I. Anatomy of the Digestive System
   A. Major Processes of Digestion
      1. Ingestion
      2. Movement of Food through Digestive Tract
      3. Mechanical & Enzymatic Digestion
      4. Absorption of Nutrients into Blood
      5. Formation & Elimination of Indigestible Materials & Wastes
   B. Organization of Digestive System Organs
      1. Digestive Tract Organs
      2. Accessory Organs
   C. General Histological Organization
      1. Digestive Tract/Gastrointestinal Tract (GI) – Alimentary Canal
         a. Mucosa – Superficial – Exposed to Lumen
            1) Mucosal Epithelium
            2) Lamina propria
            3) Muscularis mucosae
               a) Inner – Circular Layer
               b) Outer – Longitudinal Layer
            4) Functions – Depends on Type of Epithelium
               a) Secretion
               b) Absorption
               c) Protection
b. Submucosa
   1) Submucosal (Meissner) Plexus
   2) Functions
      a) Nutrition
      b) Protection

c. Muscularis externa
   1) Superficial layer – Circular
   2) Deeper layer – Longitudinal
   3) Myenteric (Auerbach) Plexus
   4) Function
      a) Peristalsis

d. Serosa or Adventitia – Deepest Layer
   1) Subserous plexus
   2) Visceral peritoneum (Most Abdominal Organs)
      a) Reduces friction as mobile Gl tract organs work
   3) Coarse fibrous connective tissue (Organs outside of Abdomen & parts of some Abdominal Organs)
      a) Anchors & protects Gl tract
D. Organs of the Digestive Tract

1. Mouth (Oral or Buccal Cavity)
   a. Labia
      1) Vermilion
      2) Labial frenulum
   b. Cheeks
   c. Vestibule
   d. Hard palate
      1) Cat – Palatine rugae
   e. Soft palate
      1) Uvula
   f. Tongue
      1) Lingual frenulum
      2) Papillae
   g. Palatoglossal arch (Anterior membrane)
   h. Palatopharyngeal arch (Posterior membrane)
   i. Fauces
2. Accessory Organs of the Mouth: Salivary Glands
   a. Parotid Glands
      1) Parotid (Stenson’s) ducts
      2) Mainly Serous
   b. Submandibular Glands
      1) Submandibular (Wharton’s) ducts
      2) Mucous & Serous (Demilunes)
   c. Sublingual Glands
      1) Sublingual (Rivinus’) ducts
      2) Mostly Mucous & Few Serous (Demilunes)
   d. Cat – Molar glands & Infraorbital glands
   e. Histology
      1) Serous Cells
         a) Chromaphilic
         b) Watery Secretion
            1] Enzymes
               a] Amylase
            2] Antibodies
      2) Mucous Cells
         a) Chromaphobic
         b) Mucin Secretion
            1] Bolus
3. Accessory Organs of the Mouth: Teeth – Mastication
   a. Tooth Anatomy
      1) Occlusal surface
      2) Periodontal Ligament
         a) Alveolar process of bone
      3) Crown
         a) Anatomical Crown
            1] Enamel
         b) Clinical Crown
            1] Gingivae
               a] Gingival sulcus
               b] Gingival margin
         c) Dentin
            a) Calcified connective tissue
         d) Pulp cavity
            a) Pulp – ONLY Living Part
      4) Neck
      5) Root
         a) Cementum covers Dentin
         b) Root Canal
         c) Apical Foramen
b. Dentitions

1) Deciduous or Primary Dentition (Milk Teeth or Baby Teeth) – Symmetrical – Quadrants
   a) Central Incisor
   b) Lateral Incisor
   c) Cuspid (Canine or Eye tooth)
   d) First Molar
   e) Second Molar

2) Permanent or Secondary – Quadrants
   a) Central Incisor
   b) Lateral Incisor
   c) Cuspid (Canine or Eye tooth)
   d) First Premolar (Bicuspid)*
   e) Second Premolar (Bicuspid)*
      1] * Replace Deciduous Molars
   f) First Molar
   g) Second Molar
   h) Third (Wisdom) Molar

3) Cat – Symmetrical
   a) Upper Jaw 3-1-3-1
   b) Lower Jaw 3-1-2-1
4. Pharynx – See Respiratory Outline

5. Esophagus (Gullet)
   a. Nonkeratinized Stratified Squamous Epithelium
   b. Muscularis externa differs
      1) Upper part – Striated Muscle
      2) Middle part – Mix of Striated & Smooth Muscle
      3) Lowest part - Smooth Muscle
      4) Gastroesophageal sphincter (Cardiac sphincter) or Lower Esophageal Sphincter
         a) Clinical Application: Acid Reflux
   c. Adventitia – NOT Serosa
   d. Pierces Diaphragm to Enter Abdominal Cavity
      1) Esophageal Hiatus
6. Stomach
   a. Regions
      1) Cardiac region or Cardia
      2) Fundic region or Fundus
      3) Body*
      4) Pyloric region or Pylorus
         a) Pyloric antrum
         b) Pyloric canal
         c) Pyloric sphincter (valve)
   b. Lesser curvature attaching Lesser omentum
   c. Greater curvature attaching Greater omentum
   d. Histology
      1) Mucosa – Simple Columnar Epithelium
         a) Mucous neck cell
         b) Gastric glands & pits
            1] Chief (Zymogenetic) cells
               a] Inactive Pepsinogen
            2] Parietal (Oxyntic) cells
               a] Hydrochloric acid
               b] Intrinsic factor
         c) Rugae
      2) Muscularis Externa – Helps form Chyme
         a) Extra layer – Superficial Oblique layer in the body of the stomach*
7. Small Intestine
   a. Segments
      1) Duodenum
      2) Jejunum
      3) Ileum
         a) Ileocecal sphincter (valve)
   b. Mesenteries proper
   c. Specializations that increase surface area
      1) Plicae circulares
      2) Villi
         a) Intestinal glands (crypts of Lieberkuhn) – Buffers & Enzymes
         b) Lacteal
      3) Brush border of Microvilli
   e. Tunics
   d. Unique Histological Features of the Submucosa
      1) Submucosal (Duodenal or Brunner’s) glands
         a) Alkaline mucus
      2) Jejunum has more intestinal crypts and longer villi for nutrient absorption
      3) Aggregate lymphoid follicles (Peyer’s patches) in submucosa of ileum
8. Large Intestine
   a. Regions
      1) Colon – mostly retroperitoneal
         a) Cecum
            1] Ileocecal valve
            2] (Vermiform) Appendix
                a] Mesoappendix
         b) Ascending Colon
         c) Right colic (hepatic) flexure
         d) Transverse Colon - mesocolon
         e) Left colic (splenic) flexure
         f) Descending Colon - retroperitoneal
         g) Sigmoid Colon – mesocolon
      2) Rectum
         a) Anal canal
            1] Anus
            2] Internal anal sphincter
               a] Smooth muscle
            3] External anal sphincter
               a] Skeletal muscle
         b) Anal columns
            1] Changes to Stratified squamous epithelium
b. Histology
   1) Mucosa
      a) Simple columnar epithelium
         (1) GOBLET CELLS
   2) Muscularis externa
      a) Longitudinal Layer - NOT continuous
         1] Taeniae coli – 3 bands
            a] Haustra
   3) Omental appendices (Epiplioic appendages)

c. Functions
   1) Bacteria manufacture vitamins B & K
   2) Reclaims water & electrolytes
   3) Waste compaction

d. Clinical Applications:
   1) Diarrhea
   2) Constipation
   3) Appendicitis
   4) Hemorrhoids
   5) Colorectal cancer
      a) Colonoscopy
9. Liver – Accessory Digestive Organ
   a. Lobes – Historically
      1) Right Lobe
         a) Quadrate Lobe
         b) Caudate Lobe
      2) Left Lobe
         a) Falciform Ligament - Anterior
            (1) Round Ligament – remnant
   b. Coronary ligament – Suspends from Diaphragm
   c. Lobules ~ 100,000 per lobe
      1) Hepatocytes (Parenchyma cells)
         a) Secrete Bile
         b) Bile Canaliculi empty into Bile Ductules which surround the lobule
      2) Sinusoids
         a) Empty into Central vein
      3) Kupffer cells – Macrophages
      4) Portal Triad
         a) Branch of Hepatic Artery Proper
         b) Branch of Hepatic Portal Vein
         c) Bile Duct
d. Ducts
1) Right & Left Hepatic Ducts
2) Common Hepatic Duct
3) Common Bile Duct
4) Hepatopancreatic Sphincter (sphincter of Oddi)
   a) Empties into Duodenal Papilla

e. Clinical Applications:
1) Hepatitis
2) Cirrhosis

10. Gallbladder – Accessory Digestive Organ
a. Cystic Duct
b. Histology
   1) Mucosa
      a) Simple Columnar – Pinched into mucosal crypts
      b) No Muscularis mucosae
   2) No Submucosa

11. Pancreas – Accessory Digestive Organ - Retroperitoneal
a. Acini (Acinar cells)
   1) Pancreatic Juice
b. Pancreatic Duct (duct of Wirsung)
   1) Duodenal Ampulla (ampulla of Vater)
c. Accessory Pancreatic Duct (duct of Santorini) – Some
II. Digestive Physiology

A. Macromolecules are broken down into Monomers
   1. Catabolism (Decomposition reaction)
      a. Enzymes lower activation energy
         1) Substrates bind to Active Sites
            a) Specificity
         2) Products are the result
         3) Denaturation
         4) Most Digestive Enzymes use Hydrolysis
            a) Hydrolases
   2. Anabolism (Dehydration synthesis reaction)

B. Mechanical/Physical Digestion
   1. Mastication
   2. Deglutition
      a. Buccal phase
         1) Bolus
         2) Voluntary
      b. Pharyngeal phase
         1) Involuntary
      c. Esophageal phase
   3. Segmentation
   4. Peristalsis
   5. Emulsification by Bile
C. Chemical Digestion

1. Digestion of Carbohydrates to Monosaccharides
   a. Benedict’s reagent – test for Sugars
   b. Lugol’s solution – test for Starch
   c. Amylase

2. Digestion of Lipids to Glycerol & Fatty acid(s)
   a. Litmus
   b. Pancreatic Lipase
   c. Bile action
      1) Emulsification
         a) Sudan IV
      2) Bile salts form Micelles
   d. Saturated fatty acids
   e. Unsaturated fatty acids

3. Digestion of Proteins to Amino acids
   a. Biuret’s Test for Protein
   b. Pancreatin – Mixture of Pancreatic Enzymes
   c. BAPNA (clear to yellow) – PhysioEx
   d. Pepsinogen – inactive – PhysioEx
      1) Pepsin – active