Digestive system
Functions of the digestive system

- Digestion - mechanical and chemical breakdown of material
- Motility - movement of material from the oral cavity to the anus - swallowing / peristalsis
- Secretion - exocrine release of enzymes into the lumen of the digestive tract for chemical digestion
- Absorption - movement of material from the lumen into the blood stream
• Alimentary canal or GI-tract- a continuous tube
  – about 30 feet in length
  – oral cavity → esophagus → stomach → small intestines → large int. → rectum

• Accessory organs- digestive organs outside of canal
  – communicate with GI tract via ducts
  – salivary glands, pancreas, liver, gallbladder, teeth, tongue
Gastrointestinal tract-

- Four layers:
- Superficial
- Tunica mucosa
- Tunica submucosa
- Tunica muscularis externa
- Tunica serosa - visceral peritoneum
- Deep
• Tunica mucosa-mucus membrane = moist epithelial tissue (different types) + loose connective tissue
  – Folding increases surface area
• Tunica submucosa—areolar connective tissue usually contains glands
• Tunica muscularis externa -2 or 3 layers of smooth muscle (3 in stomach only)
• Tunica serosa-connective tissue serous membrane NOT in esophagus/rectum-adventitia
Smooth muscle

- No sarcomere arrangement, No striations
- Many have no efferent innervation
- Gap junctions, Arranged in sheets
- Ability to stretch
- Two forms of contraction
  - Peristalsis
  - segmentation
Peristalsis
Net movement of material towards the rectum

Segmentation
No net movement of material, mixing and churning

Enteric nervous system-nerves network that control digestive reflexes
Visceral/parietal peritoneum in-folding that suspend organs

- **Falciform ligament**
  - connect liver to diaphragm and anterior wall
- **Greater omentum**
  - fold laying over-top of the large intestines
  - connected the greater curvature of the stomach to the transverse colon
  - it is filled with fat globules and lymph nodules
- **lesser omentum**
  - from liver to lesser curvature of stomach
- **mesentery proper**
  - stomach & sm. intestines to posterior abdominal wall
- **mesocolon**
  - suspends lg. intestines from posterior abdominal wall
Fig 25.1 Digestive tract & accessory organs

**SALIVARY GLANDS**
- Secretion of lubricating fluid containing enzymes that break down carbohydrates

**PHARYNX**
- Pharyngeal muscles propel materials into the esophagus

**ESOPHAGUS**
- Transport of materials to the stomach

**STOMACH**
- Chemical breakdown of materials via acid and enzymes; mechanical processing through muscular contractions

**LIVER**
- Secretion of bile (important for lipid digestion), storage of nutrients, many other vital functions

**GALLBLADDER**
- Storage and concentration of bile

**PANCREAS**
- Exocrine cells secrete buffers and digestive enzymes; endocrine cells secrete hormones

**SMALL INTESTINE**
- Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions

**LARGE INTESTINE**
- Dehydration and compaction of undigestible materials in preparation for elimination

**ORAL CAVITY, TEETH, TONGUE**
- Mechanical processing, moistening, mixing with salivary secretions
Salivary glands

- Slightly different secretions
- Stimulated by parasympathetic
- Release enzymes
- Lubrication oral cavity
- Submandibular S.G.-release majority of saliva, 70%
Dentin of teeth is similar to the inorganic portion of bone

Only example of gomphosis joint

Incisors - clipping/cutting
Canines - tearing/slashing
Premolars - mashing/grinding
Molars - mashing/grinding
• 20 Deciduous teeth-baby teeth
• Permanent dentition-32 adult teeth (molars)
• Wisdom teeth-posterior molars
Epiglottis closes over larynx

Voluntary control
esophagus

- Tunica muscularis-superior 1/3 skeletal muscle
- No serosa instead adventitia
- About 1 ft long
Tunica muscularis has three layers of muscle.

Tunica mucosa has folds, rugae when empty.
Mucous layer protects epithelia of stomach from stomach acids

G cells release hormone, Gastrin

Fluid leaving stomach is acid chyme
Small intestines

- 90 percent of nutrient absorption (most in jejunum)
- Contains plicae, villi, microvilli to increase surface area
- Releases hormones CCK & secretin
- Lacteal absorption of lipids
- Mucus and buffers (neutralize acid chyme)
Duodenum is 10 in long, Receives digestive juices from liver/pancreas

jejunum is 8 ft long

ileum is 12 ft long

Peyers patch more common
Fig 25.15

Peyer's patches
5 ft long
Larger diameter

Absorption of vitamins

Reabsorption of water & electrolytes

Compaction & storage of feces

Fig 25.17

iliocecal valve

ASCENDING COLON

TRANVERSE COLON

DESCENDING COLON

CECUM

VERMIFORM appendix

RECTUM

SIGMOID COLON
Fig 25.17

(c) Rectum, sectioned
valves

• Valves regulate passage of material from segment to segment
• pharynx/esophagus
• Esophagus/stomach-cardiac sphincter
• Stomach/small intestines-pyloric sphincter
• Small/large intestines-iliocecal valve
• Anus/environment
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Liver

• Metabolic regulation
  – absorbed nutrients are further metabolized in the liver
  – Toxins brake down
  – Fat soluble vitamins stored in liver

• Hematological regulation
  – Liver receives 25% of blood from aorta
  – breakdown of old/damaged blood cells
  – Makes plasma proteins

• Synthesis of bile/bile salts
  – Bile-pH buffer neutralize stomach acid
  – Bile salts-aids in break down of lipids
Circulation thru the digestive system:

- **Hepatic Artery**: Oxygen Rich
- **Hepatic Vein**: Nutrient rich, Low Oxygen, Detoxified blood
- **Hepatic Portal Vein**: Nutrient rich, Low Oxygen, Toxins in blood
- **Mesenteric Arteries**: Oxygen Rich
- **GI Tract**
- **Liver**
With continued exposure to ethanol, sections of the liver will die, as evidenced by these micronodules.
Fig 25.22 Stores and increases the concentration of bile
Release of bile

- Liver
- Common hepatic duct
- Common bile duct
- Gallbladder
- Cystic duct
- Duodenum
Majority of pancreas has digestive (exocrine) function
Releases pancreatic juice to the duodenum via pancreatic duct
Majority of chemical digestion
• Break
• Histology
• http://www.barixclinics.com/how_it_works/animated_surgery.jsp
• Food Pyramid
• <- point of release     enzyme name (what it metabolizes) = organ secreting enzymes

• Oral cavity  <-Amylase (carbohydrates), Lipase (lipids) = Salivary Glands
• Oropharynx
• Laryngopharynx
• Esophagus
• Stomach    <-Pepsinogen (proteins) = Chief Cells, HCL = Parietal Cells
• Duodenum  <-Pancreatic Juice (lipids, carbos, proteins) = Pancreas,
• Jejunum     Brush-border Enzymes (lipids, carbos, proteins) = Absorptive Cells
• Ileum       Bile (emulsification of lipid) = Liver & Gallbladder
• Cecum
• Ascending Colon
• Transverse Colon
• Descending Colon
• Sigmoid Colon
• Rectum
• Anus

• Inside the stomach:
  • Pepsinogen (inactive precursor) + HCL = Pepsin (active form, degrades proteins)
  • Pancreatic Juice, Brush-border Enzymes, & Bile are released into the duodenum.
Tunica mucosa

Tunica submucosa

Tunica muscularis externa

Tunica serosa
Fig 25.5

(a) Oral cavity, sagittal section
Fig 25.5

(b) Oral cavity, anterior view
(a) Lateral view with left mandibular body and ramus removed
Fig 25.7

(a) Tooth, sectional view

- Crown
- Neck
- Root
- Pulp cavity
- Enamel
- Dentin
- Gingiva
- Gingival sulcus
- Cementum
- Periodontal ligament (membrane)
- Root canal
- Bone of alveolar process
- Apical foramen
- Branches of alveolar vessels and nerve
(b) Adult upper and lower teeth
Fig 25.19

Tunica mucosa

Tunica serosa

Hastrum

Fatty appendices

Taenia coli

Simple columnar epithelium

Goblet cells

Intestinal gland

Muscularis mucosae

Submucosa

(a) Colon wall, sectional view

Longitudinal layer

Circular layer
Coronary ligament

Left lobe

Right lobe

Falciform ligament

Round ligament (ligamentum teres)

Gallbladder

(c) Anterior (parietal) surface
Fig 25.20

- Caudate lobe
- Left hepatic vein
- Inferior vena cava
- Coronary ligament
- Left lobe
- Right lobe
- Hepatic portal vein
- Hepatic artery proper
- Quadrature lobe
- Common bile duct
- Gallbladder
- Hilus (porta hepatis)

(d) Posterior (visceral) surface