

Digestive System

- I. Introduction
 - I. Tube from mouth to anus, 30 ft. long
 - II. Greatest portion below diaphragm
 - III. Function: digestion and absorption
- II. Cross section through the coelom (body cavity) and digestive tube
 - I. Lumen = hollow opening of a duct or tube
 - II. Mucous membrane = absorption, secretion
 - i. Columnar epithelium = stomach, small and large intestine
 - ii. Stratified squamous = non-keratinized, mouth esophagus, rectum
 - III. Submucosa: areolar connective tissue rich in blood vessels and nerve endings
 - IV. Muscle: function - propel food and other materials through the tube
 - i. Circular layer inner layer
 - ii. Longitudinal layer outer layer
 - iii. Transverse or oblique layer (in stomach only)
 - V. Visceral peritoneum - peritoneal layer of digestive tube
- III. Buccal Cavity
 - I. Lips - orbicularis oris muscle (striated) covered layering to mucous membrane
 - II. Cheeks - buccinator muscle aids in mastication
 - III. Tongue - striated muscle
 - i. Highly movable - limited by lingual frenulum
 - ii. Mucous membrane - covers free surface
 - iii. Papillae
 - 1. Filiform ridges (thread like) - tactile sense
 - 2. Fungiform (mushroom shaped) - taste buds on these
 - 3. Vallate papillae - posterior 1/3 of tongue, v-shaped, few in number
 - iv. Tongue function - taste, mastication, speech, deglutition (swallowing)
 - IV. Teeth - read
 - V. Oral roof
 - i. Hard palate - covered with mucous membrane, palatine bone and palatine process of maxilla
 - ii. Soft palate - striated muscle covered by mucous membrane
 - iii. Uvula - read location and function
 - iv. Functions: aid in swallowing, mastication, speech
 - VI. Salivary Glands
 - i. Parotid, Submandibular, sublingual, and minor glands
 - ii. Locations and function (secretion)
 - iii. Saliva - mucin, water, salivary amylase
- IV. Pharynx
 - I. Nasopharynx - above and behind soft palate
 - i. Posterior nares
 - ii. Eustachian tubes
 - iii. Adenoids or pharyngeal tonsils
 - II. Oropharynx
 - i. Below soft palate and posterior to buccal cavity

- ii. Palatine tonsils - located between glossopalatine arch and pharyngopalatine arch
 - iii. Function: guide food and air to laryngopharynx
 - III. Laryngopharynx
 - i. Epiglottis - fold of cartilage and mucous membrane to guide food to esophagus and air into trachea
- V. Esophagus
 - I. Structure
 - i. Muscular tube 10 inches long
 - ii. Secretion - mucous, no enzymes
 - iii. Upper third striated muscle, middle third transition from striated to smooth muscle, lower third smooth muscle
 - II. Function: connects laryngopharynx with stomach
 - III. Process of swallowing
 - i. Stage 1 = mouth, tongue thrust upward along hard then soft palate: bolus of food thrown into pharynx
 - ii. Stage 2 = air passage shut off (clang of epiglottis), food "grabbed" by constrictors of the oropharynx and forced into esophagus (constrictors are striated, but involuntary control)
 - iii. Stage 3 = food moved by peristalsis
- VI. Stomach
 - I. Location: below diaphragm and liver in Epigastric and left hypochondriac region of abdomen
 - II. Gross anatomy
 - III. Muscle layers
 - i. Longitudinal - outer
 - ii. Circular - middle
 - iii. Oblique - innermost
 - IV. Histology
 - i. Mucous membrane - simple columnar epithelium which is bent into folds called **rugae**
 - ii. Gastric pits
 - iii. Mucous cells
 - iv. Parietal cells
 - v. Chief cells or zymogenic cells
 - V. Function
 - i. Gastric juice consist of mucous, HCl (parietal cells), pepsinogen (pepsin)
 - ii. Activation of pepsin, a protease
 - iii. Gastric lipase
 - iv. Mixing
 - v. Storage
 - VI. Secretion of gastric juice
 - i. Cephalic phase - sight, smell, taste, thought of food, stimulates 25-30% of gastric secretion
 - ii. Gastric phase - mechanical stimulus of food, chemical stimulus of protein fragments, gastrin (hormone) produced in pylorus and secreted to blood,

spread to brain via CVS, fundus, stimulates further secretion of gastric juice, 75% of secretion of gastric juice is of this type

- iii. Intestinal phase - **chyme** has entered duodenum but gastric juice still is produced in the stomach

VII. Emptying of stomach

- i. Gradual process
- ii. Significance

VIII. Terms associated with stomach

- i. Gavage tube = tube to stomach
- ii. Gastrostomy = artificial opening to stomach
- iii. Nausea = characterized by upset feeling, salivation, weakness, perspiration
- iv. Vomiting = intense reverse peristalsis of stomach musculature
- v. Gastric lavage = washing of stomach
- vi. Gastric analysis = hypersecretion, hyposecretion, achlorhydria

VII. Small Intestine

I. Introduction

- i. Site of digestion and absorption
- ii. 2.5 cm x 600 cm (1 in x 20 feet)
- iii. Duodenum - 25 cm (10 inches)
- iv. Jejunum 8 feet
- v. Ileum 12 feet

II. Modifications of small intestine

- i. Circular folds
- ii. Villi - capillaries and lymph vessels
- iii. Microvilli - increased absorptive area
- iv. Intestinal glands or **crypts of lieberkuhn** secrete enzymes
- v. Lymph tissue - below epithelium of mucosa
- vi. Duodenal glands - most numerous near pylorus, secretion of mucous, protective function

III. Digestion in small intestine

i. Bile

1. Green yellow fluid: water, bile salts, bilirubin, biliverdin, cholesterol, fatty acids, lecithin, inorganic salts
2. Only bile salts (cholesterol product) are important in digestion
3. Bile salts emulsify fats by reducing surface tension
4. Bile salts also important in absorption of fatty acids
5. Bile flow and production regulated by hormone secretion
6. **Cholecystokin** regulates gall bladder emptying

ii. Pancreatic juice (pancreas is both an exocrine and endocrine gland), delivers the following to a duct system that leads to duodenum

1. Sodium bicarbonate - neutralization of acidic chyme is essential for pancreatic enzymes to work
2. Pancreatic amylase - splits polysaccharides to disaccharides (except cellulose)
3. Lipase - digests fats to three fatty acids and one glycerol
4. Proteases - digest proteins and/or polypeptides into dipeptides

- a. Trypsinogen
 - b. Chymotrypsinogen
 - c. Inactive procarboxypeptidase
 - d. Enterokinase
 - 5. Nucleases
- iii. Intestinal juice
 - 1. Enterokinase
 - 2. Maltase
 - 3. Lactase
 - 4. Sucrase
 - 5. Aminopeptidase
 - 6. Dipeptidase
 - 7. Nucleases

IV. Absorption

- i. Sugars - active transport
- ii. Fatty acids and glycerol pass through mucosa with help of bile
- iii. Amino acids - active transport
- iv. Inorganic material
 - 1. Sodium - by active transport
 - 2. Chloride - by diffusion
 - 3. Potassium - by diffusion
 - 4. Calcium - diffusion aided by parathormone
 - 5. Water - absorption function of large intestine

VIII. Large Intestine

- I. Gross anatomy
- II. Muscle layers: **taenia coli** - longitudinal bands
- III. Mucous membranes - no villi, goblet cells (mucous protection of intestine), intestinal glands
- IV. Function;
 - i. No digestion - no enzymes
 - ii. Breakdown occurs due to action of E. coli and other bacteria
 - 1. Fermentation of carbohydrates
 - 2. Putrefaction of proteins
 - a. Phenol, indole, skatol = absorbed
 - b. H₂S produced
 - c. NH₃ produced
 - d. Vitamin K synthesized and absorbed - only practical source of vitamin K
 - iii. Entry to cecum at ileocecal valve is due to relaxation of the sphincter: about 15 cc enters at a given time
 - iv. Danger of killing helpful bacteria
 - v. 8,000 ml/day absorbed
- V. Movement of fecal material
 - i. Pendular movements
 - ii. Segmentation movements
 - iii. Mass movements - propulsive, strongest in AM after a meal

- iv. Stretch receptors in rectum and significance
- v. Defecation - relaxation of internal and external sphincter, smooth muscle contraction of rectum - **levatorani muscles** (striated)
- VI. Fecal material and diagnostic significance
 - i. Normal stool
 - ii. Abnormal stool colors
 - 1. White
 - 2. Black and/or tar like
 - 3. Red streaks
 - 4. White streaks and/or dots
 - 5. Diarrhea
- VII. Terms
 - i. Ileostomy
 - ii. Colostomy
- VIII. Hormones

<u>Hormone</u>	<u>Stimulus</u>	<u>Route</u>	<u>Function</u>
Gastrin	protein fragments	pylorus to fundus	greater gastric secretion
Enterogastrone	fats, fatty acids	duodenum to stomach	inhibits gastric secretion inhibits stomach muscle contractions
Secretin	acid chyme	duodenum to pancreas	stimulate sodium bicarbonate production in pancreas, stimulates bile secretion
Pancreozymin	acid chyme	duodenum to stomach	production of enzymes
Cholecystokinin	fats, fatty acids dilute HCl	duodenum to gall bladder	release of bile

DIGESTIVE HANDOUT

Students are responsible for the following terms for definition and location on acceptable models, sheep head sections, and cat dissections.

1. mouth (buccal cavity)
2. laryngopharynx
3. nasopharynx
4. oropharynx
5. adenoids
6. tonsils
7. Eustachian tube orifice
8. nasal concha - superior, middle, inferior
9. hard palate
10. soft palate
11. glottis
12. epiglottis
13. trachea
14. larynx
15. esophagus
16. stomach
17. fundus
18. body
19. pylorus
20. pyloric sphincter
21. rugae
22. cardiac orifice
23. duodenum
24. jejunum
25. ileum
26. pancreas
27. pancreatic duct
28. liver
29. gall bladder
30. cystic duct
31. bile duct (common)
32. hepatic duct
33. ileocecal valve
34. cecum
35. appendix
36. ascending colon
37. transverse colon
38. descending colon
39. sigmoid colon
40. rectum
41. haustra
42. taenia coli
43. villi
44. spleen
45. greater curvature
46. lesser curvature