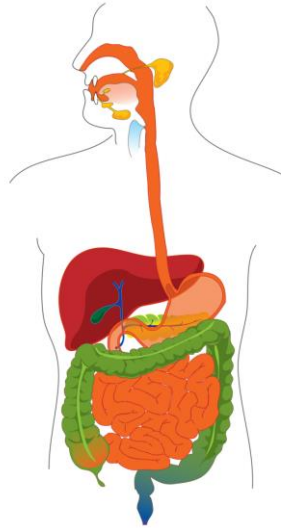


The Digestive System



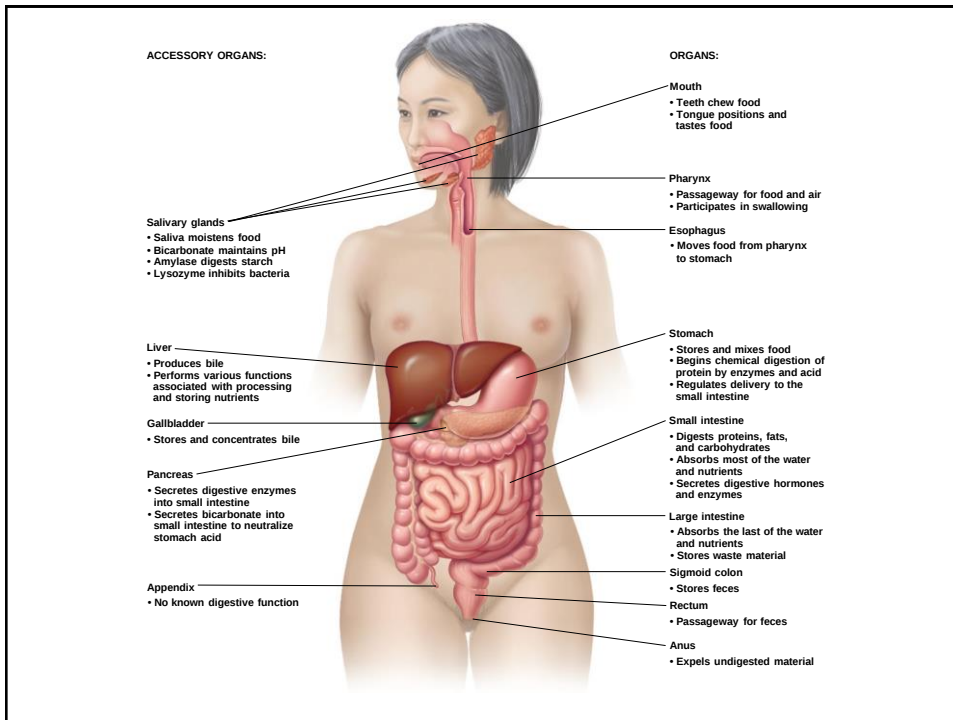
1

Digestive System Brings Nutrients Into the Body

The digestive system includes

- Gastrointestinal (GI) tract (hollow tube)
 - Lumen: space within this tube
 - Includes mouth, pharynx, esophagus, stomach, small intestine, large intestine, rectum, anus
- Accessory Organs
 - Salivary glands, liver, gallbladder, pancreas

2



3

Walls of the GI Tract Are Composed of Four Layers & 'Stop Points'

- **Mucosa**
 - innermost layer, mucous membrane in contact with the lumen
- **Submucosa**
 - layer of connective tissue containing blood vessels, lymph vessels, nerves
- **Muscularis**
 - two or three layers of smooth muscle, responsible for movement, motility
- **Serosa**
 - outermost layer

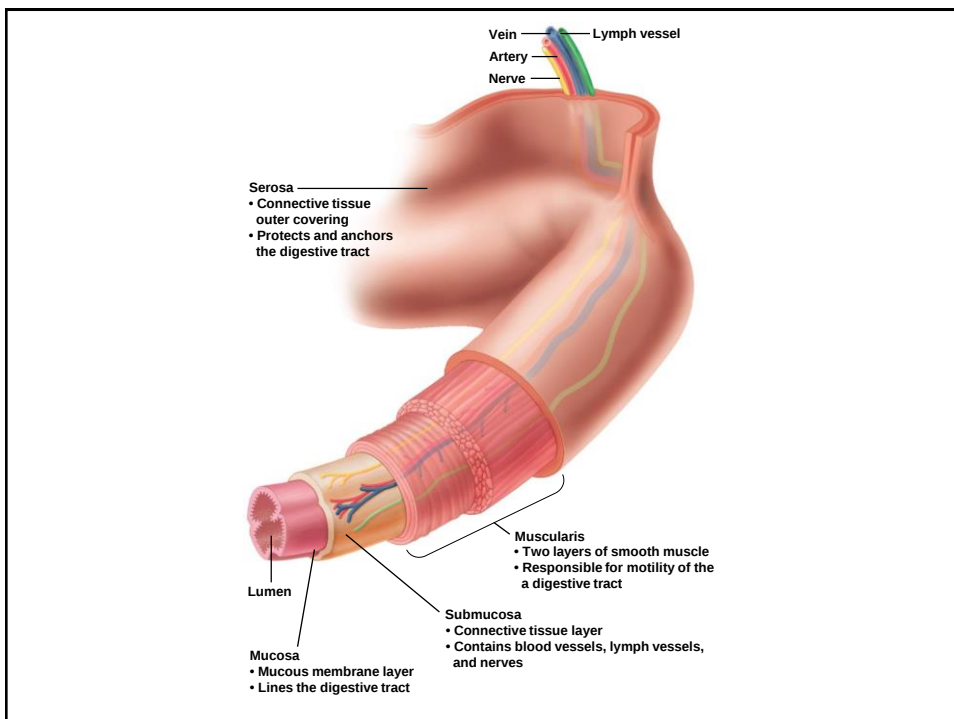
4

Walls of the GI Tract

- **Sphincters**

- thick muscular rings that separate some of the organs and create 'stop points'

5



6

Five Basic Processes Accomplish Digestive System Function

1. **Mechanical processing and movement**

- Chewing and mixing

2. **Secretion**

- Fluid
- Digestive enzymes and hormones
- Bile, acid, alkali, mucus

3. **Digestion**

- Breaking down food to smallest absorbable units
- Chemical and mechanical breakdown

7

Five Digestive System Processes (cont.)

4. **Absorption**

- Through mucosa
- Into blood or lymph vessels

5. **Elimination**

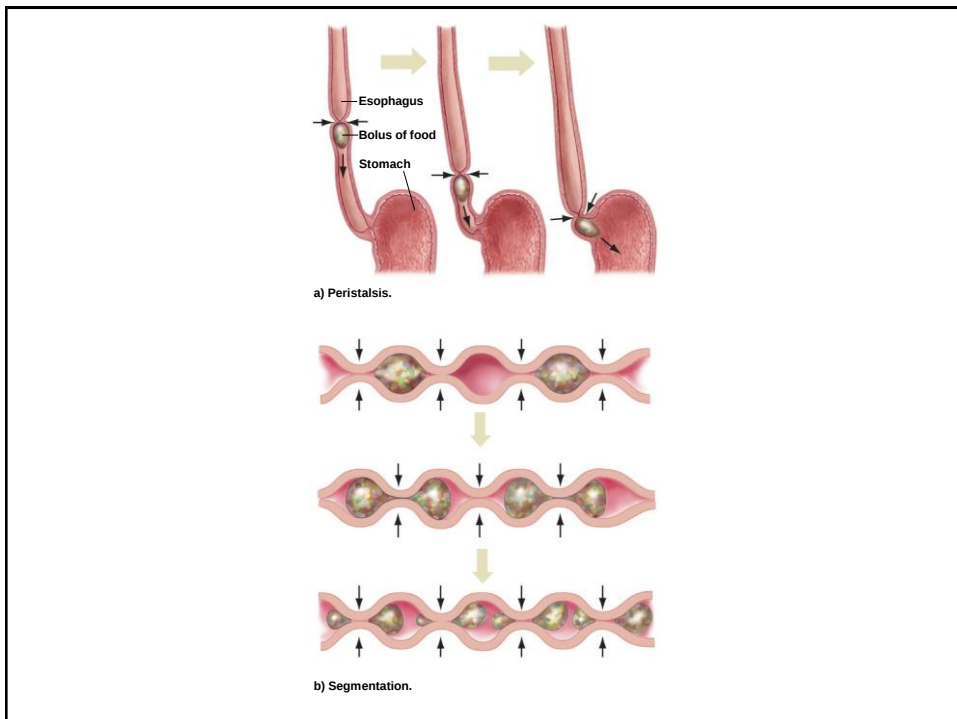
- Undigested material eliminated

8

Two Types of Motility Aid Digestive Processes

- Motility (movement) enabled by smooth muscle in the muscularis layer
 - **Peristalsis**
 - propels food forward
 - **Segmentation**
 - mixes food

9

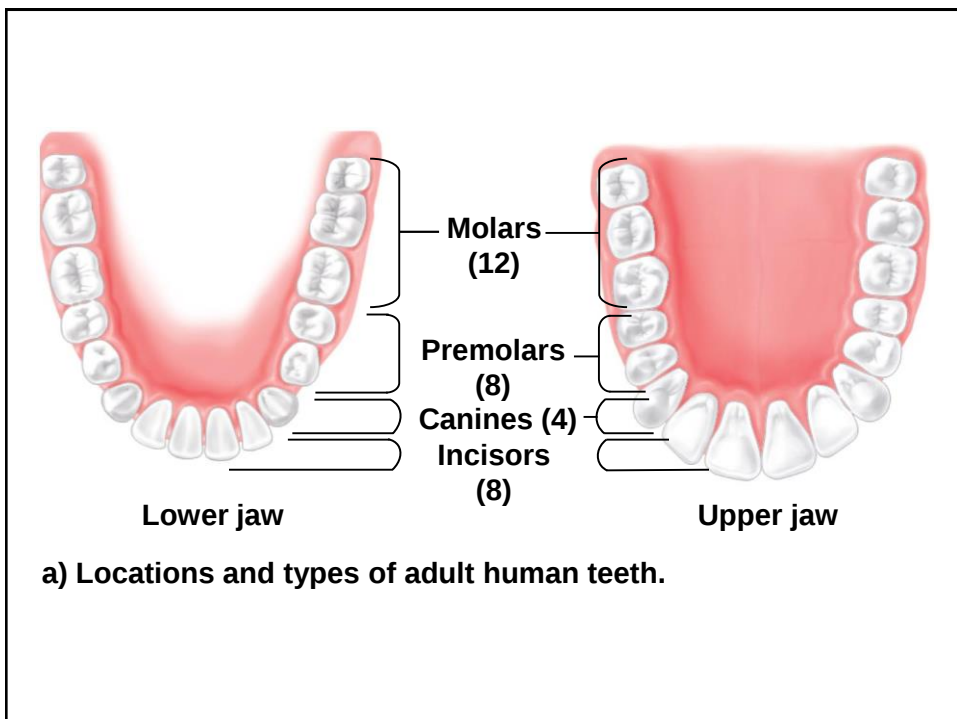


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The Mouth Processes Food for Swallowing

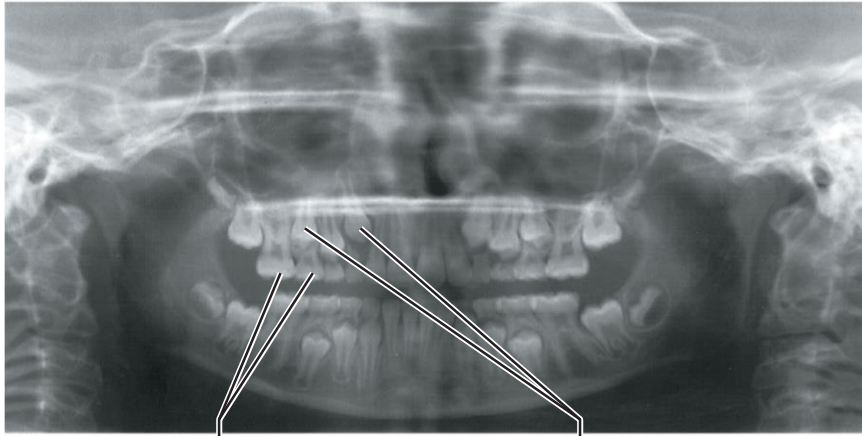
- Teeth: bite and chew food
 - Types: incisors, canines, premolars, molars
 - Children: 20 teeth
 - Adults: 32 permanent teeth
- Tongue: positions and tastes food
 - Skeletal muscle
 - Moves food in mouth
 - Taste
 - Important for speech

11



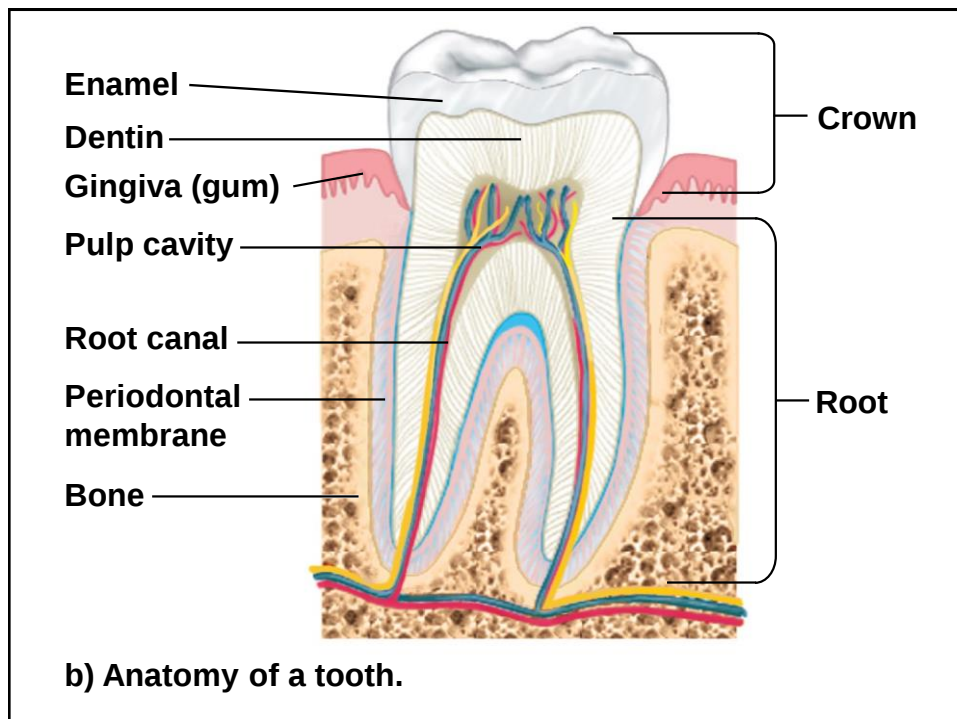
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Baby Teeth pushed out by Adult Teeth



Deciduous teeth Permanent teeth

13

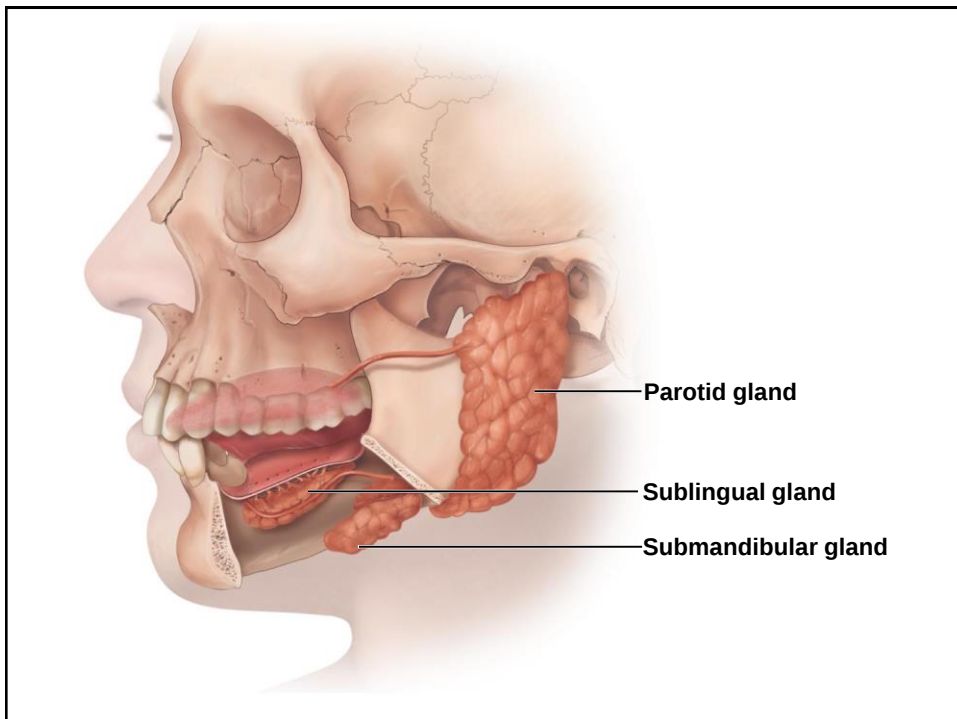


14

The Mouth Processes Food for Swallowing

- Saliva
 - Salivary glands
 - Parotid
 - Submandibular
 - Sublingual
 - Composition
 - Mucin, salivary amylase, bicarbonate, lysozyme

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Pharynx and Esophagus Deliver Food to the Stomach

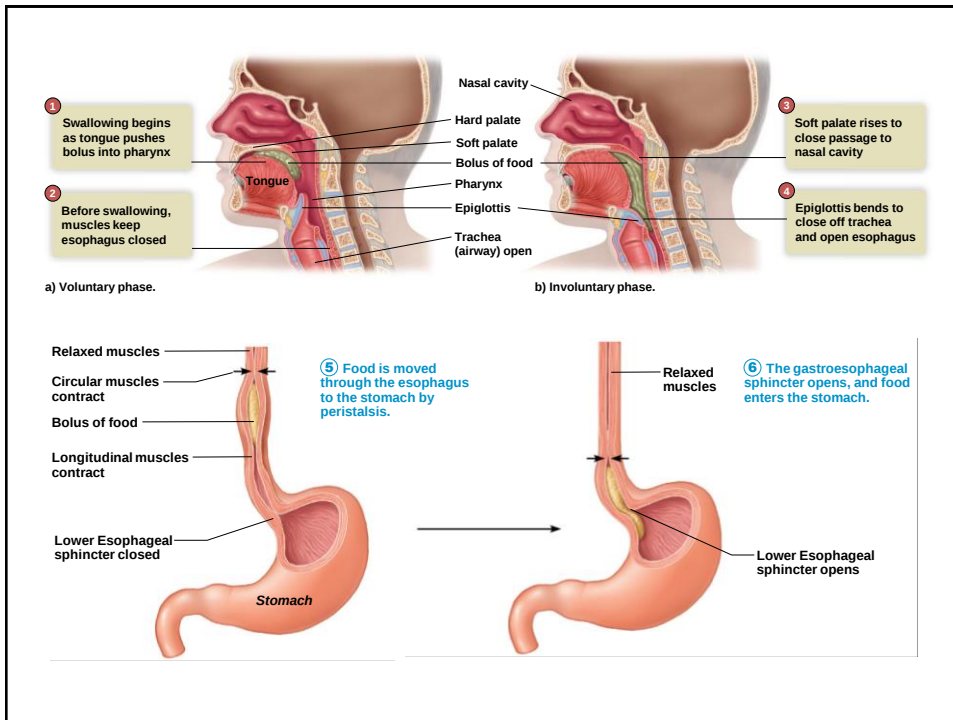
- Swallowing
 - Voluntary phase
 - tongue pushes bolus of food into pharynx (throat)
 - Involuntary phase
 - swallowing reflex
- **Pharynx**
 - common passageway for air and food
- **Epiglottis**
 - closes airway temporarily so food will not enter the trachea

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Pharynx and Esophagus Deliver Food to the Stomach (cont.)

- Food moves through **esophagus** with the help of peristaltic contractions
- Food passes through **lower esophageal sphincter** into the stomach

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Stomach Functions

- Food storage
- Regulation of delivery of partially digested food into the small intestine
- Digestion of proteins

20

Gastric Juice Breaks Down Proteins

Specific cells secrete gastric juice, which contains

- **Hydrochloric acid**

- Produces a pH of about 2; breaks down large bits of food

- **Intrinsic factor**

- Needed to absorb vitamin B₁₂

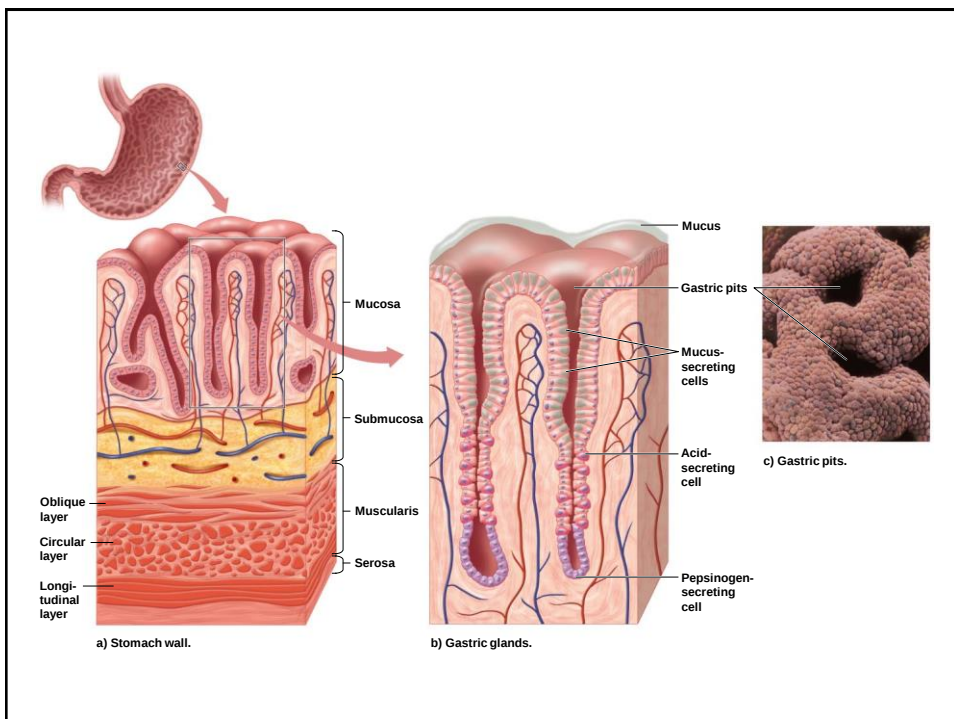
- **Mucus**

- Protects stomach lining from acid

- **Pepsinogen**

- Converted to **pepsin** by acid
- Begins protein breakdown

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Stomach Contraction

- Stomach contractions
 - blend food and propel it forward
- Chyme
 - watery mixture of partially digested food and gastric juice that is delivered to the small intestine
- Requires 2–6 hours for stomach to empty completely after a meal
- Stomach **DOES NOT** absorb nutrients

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Small Intestine Digests Food and Absorbs Nutrients and Water

- Functions
 - Digestion
 - Neutralizes acid from stomach
 - Adds digestive enzymes and bile
 - Breaks down proteins, carbohydrates, and lipids to absorbable materials
 - Absorption
 - 90% of food absorbed in small intestine

24

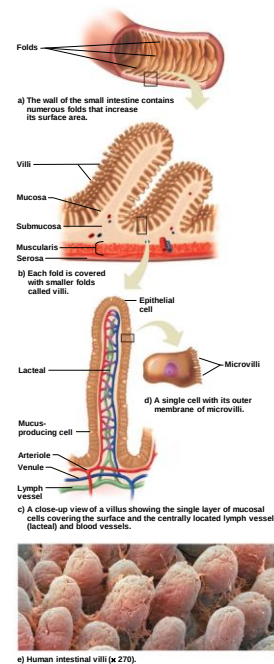
Small Intestine Has Large Surface Area for Absorption

- Three regions increase surface area
 - **Duodenum**: most digestion occurs here
 - **Jejunum**: absorption
 - **Ileum**: absorption

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Small Intestine Has Large Surface Area for Absorption

- Mucosa lining adaptations increase surface area
 - Large folds
 - **Villi**
 - microscopic projections
 - **Microvilli**
 - cytoplasmic projections of epithelial cells of the villi



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Accessory Organs Aid Digestion and Absorption

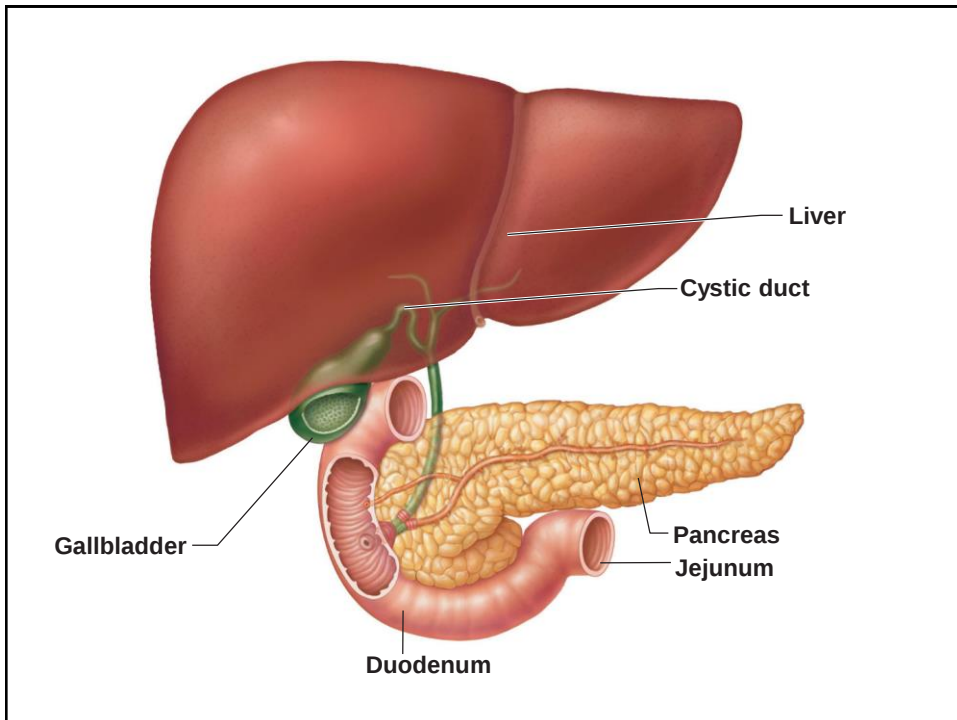
- Pancreas
 - Secretes digestive enzymes and sodium bicarbonate
 - Digestive enzymes include
 - Trypsin & Chymotrypsin
 - Helps break down protein
 - Pancreatic amylase
 - Helps break down carbohydrates
 - Lipase
 - Helps break down lipids

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Accessory Organs: Aid Digestion and Absorption

- Liver
 - Produces **bile**, which emulsifies lipids
 - Emulsify = separating lipid molecules to increase surface area
 - Hepatic portal system
 - Drains blood from the digestive tract to the liver
- Gallbladder
 - Concentrates and stores bile

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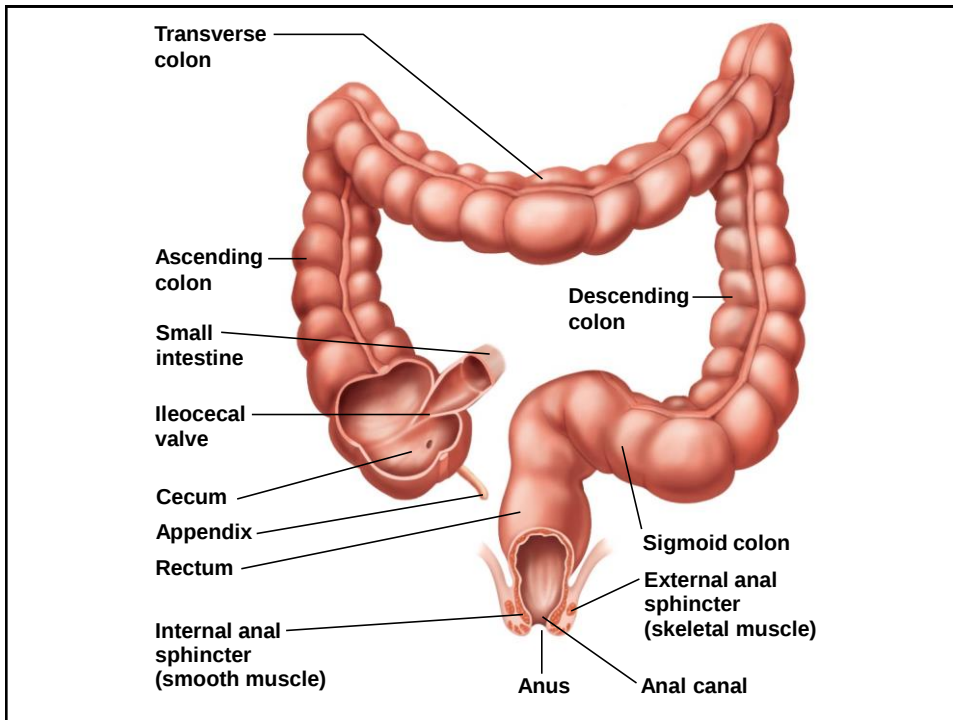


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Large Intestine Absorbs Nutrients and Eliminates Wastes

- Functions
 - Absorbs nutrients and water
 - Temporarily stores and eliminates waste

30



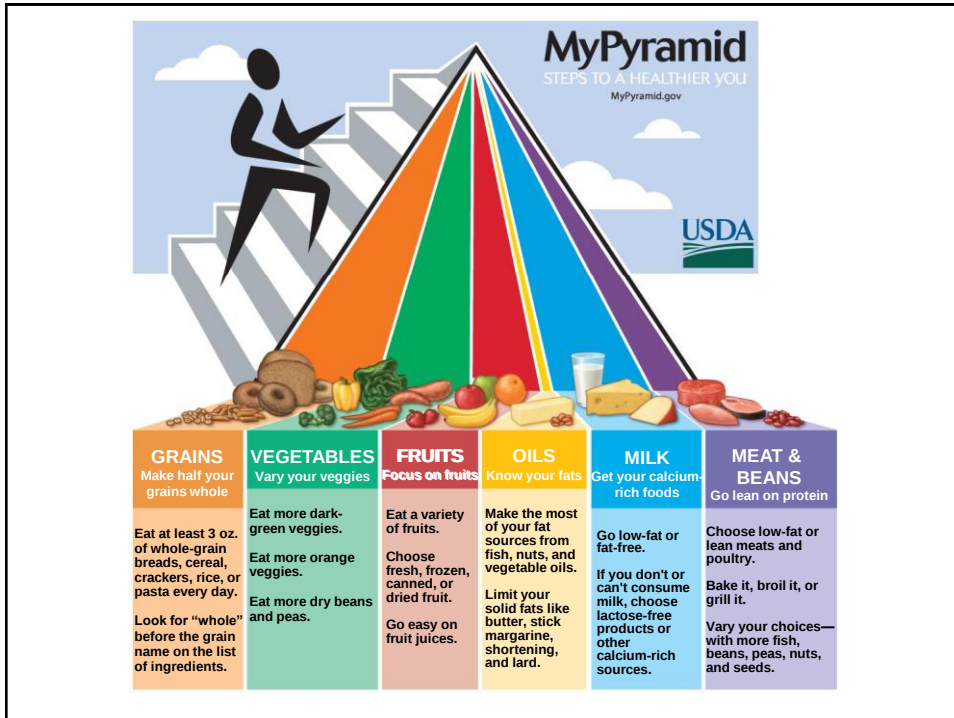
31

Nutrition: You Are What You Eat

Recommendations for a healthy diet include

- Eat a variety of foods
- Maintain a healthy weight
- Eat plenty of fruits, vegetables and whole grains
- Choose a diet low in cholesterol and saturated fat
- Use sugar only in moderation
- Consume salt and sodium in moderation
- If consuming alcohol, drink in moderation

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Carbohydrates: A Major Energy Source

- Body's primary source of energy
- 45–65% of caloric intake should be carbohydrates
- Simple carbohydrates
 - sugars
- Complex carbohydrates
 - starch, glycogen, fiber

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Lipids: Essential Cell Components and Energy Sources

- Saturated fats
 - Meat, dairy products, palm kernel oil
 - Tend to raise LDL (“bad”) cholesterol
- Unsaturated fats
 - Plant sources, olive, safflower, corn, canola oils
 - Certain cold water fish (omega-3 fatty acids)
 - Tend to lower LDL (“bad”) cholesterol
- Trans fats
 - Produced by hydrogenation of vegetable oils
 - Raise LDL cholesterol

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Proteins: Bodies Building Blocks

- 20 different amino acids
 - 12 can be made by the human body
 - 8 essential amino acids must be ingested in foods
- Complete proteins
 - Contain all 20 amino acids
 - Most animal proteins
 - Soy protein
- Incomplete proteins
 - Lack one or more essential amino acids
 - Many plant proteins

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Vitamins Are Essential for Normal Function

- At least 13 different vitamins
- Two groups
 - Fat soluble
 - Vitamins A, D, E & K
 - Absorbed with fats and stored in adipose tissue
 - Water soluble
 - Vitamins B complex & C
 - Stored only briefly
 - Must be consumed on a regular basis

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Minerals: Essential Elements for Body Processes

- 21 essential minerals
- Roles
 - Ions in blood plasma and cell cytoplasm
 - sodium, potassium, chloride, etc.
 - Chemical structure of bone
 - calcium, phosphorus
 - Nerve and muscle activity
 - sodium, potassium, calcium

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Fiber Benefits the Colon

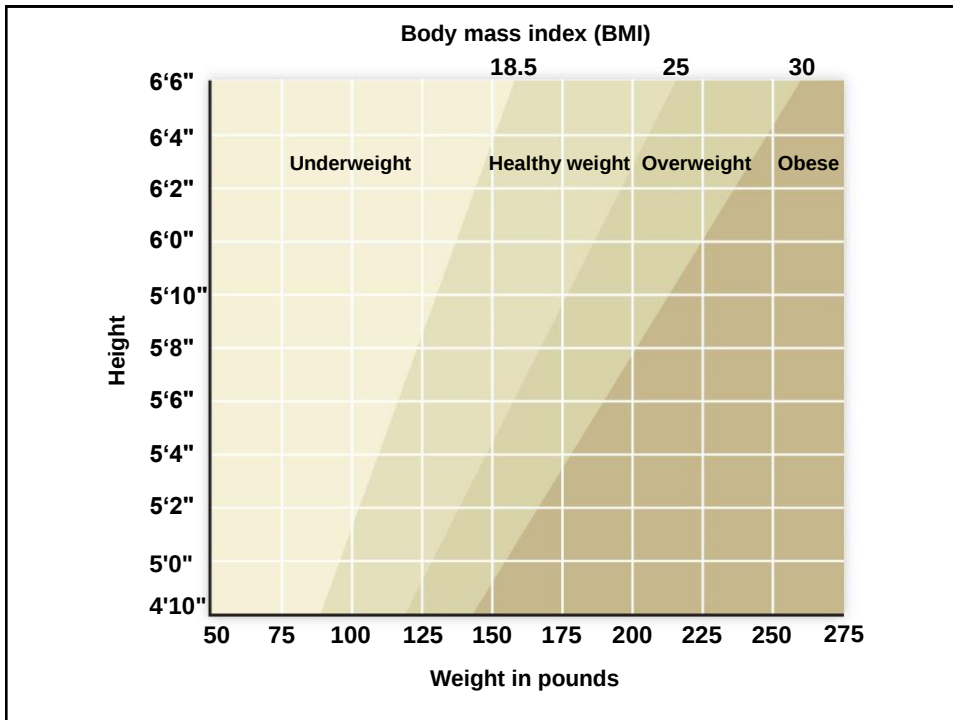
- Vegetables, fruits, grains
- Indigestible material
 - contributes bulk to feces
- Problems with a low-fiber diet
 - Contributes to chronic constipation & hemorrhoids
 - May be associated with higher risk of colon cancer

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Weight Control: Energy Consumed Versus Energy Spent

- Basic metabolic rate (BMR)
 - Number of calories needed
 - Excess intake leads to increased storage (weight)
- Influencing factors
 - Gender and body composition
 - Age
 - Health
 - Stress
 - Food intake
 - Genetics

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Disorders of the GI Tract

- **Lactose intolerance**
 - difficulty digesting milk
- **Peptic ulcers**
 - caused by infection with *H. pylori* bacteria
- **Celiac disease**
 - gluten (wheat protein) intolerance
- **Diverticulosis**
 - weakness in wall of small intestine
- **Colon polyps**
 - noncancerous growths on mucosa

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Disorders of Accessory Organs

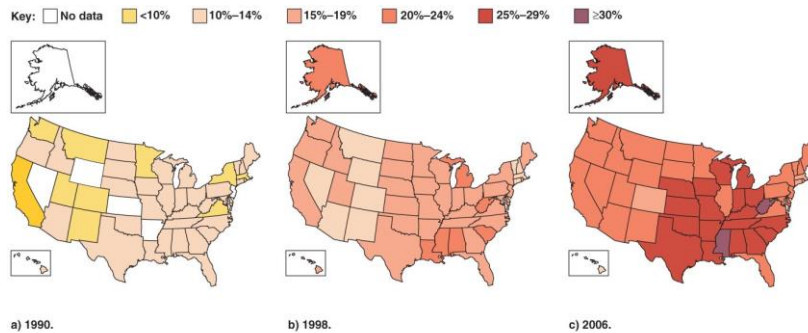
- Hepatitis
 - Inflammation of the liver
 - Three common types caused by viruses
 - Hepatitis A: transmitted by food, water
 - Hepatitis B: transmitted by body fluids, blood
 - Hepatitis C: transmitted by infected blood
- Gallstones
 - crystals may form in gallbladder and obstruct flow of bile



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Disorders of the Digestive System

- Malnutrition
 - too many or too few nutrients
 - 13% of the world's population is undernourished
- Obesity



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Disorders of the Digestive System

- Eating disorders
 - Anorexia nervosa
 - excessive dieting
 - Bulimia
 - binge eating followed by purging behaviors



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