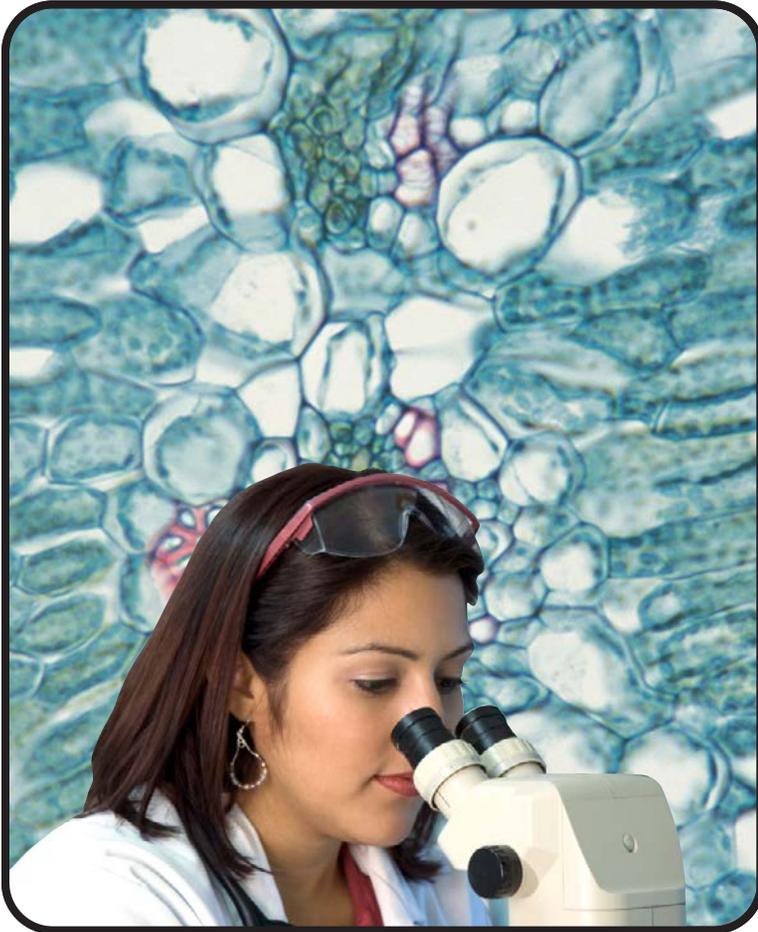


INSIDE LIVING THINGS

A Science A-Z Life Series

Word Count: 1,707



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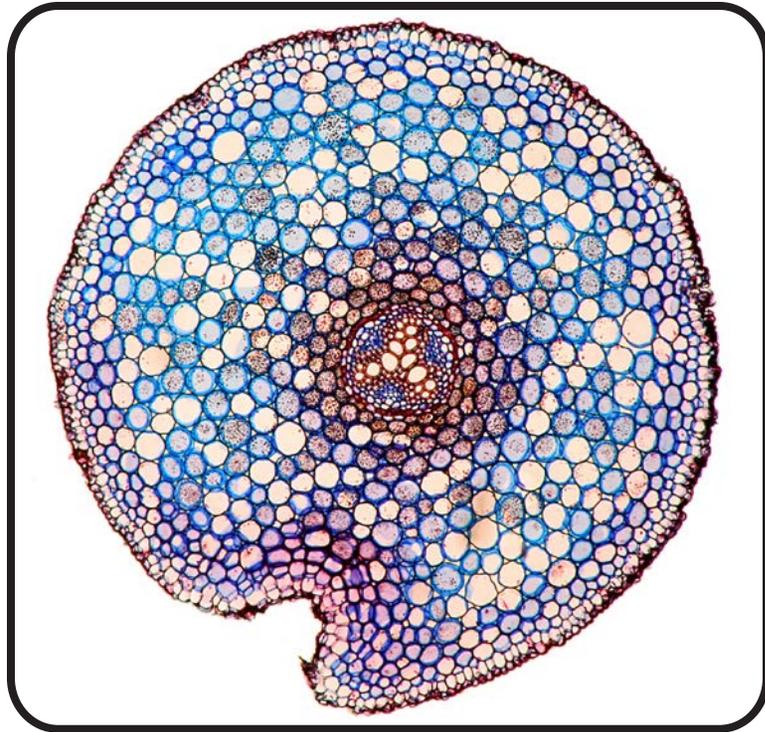
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INSIDE LIVING THINGS



Written by Ron Fridell

www.sciencea-z.com

KEY ELEMENTS USED IN THIS BOOK

The Big Idea: Humans have a common bond with all other life on Earth. All living things are made up of cells and have parts that help them meet their needs. Cells come together to form tissues, tissues work together to make organs, and organs combine to create body systems. These parts must work together to keep an organism healthy. All organisms are susceptible to illness and injury. An understanding of how bodies work can raise our awareness of our own health, leading us toward safe and healthy practices. In this way, we can protect our most important asset—our body.

Key words: antibodies, arteries, bacteria, body system, capillaries, cell, cell membrane, cell wall, chlorophyll, chloroplasts, circulatory system, cytoplasm, digestive system, disease, heart, immune system, infection, lungs, microorganism, mitochondria, muscle, muscular system, nervous system, nucleus, nutrients, organ, oxygen, pathogens, photosynthesis, plasma, pores, respiratory system, skeletal system, tissue, trillion, vacuoles, veins

Key comprehension skill: Compare and contrast

Other suitable comprehension skills: Main idea and details; cause and effect; classify information; identify facts; elements of a genre; interpret charts, graphs, and diagrams

Key reading strategy: Connect to prior knowledge

Other suitable reading strategies: Summarize; ask and answer questions; visualize; using a table of contents and headings; using a glossary and bold terms

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Front cover photo: an illustration of an animal cell

Back cover photo: a scientist looking at a slide of plant cells

Title page photo: a microscopic image of the cross section of the root of a buttercup plant

Inside Living Things

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Microscopes help us see inside cells.

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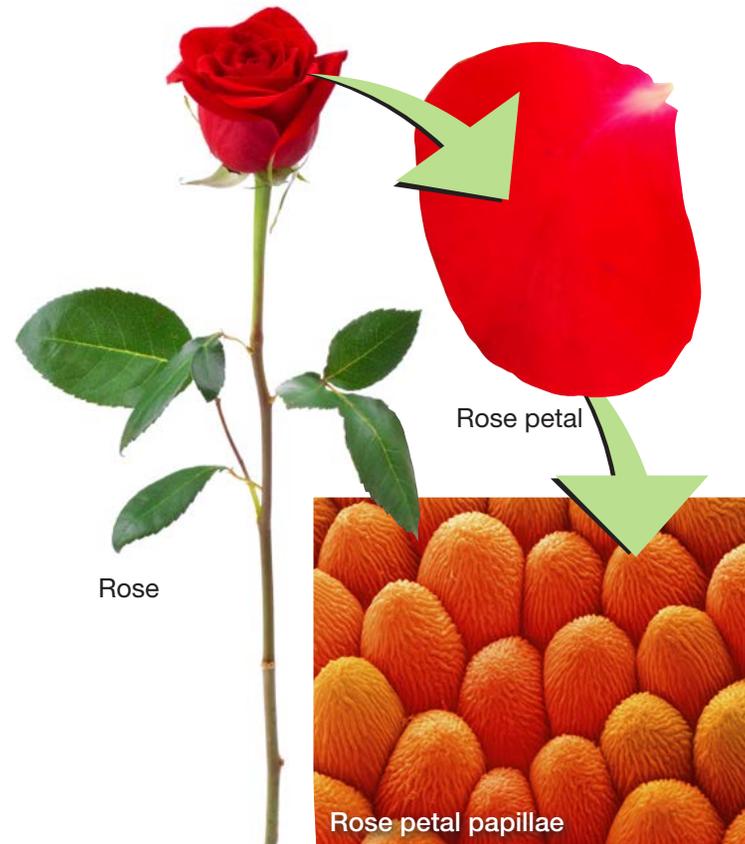
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Introduction

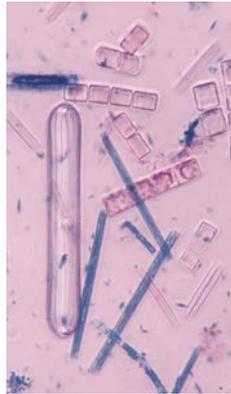
Suppose you had microscopic X-ray vision. You would be able to take a deep look inside living things. What would you learn? What would you discover deep inside a rose, for example? Or an elephant? Or a human being like yourself? This book will explore these questions by looking deep inside living things.



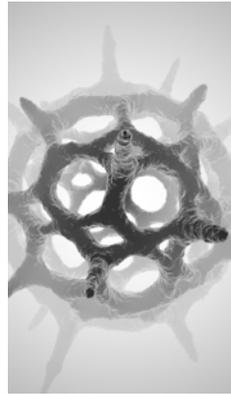
The closer you look at an organism, the more structures and parts you see.



Algae



Diatoms



Protozoa

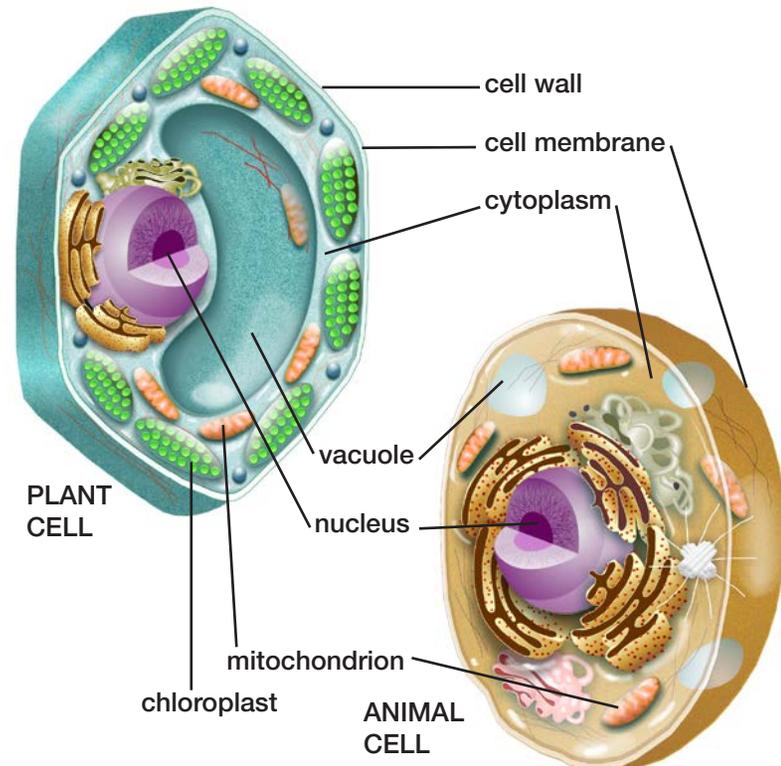
Cells

All living things are made of **cells**. Cells are the smallest units of life. They produce the energy that makes living things grow and function.

Some living things have only one cell. Tiny algae, diatoms, and protozoa are examples of organisms that have only one cell. All of the activities needed for each organism's survival are carried on in its cell. Organisms with one cell live in a wide range of places. This includes ponds, rivers, and soil. Some one-celled organisms are even found inside the bodies of other living things.

Other organisms have many cells. All of the cells work together so the organism can live. The bigger the organism, the more cells it usually has. An organism as big as a whale has trillions of cells.

There are two basic types of cells: plant cells and animal cells. Let's look at an animal cell. The outer covering of an animal cell is called the **cell membrane**. This membrane is like a filter. It allows certain things to pass into and out of the cell. Nutrients are allowed to enter the cell. Waste is allowed to exit. Inside the cell membrane is a jellylike fluid called **cytoplasm**. Other cell parts float in the cytoplasm. One important part is the **nucleus**. The nucleus is like the cell's brain. It controls all the cell's activities.



Plant and animal cells have many of the same parts. But plant cells have a cell wall and chloroplasts, which animal cells don't.

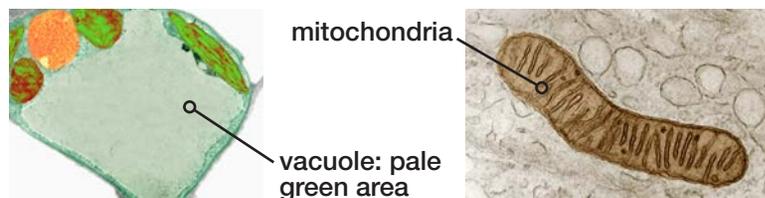
PLANT CELLS: FOOD AND STORAGE

Animals have to eat food in order to live. However, plants can make their own food. Plants store a special material called *chlorophyll*. It is found in the plant's *chloroplasts*. Chlorophyll absorbs energy from light. The plant uses this energy with other materials from air and water to make food. This process is called **photosynthesis**. Animal cells do not have chlorophyll or chloroplasts.

In many ways, plant cells are like animal cells. Both have a cell membrane, a nucleus, and cytoplasm. But they also have some parts that are different. A plant cell has a **cell wall** that surrounds the cell membrane. The cell wall supports the cell. Animal cells do not have cell walls.

All cells turn food into energy. **Mitochondria** are cell parts that change energy into forms that cells can use to do their jobs.

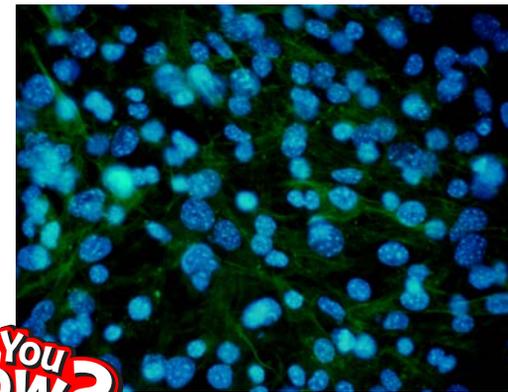
Most cells also have several sac-like structures called **vacuoles**. These structures store food and water until the cell needs them. They also store waste until it can be removed from the cell.



Different Kinds of Cells

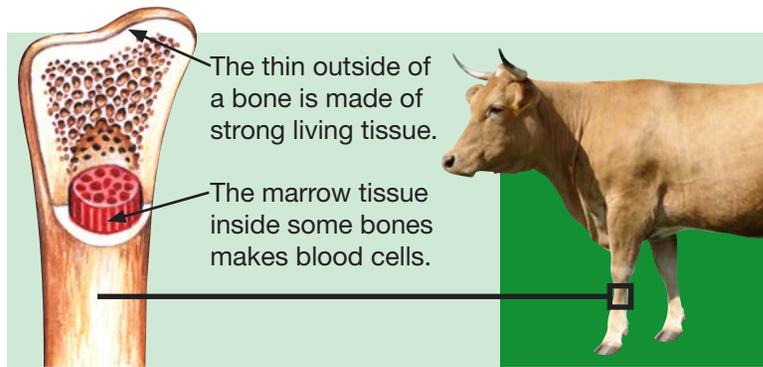
Not all cells are alike. An organism's cells differ, depending on their function. To better understand how cells can differ, let's take a look at some kinds of cells found in animals.

Most animals have many parts that work together. Each part is made up of different kinds of cells. There are muscle cells, nerve cells, blood cells, and hundreds of other types of cells. The cells must all work together to keep the body working correctly.



Do You Know?

Scientists estimate that there are about 75 trillion (75,000,000,000,000) cells in the human body, though the exact number changes. Cells are always growing, dying, and being replaced. These cells are very small. It would take ten thousand (10,000) cells just to cover the head of a pin.



Tissues

Cells that are alike form **tissues** to do a specific job. For example, animals use muscle tissue to move arms and legs. This tissue is made of muscle cells. Bone, skin, and blood are other kinds of tissues. Let's take a closer look at some of the tissues in your body.

Bone tissue makes bones. Some bone tissue has the mineral calcium. Calcium makes bones hard. This type of bone protects softer parts of the body. For example, your rib cage is made of hard bone. It protects your heart and other organs. Marrow

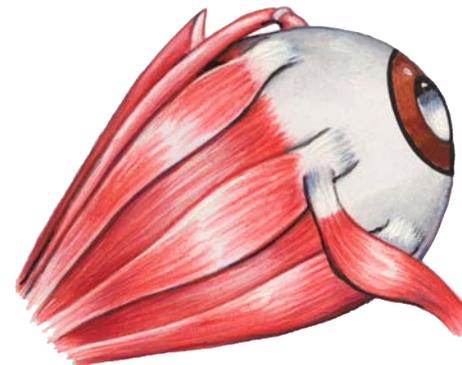
PLANT TISSUES

Plant tissues are different from animal tissues. Plants have *xylem* (ZY-lum) tissue, which carries water throughout the plant. *Phloem* (FLOW-um) tissue carries the plant's food.

is a different type of bone tissue. It is found inside larger bones. This tissue makes blood cells.

Your tissues are always working to keep you alive. Muscle tissue in your heart is always pumping blood tissue through your body. Blood tissue carries nourishment to cells. It also carries waste from cells. The muscle cells in muscle tissue tighten and then relax to move different parts of your body.

For example, reading these words uses many different types of tissues. Muscle tissue is moving your eyes back and forth across this page. At the same time, nerve tissue is carrying messages from cell to cell. The messages tell your eye muscles to move. Other messages are carried back to your brain. Your brain is a mass of nerve tissue. It



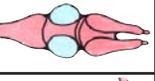
figures out the words you see and gives them meaning. Your muscle tissue and nerve tissue are working together to help you read these words.

The muscle cells in this dog's eye contract and then relax to move the eye back and forth.

Organs

Different types of tissue working together to do a particular job form an **organ**. Eyes are organs. So are lungs, brains, bones, skin, and hearts.

The table below shows various frog organs and the special function they perform.

Frog Organs	Art	Function
Heart		pumps blood to tissues
Lungs		put oxygen into the blood
Brain		runs all body activities
Stomach		breaks down food
Small intestine		absorbs nutrients from food
Kidneys		store waste from body
Liver		cleans waste from blood

PLANT ORGANS

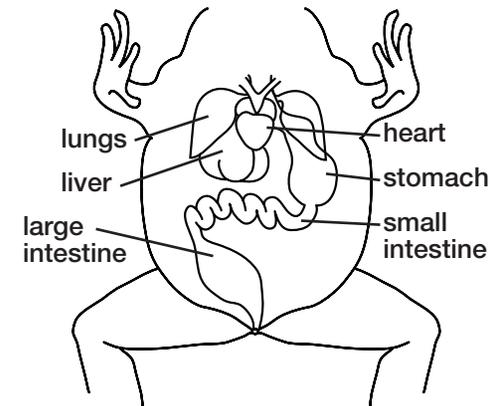
Both plants and animals have organs. Plant organs include the flower, stem, leaves, and roots. What do you know about each organ's purpose?

Body Systems

When several organs work together in an animal, they form a **body system**. This is where all the work done by cells, tissues, and organs comes together to keep an organism alive. Every animal has body systems.

The chart on the next page shows ten systems found in the frog and many other animals. These systems are also found in humans. Notice how each system has a special purpose. For instance, the job of the digestive system is to break down the food the frog eats. Then the frog's cells can make energy from the bits of food.

The immune system's job is to fight off bacteria and other organisms that could make the body sick.



PLANT SYSTEMS

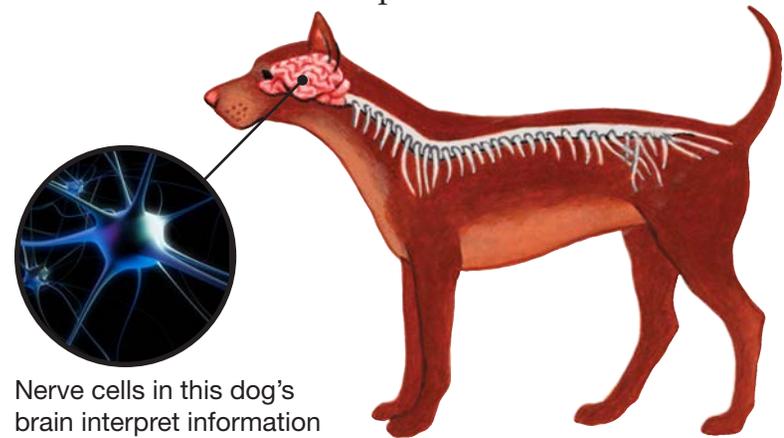
Plants have systems, too. They have the *root system*, below the ground, and the *shoot system*, which is everything above the ground.

TEN MAJOR BODY SYSTEMS		
System	Main Organs	Activities
Nervous	brain, spinal cord, nerves, and sense organs	Directs body's physical and mental activities
Muscular	frog: more than 60 muscles human: more than 600 muscles	Moves the body and substances within the body
Skeletal	frog: 159 bones human: 206 bones	Protects and supports the body
Respiratory	lungs and trachea	Supplies oxygen and removes gas wastes
Digestive	mouth, esophagus, stomach, intestines, kidneys, and liver	Breaks down food so the body can use it
Circulatory	blood vessels and heart	Transports oxygen, nutrients, and cell wastes through the body
Endocrine	pancreas, thyroid, pituitary, and other glands	Controls activities of internal organs
Immune	white blood cells and antibodies	Defends the body against bacteria and other invaders
Reproductive	female: ovaries, uterus male: testicles	Makes it possible for organisms to produce new offspring
Excretory	liver, kidney, bladder, lungs, skin	Removes waste from the body

Mission Control

All our systems are important. The nervous system, though, is especially important. It is the communication and control system for all the other systems. It gathers and uses information to control almost all of an organism's tasks. The nervous system includes several organs, such as the nose, eyes, ears, skin, and tongue. It also includes nerve cells that connect the brain to organs and all body parts. (Plants do not have nervous systems. Instead, their cells communicate by using chemicals that flow through the tissues.)

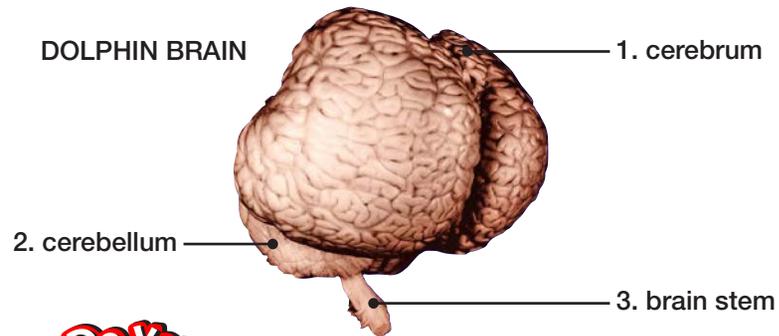
Nerve cells are different from other types of cells in many ways. Most importantly, they carry signals that allow body parts to communicate with each other. Sense organs use nerve cells to send information to the brain. The brain then sends back orders to respond.



Nerve cells in this dog's brain interpret information from the rest of its body.

The Boss

The brain of many animals has three main parts. Each plays a particular role in directing the body's activities. (1) The cerebrum manages incoming information from the senses. It helps control thinking and speaking. It is the largest part of the human brain. Most animals' brains have smaller cerebrums than human brains. (2) The cerebellum is in charge of controlling balance and the position of the body. It helps organize muscle movement. (3) The brain stem controls systems that work on their own, such as the circulatory and respiratory systems.



Other animals have brains, too. Dogs, rats, lizards, and grasshoppers have brains. Even tiny ants and fleas have brains. A giant blue whale's brain is four times bigger than a human's brain. But even though the whale brain is large, it is not as big compared to the size of its body as a human brain is.



Tears and saliva help defend the body.



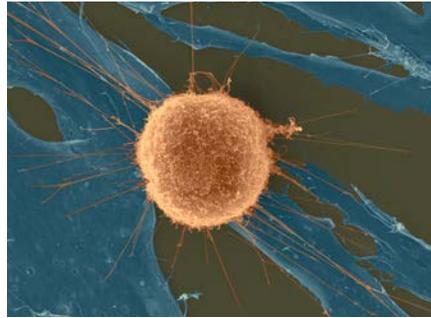
Not all microorganisms are harmful. In fact, many are helpful. For example, tiny bacteria in your digestive system help you digest the food you eat. Foods like yogurt contain these helpful bacteria.

Body Wars

Did you know that most organisms have a special system that protects them from other, harmful organisms? This is called the *immune system*. Every day, animals and plants are threatened by harmful microorganisms that can cause disease. These microorganisms are known as **pathogens**.

Pathogens can enter an organism through its various openings. Even so, the organism works to keep out pathogens. The skin of animals and plants stops many of them. The saliva in humans' and other animals' mouths kills some pathogens. The digestive juices in the stomach kill others. Even tears wash some pathogens away.

Some pathogens still succeed in breaking through an organism's defenses. They can infect cells and spread disease. At that point, an organism's immune system enters the battle. In animals with blood, white blood cells recognize the invader. More white blood cells are quickly made. They attack the pathogens and kill them. They also kill the cells that the pathogens have infected.



A human white blood cell attacks cancer cells.

Meanwhile, other white blood cells produce **antibodies**. These are chemicals that kill certain kinds of pathogens. The antibodies cause the pathogens to clump together. As clumps, they are easier to recognize and destroy.

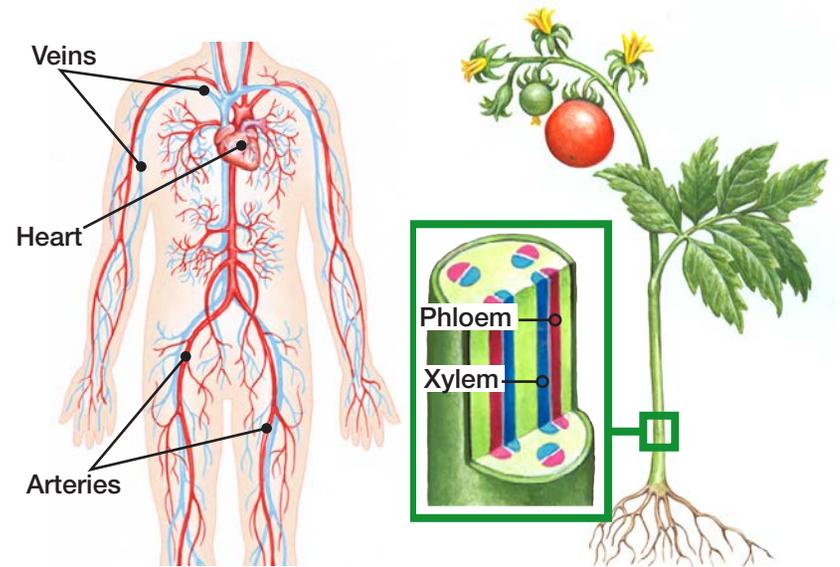
Do You Know?

All organisms have some way of defending themselves against disease. Trees ooze sap to heal cuts and keep away invasive bugs. Plants and insects use chemicals to ward off microorganisms. Even tiny bacteria use special parts to engulf and destroy other bacteria.

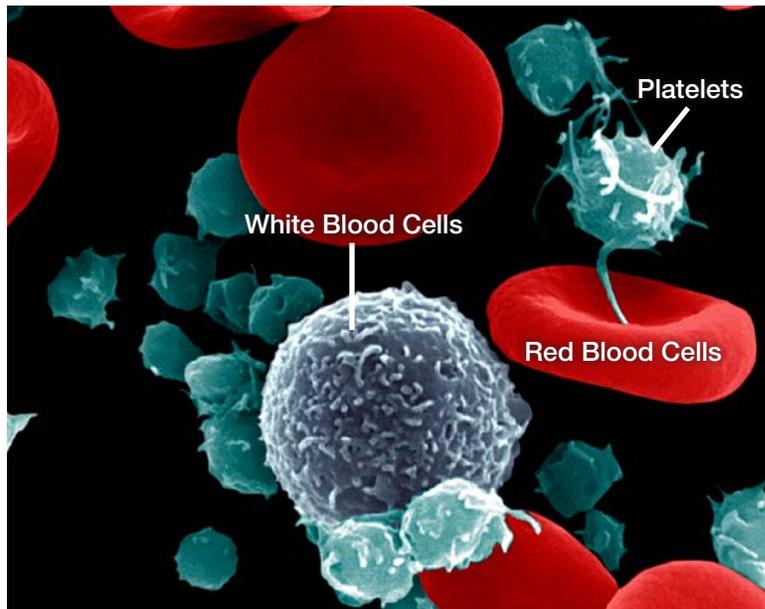
Rivers of Nutrients

Let's take a closer look at one other important system—the circulatory system. This system is like many interconnected tubes. In both animals and plants, the liquid running through these tubes delivers nutrients to cells. It also takes away the cells' waste products. In animals, the liquid is blood. In plants, the liquid is mostly water.

In animals, these tubes are miles and miles of blood vessels. Vessels called **arteries** carry blood to cells. Vessels called **veins** carry blood away from cells. Arteries and veins are connected by tiny vessels called **capillaries**. These vessels deliver antibodies to and take waste products from cells.



In humans, blood vessels circulate nutrients to all parts of the body. In plants, the phloem does this job.



In mammals, red blood cells have no nucleus, but white blood cells do. Platelets are not cells—they are packets of proteins.

The liquid part of animal blood is called **plasma**. Plasma is mostly water, but it also carries red blood cells and white blood cells. Red blood cells carry oxygen to body cells. White blood cells help fight off diseases. Blood also contains platelets. These structures help clot blood and stop bleeding when you are injured.

Do You Know?

Insects have blood, too—but it's green instead of red. That's because insect blood doesn't carry oxygen. Insects have tiny holes in their bodies that let in oxygen and release waste gas.

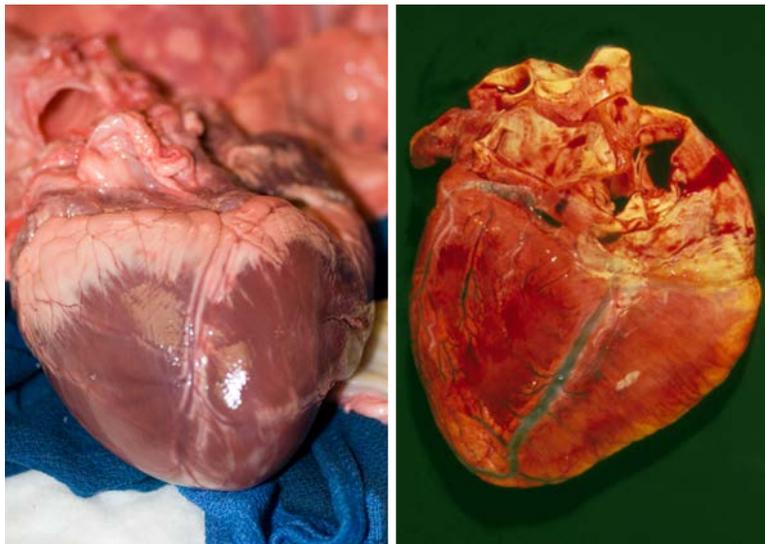
Blood does one more important task. In addition to bringing oxygen to cells, it also takes waste away from cells. Just as you produce waste and need to go to the bathroom several times a day, your cells also produce waste while they do their tasks. That waste needs to be removed. That's the other job of blood.



Breathing out releases waste gases from your cells.

Blood collects carbon dioxide gas (CO_2) and other waste from cells. It takes the CO_2 to your lungs. You release CO_2 when you breathe out. Blood takes other wastes to your kidneys. When you go to the bathroom, you get rid of waste from your cells.

In plants, the circulatory system is made mostly of xylem and phloem tissues. The xylem moves water from the roots up to the leaves. Phloem moves nutrients that the leaves make to other cells. Plants release waste through their leaves.



A pig heart (left) is similar in size and shape to a human heart (right).

In animals, the heart is like an engine that runs the circulatory system. A human adult heart is a powerful muscular organ about the size of your fist. An adult heart beats about 70 times a minute (it's a little faster in teens and children). Each beat moves blood along inside all those vessels.

Math Moment

If a human lives to the age of 80, and his or her heart beats an average of 70 times a minute, how many times will his or her heart beat through a lifetime?
Hint: How many minutes are there in an hour, day, and year with 365 days?

Conclusion

Organisms with many cells are complicated machines. The human body alone has trillions of cells. These cells make up hundreds of different types of tissues. The tissues combine to make dozens of organs that are parts of systems that all work together. No wonder scientists and doctors often specialize in one organ or type of cell. Understanding the complex system that is your body, and knowing how it works, will help you enjoy a long, healthy life.



Scientists study the structures inside living things to better understand how whole organisms can be their healthiest.

Glossary

antibodies	chemicals that attack pathogens in the body (p. 17)
arteries	blood vessels that move oxygen-rich blood from the heart to the body tissues (p. 18)
body system	a group of organs in the body that work together (p. 12)
capillaries	the tiniest blood vessels that carry blood from arteries to veins (p. 18)
cells	the smallest independently functioning units in an organism (p. 5)
cell membrane	the outside covering of an animal cell that is also inside the cell wall of plant cells (p. 6)
cell wall	the firm outside covering of a plant cell (p. 7)
cytoplasm	the liquid that lies inside the cell membrane (p. 6)
mitochondria	cell parts that produce energy (p. 7)

nucleus	the cell part that controls a cell's activities (p. 6)
organ	a part of an organism, made of different kinds of tissue, that has a specific function (p. 11)
pathogens	unicellular organisms that cause disease (p. 16)
photosynthesis	the process that plants use to make their own food (p. 7)
plasma	the liquid part of blood in which blood cells flow (p. 19)
tissues	groups of cells in an organism that are similar in form and function (p. 9)
vacuoles	cell parts that store water, nutrients, and waste (p. 7)
veins	blood vessels that carry blood back from the body's cells to the heart (p. 18)

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