The Digestive System and Body Metabolism

Premedical Biology
The Digestive System and Body Metabolism

Digestion

Breakdown of ingested food

Absorption

Passage of nutrients into the blood

Metabolism

Production of cellular energy (ATP)
Organs of the Digestive System

- Mouth (oral cavity)
- Tongue
- Parotid gland
- Sublingual gland
- Submandibular gland
- Salivary glands
- Pharynx
- Stomach
- Pancreas
- Spleen
- Esophagus
- Liver
- Gallbladder
- Small intestine:
  - Duodenum
  - Jejunum
  - Ileum
- Large intestine:
  - Transverse colon
  - Descending colon
  - Ascending colon
  - Cecum
  - Sigmoid colon
  - Rectum
  - Appendix
  - Anal canal
- Anus
Organs of the Alimentary Canal

- Mouth
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine
- Anus
Mouth (Oral Cavity) Anatomy

- Lips (labia)
- Cheeks
- Hard palate
- Soft palate
- Uvula
Mouth (Oral Cavity) Anatomy

- Vestibule
- Oral cavity
- Tongue
Mouth (Oral Cavity) Anatomy

- Tonsils
  - Palatine tonsils
  - Lingual tonsil
Processes in mouth

- Mastication (chewing) of food
- Mixing food with saliva – ptyalin (amylase)
- Initiation of swallowing by the tongue
- Allowing for the sense of taste
Tunica mucosa of Oral Cavity

- papillae
- taste buds in epithel cells
- 10,000 taste cells (chemoreceptors), nerve ends

Sweet, sour, bitter, salty

- cover the tongue, palate, epiglottis, and pharynx

Each taste cell consists of small hairs that lie in the taste pore. There, dissolved food or drink binds to a receptor, like a key in a lock.
Anatomy

- Nasopharynx - not part of the digestive system
- Oropharynx
- Laryngopharynx
- Esophagus
- nonkeratinized stratified squamous epithelium
- In the rest of tube is simple columnar epithelium.
- outer longitudinal and inner circular muscle layer.
- Upper third of esophagus consists of striated skeletal muscle.
Layers of Alimentary Canal Organs

- Mucosa
  - Surface epithelium
  - Small amount of loose connective tissue (lamina propria)
  - Small smooth muscle layer
Layers of Alimentary Canal Organs

- Submucosa
  - Soft loose connective tissue with blood vessels, nerve endings, and lymphatic tissue
  - Areolar, loose **collagenous connective tissue**
  - **nerve plexus** – *plexus submucosus Meissneri*,
Layers of Alimentary Canal Organs

- **Muscularis externa** – smooth muscle
  - Inner circular layer - sphincters
  - Outer longitudinal layer
  - myenteric nerve plexus – *plexus myentericus Auerbachii*
- **Serosa**
  - visceral peritoneum - **one layer of simple squamous epithelium** – the *mesothelium*, and an underlying connective tissue layer
Stomach Anatomy

- Cardioesophageal sphincter
- Esophagus
- Muscularis externa
- Longitudinal layer
- Circular layer
- Oblique layer
- Fundus
- Serosa
- Body
- Rugae of mucosa
- Lesser curvature
- Greater curvature
- Duodenum (a)
- Pyloric sphincter (valve)
- Pyloric antrum

Figure 14.4a
Stomach functions and Mucosa

- chyme (processed food)
- **Gastric pits** formed by folded tunica mucosa with simple columnar epithelium
- **Mucous neck cells** – produce a sticky alkaline mucus
Stomach glands

**Gastric glands:**

- **Chief cells** – produce protein-digesting enzymes (pepsinogens)
- **Parietal cells** – produce hydrochloric acid
- **Endocrine cells** – produce enteroglukagon, gastrin, somatostatin
Structure of the Stomach Mucosa
Small Intestine

- The body’s major digestive organ
- Site of nutrient absorption into the blood

- Duodenum
- Jejunum
- Ileum
Microvilli of the Small Intestine

- **Circular folds of mucose with villi** - folds of the mucosa and submucosa

- The submucosa with blood and lymphatic capillaries, lymphatic tissue

**Peyer’s patches**
Microvilli of the Small Intestine

- Microvilli found on **absorptive cells**

  **Goblet cells** are unicellular mucous glands dispersed between enterocytes in intestinal mucosa. **Glands of Lieberkühn** - they contain columnar enterocytes, mucous cells, Paneth cells, stem cells and enteroendocrine cells. Paneth cells synthesize antibacterial enzyme lysozyme and other defensive proteins.
Digestion in the Small Intestine

- Enzymes
  - Break double sugars into simple sugars
    - **pancreatic amylase**
    - Complete some protein digestion exopeptidase and endopeptidase: trypsin, chymotrypsin
  - Pancreatic enzymes play the major digestive function (lipase)
Chemical digestion

• Source of enzymes that are mixed with chyme
  Intestinal cells
  Pancreas
• Bile enters from the gall bladder - the bile is necessary for lipid digestion:
• bile salts, bile pigment (mostly bilirubin from the breakdown of hemoglobin), cholesterol, phospholipids electrolytes
Chemical digestion
Absorption in the Small Intestine

- Water is absorbed along the length of the small intestine
- End products of digestion
  - Most substances are absorbed by active transport through cell membranes
  - Lipids are absorbed by diffusion
- Substances are transported to the liver by the hepatic portal vein or lymph
Structures of the Large Intestine

- Colon
  - Ascending
  - Transverse
  - Descending
  - S-shaped sigmoidal
- Rectum
- Anus – external body opening

- Circular layer is thicker in area of rectum and in area of anal canal creates the **inner anal sphincter**.
Large Intestine

- Left colic (splenic) flexure
- Transverse mesocolon
- Descending colon
- Cut edge of mesentery
- Teniae coli
- Sigmoid colon
- Cecum
- Ileocecal valve
- Ileum (cut)
- Ascending colon
- Haustra
- Right colic (hepatic) flexure
- Transverse colon
- Rectum
- Anal canal
- Vermiform appendix
- External anal sphincter
Functions of the Large Intestine

- Absorption of water
- Eliminates indigestible food from the body as feces
- Does not participate in digestion of food
- Goblet cells produce mucus to act as a lubricant
- Resident bacteria digest remaining nutrients
Accessory Digestive Organs

- Salivary glands
- Teeth
- Pancreas
- Liver
- Gall bladder
Salivary Glands and Teeth

- Saliva-producing glands, exocrine
  - Parotid gland – located anterior to ears
  - Submandibular gland
  - Sublingual gland

- Humans have two sets of teeth
  - Deciduous (baby or milk) teeth, 20
Teeth

- Permanent teeth
  - Replace deciduous teeth between ages of 6 to 12
  - A full set is 32 teeth, but some people do not have wisdom teeth
Classification of Teeth

- Incisors (8)
- Canines (4)
- Premolars (8)
- Molars (12)
Regions of a tooth

- Crown – exposed part
  - Outer enamel - hardest substance in the human body
  - Dentin
  - Pulp cavity
- Neck
  - Region in contact with the gum
  - Connects crown to root
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
- Connected to the gall bladder via the common hepatic duct
Role of the Liver in Metabolism

- Detoxication of blood (phagocytosis, biotransformation) from drugs and alcohol
- Ammonium detoxification
- Saccharide metabolism (maintain blood glucose)
- Lipid metabolism
- Modifications of hormones and vitamins
- Produce cholesterol, plasma transport proteins, albumin and clotting proteins, hormones (IGF-1), non-essential amino acids
- Maintenance of internal environment
Processes of the Digestive System

- Peristalsis
- Segmentation – moving materials back and forth to aid in mixing
Thank you for your attention