



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.

S7L2.b Organization of tissues, organs, systems, and organisms

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



Lesson Labs

Quick Labs

- Evaluating Specialization
- Observing Plant Organs

Exploration Lab

- The Organization of Organisms



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 a(n) _____.

Plant organs include stems and _____.

Animal and plant organs are organized into organ systems, thus resembling the way 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:

An organ can be very difficult to play.

organ:

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?

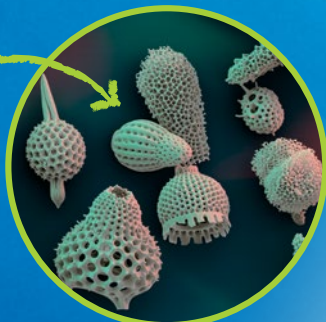
An **organism** is a living thing that can carry out life processes by itself. *Unicellular organisms* are made up of just one cell that performs all of the functions necessary for life. Unicellular organisms do not have levels of organization. Having only one cell has advantages and disadvantages. For example, unicellular organisms need fewer resources, and some 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.

Into 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, are specialized to perform specific functions. Many multicellular organisms reproduce through sexual reproduction, during which a male sex cell fertilizes a female sex cell. The single cell that results from fertilization divides repeatedly. This cell division forms the basic tissues of an embryo, which further develop into all of the specialized tissues and organs within a multicellular organism. Other characteristics of multicellular organisms include a larger size and a longer lifespan than unicellular organisms.

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 to live.

Diatoms are microscopic unicellular organisms that live in water.



Humpback whales are multicellular organisms.



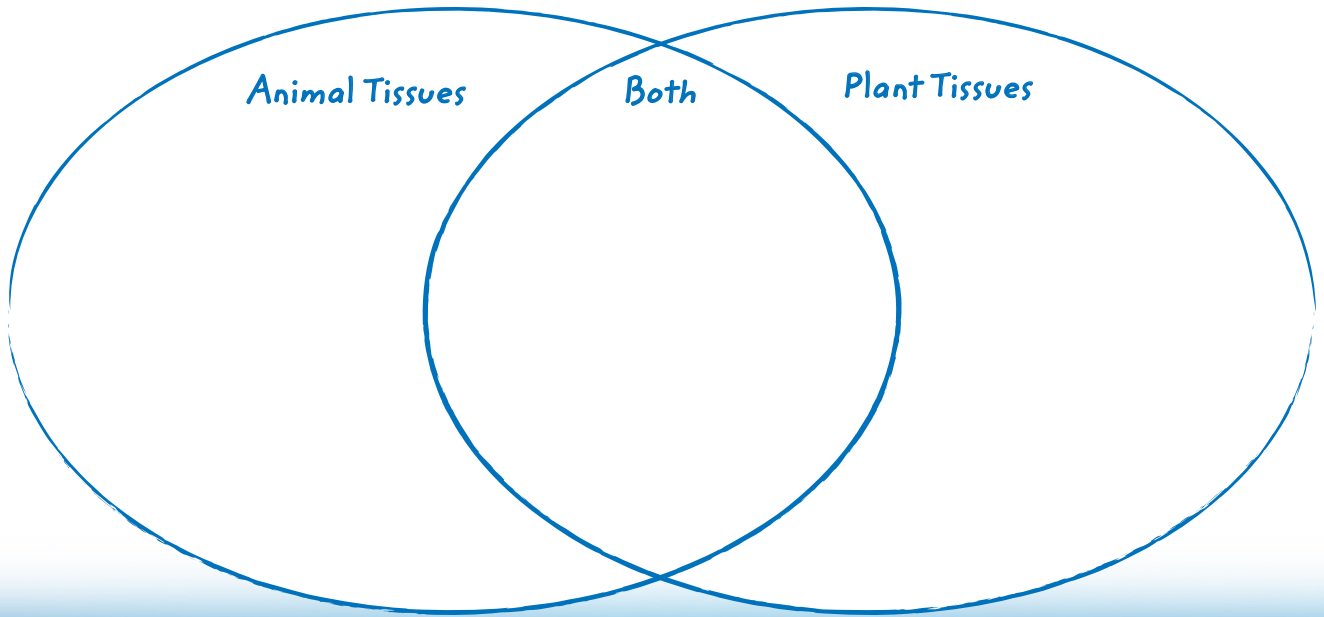
Into Tissues

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 through the plant. Protective tissue protects the outside of the plant. Ground tissue provides internal support and storage and absorbs light energy to make food in photosynthesis (foh•toh•SIN•thuh•sis).



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 Does either one of the organisms shown on the opposite page contain cells that are organized into tissues? Use evidence to support your answer.

Into 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 the stomach's 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 move 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?

Two organ systems in plants include the shoot system, which includes stems and leaves, and the root system, which is usually found below the ground.



Plant cell



Leaf tissue



Leaf (organ)

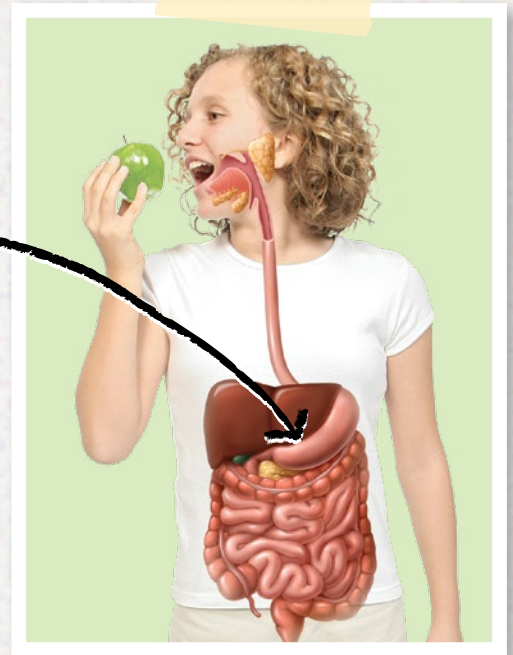
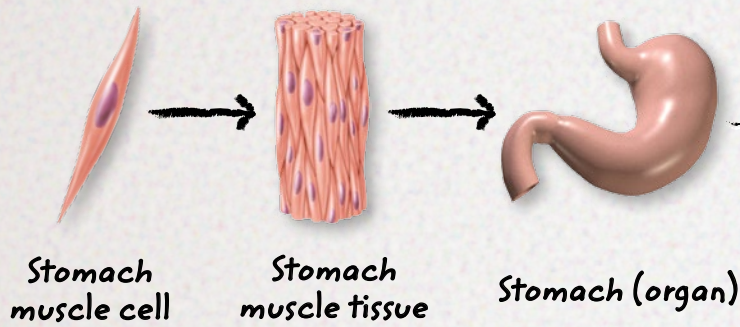


Visualize It!

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 found in most animals, including humans.

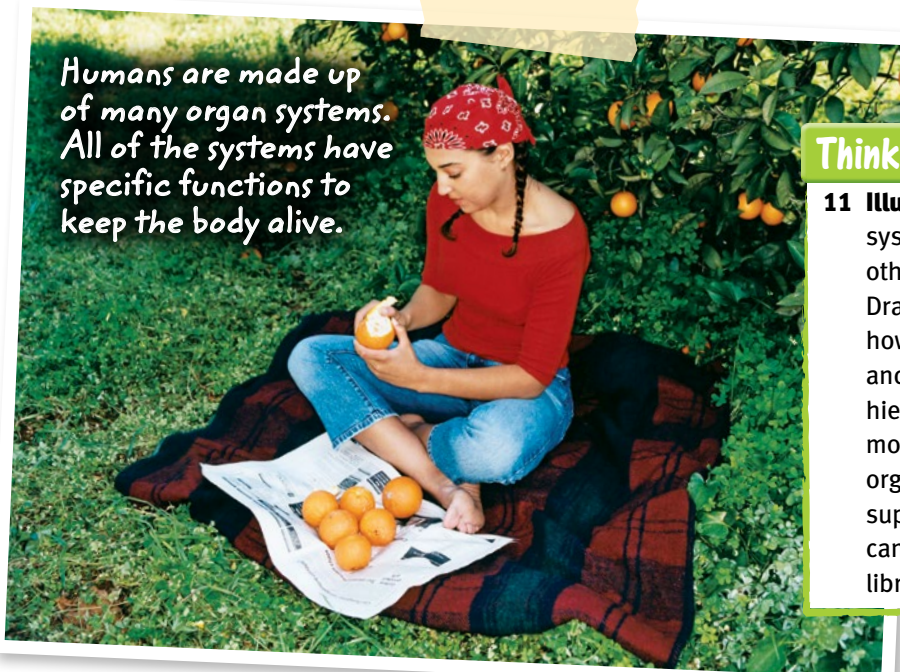


Human digestive system

10 Claims • Evidence • Reasoning Voluntary muscles can be controlled, while involuntary muscles cannot. Do you think stomach muscle is voluntary or involuntary? Provide evidence to support your reasoning.

Into 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. Draw a conceptual model of how the cells, tissues, organs, and systems are organized hierarchically. Then, use the model to conclude how the organization of the human body supports specific functions. (You can refer to resources in your library or to Unit 4.)

What's Your Function?

What is the connection between structure and function?

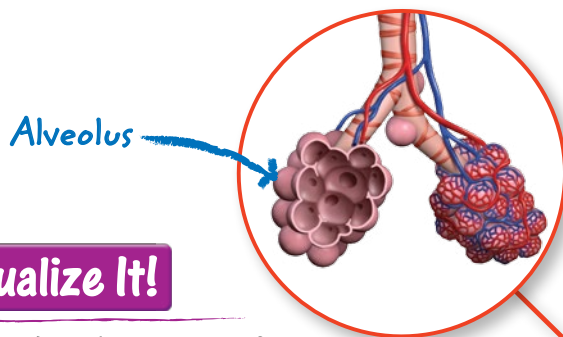
Cells, tissues, organs, and organ systems make up the structure of a multicellular organism. **Structure** is the arrangement of parts in an organism or an object. The structure of a cell, tissue, or organ determines its **function**, or the activity of each part in an organism. In fact, the structure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

Active Reading

12 Recognize As you read, underline examples of multicellular structures.

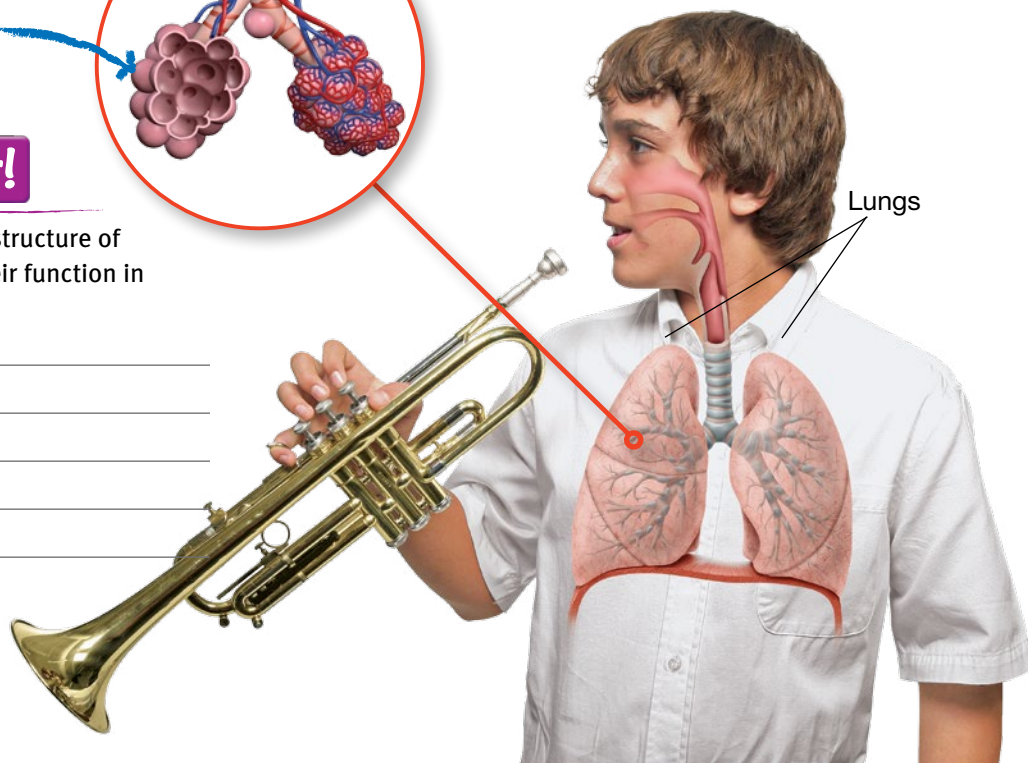
Structure Determines Function

Cells, tissues, and organs vary in structure. For example, bone cells look different from plant leaf cells. A lung differs from a stomach because the two organs have different functions. Cells, tissues, and organs are specialized to perform specific 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* (singular, *alveolus*). The large number of alveoli increases the surface area of the lungs to let enough oxygen and carbon dioxide move between the lungs and the blood.



Visualize It!

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



Why It Matters

Odd Bodies

WEIRD
SCIENCE

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 that 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 longhorn cowfish is a marine organism that lives on the sandy ocean bottom at depths up to 50 m. 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

Inquiry

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

- 16 Claims • Evidence • Reasoning** Describe an organism that might live in an extreme environment such as inside a volcano, deep in the ocean, or in an icy cave. What type of organism is it? What special structures would it have in order to survive in that environment? Summarize evidence to support your claim and explain your reasoning.

Systems at Work

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

Complex organisms are made up of many systems. These systems work together to perform actions needed by cells to function properly. 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.

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.

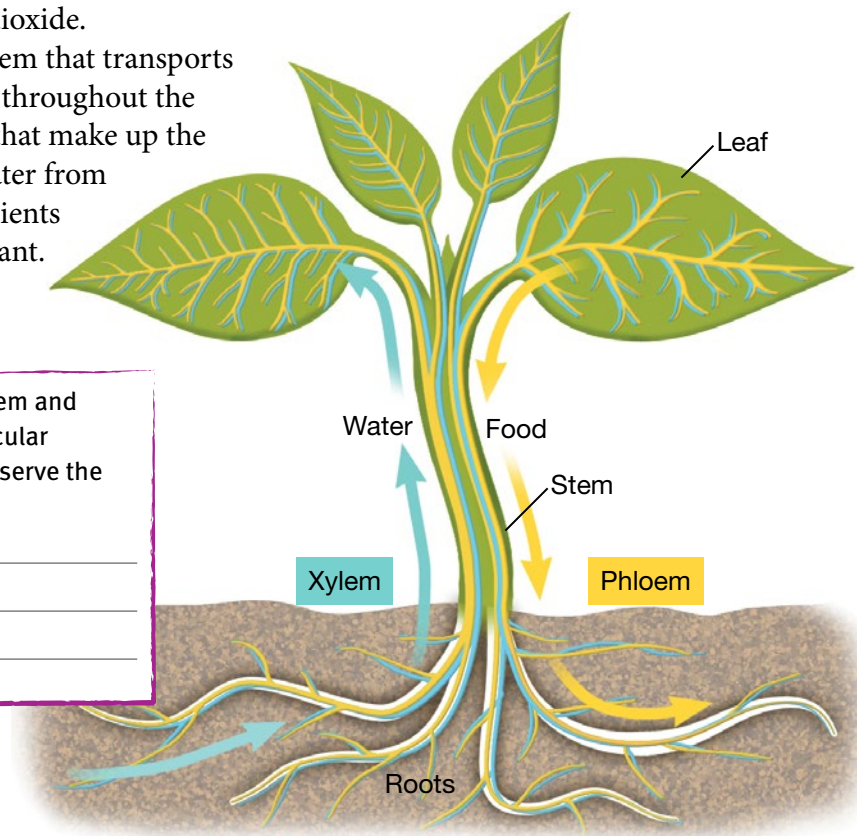
Some plants have a vascular system that transports water and nutrients to and from cells throughout the plant. Xylem and phloem are tissues that make up the vascular system. Xylem transports water from roots to cells. Phloem transports nutrients made in leaf cells to all parts of the plant.

Active Reading

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

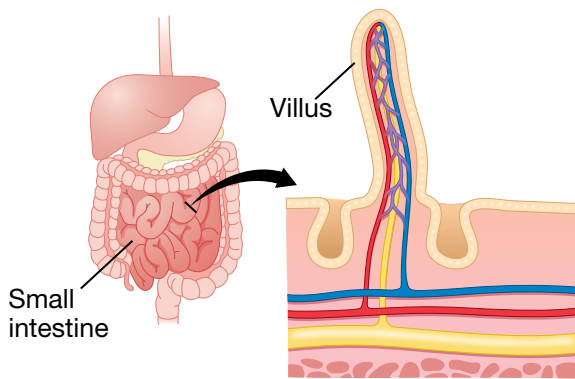
Visualize It!

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



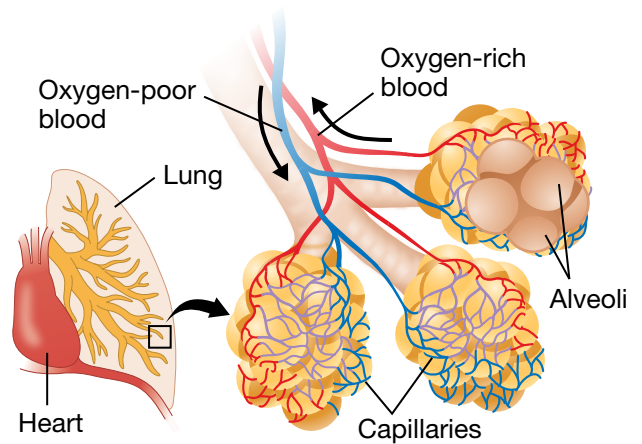
Delivering Nutrients

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, called villi, and then into the blood vessels of the circulatory system. Once in the blood, the nutrients are delivered to cells throughout the body.



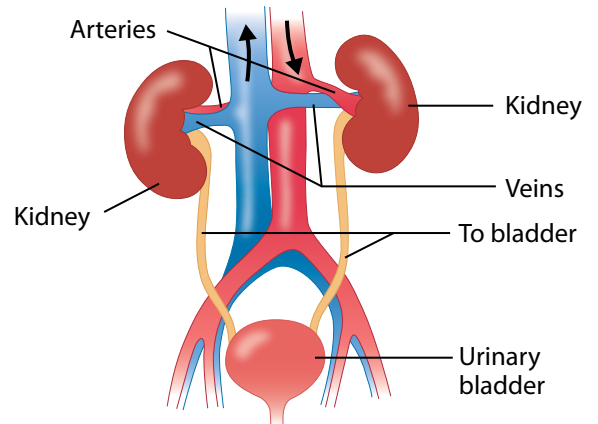
Delivering Oxygen

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 the body. 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!

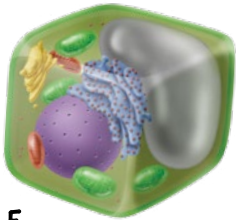
19 Synthesize Notice that oxygen-poor blood (blue) and oxygen-rich blood (red) are shown in all three diagrams. Describe the role of blood in the transportation of materials throughout the body.

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.

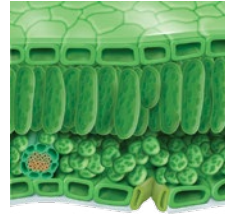
Cellular Organization

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.

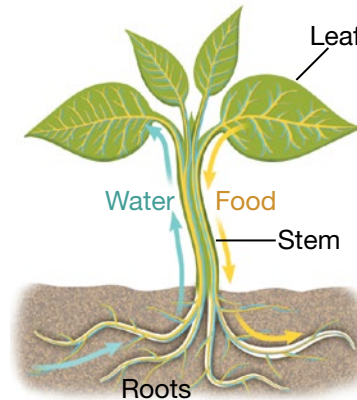


T F
21 The protective tissue on a leaf has a structure that keeps the leaf from drying out.

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 False; 21 True; 22 True; 23 True

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

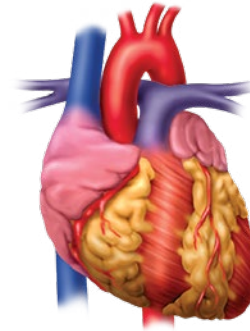
- Describe** What are the levels of organization in multicellular organisms?

- Analyze** Multicellular organisms have specialized cells. Would such organisms be better served by cells that are all the same instead? Use evidence to support your claim and explain your reasoning.

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

Critical Thinking

Use the figure to answer the next two questions.



Human heart

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

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

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

My Notes

