Chapter 24: Digestive System

I. Anatomy of the Digestive System

A. List the seven regions of the digestive tract:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

II. Functions of the Digestive System

A. List and describe the eight major functions of the digestive system:

1. _____
   _____
2. _____
   _____
3. _____
   _____
4. _____
   _____
5. _____
   _____
6. _____
   _____
   _____
7. _____
   _____
8. _____
   _____

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III. Histology of the Digestive Tract

A. List the three major types of glands associated with the digestive tract:
   1. _____
   2. _____
   3. _____

B. Mucosa
   1. Consists of _____
   2. The inner layer _____ is in contact with food
      a. In the mouth, oropharynx, esophagus and anal canal the epithelium is _____
      b. In the rest of the digestive tract the epithelium is _____
   3. The second layer of the mucosa is called the lamina propria and consists of: _____
   4. The outer portion of the mucosa is composed of a thin layer of smooth muscle called the _____

C. Submucosa
   1. The submucosa is a thick _____ containing:
      a. _____
      b. _____
      c. _____ that lie _____
   2. What is the submucosal plexus? _____ _____

D. Muscularis
   1. Consists of an:
      a. Inner layer of _____
      b. Outer layer of _____
   2. Two exceptions in the tunica muscularis are the:
      a. Upper esophagus where _____
      b. Stomach has _____
   3. What is the myenteric plexus? _____
   4. The enteric plexus is composed of _____ & _____

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5. Functionally the enteric plexus is important in _____ _____

E. Serosa or Adventitia
   1. Structurally is a _____ layer
   2. Serosa is found on parts of the digestive tract that _____ _____
      a. This serosa is a _____
      b. It consists of:
         1. Thin _____ &
         2. Simple _____
   3. Adventitia is derived from _____
      a. Consists of a _____ that blends with _____

IV. Regulation of the Digestive System

A. Nervous Regulation of the Digestive System
   1. What is the enteric nervous system (ENS)? _____ _____
   2. There are three major types of enteric neurons:
      a. Enteric sensory neurons detect changes in:
         1. Chemical _____
         2. Mechanical _____
      b. Enteric motor neurons stimulate or inhibit _____ & _____
      c. Enteric interneurons connect _____ & _____
   3. The ENS coordinates _____ & regulates _____
   4. Autonomic innervation from the CNS influences _____
   5. CNS control of the digestive system occurs when reflexes are activated by stimuli _____
      a. Sensory neurons transmit information to the CNS via the _____
      b. CNS _____ the reflexes

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6. CNS reflexes may also be activated by the _____, _____, or _____, which stimulate the sensation of _____
7. All of the reflexes influence _____ neurons
8. Motor neurons connect to the digestive tract through the _____
    a. Control _____
    b. Alter the activity of _____ & _____
9. Sympathetic neurons:
    a. Inhibit _____ & _____
    b. Decrease _____

B. Chemical Regulation of the Digestive System
1. The digestive tract produces a number of _____
2. Carried through the circulation to target organs of the:
    a. _____ or to
    b. Target tissues in _____
3. Functionally the hormones help regulate:
    a. Many _____
    b. Secretions of _____
4. Paracrine chemicals are released locally within the digestive tract and influence _____
    a. Help local reflexes within the ENS control _____ _____

V. Peritoneum

A. Serous Membranes
1. The visceral peritoneum _____
2. The parietal peritoneum _____

B. Mesenteries
1. Within the abdominal cavity mesenteries _____
2. Structurally mesenteries are composed of:
    a. Two _____ with
    b. Thin _____

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3. Mesenteries also provide a route for _____ & _____ to pass from the body wall to the organs
4. What does retroperitoneal refer to? _____
5. What does the lesser omentum connect? _____

   _____
6. The mesentery extending as a fold from the greater curvature of the stomach and then to the transverse colon is called _____
7. The greater omentum also forms _____

   _____
8. What is the omental bursa? _____
9. What does the coronary ligament attach? _____
10. What does the falciform ligament attach? _____
11. What is the mesentery proper? _____
12. The transverse mesocolon _____
13. The sigmoid mesocolon _____
14. What is the mesoappendix? _____

VI. Oral Cavity

A. General

1. The oral cavity is bounded:
   a. Anteriorly by _____
   b. Posteriorly by _____
   c. Laterally by _____
   d. Superiorly by _____
   e. Inferiorly by _____
2. The oral cavity is divided into two regions:
   a. The vestibule is _____
   b. The oral cavity proper lies _____
3. What kind of epithelium lines the oral cavity? _____
   a. This epithelium provides _____

B. Lips and Cheeks

1. The lips or _____ are muscular structures formed mostly by the

_____ as well as _____

2. The outer surfaces of the lips are covered by _____
3. The skin is _____ at the margin of the lips and is not as highly _____
    a. Therefore it is more _____
    b. This allows color from _____
4. At the internal margin of the lips the epithelium is continuous with the _____
5. What are frenula? _____
6. Structurally cheeks consist of:
    a. Interior lining of _____
    b. Exterior covering of _____
    c. Substance of the cheek includes _____ &
    d. Buccal _____
7. Functionally the lips and cheeks are important in the processes of:
    a. Mastication
        1. Help manipulate _____
        2. Hold food in place while _____
    b. Speech
        1. Help form _____

C. Palate and Palatine Tonsils
1. The hard palate is the _____
2. The soft palate is the _____
3. What is the uvula? _____
4. Functionally the palate is important during swallowing because it prevents _____
5. Where are the palatine tonsils? _____

D. Tongue
1. The tongue is a _____
2. What is the frenulum? _____
3. Muscles of the tongue are divided into two groups:
    a. Intrinsic muscles _____

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b. Extrinsic muscles _____

4. Functionally the intrinsic muscles are responsible for:
   a. Changing _____
5. Functionally the extrinsic muscles:
   a. Protrude and _____
   b. Move it _____
   c. Change its _____
6. What is the terminal sulcus? _____
   a. Anterior to the terminal sulcus accounts for about _____
      1. Covered by _____ some of which contain _____
   b. Posterior to the terminal sulcus:
      1. Tongue is _____ has only a few _____
      2. Has a few small _____
      3. Large amount of _____ called _____
7. What type of epithelium covers the tongue? _____
8. Functionally the tongue:
   a. Moves food in _____
   b. Holds food in _____
   c. Plays a major role in _____
   d. Major sensory organ _____
   e. Primary organ of _____

E. Teeth

1. A normal adult has _____ teeth
2. The teeth are contained in two dental arches:
   a. The upper arch is called _____
   b. The lower arch is called _____
3. The teeth in each quadrant include:
   a. One central _____
   b. One lateral _____
   c. One _____
   d. First and second _____
   e. First, second, and third _____

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a. Which are the wisdom teeth? _____

4. The teeth that appear as infants are called _____ or _____
5. The teeth that grow in later are called _____ or _____
6. Each tooth consists of a _____ with one or more _____, a _____, and a _____
7. What is the clinical crown? _____
8. What is the anatomical crown? _____
9. Where is the pulp cavity? _____
   a. It is filled with: _____
10. What is the root canal? _____
11. What is the apical foramen? _____
12. Dentin surrounds the pulp cavity and consists of _____ _____
13. The dentin of the tooth crown is surrounded by _____
    a. This substance is extremely hard, _____, & _____
14. The dentin of the root is covered with _____
    a. This substance is a cellular _____
    b. Helps anchor _____
15. The teeth are set in _____
16. What do periodontal ligaments do? _____
17. The gingiva are composed of:
    a. Dense _____ &
    b. Stratified _____
18. The gingiva cover _____
19. The teeth play an important role in _____ & a role in _____

F. Mastication

1. The incisors and canines primarily _____
2. The premolars and molars primarily _____
3. Mastication breaks _____ into _____ which have a _____
   a. This increases the efficiency of _____ because digestive enzymes digest _____

4. Which three muscles close the jaw for mastication?
    a. _____
    b. _____
    c. _____
5. Which muscle opens the jaw? _____
6. The basic movements of chewing are controlled by the _____ which is integrated in the _____
    a. Presence of the food in the mouth initiates a reflex which causes the muscles of mastication to _____
    b. As the mandible is lowered the muscles are _____ which activates a reflex causing the muscles to _____
    c. Once the mouth is closed the presence of the food again stimulates the muscles of mastication to _____ and repeat the cycle
7. Chewing can be initiated or stopped consciously by the _____
8. The rate and intensity of chewing can be influenced by the _____

G. Salivary Glands
1. List the three pairs of multicellular salivary glands:
    a. _____
    b. _____
    c. _____
2. Where else is salivary glandular tissue located? _____
    _____
3. Functionally salivary gland secretions help keep the oral cavity _____ and begin _____
4. Describe the structure of the large salivary glands: _____
    _____
5. Saliva is a combination of _____ and _____ secretions
6. Where are the parotid glands located? _____
    a. The parotid duct empties into the oral cavity adjacent to _____
7. Where are the submandibular glands located? _____
    _____
    a. The submandibular duct empties into the oral cavity beside _____

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8. Where are the sublingual glands located? _____
    a. They secrete saliva into the oral cavity through _____
9. How much saliva is secreted per day? _____
10. Salivary amylase is a _____ contained in saliva
    a. Functionally salivary amylase breaks the _____ between _____ in _____
    b. The end product of the digestion is _____ or _____
11. Saliva prevents bacterial infection in the mouth:
    a. By _____ the oral cavity
    b. Contains lysozyme which _____
    c. Immunoglobulin A which _____
12. What provides the lubricating quality of saliva? _____ _____
13. Secretion of saliva is stimulated by:
    a. _____ and _____ nervous systems
        1. Which is more important? _____
    b. Which cranial nerves are involved?
        1. _____
        2. _____
    c. Higher centers of the brain can stimulate secretion of saliva due to:
        1. _____ trigger thoughts of food
        2. Sensation of _____

VII. Pharynx

A. List the three parts of the pharynx:
    1. _____
    2. _____
    3. _____
B. Which two parts normally carry food:
    1. _____
    2. _____

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C. Pharyngeal Constrictors

1. What are the pharyngeal constrictors? _____
2. What is their location in the pharynx? _____

VIII. Esophagus

A. Gross Anatomy

1. The esophagus extends from _____ to the _____
2. It lies in the _____ anterior to _____ & posterior to _____
3. What is the esophageal hiatus? _____
4. Functionally the esophagus transports _____

B. Histology

1. The esophagus has _____ walls
2. The muscular tunic is different from the rest of the digestive tube because:
   a. The superior part consists of _____
   b. The inferior part consists of _____
3. The upper esophageal sphincter regulates _____
4. The lower esophageal sphincter regulates _____
5. Where does the lubricating mucus come from? _____

   _____

IX. Swallowing (Deglutition)

A. Voluntary Phase

1. Bolus of food is formed in the mouth and pushed by the tongue:
   a. Against _____
   b. Forcing _____ &
   c. Into _____

B. Pharyngeal Phase

1. Reflex initiated by stimulation of tactile receptors in the _____
2. Begins with the elevation of the _____
   a. Closes the passage between _____ & _____
3. The pharynx elevates to _____

4. The pharyngeal constrictor muscles contract in succession forcing _____ _____
5. The upper esophageal sphincter _____
6. The elevated pharynx opens the _____ & food is _____ _____
7. To prevent food from passing into the larynx:
   a. The vestibular folds are _____
   b. The epiglottis is _____so that _____
   c. The larynx is _____

C. Esophageal Phase
1. Responsible for moving food from the _____ to the _____
2. Food moved by muscular contractions in the wall of the esophagus that occur in _____
3. The lower esophageal sphincter relaxes in response to _____ _____
4. The lower esophageal sphincter remains tonically contracted to prevent _____
5. The peristaltic waves are controlled by _____

X. Stomach

A. Anatomy of the Stomach
1. What is the opening from the esophagus into the stomach called? _____
2. The region of the stomach around this opening is called _____
   a. Because of this the lower esophageal sphincter is also called _____
3. What part of the stomach is the fundus? _____ _____
4. The largest part of the stomach is called the _____
   a. The large round side is called the _____
   b. The small curved side is called the _____
5. The body narrows to form the _____
6. The pyloric opening is between the _____ & the _____

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a. This opening is surrounded by a relatively thick ring of smooth muscle called the _____

B. Histology of the Stomach
   1. The outermost layer of the stomach is called _____ or _____
      a. It consists of:
         1. Inner layer of _____
         2. Outer layer of _____
   2. The muscularis of the stomach consists of _____ layers:
      a. Outer _____
      b. Middle _____
      c. Inner _____
   3. What are rugae? _____
   4. Functionally rugae allow _____
   5. The stomach lining is _____
   6. What are gastric pits? _____
   7. The stomach epithelium has _____ of cells:
      a. Surface mucous cells produce _____
         1. They are found _____ & _____
      b. List the four cell types found in gastric glands and what they produce:
         1. _____ produce _____
         2. _____ produce _____ & _____
         3. _____ produce _____
         4. _____ produce _____

C. Secretions of the Stomach
   1. Chyme is a semifluid material formed from _____
   2. Functionally the stomach is primarily a _____ & _____
   3. Mucous Cells
      a. Secrete a _____ & _____ that covers _____ _____
      b. The thick layer of mucus _____ & _____ the epithelial cells from _____ & _____

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c. A greater volume of mucus is secreted in response to _____

_____

4. Parietal Cells
   a. Secrete _____ & _____
   b. Functionally intrinsic factor _____

      _____
   c. Hydrochloric acid produces _____
      1. Has a minor _____
      2. One main function is to _____
      3. Inactivates _____
      4. Denatures many _____
      5. Provides the proper _____
5. Chief Cells
   a. Secrete _____, which is packaged into _____ that are released by _____
   b. In the lumen of the stomach _____ and previously formed _____ convert pepsinogen to _____
   c. The optimum pH for pepsin enzyme activity is _____
   d. Functionally pepsin breaks proteins into _____
6. Regulation of Stomach Secretion
   a. Cephalic Phase
      1. Centers within the medulla oblongata are stimulated by:
         a. _____ & _____ of food
         b. Stimulation of tactile receptors during _____ & _____
         c. Pleasant _____
      2. Parasympathetic stimulation of the stomach mucosa increases:
         a. Secretory activity of both _____ & _____ cells
         b. Stimulates the secretion of _____ & _____
      3. Gastrin is released into circulation and:
         a. Stimulates parietal cells to secrete additional _____ & _____
         b. Stimulates endocrine cells to release more _____ ,

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which stimulates parietal cells to secrete more _____

b. Gastric Phase
    1. Produces the _____ of gastric secretions
    2. The gastric phase is initiated by _____
    3. Distention of the stomach wall especially in the _____
        a. Results in the stimulation of _____
        b. Initiates reflexes that involve _____ & _____
        c. Results in secretion of _____, _____, _____, _____, & _____
        d. Gastrin release is also stimulated by the presence of:
            1. Partially digested _____
            2. Moderate amounts of _____ or _____
        e. The distention stimulus is blocked when _____
    4. Presence of amino acids and peptides directly stimulate _____ to secrete _____

c. Intestinal Phase
    1. Controlled by entrance of _____ into _____
    2. Secretin is released into circulation in response to _____
        a. Secretin inhibits both _____ & _____
    3. Acidic solutions also initiate a local _____
    4. The hormones gastric inhibitory peptide and cholecystokinin are released in response to _____ in the duodenum
        a. Which hormone strongly inhibits gastric secretion? _____
    5. Hypertonic solutions in the duodenum and jejunum also _____ _____
        a. Perhaps through a hormone referred to as _____
    6. The enterogastric reflex consists of _____ _____ & _____ gastric secretions
        a. It is activated by:
            1. Distention of the _____

2. _____ substances in the duodenum
3. _____ pH and _____ or _____ solutions

D. Movements of the Stomach
   1. Stomach Filling
      a. As food enters the stomach, the rugae _____ and the stomach volume _____
      b. Pressure in the stomach does not increase because:
         1. Smooth muscle _____
         2. Reflex inhibits _____
   2. Mixing of Stomach Contents
      a. Chyme is formed by thoroughly mixing _____ & _____
      b. Describe mixing waves and what they accomplish: _____
      _____
      c. Describe peristaltic waves and what they accomplish: _____
      _____
   3. Stomach Emptying
      a. The pyloric sphincter usually remains partially closed because of mild _____
      b. Each peristaltic contraction is sufficiently strong to _____
      _____
      c. The term "pyloric pump" refers to _____
      _____
   4. Regulation of Stomach Emptying
      a. Distention of the stomach stimulates _____, _____, and _____
         1. All of these
            a. Increase _____ &
            b. Cause _____
               1. Results in an increase in _____
      b. Hormonal and neural mechanisms that decrease gastric secretion also:
         1. _____ gastric motility & _____ pyloric sphincter
            a. Results in a _____ in stomach emptying

XI. Small Intestine

A. Anatomy of the Small Intestine

1. Duodenum
   a. How long is the duodenum? _____
   b. Two small mounds are found inside the duodenum called:
      1. _____
      2. _____
   c. At the major papilla, the _____ & _____ join to form the _____ & empties into duodenum
      1. The opening of the ampulla is controlled by a smooth muscle sphincter called _____
   d. What opens at the tip of the lesser papilla in most people? _____ _____
   e. Modifications to the surface of the duodenum allow for more efficient _____ & _____
      1. Circular folds or plicae circulares:
         a. These are a series of folds of the _____ & _____
         b. The folds run _____ to the long axis of the tube
      2. Villi
         a. These are fingerlike projections of the _____
         b. Each villus is covered by a _____
         c. Each villus contains a _____ and a _____ called a _____
      3. Microvilli
         a. These are _____ of the cells
         b. The combined microvilli on the entire epithelial surface form _____
      4. These modifications greatly _____ and as a result greatly _____
   f. The four types of epithelial cells in the duodenal mucosa include:
      1. _____ with _____ which produce _____ and _____ food

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2. _____ which produce _____
3. _____ which may help _____
   _____
4. _____ which produce _____

g. The epithelial cells are produced in intestinal glands that are described as
   _____
   at the base _____
   1. The absorptive and goblet cells migrate from the intestinal gland to
      _____
   2. The granular and endocrine cells remain _____

h. Where are the duodenal glands? _____
   1. What do they produce? _____

2. Jejunum and Ileum
   a. Structure is similar to duodenum except that there is a gradual decrease in
      1. _____ of the small intestine
      2. _____ of the intestinal wall
      3. Number of _____
      4. Number of _____ as one progresses through the tube
   b. What parts of the small intestine do most of the absorption? _____
      _____
   c. What are Peyer's patches? _____
      1. What tissue layers of the ileum are they located in? _____ &
         _____
   d. Where is the ileocecal junction? _____
      a. The ileocecal sphincter is composed of _____
      b. The ileocecal valve is a _____

B. Secretions of the Small Intestine
   1. The small intestine produces secretions that primarily contain
      _____, _____, & _____
      a. These secretions _____ & _____
         the intestinal wall and keep chyme in a _____ form

2. The small intestine also receives secretions from the _____ & _____
    a. The pancreas secretes most of _____
3. Large amounts of mucus are secreted by the _____ glands, _____ glands, and _____ cells
    a. The mucus protects the intestinal wall against:
        1. Irritating _____ &
        2. _____ that enter from the pancreas
4. Secretin and cholecystokinin are secreted from the intestinal mucosa and stimulate _____
5. Enzymes of the intestinal mucosa are _____
    a. Disaccharidases break _____ into _____
    b. Peptidases hydrolyze _____
    c. Nucleases break down _____
6. Small molecules resulting from digestion are absorbed through _____ and enter the _____ or _____

C. Movement in the Small Intestine
1. The primary mechanical events in the small intestine are _____ and _____
2. Functionally segmental contractions _____
3. Functionally peristaltic contractions _____
4. Smooth muscle contraction increases in response to:
    a. _____ of the intestinal wall
    b. Solutions that are _____, _____, or with a low _____
    c. Products of _____
5. These movements are mediated by _____ reflexes
6. The ileocecal sphincter remains _____ most of the time
    a. Peristaltic waves cause it to _____ and allow _____ _____
    b. Cecal distention initiates a _____ that causes _____
        1. This facilitates _____

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2. Prevents _____

XII. Liver

A. Anatomy of the Liver

1. The liver consists of:
    a. Two major lobes called _____ and _____
    b. Two minor lobes called _____ and _____
2. What is the porta? _____
3. The common hepatic duct is formed by the joining of the _____ and _____
4. The cystic duct comes from the _____
5. The common hepatic duct and cystic duct unite to form _____ _____ which joins the pancreatic duct at the _____
    a. The duct empties into the duodenum at the _____
6. What is the gall bladder? _____

B. Histology of the Liver

1. The liver is covered with a _____ & _____
2. The main support of the liver is provided by a branching _____ which arise from the connective tissue capsule
3. The liver is divided into hexagonal shaped _____ with a _____ at each corner
    a. The term triad refers to the fact that they contain a _____, _____, and a _____
4. In the center of each lobule is a _____
5. Hepatic veins are formed by the union of _____
6. Hepatic veins empty into the _____
7. Hepatic Cords
    a. Radiate out from the _____
    b. Composed of _____ the _____ of the liver
8. Hepatic sinusoids are the _____
    a. Sinusoids are lined with a _____

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1. The lining is composed of two cell populations:
    a. Extremely _____
    b. Hepatic _____
2. Between the cells of each cord is a _____

9. The hepatic sinusoids receive two blood supplies that mix in the sinusoid:
    a. Hepatic portal vein delivers _____ blood
    b. Hepatic artery delivers _____ blood
10. From the blood in the sinusoids the hepatocytes take up _____ & _____
    a. The nutrients are _____, _____, _____, or used to _____
    b. Hepatocytes release molecules into the _____ or _____
11. Blood in the hepatic sinusoid flows to the _____
12. Bile flows through the _____ to the _____ duct

C. Functions of the Liver
1. Bile Production
    a. Functionally bile _____ & _____ stomach acid and _____
    b. Bile salts _____ fats
    c. Bile also contains _____ from the breakdown of hemoglobin
    d. Secretin, from the small intestine, _____ secretion
    e. Bile salts increase bile secretion through a _____
2. Storage
    a. Hepatocytes remove sugar from the blood and store it as _____
        1. Hepatocytes control blood sugar levels within _____
    b. Hepatocytes can also store _____, _____, _____, & _____
    c. Is the storage of material short or long term? _____
3. Nutrient Interconversion
    a. Liver can convert nutrients _____ if not in the diet
        1. Amino acids could be used to produce _____, _____, & _____
    b. Transform substances into more _____

1. Phospholipids are formed by _____

   _____

c. What happens to Vitamin D in the liver? _____

4. Detoxification
   a. Needs to deal with two sources of material:
      1. Many _____ are harmful
      2. Body itself _____
   b. The liver detoxifies many substances by _____ to make them less _____ or make their _____
5. Phagocytosis
   a. Hepatic phagocytic cells also called _____ phagocytize
      1. "Worn-out" and dying _____ and _____
      2. Some _____ and other _____
6. Synthesis
   a. The liver produces many blood _____

XIII. Gallbladder

A. Anatomy
   1. Where is the gallbladder located? _____
   2. The gallbladder connects to the common bile duct through the _____
   3. Three tunics form the gallbladder wall:
      a. Inner mucosa _____
      b. Muscularis _____
      c. Outer _____

B. Function
   1. How much bile can the gallbladder store? _____
   2. While in the gallbladder _____ & _____ are absorbed from the bile
      a. This makes bile salts and pigments more _____
   3. Shortly after a meal the small intestine releases cholecystokinin which causes the gallbladder to _____
      a. There is also a smaller response to _____ stimulation

4. Contraction of the gallbladder dumps _____

XIV. Pancreas

A. Anatomy of the Pancreas
   1. The pancreas is composed of both _____ & _____ tissue
   2. The pancreas consists of a:
      a. Head located _____
      b. _____ and a tail which _____
   3. The endocrine portion of the pancreas is called _____
      a. These cells produce _____ & _____
         1. Important in controlling _____
      b. And _____
         1. Which regulates _____ & _____ secretion and may _____
   4. The exocrine portion of the pancreas is a _____
      a. The acini produce _____
      b. Clusters of acini form _____
      c. The secretions of the acini drain into:
         1. _____ which connect to
         2. _____ which leave the lobules to join
         3. _____ between the lobules and attach to
         4. _____ which joins the common bile duct at the hepatopancreatic ampulla

B. Pancreatic Secretions
   1. Pancreatic juice produced by the exocrine tissue has two components:
      a. Aqueous Component
         1. Produced principally by the _____
         2. It contains _____
         3. A major part of the aqueous component is _____
            a. They neutralize the _____
               1. The increased pH stops _____ but provides _____

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b. Enzymatic Component
    1. Produced by the _____
    2. Enzymes that digest protein are secreted in an inactive form:
        a. Inactive _____ converted to active _____
        b. Inactive _____ converted to active _____
        c. Inactive _____ converted to active _____
        d. If produced in their active forms _____
        e. _____ is attached to the brush border of the small intestine and converts trypsinogen to _____
        f. Trypsin then activates more _____, _____, and _____
    3. Pancreatic amylase continues _____
    4. What are pancreatic lipases? _____
    5. Deoxyribonucleases break _____ into _____
    6. Ribonucleases break _____ into _____

C. Regulation of Pancreatic Secretion
    1. Acidic chyme in the duodenum:
        a. Primary stimulus for release of the hormone _____
        b. In turn _____ stimulates the pancreas to secrete a _____ containing _____
    2. Fatty acids and other lipids in the duodenum:
        a. Major stimulus for the release of the hormone _____
        b. In turn the hormone _____ stimulates:
            1. Release of _____ from the gallbladder
            2. Secretion of pancreatic juice _____
    3. Parasympathetic nerve impulses stimulate _____
    4. Sympathetic nerve impulses _____
    5. Nerve stimulation is greatest during the _____ & _____ phases of stomach secretion

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XV. Large Intestine

A. Anatomy of the Large Intestine

1. Cecum
    a. The cecum is the _____
    b. The cecum extends inferiorly past the ileocecal junction in the form of a _____
    c. What is the vermiform appendix? _____
        1. The walls of the appendix contain _____
2. Colon
    a. The colon consists of _____:
        1. The ascending colon extends _____ ends at the _____
        2. The transverse colon extends from _____ to _____
        3. The descending colon extends from _____ to the _____
        4. The sigmoid colon forms _____ that extends into the _____ and ends at the _____
    b. The circular layer of the muscularis is _____
    c. The longitudinal layer of the muscularis forms _____ called _____ that run the _____
    d. What cause haustra to form? _____
    e. What are epiploic appendages? _____
        1. Are they inside or outside the colon? _____
    f. The mucosal lining consists of _____
        1. It has numerous straight tubular glands called _____
            a. They have three cell types: _____, _____, & _____ but _____ predominate
3. Rectum
    a. The rectum is a _____
    b. Begins at the _____ and ends at the _____

c. The muscularis is _____

4. Anal Canal
   a. Begins at the _____ and ends at the _____
   b. The internal anal sphincter is formed by _____
      1. It is located at the _____
   c. The external anal sphincter is formed by _____
      1. It is located at the _____

B. Secretions of the Large Intestine
   1. The major secretory product of the colon is _____ which _____ the wall of the colon and helps the _____
   2. A molecular pump exchanges _____ for _____ _____ in response to _____
   3. Another pump exchanges _____ for _____
   4. Water moves through the wall of the colon by _____
   5. The feces that is eliminated consists of _____, _____, _____, and _____
   6. Bacterial action in the colon:
      a. Synthesizes _____
      b. Breaks down a small amount of _____ to _____
      c. Produce gas called _____

C. Movement in the Large Intestine
   1. Which kind of movement is uncommon in the colon? _____
   2. Which kind of movement is largely responsible for moving chyme along the ascending colon? _____
   3. What are mass movements? _____
   4. Mass movements are very common _____
      a. _____ if initiated by the stomach
      b. _____ if initiated by the duodenum
   5. The defecation reflex is initiated by _____
      a. Local reflexes cause _____ of the rectum and _____

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b. Parasympathetic reflexes cause _____ of the rectum and are normally responsible for _____

c. The defecation reflex reduces action potentials to the _____ _____ causing it to _____

6. The external anal sphincter is under _____ control because it is composed of _____

a. Prevents the _____

b. If this sphincter is _____ feces is _____

7. The defecation reflex is often reinitiated as a result of _____

8. Defecation is usually accompanied by _____

a. Forceful contraction of the _____

XVI. Digestion, Absorption, and Transport

A. General

1. Digestion is breakdown of food to molecules that are _____ to be _____
2. Mechanical digestion breaks _____
3. Chemical digestion involves the breaking of _____ in _____ by _____
4. Digestion begins in the _____ and continues in the _____ but most digestion occurs in _____
5. Absorption of certain molecules can occur all along the digestive tract:

a. In the oral cavity a few molecules are absorbed through the _____ under the tongue

b. In the stomach _____ can diffuse into circulation

c. Most absorption occurs in the _____ & _____

1. Some absorption does occur in the _____

d. What types of substances enter the hepatic portal system?

_____

e. What substances are transported into lacteals? _____

B. Carbohydrates

1. Carbohydrate digestion begins in the oral cavity with _____

2. A minor amount of digestion occurs in the stomach through the action of _____ and _____
3. Carbohydrate digestion is continued in the intestine by _____
4. Disaccharidases bound to the microvilli digest _____ into _____
5. What monosaccharides are absorbed by cotransport powered by a sodium gradient? _____ and _____
6. What monosaccharides are absorbed by facilitated diffusion? _____
7. Monosaccharides move into the bloodstream by _____

C. Lipids

1. The first step in lipid digestion is _____ which is the _____ into _____
   a. This increases the _____ for digestive enzymes
   b. Emulsification is accomplished by _____
2. Chemical digestion of lipids is accomplished by the digestive enzyme _____ most of which is secreted by the _____
3. The primary products of lipase digestion are:
   a. _____ &
   b. _____
4. Micelles are formed when bile salts _____
   a. The hydrophobic ends are directed toward _____
   b. The hydrophilic ends are directed toward _____
5. When micelles come into contact with an epithelium cell of the small intestine the contents of the micelle _____
6. Lipid Transport
   a. Inside the intestinal epithelial cells:
      1. Triglycerides are formed inside the _____
      2. Chylomicrons are formed when _____ attach to _____
   b. Chylomicrons leave the epithelial cells and enter _____ instead of blood capillaries because they lack _____ _____ and are _____
   c. Chylomicrons are carried through the _____ to the

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_____ and by blood to _____

d. Triglycerides are broken into _____ & _____ before entering adipose tissue and inside fat cells are _____ _____
e. In the liver chylomicron lipids are _____, _____ _____, or used as _____
f. The chylomicron remnant is _____
g. What are lipoproteins? _____
    1. Why are lipids combined with proteins? _____ _____
h. Chylomicrons have an extremely low density because they are composed of _____ lipids and only _____ proteins
i. Specify the composition of the major transport lipoproteins:
    1. Very low-density lipoprotein (VLDL) _____ lipid & _____ protein
    2. Low-density lipoprotein (LDL) _____ lipid & _____ protein
    3. High-density lipoprotein (HDL) _____ lipid & _____ protein
j. How much of the cholesterol in the body is manufactured by the body? _____
k. Most of the lipid leaving the liver is in the form of _____
l. At adipose tissue _____ are removed from the _____ which turns it into _____ (less lipid, more protein)
m. The cholesterol in LDL is critical for:
    1. Production of _____ &
    2. Production of _____ in the liver
    3. It is also an important component of _____
n. Where are the LDL receptors? _____
    1. When LDL is bound to the receptors the _____ and the LDL is taken into the cell by _____
    2. Inside the cell the vesicle combines with a _____ & LDL components are _____
o. Cells also make their own _____
p. When intake and manufacture of cholesterol exceeds a cell's needs, a

negative-feedback system functions. This negative-feedback system:

1. Reduces _____
2. Reduces _____ manufactured by the cell

q. Cells also package excess lipids into _____

1. These are transported to the liver for _____ or _____

D. Proteins

1. Gastric pepsin digests as much as _____ of ingested protein
2. In the small intestine proteolytic enzymes from the _____ continue the process to produce _____
3. Peptidases bound to the microvilli break these into _____, _____, and _____
4. How do dipeptides and tripeptides enter intestinal epithelial cells? _____

   _____

   _____
5. Acidic and most neutral amino acids are _____
6. Basic amino acids enter the epithelial cells by _____
7. Inside the cells:
   a. Dipeptidases split _____ into _____
   b. Tripeptidases split _____ into _____
8. Individual amino acids leave the epithelial cells and enter the _____ _____ to the _____
9. Amino acids enter various cells of the body by _____
   a. Mechanism is stimulated by _____ & _____
10. Most amino acids are used as _____ but some amino acids are used for _____

E. Water

1. Most water is absorbed in the _____
2. Osmotic gradients across the epithelium determine the _____
3. When chyme is dilute _____
4. When chyme is concentrated _____
5. As nutrients are absorbed from chyme the osmotic pressure _____
   a. Therefore water moves _____

6. Because of the osmotic gradient produced as nutrients are absorbed in the small intestine _____ of the water entering the digestive tube is reabsorbed

F. Ions
   1. List the ions that are reabsorbed by active transport mechanisms within the epithelial cells of the small intestine:
      a. _____
      b. _____
      c. _____
      d. _____
      e. _____
   2. For the most part _____ move passively following the positive charged _____
      a. However, in the ileum _____
   3. Vitamin D is required for the transport of _____

XVII. Effects of Aging on the Digestive System

A. Gradual changes occur throughout the digestive tract:
   1. Thinning of the _____, _____, & _____
   2. Blood supply _____
   3. Decreased motility due to _____
   4. Less mucus because _____
   5. Glands tend to secrete _____

B. Liver
   1. Ability to detoxify certain chemicals
   2. Ability of the hepatic phagocytic cells _____
   3. Ability to store glycogen _____
      a. These problems are more severe in _____

C. Elderly people are more susceptible to _____ and _____
   1. More likely to develop _____ and _____

D. Medications
   1. Decreased mucus covering _____
   2. Decline in blood supply _____

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