

## IX. Digestive System

### A. General Info

1. Divisions
  - a. **Alimentary canal** - "food tube"
  - b. **Accessory organs** - No food passes through
2. Layers - See Diagrams
  - a. **Serosa** - Connective for support and protection
  - b. **Smooth muscle** (2-3 layer)
    - 1) Peristalsis - moving from start to finish
    - 2) Mixing and churning
  - c. **Submucosa** - basement memb for mucosa - blood vessles for absorption
  - d. **Mucosa** - simple squamous
    - 1) Goblet cells - mucus production
    - 2) Secretory cells - Acid and Enzymes
    - 3) Villi - Surface area (fine as velvet)

### 3. Phases of digestion

- a. **Mechanical** - Breaking large chunks to small ones (Mastication, Churning, mixing)
- b. **Chemical** - Enzymes break large molecules in to small molecules
- c. **Absorption** - Passage of digested food from lumen to blood in submucosa
- d. **Egestion** - removal of undigested food

## **B. Anatomy**

### 1. Mouth -

#### a. Lined in non-keratinized stratified squamous

#### b. Structures

- 1) Lips - keep food in while masticating
- 2) Teeth - mastication
- 3) Palate (roof of mouth) separates mouth and nose
  - a) *Hard - palatine and maxilla bones*
  - b) *Soft - Muscle/ connective*
  - c) *Uvula - "punching bag" blocks nose while swallowing.*
- 4) Tongue
  - a) *Structure - made of skeletal muscle, attached to hyoid bone. Strongest muscle for its size.*
  - b) *Functions - Speech, taste, mastication, deglutation, clean teeth and gums*

**c. Salivary glands - See Diagrams**

2. Pharynx

**a. Common air/food passage**

**b. 3 regions**

- 1) Nasopharynx - above uvula
- 2) Oropharynx - back of throat
- 3) Laryngopharynx - below tongue to epiglottis (throat switch -lung or stomach)

3. Esophagus

**a. Pharynx to stomach**

**b. Posterior to trachea, anterior to vertebrae**

**c. Layers -see diagrams - same as int.**

**d. Cardiac sphincter - ring of musc. Seals top of stomach. Heart burn.**

4. Stomach

**a. General**

**b. J shaped sac, behind liver and ribs**

- 1) Very little digestion here, sterile holding tank , mechanical mixing w stomach acids and some enzymes
- 2) Regions - see diagrams
- 3) c. Layers - see diagrams

## 5. Small Intestine

- a. 2.5 cm (1") diameter, 6.5 M (20') long
- b. Duodenum - first .3 M (1') bile enters here
- c. Jejunum - middle 3.5 M (10'),
- d. ileum - last 4 M (12') enters L.I.
- e. Layers - see diagrams

## 6. Large Intestine

- a. 5 cm (2.5") in diameter, 2M (6') long
- b. Regions - see diagrams
- c. Layers - see diagrams

## ***C. Physiology***

### 1. Mouth

#### **a. Mechanical**

- 1) mastication - break up, mix w/ saliva. Bolus - a "swallow"
- 2) Deglutition - swallowing. Involuntary once in pharynx

#### **b. Chemical**

- 1) Saliva - 90 - 98% water, lubrication
- Salivary amylase - begins starch digest.*

## 2. Pharynx and Esophagus

**a. Mechanical** - deglutation & peristalsis

**b. Chemical** - S.A. still active

## 3. Stomach (3 - 4hours)

**a. Mechanical** -Churn and mix w gastric juice

1) pH 2 - 2.5 - kills most microbes

2) Chyme - "barf" - food/gastric juice mixture

3) Vomiting - esoph makes more mucus, cardiac sphincter opens, stomach/diaphragm/abdominals contract - viola'

**b. Chemical**

1) mucus - protection from enz. & acid

2) Gastric juice (SEE CHART for ENZYMES)

## 4. Small Intestine (5 -6 hours)

**a. Mechanical**

1) Rhythmic segmentation - "pinching", moves chyme back and forth to "stir"

2) Movement of villi - keeps fresh nutrients in contact with lining for max absorb.

3) Peristalsis - forward movement  $\approx$  5 hrs in SI.

**b. Chemical**

1) Pancreatic & liver secretions pour into duodenum via Sphincter of Oddi

2) Intestinal secretions

3) Bile (from liver)

a) composition – Bile acids, Carbonates, Waste

b) function

c) emulsify lipids – BA's

d) neutralize chyme – carb

e) elimination of cholesterol

f) elimination of metabolic waste (bilirubin & biliverdin from hemolysis)

g) absorption of fat sol vitamins (if low fat diet)

## 5. Large Intestine (12 – 24 hours)

### a. Mechanical

1) Haustral churning – “kneading”

2) Mass peristalsis – large rush of peristalsis. Triggered by new food from stomach.. Involuntary.

3) Defecation – controlled by two anal sphincters. Voluntary.

### b. Chemical

1) No enzymes added

2) Bacterial digestion of cellulose (a little)

### c. Absorption of Water – reclaimed from all of the liquid enzymes used

1) Constipation – too much removed, feces too dense

2) Diarrhea – Not enough absorbed, too liquid

### d. Components of Feces

1) Indigestibles – cellulose, inorganics

2) Undigested food

3) Bile waste, cholesterol, remaining enzymes

4) Live intestinal bacteria - 25% of mass

**e. Total Elapsed time (20 - 34 hours)**

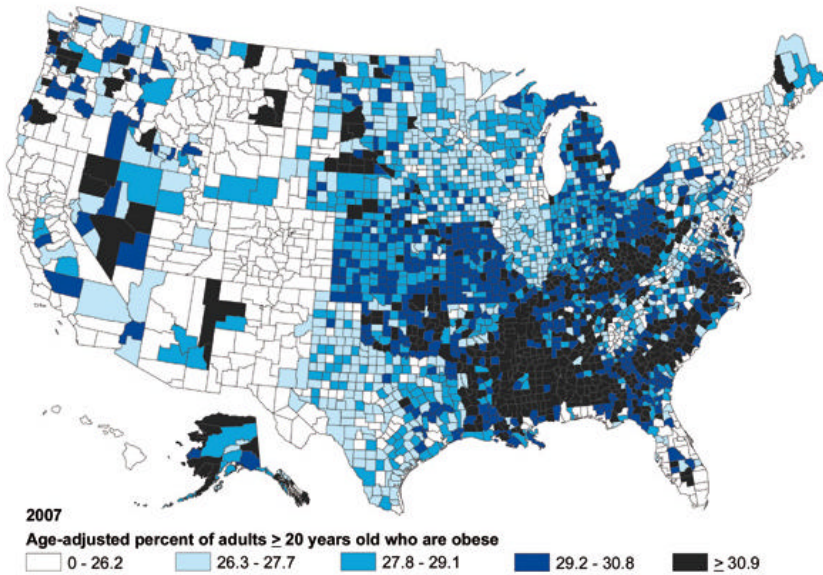
1) Depends on type of food, frequency and quantity of additional meals, chemical activity

**D. Practical considerations**

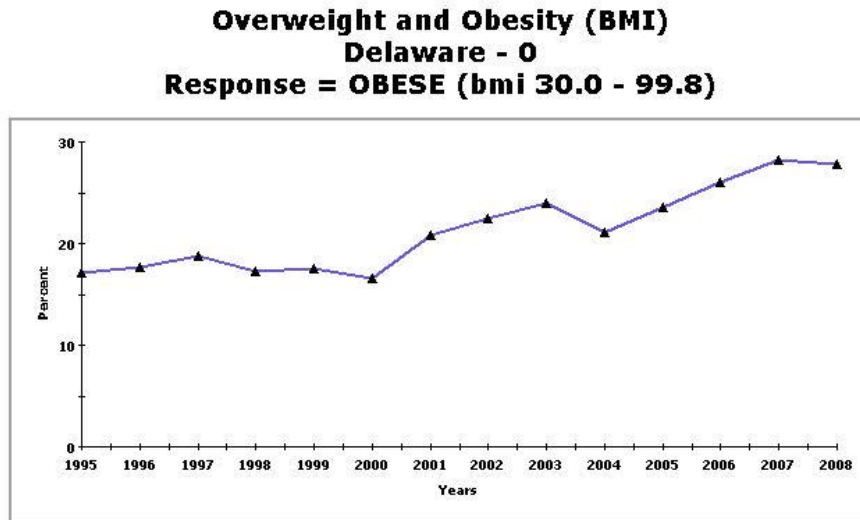
1. Malnutrition - any deficiency in the minimum dietary requirements.

2. Obesity (BMI of 30 kg/m<sup>2</sup> or greater)

**a. National Statistics (from the CDC)**



b. Delaware Statistics from the CDC



c. Causes -

- Hormonal imbalance (hypothyroidism - metabolism severely low, burn fewer calories than average)
- Overeating - taking in more calories than necessary.

**Emotional / psychological**

**Neurotransmitter imbalance**

**Eat too fast (20 min rule)**

- Lack of exercise - activity, muscle mass inc metabolism.

d. Potential Consequences

- diabetes
- heart disease
- stroke



- a. hypertension
- b. gallbladder disease
- c. osteoarthritis (degeneration of cartilage and bone of joints)
- d. sleep apnea and other breathing problems
- e. some forms of cancer (uterine, breast, colorectal kidney, and gallbladder).

### 3. Other Disorders

- a. **Ulcer** - Thinning of mucus protection of stomach. Acid & enz digest stomach.  
Perforated - requires surgery
  
- b. **Gall Stones** - precipitation of cholesterol/ and bile salts (calcium)
  
- c. **Cirrhosis** - destruction of liver by poisoning (alcohol, OD)
  
- d. **Jaundice** - toxic buildup of bilirubin in blood due to liver dysfunction
  
- e. **Colitis (Crone's disease)** - "irritable bowel syndrome" food causes massive swelling, pain of small and large intestine. Genetic. Often Severe