



GIS

Summery

HISTOLOGY



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❖ Oral Cavity

- ✓ The oral cavity is lined primarily by mucosa with **nonkeratinized** stratified squamous epithelium, with **keratinized** stratified squamous epithelium on the hard palate and gingiva.
- ✓ The dorsal surface mucosa of the tongue has projecting lingual papillae of four types: filiform papillae with keratinized epithelium and nonkeratinized foliate, fungiform, and large vallate papillae.
- ✓ All lingual papillae, except the filiform type, have epithelial taste buds on their sides, with chemosensory gustatory cells with synapses to basal sensory innervation, support cells, and an apical taste pore.
- ✓ Each tooth has enamel covering its crown and neck and a vascularized, innervated central pulp cavity within the dentin that makes up the roots and extends into the neck.
- ✓ Enamel calcifies as parallel enamel rods in a process guided by the protein amelogenin after secretion from columnar epithelial cells called **ameloblasts** in the enamel organ of the embryonic tooth bud.
- ✓ Predentin is secreted as elongated dentinal tubules from tall odontoblasts that line the pulp cavity and persist in the fully formed tooth, with apical odontoblast processes extending between the tubules.
- ✓ The periodontium of each tooth consists of a thin layer of bone-like cementum surrounding dentin of the roots and the periodontal ligament binding the cementum to alveolar bone on the jaw socket.

Layers of the Digestive Tract

- ✓ From the esophagus to the rectum, the digestive tract has four major layers: a lining mucosa, a submucosa, a muscularis, and an outermost adventitia or mesothelium-covered serosa.
- ✓ The mucosa varies regionally along the tract but always consists of a lining epithelium on a lamina propria of loose connective tissue and smooth muscle fibers extending from muscularis mucosae layer.

Esophagus

- ✓ The mucosa of the esophagus has nonkeratinized stratified squamous epithelium; its muscularis is striated at its superior end with smooth muscle at its inferior end, with mixed fiber types in the middle.
- ✓ Most of the outer layer of the esophagus is adventitia, merging with other tissues of the mediastinum.

At the esophagogastric junction, stratified squamous epithelium changes abruptly to simple columnar epithelium invaginating into the lamina propria as many branched tubular glands.

❖ Stomach

- ✓ The stomach has four major regions: the superior cardia and inferior pylorus, which are rather similar histologically, and the intervening fundus and body, which are also similar.
- ✓ The mucosa of the stomach fundus and body is penetrated by numerous gastric pits, which are lined like the stomach lumen with surface mucous cells and which lead into branching gastric glands.
- ✓ The surface mucous cells secrete a thick layer of viscous mucus with bicarbonate ions, which protects these cells and the underlying lamina propria.
- ✓ **The gastric glands are lined by epithelium with four major cell types, as well as their pluripotent stem cells that are located in the narrow neck regions of these glands:**
 - **Mucous neck cells** include immature precursors of the surface mucous cells but produce less alkaline mucus while migrating up into the gastric pits.
 - **Parietal cells** are large cells with many mitochondria and large intracellular canaliculi for production of HCl in the gastric secretion; they also secrete intrinsic factor for vitamin B12 uptake.
 - **Chief (zymogenic) cells**, clustered mainly in the lower half of the gastric glands, secrete the protein pepsinogen that is activated by the low pH in the lumen to form the major protease pepsin.
 - **Enteroendocrine cells** are scattered epithelial cells of the diffuse neuroendocrine system, which release peptide hormones to regulate activities of neighboring tissues during food digestion.
- ✓ The mucosa of the stomach cardiac and pyloric regions has branching cardiac and pyloric glands that consist almost entirely of columnar mucous cells, lacking parietal and chief cells.

❖ Small Intestine

- ✓ The small intestine has three regions: the duodenum with large mucous glands in the submucosa called duodenal glands; the jejunum; and the ileum with the large mucosal and submucosal Peyer patches.

- ✓ In all regions of small intestine the mucosa has millions of projecting villi, with simple columnar epithelium over cores of lamina propria, and intervening simple tubular intestinal glands (or crypts).
- ✓ **Stem cells** in these glands produce the columnar epithelial cells of villi, mainly goblet cells and enterocytes for nutrient absorption, as well as defensin-producing Paneth cells deep in the glands.
- ✓ Sugars and amino acids produced by final steps of digesting carbohydrates and polypeptides in the glycocalyx undergo transcytosis through enterocytes for uptake by **capillaries**.
- ✓ Products of lipid digestion associate with bile salts, are taken up by enterocytes, and are converted to triglycerides and lipoproteins for release as chylomicrons and uptake by a lymphatic called **a lacteal in the core of each villus**.
- ✓ Smooth muscle of the lamina propria and muscularis mucosae, under the control of the autonomic submucosal (**Meissner) plexus**, moves the villi and helps propel lymph through the lacteals.
- ✓ Smooth muscle in the inner circular layer and the outer longitudinal layer of the muscularis, under the control of the **autonomic myenteric** (Auerbach) plexus, produces strong peristalsis.

❖ Large Intestine

- ✓ The large intestine has three major regions: the short cecum, with the appendix; the long colon, with its ascending, transverse, descending, and sigmoid portions; and the rectum.
- ✓ Along its entire length, the mucosa of the large intestine has millions of short simple tubular intestinal glands, lined by lubricant goblet cells and absorptive cells for the uptake of water and electrolytes.
- ✓ The muscularis of the colon has its outer longitudinal layer subdivided into three bands of smooth muscle called **teniae coli**, which act in the peristaltic movement of feces to the rectum.

❖ Anal Canal

- ✓ At the anal canal the **simple columnar epithelium** lining the rectum shifts abruptly to stratified squamous epithelium of the skin at the anus.
- ✓ Near the anus the circular layer of the rectum's muscularis forms the internal anal sphincter, with further control exerted by striated muscle of the external anal sphincter.

❖ Salivary Glands

- ✓ Salivary glands have secretory units of either **protein-secreting** serous cells, usually organized in round or oval acini, or of mucin-secreting mucous cells in elongated tubules. Parotid glands have only serous acini; sublingual glands are mixed but have primarily mucous tubules, some with serous demilunes; submandibular glands are also mixed but have mainly serous acini.
- ✓ Salivary secretory units are drained by simple cuboidal intercalated ducts that merge as simple columnar **striated ducts**, which merge as larger interlobular or **excretory ducts**.
- ✓ Cells of **striated ducts** have mitochondria-lined, basolateral membrane folds specialized for electrolyte reabsorption from the secretion; excretory ducts are unusual in having stratified cuboidal or columnar cells.

❖ Pancreas

- ✓ Pancreatic islets of endocrine cells are embedded in exocrine **serous acinar** tissue, which comprises most of the pancreas and in which the cells secrete hydrolytic **digestive enzymes** for delivery to the duodenum.
- ✓ Each pancreatic acinar cell is pyramidal, with secretory (zymogen) granules in the narrow apical end and Golgi complexes, much rough ER, and a large nucleus at the basal end.
- ✓ Intercalated ducts draining pancreatic acini, including their initial **centroacinar** cells that insert into the acinar lumen, secrete bicarbonate ions (HCO_3^-) to neutralize chyme entering the duodenum from the stomach.

❖ Liver

- ✓ Liver **hepatocytes** are large epithelial cells with large central nuclei (polyploid and often binucleated), much smooth and rough ER, and many small Golgi complexes.
- ✓ Hepatocytes have many functions, including endocrine (plasma protein secretion), exocrine (**bile** secretion), glucose storage (**glycogen granules**), and **detoxification** (using SER and peroxisomes).
- ✓ In the liver, **hepatocytes** are organized into irregular plates to form polygonal **hepatic lobules** in which the hepatocyte plates radiate toward a small **central vein**.
- ✓ Each hepatic lobule is surrounded by sparse connective tissue that is more abundant in **the portal areas** at the corners.
- ✓ Portal areas or tracts contain a small lymphatic and the **portal triad**: a **portal venule** branch from the portal vein, a **hepatic arteriole** branch of the hepatic artery, and a **bile ductule** branch of the biliary tree.

- ✓ In the lobules the portal venule and hepatic arteriole both branch into irregular **sinusoids** between the hepatic plates where the nutrient-rich and O₂-rich blood mixes, flows past hepatocytes, and drains to the central vein.
- ✓ The endothelium of the hepatic sinusoids is discontinuous and fenestrated; between it and the hepatocytes is the perisinusoidal space (**of Disse**) where exchange occurs between the hepatocytes and blood plasma.
- ✓ The sinusoidal endothelium includes many specialized stellate macrophages or **Kupffer cells**, which recognize and remove effete erythrocytes, releasing iron and bilirubin for uptake by hepatocytes.
- ✓ Also present in the perisinusoidal spaces are hepatic stellate cells (or Ito cells) containing many small lipid droplets for storage of **vitamin A** and other fat-soluble vitamins.
- ✓ Between adherent hepatocytes in the hepatic plates are grooves called bile canaliculi, sealed by tight junctions, into which hepatocytes secrete water and bile components, including bilirubin and bile acids.
- ✓ In each hepatic lobule, all bile canaliculi converge on the bile canals (of Hering), which join the bile ductules in the portal areas and eventually all merge to form the left and right hepatic ducts.

❖ **Biliary Tract and Gallbladder**

- ✓ All bile-conducting ducts after the bile canaliculi are lined by simple cuboidal or columnar cells **called cholangiocytes**.
- ✓ The common hepatic duct leads to the cystic duct that carries bile to **the gallbladder** for temporary **bile storage** and concentration.
- ✓ The mucosa of the gallbladder has many folds with a large surface area, a well-vascularized lamina propria, and a lining of columnar cholangiocytes specialized for water uptake from bile.
- ✓ Contraction of the gallbladder muscularis sends bile to the duodenum via the common bile duct and is induced by cholecystokinin (**CCK**) from enteroendocrine cells in the duodenum when food is present.

TABLE 15-2

Summary of distinguishing digestive tract features, by region and layers.

Region and Subdivisions	Mucosa (Epithelium, Lamina Propria, Muscularis Mucosae)	Submucosa (With Submucosal Plexuses)	Muscularis (Inner Circular and Outer Longitudinal Layers, With Myenteric Plexuses Between Them)	Adventitia/Serosa
Esophagus (upper, middle, lower)	Nonkeratinized stratified squamous epithelium ; cardiac glands at lower end	Small esophageal glands (mainly mucous)	Both layers striated muscle in upper region; both layers smooth muscle in lower region; smooth and striated muscle fascicles mingled in middle region	Adventitia, except at lower end with serosa
Stomach (cardia, fundus, body, pylorus)	Surface mucous cells and gastric pits leading to gastric glands with parietal and chief cells , (in the fundus and body) or to mucous cardiac glands and pyloric glands	No distinguishing features	Three indistinct layers of smooth muscle (inner oblique, middle circular, and outer longitudinal)	Serosa
Small Intestine (duodenum, jejunum, ileum)	Plicae circulares ; villi , with enterocytes and goblet cells , and crypts/glands with Paneth cells and stem cells ; Peyer patches in ileum	Duodenal (Brunner) glands (entirely mucous); possible extensions of Peyer patches in ileum	No distinguishing features	Mainly serosa
Large Intestine (cecum, colon, rectum)	Intestinal glands with goblet cells and absorptive cells	No distinguishing features	Outer longitudinal layer separated into three bands, the teniae coli	Mainly serosa, with adventitia at rectum
Anal canal	Stratified squamous epithelium ; longitudinal anal columns	Venous sinuses	Inner circular layer thickened as internal sphincter	Adventitia

Questions

1. Which of the following is true of the absorptive cells of the small intestine?
 - a. Also called enteroendocrine cells
 - b. Have many microvilli covering their basal surfaces
 - c. Absorb lipids by active transport
 - d. Synthesize triglycerides from absorbed lipids
 - e. Undergo mitosis at tips of villi and are sloughed off into crypts

2. A 52-year-old man is diagnosed with a carcinoid after an appendectomy. The enteroendocrine cells producing this disorder differ from goblet cells in which of the following?
 - a. The direction of release of secretion
 - b. The use of exocytosis for release of secretory product
 - c. Their presence in the small and large intestines
 - d. The origin from a crypt stem cell
 - e. Their location in a simple columnar epithelium

3. A 14-month-old girl is brought to the pediatric dentistry clinic because her erupted deciduous teeth are opalescent with fractured and chipped surfaces. X-rays reveal bulb-shaped crowns, thin roots, and enlarged central cavities. Tissue immediately surrounding one tooth's central cavity is biopsied and prepared for histology, which reveals irregular, widely spaced tubules. Which of the following applies to this irregular tissue layer?

- a. It has a composition similar to that of bone and is produced by cells similar in appearance to osteocytes.
- b. It is formed on a noncollagenous matrix that is resorbed after mineralization by the same cells that secreted it.
- c. It contains abundant nerves, microvasculature, and loose connective tissue.
- d. It consists of mineralized collagen secreted by cells derived from the neural crest.
- e. It is the site of inflammation in diabetic patients and is sensitive to vitamin C deficiency.

4. A 39-year-old woman presents with dyspnea, fatigue, pallor, tachycardia, anosmia, and diarrhea. Laboratory results are: hematocrit 32% (normal 36.1%-44.3%), MCV 102 fL (normal 78-98 fL), 0.3% reticulocytes (normal 0.5%-2.0%), 95 pg/mL vitamin B12 (normal 200-900 pg/mL), and an abnormal stage I of the Schilling test. Autoantibodies are detected against a cell type located in one region of the GI tract. In which regions would those cells be found?

- a. Esophagus
- b. Body of the stomach
- c. Pyloric region of the stomach
- d. Cardiac region of the stomach
- e. Duodenum

5. In which of the following structures of the oral cavity would taste buds be localized in the highest concentration?

- a. Fungiform papillae
- b. Gingiva
- c. Filiform papillae
- d. Ventral surface of the tongue
- e. Vallate papillae

6. Certain antibiotic therapies slow the replacement of the cells lining the small intestine. This may cause the loss of what tissue type?

- a. Ciliated pseudostratified columnar epithelium
- b. Simple cuboidal epithelium
- c. Simple columnar epithelium
- d. Pseudostratified columnar epithelium with stereocilia
- e. Stratified squamous, nonkeratinized epithelium

7. The teniae coli of the large intestine represent an organ-specific specialization of which layer of the intestinal tract wall?

- a. Epithelium
- b. Lamina propria
- c. Muscularis mucosa d. Muscularis externa
- e. Serosa

8. Which of the following would most likely result from a reduction in the number of Paneth cells?

- a. Thinning of the glycocalyx
- b. Reduced breakdown of fats
- c. Elevated levels of undigested proteins
- d. Decreased mucus in the intestine
- e. Increased number of intestinal bacteria

9. A medical student on a rotation in the pathology laboratory is given an unlabeled microscope slide with tissue provided by a gastroenterologist from a cancer patient she is attending. The mucosa and submucosa are poorly preserved, with only the thick muscularis well-stained, showing striated fibers. The slide most likely shows a biopsy of which region of the GI tract?

- a. Pyloric sphincter
- b. Esophagus
- c. Colon
- d. Corpus of the stomach
- e. Ileum

10. Diarrhea may result if which of the following organs fails to carry out its role in absorbing water from the feces?

- a. Anal canal
- b. Cecum
- c. Colon
- d. Jejunum
- e. Duodenum

11. In a liver biopsy from a long-time drug user which of the following hepatocyte organelles would be expected to be more extensive than normal?

- a. Rough endoplasmic reticulum
- b. Golgi apparatus
- c. Lysosomes
- d. Peroxisomes
- e. Smooth endoplasmic reticulum

12. Which description is true of pancreatic zymogens?

- a. Are packaged for secretion in the SER
- b. Are synthesized on free ribosomes
- c. Are inactive until they reach the duodenal lumen
- d. Are stored in the basal cytoplasm of acinar cells
- e. Are produced by cuboidal cells lining the pancreatic duct

13. Which process increases in response to parasympathetic stimulation of the salivary glands?

- a. Volume of secretion
- b. Cell division in secretory acini
- c. Mucus content of saliva
- d. Inorganic salts content of saliva
- e. Cell division in interlobular ducts

14. Which feature is unique to the exocrine pancreas?

- a. Insulin-secreting β cells
- b. Centroacinar cells
- c. Predominately serous secretory cells
- d. Striated interlobular ducts
- e. Striated intralobular ducts

15. Which description is true of the bile canaliculi?

- a. Are bordered directly by endothelial cells
- b. Are part of the portal triad
- c. Are surrounded by the hepatic sinusoids
- d. Lumens are entirely sealed by junctional complexes
- e. Normally contain some blood plasma

16. Which description is true of the gallbladder?

- a. Dilutes bile
- b. Absorbs bile
- c. Secretes mucus
- d. Has a thick submucosa
- e. Is covered entirely by serosa

17. Which description is true for the hepatic space of Disse?

- a. Is surrounded by the hepatic sinusoid
- b. Contents flow toward the central vein
- c. Is directly contacted by hepatocytes
- d. Lumen sealed by junctional complexes
- e. Contents empty into canals of Hering lined by cholangiocytes

18. A 50-year-old woman presents to the family medicine clinic. She admits to drinking a six-pack of beer each day with a little more intake on weekends. Laboratory tests show elevated alanine aminotransferase/serum glutamic oxaloacetic transaminase (AST/SGOT). Her sclerae appear jaundiced and her serum bilirubin is 2.5 mg/dL (normal 0.3-1.9 mg/dL). A biopsy shows hepatic fibrosis with significant loss of normal lobular structure. Jaundice is most likely to result when the proper location or orientation of what hepatic structures is disrupted?

- a. Central veins
- b. Spaces of Disse
- c. Kupffer cells
- d. Hepatocytes
- e. Merging sinusoids

19. A 48-year-old woman is referred to an allergy and rheumatology specialist with itching eyes, dryness of the mouth, difficulty swallowing, loss of the sense of taste, hoarseness, fatigue, and swollen parotid glands. She reports increasing joint pain over the past 2 years. She complains of frequent mouth sores. Laboratory tests show a positive antinuclear antibody (ANA) and rheumatoid factor (RF) levels of 70 U/mL (normal < 60 U/mL) by the nephelometric method. A parotid gland biopsy shows inflammatory infiltrates in the interlobular connective tissue with damage to the acinar cells and striated ducts. In this case, resorption of which of the following will be most altered by destruction of those ducts?

- a. Na⁺
- b. H₂O
- c. HCO₃
- d. Cl
- e. Ca²⁺

❖ Key Answers:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
e	c	d	e	b	c	d	a	d	b	e	c	a	b	d	c	c	d	a

GOOD LUCK 