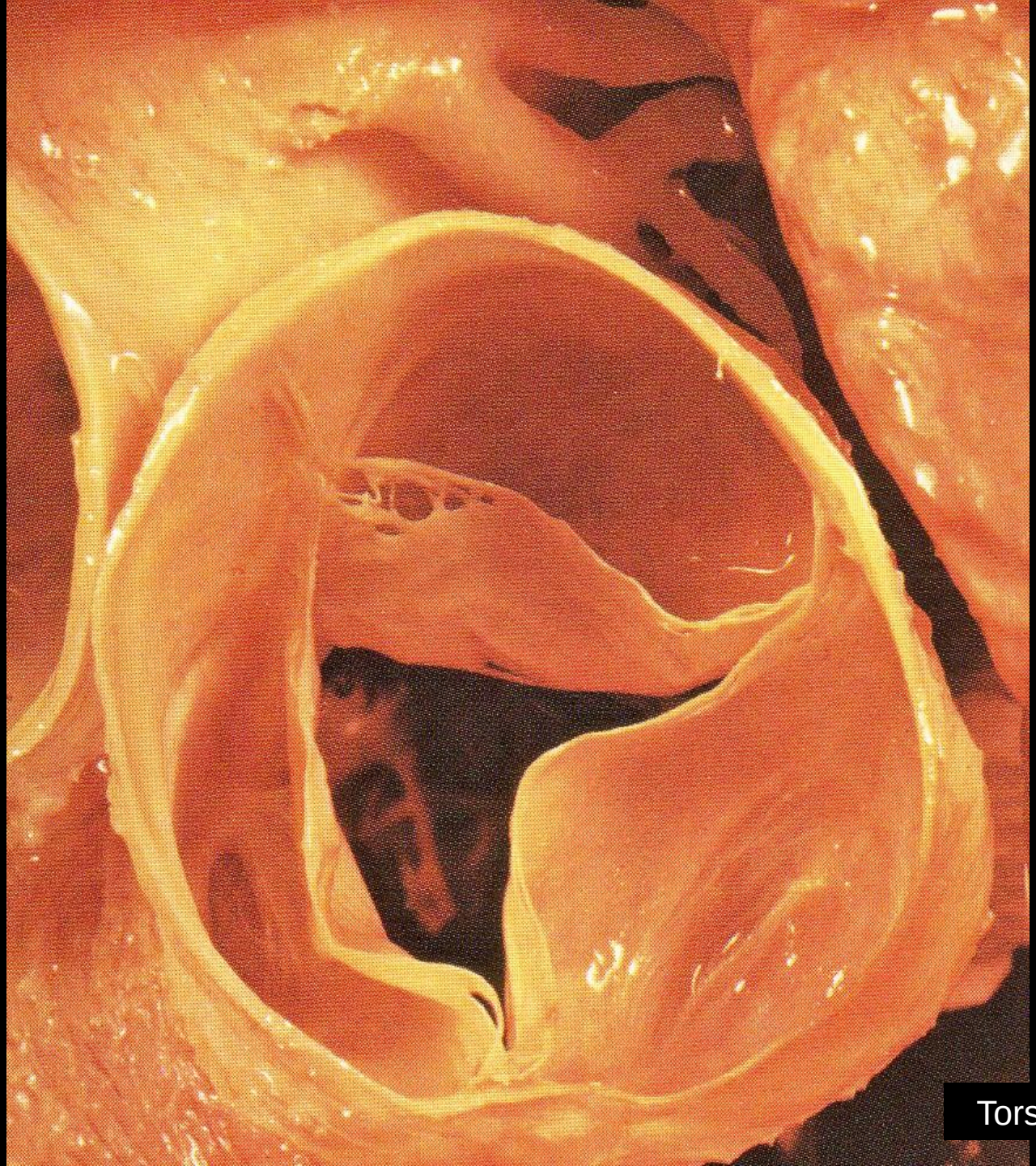


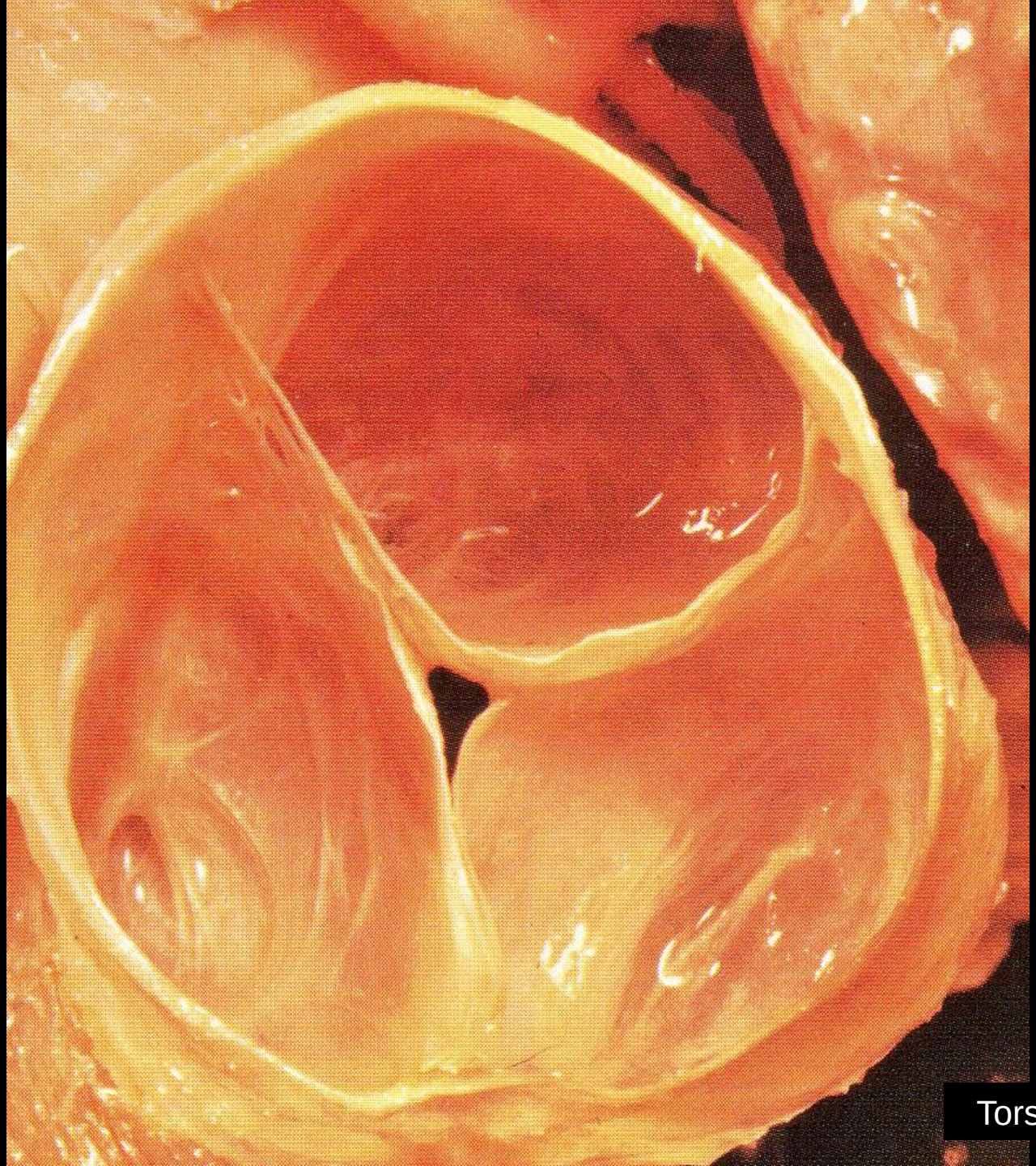
FIGURE 9–6

Mitral and aortic valves.

Guyton & Hall



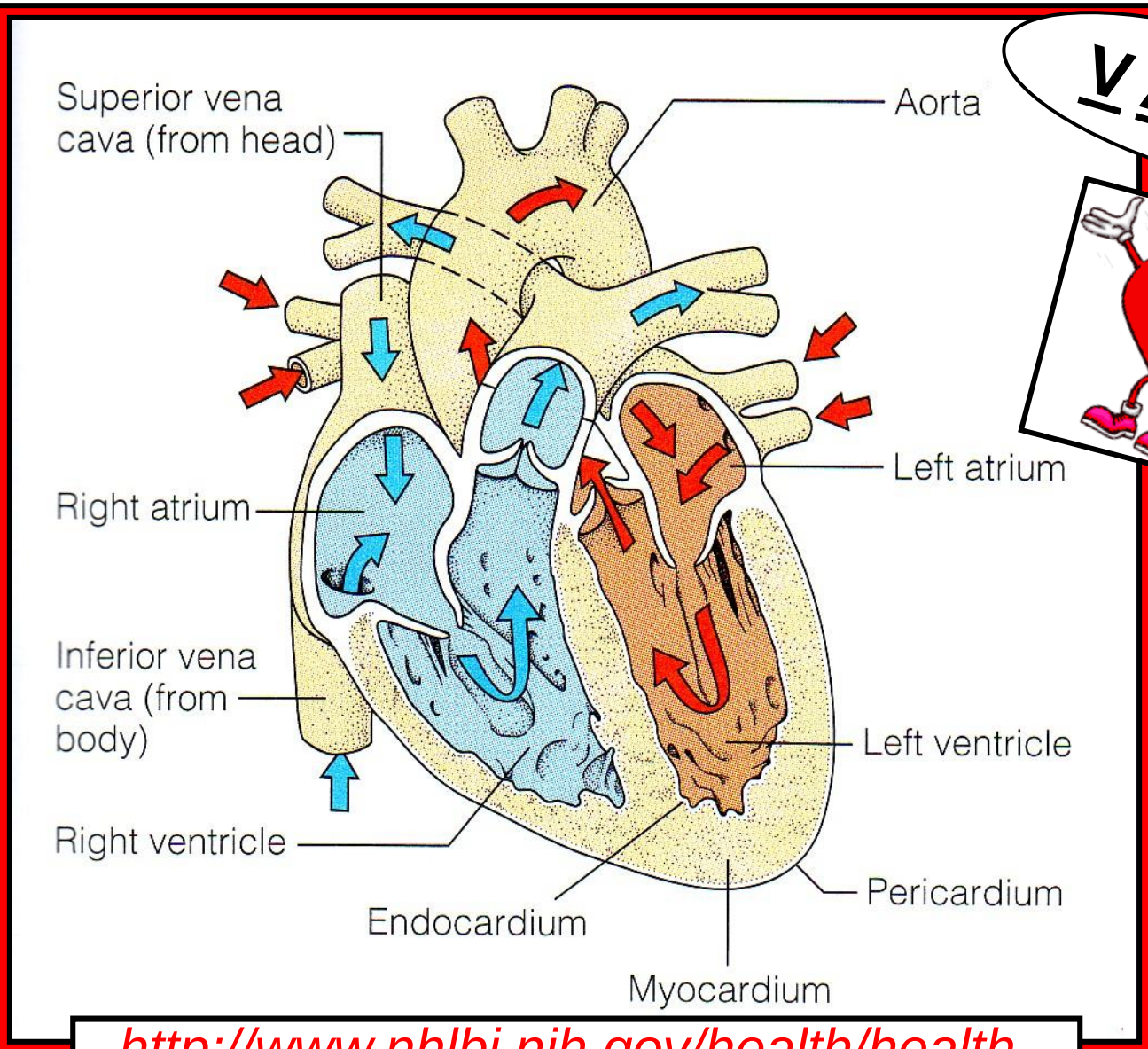
Torstar Books 1984

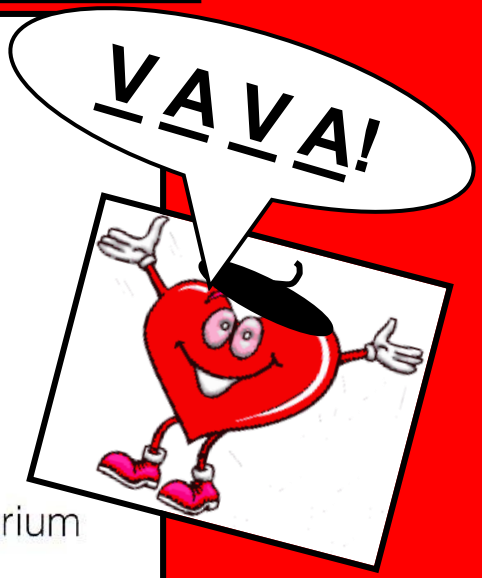


Torstar Books 1984

Torstar Books 1984

Veins → Atria → Ventricles → Arteries

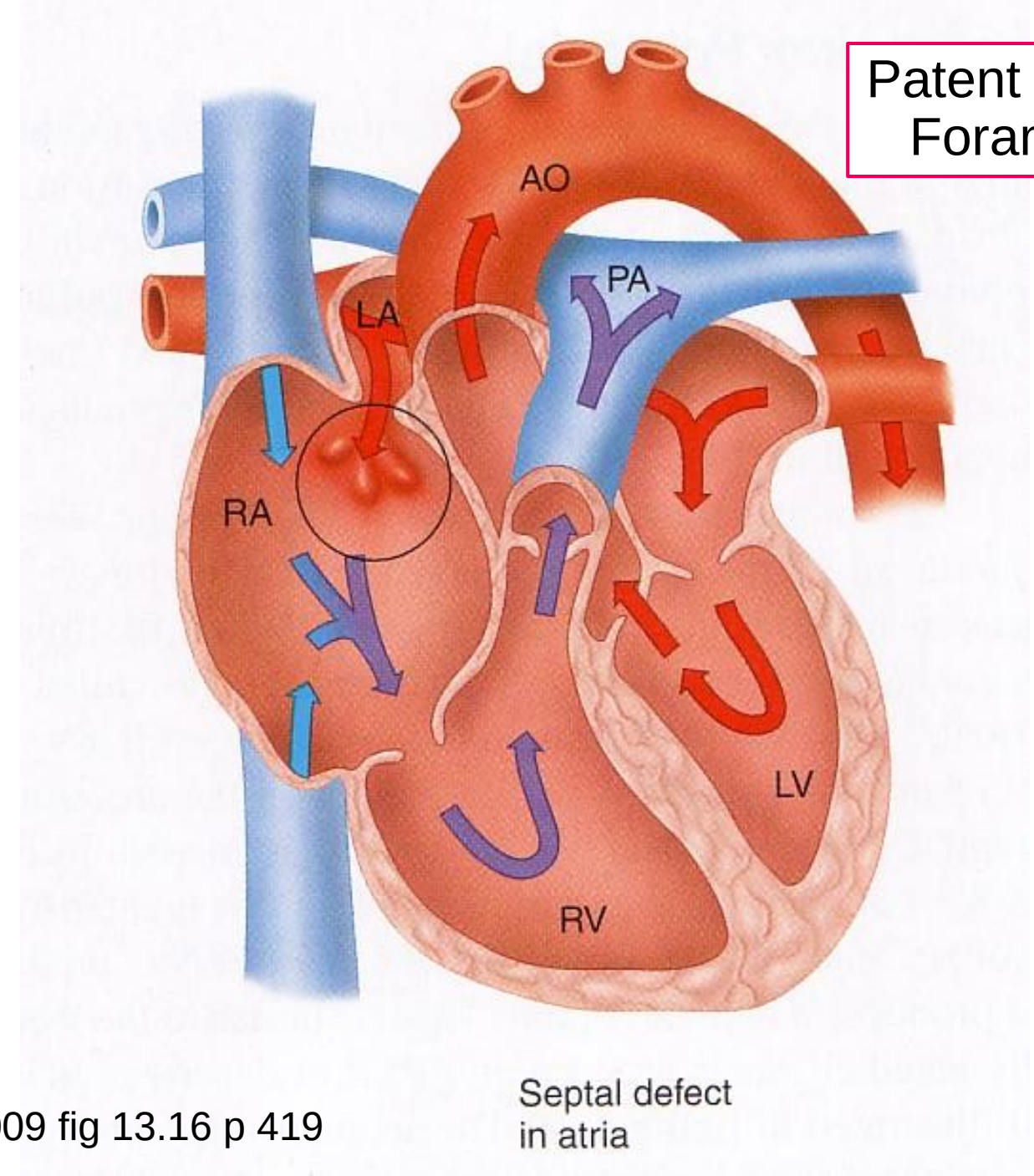




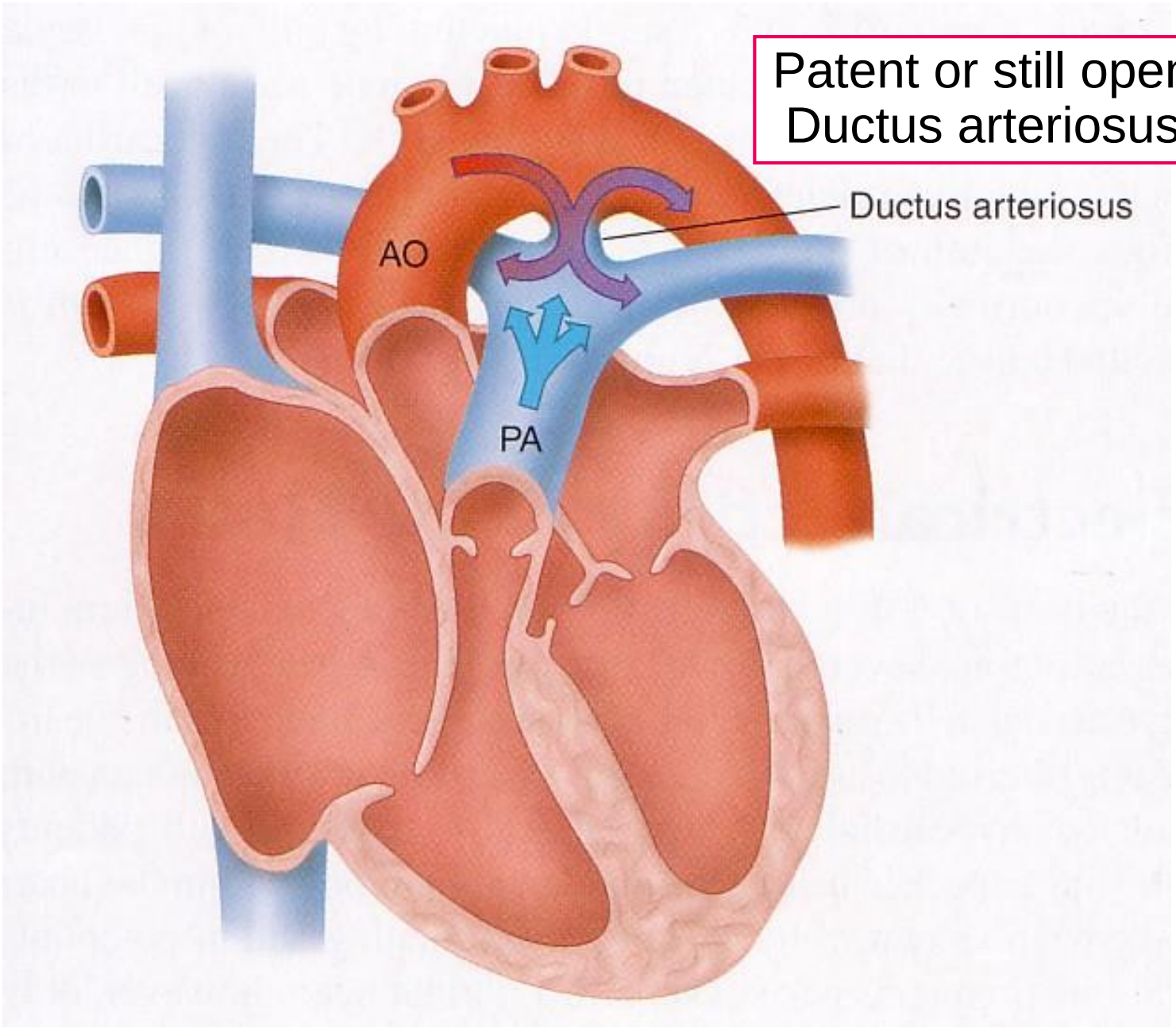
http://www.nhlbi.nih.gov/health/health-topics/topics/hhw/contraction.html

LS2007

Patent or still open!
Foramen ovale!



SI Fox 2009 fig 13.16 p 419



SI Fox 2009 fig 13.17 p 420