

# CHAPTER 5

## PHYSIOLOGY

- **THE LIVING ENVIRONMENT: KEY IDEA 1**  
*Living things are both similar to and different from each other and from non-living things.*
- **THE LIVING ENVIRONMENT: KEY IDEA 5**  
*Organisms maintain a dynamic equilibrium that sustains life.*

### Cells to Organ Systems

Cells are organized in multicellular organisms into **tissues**. For example, blood tissue is made of red and white blood cells and platelets. The red blood cells carry oxygen to other body cells, white blood cells fight disease and infection, and platelets help in blood clotting.

**Organs** are made of tissues. The heart is made of cardiac tissue. Organs that function together make up **organ systems**. The circulatory system is made up of the heart, veins, and arteries. The excretory system includes the lungs, kidneys, and bladder.

Each organ system is composed of organs that perform specific functions. Organ systems interact with each other. The nervous system sends impulses to the skeletal-muscle system to cause movement of body parts. The respiratory system adds oxygen to the blood of the circulatory system.

Tissues, organs, and organ systems provide each cell with nutrients and oxygen, and perform the task of removing of wastes. Diseases break down the structure or function of an organism. Some diseases are the result of the failure of an organ system. Kidney failure, caused by a disease of the kidneys, can make the whole organism fail to function properly.

### Review Questions

1. Cells organized together to perform the same function make up \_\_\_\_\_.
2. Organs are made of \_\_\_\_\_ that act together.
3. The stomach, small intestine, and large intestine are part of an \_\_\_\_\_ system.

### Nutrition

**Nutrition** is the activity by which the body obtains food and changes it into a form that is useable by the organism. Food provides the molecules that are the “fuel” for the body and the “building materials” for cells. Nutrients provide energy at the cell and body level. Food energy is measured in **Calories**. The total Calorie value of each type of food varies. The number of Calories an organism requires depends on the species, age, sex, size, and level of activity of the organism. Teenagers have the greatest daily Calorie requirement.

Nutrients provide chemicals needed for metabolism which regulates body processes and maintains homeostasis. **Metabolism** includes all the chemical reactions in an organism. Metabolism can be influenced by hormones, diet, exercise, and aging. Nutrients also provide the building materials for the organism. For example, proteins obtained through nutrients provide the materials necessary to make hemoglobin, an essential part of the blood.

### Review Questions

4. The activity by which the body obtains food is called \_\_\_\_\_.
5. Nutrients are the useable parts of \_\_\_\_\_.
6. The energy in food is measured in \_\_\_\_\_.
7. Nutrients provide \_\_\_\_\_ needed for metabolism.
8. All the chemical reactions in an organism is \_\_\_\_\_.

### Types of Nutrients

Organisms need food for energy, growth and repair, and as a source of chemicals. There are several major types of nutrients which supply needed energy and chemicals to the organism.

NUTRIENT	EXAMPLE(S)	FUNCTION(S)
Carbohydrate	sugar, starches	main source of energy for life processes
Fat	oils, butter, cream	a reserve energy supply, building material for certain cell structures
Protein	meat, eggs, beans, milk, fish	supplies amino acids which make new cells and body chemicals, repairs and maintains body tissues
Vitamins	A, B, C, D, K	necessary for good health and a healthy body, lack of a vitamin can cause disease
Minerals	calcium, iron, potassium	regulate body functions, needed for structure of body parts, maintain good health
Water	water	dissolves and transports materials in the body which is 70% water, needed for chemical reactions in the body

The indigestible part of food is roughage. It is removed from the digestive tract. An unbalanced diet leads to malnutrition, disease, and weight gain or loss. All organisms have a minimum daily requirement of each type of nutrient to maintain good health.

### Review Questions

9. Carbohydrates such as sugar and starch are a source of \_\_\_\_\_.
10. The amino acids found in \_\_\_\_\_ build and repair cells.
11. Calcium and iron are examples of \_\_\_\_\_ needed for good health.
12. Water will \_\_\_\_\_ and \_\_\_\_\_ materials in the body.
13. A disease such as rickets can be caused by an improper amount of \_\_\_\_\_ in the diet.

## Human Physiology

Each organ system is composed of organs which perform specific functions. The organ systems interact with each other. The respiratory and excretory systems work together to rid the body of wastes. Tissues, organs, and organ systems help to provide all cells with nutrients, oxygen, and waste removal.

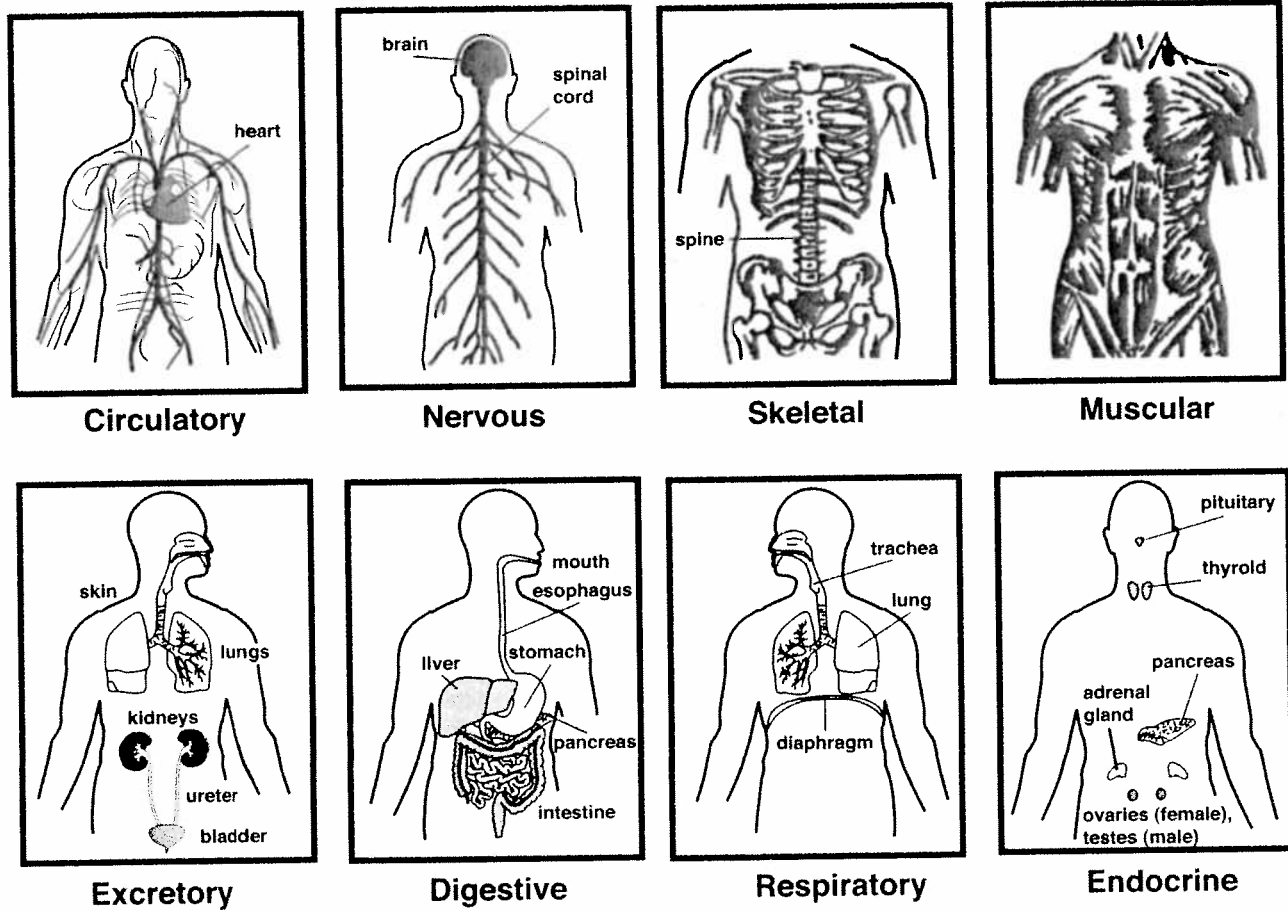


FIGURE 1. HUMAN BODY SYSTEMS

## HUMAN BODY SYSTEMS

### DIGESTIVE

ORGANS	FUNCTION(S)	INTERACTION(S) WITH OTHER SYSTEMS
Mouth	Physical and chemical breakdown of food	
Esophagus	Connects the mouth and stomach	
Stomach	Chemical breakdown of food	
Small Intestine	Completes chemical digestion, results in smaller molecules that can be absorbed and transported to cells	Interacts with the circulatory system when nutrients are absorbed into the blood and transported to all body cells
Liver	Produces chemicals needed for digestion	
Pancreas		
Large Intestine	Absorbs water, collects undigested food for removal from body	Interacts with circulatory system to absorb and transport water

### RESPIRATORY

ORGANS	FUNCTION(S)	INTERACTION(S) WITH OTHER SYSTEMS
Nose/mouth	Inhale oxygen and exhale carbon dioxide	
Trachea	Connects nose and lungs	
Bronchial tubes	Connect trachea to lungs	Interacts with the excretory system to rid the body of gaseous waste
Lungs	Site of gas exchange in air sacs called alveoli; oxygen goes into the blood, carbon dioxide is removed from the blood	Interacts with the circulatory system to exchange O <sub>2</sub> for CO <sub>2</sub> in the blood
Diaphragm	Muscle that helps to move air into and out of the lungs	

### EXCRETORY

ORGANS	FUNCTION(S)	INTERACTION(S) WITH OTHER SYSTEMS
Kidneys	Filter out liquid waste from the blood	Interacts with the circulatory system and respiratory system to eliminate liquid and gaseous wastes from the body
Liver	Removes harmful substances from blood	
Ureters	Connect kidneys to bladder	
Bladder	Stores and eliminates liquid waste	
Lungs	Elimination of gaseous waste (carbon dioxide)	
Skin	Elimination of excess heat	

### CIRCULATORY

ORGANS	FUNCTION(S)	INTERACTION(S) WITH OTHER SYSTEMS
Heart	Pumps blood through the body and the lungs	Interacts with the digestive and respiratory system to move substances to and from the cells
Arteries	Move blood away from the heart to the body	
Capillaries	Allow for the exchange of nutrients, oxygen, and wastes between the blood and body cells	
Veins	Move blood to the heart from the body	
Blood which includes:		
plasma	Immunity, antibodies	
platelets	Blood clotting	
white blood cells	Fight disease	
red blood cells	Transport oxygen and carbon dioxide	
Lymph Nodes	Remove bacteria, cancer cells, and disease-causing microorganisms before they enter the blood stream	

<b>SKELETAL</b>		
<b>ORGANS</b>	<b>FUNCTION(S)</b>	<b>INTERACTION(S)</b>
<b>Bones</b>	Support body	Interacts with muscular system for movement of the body
	Protects organs	Coordinated by the nervous system
	Produce new red blood cells in the bone marrow	
<b>Cartilage</b>	Cushions bones	
<b>Tendons</b>	Attach muscles to bones	
<b>Ligaments</b>	Connect bone to bone	

<b>MUSCULAR</b>		
<b>ORGANS</b>	<b>FUNCTION(S)</b>	<b>INTERACTION(S) WITH OTHER SYSTEMS</b>
<b>Muscles</b>	Motion of organs	Interacts with all organ systems causing movement of tissues and organs
	Locomotion of body	Interacts with skeletal and nervous systems so that organism can move to escape danger, obtain food and shelter, and reproduce

<b>NERVOUS</b>		
<b>ORGANS</b>	<b>FUNCTION(S)</b>	<b>INTERACTION(S) WITH OTHER SYSTEMS</b>
<b>Brain</b>	Interprets stimuli, sends impulses to the body	Interacts with the endocrine system to regulate the body's responses to changes in the environment
<b>Spinal cord</b>	Sends impulses to the brain	
<b>Nerves</b>	Send messages to the spinal cord, muscles and glands for response	
<b>Sense organs</b>	Detect changes in the environment	

<b>ENDOCRINE</b>		
<b>ORGANS</b>	<b>FUNCTION(S)</b>	<b>INTERACTION(S) WITH OTHER SYSTEMS</b>
<b>Glands which include:</b>		Interacts with all organ systems to chemically regulate and control each body function
<b>Pituitary</b>	Produces hormones that control the actions of other glands	
<b>Thyroid</b>	Produces hormones that regulate metabolism	
<b>Pancreas</b>	Produces insulin, hormone that controls blood sugar	
<b>Adrenal</b>	Produces hormones that help the body deal with stress	

<b>REPRODUCTIVE</b>		
<b>ORGANS</b>	<b>FUNCTION(S)</b>	<b>INTERACTION(S) WITH OTHER SYSTEMS</b>
<b>Female: ovaries</b>	Produce egg cells	Interacts with the endocrine system by producing hormones
<b>Male: testes</b>	Produces sperm cells	

## Review Questions

14. The \_\_\_\_\_ system transports substances throughout the body.
15. Changes in the environment are noticed by \_\_\_\_\_ organs.
16. The excretory system eliminates liquid and gaseous \_\_\_\_\_.
17. The \_\_\_\_\_ system mechanically and chemically breaks down food.
18. Sex cells are produced by the \_\_\_\_\_ system.
19. Hormones are chemicals produced by the \_\_\_\_\_ system.
20. The alveoli in the lungs are part of the \_\_\_\_\_ system.
21. Liquid and gaseous wastes are removed from the body by the kidneys, \_\_\_\_\_ and \_\_\_\_\_.
22. Bone marrow produces \_\_\_\_\_.
23. Nutrients are provided to the cells by the interactions of the \_\_\_\_\_ and \_\_\_\_\_ systems.

## Disease

**Disease** breaks down the structures or functions of an organism. Disease can affect the internal balance (**homeostasis**) of the organism. Disease in the human body can be infectious or non-infectious. **Infectious** disease is caused by microorganisms (**microbes**) and can be spread from person to person, such as influenza virus, or from animal to person, such as West Nile disease. We can have **immunity** from an infectious disease like measles because we have been vaccinated against it. Or perhaps we had a disease, like chicken pox, which caused us to produce antibodies against it. Specialized cells found in the blood protect the body from some infectious diseases. Chemicals produced by these cells identify and destroy microbes that enter the body.

**Non-infectious** diseases can not be transmitted from organism to organism. Some of these diseases are the result of failure of an organ or organ system. Kidney failure, caused by a malfunction of the kidneys, causes the entire system to fail. Personal behaviors involving the use of toxic substances such as alcohol and tobacco may cause disease. Emphysema is a disease of the lungs caused by the inhalation of tobacco smoke or chemicals. Poor dietary habits such as overeating (obesity) or under-eating (malnutrition) will interfere with one's internal dynamic equilibrium (balance) and affect the health of the person. Cancer is caused by abnormal cell division.

Other non-infectious diseases are hereditary. These diseases are a result of a genetic change in the chromosomes which may be passed to future generations. Cystic fibrosis, a disorder of the respiratory system, and sickle cell anemia, a disease of the blood, are hereditary.

During pregnancy poor personal behaviors by the mother may affect the development of her unborn child. Some of these effects can be seen immediately at birth, other effects may not appear for years.

## Review Questions

24. Disease breaks down the structure or \_\_\_\_\_ of an organ system.
25. Disease can upset the internal balance or \_\_\_\_\_ in the organism.
26. Microbes that can be passed from organism to organism cause \_\_\_\_\_ disease.
27. Specialized \_\_\_\_\_ in the blood protect the body from infectious disease.
28. The chemicals produced by some specialized cells identify and destroy \_\_\_\_\_.
29. A poor diet can cause a \_\_\_\_\_ disease that can not be passed to another organism.

## Plants

Green plants must carry out all the life functions through unique structures. The most important structures of the plant are the roots, stems, leaves, and flowers.

The **roots** absorb water and nutrients from the soil that the plant needs to stay alive. The roots anchor the plant to the ground.

The **stem** transports water and nutrients from the roots to the leaves. It also transports the food made in the leaves throughout the plant body. The stem supports the plant and its structures such as branches, leaves, and flowers.

The **leaf** is where the processes of gas exchange and photosynthesis take place. Through pores in the leaf, water vapor and carbon dioxide are exchanged with the air. In sunlight, chloroplasts in the leaf cells use carbon dioxide and water to produce oxygen and food by the process of **photosynthesis**.

Photosynthesis is a chemical reaction that occurs when chlorophyll in the chloroplasts absorbs light energy. Oxygen is eliminated from the plant through the leaf pores. The food, glucose, is then transported throughout the plant.

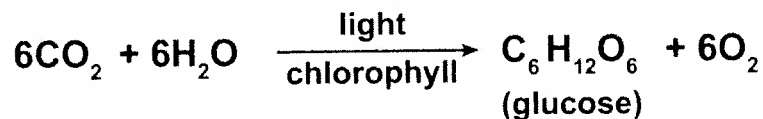


FIGURE 3. CHEMICAL REACTION OF PHOTOSYNTHESIS

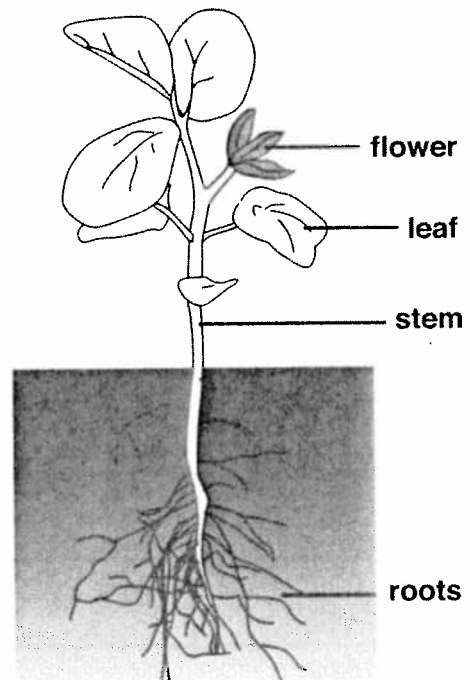


FIGURE 2.  
PLANT STRUCTURES

Reproduction in flowering plants takes place in the flowers. Here fruits and seeds are produced.

9. Which is an appropriate heading for column X?

Organism	X
earthworm	moist skin
fish	gills
humans	lungs

- (1) Structures Used in Gas Exchange                      (3) Endocrine Systems  
(2) Sensory Organs    (4) Structures Needed for Digestion

10. Which body system is functioning improperly when not enough of the hormone insulin is produced?

- (1) digestive                      (2) endocrine                      (3) nervous                      (4) reproductive

11. Kidney stones will affect the

- (1) excretory system    (3) circulatory system  
(2) digestive system    (4) respiratory system

12. Which is the first system affected when you hear a loud sound?

- (1) excretory                      (2) skeletal                      (3) nervous                      (4) endocrine

13. Which system is associated with transmission of impulses to the muscles?

- (1) excretory                      (2) skeletal                      (3) nervous                      (4) respiratory

14. The ribs protect the

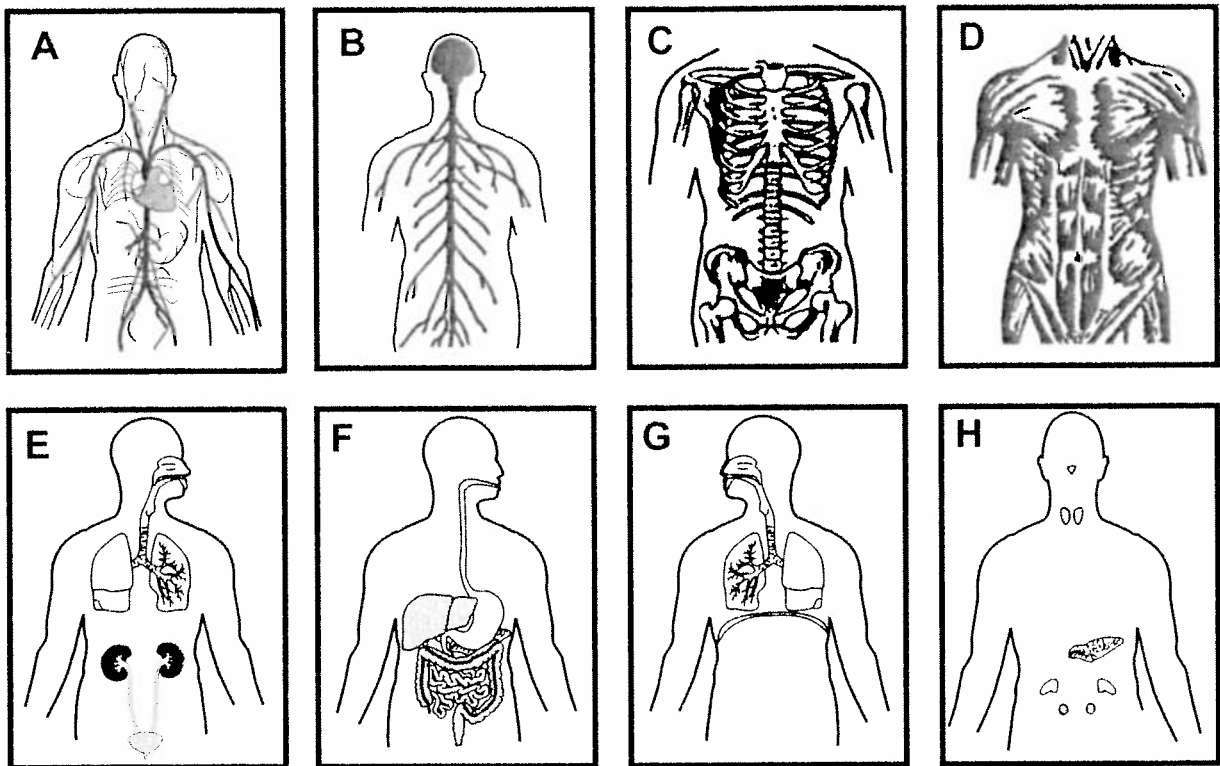
- (1) spinal cord and brain    (3) heart and kidneys  
(2) lungs and heart    (4) lungs and spinal cord

15. Structures which return blood to the heart are the

- (1) arteries    (3) bronchial tubes  
(2) veins    (4) capillaries



Base your answers to questions 16 – 24 on the following diagram:



16. Which two systems work together to cause body motion?  
 (1) A and B                      (2) A and C                      (3) C and D                      (4) B and F
17. Which system exchanges oxygen for carbon dioxide?  
 (1) B                                  (2) C                                  (3) D                                  (4) G
18. Which system coordinates and regulates all body activities?  
 (1) A                                  (2) B                                  (3) C                                  (4) D
19. Which system includes the kidneys and bladder?  
 (1) A                                  (2) C                                  (3) E                                  (4) G
20. Which systems release wastes from the body?  
 (1) B and C                      (2) C and G                      (3) C and F                      (4) E and G
21. Which system removes undigested food from the body?  
 (1) B                                  (2) E                                  (3) F                                  (4) G
22. Which system circulates nutrients and oxygen throughout the body?  
 (1) A                                  (2) D                                  (3) E                                  (4) H
23. The body system in diagram D is directly involved in:  
 (1) blood clotting                      (3) excretion of liquid wastes  
 (2) causing body movements                      (4) exchange of gases
24. Which systems work together to provide oxygen for all body cells and tissues?  
 (1) A and G                      (2) C and D                      (3) C and E                      (4) B and G

25. Which are organs of the human digestive system?
- (1) lungs, bladder, stomach
  - (2) lungs, heart, small intestine
  - (3) stomach, small intestine, large intestine
  - (4) small intestine, large intestine, kidneys
26. The lungs, skin, and kidneys are all part of which system?
- (1) digestive
  - (2) excretory
  - (3) respiratory
  - (4) circulatory
27. The chemicals that are secreted by the endocrine system to regulate organs and body activities are
- (1) enzymes
  - (2) platelets
  - (3) hormones
  - (4) plasma
28. The main function of the human digestive system is to
- (1) rid the body of wastes
  - (2) break down food so that nutrients can enter the body cells
  - (3) provide energy for the cells
  - (4) control and coordinate all body activities
29. A decrease in chlorophyll will affect a plant's ability to
- (1) excrete wastes
  - (2) carry on photosynthesis
  - (3) carry on reproduction
  - (4) absorb oxygen
30. In a tree, light energy is converted to chemical energy in the
- (1) root
  - (2) leaf
  - (3) stem
  - (4) seed
31. Which is *not* needed for photosynthesis?
- (1) chlorophyll
  - (2) light
  - (3) oxygen
  - (4) carbon dioxide
32. Eating a sweet potato provides energy for human metabolism. The original source of this energy came from
- (1) minerals in the soil
  - (2) sunlight absorbed during photosynthesis
  - (3) water absorbed by the plant
  - (4) absorption of carbon dioxide by the leaf
33. A stalk of celery is placed in water dyed blue. After a few days the blue dye is found in the upper part of the celery. Which life process occurred?
- (1) respiration
  - (2) excretion
  - (3) reproduction
  - (4) transport

## EXTENDED RESPONSE

34. Read the passage below.

### Lyme Disease

Since 1980, the number of reported cases of Lyme disease in New York State has been increasing. The carrier of this disease is a small deer tick, *Ixodes dammini*. The disease is spread from infected animals to ticks that bite them. Humans bitten by these ticks may become infected.

The symptoms of Lyme disease do not always occur immediately. After an infected tick bite, a person may develop a skin rash several days or weeks later. Flu-like symptoms such as headache, muscle ache, joint pains, and fever may also develop. Sometimes these symptoms clear up and the person may not seek medical help. Sometimes there are no symptoms other than the sudden onset of arthritis. In a small number of cases if the person is not treated, they may develop chronic arthritis or disorders of the heart and nervous systems.

A simple blood test can diagnose Lyme disease. Antibiotics are effective in treating the disease. People can take precautions to lower their risk of getting this disease. They should check themselves and pets for ticks. When walking outside wear light colored clothing, tuck pants into socks, wear long sleeves and use insect repellent. People should seek immediate medical treatment if they suspect they have the disease.

- a. This disease is considered (infectious) (non-infectious).
- b. Name ONE activity that would put you at risk for Lyme disease.
- \_\_\_\_\_
- c. There is concern about increases in the deer population in some communities. Explain, based on this reading, why this would be so..
- \_\_\_\_\_
- \_\_\_\_\_
- d. State ONE way that you can protect yourself from getting Lyme disease.
- \_\_\_\_\_
- e. State TWO symptoms of Lyme disease.
- (1) \_\_\_\_\_ (2) \_\_\_\_\_
- f. Name TWO body systems that could be affected by Lyme disease.
- (1) \_\_\_\_\_ (2) \_\_\_\_\_

35. A scientific study showed that the depth at which green algae is found in a lake varies from day to day. On a sunny day, the algae is found as much as 6 meters below the surface. On a cloudy day, the algae is nearer the surface.

Explain a possible reason for this.

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36. In an investigation, three young plants of the same species were placed in three different locations. Each plant had the same type and amount of soil and received the same amount of water each day. At the end of one week the following data was collected.

Location	Height (cm)	Leaf Color
Sunny windowsill	11.0	Green
Indirect sunlight	9.0	Green
Closed closet	7.0	Whitish Yellow

- a. Write the hypothesis that was being tested by this experiment.

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- b. Explain the reason that the plant in the closet did not have green leaves.

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- c. Write a conclusion based on this data.

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39. Many human organ systems interact to carry out the life processes.

Digestive	Respiratory	Excretory	Circulatory	Nervous	Endocrine	Muscular	Skeletal
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a. Select TWO organ systems and explain how and why they interact with each other.

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b. Describe ONE malfunction or disease associated with ONE of the systems.

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40. For each statement select the human body system involved.

a. The hormone adrenaline is produced when you are excited. \_\_\_\_\_

b. Prepares nutrients for absorption in to the body. \_\_\_\_\_

c. Protects the major body organs. \_\_\_\_\_

d. Blood returns to the heart through the veins. \_\_\_\_\_

e. You listen to a music concert. \_\_\_\_\_

f. During a bicycle ride you sweat. \_\_\_\_\_

g. You read and interpret a poem. \_\_\_\_\_

h. The kidneys filter wastes from your blood. \_\_\_\_\_