The Digestive System and Body Metabolism

Gross Anatomy

Function

The Digestive System Functions

Ingestion—taking in food

Digestion—breaking food down both physically and chemically

Absorption—movement of nutrients into the bloodstream

Defecation—rids the body of indigestible waste

Organs of the Digestive System

Two main groups

- Alimentary canal (gastrointestinal or GI tract)—continuous coiled hollow tube
- Accessory digestive organs

Organs of the Digestive System

Organs of the Alimentary Canal

- Mouth
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine
- Anus

Mouth (Oral Cavity) Anatomy

- Lips (labia)—protect the anterior opening
- Cheeks—form the lateral walls
- Hard palate—forms the anterior roof
- Soft palate—forms the posterior roof
- Uvula—fleshy projection of the soft palate
Mouth (Oral Cavity) Anatomy

- Vestibule—space between lips externally and teeth and gums internally
- Oral cavity proper—area contained by the teeth
- Tongue—attached at hyoid bone and styloid processes of the skull, and by the lingual frenulum to the floor of the mouth

Tonsils
  - Palatine
  - Lingual

Mouth (Oral Cavity) Anatomy

Mouth Physiology

- Mastication (chewing) of food
- Mixing masticated food with saliva
- Initiation of swallowing by the tongue
- Allows for the sense of taste

Pharynx Anatomy

- Nasopharynx—not part of the digestive system
- Oropharynx—posterior to oral cavity
- Laryngopharynx—below the oropharynx and connected to the esophagus

Pharynx Physiology

- Serves as a passageway for air and food
- Food is propelled to the esophagus by muscle layers
- Food movement is by alternating contractions of the muscle layers (peristalsis)

Esophagus Anatomy and Physiology

Anatomy
  - About 10 inches long
Run from pharynx to stomach through the diaphragm

Physiology

- Conducts food by peristalsis (slow rhythmic squeezing)
- Passageway for food only (respiratory system branches off after the pharynx)

Stomach Anatomy

- Located on the left side of the abdominal cavity
- Food enters at the cardioesophageal sphincter
- Food empties into the small intestine at the pyloric sphincter (valve)

Stomach Anatomy

- Regions of the stomach
  - Cardiac region—near the heart
  - Fundus—expanded portion lateral to the cardiac region
  - Body—midportion
  - Pylorus—funnel-shaped terminal end

Stomach Anatomy

- Rugae—internal folds of the mucosa

Stomach Anatomy

- External regions
  - Lesser curvature—concave medial surface
  - Greater curvature—convex lateral surface

Stomach Anatomy

Stomach Anatomy

Stomach Anatomy

Stomach Anatomy

Stomach Physiology

- Temporary storage tank for food
- Site of food breakdown
- Chemical breakdown of protein begins
Delivers chyme (processed food) to the small intestine

- Small Intestine
  - The body's major digestive organ
  - Site of nutrient absorption into the blood
  - Muscular tube extending from the pyloric sphincter to the ileocecal valve
  - Suspended from the posterior abdominal wall by the mesentery
- Subdivisions of the Small Intestine
  - Duodenum
    - Attached to the stomach
    - Curves around the head of the pancreas
  - Jejunum
    - Attaches anteriorly to the duodenum
  - Ileum
    - Extends from jejunum to large intestine

- Chemical Digestion in the Small Intestine
  - Chemical digestion begins in the small intestine
    - Enzymes are produced by
      - Intestinal cells
      - Pancreas
    - Pancreatic ducts carry enzymes to the small intestine
    - Bile, formed by the liver, enters via the bile duct

- Small Intestine Anatomy
  - Three structural modifications that increase surface area
    - Microvilli—tiny projections of the plasma membrane (create a brush border appearance)
    - Villi—fingerlike structures formed by the mucosa
- **Circular folds (plicae circulares)**—deep folds of mucosa and submucosa

**Small Intestine Anatomy**

- **Small Intestine Anatomy**
- **Small Intestine Anatomy**
- **Large Intestine**

**Large Intestine**

- Larger in diameter, but shorter in length, than the small intestine
- Frames the internal abdomen

**Large Intestine Anatomy**

- Cecum—saclike first part of the large intestine
- **Appendix**
  - Accumulation of lymphatic tissue that sometimes becomes inflamed (appendicitis)
  - Hangs from the cecum

**Large Intestine**

- **Large Intestine Anatomy**

**Colon**

- Ascending—travels up right side of abdomen
- Transverse—travels across the abdominal cavity
- Descending—travels down the left side
- Sigmoid—enters the pelvis

**Rectum and anal canal**—also in pelvis

**Large Intestine**

- **Large Intestine Anatomy**

**Anus**—opening of the large intestine

- External anal sphincter—formed by skeletal muscle and under voluntary control
- Internal involuntary sphincter—formed by smooth muscle
- These sphincters are normally closed except during defecation

**Large Intestine**
Large Intestine Anatomy
- No villi present
- Goblet cells produce alkaline mucus which lubricates the passage of feces
- Muscularis externa layer is reduced to three bands of muscle called teniae coli
- These bands cause the wall to pucker into haustra (pocketlike sacs)

Accessory Digestive Organs
- Teeth
- Salivary glands
- Pancreas
- Liver
- Gallbladder

Teeth
- Function is to masticate (chew) food
- Humans have two sets of teeth
  - Deciduous (baby or “milk”) teeth
  - 20 teeth are fully formed by age two

Permanent teeth
- Replace deciduous teeth between the ages of 6 and 12
- A full set is 32 teeth, but some people do not have wisdom teeth (third molars)
- If they do emerge, the wisdom teeth appear between ages of 17 and 25

Classification of Teeth
- Incisors—cutting
- Canines—tearing or piercing
- Premolars—grinding
- Molars—grinding
Human Deciduous and Permanent Teeth

Regions of a Tooth

Crown—exposed part
- Enamel—hardest substance in the body
- Dentin—found deep to the enamel and forms the bulk of the tooth
- Pulp cavity—contains connective tissue, blood vessels, and nerve fibers
- Root canal—where the pulp cavity extends into the root

Regions of a Tooth

Neck
- Region in contact with the gum
- Connects crown to root

Root
- Cementum—covers outer surface and attaches the tooth to the periodontal membrane

Regions of a Tooth

Salivary Glands

Three pairs of salivary glands empty secretions into the mouth
- Parotid glands
- Submandibular glands
- Sublingual glands

Salivary Glands

Saliva
- Mixture of mucus and serous fluids
- Helps to form a food bolus
- Contains salivary amylase to begin starch digestion
- Dissolves chemicals so they can be tasted

Pancreas
- Found posterior to the parietal peritoneum
- Extends across the abdomen from spleen to duodenum
  - Pancreas
- Produces a wide spectrum of digestive enzymes that break down all categories of food
- Enzymes are secreted into the duodenum
- Alkaline fluid introduced with enzymes neutralizes acidic chyme coming from stomach
- Hormones produced by the pancreas
  - Insulin
  - Glucagon
- Pancreas
- Pancreas
- Liver
- Largest gland in the body
- Located on the right side of the body under the diaphragm
- Consists of four lobes suspended from the diaphragm and abdominal wall by the falciform ligament
- Connected to the gallbladder via the common hepatic duct
  - Liver
  - Liver
  - Bile
- Produced by cells in the liver
- Composition is
  - Bile salts
  - Bile pigments (mostly bilirubin from the breakdown of hemoglobin)
  - Cholesterol
  - Phospholipids
  - Electrolytes
Bile

Function—emulsify fats by physically breaking large fat globules into smaller ones

Gallbladder

Sac found in hollow fossa of liver

When no digestion is occurring, bile backs up the cystic duct for storage in the gallbladder

When digestion of fatty food is occurring, bile is introduced into the duodenum from the gallbladder

Gallstones are crystallized cholesterol which can cause blockages