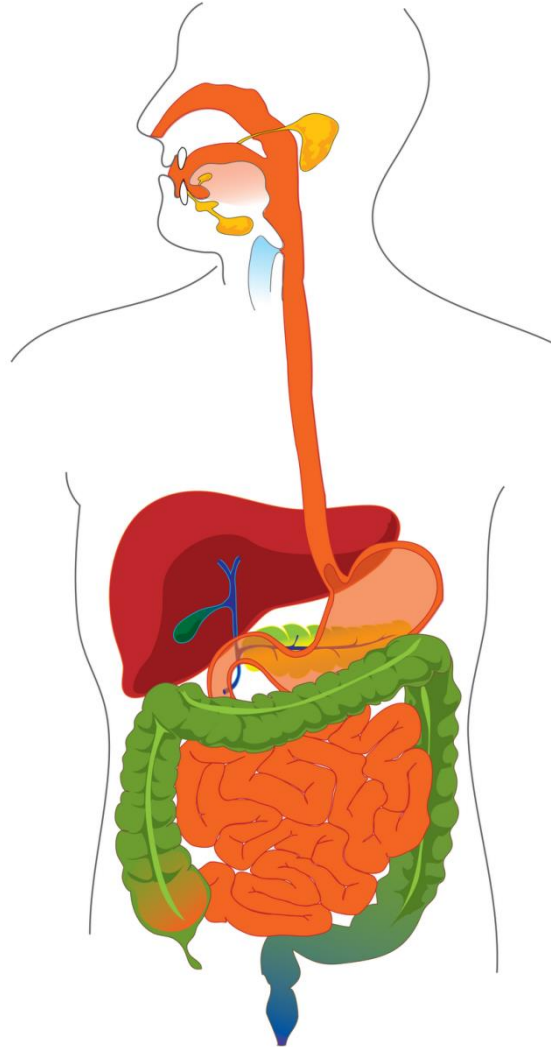


The Digestive System



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

ACCESSORY ORGANS:

Salivary glands

- Saliva moistens food
- Bicarbonate maintains pH
- Amylase digests starch
- Lysozyme inhibits bacteria

Liver

- Produces bile
- Performs various functions associated with processing and storing nutrients

Gallbladder

- Stores and concentrates bile

Pancreas

- Secretes digestive enzymes into small intestine
- Secretes bicarbonate into small intestine to neutralize stomach acid

Appendix

- No known digestive function

ORGANS:

Mouth

- Teeth chew food
- Tongue positions and tastes food

Pharynx

- Passageway for food and air
- Participates in swallowing

Esophagus

- Moves food from pharynx to stomach

Stomach

- Stores and mixes food
- Begins chemical digestion of protein by enzymes and acid
- Regulates delivery to the small intestine

Small intestine

- Digests proteins, fats, and carbohydrates
- Absorbs most of the water and nutrients
- Secretes digestive hormones and enzymes

Large intestine

- Absorbs the last of the water and nutrients
- Stores waste material

Sigmoid colon

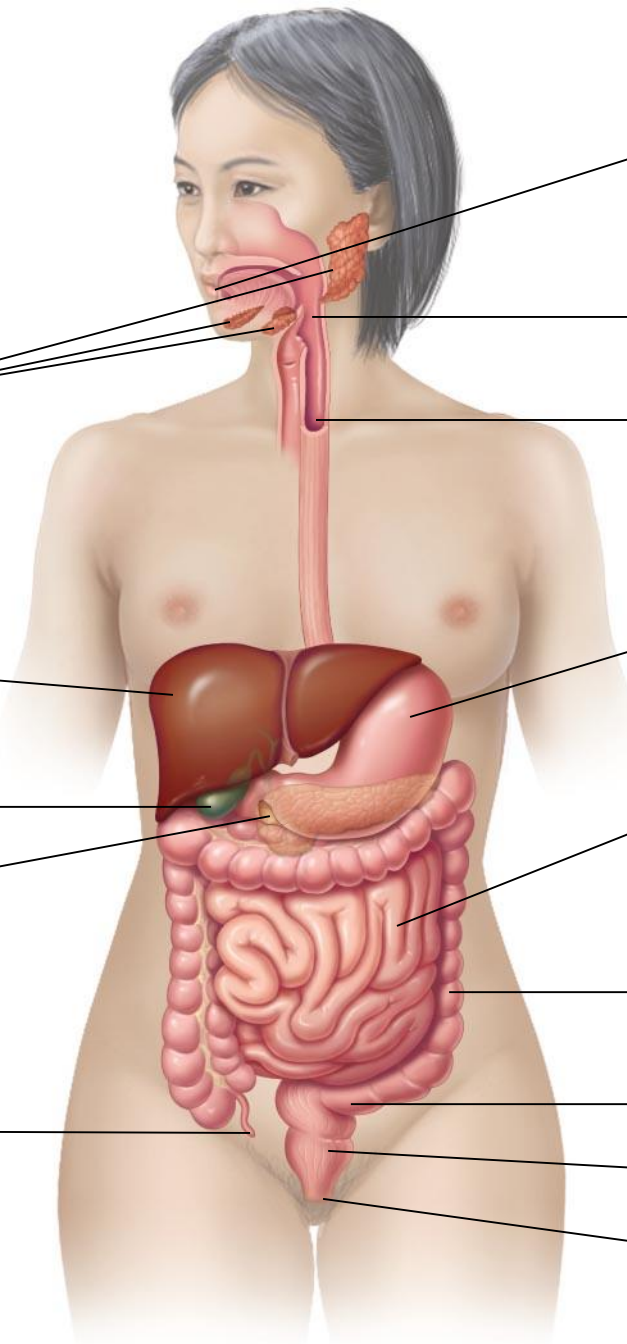
- Stores feces

Rectum

- Passageway for feces

Anus

- Expels undigested material

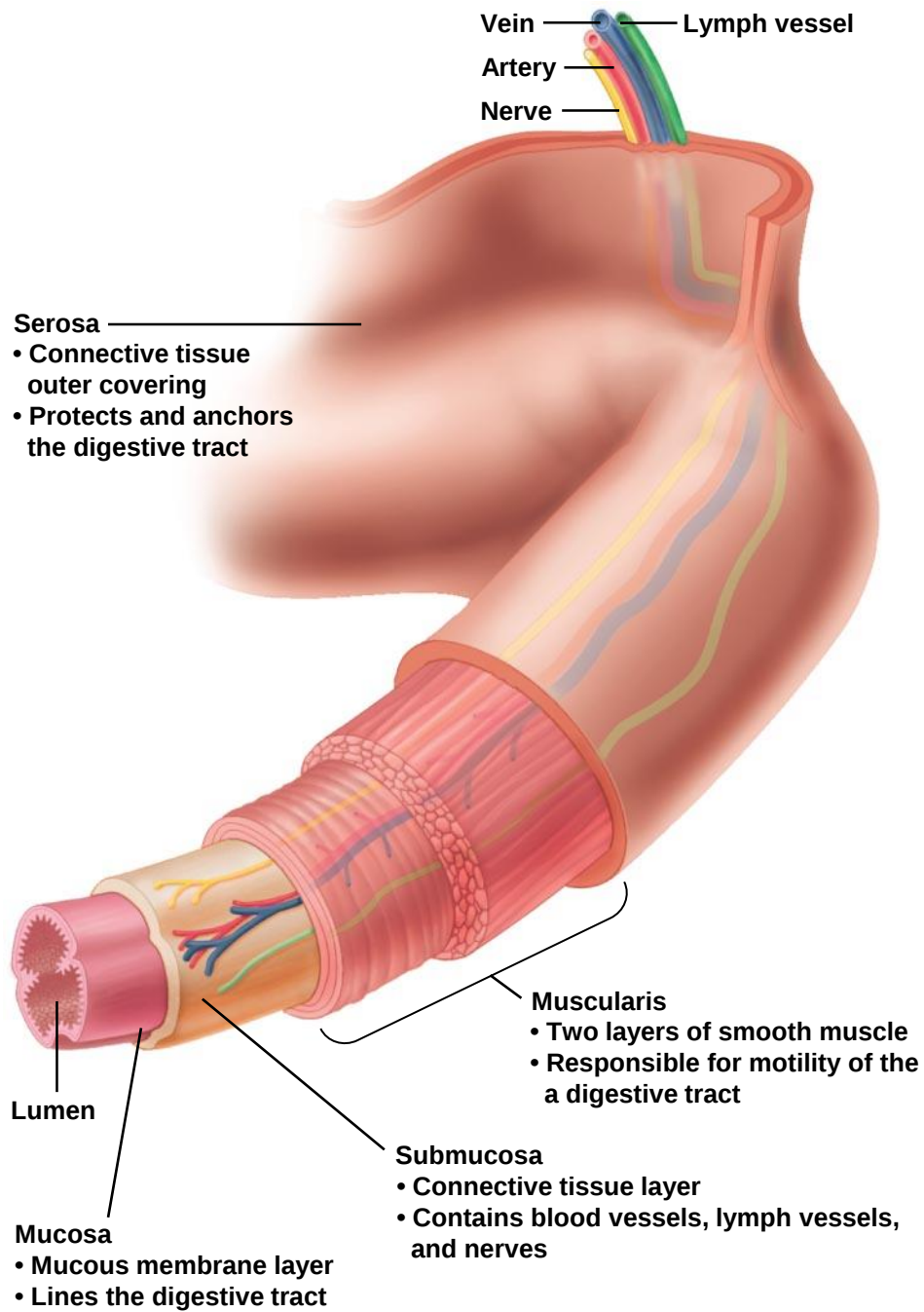


Walls of the GI Tract Are Composed of Four Layers & 'Stop Points'

- **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

Walls of the GI Tract

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



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

Five Digestive System Processes (cont.)

4. **Absorption**

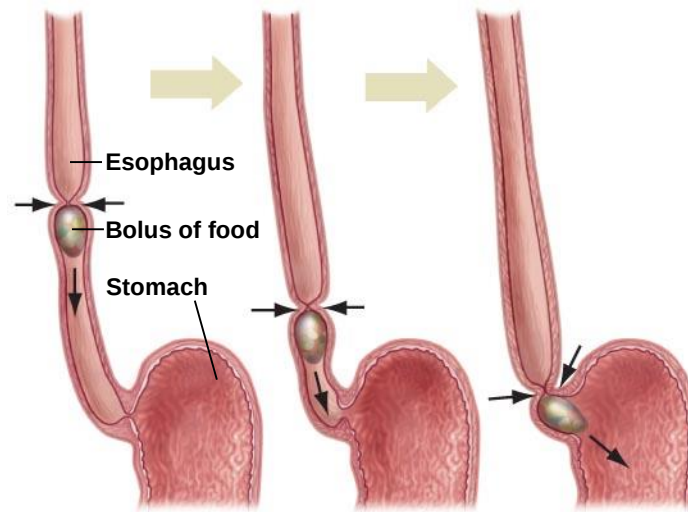
- Through mucosa
- Into blood or lymph vessels

5. **Elimination**

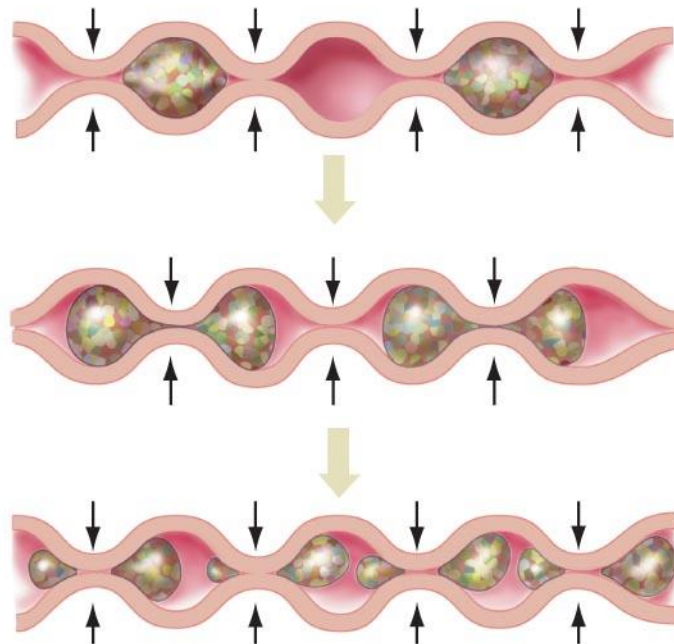
- Undigested material eliminated

Two Types of Motility Aid Digestive Processes

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



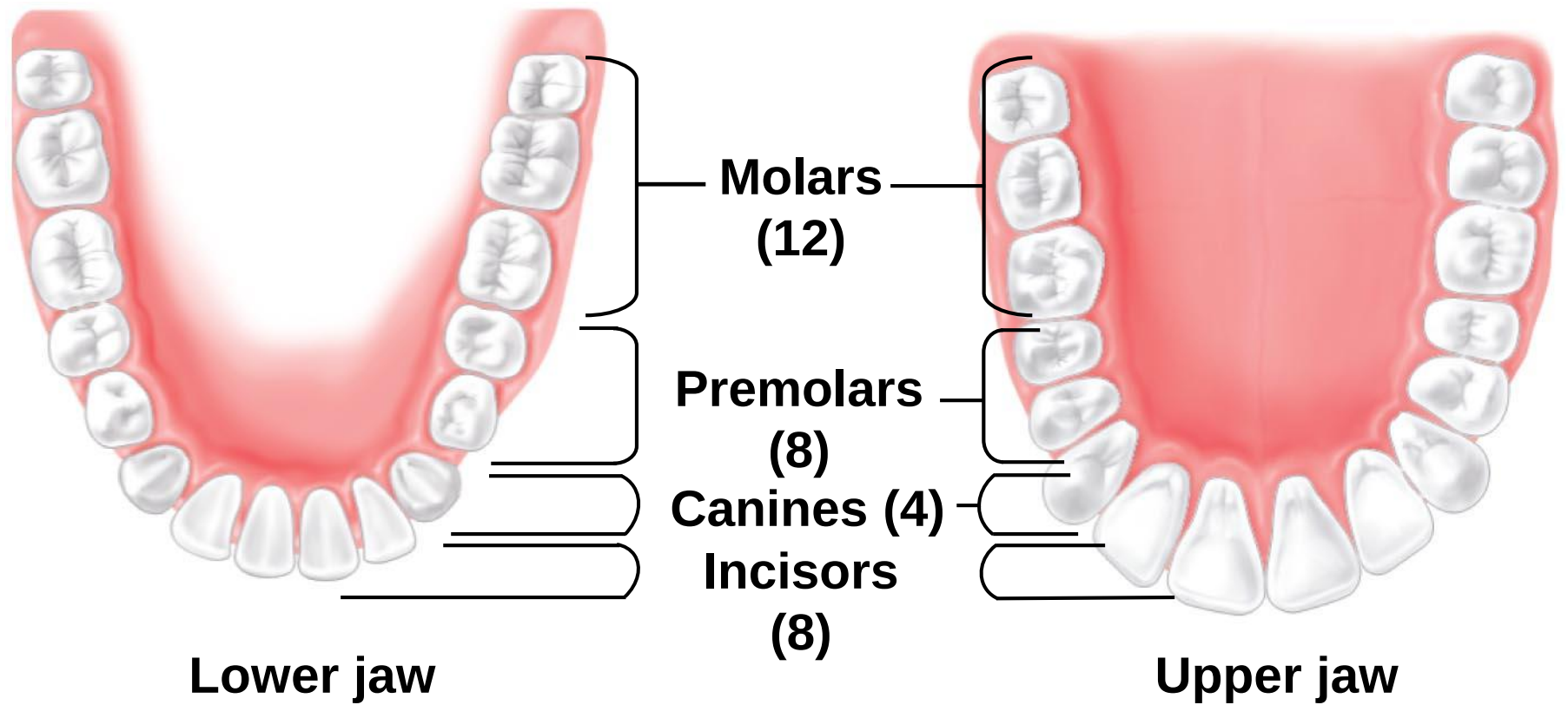
a) Peristalsis.



b) Segmentation.

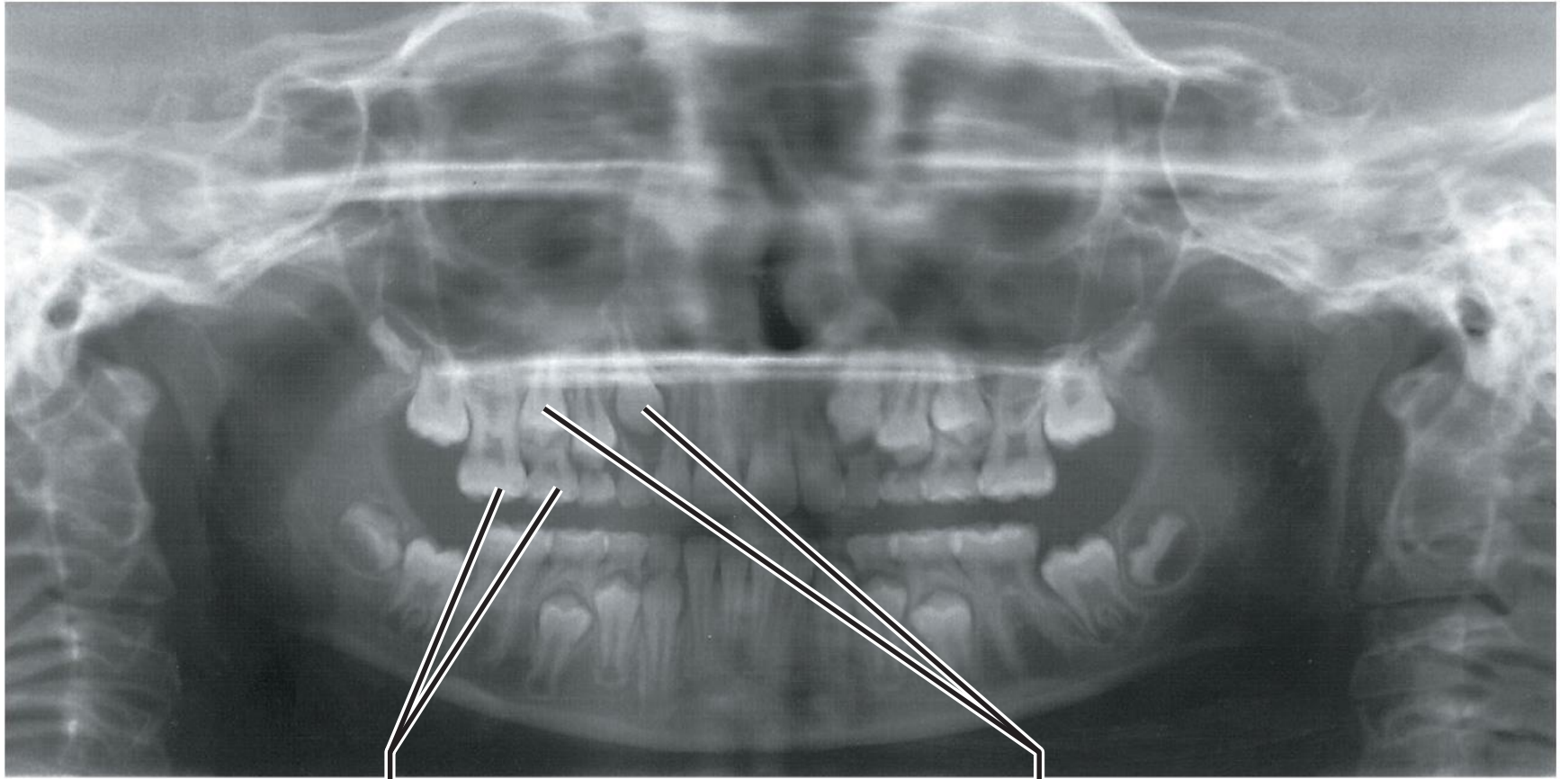
The Mouth Processes Food for Swallowing

- 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



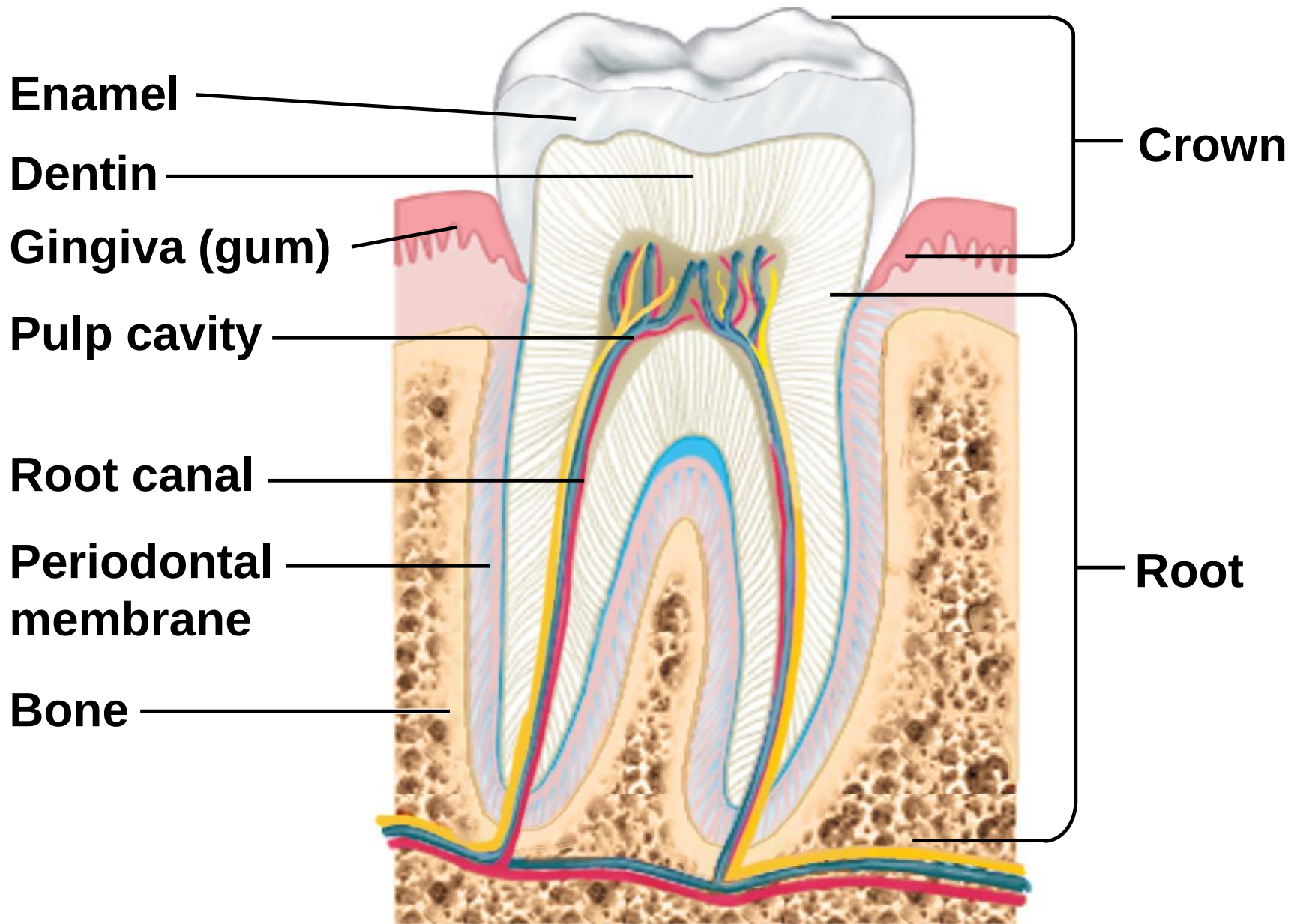
a) Locations and types of adult human teeth.

Baby Teeth pushed out by Adult Teeth



Deciduous teeth

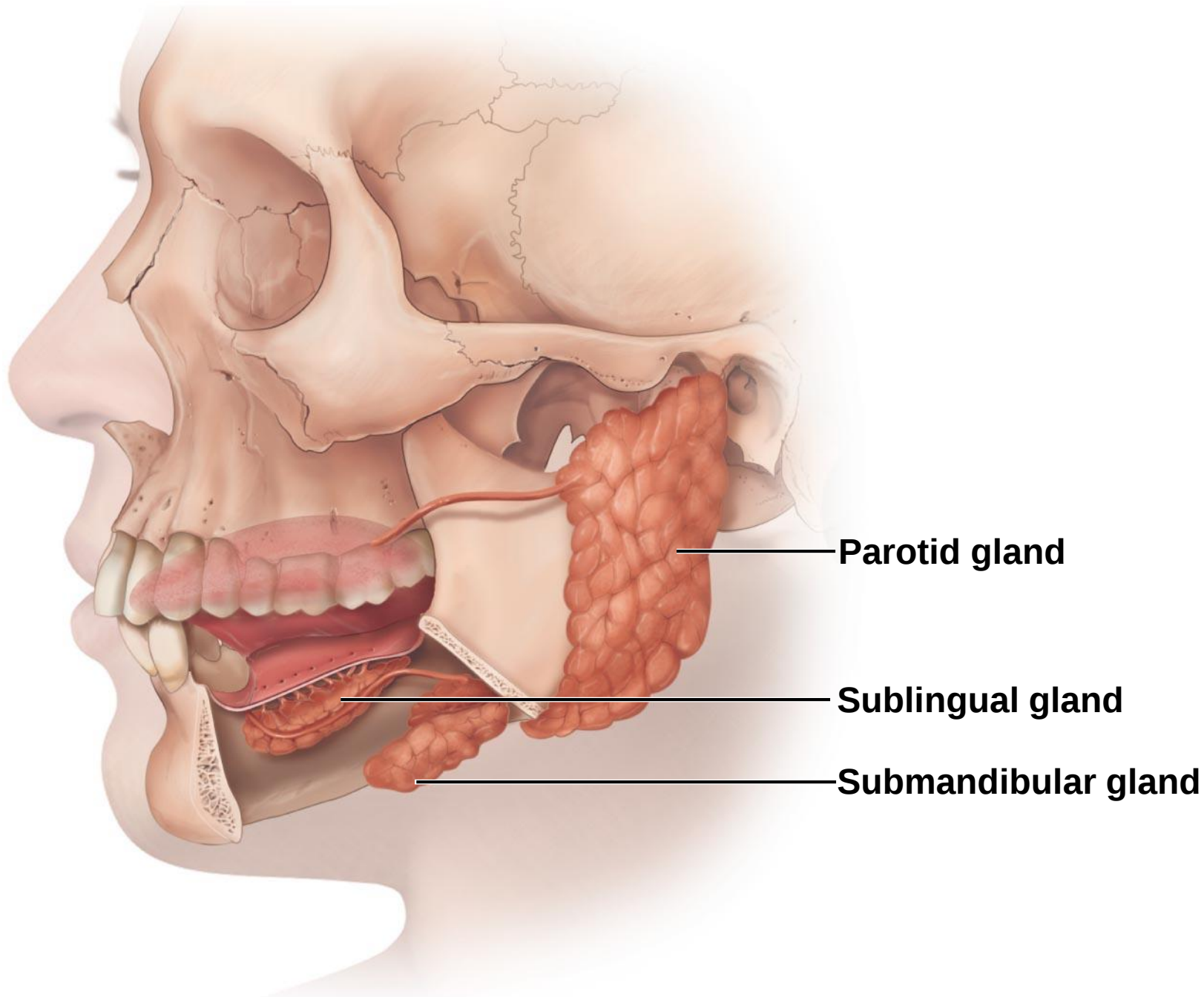
Permanent teeth



b) Anatomy of a tooth.

The Mouth Processes Food for Swallowing

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

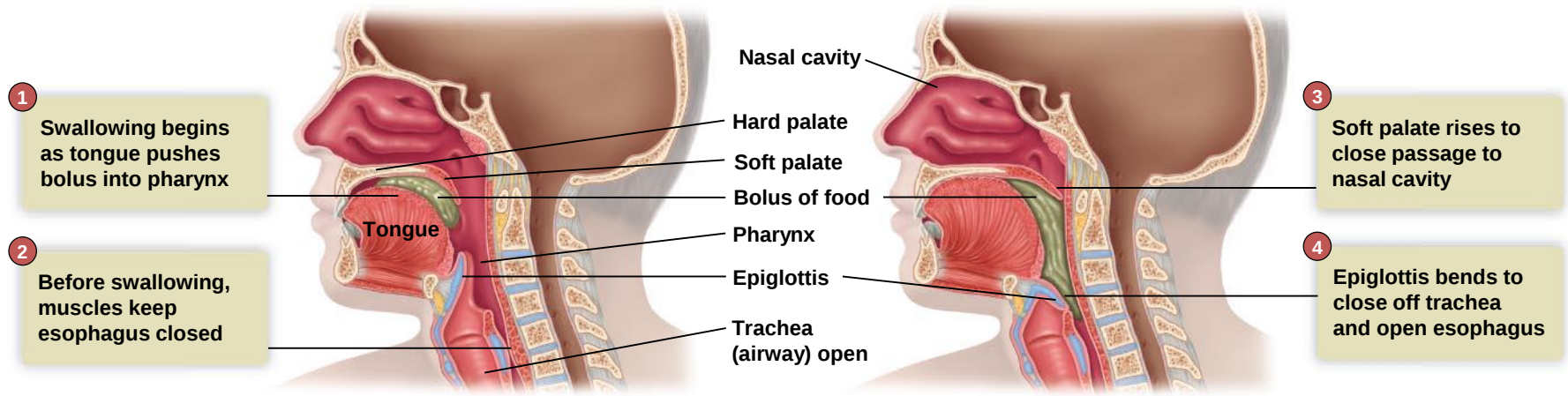


Pharynx and Esophagus Deliver Food to the Stomach

- 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

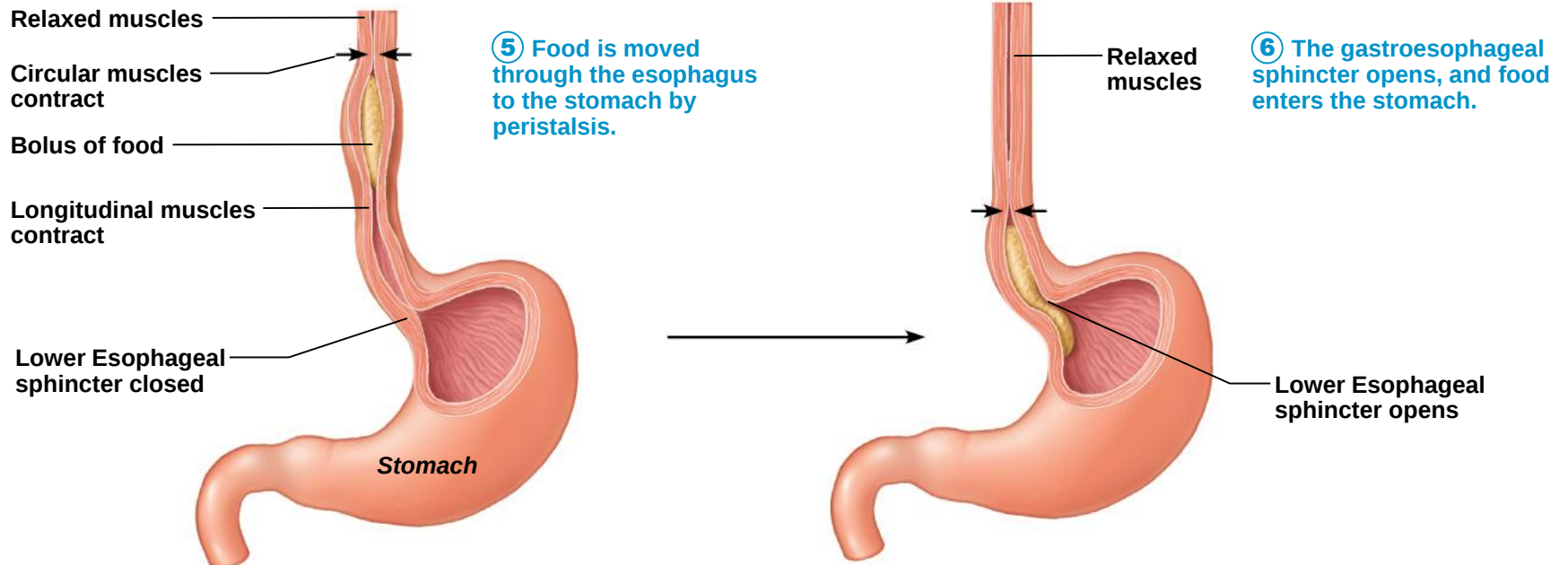
Pharynx and Esophagus Deliver Food to the Stomach (cont.)

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



a) Voluntary phase.

b) Involuntary phase.



Stomach Functions

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

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**

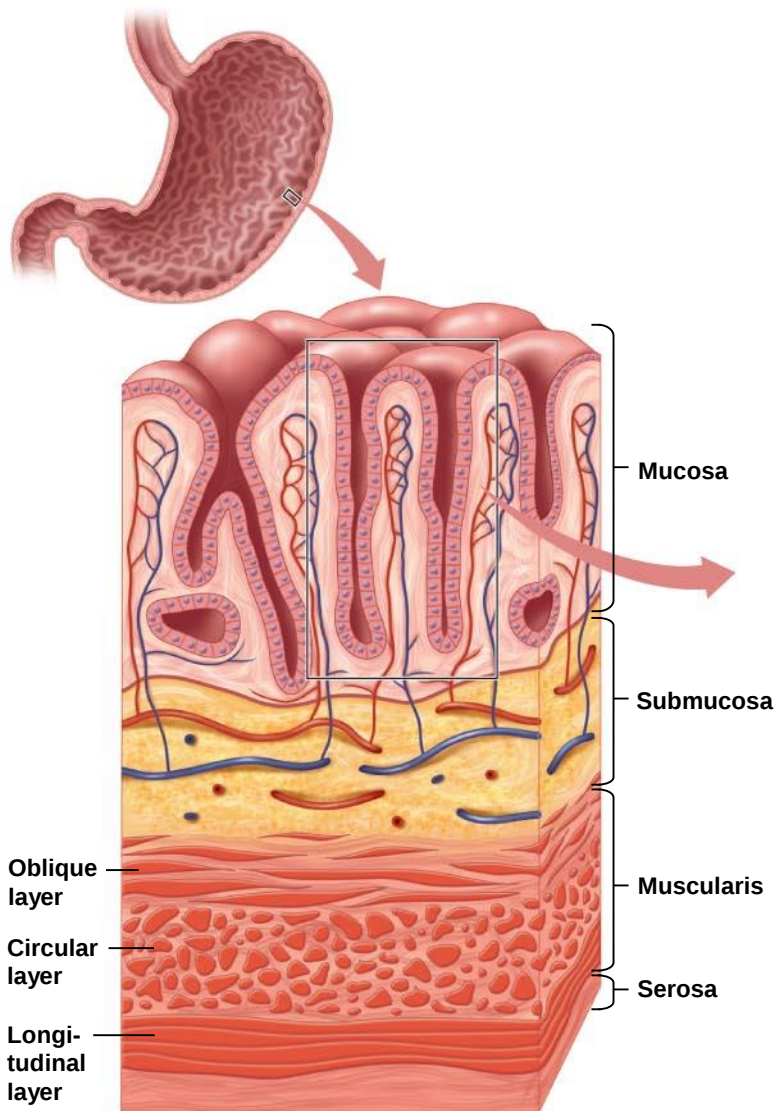
- Needed to absorb vitamin B₁₂

- **Mucus**

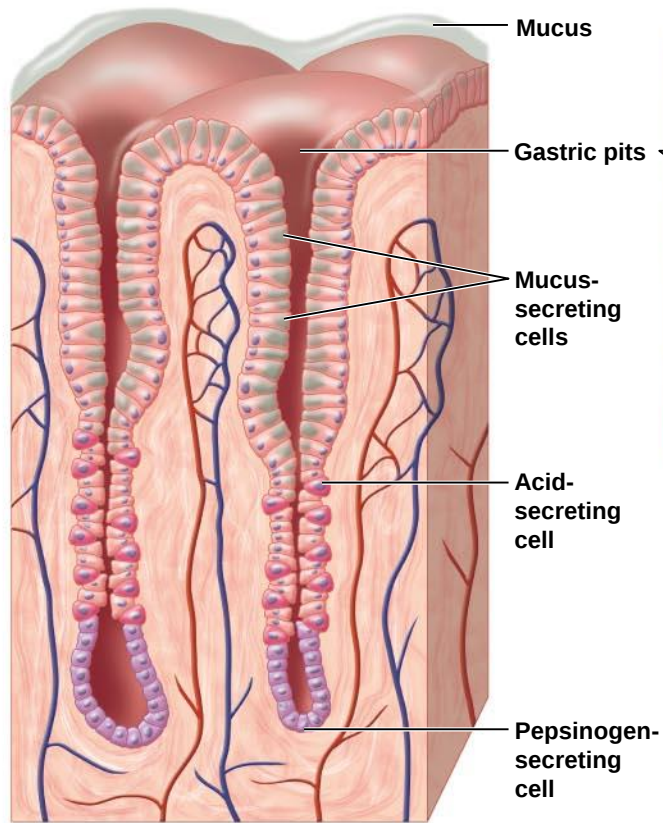
- Protects stomach lining from acid

- **Pepsinogen**

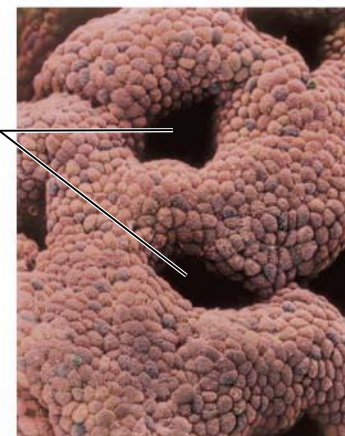
- Converted to **pepsin** by acid
- Begins protein breakdown



a) Stomach wall.



b) Gastric glands.



c) Gastric pits.

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

Small Intestine Digests Food and Absorbs Nutrients and Water

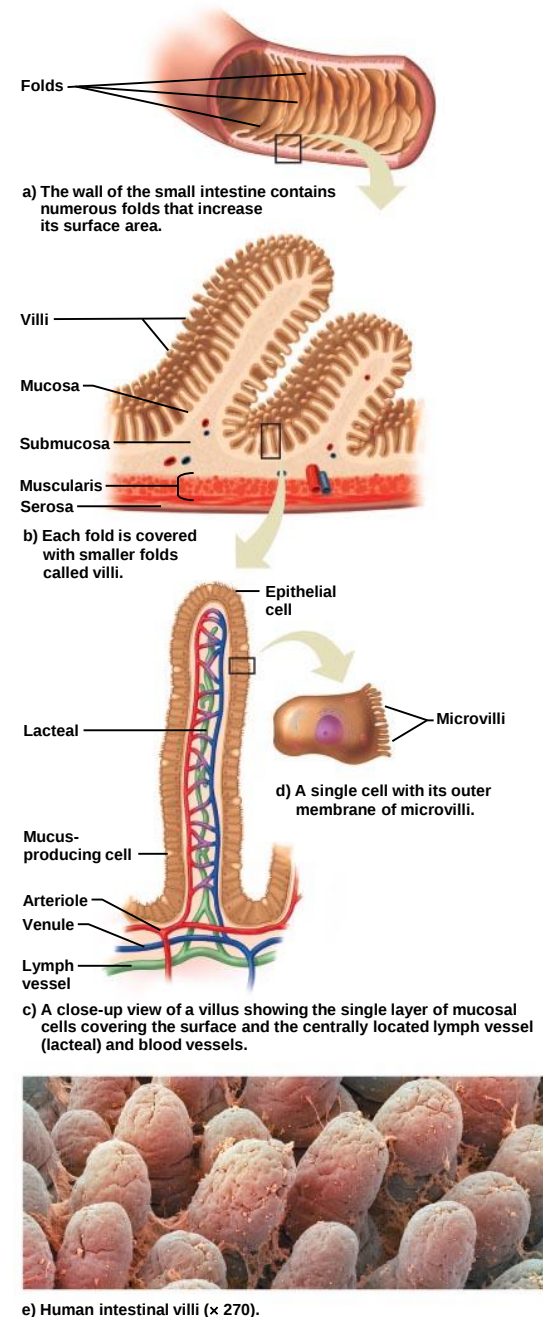
- Functions
 - Digestion
 - Neutralizes acid from stomach
 - Adds digestive enzymes and bile
 - Breaks down proteins, carbohydrates, and lipids to absorbable materials
 - Absorption
 - 90% of food absorbed in small intestine

Small Intestine Has Large Surface Area for Absorption

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

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

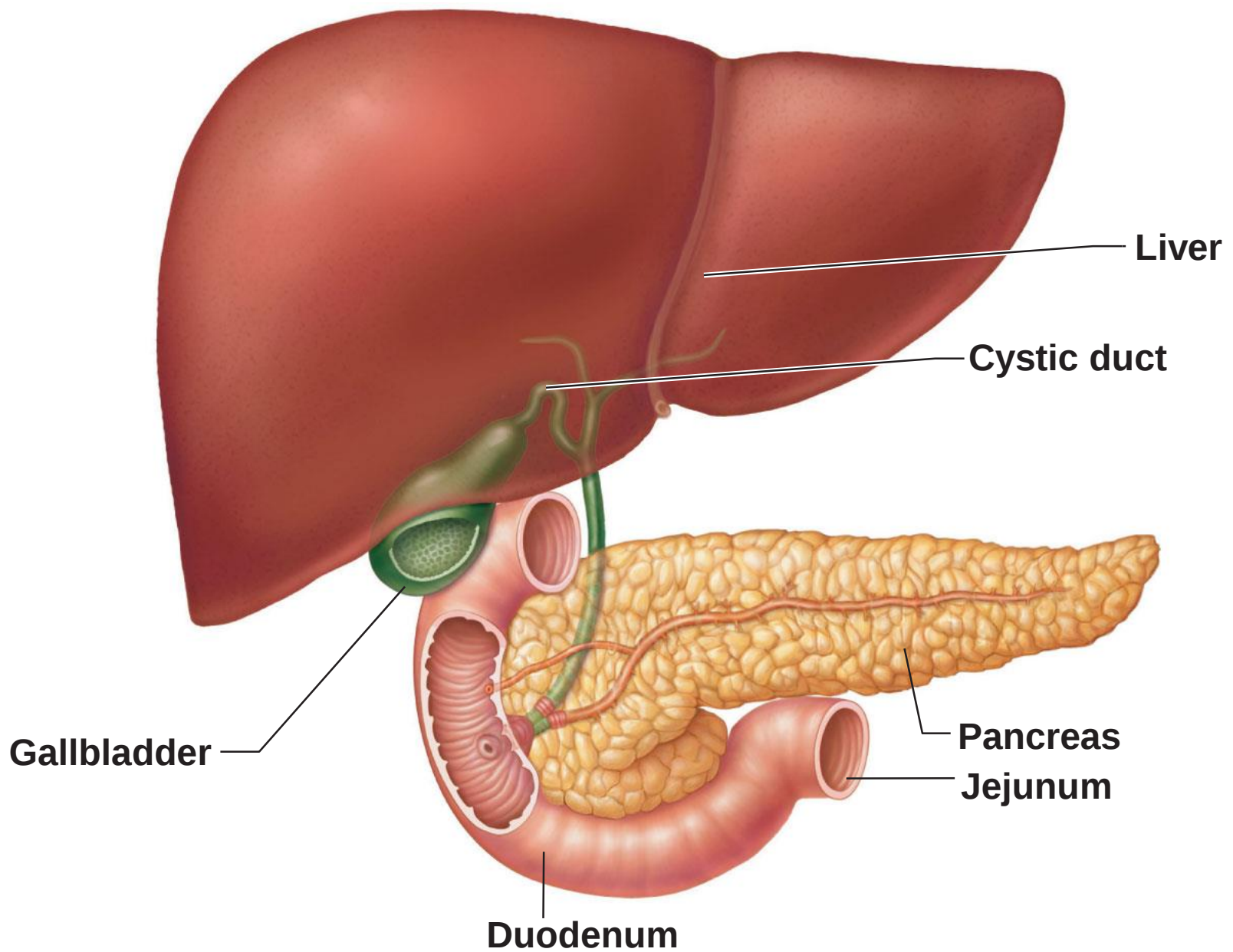


Accessory Organs Aid Digestion and Absorption

- 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

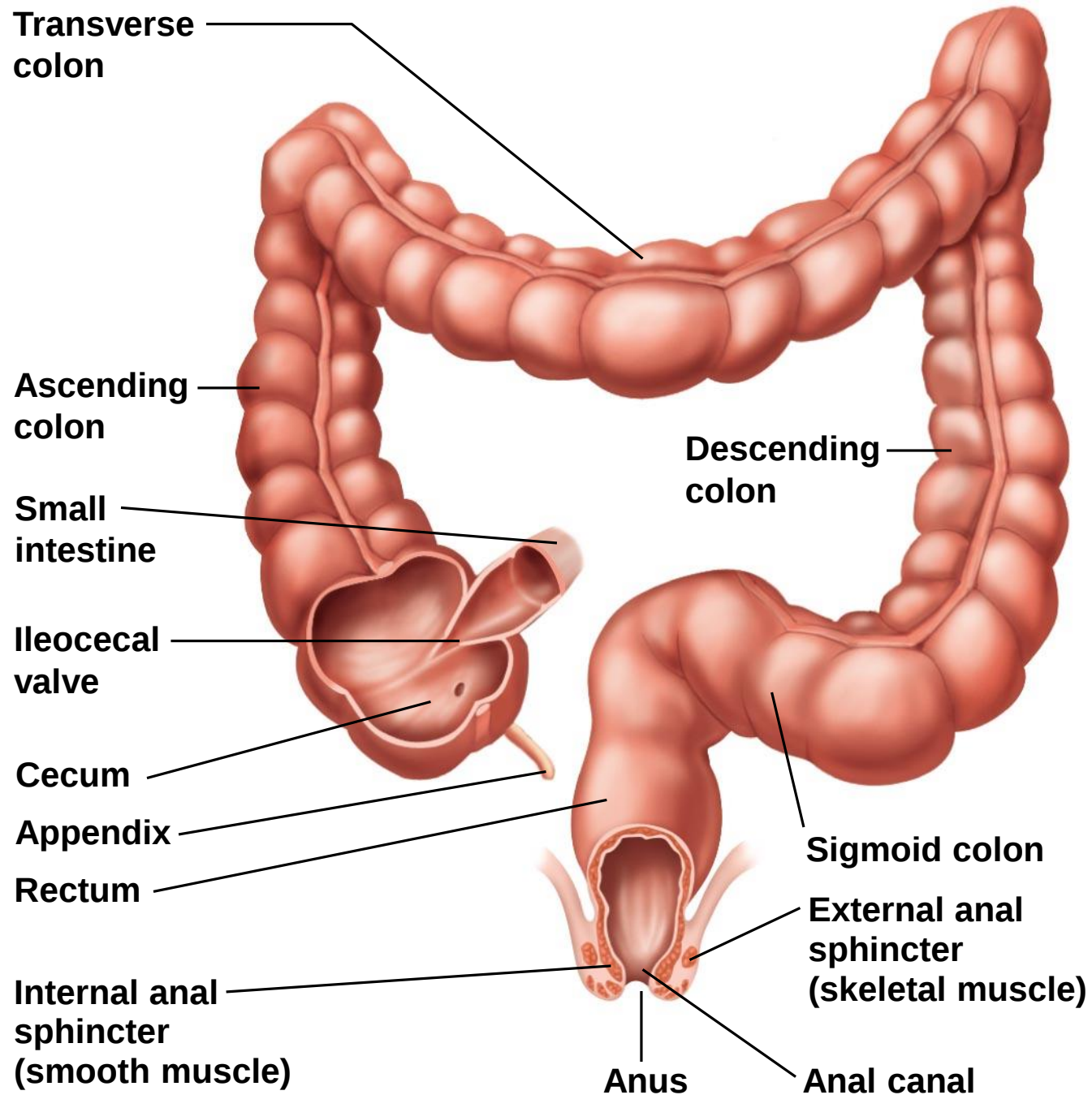
Accessory Organs: Aid Digestion and Absorption

- 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



Large Intestine Absorbs Nutrients and Eliminates Wastes

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



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



GRAINS	VEGETABLES	FRUITS	OILS	MILK	MEAT & BEANS
Make half your grains whole	Vary your veggies	Focus on fruits	Know your fats	Get your calcium-rich foods	Go lean on protein
Eat at least 3 oz. of whole-grain breads, cereal, crackers, rice, or pasta every day. Look for “whole” before the grain name on the list of ingredients.	Eat more dark-green veggies. Eat more orange veggies. Eat more dry beans and peas.	Eat a variety of fruits. Choose fresh, frozen, canned, or dried fruit. Go easy on fruit juices.	Make the most of your fat sources from fish, nuts, and vegetable oils. Limit your solid fats like butter, stick margarine, shortening, and lard.	Go low-fat or fat-free. If you don't or can't consume milk, choose lactose-free products or other calcium-rich sources.	Choose low-fat or lean meats and poultry. Bake it, broil it, or grill it. Vary your choices—with more fish, beans, peas, nuts, and seeds.

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

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

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

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

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

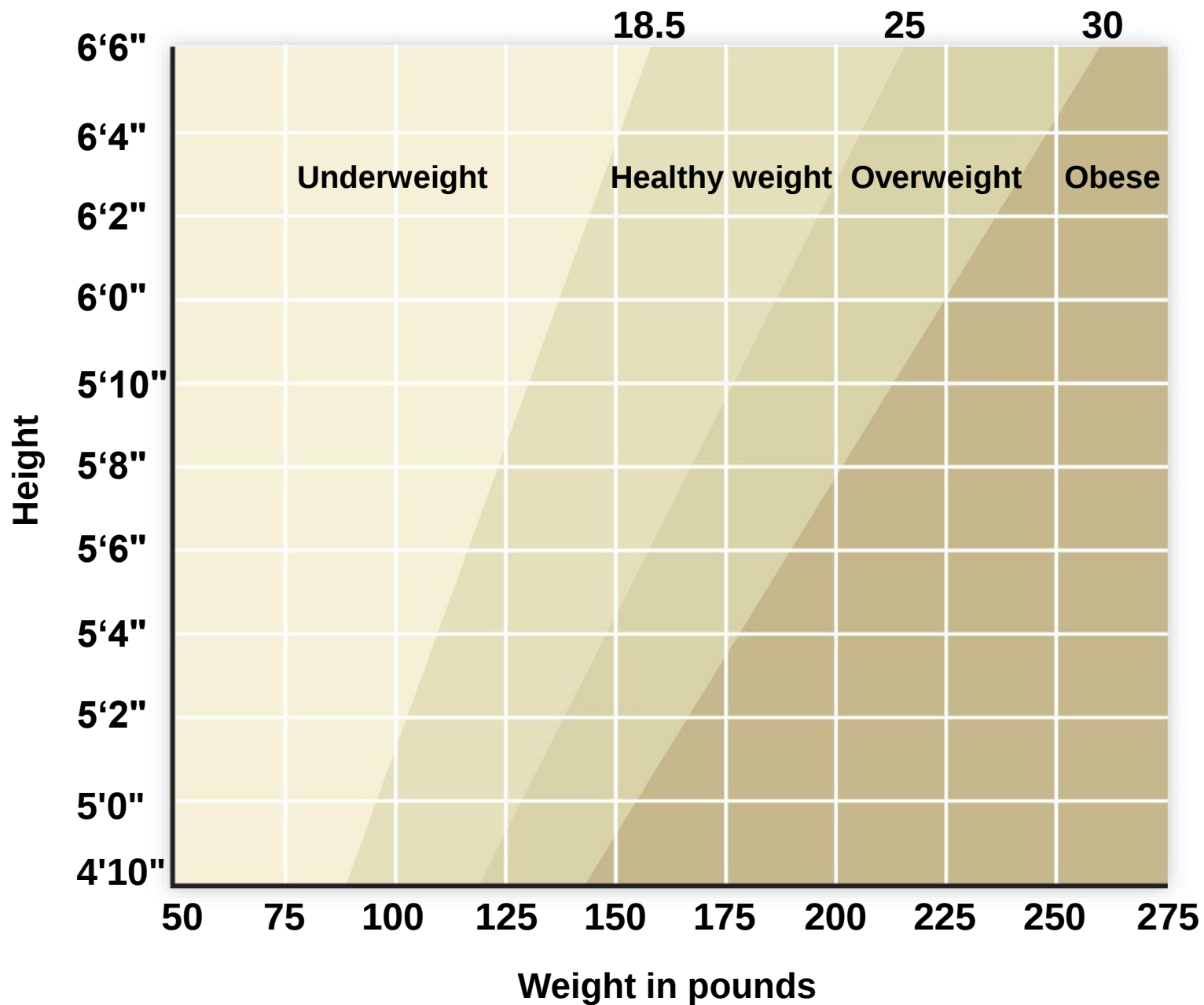
Fiber Benefits the Colon

- 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

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

Body mass index (BMI)

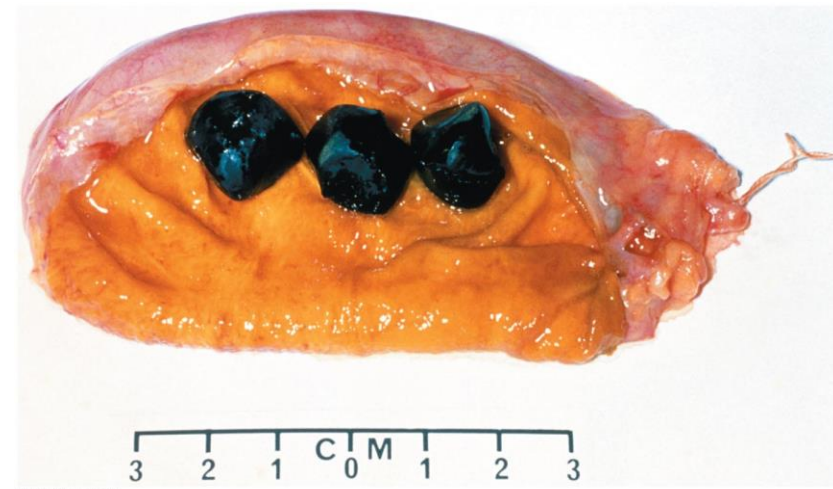


Disorders of the GI Tract

- **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

Disorders of Accessory Organs

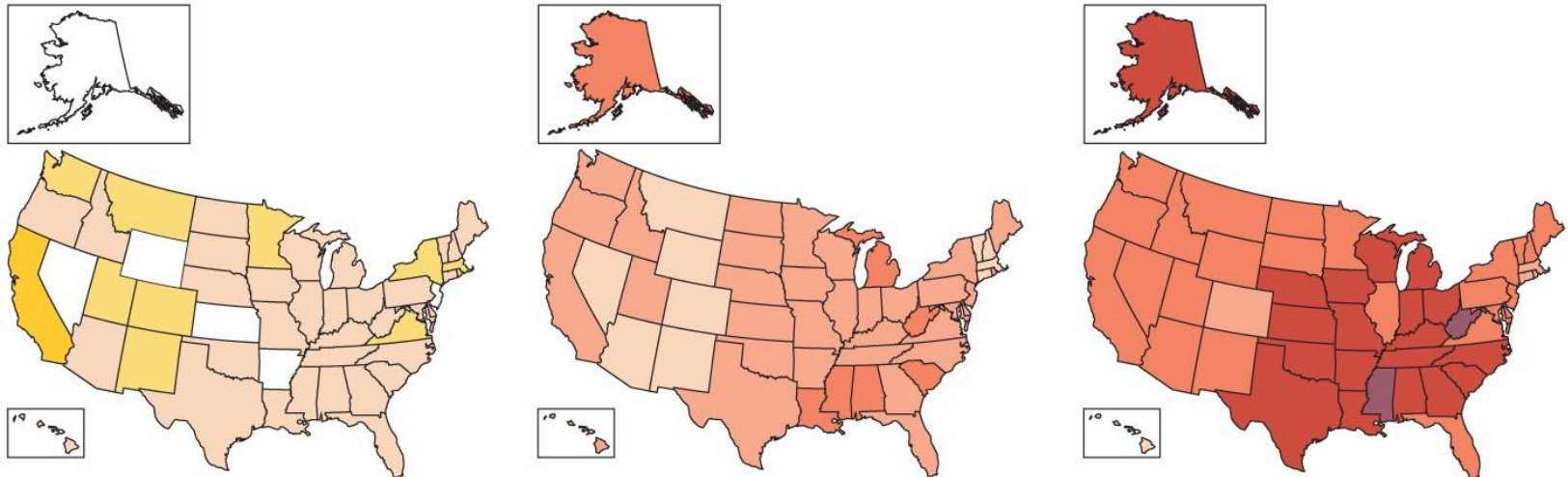
- Hepatitis
 - Inflammation of the liver
 - Three common types caused by viruses
 - Hepatitis A: transmitted by food, water
 - Hepatitis B: transmitted by body fluids, blood
 - Hepatitis C: transmitted by infected blood
- Gallstones
 - crystals may form in gallbladder and obstruct flow of bile



Disorders of the Digestive System

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

Key:  No data  <10%  10%–14%  15%–19%  20%–24%  25%–29%  ≥30%



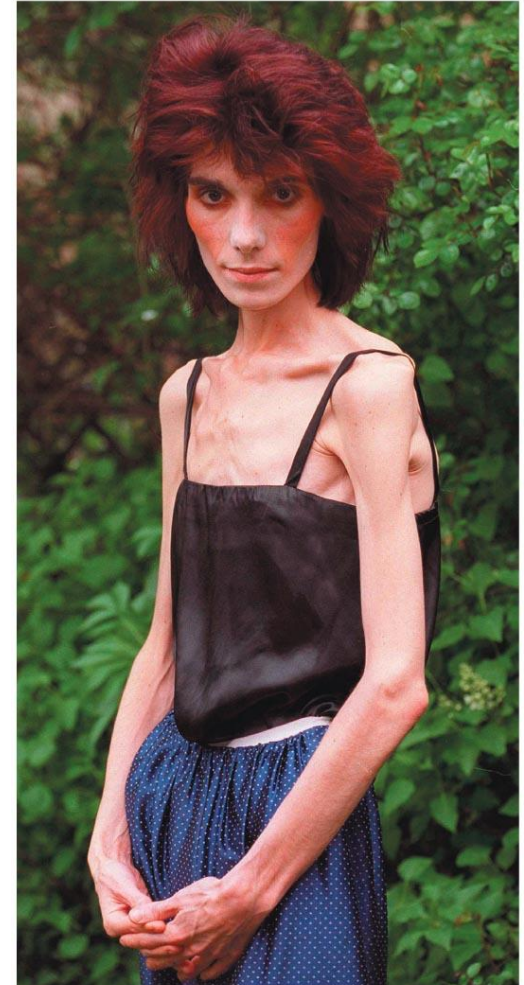
a) 1990.

b) 1998.

c) 2006.

Disorders of the Digestive System

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



© 2012 Pearson Education, Inc.