The SEED School of Maryland

BIOLOGY

2015 THANKSGIVING BREAK ACTIVITIES

Note to Students

This Thanksgiving break packet has been compiled to provide enrichment activities during the holiday break. The information in this packet was taken form your textbook.

Pace yourself according to the timeline provided. This activity will provide you with some practice to help prepare you for the HSA in January.

Days	Suggested Assignment dates	Assignment to Complete	Page(s) Location in this document	Questions to Complete (pages)
1	Nov 23 (Monday)	* Ch 28.1 Levels of Organization * Ch 28.3 Interactions Among Systems	1 – 9	21 - 26
2	Nov 24 (Tuesday)	Ch 29.1 How Organ Systems Communicate Ch 30.1 Respiratory and Circulatory Functions	10 – 15	27 – 31
3	Nov 25 (Wednesday)	Ch 32.1 Nutrients & Homeostasis	16 – 20	32 – 36

Student _____

Dr. MA Legaspi
Instructor

28.1 Levels of Organization

VOCABULARY

determination
differentiation
tissue
organ
organ system

KEY CONCEPT **The human body has five levels of organization.**

MAIN IDEAS

- Specialized cells develop from a single zygote.
- Specialized cells function together in tissues, organs, organ systems, and the whole organism.

VIRGINIA STANDARDS

BIO.4 The student will investigate and understand life functions of Archaea, Bacteria and Eukarya.
BIO.4.EKS-4; BIO.5.EKS-2

Connect to Your World

Climbing a wall of ice requires careful interaction among all parts of the body. You probably know that the brain and muscles work together to coordinate the climber's movements. The heart and lungs also have to work together to help provide energy for the climb. Yet every human body starts out as a single cell, a fertilized zygote. How does a single cell give rise to all the different types of cells, tissues, and organs in the human body? Further, how do such different parts coordinate their activities to keep the body functioning?

MAIN IDEA

Specialized cells develop from a single zygote.

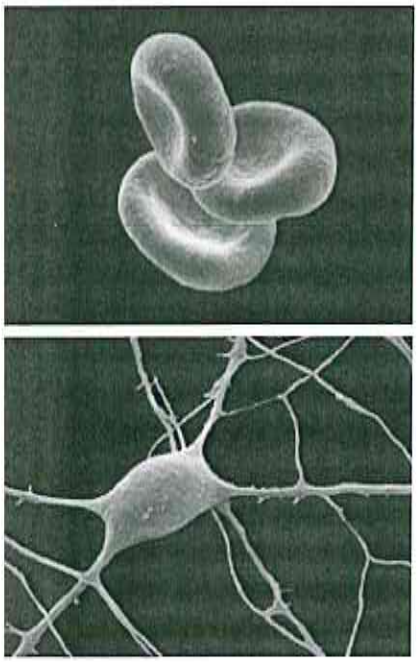

FIGURE 1.1 The disk-shaped red blood cells (top) carry oxygen to all parts of the body. The neuron (bottom), through its extensions, receives and transmits messages from and to other neurons. (colored SEMs; magnifications: blood cells 2800×; neuron about 1600×)

If you were to watch an emergency medical team in action, you would quickly notice that each person has a special job. One keeps in radio contact with the main hospital. Another monitors the patient's vital signs. Still others perform life-saving procedures. All emergency teams are made up of people, but each person within the group has a different job.

Likewise, multicellular organisms are made up of cells, but different cells in the organism have different functions. Take a moment to study the images of the blood cells and nerve cells, or neurons, in **FIGURE 1.1.** You will notice that the red blood cells are round with a concave center. This structure gives them more surface area to help deliver oxygen to all parts of the body. In contrast, neurons develop extensions that transmit and receive messages from other neurons.

Humans, like almost all multicellular organisms, are collections of specialized cells that work together. These cells arise from a single cell, the zygote, which is formed by the union of an egg and sperm. The zygote divides and differentiates into more than 200 different types of human cells. These cells allow you to do everything from lifting a glass, to learning people's names, to maintaining your body temperature on a cold day. Cell specialization involves two main steps: determination and differentiation.

Determination

The cells produced during the first few divisions of the zygote are known as embryonic stem cells. These cells have the potential to become any type of specialized cell in the body. Within a few weeks, however, a process called **determination** occurs in which most stem cells become committed to develop

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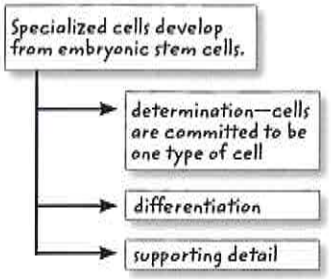
into only one type of cell. For instance, a stem cell might become a cardiac muscle cell or a spinal neuron. These committed cells still retain all of the genetic information needed to build an entire organism. However, during determination, they lose their ability to express some of this information.

Once a cell is committed to becoming a specialized cell, it will develop into only that type of cell. For instance, a cell that will become a neuron can only be a neuron, even if it is transplanted into another part of the body. During normal development, determination cannot be reversed.

READING TOOLBOX

TAKING NOTES

Use a supporting main ideas strategy to take notes about processes such as cell specialization.



Differentiation

Differentiation is the process by which committed cells acquire the structures and functions of highly specialized cells. Differentiation occurs because specific genes in each cell are turned on and off in a complex, regulated pattern. The different structures of these specialized cells, such as those shown in **FIGURE 1.2,** allow them to perform specific functions within the body.

The function of muscle cells, for example, is to produce movement by contracting and relaxing. However, skeletal muscle and smooth muscle cells have different structures. Skeletal muscle cells align in bands of orderly rows and contain many nuclei. They are responsible for nearly all voluntary muscle movements, such as lifting your foot to kick a ball. In contrast, smooth muscle cells are shorter and have only one nucleus. They perform involuntary movements, such as raising the hairs on your arms and legs.

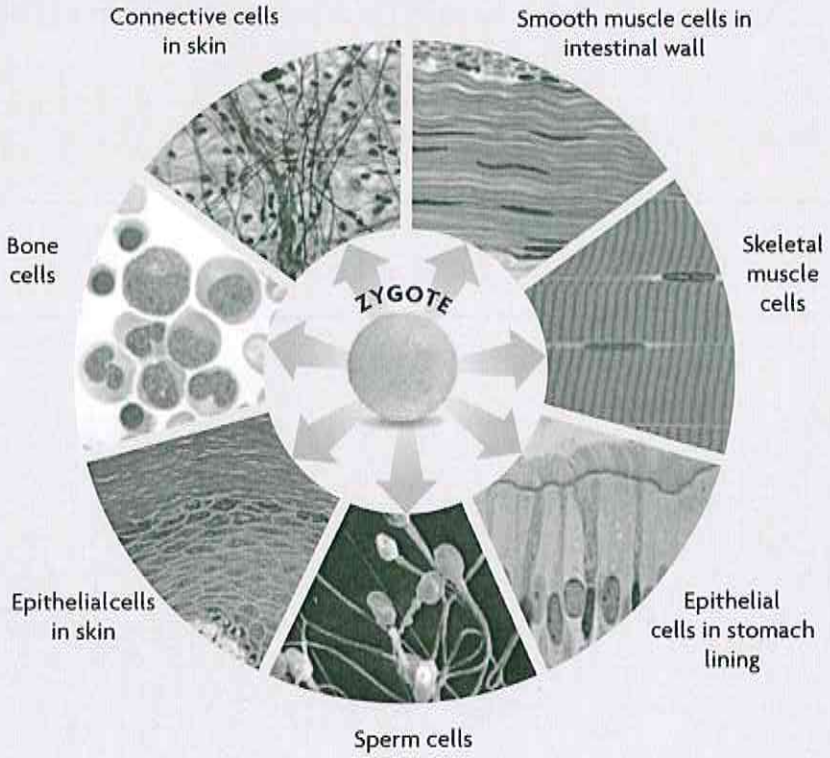
Other cells have even more specialized structures and functions. Sperm cells, for instance, develop whiplike tails that enable them to swim. Cells lining the gut are elongated and tightly packed to provide more surface area for the absorption of nutrients.

Not all cells continue to develop into specialized cells. The process of programmed cell death, called apoptosis (AP-uhp-TOH-sihs), is also a normal part of development. For example, when your hands first formed, your fingers resembled a mitten. The death of cells between the fingers allowed individual fingers to develop.

Analyze **What are some of the reasons that multicellular organisms need specialized cells?**

FIGURE 1.2 Cell Differentiation

Cells develop specialized structures and functions during differentiation.



Contrast **How do the structures of sperm cells and epithelial cells in the stomach differ?**

skeletal muscle tissue, smooth muscle, stratified epithelium, columnar epithelium, ©Ed Reschke/Peter Arnold, Inc.; zygote ©Dr. Yorgos Nikas/Photo Researchers, Inc; group of sperm ©CNRI/Photo Researchers, Inc.; New-Human bone marrow cells ©Carolina Biological Supply company/Phototake Inc./Alamy Ltd; areolar tissue ©Educational Images/Custom Medical Stock Photos

MAIN IDEA

Specialized cells function together in tissues, organs, organ systems, and the whole organism.

Specialized, or differentiated, cells are only the first level of organization in a multicellular organism. Scientists organize multicellular structures into five basic levels, beginning with cells and moving to increasingly complex levels—tissues, organs, organ systems, and the whole organism. These five levels in the human body are shown in **FIGURE 1.3**.

1. **Cells** Each type of specialized cell has a particular structure and a chemical makeup that enable it to perform a specific task. Some cells in the lungs, for instance, are involved in the exchange of gases. Others secrete mucus that helps to trap foreign particles and to protect the lungs from pathogens, such as bacteria and viruses.
2. **Tissues** Groups of similar cells that work together to perform a specialized function are known as **tissues.** The human body is made up of four general types of tissues.
   - Epithelial tissue consists of protective sheets of tightly packed cells connected by special junctions. The skin and the membranes that line the stomach, the lungs, and other organs are epithelial tissues.
   - Connective tissue serves to support, bind together, and protect other tissues and organs. Tendons, ligaments, bone, and cartilage are all connective tissues.
   - Muscle tissue is capable of contracting to produce movement. The human body contains skeletal, cardiac, and smooth muscle tissues.
   - Nervous tissue transmits and receives impulses in response to stimuli, processes information, and regulates the body's response to its environment.
3. **Organs** Different types of tissue that function together form an **organ.** For example, the lungs are organs composed of all four types of tissues. Muscle and connective tissues expand and contract the lungs. Nervous tissue sends and receives messages that help regulate gas exchange in the lungs and the rate at which a person breathes. Epithelial tissue forms the inner lining of the lungs.
4. **Organ systems** Two or more organs working in a coordinated way form an **organ system.** The organ system that allows you to breathe includes not only the lungs but also the sinuses, the nasal passages, the pharynx, and the larynx (the voice box). Organ systems perform the most complex activities in the body.
5. **Organism** Together, the organ systems make up the entire organism. For you or any other organism to stay alive, all of the systems must interact and work together. As a result, anything that harms one organ or organ system will affect the health of the entire body.

CONNECT TO

DIGESTION AND ELIMINATION

In addition to serving as a protective layer, epithelial tissue can absorb materials and secrete special types of fluids. Your ability to digest food and eliminate waste depends in part on the specialized functions of epithelial tissue, as you will learn in **Digestive and Excretory Systems**.

3

FIGURE 1.3 Five Levels of Organization

All levels of organization interact and work together to maintain the body's health.

Animated Biology
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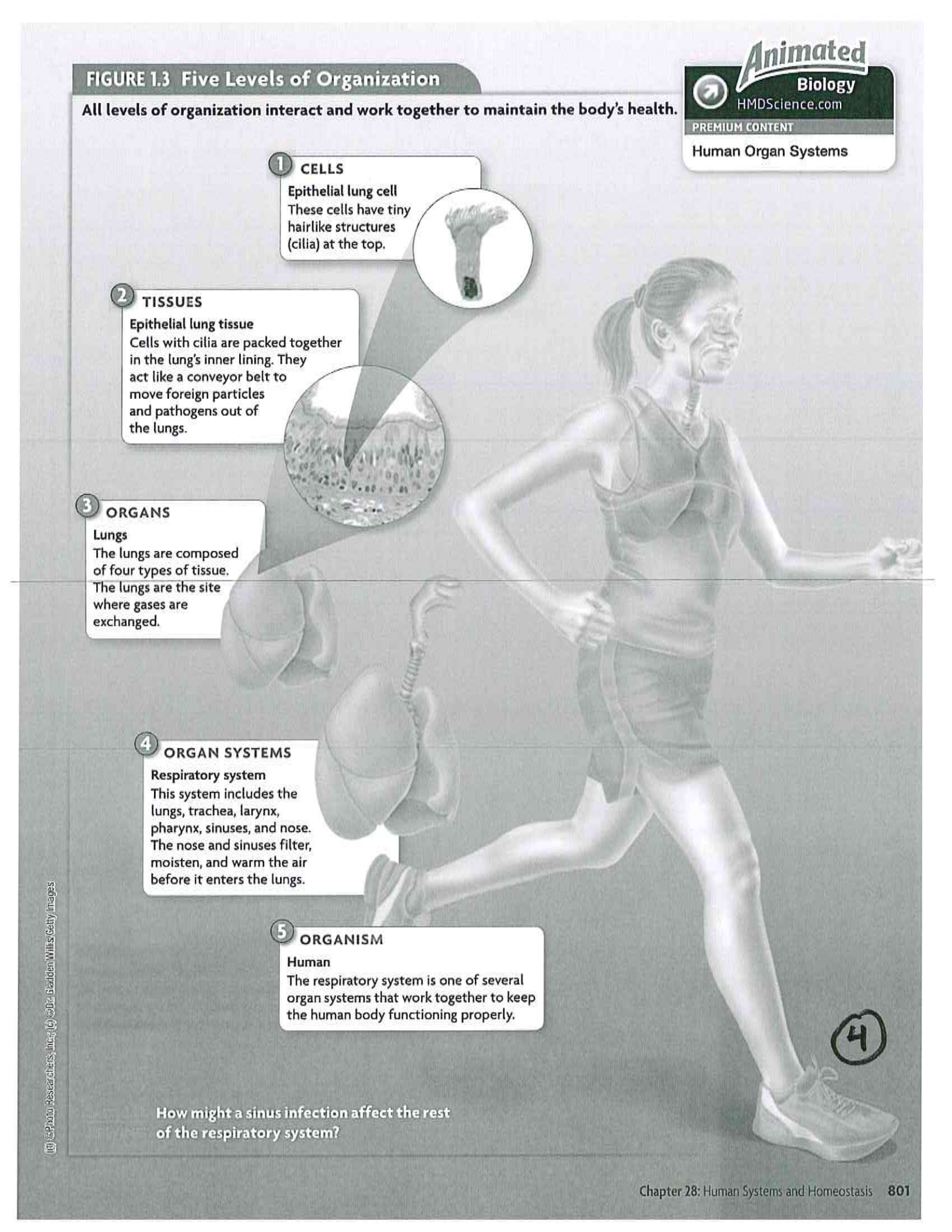
PREMIUM CONTENT
Human Organ Systems



1 CELLS
Epithelial lung cell
These cells have tiny hairlike structures (cilia) at the top.

2 TISSUES
Epithelial lung tissue
Cells with cilia are packed together in the lung's inner lining. They act like a conveyor belt to move foreign particles and pathogens out of the lungs.

3 ORGANS
Lungs
The lungs are composed of four types of tissue. The lungs are the site where gases are exchanged.

4 ORGAN SYSTEMS
Respiratory system
This system includes the lungs, trachea, larynx, pharynx, sinuses, and nose. The nose and sinuses filter, moisten, and warm the air before it enters the lungs.

5 ORGANISM
Human
The respiratory system is one of several organ systems that work together to keep the human body functioning properly.

How might a sinus infection affect the rest of the respiratory system?

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FIGURE 1.4 Major Organ Systems

SYSTEM	MAJOR TISSUES AND ORGANS	PRIMARY FUNCTION
Circulatory	heart, blood vessels, blood, lymph nodes, lymphatic vessels	transports oxygen, nutrients, wastes; helps regulate body temperature; collects fluid lost from blood vessels and returns it to circulatory system
Digestive	mouth, pharynx, esophagus, stomach, small/large intestines, pancreas, gallbladder, liver	breaks down and absorbs nutrients, salts, and water; eliminates some wastes
Endocrine	hypothalamus, pituitary, thyroid, parathyroid, adrenals, pancreas, ovaries, testes	influences growth, development, metabolism; helps maintain homeostasis
Excretory	skin, lungs, kidneys, bladder	eliminates waste products; helps maintain homeostasis
Immune	white blood cells, thymus, spleen	protects against disease; stores and generates white blood cells
Integumentary	skin, hair, nails, sweat and oil glands	acts as a barrier against infection, injury, UV radiation; helps regulate body temperature
Muscular	skeletal, smooth, and cardiac muscles	produces voluntary and involuntary movements; helps to circulate blood and move food through digestive system
Nervous	brain, spinal cord, peripheral nerves	regulates body's response to changes in internal and external environment; processes information
Reproductive	*male:* testes, penis, associated ducts and glands *female:* ovaries, fallopian tubes, uterus, vagina	produces reproductive cells; in females, provides environment for embryo
Respiratory	nose, sinuses, pharynx, larynx, trachea, lungs	brings in O_2 for cells; expels CO_2 and water vapor
Skeletal	bones, cartilage, ligaments, tendons	supports and protects vital organs; allows movement; stores minerals; serves as the site for red blood cell production

The major organ systems in the human body, including their main parts and primary functions, are listed in **FIGURE 1.4**. Keep in mind that all of the organs in these systems developed from specialized cells and tissues that arose from a single cell, the zygote. The major parts and functions of each organ system are examined in greater detail in the following chapters on human body systems.

How do these complex organs and organ systems keep functioning and working together properly? As you will read in Section 2, the body has sophisticated mechanisms for maintaining a stable internal environment.

Compare and Contrast **How do tissues differ from organs and organ systems?**

28.1 Formative Assessment

SELF-CHECK Online
HMDScience.com
PREMIUM CONTENT

REVIEWING ◉ MAIN IDEAS

1. How does the process of cell **determination** differ from the process of cell **differentiation**?
2. Briefly define and give an example of each of the five levels of organization in multicellular organisms.

CRITICAL THINKING

3. **Apply** What **organ systems** must work together to bring oxygen to the body's cells?
4. **Predict** A cell has undergone determination to become an endocrine gland cell. If it is transplanted to a leg muscle, what do you think will happen to this cell?

CONNECT TO

CELL CYCLE

5. In the spring, tadpoles lose their tails as part of their life cycle. At a certain stage in development, the human fetus acquires individual fingers and toes. What occurs in some cells of both species to explain these changes? 5

28.3 Interactions Among Systems

VOCABULARY

thermoregulation

KEY CONCEPT **Systems interact to maintain homeostasis.**

MAIN IDEAS

- Each organ system affects other organ systems.
- A disruption of homeostasis can be harmful.

VIRGINIA STANDARDS

BIO.4 The student will investigate and understand life functions of Archaea, Bacteria and Eukarya. Key concepts include:
BIO.4.b maintenance of homeostasis.
BIO.4.c how the structures and functions vary among and within the Eukarya kingdoms of protists, fungi, plants, and animals, including humans.
BIO.4.EKS-2; BIO.4.EKS-4; BIO.4.EKS-5

Connect to Your World

The moment a race car pulls in for a pit stop, the pit crew springs into action. Each person has a special role that must be coordinated with the efforts of the team. As one member jacks up the car, others are changing the tires, putting in fuel, and checking the engine. If anyone fails to do a job properly, it affects the entire team and places the driver at serious risk.

MAIN IDEA

Each organ system affects other organ systems.

At its most basic level, the body is a community of specialized cells that interact with one another. On a larger scale, all of the organ systems form a type of community regulated by feedback mechanisms. This interaction among organ systems means that what affects a single organ system affects the entire body.

Like highly trained crew members, each organ system in your body must do its own special job. But for you to remain healthy, each system also must coordinate with other organ systems through chemical messages and nerve impulses. The relationship among your organs and organ systems is not always obvious—for example, when the body produces a substance such as vitamin D. In other cases, you are more aware that some organs are affecting others, as in the regulation of your body temperature in hot or cold weather.

FIGURE 3.1 Precision teamwork is the secret to a pit crew's success. Likewise, your life depends on every organ system doing its job at the right time and in the right order.

Vitamin D Production

You may know that sunlight plays a part in the production of vitamin D in your body. You may not know that the liver, kidneys, circulatory system, and endocrine system are necessary for this process as well. The skin contains a substance that in the presence of ultraviolet light is changed into an inactive form of vitamin D. As **FIGURE 3.2** shows, this form enters the blood and is carried to the liver. The liver changes the inactive form of vitamin D into another compound, which is then carried to the kidneys. Here, this compound is converted into active vitamin D.

The blood transports active vitamin D throughout the body, where it interacts with hormones that regulate the amount of calcium and phosphorus in the body. These two minerals are essential for building strong bones. If any organ along this path fails to do its job, the level of vitamin D in the body decreases. Without enough vitamin D, children's bones do not develop normally. Adults lose bone mass, which means their bones break more easily.

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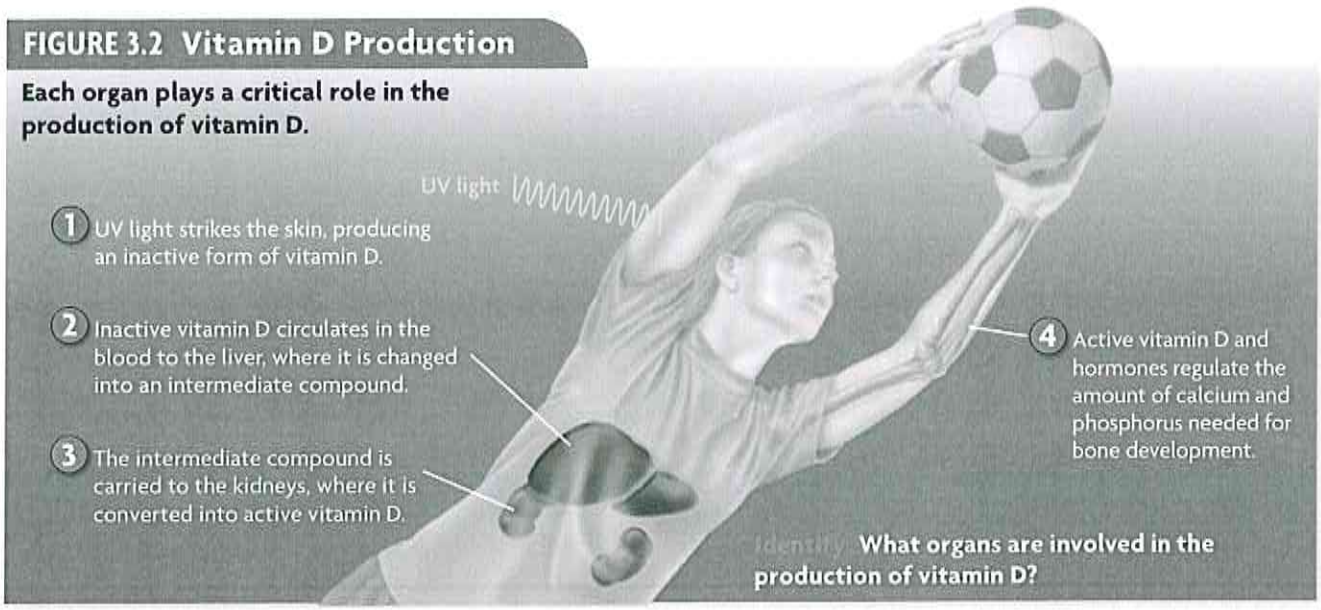
FIGURE 3.2 Vitamin D Production

Each organ plays a critical role in the production of vitamin D.



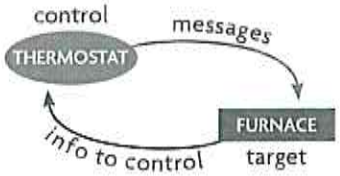
Identify **What organs are involved in the production of vitamin D?**

Regulation of Body Temperature

The process of maintaining a steady body temperature under a variety of conditions is known as **thermoregulation** (THUR-moh-REHG-yoo-LAY-shuhn). The most obvious organ systems involved in maintaining body temperature are the skin and muscles. You sweat in hot weather and shiver when you are cold. However, far more is going on than what you can see on the surface. Thermoregulation requires the close interaction of the respiratory, circulatory, nervous, and endocrine systems.

VISUAL VOCAB

Thermoregulation maintains a stable body temperature under a variety of conditions, just as a thermostat regulates a furnace. Both mechanisms use feedback to keep temperatures within set ranges.



Sensors in the skin and blood vessels provide information about body temperature to a control center in the brain called the hypothalamus. The hypothalamus protects the body's internal organs by monitoring temperature. When the hypothalamus receives information that the temperature of the blood is rising, it sends messages through the nervous and endocrine systems. These messages activate the sweat glands, dilate blood vessels in the skin, and increase both heart and breathing rates. All of these activities carry heat away from the center of the body to the surface, where excess heat can escape.

When the temperature of the blood falls too low, the hypothalamus sends another set of signals to the skin and to the muscular, respiratory, and circulatory systems. Blood vessels in the skin constrict, reducing blood flow to prevent loss of heat. Muscles in the skin contract around the pores, reducing their size. Rapid, small contractions of skeletal muscles cause shivering. The thyroid gland releases hormones that increase metabolism. All of these activities increase body heat and reduce the loss of heat to the environment.

Infer **If a person's circulatory system does not function well, how might thermoregulation in his or her body be affected?**

CONNECT TO

ANIMALS

In **A Closer Look at Amniotes** you learned that animals have many ways of regulating their body temperatures. For example, some animals stay cool by panting, by being active only at night, or by getting rid of excess heat through their body structures, such as large ears or thin skins.

WebQuest

HMDScience.com

PREMIUM CONTENT

Hypothermia

MAIN IDEA

A disruption of homeostasis can be harmful.

Some changes may be too great or too rapid for your body to control through feedback mechanisms. Homeostasis can be disrupted for several reasons.

- Sensors fail to detect changes in the internal or external environment.
- Wrong messages may be sent or the correct ones fail to reach their targets.
- Serious injuries can overwhelm the homeostatic mechanisms.
- Viruses or bacteria can change the body's internal chemistry.

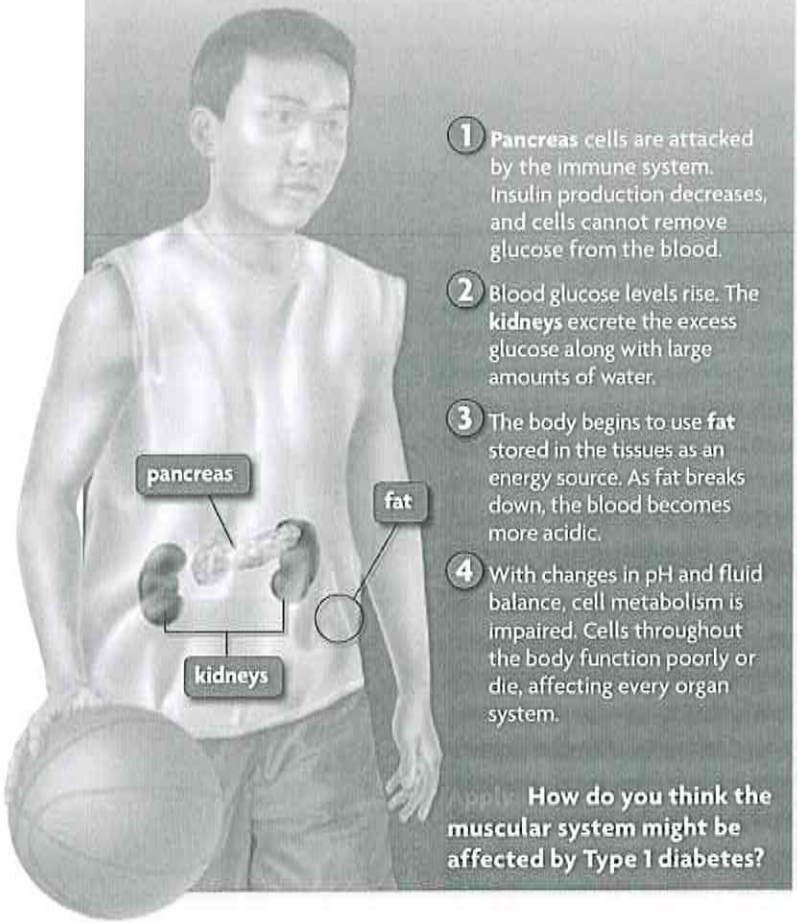
Disruption of homeostasis can begin in one organ or organ system and result in a chain reaction that affects other organs and organ systems. These effects can be harmful to your body over the short or long term.

Short-Term Effects

Short-term effects usually last a few days or weeks. For example, when a cold virus first enters your body, your immune system may not be able to prevent the virus from multiplying. As a result, you develop a sore throat, runny nose, and dry cough, and your muscles and joints become inflamed. However, within a few days, your body's immune system begins to kill the virus and to restore homeostasis. Usually, there is no lasting harm to your body.

FIGURE 3.3 Type 1 Diabetes

Failure to control glucose levels affects the entire body.



Apply How do you think the muscular system might be affected by Type 1 diabetes?

Long-Term Effects

A long-term disruption of homeostasis, as in the case of diabetes, can cause more damage. Diabetes occurs when the body fails to control the amount of glucose circulating in the blood.

Normal glucose control Glucose levels are controlled by two hormones—insulin and glucagon—which are released by the pancreas. When glucose in the blood rises above a set point, beta cells in the pancreas release insulin. Insulin causes cells to take in more glucose from the blood and causes the liver to store glucose as glycogen. When blood glucose levels fall below the set point, alpha cells in the pancreas release glucagon. This hormone stimulates the liver to break down stored glycogen into glucose and release it until levels in the blood rise to the set point.

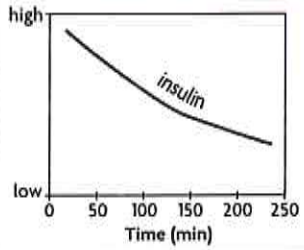
Type 1 and Type 2 diabetes What if the pancreas fails to do its job? The result can be diabetes mellitus, a condition in which the body can no longer regulate glucose levels. There are two types of diabetes. Type 1 occurs when the body's immune system destroys the ability of beta cells to produce insulin. Type 2 is caused when insulin production decreases or when insulin cannot move glucose into cells.

DATA ANALYSIS

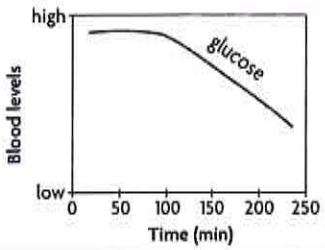
INTERPRETING INVERSE RELATIONSHIPS

Two variables are inversely related if an increase in the value of one variable is associated with a decrease in the value of the other variable. For example, the level of insulin decreases the longer a person exercises. Therefore, insulin levels have an inverse relationship with exercise time. The graphs at right show the levels of insulin, glucose, and glucagon during moderate exercise over 250 minutes. Use the graphs to answer the questions.

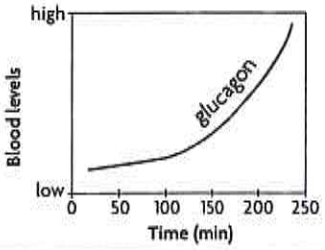
GRAPH 1. INSULIN LEVELS



GRAPH 2. GLUCOSE LEVELS



GRAPH 3. GLUCAGON LEVELS



1. **Analyze** Which variable(s) has/have an inverse relationship with time?
2. **Conclude** What relationship exists between glucagon and the other two variables (insulin and glucose)? Explain.

In Type 1 diabetes, the failure of the pancreas sets up a destructive chain reaction in other organ systems, as shown in **FIGURE 3.3.** As glucose builds up in the blood, the kidneys must remove it along with large amounts of water. Also, since the body is unable to use glucose as an energy source, it must use stored fat instead. As the fat breaks down, the blood becomes more acidic. This altered pH disrupts the metabolism of the cells in every organ and every system in the body. The long-term effects can result in heart disease, blindness, nerve damage, kidney damage, and even coma and death.

In Type 2 diabetes, the pancreas cannot produce enough insulin, or the insulin cannot be used to move glucose into the cells. As a result, blood glucose levels rise, and the cells starve. Risk factors for developing Type 2 diabetes include chronic obesity, a family history of diabetes, and aging.

Connect **Why might diabetes be a particular problem for an athlete?**

Biology VIDEO CLIP
HMDScience.com
PREMIUM CONTENT
Diabetes and the Immune System

SELF-CHECK Online
HMDScience.com
PREMIUM CONTENT

28.3 Formative Assessment

REVIEWING ◉ MAIN IDEAS

1. Why do the organ systems in the body need to work so closely together?
2. Explain why a long-term disruption of homeostasis can often be more damaging to the body than a short-term disruption is.

CRITICAL THINKING

3. **Analyze** Why would giving syn-thetic insulin to people with Type 1 diabetes restore their glucose homeostasis?
4. **Predict** If you lived in Alaska for the whole year, what changes might occur in your calcium and phosphorus levels during the winter versus the summer? Explain.

CONNECT TO EVOLUTION

5. Some animals can store more glucose—in the form of glycogen—in their bodies than can other animals. What might be the evolutionary advantage of having these extra energy stores?

9

29.1 How Organ Systems Communicate

VOCABULARY

- nervous system
- endocrine system
- stimulus
- central nervous system (CNS)
- peripheral nervous system (PNS)

KEY CONCEPT **The nervous system and the endocrine system provide the means by which organ systems communicate.**

MAIN IDEAS

- The body's communication systems help maintain homeostasis.
- The nervous and endocrine systems have different methods and rates of communication.

VIRGINIA STANDARDS

BIO.4.d The student will investigate and understand life functions of Archaea, Bacteria and Eukarya. Key concepts include human health issues, human anatomy, and body systems.
BIO.4.EKS-2; BIO.4.EKS-5

Connect to Your World

Scientists try to find new ways, such as MRI scans, to study the brain because the brain is so important. Your brain lets you think and move. It controls digestion, heart rate, and body temperature. Your brain does these things with help from the endocrine system and the rest of the nervous system.

MAIN IDEA

The body's communication systems help maintain homeostasis.

Homeostasis depends on the ability of different systems in your body to communicate with one another. To maintain homeostasis, messages must be generated, delivered, interpreted, and acted upon by your body. The nervous system and the endocrine system are the communication networks that allow you to respond to changes in your environment countless times each day.

- The **nervous system** is a physically connected network of cells, tissues, and organs that controls thoughts, movements, and simpler life processes such as swallowing. For example, when you walk outside without sunglasses on a sunny day, your nervous system senses the bright light coming into your eyes. It sends a message that tells your pupils to shrink and let in less light.
- The **endocrine system** (EHN-duh-krihn) is a collection of physically disconnected organs that helps to control growth, development, and responses to your environment, such as body temperature. For example, when you are outside on a hot day or you exercise, your body starts to feel warm. Your endocrine system responds by producing messages that tell your body to sweat more so that you can cool down.

Both of these systems, which are shown in **FIGURE 1.1**, let you respond to a stimulus in your environment and maintain homeostasis. A **stimulus** (STIHM-yuh-luhs) is defined most broadly as something that causes a response. In living systems, a stimulus is anything that triggers a change in an organism. Changes can be chemical, cellular, or behavioral.

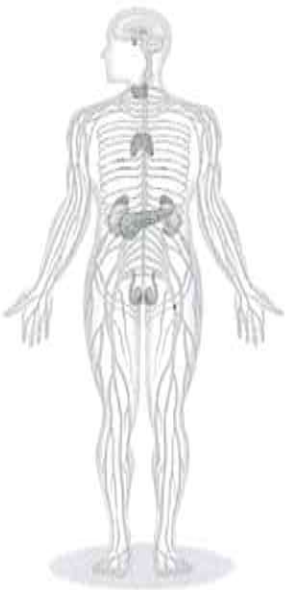


FIGURE 1.1 The nervous system (yellow) is a physically connected network, while the endocrine system (red) is made up of physically separated organs.

Analyze **What stimuli cause you to sweat and cause your pupils to shrink?**

(10)

MAIN IDEA

The nervous and endocrine systems have different methods and rates of communication.

You can think about your endocrine system as working like a satellite television system. A satellite sends signals in all directions, but only televisions that have special receivers can get those signals. Your endocrine system's chemical signals are carried by the bloodstream throughout the body, and only cells with certain receptors can receive the signals. On the other hand, your nervous system is like cable television. A physical wire connects your television to the cable provider. Similarly, your nervous system sends its signals through a network of specialized tissues.

The nervous and endocrine systems also have different rates of communication. Your endocrine system works slowly and controls processes that occur over long periods of time, such as hair growth, aging, and sleep patterns. The endocrine system also helps regulate homeostatic functions such as body temperature and blood chemistry. For example, as the day gradually warms, your endocrine system responds by releasing chemicals that stimulate sweat glands. The change in the temperature over the course of a day is slow so you do not need a rapid response from your body.

Your nervous system works quickly and controls immediate processes, such as heart rate and breathing. If you touch your hand to a hot stove, an immediate response from the nervous system causes you to jerk your hand away. Without a quick reaction, your hand would be badly burned.

Signals move from the skin on your hand to the muscles in your arm by passing through the two parts of the nervous system: the central and the peripheral. The **central nervous system (CNS)** includes the brain and spinal cord. The CNS interprets messages from other nerves in the body and stores some of these messages for later use. The **peripheral nervous system (PNS)** is a network of nerves that transmits messages to the CNS and from the CNS to other organs in the body. You can see some of the nerves of the PNS extending from the spinal cord toward the neck and shoulders in **FIGURE 1.2.**

Infer **Which system controls the rate at which your fingernails grow?**

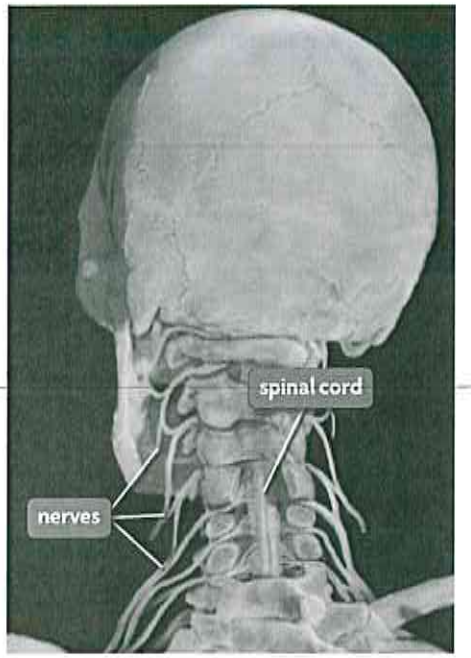


FIGURE 1.2 This medical illustration shows how the spinal cord connects the brain to the nerves that run throughout the body.

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29.1 Formative Assessment

SELF-CHECK Online
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PREMIUM CONTENT

REVIEWING MAIN IDEAS

1. Why does your body need a communication system?
2. What are three differences between the ways in which the **endocrine system** and the **nervous system** work?

CRITICAL THINKING

3. **Apply** Which system, the endocrine or the nervous, controls the rate at which you blink? Explain.
4. **Predict** How might a clogged blood vessel affect the nervous system's and the endocrine system's abilities to deliver signals?

CONNECT TO

CELL STRUCTURE

5. What structures on a cell membrane might ensure that the endocrine system's signals only affect the cells for which they are intended?

30.1 Respiratory and Circulatory Functions

VOCABULARY

circulatory system
respiratory system
trachea
lung
alveoli
diaphragm
heart
artery
vein
capillary

KEY CONCEPT **The respiratory and circulatory systems bring oxygen and nutrients to the cells.**

MAIN IDEAS

- The respiratory and circulatory systems work together to maintain homeostasis.
- The respiratory system moves gases into and out of the blood.
- The circulatory system moves blood to all parts of the body.

Connect to Your World

You have thousands of kilometers of blood vessels in your body and several hundred *million* tiny air sacs in your lungs. Blood circulates constantly through the vessels, while air continually fills and empties from the tiny air sacs. Your heart keeps beating and your lungs keep working 24 hours a day, every day of your life. Even more amazing, everything works without your having to think about it.

VIRGINIA STANDARDS

BIO.4.d The student will investigate and understand life functions of Archaea, Bacteria and Eukarya. Key concepts include human health issues, human anatomy, and body systems.
BIO.4.EKS-2; BIO.4.EKS-5

MAIN IDEA

The respiratory and circulatory systems work together to maintain homeostasis.

Every cell in your body needs nutrients and oxygen to function and needs to get rid of its waste products. The **circulatory system** is the body system that transports blood and other materials. It brings vital supplies to the cells and carries away their wastes. The blood vessels of the circulatory system also keep oxygen-poor blood from mixing with oxygen-rich blood. The **respiratory system** is the body system in which gas exchange takes place. You can think of your respiratory system as a major supply depot where the blood can pick up oxygen (O_2) and deposit excess carbon dioxide (CO_2). The lungs of the respiratory system are the only place in your body where gases in the blood are exchanged with gases from the atmosphere.

The respiratory and circulatory systems work closely together to maintain homeostasis in the face of constant change. Every time you exercise, lie down to rest, or simply stand up, you change your needs for oxygen and nutrients. As a result, your heart speeds up or slows down and you breathe faster or slower, depending on your activity. This section gives you an overview of the major structures of the respiratory and circulatory systems and their functions. Sections 2 through 5 provide a closer look at the organs of each system, how they work, and what can damage them.

Apply **When you stand up after lying down, why do your heart rate and breathing rate increase?**

READING TOOLBOX

TAKING NOTES

Use a supporting main ideas strategy to help you remember the respiratory and circulatory structures and their functions.

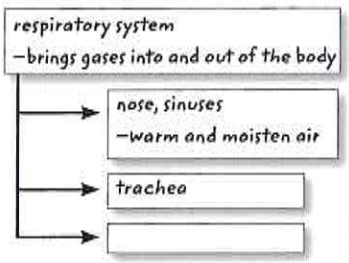

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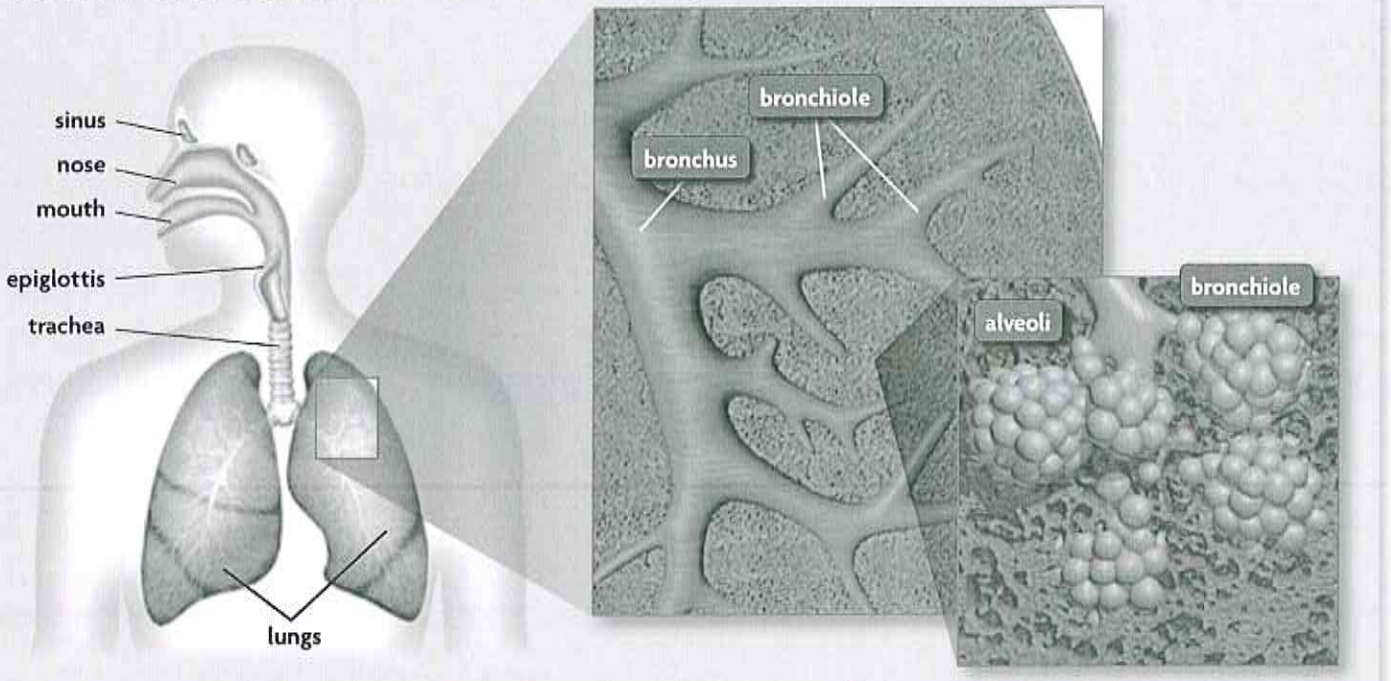
FIGURE 1.1 Respiratory Organs and Tissues

Specialized structures move air into and out of the body.



Infer **How do the structures in the lungs increase their surface area?**

MAIN IDEA

The respiratory system moves gases into and out of the blood.

The function of the respiratory system is to bring O_2 into the body and to expel CO_2 and water vapor. The structures of this system bring the gases in close contact with the blood, which absorbs O_2. The circulatory system then carries O_2 to all of the body's cells and transports CO_2 from the rest of the body to the lungs, where it is exhaled.

The specialized structures of the respiratory system are shown in **FIGURE 1.1.** The nose and mouth are the entry points to the system. When air enters the nose, mucus that lines the nasal passages warms and moistens the air. The mucus and tiny hairs called cilia help filter dust and pathogens from the air. At the back of the throat, a small piece of tissue, the epiglottis, regulates airflow into the trachea, or windpipe. The **trachea** (TRAY-kee-uh) is a long structure made of soft tissue reinforced with C-shaped rings of cartilage. It resembles the hose of a vacuum cleaner. When you swallow, the epiglottis closes the entrance to the trachea to keep food or saliva from entering the airways. The trachea divides into the two bronchi, with one branch going to each lung.

The **lungs** are the organs that absorb O_2 from the air you inhale. Inside the lungs, the bronchi divide into smaller and smaller branches that resemble the limbs and twigs of a tree. The smallest branches, the bronchioles, end in clusters of tiny air sacs called **alveoli** (al-VEE-uh-LY). One air sac is called an alveolus. The lungs have a huge number of alveoli—from 300 to 600 million.

CONNECT TO

CELLULAR RESPIRATION

You learned in **Cells and Energy** that eukaryotic cells require a constant supply of oxygen to produce ATP, which is the main energy source for cells.

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PREMIUM CONTENT
How You Breathe

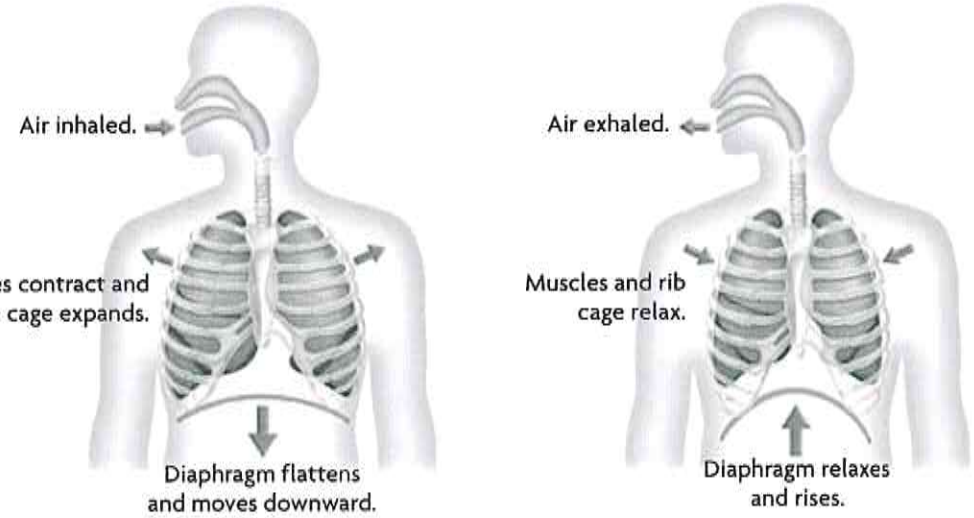

FIGURE 1.2 When you inhale, movements of the rib cage and diaphragm produce lower pressure in the lungs, and air flows in. When you exhale, rib cage and diaphragm movements produce higher pressure in the lungs, and air flows out.

This huge number of alveoli gives the lungs a massive surface area for absorbing O_2 and releasing CO_2 and water vapor. Lung tissue is spongy and elastic, which allows the lungs to expand and contract as you breathe. Lung mucus and cilia help trap and remove foreign materials and pathogens.

The mechanics of breathing involve the muscles of the rib cage and the diaphragm, as **FIGURE 1.2** shows. The **diaphragm** is a dome-shaped muscle at the base of the rib cage. When you inhale, the muscles of the rib cage contract, causing the rib cage to expand. The diaphragm then flattens and moves downward. The volume of your lungs increases, and the air pressure decreases, falling below the air pressure outside your body. Gases move from areas of greater pressure to areas of lower pressure, so air flows into the lungs.

When you exhale, the rib cage muscles relax, and the rib cage becomes smaller. The diaphragm also relaxes, causing it to rise and regain its domelike shape. Now the air pressure inside your lungs is greater than the air pressure outside your body, so air flows out.

READING TOOLBOX

VOCABULARY

The word *diaphragm* is based on the Latin *diaphragma*, which means "midriff." The midriff extends from below the breast to the waist. The diaphragm is located in this area.

Predict **How might damaged alveoli affect the oxygen level in the blood?**

MAIN IDEA

The circulatory system moves blood to all parts of the body.

Animated Biology
HMDScience.com
PREMIUM CONTENT
Build the Circulatory and Respiratory Systems

The function of the circulatory system is to transport O_2 and nutrients to body cells and to carry oxygen-poor blood and CO_2 back to the heart and lungs. To do its job, the system must keep blood constantly circulating.

The main parts of the circulatory system are the heart, the blood, and the blood vessels. The **heart** is a muscular pump, about the size of your fist, that keeps the blood moving to every part of the body. The blood circulates through a closed system—that is, blood in the circulatory system stays inside the vessels. The average adult body contains about 5 liters (more than 5 qt) of blood. On average, your blood circulates from your heart, throughout your body, and back to your heart about every 60 seconds.

The circulatory system has three types of blood vessels: arteries, veins, and capillaries. **Arteries** are blood vessels that carry blood away from the heart to the rest of the body. **Veins** are blood vessels that carry blood from the rest of the body back to the heart. As illustrated in **FIGURE 1.3**, arteries carry oxygen-rich blood (red) and veins carry oxygen-poor blood (blue). Blue is used for illustration purposes only. In your body, oxygen-poor blood is not actually blue but a darker red color. You can think of arteries and veins as a system of roads. Large arteries and veins are like major highways. Smaller arteries and veins are like streets that route traffic through local neighborhoods.

Arteries and veins are connected by a system of capillaries. **Capillaries** are the tiny blood vessels that transport blood to and from the cells of the body. These vessels are so small that blood cells must move through them in single file. The walls of these tiny blood vessels are only one cell thick. Materials can easily diffuse into and out of them.

In addition to transporting vital supplies to the cells, the circulatory system performs two other important functions that maintain homeostasis.

- The circulatory system collects waste materials produced by digestion and cell metabolism, and delivers them to the liver and kidneys to be filtered out of the body. For example, muscle cell activity produces a waste product known as urea. As blood moves past the muscle cells, urea is moved into the bloodstream and carried to the kidneys to be excreted.
- The circulatory system helps maintain body temperature by distributing the heat that cells produce in the muscles and internal organs. When you are active, your organs and muscles produce more heat. The heart pumps harder, and the blood vessels dilate to bring excess heat to the skin, where it can escape. In cold weather, the blood vessels constrict to conserve heat.

The heart, the blood vessels, and the blood are described in more detail in Sections 3 through 5.

Infer **If a person has a weak heart, how might his or her ability to maintain a stable body temperature be affected?**

FIGURE 1.3 The circulatory system is composed of the heart, arteries carrying oxygen-rich blood (red), veins carrying oxygen-poor blood (blue), and capillaries.

SELF-CHECK Online
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PREMIUM CONTENT

30.1 Formative Assessment

REVIEWING ◉ MAIN IDEAS

1. How do the **respiratory** and **circulatory systems** help maintain homeostasis in the body?
2. List the main parts and functions of the respiratory system.
3. Describe the basic parts and functions of the circulatory system.

CRITICAL THINKING

4. **Apply** Why can't you breathe through the mouth while you are swallowing food? What would happen if you could do this?
5. **Infer** **Arteries** and **veins** are equally distributed throughout the body. How does this arrangement help to maintain the functions of each cell?

CONNECT TO

SCIENCE AND TECHNOLOGY

6. A mechanical ventilator breathes for a paralyzed person. During inhalation, the machine forces air under pressure into the **lungs**. During exhalation, the pressure drops and air moves out of the lungs. How does this machine compare with natural breathing?

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32.1 Nutrients and Homeostasis

VOCABULARY

mineral
vitamin
Calorie

KEY CONCEPT **Cells require many different nutrients.**

MAIN IDEAS

- Six types of nutrients help to maintain homeostasis.
- Meeting nutritional needs supports good health.

VIRGINIA STANDARDS

BIO.2 The student will investigate and understand the chemical and biochemical principles essential for life.
BIO.2.EKS-2; BIO.4.EKS-2; BIO.4.EKS-4; BIO.4.EKS-5

Connect to Your World

Nowadays, many foods are enriched with essential vitamins, and you have been taught about nutrients that your body needs. But until the 1740s, British sailors on long voyages were crippled by scurvy, an illness that produced weakness, bruising, bleeding gums, and painful joints. Meanwhile, Dutch sailors who ate oranges at sea never got scurvy. British physician James Lind hypothesized that citrus fruits might not only cure the illness but prevent it as well. Lind divided the crew of one ship into six groups and gave each different foods. Sailors eating oranges and lemons remained healthy. Simply adding vitamin C eliminated scurvy at sea.

MAIN IDEA

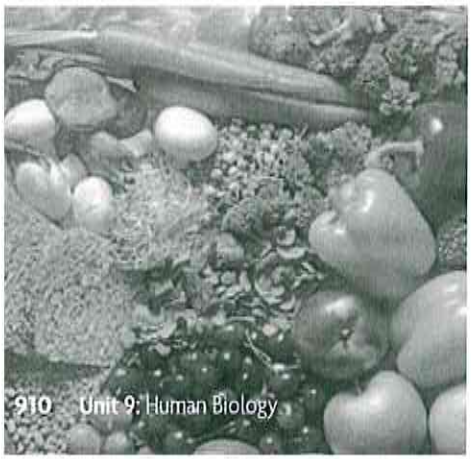
Six types of nutrients help to maintain homeostasis.

Today, scientists and health experts know a great deal more about how important nutrients are to maintain homeostasis in your body. You need to consume six types of nutrients every day to keep your body in good health: water, carbohydrates, proteins, fats, minerals, and vitamins. If any one of these nutrients is missing for too long, your body's cells will stop working properly, which also affects your organs.

Water

Your body is made up of 55 to 60 percent water. As a natural solvent, water is involved in nearly every chemical reaction in every cell of your body. It also helps you to digest food and eliminate waste products, maintain your blood volume, regulate your body temperature, and keep your skin moist. To maintain your fluid balance, you need to drink about 2 liters (8 cups) of water a day to replace the amount you lose through sweat, urine, and respiration.

FIGURE 1.1 Complex carbohydrates (whole grains, potatoes, vegetables) must be broken down into sugars to be used as fuel. Simple carbohydrates, such as those found in fruits, do not need to be broken down as much.



Carbohydrates

Carbohydrates, shown in **FIGURE 1.1**, are the main source of energy for your body. Simple carbohydrates are sugars found in sugar cane, honey, and fruits. Complex carbohydrates are starches found in vegetables, grains, and potatoes. To be absorbed by your body, starches must be broken down during digestion into simple sugars, such as glucose. Excess supplies of glucose are converted to glycogen and are stored in the liver and muscle tissues for future use. Many grains, fruits, and vegetables also contain cellulose, a dietary fiber. Fiber cannot be digested, but it helps move food through your digestive system.

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Proteins

Proteins are the raw materials used for the growth and repair of the body's cells and tissues. In addition, proteins make up all enzymes and many hormones that are vital for cell metabolism. Proteins are composed of chains of amino acids. Your body can make only 12 of the 20 amino acids it needs to build proteins. The other 8, called essential amino acids, must come from the foods you eat. Foods such as meat, cheese, and eggs contain all eight essential amino acids. However, most plant proteins lack at least one essential amino acid. Vegans—people who do not eat meat, dairy products, or eggs—must eat plant foods in combination to obtain all the amino acids they need. For example, red beans and rice together contain all 20 amino acids.

Fats

Fats provide energy and key components in cell membranes, myelin sheaths for neurons, and certain hormones. Fats consist of long chains of fatty acids hooked to glycerol molecules. Your body can make some fatty acids, but you must obtain all of the essential fatty acids from the foods you eat. Fats are classified as either saturated or unsaturated, depending on the structure of their fatty acid chains. Saturated fats are solid at room temperature and are found in animal products. Most unsaturated fats are liquid at room temperature and are found in plant oils, such as corn or olive oils, and in some fish, such as cod or salmon. In general, unsaturated fats are considered more beneficial to people's health than are saturated fats.

Minerals

Small amounts of minerals and vitamins are also needed to maintain homeostasis. **Minerals** are inorganic materials the body uses to carry out processes in cells and to build or repair tissues. Some of the more common minerals are listed in **FIGURE 1.3.** Calcium, for example, is essential for bone and tooth formation, muscle contraction, and nerve transmission. Sodium and potassium help to maintain the body's fluid homeostasis. You are constantly losing minerals in sweat, urine, and other waste products. You can replace them by eating a variety of plant foods or by combining plant and animal foods.

FIGURE 1.2 Proteins and fats are often found in the same foods. Beef, chicken, and eggs contain protein and saturated fats. Fish, nuts, beans, and seeds contain protein and unsaturated fats.

READING TOOLBOX

TAKING NOTES

Use a two-column chart to organize your notes about different nutrients and their functions.

Water	- makes up 55 to 60% of body - maintains blood volume

FIGURE 1.3 Important Minerals

MINERALS	SOURCES	IMPORTANT FOR
Calcium	dairy products, salmon, sardines, dark leafy greens	blood clotting, bone/tooth formation; muscle/nerve function
Iron	liver, dark leafy greens, whole grains	component in hemoglobin
Iodine	iodized salt, seafoods, sea vegetables	component in thyroid hormones
Magnesium	nuts, whole grains, leafy green vegetables	bone/tooth formation; coenzyme in protein synthesis
Phosphorus	meats, dairy products, nuts, dried peas and beans	bone/tooth formation; active in many metabolic processes
Potassium	meats, dairy products, many fruits and vegetables	regulation of pH, fluid balance, and muscle/nerve function
Sodium	table salt, seafoods, processed foods	regulation of pH, fluid balance, and muscle/nerve function
Zinc	meats, seafoods, grains	activation of many enzymes in metabolic processes

©Corbis Production Department/Alamy Images

Vitamins

Vitamins are organic molecules that work with enzymes to regulate cell functions, growth, and development. As shown in **FIGURE 1.4**, these nutrients are divided into fat-soluble vitamins and water-soluble vitamins. Fat-soluble vitamins dissolve in fatty acids. The fat-soluble vitamins A, D, E, and K can be stored in the body's fatty tissues for future use. For this reason, taking high doses of these vitamins can actually create harmful, or toxic, levels in the body.

Water-soluble vitamins dissolve in water. The water-soluble vitamin C and the B vitamins cannot be stored and are excreted in urine and feces. As a result, you need to eat foods rich in these nutrients to keep replenishing them. The National Academy of Sciences publishes recommended daily amounts of minerals and vitamins based on your age, gender, and level of activity.

Apply Would a diet higher in protein or in complex carbohydrates give you more energy? Explain your answer.

FIGURE 1.4 Essential Vitamins

VITAMIN	SOURCES	IMPORTANT FOR
Fat-Soluble (Dissolves in Fat)		
A (retinol)	dark green, yellow, and orange vegetables, fortified milk, fish and liver oils	healthy skin, mucous membranes, vision
D (calciferol)	fortified dairy and whole grain products, egg yolks, fish and liver oils	bone and tooth formation, increase in calcium and phosphorus absorption
E (tocopherol)	vegetable oils, nuts, fish oils, meats, leafy green vegetables	prevention of cell damage
K	leafy green vegetables, egg yolks, liver; also made by intestinal bacteria	blood clotting and synthesis of clotting factors
Water-Soluble (Dissolves in Water)		
B_1 (thiamine)	pork and red meats, whole grains, dried beans and peas, eggs	metabolism of carbohydrates
B_2 (riboflavin)	dairy products, liver and organ meats, enriched whole grains	metabolism of carbohydrates and proteins, normal growth in skin, lips, and mucous membranes
B_3 (niacin)	meats, dried peas and beans, whole grains	metabolism of glucose, fats, and proteins
B_6 (pyridoxine)	meats, fish, peanuts, eggs, bran cereal	metabolism of amino acids
B_{12}	liver, meats, eggs, dairy products	protein synthesis and red blood cell production
C (ascorbic acid)	citrus fruits, berries, tomatoes, broccoli, cabbage, potatoes, melons	antioxidant, maintenance of cartilage and bone, iron absorption, tissue repair, wound healing, healthy gums
Pantothenic acid	meats, dairy products, whole grains	metabolism of glucose, fats, and proteins
Folic acid	leafy green vegetables, liver, nuts, oranges, broccoli, peas, fortified cereals	amino acid synthesis and metabolism, prevention of neural tube defects in fetuses
Biotin	egg yolks, liver, soybeans	metabolism of carbohydrates, proteins, and fats
Choline	egg yolks, liver, whole grains	production of phospholipids and neurotransmitters

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MAIN IDEA

Meeting nutritional needs supports good health.

A balanced diet is important throughout your life, but particularly during pre-teen and early teen years. During these years, you are growing and developing faster than at any other time since the first two years of your life. Your bone mass is increasing nearly 40 percent, you are gaining most of your adult body mass, and you are developing sexual characteristics.

To fuel this growth spurt, your body requires considerably more nutrients and more energy in the form of Calories consumed, as shown in **FIGURE 1.5.** A calorie, with a small *c*, is the amount of energy required to raise one gram of water one degree Celsius. One **Calorie** (capital *C*) from food equals one kilocalorie, or 1000 calories. Different foods contain different amounts of energy. One gram of protein or carbohydrate yields four Calories, while one gram of fat yields nine Calories.

Calories alone are not the whole story, however. The rapid changes in your body require adequate amounts of all six nutrients. Dietary experts recommend that most of your Calories come from eating whole grains, fruits, and vegetables, which are rich in fiber, vitamins, and minerals. Also, experts suggest drinking more low-fat milk or soy drinks and water, and fewer high-sugar soft drinks and juices. High-sugar foods provide Calories but very little nutritional value. Dietary experts also recommend eating more lean meats and fish, while cutting down on foods high in saturated fat.

It is also important to find a balance between food and physical activity so that you use about as many Calories as you consume. The U.S. Department of Agriculture (USDA) Web site provides information on how to develop a balanced diet.

CONNECT TO

CELLULAR RESPIRATION

You read in **Cells and Energy** about the different ways that plant and animal cells obtain energy. In nearly all plant and animal cells, mitochondria use molecules broken down by digestion to build ATP, the main power source for cells.

FIGURE 1.6 Your food choices can help you consume high-quality energy and nutrients at a time when your body needs them the most.

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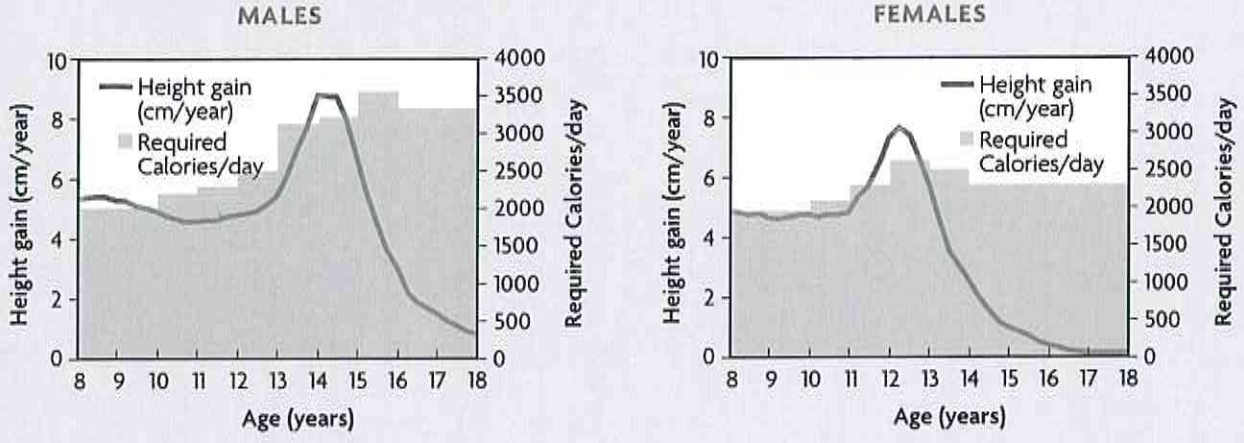
FIGURE 1.5 Growth and Energy Needs

During rapid growth, the body requires significantly more energy.



Contrast **What differences do you notice between the two charts?**

Sources: Adapted from JM Tanner: *Growth at Adolescence*, ed.2, Oxford; Food and Nutrition Board: *Recommended Dietary Allowances*, ed. 10, National Academy Press; Institute of Medicine, Food and Nutrition Board, *Dietary Reference*, National Academies Press

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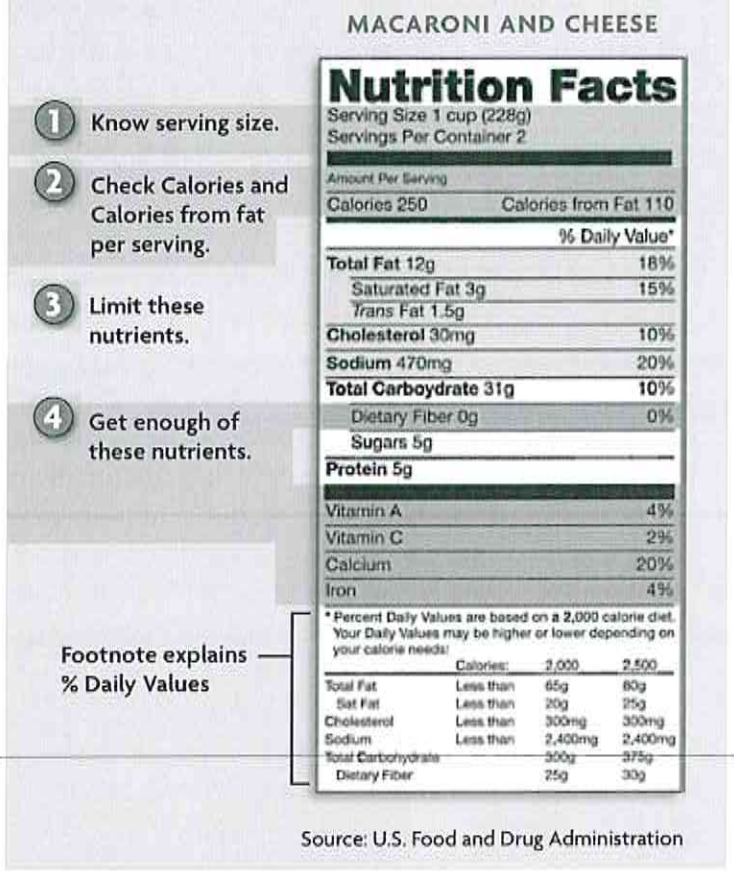
FIGURE 1.7 READING A FOOD LABEL



Source: U.S. Food and Drug Administration

The information on a food label, such as the one in **FIGURE 1.7,** can help you make good choices and compare the values of different foods. The label shown here is from a box of macaroni and cheese.

1. **Serving size and number** This measurement varies from one product to another. In this case, one serving equals one cup. Notice that this container holds *two* servings.
2. **Calories and Calories from fat** The numbers listed on the label are for *one serving only.* If you eat both servings, you are actually getting 500 Calories, nearly half from fat.
3. **Nutrients to limit** Americans usually consume too much saturated fat, trans fat, cholesterol, and sodium. Trans fat is a type of fat that can cause cell damage. A diet high in these nutrients is linked to obesity, which affects more and more Americans of all ages. Too much sodium can raise blood pressure by causing the body to retain water.
4. **Nutrients to target** Americans need to consume enough of these nutrients each day. Notice that this product is low in vitamins and minerals, except for calcium, and has no dietary fiber. The wheat used in the macaroni has been processed until there is no fiber left.

As the label shows, if you eat this product, you will also need to eat whole grains, vegetables, and fruits during the day to obtain the nutrients that are missing from this food.

Analyze What nutritional advantages do unprocessed foods offer over processed foods?

WebQuest
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PREMIUM CONTENT
Obesity

SELF-CHECK Online
HMDScience.com
PREMIUM CONTENT

32.1 Formative Assessment

REVIEWING ▶ MAIN IDEAS

1. What six types of nutrients must you consume to stay healthy? Give two examples of how nutrients help to maintain homeostasis.
2. What information besides the number of **Calories** can help you make good food choices?

CRITICAL THINKING

3. **Apply** Explain why vegans—people who eat no animal products—may have trouble getting all the essential amino acids from their diet.
4. **Contrast** How do the functions of **vitamins** and **minerals** differ from the functions of proteins and carbohydrates?

CONNECT TO

CELLULAR RESPIRATION

5. All cells need ATP to power their metabolic processes. Explain why eating carbohydrates is so important to the process of cellular respiration.

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Name: _____ **Date:** _____

Study Guide 28.1 Levels of Organization

____ 1. Which of the following carries messages to parts of the body?
a. organs
b. sensors
c. hormones
d. targets

____ 2. What process is shown in the diagram in Figure 28.1?

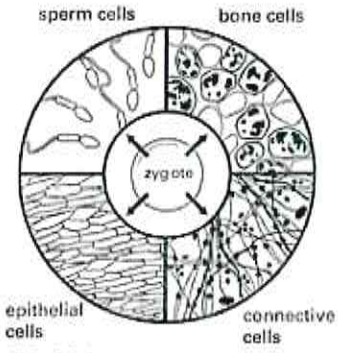

FIG. 28.1

a. cell differentiation
b. cell determination
c. control systems
d. internal environment

____ 3. Which cells are produced during the first few divisions of the zygote?
a. cardiac muscle cells
b. embryonic stem cells
c. bone cells
d. epithelial cells

____ 4. Through the process of thermoregulation, the body maintains a stable
a. sense of balance.
b. glucose level.
c. internal temperature.
d. control center.

____ 5. Information from the body's sensors goes first to a(n)
a. impulse hormone.
b. control center.
c. internal receptor.
d. specific target.

____ 6. Which of the following is the most complex level of organization in a multicellular structure?
a. tissues
b. organs
c. cells
d. organ systems

____ 7. Which type of cell goes through the determination process?
a. epithelial
b. connective
c. stem
d. muscle

____ 8. When organ systems work together, they form another level of organization called
a. cells.
b. tissues.
c. organs.
d. organisms.

____ 9. The diagram in Figure 30.2 shows the organization of structures within the human body. Structures become increasingly large and complex from left to right. Which group of structures is missing from the diagram?

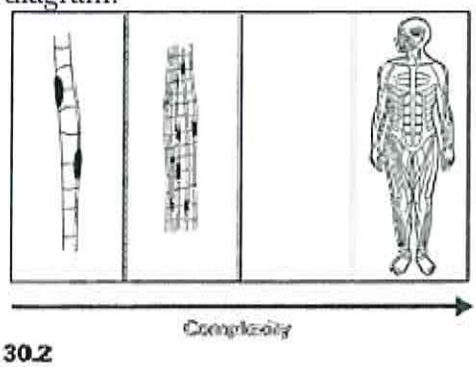

FIG. 30.2

a. organ systems
b. cells
c. tissues
d. organs

____ 10. What do the different shapes of the cells shown in Figure 28.1 reflect?

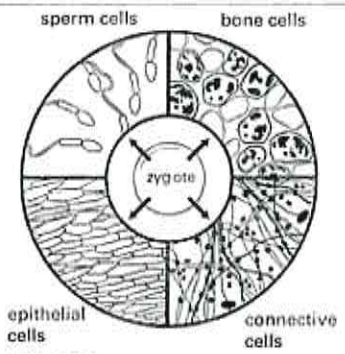

FIG. 28.1

a. They have different functions.
b. They are going through apoptosis.
c. They lack basic cell parts.
d. They are becoming stem cells.

____ 11. Apoptosis is a normal part of
a. development.
b. systems.
c. tissues.
d. determination.

____ 12. The major organ system that eliminates waste products is the
a. integumentary system.
b. reproductive system
c. endocrine system.
d. excretory system.

____ 13. Why must organ systems interact as a community?

a. Each organ has to oversee the functioning of other organs.
b. Organ tissues are not specialized, so they work together.
c. No organ can function without positive feedback.
d. Each organ alone cannot perform all the necessary tasks.

____ 14. Which type of tissue lines the stomach and the lungs?

a. connective
b. muscle
c. nervous
d. epithelial

____ 15. What is the simplest level of organization in the body?

a. cell
b. organ
c. tissue
d. organ system

____ 16. Which of the following processes results in cells losing their potential to become any type of cell?

a. differentiation
b. determination
c. apoptosis
d. specialization

Name: _____ Date: _____

SG 28.3 Interactions Among Systems

____ 1. Which of the following is an example of sensors working during homeostasis?
   a. energy demands triggering a release of glucose
   b. the pancreas failing to release insulin
   c. blood volume decreasing from lack of water
   d. acidic blood pH disrupting cell metabolism

____ 2. Each organ system coordinates with other organ systems through
   a. chemical and nerve messages.
   b. connective and muscular tissue.
   c. their stem cells.
   d. identical sensors and targets.

____ 3. The body works to maintain homeostasis in response to what conditions?
   a. internal and external changes
   b. production of key vitamins
   c. cell differentiation and determination
   d. tissue and cell formation

____ 4. Which of the following organ systems interact to regulate the level of vitamin D produced in your body?
   a. integumentary and skeletal
   b. endocrine and skeletal
   c. endocrine and circulatory
   d. respiratory and circulatory

____ 5. How does the liver help to regulate glucose levels in the blood?
   a. by excreting excess water
   b. by producing insulin
   c. by releasing glucagon
   d. by storing glucose

____ 6. When cells do not continue to develop into specialized cells, they undergo
   a. determination.
   b. homeostasis.
   c. apoptosis.
   d. differentiation.

____ 7. When you hold your breath, sensors in the blood vessels detect lower oxygen levels. The brain stem receives the information and sends messages through the nervous and endocrine systems to the muscles of the diaphragm, forcing you to breathe. Which part of this feedback loop would be considered the control center?
   a. the brain stem
   b. the endocrine system
   c. oxygen in the blood
   d. muscles of the diaphragm

____ 8. Which of the following organs acts as the control center in thermoregulation of the body?
   a. pancreas
   b. hypothalamus
   c. liver
   d. kidneys

____ 9. What is another way of describing what happens to your body when you have a cold?
   a. vitamin D deficiency
   b. short-term disruption of homeostasis
   c. homeostatic mechanism destruction
   d. immune system damage

____ 10. On a hot day, which of the following is an outward sign that thermoregulation is taking place?
   a. sweating
   b. sunburn
   c. slow breathing
   d. dry mouth

____ 11. What two organ systems provide communication in thermoregulation?
   a. nervous and endocrine
   b. circulatory and integumentary
   c. integumentary and muscular
   d. respiratory and nervous

____ 12. During childbirth, a woman's body produces oxytocin, which causes the uterus to contract. To maintain the contractions, more oxytocin is produced until the baby is born. This is an example of
   a. cell death.
   b. positive feedback.
   c. thermoregulation.
   d. sensor failure.

____ 13. How does a positive feedback loop respond to changing conditions?
   a. It reduces any change that overwhelms a set point.
   b. It increases a change away from a set point.
   c. It counteracts a variation from a set point.
   d. It changes a set point to match current conditions.

____ 14. If homeostasis were disrupted, all of the following would occur *except*
   a. the heart would immediately stop pumping blood.
   b. enzymes would be inactivated.
   c. body temperature would not be maintained.
   d. strenuous physical activity would be difficult.

____ 15. Several organs must work together to produce vitamin D. If one organ is not working well, the body makes less of this vitamin. Which organ system would suffer most from a lack of vitamin D?
   a. circulatory
   b. skeletal
   c. integumentary
   d. endocrine

____ 16. The long-term effects of a disruption of homeostasis include
   a. establishment of feedback mechanisms.
   b. destruction of organ systems.
   c. the immune system takes control.
   d. regulation of the internal environment.

Name: _____ Date: _____

SG 29.1 How Organs Systems Communicate

____ 1. Unlike the parts of the nervous system, the endocrine system's parts
   a. work independently of one another.
   b. are physically disconnected.
   c. control many processes.
   d. communicate with each other.

____ 2. Thoughts, movements, and some life processes are controlled by the
   a. nervous system.
   b. endocrine system.
   c. muscular system.
   d. circulatory system.

____ 3. Something that causes your nervous system or endocrine system to produce a response is called a
   a. receptor.
   b. change.
   c. message.
   d. stimulus.

____ 4. Which system transmits the message that you have a pebble in your shoe?
   a. peripheral nervous system
   b. endocrine system
   c. central nervous system
   d. skeletal system

____ 5. When you compare the endocrine system to a satellite television system, a satellite dish is compared to a
   a. signal.
   b. receptor.
   c. nerve.
   d. stimulus.

____ 6. Both the nervous and the endocrine systems allow you to
   a. analyze thoughts.
   b. respond to stimuli.
   c. control growth.
   d. react at the same rate.

___ 7. Which is an example of how the nervous system and the endocrine system work together?
   a. Neurotransmitters link the hypothalamus and pituitary glands.
   b. A reflex arc triggers glands to produce hormones.
   c. Hormones stimulate sensory receptors.
   d. The hypothalamus receives action potentials and releases hormones.

___ 8. Nearly instantaneous responses to changes in the environment
   a. are impossible.
   b. result from activation of the endocrine system.
   c. involve the activity of the nervous system.
   d. require messages from the pituitary gland.

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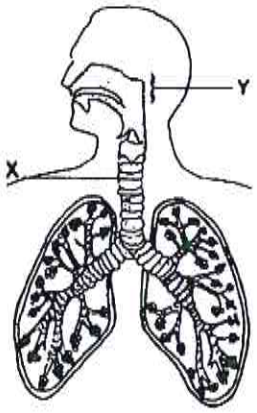
SG 30.1 Respiratory & Circulatory Functions



____ 1. Refer to the illustration above. The structure labeled *X* is the
   a. diaphragm.
   b. larynx.
   c. pharynx.
   d. trachea.

____ 2. When the diaphragm and rib cage muscles relax,
   a. it is impossible to breathe.
   b. the chest cavity enlarges.
   c. exhalation occurs.
   d. inhalation occurs.

____ 3. Which of the following occurs as air rushes into the lungs from the environment to equalize air pressure?
   a. contraction
   b. inhalation
   c. exhalation
   d. speech

____ 4. Blood is carried to and from the cells of the body by the
   a. veins.
   b. arteries.
   c. capillaries.
   d. muscles.

____ 5. When your heart and breathing speed up or slow down, your body is trying to
   a. increase lung volume.
   b. bring in more carbon dioxide.
   c. maintain homeostasis.
   d. increase its red blood cells.

____ 6. The arteries and arterioles of the circulatory system transport O
   a. lungs.
   b. heart.
   c. cells.
   d. mouth.

SG 30.1 Respiratory & Circulatory Functions

____ 7. Oxygen diffuses into the blood from the
   a. trachea.
   b. alveoli.
   c. aorta.
   d. bronchioles.

____ 8. The dome-shaped muscle below the chest cavity is called the
   a. larynx.
   b. diaphragm.
   c. pharynx.
   d. trachea.

____ 9. Which of the following is *not* a function of the human cardiovascular system?
   a. filtering wastes out of the blood
   b. distributing nutrients throughout the body
   c. carrying wastes to the urinary system
   d. helping the body maintain a constant body temperature

____ 10. The smallest and most numerous blood vessels in the body are the
   a. veins.
   b. capillaries.
   c. venules.
   d. arteries.

____ 11. The huge surface area in the lungs where O
   a. alveoli.
   b. bronchioles.
   c. trachea.
   d. bronchi.

____ 12. Which part of the respiratory system greatly increases its interior surface area?
   a. alveoli clusters
   b. trachea cartilage rings
   c. bronchiole openings
   d. sinus cilia

____ 13. Why is it difficult for your body to return blood from your feet when you sit for too long?
   a. The heart does not beat fast enough at rest.
   b. Skeletal muscles are not squeezing the veins.
   c. Gravity makes the blood flow backward.
   d. Blood has to travel a greater distance.

14. Oxygen is distributed throughout the body by the <u>respiratory</u> system. _____

____ 15. The blood in veins is
   a. leaving the lungs.
   b. carrying oxygen.
   c. traveling to the heart.
   d. moving in single file.

____ 16. The actual exchange of gases occurs at the site of the
   a. alveoli.
   b. trachea.
   c. larynx.
   d. nasal passageway.

____ 17. Vessels that carry blood away from the heart are called
a. capillaries.
b. venules.
c. veins.
d. arteries.

18. Blood is carried through the body in blood vessels. _____

____ 19. What determines whether molecules diffuse into or out of the blood?
a. the concentration of molecules dissolved in plasma
b. the number of capillaries the blood flows through
c. the ratio of red blood cells to white blood cells
d. the surface protein markers that indicate blood type

____ 20. Which muscles help blood return to the heart?
a. cardiac
b. arterial
c. smooth
d. skeletal

____ 21. A pulmonary artery carries blood from
a. the right ventricle to the lung.
b. one lung to the other.
c. the lung to the left atrium.
d. the pulmonary vein to the heart.

____ 22. Which of the following actions increases the volume of your lungs?
a. The diaphragm flattens and moves downward.
b. Air pressure increases inside the lungs.
c. The rib cage becomes smaller.
d. Gases move from areas of lower pressure.

____ 23. An artery
a. has thin, slightly elastic walls.
b. has valves that prevent blood from flowing backward.
c. is smaller than an arteriole.
d. usually carries oxygen-rich blood.

____ 24. In which direction would oxygen-rich blood flow in this diagram?

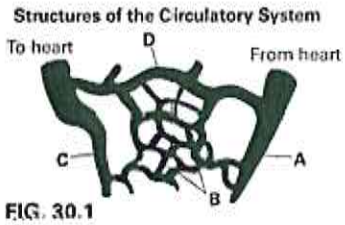


FIG. 30.1

a. from C to A
b. from A to C
c. from B to A
d. from C to D

Name: _____ **Date:** _____

SG 32.1 Nutrients & Homeostasis

____ 1. Suppose you are eating a piece of cheese pizza. Where would digestion of the pizza begin?
a. stomach
b. jejunum
c. duodenum
d. mouth

____ 2. carbohydrates : energy ::
a. amino acids : enzymes
b. fats : muscle
c. proteins : insulation for nerve tissue
d. fats : protein

____ 3. Figure 32.1 shows the label from a carton of yogurt. How many Calories per serving are from fat?

Nutrition Facts
Serving Size 1 Container

Amount Per Serving	
Calories 130	Fat Cal 15
Total Fat 1.5g	2%
Sat Fat 1g	5%
Trans Fat 0g	
Cholest 5mg	2%
Sodium 95mg	4%
Total Carb 25g	8%
Dietary Fiber 2g	8%
Sugars 22g	
Protein 6g	12%

Vitamin A 0% • Vitamin C 0%
Calcium 25% • Iron 0%
*Percent Daily Values (DV) are based on a 2,000 calorie diet.

FIG.32.1

a. 2
b. 65
c. 15
d. 130

____ 4. The food label on a package of cookies tells you that the amount of Calories per serving is 250, 150 of which are from fat. If you eat 2 servings (4 cookies), how many Calories will you be getting?
a. 400
b. 300
c. 600
d. 500

____ 5. Which nutrient is required for nearly every chemical reaction in every cell in your body?
a. calcium
b. vitamin B6
c. water
d. protein

____ 6. Most of the body's energy needs should be supplied by dietary
a. vitamins.
b. proteins.
c. fats.
d. carbohydrates.

____ 7. Which nutrient is a key component in cell membranes, neurons, and certain hormones?
a. protein
b. fat
c. water
d. iron

____ 8. vitamins : minute amounts ::
a. vitamin D deficiency : pellagra
b. rickets : vitamin C deficiency
c. carbohydrates : large amounts
d. B vitamins : scurvy

____ 9. The food guide pyramid was developed by the
a. USAF.
b. FDA.
c. CDC.
d. USDA.

____ 10. Excess calories and fat in the diet cause all of the following *except*
a. heart disease.
b. obesity.
c. weight loss.
d. increase the risk of diabetes and heart disease.

____ 11. The nutritional guide that lists the number of servings needed by your body daily from each food group is in the shape of a
a. pyramid.
b. circle.
c. square.
d. football.

____ 12. Excessive amounts of fat-soluble vitamins such as vitamins A, D, E, and K
a. prevent beriberi.
b. present no problem since they are not stored in the body.
c. can be harmful.
d. lead to excellent health.

____ 13. Which of the following types of food should be eaten in limited quantities?
a. fish
b. fruits
c. grains
d. fats

____ 14. Which of the following foods is the best source of protein and unsaturated fat?
a. eggs
b. beef
c. cheese
d. fish

____ 15. Vitamin K
a. assists with calcium uptake.
b. is stored in muscle tissue.
c. is needed for normal blood clotting.
d. is found in citrus fruits.

____ 16. All essential amino acids
a. must be obtained from the foods we eat.
b. are found in gelatin.
c. come from enzymes.
d. are made in our body.

____ 17. Vitamins are organic compounds that
a. help form cell membranes.
b. are not obtained from food.
c. play important roles in metabolism.
d. provide energy for metabolism.

____ 18. Good nutrition is especially important during the first two years of life and during the preteen years to
a. help maintain normal childhood homeostasis.
b. prevent excessive carbohydrate consumption.
c. support accelerated growth and development.
d. ensure you get enough green, leafy vegetables.

____ 19. According to the MyPyramid food guidance system, a person should obtain the most servings per day from
a. milk, yogurt, and cheese.
b. fruits.
c. fats, oils, and sweets.
d. breads, cereals, rice, and pasta.

____ 20. Which nutrient is your body's main source of the raw materials used for growth and repair?
a. vitamin B_{12}
b. proteins
c. animal fats
d. minerals

____ 21. Which of the following foods is a good source of lean protein?
a. oranges
b. grains
c. fish
d. potatoes

____ 22. Which of the following vitamins is vital for maintaining healthy cartilage and bone?
a. vitamin K
b. folic acid
c. B vitamins
d. vitamin C

____ 23. Figure 32.1 shows the label from a carton of yogurt. Approximately what percentage of the total Calories per serving is from fat?

Nutrition Facts
Serving Size 1 Container

Amount Per Serving	
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Sat Fat 1g	5%
Trans Fat 0g	
Cholest 5mg	2%
Sodium 95mg	4%
Total Carb 25g	8%
Dietary Fiber 2g	8%
Sugars 22g	
Protein 6g	12%

Vitamin A 0% • Vitamin C 0%
Calcium 25% • Iron 0%
*Precent Daily Values (DV) are based on a 2,000 calorie diet.

FIG.32.1

a. 15%
b. 7%
c. 12%
d. 2%

____ 24. Which food is considered a complex carbohydrate?
a. red meat
b. honey
c. peach
d. potato

____ 25. Which fat-soluble vitamin, found in egg yolks, is important for blood clotting?
a. vitamin C
b. riboflavin
c. folic acid
d. vitamin K

____ 26. According to dietary experts, foods that contain unsaturated fats are more beneficial than foods that contain saturated fats. Which food is a good source of unsaturated fat?
a. chicken
b. cheeses
c. omelets
d. almonds

____ 27. Which of the following is *not* considered a nutrient?
a. lipid
b. carbohydrate
c. energy
d. protein

____ 28. Which of the following foods is a good source of carbohydrates?
a. seeds
b. chicken
c. potatoes
d. cheese

____ 29. How much water do you need to drink each day in order to replace fluids lost through urine, sweat, and respiration?
   a. about 8 cups
   b. about 24 cups
   c. about 16 cups
   d. about 2 cups

____ 30. Which nutrient is your body's main source of energy?
   a. B vitamins
   b. saturated fats
   c. carbohydrates
   d. animal proteins