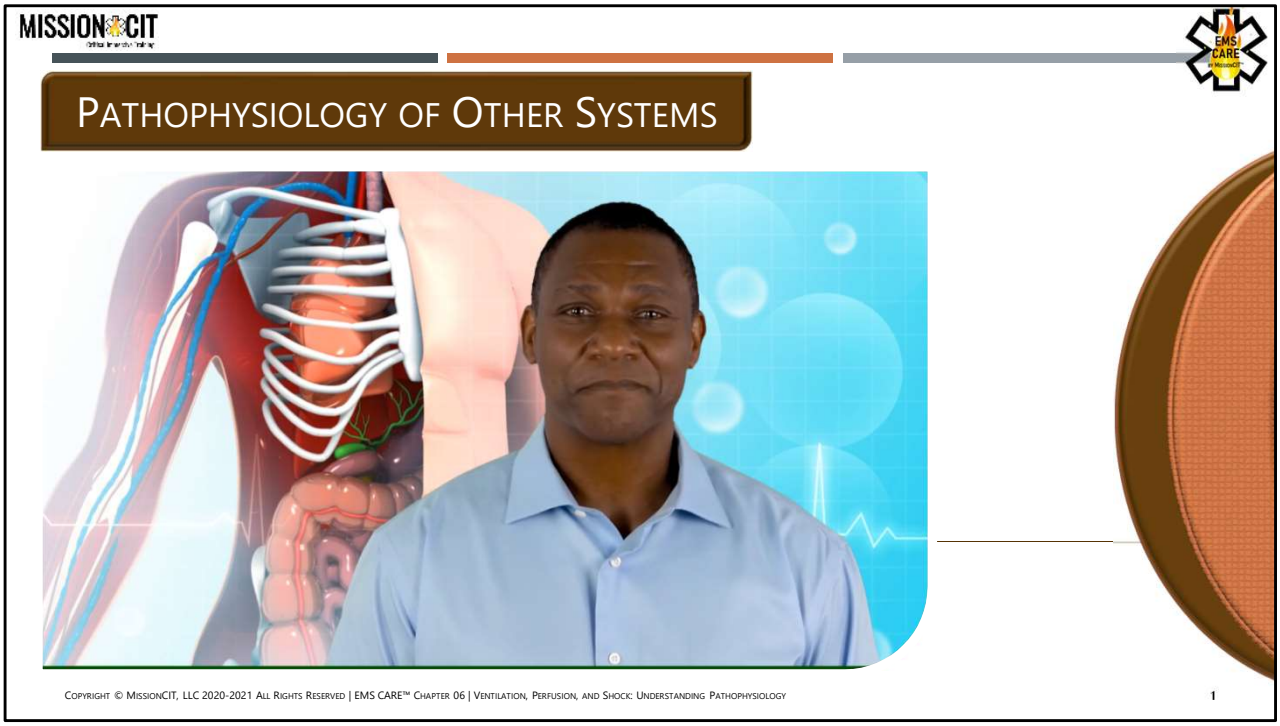
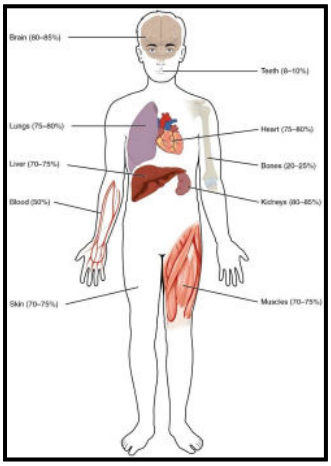


In this lesson, we will discuss the Pathophysiology of Other Systems. We will link dysfunction of the nervous, endocrine, digestive, and immune systems to our previous discussions of normal function.

Fluid Balance

- Body is mostly water
  - ✓ 75% body mass in infants
  - ✓ 50-60% in adult men and women
  - ✓ As low as 45 % in old age
- Percentage of body water changes with development
- Brain and kidneys have highest proportions of water
- Teeth have the lowest proportion of water



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Human beings are mostly water, ranging from about 75 percent of body mass in infants to about 50–60 percent in adult men and women, to as low as 45 percent in old age. The percent of body water changes with development, because the proportions of the body given over to each organ and muscles, fat, bone, and other tissues change from infancy to adulthood. Your brain and kidneys have the highest water proportions, which compose 80–85 percent of their masses. In contrast, teeth have the lowest proportion of water, at 8–10 percent.

The NIH advises that Fluid balance is critical in health and disease. Attention to management is required in a variety of instances. These include stress that healthy individuals may experience at certain times, such as during intense exercise. It may also affect people with cognition disorders or chronic diseases. Additionally, very young and very old may be susceptible and those with obesity and high blood pressure. Distinguishing typical from the abnormal fluid balance on a call may be challenging.

The diagnosis of fluid balance abnormalities often requires the informed and reasoned interpretation of clinical and laboratory information.

Fluid Balance (Cont.)

- Three major fluid compartments:
  - ✓ Intracellular
  - ✓ Interstitial
  - ✓ Plasma
- Fluid, molecules, and ions flow across physical barriers between the fluid compartments

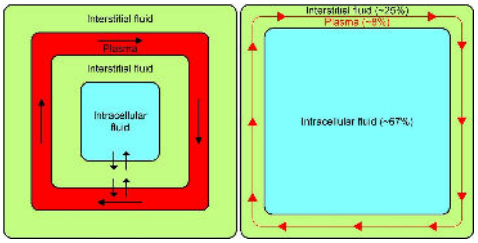
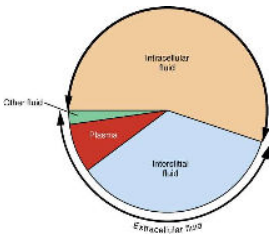


Figure 1



A Pie Graph Showing the Proportion of Total Body Fluid in Each of the Body's Fluid Compartments

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Body fluids can be discussed in terms of their specific fluid compartment, a location that is largely separate from another compartment by some form of a physical barrier. In the human body plan, three major fluid compartments are functionally interconnected. These are (1) intracellular fluid compartment, (2) interstitial fluid, and (3) plasma.

Fluid, molecules, and ions flow across physical barriers between the fluid compartments. The physical barrier separating the intracellular fluid compartment (that is, cytoplasm) and the interstitial fluid is the cell plasma membrane. The capillary endothelium is the physical barrier that separates the interstitial fluid from plasma. Nutrient molecules traveling in the blood must first cross the capillary endothelium to enter the interstitial fluid. They then must cross the plasma membrane to enter the cytoplasmic compartment of cells. Waste products produced by cells follow the reverse path from the cytoplasmic compartment to plasma.

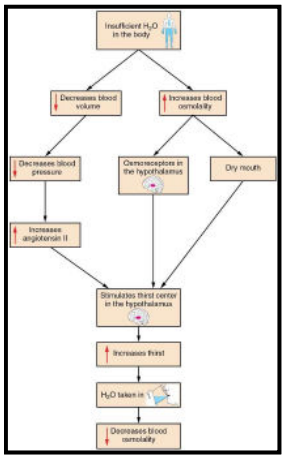
In Figure 1, the left diagram allows for a better demonstration of the relationship between the intracellular fluid, interstitial fluid, and plasma, however, the relative size of each of the compartments is not drawn to scale. The right diagram shows the three major fluid compartments drawn to scale. The intracellular fluid compartment

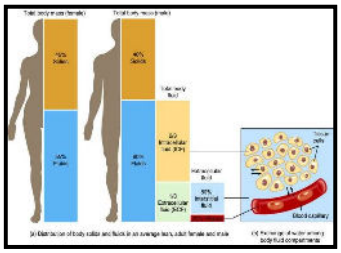
contains most of the water in the body (67% of total). The interstitial fluid contains 25% of the total body water. Plasma is the smallest fluid compartment (8% of total body water). Note that this diagram places focus only on these three major fluid compartments.

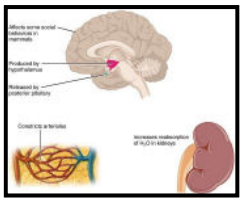
Additionally, here is a pie graph showing the proportion of total body fluid in each of the body's fluid compartments.

Thirst Response

- Osmoreceptors monitor the concentration of solutes (osmolality) of the blood
- Hypothalamus transmits signals that result in awareness of thirst
- ADH signals kidneys to recover water from urine
- Cell membrane and capillary permeability regulate flow in and out







Antidiuretic Hormone (ADH)

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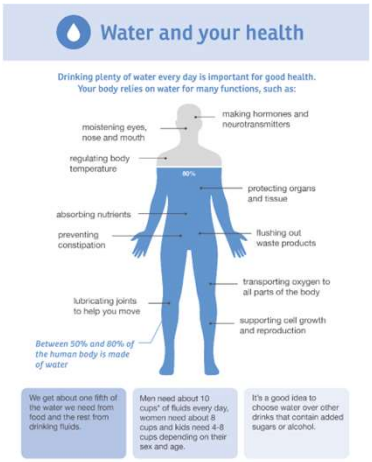
Thirst is a crucial component of blood volume regulation, which is slowly regulated by homeostasis.

Osmoreceptors are sensory receptors in the thirst center in the hypothalamus that monitor the concentration of solutes of the blood. If blood osmolality increases above its ideal value, the hypothalamus transmits signals that result in a conscious awareness of thirst. The hypothalamus of a dehydrated person also releases antidiuretic hormone (ADH) through the posterior pituitary gland. ADH signals the kidneys to recover water from urine, effectively diluting the blood plasma. To conserve water, the hypothalamus of a dehydrated person also sends signals via the sympathetic nervous system to the salivary glands in the mouth. The signals result in a decrease in watery, serous output (and an increase in stickier, thicker mucus output). These changes in secretions result in a “dry mouth” and the sensation of thirst. Here is a Flowchart Showing the Thirst Response.

First, the brain and kidneys regulate the thirst and elimination of excess fluid. Then, Blood plasma proteins pull fluid into the bloodstream. Also, Cell membrane and capillary permeability regulate flow in and out. Note that the fluid makeup in males and females differ slightly from each other.

Disruptions of Fluid Balance

- Fluid loss (dehydration)
- Decrease in total water volume
- Poor fluid distribution
- Water not getting to where it needs to go
- Edema
- Too much water in some parts of the body

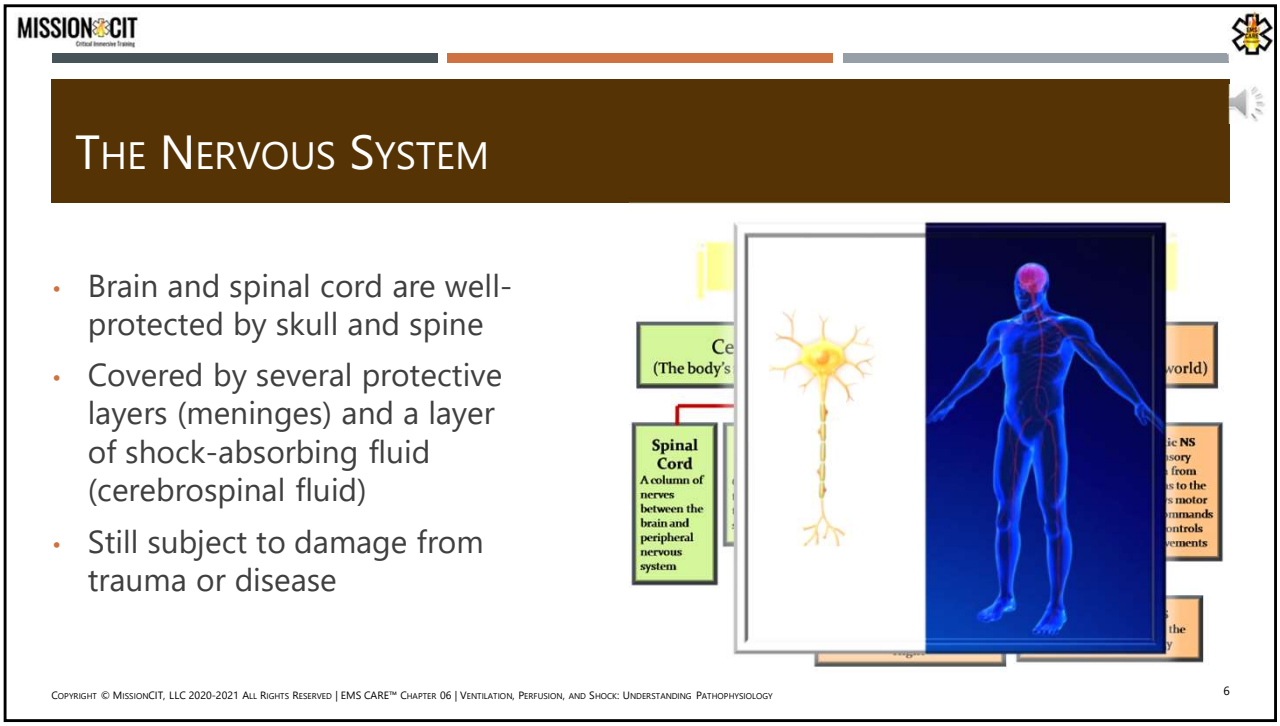


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Fluid balance in the body may be disrupted in several ways. Here are 6 disruptors – and there are more.

1. Fluid loss or dehydration.
2. Decrease in total water volume.
3. Poor fluid distribution.
4. When water is not getting to where it needs to go.
5. Edema.
6. When there is too much water in some parts of the body.

Also, take some time to examine the chart showing what water does for the body.



The nervous system transmits signals between the brain and the rest of the body, including internal organs. In this way, the nervous system's activity controls the ability to move, breathe, see, think, and more. The basic unit of the nervous system is a nerve cell or neuron. The nervous system also includes non-neuron cells, called glia. Glia perform many important functions that keep the nervous system working properly. The nervous system plays a role in nearly every aspect of our health and well-being. It guides everyday activities such as waking up; automatic activities such as breathing; and complex processes such as thinking, reading, remembering, and feeling emotions. The nervous system is one of the body's most protected structures. Yet still subject to damage from trauma or disease.

The nervous system has two main parts:

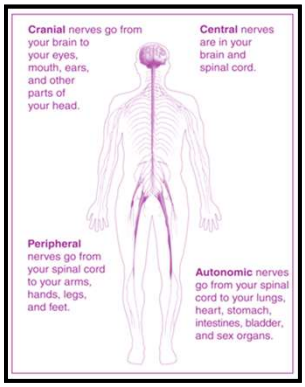
- The central nervous system is made up of the brain and spinal cord. It is referred to as "central" because it combines information from the entire body and coordinates activity across the whole organism.
- The peripheral nervous system is made up of nerves that branch off from the spinal cord and extend to all parts of the body.

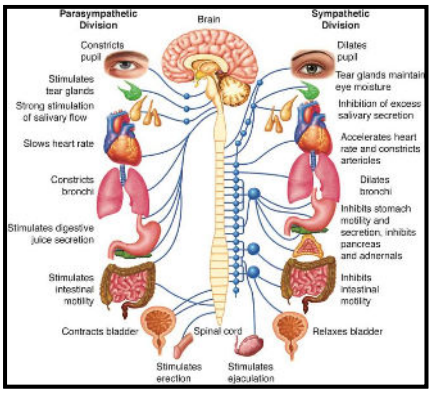
The brain is protected first by the skull and then by several protective layers referred to as meninges. There is also a layer of shock-absorbing fluid called cerebrospinal

fluid for protection.
And the spinal cord is of course protected by the spine. Nervous system injuries can be devastating and life-threatening. They can affect the airway, breathing, and circulation.

Nervous System Dysfunction

- Trauma
- Motor-vehicle crashes
- Falls
- Diving accidents



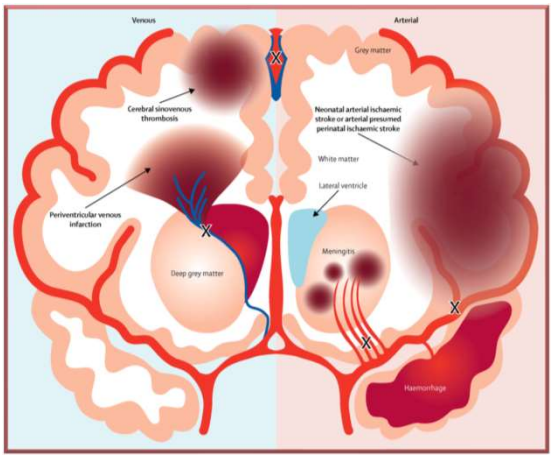


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The brain and spinal cord make up the Central Nervous System. The brain coordinates higher-level functions, and the spinal cord serving mainly as the communication pathway between the brain and the periphery. Nervous System Dysfunction may arise as a result of trauma, motor-vehicle crashes, falls, or other accidents. Traumatic brain injury and traumatic spinal cord injury result when an external physical insult causes damage, this can range from mild to severe.

Nervous System Dysfunction (Cont.)

- Medical dysfunction
  - ✓ Strokes
  - ✓ Infection (meningitis, encephalitis)
  - ✓ Disease (Lou Gehrig disease, ALS)
  - ✓ Low blood sugar (hypoglycemia)



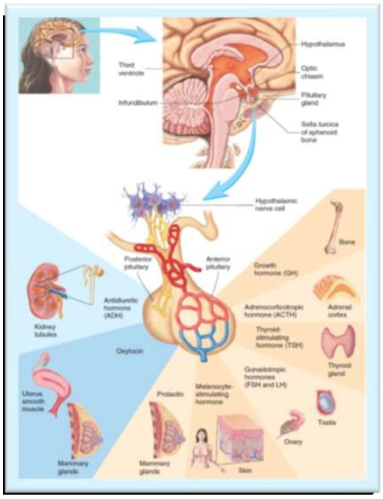
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Nervous System Dysfunction may result from medical dysfunction as well. We illustrate four common conditions: First, Strokes. Number two is infections such as meningitis, and encephalitis. Next are several diseases such as ALS or Lou Gehrig's Disease. Finally, low blood sugar or hypoglycemia may also affect brain function.

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THE ENDOCRINE SYSTEM

- Glands secrete hormones
- Hormones send chemical messages to the body to control body functions
- The Glands are
  - ✓ Hypothalamus
  - ✓ Pituitary
  - ✓ Pineal
  - ✓ Parathyroid
  - ✓ Thymus
  - ✓ Adrenal
  - ✓ Pancreas



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The endocrine system is a network of glands in your body that make the hormones that help cells talk to each other. They're responsible for almost every cell, organ, and function in your body.
The endocrine system is made up of a complex network of glands, which are organs that secrete substances.

The glands of the endocrine system are where hormones are produced, stored, and released. Each gland produces one or more hormones, which go on to target specific organs and tissues in the body.

The glands of the endocrine system include:

- Hypothalamus. While some people don't consider it a gland, the hypothalamus produces multiple hormones that control the pituitary gland. It's also involved in regulating many functions, including sleep-wake cycles, body temperature, and appetite. It

can also regulate the function of other endocrine glands.

- Pituitary. The pituitary gland is located below the hypothalamus. The hormones it produces affect growth and reproduction. They can also control the function of other endocrine glands.
- Pineal. This gland is found in the middle of your brain. It's important for your sleep-wake cycles.
- Thyroid. The thyroid gland is located in the front part of your neck. It's very important for metabolism.
- Parathyroid. Also located in the front of your neck, the parathyroid gland is important for maintaining control of calcium levels in your bones and blood.
- Thymus. Located in the upper torso, the thymus is active until puberty and produces hormones important for the development of a type of white blood cell called a T cell.
- Adrenal. One adrenal gland can be found on top of each kidney. These glands produce hormones important for regulating functions such as blood pressure, heart rate, and stress response.
- Pancreas. The pancreas is located in your abdomen behind your stomach. Its endocrine function involves controlling blood sugar levels.

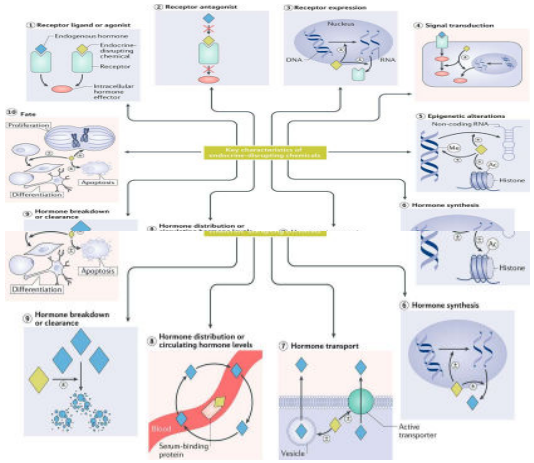
Some endocrine glands also have non-endocrine functions. For example, the ovaries and testes produce hormones, but they also have the non-endocrine

function of producing eggs and sperm, respectively.

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Endocrine System Dysfunction

- Organ or gland problems
- Present at birth or result of illness
- Too many hormones
  - ✓ Graves' disease (too much thyroid hormone)
  - ✓ Problems with heart rate and temperature regulation
- Not enough hormones
  - ✓ Diabetes



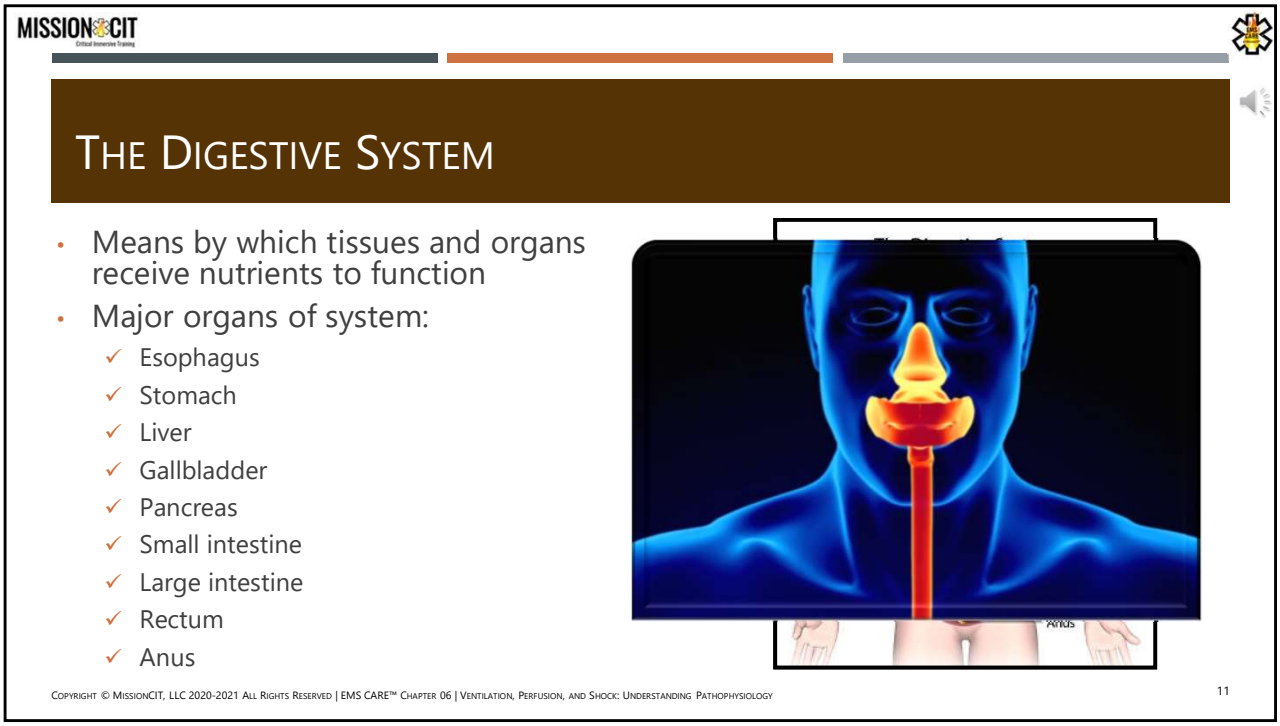
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Endocrine System Dysfunction occurs when hormone levels are too high or too low. Common causes of Endocrine System Dysfunction include:

First, Organ or gland problems. These may be present at birth or a result of illness.

Next, there may be too many hormones. Examples are Graves disease which is due to too much thyroid hormone. Other conditions may include problems with heart rate and temperature regulation.

Last on this list is when there are not enough hormones. Diabetes is the poster child example here.



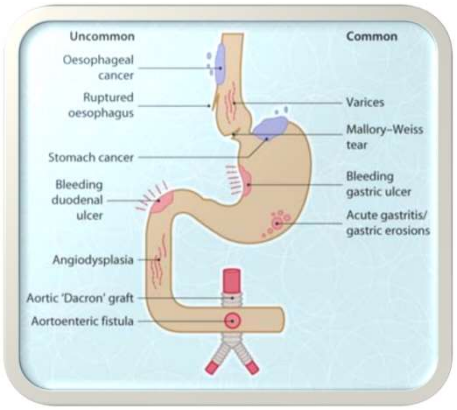
The digestive system is the means by which tissues and organs receive nutrients to function. The system breaks down food, extracts nutrients from it, and converts them into energy.

The digestive system is made up of the gastrointestynal tract—also called the GI tract or digestive tract—and the liver, pancreas, and gallbladder. The GI tract is a series of hollow organs joined in a long, twisting tube from the mouth to the anus. The hollow organs that make up the GI tract are the mouth, esophagus, stomach, small intestyne, large intestyne, and anus. The liver, pancreas, and gallbladder are the solid organs of the digestive

system.
The small intestyne 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 intestyne 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 intestyne. The colon is next. The rectum is the end of the large intestyne.

Digestive Dysfunction

- Impacts hydration levels and nutrient transfer
- Gastrointestinal bleeding
  - ✓ Can be slow
  - ✓ Chronic bleeding
- Can be massive, with rectal bleeding and/or vomiting blood

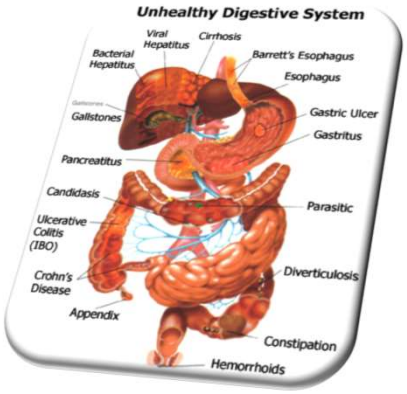


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Some digestive diseases and conditions are acute, lasting only a short time, while others are chronic, or long-lasting. Digestive Dysfunction impacts hydration levels and nutrient transfer. It may result from Gastrointestinal bleeding. Gastrointestinal bleeding may be slow resulting from chronic bleeding. Or can be massive, with rectal bleeding and/or vomiting blood.

Digestive Dysfunction (Cont.)

- Common disorders:
  - ✓ Bleeding, bloating, constipation, diarrhea, heartburn, pain, nausea and vomiting
- Variety of causes
- May result in malnutrition and dehydration



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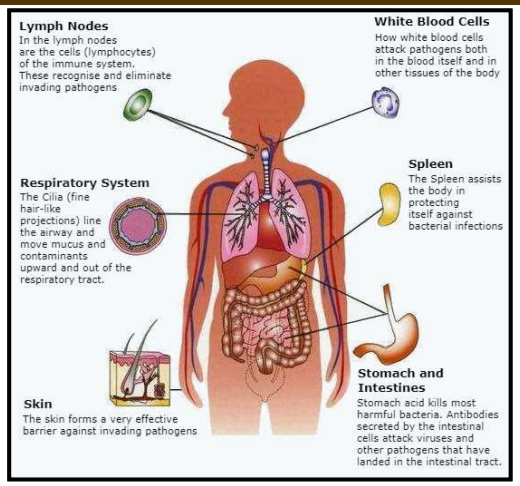
Digestive disorders affect millions of Americans each year. These conditions involve the digestive tract, which is also known as the gastrointestinal (GI) tract. The GI tract includes the esophagus, liver, stomach, small and large intestines, gallbladder, and pancreas. Digestive disorders encompass a variety of diseases ranging from mild to severe. Common digestive disorders include gastroesophageal reflux disease, cancer, irritable bowel syndrome, lactose intolerance, and hiatal hernia.

The most common symptoms of digestive disorders include bleeding, bloating, constipation, diarrhea, heartburn, pain, nausea, and vomiting. These are the most common disorders arising from a variety of causes. Together, they may result in malnutrition and dehydration.

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The Immune System

- Immune system prevents or limits infection
- Parts of the immune system:
  - ✓ Bone marrow
  - ✓ Thymus
  - ✓ Lymph nodes
  - ✓ Spleen
  - ✓ Tonsils
  - ✓ Mucous membranes



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Our immune system is essential for our survival. Without an immune system, our bodies would be open to attack from bacteria, viruses, parasites, and more. It is our immune system that keeps us healthy as we drift through a sea of pathogens. The overall function of the immune system is to prevent or limit infection.

The immune system can distinguish between normal, healthy cells and unhealthy cells by recognizing a variety of "danger" cues called danger-associated molecular patterns. Cells may be unhealthy because of infection, or because of cellular damage caused by non-infectious agents like sunburn or cancer. Infectious microbes such as viruses and bacteria release another set of signals, recognized by the immune system called pathogen-associated molecular patterns.

All immune cells come from precursors in the bone marrow and develop into mature cells through a series of changes that can occur in different parts of the body shown in the diagram on the right.

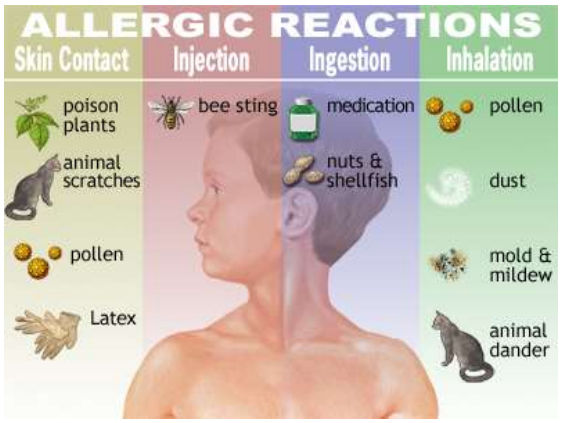
The parts of the immune system are:

- Bone marrow

- Thymus
- Lymph nodes
- Spleen
- Tonsils, and
- Mucous membranes

Hypersensitivity (Allergic Reaction)

- Allergic reaction to certain food, drugs, other substances
- Result of exaggerated immune response
- Chemicals affect more than just invader



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Hypersensitivity reactions occur when the normally protective immune system responds abnormally, potentially harming the body. While often manifested as an allergic reaction to a certain food, drugs, or other substances. The complications arise when the immune system does not function properly. Some issues are less pervasive, such as pollen allergy. While others are extensive, such as genetic disorders that wipe out the presence or function of an entire set of immune cells.

Hypersensitivity (Allergic Reaction) (Cont.)

- Produces edema
- Results in a rapid drop in blood pressure
- Common triggers:
  - ✓ Food triggers
  - ✓ Reactions from stinging and biting insects
  - ✓ Latex
  - ✓ Medication





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Allergic reactions may be severe and life-threatening. Examples include when hypersensitivity produces edema or results in a rapid drop in blood pressure.

There are a plethora of triggers that may cause severe allergic reactions. Food triggers can include Peanuts, Eggs, Milk, Tree Nuts, Wheat, Soy, Sesame Seed, Seafood including fish, crustaceans and shellfish, Sulfites, and Mustard. You may encounter reactions from stinging and biting insects. Latex is a frequent cause too. Latex may be found in Gloves, Condoms, diaphragms, dental dams, and adhesive bandages, Spandex, and Party balloons. Other causes may be medication. And even exercise may precipitate a severe reaction known as exercise-induced anaphylaxis, a form of physical allergy.

This brings us to the end of this lesson, and Missah will take you through the chapter review next.