

# Levels of Cellular Organization

## ESSENTIAL QUESTION

*How are  
living things  
organized?*

By the end of this lesson, you should be able to describe the different levels of organization in living things.

### **I** Indiana Standards

**7.3.3** Explain that although the way cells function is similar in all living organisms, multicellular organisms also have specialized cells whose specialized functions are directly related to their structure.

**7.3.6** Explain that after fertilization, a small cluster of cells divides to form the basic tissues of an embryo which further develops into all the specialized tissues and organs within a multicellular organism.

**7.3.7** Describe how various organs and tissues serve the needs of cells for nutrient and oxygen delivery and waste removal.

*The eye of a green iguana is an organ made of millions of cells and many layers of tissues.*

# Lesson Review

## Vocabulary

In your own words, define the following terms.

1 homeostasis

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2 endocytosis

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## Key Concepts

3 **Compare** What is the difference between passive and active transport?

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4 **List** List four things that cells do to maintain homeostasis.

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5 **Describe** What happens during mitosis?

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6 **Apply** How do the cells in your body get energy?

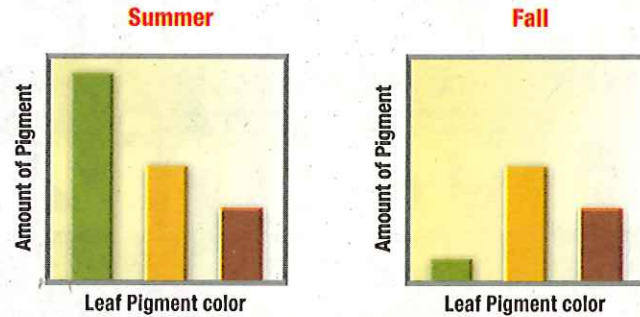
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## Critical Thinking

Use the graphs to answer the next two questions.



7 **Compare** How do the amounts of green pigment, chlorophyll, differ from summer to fall?

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8 **Infer** How do you think the change in chlorophyll levels is a response to changes in the length of day from summer to fall?

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9 **Explain** Why is homeostasis important for cells as well as for an entire organism?

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## Engage Your Brain

**1 Describe** Fill in the blank with the word or phrase you think correctly completes the following sentences.

Your body has many organs, such as a heart and \_\_\_\_\_

Plant organs include stems and \_\_\_\_\_

Animal and plant organs are organized into organ systems, much like you organize your homework in \_\_\_\_\_

**2 Explain** How is the structure of a hammer related to its function?



## Active Reading

**3 Relate** Many scientific words, such as *organ* and *tissue*, also have everyday meanings. Use context clues to write your own definition for each underlined word.

It is helpful to use a tissue when sneezing to prevent the spread of droplets carrying bacteria.

**tissue:**

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An organ can be very difficult to play.

**organ:**

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### Vocabulary Terms

- organism
- tissue
- organ
- organ system
- structure
- function

**4 Apply** As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

# Body Building

## Active Reading

**5 Identify** As you read, underline the characteristics of unicellular and multicellular organisms.

## How are living things organized?

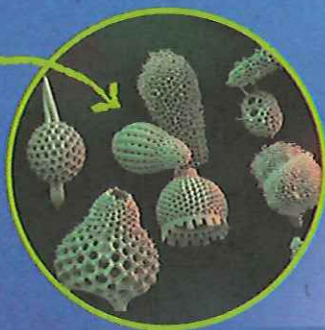
An **organism** is a living thing that can carry out life processes by itself. *Unicellular organisms* are made up of just one cell that performs all of the functions necessary for life. Unicellular organisms do not have levels of organization. Having only one cell has advantages and disadvantages. For example, unicellular organisms need fewer resources and can live in harsh conditions, such as hot springs and very salty water. However, a disadvantage of being unicellular is that the entire organism dies if the single cell dies.

## Cells

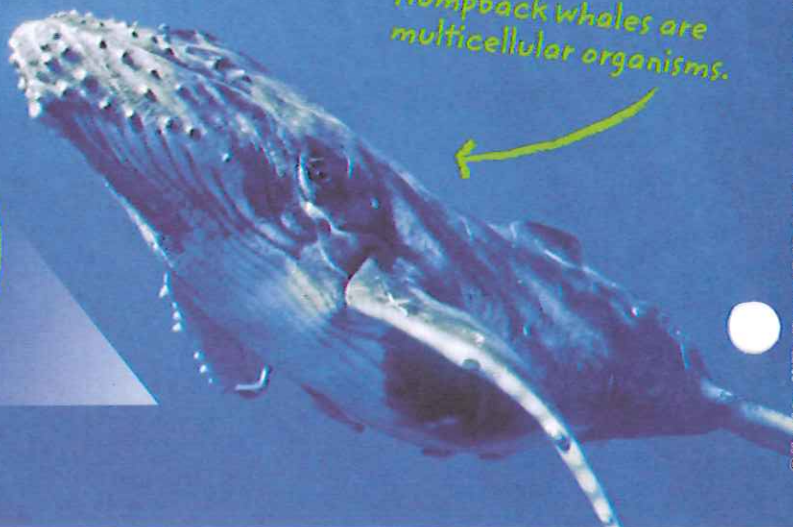
*Multicellular organisms* are made up of more than one cell. These cells are grouped into different levels of organization, including tissues, organs, and organ systems. The cells that make up a multicellular organism, such as humans and plants, may be specialized to perform specific functions. Many multicellular organisms reproduce through sexual reproduction, during which a male sex cell fertilizes a female sex cell. After fertilization, a small cluster of cells divides from the basic tissues of an embryo, which further develops into all the specialized tissues and organs within a multicellular organism. Other characteristics of multicellular organisms include larger size and a longer life span.

There are some disadvantages to being multicellular. Multicellular organisms need more resources than do unicellular organisms. Also, the cells of multicellular organisms are specialized for certain jobs, which means that cells must depend on each other to perform all of the functions that an organism needs.

Diatoms are microscopic unicellular organisms that live in water.



Humpback whales are multicellular organisms.



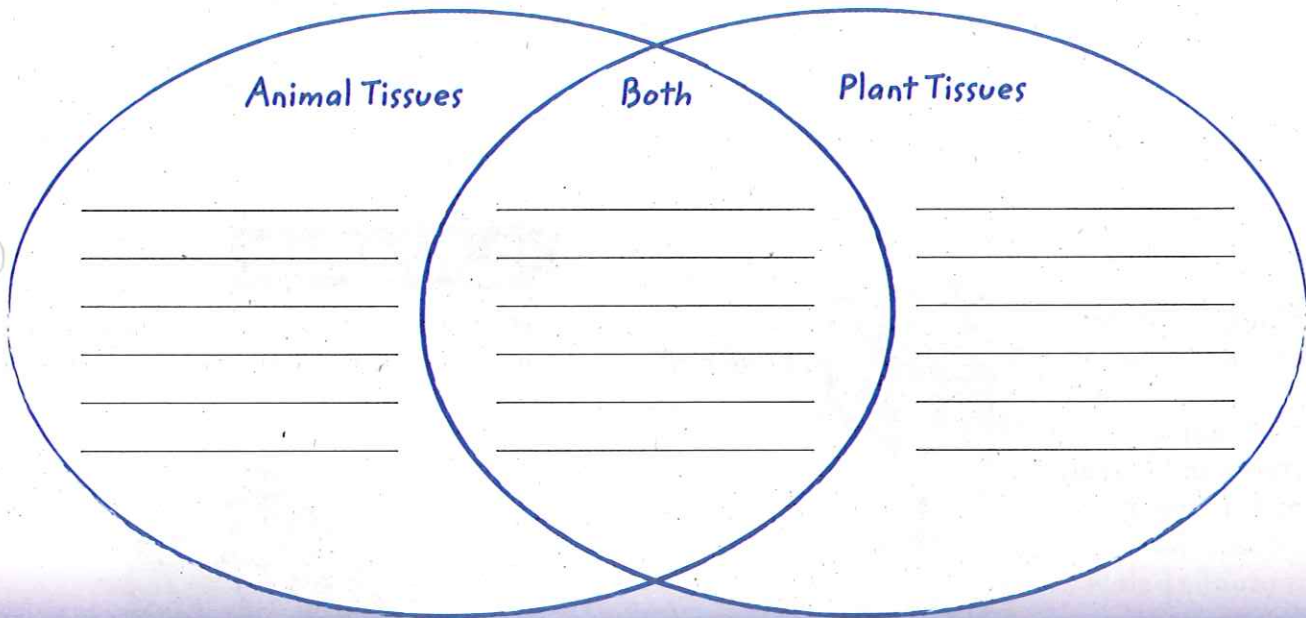
# Tissues

A **tissue** is a group of similar cells that perform a common function. Humans and many other animals are made up of four basic types of tissue: nervous, epithelial, connective, and muscle. Nervous tissue functions as a messaging system within the body. Epithelial tissue is protective and forms boundaries, such as skin. Connective tissue, including bones and blood, holds parts of the body together and provides support and nourishment to organs. Muscle tissue helps produce movement.

Plants have three types of tissue: transport, protective, and ground. Transport tissue moves water and nutrients throughout the plant. Protective tissue protects the outside of the plant. Ground tissue provides internal support, storage, and absorbs light energy to make food in photosynthesis (foh•toh•SYN•thuh•sys).



**6 Compare** Fill in the Venn diagram to compare the functions of animal tissues and plant tissues. What functions do they share?



## Visualize It!

**7 Apply** In which organism shown on the opposite page are cells organized into tissues? Explain your answer.

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\_\_\_\_\_

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## Organs

A structure made up of a collection of tissues that carries out a specialized function is called an **organ**. The stomach is an organ that breaks down food for digestion. Different types of tissues work together to accomplish this function. For example, nervous tissue sends messages to muscle tissue to tell the muscle tissue to contract. When the muscle tissue contracts, food and stomach acids are mixed and the food breaks down.

Plants also have organs that are made up of different tissues working together. For example, a leaf is an organ that contains protective tissue to reduce water loss, ground tissue for photosynthesis, and transport tissue to distribute nutrients from leaves to stems. Stems and roots are organs that function to transport and store water and nutrients in the plant. The trunk of most trees is a stem. Roots are usually below the ground.

### Active Reading

**8 Apply** How do organs relate to cells and tissues?

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Plants have two organ systems: the shoot system that includes stems and leaves, and the root system that is usually below the ground.



Plant cell



Leaf tissue



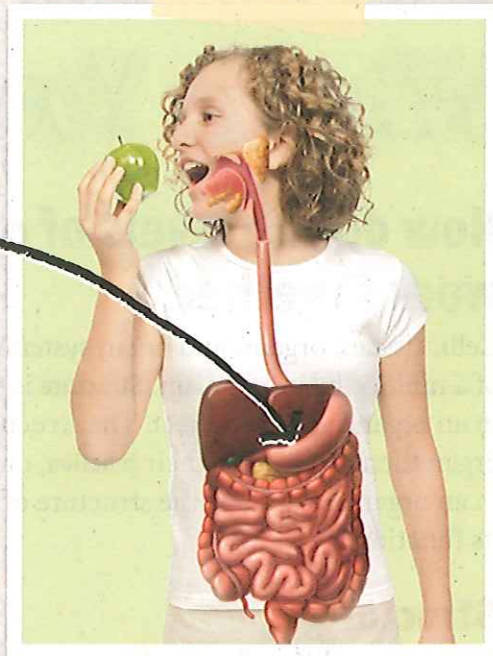
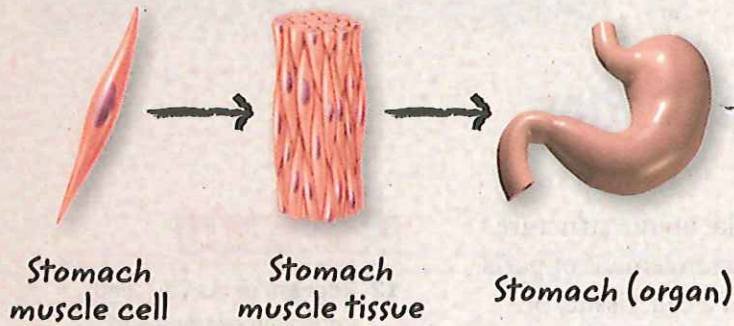
Leaf (organ)

### Visualize It!

**9 Identify** Label the organ system shown in the tree below. Then draw and label the tree's root system.



The digestive system is an organ system in many animals, including humans.



Human digestive system

**10 Infer** The cells that make up the stomach lining are tightly packed together to form a boundary of the stomach. Explain which basic type of tissue makes up this boundary of the stomach.

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## Organ Systems

An **organ system** is a group of organs that work together to perform body functions. Each organ system has a specific job to do for the organism. For example, the stomach works with other organs of the digestive system to digest and absorb nutrients from food. Other organs included in the digestive system are the esophagus and the small and large intestines.

Humans are made up of many organ systems. All of the systems have specific functions to keep the body alive.



### Think Outside the Book Inquiry

**11 Illustrate** Research an organ system of the human body other than the digestive system and draw a sketch of the organs included in that system.

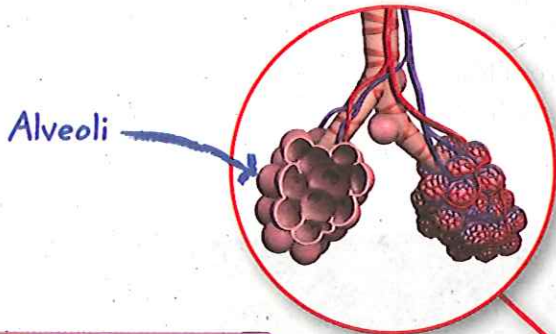
# What's Your Function?

## How do the levels of organization work together?

Cells, tissues, organs, and organ systems make up the structure of a multicellular organism. **Structure** is the arrangement of parts in an organism or an object. The structure of a cell, tissue, or organ then determines their **function**, or the activity of each part in an organism. In fact, the structure of any object can determine its function.

### Structure

A sports car differs from a dump truck even though they are both vehicles. The structure of the parts in a sports car allow it to go fast. A dump truck is large and sturdy, which allows it to haul things. Cells, tissues, and organs also vary in structure. For example, bone cells look different from plant leaf cells. A lung differs from a stomach because they have different functions.



### Visualize It!

**13 Relate** How does the structure of the alveoli relate to their function in the lungs?

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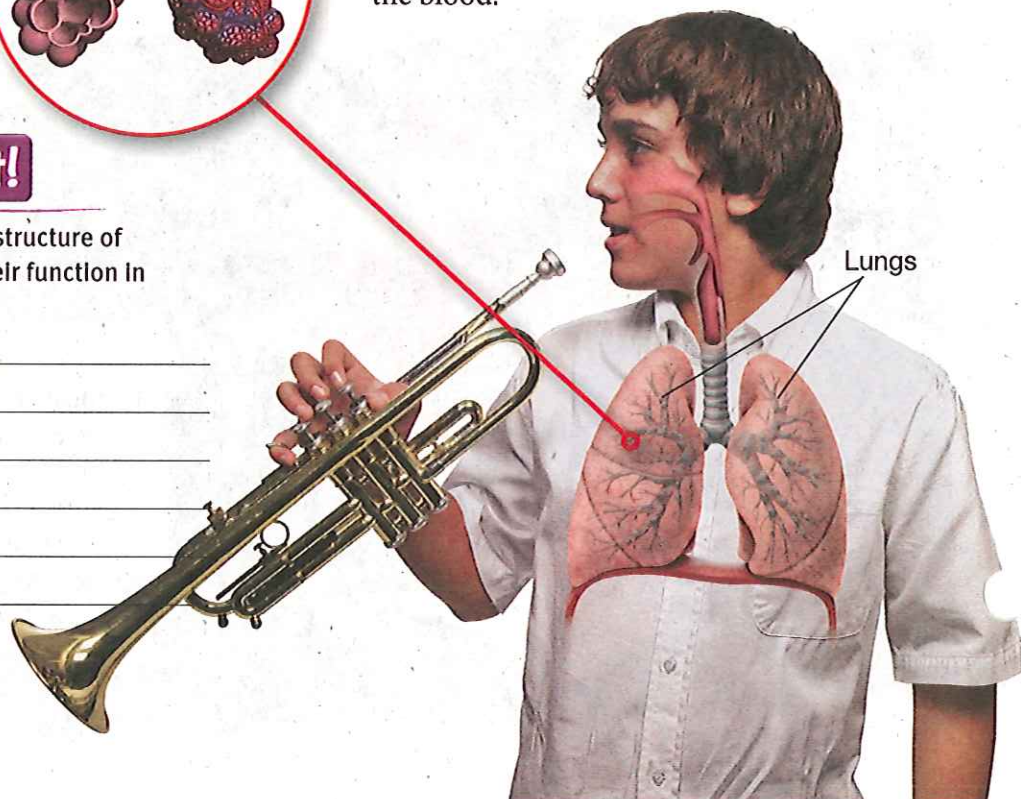
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### Function

The structure of each vehicle determines what function the vehicle performs. The relationship of structure and function is true for cells, too. Cells, tissues, and organs are specialized to perform specific functions. Those that have similar structures likely have similar functions. For example, a lung is an organ made up of cells and tissues that work together to help you breathe. The lungs are made up of millions of tiny air sacs called *alveoli* (ahl•VEE•oh•lye). The large number of alveoli increases the surface area of the lungs to allow enough oxygen and carbon dioxide to move between the lungs and the blood.



### Active Reading

**12 Recognize** As you read, underline examples of cellular structures.



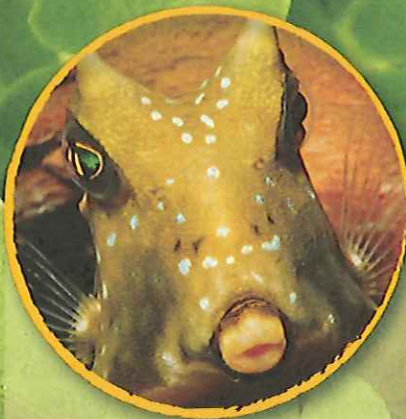
# Odd Bodies

With millions of different organisms that exist on Earth, it's no wonder there are so many different body structures. Some organisms have special structures, which can help them eat, or not be eaten!



## Can't Touch This!

Named for its prickly body, the spiny katydid doesn't make much of a meal for its predator. Male katydids sing loudly at night to attract female katydids. The singing can also attract predators, such as bats, who hunt for food at night. Its spines provide the katydid with some protection from being eaten.



## Blow on Your Food

The Long Horned Cowfish is a marine organism that lives on the sandy bottom at up to 50 m deep. Its permanently puckered mouth helps the cowfish find food. The cowfish blows jets of water into the sand to find and feed on tiny organisms.



## Night Vision

The tarsier's huge eyes provide excellent vision for hunting insects at night. Its eyes average 16 mm in diameter, but the tarsier's overall body size ranges from 85 mm to 165 mm. In comparison, your eyes would be the size of apples! When the tarsier spots its prey, it leaps through the air to pounce on it. The tarsier's long fingers help it grasp branches when it's on the move.

## Extend

- 14 Relate** How does the body structure of each of these organisms contribute to a particular function?
- 15 Contrast** How do structures in organisms compare with structures of nonliving things such as construction cranes, buildings, ships, airplanes, or bridges?

- 16 Imagine** Describe an organism that might live in an extreme environment like inside a volcano, deep in the ocean, or in an icy cave. Is it a plant or an animal? What special structures would it have in order to survive in that environment?

## Inquiry

# Systems at Work

## What tasks do systems perform to meet the needs of cells?

Complex organisms are made up of many systems. Whether it is a bone cell or a skin cell, each cell in the organism needs to receive nutrients, exchange carbon dioxide and oxygen, and have waste products taken away. Systems work together in ways that serve the needs of the cells in complex organisms.

A unicellular organism must perform all functions necessary for life, such as getting nutrients, exchanging gases, and removing wastes. The functions must be performed by a single cell, because there is no opportunity for cell specialization.

Multicellular organisms face different challenges. Multicellular organisms have different cell types that can work together in groups to perform specific functions. Groups of cells that work together form tissues. Groups of tissues that work together form organs, and groups of organs that work together form systems. Systems work with other systems. In most animals, the digestive, respiratory, and excretory systems interact with the circulatory system to maintain healthy cells. A circulatory system delivers nutrients to body cells and carries away wastes. It carries oxygen to cells and removes carbon dioxide.

Some plants have a vascular system that transports water and nutrients to and from cells throughout the plant. Xylem and phloem are tissues that make up the vascular system. Xylem transports water from roots to cells. Phloem transports nutrients made in leaf cells to all parts of the plant.

### Active Reading

**17 Compare** How do unicellular organisms and multicellular organisms compare in meeting their needs to stay alive?

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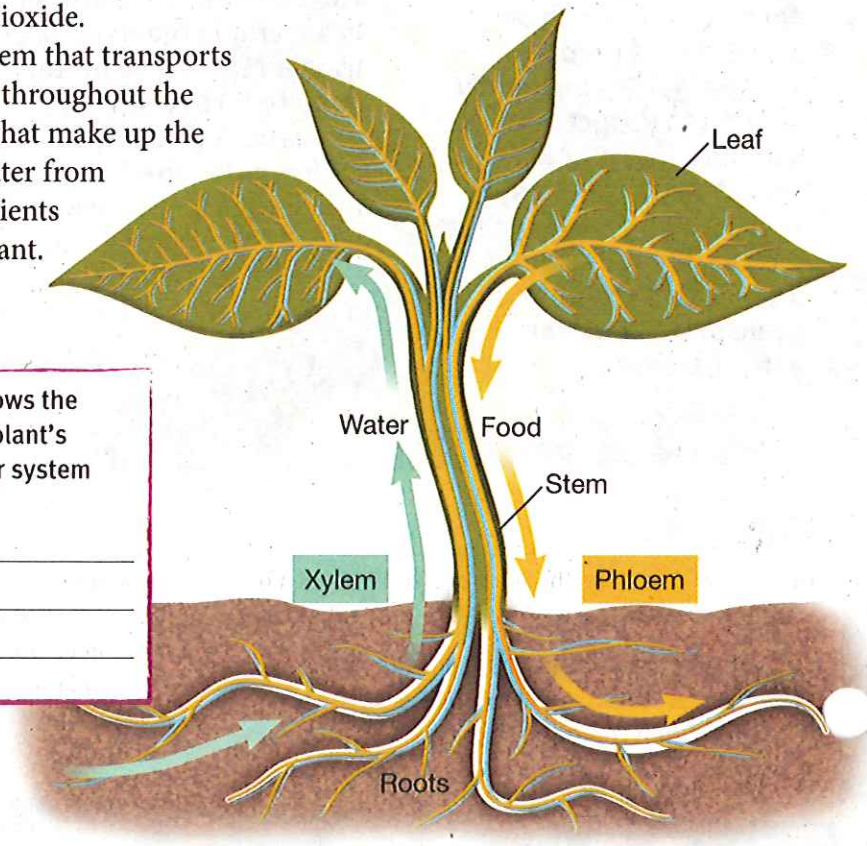
### Visualize It!

**18 Analyze** The diagram at the right shows the xylem and phloem that make up the plant's vascular system. How does a vascular system serve the needs of plant cells?

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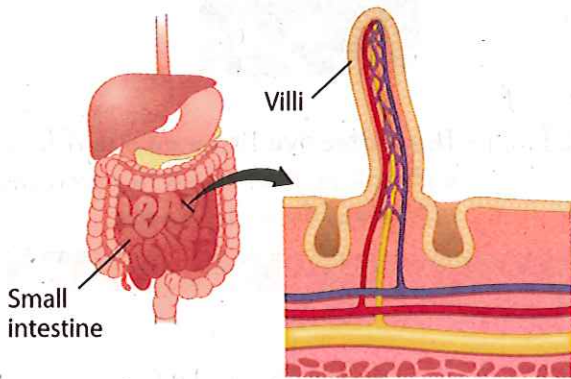
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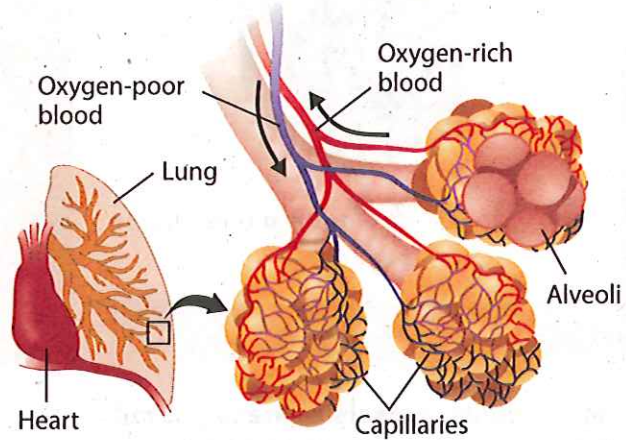
## Delivering Nutrients

The digestive system in most animals breaks down food mechanically and chemically. In most animals, the digestive system works with a circulatory system. In the small intestine, nutrients are absorbed through thousands of finger-like projections in the wall of the small intestine and then into the blood vessels of the circulatory system. Once in the blood, the nutrients are delivered to cells throughout the body.



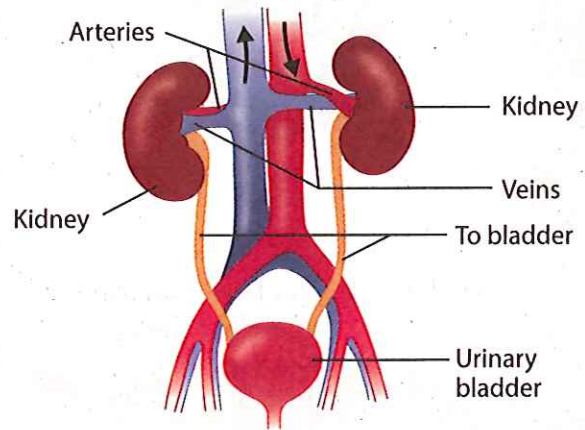
## Delivering Oxygen

In animals, taking in oxygen is a function of the respiratory system. Depending on the animal, oxygen enters a body through skin, gills, spiracles, or lungs. There, it comes in contact with the circulatory system. Oxygen enters the bloodstream and is carried to the cells of the body. Once in the cells, oxygen is used to release energy from nutrients from digestion.



## Removing Wastes

Skin, lungs, the digestive system, and the kidneys all have processes for removing waste products from body cells. Sweat evaporates from the skin. Solid wastes and some water move out as part of the digestive system. Carbon dioxide and some water are breathed out through the respiratory system. In humans, the largest amount of excess water and waste products from cells is carried by the blood to the kidneys. There, wastes are filtered out of the blood through a complex series of tubules in the kidneys and leave the body as urine.



## Visualize It!

**19 Synthesize** Notice that oxygen-poor blood (blue) and oxygen-rich blood (red) are shown in all three diagrams. Describe how blood helps serve the needs of some animal cells.

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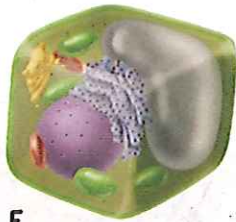
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# Visual Summary

To complete this summary, fill in the blanks with the correct word. Then, use the key below to check your answers. You can use this page to review the main concepts of the lesson.

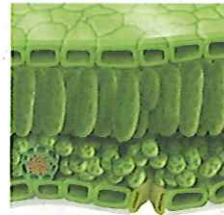
## Cellular Organization

All organisms are made up of one or more cells.



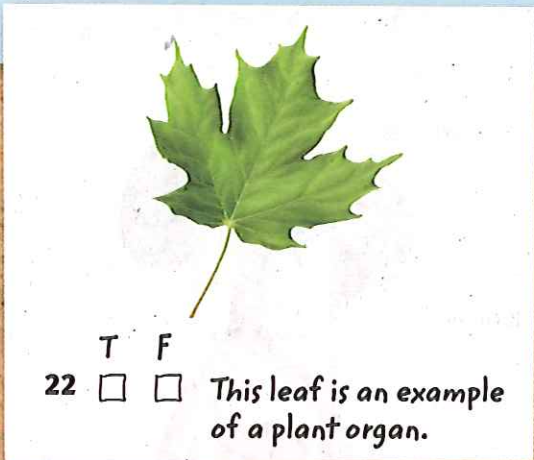
T F  
20.   A plant is a unicellular organism.

The structures of cells, tissues, and organs determine their functions.

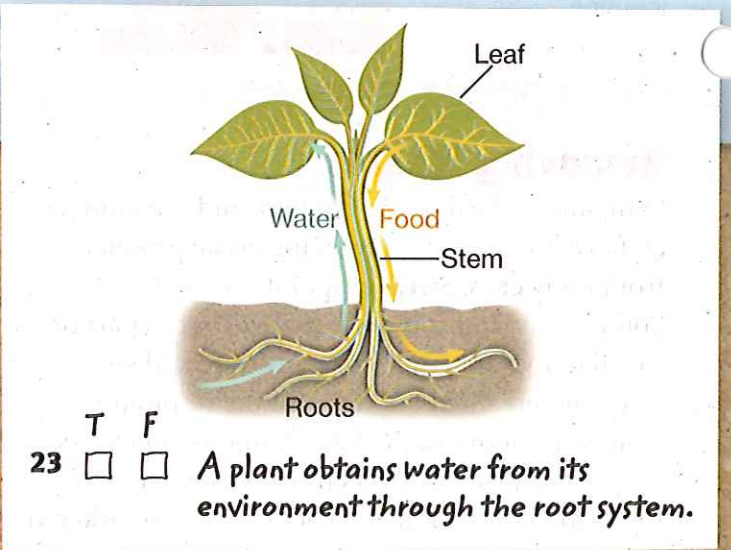


T F  
21.   The protective tissue on a leaf has a structure that keeps the moisture in the leaf from drying out.

Multicellular organisms are organized into tissues, organs, and organ systems.



T F  
22.   This leaf is an example of a plant organ.



T F  
23.   A plant obtains water from its environment through the root system.

Answers: 20 F; 21 T; 22 T; 23 T

**24 Synthesize** How do cells, tissues, organs, and organ systems work together in a multicellular organism?

# Lesson Review

## Vocabulary

Fill in the blank with the term that best completes the following sentences.

- Animals have four basic types of \_\_\_\_\_: nervous, epithelial, muscle, and connective.
- Together, the esophagus, stomach, and intestines are part of a(n) \_\_\_\_\_.

## Key Concepts

- Describe** What are the levels of organization in multicellular organisms?

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- Analyze** Discuss two benefits of multicellular organisms having some specialized cells rather than all the cells being the same.

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- Relate** How do the structures in an organism relate to their functions?

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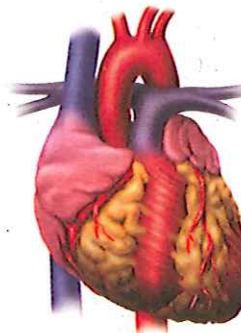
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## Critical Thinking

Use the figure to answer the next two questions.



Human heart

- Apply** What level of organization is shown here?

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- Relate** How does this level of organization relate to cells? To organ systems?

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- Analyze** Explain why a circulatory system is important in meeting the needs of all cells throughout an animal's body.

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# My Notes