Objectives
- To understand the role of digestive system & interaction with other systems of the body to maintain homeostasis.
- To outline the function of the digestive system.
- To identify the difference between the GI tract & accessory structures of the digestive system.

Functions of the Digestive System
- Ingest the food.
- Break down the food into small molecules that can cross the plasma membrane of cells.
  - Mechanical
  - Chemical
- Secretion of digestive enzymes into the lumen. – Chemical digestion
- Absorb these nutrient molecules.
- Eliminate non-digestible wastes.

Dilemma of Obesity
Fat cells secrete leptin, which reduces appetite; an empty stomach secretes ghrelin, which makes you hungry – the goal is healthy nutrition.

Incomplete vs. Complete Digestive systems

What about us?
- Humans have a complete digestive system lined with mucus-covered epithelium
- If the tubular gut of an adult human were fully stretched out, it would extend up to 9 meters (30 feet).
GI tract vs Role of Accessory Structures

**GI tract**
- Alimentary canal
- Composed of numerous layers.
  - Mucosa/endothelium
  - Muscles (2 layers)
  - Visceral Peritoneum
- Through "gut" system
  - Bolus → Chyme

**Accessory structures**
- Structures that assist in the breakdown of food.
  - Mechanical digestion
  - Chemical digestion
- Technically outside of the GI tract, but contribute to processing.

Path of Food through the GI tract

- Mouth
- OroPharynx (throat)
- Esophagus
- Stomach
- Sm. Intestine
- Lg. Intestine
- Rectum
- Anus

Process / Physiology

Food is moved through the esophagus by *peristalsis* through a *sphincter* to the stomach, which adds acids and enzymes to food and mixes them together to form *chyme*.

Accessory Organs/Structures

- Teeth
- Glands
  - Salivary glands
  - Liver
  - Pancreas
  - Gall Bladder
Salivary Glands

- **Parotid** - Located in front of and below the ears.
- **Sublingual** - Lie beneath the tongue.
- **Submandibular** - Lie in the posterior floor of the oral cavity, beneath the base of the tongue.

- 1 liter of saliva per day is produced by the salivary gland.
- Function of saliva is to soften the food and begin the digestion of starch with salivary amylase.

The function of the pharynx

Movement of bolus through the pharynx.

Notice that epiglottis folds over larynx during swallowing.

Esophagus

The food tube that connects the pharynx to the stomach.

*Peristalsis* - Rhythmic movement of food along the digestive tract.

Stomach

- Thick walled, J-shaped organ which lies below the diaphragm.
- Stores food and starts the digestion of proteins.
- Folds are called *rugae* which allows the stomach to expand.
- Muscular wall of stomach churns, mixing the contents.
- *Chyme* passes into the small intestine

Structures of the Stomach

*Functions*:
- Stores food
- Mechanically mixes
- Secretes chemicals used in digestion
Digestive Juices

Contributed by:
- Liver – Bile for fat breakdown
- Gallbladder – Stores bile
- Pancreas
  - Pancreatic amylase
  - Bicarbonate – to neutralize acids
  - Hormones

Intestines

- In the small intestine, carbohydrates, lipids and proteins are digested by secretions from liver and pancreas; nutrients and water are absorbed.

Secretes
- Secretin
- Cholecystokinin - CCK - which stimulate the pancreas to secrete its juices

Specialized features of Small Intestine

Villi:
- Finger-like projections that have extensions called microvilli that increase the surface area for nutrient absorption.
- Contains blood vessels and a small lymph vessel called a lacteal.
- Fat enters lacteals, but sugars and amino acids enter into the blood system.

Small Intestine

Averages 3 meters - around 10 feet. Found in the central and lower portion of the abdominal cavity. Supported by fan-shaped mesentery.

Composed of three regions:
- Duodenum - first 10 inches, contains distinctive glands that secrete mucus.
- Jejunum - next 3 feet, contains folds and villi.
- Ileum - Last 2 meters (6-7 feet).

Microanatomy of Sm. Intestine – Site of Absorption
Large Intestine

The large intestine absorbs water and ions, and compacts wastes, which collect in the rectum, and are expelled from the anus.

The large intestine is wider than the small intestine, but also much shorter—only about 1.5 meters (5 feet) long.

Contains E. coli bacteria that assist in the absorption of Vitamin K & some B vitamins, amino acids.

Rectum & Anus

Rectum: Storage area for feces before it is excreted.

Anus: Function is for defecation.

Hormonal Controls

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Source</th>
<th>Effects on Digestive System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrin</td>
<td>Stomach</td>
<td>Stimulates stomach acid secretion</td>
</tr>
<tr>
<td>Cholecystokinin (CKK)</td>
<td>Small intestine</td>
<td>Stimulates pancreatic enzyme secretion and gallbladder contraction</td>
</tr>
<tr>
<td>Secretin</td>
<td>Small intestine</td>
<td>Stimulates pancreas to secrete bicarbonate and slows contractions of small intestine</td>
</tr>
</tbody>
</table>

Chemical Digestion

<table>
<thead>
<tr>
<th>Enzymes Present</th>
<th>Enzymes Source</th>
<th>Enzyme Substrate</th>
<th>Metabolism Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate Digestion</td>
<td>Mouth, stomach</td>
<td>Stomach</td>
<td>Stomach</td>
</tr>
<tr>
<td>Protein Digestion</td>
<td>Mouth, stomach</td>
<td>Stomach</td>
<td>Stomach</td>
</tr>
<tr>
<td>Lipid Digestion</td>
<td>Mouth, stomach</td>
<td>Stomach</td>
<td>Stomach</td>
</tr>
<tr>
<td>Nucleic Acid Digestion</td>
<td>Mouth, stomach</td>
<td>Stomach</td>
<td>Stomach</td>
</tr>
</tbody>
</table>

* Breakdown products small enough to be absorbed into the internal environment.