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. ______________________________________________________________
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 ______________________________ &
      ____________________________________________________________
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
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 ______________________________
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
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 __________________________
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 ____________________
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 ________________
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. ____________________________
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 ________________
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 ______________________________ & _____________
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 ______________
            ,
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
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 _____________________________________________
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 ______________________________
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 ________________
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
XV. Large Intestine

A. Anatomy of the Large Intestine

1. Cecum
   a. The cecum is ____________________________
   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

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. ___________________________ & ___________________________
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
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 ____________
      ______________________________________________________________________
   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 ______________________________