Digestion and absorption of nutrients
Small intestine

• Almost all digestion of protein, fat, and carbohydrate is performed in the small intestine

Divided into three parts:
• Duodenum (the first 10-12 inches)
• Jejunum (~ 4 feet)
• Ileum (~ 5 feet)
Nutrient digestion in the small intestine

• SECRETIN is released upon the appearance of chyme in the SI

• SECRETIN stimulates the release of BICARBONATE from the pancreas

• BICARBONATE neutralizes the chyme
• The neutralization is important because the enzymes in the SI need a neutral environment.

• Pancreatic juice and secretions from the intestinal wall cells contain a variety of digestive enzymes that help to digest fats, carbohydrates, and proteins.
• BILE is released from the gall bladder upon the appearance of fat in the SI

• BILE acts as an emulsifier, and without it, lipids might not come into contact with pancreatic lipase, and would not be properly digested
• With pancreatic and intestinal enzymes working together, digestion creates smaller compounds of protein, fat, and carbohydrate which can then be easily absorbed.

• Minerals, vitamins, and cholesterol are not broken down and are generally absorbed unchanged.
Nutrient absorption in the small intestine

• Most absorption occurs in the SI – 90%

• Provides the surface area equivalent to a tennis court!

• Nutrients are trapped in folds of the intestinal wall and absorbed through the microvilli

• Each villus contains blood vessels and a lymph vessel which transport nutrients
• Water-soluble nutrients are absorbed directly into the bloodstream

• Fat-soluble lipid compounds are absorbed into the lymph rather than the blood
• Duodenum and Upper Jejunum: most minerals (except sodium, chloride, and potassium)

• Jejunum and Upper Ileum: carbohydrates, amino acids, water-soluble vitamins

• Jejunum: lipids and fat-soluble vitamins

• Terminal Ileum: Vitamin B12
Large intestine

- Is ~ 5 feet long and includes the cecum, colon, rectum, and anal canal

Nutrient digestion in the large intestine

- Little digestion occurs in the large intestine

- The large population of bacteria digests small amounts of fiber

- This bacterial activity forms: Vitamin K, Vitamin B12, Thiamin, Riboflavin, Biotin, and gases
Large intestine

- Colon
- Cecum
- Rectum
- Anal canal

**Absorbs water, sodium, chloride, potassium and vitamin K**

**Bacteria digest small amounts of fiber**
Nutrient absorption in the large intestine

• Little absorption occurs in the large intestine

• However, it does absorb: water, sodium, potassium, chloride, and some of the Vitamin K produced by bacteria

• It does not absorb Vitamin B12
Healthy bacteria

• **Probiotics** are live microorganisms (in most cases, bacteria) that are similar to beneficial microorganisms found in the human gut.

• Probiotics are available to consumers mainly in the form of dietary supplements and foods.

• Look for “live and active cultures”. The good bacteria most often comes from two groups: *Lactobacillus* or *Bifobacterium*. 
## Enzyme Involved in Digestion

<table>
<thead>
<tr>
<th>pH</th>
<th>Location</th>
<th>Substrate</th>
<th>Enzyme</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 – 8 (neutral-slightly alkaline)</td>
<td>Mouth (saliva)</td>
<td>Starch</td>
<td>Salivary amylase</td>
<td>Maltose</td>
</tr>
<tr>
<td>1 – 2 (acidic)</td>
<td>Stomach (gastric juice)</td>
<td>Rennin, Pepsin</td>
<td>Milk proteins, Other proteins &amp; coagulated proteins</td>
<td>Coagulated proteins polypeptides</td>
</tr>
<tr>
<td>7 – 8 (neutral-slightly alkaline)</td>
<td>Duodenum (pancreatic juice)</td>
<td>Starch, Polypeptides, Emulsified fats</td>
<td>Pancreatic amylase, Trypsin, Lipase</td>
<td>Maltose, Dipeptides, Fatty acids &amp; glycerol</td>
</tr>
<tr>
<td>7 – 8 (neutral-slightly alkaline)</td>
<td>Ileum (intestinal juice)</td>
<td>Maltose, Lactose, Sucrose, Dipeptides, Emulsified fats</td>
<td>Maltase, Lactase, Sucrase, Peptidase, Lipase</td>
<td>Glucose, Glucose &amp; Galactose, Glucose &amp; Fructose, Amino acids, Fatty acids &amp; glycerol</td>
</tr>
</tbody>
</table>