Human Body Systems

Transport and Defense

**Before You Read**

**What do you think?** Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. A human body has organ systems that carry out specific functions.</td>
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<tr>
<td></td>
<td>2. The body protects itself from disease.</td>
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**Read to Learn**

The Body’s Organization

Libraries have thousands of books grouped together by subject. Grouping books by subject helps keep them organized and easier to find. Your body’s organization helps it function.

All organisms have different parts with special functions. Cells are the basic unit of all living organisms. Organized groups of cells that work together are tissues. Groups of tissues that perform a specific function are organs. Groups of organs that work together and perform a specific task are **organ systems**. Organ systems provide movement, transport (carry) substances, and perform many other functions.

Organ systems work together and maintain **homeostasis** (hoh mee oh STAY sus), or steady internal conditions when external conditions change. When you exercise, your body uses stored energy. Your body releases excess energy as thermal energy. Sweat, also called perspiration (pur spuh RAY shun), helps the body release thermal energy and maintain homeostasis.

**Digestion and Excretion**

Humans need food, water, and oxygen to survive. Food contains energy that is processed by the body. The process by which food is broken down is called digestion. After digestion, substances the body does not use are removed through excretion (ihk SKREE shun).

**Key Concepts**

- How does food enter and leave the body?
- How do nutrients travel through the body?
- How does the body defend itself from harmful invaders?

**Building Vocabulary**

Work with another student to write a question about each vocabulary term in this lesson. Answer the questions and compare your answers. Reread the text to clarify the meaning of the terms.

**Reading Check**

1. Define What is digestion?

   ________________
The Digestive System

The digestive system is made up of several organs. The organs are shown in the figure below. Food and water enter the digestive system through the mouth.

Visual Check

2. Name the organs in the digestive system.

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Reading Check

3. Identify where food enters the body.

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Digestion After food enters the mouth, chewing breaks food into smaller parts. Saliva also helps the mouth break down food. Saliva contains enzymes, which are proteins that speed up chemical reactions.

When you swallow, food, water, and other liquids move into a hollow tube called the esophagus (ih SAH fuh gus). The esophagus connects the mouth to the stomach. Digestion continues as food moves into the stomach.

The stomach is a flexible, baglike organ. It contains other enzymes that break down food into smaller parts. After the food is broken down by enzymes, it can be used by the body.
Absorption After food leaves the stomach, it moves into the small intestine. By the time food gets to the small intestine, it is a soupy mixture.

The small intestine is a tube that has two functions—digestion and absorption. The liver makes a substance called bile. The pancreas makes enzymes. Bile and enzymes are used in the small intestine to break down food even more. Because the small intestine is very long, it takes hours for food to move through it. During that time, particles of food and water are absorbed into the blood.

Excretion The large intestine, or colon (KOH lun), receives digested food that the small intestine did not absorb. The large intestine also absorbs water from the remaining waste material.

Most foods are completely digested into smaller parts. These small parts can be absorbed easily by the small intestine. However, some foods travel through the entire digestive system without being digested or absorbed. For example, some types of fiber, called insoluble fiber, in vegetables and whole grains are not digested and leave the body through the rectum.

Nutrition

As you have read, one of the functions of the small intestine is absorption. Nutrients are the parts of food used by the body to grow and survive. There are several types of nutrients. Proteins, fats, carbohydrates, vitamins, and minerals are nutrients. Nutrition labels on food packages show the amount of each nutrient in that food. Studying food labels can help you make sure you get all the nutrients you need.

Different people need different amounts of nutrients. For example, football players, swimmers, and other athletes need a lot of nutrients for energy. Pregnant women also need lots of nutrients to provide for their developing babies.

Digestion helps release energy from food. A Calorie is the amount of energy it takes to raise the temperature of 1 kg of water by 1°C. The body uses Calories from proteins, fats, and carbohydrates. Each of these nutrients contains a different amount of energy.

The Excretory System

The excretory system removes solid, liquid, and gas waste materials from the body. The lungs, skin, liver, kidneys, bladder, and rectum are parts of the excretory system.

Math Skills

A proportion is an equation of two equal ratios. You can solve a proportion for an unknown value. For example, a 50-g egg provides 70 Calories (C) of energy. How many Calories would you get from 125 g of scrambled eggs?

Write a proportion.

\[
\frac{50 \text{ g}}{70 \text{ C}} = \frac{125 \text{ g}}{x}
\]

Find the cross products.

\[
50 \text{ g} \cdot x = 70 \text{ C} \cdot 125 \text{ g}
\]

Divide both sides by 50.

\[
\frac{50 \text{ g} \cdot x}{50 \text{ g}} = \frac{70 \text{ C} \cdot 125 \text{ g}}{50 \text{ g}}
\]

Simplify the equation.

\[x = 175 \text{ C}\]

4. Use Proportions

The serving size of a large fast-food hamburger with cheese is 316 g. It contains 790 C of energy. How many Calories would you consume if you ate 100 g of the burger?

Reading Check

5. Identify Name five types of nutrients.

☐ The Excretory System

☐ Reading Essentials Human Body Systems
**The Lungs**  When you breathe out, or exhale, the lungs remove carbon dioxide (CO₂) and excess water as water vapor. The skin removes water and salt when you sweat.

**The Liver**  The organ that removes wastes from the blood is the liver. As you have read, the liver is also a part of the digestive system. The digestive and excretory systems work together to break down, absorb, and remove food.

**The Kidneys and Bladder**  When the liver breaks down proteins, urea forms. Urea is deadly if it stays in the body. See the figure to the right. The kidneys remove urea by making urine. Urine contains water, urea, and other waste. Urine leaves each kidney through a tube called the ureter (YOO ruh tur) and is stored in a flexible sac called the bladder. Urine is removed from the body through a tube called the urethra (yoo REE thruh).

**The Rectum**  Like the liver, the rectum is part of the excretory system and the digestive system. Food substances that are not absorbed by the small intestine are mixed with other wastes and form feces. The rectum stores feces until it moves out of the body.

**Respiration and Circulation**

You have read about how the body converts food into nutrients and absorbs them. But how do the oxygen you breathe in and the nutrients you absorb get to the rest of your body? And how do waste products leave the body?

**The Respiratory System**

The respiratory system exchanges gases between the body and the environment. As air flows through the respiratory system, it passes through the nose and mouth, pharynx (FER ingks), trachea (TRAY kee uh), bronchi (BRAHN ki; singular, bronchus), and lungs. The parts of the respiratory system work together to supply the body with oxygen. They also rid the body of wastes, such as carbon dioxide. The respiratory system is shown on the next page.

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**Key Concept Check**

7. **Explain**  How does food enter and leave the body?

8. **State**  Which organ system supplies the body with oxygen?

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**Visual Check**

6. **Identify**  Circle the tubes through which urine leaves the kidneys.

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**Reading Check**

7. **Explain**  Circle the tubes through which urine leaves the kidneys.

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**Visual Check**

6. **Identify**  Circle the tubes through which urine leaves the kidneys.

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**Pharynx and Trachea** Oxygen enters the body when you inhale, or breathe in. Carbon dioxide leaves the body when you exhale. When you inhale, air enters the nostrils and passes through the pharynx. Because the pharynx is part of the throat, it is a part of the digestive and respiratory systems. Food goes through the pharynx to the esophagus. Air travels through the pharynx to the trachea. The trachea is also called the windpipe because it is a long, tubelike organ that connects the pharynx to the bronchi.

**Bronchi and Alveoli** The trachea branches into two bronchi. One enters the left lung, and one enters the right lung. The bronchi divide into smaller tubes that end in tiny groups of cells that look like bunches of grapes. These groups of cells are called alveoli (al VEE uh li).

More than 100 million alveoli are inside each lung. They are surrounded by blood vessels called capillaries. Oxygen in the alveoli enters the capillaries. The blood inside capillaries transports oxygen to the rest of the body. Carbon dioxide enters the alveoli from the capillaries.

Inhaling and exhaling require the movement of a thin muscle under your lungs called the diaphragm (DI uh fram). The diaphragm contracts when you inhale and air enters your lungs. The diaphragm relaxes when you exhale.

**Visual Check**
9. Illustrate Trace the path of airflow through the respiratory system.

**Reading Check**
10. Name Which organ is part of the digestive system and the respiratory system?

**Reading Check**
11. Recognize What are alveoli, and what do they do?
The Circulatory System

The heart, blood, and blood vessels make up the circulatory system. The circulatory system transports nutrients, gases, wastes, and other substances through your body. Blood vessels transport blood to all organs in your body. Your body uses oxygen and nutrients continually. So your circulatory system transports blood between your heart, lungs, and other organs more than 1,000 times each day!

Heart and Vessels Your heart, shown in the figure below, is made up of muscle cells that constantly contract and relax. Contractions pump blood in your heart out of the heart to the rest of your body. When your heart muscles relax, blood from the rest of your body enters your heart.

Blood travels through your body in tiny tubes called vessels. If all the blood vessels in your body were laid end-to-end in a single line, it would be more than 95,000 km long.

The three main types of blood vessels are arteries, veins, and capillaries. Arteries carry blood away from your heart. This blood is usually full of oxygen and contains nutrients. Blood in the pulmonary arteries contains CO₂. Arteries are large. They are surrounded by muscle cells that help blood move through the vessels faster. Veins transport blood that contains CO₂ back to your heart, except for the blood in the pulmonary veins, which is full of oxygen. Capillaries are tiny vessels that enable oxygen, CO₂, and nutrients to move between your circulatory system and your entire body.

Capillaries surround the alveoli in your lungs. Capillaries also surround your small intestine, where they absorb nutrients and transport them to the rest of your body.

Blood The blood that circulates through vessels has several parts. The liquid part of blood is called plasma. Plasma contains nutrients, water, and CO₂. Blood also contains red blood cells, platelets, and white blood cells. Red blood cells carry oxygen. Platelets help your body heal when you get a cut. White blood cells help your body defend itself from toxins and diseases.
Everyone has red blood cells. However, different people have different proteins on the surfaces of their red blood cells. Scientists classify these different red-blood-cell proteins into groups called blood types. These different human blood types are shown in the table above.

People with A proteins on their red blood cells have type A blood. People with B proteins on their red blood cells have type B blood. Some people have both A and B proteins on their red blood cells. They have type AB blood. People with type O blood have neither A nor B proteins on the surfaces of their red blood cells.

Medical professionals use blood types to determine which type of blood a person can receive from a blood donor. For example, people with type O blood can receive blood only from a donor who also has type O blood. This is because people with type O blood have no proteins on the surfaces of their red blood cells.

The Lymphatic System

Have you ever had a cold and found it painful to swallow? This can happen when your tonsils swell. Tonsils are small organs on both sides of your throat. They are part of the lymphatic (lihm FA tihk) system.

Parts of the Lymphatic System The spleen, the thymus, bone marrow, and lymph nodes also are parts of the lymphatic system. The spleen stores blood for use in an emergency. The thymus, the spleen, and bone marrow make white blood cells.
Functions of the Lymphatic System

Your lymphatic system has three main functions: removing excess fluid around organs, producing white blood cells, and absorbing and transporting fats. The lymphatic system helps your body maintain fluid homeostasis. About 65 percent of the human body is water. Most of this water is inside cells.

Sometimes, when water, wastes, and nutrients move between capillaries and organs, not all of the fluid is taken up by the organs. When fluid builds up around organs, swelling can occur. The lymphatic system removes the fluid and keeps swelling from occurring.

Lymph vessels are all over your body. Fluid that travels through the lymph vessels flows into organs called lymph nodes. Humans have more than 500 lymph nodes. The lymph nodes work together and protect the body by removing toxins, wastes, and other harmful substances.

The lymphatic system makes white blood cells. White blood cells help the body defend against infection. There are many different types of white blood cells. A lymphocyte (LIHM fuh site) is a type of white blood cell that is made in the thymus, the spleen, or the bone marrow. Lymphocytes protect the body by traveling through the circulatory system, defending against infection.

Immunity

The lymphatic system protects your body from harmful substances and infection. The resistance to specific pathogens or disease-causing agents, is called immunity. The skeletal system produces immune cells. The circulatory system transports immune cells throughout the body.

Immune cells include lymphocytes and other white blood cells. These cells detect viruses, bacteria, and other foreign substances that are not normally made in the body. The immune cells attack and destroy them.

If the body is exposed to the same bacteria, virus, or substance later, some immune cells remember and make proteins called antibodies. These antibodies recognize specific proteins on the harmful agent and help the body fight infection faster. There are many different types of bacteria and viruses, so humans make billions of different types of antibodies. Each type responds to a different harmful agent.

Reading Check

17. Identify a function of the lymphatic system.

18. Explain why your spleen is important.

ACADEMIC VOCABULARY

detect (verb) to discover the presence of
**Types of Diseases**

There are two main groups of diseases—infectious and noninfectious. Infectious diseases are caused by pathogens, such as bacteria and viruses. Infectious diseases are usually contagious. This means that they can be spread from one person to another. The flu is an example of an infectious disease. Viruses that invade organ systems of the body, such as the respiratory system, cause infectious diseases.

A noninfectious disease is caused by the environment or a genetic disorder, not a pathogen. Skin cancer, diabetes, and allergies are noninfectious diseases. Noninfectious diseases are not contagious and cannot be spread from one person to another. The table below lists some examples of infectious and noninfectious diseases.

<table>
<thead>
<tr>
<th>Infectious Disease</th>
<th>Noninfectious Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disease</strong></td>
<td><strong>Pathogen</strong></td>
</tr>
<tr>
<td>colds</td>
<td>virus</td>
</tr>
<tr>
<td>AIDS</td>
<td>virus</td>
</tr>
<tr>
<td>strep throat</td>
<td>bacteria</td>
</tr>
<tr>
<td>chicken pox</td>
<td>virus</td>
</tr>
</tbody>
</table>

**Lines of Defense**

The human body has many ways of protecting itself from viruses, bacteria, and harmful substances. Skin and mucus (MYEW kus) are parts of the first line of defense. They prevent toxins and other substances from entering the body. Mucus is a thick, gel-like substance in the nostrils, trachea, and lungs. Mucus traps harmful substances and prevents them from entering your body.

The second line of defense is the immune response. In the immune response, white blood cells attack and destroy harmful substances.

The third line of defense protects your body against substances that have infected the body before. As you have read, immune cells make antibodies that destroy the harmful substances. Vaccines are used to help the body develop antibodies against infectious diseases. For example, many people get an influenza vaccine annually to protect them against the flu.

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**Interpreting Tables**

19. **Classify** Circle all the diseases in the table that are caused by viruses. Underline the diseases that are caused by bacteria.

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**Key Concept Check**

20. **Describe** How does the body defend itself from harmful invaders?
Mini Glossary

**Calorie:** the amount of energy it takes to raise the temperature of 1 kg of water by 1°C.

**homeostasis (hoh mee oh STAY sus):** steady internal conditions when external conditions change

**immunity:** the resistance to specific pathogens, or disease-causing agents

**lymphocyte (LIHM fuh site):** a type of white blood cell that is made in the thymus, the spleen, or the bone marrow

**nutrient:** the part of food used by the body to grow and survive

**organ system:** a group of organs that work together and perform a specific task

1. Review the terms and their definitions in the Mini Glossary. Write a sentence explaining how lymphocytes aid in immunity.

2. Use the graphic organizer to identify the organ that removes the type of waste material indicated.

<table>
<thead>
<tr>
<th>Name of Organ</th>
<th>Type of Waste Material Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>removes carbon dioxide and excess water vapor when you exhale</td>
</tr>
<tr>
<td></td>
<td>removes urea from the body</td>
</tr>
<tr>
<td></td>
<td>removes wastes from the blood</td>
</tr>
<tr>
<td></td>
<td>removes feces from the body</td>
</tr>
</tbody>
</table>

3. Explain what is unique about people with type AB blood.

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**What do you think **NOW**?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?