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 **College of Pharmacy**

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**Human Biology**

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 **Lec. 3,4 Nutrition**

The digestive system is made up of the gastrointestinal tract—also called the GI tract or digestive tract and the accessories (liver, pancreas and gall bladder). The GI tract is a series of hollow organs joined in a long, twisting tube from the mouth to the anus. **Digestion** involves the breakdown of food into smaller and smaller components, until they can be absorbed and assimilated into the body. The hollow organs that make up the GI tract are the mouth, the small intestine has three parts. The first part is called the duodenum. The jejunum is in the middle and the ileum is at the end. The large intestine includes the appendix, cecum, colon, and rectum. The appendix is a finger-shaped pouch attached to the cecum. The cecum is the first part of the large intestine. The colon is next. The rectum is the end of the large intestine. Digestion is important because your body needs nutrients from food and drink to work properly and stay healthy.



Nutrition, nourishment, or aliment, is the supply of materials - food - required by organisms and cells to stay alive. In science and human medicine, nutrition is the science or practice of consuming and utilizing foods. It includes food intake, absorption, assimilation, biosynthesis, catabolism, and excretion. Nutritional science studies how the body breaks food down (catabolism) and how it repairs and creates cells and tissue (anabolism). Catabolism and anabolism combined can also be referred to as metabolism. digestive system breaks nutrients into parts small enough for your body to absorb and use for energy, growth, and cell repair.

**Important Facts on Nutrition**

•The human body requires seven major types of nutrients.

•Not all nutrients provide energy but are still important, such as water and fibers.

•Micronutrients are important but required in smaller amounts.

•Vitamins are essential organic compounds that the human body cannot synthesize.

•A nutrient is a source of nourishment, a component of food, for instance, protein, carbohydrate, fat, vitamin, mineral, fibers, and water.

**Macronutrients** are nutrients we need in relatively large quantities.

**Micronutrients** are nutrients we need in relatively small quantities.

Macronutrients can be further split into energy macronutrients (that provide energy), and macronutrients that do not provide energy.

**Energy macronutrients**

Energy macronutrients provide energy, which is measured either in kilocalories (kcal or [calories](https://www.medicalnewstoday.com/articles/245588.php)) or Joules. 1 kilocalorie (calorie) = 4185.8 joules. Energy macronutrients include:

**Carbohydrates - 4 kcal per gram**

Carbohydrate molecules include monosaccharides (glucose, fructose, galactose), disaccharides, and polysaccharides (starch).

Nutritionally, polysaccharides are favored over monosaccharides because they are more complex and therefore take longer to break down and be absorbed into the bloodstream; this means that they do not cause major spikes in blood sugar levels, which are linked to heart and vascular diseases.

**Proteins - 4 kcal per gram**

There are 20 amino acids - organic compounds found in nature that combine to form proteins. Some amino acids are essential, meaning they need to be consumed. Other amino acids are non-essential because the body can make them.

**Fats - 9 kcal per gram**

Fats are triglycerides - three molecules of fatty acid combined with a molecule of the alcohol glycerol. Fatty acids are simple compounds (monomers) while triglycerides are complex molecules (polymers).Fats are required in the diet for health as they serve many functions, including lubricating joints, helping organs produce hormones, assisting in absorption of certain vitamins, reducing [inflammation](https://www.medicalnewstoday.com/articles/248423.php), and preserving brain health.

### Macronutrients that do not provide energy

These do not provide energy, but are still important:

**Fiber**

Fiber consists mostly of carbohydrates. However, because it is not easily absorbed by the body, not much of the sugars and starches get into the blood stream. Fiber is a crucial part of nutrition, health, and fuel for gut bacteria.

**Water**

About 70 percent of the non-fat mass of the human body is water. It is vital for many processes in the human body.Nobody is completely sure how much water the human body needs - claims vary from 1-7 liters per day to avoid [dehydration](https://www.medicalnewstoday.com/articles/153363.php). We do know that water requirements are very closely linked to body size, age, environmental temperatures, physical activity, different states of health, and dietary habits; for instance, somebody who consumes a lot of salt will require more water than another similar person.

### Micronutrients

Micronutrients are required in smaller quantities:

**Minerals**

Dietary minerals are the other chemical elements our bodies need, other than carbon, hydrogen, oxygen, and nitrogen

**Potassium**

What it does - a systemic (affects entire body) electrolyte, essential in co-regulating ATP (an important carrier of energy in cells in the body, also key in making RNA) with sodium.

**Chloride**

What it does - key for producing stomach acid, important in the transport of molecules between cells, and vital for the proper functioning of nerves.

**Sodium**

What it does - a systemic electrolyte, and essential in regulating ATP with [potassium](https://www.medicalnewstoday.com/articles/287212.php). Important for nerve function and regulating body fluid levels.

**Calcium**

What it does - important for muscle, heart, and digestive health. Builds bone, assists in the synthesis and function of blood cells.

**Phosphorus**

What it does - important for the structure of DNA, transporter of energy (ATP), component of cellular membrane, helps strengthen bones.

### Vitamins

These are organic compounds we require in tiny amounts. An organic compound is any molecule that contains carbon.

It is called a vitamin when our bodies cannot synthesize (produce) enough or any of it, so we need to get it from our food.Vitamins are classified as water soluble (they can be dissolved in water) or fat soluble (they can be dissolved in fat). For humans, there are four fat-soluble vitamins (A, D, E, and K) and nine water-soluble vitamins (eight B vitamins and vitamin C).

Water-soluble vitamins need to be consumed more regularly because they are eliminated faster (in urine) and are not easily stored.

Fat-soluble vitamins are absorbed through the intestines with the help of fats (lipids). They are more likely to accumulate in the body because they are harder to get rid of quickly. If too many vitamins build up, it is called hypervitaminosis. A very low-fat diet can affect the absorption of fat-soluble vitamins. Most foods contain a combination of some or all of the seven nutrient classes. We require some nutrients regularly, and others less frequently.

Each part of the digestive system helps to move food and liquid through GI tract, break food and liquid into smaller parts, or both. Once foods are broken into small enough parts, the body can absorb and move the nutrients to where they are needed. Large intestine absorbs water, and the waste products of digestion become [stool](https://www.niddk.nih.gov/Dictionary/S/stool). Nerves and hormones help control the digestive process. The digestive process is:

| Organ | Movement |
| --- | --- |
| Mouth | Chewing |
| Esophagus | [Peristalsis](https://www.niddk.nih.gov/Dictionary/P/peristalsis) |
| Stomach | Upper muscle in stomach relaxes to let food enter, and lower muscle mixes food with digestive juice |
| Small intestine | Peristalsis |
| Pancreas | None |
| Liver | None |
| Large intestine | Peristalsis |

**The major parts of the digestive system:**

* **Salivary glands.**
* **Pharynx.**
* **Esophagus.**
* **Stomach.**
* **Small Intestine.**
* **Large Intestine.**
* **Rectum.**
* **Accessory digestive organs: liver, gallbladder, pancreas.**
* **Small Intestine Made up of three segments - the duodenum, jejunum, and ileum**
* **Large Intestine made up of the ileum (last part of the small intestine) connects to the cecum (first part of the colon) in the lower right abdomen. The rest of the colon is divided into four parts: The ascending colon travels up the right side of the abdomen.**
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##  **How does food move through the GI tract?**

Chewing, in which food is mixed with saliva begins the mechanical process of digestion. This produces a bolus which can be swallowed down the esophagus to enter the stomach. Here it is mixed with gastric acid until it passes into the duodenum where it is mixed with a number of enzymes produced by the pancreas. Saliva also contains a catalytic enzyme called amylase which starts to act on food in the mouth. Another digestive enzyme called lingual lipase is secreted by some of the lingual papillae on the tongue and also from serous glands in the main salivary glands. Digestion is helped by the chewing of food carried out by the muscles of mastication, by the teeth, and also by the contractions of peristalsis, and segmentation. Gastric acid, and the production of mucus in the stomach, are essential for the continuation of digestion.

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Peristalsis is the rhythmic contraction of muscles that begins in the esophagus and continues along the wall of the stomach and the rest of the gastrointestinal tract. This initially results in the production of chyme which when fully broken down in the small intestine is absorbed as chyle into the lymphatic system. Most of the digestion of food takes place in the small intestine. Water and some minerals are reabsorbed back into the blood in the colon of the large intestine. The waste products of digestion (feces) are defecated from the anus via the rectum.

**Mouth** : the natural opening through which food passes into the body of an animal and which in [vertebrates](https://www.merriam-webster.com/dictionary/vertebrate#h1) is typically bounded externally by the lips and internally by the [pharynx](https://www.merriam-webster.com/dictionary/pharynx) and encloses the tongue, gums, and teeth.

Salivary glands: any of various glands that discharge a fluid secretion and especially saliva into the mouth cavity and that in humans comprise large compound consist glands including the parotid glands, the sublingual glands, and the submandibular glands, that differ in the type of secretion they produce: parotid glands produce a **serous**, **watery** secretion. **submaxillary** (mandibular) glands produce a mixed **serous** and **mucous** secretion.

In serous secretions, the main type of protein secreted is alpha-amylase, an enzyme that breaks down starch into maltose and glucose, whereas in mucous secretions the main protein secreted is mucin, which acts as a lubricant.

**Esophagus**; is a long, hollow organ which transports food from the mouth to the [digestive system](https://biologydictionary.net/digestive-system/). When the swallowing begin, the process becomes automatic, signals the muscles of the esophagus and peristalsis begins. Lower esophageal sphincter. When food reaches the end of esophagus, a ring like muscle called the lower esophageal sphincter relaxes and lets food pass into the stomach. This sphincter usually stays closed to keep what’s in the stomach from flowing back into esophagus.

**Stomach:**  is a muscular, [hollow organ](https://en.wikipedia.org/wiki/Organ_%28anatomy%29) in the [gastrointestinal tract](https://en.wikipedia.org/wiki/Gastrointestinal_tract) of humans The stomach secretes acid and enzymes that digest food. Ridges of muscle tissue called rugae line the stomach. The stomach muscles contract periodically, churning food to enhance **digestion**. The pyloric sphincter is a **muscular** valve that opens to allow food to pass from the stomach to the small intestine. stomach is divided into four sections, beginning at the cardia, fundus, body and pylorus. Parietal cells in the stomach secrete roughly two liters of acid a day in the form of hydrochloric acid. Acid in the stomach functions to kill bacteria, and to aid digestion by solubilizing food. The acid is also important to establish the optimal pH (between 1.8-3.5) for the function of the digestive enzyme pepsin.

**Gastric acid, gastric juice or stomach acid,** is a digestive fluid formed in the stomach and is composed of hydrochloric acid (HCl), potassium chloride (KCl) and sodium chloride (NaCl). The acid plays a key role in digestion of proteins, by activating digestive enzymes, and making ingested proteins unravel so that digestive enzymes break down the long chains of amino acids. Gastric acid is produced by cells in the lining of the stomach.

The **small intestine** or **small bowel** is the part of the [gastrointestinal tract](https://en.wikipedia.org/wiki/Human_gastrointestinal_tract) between the [stomach](https://en.wikipedia.org/wiki/Stomach) and the [large intestine](https://en.wikipedia.org/wiki/Large_intestine), The [small](https://www.biology-online.org/dictionary/Small) [intestine](https://www.biology-online.org/dictionary/Intestine) is composed of three [sections](https://www.biology-online.org/dictionary/Sections): [duodenum](https://www.biology-online.org/dictionary/Duodenum), [jejunum](https://www.biology-online.org/dictionary/Jejunum) and [ileum](https://www.biology-online.org/dictionary/Ileum). and is where most of the end absorption of food takes place. The [total](https://www.biology-online.org/dictionary/Total) [length](https://www.biology-online.org/dictionary/Length) of the [small](https://www.biology-online.org/dictionary/Small) [intestine](https://www.biology-online.org/dictionary/Intestine) is approximately 22 [feet](https://www.biology-online.org/dictionary/Feet) The small intestine is the site where most food is, where digestive enzymes are secreted into it. The small intestine is the site where most food is absorbed in an organism, where digestive enzymes are secreted into it. The main function of the small intestine is absorption of nutrients and minerals from food. Digestion involves two distinct parts. The small intestine is where most chemical digestion takes place. Many of the digestive enzymes that act in the small intestine are secreted by the pancreas and liver and enter the small intestine via the pancreatic duct. Pancreatic enzymes and bile from the gallbladder enter the small intestine in response to the hormone cholecystokinin, which is produced in the small intestine in response to the presence of nutrients. Secretin, another hormone produced in the small intestine, causes additional effects on the pancreas, where it promotes the release of bicarbonate into the duodenum in order to neutralize the potentially harmful acid coming from the stomach. The three major classes of nutrients that undergo digestion are proteins, lipids (fats) and carbohydrates.

**Liver:** The largest solid organ in the body, situated in the upper part of the abdomen on the right side. The liver has a multitude of important and complex functions, including to manufacture proteins, including albumin (to help maintain the volume of blood) and blood clotting factors; to synthesize, store, and process fats, including fatty acids (used for energy) and cholesterol; to metabolize and store carbohydrates (used as the source for the sugar in blood); to form and secrete bile that contains bile acids to aid in the intestinal absorption of fats and the fat-soluble vitamins A, D, E, and K; to eliminate, by metabolizing or secreting, the potentially harmful biochemical products produced by the body, such as bilirubin, from the breakdown of old red blood cells and ammonia from the breakdown of proteins; and to detoxify, by metabolizing and/or secreting, drugs, alcohol, and environmental toxins.

**pancreas**a large lobulated mixed gland, having both an endocrine and an exocrine function. As an endocrine gland, it secretes into the blood several important hormones, including insulin, glucagon, somatostatin, and pancreatic polypeptide. As an exocrine gland, it secretes pancreatic juice into the duodenum through the pancreatic duct. This juice contains bicarbonate, which neutralizes acid entering the duodenum from the stomach; and digestive enzymes, which break down carbohydrates, proteins, and lipids in ingested food entering the duodenum from the stomach. The endocrine part is composed of hormonal tissue distributed along the pancreas in discrete units called islets of Langerhans. The endocrine part is composed of hormonal tissue distributed along the pancreas in discrete units called islets of Langerhans. Approximately 3 million cell clusters called pancreatic islets are present in the pancreas. Within these islets are four main types of cells which are involved in the regulation of blood glucose levels. Each type of cell secretes a different type of hormone: α alpha cells secrete glucagon (increase glucose in blood), β beta cells secrete insulin (decrease glucose in blood), δ delta cells secrete somatostatin (regulates/stops α and β cells) and PP cells, or γ (gamma) cells, secrete pancreatic polypeptide. These act to control blood glucose through secreting glucagon to increase the levels of glucose, and insulin to decrease it.

 **Gallbladder**. a membranous muscular sac, pear-shaped organ located below the liver that stores the bile secreted by the liver. During and after a fatty meal, the **gallbladder** contracts, delivering the bile through the bile ducts into the intestines to help with digestion.

**Large intestine** is the last part of the gastrointestinal tract and of the digestive system. The major function of the large intestine is to absorb water from the remaining indigestible food matter and transmit the useless waste material from the body by defecation. Unlike the small intestine, the colon does not play a major role in absorption of foods and nutrients. About 1.5 liters or 45 ounces of water arrives in the colon each day. The length of the adult human male colon is 65 inches or 166 cm (range of 80 to 313 cm), on average, for females it is 155 cm (range of 80 to 214 cm).