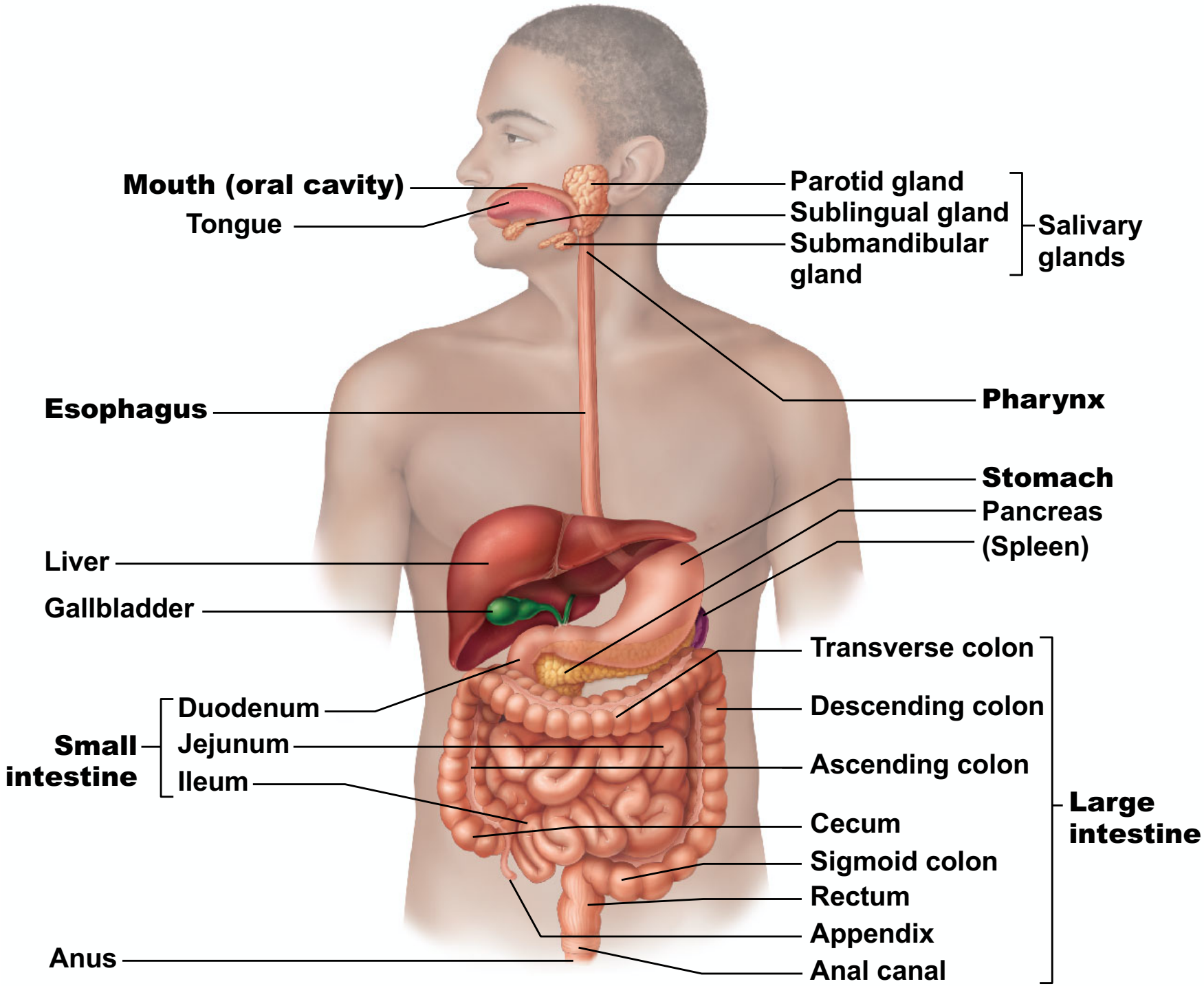
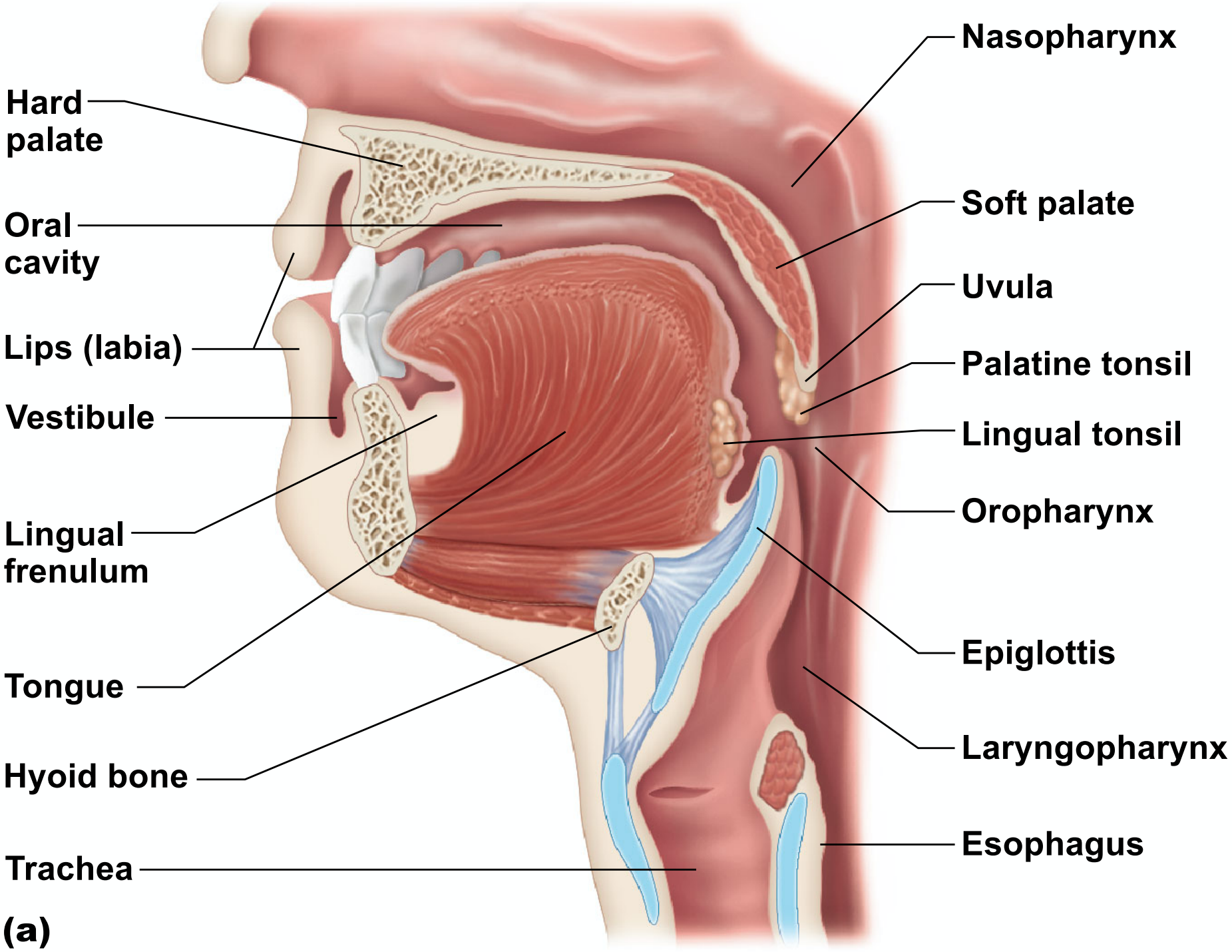
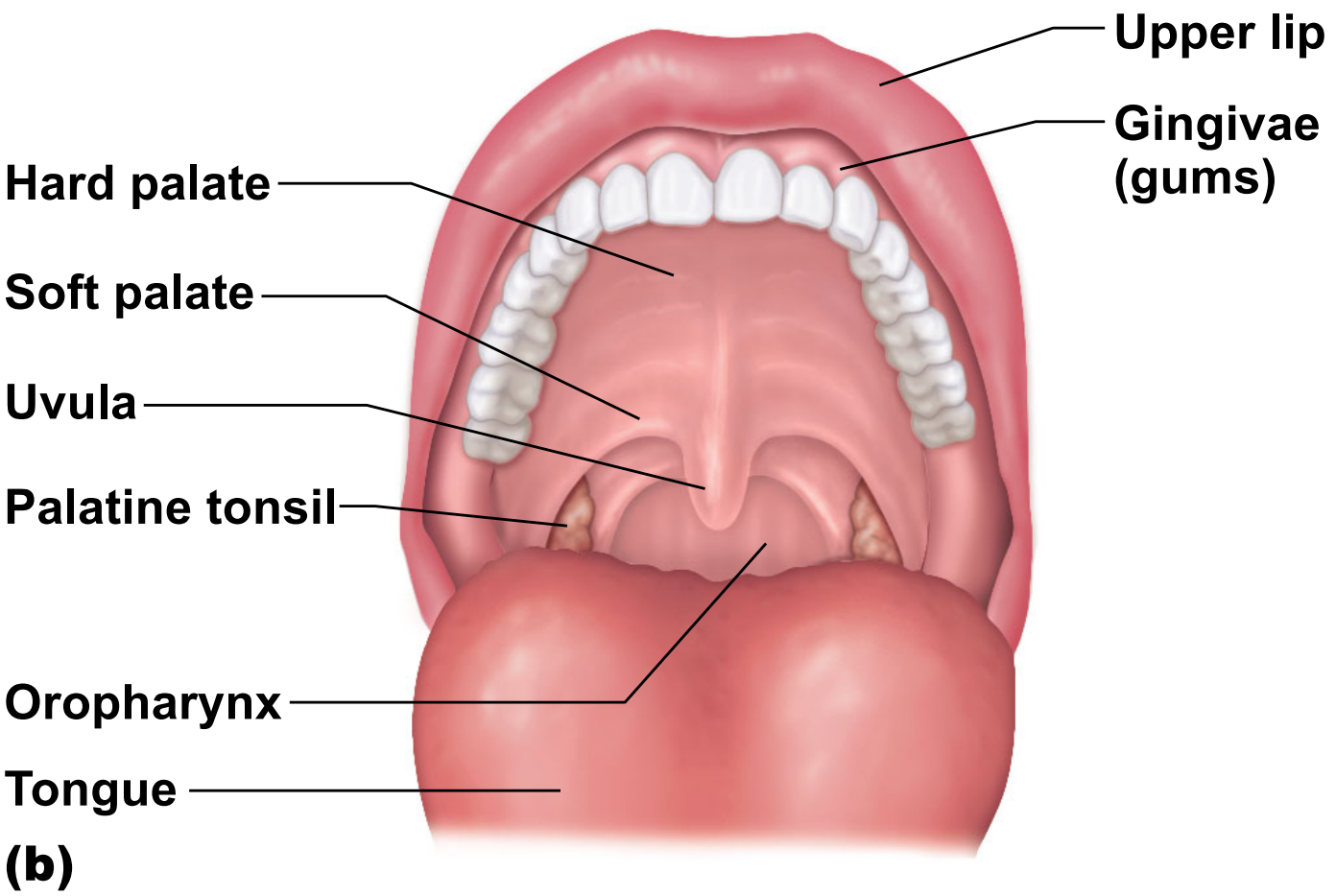
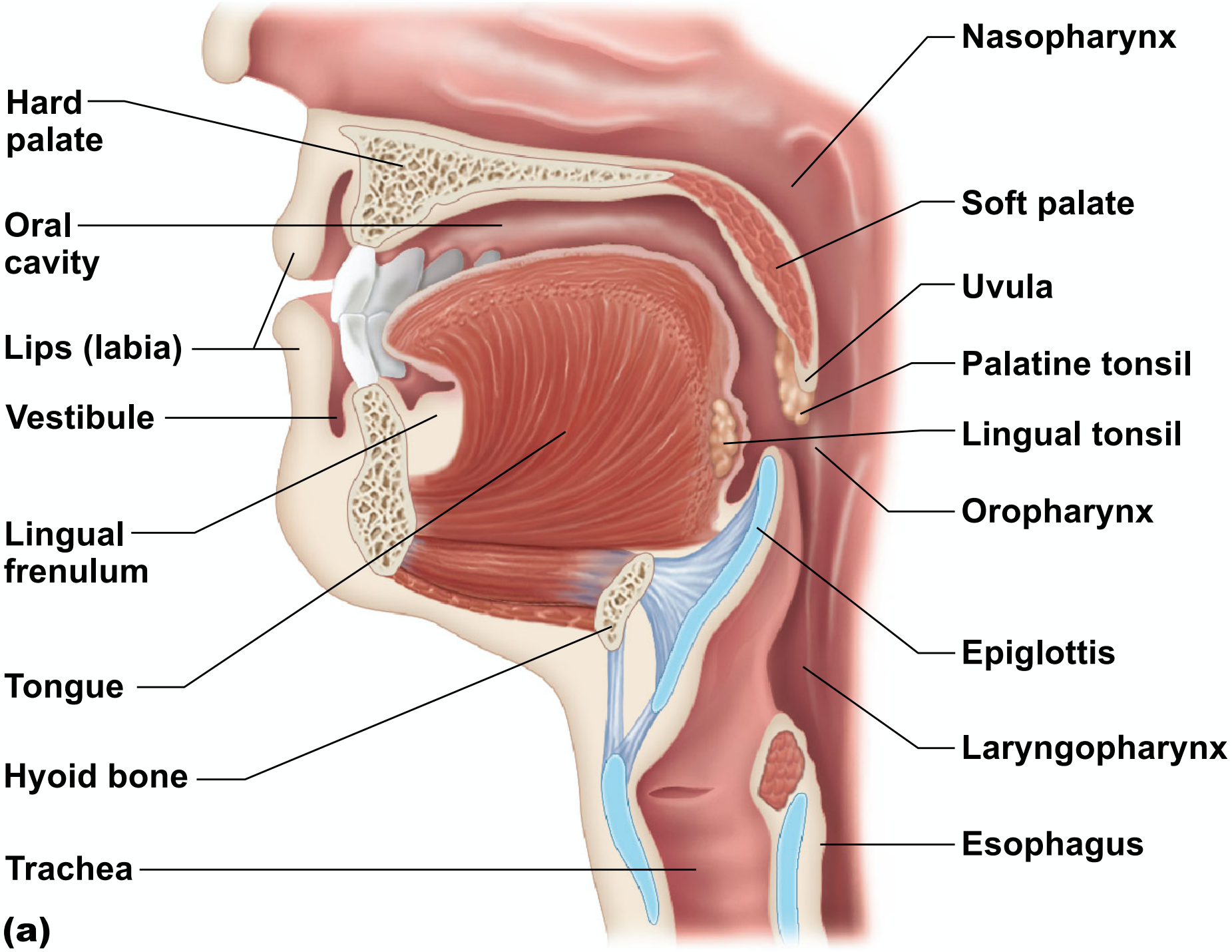
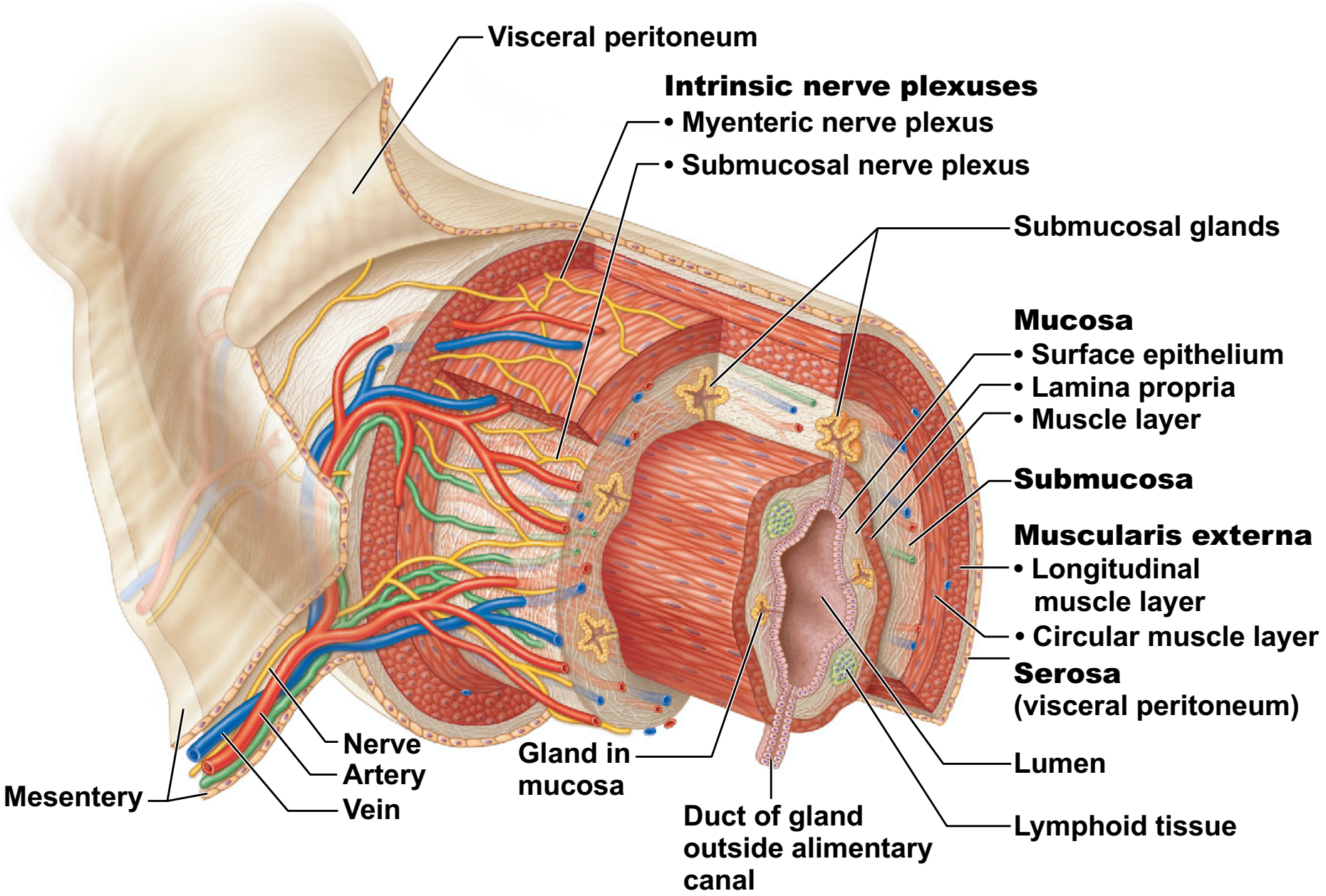


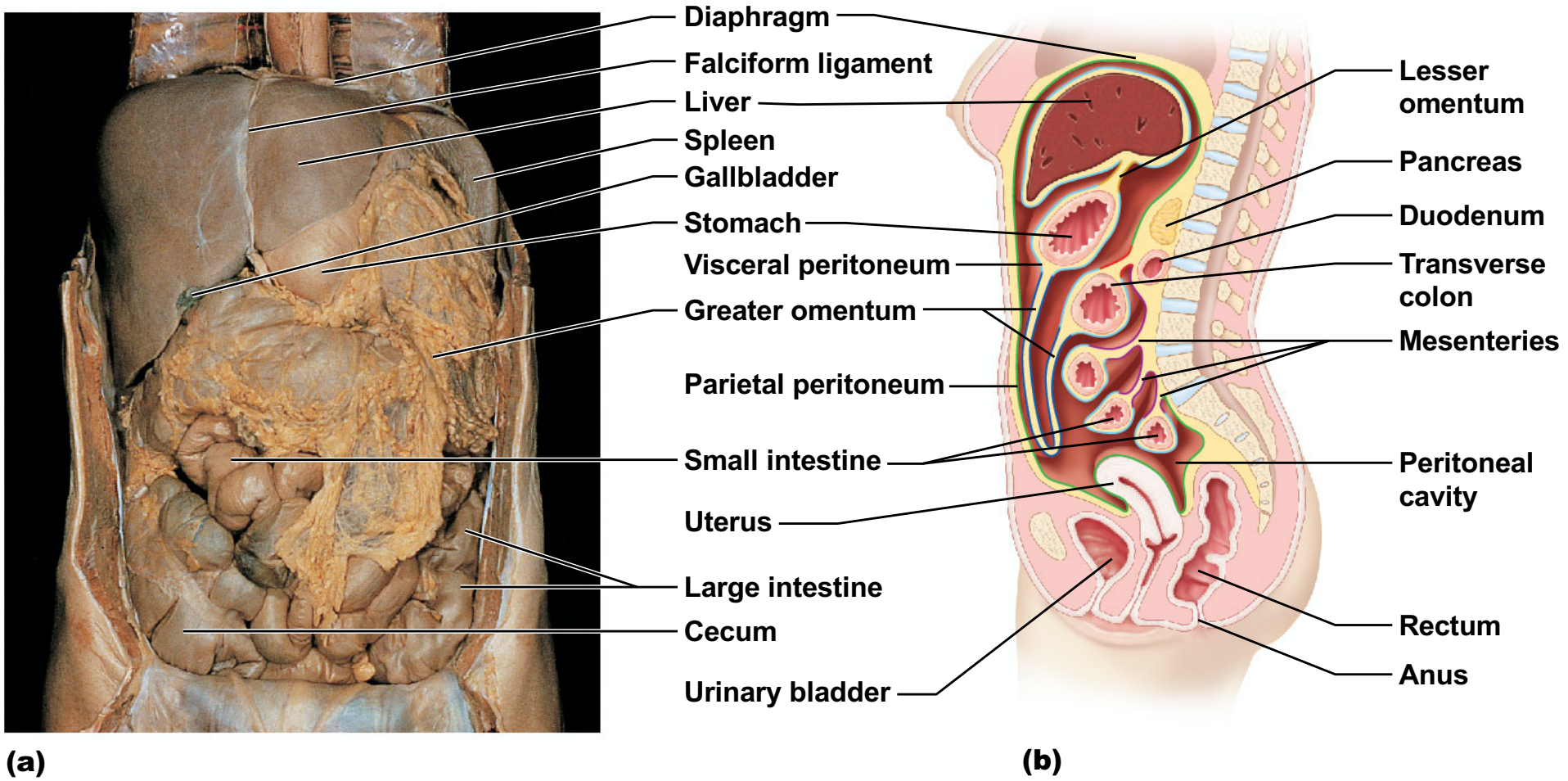


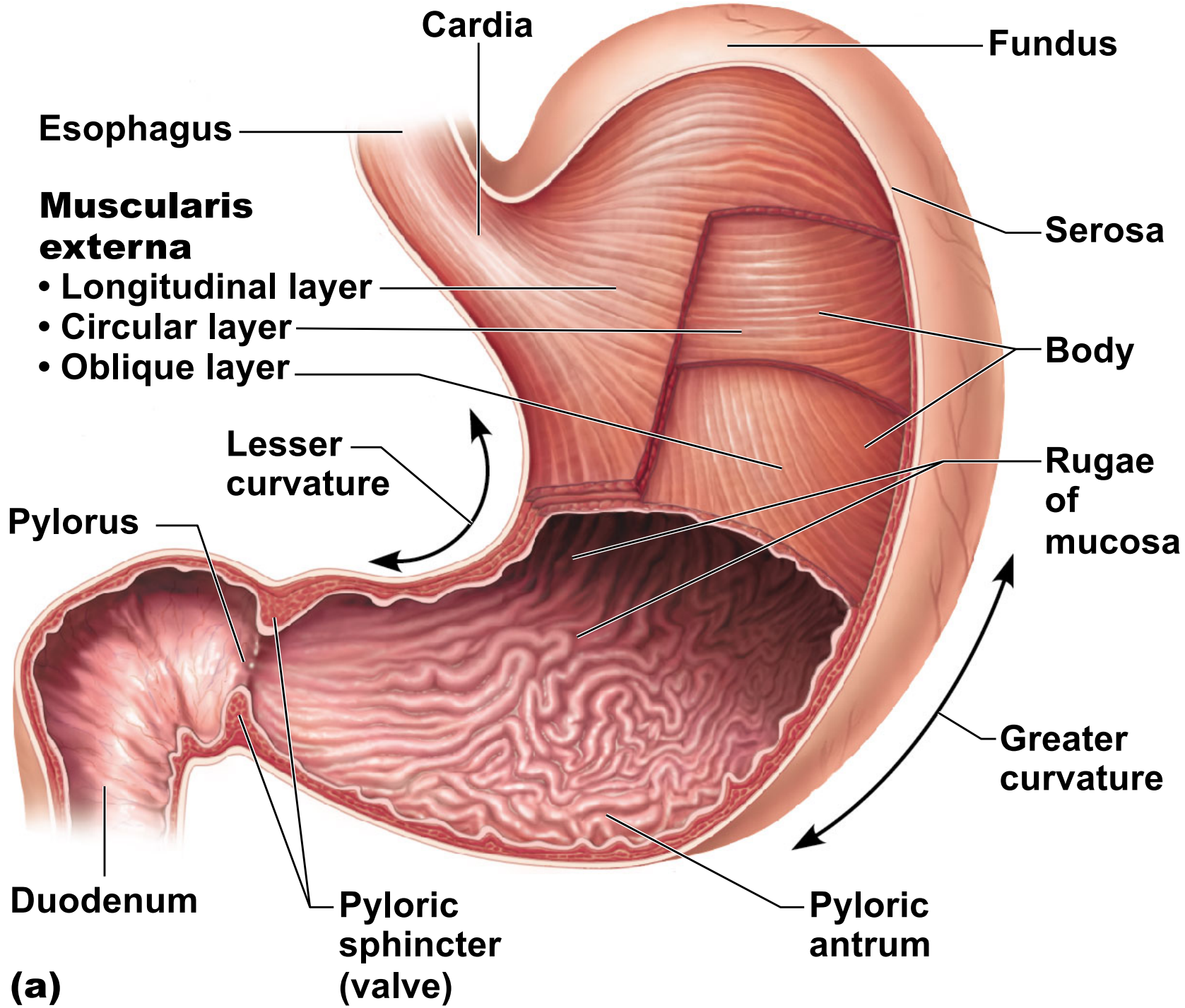
(a)

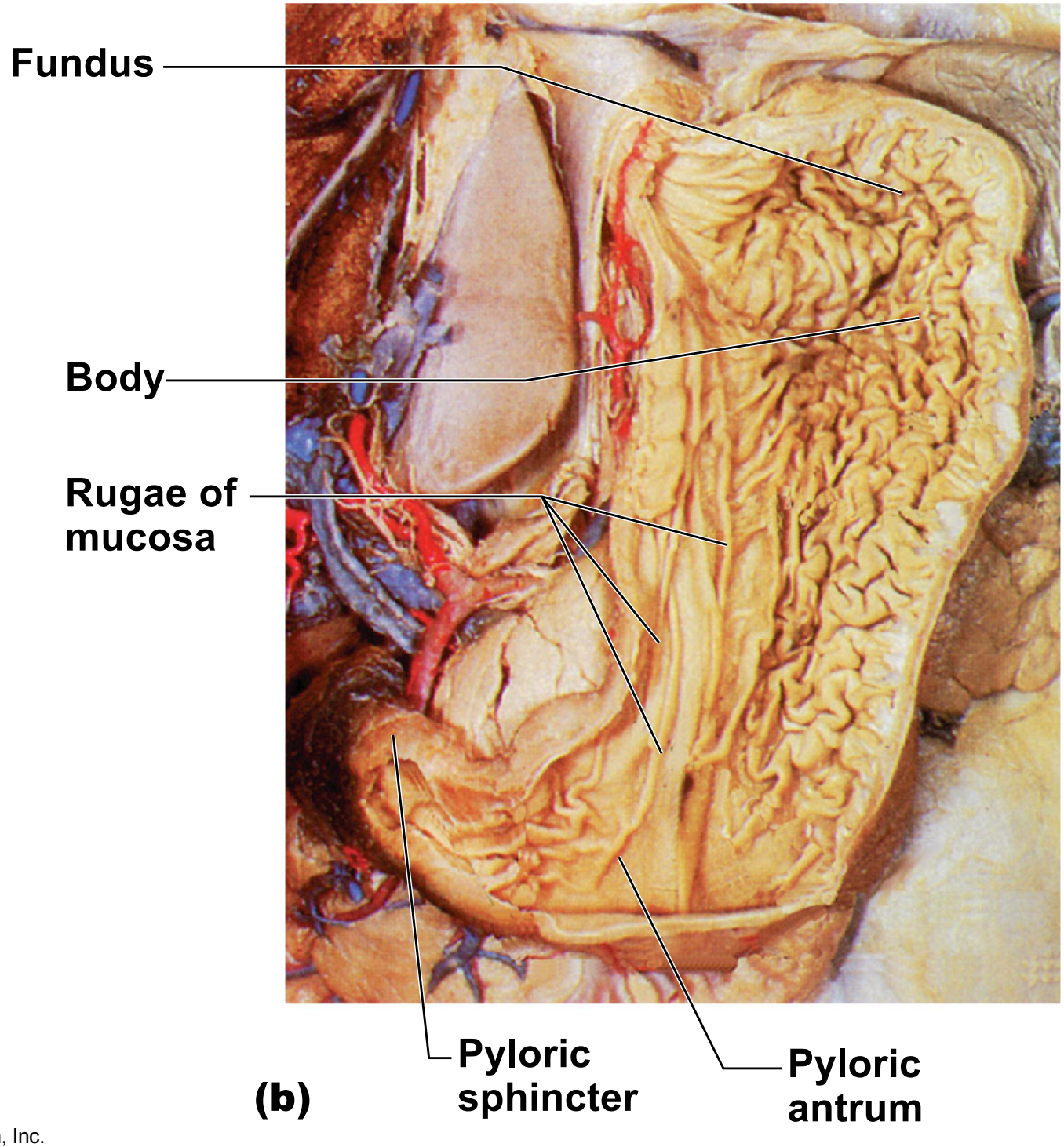


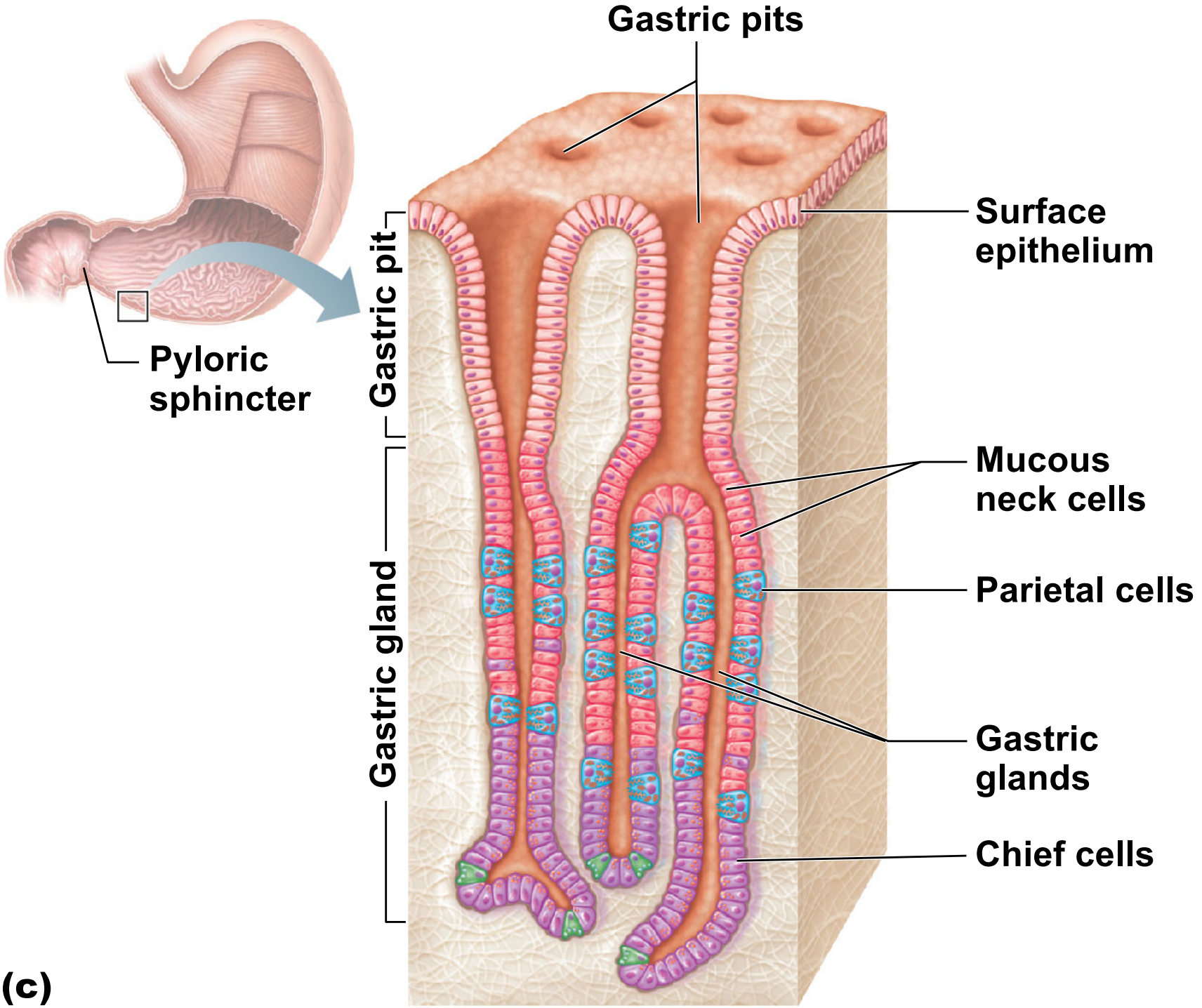




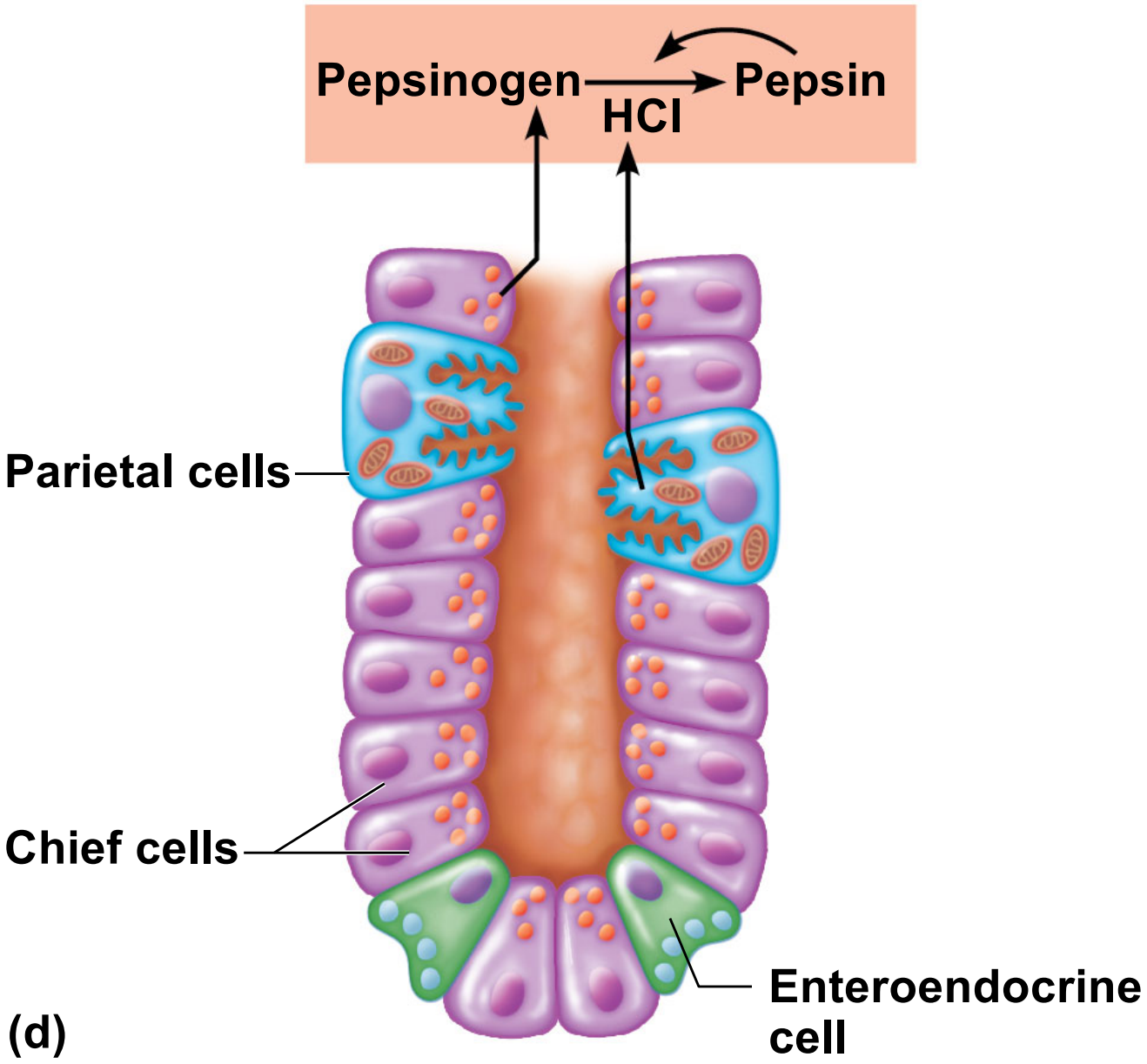


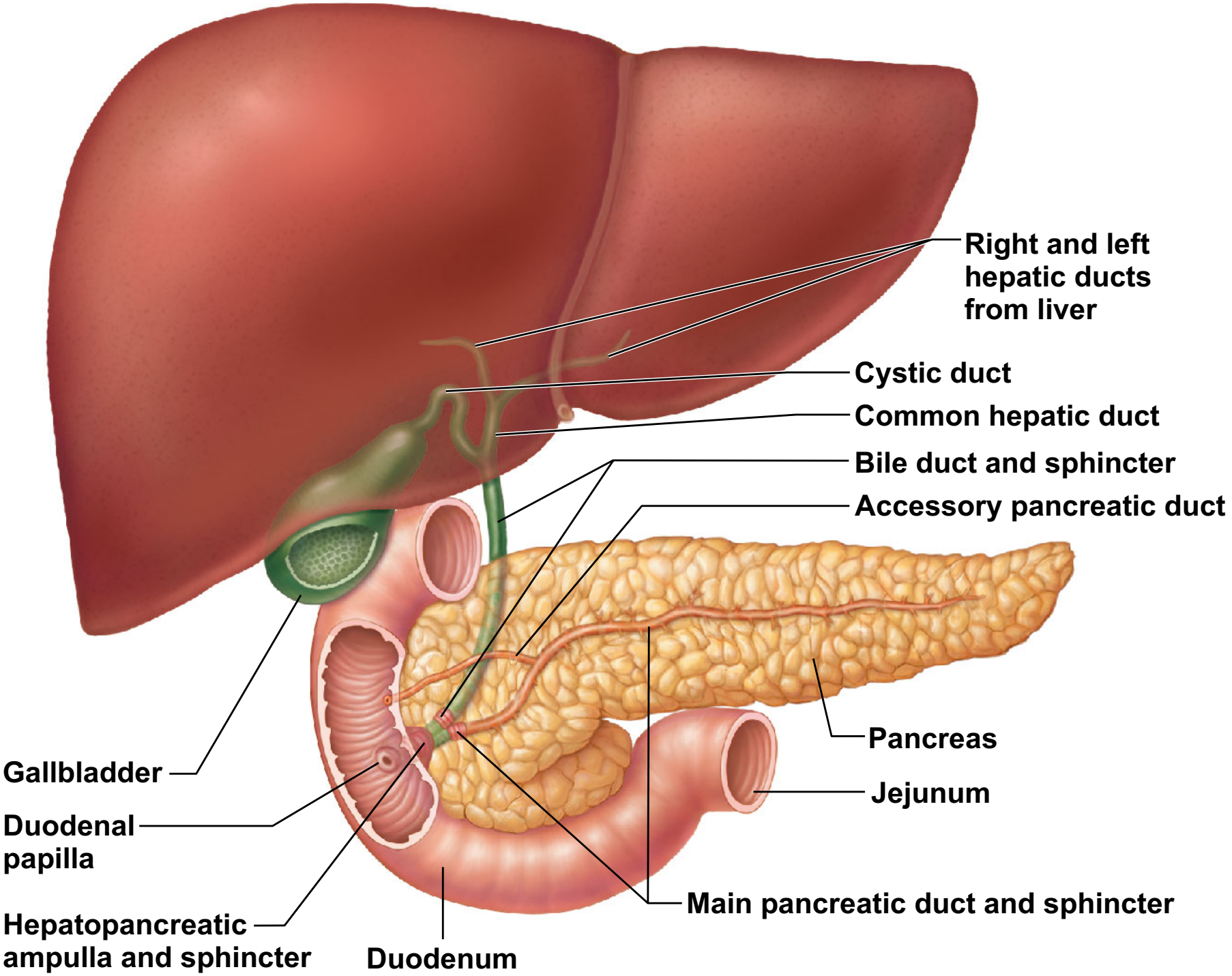


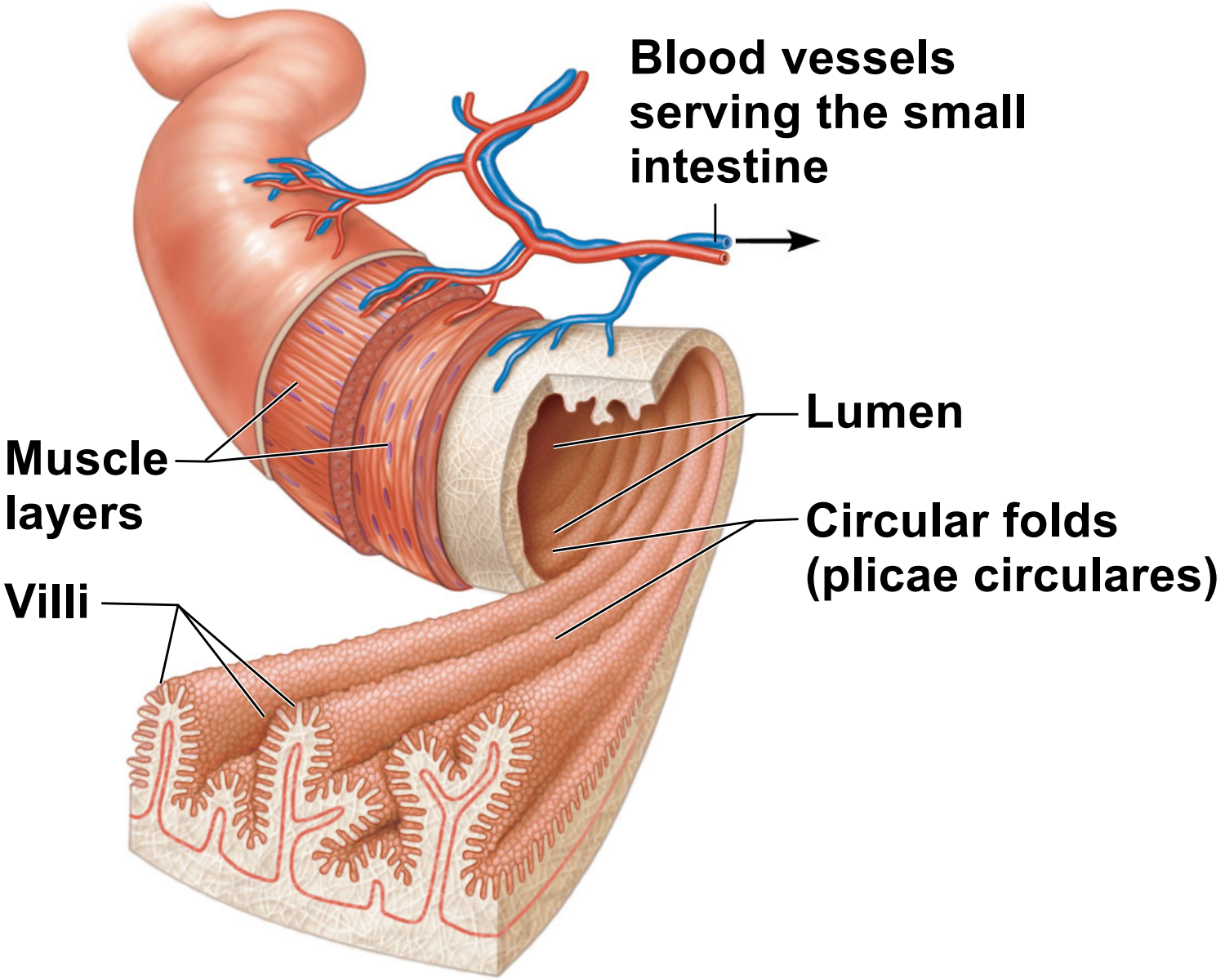




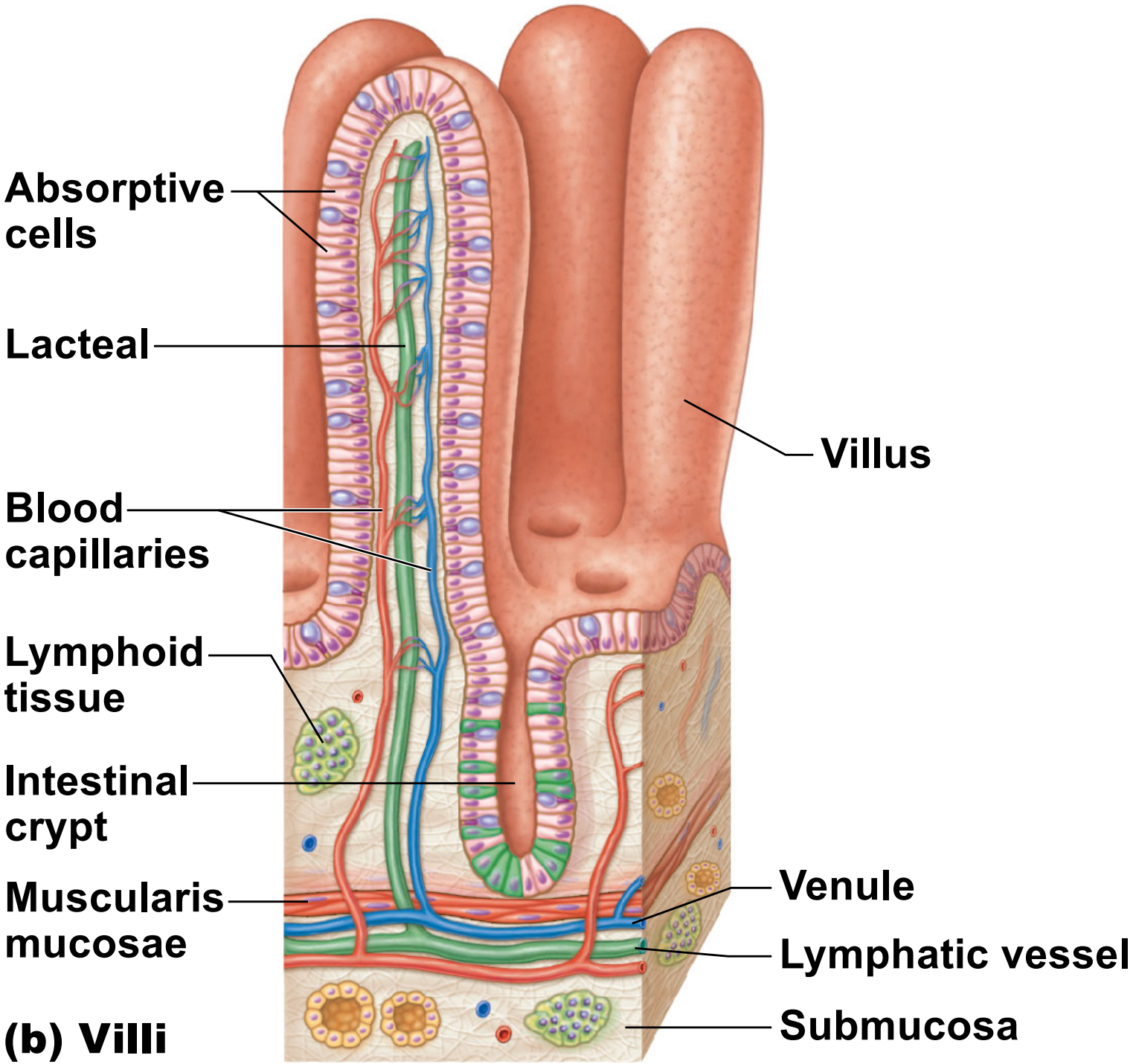
(c)



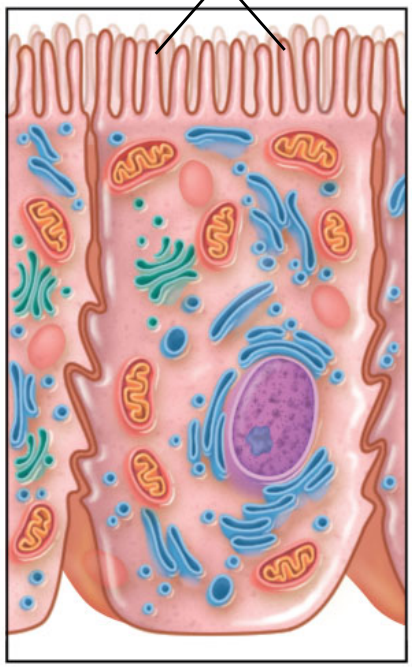




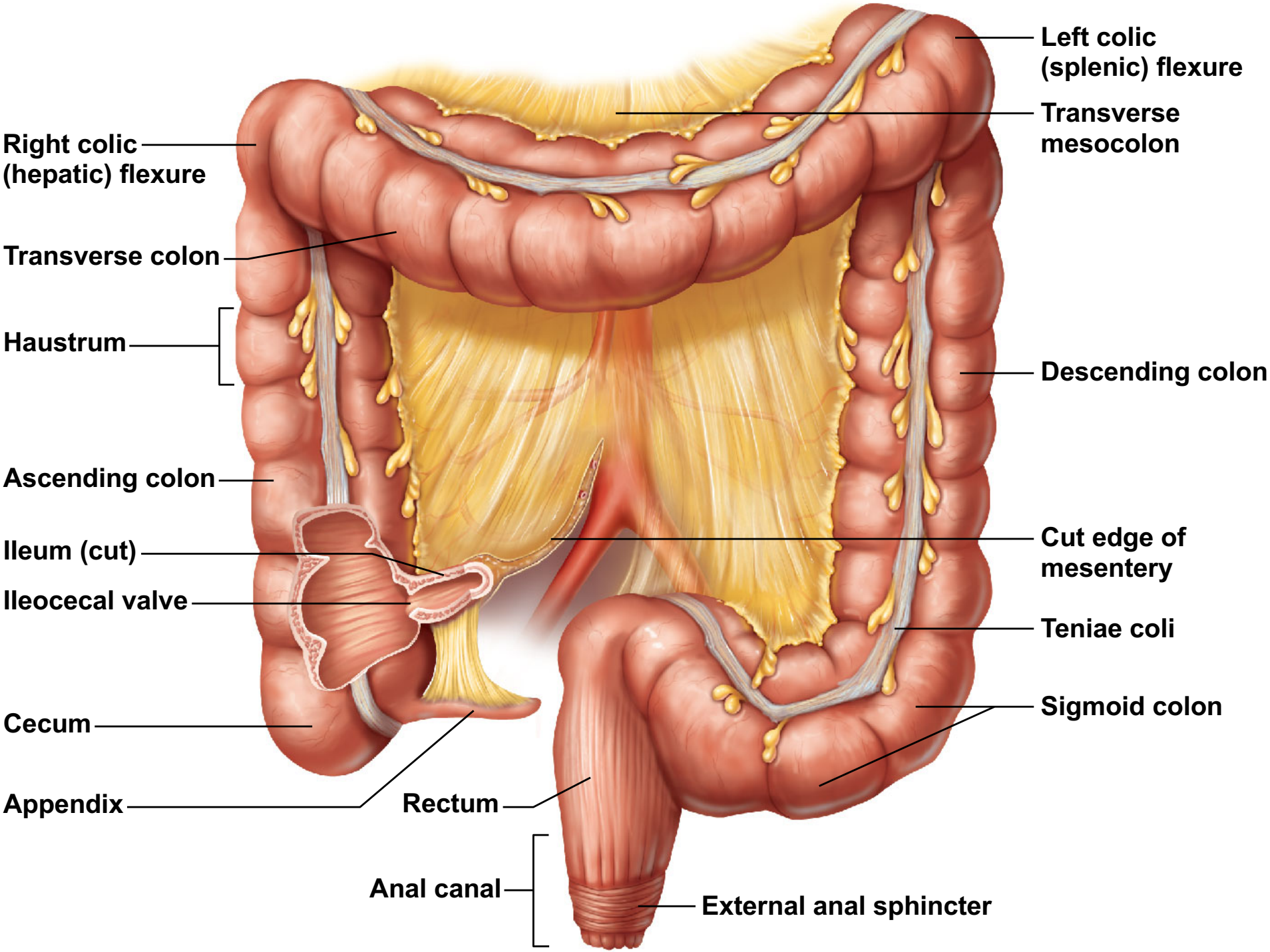
(a) Small intestine

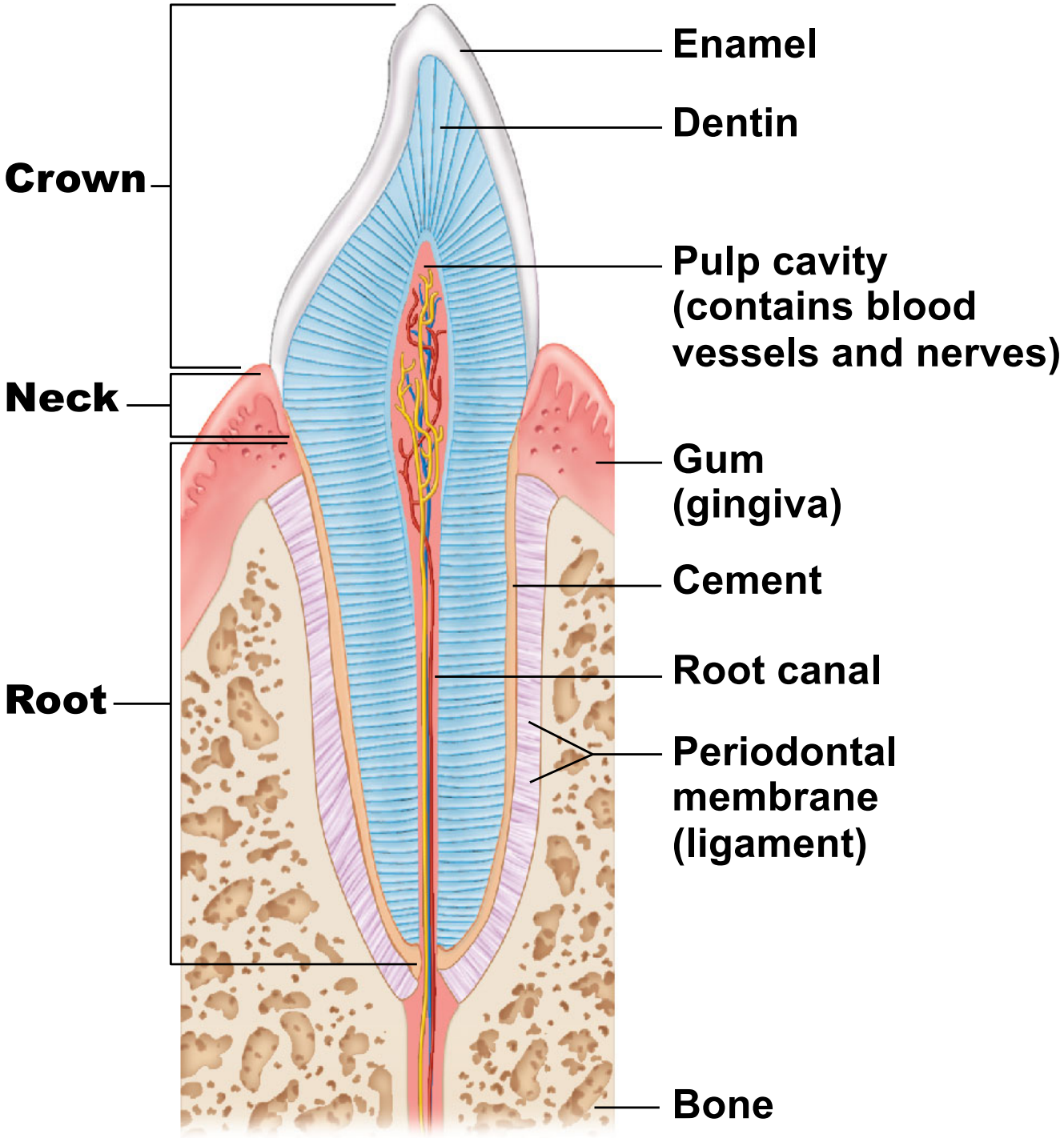


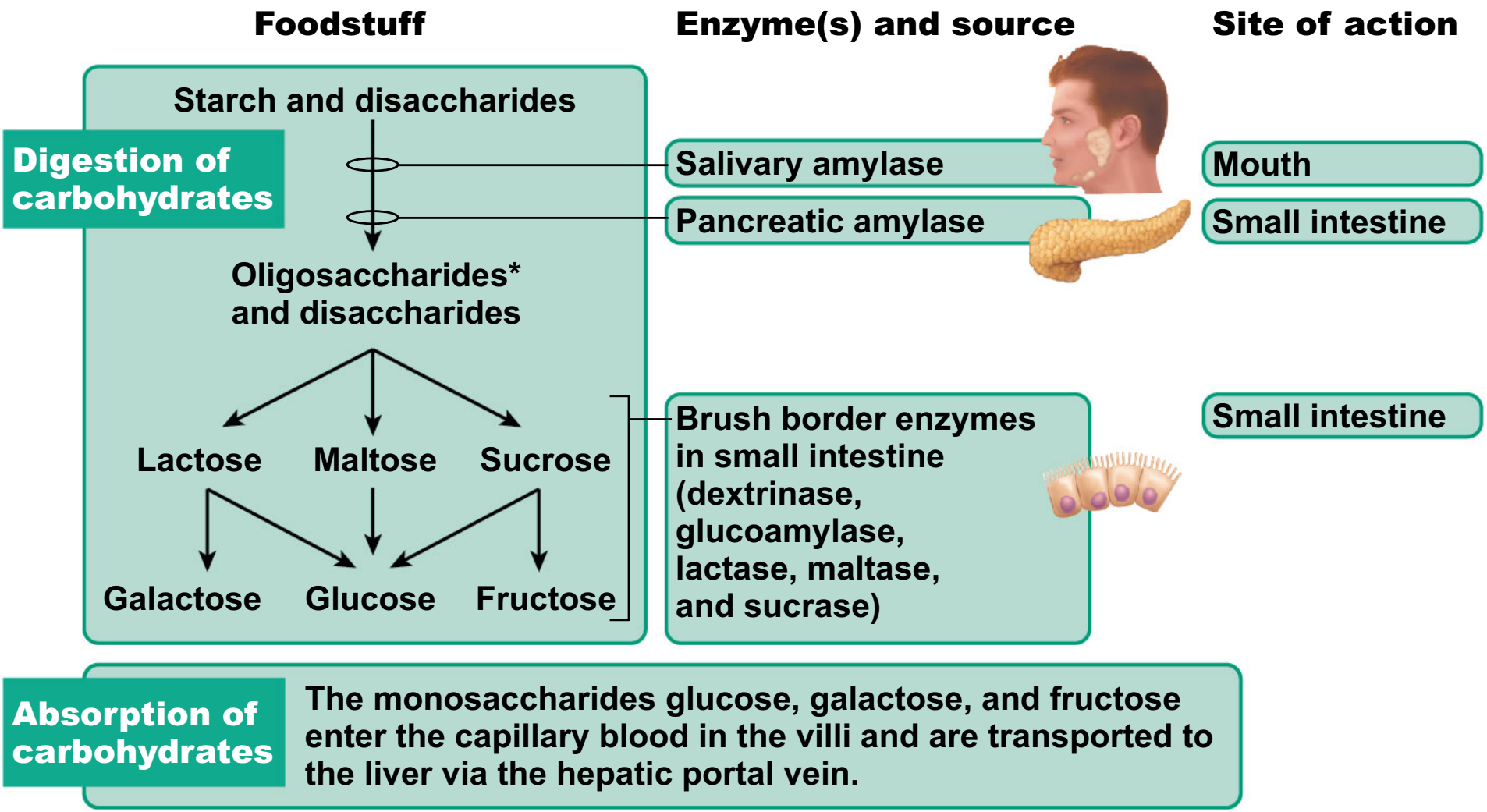
Microvilli
(brush border)



(c) Absorptive cells

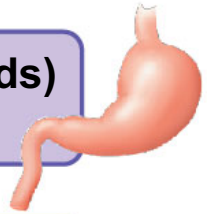






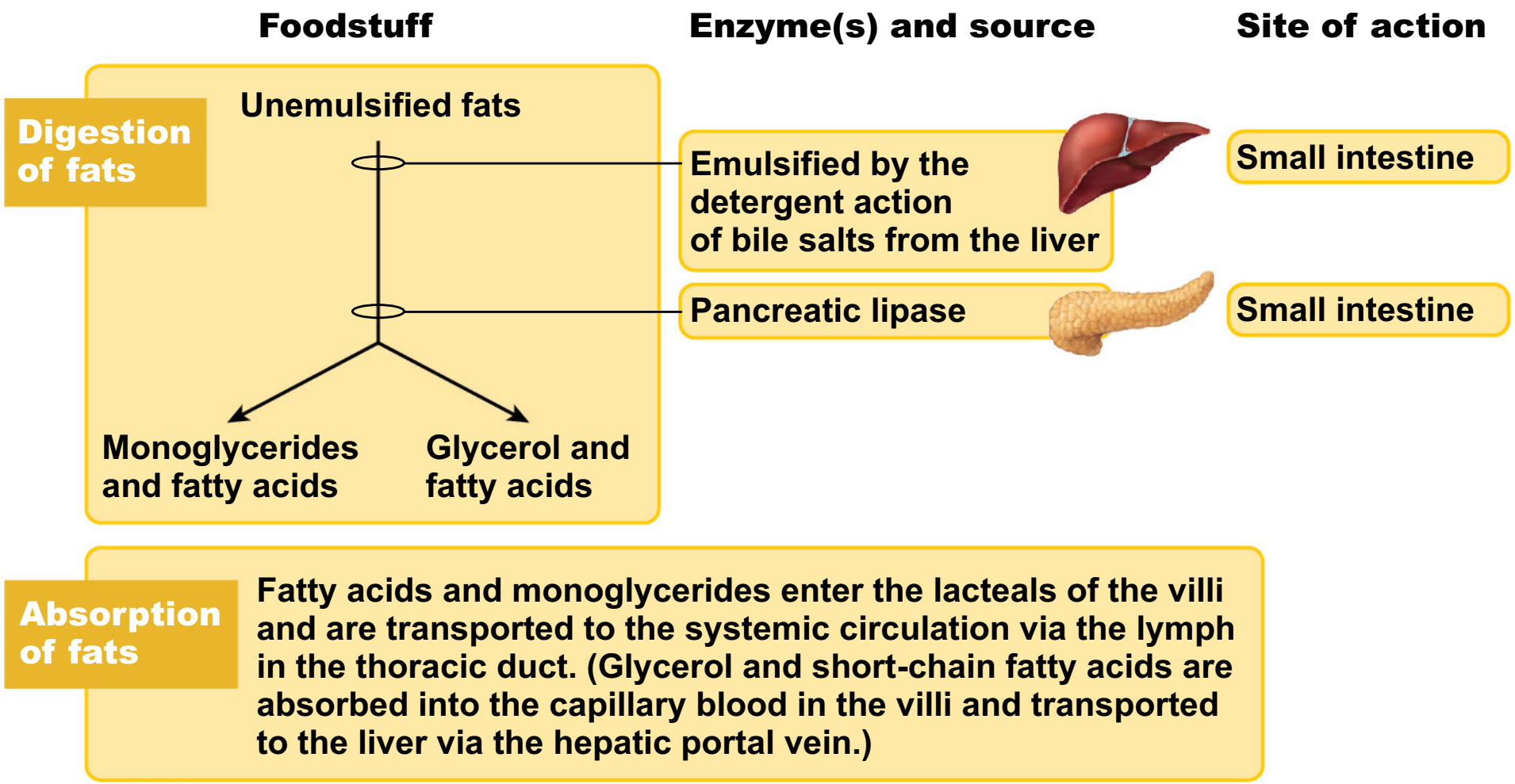
*Oligosaccharides consist of a few linked monosaccharides.

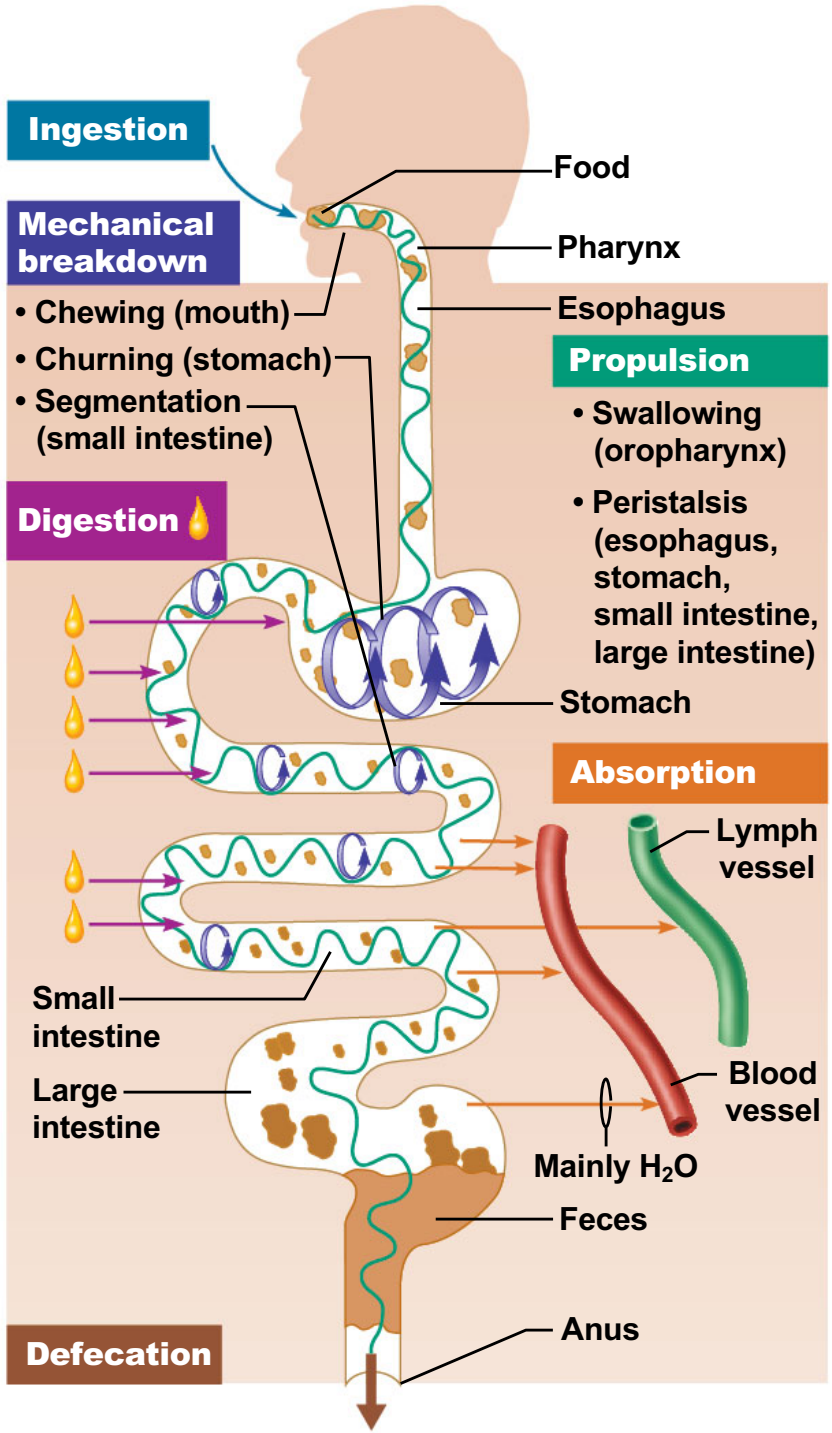
Foodstuff	Enzyme(s) and source	Site of action
Digestion of proteins		
Protein		
↓	Pepsin (stomach glands) in the presence of HCl	Stomach
Large polypeptides		
↓	Pancreatic enzymes (trypsin, chymotrypsin, carboxypeptidase)	Small intestine
Small polypeptides		
↓	Brush border enzymes (aminopeptidase, carboxypeptidase, and dipeptidase)	Small intestine
Amino acids (some dipeptides and tripeptides)		

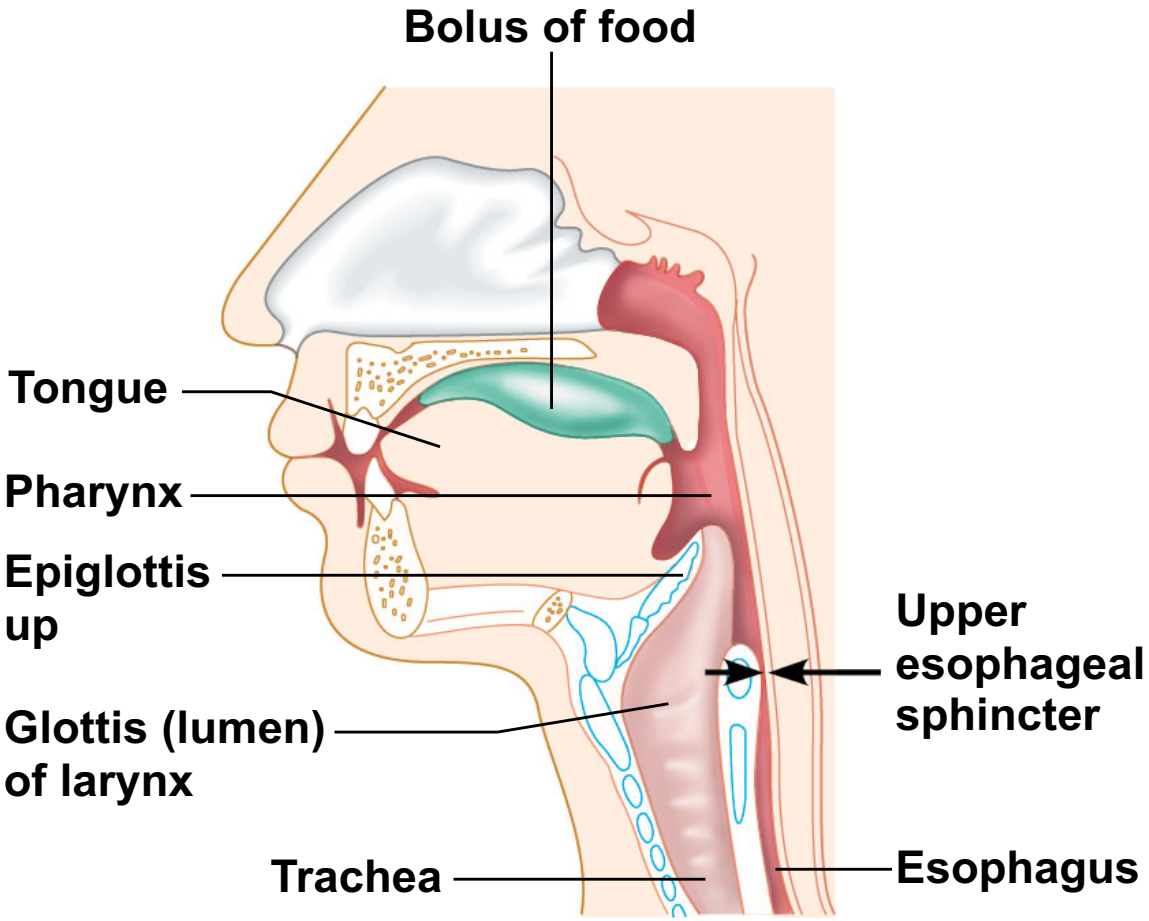


Absorption of proteins

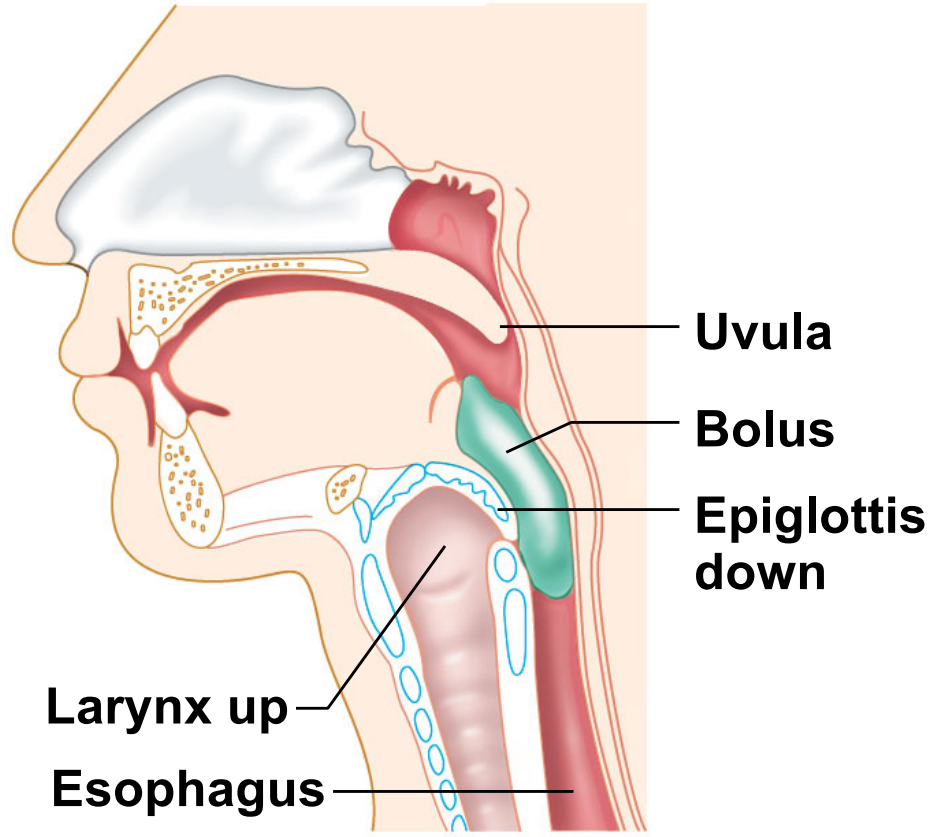
Amino acids enter the capillary blood in the villi and are transported to the liver via the hepatic portal vein.



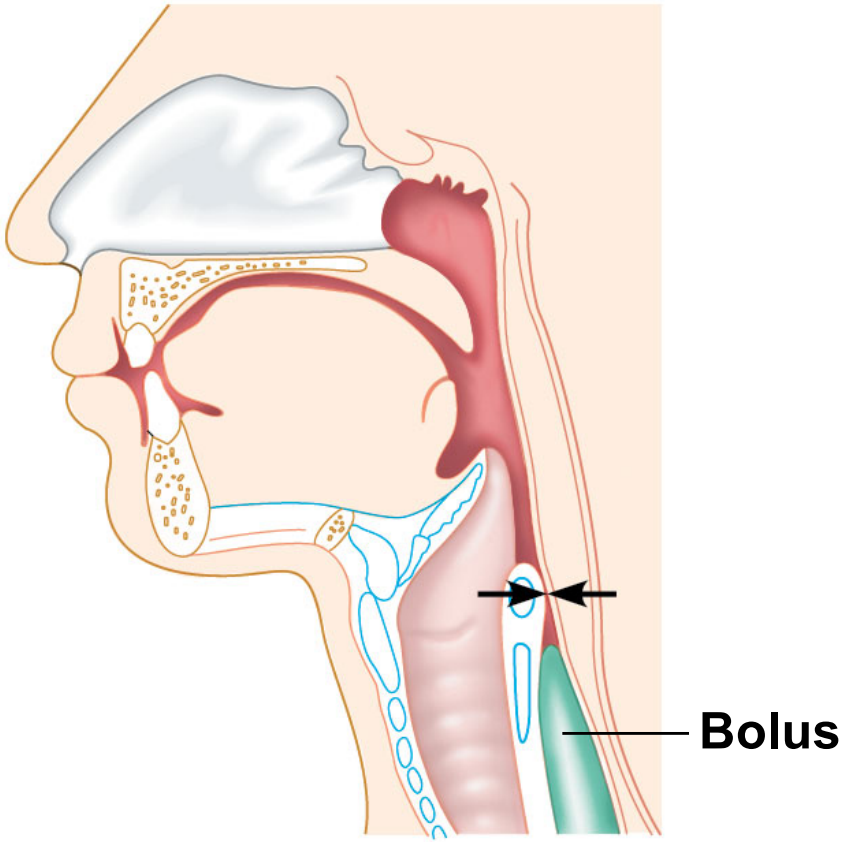




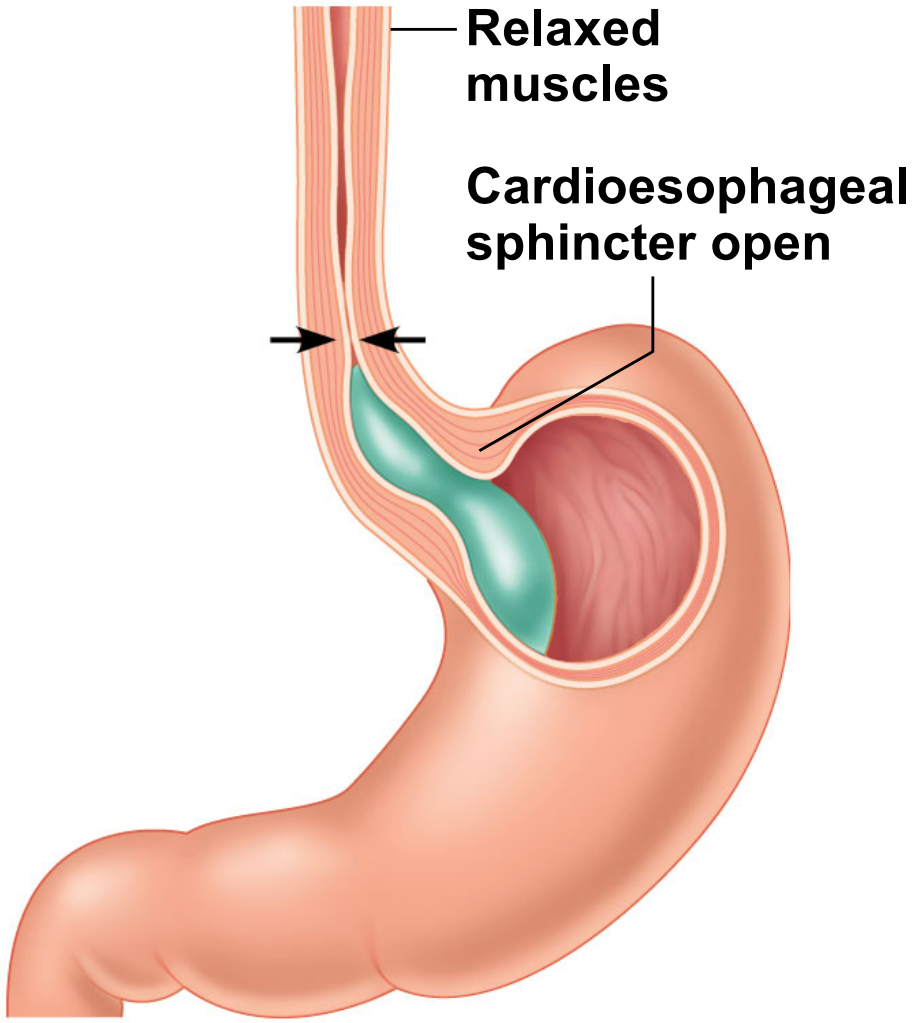
1 **Upper esophageal sphincter contracted**



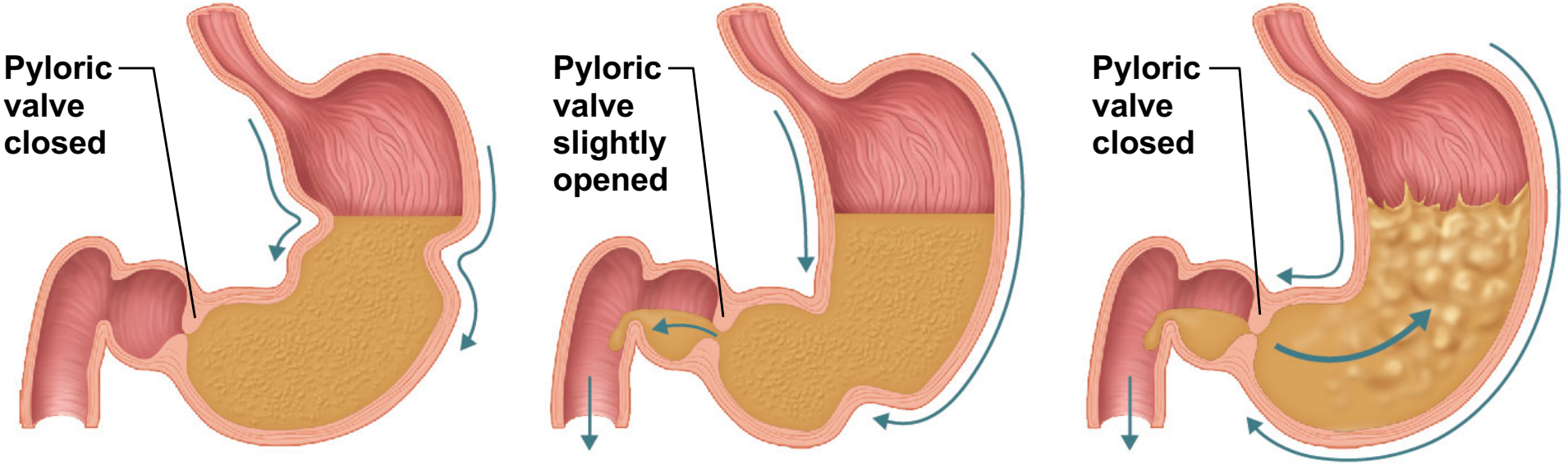
2 Upper esophageal sphincter relaxed



3 **Upper esophageal sphincter contracted**



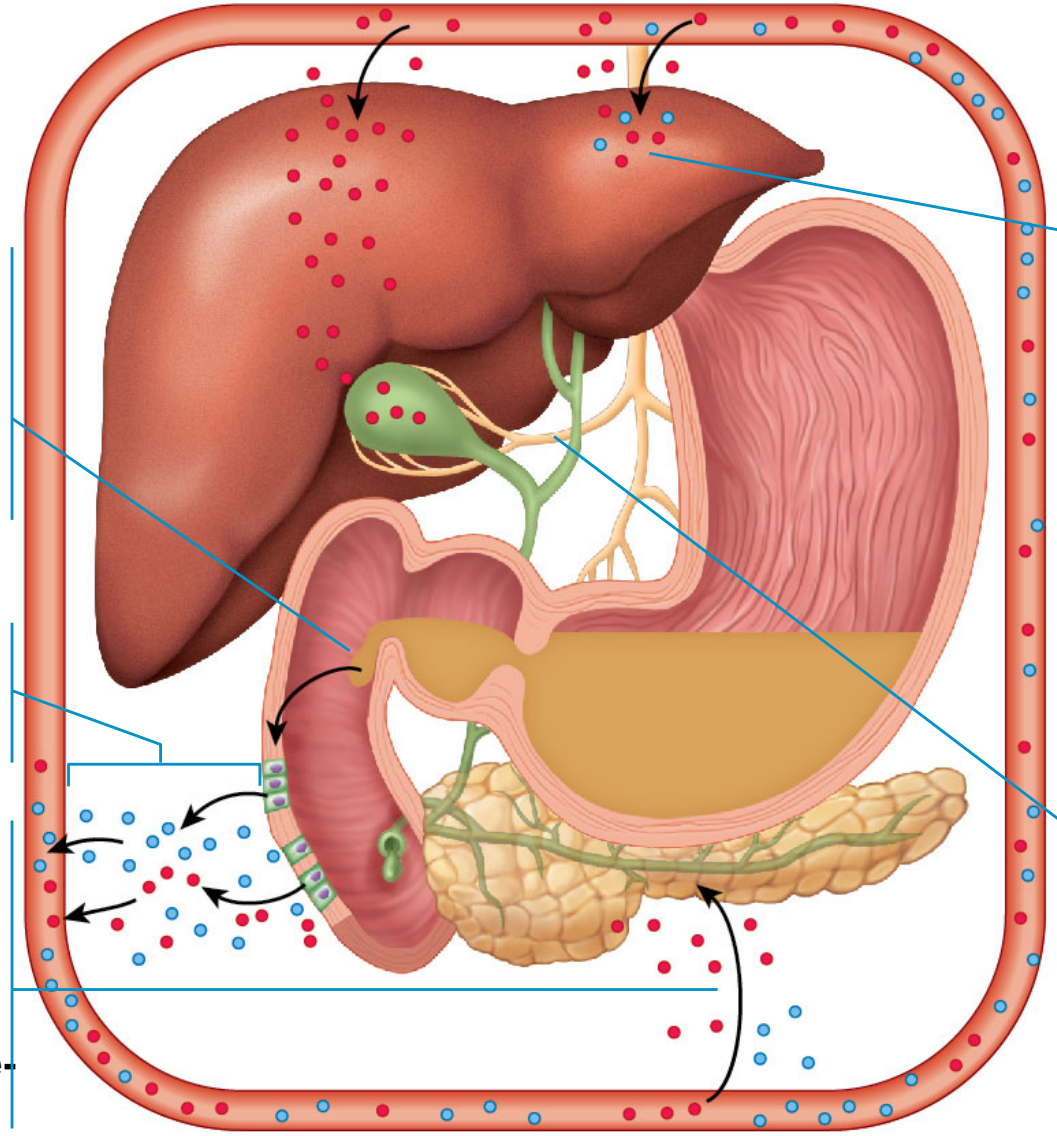
4 Cardioesophageal sphincter relaxed



1 Propulsion: Peristaltic waves move from the fundus toward the pylorus.

2 Grinding: The most vigorous peristalsis and mixing action occur close to the pylorus. The pyloric end of the stomach acts as a pump that delivers small amounts of chyme into the duodenum.

3 Retropulsion: The peristaltic wave closes the pyloric valve, forcing most of the contents of the pylorus backward into the stomach.



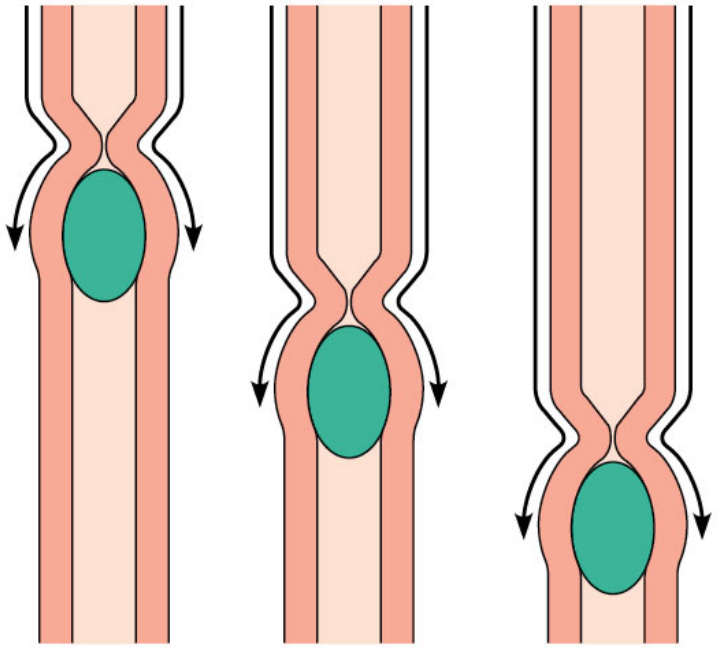
1 Chyme entering duodenum causes duodenal entero-endocrine cells to release cholecystokinin (CCK) and secretin.

2 CCK (red dots) and secretin (blue dots) enter the bloodstream.

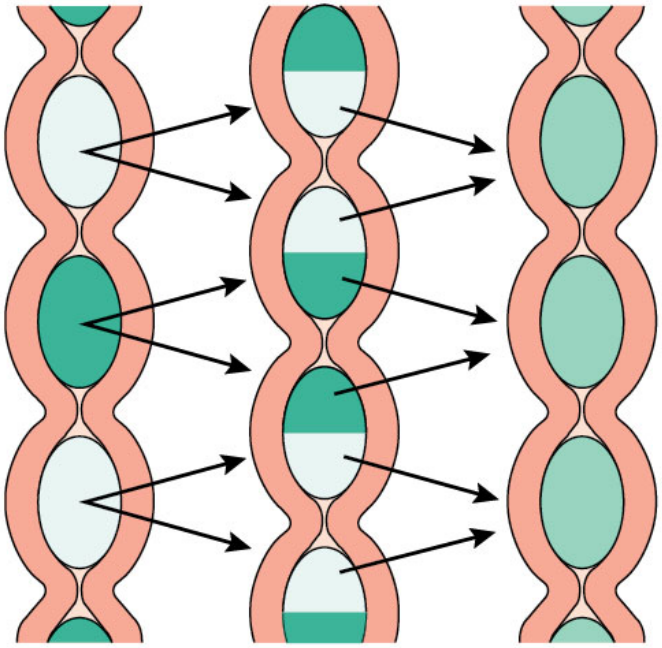
3 Upon reaching the pancreas, CCK induces secretion of enzyme-rich pancreatic juice; secretin causes secretion of bicarbonate-rich pancreatic juice.

4 Secretin causes the liver to secrete more bile; CCK stimulates the gallbladder to release stored bile and the hepatopancreatic sphincter to relax (allows bile from both sources to enter the duodenum).

5 Stimulation by vagal nerve fibers causes release of pancreatic juice and weak contractions of the gallbladder.



(a)



(b)