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

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?

II. ***Nutrition Final Comments & Discussion*** Recommended diets? Nutrition Quackery? Kleiner & Monaco. Diet & disease?

III. ***Gastrointestinal Physiology*** DC Module 3 pp 17-23, LS ch 15+

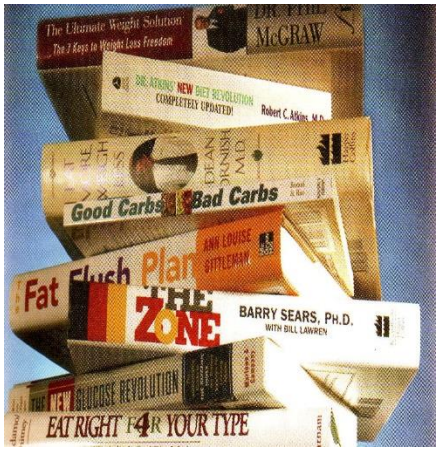
- A. GI = Donut? GI secretions: What? Where? Why? LS p 438
- B. How is the gut controlled?
- C. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
- D. Zymogen? = Inactive precursor LS fig 15-9 p 452...
- E. Accessory organs? Pancreas, Liver, Recycling! pp 457-63
- F. Small intestine? Ulcers? LS fig 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

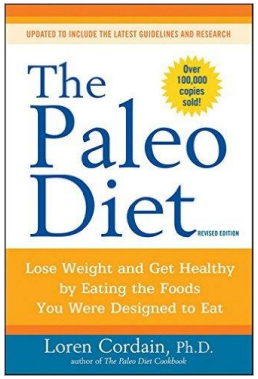
IV. ***Cardiovascular System*** DC Mod 4, LS ch 9, Torstar, G&H+…

- 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+…

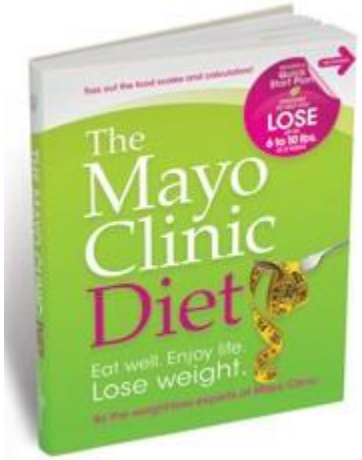
NOT PEER-REVIEWED =

TRADE BOOKS





PEER-REVIEWED = TEXTS → RESEARCH



AHA + DASH + MAYO CLINIC

LOWER CARBOHYDRATE

LOWER FAT

ELIMINATE CALORIES or FOOD GROUPS ENCOURAGE FASTING

ADEQUACY BALANCE CONSISTENCY & MODERATION

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.**

Alice Waters, p. 8 | How food marketers snag us, p. 10 | 10 foods to try, p. 13

Nutrition Action HEALTH LETTER®
OCTOBER 2011 $2.50
CENTER FOR SCIENCE IN THE PUBLIC INTEREST

Eat Real, America!

"With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke," says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. "Those are the three pillars. They really do make a difference."

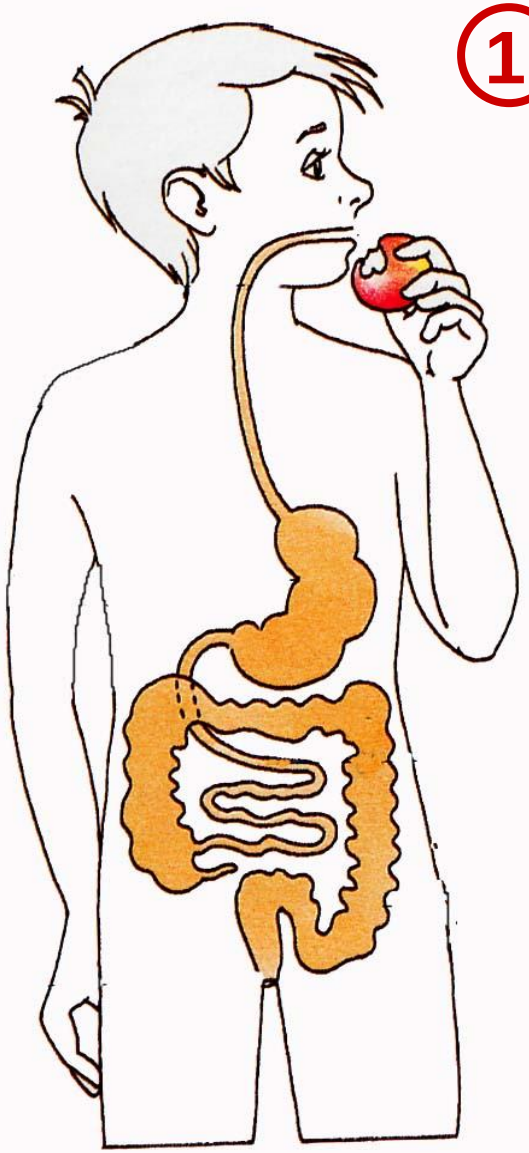
The right food choices are simple: Eat less red meat, sweets, refined grains, and salt, and drink fewer sugary beverages. Replace unhealthy foods with vegetables, fruit, beans, and whole grains, and with smaller amounts of fish, poultry, and low-fat dairy. Those foods aren't just good for our health. They can also help protect the Earth.

Here's why—and how—to eat real.

Continued on page 3.

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

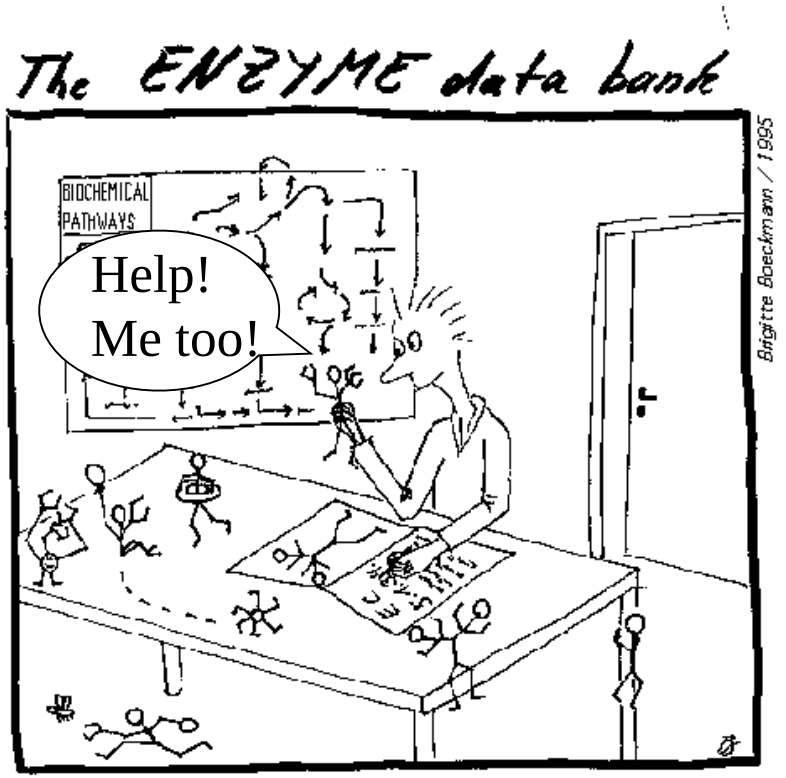


1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

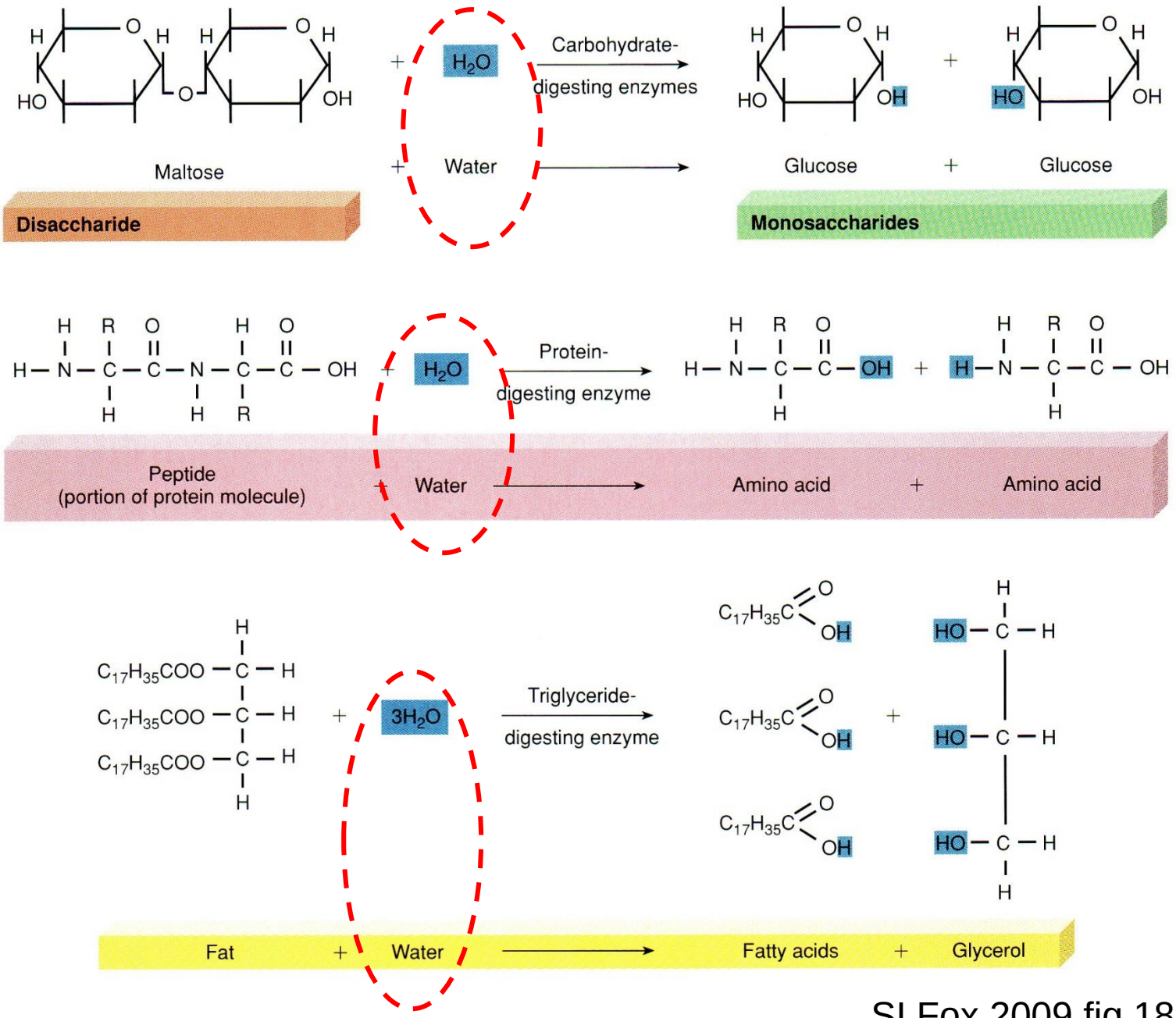
SOURCE: Dr. Eugene Evonuk, 1989. *cf*: L Sherwood, 2012 pp 437-8.

Hydrolysis of Energy Nutrients

+

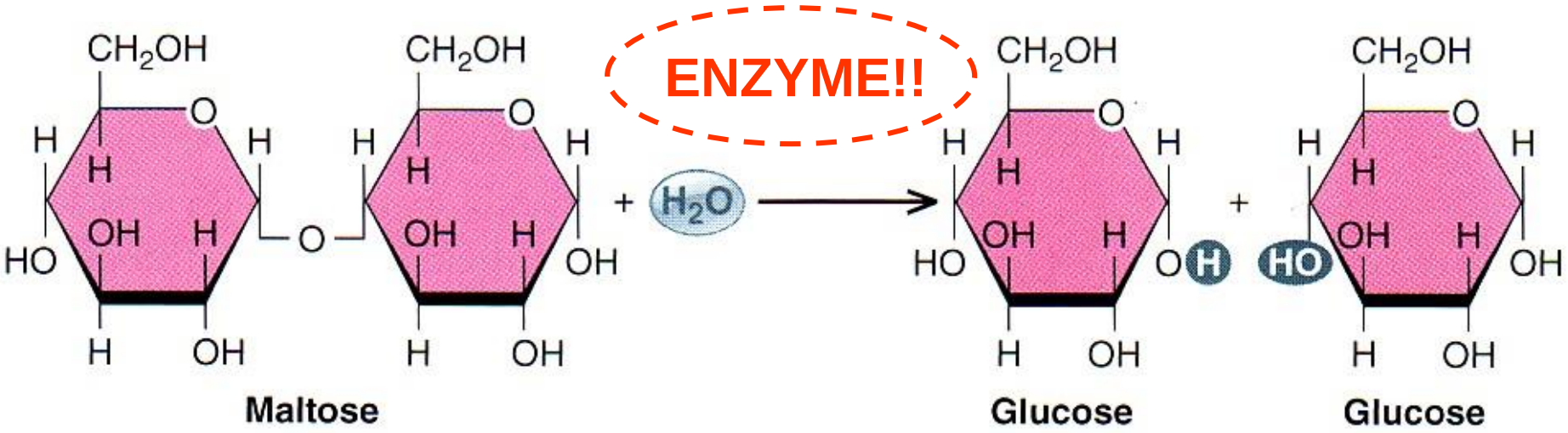


H_2O + Enzyme



SI Fox 2009 fig 18.1 p 614

What's missing?



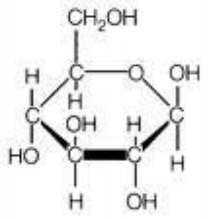
● **FIGURE 15-1 An example of hydrolysis.** In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of H_2O at the bond site.

LS 2012 fig 15-1 p 438

Polymer to Monomer (Many to One)

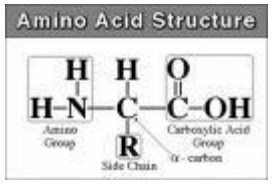
…Central-linking theme!!

Carbohydrate

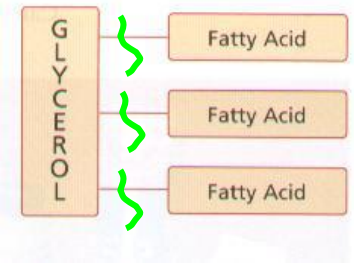


Glucose

Protein
+
Fat

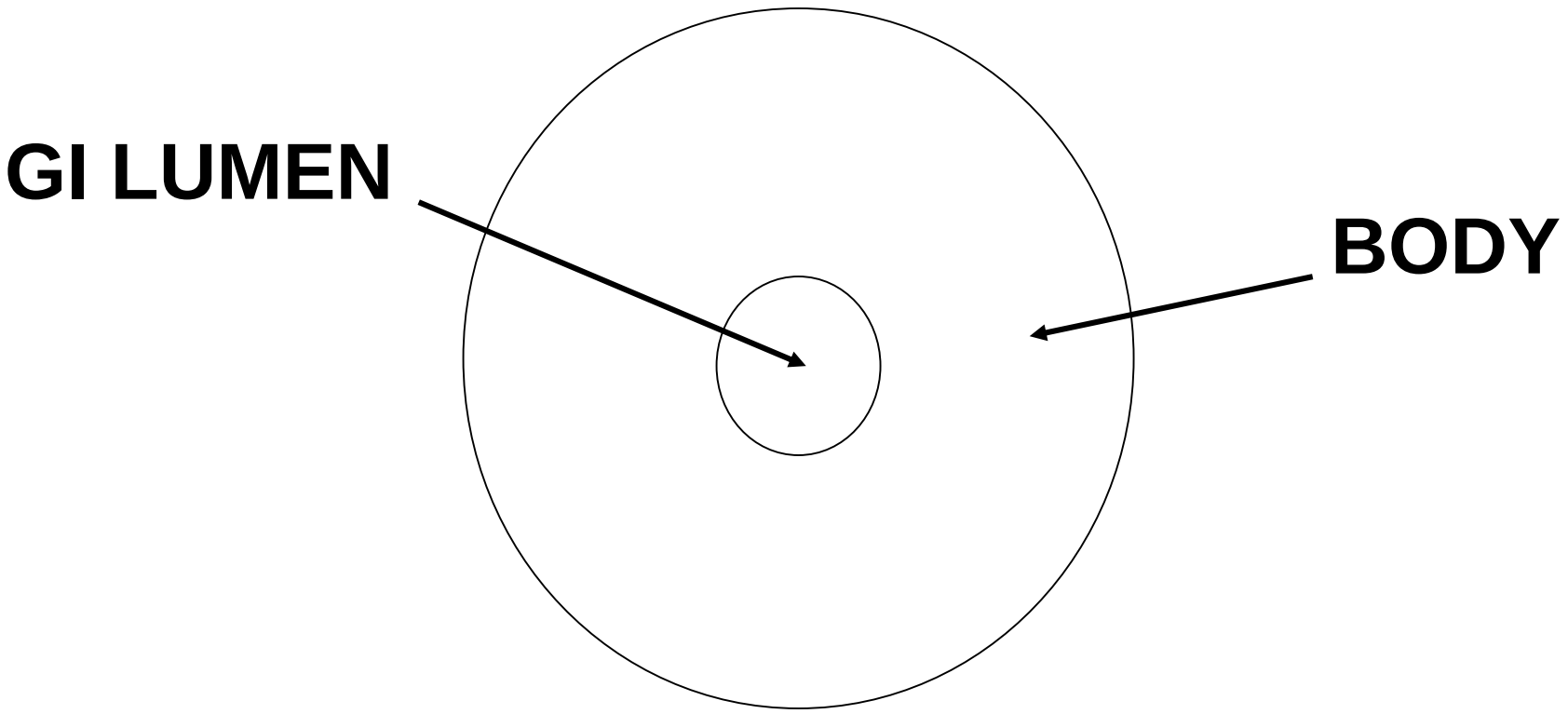


Amino Acids



Fatty Acids
+
Glycerol

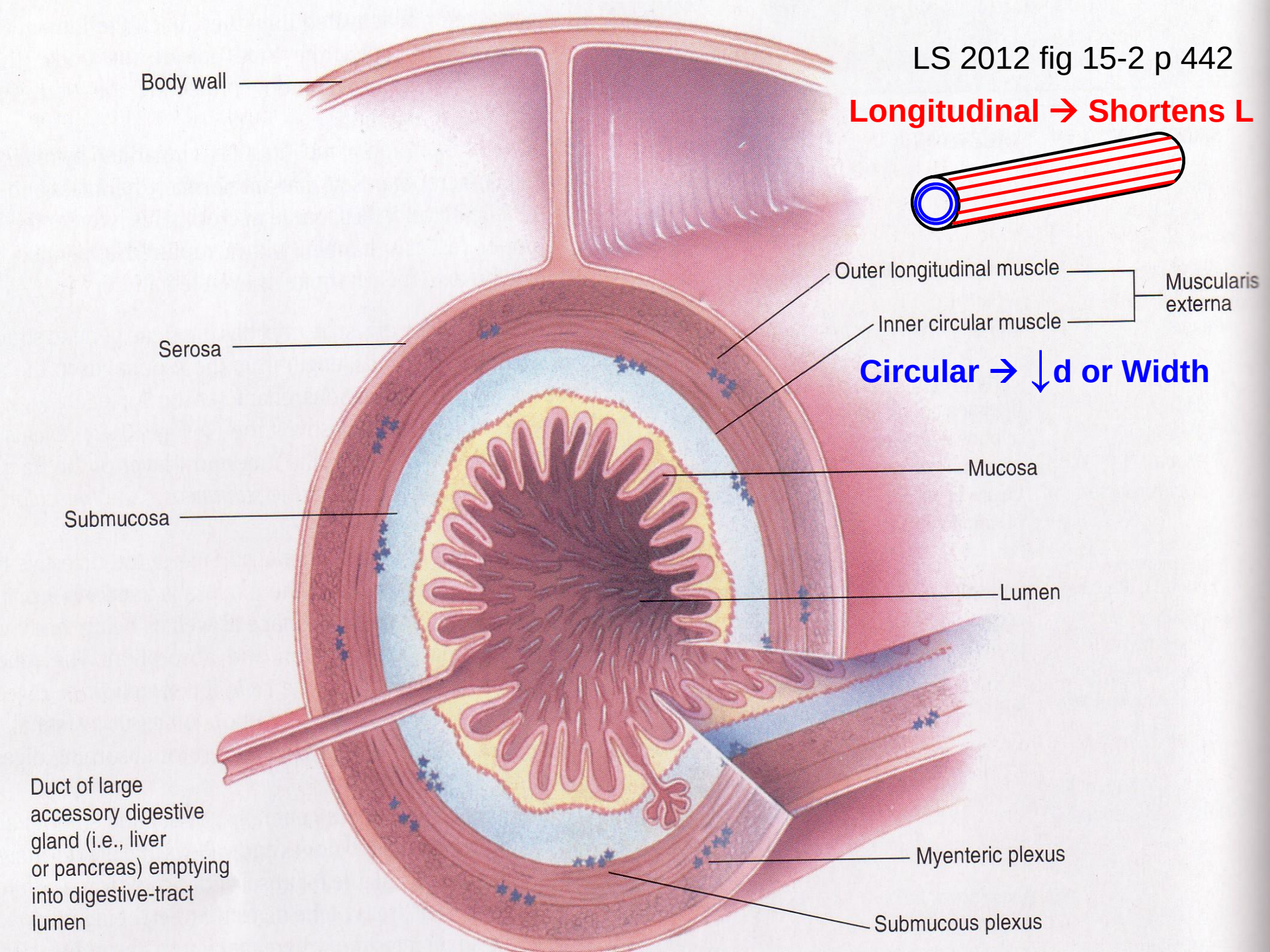
GI-DONUT ANALOGY



Common Control Mechanisms

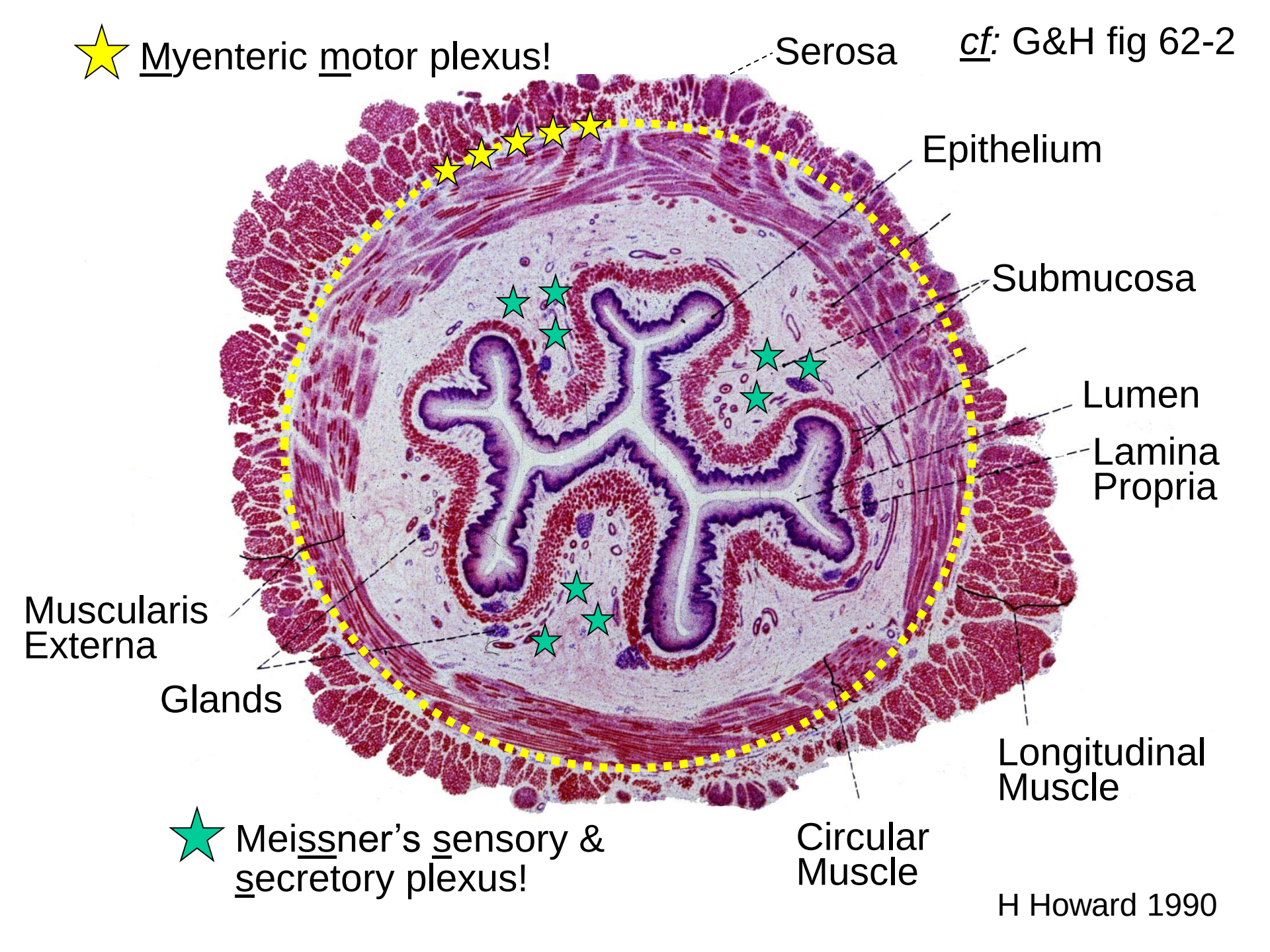
1. **Local (autoregulation)**
2. **Nervous (rapidly-acting)**
3. **Hormonal (slower-acting/ reinforcing)**

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

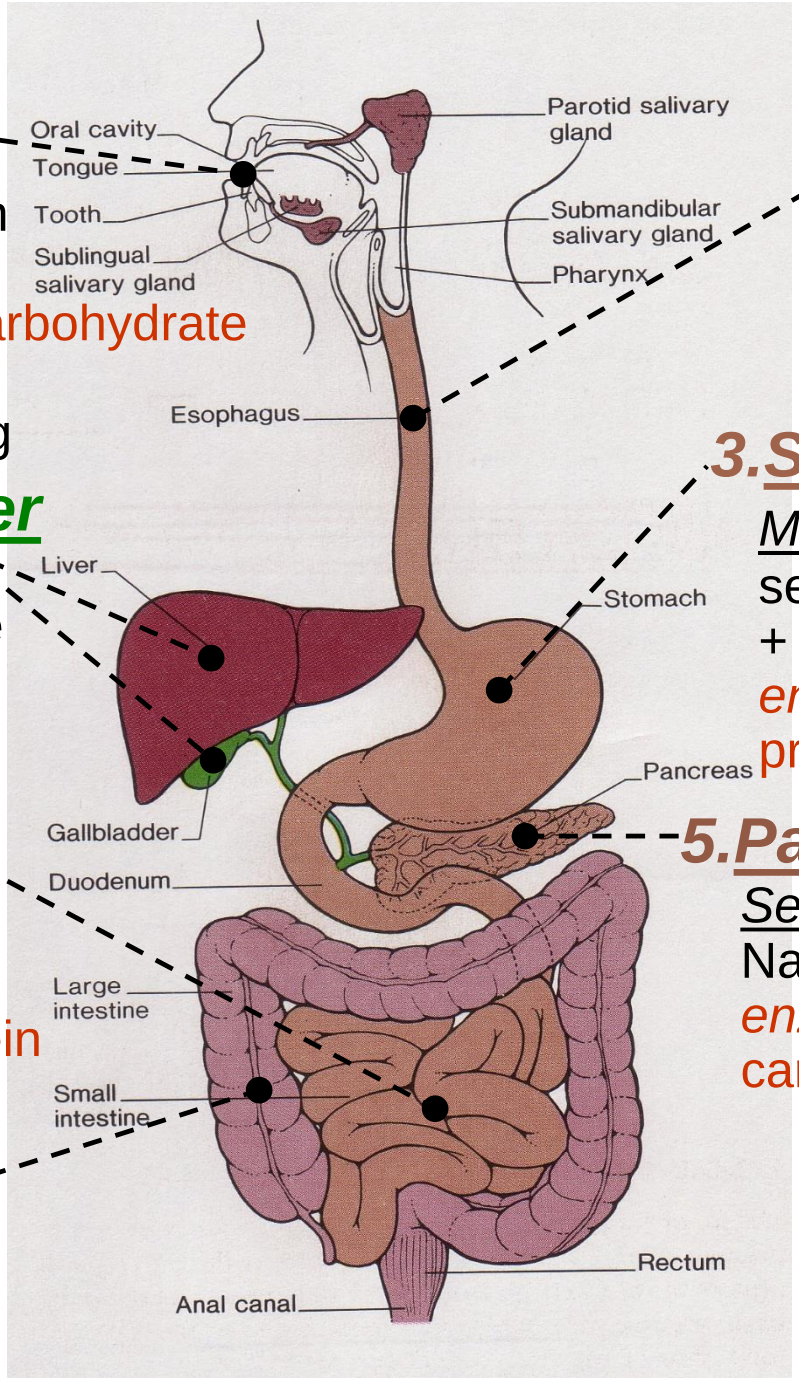
Secretion mucus +
$NaHCO_3$ + enzymes
enzymatic digestion:
carbohydrate, fat, protein

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?

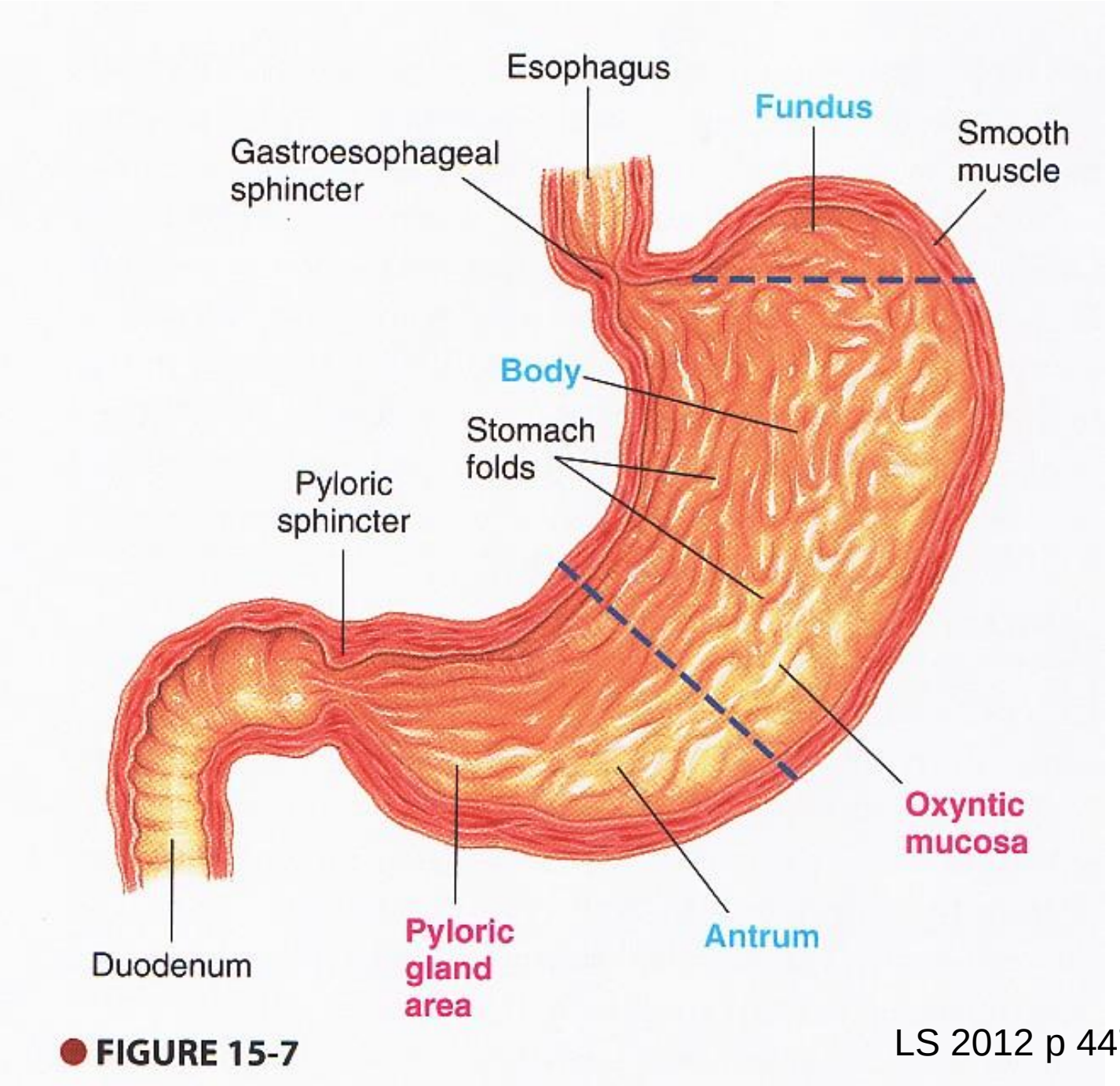
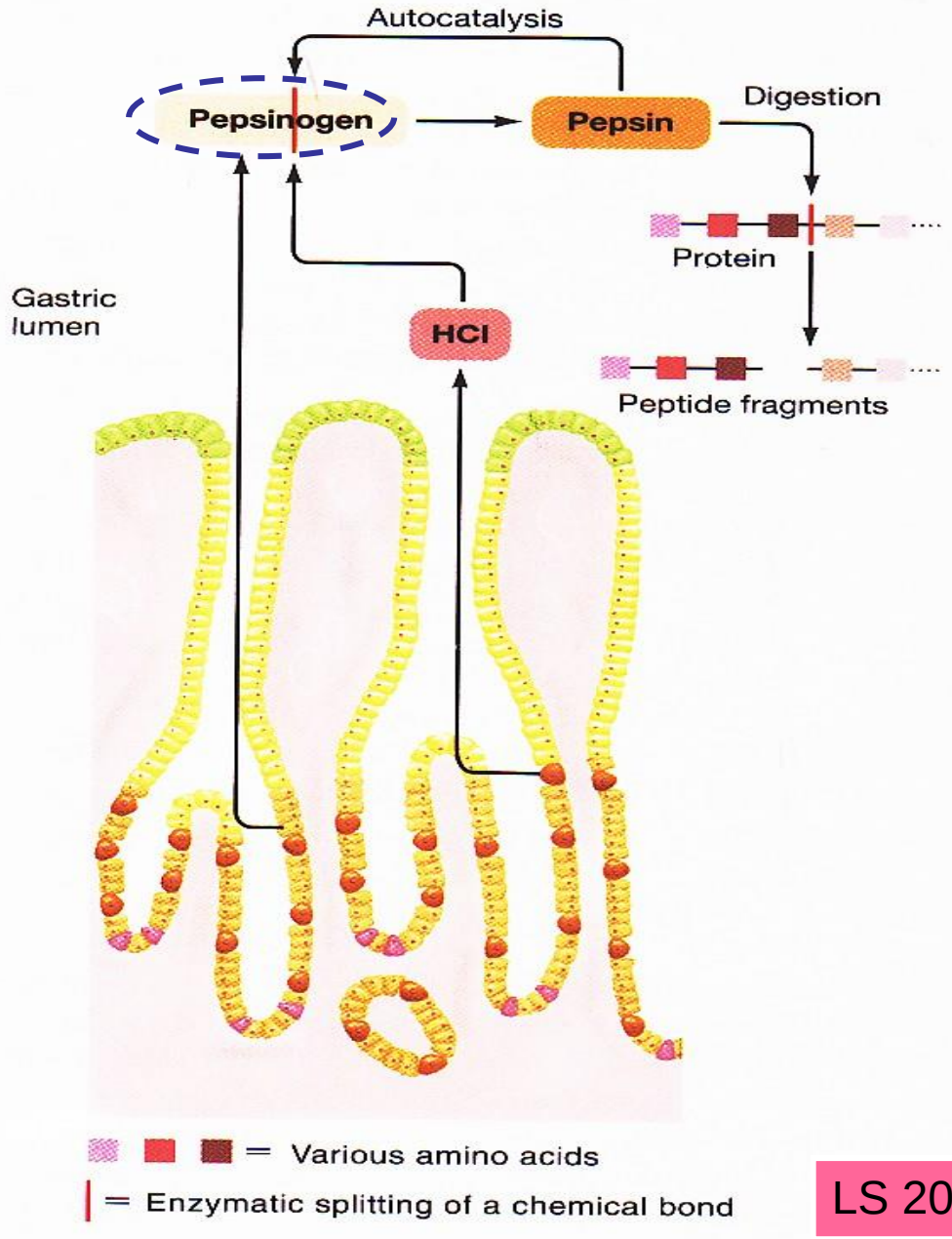


FIGURE 15-7

LS 2012 p 447

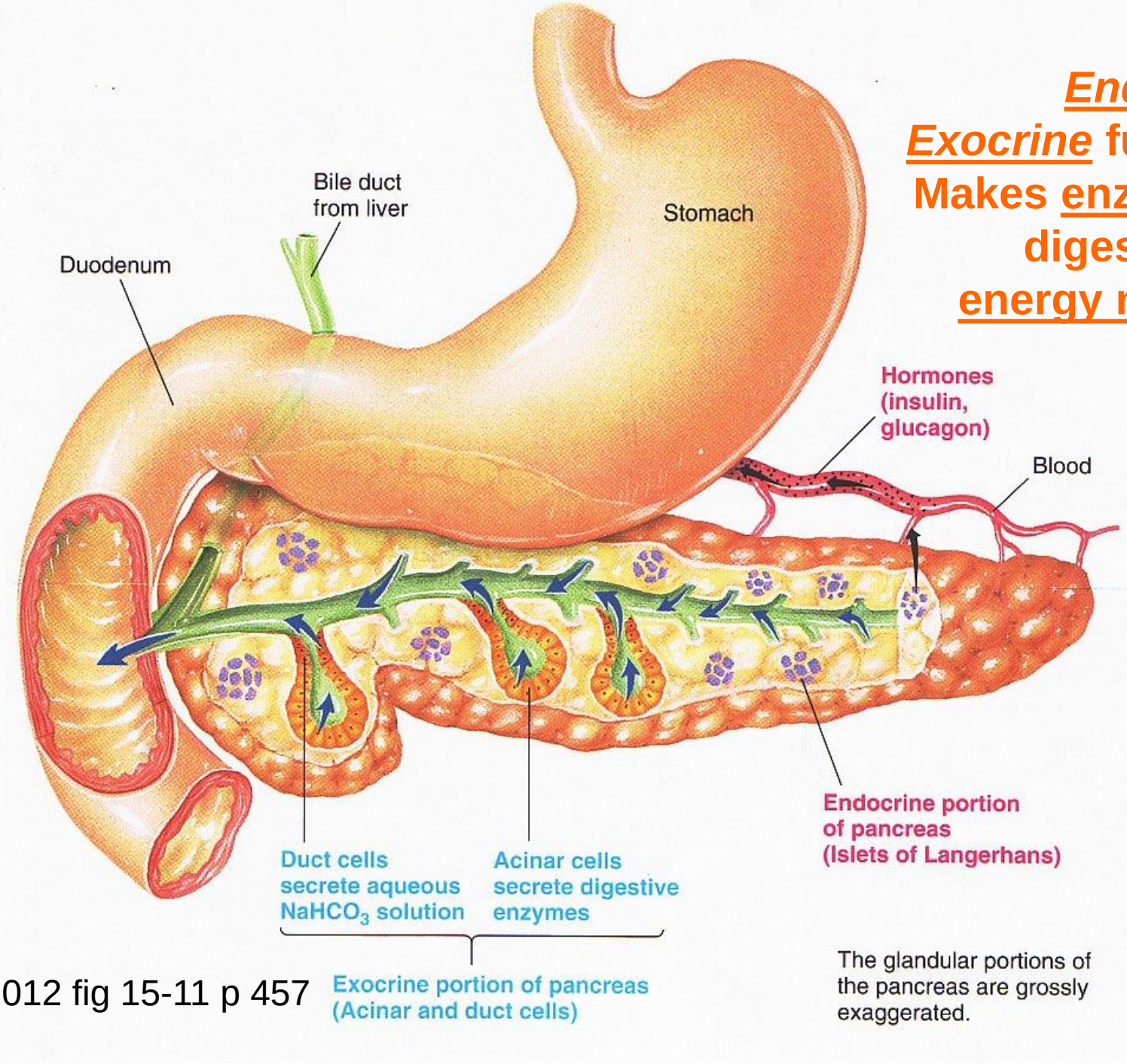
Zymogen= an inactive precursor



LS 2012 fig 15-9 p 452

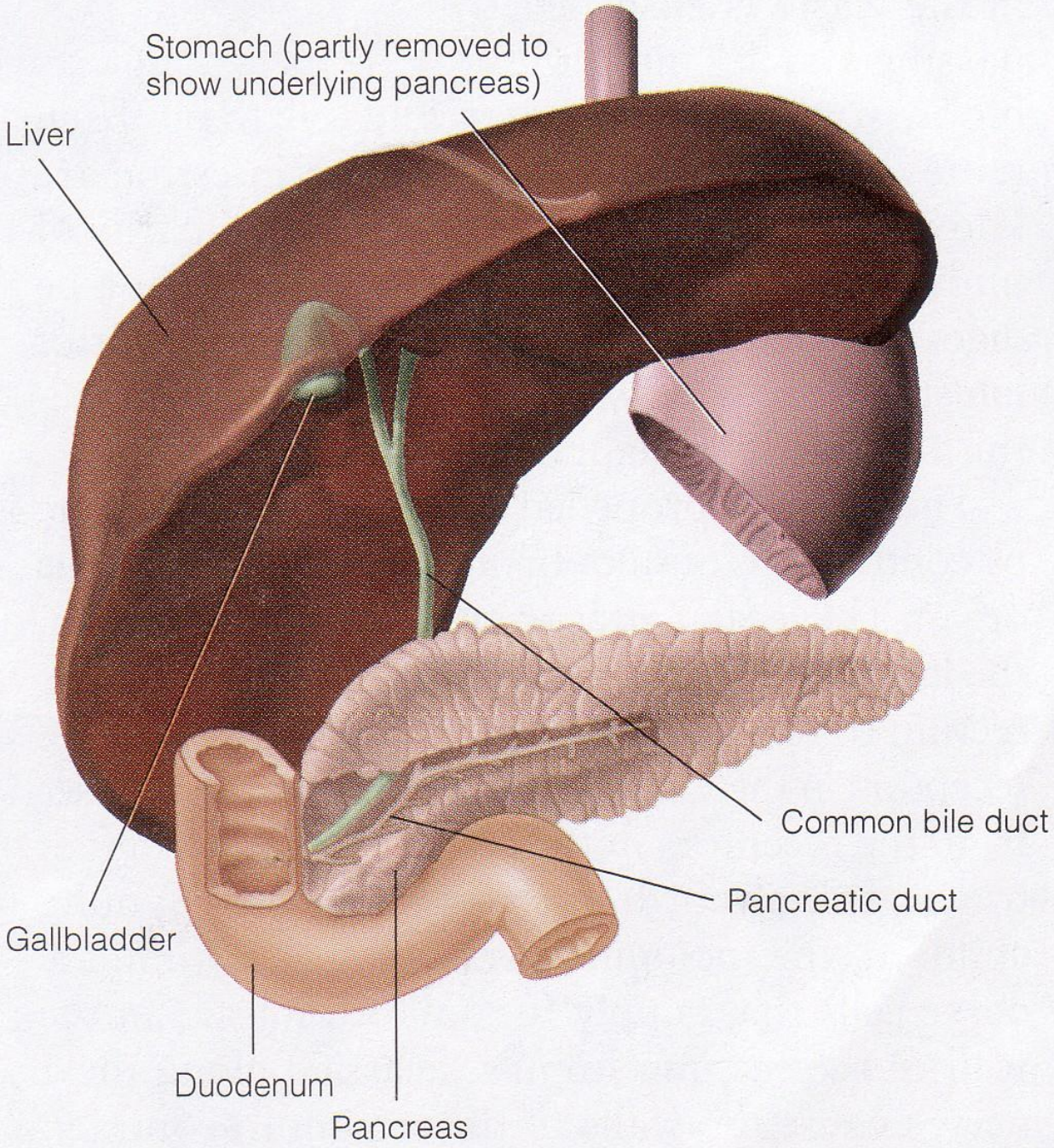
Why is the *pancreas* so unique?

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



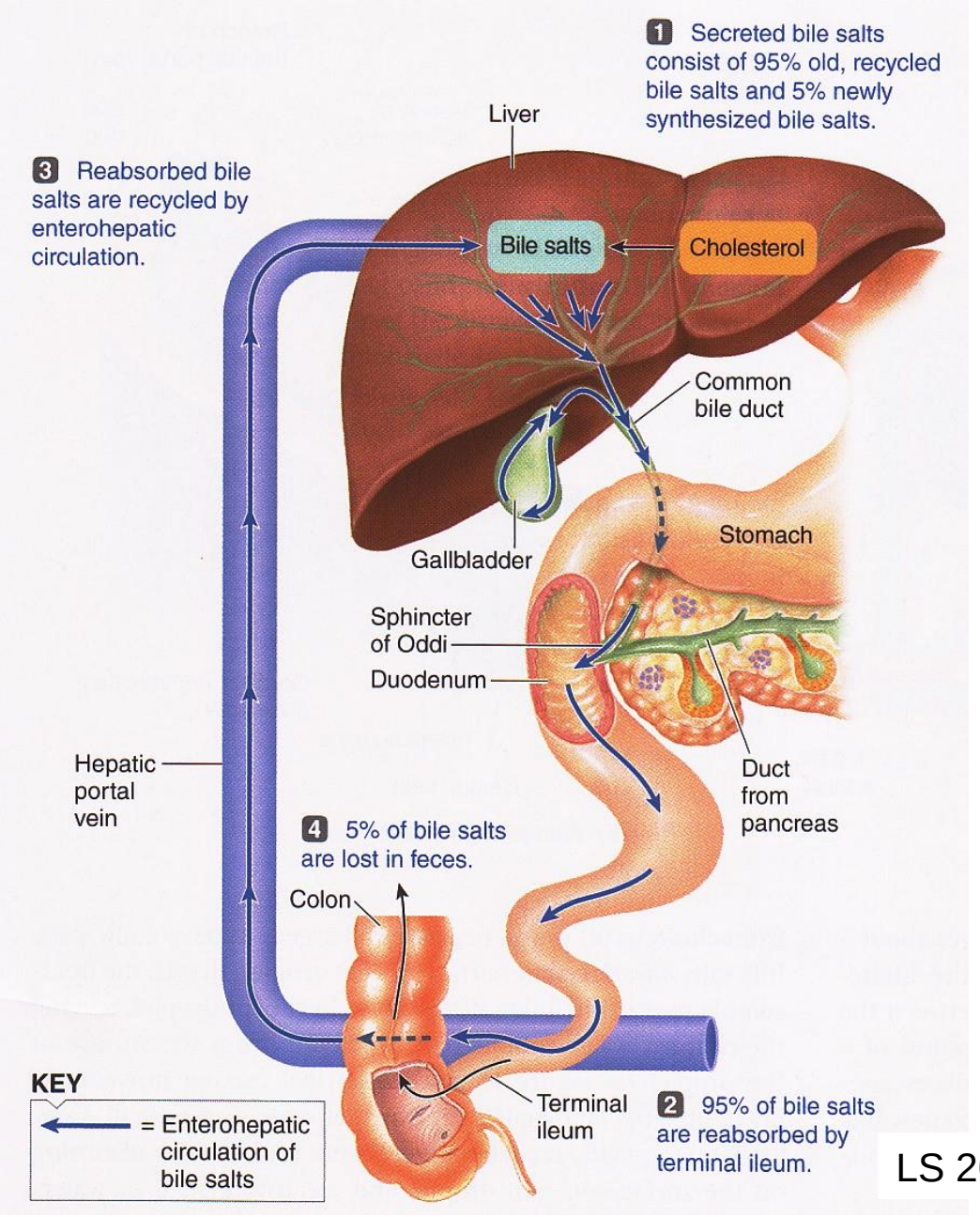
LS 2012 fig 15-11 p 457

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

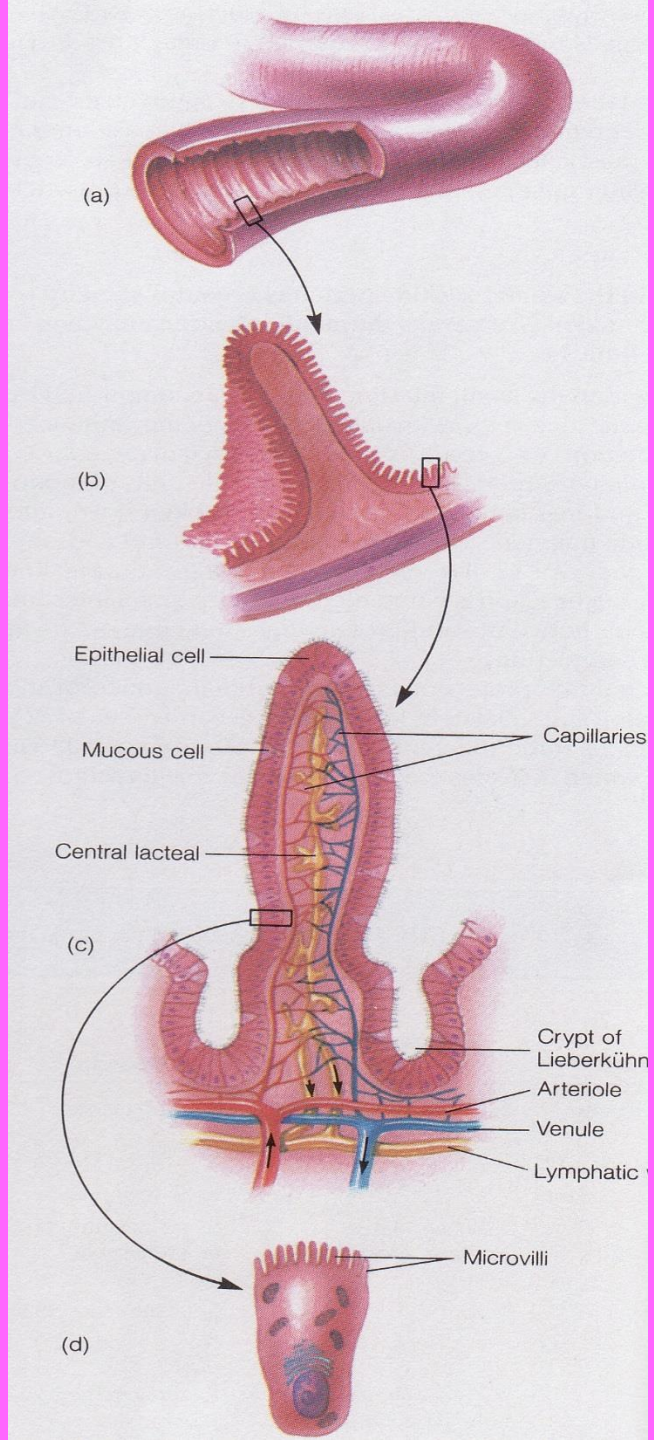
Liver: Amazing Recycling of Bile Salts!



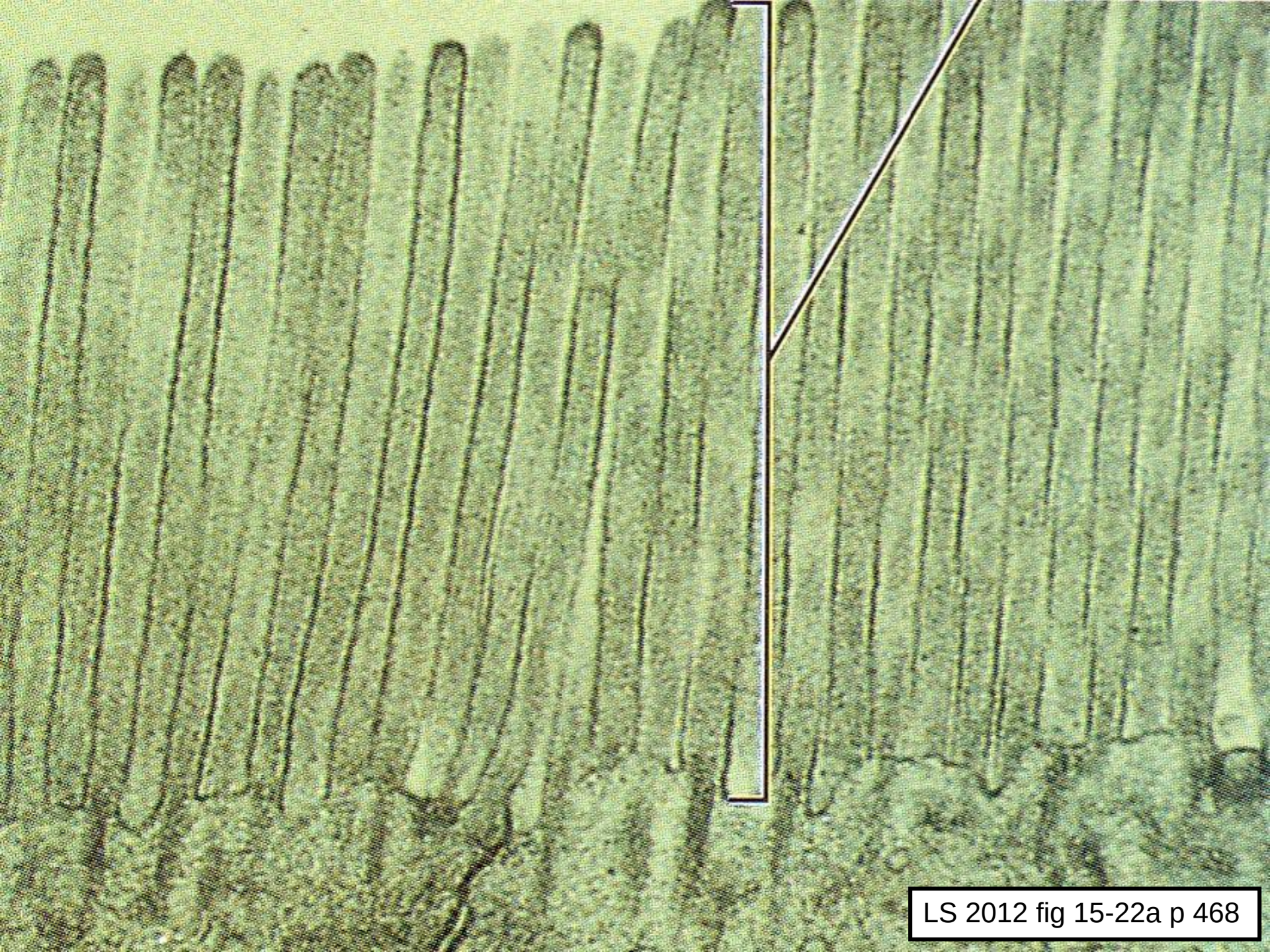
LS 2012 fig 15-11 p 462

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/

http://molbio.uoregon.edu/guillemin/

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.

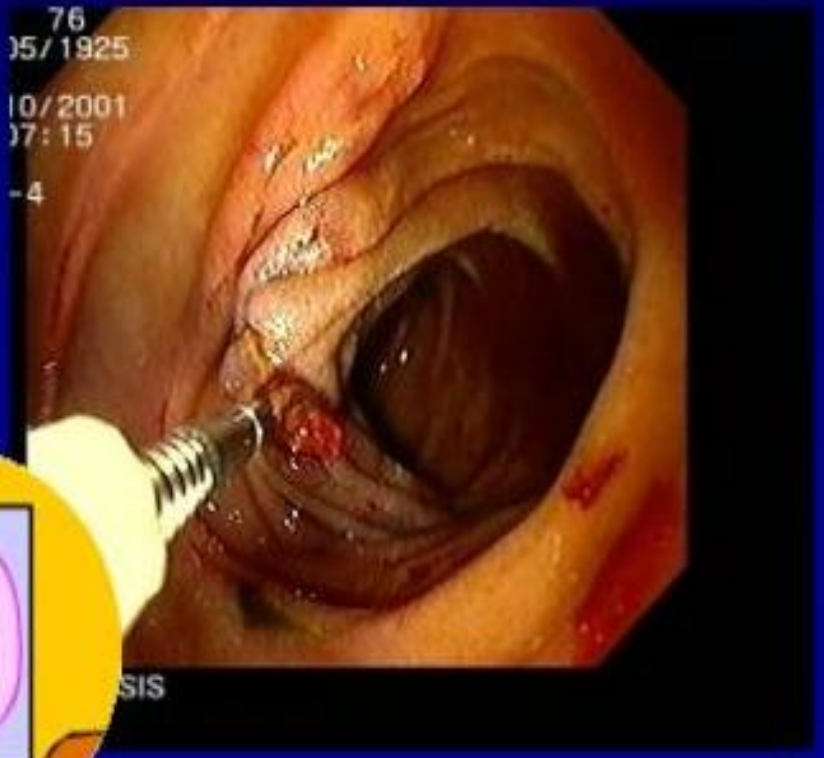
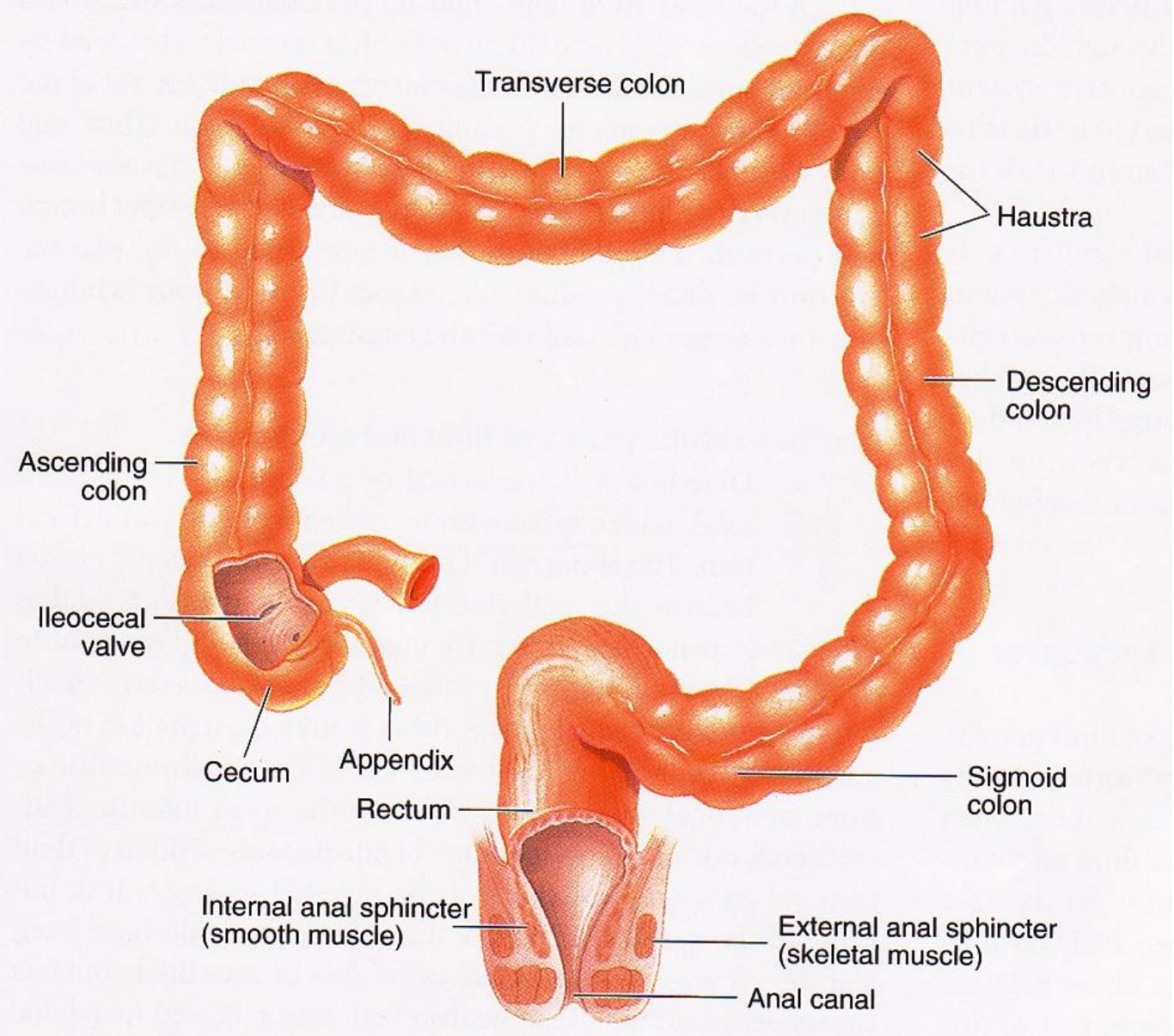


Table 15-5 Digestive Processes for the Three Major Categories of Nutrients

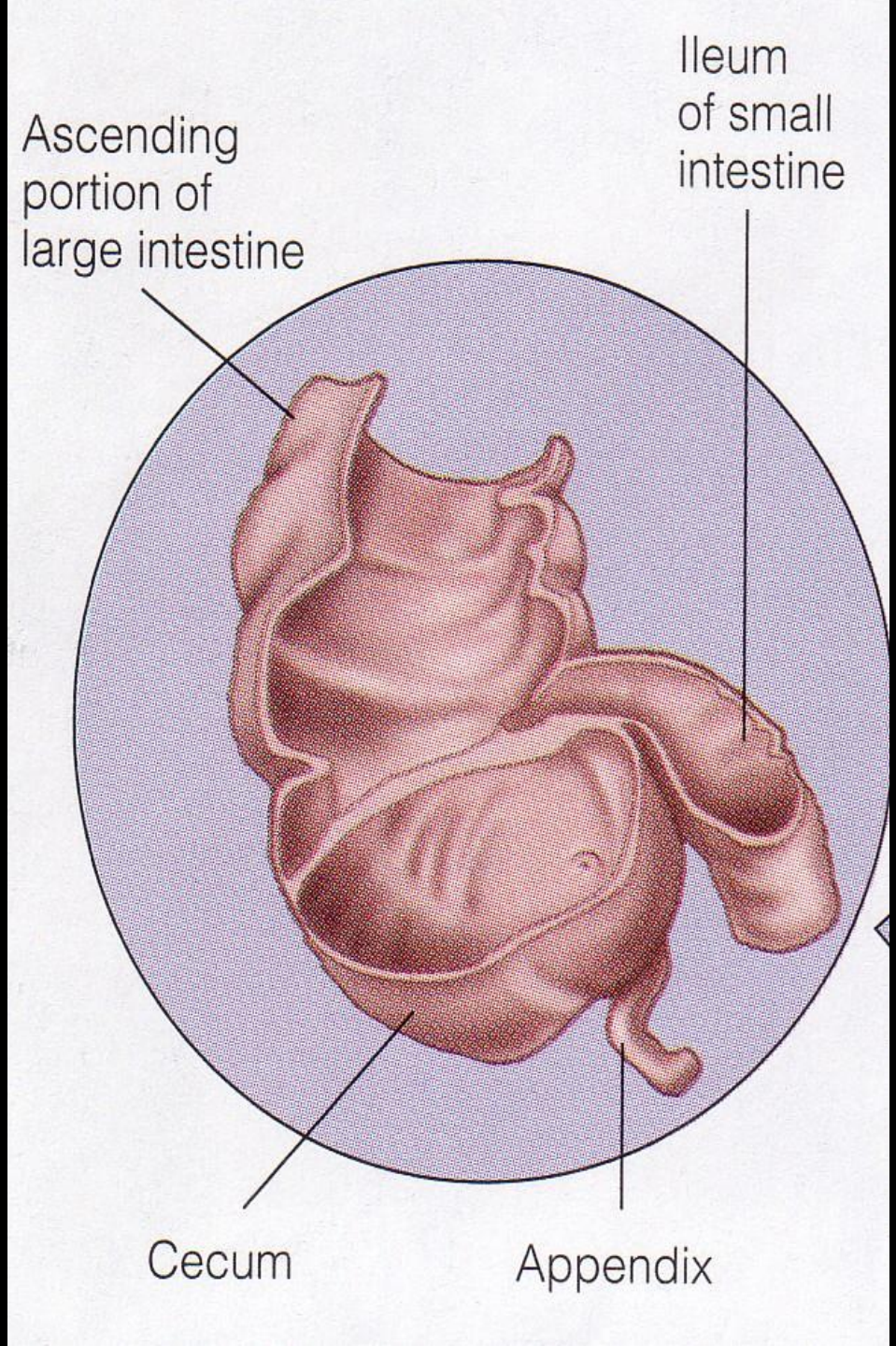
Nutrients	Enzymes for Digesting the Nutrients	Source of Enzymes	Site of Action of Enzymes	Action of Enzymes	Absorbable Units of the Nutrients
Carbohydrates	Amylase	Salivary glands	Mouth and (mostly) body of stomach	Hydrolyzes polysaccharides to disaccharides (maltose)	
		Exocrine pancreas	Small-intestine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

LS 2012 p 446

Large Intestine Structure & Function

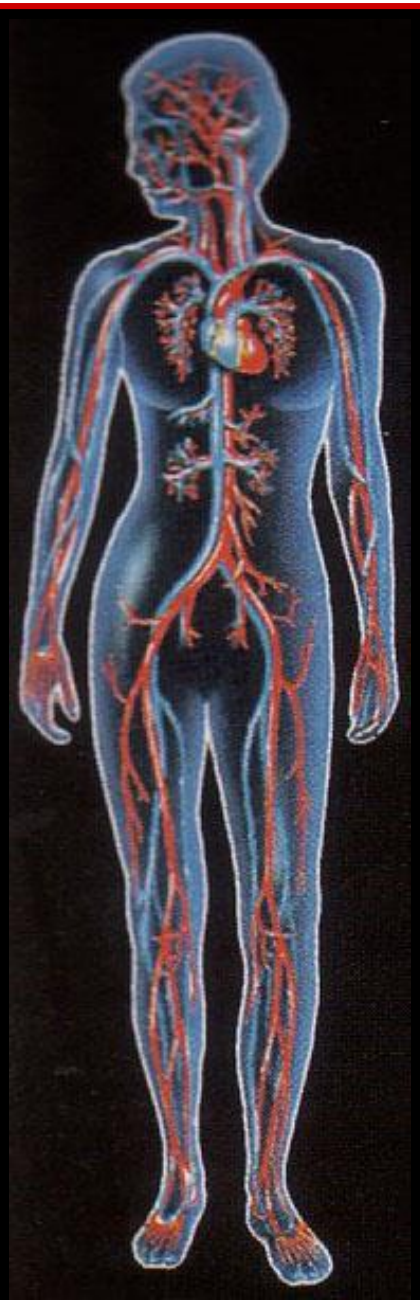


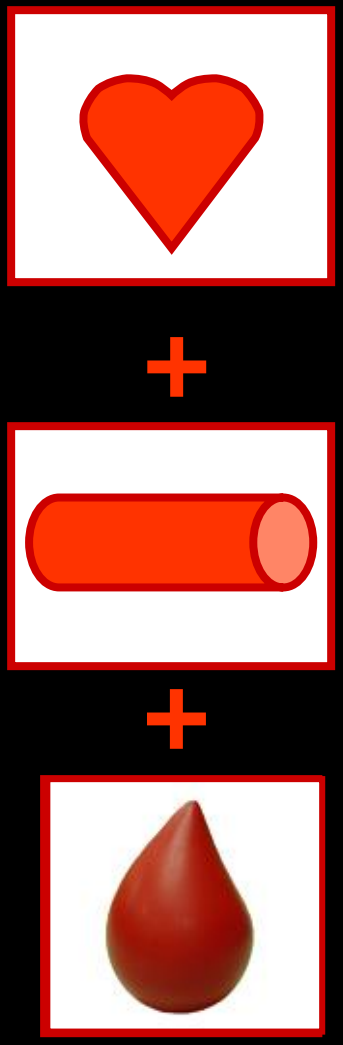
LS 2012 fig 15-24 p 472


Ileum
of small
intestine
Ascending
portion of
large intestine
Cecum
Appendix

DC 2003

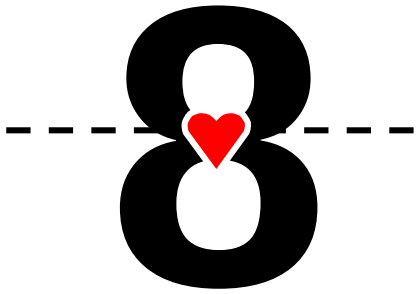
Cardiovascular (CV) = Heart + Vessels + Blood!



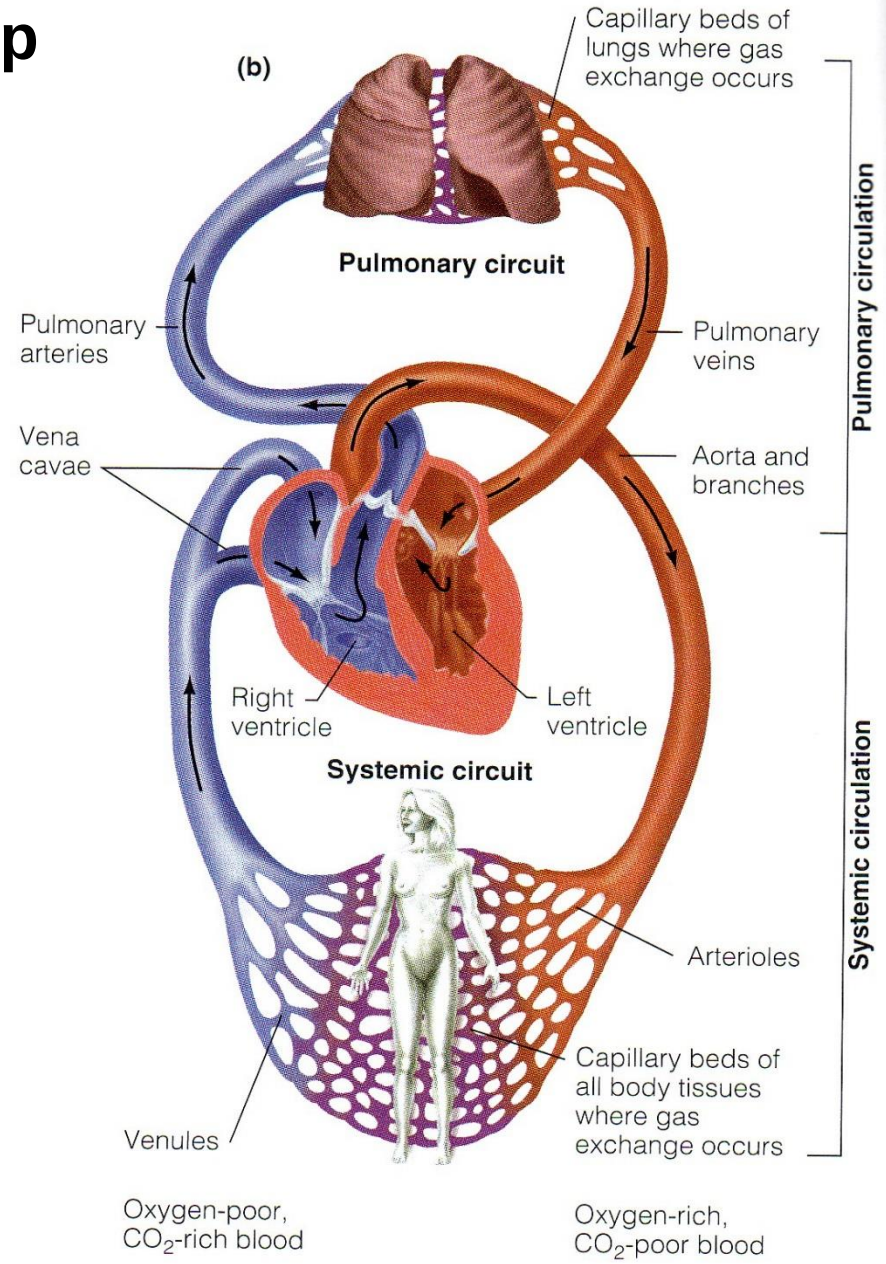


NB: Figure-8 loop

Pulmonary

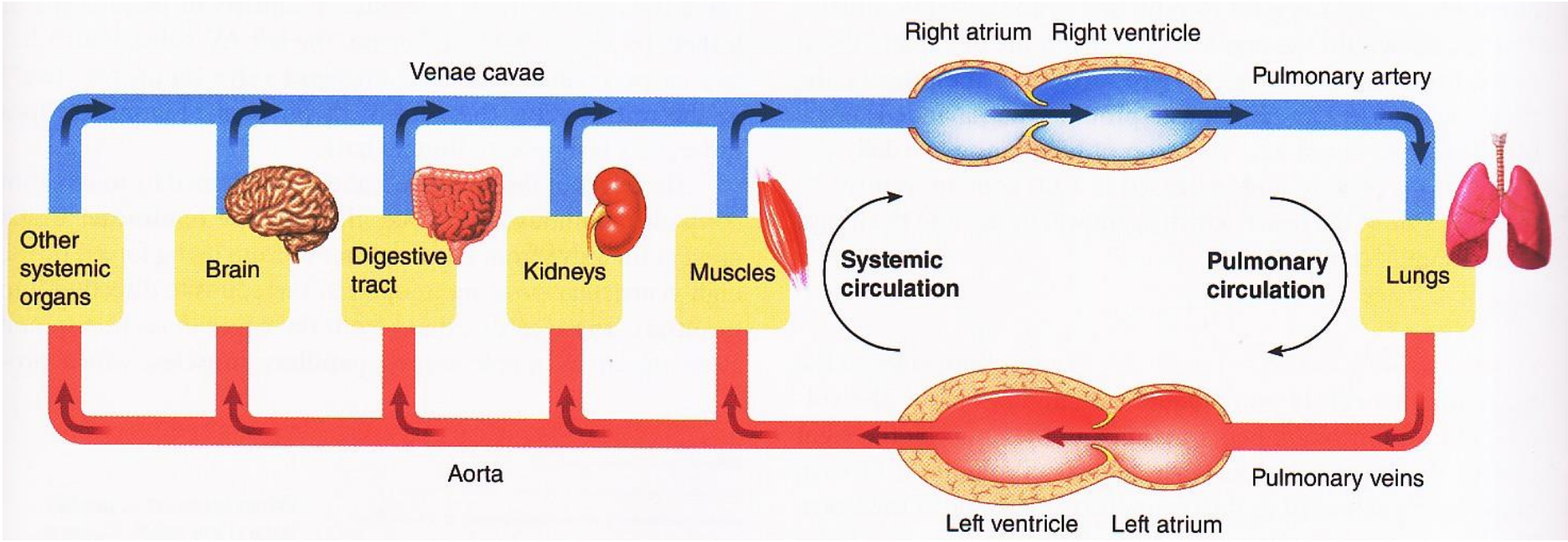


Systemic

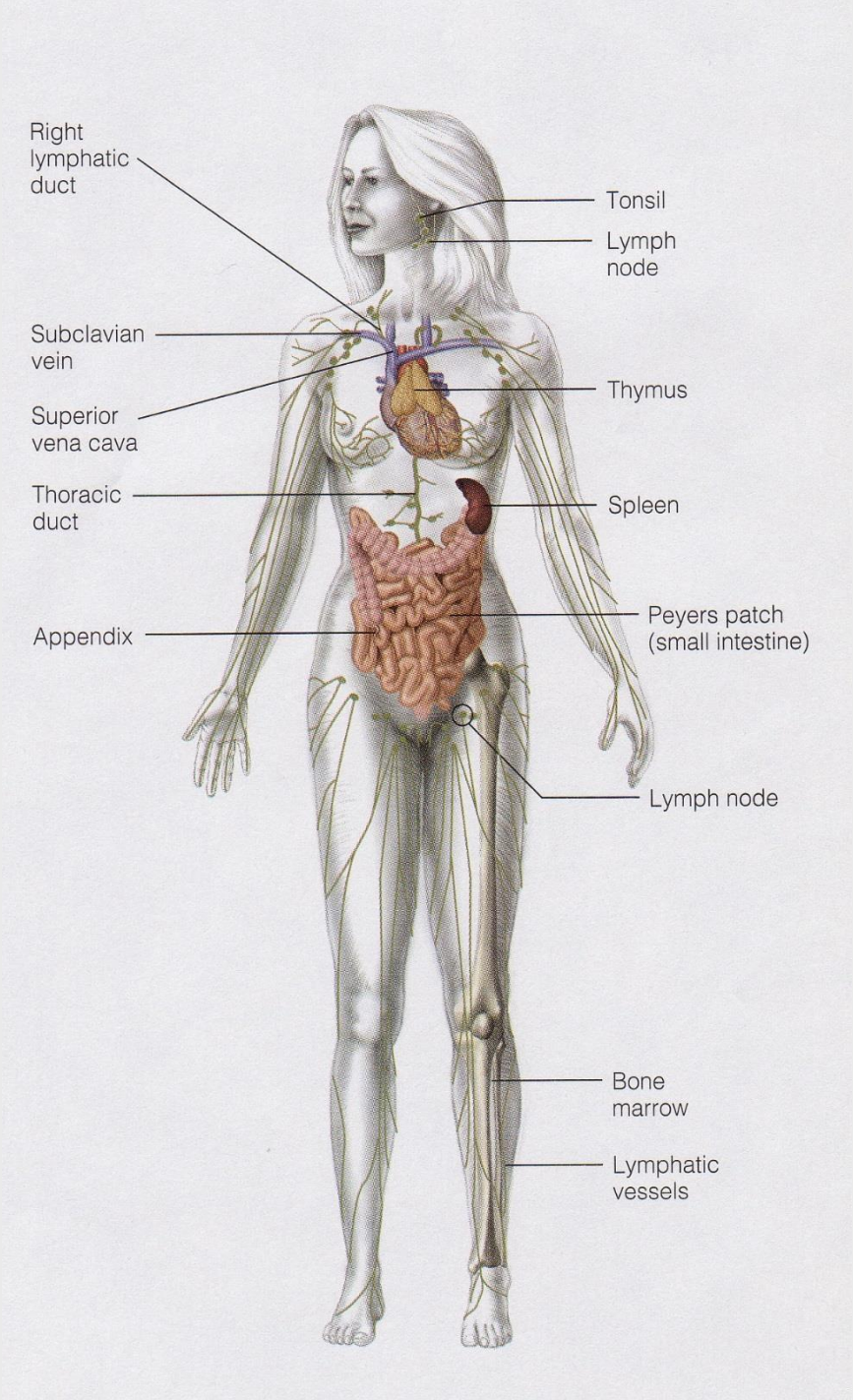


D Chiras 2013 fig 4-1b

Dual Pump Action & Parallel Circulation

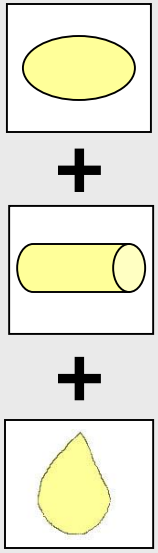


LS 2012 fig 9-2b p 231



Lymphatic System

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



No pump!

DC 2003

Lymphatic System

Alternative System of Circulation

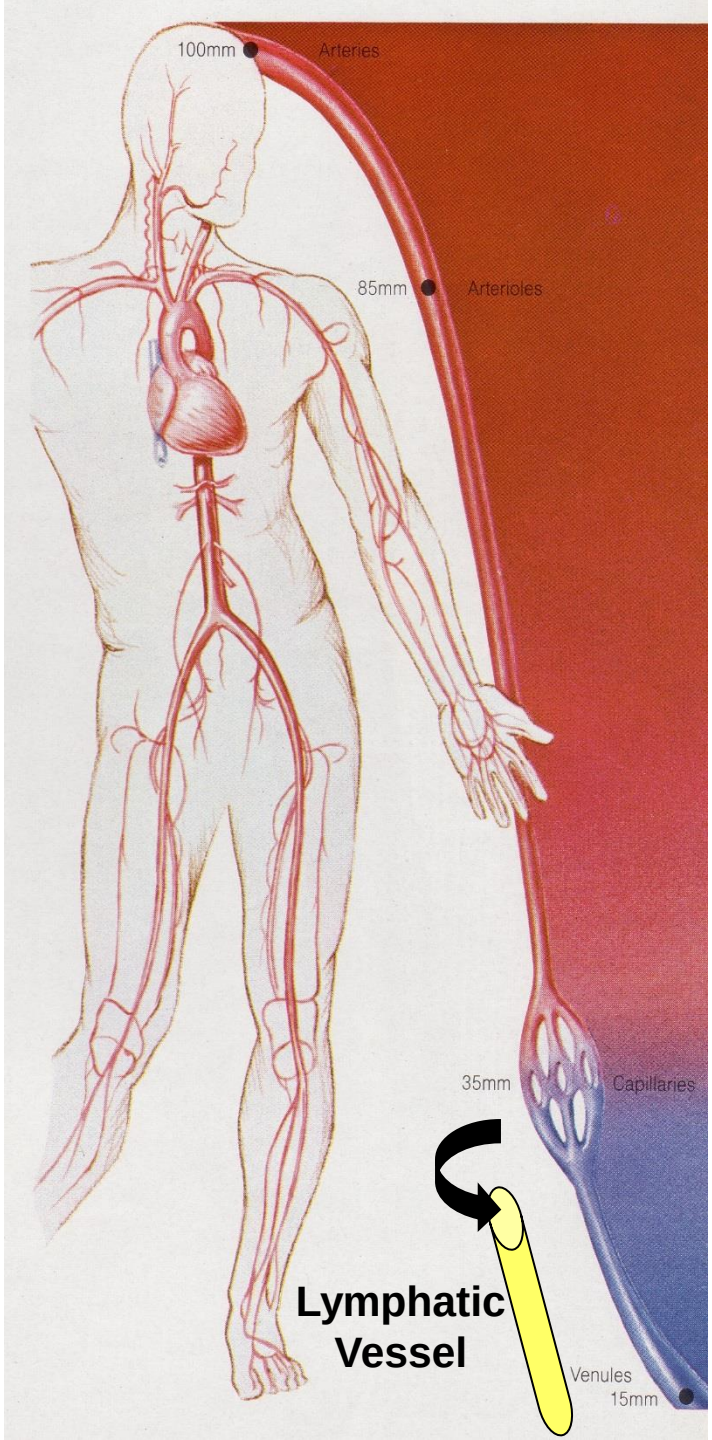
or

Drainage System

Lymph Vessels || ***Veins***

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

LS 2012 fig 10-21 p 283

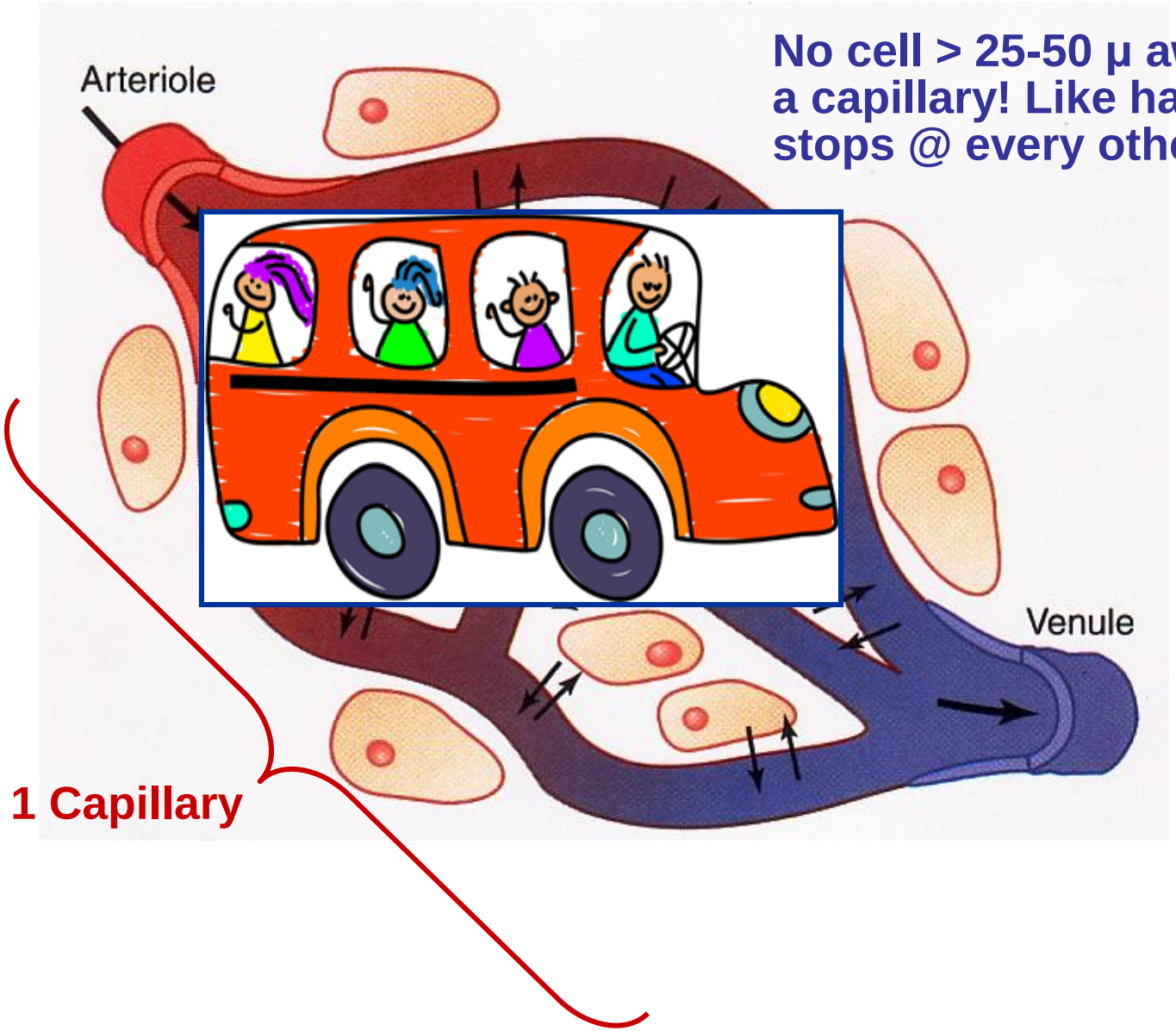


Lymphatics collect run-off & are parallel to venules/small veins!

Torstar Books 1984

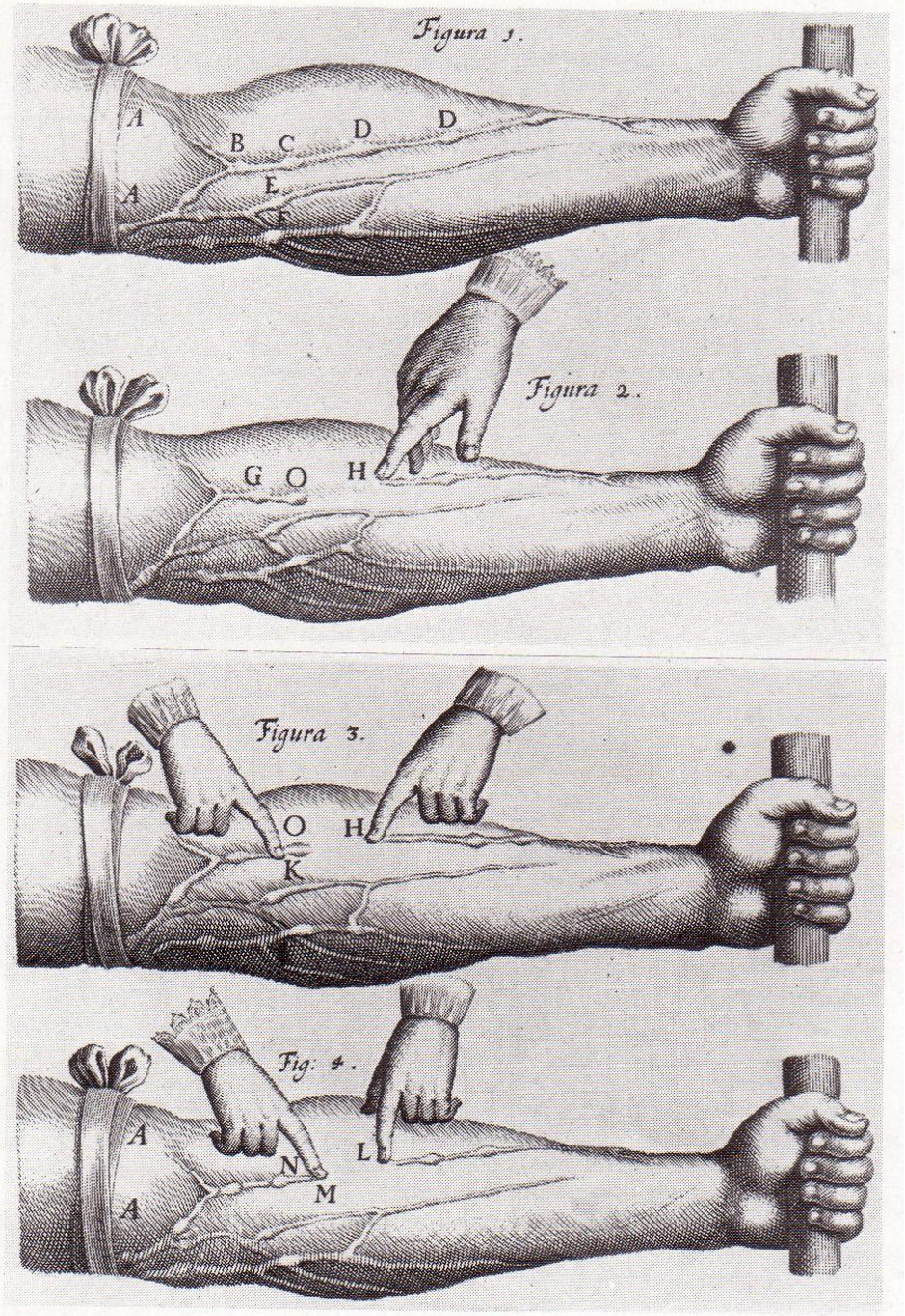

Torstar Books 1984

Microcirculation Exchange: 10 Billion Capillaries!



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

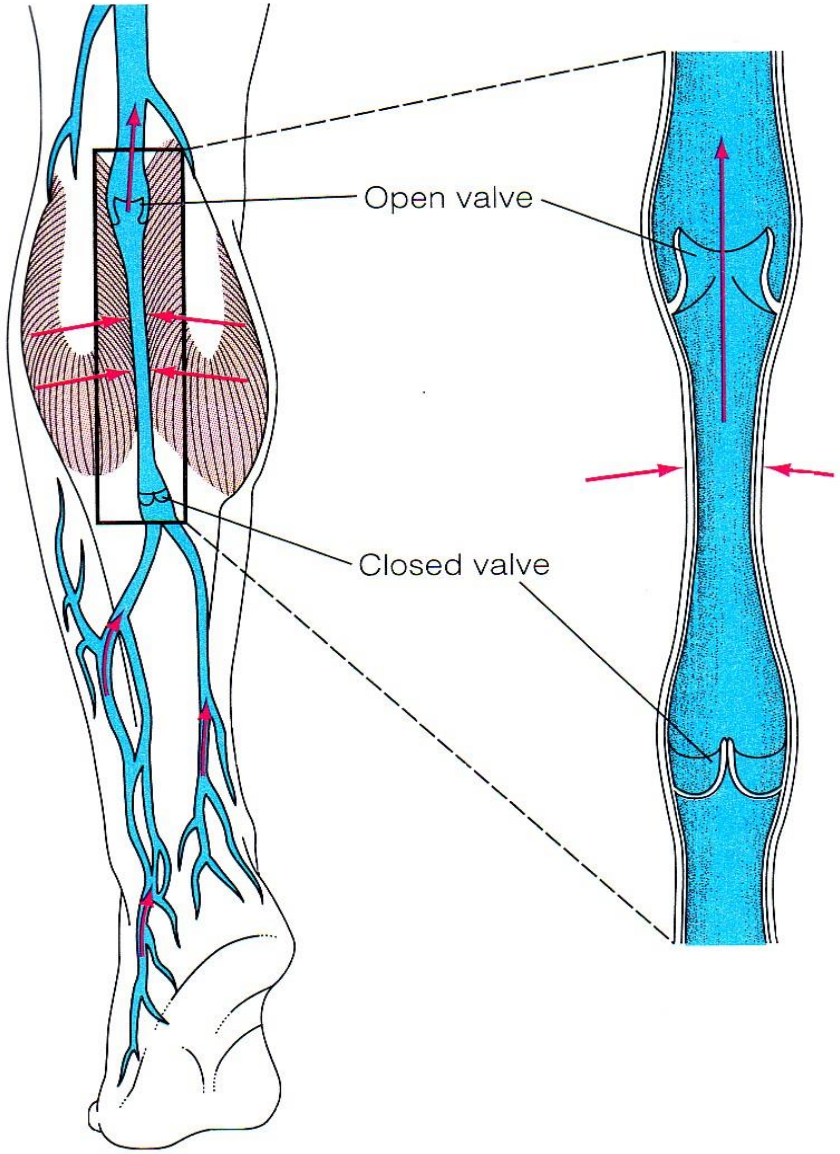
Guyton & Hall 2011 fig 1-2



Harvey Experiments: 1-way system of venous valves!

Torstar Books 1984

Skeletal Muscle Pump

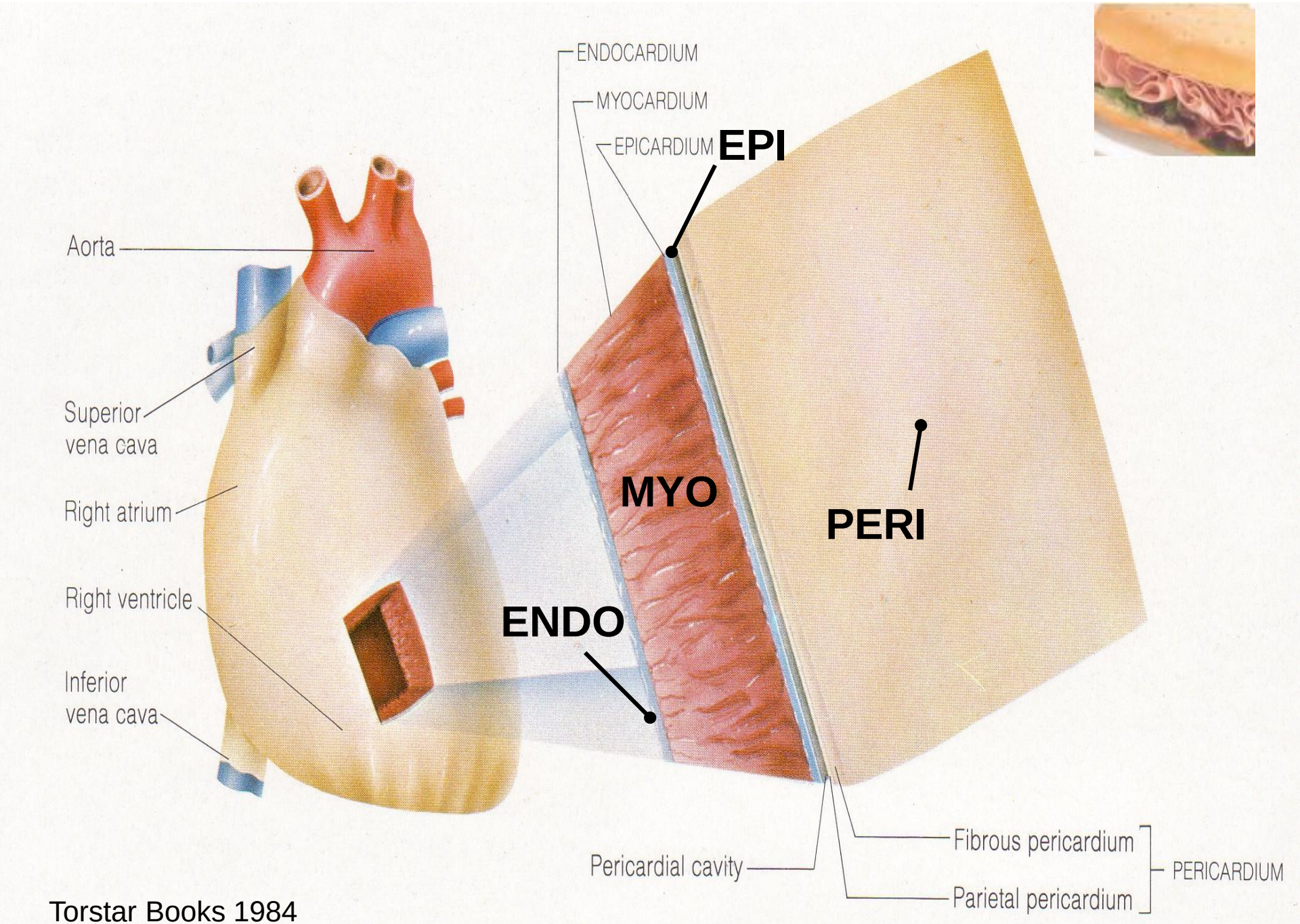


LS 2006

DC 2003

The Heart

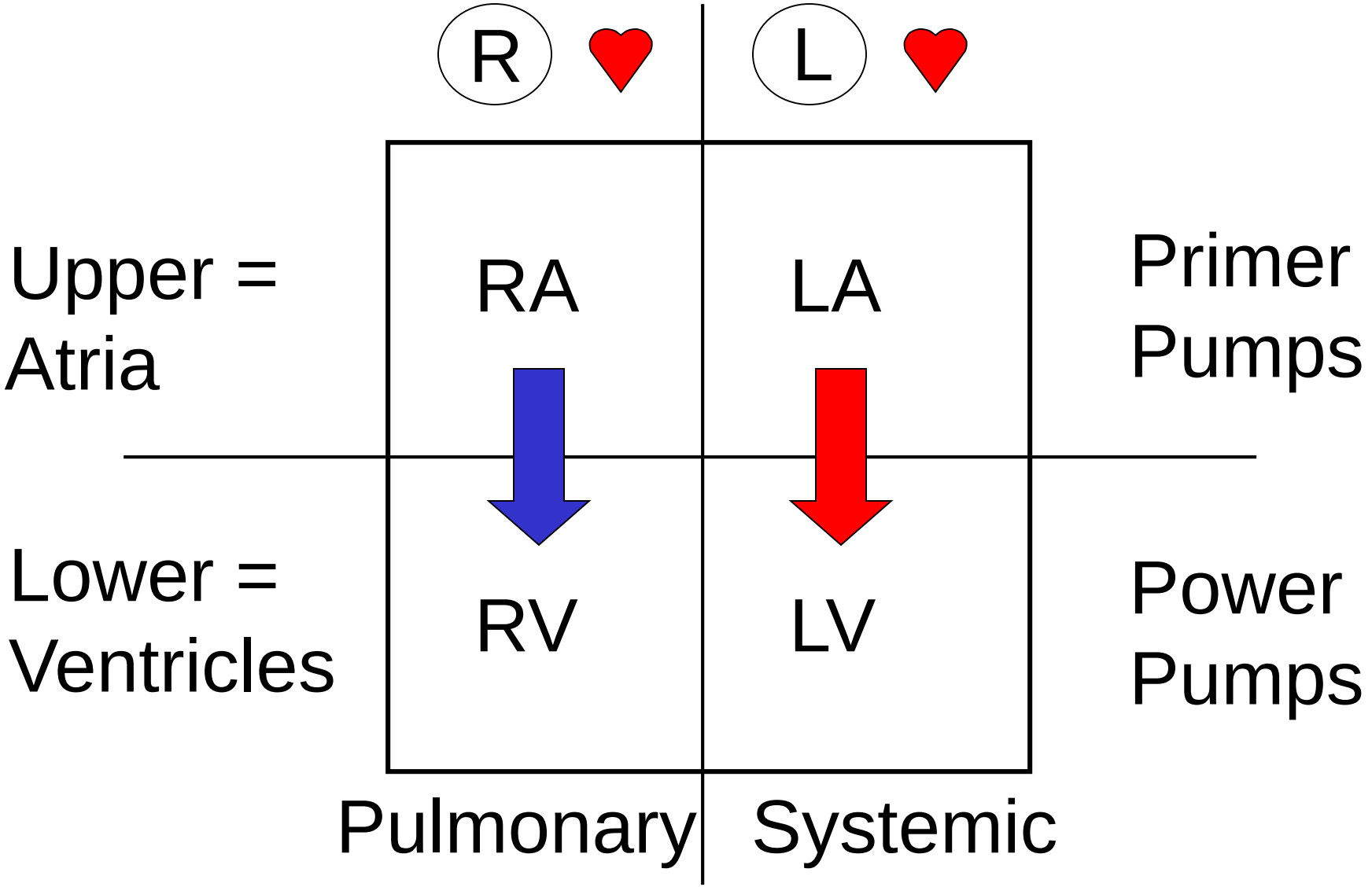
The Living Pump

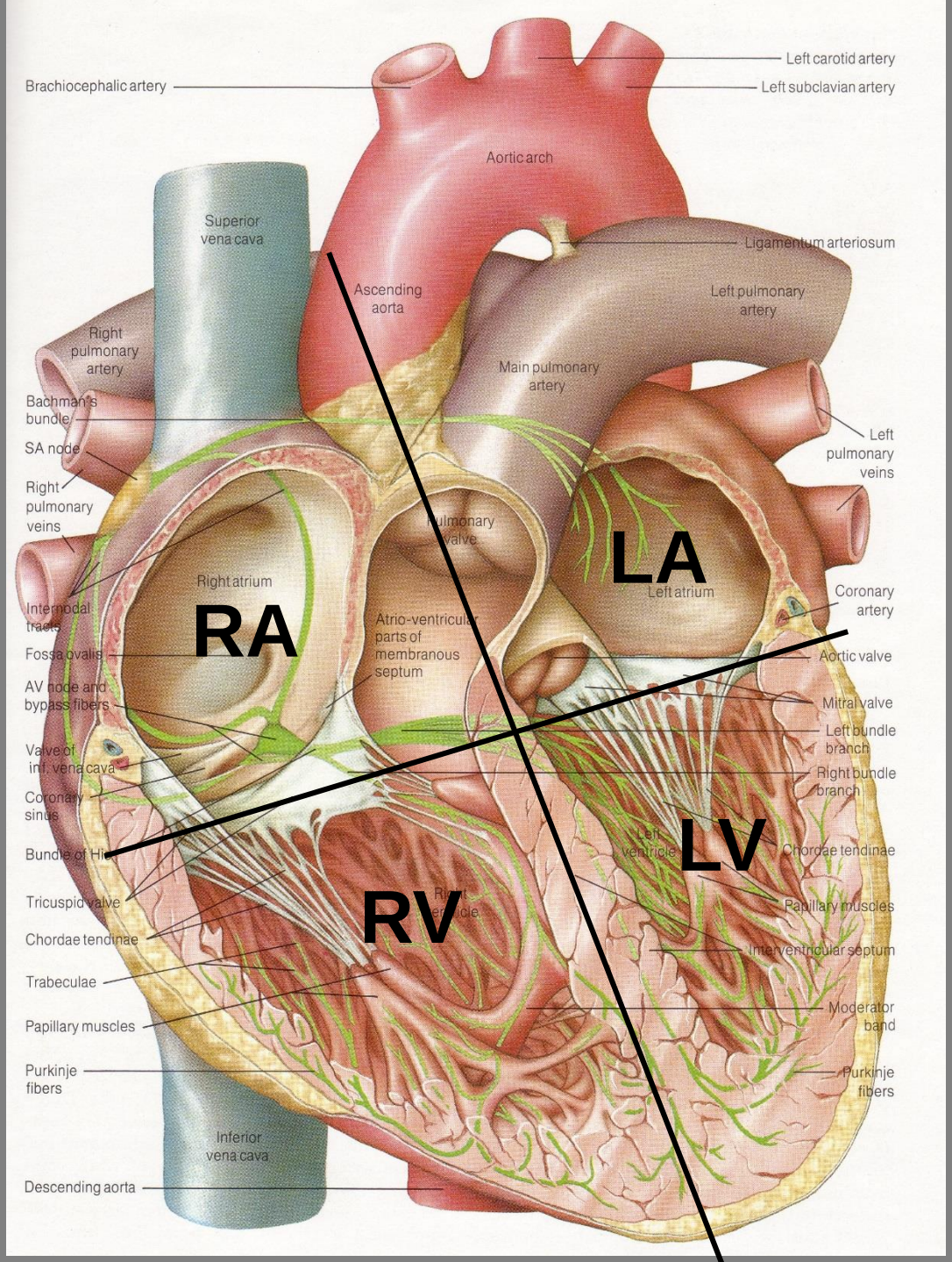


Torstar Books 1984

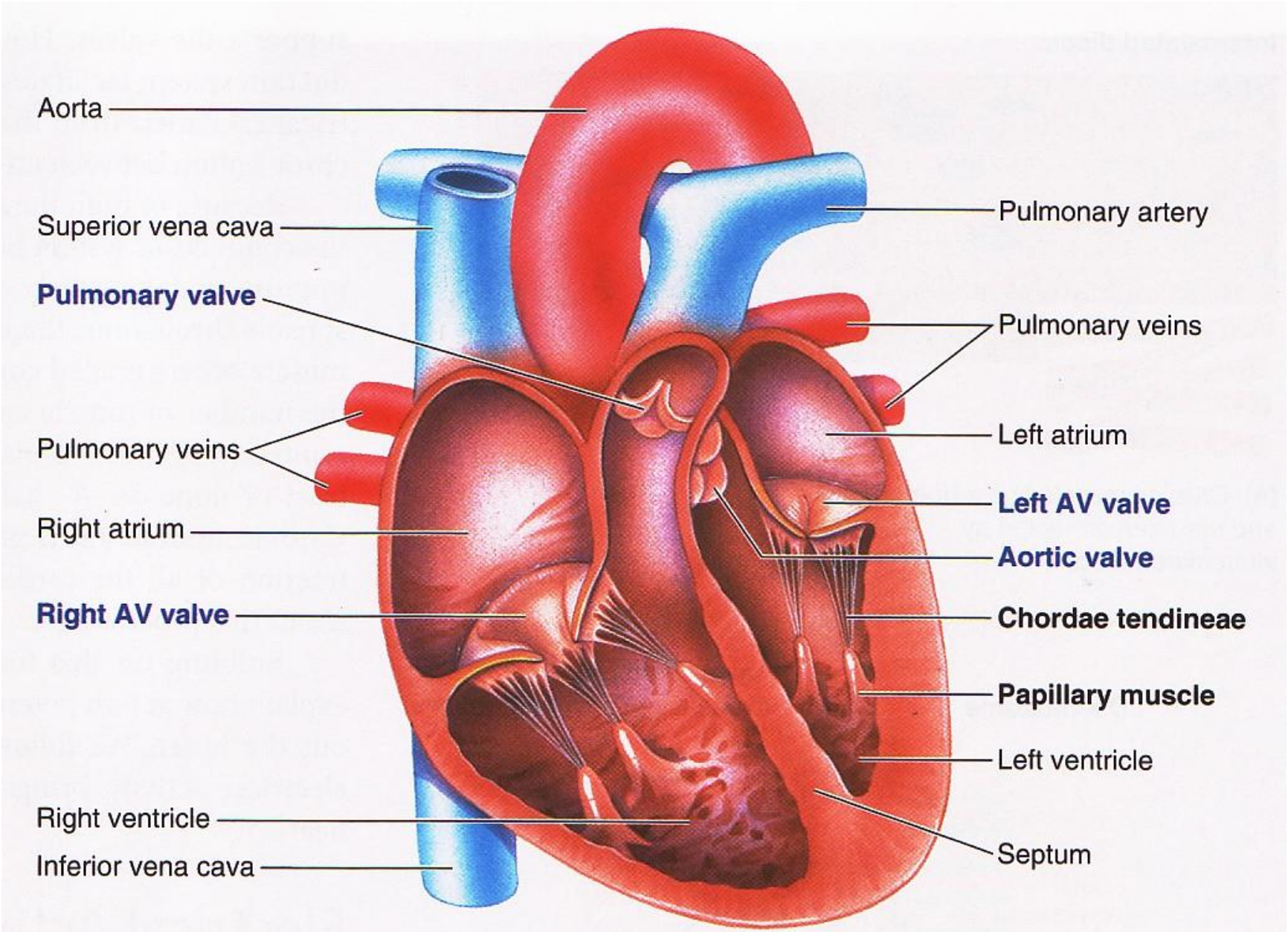
Human ♥ = 4-chambered box?

2 separate pumps?





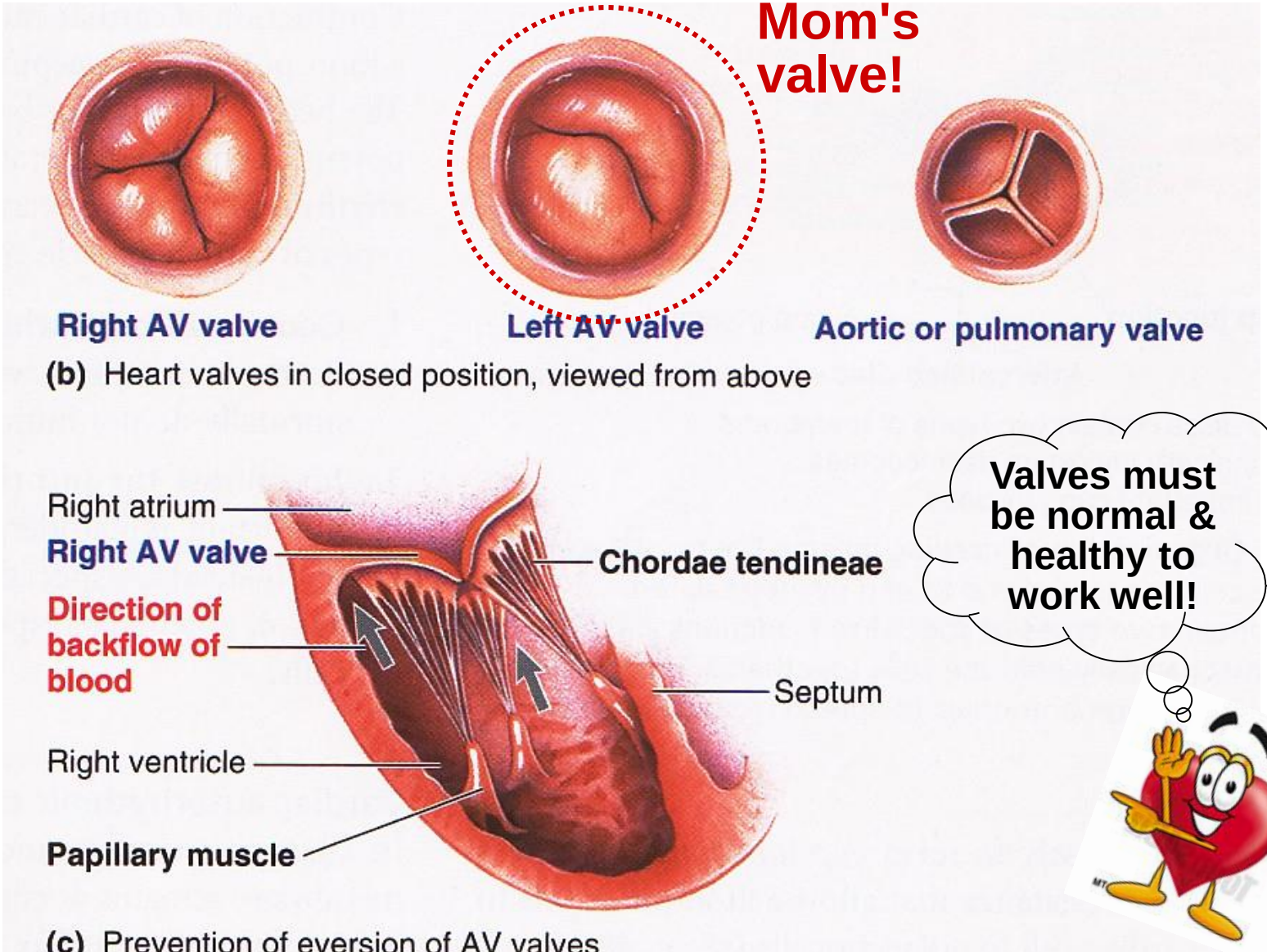
Torstar Books 1984

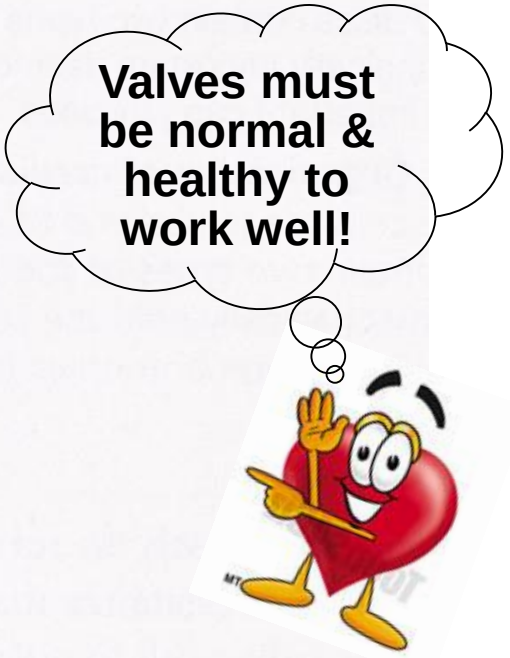


(a) Location of the heart valves in a longitudinal section of the heart

LS 2012 fig 9-4a p 233

Heart Valves Ensure Unidirectional Blood Flow!





LS 2012 p 233

Human ♥ = 4 unique valves?
2 valve sets?

Semilunar = *Half-moon shaped*

More rigid

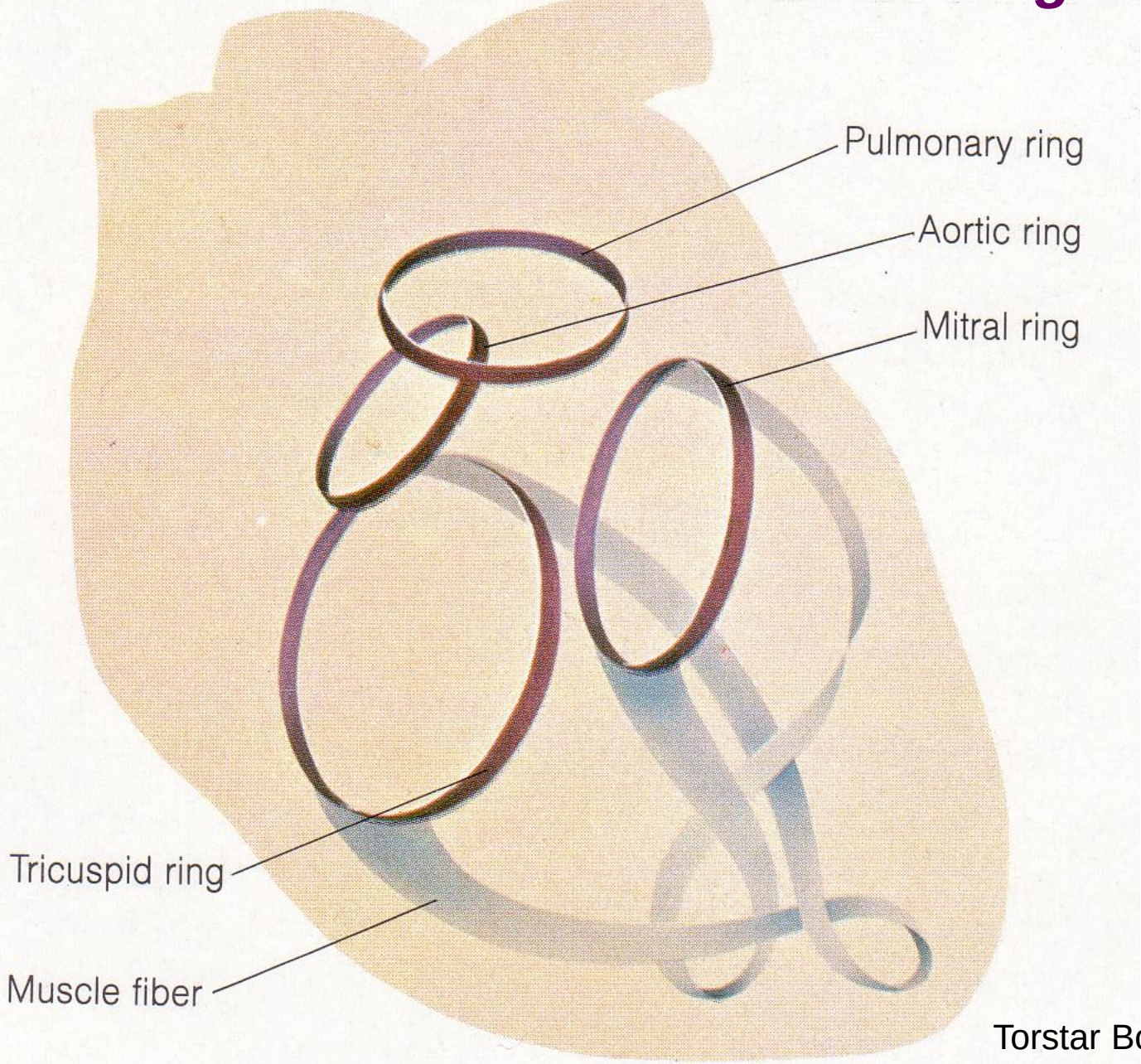
1. Pulmonic/Pulmonary
2. Aortic

AV = *Atrioventricular*

More flimsy

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

Heart Valve Orientation & Scaffolding



Torstar Books 1984

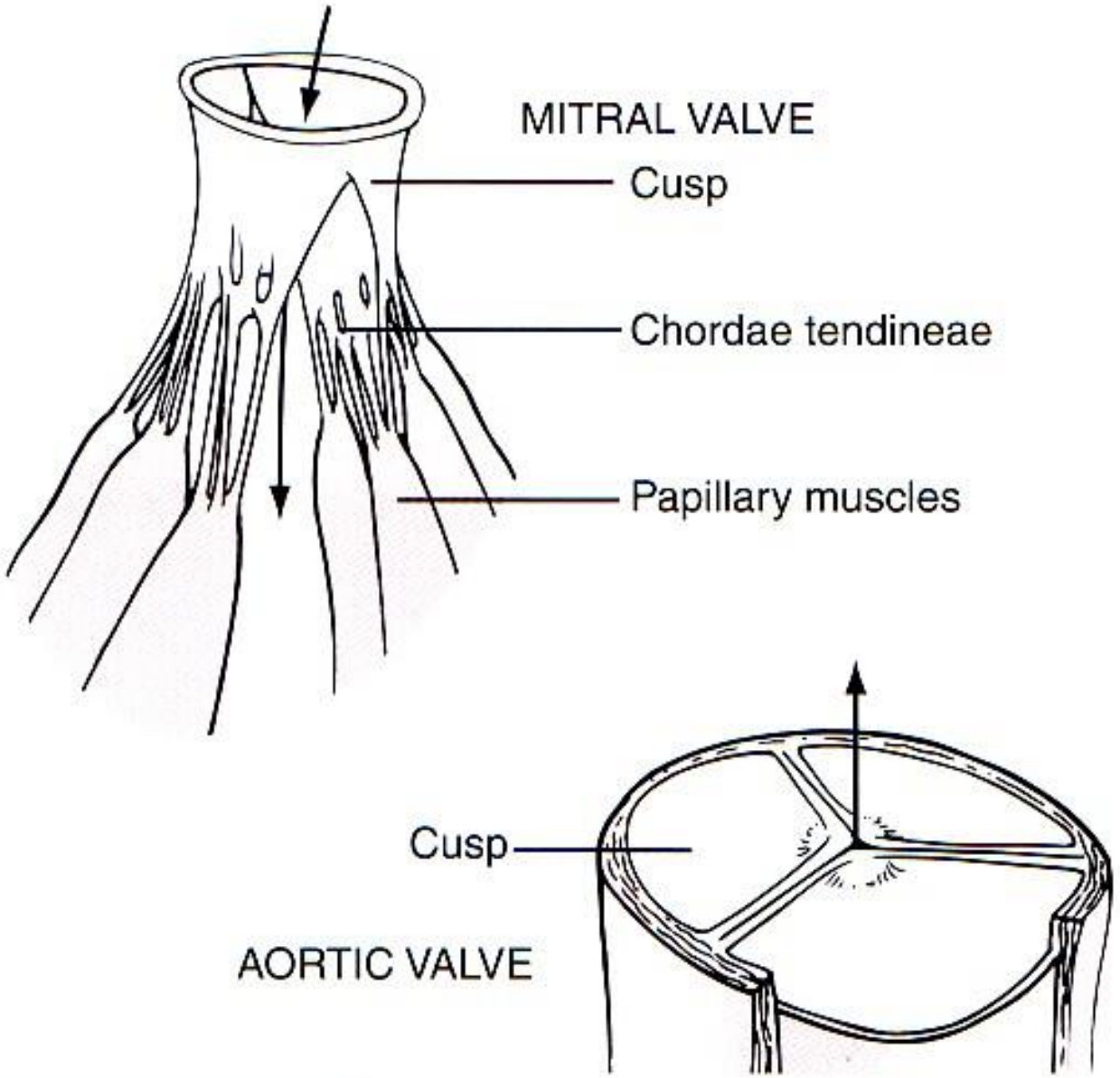
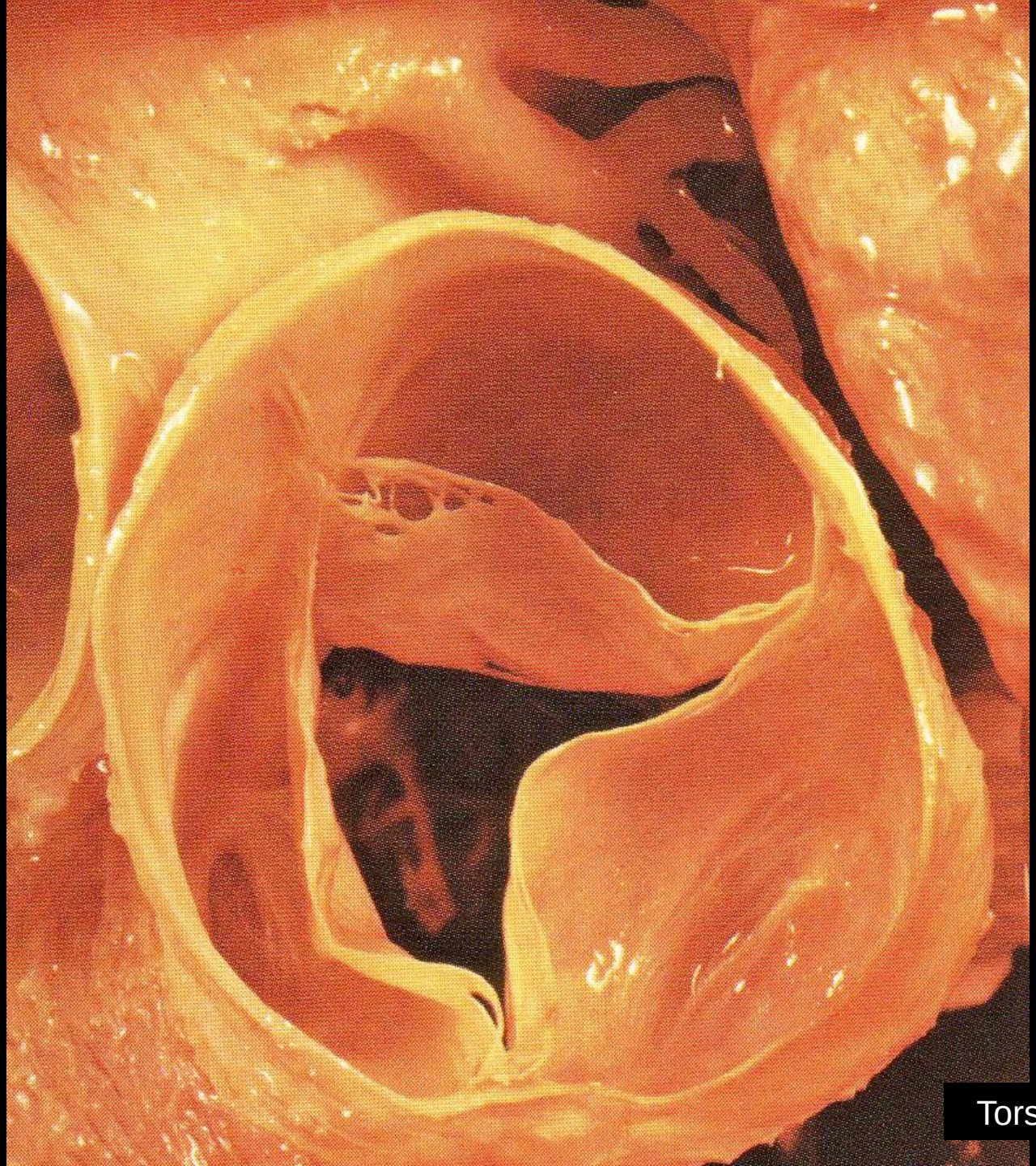


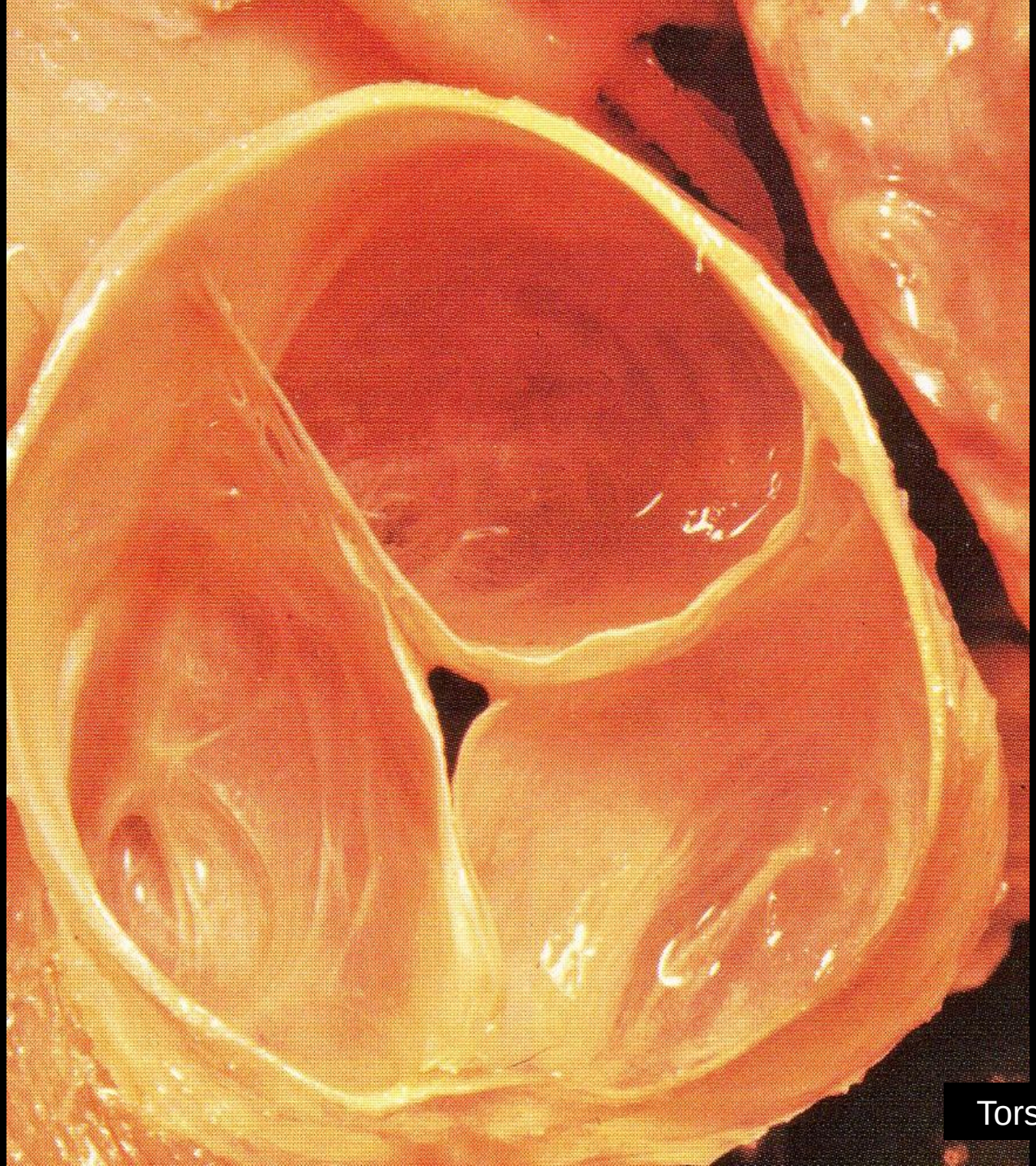
FIGURE 9–6

Mitral and aortic valves.

Guyton & Hall



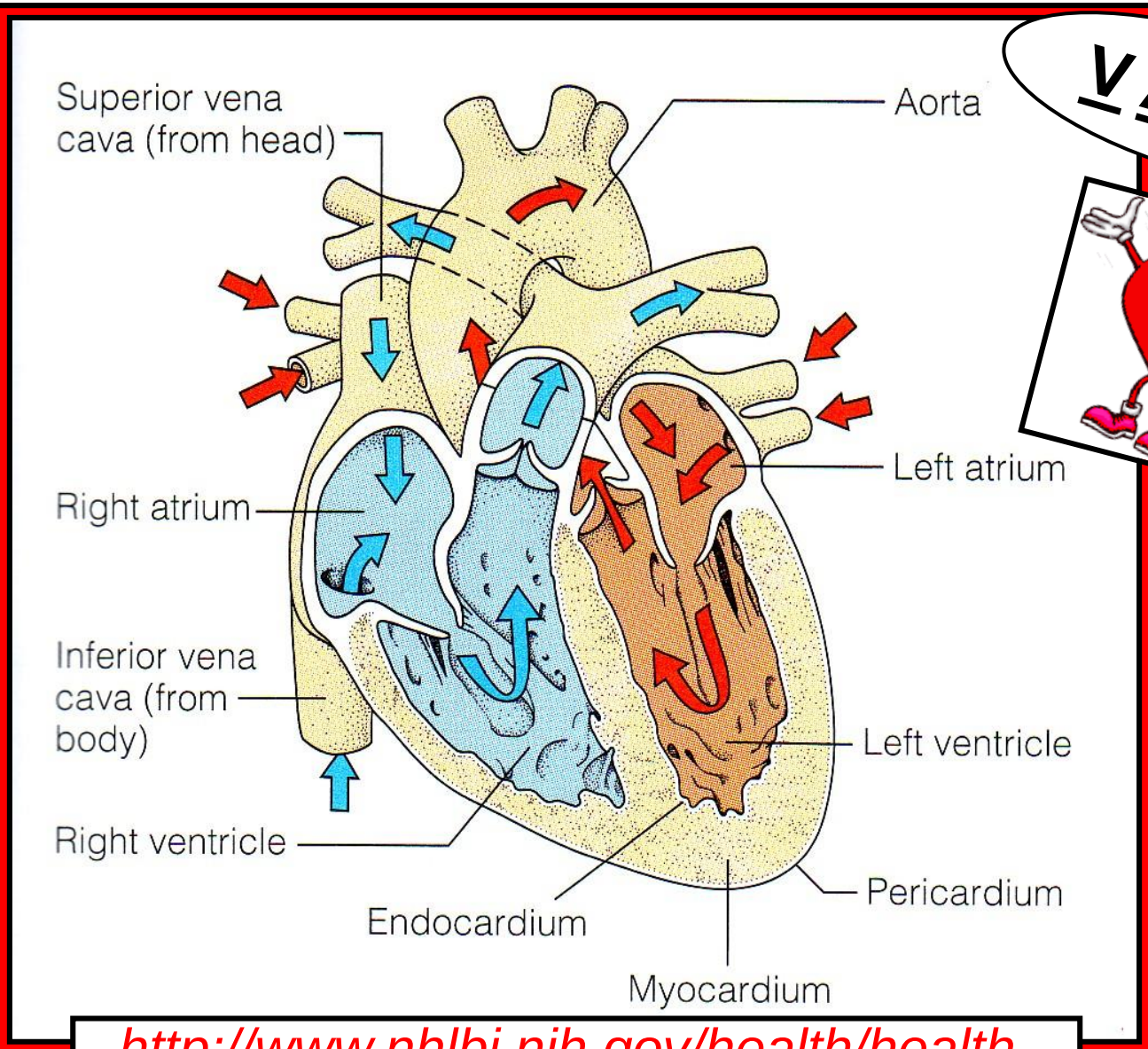
Torstar Books 1984

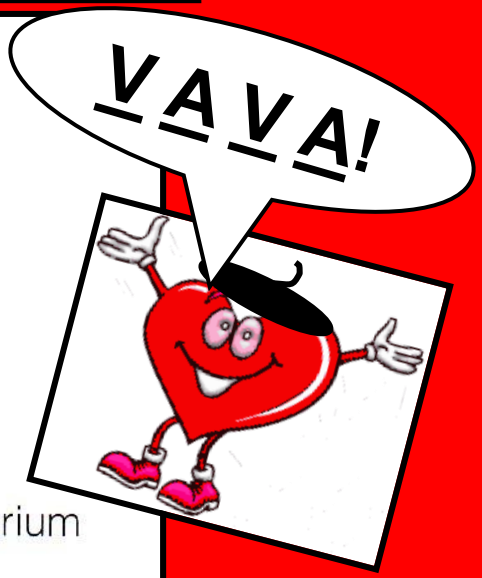


Torstar Books 1984

Torstar Books 1984

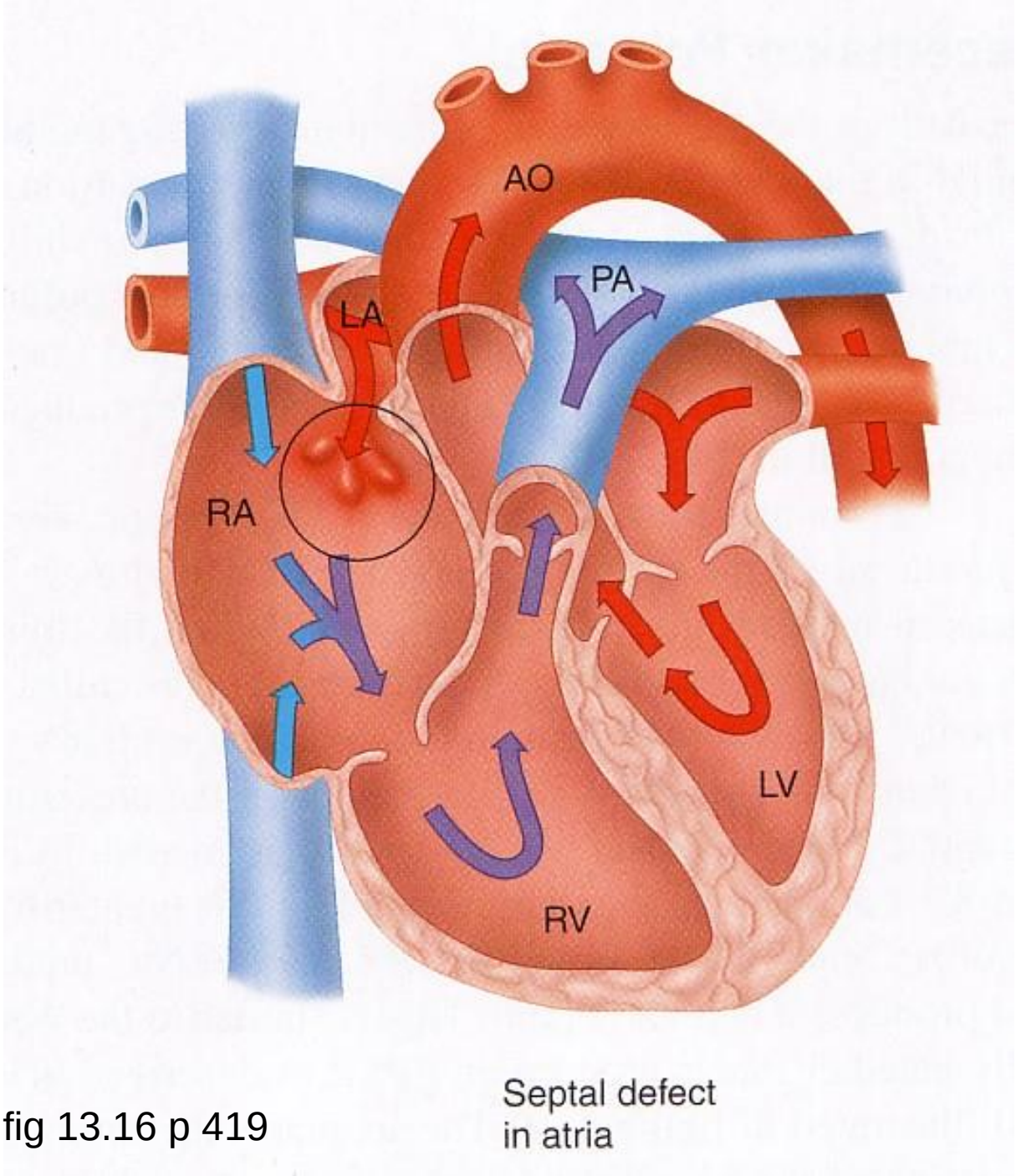
Veins → Atria → Ventricles → Arteries



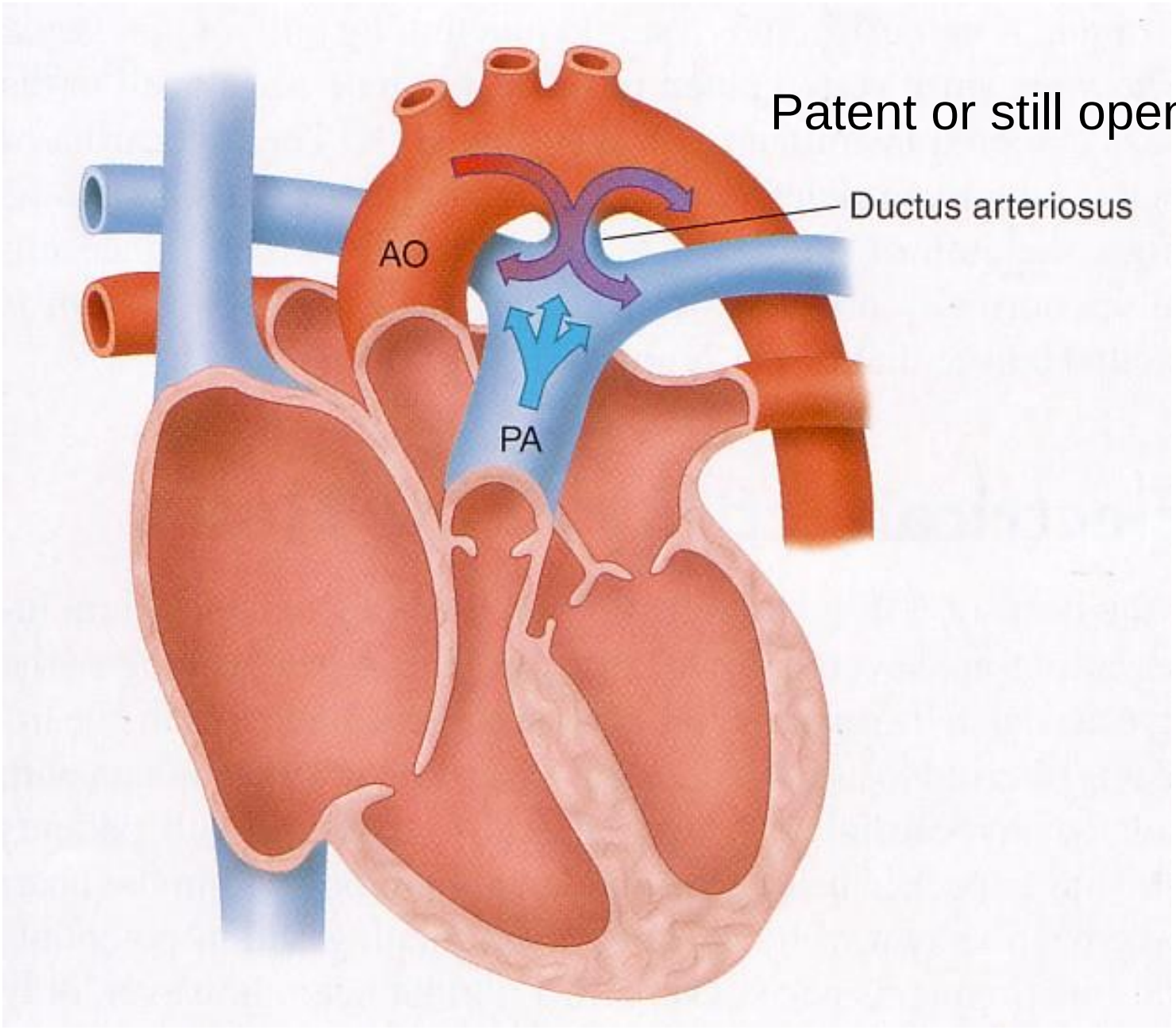


http://www.nhlbi.nih.gov/health/health-topics/topics/hhw/contraction.html

LS2007



SI Fox 2009 fig 13.16 p 419



SI Fox 2009 fig 13.17 p 420