Digestive System

Digestion is the process of reducing food to small molecules that can be absorbed into the body.

2 Types of Digestion

Mechanical digestion - physical breakdown of food into small particles (increasing surface area).
> example: chewing and muscular churning
> speeds up chemical digestion by exposing large amounts of food to digestive enzymes

Chemical digestion - the chemical breakdown of large molecules into smaller ones.
There are 4 main steps of digestion:

1. **ingestion** - bringing food into the body

2. **digestion** - physical and chemical breakdown of food
   - carbohydrates converted into monosaccharides (i.e. glucose)
   - proteins converted into amino acids
   - fats converted into glycerol and fatty acid

3. **absorption** - taking useful nutrients into the body

4. **elimination** - body gets rid of digestive wastes (solid)
The Human Digestive System

> a long tube which begins at the mouth and ends at the anus. (alimentary canal / gastrointestinal tract)
> various glands along the digestive tract are essential for us to obtain energy from our food.
The Mouth
> the organs involved in taste are the tongue (sweet, sour, bitter, salty), the nose and the brain.
> teeth cut food into bite-sized pieces, then the food is torn apart the tongue kneads food into a smooth ball called a bolus food is chewed and mixed with saliva (adds moisture and contains the enzyme amylase which begins the breakdown of starch).
> food passes from the mouth to the pharynx, the uvula (a small flap of tissue hanging from the soft palate at the back of the mouth) prevents food from entering the nasal cavity when we swallow.
> swallowing begins as a VOLUNTARY process (not automatic) when food reaches the pharynx, it becomes an INVOLUNTARY process.
> food travels from the pharynx to the esophagus
The Esophagus
> the epiglottis covers the opening of the windpipe when swallowing.
> the food moves down the esophagus (25cm long) to the stomach by the process of peristalsis (the rhythmic contraction and relaxation of muscles to move substances along a path).

Peristalsis

Peristalsis in the stomach
http://www.youtube.com/watch?v=o18UycWRsaA
The Stomach
- the sphincter is a circular smooth muscle that closes a tube when it contracts
  - when the cardiac sphincter relaxes it allows food to enter the stomach
  - the second sphincter (pyloric sphinter) is located at the end of the stomach. When it relaxes partially digested food moves out of the stomach.
- holds 1.5L of food
- pH of stomach is 2
- three kinds of cells in the stomach
  - one that secretes mucus - protects stomach lining
  - one that secretes enzymes - pepsin breaks down PROTEIN into polypeptides
  - one that secretes hydrochloric acid and water - HCl helps break up connective tissue and cell membranes of food and helps kill bacteria > the secretions combine to form gastric juices.
- slow waves of muscle movement pass the food. The food bolus is changed into a thick liquid called CHYME.
- protein rich foods stay in the stomach the longest (3 - 4 hours).
- foods high in carbohydrates leave within 1.5 - 2 hours.
- very little is absorbed directly into the bloodstream from the stomach.
- some water, glucose, salts, and alcohol are absorbed

Healthy Esophagus and stomach

http://www.youtube.com/watch?v=OBbwC2V2NpQ&feature=related
The Small Intestine.
Chyme passes from the pylorus (bottom section of the stomach) to the small intestine. This has a length of up to 6m. It is considered to have 3 parts:

1. duodenum - receives secretions from pancreas and liver
2. jejunum - most of digestion and chemical absorption
3. ileum - absorption continues

The lining of the small intestine has finger-like extensions called villi and the surface of each of these is lined with microvilli. The two structures increase the surface area for absorption. They are surrounded by capillaries (allows for easy diffusion and transport from cells in intestinal wall to blood). About 80% of absorption occurs in the small intestine. The villi are in close proximity to many capillaries so that nutrients can be transferred to the blood.
The Large Intestine
> It is only about 1.5m long but it has a larger diameter than the small intestine.
> The ileocaecal valve allows materials to enter from the small intestine.

The large intestine consists of:
1. caecum - receives material from small intestine
2. ascending colon
3. transverse colon
4. descending colon
5. sigmoid colon
6. rectum - end of digestive tract

> the main function of the large intestine is to reabsorb water and compact the unabsorbed material.
> there are a large number of micro-organisms living there as well. They produce vitamin K and breakdown some indigestible materials.
> the feces is about 75% water and 25% solid material, consisting of bacteria, cellulose, fat, inorganic matter and protein.

Healthy Colon
http://www.youtube.com/watch?v=yXCYHjbKenA&feature=related
Accessory Organs in Digestion

1. Salivary Glands
The secretions include two substances:
> parotids gland secretes salivary amylase - break down of starch (watery fluid).
> buccal gland secretes mucus - lubricates food (thick, slippery fluid).
2. **Liver**
> It is the second largest organ (after the skin) in the human body, weighing **1.5kg**.
> It performs many important functions, including **filtering of blood**, and the **production of bile** (about 1 L per day!)
> **Bile** is a yellowish-orange fluid, made up of bile pigments, bile salts, and cholesterol. Breaks down fats and oils into smaller droplets. This process is also known as **emulsification**.
> Has a high concentration of **catalase** (enzyme) which plays a key role in **decomposing toxins**.
3. Gall Bladder
> It is a muscular sac that stores and concentrates the bile that it receives from the liver. When fat enters the small intestine, a hormone called CCK (also known as cholecystokinin) is released which will cause the gallbladder to contract and release bile through the bile duct.
4. **Pancreas**

> It is an organ that is about **15 cm long**.

The chyme entering the small intestine is **acidic**, so a hormone called **secretin** is released by the duodenal walls. It enters the bloodstream and travels to the pancreas to cause the release of **bicarbonate ions**. It neutralizes HCl and raises the **pH to 9**.

Other pancreatic secretions involved in digestion include:
1. **lipases** - to work on lipids
2. **carbohydrases** - to digest sugars and starches
3. **proteases** - to break apart proteins

http://www.youtube.com/watch?v=QtDgQjOGPJM

Click here for link to digestion video (converted).mpg