

BI 121 Lecture 7 **Exam I one week from today! I'll be ready!...** 

**I. Announcements** Lab Notebooks? Q? from last time?

**II. GI Physiology Connections** DC Module 3 pp 17-23, LS ch 15+

- A. How is the gut controlled? Common control mechanisms
- B. Gut layers LS fig 15-2 pp 439-43 → DC p 23 →
- C. GI secretions: What? Where? Why? LS p 438
- D. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
- E. Zymogen? = Inactive precursor LS fig 15-9 p 452...
- F. Accessory organs? Pancreas, Liver, Recycling! pp 457-63
- G. Small intestine? Ulcers? LS fig 15-20, 15-22 pp 467-8  
<http://www.cdc.gov/ulcer> *Beyond the Basics* LS p 456
- H. Large intestine? LS fig 15-24 pp 472-4

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

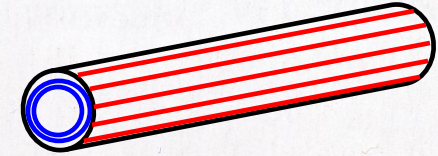
- A. Circulatory vs. Cardiovascular (CV)? CV vs. Lymphatic  
CV Pulmonary & Systemic circuits DC pp 23-31+LS p 229+  
DC fig 4-1 p 24, LS fig 9-2b p 231
- B. Arteries, capillaries, veins, varicosities? G&H, Torstar, DC
- C. ♥ layers, box, chambers, valves, inlets, outlets  
LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6
- D. Normal vs. abnormal blood flow thru ♥ & CVS LS, Fox+...

# ***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**



Outer longitudinal muscle } Muscularis externa  
Inner circular muscle }

**Circular → ↓ d or Width**

Body wall

Serosa

Submucosa

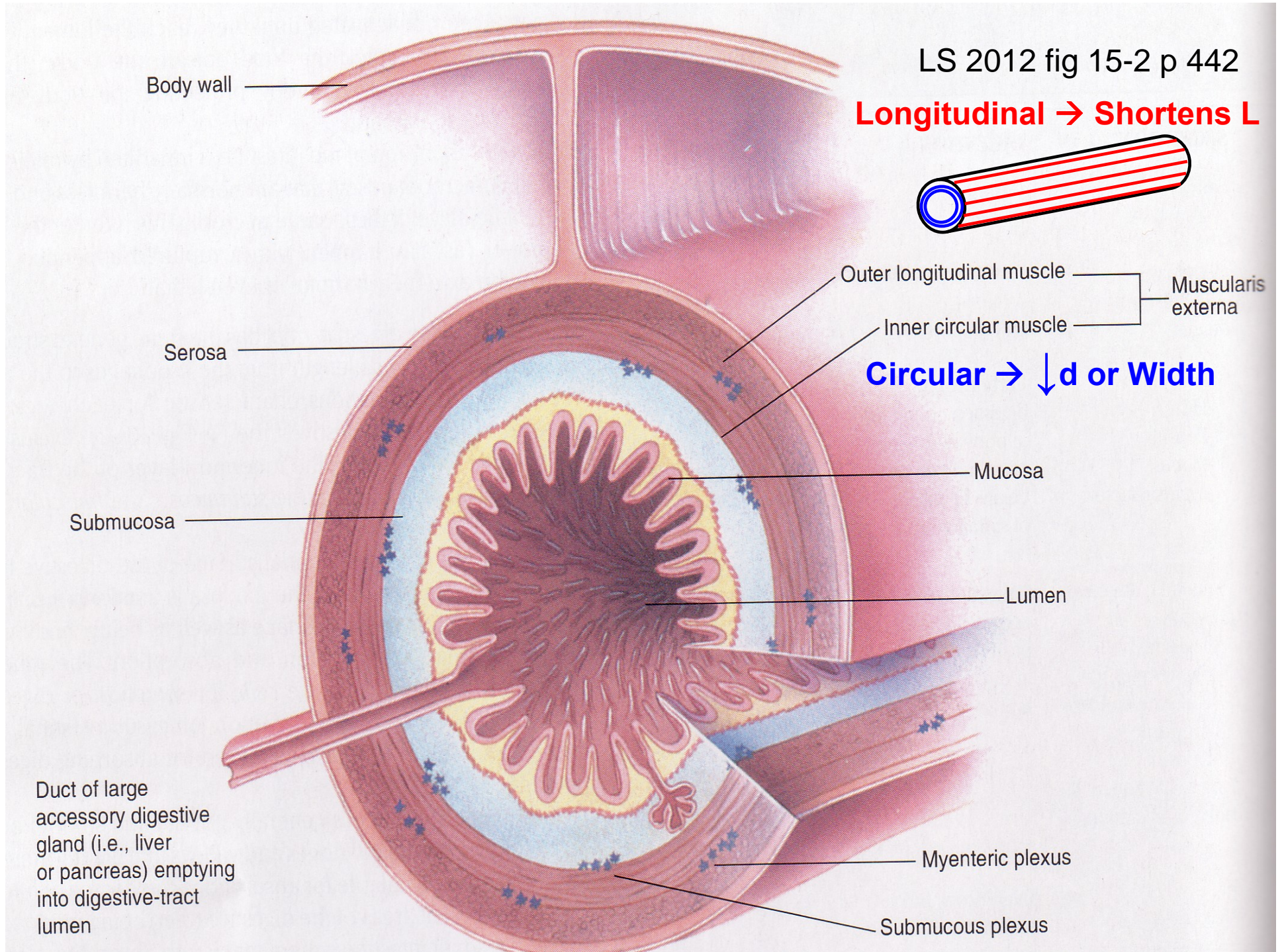
Duct of large accessory digestive gland (i.e., liver or pancreas) emptying into digestive-tract lumen

Mucosa

Lumen

Myenteric plexus

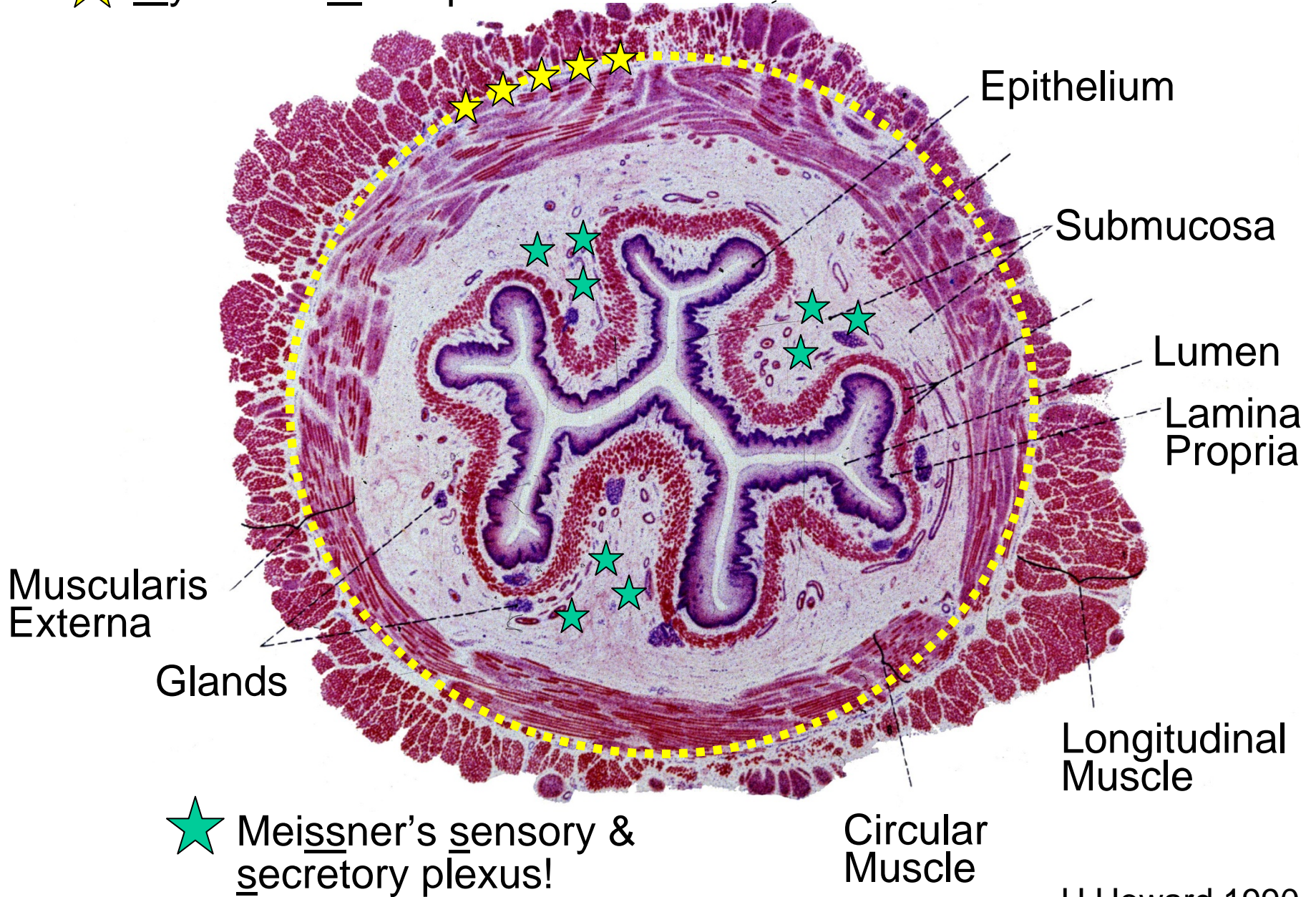
Submucous plexus



★ Myenteric motor plexus!

Serosa

cf: G&H fig 62-2



Epithelium

Submucosa

Lumen

Lamina Propria

Muscularis Externa

Glands

Longitudinal Muscle

Circular Muscle

★ Meissner's sensery & secretory plexus!

H Howard 1990

# ***Gut Secretions***

## ***Secretion***

## ***Release Site***

**1. Mucus**

**into GI Lumen**

**2. Enzymes**

**into GI Lumen**

**3. H<sub>2</sub>O, 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

# 4. Liver-Gall Bladder

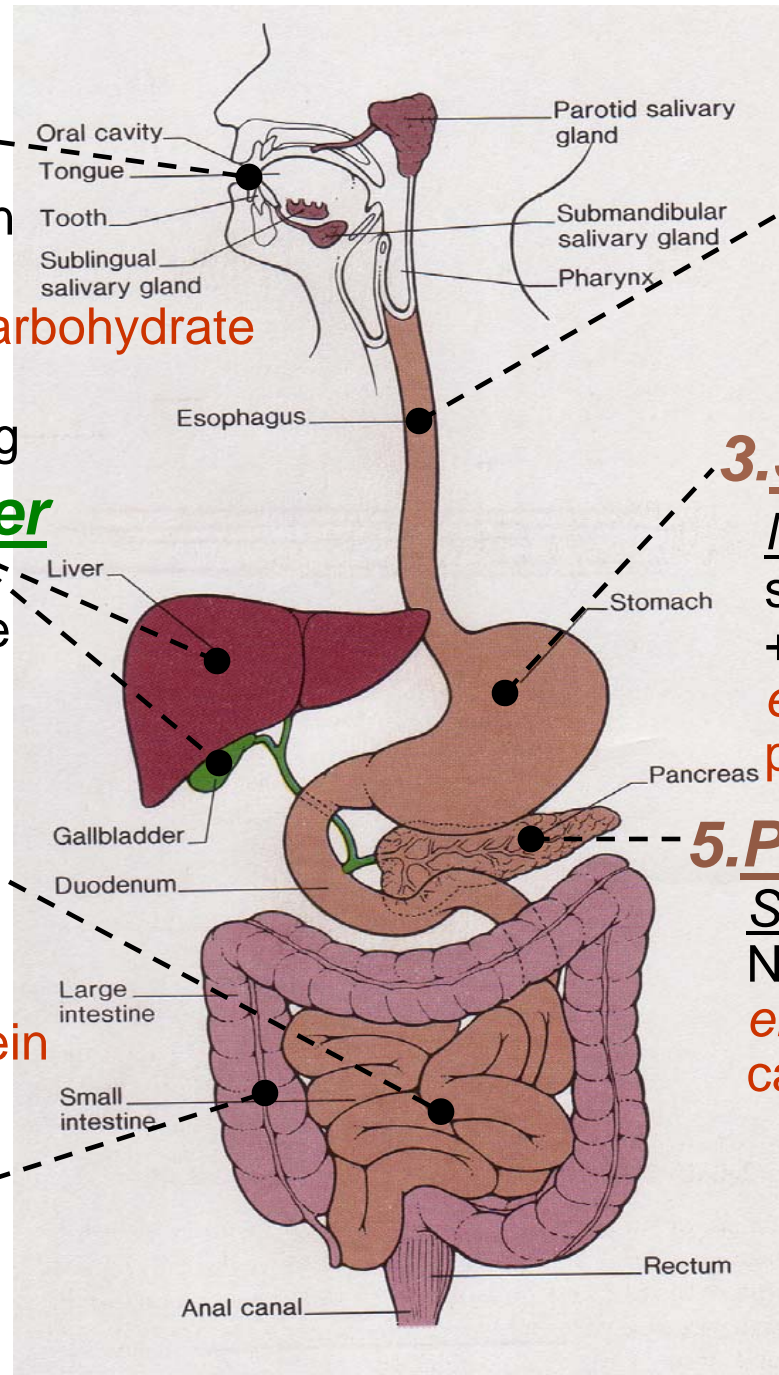
Emulsification =  
detergent action of bile  
+ secretion

# 6. Small Intestine

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

# 7. Large Intestine

Dehydration  
secretion + absorption  
storage + peristalsis



# 2. Esophagus

Rapid transit  
peristalsis  
secretion mucus

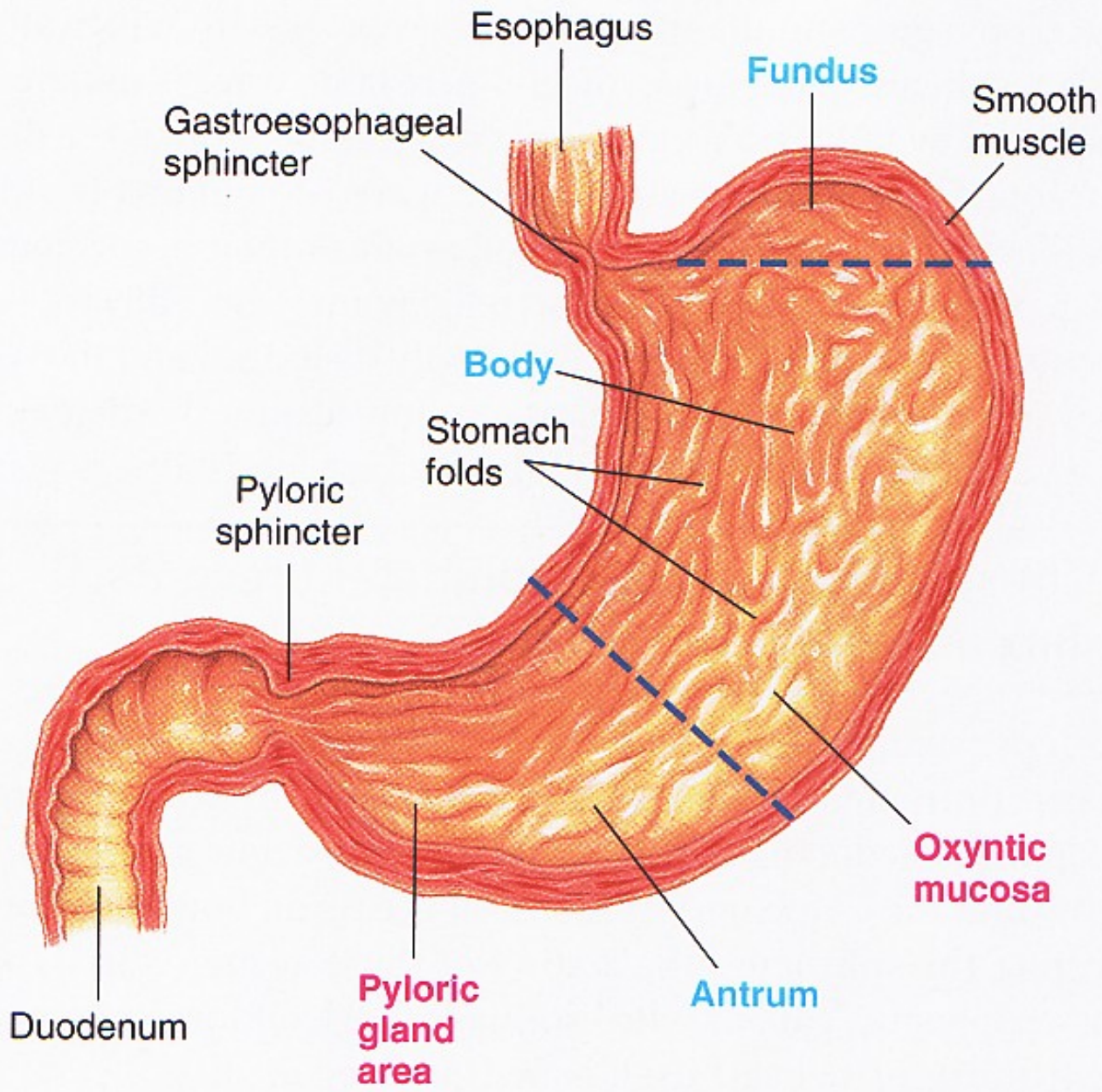
# 3. Stomach

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

# 5. Pancreas

Secretion mucus +  
NaHCO<sub>3</sub> + enzymes  
enzymatic digestion:  
carbohydrate, fat, protein

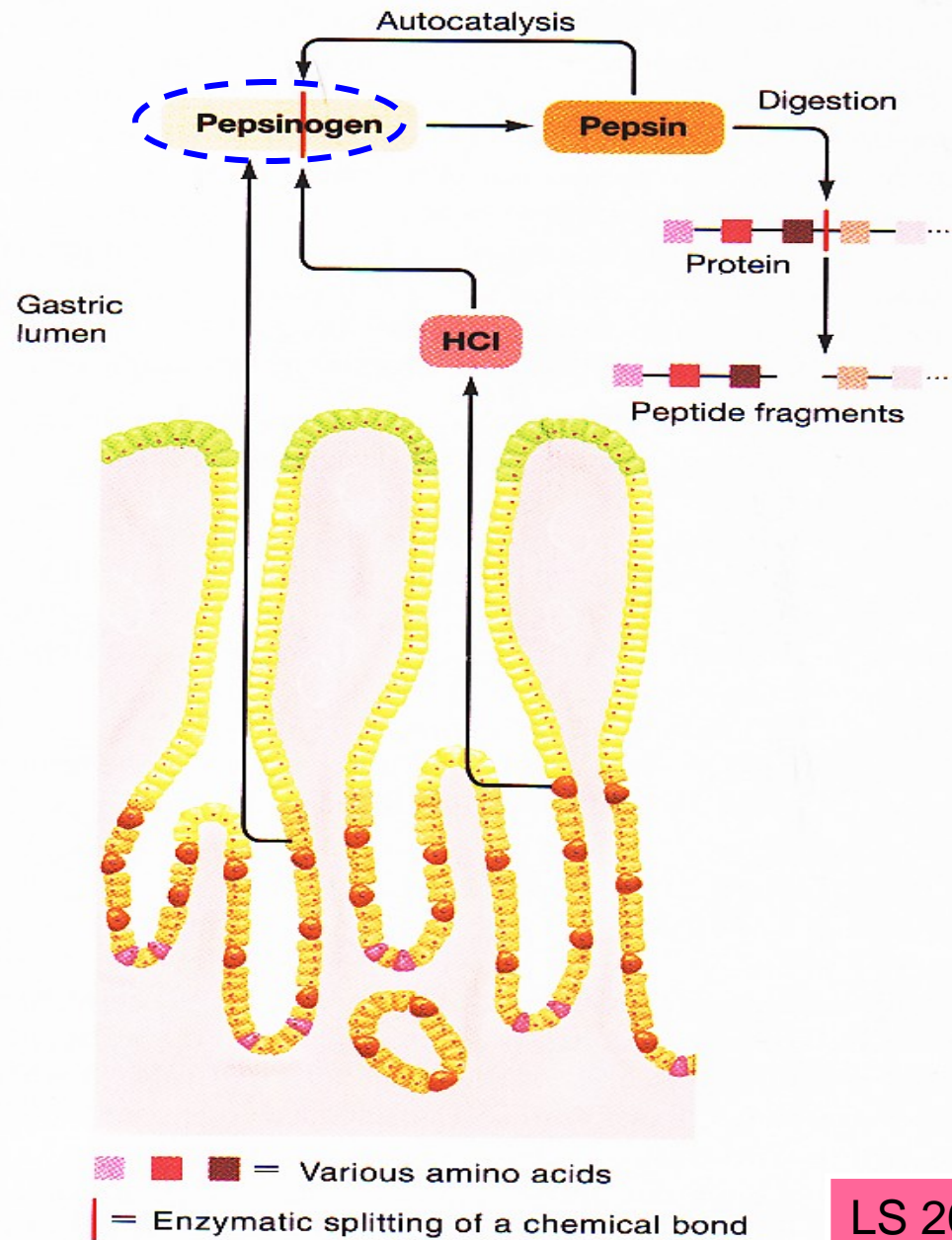
**Where does**  
**enzymatic**  
**digestion of**  
**protein**  
**begin?**



● **FIGURE 15-7**

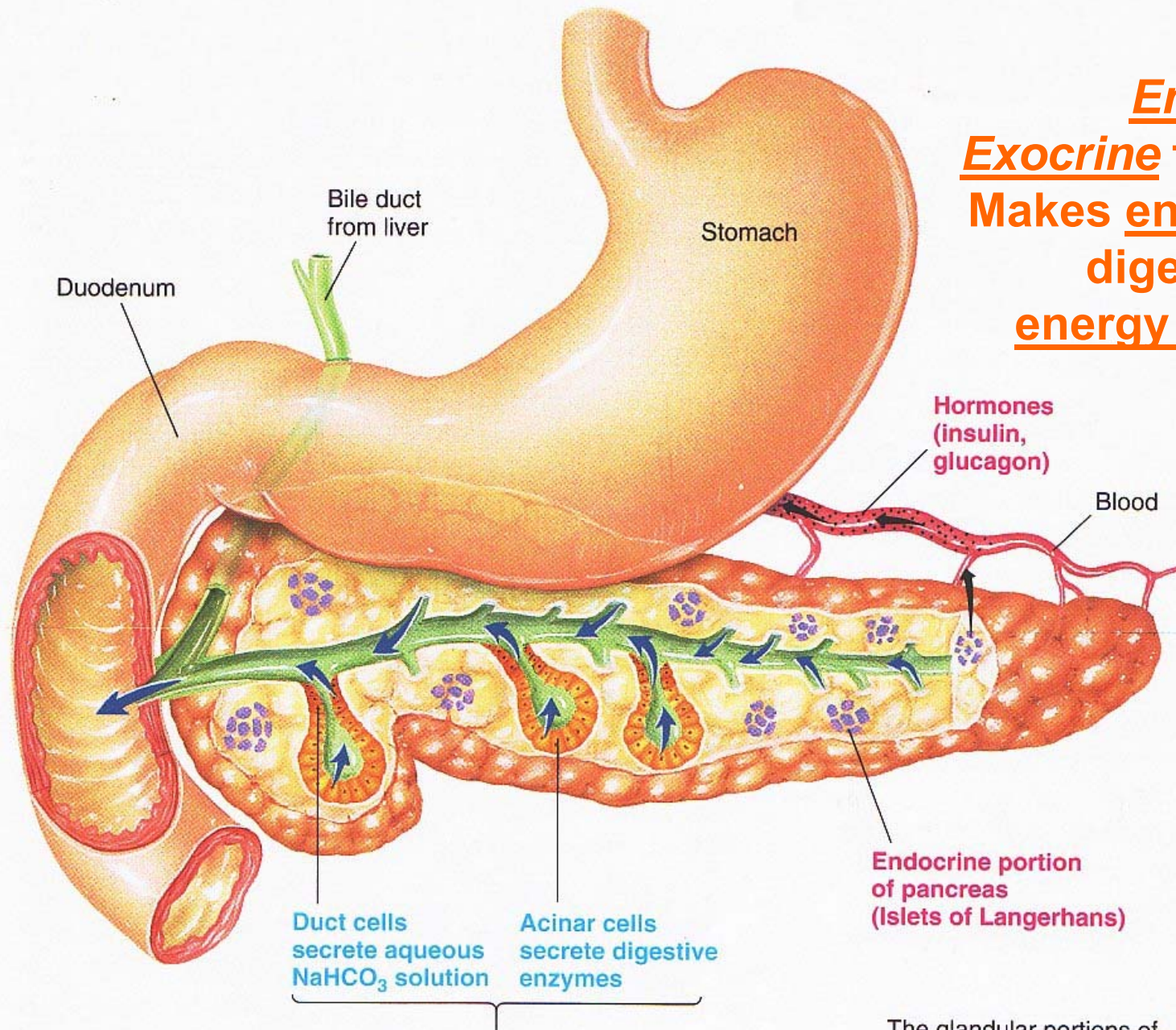


**Zymogen =  
an inactive  
precursor**



**Why is the**  
**pancreas so**  
**unique?**

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



**Endocrine portion  
of pancreas  
(Islets of Langerhans)**

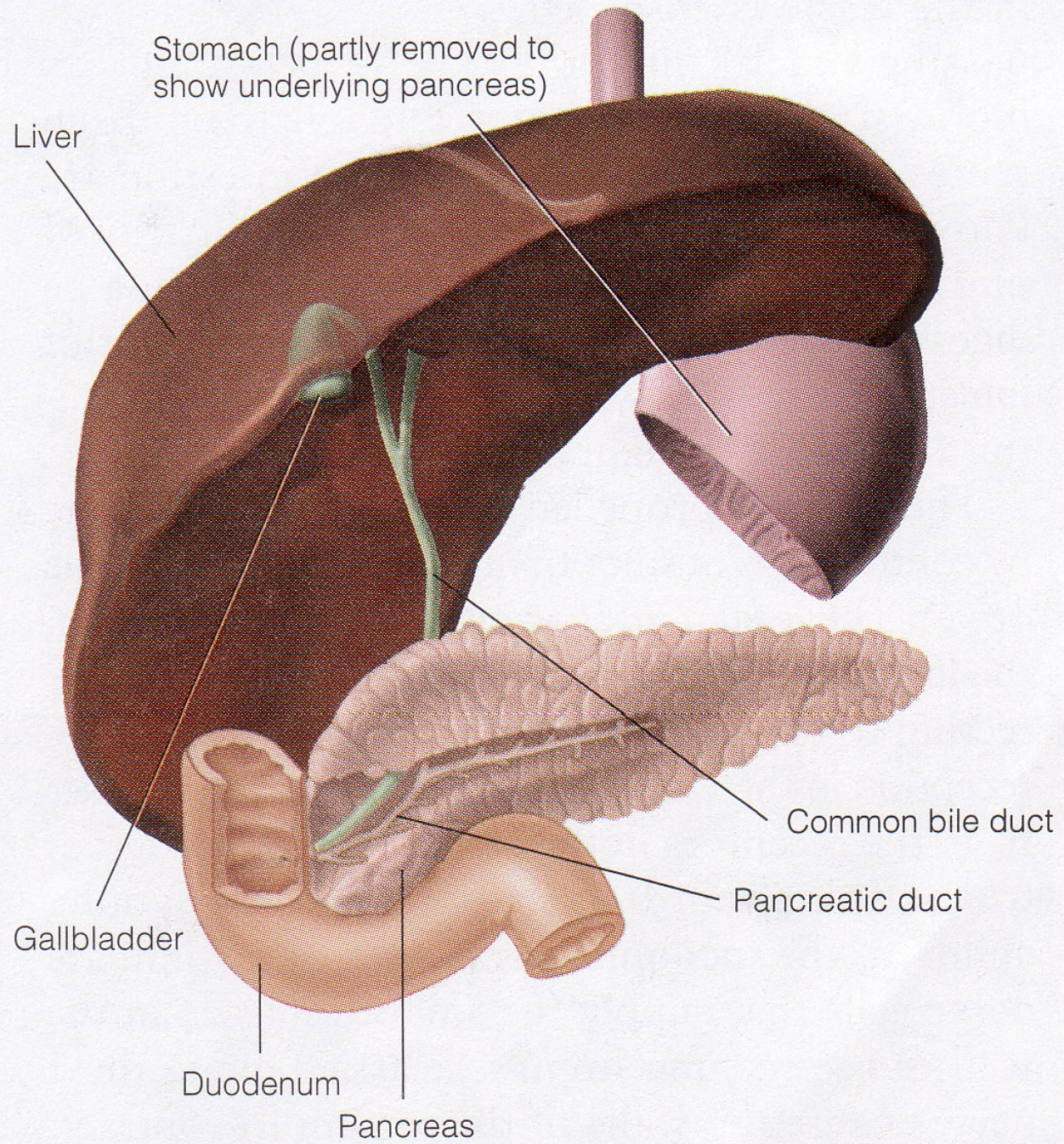
**Duct cells  
secrete aqueous  
 $\text{NaHCO}_3$  solution**

**Acinar cells  
secrete digestive  
enzymes**

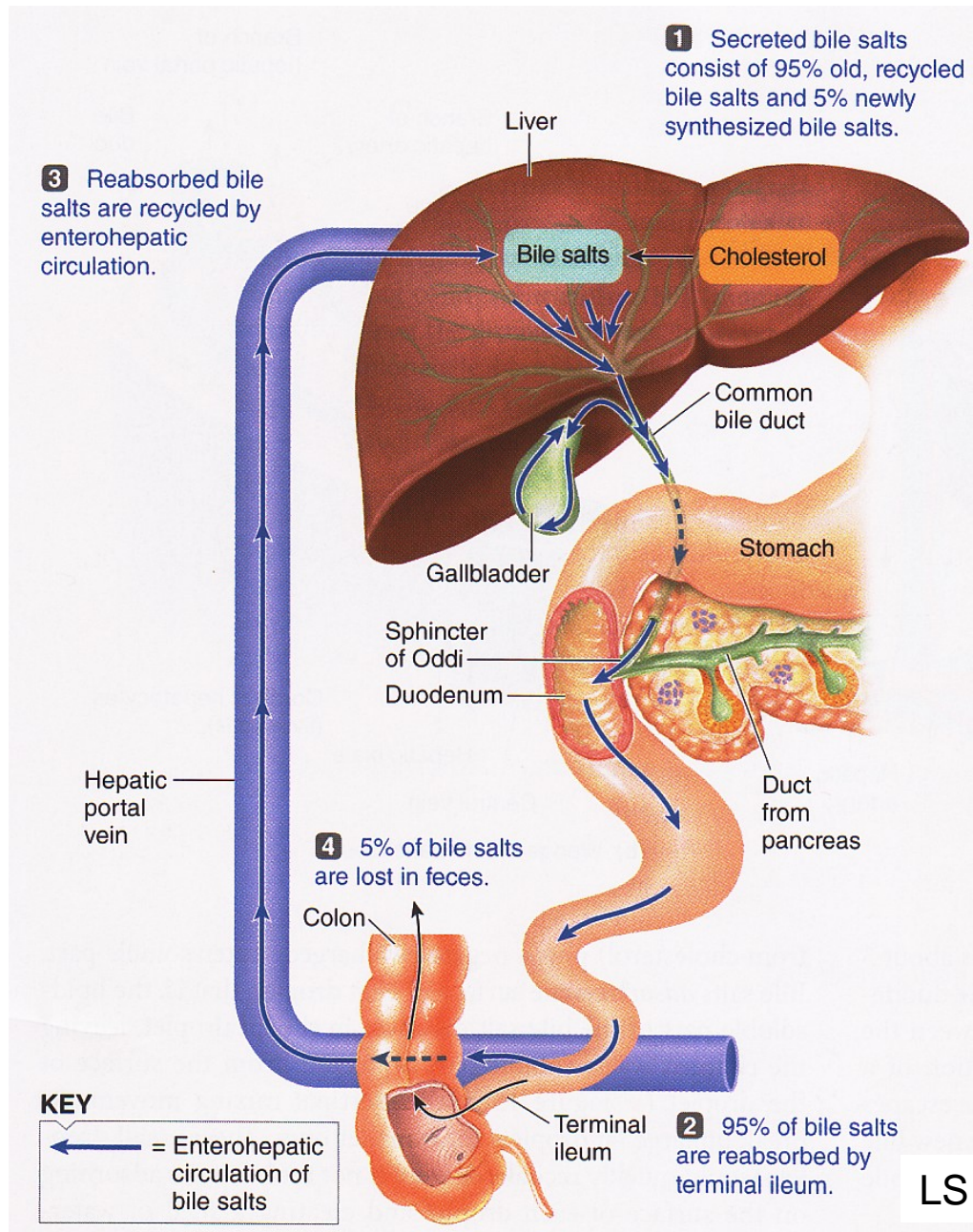
The glandular portions of the pancreas are grossly exaggerated.

LS 2012 fig 15-11 p 457 **Exocrine portion of pancreas  
(Acinar and duct cells)**

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

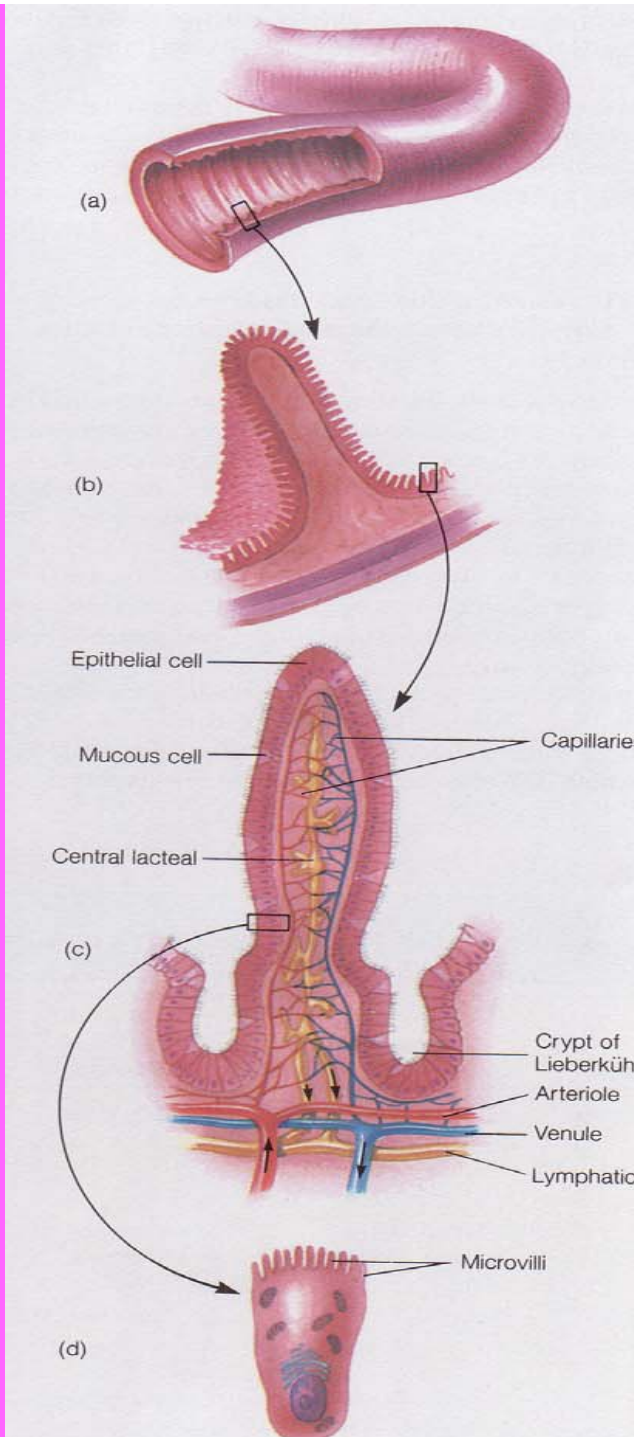


# Liver: Amazing Recycling of Bile Salts!

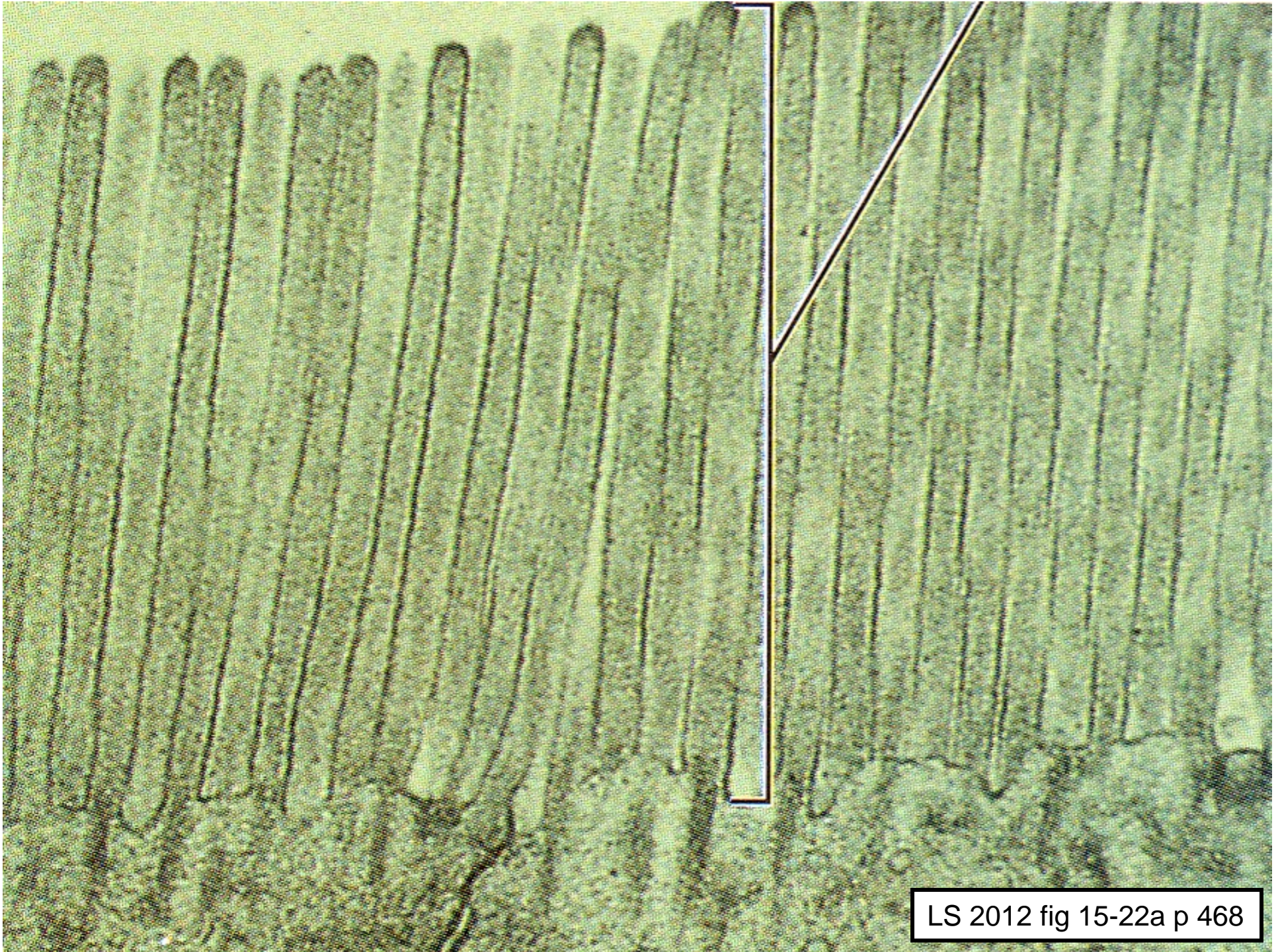


What is the major  
function of the  
small intestine?

***Absorption!!***



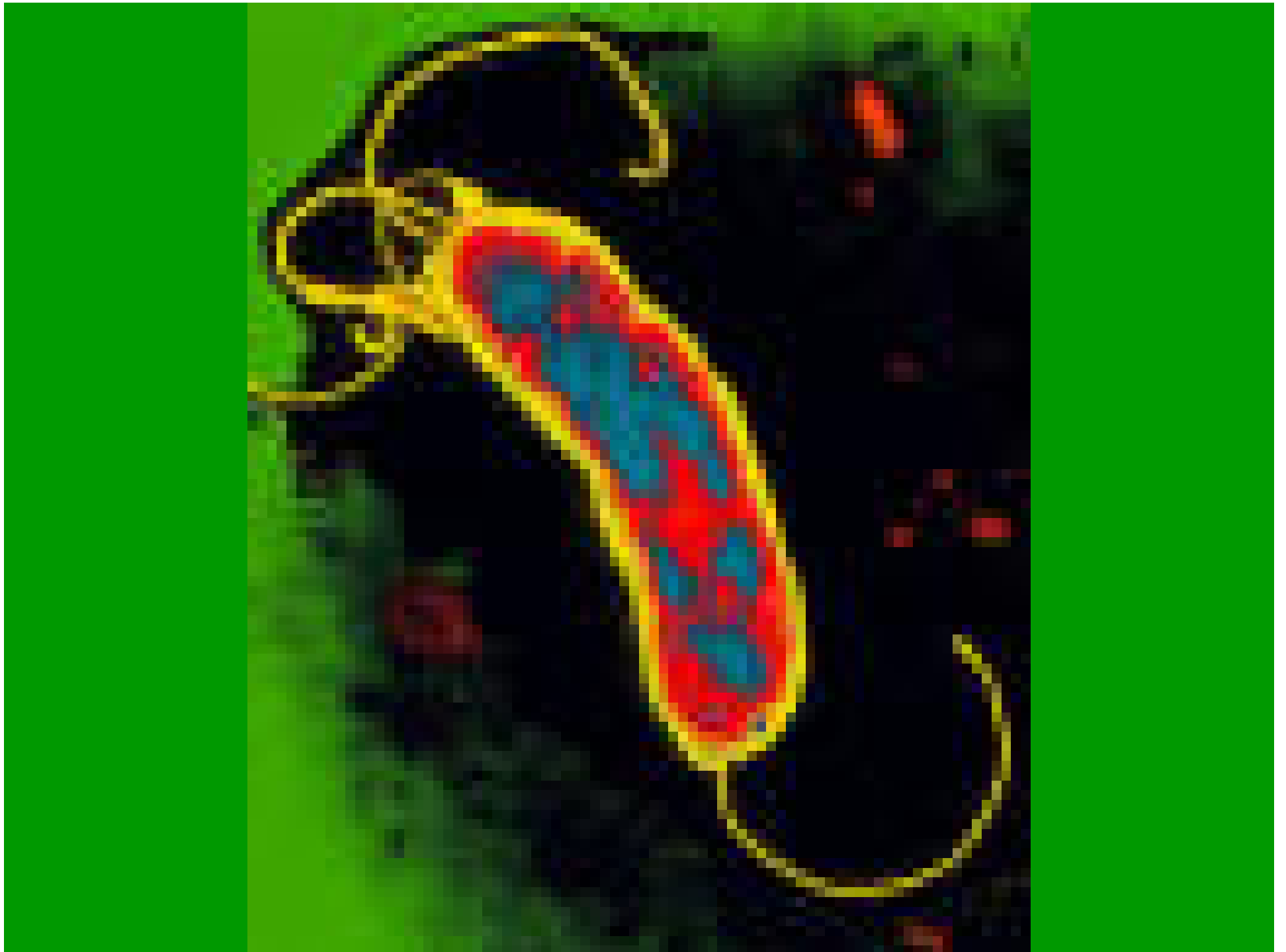




LS 2012 fig 15-22a p 468



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



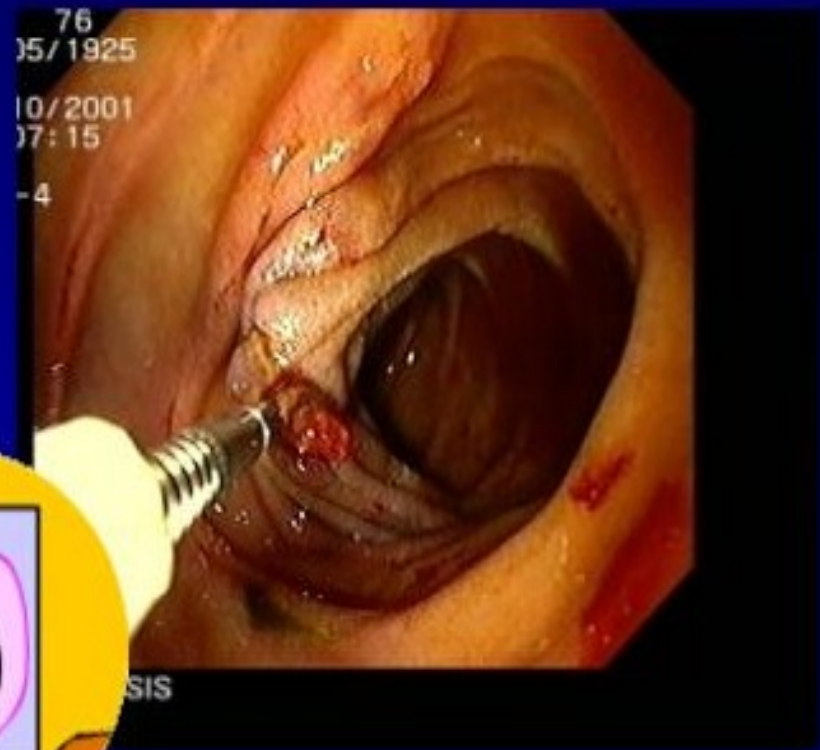
## Ulcer Facts

- 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.

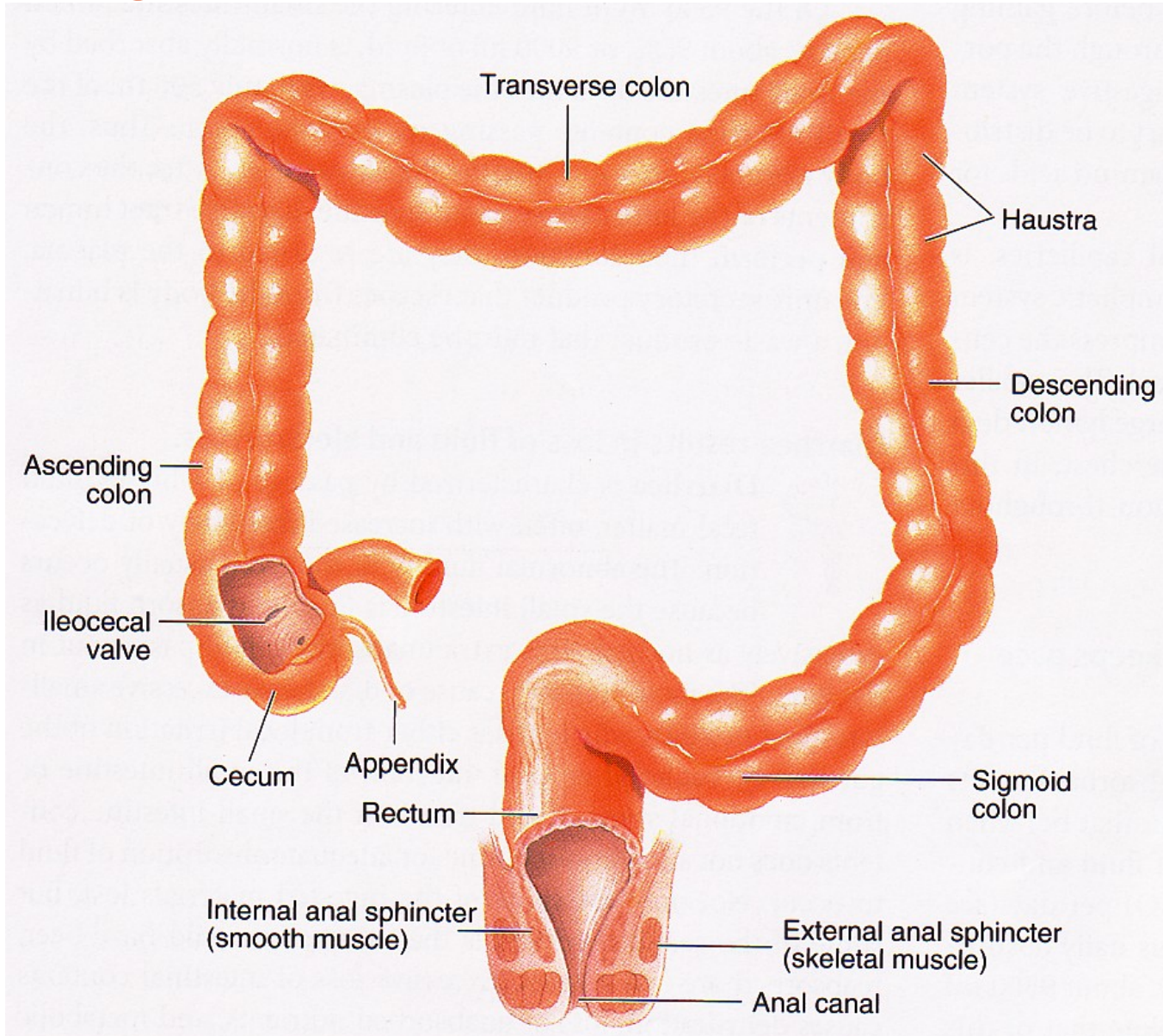
In the second photograph, a disposable metal clip is applied to the ulcer. The patient remained well and left hospital three days later.



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

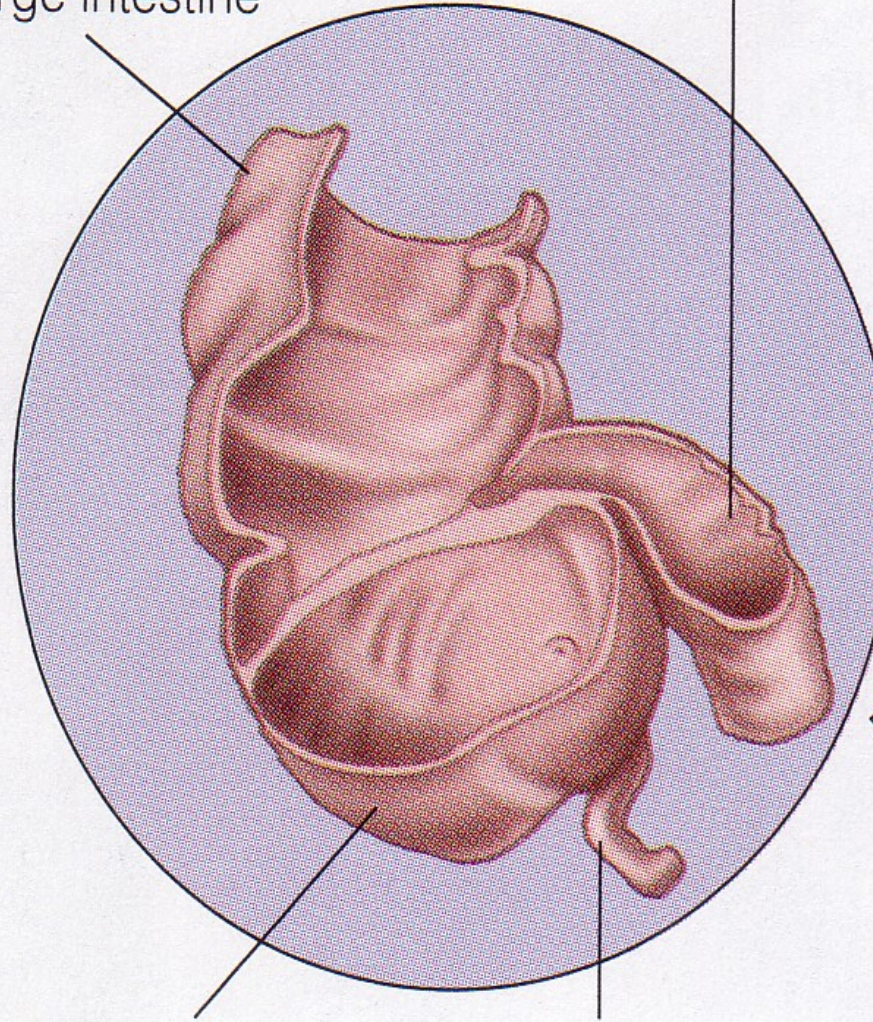
Nutrients	Enzymes for Digesting the Nutrients	Source of Enzymes	Site of Action of Enzymes	Action of Enzymes	Absorbable Units of the Nutrients
<b>Carbohydrates</b>	Amylase	Salivary glands	Mouth and (mostly) body of stomach	Hydrolyzes polysaccharides to disaccharides (maltose)	
		Exocrine pancreas	Small-intestine lumen		
	Disaccharidases (maltase, sucrase, lactase)	Small-intestine epithelial cells	Small-intestine brush border	Hydrolyze disaccharides to monosaccharides	Monosaccharides, especially glucose
<b>Proteins</b>	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
<b>Fats</b>	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	

# Large Intestine Structure & Function



Ascending  
portion of  
large intestine

Ileum  
of small  
intestine

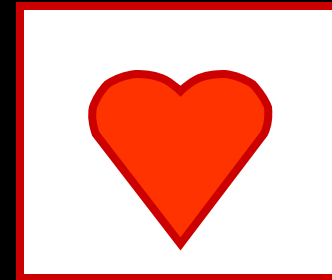


Cecum

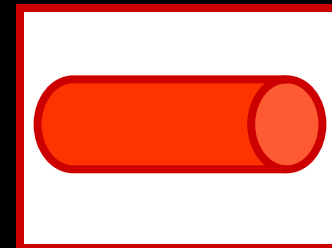
Appendix



***Cardiovascular (CV) = Heart + Vessels + Blood!***



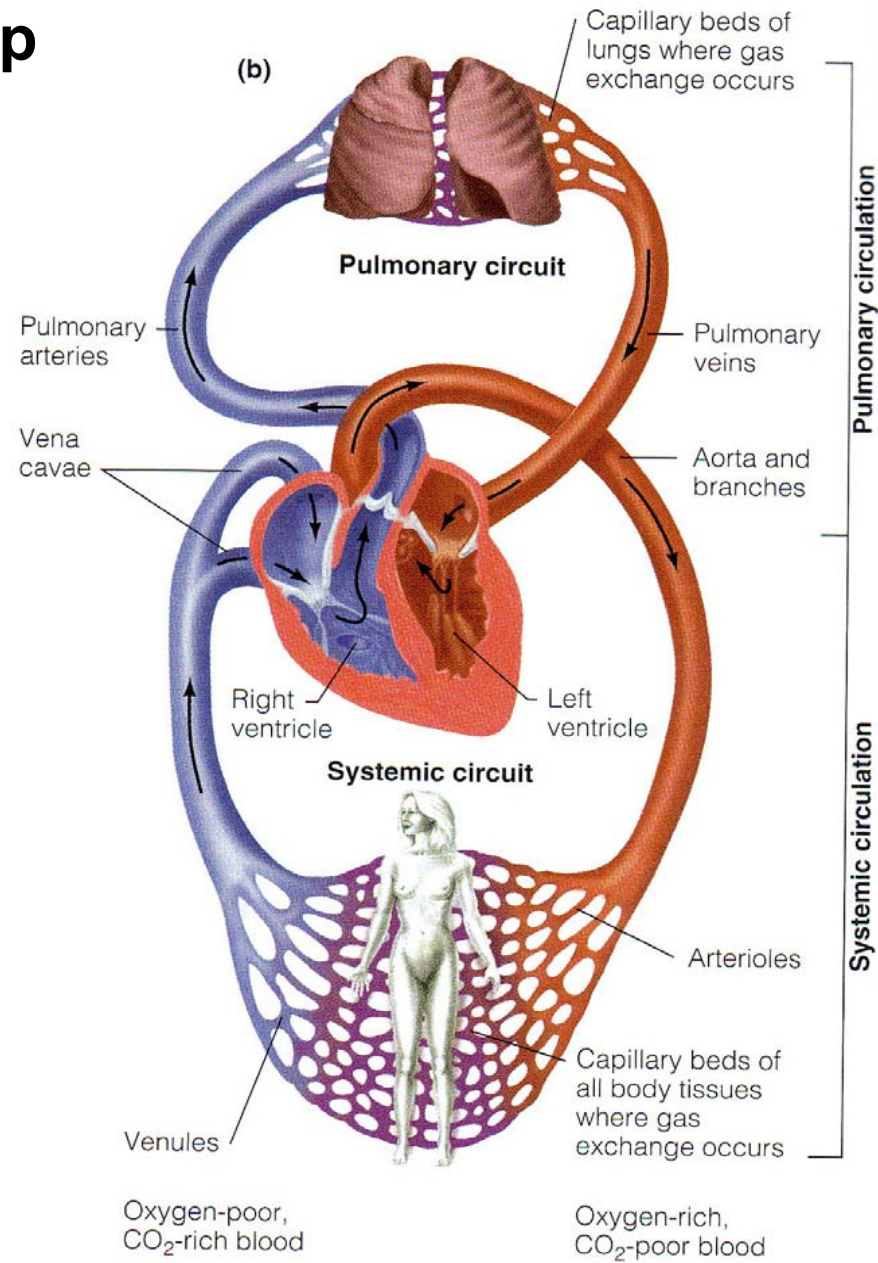
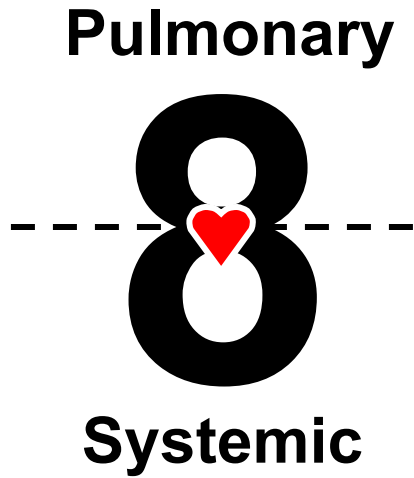
+



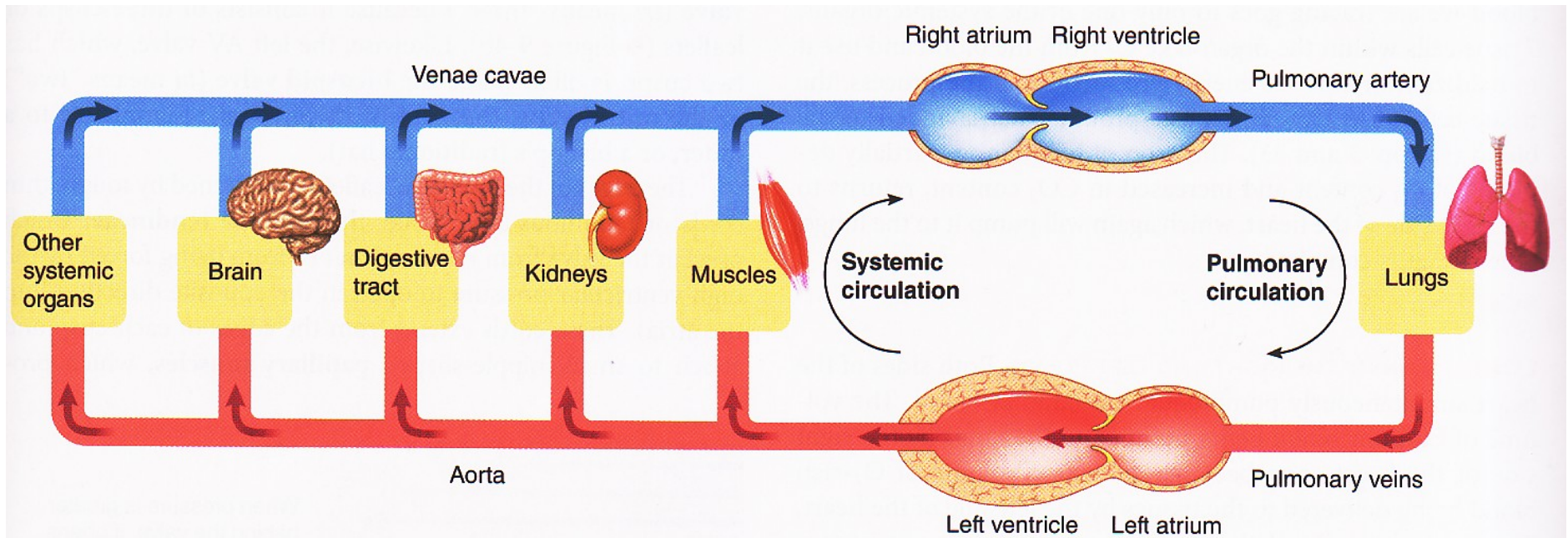
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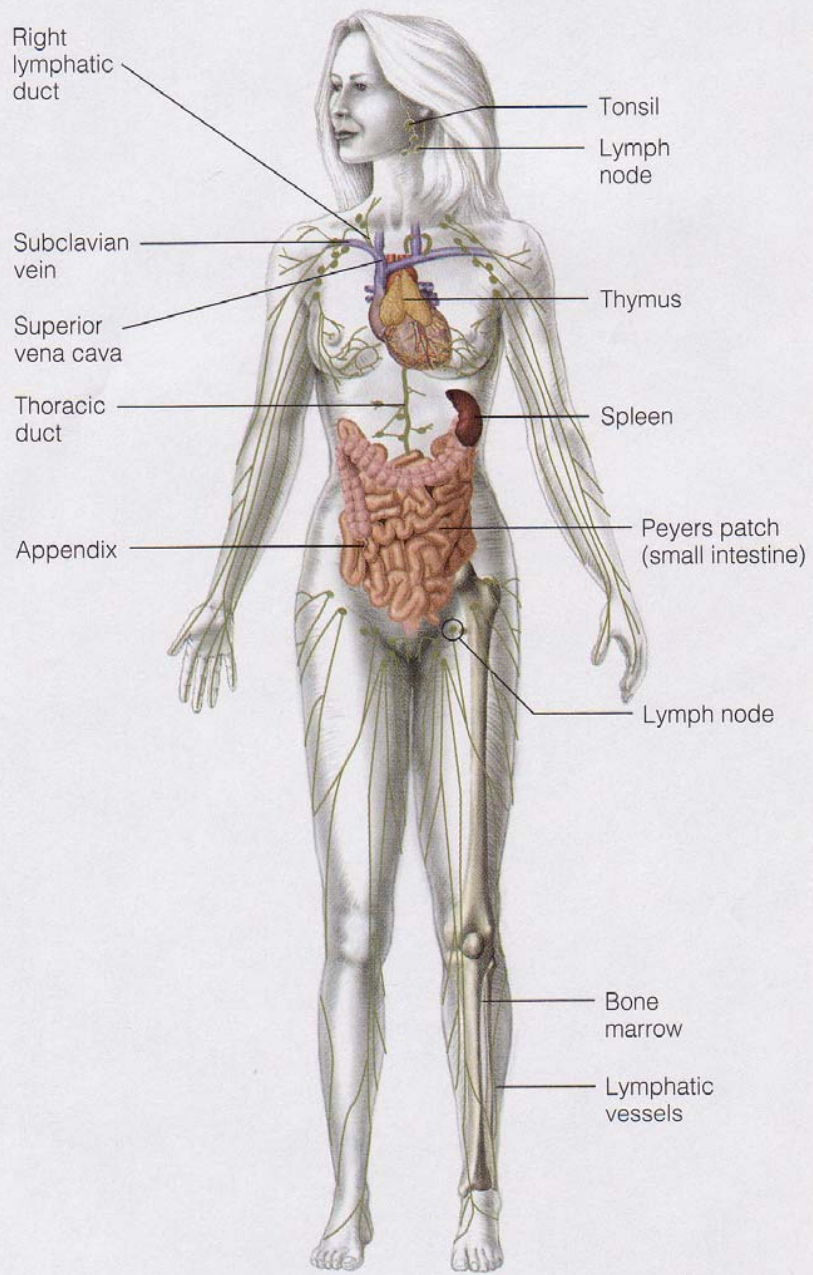


**NB: Figure-8 loop**



# Dual Pump Action & Parallel Circulation



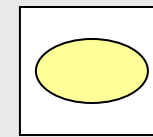


# ***Lymphatic System***

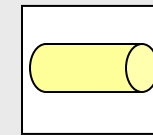
## **1. Lymph Nodes**

## **2. Vessels**

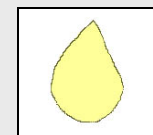
## **3. Lymph**



**+**



**+**



**No pump!**

# **Lymphatic System**

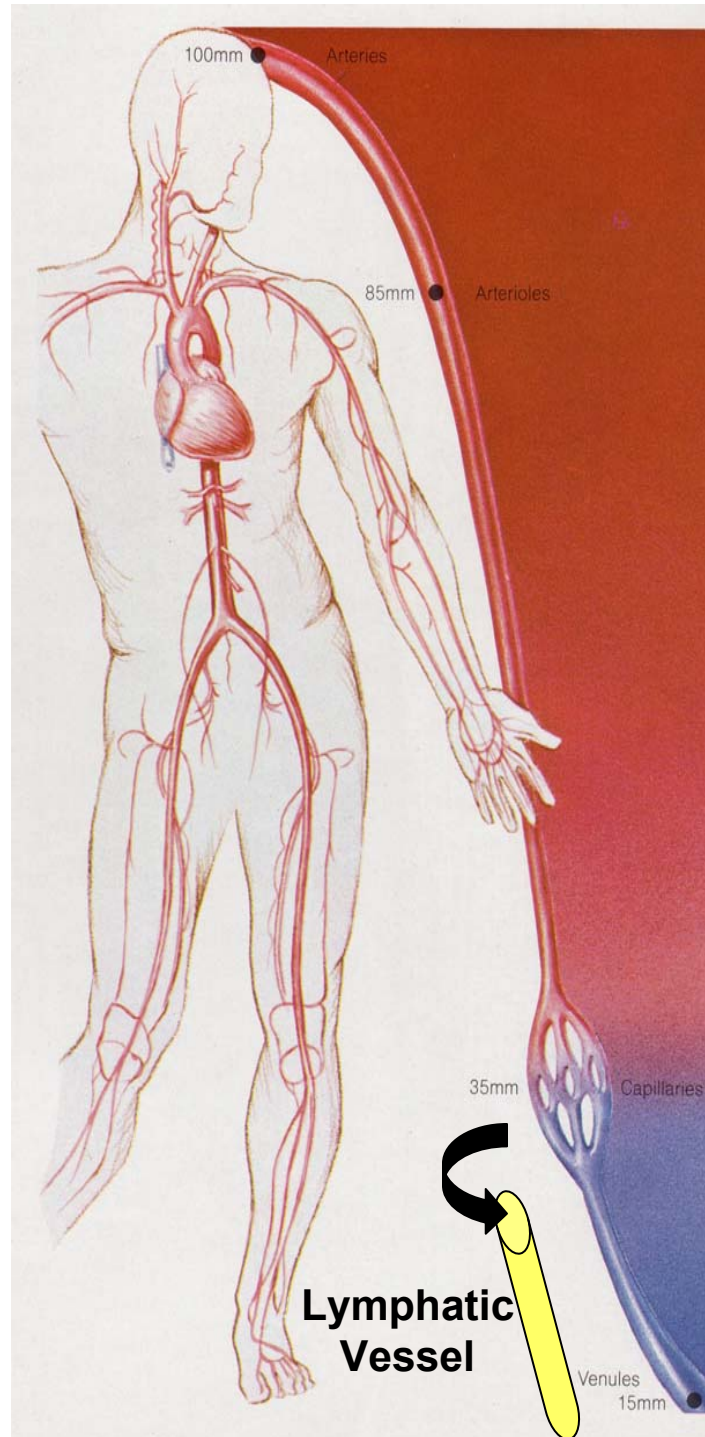
**Alternative System of  
Circulation  
or  
Drainage System**

***Lymph Vessels || Veins***

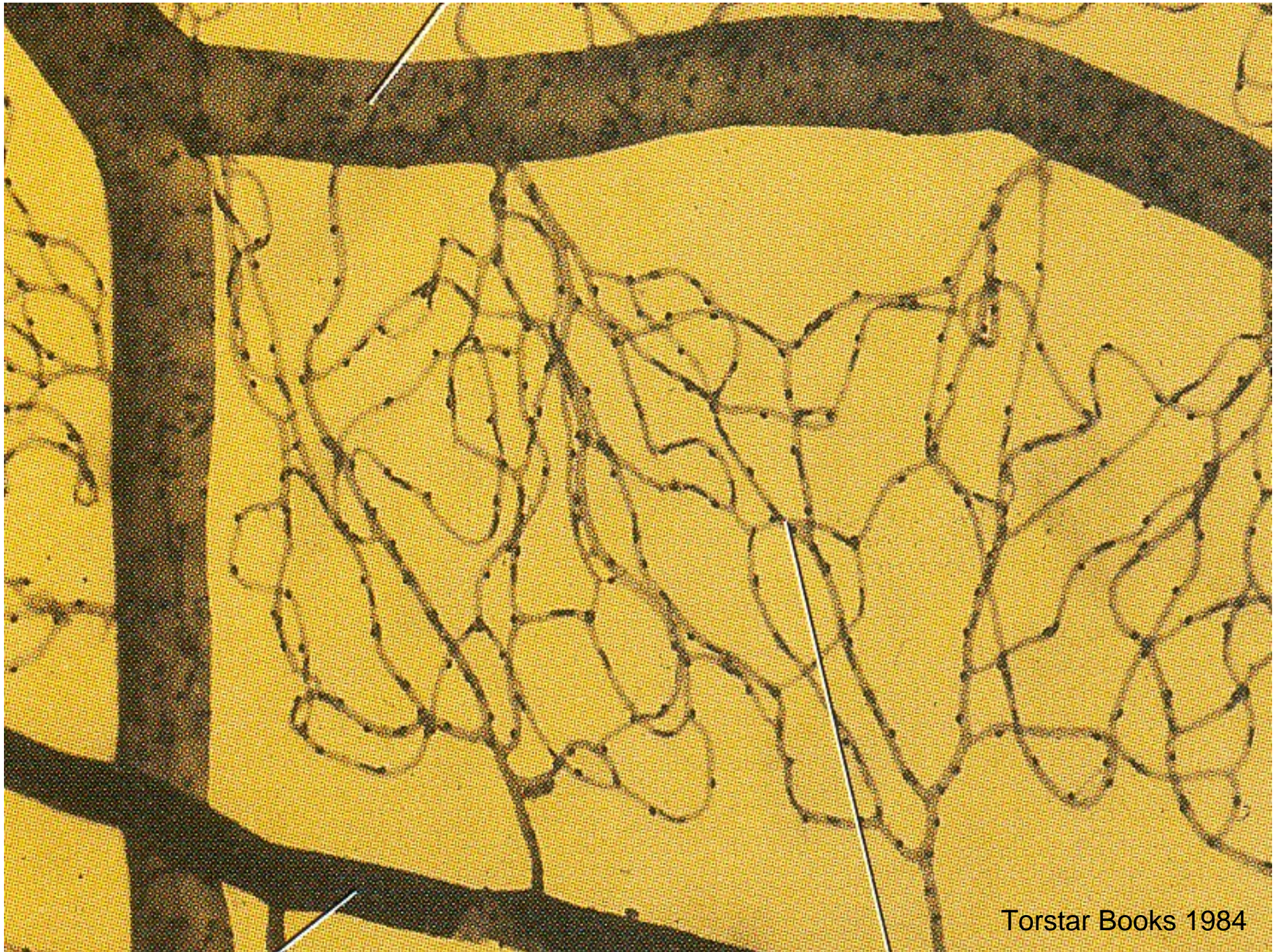
# ***Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm***



Fred Marsik/Visuals Unlimited



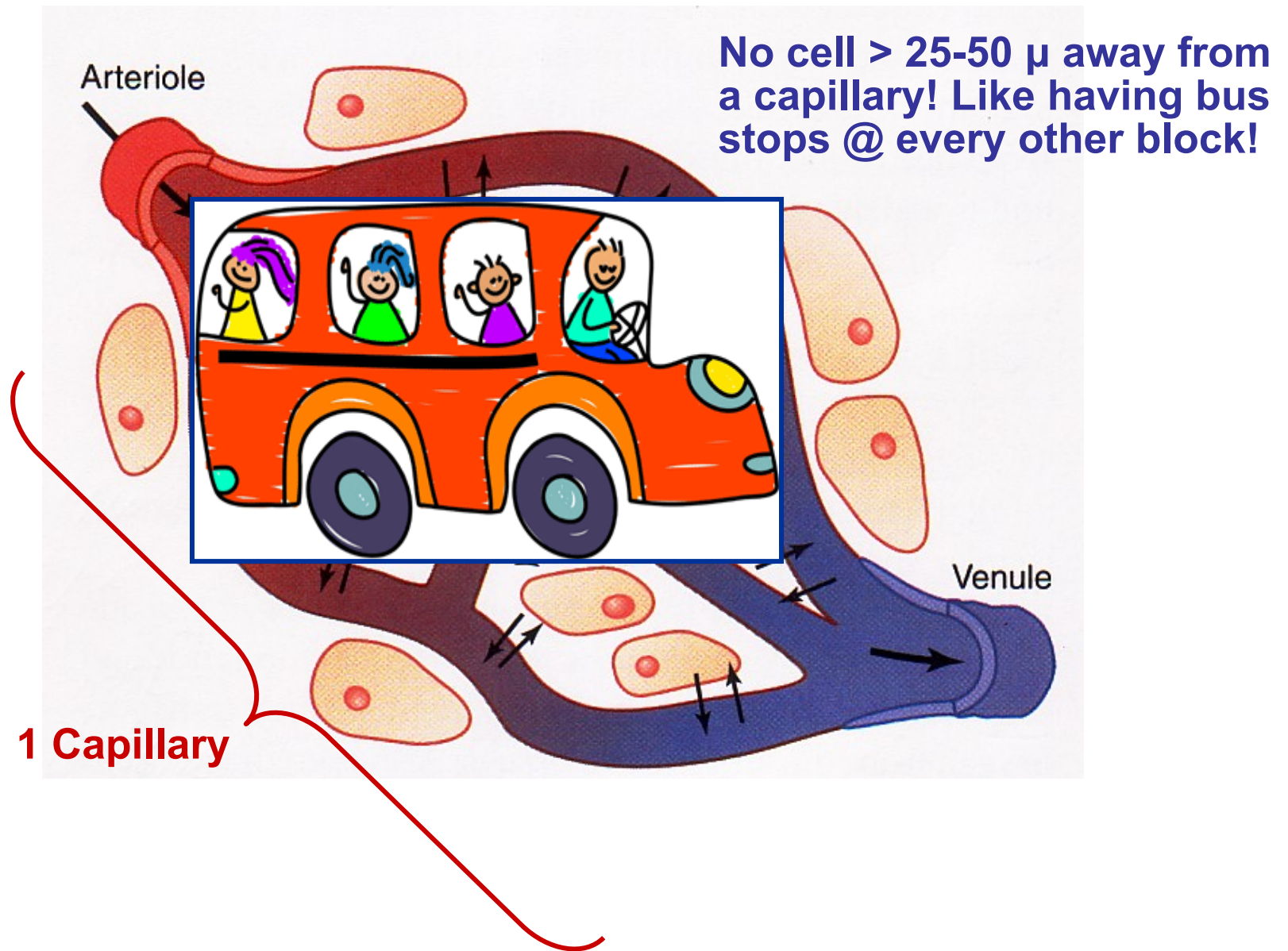
**Lymphatics collect run-off & are parallel to venules/small veins!**

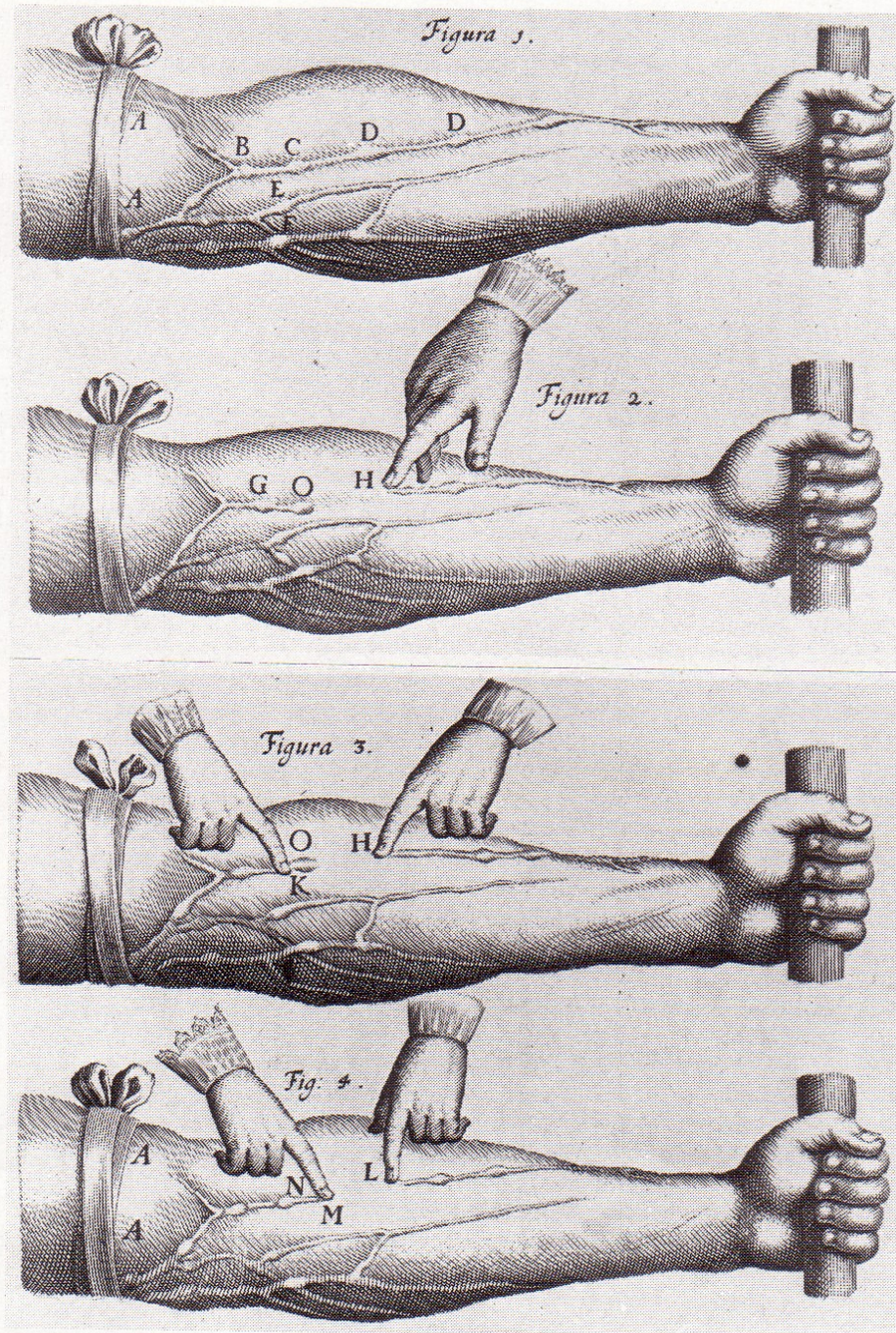


Torstar Books 1984



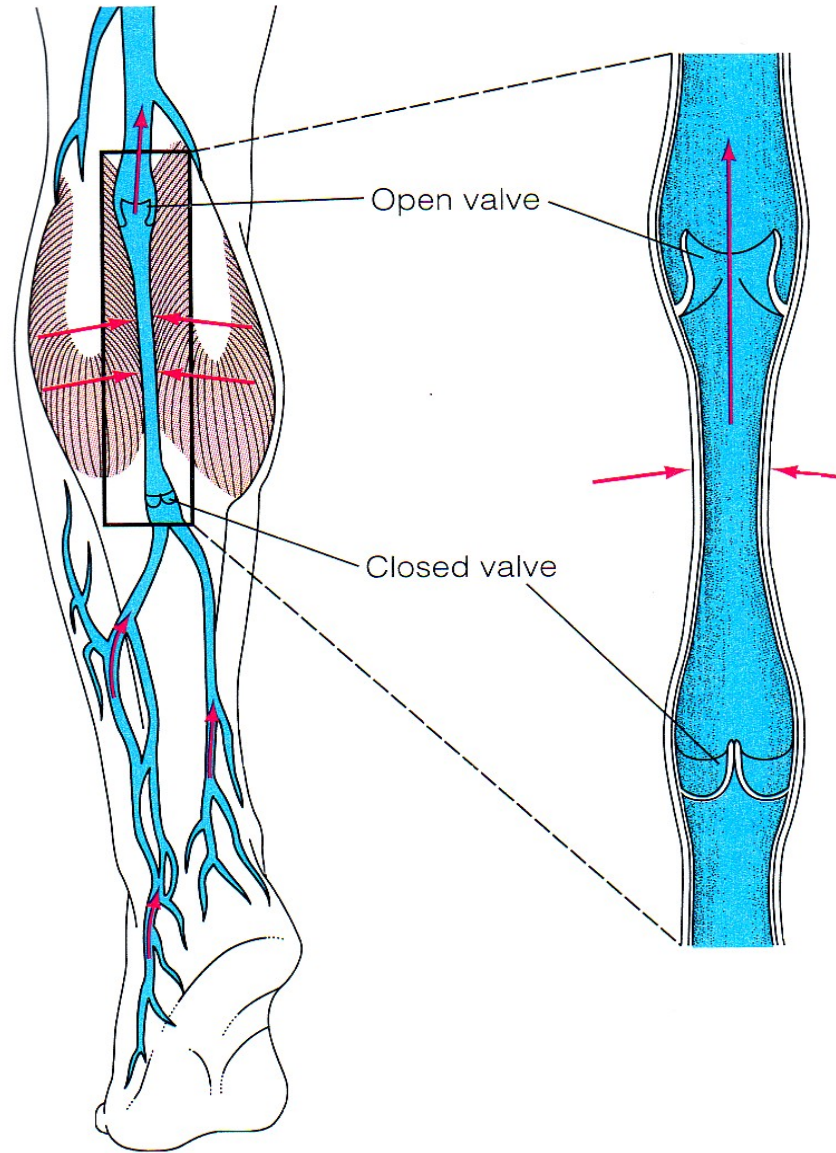
# Microcirculation Exchange: 10 Billion Capillaries!





**Harvey  
Experiments:  
1-way system  
of venous  
valves!**

# *Skeletal Muscle Pump*

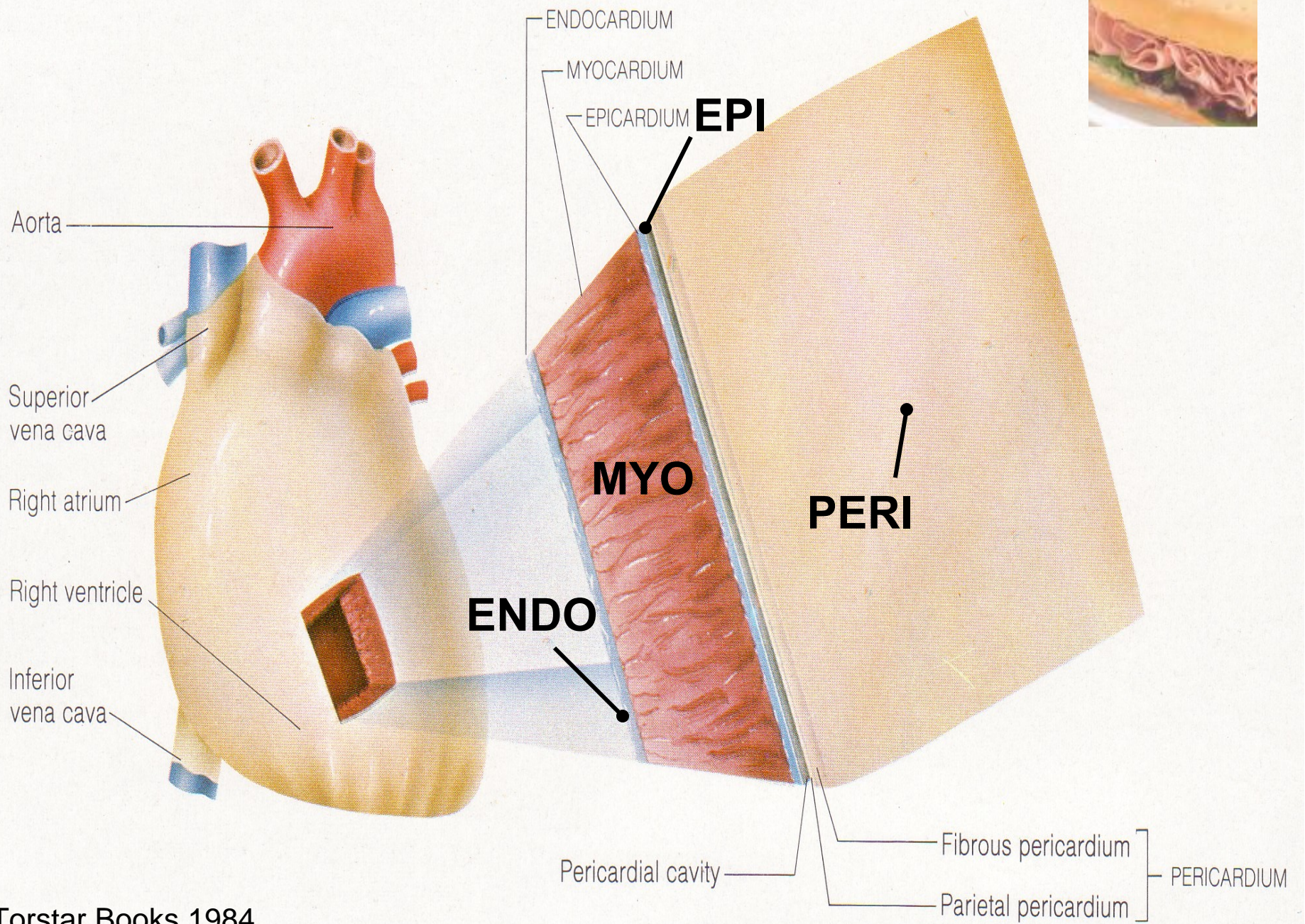




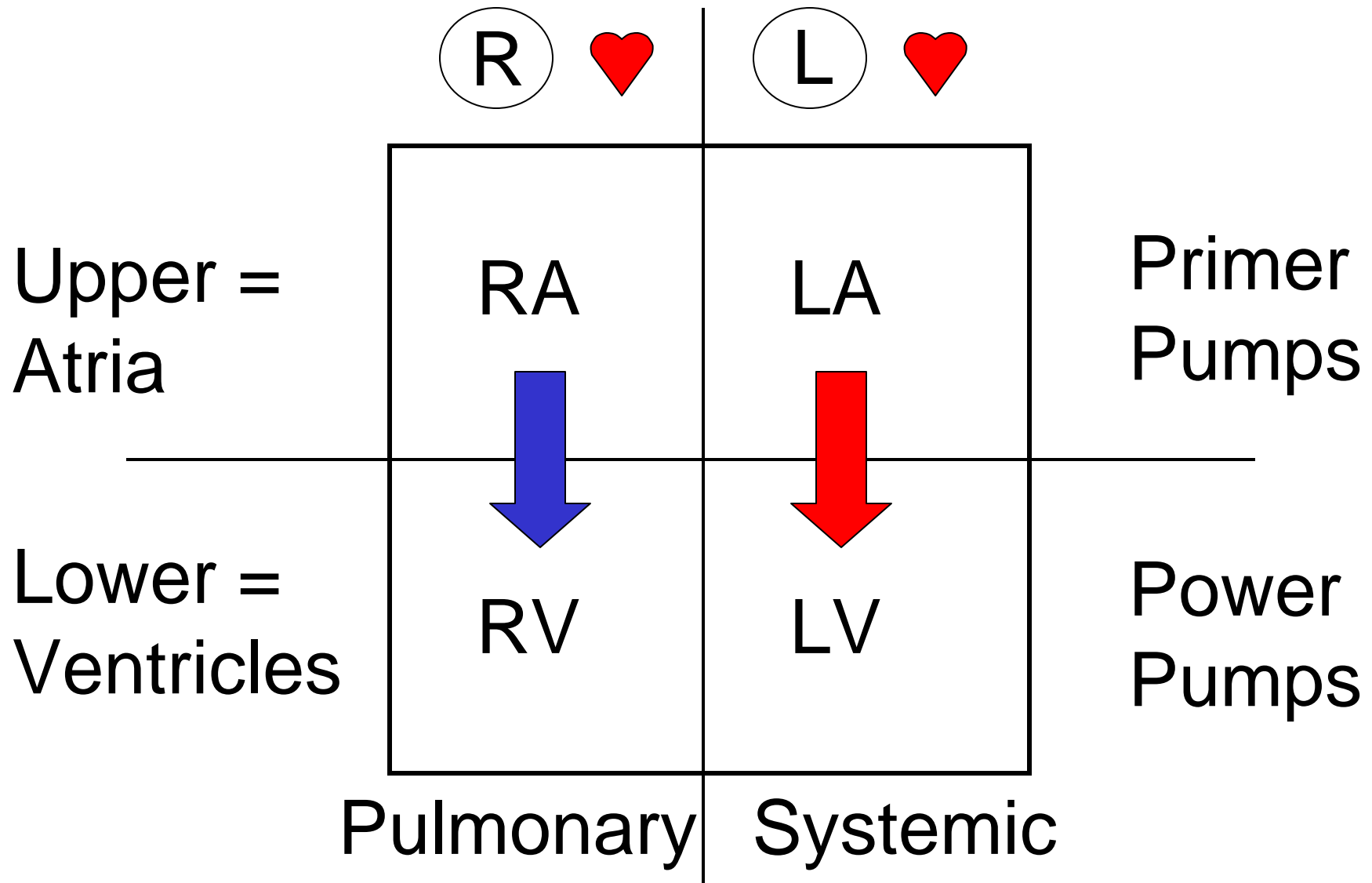
DC 2003

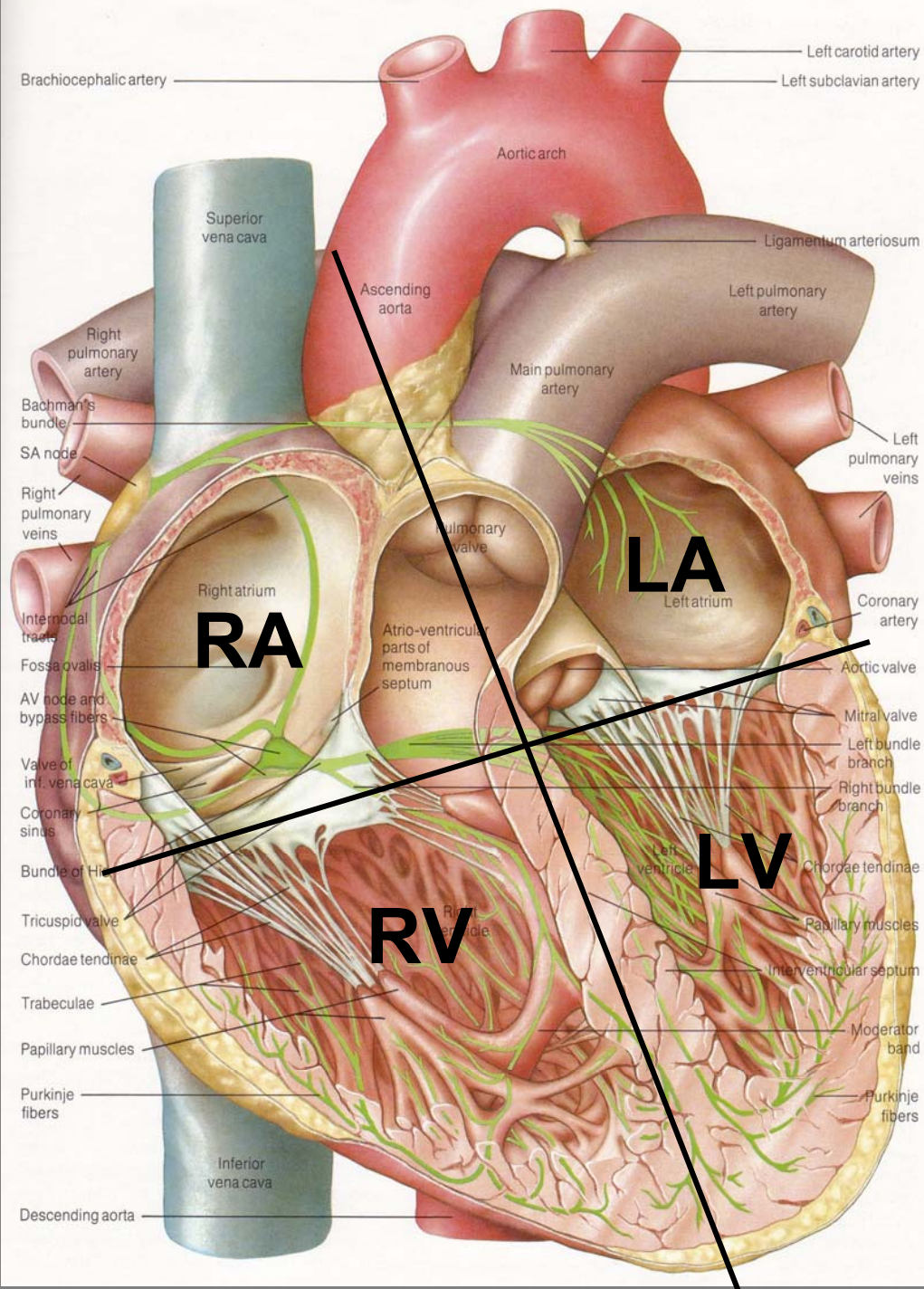
# The Heart

The Living Pump

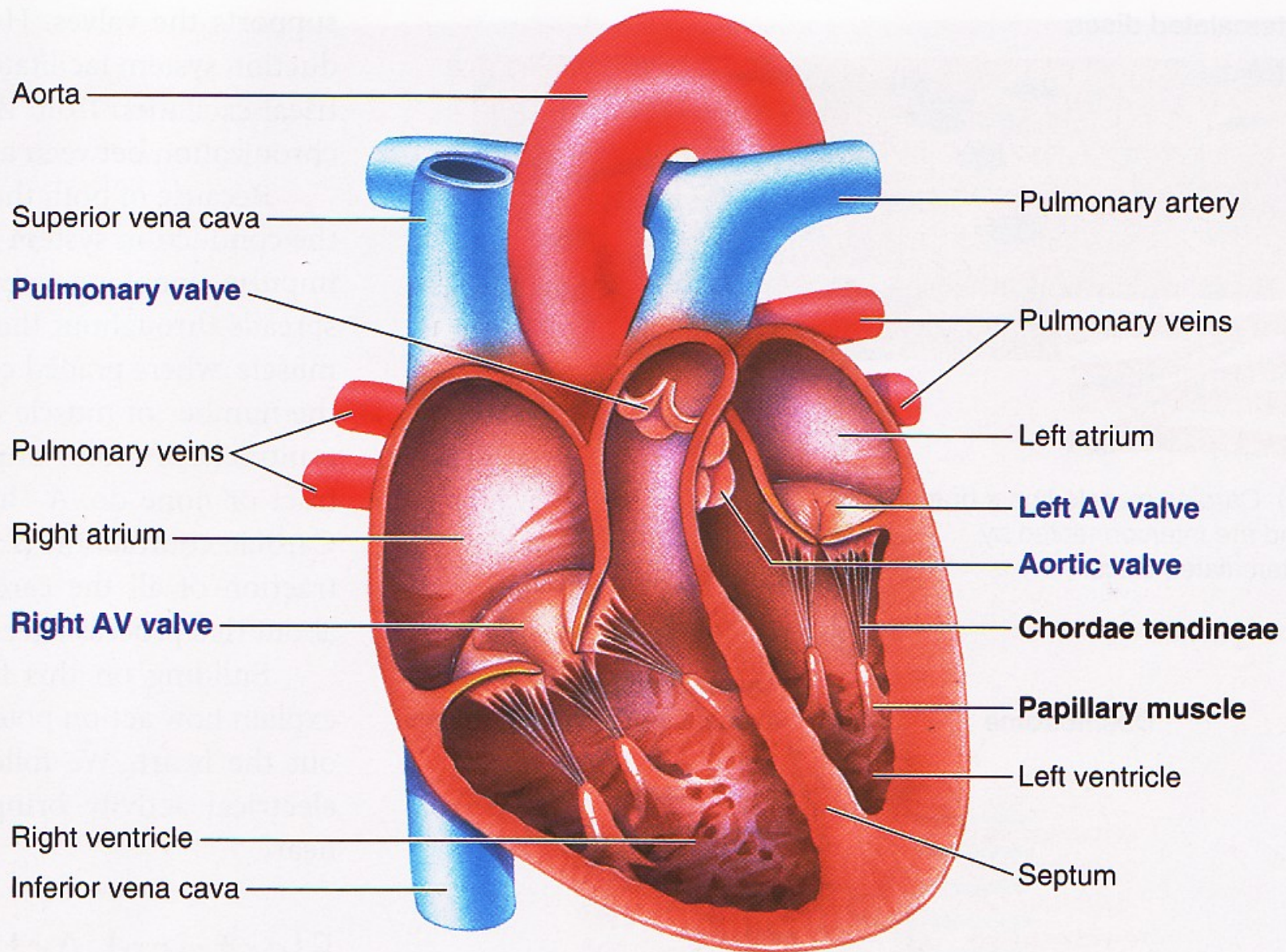


Human  = 4-chambered box?  
2 separate pumps?



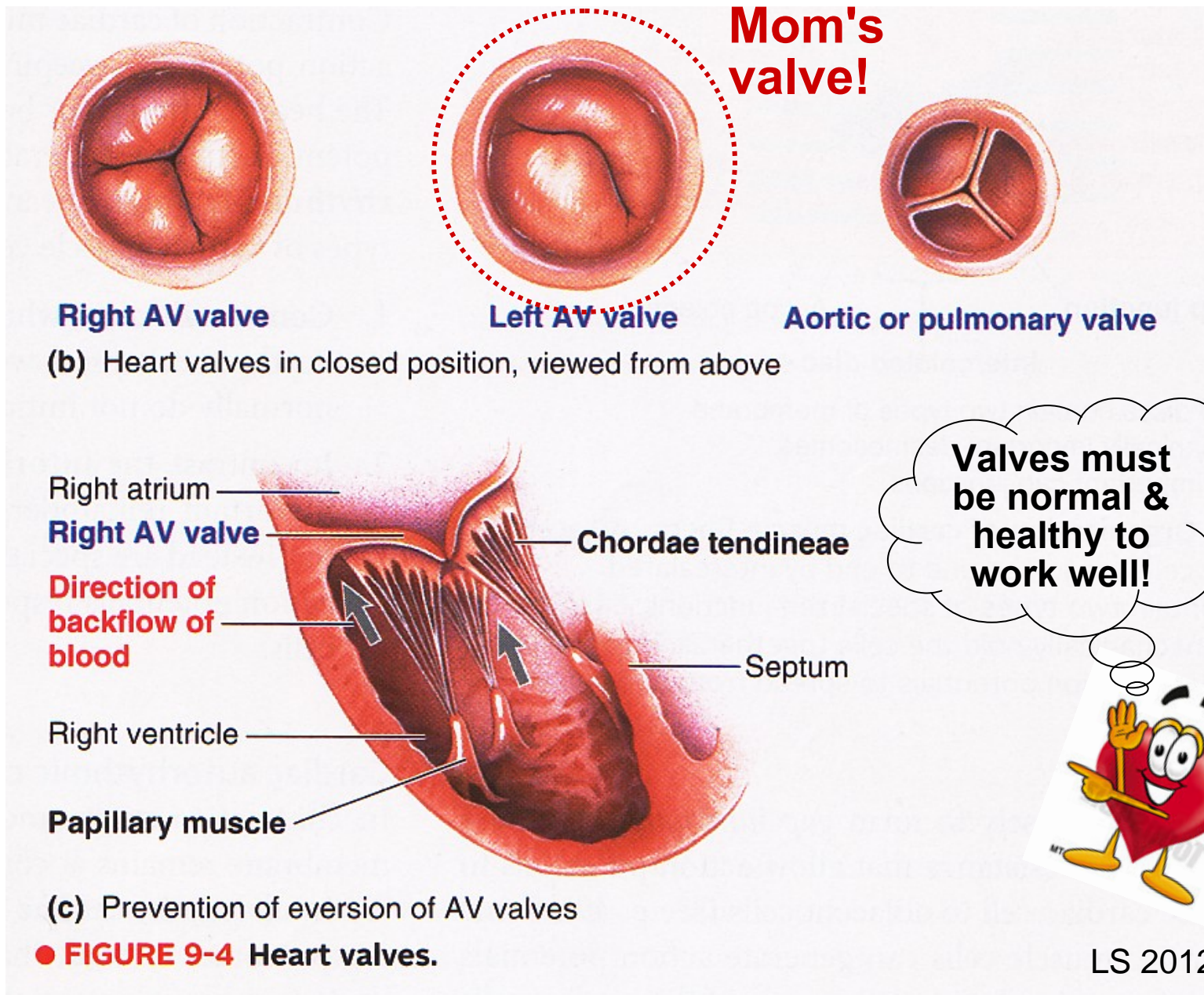






(a) Location of the heart valves in a longitudinal section of the heart

# Heart Valves Ensure Unidirectional Blood Flow!



Human ♥ = 4 unique valves?  
2 valve sets?

Semilunar = Half-moon shaped

More rigid

1. Pulmonic/Pulmonary
2. Aortic



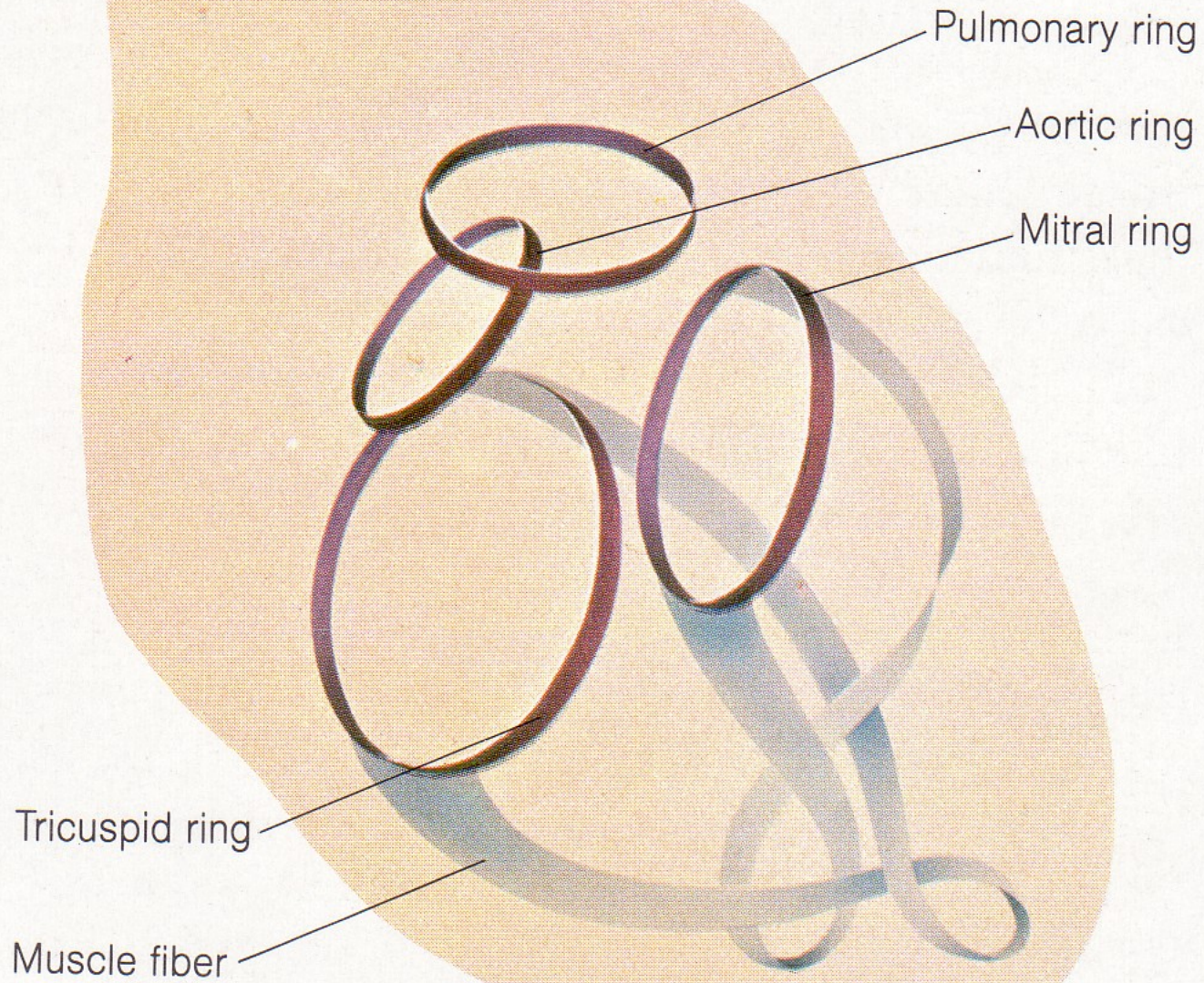
AV = Atrioventricular

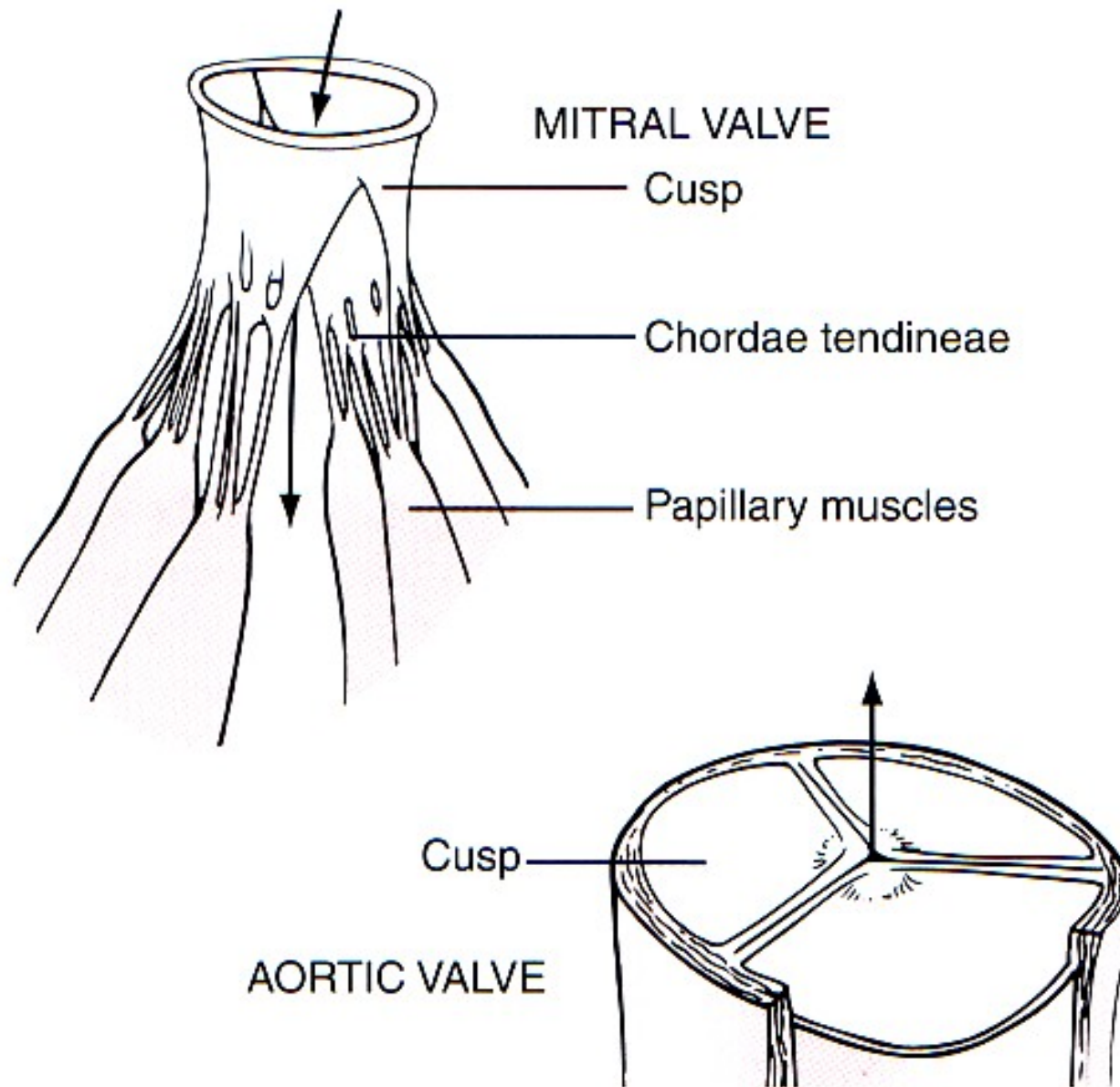
More flimsy

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



# Heart Valve Orientation & Scaffolding

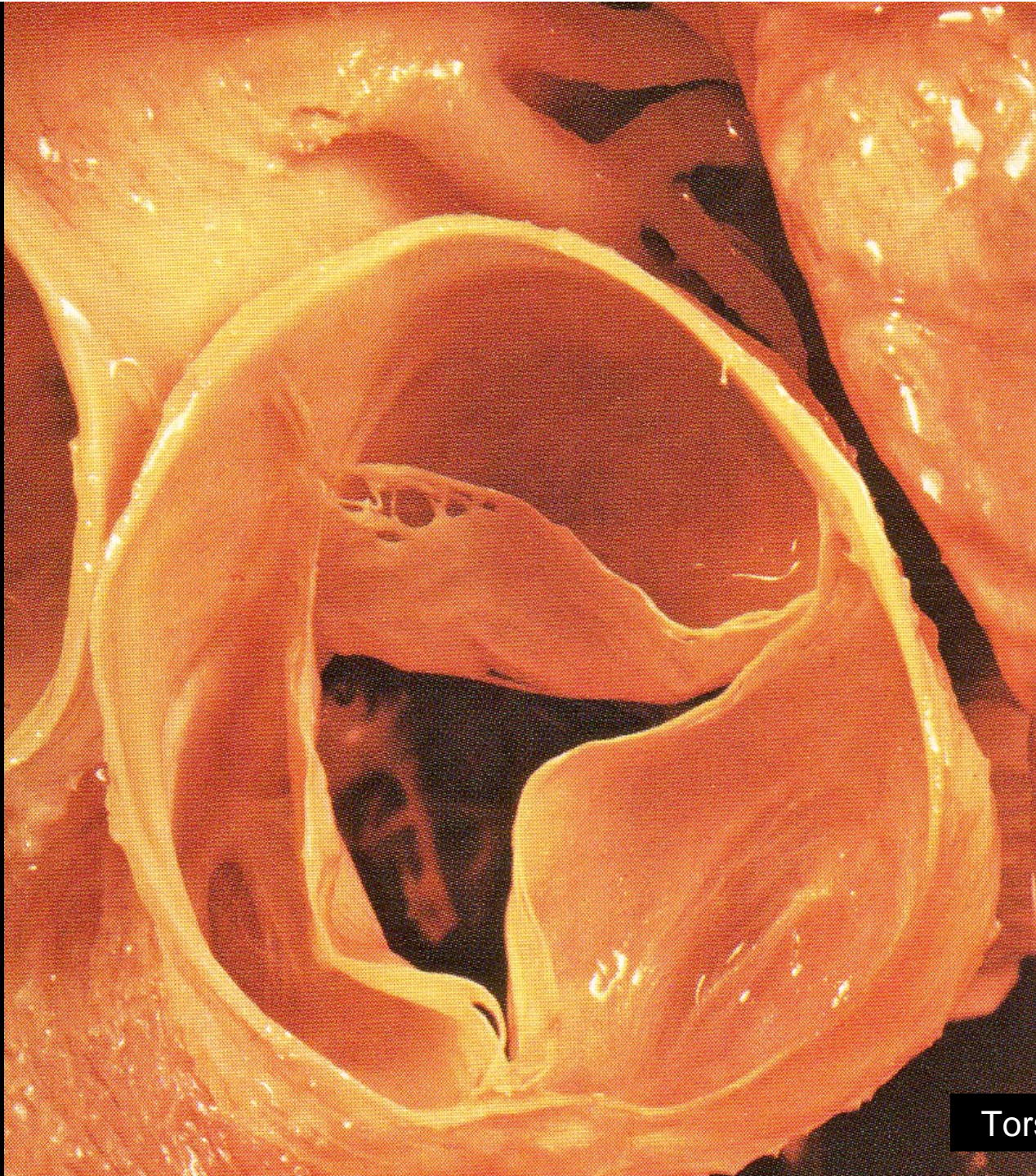


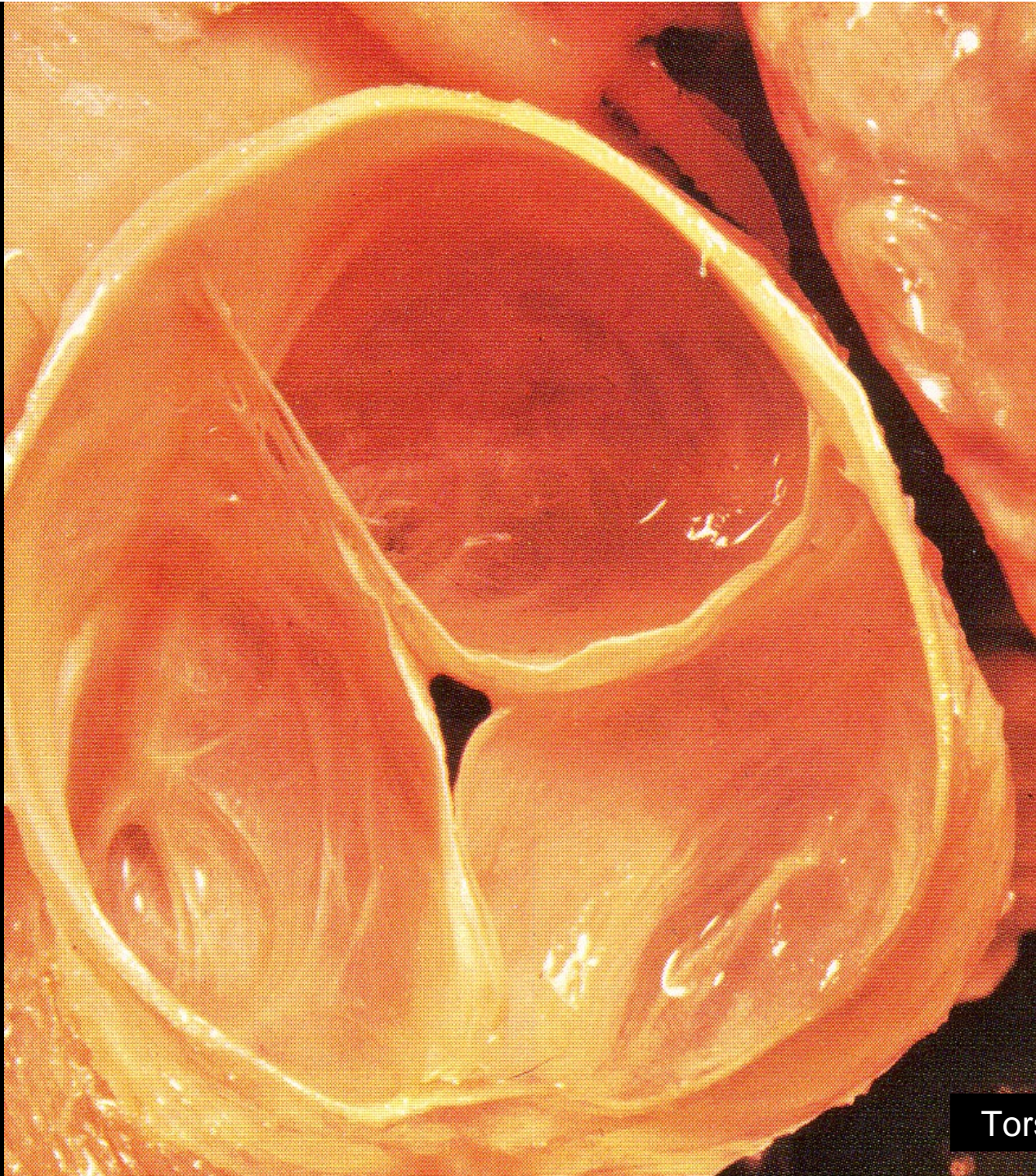


**FIGURE 9-6**

Mitral and aortic valves.

Guyton & Hall



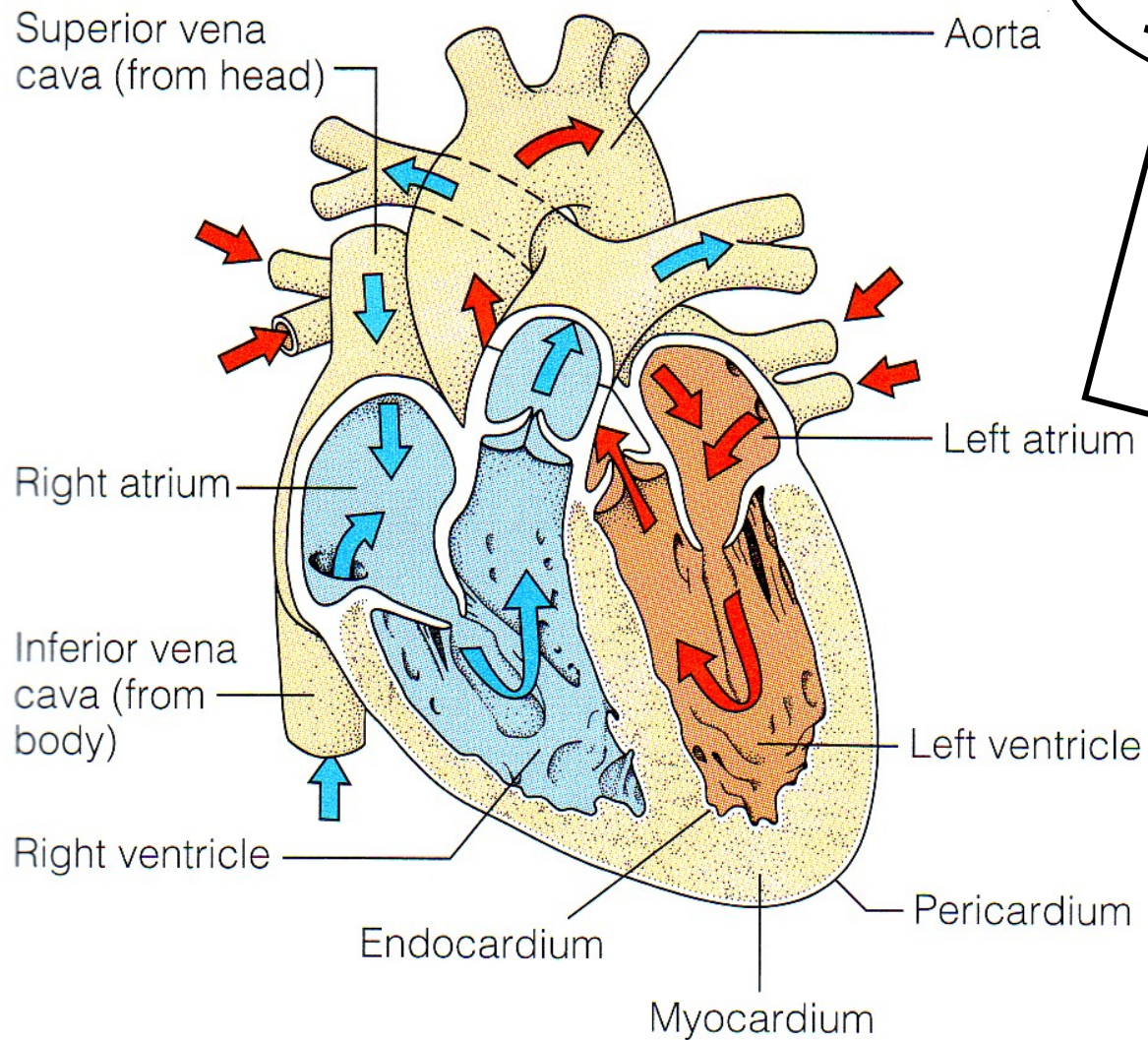




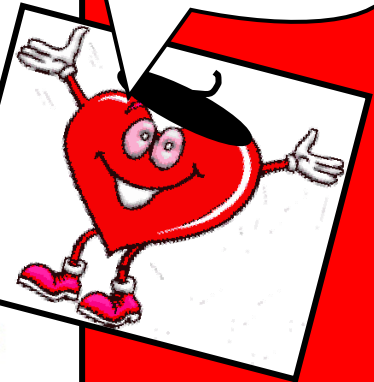
Torstar Books 1984



# Veins → Atria → Ventricles → Arteries

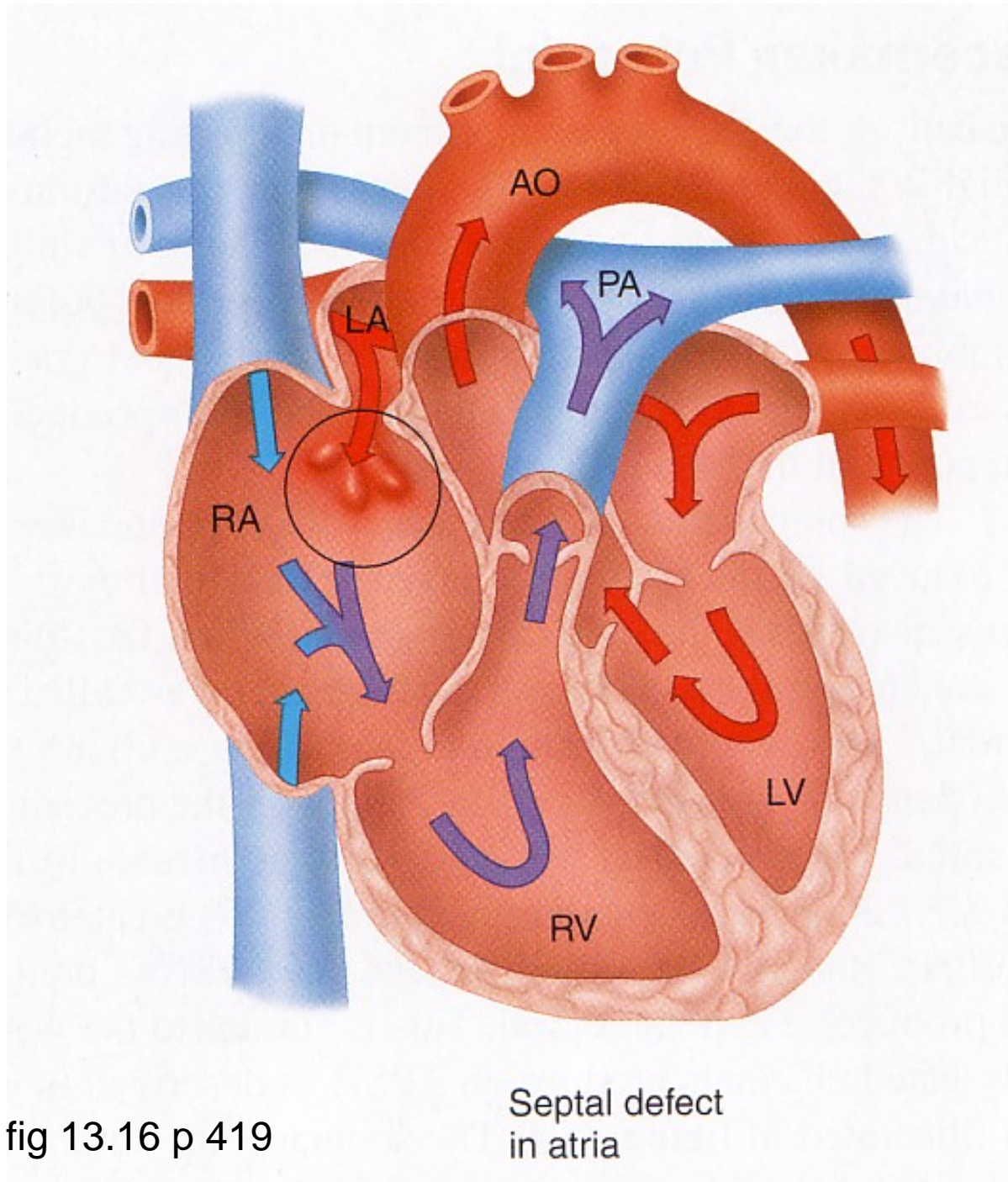


VAVA!



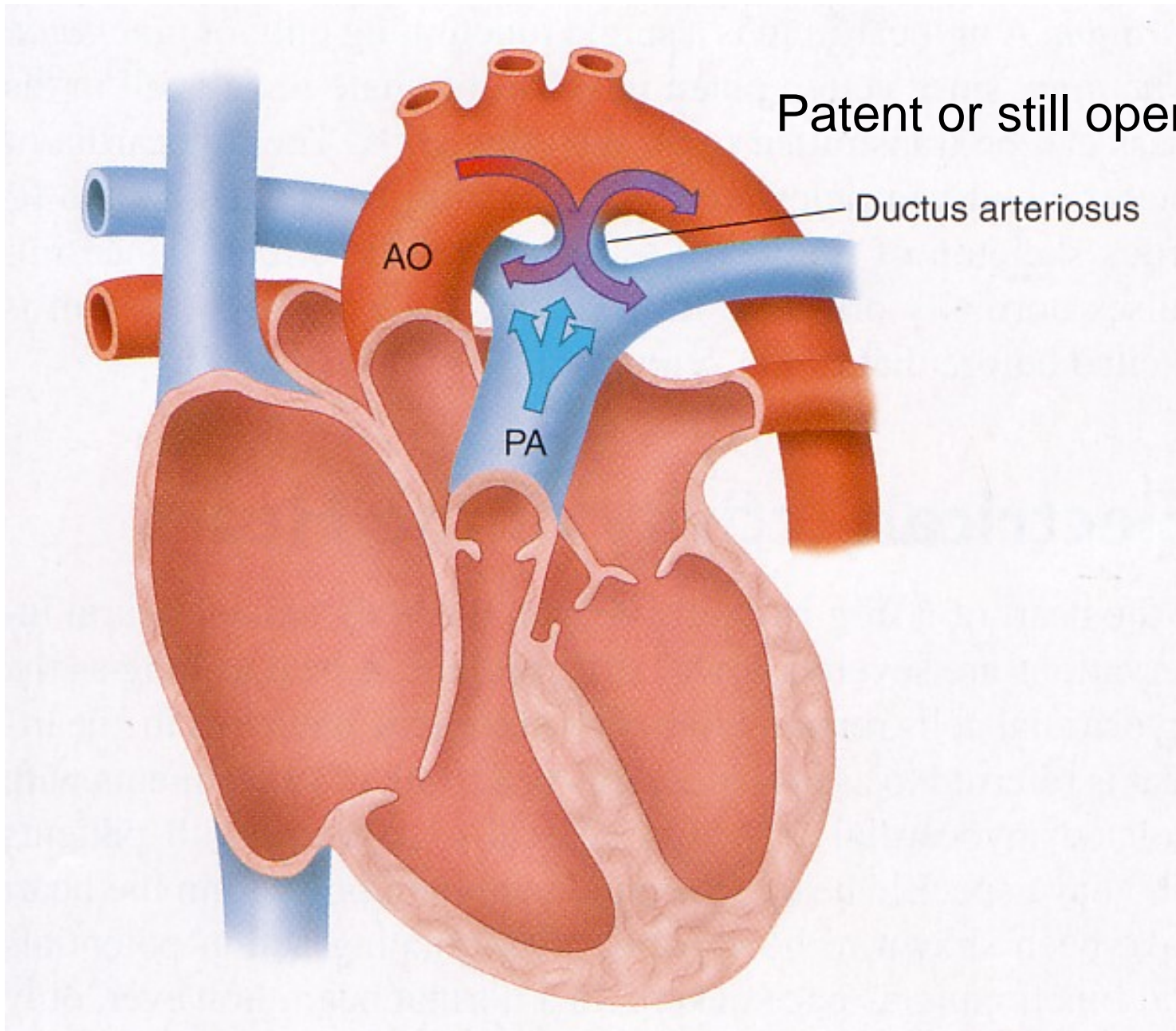
<http://www.nhlbi.nih.gov/health/health-topics/topics/hhw/contraction.html>

LS2007



SI Fox 2009 fig 13.16 p 419

Septal defect  
in atria



SI Fox 2009 fig 13.17 p 420