Chapter 25 – Digestive System

Digestive tube or alimentary canal starts in your oral cavity and goes all the way down to the anus. It is a tube within a tube. Torso is considered a tube and elementary canal is a tube within the torso.

Starts at Oral Cavity > Pharynx > Esophagus > Stomach > Small Intestine (Pancreas in inner curvature of small intestine, Duodenum, Jejunum, Ileum) > Large Intestine (Cecum, Ascending colon, Transverse colon, Descending colon, Sigmoid colon, rectum, anus)

Unable to digest corn because we are unable to break down cellulose, we lack enzyme to break it down.

**Function**: Take whatever is ingested and break it down into smaller molecules. We catabolize food.

**Nutrients**: Amino acids, simple fats, and cholesterol (needed for steroid hormones). Nutrients travel through blood stream.

3 layers of the digestive tube

1. Serosa (visceral peritoneum) - outside
2. Mucosa – inside
3. Muscularis externa (has 2 layers)
   - Longitudinal – outside
   - Circular – inside (constrictor muscle)

Submucosa found between mucosa and muscularis externa. Very specific mainly in the duodenal glands.

Mucosa contains simple columnar epithelium with microvilli to increase surface area for absorption.

Oral cavity and anus contains stratified squamous epithelium.

Mesentery – 2 layers of peritoneum

**Embryology** (pg. 681)

4th week of development – we folded and incorporated yolk sac. Yolk sac makes up part of digestive tube. Ventral mesentery and dorsal mesentery suspend tube between back wall and front wall. As mesentery develops to 5 weeks, ventral mesentery diminishes in size and has a liver that develops into it. Liver is an accessory organ that is not part of the tube. The liver and pancreas are accessory organs that grow out of mesentery that join to the tube but are not part of the tube. As liver moves to the right side of the body, the ventral mesentery stretches out and hangs to form an omentum. Dorsal mesentery holds guts and prevents guts from falling to the floor.

2 omentums

1. Lesser omentum (dorsal)
2. Greater omentum (ventral)

**Purpose of omentum**: It covers organs and serves as the policeman of the abdominal cavity. (i.e. c-section - creates adhesions. Appendicitis – wraps around appendix to prevent peritonitis in case of rupture.
The Pancreas and the Duodenum are retroperitoneum since they are behind the peritoneum.

**The Oral Cavity (pg. 656)**
- The tongue
- The pharynx
- Contains opening of salivary glands (parotid gland, submandibular, and sublingual)
- Important because of saliva, which contains an enzyme called salivary amylase which breaks down starches. (I.e saltine cracker)

*Starch (carbohydrate) digestion begins in the oral cavity*

**Teeth**
Used for mechanical digestion

- **Per Quadrant**
  - Incisors (2) – shaped like a chisel to cut food
  - Canine – used for tearing
  - Premolars (2) – used for grinding
  - Molars (3) – used for grinding
  - *3rd molars are wisdom teeth*

Parotid duct located underneath 2nd maxillary molar
Submandibular located on each side of the frenulum. “squirter”
Sublingual located underneath tongue.

Lingual Frenulum – holds tongue down to the bottom or floor of mouth. If it goes to the tip, you break your tongue too soon causing a lisp. It can be fixed by cutting the frenulum. On each side of the frenulum is the opening to submandibular gland. Sublingual salivary gland located underneath tongue.

Frenulum = break

Esophagus is the tube that connects oral cavity with stomach. Esophagus has smooth muscle with longitudinal and circular muscles contracting.

Peristalsis – Muscle contraction that moves food through the digestive tract.

**The Stomach**
- J-shaped hollow muscular organ
- Has smooth muscle with 3 layers of muscle

3 layers of muscle (pg. 664)
1. longitudinal
2. circular
3. oblique

3 parts of the stomach
1. fundus (portion of stomach near entrance of esophagus)
2. pyloric region (portion of stomach about to empty into the small intestine)
3. body
Has 1 entrance and 1 exit. Circular fibers form sphincter.

Cardia Sphincter – sphincter in entrance of stomach. Called cardia because it is near the heart.
Pyloric Sphincter – sphincter at exit of stomach before it opens to duodenum.

Mucosa of stomach has wrinkles called Rugae.
Rugae= wrinkles

Pepsin is an enzyme that digests protein. Protein digestion occurs in stomach.

**Bolus > Chyme** (when food leaves stomach to go to small intestine. Starch and protein digestion have occurred.)

**Small Intestine**
Duodenum : C-shaped hollow muscular organ
  - Duodenum papilla
Jejunum
Ileum

**The Liver (pg. 678)**
-Has 2 lobes (left and right)
-It is important since it is an accessory organ for the digestive system. Creates a substance called bile.
-Liver makes bile
  - Bile is a chemical substance that emulsifies fat. Emulsification is a process in where the fat gets a polar coating around each fat molecule that allows it to be digested.

Each lobe has a duct called the hepatic duct(right and left). They join to form the common hepatic duct. Sprouting out of common hepatic duct is the cystic duct which goes to a bag called the gall bladder. Gall bladder is where bile is stored. It stores 50 cc or 10 tspns of bile. Common bile duct is where bile goes, which is behind the stomach and pancreas, and empties it into the duodenum of the small intestine.

**The Pancreas (pg. 679)**
-sits on the inner C curvature of the duodenum. It has a duct called the main pancreatic duct which brings pancreatic juices that have a series of enzymes

**Pancreatic Enzymes**
1. Lypase – digest lipids
2. Pancreatic amylase – digest starch
3. Chymase or peptidase – digest proteins (breaks down peptide bonds into simple amino acids)

  - Lypase break up lipids into fatty acids and triglycerides to get absorbed into the small intestine.
  - Pancreatic amylase breaks up starch that may not have been digested in small intestine
  - Peptidase breaks down peptides in the chyme and complete digestion into small intestine.

Chyme > Feces (once it gets into colon)

Chyme changes its name after nutrients have been absorbed in the small intestine from the jejunum and ileum. Vagus nerve innervates jejunum and ileum, since it goes up to right 2/3 of transverse colon in the
large intestine.

**Different parts of mucosa**
- **Duodenum** - Folds of mucosa in duodenum are called plica circulares. Not much absorption taking place.
- **Jejunum and Ileum** – Most of absorption happens in jejunum and in the ileum. Plica circulares in jejunum are taller and in the ileum the plica circulares begin to get shorter. Ileum joins to the large intestine, where water absorption occurs.

**Microvilli of plica circulares (pg. 668)**
- Columnar epithelium
- Blood vessels
  - Arteriole – arterio capillary
  - Venule – venous capillary (where nutrients are absorbed)
- Lacteal – important for fat absorption. Fat cannot go straight into blood stream because it will clog blood vessels. Lacteal is a lymphatic vessel. Lymphatic system transports lipids.

- Protein (amino acids) and carbohydrate (sugars) derivatives go straight to blood stream. Then they go to liver. Nutrient rich blood has to go to the liver first.

**Large Intestine (pg. 670) (***upper 2/3 innervated by Vagus, lower 1/3 by pudendal***)**
- Cecum
- Ascending colon
- Transverse colon
- Descending colon
- Sigmoid colon
- Rectum

**Arterial supply**
Superior Mesenteric – Ascending colon to right 2/3 transverse colon
Inferior Mesenteric – Left 1/3 of transverse colon, descending and sigmoid colon

**Ileocecal junction** – where ileum joins with the cecum.

Chyme is yellow
Feces is black

Appendix is retrocecal.

Haustra – pockets in the large intestine (because longitudinal muscles are shorter than circular muscles)
Taenia coli – strips of the large intestine (longitudinal muscle)
  - called taenia cause it looks like a worm
Epiploic appendages – fatty appendices (pg. 671)

*Large intestine absorbs water.

Diarrhea is caused be food not staying long enough in the large intestine for the water to be absorbed.

It takes about 24 hours for food to be digested to become fecal material.
**Video Notes**

Energy comes from food. Food needs to be digested so that nutrients can be recovered.

**Digestive System**
- Mouth
- Esophagus
- Stomach
- Small Intestine
- Large Intestine

Food is chewed and mixed with saliva before it passes through esophagus. Food travels from esophagus to stomach. Stomach volume is about 2 meters.

Stomach walls contain cells that secrete enzymes, mucus and hydrochloric acid.

Gastric juices excreted from gastric glands are acidic.

Stomach's gastric juice only digests proteins, does not digest fat or starch.

Starches are dissolved by enzymes in saliva.

Stomach muscle crushes the food and keeps it well mixed with gastric juice.

Food travels to small intestine. Starts from organ called duodenum. Food is mixed with juice secreted from pancreas and mixed with bile produced from the liver. Bile is stored in gall bladder. Pancreatic juice contains enzyme that digests fats. Fats are digested only after entering the small intestine.

Walls of small intestine have folds and ridges called plica circulares. The also have villi with small openings called the intestinal glands, which secretes intestinal juice. Starches are broken down to glucose by enzyme in intestinal juice. Enzymes also complete break down of protein into amino acids, vitamins and other nutrients. The glucose and amino acids are absorbed into the walls of the small intestine and used by the body.

Small intestine is about 6 meters long and has a surface area of about 6 sq. meters. Blood stream transfers nutrients to the liver. Digestive fat carried away by lymph vessels.

Remaining food transferred to large intestine. Made up of many regular folds called haustra. Has blood vessels on the surface. Has many small openings on the surface that secretes mucus to protect the walls of the large intestine. Food residue still has water which will be absorbed by the large intestine. Large intestine is about 1 ½ meters long. Finally all undigested residue is excreted as feces.