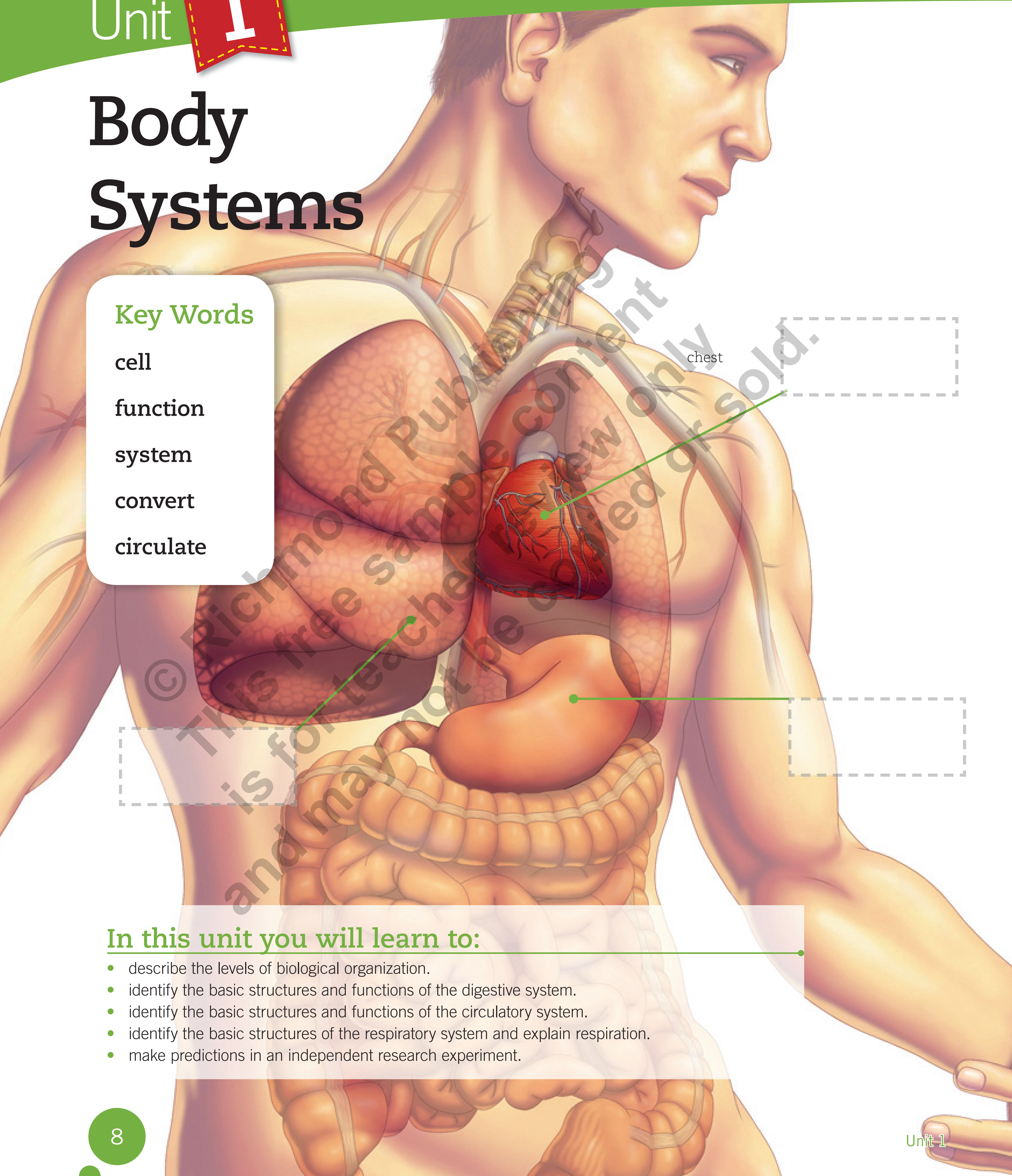
Unit 1

Body Systems



Key Words

cell

function

system

convert

circulate

In this unit you will learn to:

- describe the levels of biological organization.
- identify the basic structures and functions of the digestive system.
- identify the basic structures and functions of the circulatory system.
- identify the basic structures of the respiratory system and explain respiration.
- make predictions in an independent research experiment.

What Do You Know?

Initial Evaluation

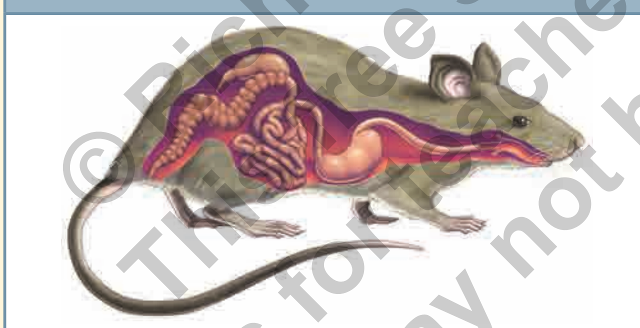
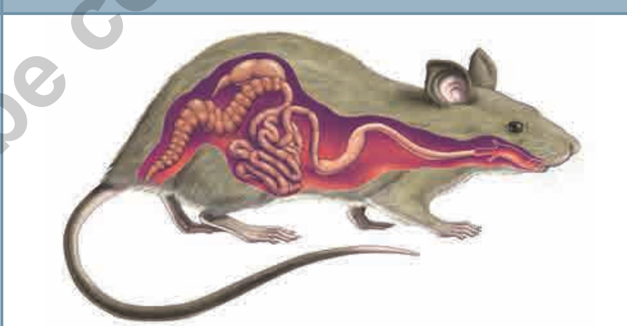
Go to **Cutout 1** on **page 165**. Glue the names of the organs in the correct boxes.

1. Mark the function of each organ listed with a ✔.

	Heart	Lungs	Stomach
Allow air to enter and exit the body			
Pumps blood to other parts of the body			
Helps digest food			

Scientific Skill: Predict

2. A scientist observes the following in a lab:

Situation 1	Situation 2
	
The mouse has a normal **digestive tract**.	The mouse has an irregular **digestive tract**.

a. Circle the **difference** between the digestive tracts of the mice.

b. What are the possible **side effects** of an irregular digestive tract? (Situation 2)

The Levels of Biological Organization

Connecting

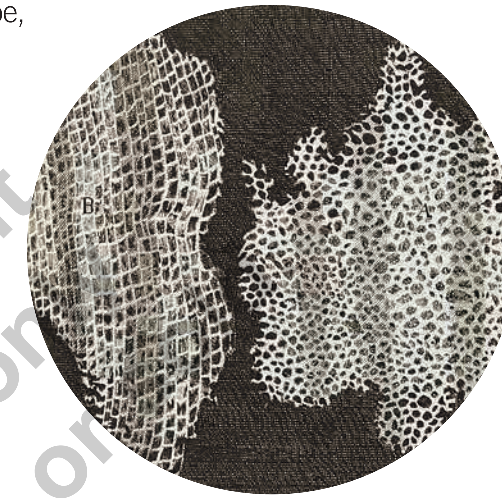
The Discovery of Cells

Think about the smallest object visible to the naked eye. Thanks to the microscope, we can now see objects that we could not see before. Robert Hooke, an English scientist, invented the **microscope** in the 17th century. He used his invention to look closely at thin slices of cork.

spongy bark of a tree

Based on his observations, Hooke drew the pieces of cork he saw. He showed they consisted of smaller parts that he named **cells**. After many years, it was proven that cells are present in all living things.

demonstrated



Drawing of Hooke's observations.

Classifying Living Things

Look at the images and identify similarities between the two organisms.

Do they have anything in common? It does not look like it, but they are actually very similar. Even if we cannot see it, organized cells form both organisms. Cells group together and create more complex parts. For example, cells form the bones and muscles of animals, and the leaves and stems of plants.

We can see that living things are created in a specific way: from small to big and from simple to complex. In other words, living things have levels of **organization** that go from the cell to the entire organism.

Did You Know...?

The levels of biological organization are studied by different areas:

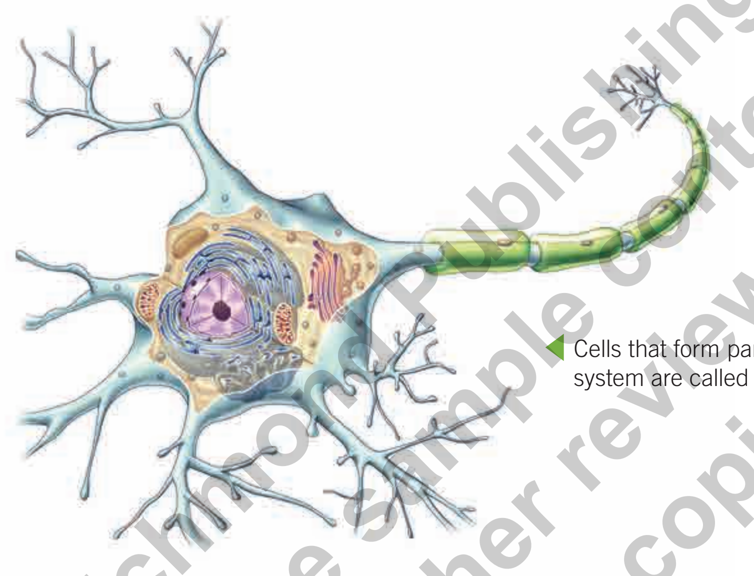
- **chemistry:** atoms to macromolecules.
- **biology:** cells to organisms.
- **ecology:** organisms and the environment.

The Cell

Every living thing on the planet is different, and there is a great variety of plants and animals. However, they all have one thing in common: they consist of cells. **The cell is the first and smallest level of biological organization**. Although it is a small structure, it is complex. The existence of life depends on the components of the cell working together. In the following image, you can see a cell from the nervous system.

Did You Know...?

It is estimated that a human has 75,000,000,000,000 (75 trillion) cells.



Cells that form part of the nervous system are called neurons.

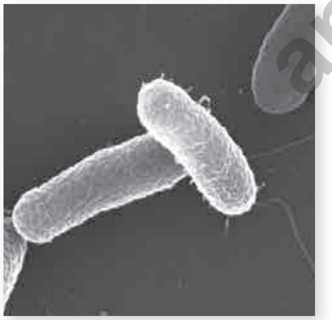
Single-celled Organisms

Living things come in different shapes and sizes and have a different number of cells. Some organisms consist of many cells (**multicellular**) and are easily visible. Others consist of one cell (**unicellular**). Without a microscope, most unicellular organisms are invisible. We call them microorganisms. In microorganisms, life processes like feeding, growth and reproduction all occur in one cell.

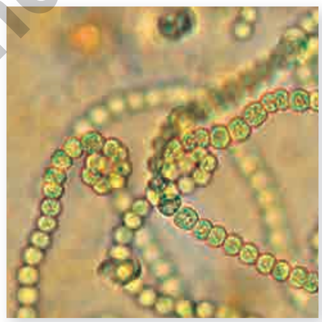
the act of eating food

Challenge

Microscope and microorganism both start with **micro**. What do you think **micro** means?



bacteria



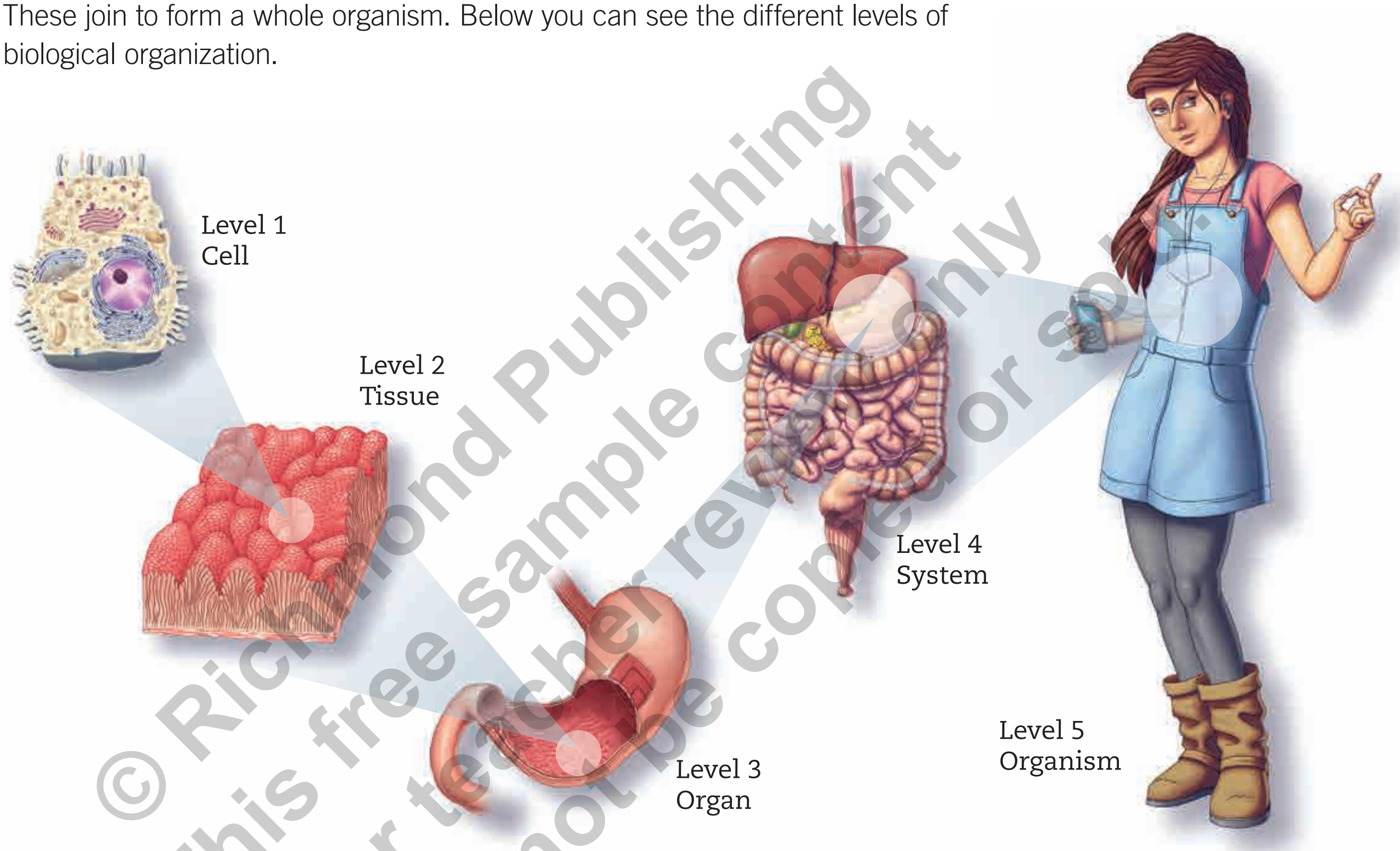
bacteria

protozoa

Here you can see some unicellular organisms. They are part of the first level of the biological system.

The Organization of Multicellular Organisms

The cell is the first level of biological organization. Unicellular organisms consist of just one cell and never grow more than that. Think about your body. How many cells do you think you have? **Multicellular** beings, like humans, have millions of cells that unite and organize to form tissues, organs and systems. These join to form a whole organism. Below you can see the different levels of biological organization.

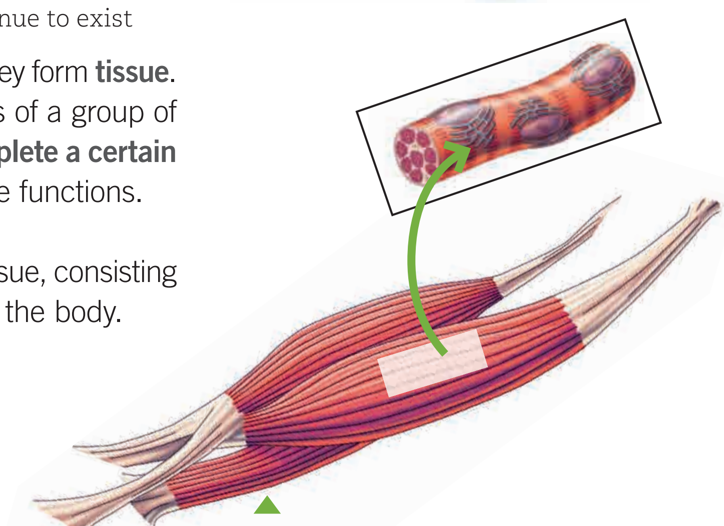


Tissue

continue to exist

Your body has millions of cells, but they cannot survive alone, so they form **tissue**. Tissue is the **second level of biological organization**. It consists of a group of cells that are similar in shape and size. They communicate to **complete a certain function**. Each type of cell forms different tissue and has unique functions.

In the image, you can see an example of human tissue. Muscle tissue, consisting of muscle cells, contracts and relaxes to move different parts of the body.



Tissue is an example of the second level of biological organization. What types of organisms have tissue?

Challenge

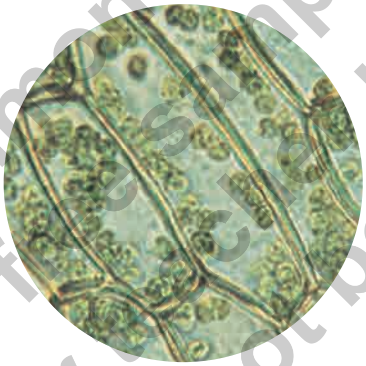
Human beings are organized from small, simple cells to complex systems. Is it possible to find organs in unicellular beings?

Practicing

1. Write a **U** in the boxes next to unicellular organisms and an **M** next to the multicellular ones. Identify




2. Jonathan looks at this sample in his laboratory and confirms that it is tissue.



a. Why does Jonathan classify this as tissue? Explain

Summarizing

In nature, some living things consist of one cell (unicellular organisms), and others consist of many cells (multicellular organisms).
Multicellular organisms possess millions of cells. Cells come together to form increasingly complex structures: tissues, organs, systems and finally organisms.
Tissue is the second level of biological organization and consists of groups of cells that have the same function. Examples are muscle tissue and nerve tissue.

Connecting

Organs

organs that clean the blood

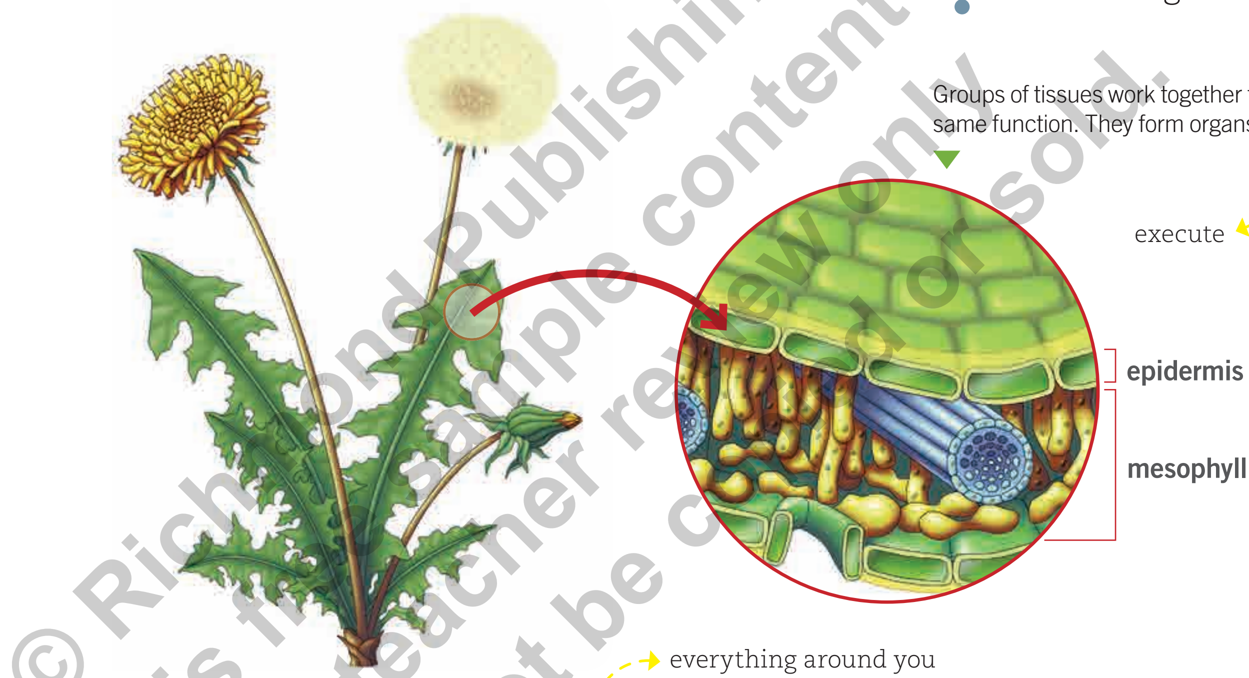
Have you ever heard of the lungs, kidneys or the heart? These are all examples of **organs: the third level of biological organization**. An organ consists of various groups of tissues working together to complete the same function. For example, in plants, leaves are the organs responsible for photosynthesis. Leaves consist of two types of tissues: the epidermis and the mesophyll.

Word Focus

Photosynthesis is the process by which plants produce food using carbon dioxide, water and sunlight.

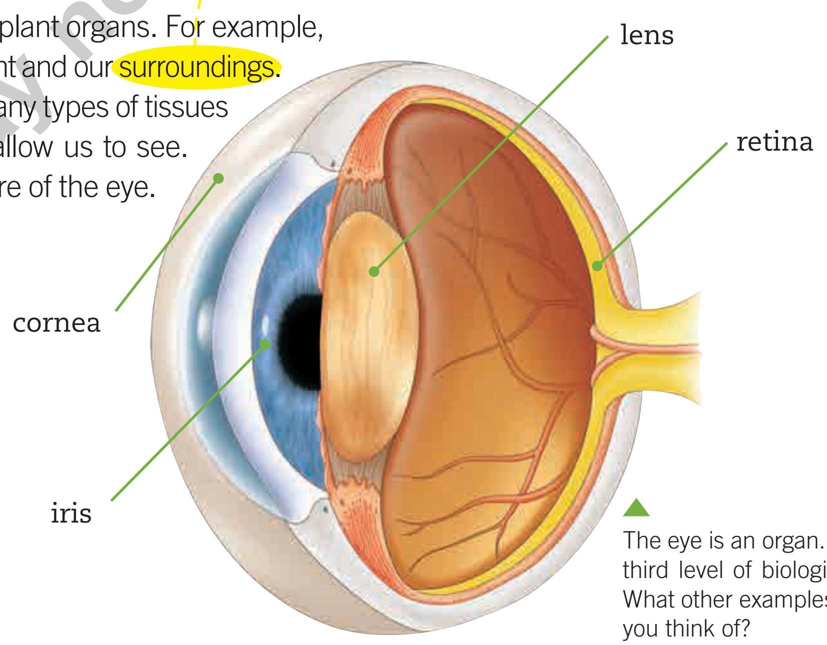
Groups of tissues work together to perform the same function. They form organs, like this leaf.

execute



everything around you

Animal organs are more complex than plant organs. For example, think of our eyes. They allow us to see light and our surroundings. To perform this function, the eye has many types of tissues and structures that work together to allow us to see. The following image shows the structure of the eye. Pay attention to the different tissues.

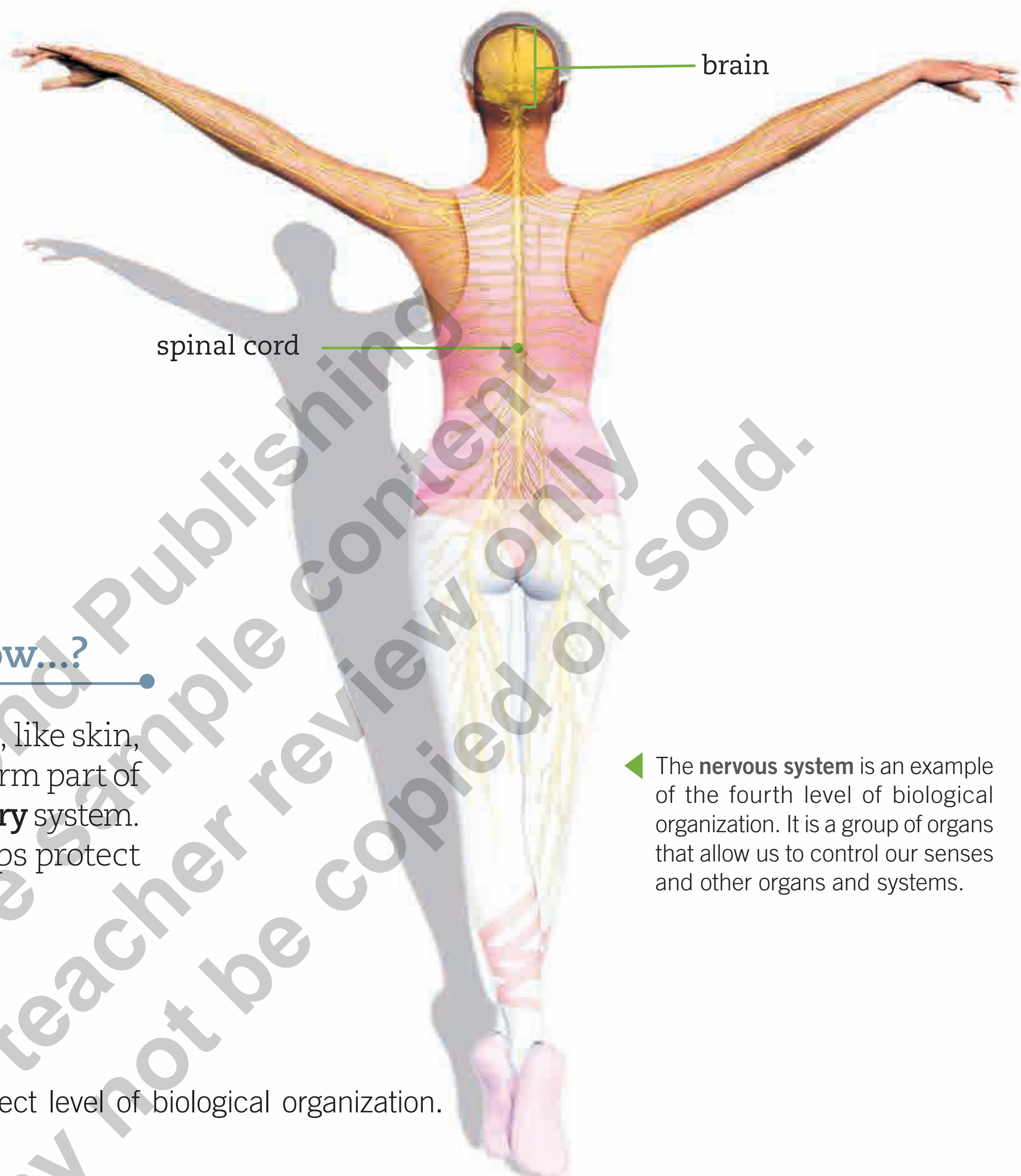


The eye is an organ. It represents the third level of biological organization. What other examples of this level can you think of?

Systems

The fourth level of biological organization is a **system**. A system is a group of organs that work together to perform the same function.

For example, the nervous system consists of two principal organs: the brain and the spinal cord. The two organs work together to control other organs and to adjust to the environment.



The **nervous system** is an example of the fourth level of biological organization. It is a group of organs that allow us to control our senses and other organs and systems.

Did You Know...?

Some structures, like skin, hair and nails, form part of the **integumentary** system. This system helps protect our bodies.

Practicing

1. Complete the table with the correct level of biological organization.
Compare and Contrast

Structure	Neuron	Muscle	Brain	Nervous System	Leaves
Level					

Summarizing

Organs are the third level of biological organization. They are groups of tissues that work together.
Systems are the fourth level of biological organization. They are groups of organs that work together.

Connecting

Organisms

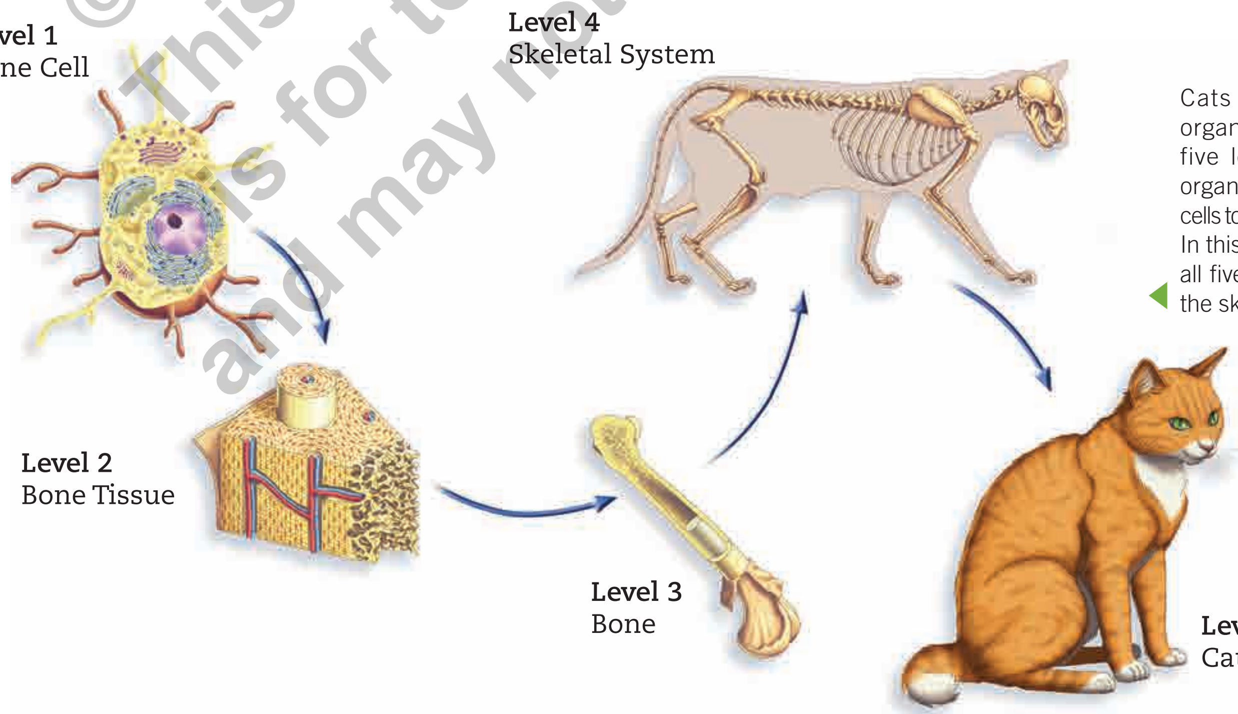
Look at the following images.

The living things above are all multicellular organisms. At what level of biological organization do you classify them? You will notice that they are different from the previous levels. This is because they are all part of the fifth and final level: the **organism**.

A multicellular organism consists of several biological systems that work together to allow its body to function. A cat is an organism that has a digestive system, a nervous system and a skeletal system, among others. They all help the cat move and live.

Challenge

Cats and other animals have a skeletal system. What is the equivalent structure in a tree?



Cats are multicellular organisms that have all five levels of biological organization, from single cells to a complete organism. In this image, you can see all five levels in relation to the skeletal system.

Practicing

1. Number the levels 1–5 from least complex to most complex. Put in order

☐	tissue	☐	organism	☐	cell	☐	organ	☐	system

2. Which level of biological organization includes all the other levels? Explain

____

____

____

Summarizing

Multicellular organisms are the fifth level of biological organization. They are living things with many biological systems that help them live and move.

Quiz Yourself

1. Complete the following chart.

The Basic Levels of Biological Organization		
Level	**Description**	**Examples**
Cell		
	Group of cells that work together.	
		heart, lungs
System		
		lion, lizard

Connecting

The Organs of the Digestive System

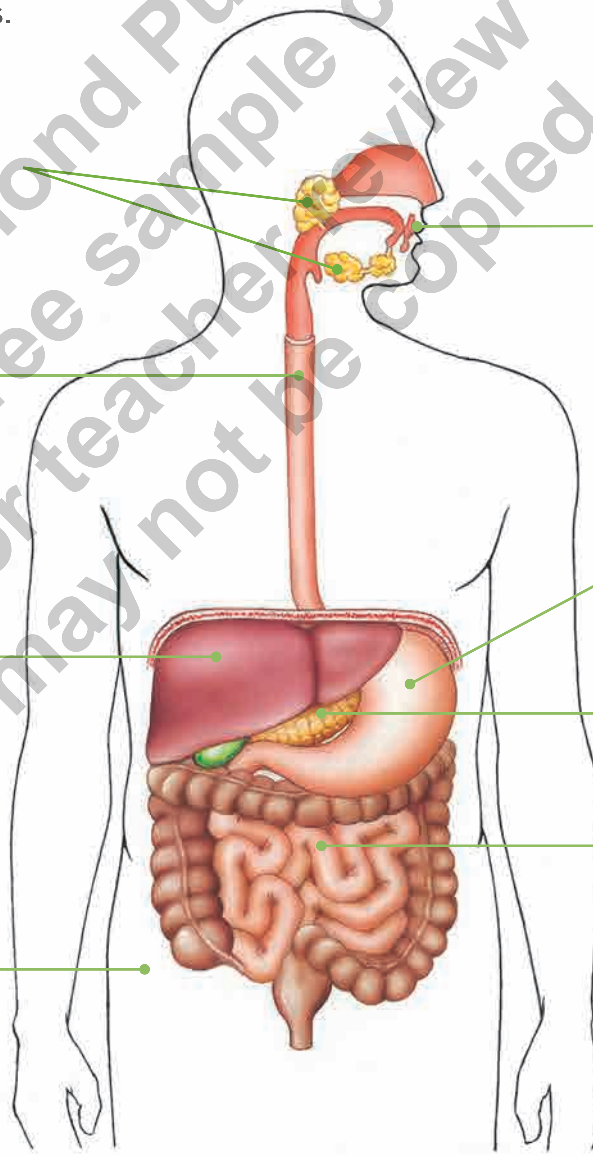
Have you ever wondered what happens to food after you swallow it? Where does it go? How is it used? The answers to these questions are related to one of the systems in our bodies: the **digestive system**. This system consists of a group of organs that **convert** food into **nutrients** and eliminate what we do not need.

pass from the mouth to the stomach

The digestive organs surround the digestive tract, which starts at the **mouth** and ends at the **anus**. This system also includes a group of **digestive glands**. The glands secrete various substances that convert food into **nutrients.** Nutrients give our bodies the energy we need to live.

produce and emit

Look at the following image of the digestive system. Pay attention to all the organs.



The digestive system consists of the **digestive tract** and **digestive glands**. Its purpose is to convert food into nutrients, which give us energy.

The Digestive Process

Our digestive system converts food into simpler substances called **nutrients**, which enter our cells and give us the energy we need to live. This process, called the **digestive process**, consists of four stages, which occur in the following order:

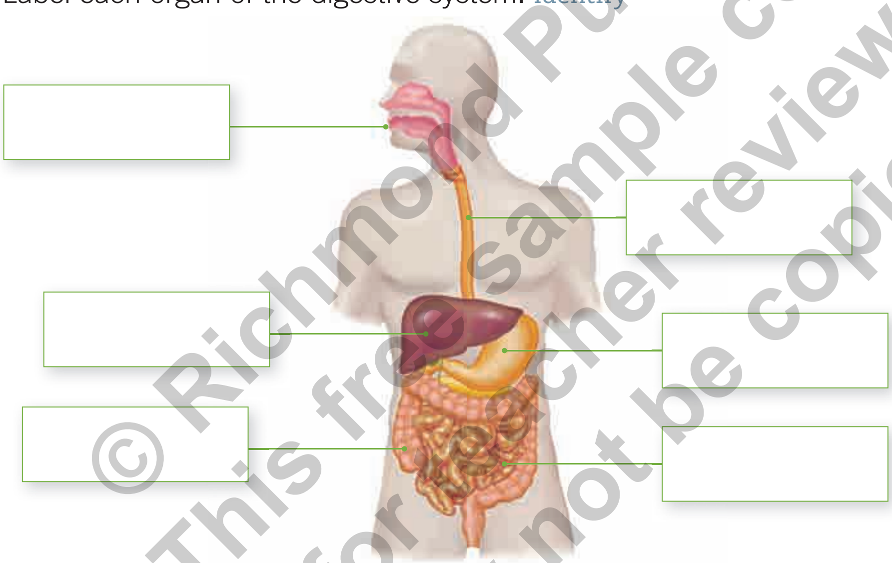
- **ingestion:** when food enters the mouth
- **digestion:** the transformation of food in the digestive tract
- **absorption:** when nutrients enter the blood
- **egestion:** the elimination of waste through the anus

Did You Know...?

Nutrients are components of food that give energy to an organism. They also help regulate and repair the body. Nutrients are classified as: **carbohydrates**, found in foods like bread; **proteins**, found in foods like eggs; **lipids and fat**, found in oils; and **vitamins and minerals**, found in fruits and vegetables.

Practicing

1. Label each organ of the digestive system. Identify



2. Put the stages of the digestion process in order. Sequence

egestion – digestion – ingestion – absorption

→	→	→	

Summarizing

The digestive system allows the body to absorb nutrients and eliminate waste. The stages of the digestive process are: ingestion, digestion, absorption and egestion.

Connecting

The Beginning of the Digestive Process

As you already know, the digestive process consists of four stages: ingestion, digestion, absorption and egestion.

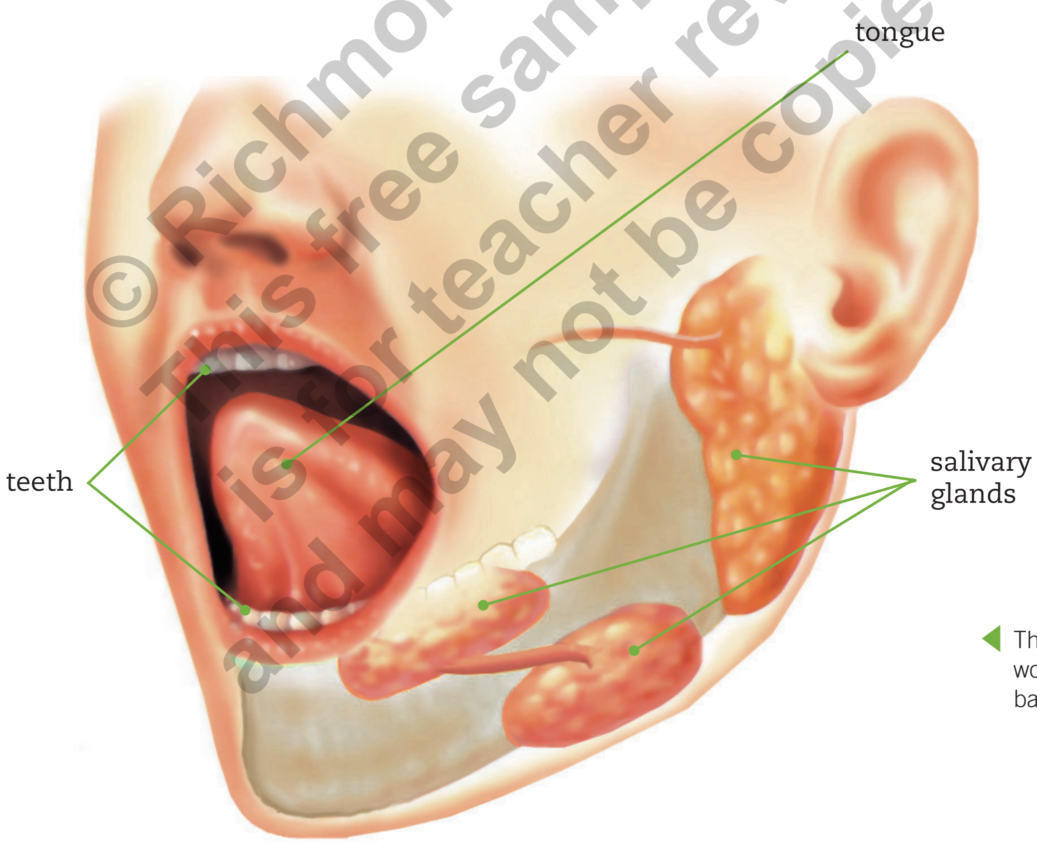
Ingestion is the first stage, and it begins the moment you start to eat.

Put a piece of bread in your mouth, but do not chew. Wait one minute, and then chew and **swallow** it. Did you notice any change in the food? This is because **digestion** begins in the mouth. **Teeth** are used to chew food and break it down into smaller pieces. Salivary glands in the mouth produce saliva. The tongue moves and mixes the food with the saliva. All these processes make a **bolus**, a ball of food ready to be swallowed and to continue down the digestive tract.

bite repeatedly with the teeth

Remember!

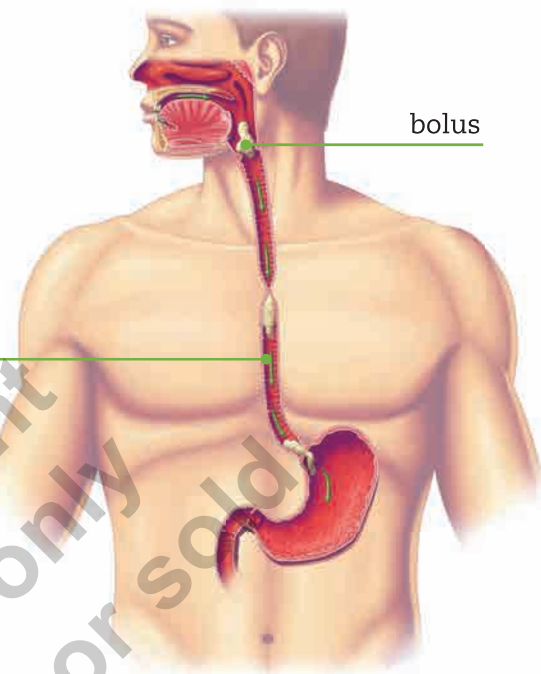
Each animal's teeth are adapted to the type of food it eats. A carnivore has long, sharp teeth to rip meat, while herbivores have large, flat teeth to chew plants.



The mouth, teeth, tongue and saliva all work together to convert food. Why can't babies eat solid food?

Swallowing

Take a sip of water. Did you notice what happens in the back of your mouth? The process of moving liquid from the mouth to the stomach is called **swallowing**. Swallowing consists of two stages. The first stage is voluntary and occurs when we push food to the back of the mouth. The second stage is involuntary and occurs when the food enters the digestive tract and moves down the esophagus to the stomach.



Swallowing is a mechanism that allows food to enter our bodies. After the food is swallowed, peristaltic movements help push the food through the digestive tract.

Peristaltic Movements

We have talked about food moving through the digestive tract. How does this happen? The esophagus expands and contracts to push the bolus down to the stomach. These movements are called **peristaltic movements**.

becomes smaller

Practicing

1. Put a small ball inside a tube that has the same **diameter** as the ball. Use your fingers to squeeze the tube and push the ball to the other side. If the ball represents the bolus, what does the tube represent? What movement are you demonstrating with your hands? Explain. Interpret

Summarizing

Ingestion is the first step of the digestive process. Digestion begins in the mouth when food is converted into a bolus and pushed down the esophagus. Peristaltic movements move the food through the different organs of the digestive system.

Word Focus

Diameter is the length of a straight line passing through the center of something from one side to the other. In this case, it is the thickness of the tube.

without curves

Connecting

Digestion in the Stomach: The Process Continues

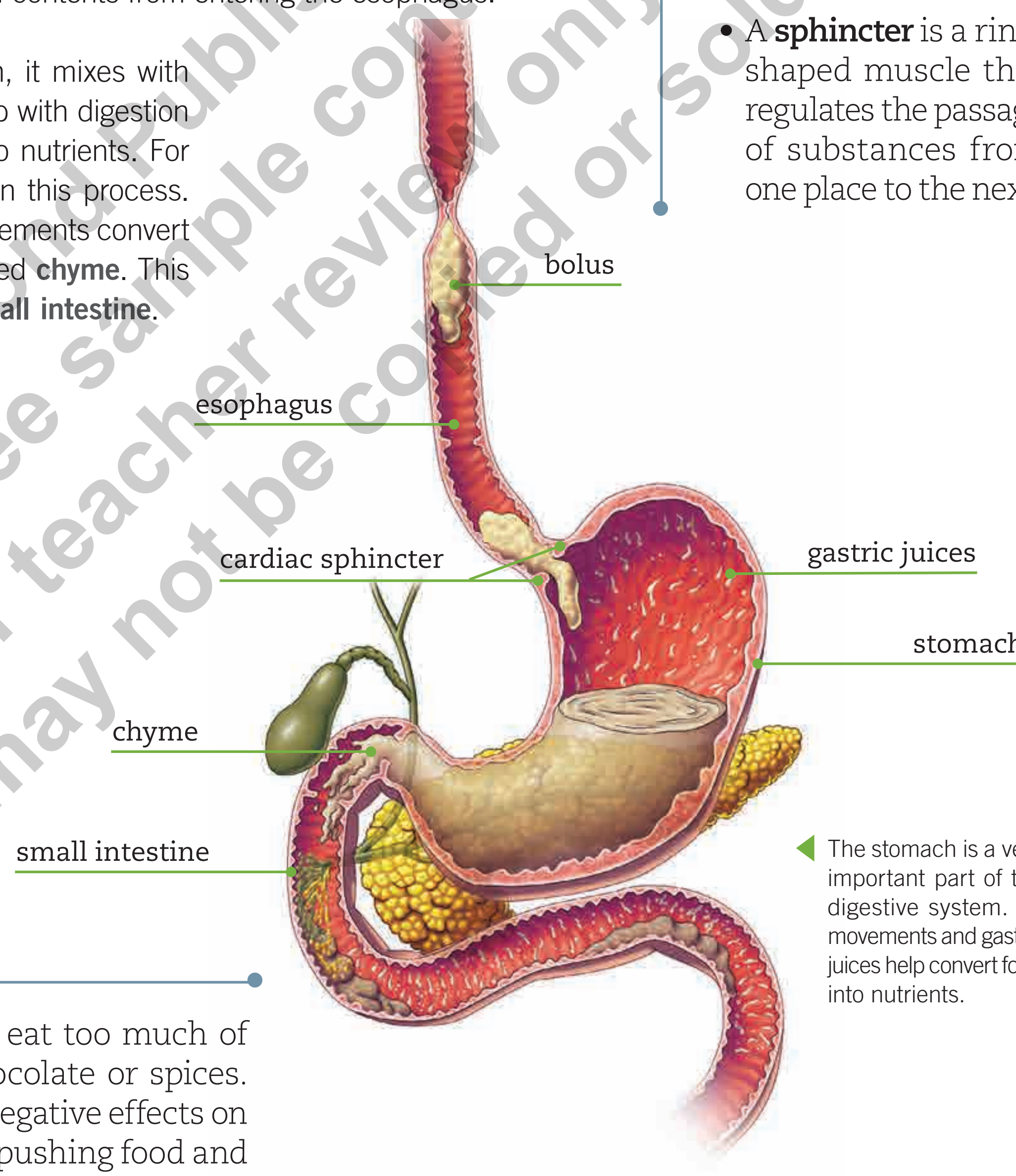
Does your stomach ever make noises after you eat? Or have you ever heard your stomach **growling** when you are hungry? This happens because the **stomach** is a muscular organ shaped like a bean, with walls that move to help process food.

The **bolus** of food moves through the **esophagus** to reach the stomach. Then it goes through a valve located at the entrance of the stomach. This valve is called the **cardiac sphincter**. Its function is to allow food to pass through to the stomach and to prevent stomach contents from entering the esophagus.

When food gets to the stomach, it mixes with **gastric juices**. Gastric juices help with digestion —the transformation of food into nutrients. For example, proteins are digested in this process. Gastric juices and peristaltic movements convert the bolus into a **thick liquid** called **chyme**. This liquid then moves toward the **small intestine**.

Word Focus

- The word **growl** normally describes the sound a dog makes when it is angry. Growl also means the noise your stomach makes when you are hungry!
- A **sphincter** is a ring-shaped muscle that regulates the passage of substances from one place to the next.



The stomach is a very important part of the digestive system. Its movements and gastric juices help convert food into nutrients.

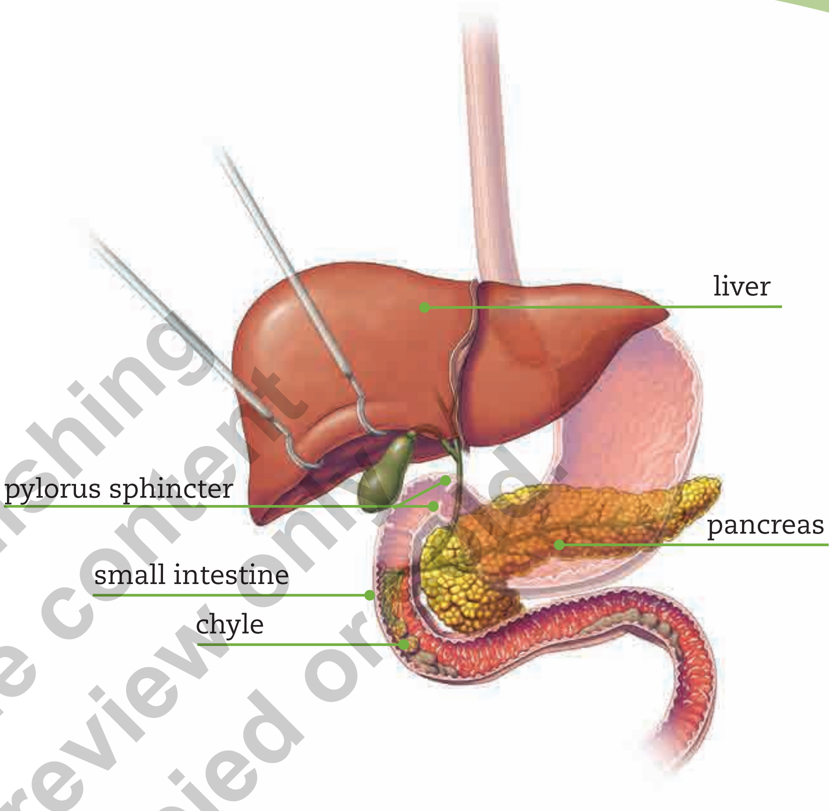
Staying Healthy

It is important not to eat too much of certain foods like chocolate or spices. Some foods can have negative effects on the cardiac sphincter, pushing food and gastric juices back into the esophagus.

The End of the Digestive Process

We have already seen that, with the help of the stomach, the bolus is converted into a thick liquid called chyme. The digestive process continues as this liquid leaves the stomach through a valve called the **pylorus sphincter** and enters the **small intestine**.

The most important part of digestion happens in the small intestine with the help of different fluids. They are: **bile**, produced by the liver; **pancreatic juice**, produced by the pancreas; and **intestinal juice**, produced by the small intestine. Through the action of these juices, the chyme becomes a **thinner liquid** called **chyle**. This is the last transformation of nutrients before the third stage of the digestive process: **absorption**.



Practicing

1. Complete the diagram by writing how food changes in each stage. Identify

mouth → ______ stomach → ______ small intestine → ______

2. Explain the functions of the stomach and the small intestine during digestion. Explain

---

Tip

In these terms, "ph" is pronounced as "f", and "ch" is pronounced as "k."

Summarizing

The stomach has walls made of muscle to move and digest the food. It also produces gastric juices that help make chyme.

The small intestine produces intestinal juices, which combine with bile (from the liver) and pancreatic juice (from the pancreas) to help make chyle.

Connecting

Absorption

After the chyle is formed, it continues through the small intestine and the next stage of the digestive process starts: **absorption**. During this process, most of the nutrients and water go through the **small intestinal wall.** Small hairs called villi allow the nutrients to reach the blood, which carries them to all the cells of the organism.

The **intestinal villi** on the walls of the intestine increase the efficiency of absorption. In fact, if we could extend all the villi of a human being, they would cover an area of 300 square meters, about the area of a tennis court. The following image shows the structures involved in absorption.

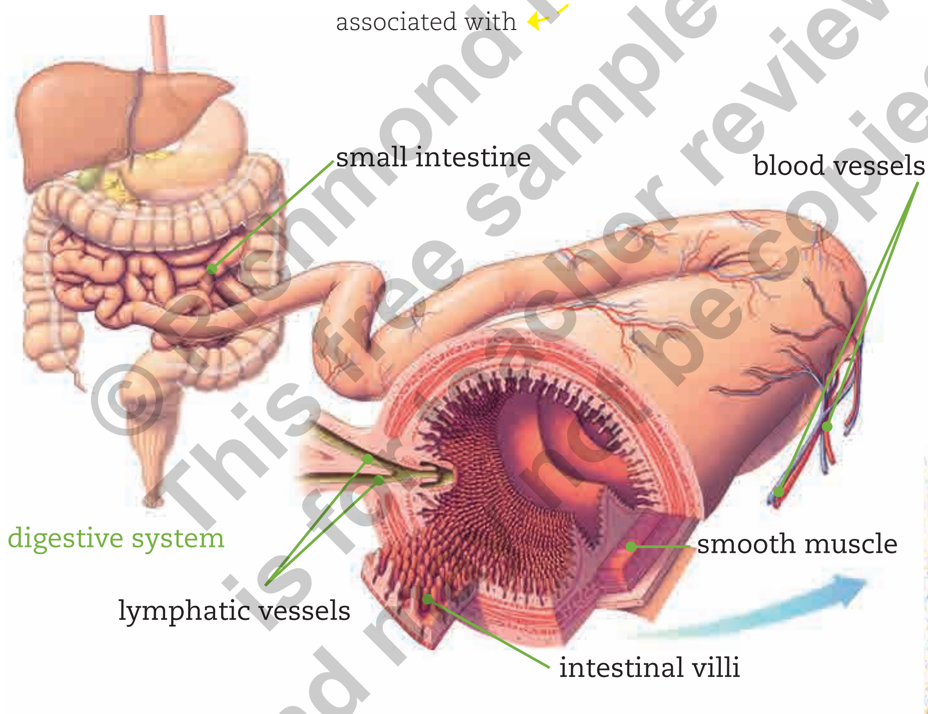
associated with

Did You Know...?

A human's small intestine can be seven meters long, the same as the width of a professional soccer goal.

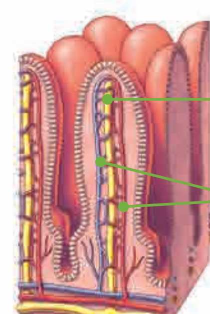
Tip

Villi is pronounced "vil-lie." The singular form is villus.



close-up of the small intestine

This close-up of the small intestine's wall shows the villi that allow nutrients to reach the blood, which then carries them to all the cells in the body. What would happen if there were no villi in the small intestine?



small intestinal villi

The villi are very important in the absorption process. For example, every day our small intestine receives six liters of chyle, which is reduced to one liter after absorption. Do you know what happens to the rest? It passes through the bloodstream to reach all the cells, providing the organism with basic materials and energy.

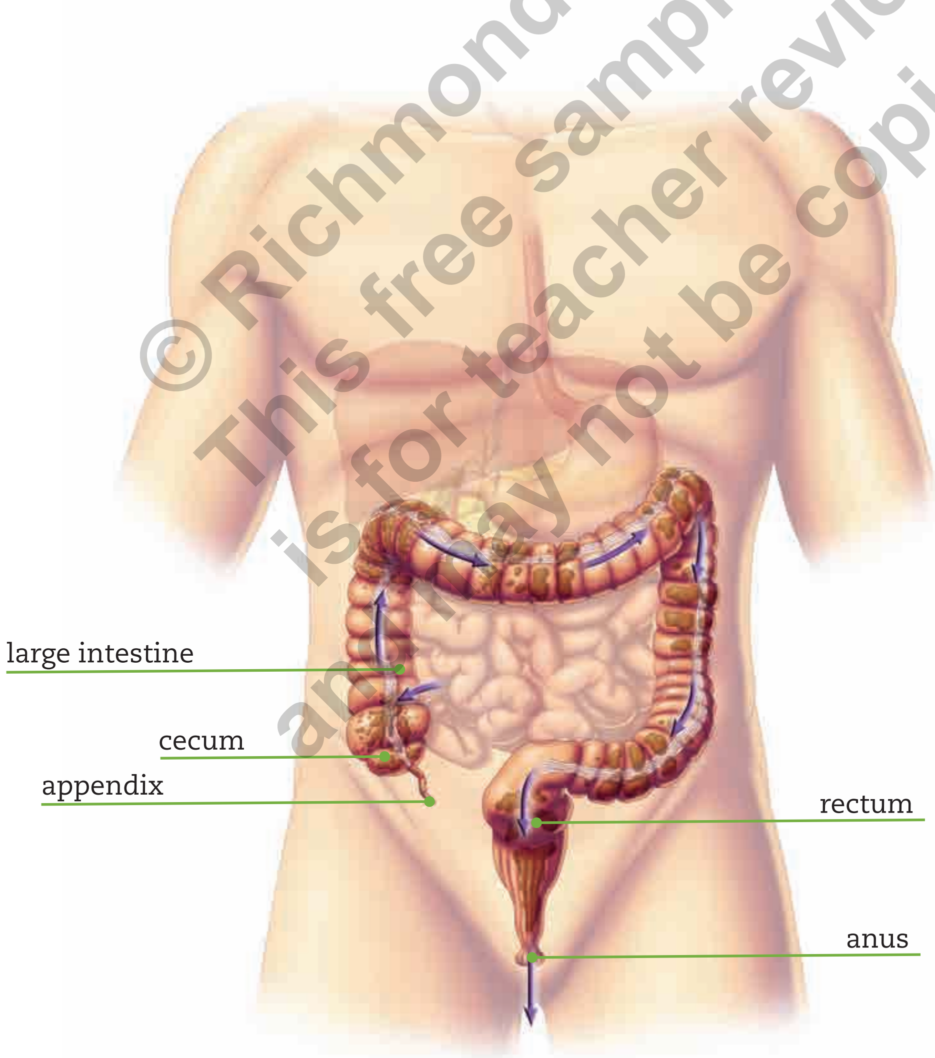
Elimination of Waste: The Final Process

We have seen how our digestive system converts food into nutrients, but what happens to the things we cannot use? To answer this, we turn to the **large intestine**, which comes after the small intestine.

After all the nutrients are absorbed, the leftover waste passes to the large intestine. In the final stage of the digestive process, the large intestine forms and eliminates fecal matter in a process called **egestion**.

The large intestine absorbs any water, giving fecal matter its firm consistency. Finally, the fecal matter is temporarily stored in a part of the large intestine called the **rectum**. Then with the help of bowel movements, it is expelled through a final sphincter: **the anus**.

accumulated



The large intestine forms and eliminates fecal matter as the final stage of the digestive process.

Did You Know...?

Intestinal flora is the bacteria that live in our intestines. They are necessary for healthy intestines and a healthy body.

Staying Healthy

Eating a variety of food and an adequate quantity of vegetables contribute to a healthy digestive system. Foods that are high in fiber are especially good for our digestion.

Practicing

1. A study measured the amount of food circulating in different areas of the digestive tract from **ingestion** to **egestion**. Look at the table and answer the following questions.

Digestive Tract Content of an Animal				
Part of the Tract	Mouth	Stomach	Small Intestine	Large Intestine
Amount of Food (grams)	490	490	80	70

a. What happened to the amount of food as it circulated through the digestive system? Interpret

____

b. According to the table, where does the most absorption occur? Interpret

____

2. Go to **Cutout 2** on **page 165**. Glue each organ according to its function. Identify

Helps with the absorption of nutrients. [ ]

Absorbs water and eliminates fecal matter. [ ]

Summarizing

Absorption is when nutrients pass from the digestive tract to the bloodstream. Absorption occurs through the villi in the small intestine. The large intestine absorbs water and forms fecal matter.

Quiz Yourself

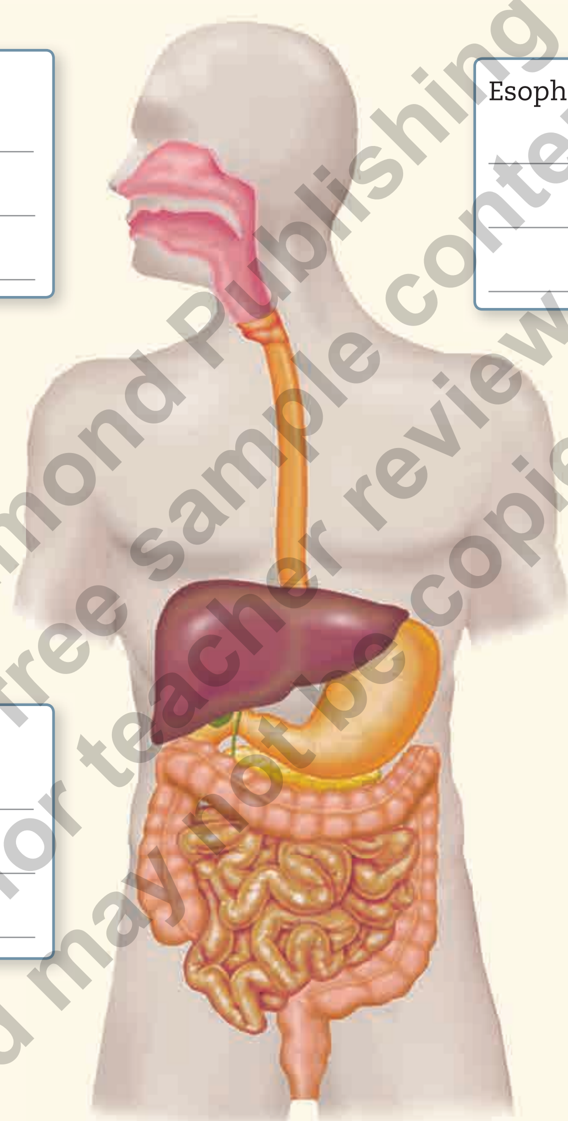
1. Look at the diagram and do the activities.

a. Match each part of the digestive system with the correct word. Then describe its function.

b. On the diagram, draw arrows to show the path of food through the digestive system.

Mouth:

Esophagus:



Stomach:

Large Intestine:

Small Intestine:

2. What would happen if food passed directly from the stomach to the large intestine?

Scientific Skill: Predict

The Function of Saliva

Basic Framework

The digestive system converts food into more simple substances called nutrients. These nutrients give us the energy we need to live. To be able to convert food into **energy**, the digestive system consists of several organs, each with a specific function. The digestive process starts in the mouth, with the help of teeth and saliva. Saliva is a secretion containing amylase, which breaks down food starches. Starch is a nutrient found in potatoes, corn and dough.

liquid produced by an organ

Observation

A group of students conducted an experiment in a laboratory. They observed two samples: one of potato and saliva and another of potato and water. One changed color when **povidone** or Lugol's iodine (antiseptic solutions) was added. Why do you think the colors are different?

destroying bacteria

Research Question

What is the effect of saliva on food?

Hypothesis

Mark the correct hypothesis for the research question.

☐ Amylase breaks down food starch into simpler substances.

☐ Amylase does not have any effect on food starch.

Predictions

Based on the situation described in the observation stage, answer:

a. What will the saliva do to the potato?

____

How do you formulate predictions?

- Based on a situation, answer the questions.
- To answer, use your hypothesis and any previous knowledge you might have.

The questions guide you in formulating a prediction. Your prediction helps you answer the questions.

Experimental Procedure

1. In groups of four students, collect the following supplies:

reduced to small strips

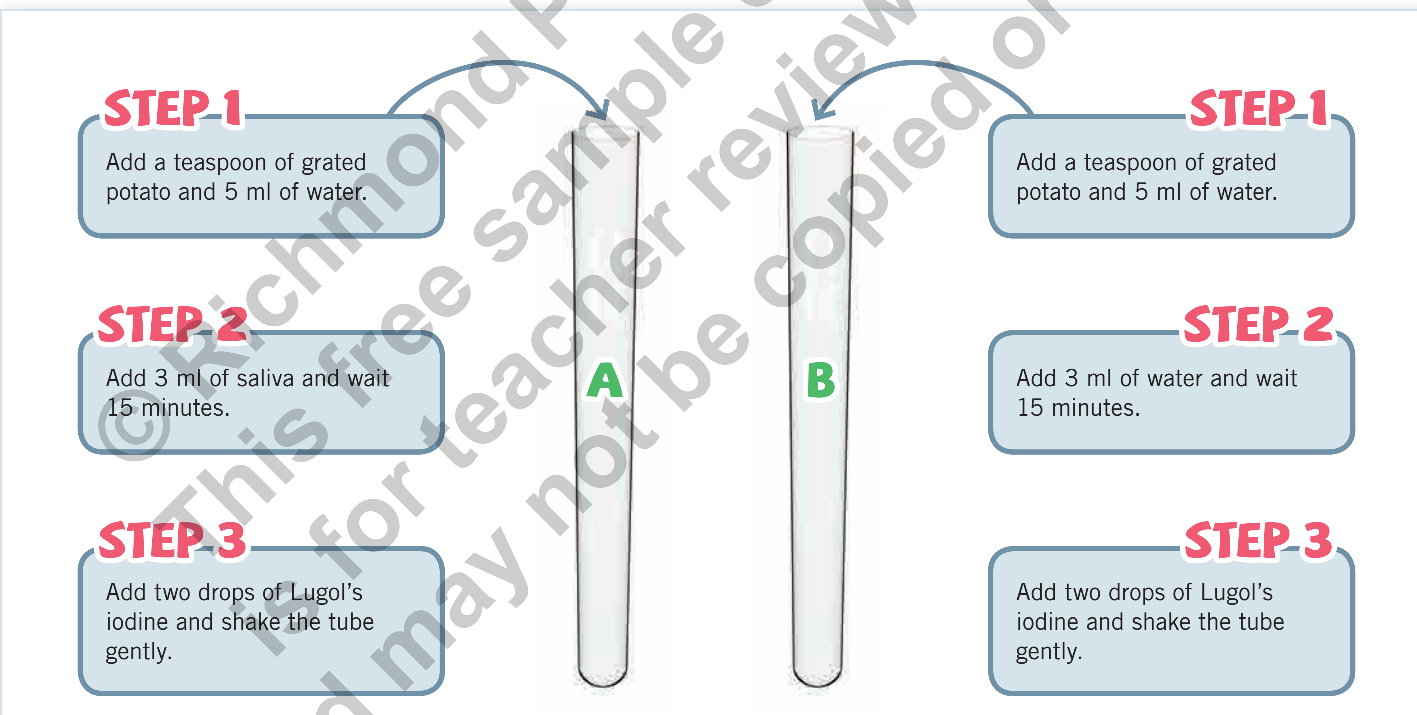
- 1 grated potato
- Lugol's iodine (or povidone)
- water
- 2 syringes (without the needles)
- 2 test tubes
- 1 marker
- 1 teaspoon
- 1 dropper

Evidence of amylase's activity appears because Lugol's iodine, a special coloring, recognizes food starches. If the food has starches, the color will change from brown to blue.

Use one of the syringes to extract saliva and the other to add water to the test tubes.

collect

2. Gather some saliva in your mouth and extract it with a syringe.
   Be careful: The syringe should not have a needle.
3. Mark the test tubes **A** and **B** with the marker.
4. Follow the steps for each tube as indicated in the diagram:

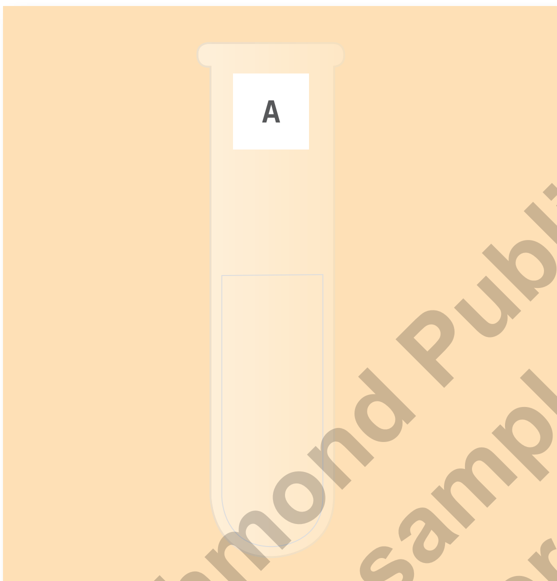


5. Observe the initial color of each tube and mark it in the **Results** section.
6. Wait 15 minutes and observe any changes in color.
7. In this experiment, why did you add three more milliliters of water to tube **B**?

Results

Use the space below to record the results.

a. Draw what happened to tube **A** when you added Lugol's iodine.



Mark the color of the content in tube **A** before and after you added Lugol's iodine.

INITIAL COLOR

- [ ] brown
- [ ] blue

FINAL COLOR

- [ ] brown
- [ ] blue

b. Draw what happened to tube **B** when you added Lugol's iodine.

Mark the color of the content in tube **B** before and after you added Lugol's iodine.

INITIAL COLOR

- [ ] brown
- [ ] blue

FINAL COLOR

- [ ] brown
- [ ] blue

Interpreting and Analyzing the Results

1. What differences are there between the results from tube **A** and tube **B**? Remember to think about the change in color of each solution.

2. What do you think caused the difference in color between tube **A** and tube **B** after adding Lugol's iodine?

   In tube A:

   In tube B:

3. Which observation proves that saliva breaks down starch?

Conclusions

1. Did the experiment prove the hypothesis? Explain.

2. What function does amylase serve in the digestion of food like potatoes?

3. Why is it important to break down the starch in foods? Look at the **Basic Framework** to help you answer.

4. What other foods can you use in this experiment? Explain. Use the **Basic Framework** to help you answer.

Let's Check!

1. Go to **Cutout 3** on **page 167** (levels of biological organization). Follow the instructions.

points

/ 8

a. Write the name of each level.
b. Determine the order of the levels.
c. Carefully glue the pictures in the correct order.

Level 1	Level 2	Level 3

Level 4	Level 5

d. Which level of biological organization includes all the other levels?

____

e. What is the first and smallest level of organization?

____

f. In which level would you classify bones? Explain.

____

2. Determine which stage of the digestive process is represented in each photograph and in which organ the stage occurs.

points
/ 8

Situation	Stage	Organ
		
		
		
		

Section 3

The Circulatory System

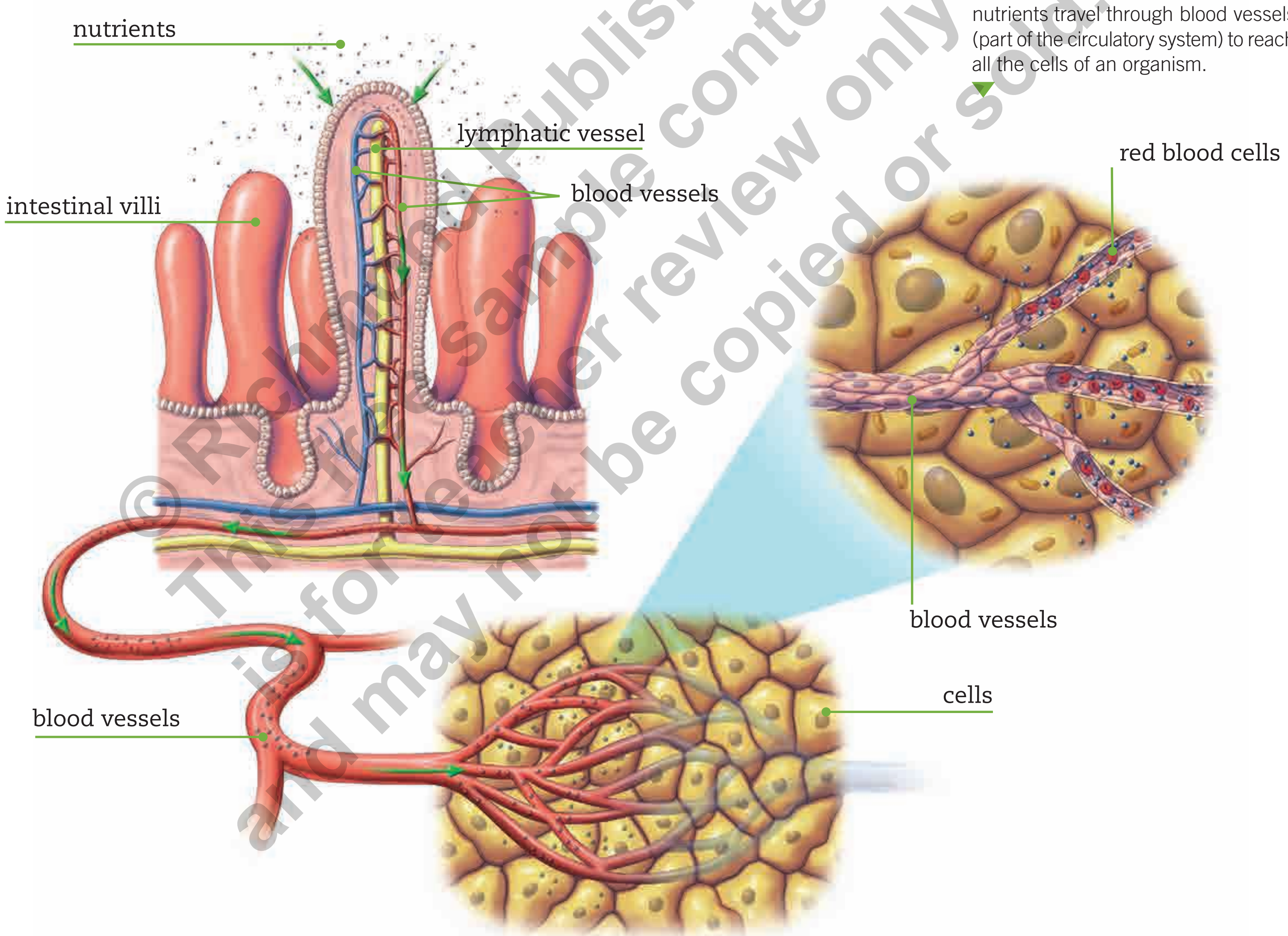
Connecting

Understanding the Circulatory System

Have you ever felt your heart beat? Put your hand on your chest and try to feel it. We are not always conscious of our heart beating, but it is always working. It is part of the **circulatory system**. In the previous section, you learned that the digestive system converts food into nutrients and that these nutrients pass into the bloodstream, which carries them to all parts of the body. The circulatory system is a very efficient transportation system.

pulsate

After absorption in the small intestine, nutrients travel through blood vessels (part of the circulatory system) to reach all the cells of an organism.



The circulatory system transports substances like water, nutrients and cell waste through the organism. It keeps every part of the body supplied with the necessary elements to function.

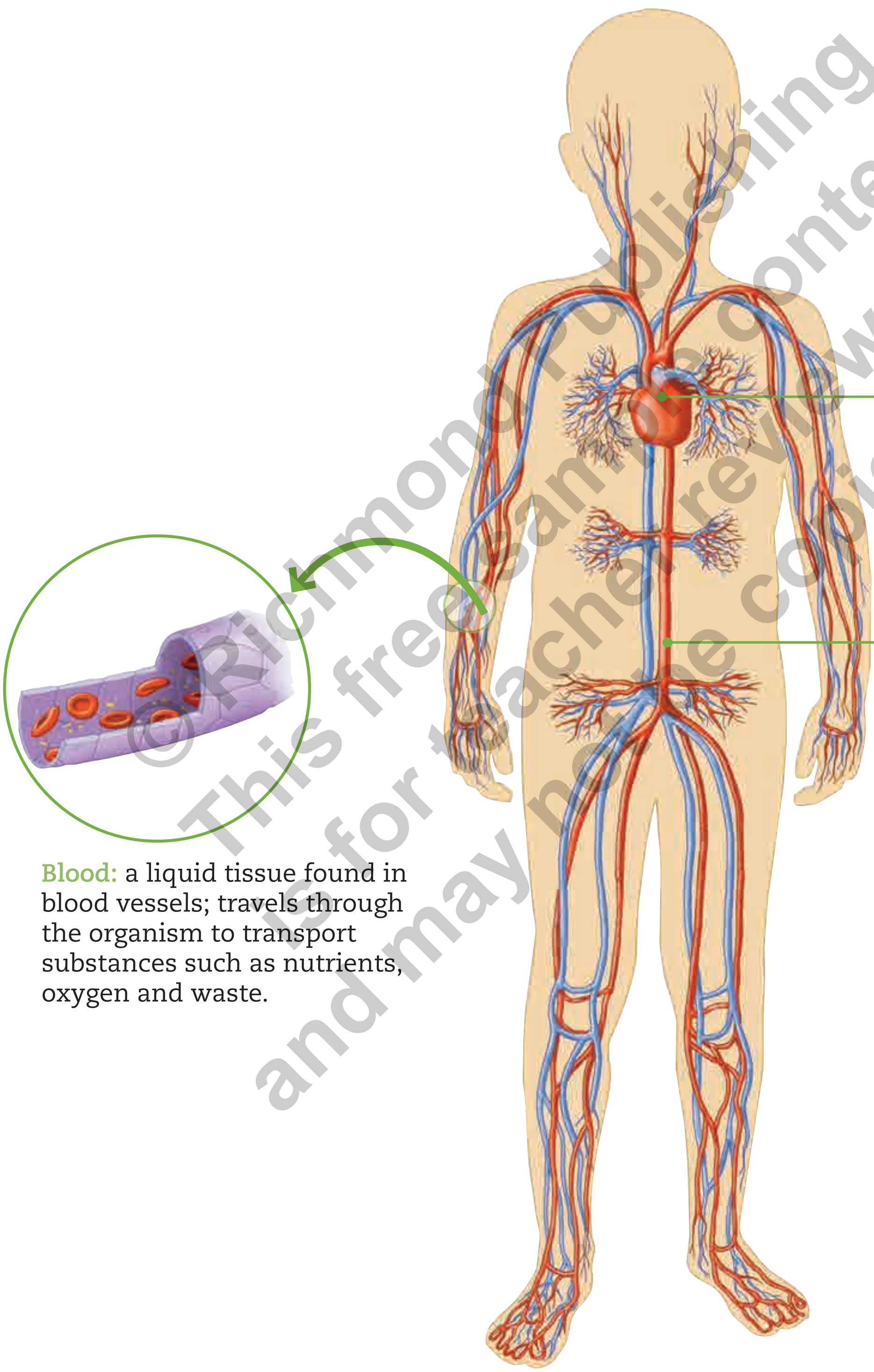
provided with or stocked

Circulatory System Components

The circulatory system consists of three large components that work together to transport substances such as nutrients and waste through the body. The three components are: the **heart**, **blood** and **blood vessels**, as seen in the diagram below.

Did You Know...?

In the 15th century, an English doctor named William Harvey was the first to correctly describe the relationship between the heart, blood and blood vessels. He said that blood goes to all parts of the body through the blood vessels with the help of the heart.



The heart, blood and blood vessels are parts of the circulatory system.

Challenge

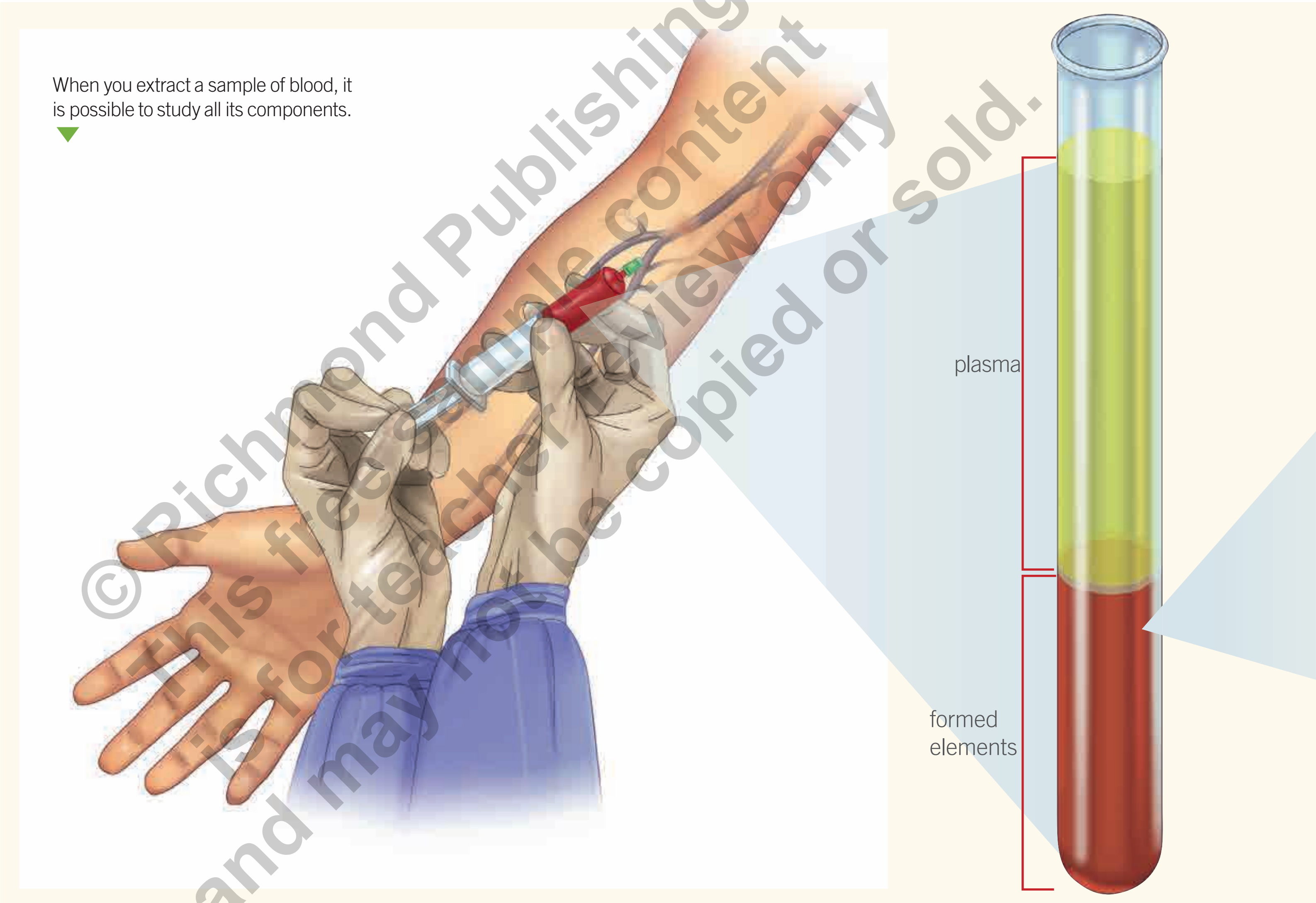
The circulatory system moves a liquid (blood) through the body. Name two different systems in machinery or other areas that have a similar system. Compare and contrast the systems.

Our Blood

Now that you know that blood travels to all parts of the body, have you ever wondered what blood looks like? To the naked eye, it just looks like a red liquid, but it is actually a liquid tissue consisting of cells. If you extract blood from a person and examine it under a microscope, you can see the cells. Remember that cells are very small.

unassisted vision

When you extract a sample of blood, it is possible to study all its components.



Did You Know...?

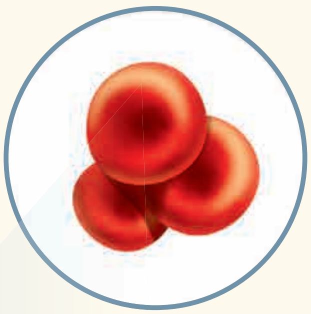
Some animals, such as mollusks, have blue blood. Their blood has a substance called hemocyanin, which transports oxygen and turns the blood blue.

Components of Blood

Blood is a tissue that consists of a liquid called **plasma** and a group of cells and cell fragments called **formed elements**. This group consists of **red blood cells**, **white blood cells** and **platelets**.

Did You Know...?

The amount of blood you have in your body changes with age. A baby has about 300 ml, and an adult has about 5,000 ml.



Red blood cells: are the most abundant. They give blood its color and they transport oxygen.

White blood cells: are less abundant than red blood cells. They defend the organism against illnesses.

Platelets: are pieces of cells that form a plug, or **clot**. This clot is what stops the bleeding when you cut yourself. This process is called **coagulation**.

Summarizing

The circulatory system has three parts: the heart, blood and blood vessels. One of its functions is to transport nutrients and waste through the body. Blood is a tissue that consists of a liquid called plasma and a group of cells called formed elements. Formed elements are: red blood cells that transport oxygen; white blood cells that protect the organism from illness; and platelets that coagulate to stop bleeding and protect a wound.

Connecting

Blood Vessels

Blood transports substances to all parts of the body. Blood has a defined route through tubes called **blood vessels**.

Blood vessels are tubes that form a **closed circuit** where blood circulates. Have you ever noticed that even small cuts always bleed? That is because we have blood vessels all over our bodies. When we get hurt, sometimes the blood vessels break internally (inside), forming **bruises**, and other times the blood comes out externally (outside). The following image shows the main blood vessels in the body.

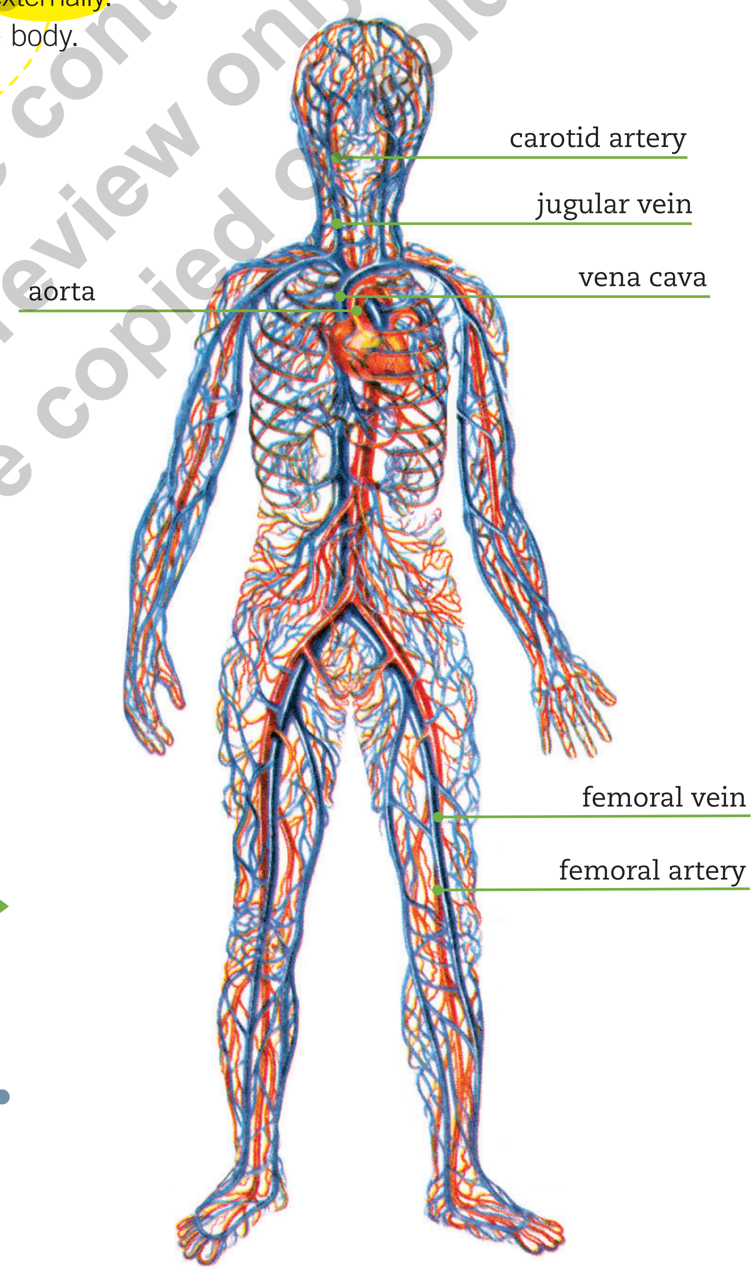
Blood vessels are tubes that form a **closed circuit**. This allows the blood to circulate permanently within the body. If the racetrack above represents the blood vessels, what do the cars represent?

Word Focus

Bruises are dark colored spots that form on our skin when the skin is hurt but not broken.

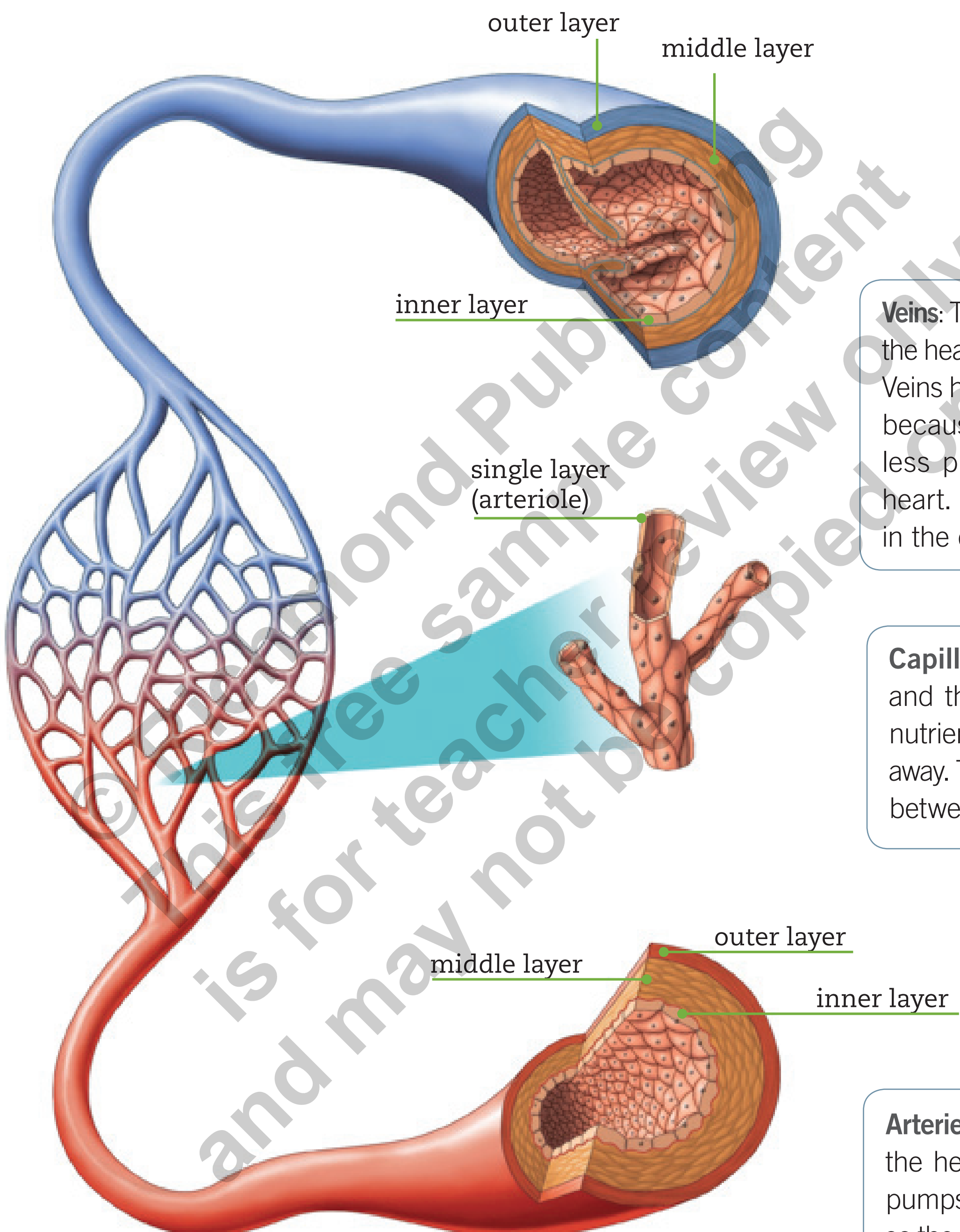
Did You Know...?

If extended in a straight line, the blood vessels of an adult would reach a length of 100,000 kilometers. That is the same as about three trips around the planet.



Types of Blood Vessels

The blood vessels in our bodies are classified into three groups: **veins**, **arteries** and **capillaries**.



Veins: These move blood from tissues to the heart in the process of circulation. Veins have thinner walls than arteries because the blood circulates with less pressure as it returns to the heart. The veins are shown in blue in the diagram.

Capillaries: These are very small and thin blood vessels. They take nutrients to the cells and take waste away. They are located in organ tissue between the arteries and veins.

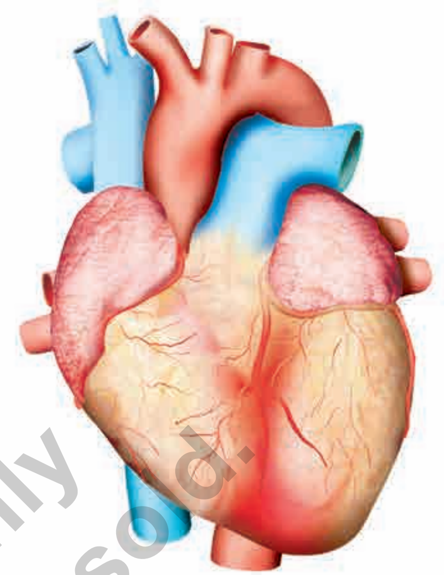
Arteries: These move the blood from the heart to the organs. The heart pumps blood with a lot of pressure, so the artery walls are thick, resistant and flexible. They are shown in red in the diagram.

The walls of the veins and arteries have three layers.
The walls of the capillaries have only one layer.

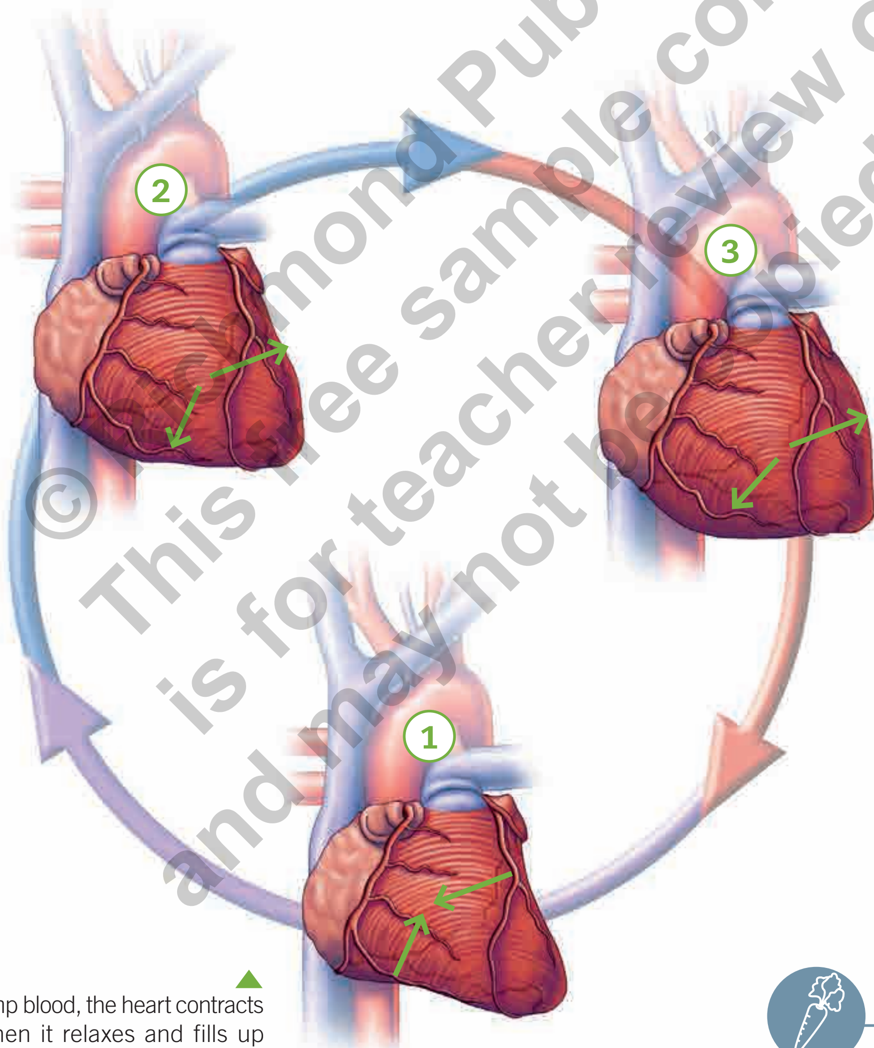
The Heart's Function

As you have learned, blood transports nutrients to all the cells in the body, and the blood vessels are tubes in which the blood circulates. But how does the blood move? What pushes it? The answers to these questions are related to one of the most important organs in our body: **the heart**.

The heart is an organ made primarily of muscle tissue. The walls of the heart contract and expand to pump blood through the blood vessels. This movement is called the **heartbeat**. This movement can be felt in some blood vessels as a **pulse**.



The heart is a muscular organ that causes blood to circulate through blood vessels and the body. Blood continually circulates during the life of an organism.



To pump blood, the heart contracts (1). Then it relaxes and fills up with blood (2), which causes it to expand (3). This movement, called the heartbeat, is repeated over and over to move blood through our bodies.

Did You Know...?

The human heart beats about 2,500,000,000 times in a lifetime.

Staying Healthy

Eating low-fat foods and exercising or playing sports helps the heart and keeps it working well.

Practicing

1. Follow the steps below to check your pulse.

- You need a piece of clay and a toothpick.
- Make a small hole in the clay with the toothpick and stick the toothpick in, as shown in image **1**.
- Place your hand on the table and put the toothpick on your wrist, as shown in image **2**, so you can detect movement.

Answer the following questions.

a. What happened to the toothpick? Why? Explain

b. Why do the results vary when you place the toothpick on different parts of the wrist? Explain

c. If your heart beats about eight times in ten seconds, how many times do you think the toothpick will move in the same amount of time? Predict

d. What is the connection between the movement of the toothpick, your heartbeat and your pulse? Explain. Infer

1. Go to **Cutout 4** on **page 169**. Glue each type of blood vessel in the correct box, and then write its name. Identify

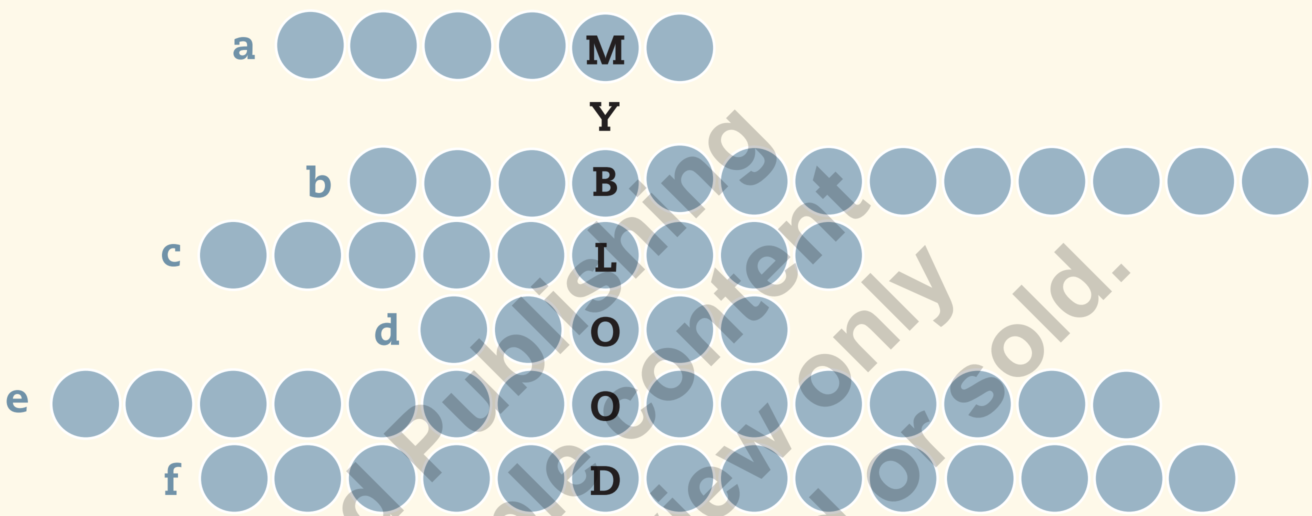
Types of Blood Vessels and Their Functions		
	These blood vessels allow substances to move through the blood and toward tissues. Their walls are thin, and they are located between the arteries and the veins.	-------------------
	These blood vessels transport blood from the tissues to the heart. Their walls are thinner than in arteries because the blood flows with less pressure. moves in a steady, smooth way	-------------------
	These blood vessels transport blood from the heart to the tissues. Their walls are thicker than in veins because the pressure is higher.	-------------------

Summarizing

Blood vessels are tubes that form a closed circuit around the whole body. There are three types of blood vessels: arteries, veins and capillaries. The heart pumps blood through the blood vessels so that it circulates around all parts of the body.

Quiz Yourself

1. Write the words that correspond to the definitions.



a. The liquid part of blood.
b. Blood cells that transport oxygen.
c. The formed elements that cause coagulation.
d. The plugs that block blood vessels when they break.
e. Cells that defend against illness.
f. The group of cells composed of red blood cells, white blood cells and platelets.

2. Complete the table with the correct definition or concept.

Transports nutrients, oxygen and waste.	
	veins
Transports blood from the heart to the tissues.	
	heart

The Respiratory System

Connecting

Respiration

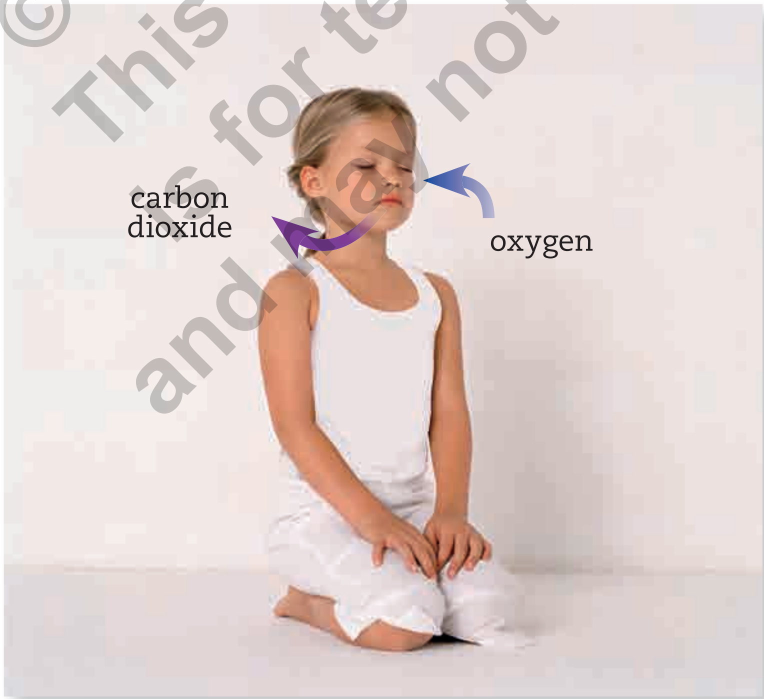
Try holding your breath for a few seconds. It is impossible to hold it for very long. This shows that breathing is an important process for the body. In previous units, you learned that the digestive and circulatory systems are **vital** for human beings since they help us absorb and distribute nutrients. The **respiratory system** is also important for our survival.

maintain

continued existence

The respiratory system is **involuntary** and automatic. Since your birth, you have been breathing all the time without thinking about it. Have you ever asked yourself why breathing is important? What is the purpose of this involuntary action?

Think about your body. You know you need to absorb nutrients from food to survive. It is also necessary to eliminate waste as fecal matter. Similarly, all the cells in your body absorb nutrients and eliminate waste to keep you alive. Through **respiration** our body takes in oxygen from the air. **Oxygen** is transported in the blood to all the cells. In the cells, it is used to generate energy from nutrients. Finally, the cell waste is eliminated as carbon dioxide.



Word Focus

Vital means very important and necessary for survival.

Fun Fact!

Plants and trees take in carbon dioxide and expel oxygen as waste. This is the opposite of humans and animals. Why do you think we need to protect the trees and plants in our environment?

Oxygen and carbon dioxide are very important gases. Oxygen is necessary for survival and is absorbed through the air. Carbon dioxide is waste from the respiratory process and must be eliminated quickly.

Organs of the Respiratory System

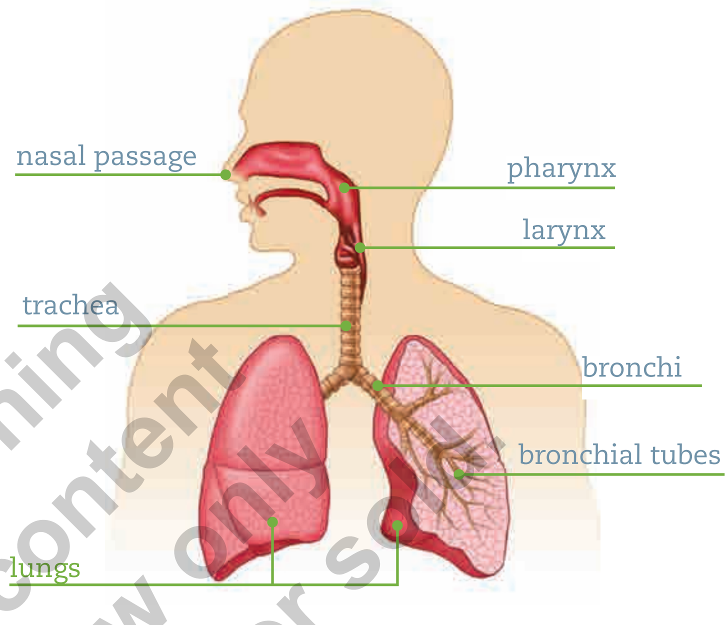
The **respiratory system** consists of the **pulmonary airways** and **lungs**.

Pulmonary Airways are respiratory ducts that move air from the outside to the inside of our bodies and vice versa. The airways are the: **nasal passage**, **pharynx**, **larynx**, **trachea**, **bronchus** and **bronchial tubes**.

Lungs are responsible for **gas exchange**. This is the exchange of oxygen and carbon dioxide that occurs within the organism. The lungs are located in the thorax on either side of the heart.

interchange

one or the other



The parts of the respiratory system allow air from the outside world to enter the lungs.

Practicing

1. Color the pulmonary airways **blue** and the lungs **red**. Identify

Word Focus

Pulmonary means anything relating to the lungs. Does the word pulmonary look like a word in your first language?

Did You Know...?

Some amphibians, like frogs, use their lungs and their skin for gas exchange, or breathing. Their skin is very thin and has many blood vessels.

Summarizing

Respiration is the process of gas exchange between oxygen and carbon dioxide. The respiratory system consists of the pulmonary airways and the lungs. The lungs are organs located on each side of the thorax and are responsible for gas exchange.

Connecting

The Role of Respiratory System Organs

Imagine you are very small and can float in the air. Let's follow the air you breathe into your body from the exterior to the interior.

The Air's Journey into the Body

1 **Nasal Passage:** The entrance is through the interior of the nose, called the nasal passage. Here air becomes **warm and moist**, and the nasal passage **removes** harmful substances.

2 **Pharynx:** Our journey continues through this muscular tube where the digestive and respiratory systems meet. **Air circulates** from the nasal passage to the larynx.

expedition

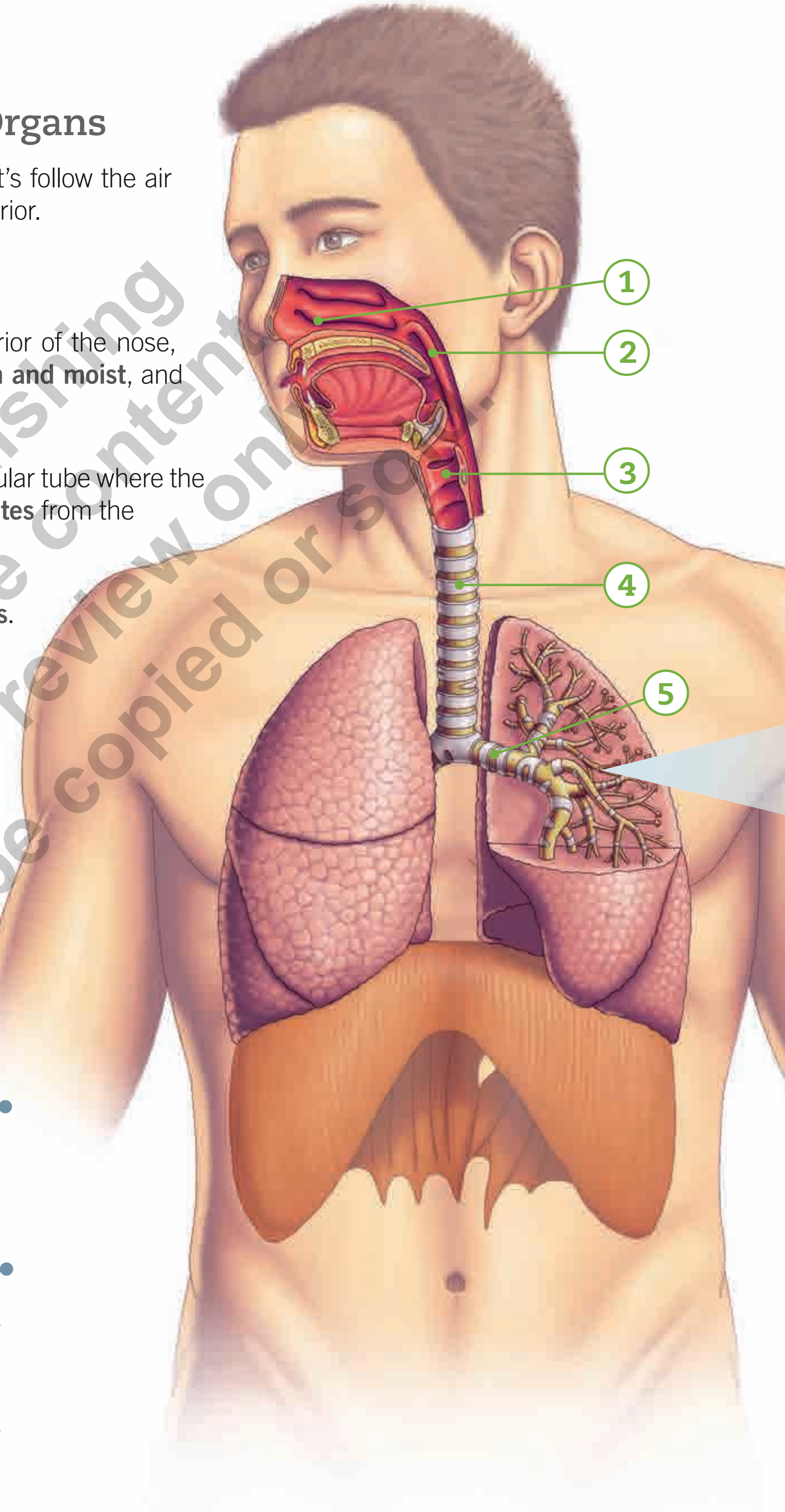
3 **Larynx:** We are now in the home of the **vocal cords**. When air exits, it makes these cords vibrate, which creates sounds. Vocal cords allow us to talk.

leaves

4 **Trachea:** We continue our journey through this tube. It consists of a series of **cartilage rings** that maintain its shape. As we travel down the trachea, the path divides in two: the bronchi.

5 **Bronchi:** Each bronchus enters a lung and then branches out into many narrower bronchial tubes.

divides



Did You Know...?

The trachea is also called the windpipe.

Fun Fact!

Some animals also have vocal cords, but these are different from human vocal cords. They allow them to make different kinds of sounds. Think of dogs and cats. What sounds do they make? Giraffes do not have vocal cords, so they cannot make sounds.

6 **Bronchial Tubes:** As we travel through these tubes, they get smaller and narrower. This allows air to reach the whole lung. At the end of the tubes, there are clusters of small sacs.

7 **Alveoli:** We have reached the end of the respiratory system, the alveoli. These are small clustered sacs, surrounded by capillaries. Oxygen enters the blood to reach all the cells in the body through the alveoli. Carbon dioxide (cell waste) travels through the blood into the alveoli to exit the body. This process is called gas exchange.

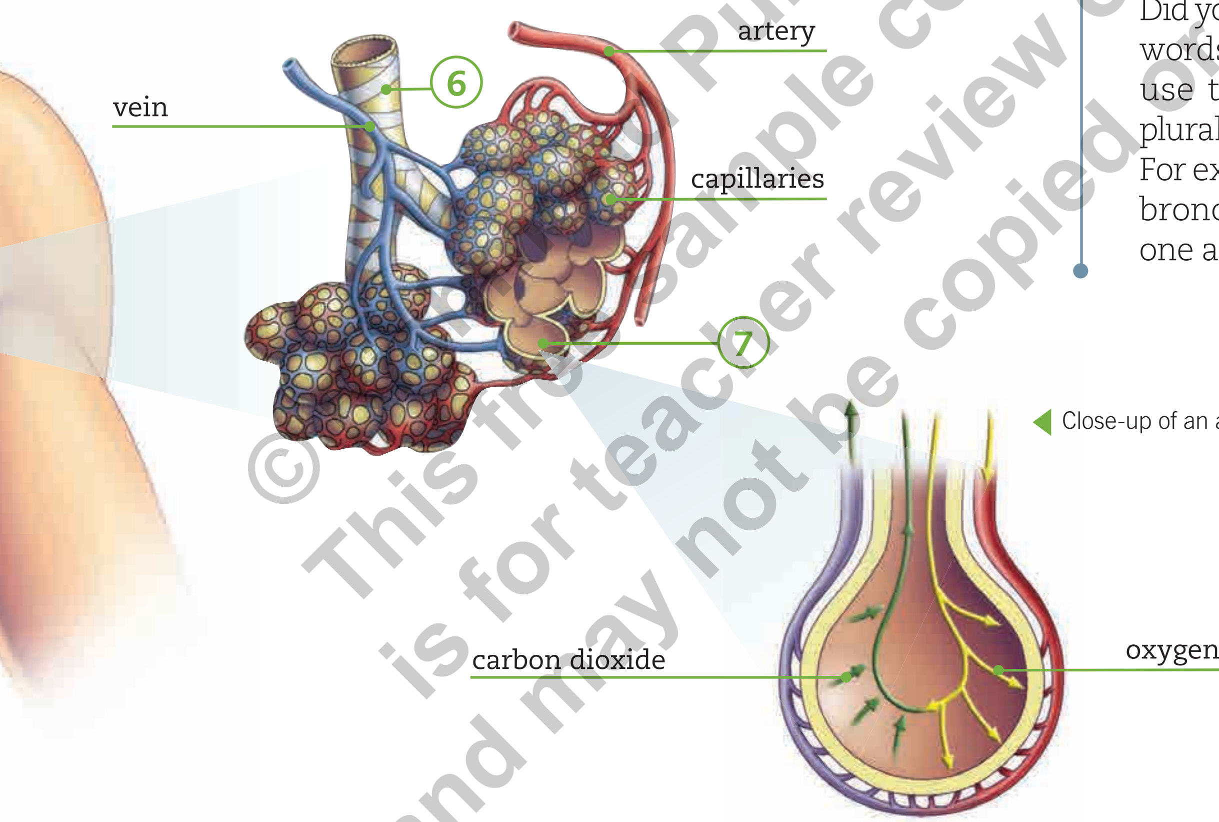
close groups

Staying Healthy

Cigarette smoke harms smokers' lungs and the lungs of anyone nearby. Damage includes loss of the elasticity or flexibility in the walls of the alveoli, decreasing the amount of oxygen absorbed by the blood.

Fun Fact!

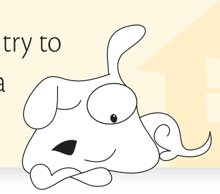
Did you know that all scientific words come from Latin? We use the Latin singular and plural endings for these words. For example, there can be one bronchus and two bronchi; one alveolus and two alveoli.



Close-up of an alveolus.

Education through Values

Although some clean vehicles exist, most modes of transportation contaminate the air we breathe. We should try to develop habits that do not contaminate the air. For example, you can ride a bicycle instead of getting a ride in a car. Little things can help make the environment better for everyone!



Exploring

You have now learned about some elements of respiration, such as how air goes from the outside world to the inside of our bodies. Work with your classmates to better understand how air enters and leaves our bodies.

extends

1. Work in groups of four.
2. You will need a pencil, a notebook and a measuring tape.
3. Your classmate stands up and spreads his or her arms, as shown in the photograph.

Word Focus

Exhale means to breathe out.
Inhale means to breathe in.

4. Your partner **inhales** deeply and holds the air in while you measure around his or her chest, as shown in the photograph.
5. Ask your classmate to **exhale**, and then take another chest measurement.
6. Do the same with the rest of your group and complete the chart.

Name	Measurements of Thorax (cm)		Difference (cm)
	Inhale	Exhale	

7. Get together with your classmates and discuss your results. Answer the following questions.

a. What happened to the thorax when **inhaling**? Identify

____

b. What happened to the thorax when **exhaling**? Identify

____

c. What is the difference in these movements? Explain. Interpret

____

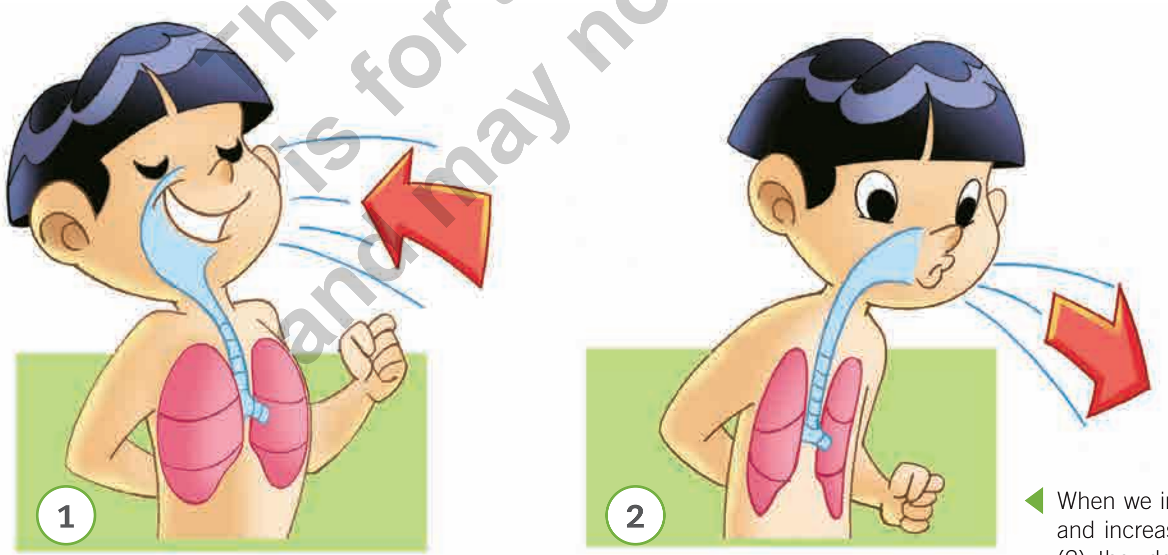
____

Understanding Respiration

In the previous activity, we proved that the thorax changes in size when breathing in and out. The thorax is bigger when we inhale and smaller when we exhale. Why? When we inhale, our lungs fill with air. When we exhale, the air leaves our lungs.

Word Focus

Chest is another word for thorax.



When we inhale (1), our lungs fill with air and increase in volume; when we exhale (2), they decrease in volume.

Practicing

1. Go to **Activity Card 1**. Number the parts of the respiratory system in order from inhaling air through the nasal passage to the alveoli. Identify

2. The chart below shows a child's thorax measurements upon inhalation and exhalation.

	Thorax Measurements (cm)	
Breath 1	63	81
Breath 2	61	83

a. Which numbers represent inhalation? Explain. Infer

b. Which numbers represent exhalation? Explain. Infer

c. Why are the changes in the thorax important? Explain. Hypothesize

Tip

Breathe (v) has the same vowel sound as meat. **Breath** (n) has the same vowel sound as met.

Summarizing

Air enters the body through the pulmonary airways. Then it reaches the lungs, where gas exchange occurs. This exchange consists of oxygen entering the blood and carbon dioxide leaving it.

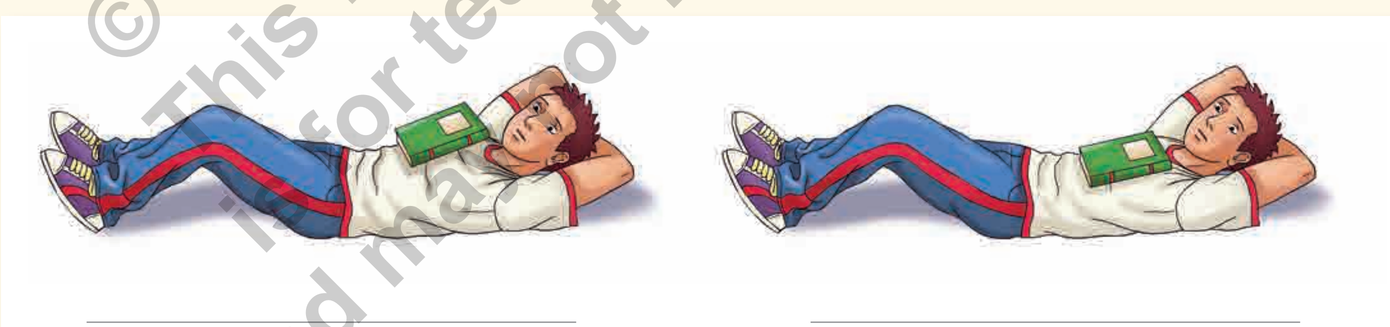
When we breathe, our thorax changes in size allowing air to enter and exit the lungs.

Quiz Yourself

1. Go to **Cutout 5** on **page 169**. Glue the pictures in the correct boxes and label the parts of the respiratory system. Identify

Tubes that enter the lungs.	Organ where air enters the body.	Sacs where gas exchange occurs.	Large duct that directs air to the bronchial tubes.	Organ that fills with air during inhalation.

2. Look at the following images and write which respiratory movements are shown. Draw an arrow showing in which direction the air is moving. Apply

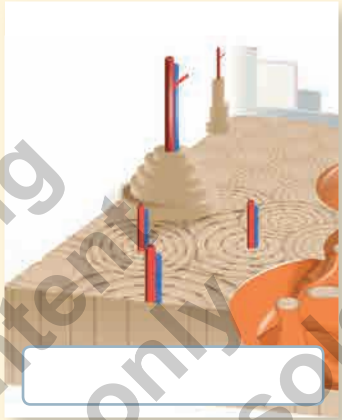


3. Explain gas exchange in the alveoli. Reread the **Summarizing** section on **page 50** if you need help. Explain

What Did You Learn?

1. Identify the level of biological organization shown in each image.

points
/ 5



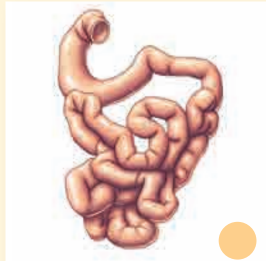
2. Complete the following table.

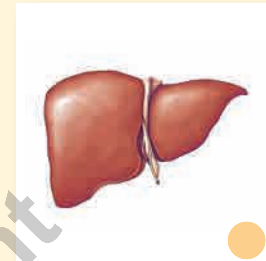
points
/ 10

Level of Biological Organization	Characteristics of the Level	Examples
Level 1		
Level 2		
Level 3		
Level 4		
Level 5		

3. Match each image with the correct description.

points
/ 4



This organ absorbs nutrients.	This organ produces bile to help digestion.	This organ helps eliminate waste.	This organ produces gastric juices to help digestion.

4. Fill in the blanks with the correct words.

points
/ 5

chyme	pylorus sphincter	esophagus	mouth	egestion

a. The bolus forms in the ______________________ before swallowing.

b. The ______________________ is located between the stomach and the small intestine.

c. The bolus passes from the mouth to the stomach through the ______________________.

d. After it passes through the stomach, food is called ______________________.

e. The process of eliminating waste is called ______________________.

5. Complete the table.

points
/ 4

	Veins	Arteries
Are the walls thick or thin?		
Does the blood go to the heart or to the organs?		

6. Complete the diagram.

points
/ 8

Blood

consists of

are

their function is

their function is

their function is

7. Which of the following statements about the human heart is **correct**?

point
/ 1

A. It expands and contracts to pump blood.
B. It is located under the lungs.
C. It contracts voluntarily.
D. It is a tissue.

8. Complete the following diagram showing the path of air from the nasal passage to the alveoli.

points
/ 5

nasal passage

alveoli

9. Complete.

points
/ 5

a. The movement that forces air out of the lungs is called ______________________.

b. In the alveoli, the absorption of oxygen and elimination of carbon dioxide occurs through

__________________________________.

c. The primary organs of the respiratory system are the ______________________________.

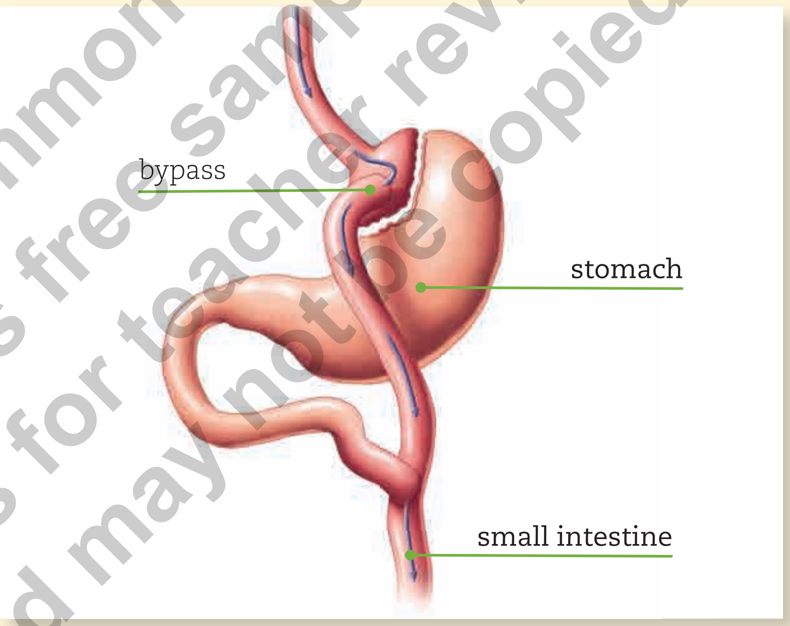
d. To allow air to enter the body, we need to ____.

e. The oxygen we need comes from the ____.

Scientific Skill: Predict

10. The following image shows gastric bypass surgery. This surgery is for people who suffer from severe obesity. Look at the image and answer the question.

points
/ 3



Using what you have learned in this unit, how can people who have this surgery absorb nutrients?

____

____

____