

# The Human Body: An Orientation

Most of us have a natural curiosity about our bodies, and a study of anatomy and physiology elaborates on this interest. Anatomists have developed a universally acceptable set of reference terms that allows body structures to be located and identified with a high degree of clarity. Initially, students might have difficulties with the language used to describe anatomy and physiology, but without such a special vocabulary, confusion is bound to occur.

The topics in this chapter enable students to test their mastery of terminology commonly used to describe the body and its various parts, and concepts concerning functions vital for life and homeostasis. Body organization from simple to complex levels and an introduction to the organ systems forming the body as a whole are also covered.

## AN OVERVIEW OF ANATOMY AND PHYSIOLOGY

1. Match the terms in Column B to the appropriate descriptions provided in Column A. Enter the correct letter or its corresponding term in the answer blanks.

### Column A

1. The branch of biological science that studies and describes how body parts work or function
2. The study of the shape and structure of body parts
3. The tendency of the body's systems to maintain a relatively constant or balanced internal environment
4. The term that indicates *all* chemical reactions occurring in the body

### Column B

- A. Anatomy
- B. Homeostasis
- C. Metabolism
- D. Physiology

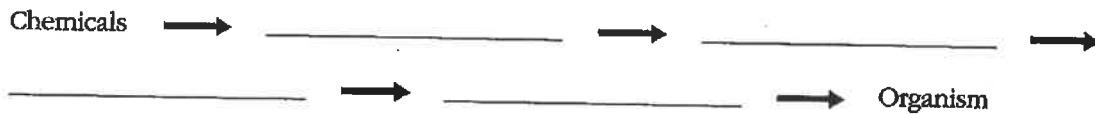
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2. Circle all the terms or phrases that correctly relate to the study of *physiology*. Use a highlighter to identify those terms or phrases that pertain to the study of *anatomy*.

- |   |                      |
|---|----------------------|
| A. Measuring an organ's size, shape, and weight | H. Dynamic           |
| B. Can be studied in dead specimens             | I. Dissection        |
| C. Often studied in living subjects             | J. Experimentation   |
| D. Chemistry principles                         | K. Observation       |
| E. Measuring the acid content of the stomach    | L. Directional terms |
| F. Principles of physics                        | M. Static            |
| G. Observing a heart in action                  |                      |

## LEVELS OF STRUCTURAL ORGANIZATION

3. The structures of the body are organized into successively larger and more complex structures. Fill in the answer blanks with the correct terms for these increasingly larger structures.



4. Circle the term that does not belong in each of the following groupings.

- |               |                  |               |                |                   |
|---------------|------------------|---------------|----------------|-------------------|
| 1. Atom       | Cell             | Tissue        | Alive          | Organ             |
| 2. Brain      | Stomach          | Heart         | Liver          | Epithelium        |
| 3. Epithelium | Heart            | Muscle tissue | Nervous tissue | Connective tissue |
| 4. Human      | Digestive system | Horse         | Pine tree      | Amoeba            |

5. Using the key choices, identify the organ systems to which the following organs or functions belong. Insert the correct letter or term in the answer blanks.

### Key Choices

- |                   |                     |                 |             |
|-------------------|---------------------|-----------------|-------------|
| A. Cardiovascular | D. Integumentary    | G. Nervous      | J. Skeletal |
| B. Digestive      | E. Lymphatic/Immune | H. Reproductive | K. Urinary  |
| C. Endocrine      | F. Muscular         | I. Respiratory  |             |

- \_\_\_\_\_ 1. Rids the body of nitrogen-containing wastes
- \_\_\_\_\_ 2. Is affected by the removal of the thyroid gland
- \_\_\_\_\_ 3. Provides support and levers on which the muscular system can act
- \_\_\_\_\_ 4. Includes the heart
- \_\_\_\_\_ 5. Protects underlying organs from drying out and mechanical damage
- \_\_\_\_\_ 6. Protects the body; destroys bacteria and tumor cells
- \_\_\_\_\_ 7. Breaks down foodstuffs into small particles that can be absorbed
- \_\_\_\_\_ 8. Removes carbon dioxide from the blood
- \_\_\_\_\_ 9. Delivers oxygen and nutrients to the body tissues
- \_\_\_\_\_ 10. Moves the limbs; allows facial expression
- \_\_\_\_\_ 11. Conserves body water or eliminates excesses
- \_\_\_\_\_ 12. Provides for conception and childbearing
- \_\_\_\_\_ 13. Controls the body with chemicals called hormones
- \_\_\_\_\_ 14. Is damaged when you cut your finger or get a severe sunburn

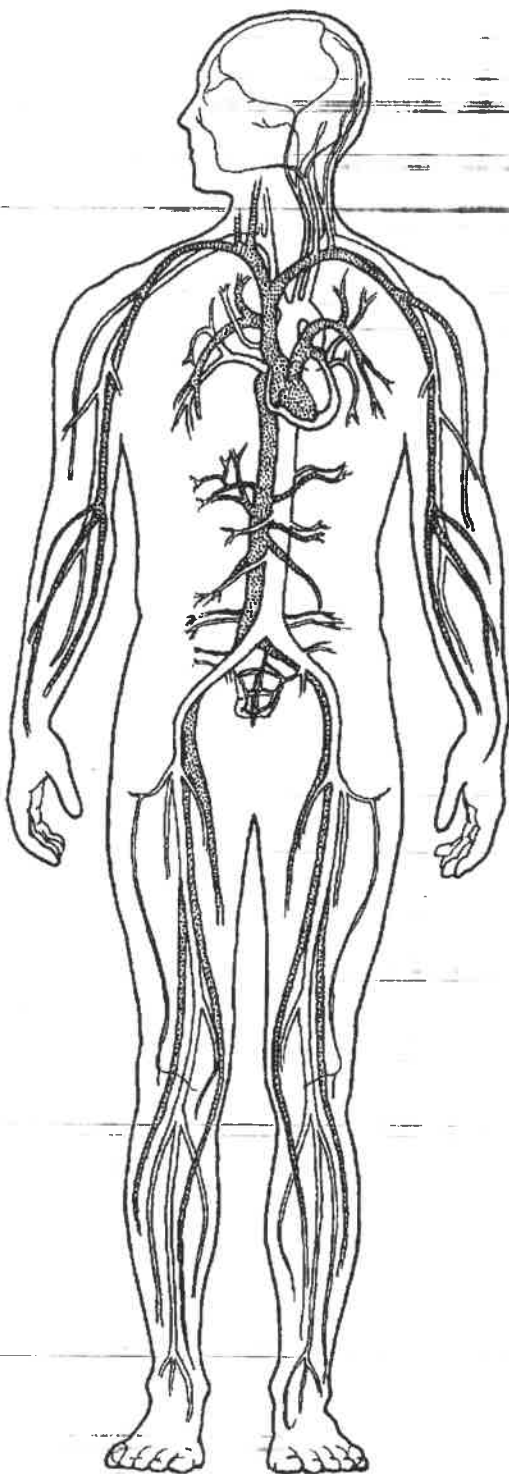
6. Using key choices from Exercise 5, choose the organ system to which each of the following sets of organs belongs. Enter the correct letter or term in the answer blanks.

- \_\_\_\_\_ 1. Blood vessels, heart
- \_\_\_\_\_ 2. Pancreas, pituitary, adrenal glands
- \_\_\_\_\_ 3. Kidneys, bladder, ureters
- \_\_\_\_\_ 4. Testis, vas deferens, urethra
- \_\_\_\_\_ 5. Esophagus, large intestine, rectum
- \_\_\_\_\_ 6. Breastbone, vertebral column, skull
- \_\_\_\_\_ 7. Brain, nerves, sensory receptors

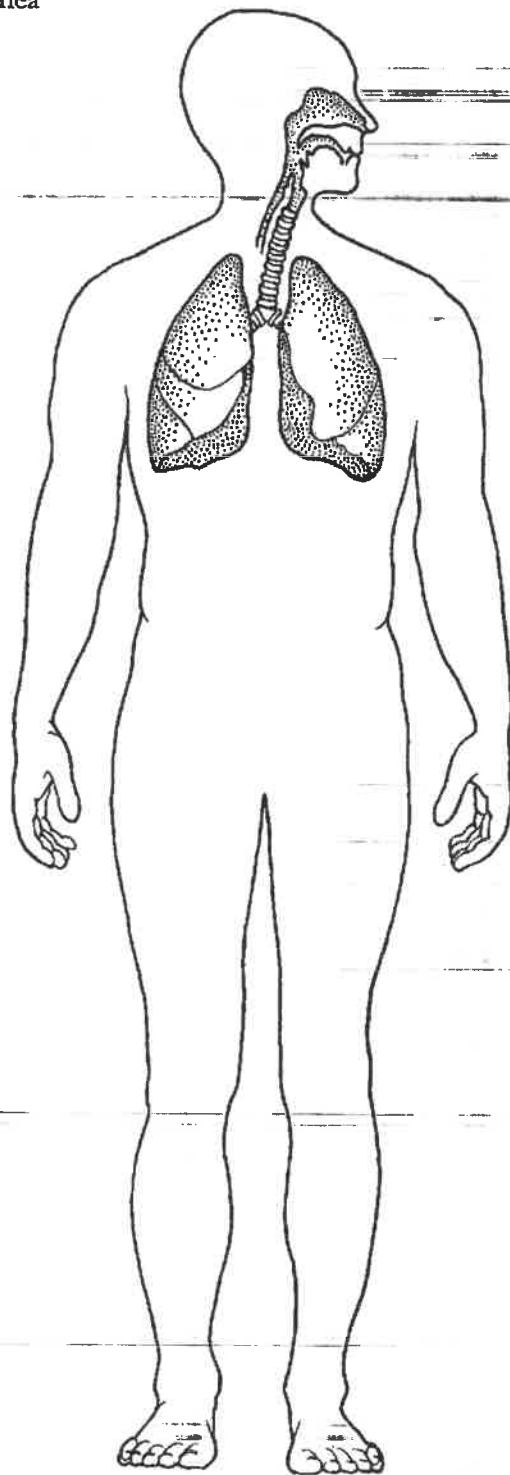
7. Figures 1-1 to 1-6, on pages 4-6, represent the various body organ systems. First identify and name each organ system by labeling the organ system under each illustration. Then select a different color for each organ and use it to color the coding circles and corresponding structures in the illustrations.

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- ☐ Blood vessels
- ☐ Heart
- ☐ Nasal cavity
- ☐ Lungs
- ☐ Trachea



**Figure 1-1**



**Figure 1-2**

☐ Brain

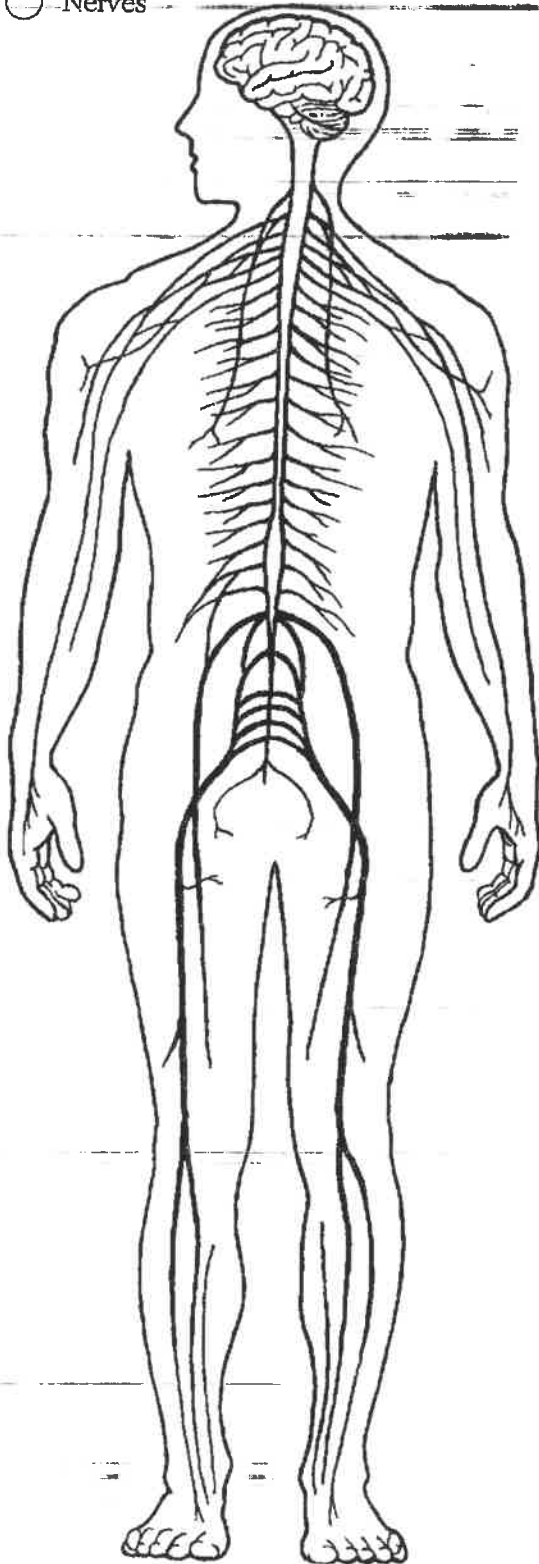
☐ Spinal cord

☐ Nerves

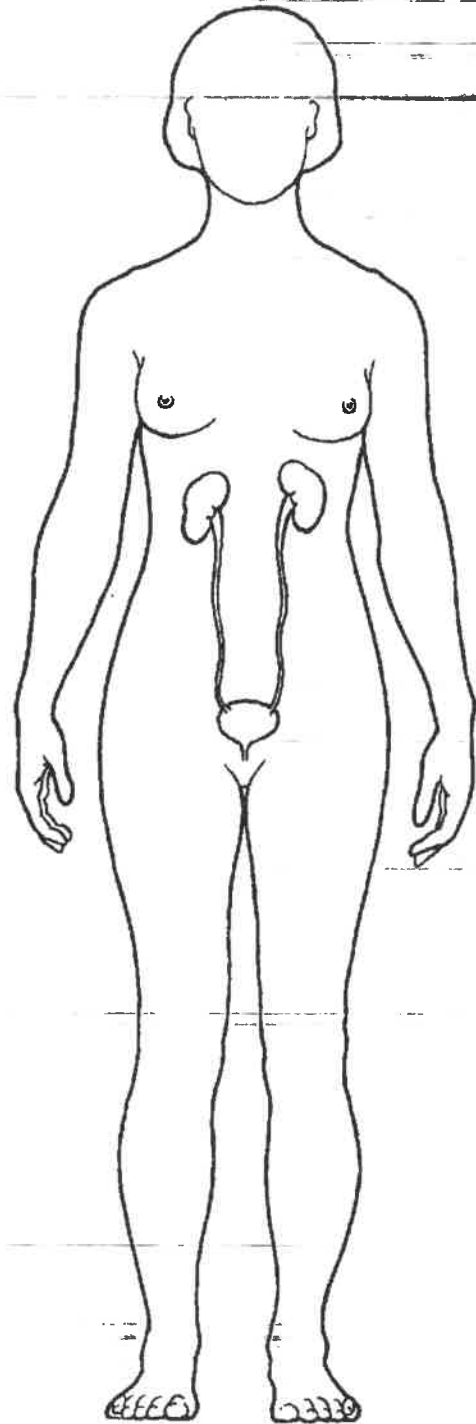
☐ Kidneys

☐ Ureters

☐ Bladder



**Figure 1-3**



**Figure 1-4**

**6** Anatomy & Physiology Coloring Workbook

○ Stomach

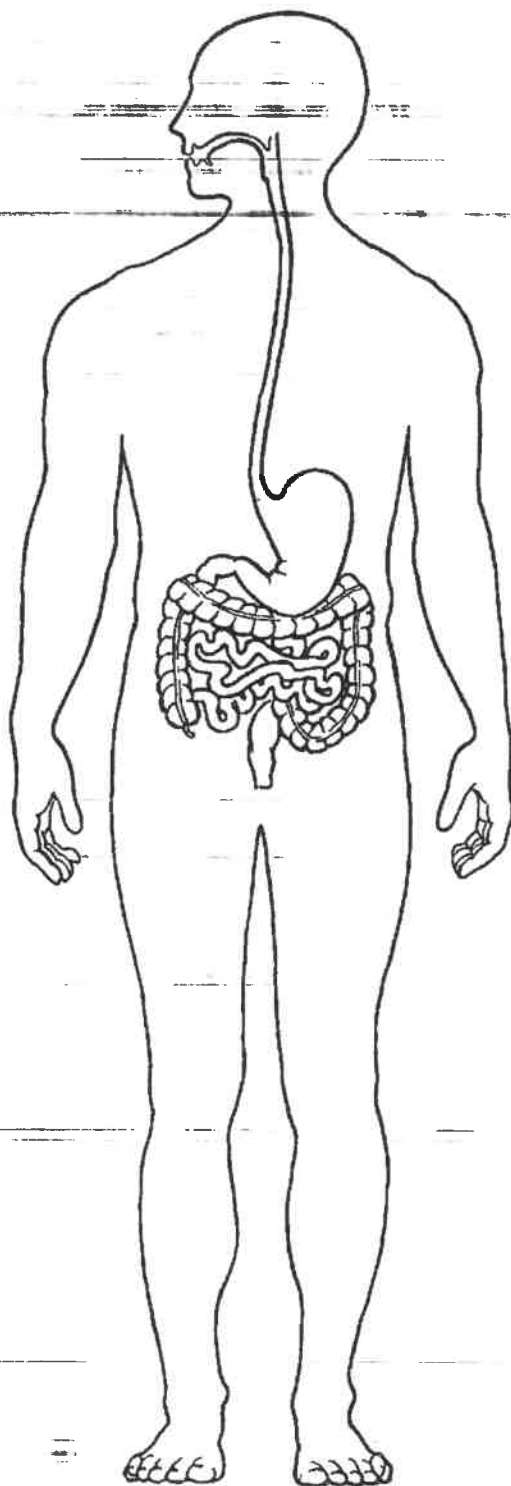
○ Esophagus

○ Ovaries

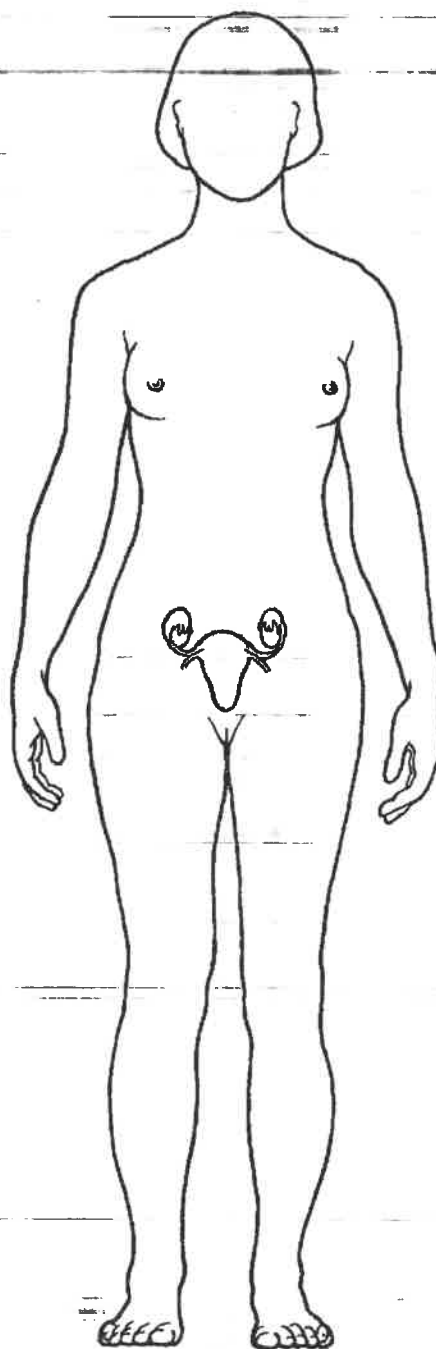
○ Intestines

○ Oral cavity

○ Uterus



**Figure 1-5**



**Figure 1-6**

## MAINTAINING LIFE

8. Match the terms pertaining to functional characteristics of organisms in Column B with the appropriate descriptions in Column A. Fill in the answer blanks with the appropriate letter or term.

### Column A

### Column B

- |  |                              |
|--|------------------------------|
| _____ 1. Keeps the body's internal environment distinct from the external environment                    | A. Digestion                 |
| _____ 2. Provides new cells for growth and repair  | B. Excretion                 |
| _____ 3. Occurs when constructive activities occur at a faster rate than destructive activities          | C. Growth                    |
| _____ 4. The tuna sandwich you have just eaten is broken down to its chemical building blocks            | D. Maintenance of boundaries |
| _____ 5. Elimination of carbon dioxide by the lungs and elimination of nitrogenous wastes by the kidneys | E. Metabolism                |
| _____ 6. Ability to react to stimuli; a major role of the nervous system                                 | F. Movement                  |
| _____ 7. Walking, throwing a ball, riding a bicycle  | G. Responsiveness            |
| _____ 8. All chemical reactions occurring in the body  | H. Reproduction              |
| _____ 9. At the cellular level, membranes; for the whole organism, the skin                              |                              |

9. Using the key choices, correctly identify the survival needs that correspond to the following descriptions. Insert the correct letter or term in the answer blanks.

### Key Choices

- |                                 |              |          |
|---------------------------------|--------------|----------|
| A. Appropriate body temperature | C. Nutrients | E. Water |
| B. Atmospheric pressure         | D. Oxygen    |          |

- |  |
|--|
| _____ 1. Includes carbohydrates, proteins, fats, and minerals  |
| _____ 2. Essential for normal operation of the respiratory system and breathing  |
| _____ 3. Single substance accounting for over 60% of body weight   |
| _____ 4. Required for the release of energy from foodstuffs  |
| _____ 5. Provides the basis for body fluids of all types   |
| _____ 6. When too high or too low, physiological activities cease, primarily because molecules are destroyed or become nonfunctional |

## HOMEOSTASIS

10. The following statements refer to homeostatic control systems. Complete each statement by inserting your answers in the answer blanks.

- \_\_\_\_\_ 1. There are three essential components of all homeostatic control mechanisms: control center, receptor, and effector. The
- \_\_\_\_\_ 2. (1) senses changes in the environment and responds by sending information (input) to the (2) along the (3)
- \_\_\_\_\_ 3. pathway. The (4) analyzes the input, determines the appropriate response, and activates the (5) by sending information along the (6) pathway. When the response causes the
- \_\_\_\_\_ 4. initial stimulus to decline, the homeostatic mechanism is referred to as a (7) feedback mechanism. When the
- \_\_\_\_\_ 5. response enhances the initial stimulus, the mechanism is called a (8) feedback mechanism. (9) feedback mechanisms are much more common in the body.
- \_\_\_\_\_ 6.
- \_\_\_\_\_ 7.
- \_\_\_\_\_ 8.
- \_\_\_\_\_ 9.

## THE LANGUAGE OF ANATOMY

11. Complete the following statements by filling in the answer blanks with the correct term.

- \_\_\_\_\_ 1. The abdominopelvic and thoracic cavities are subdivisions of the (1) body cavity; the cranial and spinal cavities are parts of the (2) body cavity. The (3) body cavity is totally surrounded by bone and provides very good protection to the structures it contains.
- \_\_\_\_\_ 2.
- \_\_\_\_\_ 3.

12. Circle the term or phrase that does not belong in each of the following groupings.

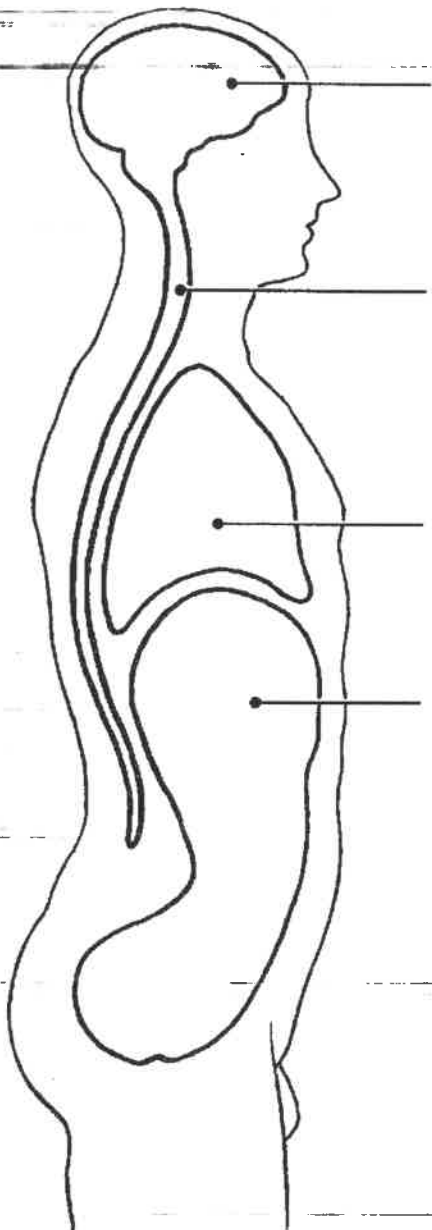
- |               |             |             |                     |
|---------------|-------------|-------------|---------------------|
| 1. Transverse | Distal      | Frontal     | Sagittal            |
| 2. Lumbar     | Thoracic    | Antecubital | Abdominal           |
| 3. Sural      | Brachial    | Femoral     | Popliteal           |
| 4. Epigastric | Hypogastric | Right iliac | Left upper quadrant |



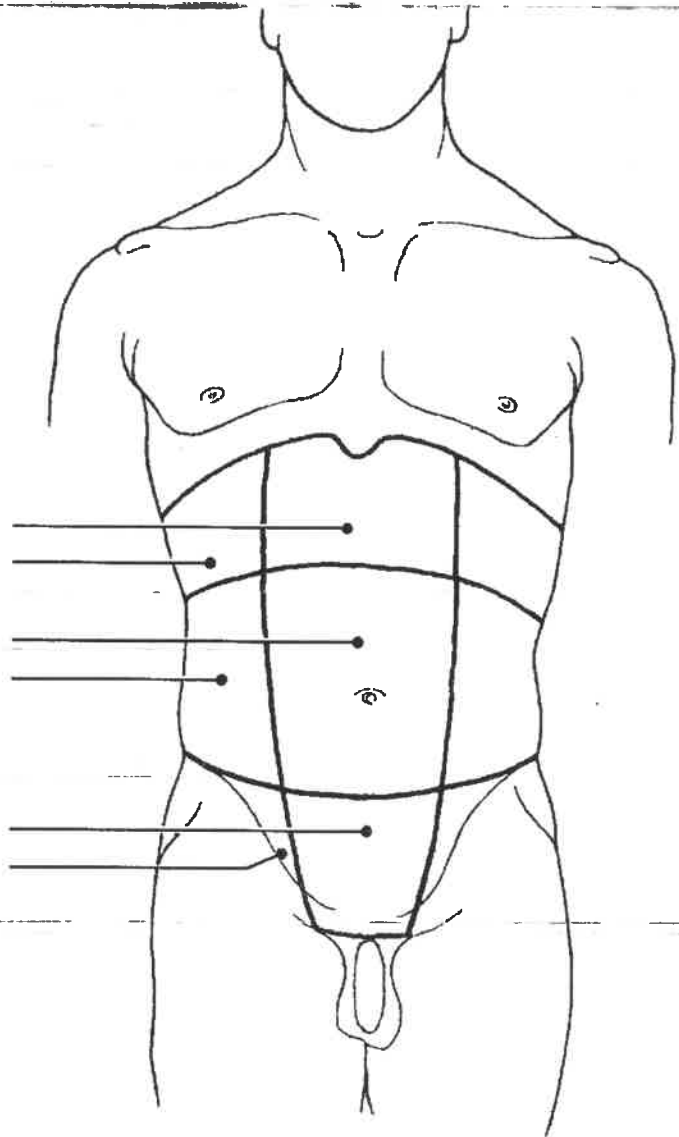
13. Select different colors for the *dorsal* and *ventral* body cavities. Color the coding circles below and the corresponding cavities in part A of Figure 1-7. Complete the figure by labeling those body cavity subdivisions that have a leader line. Complete part B by labeling each of the abdominal regions indicated by a leader line.

☐ Dorsal body cavity

☐ Ventral body cavity



A



B

Figure 1-7

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14. Select the key choices that identify the following body parts or areas. Enter the appropriate letter or corresponding term in the answer blanks.

### Key Choices

- |                |             |              |              |
|----------------|-------------|--------------|--------------|
| A. Abdominal   | E. Buccal   | I. Inguinal  | M. Pubic     |
| B. Antecubital | F. Cervical | J. Lumbar    | N. Scapular  |
| C. Axillary    | G. Femoral  | K. Occipital | O. Sural     |
| D. Brachial    | H. Gluteal  | L. Popliteal | P. Umbilical |

- \_\_\_\_\_ 1. Armpit
- \_\_\_\_\_ 2. Thigh region
- \_\_\_\_\_ 3. Buttock area
- \_\_\_\_\_ 4. Neck region
- \_\_\_\_\_ 5. "Belly button" area
- \_\_\_\_\_ 6. Genital area
- \_\_\_\_\_ 7. Anterior aspect of elbow
- \_\_\_\_\_ 8. Posterior aspect of head
- \_\_\_\_\_ 9. Area where trunk meets thigh
- \_\_\_\_\_ 10. Back area from ribs to hips
- \_\_\_\_\_ 11. Pertaining to the cheek

15. Using the key terms from Exercise 14, correctly label all body areas indicated with leader lines on Figure 1-8.

In addition, identify the sections labeled A and B in the figure.

Section A: \_\_\_\_\_

Section B: \_\_\_\_\_

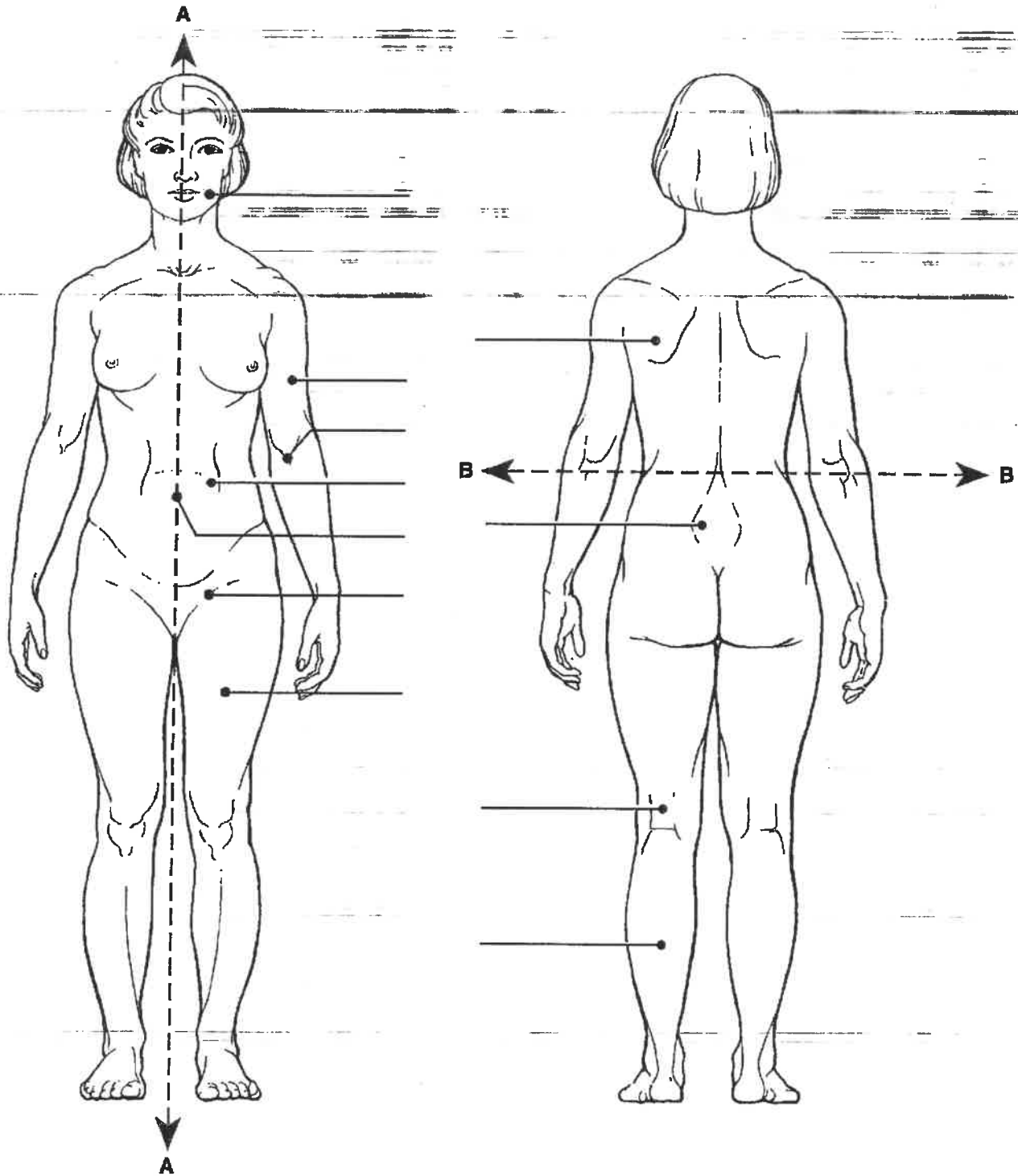


Figure 1-8

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16. From the key choices, select the body cavities where the following surgical procedures would occur. Insert the correct letter or term in the answer blanks. Be precise: also select the name of the cavity subdivision if appropriate.

### Key Choices

- |              |           |             |            |
|--------------|-----------|-------------|------------|
| A. Abdominal | C. Dorsal | E. Spinal   | G. Ventral |
| B. Cranial   | D. Pelvic | F. Thoracic |            |

- \_\_\_\_\_ 1. Removal of the uterus, or womb
- \_\_\_\_\_ 2. Coronary bypass surgery (heart surgery)
- \_\_\_\_\_ 3. Removal of a serious brain tumor
- \_\_\_\_\_ 4. Removal of a "hot" appendix
- \_\_\_\_\_ 5. A stomach ulcer operation

17. Complete the following statements by choosing an anatomical term from the key choices. Enter the appropriate letter or term in the answer blanks.

### Key Choices

- |             |             |              |               |
|-------------|-------------|--------------|---------------|
| A. Anterior | D. Inferior | G. Posterior | J. Superior   |
| B. Distal   | E. Lateral  | H. Proximal  | K. Transverse |
| C. Frontal  | F. Medial   | I. Sagittal  |               |

- \_\_\_\_\_ 1. In the anatomical position, the face and palms are on the \_\_\_\_\_ (1) body surface, the buttocks and shoulder blades are on the \_\_\_\_\_ (2) body surface, and the top of the head is the most \_\_\_\_\_ (3) part of the body. The ears are \_\_\_\_\_ (4) to the shoulders and \_\_\_\_\_ (5) to the nose. The heart is \_\_\_\_\_ (6) to the spine and \_\_\_\_\_ (7) to the lungs. The elbow is \_\_\_\_\_ (8) to the fingers but \_\_\_\_\_ (9) to the shoulder. In humans, the dorsal surface can also be called the \_\_\_\_\_ (10) surface; however, in four-legged animals, the dorsal surface is the \_\_\_\_\_ (11) surface.
- \_\_\_\_\_ 6.
- \_\_\_\_\_ 7.
- \_\_\_\_\_ 8.
- \_\_\_\_\_ 9.
- \_\_\_\_\_ 10.
- \_\_\_\_\_ 11.

- \_\_\_\_\_ 12. If an incision cuts the heart into right and left parts, the section is a (12) section, but if the heart is cut so that anterior and posterior parts result, the section is a (13) section.
- \_\_\_\_\_ 13. You are told to cut an animal along two planes so that the paired kidneys are observable in both sections. The two sections that meet this requirement are the (14) and (15) sections.
- \_\_\_\_\_ 14.
- \_\_\_\_\_ 15.

18. Using key choices, identify the body cavities where the following body organs are located. Enter the appropriate letter or term in the answer blanks.

*Key Choices*

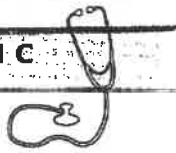
A. Abdominopelvic      B. Cranial      C. Spinal      D. Thoracic

- \_\_\_\_\_ 1. Stomach
- \_\_\_\_\_ 2. Small intestine
- \_\_\_\_\_ 3. Large intestine
- \_\_\_\_\_ 4. Spleen
- \_\_\_\_\_ 5. Liver
- \_\_\_\_\_ 6. Spinal cord
- \_\_\_\_\_ 7. Bladder
- \_\_\_\_\_ 8. Trachea
- \_\_\_\_\_ 9. Lungs
- \_\_\_\_\_ 10. Pituitary gland
- \_\_\_\_\_ 11. Rectum
- \_\_\_\_\_ 12. Ovaries

19. Refer to the organs listed in Exercise 18. In the spaces provided, record the numbers of the organs that would be found in each of the abdominal regions named here. Some organs may be found in more than one abdominal region.

- \_\_\_\_\_ 1. Hypogastric region
- \_\_\_\_\_ 2. Right lumbar region
- \_\_\_\_\_ 3. Umbilical region
- \_\_\_\_\_ 4. Epigastric region
- \_\_\_\_\_ 5. Left iliac region

**AT THE CLINIC**



20. A jogger has stepped in a pothole and sprained his ankle. What systems have suffered damage?
21. A newborn baby is unable to hold down any milk. Examination reveals a developmental disorder in which the esophagus fails to connect to the stomach. What survival needs are most immediately threatened?
22. The Chan family was traveling in their van and had a minor accident. The children in the back seat were wearing lap belts but they still sustained bruises around the abdomen and had some internal organ injuries. Why is this area more vulnerable to damage than others?
23. John, a patient at Jones City Hospital, is in tough shape. He has a hernia in his inguinal region, pain from an infected kidney in his lumbar region, and severe bruises and swelling in his pubic region. Explain where each of these regions is located.
24. The hormone thyroxine is released in response to a pituitary hormone called TSH. As thyroxine levels increase in the blood, they exert negative feedback on the release of TSH by the pituitary gland. What effect will this have on the release of TSH?

# 2 Basic Chemistry

Everything in the universe is composed of one or more elements, the unique building blocks of all matter. Although over 100 elemental substances exist, only four of these (carbon, hydrogen, oxygen, and nitrogen) make up over 96% of all living material.

The student activities in this chapter consider basic concepts of both inorganic and organic chemistry. Chemistry is the science that studies the composition of matter. Inorganic chemistry studies the chemical composition of nonliving substances that (generally) do not contain carbon. Organic chemistry studies the carbon-based chemistry (or biochemistry) of living organisms, whether they are maple trees, fish, or humans.

Understanding atomic structure, bonding behavior of elements, and the structure and activities of the most abundant biologic molecules (proteins, fats, carbohydrates, and nucleic acids) is tested in various ways. Mastering these concepts is necessary to understand how the body functions.

## CONCEPTS OF MATTER AND ENERGY

1. Select *all* phrases that apply to each of the following statements and insert the letters in the answer blanks.

- \_\_\_\_\_ 1. The energy located in the bonds of food molecules:
- A. is called thermal energy
  - B. is a form of potential energy
  - C. causes molecular movement
  - D. can be transformed to the bonds of ATP
- \_\_\_\_\_ 2. Heat is:
- A. thermal energy
  - B. infrared radiation
  - C. kinetic energy
  - D. molecular movement
- \_\_\_\_\_ 3. Whenever energy is transformed:
- A. the amount of useful energy decreases
  - B. some energy is lost as heat
  - C. some energy is created
  - D. some energy is destroyed

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2. Use choices from the key to identify the energy *form* in use in each of the following examples.

### Key Choices

A. Chemical      B. Electrical      C. Mechanical      D. Radiant

- \_\_\_\_\_ 1. Chewing food
- \_\_\_\_\_ 2. Vision (two types, please—think!)
- \_\_\_\_\_ 3. Bending your fingers to make a fist
- \_\_\_\_\_ 4. Breaking the bonds of ATP molecules to energize your muscle cells to make that fist
- \_\_\_\_\_ 5. Lying under a sunlamp

## COMPOSITION OF MATTER

3. Complete the following table by inserting the missing words.

Particle	Location	Electrical charge	Mass
		+ 1	
Neutron			
	Orbitals		

4. Insert the *chemical symbol* (the chemist's shorthand) in the answer blank for each of the following elements.

- \_\_\_\_\_ 1. Oxygen      \_\_\_\_\_ 4. Iodine      \_\_\_\_\_ 7. Calcium      \_\_\_\_\_ 10. Magnesium
- \_\_\_\_\_ 2. Carbon      \_\_\_\_\_ 5. Hydrogen      \_\_\_\_\_ 8. Sodium      \_\_\_\_\_ 11. Chloride
- \_\_\_\_\_ 3. Potassium      \_\_\_\_\_ 6. Nitrogen      \_\_\_\_\_ 9. Phosphorus      \_\_\_\_\_ 12. Iron

5. Using the key choices, select the correct responses to the following descriptive statements. Insert the appropriate answers in the answer blanks.

### Key Choices

A. Atom      C. Element      E. Ion      G. Molecule      I. Protons

B. Electrons      D. Energy      F. Matter      H. Neutrons      J. Valence

- \_\_\_\_\_ 1. An electrically charged atom or group of atoms
- \_\_\_\_\_ 2. Anything that takes up space and has mass (weight)



- \_\_\_\_\_ 3. A unique substance composed of atoms having the same  
atomic number.
- \_\_\_\_\_ 4. Negatively charged particles, forming part of an atom
- \_\_\_\_\_ 5. Subatomic particles that determine an atom's chemical  
behavior, or bonding ability
- \_\_\_\_\_ 6. The ability to do work
- \_\_\_\_\_ 7. The smallest particle of an element that retains the  
properties of the element
- \_\_\_\_\_ 8. The smallest particle of a compound, formed when atoms  
combine chemically
- \_\_\_\_\_ 9. Positively charged particles forming part of an atom
- \_\_\_\_\_ 10. Name given to the electron shell that contains the most  
reactive electrons
- \_\_\_\_\_ 11. \_\_\_\_\_ 12. Subatomic particles responsible  
for most of an atom's mass

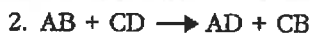
6. For each of the following statements that is true, insert *T* in the answer blank. If any of the statements are false, correct the underlined term by inserting your correction in the answer blank.

- \_\_\_\_\_ 1.  $\text{Na}^+$  and  $\text{K}^+$  are needed for nerve cells to conduct electrical impulses.
- \_\_\_\_\_ 2. The atomic number of oxygen is 8. Therefore, oxygen atoms always contain 8 neutrons.
- \_\_\_\_\_ 3. The greater the distance of an electron from the nucleus, the less energy it has.
- \_\_\_\_\_ 4. Electrons are located in more or less designated areas of space around the nucleus called orbitals.
- \_\_\_\_\_ 5. An unstable atom that decomposes and emits energy is called retroactive.
- \_\_\_\_\_ 6. Iron is necessary for oxygen transport in red blood cells.
- \_\_\_\_\_ 7. The most abundant negative ion in extracellular fluid is calcium.
- \_\_\_\_\_ 8. The element essential for the production of thyroid hormones is magnesium.
- \_\_\_\_\_ 9. Calcium is found as a salt in bones and teeth.

## MOLECULES, CHEMICAL BONDS, AND CHEMICAL REACTIONS

7. Match the terms in Column B to the chemical equations listed in Column A.  
Enter the correct letter or term in the answer blanks.

### Column A



### Column B

A. Decomposition

B. Exchange

C. Synthesis

8. Figure 2-1 is a diagram of an atom. Select two different colors and use them to color the coding circles and corresponding structures on the figure. Complete this exercise by responding to the questions that follow, referring to the atom in this figure. Insert your answers in the answer blanks provided.

☐ Nucleus

☐ Electrons

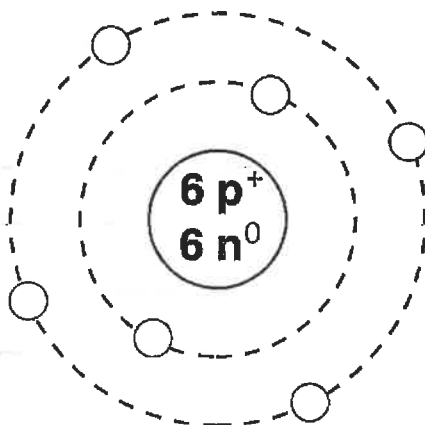


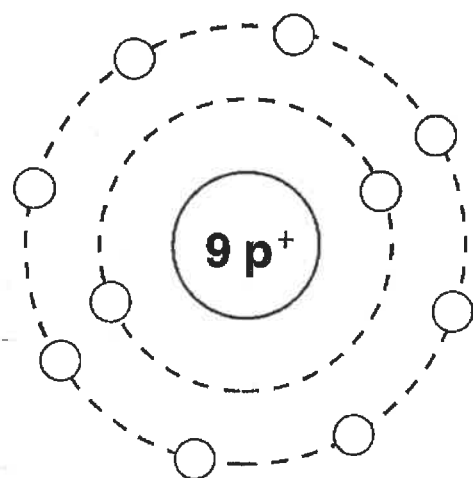
Figure 2-1

- What is the atomic number of this atom? \_\_\_\_\_
- What is its atomic mass? \_\_\_\_\_
- What atom is this? \_\_\_\_\_
- If this atom had one additional neutron but the other subatomic particles remained the same as shown, this slightly different atom (of the same element) would be called a(n) \_\_\_\_\_
- Is this atom chemically active or inert? \_\_\_\_\_
- How many electrons would be needed to fill its outer (valence) shell? \_\_\_\_\_

7. Would this atom most likely take part in forming ionic or covalent bonds? \_\_\_\_\_ Why? \_\_\_\_\_

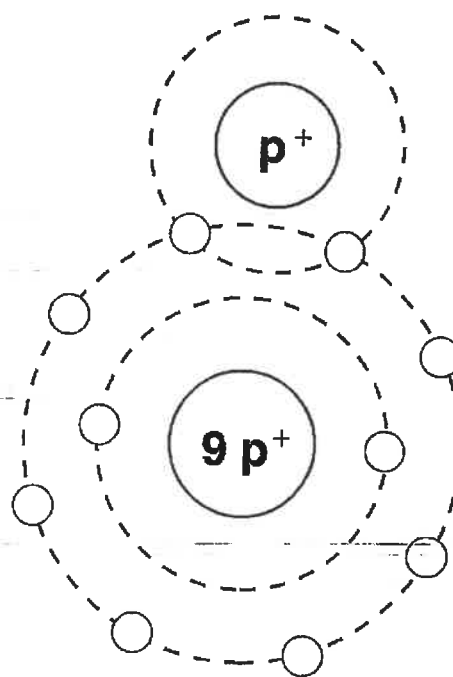
9. Both  $\text{H}_2\text{O}_2$  and  $2\text{OH}^-$  are chemical species with two hydrogen atoms and two oxygen atoms. Briefly explain how these species are different: \_\_\_\_\_

10. Two types of chemical bonding are shown in Figure 2-2. In the figure, identify each type as a(n) *ionic* or *covalent* bond. In the case of the ionic bond, indicate which atom has lost an electron by adding a colored arrow to show the direction of electron transfer. For the covalent bond, indicate the shared electrons.



A

Type of bond: \_\_\_\_\_



B

Type of bond: \_\_\_\_\_

Figure 2-2

11. Figure 2-3 illustrates five water molecules held together by hydrogen bonds. First, correctly identify the oxygen and hydrogen atoms both by color and by inserting their atomic symbols on the appropriate circles (atoms). Then label the following structures in the figure:

- ☐ Oxygen
- ☐ Hydrogen
- ☐ Positive pole (end)
- ☐ Negative pole (end)
- ☐ Hydrogen bonds

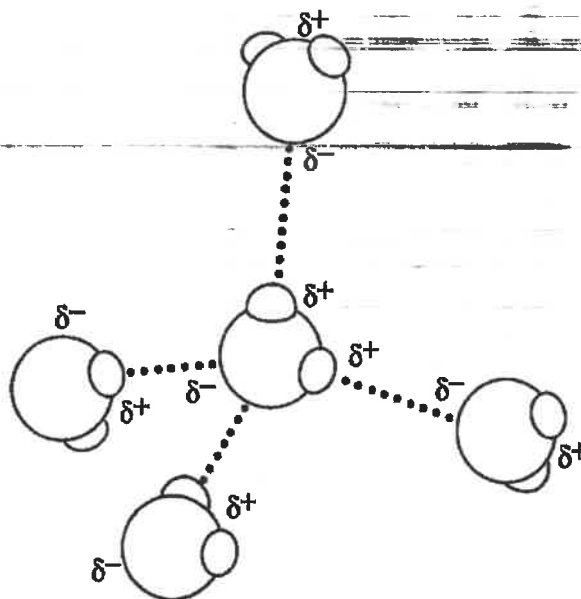
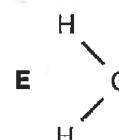
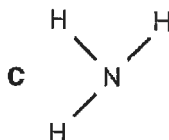
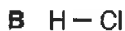
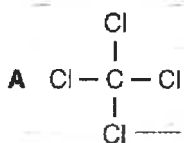


Figure 2-3

12. Circle each structural formula that is *likely* to be a polar covalent compound.



13. Respond to the instructions following the equation:



- In the space provided, list the chemical formula(s) of compounds. \_\_\_\_\_
- In the space provided, list the chemical formula(s) of ions. \_\_\_\_\_
- Circle the product(s) of the reaction.
- Modify the equation by adding a colored arrow in the proper place to indicate that the reaction is reversible.

## BIOCHEMISTRY: THE COMPOSITION OF LIVING MATTER

14. Use key choices to identify the substances described in the following statements. Insert the appropriate letter(s) or corresponding term(s) in the answer blanks.

### Key Choices

A. Acid(s)    B. Base(s)    C. Buffer    D. Salt(s)

- \_\_\_\_\_ 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. Substances that ionize in water; good electrolytes
- \_\_\_\_\_ 4. Proton ( $H^+$ ) acceptor
- \_\_\_\_\_ 5. Ionize in water to release hydrogen ions and a negative ion other than hydroxide ( $OH^-$ )
- \_\_\_\_\_ 6. Ionize in water to release ions other than  $H^+$  and  $OH^-$
- \_\_\_\_\_ 7. Formed when an acid and a base are combined
- \_\_\_\_\_ 8. Substances such as lemon juice and vinegar
- \_\_\_\_\_ 9. Prevents rapid/large swings in pH

15. Complete the following statements concerning the properties and biological importance of water.

- \_\_\_\_\_ 1. The ability of water to maintain a relatively constant temperature and thus prevent sudden changes is because of its high \_\_\_\_\_
- \_\_\_\_\_ 2. (1) Biochemical reactions in the body must occur in (2) About (3) % of the volume of a living cell is water. Water molecules are bonded to other water molecules because of the presence of (4) bonds. Water, as  $H^+$  and  $OH^-$  ions, is essential in biochemical reactions such as (5) and (6) reactions. Because of its (7), water is an excellent solvent and forms the basis of mucus and other body (8)
- \_\_\_\_\_ 3.
- \_\_\_\_\_ 4.
- \_\_\_\_\_ 5.
- \_\_\_\_\_ 6.
- \_\_\_\_\_ 7.
- \_\_\_\_\_ 8.

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16. Using the key choices, fully characterize weak and strong acids:

### Key Choices

- |  |                      |
|--|----------------------|
| A. Ionize completely in water                        | E. Ionize at high pH |
| B. Ionize incompletely in water                      | F. Ionize at low pH  |
| C. Act as part of a buffer system                    | G. Ionize at pH 7    |
| D. When placed in water, always act to change the pH |                      |

Weak acid: \_\_\_\_\_ Strong acid: \_\_\_\_\_

17. Use an *X* to designate which of the following are organic compounds.

- |                      |            |                |                        |
|----------------------|------------|----------------|------------------------|
| _____ Carbon dioxide | _____ Fats | _____ Proteins | _____ H <sub>2</sub> O |
| _____ Oxygen         | _____ KCl  | _____ Glucose  | _____ DNA              |

18. Match the terms in Column B to the descriptions provided in Column A. Enter the correct letter(s) or term(s) in the answer blanks.

### Column A

- |   |  |
|---|--|
| _____ 1. Building blocks of carbohydrates                                 | A. Amino acids   |
| _____ 2. Building blocks of fat   | B. Carbohydrates   |
| _____ 3. Building blocks of protein                                       | C. Lipids (fats)   |
| _____ 4. Building blocks of nucleic acids                                 | D. Fatty acids   |
| _____ 5. Cellular cytoplasm is primarily composed of this substance       | E. Glycerol  |
| _____ 6. The single most important fuel source for body cells             | F. Nucleotides   |
| _____ 7. Not soluble in water   | G. Monosaccharides   |
| _____ 8. Contain C, H, and O in the ratio CH <sub>2</sub> O               | H. Proteins  |
| _____ 9. Contain C, H, and O, but have relatively small amounts of oxygen |  |
| _____ 10. _____   | 11. These building blocks contain N in addition to C, H, and O |
| _____ 12. Contain P in addition to C, H, O, and N                         |  |
| _____ 13. Used to insulate the body and found in all cell membranes       |  |
| _____ 14. Primary components of meat and cheese                           |  |
| _____ 15. Primary components of bread and lollipops                       |  |
| _____ 16. Primary components of egg yolk and peanut oil                   |  |

17. Include collagen and hemoglobin
18. Class that usually includes cholesterol
19. Using key choices, correctly select ~~all~~ terms that correspond to the following descriptions. Insert the correct letter(s) or their corresponding term(s) in the answer blanks.

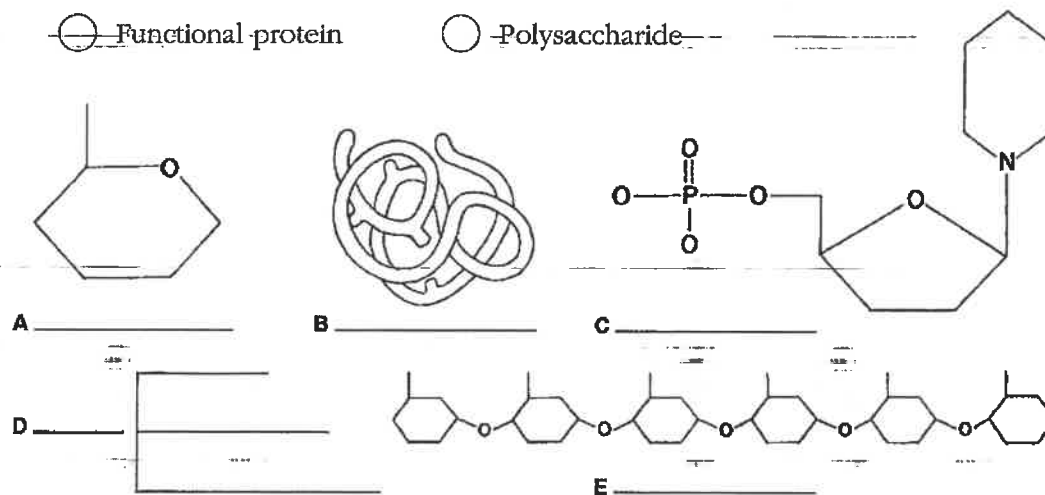
**Key Choices**

A. Cholesterol	D. Enzyme	G. Hormones	J. Maltose
B. Collagen	E. Glycogen	H. Keratin	K. RNA
C. DNA	F. Hemoglobin	I. Lactose	L. Starch

1. Example(s) of fibrous (structural) proteins
2. Example(s) of globular (functional) proteins
3. Biologic catalyst
4. Plant storage carbohydrate
5. Animal storage carbohydrate
6. The "stuff" of the genes
7. A steroid
8. Double sugars, or disaccharides

20. Five simplified diagrams of biological molecules are depicted in Figure 2-4. First, identify the molecules and insert the correct names in the answer blanks on the figure. Then select a different color for each molecule listed below and use them to color the coding circles and the corresponding molecules on the illustration.

- ☐ Fat                      ☐ Nucleotide                      ☐ Monosaccharide
- ☐ Functional protein                      ☐ Polysaccharide

**Figure 2-4**

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21. Circle the term that does not belong in each of the following groupings.

1. Adenine      Guanine      Glucose      Thymine
2. DNA      Ribose      Phosphate      Deoxyribose
3. Galactose      Glycogen      Fructose      Glucose
4. Amino acid      Polypeptide      Glycerol      Protein
5. Glucose      Sucrose      Lactose      Maltose

22. For each true statement, insert *T* in the answer blank. If any are false, correct the underlined term and insert your correction in the answer blank.

- \_\_\_\_\_ 1. Phospholipids are polarized molecules.
- \_\_\_\_\_ 2. Steroids are the major form in which body fat is stored.
- \_\_\_\_\_ 3. Water is the most abundant compound in the body.
- \_\_\_\_\_ 4. Nonpolar molecules are generally soluble in water.
- \_\_\_\_\_ 5. The bases of RNA are A, G, C, and U.
- \_\_\_\_\_ 6. The universal energy currency of living cells is RNA.
- \_\_\_\_\_ 7. RNA is single stranded.
- \_\_\_\_\_ 8. The four elements comprising over 90% of living matter are C, H, N, and Na.

23. Figure 2-5 shows the molecular structure of DNA, a nucleic acid.

A. First, identify the two unnamed nitrogen bases and insert their correct names and symbols in the two blanks beside the color-coding circles.

B. Complete the identification of the bases on the diagram by inserting the correct symbols in the appropriate spaces on the right side of the diagram.

C. Select different colors and color the coding circles and the corresponding parts of the diagram.

D. Label one d-R sugar unit and one P unit of the "backbones" of the DNA structure by inserting leader lines and labels on the diagram.

E. Circle the associated nucleotide.

- |   |                                    |                                 |
|---|------------------------------------|---------------------------------|
| <input type="radio"/> Deoxyribose sugar (d-R) | <input type="radio"/> Adenine (A)  | <input type="radio"/> _____ ( ) |
| <input type="radio"/> Phosphate (P)           | <input type="radio"/> Cytosine (C) | <input type="radio"/> _____ ( ) |

Then answer the questions following Figure 2-5 by writing your answers in the answer blanks.



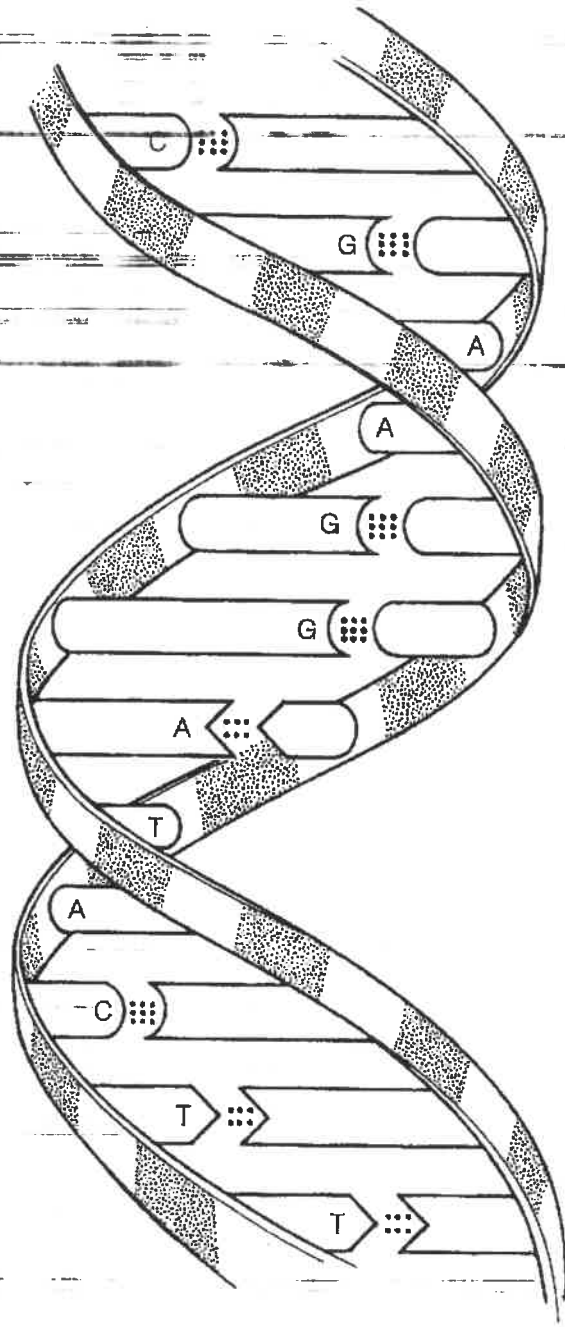


Figure 2-5

1. Name the bonds that help to hold the two DNA strands together. \_\_\_\_\_
2. Name the three-dimensional shape of the DNA molecule. \_\_\_\_\_
3. How many base-pairs are present in this segment of a DNA model? \_\_\_\_\_
4. What is the term that means "base-pairing"? \_\_\_\_\_

24. The biochemical reaction shown in Figure 2-6 represents the complete digestion of a polymer (a large molecule as consumed in food) down to its constituent monomers, or building blocks. Select two colors and color the coding circles and the structures. Then, select the one correct answer for each statement below and insert your answer in the answer blank.

☐ Monomer

☐ Polymer



Figure 2-6

- \_\_\_\_\_ 1. If starch is the polymer, the monomer is:  
 A. glycogen    B. amino acid    C. glucose    D. maltose
- \_\_\_\_\_ 2. During polymer digestion, water as  $H^+$  and  $OH^-$  ions would:  
 A. be a product of the reaction.  
 B. act as a catalyst.  
 C. enter between monomers, bond to them, and keep them separated.  
 D. not be involved in this reaction.
- \_\_\_\_\_ 3. Another name for the chemical digestion of polymers is:  
 A. dehydration    B. hydrolysis    C. synthesis    D. displacement
- \_\_\_\_\_ 4. If the monomers are amino acids, they may differ from each other by their:  
 A. R group    B. amino group    C. acid group    D. peptide bond



## INCREDIBLE JOURNEY

### *A Visualization Exercise for Biochemistry*

*... you are suddenly up-ended and are carried along in a sea of water molecules at almost unbelievable speed.*

25. Complete the narrative by inserting the missing words in the answer blanks.

For this journey, you are miniaturized to the size of a very small molecule by colleagues who will remain in contact with you by radio. Your instructions are to play the role of a water molecule and

1. to record any reactions that involve water molecules. Since water molecules are polar molecules, you are outfitted with
  2. an insulated rubber wet suit with one (1) charge at your helmet and two (2) charges, one at the end of each leg.
  - 3.
  4. As soon as you are injected into your host's bloodstream, you feel as though you are being pulled apart. Some large, attractive forces are pulling at your legs from different directions!
  5. You look about but can see only water molecules. After a moment's thought, you remember the polar nature of your
  6. wet suit. You record that these forces must be the (3) that are easily formed and easily broken in water.
  - 7.
  8. After this initial surprise, you are suddenly up-ended and carried along in a sea of water molecules at almost unbelievable speed. You have just begun to observe some huge, red, disk-shaped structures (probably (4) ) taking up  $O_2$  molecules, when you are swept into a very turbulent environment. Your
  9. colleagues radio that you are in the small intestine. With difficulty, because of numerous collisions with other molecules,
  10. you begin to record the various types of molecules you see.
  - 11.
  12. In particular, you notice a very long helical molecule made of units with distinctive R-groups. You identify and record this
  13. type of molecule as a (5), made of units called (6) that are joined together by (7) bonds. As you move too close to
  13. the helix during your observations, you are nearly pulled apart to form two ions, (8), but you breathe a sigh of relief
  14. as two ions of another water molecule take your place. You watch as these two ions move between two units of the long
  15. helical molecule. Then, in a fraction of a second, the bond between the two units is broken. As you record the occurrence of this chemical reaction, called (9), you are
- jolted into another direction by an enormous globular protein, the very same (10) that controls and speeds up this chemical reaction.

Once again you find yourself in the bloodstream, heading into an organ identified by your colleagues as the liver. Inside a liver cell, you observe many small monomers, made up only of C, H, and O atoms. You identify these units as (11) molecules because the liver cells are bonding them together to form very long, branched polymers called (12). You record that this type of chemical reaction is called (13), and you happily note that this reaction also produces (14) molecules like you!

After another speedy journey through the bloodstream, you reach the skin. You move deep into the skin and finally gain access to a sweat gland. In the sweat gland, you collide with millions of water molecules and some ionized salt molecules that are continually attracted to your positive and negative charges. Suddenly, the internal temperature rises, and molecular collisions (15) at an alarming rate, propelling you through the pore of the sweat gland onto the surface of the skin. So that you will be saved from the fate of evaporating into thin air, you contact your colleagues and are speedily rescued.

AT THE CLINIC



26. It is determined that a ~~patient is in acidosis~~. What does this mean, and would you treat the condition with a chemical that would *raise* or *lower* the pH?
27. A newborn is diagnosed with sickle-cell anemia, a genetic disease in which substitution of one amino acid results in abnormal hemoglobin. Explain to the parents how the substitution can have such a drastic effect on the structure of the protein.
28. Johnny's body temperature is spiking upward. When it reaches  $104^{\circ}\text{F}$ , his mother puts in a call to the pediatrician. She is advised to give Johnny children's acetaminophen or ibuprofen and sponge his body with cool to tepid water to prevent a further rise in temperature. How might a fever (excessively high body temperature) be detrimental to Johnny's welfare?
29. Mrs. Gallo's physician suspects that she is showing the initial signs of multiple sclerosis, a disease characterized by the formation of hardened plaques in the insulating sheaths surrounding nerve fibers. What medical imaging technique will the physician probably order to determine if such plaques are present?
30. Stanley has indigestion and is doubled over with pain. How could an antacid reduce his stomach discomfort?