

Chapter 3

Digestion, Absorption and Transport

Definition of Terms

1. Lumen- the inside of a tube. For example the intestinal lumen would be the area inside the intestine whereas the intestinal wall would be the perimeter of the intestine.
2. Villi- small finger-like projections on the intestinal lumen. Microvilli are small finger-like projections on the villi. These serve to increase the surface area of the intestinal wall where absorption of nutrient occurs.
2. Sphincter muscle- a circular muscle that contracts and relaxes controlling passage of material through a tube
3. Bolus- a quantity of a substance. For example a amount of food swallowed at one time.
4. Chyme- a semi liquid material made up of food and digestive secretions mixed together released by the stomach..
5. Digestion- process of consuming and breaking down foods
6. Absorption- process of food particles, resulting from digestion of food, entering the body
7. Enzyme- a protein that speeds up a reaction. Enzymes are very specific in the reaction they participate in. Typically the -ase ending denotes an enzyme. For example sucrase.
8. Bile- detergent like liquid made in the liver, stored in the gall bladder and secreted into the small intestine. Functions in allowing fat and water to mix and assists in the absorption of fats.
9. Feces- solid waste
10. pH- measurement of hydrogen ions (H^+)
acid- solution of low pH, or a high concentration of H^+
base- solution of high pH, or low concentration of H^+
11. Hormone- molecule that is released from one cell and acts on another
12. Gland-a cell or group of cells that produce specific molecules that are secreted outside the cell or organ
12. Vein- blood vessel that takes blood to the heart
13. Artery- blood vessel that takes blood away from the heart
14. Homeostasis- maintaining a constant state

I. Digestion

A. Anatomy of the digestive system

1. Mouth
 - a. Process of digestion begins here
 1. Mechanical breakdown of food
 2. Some enzymatic activity
 3. Lubrication
 - b. Food enters the mouth a **bolus** leaves
2. Esophagus
 - a. Tube that connects the mouth to the stomach
3. Epiglottis- cartilage that prevents food from entering the trachea
4. Cardiac sphincter
 - a. A circular muscle found at the junction of the stomach and the esophagus that prevents food from leaving the stomach and entering the esophagus
5. Stomach
 - a. Muscular organ in which the bolus is further broken down by mechanical, chemical and enzymatic action
 - b. A bolus of food enters the stomach and **chyme** leaves
6. Pyloric sphincter
 - a. A circular muscle found at the junction of the stomach and small intestine that controls the release of chyme from the stomach to the small intestine
7. Intestine
 - a. Small intestine
 1. Consists of the duodenum, jejunum and ileum
 - b. Functions in the enzymatic breakdown of food particles
 - c. Functions in the absorption of particles from the breakdown of food
8. Ileocecal sphincter
 - a. Circular muscle that separates the ileum from the large intestine
9. Large intestine
 - a. Ascending, transverse and descending colon
 - b. Functions in the absorption of nutrients
 - c. Functions in the formation and excretion of solid waste (feces)
10. Anus (rectum)
 - a. Functions in the formation and excretion of solid waste
11. Anal sphincter
 - a. Circular muscle that controls excretion of feces
12. Liver- organ that synthesizes and secretes bile
13. Gallbladder- organ that stores and concentrates bile

B. Muscular actions in digestion

1. Peristalsis
 - a. Contraction of circular and longitudinal muscles lining the gastrointestinal (**GI**) system
 1. Functions to move a bolus of food along the digestive system
2. Stomach
 - a. Circular, longitudinal and diagonal muscles that serve to churn the bolus of food creating the semi-liquid mass called chyme
3. Segmentation
 - a. Process of squeezing off segments of the intestine resulting in a backward/forward movement of materials (chyme)

4. Sphincter contraction
 - a. Circular muscles normally under tonic constriction
 1. Relaxation of the anal sphincter allows defecation
- C. Secretions of digestion
1. Mouth
 - a. Salivary glands secrete saliva (a lubricant) and enzymes involved in CHO breakdown
 2. Stomach
 - a. Stomach secretes hydrochloric acid and some enzymes involved in protein breakdown
 3. Small intestine
 - a. Secretes enzymes involved in CHO breakdown
 4. Pancreas
 - a. Secretes enzymes into the small intestine that are involved in protein, CHO and fat breakdown
 - b. Enzymes secreted by the pancreas are responsible for over 70% of food breakdown
 5. Liver
 - a. Liver synthesizes and secretes bile which is stored in the gall bladder
 6. Gall bladder- stores and concentrates bile secreted by the liver

II. Absorption

A. Requirements

1. Foods have been broken down into their smallest units (digestion).
 - a. proteins have been broken down to amino acids
 - b. CHO has been broken down to monosaccharides
 - c. fats have been broken down.
2. Small particles of food (resulting from mechanical, enzymatic and chemical breakdown) are in a water environment where enzyme activity occurs.

B. Intestinal cell

1. Transport of nutrients into intestinal cell
 - a. Specialized proteins in cell membrane that transport food particles from the lumen of the intestine into the intestinal cell
 1. Active transport
 - a. Utilizes specific transporter and requires energy to function
 - b. Amino acids
 2. Facilitated transport or diffusion
 - a. Utilizes specific transporter and does not require energy to function
 - b. Some vitamins
 - b. Some food particles pass right through the intestinal cell membrane
 1. Passive diffusion
 - a. Do not require a transporter or energy
2. Transport nutrients out of the intestinal cell
 - a. Specific transport mechanisms

III. Circulatory systems

A. Blood

1. A vasculature surrounds the intestines and infiltrates each villi
2. **Water soluble** compounds enter into this vasculature from each intestinal cell and then into the portal vein
3. The portal vein takes the nutrients to the liver

B. Lymph

1. A lymphatic system surrounds the intestines and infiltrates each villi
2. **Fat soluble** nutrients enter into the lymphatic circulatory system, travel into and through the thoracic duct and eventually empty into the blood circulatory system at the left subclavian vein

IV. Regulation of Digestion and Absorption

- A. Coordination of events- digestive enzymes must be present at the appropriate time: when food is present

<u>Stimulus</u>	<i>stimulus → response</i>	<u>Response</u>
Food or sight or smell of food	→	salivary gland secretions
- salivary amylase	→	breaks down starch (CHO)
- saliva	→	lubrication
Food entering stomach	→	gastric (stomach) secretions
- gastrin	→	stimulate hydrochloric acid (HCl) secretion
- HCl → ↓ pH	→	denatures (breaks down) protein
- pH in duodenum controls the pyloric sphincter		
↓ pH closed, ↑ pH open (chyme released)		
- gastric inhibitory peptide (GIP)	→	slows stomach motility (fats)
Food entering duodenum	→	secretin and cholecystokinin (CCK) secreted by intestinal cell
- Secretin	→	pancreatic secretion (enzymes and bicarbonate)
- CCK	→	stimulates bile release (for fat digestion) from the gallbladder