Digestive System
Primary Function

1. **Ingestion**: food enters the system
   - Physical and enzymatic breakdown begins

2. **Digestion**: Further breakdown
   - Chemical/enzymatic

3. **Absorption**: Nutrients enter circulatory system
   - Delivered to tissues of the body

4. **Elimination of Waste (Egestion)**: Removal of wastes from body
1. Ingestion
Salivary Glands = Saliva

- **Lubricates** food so it can be swallowed
- **Dissolves** food particles so food can be tasted
  - Food must be dissolved to be tasted
Saliva

- On average we produce .75 to 1.5L of saliva per day
- Most of it is water which moistens the food into a ball or **bolus**
Teeth

- **Physical Digestion**
- Incisors (cutting), canines (tearing), premolars (grinding), molars (crushing), wisdom teeth (annoying)
Epiglottis

- A flap of soft tissue covers the entrance to the trachea to prevent food from entering the lungs
Esophagus

- Connects mouth to stomach
- Composed of *smooth muscle* (contracts in rhythmic wavelike fashion = **peristalsis**)
- Peristalsis (not gravity!) moves bolus down esophagus
Peristalsis

- Phase 1: Contraction of smooth muscle
- Phase 2: Smooth muscle is stretched
- Phase 3: Bolus

Diagram showing the progression of peristalsis through the phases.
2. DIGESTION
Stomach

- Churns food and mixes it with digestive juices and enzymes
1. **Mucus** provides a protective coating.
2. **Hydrochloric acid** kills many harmful substances that are ingested with food.
3. **Pepsin** is a protein-digesting enzyme.
Stomach Ulcers

- One specie of bacteria, *Helicobacter pylori* (*H. pylori*) is able to survive in the stomach by secreting acid-neutralizing enzymes.
- They prevent mucus-producing cells from producing enough mucus.
- Exposed stomach lining = ulcer.
- Successfully eliminated with antibiotics.
3. Absorption of Materials
Pancreas

- Secretes enzymes for digestion
- AND hormones that regulate absorption and storage of glucose
- Food entering small intestine is very acidic therefore the pancreas releases bicarbonate ions to neutralize the acid
Small Intestine

- 2.5cm diameter, 7m in length
- Digestion in the first portions
- Absorption in the latter portions

Duodenum
Jejunum
Ileum
Absorption in the Small Intestine

- Long finger-like folds/tubes (villi, singular: villus) project from the lining of the small intestine to increase the surface area for absorption.

- **Microvilli** project from the cell membranes of the villi to increase the surface area even more.
Villi
Microvilli
Absorption in the small intestine

Intestinal Villus

Microvilli lining the cells of the villus
Absorption in the small intestine

Capillaries (tiny blood vessels) line the inside of villi to absorb nutrients into the circulatory system.
Absorption in the small intestine

- Villi/microvilli increase the surface area of the small intestine 10-30x
  - More surface area = more efficient absorption

- All of these folds give the small intestine a surface area close to that of a tennis court
Celiac Disease

- Inherited disorder of the small intestine
- Severe immune response to gluten (a protein found in wheat)
- Ultimately, the villi become inflamed and damaged/blunted which affects their absorptive capabilities
  - Diagnosis: fat/oil droplets present in feces that passed through the small intestine instead of being absorbed
- Can be controlled with a gluten-free diet

Damaged/blunted villi due to celiac disease
Kwashiorkor

- **Kwashiorkor** = disorder among children who have a chronic deficiency of protein in their diet
- **Symptoms** = distended and severely swollen abdomen
Liver and Gall Bladder

- All blood travelling through the intestines goes directly to the liver before return to the heart
- **Liver** involved in the removal and breakdown of toxins (such as alcohol)
- Liver produces and secretes bile
- **Bile** = a substance that emulsifies fats for faster breakdown
- **Gall bladder** stores bile until food enters the duodenum
Absorption in the Large Intestine/Colon

- 7.6cm diameter, 1.5m in length
- **Colon**: largest part of the large intestine
  - **Water**, salts, minerals are **absorbed** here
  - Nearly **8 L of fluid enters** the large intestine – only about **0.1 L or so comes out** as solid waste
Large Intestine - Rectum

- The lower 20cm of the large intestine where feces are stored
  - It may take 4 to 72 hours for the undigested material to pass through the large intestine, depending on the types and volume of food eaten
Relationship with other Systems

- **Circulatory system**: capillaries line the small and large intestine and absorb nutrients and water.
Endoscopes

- **endoscope**: an instrument to view the interior of the body
Endoscopy
Capsule Endoscope

- Miniature and wireless technology have enabled the creation of a camera small enough to fit inside a capsule that can be swallowed.

- The capsule passes through the digestive tract, taking thousands of pictures that are transmitted wirelessly to a receiver.
Constipation

- When you don’t drink enough water
- Your body works very hard to absorb as much water as it can from the food you eat
Diarrhea

- A **protective** mechanism
- Inadequate absorption of water in the colon
- A very common condition, must people experience it 3-4 times a year
- Usually caused by an infection (bacteria, viruses, or parasites)
- Kills about **2 million** children worldwide each year