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CHAPTER 2 THE CHEMISTRY OF LIFE

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1. a
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CHAPTER 3 CELL STRUCTURE

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CHAPTER 2 THE CHEMISTRY OF LIFE

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CHAPTER 3 CELL STRUCTURE

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Lesson Plans

CHAPTER 1: THE HUMAN BODY

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Define the anatomic terms used to refer to the body in terms of directions and geometric planes.
2. Describe the major cavities of the body and the organs they contain.
3. Explain what a cell is.
4. Describe the major functions of the four types of human tissue.
5. List the major systems of the body, the organs they contain, and the functions of those systems.
6. Define the terms *anatomy* and *physiology*.
7. Define *homeostasis*.

LESSON PLAN

1. Introduction: Explain how the body is organized from cells to tissues to organs to systems.
2. Terms of direction: Define and illustrate the terms of direction with examples. Use a smart board.
3. Planes: Discuss the anatomic planes of reference and their applications; use a smart board.
4. Cavities: Discuss the dorsal and ventral cavities of the body and their subdivisions; discuss the major organs they contain. Use a model or smart board.
5. Structural units: Explain the nature of a cell and how cells form the four tissues of the body (epithelial, connective, muscle, nervous); discuss how tissues form organs (use examples); discuss the systems of the body and their major organs and explain the function of each system (use transparencies to illustrate).
6. Homeostasis: Discuss the significance of homeostasis and what it means to the maintenance of a healthy body.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss what homeostasis means, and ask the learners to give examples of how this operates in their own bodies.
2. Discuss how all bodily functions begin and start at the cellular level of organization.

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3. Compare the functions of the body's two major cavities and relate these to the organs they contain.
4. Ask the learners what organs they already know as parts of certain systems of the body.

CHAPTER 2: THE CHEMISTRY OF LIFE

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Define the structure of an atom and its component subatomic particles.
2. List the major chemical elements found in living systems.
3. Compare the differences between ionic and covalent bonding and how molecules formed by either ionic or covalent bonds react in water.
4. Understand the basic chemical structure of water, carbon dioxide and oxygen gas, ammonia, the mineral salts, carbohydrates, lipids, proteins, the nucleic acids DNA and RNA, and ATP and their role in living systems.
5. Explain the difference between diffusion, osmosis, and active transport and their role in maintaining cellular structure and function.
6. Define *pH* and its significance in the human body.
7. Explain why water is so important to the body.
8. Define the terms *acid*, *base*, and *salt*.
9. Explain how the numbers on the pH scale relate to acidity and alkalinity.

LESSON PLAN

1. Introduction: Introduce the significance of chemistry as the basis for cellular structure, because the cell is made up of various chemicals that combine to form molecules and structures.
2. Atomic structure: Discuss the nature and structure of atoms (use chemical models or transparencies).
3. Elements, isotopes, compounds: Define and give examples.
4. Bonds and energy: Explain ionic and covalent bonds; show how breaking bonds release energy to make ATP.
5. Common substances in living systems: Discuss the chemical nature of the following substances and give examples of their roles in the human body.
    - Water, e.g., lubricant, medium for transportation and chemical reactions
    - Carbon dioxide, e.g., part of the waste products of cellular respiration, source of carbon for organic molecules
    - Molecular oxygen, e.g., needed for cellular respiration to occur
    - Ammonia, e.g., waste product of protein breakdown converted to urea by the liver, source of nitrogen
    - Mineral salts, e.g., calcium needed for bones, muscle contraction
    - Carbohydrates, e.g., sugars, starch, glycogen

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- Lipids, e.g., needed for insulation, source of energy
- Proteins, e.g., enzymes, part of the structure of membranes, actin and myosin of muscle cells
- Nucleic acids, e.g., genetic material of cells
- Adenosine triphosphate, e.g., chemical energy that fuels cells

6. Movement of materials into and out of cells: Use a video or CD-ROM to introduce this topic.
   - Diffusion: Define and give examples.
   - Osmosis: Define and give examples.
7. pH: Discuss what pH is and its significance to the maintenance of a healthy body.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss why salt dissolves in water, whereas sugars go into colloidal suspensions; relate this to bonding.
2. Compare the significance of carbohydrates, fats, and proteins to the functioning of a cell.
3. Discuss why water is so critical to bodily functions.

CHAPTER 3: CELL STRUCTURE

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Name the major contributors to the cell theory.
2. State the principles of the modern cell theory.
3. Explain the molecular structure of a cell membrane.
4. Describe the structure and function of the following cellular organelles: nucleus, endoplasmic reticulum, Golgi body, mitochondria, lysosomes, ribosomes, and centrioles.
5. Explain the significance and process of protein synthesis.

LESSON PLAN

1. Introduction: Discuss the significance of the cell as the basic unit of all biological organization; structures in the cell are called organelles.
2. History of the cell theory: Discuss the contributions of Robert Hooke, Anton Von Leeuvenhoek, Matthias Schleiden, and Theodor Schwann. Discuss the principles of the modern cell theory.
3. Anatomy of a typical cell: Use a smart board to illustrate and discuss cell anatomy and function.
   a. The cell membrane: Fluid mosaic pattern of proteins and phospholipids
   b. Cytoplasm of the cell: Chemical nature of colloidally suspended organic molecules, dissolved inorganic molecules, and mineral salts
   c. The nucleus: Discuss significance, structure, and function
      - Nuclear membrane: Double membrane with pores, and outer membrane connects to endoplasmic reticulum

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- Nucleoplasm: Colloidal suspension of DNA, RNA, and chemicals
- Chromatin: Genetic material of the nucleus
- Nucleolus: Site of ribosome synthesis

d. The mitochondria: Powerhouses of the cell; produce ATP

e. Lysosomes: Involved in repair and maintenance, autolysis, and breakdown of stored food

f. Endoplasmic reticulum: System of channels in the cytoplasm

- The rough or granular ER: Involved in protein synthesis
- The agranular or smooth ER: Transports fats, sex hormone synthesis
- The Golgi apparatus: Storage area for cellular products

h. Ribosomes: Site of protein synthesis

- Protein synthesis: Discuss transcription and the role of mRNA, translation and the role of tRNA, role of the ribosomes

i. Centrioles: Form spindle fibers during cell division

j. Cilia and flagella: Movement of material across cell surfaces or movement of a cell (sperm)

k. Plastids of plant cells: Leucoplasts, store sugar or starch; chloroplasts, site of photosynthesis, have chlorophyll (discuss the significance of plants in converting sun energy into usable chemical energy like sugars); chromoplasts, contain other pigments

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss how the nucleus exerts complete control over cellular functions.
2. Discuss the significance of ribosomes and protein synthesis to the survival and function of the cell.
3. Discuss why humans could not exist without plants.

CHAPTER 4: CELLULAR METABOLISM AND REPRODUCTION: MITOSIS AND MEIOSIS

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Define *metabolism*.
2. Describe the basic steps in glycolysis and indicate the major products and ATP production.
3. Describe the Krebs citric acid cycle and its major products and ATP production.
4. Describe the electron transport system and how ATP is produced.
5. Compare aerobic glycolysis with anaerobic production of ATP in muscle cells and fermentation.
6. Explain how other food compounds besides glucose are used as energy sources.
7. Name the discoverers of the anatomy of the DNA molecule.
8. Know the basic structure of the DNA molecule.
9. Name the nitrogen base pairs and how they pair up in the DNA molecule.

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10. Define the stages of the cell cycle.
11. Explain the significance of mitosis in the survival of the cell and growth in the human body.
12. Understand the significance of meiosis as a reduction of the genetic material and for the formation of the sex cells.

LESSON PLAN

1. Introduction to cellular metabolism: Discuss the significance of chemical reactions to the maintenance of cellular structure and function and that these reactions require a source of energy, which is ATP.
2. Cellular metabolism or biochemical respiration: Use the diagrams in the text to explain how this process converts the food we eat into ATP molecules and that it involves three steps: glycolysis, the citric acid cycle, and electron transport.
    a. Glycolysis: Explain that this occurs in the cytoplasm, and show the steps that convert a glucose molecule into two pyruvic acid molecules but produce only two ATP molecules.
    b. The Krebs citric acid cycle: Explain that this occurs on the cristae of the mitochondria and show the steps that convert acetic acid into CO_2, H_2O, and 30 ATP.
    c. The electron transport (transfer) system: Explain how this step is an essential part of the citric acid cycle and how the energy of H atoms is converted to ATP.
    d. Summary of ATP production during glycolysis, the citric acid cycle, and electron transport: Compare the ATP production in each step and summarize the total number of ATP molecules produced.
3. Anaerobic respiration: Explain how this inefficient process occurs in the absence of oxygen. There are two examples.
    a. Fermentation: Explain how yeast cells convert glucose to ethyl alcohol and two ATP and the economic significance to humans.
    b. Anaerobic production of ATP by muscles: Explain how overworked muscles that cannot get enough oxygen convert glucose to lactic acid and only two ATP, causing pain and fatigue.
4. Production of ATP from general food compounds: Explain how other foods we eat fit into the metabolic cycle.
5. Introduction to cellular reproduction: Explain how this is the process by which a cell duplicates itself and its genetic material (mitosis), and that it is also how sex cells are formed with reduced genetic material (meiosis).
6. The structure of the DNA molecule: Use a smart board or model to explain its structure as a double helical chain of nucleotides.
    a. The history of the discovery of DNA: Discuss the contributions of James Watson, Francis Crick, and Rosalind Franklin.
    b. The anatomy of the DNA molecule: Define a nucleotide; explain what it is and how the four nitrogen bases pair up via hydrogen bonds; use a model or smart board to explain its anatomy.
7. The cell cycle: Discuss the following with the aid of a smart board.

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a. Interphase: Explain what occurs in G_1, S, and the G_2 stages of interphase.

b. Mitosis: Explain that this occurs only in the nucleus.

c. Prophase: Explain that as this occurs, the nuclear membrane and nucleolus disappear and the chromatin thickens.

d. Metaphase: Explain how the chromosomes line up at the equator.

e. Anaphase: Explain how the double chromosomes split at their centromere and move to the opposite poles.

f. Telophase: Explain how the two new daughter cells are formed.

g. Cytokinesis: Explain that this occurs in the cytoplasm and the organelles are now duplicated.

8. Meiosis—a reduction division: Explain that this occurs only in the ovary of a female and in the seminiferous tubules of a testis of a male.

a. The stages of meiosis: Explain with the aid of a diagram or smart board what occurs in the following stages of meiosis:

- Prophase I
- Metaphase I
- Anaphase I
- Telophase I
- Prophase II
- Metaphase II
- Anaphase II
- Telophase II

9. Gametogenesis—the formation of the sex cells: Discuss how four sperm cells form and how only one egg cell results from meiosis. Use a smart board of gametogenesis.

10. A comparison of mitosis and meiosis: Discuss the differences and similarities of the two divisions, using a chart or diagram.

11. Show a video on mitosis and meiosis as a concluding summation, if possible.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss how a piece of chocolate is converted into ATP, the chemical fuel of cells.
2. Compare aerobic respiration with anaerobic respiration in terms of energy efficiency.
3. Discuss why the discovery of the DNA molecule's anatomy is considered the major discovery in biology of the 20th century and relate this to the human genome project.
4. Compare mitosis with meiosis, indicating similarities and major differences.

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CHAPTER 5: TISSUES

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Classify epithelial tissue based on shape and arrangement and give examples.
2. Name the types of glands in the body and give examples.
3. Name the functions of connective tissue.
4. Compare epithelial tissue with connective tissue in terms of cell arrangement and interstitial materials.
5. Name the three major types of connective tissue and give examples.
6. List the functions of epithelial tissue.
7. List the three types of muscle and describe each based on structure and function.
8. Describe the anatomy of a neuron and the function of nervous tissue.

LESSON PLAN

1. Introduction: Introduce tissue as groups of cells with a similar structure and function. Explain that tissues are classified based on how these cells are arranged and by what kind and how much interstitial material separates them.
2. Epithelial tissue: Explain how this tissue protects, absorbs, secretes, and excretes. Use visual aids.
    a. Classification based on shape: Discuss squamous, cuboidal, and columnar, and give examples.
    b. Classification based on arrangement: Discuss simple, stratified, pseudostratified, and transitional, and give examples.
    c. Classification based on function: Discuss mucous membranes, exocrine and endocrine glands, endothelium, and mesothelium, with examples.
3. Connective tissue: Explain how this tissue provides support and allows movement and that it contains fibers of elastin and collagen.
    a. Loose connective tissue: Discuss areolar, adipose, and reticular tissue and the cells they contain.
    b. Dense connective tissue: Discuss the nature of tendons, ligaments, aponeuroses, muscle sheaths, capsules, and fascia.
    c. Specialized connective tissue: Discuss the types of cartilage, bone, dentin, blood, lymphoid tissue, and the reticuloendothelial system.
    d. Connective tissue functions: Summarize the many and varied functions with examples as support, nourishment, transportation, connection, movement, protection, insulation, storage, attachment, and separation.
4. Muscle tissue: Discuss the anatomy of skeletal, smooth, and cardiac muscles and their functions and locations.
5. Nervous tissue: Discuss the anatomy and function of transmitting neurons and the protection and support of neuroglia. Show a video or slides of all the types of tissues as a conclusion.

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CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss why the arrangement of epithelial cells allows epithelial tissue to protect, secrete, and absorb.
2. Discuss the significance of collagen and elastin fibers and various types of cells in the matrix of connective tissue; relate this to function.
3. Compare the anatomy of skeletal, smooth, and cardiac muscle.

CHAPTER 6: THE INTEGUMENTARY SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Name the layers of the epidermis.
2. Define *keratinization*.
3. Explain why there are skin color differences among people.
4. Describe the anatomic parts of a hair.
5. Compare the two kinds of glands in the skin based on structure and secretion.
6. Explain why sweating is important to survival.
7. Explain how the skin helps regulate body temperature.
8. Name the functions of the skin.

LESSON PLAN

1. Introduction: Introduce the system as being made up of the skin, hair, nails, and sweat and sebaceous glands. It protects and insulates us and participates in temperature regulation.
2. The layers of the skin: Discuss the significance of the epidermis and dermis.
    a. Epidermis: Introduce the five layers; use a visual aid such as a smart board.
        - The stratum corneum: Leathery layer made of dead cells; it is a barrier against microorganisms; it protects us from harmful chemical and physical agents.
        - The stratum lucidum: Clear layer made of flat transparent cells.
        - The stratum granulosum: Layer active in keratinization.
        - The stratum spinosum: Polyhedron-shaped cells; contains desmosomes.
        - The stratum germinativum or basale: Most important layer; cells divide by mitosis; contains melanocytes. Discuss skin color and the production of melanin, based on genetics.

    b. Dermis: Describe this “true skin” layer that consists of connective tissue, blood vessels, nerves, lymph vessels, smooth muscle, hair follicles, and sweat and sebaceous glands.
3. The accessory structures of the skin: Introduce hair, nails, and sweat and sebaceous glands.
    a. Hair: Discuss the anatomy of hair and the layers of cells that make up a hair. Use a visual aid such as a smart board.
    b. Hair growth: Explain how hair grows from the deepest layers in the hair follicle.

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c. Hair texture: Discuss straight, curly, tightly curly, and the genetic factors involved. Discuss the chemistry of the keratin of the cortex.

d. Hair color: Explain genetic factors and what causes white and gray hair.

e. Nails: Discuss the anatomy of nails. Use a visual aid such as a smart board.

f. Sebaceous glands: Explain the anatomy and function of sebaceous glands for lubrication and the cosmetic gloss for the skin and hair.

g. Sweat glands: Discuss the anatomy and significance of sweating for body temperature control. Discuss the constituents of sweat.

h. Discuss some of the diseases/disorders of the integumentary system that students may have experienced.

4. The functions of the integumentary system: Summarize.

a. Sensation: Discuss the receptor sites for changes in temperature and pressure.

b. Protection: Discuss it as a barrier to physical and chemical agents; explain how melanin protects us from the harmful rays of the sun; discuss how the acid mantle destroys microorganisms.

c. Thermoregulation: Discuss how dilation and constriction of blood vessels, as well as sweating, help control body temperature.

d. Secretion: Discuss the role of sebum in antifungal and antibacterial functions; explain how the skin produces vitamin D via exposure to sunlight.

5. Choose and discuss some of the problems with the system such as skin cancer, acne, cold sores, warts, etc.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss the significance of melanocytes and the harmful rays of the sun and relate this to skin pigmentation and skin cancer.
2. Discuss what skin pH means and relate this to protection from microorganisms.
3. Compare the functions of sebaceous glands with sweat glands.

CHAPTER 7: THE SKELETAL SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Name the functions of the skeletal system.
2. Name the two types of ossification.
3. Describe why diet can affect bone development in children and bone maintenance in older adults.
4. Describe the histology of compact bone.
5. Define and give examples of bone markings.
6. Name the cranial and facial bones.

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7. Name the bones of the axial and appendicular skeleton.

LESSON PLAN

1. Introduction: Introduce the system as the supporting structure of the body that provides levers for muscles to pull on, resulting in movement.
2. The functions of the skeletal system: Discuss the five general functions of the system—support, protection, movement, blood cell production, and storage.
3. The growth and formation of bone: Discuss ossification, bone maturation and remodeling, the protein matrix of bone, and the mineral salts in that matrix.
    a. Deposition of bone: Use a visual aid showing structures of osteoblasts and osteocytes; discuss the role of osteoclasts in remodeling.
    b. Types of ossification: Explain endochondral and intramembranous ossification, with examples.
    c. Maintaining bone: Discuss the significance of parathormone and calcitonin in maintaining levels of calcium in the blood.
4. The histology of bone: Use a smart board.
    a. The haversian system of compact bone: Explain an osteon, lamella, lacuna, canaliculi, and perforating canals.
    b. Cancellous bone: Compare to compact bone; discuss different functions.
    c. Bone marrow: Compare functions of red and yellow bone marrow.
    d. Summary: Summarize the nature of the anatomy of compact bone.
5. The classification of bones based on shape: Use bones (either real or plastic reproductions) and define the following.
    a. Long bones, e.g., humerus and tibia
    b. Short bones, e.g., carpals and tarsals
    c. Flat bones, e.g., scapula, pelvis
    d. Irregular bones, e.g., vertebrae
    e. Sesamoid bones, e.g., patella
6. Bone markings: Use bones or a smart board to illustrate examples.
    a. Processes: Spine, condyle, tubercle, trochlea, trochanter, crest, line, head, neck
    b. Fossae: Suture, foramen, meatus, sinus, sulcus
7. Divisions of the skeleton: Have an articulated skeletal model to illustrate the parts and divisions of a human skeleton.
8. The axial skeleton: Illustrate all parts, use a skull to show cranial and facial bones.
    a. The cranial bones: Frontal, parietal, occipital, temporal, sphenoid, ethmoid, auditory ossicles, wormian
    b. The facial bones: Nasal, palatine, maxillary, zygomatic, lacrimal, turbinates, vomer, mandible

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c. The orbits: Use a smart board to illustrate the bones that contribute to the formation of the eye sockets.

d. The nasal cavities: Use a smart board to illustrate those bones that make up the nasal cavities.

e. The hyoid bone: Use an example to illustrate the body and the greater and lesser cornu. Discuss its function as a support for the tongue.

f. How to study the bones of the skull: Teach students how to use the color plates from the text first then have them go to a real or a model of a skull.

- The torso or trunk: Discuss sternum, ribs, and all five types of vertebrae.
- The thorax: Illustrate what bones make up this "rib cage" of the body.
- The sternum: Illustrate the three parts: manubrium, gladiolus, and xiphoid.
- The ribs: Explain what is meant by the terms the *seven true* and *five false ribs*.
- Illustrate the two floating ribs and explain why they are referred to in that way.

9. The appendicular skeleton: Use the same articulated skeletal model.

a. The bones of the upper extremities: Show the clavicle, scapula, humerus, radius, and ulna; name the various carpals, metacarpals, and phalanges.

b. The bones of the lower extremities: Illustrate the three bones that make up a pelvic bone; show the femur, tibia, and fibula; name the tarsals, metatarsals, and phalanges.

10. The arches of the foot: Use a smart board or foot model to illustrate the bones of the medial and lateral longitudinal arches and the bones of the transverse arch.

11. Discuss some of the diseases or disorders of the skeletal system like osteoporosis, herniated disk, etc.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the anatomy of compact bone with that of cancellous bone; relate this to function.
2. Discuss why certain bones of the body are stronger with more compact bone than others.
3. Discuss why the supply of blood cells in the body is dependent, in part, on the skeletal system.

CHAPTER 8: THE ARTICULAR SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Name and describe the three types of joints.
2. Name examples of the two types of synarthroses joints.
3. Name examples of the two types of amphiarthroses joints.
4. Describe and give examples of the six types of diarthroses or synovial joints.
5. Describe the capsular nature of a synovial joint.
6. Describe the three types of bursae.
7. Name some of the disorders of joints.

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8. Describe the possible movements at synovial joints.

LESSON PLAN

1. Introduction: Introduce the fact that an articulation is a place of union between two or more bones regardless of the degree of movement, hence the name of the system (articular).
2. The classification of joints—structure and function: Explain how joints can be classified based on the degree of movement they allow (function) and the type of material that holds the bones together (structure).
   a. Synarthroses: Discuss suture and syndesmosis, with examples.
   b. Amphiarthroses: Discuss symphysis and synchondrosis, with examples.
   c. Diarthroses or synovial joints: Define and explain the anatomy of diarthroses joints and their capsular structure. Use a model for demonstration of a synovial joint.
3. Movements at synovial joints: Define flexion and extension, hyperextension, dorsiflexion, and plantar flexion of the foot, abduction and adduction, rotation, circumduction, supination, and pronation of the hand, eversion and inversion, protraction, retraction, elevation, depression, opposition, and reposition. Have students do these movements.
4. The six types of diarthroses or synovial joints: Use a smart board to illustrate and define with examples—ball and socket, hinge, pivot, condyloid, saddle, and gliding joints.
5. Bursae: Define and explain subcutaneous, subfascial, and subtendinous bursae.
6. Choose and discuss some of the problems that can occur with the system such as arthritis, bursitis, gout, rheumatic fever, etc.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the nature of the three types of joints; relate this to structure and function.
2. Discuss what the term *capsule* means referring to a synovial joint.
3. Discuss why bursae must be part of a synovial joint.

CHAPTER 9: THE MUSCULAR SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Describe the gross and microscopic anatomy of skeletal muscle.
2. Describe and compare the basic differences between the anatomy of skeletal, smooth, and cardiac muscles.
3. Explain the current concept of muscle contraction based on three factors: neuroelectrical, chemical, and energy sources.
4. Define *muscle tone* and compare isotonic and isometric contractions.

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5. List factors that can cause muscles to malfunction, causing various disorders.
6. Name and identify the location of major superficial muscles of the body.

LESSON PLAN

1. Introduction: Introduce that muscles not only allow one to move in the environment but that they contain blood in arteries and veins, push food through the digestive tract, transport urine down the ureters to the bladder, allow the eyes to move, help us to breathe, and pump blood through the circulatory system.
2. The types of muscles: Introduce the general anatomy of skeletal, smooth, and cardiac muscle.
3. The anatomy of skeletal or striated muscle: Use a smart board to illustrate the microscopic anatomy. Explain sarcolemma, fasciculi, endomysium, perimysium, epimysium, fascia, A bands, I bands, Z line, H band, sarcomere, T system, sarcoplasmic reticulum.
4. The physiology of muscle contraction: Use a video or CD-ROM to illustrate muscle contraction. Discuss the following three stages.
    a. Neuroelectrical factors: Explain the ionic and electrical charge around and in a muscle cell. Define *resting* and *action potential*. Explain the role of acetylcholine, troponin, and tropomyosin.
    b. Chemical interactions: Explain the role of calcium ions and their effect on actin and myosin. Explain cross-bridges and ATP function.
    c. Energy sources: Explain the role of glycolysis, the citric acid cycle, electron transport, phosphocreatine, and free fatty acids as sources of ATP.
5. The muscle twitch: Use a smart board or diagram to illustrate.
6. Muscle tone: Define *tone*. Explain the two types of contraction—isotonic and isometric.
7. The anatomy of smooth muscle: Use a smart board and explain the microscopic anatomy of smooth muscle and its function in the body.
8. The anatomy of cardiac muscle: Use a smart board and explain the microscopic anatomy of cardiac muscle and its contraction rate per minute.
9. The naming and actions of skeletal muscles: Mention that muscles can be named according to action, location, origin and insertion, number of divisions, or directions of fibers, with examples. Review the actions of muscles at synovial joints.
10. The function and location of selected skeletal muscles: Use transparencies, CD-ROM, or 35 mm slides to illustrate some of the major muscles from the following areas of the body: muscles of facial expression, muscles of mastication, muscles moving the eye, muscles moving the head, muscles moving the shoulder girdle, muscles moving the humerus, muscles moving the elbow, muscles moving the wrist, muscles moving the hand, muscles moving the thumb, muscles moving the fingers, muscles of the abdominal wall, muscles of respiration or breathing, muscles moving the femur, muscles moving the knee joint, muscles moving the foot, and muscles moving the toes.
11. Choose and discuss some of the problems that can occur in the system, such as cramps, contractures, atrophy, muscular dystrophy, myasthenia gravis, etc.

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CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss why knowing the microscopic anatomy of a skeletal muscle cell is crucial to understanding muscle contraction.
2. Compare the three types of muscle cells and relate this to the arrangement of fibers and anatomy.
3. Discuss the sources of ATP for muscle contraction.

CHAPTER 10: THE NERVOUS SYSTEM: INTRODUCTION, SPINAL CORD, AND SPINAL NERVES

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Name the major subdivisions of the nervous system.
2. Classify the different types of neuroglia cells.
3. List the structural and functional classification of neurons.
4. Explain how a neuron transmits a nerve impulse.
5. Name the different types of neural tissues and their definitions.
6. Describe the structure of the spinal cord.
7. Name and number the spinal nerves.

LESSON PLAN

1. Introduction: Introduce this system as the control center and communication network of the body. Discuss how it allows us to interpret and react to changes in our external and internal environment.
2. Organization: Discuss the parts of the central nervous system, the peripheral nervous system and its major subcategories, the afferent and efferent systems. Introduce the autonomic nervous system as a subcategory of the efferent system.
3. Classification of nerve cells: Discuss the two types of functions—neurons that transmit impulses and neuroglia that support and protect the neurons.
   a. Neuroglial cells: Use a smart board. Illustrate and discuss the structure and function of astrocytes, oligodendrocytes, microglial cells, ependymal and Schwann cells.
   b. The structure of a neuron: Explain the various parts of a neuron—dendrites, axon, and axon terminals.
      - Structural classification of neurons: Compare multipolar, bipolar, and unipolar neurons.
      - Functional classification of neurons: Discuss and compare the functions of sensory or afferent, motor or efferent, and internuncial or association neurons.
4. The physiology of the nerve impulse: Explain resting potential, action potential, depolarization, repolarization, unmyelinated versus myelinated fibers, and the all-or-none law.

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5. The synaptic transmission: Discuss how neurotransmitters function in transmitting the impulse across a synapse. Define a synapse and where they are located.
6. The reflex arc: Use a smart board to illustrate the knee jerk reflex arc and explain, use student volunteers.
7. Grouping of neural tissue: Define white matter, gray matter, nerve, ganglia, tract, nucleus, and horns.
8. The spinal cord: Use a smart board to illustrate the anatomy of the spinal cord. Discuss the spinal meninges and their layers and spaces. Explain how a spinal tap is done and for what purposes.
   a. Functions of the spinal cord: Discuss its role in bringing in sensory impulses via the posterior or dorsal root to be interpreted and then acted on via the motor or anterior or ventral root.
9. The spinal nerves: Explain the naming of the 31 pairs of spinal nerves.
10. Discuss some of the diseases or disorders of the spinal cord or spinal nerves such as spinal meningitis or spina bifida.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the physiology of a muscle cell contraction with that of a nerve cell contraction.
2. Compare the structure of a sensory, internuncial, and motor neuron and relate this to function.
3. Discuss the path of a reflex arc, beginning at a receptor site and ending up at a motor neuron near a muscle or gland.

CHAPTER 11: THE NERVOUS SYSTEM: THE BRAIN, CRANIAL NERVES, AUTONOMIC NERVOUS SYSTEM, AND THE SPECIAL SENSES

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. List the principal parts of the brain.
2. Name the functions of the cerebrospinal fluid.
3. List the principal functions of the major parts of the brain.
4. List the 12 cranial nerves and their functions.
5. Name the parts of the autonomic nervous system and describe how it functions.
6. Describe the basic anatomy of the sense organs and explain how they function.

LESSON PLAN

1. The principal parts of the brain: Use a smart board to illustrate the brainstem and its parts—medulla oblongata, pons, midbrain; the diencephalon and its parts—thalamus and hypothalamus; the cerebrum; and the cerebellum. Discuss the ventricles and their connections with each other and the spinal cord.

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2. The anatomy and function of the brainstem: Discuss decussation of pyramids in the medulla and its role in consciousness and heartbeat rate, breathing, and blood flow; discuss the pons and breathing; discuss the midbrain's role in visual and auditory responses.
3. The anatomy and function of the diencephalon: Discuss the role of the thalamus in recognition of pain and temperature and response to odor; discuss the many roles of the hypothalamus related to homeostasis, food and water intake, body temperature, etc.
4. The cerebrum—structure and function: Discuss its anatomy, the lobes and their function. Discuss the significance of emotions and intellect and the cerebrum.
5. The cerebellum—structure and function: Discuss its role in coordinating skeletal muscle movements, body posture, and balance.
6. The autonomic nervous system: Discuss how it controls the internal organs via glands and smooth and cardiac muscle. Explain how it maintains heartbeat rate, breathing, and blood flow. Discuss the roles of the sympathetic and parasympathetic divisions.
7. The 12 cranial nerves and their functions: Use a smart board of a table of the nerves. List the 12 cranial nerves by function and roman numerals. Indicate which are sensory only and which are mixed (both sensory and motor).
8. The special senses: Introduce the five special senses.
    a. The sense of smell: Use a smart board of the nose. Explain the anatomy and physiology of the sense of smell.
    b. The sense of taste: Use a smart board of a tongue showing taste bud distribution. Explain the four major types of taste sensations; explain the anatomy of a taste bud.
    c. The sense of sight: Explain how this is one of our most important senses. Discuss how the eyes are protected.
        - The anatomy of the eye: Use a smart board of the anatomy of an eye or a model of the eye. Discuss the layers of the wall of the eye, the ciliary body, lens, iris, pupil, fluids, and the physiology of light interpretation.
    d. The sense of hearing and equilibrium: Use a smart board of the inner and outer ear. Explain the anatomy of the inner ear and how this relates to the functions of hearing and balance.
9. Choose and discuss some of the problems that can occur in the system, such as meningitis, encephalitis, Parkinson's disease, epilepsy, otitis media, glaucoma, motion sickness, conjunctivitis, myopia, hyperopia, Alzheimer's disease, presbyopia, stroke, and color blindness.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss the significance of the hypothalamus to controlling major bodily functions.
2. Discuss how the size of the cerebral hemispheres relates to thought, interpretation, and emotions.
3. Discuss how the autonomic nervous system stimulates and restores bodily activities.
4. Discuss how tasting food relates to food staying in the mouth for a short period of time; relate this to smell.

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CHAPTER 12: THE ENDOCRINE SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. List the functions of hormones.
2. Classify hormones into their major chemical categories.
3. Describe how the hypothalamus of the brain controls the endocrine system.
4. Name the endocrine glands and state where they are located.
5. List the major hormones and their effects on the body.
6. Discuss some of the major diseases of the endocrine system and their causes.

LESSON PLAN

1. Introduction: Introduce the system as the one that exerts chemical (hormonal) control over the body in conjunction with the nervous system to maintain homeostasis. Discuss how the endocrine glands are ductless glands that secrete their hormones directly into the bloodstream.
2. The functions of hormones: Explain how they control cellular respiration, growth, and development. Explain how they control fluid levels and electrolyte balances, behavior, reproductive cycles, the secretion of other hormones, and our growth cycles.
3. The classification of hormones: Discuss negative feedback and hormone control. Discuss the three chemical categories with examples: modified amino acids, protein hormones, and the steroid hormones.
4. The hypothalamus of the brain: Use a smart board to illustrate how the hypothalamus controls the pituitary gland via neural and chemical signals. Discuss releasing hormones and releasing inhibitory hormones.
5. The major endocrine glands and their hormones: Use a smart board to illustrate the location of the endocrine glands. Show a video on the system and the effects of hormones on the body.
    a. The anterior pituitary gland, its hormones, and some disorders: Discuss its anatomy. List and give the functions of growth hormone, thyroid-stimulating hormone, adrenocorticotropic hormone, melanocyte-stimulating hormone, follicle-stimulating hormone, luteinizing hormone, and prolactin. Discuss what causes a pituitary dwarf and a giant.
    b. The posterior pituitary gland and its hormones: List and give the functions of antidiuretic hormone, or vasopressin, and oxytocin.
    c. The thyroid gland, its hormones, and some disorders: Discuss its anatomy and discuss T_4 and T_3. Discuss the effects of hypothyroidism, hyperthyroidism, and Graves' disease and cretinism. Also cover calcitonin and its effects.
    d. The parathyroid glands, their hormone, and some disorders: Discuss their anatomy and the effect that parathormone has on raising blood calcium levels. Explain hypoparathyroidism and hyperparathyroidism.

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e. The adrenal glands, their hormones, and some disorders: Explain their anatomy—the cortex and medulla. Explain the effects of epinephrine, norepinephrine, aldosterone, cortisol, and the androgens. Discuss Addison's disease and Cushing's syndrome.

f. The pancreas, its hormones, and some disorders: Review the anatomy of the pancreas (use a smart board). Discuss the alpha and beta cells and glucagon and insulin. Discuss diabetes and acidosis.

g. The testes and the ovaries: Discuss their general anatomy and location. Discuss the effects of testosterone, estrogen, and progesterone.

h. The thymus gland and its hormone: Discuss its anatomy and the effects of thymosin and the T cells.

i. The pineal gland and its hormone: Discuss its anatomy and location. Discuss the effects of melatonin on body rhythms; also cover serotonin and its effects.

6. Choose and discuss in more detail some of the problems that can occur in the system, such as diabetes mellitus, cretinism, Graves' disease, Addison's disease, Cushing's syndrome, etc.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss the connections between the nervous system and the endocrine system.
2. Discuss negative feedback and its role in the endocrine system; compare this to positive feedback.
3. Compare the different effects the sex hormones have on male and female body development.
4. Discuss the role of the pituitary gland as a "master gland" of the system.

CHAPTER 13: THE BLOOD

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Describe the functions of blood.
2. Classify the different types of blood cells.
3. Describe the anatomy of erythrocytes relative to their function.
4. Compare the functions of the different leukocytes.
5. Explain how and where blood cells are formed.
6. Explain the clotting mechanism.
7. Name the different blood groups.

LESSON PLAN

1. Introduction: Introduce the uniqueness of blood—a fluid tissue made up of a fluid portion (plasma) and the formed elements, the red and white blood cells, and platelets. Explain that plasma makes up 55% of blood and the formed element account for 45%.

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2. Functions of the blood: Discuss transportation of oxygen and carbon dioxide gas, nutrients, ions, water, and hormones. Explain how blood regulates body pH, body temperature, and the water of cells. Discuss its role in clotting and protection against microorganisms and toxins.
3. The classification of blood cells and the composition of plasma: Use a smart board and classify blood cells into: (1) erythrocytes; (2) leukocytes—granular, e.g., neutrophils, eosinophils, basophils; agranular, e.g., monocytes, lymphocytes; (3) thrombocytes. Discuss the composition of plasma: water, albumin, globulins, fibrinogen.
4. Formation of the blood cells—hematopoiesis: Discuss the sources of blood cells—red bone marrow (myeloid tissue) and lymphatic tissue that produces lymphocytes and monocytes.
5. Blood cell anatomy and functions: Mention that erythrocytes carry oxygen and CO_2 due to hemoglobin and are nonnucleated. Discuss the nucleated leukocytes: (1) neutrophils produce lysozyme and destroy bacteria and cellular debris; (2) monocytes destroy bacteria and debris, and in tissue they are called macrophages; (3) eosinophils combat irritants that cause allergies and produce antihistamines; (4) basophils are involved in allergic reactions and produce heparin, histamine, and serotonin; (5) lymphocytes produce antibodies and are involved in immunity; discuss the anatomy of thrombocytes and that they cause the clotting response.
6. The clotting mechanism: Use a smart board to illustrate clotting. Discuss the role of thromboplastin, prothrombin, thrombin, fibrinogen, and fibrin in the formation of a clot. Explain clot retraction and fibrinolysis.
7. The blood groups: Explain that there are different human blood groups and that only certain types are compatible—otherwise agglutination will occur.
   a. The ABO blood group: Discuss the antigens A and B. Then discuss the blood types A, B, AB, and O.
   b. The Rh blood group: Discuss antigen D and introduce Rh positive and Rh negative as a factor in pregnancies.
8. Choose and discuss some of the problems that can occur with the blood, such as hemophilia, leukemia, anemia, sickle cell anemia, malaria, mononucleosis, and others.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the anatomy of erythrocytes to leukocytes and relate this to functions.
2. Discuss the factors involved in the clotting mechanism.
3. Discuss why blood typing is critical to blood transfusions.

CHAPTER 14: THE CARDIOVASCULAR SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Describe how the heart is positioned in the thoracic cavity.

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2. List and describe the layers of the heart wall.
3. Name the chambers of the heart and their valves.
4. Name the major vessels that enter and exit the heart.
5. Describe blood flow through the heart.
6. Explain how the conduction system of the heart controls proper blood flow.
7. Describe the stages of the cardiac cycle.
8. Compare the anatomy of a vein, artery, and capillary.
9. Name the major blood circulatory routes.

LESSON PLAN

1. Introduction: Introduce the system as the one that pumps the blood, which carries oxygen, nutrients, hormones, enzymes, and cellular wastes through thousands of miles of arteries, veins, and capillaries. Explain that the heart is the pumping organ of the system that beats about 72 times per minute.
2. The anatomy of the heart: Use a smart board to illustrate its position in the mediastinum. Describe the layers of the pericardial sac.
    a. The layers of the heart wall: Use a visual aid to explain the epicardium, myocardium, and endocardium.
    b. The chambers of the heart: Describe the anatomy and size of the two atria and the two ventricles. Discuss the auricles, the musculi pectinati, the interventricular septum, the trabeculae carneae, and the anterior and posterior interventricular sulci.
    c. The great vessels of the heart: Describe the position and function of the superior and inferior venae cavae, the pulmonary trunk and its two branches, the pulmonary veins, the ascending aorta, the arch of the aorta, the descending thoracic aorta, and abdominal aorta.
    d. The valves of the heart: Explain the anatomy of the tricuspid and bicuspid, or mitral, valves and their chordae tendineae and papillary muscles. Explain the aortic and semilunar valve anatomy and function.
3. Blood flow through the heart: Prepare a diagram or smart board and explain blood flow through the heart, naming all vessels, chambers, and valves.
4. The conduction system of the heart: Use a smart board to illustrate the conduction system. Explain the position and role of the SA node or pacemaker, the AV node or atrioventricular node, the bundle of His and its branches, and Purkinje's fibers.
5. A cardiac cycle: Describe a typical cardiac cycle in terms of systole and diastole of the chambers and valve function.
6. Some major blood circulatory routes: Use transparencies to illustrate and describe systemic circulation and some of its subdivisions, pulmonary circulation, cerebral circulation, and the fetal circulation routes.

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7. Anatomy of blood vessels: Use a smart board. Compare the differences in the three walls of arteries and veins. Explain why exchange only occurs in capillaries due to their unique structure. Define arterioles, venules, and venous sinuses.
8. Major arteries and veins of the body: Use a smart board to illustrate some of the major vessels of the body and how they are named. Explain why arteries are shown in red and veins in blue.
9. Choose and discuss some of the problems that can occur in the system, such as rheumatic heart disease, myocarditis, atherosclerosis, coronary heart disease, heart failure, hypertension, congenital heart disease, and so forth.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the thickness of the walls of the chambers of the heart and relate this to the function of the chambers.
2. Discuss why exchange of gases, nutrients, and wastes between the blood and body cells can only occur through capillaries and not arteries and veins.
3. Discuss how an artificial pacemaker can replace a defective conduction system of the heart.

CHAPTER 15: THE LYMPHATIC SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Name the functions of the lymphatic system.
2. Explain what lymph is and how it forms.
3. Describe lymph flow through the body.
4. Name the principal lymphatic trunks.
5. Describe the functions of the tonsils and spleen.
6. Explain the unique role the thymus gland plays as part of the lymphatic system.
7. Describe the different types of immunity.
8. Explain the difference between blood and lymphatic capillaries.
9. Explain the difference between active and passive immunity.
10. Define an antigen and an antibody.

LESSON PLAN

1. Introduction: Introduce this system as being closely related to the blood and cardiovascular system. Explain that it also transports a fluid called lymph through a series of vessels called lymphatic capillaries and lymphatics, and that this system helps control body fluid and protects us from microorganisms.

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2. The functions of the system and the structure and functions of the lymphatic vessels: Use a diagrammatic visual aid to illustrate structures and vessels. Discuss the following functions: drainage of fluid from tissue spaces that escapes from capillaries, the transportation of fats from the digestive tract to the blood, the production of lymphocytes, and the development of immunities.
   a. Lymphatic vessels: Discuss the location and structure of lymph capillaries and lymphatics.
   b. Lymph nodes: Explain the anatomy and function of lymph nodes; discuss hilum, afferent and efferent lymphatics, trabeculae, cortical nodules, germinal center, and lymph sinuses.
3. Lymph circulation: Explain how lymph circulates through the body. Discuss the main lymphatic trunks and what they drain—lumbar, intestinal, bronchomediastinal, intercostal, subclavian, and jugular. Explain how they merge into the left and right lymphatic ducts to connect with the subclavian veins of the blood circulatory system.
4. The organs of the lymphatic system: Discuss the location, anatomy, and function of the three pairs of tonsils, the spleen, the thymus gland, and Peyer's patches in the small intestine.
5. Immunity: Explain the differences between the two types of immunity in the body—humoral and cellular. Explain how B lymphocytes and T lymphocytes function.
6. Antigens and antibodies: Discuss that an antigen is a foreign protein and give examples. Explain the role of the five types of antibodies that the body produces. Explain active and passive immunity.
7. The cells of the immune response and other defenses: List and explain the function of B cells, plasma cells, helper T cells, killer T cells, suppressor T cells, memory cells, macrophages, lymphokines, monokines, and the other body defenses such as the skin, sebum, mucous membranes, and the hairs in the nose.
8. Choose and discuss some of the problems that can occur in the system, such as AIDS, allergies, lymphoma, lymphadenitis, the historical significance of bubonic plague, etc.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss the possible events in an immune response when the body is invaded by foreign microorganisms such as bacteria or viruses.
2. Compare the different functions of a T lymphocyte with a B lymphocyte and relate this to the two types of immunity in the body.
3. Discuss why the AIDS virus can hide from the immune response of our bodies.

CHAPTER 16: NUTRITION AND THE DIGESTIVE SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. List and describe the five basic activities of the digestive process.
2. List the four layers or tunics of the walls of the digestive tract.
3. Name the major and accessory organs of the digestive tract and their component anatomic parts.

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4. Explain the major digestive enzymes and how they function.
5. Explain the functions of the liver.
6. Explain how absorption of nutrients occurs in the small intestine and how the feces form in the large intestine.
7. Name and describe the functions of the organs of the digestive tract.

LESSON PLAN

1. Introduction: Introduce the system as the one that breaks down food via hydrolysis into simple molecules for use by cells. Discuss its five basic activities: ingestion, peristalsis, digestion (mechanical and chemical), absorption, and defecation.
2. General organization: Use a visual aid, such as a smart board or model, to illustrate the major and accessory organs of the system and their location.
3. Histology: Discuss the anatomy of the four tunics or layers of the alimentary canal wall—tunica mucosa, submucosa, muscularis, and adventitia or serosa. Use a visual aid.
4. The mouth or oral cavity: Discuss the hard and soft palates and the uvula. Explain the anatomy of the tongue and the three types of papillae on the tongue and their taste buds.
5. The salivary glands: Discuss the composition of saliva and the location of the three pairs of salivary glands—parotid, submandibular, and sublingual.
6. Teeth: Use a smart board of the anatomy of a tooth. Discuss the various kinds of teeth. Explain the crown, cervix, root, gums or gingivae, dentin, pulp cavity, root canal, apical foramen, and periodontal ligament.
7. The pharynx: Discuss the two parts of the pharynx associated with digestion—oropharynx and nasopharynx. Explain the process of swallowing.
8. The esophagus: Explain its anatomy and functions—secrete mucus, move food to the stomach. Explain how the esophageal hiatus pierces the diaphragm muscle.
9. The stomach: Use a smart board to illustrate the stomach and its layers. Explain the four parts—cardia, fundus, body, and pylorus. Discuss the three types of cells and their function: zymogenic or chief cells, parietal cells, and mucous cells. Discuss the unique three layers of smooth muscle in its walls and the role of the rugae. Discuss the chemical processes that occur and what can be absorbed in the stomach—alcohol, drugs, water, and some salts.
10. The pancreas: Use a smart board to illustrate its anatomy. Discuss its parts—head, body, and tail. Explain its dual role. Explain that islet cells produce hormones, whereas acini produce digestive juices. Explain the role of the pancreatic duct.
11. The liver: Explain the anatomy of the liver and discuss its six major functions; emphasize that we cannot live without it.
12. The gallbladder: Illustrate and explain its anatomy and function as a storage organ for bile.

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13. The small intestine: Use a smart board to illustrate its parts and anatomy. Discuss its three parts—duodenum, jejunum, and ileum. Discuss its glands—intestinal glands and duodenal glands. Illustrate its unique anatomic structure for absorption—plicae or folds, villi and its cells with their brush border, capillaries, and lacteals.
14. The large intestine: Use a smart board. Discuss its three functions and its principal regions—cecum, the colon and its subdivisions, rectum, and anal canal. Discuss the types of mechanical movements.
15. The formation of the feces: Discuss the composition of the feces and the importance of fiber in the diet.
16. Choose and discuss some of the problems that can occur in the system, such as dental cavities, hiatal hernias, hepatitis, cirrhosis of the liver, gallstones, appendicitis, Crohn's disease, diverticulosis, colorectal cancer, or diarrhea.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the roles of the liver and the pancreas to the digestive process.
2. Discuss the significance of specific enzymes to the breakdown of food so that it can be absorbed by the intestinal cells.
3. Discuss the anatomy of a villus and relate this to absorption.

CHAPTER 17: THE RESPIRATORY SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Explain the function of the respiratory system.
2. Name the organs of the system.
3. Define the parts of the internal nose and their functions.
4. Name the three areas of the pharynx and explain their anatomy.
5. Name the cartilages and membranes of the larynx and how they function.
6. Explain how the anatomy of the trachea prevents collapse during breathing and allows for esophageal expansion during swallowing.
7. Explain what is meant by the term *bronchial tree*.
8. Describe the structure and function of the lungs and pleura.
9. Describe the overall process of gas exchange in the lungs and tissues.
10. Define *ventilation, external respiration,* and *internal respiration*.

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LESSON PLAN

1. Introduction: Introduce this system as one that shares with the cardiovascular system the responsibility of supplying oxygen to and eliminating carbon dioxide gas from the body. Define the process of respiration. Use a smart board to illustrate the organs and their location in the system.
2. The anatomy and functions of the nose: Use a smart board or model of the internal anatomy of the head. Discuss the anatomy and function of the external and internal nares, the nasal cavities, the septum, and the vestibules. Discuss the three functions of the interior nose—to warm, filter, and moisten air; to smell; and to provide resonating chambers for speech.
3. The structure and functions of the pharynx: Discuss the two functions—a passageway for food and air and a resonating chamber. Explain the anatomy of its three portions—nasopharynx, oropharynx, and laryngopharynx.
4. The larynx or voice box: Discuss its three pieces of single cartilage—the thyroid, epiglottis, and cricoid—and its three double—the arytenoid, corniculate, and cuneiform. Explain how sound is turned into speech and the role and anatomy of the vocal cords.
5. The trachea or windpipe: Use a smart board of the trachea, bronchi, and lungs. Describe the tissues that line the trachea and their roles. Explain why the hyaline cartilage is arranged as a stack of Cs with the open part facing the esophagus.
6. The bronchi and bronchial tree: Explain how the bronchi branch into primary bronchi to each lung, then secondary bronchi to each lobe, then tertiary or segmental to each segment of a lobe, then to bronchioles, and, finally, to terminal bronchioles.
7. The anatomy and function of the lungs: Describe the membranes that cover each lung. Explain the anatomy and physiology of the lobules at the microscopic level. Discuss bronchioles, alveolar ducts, alveoli, alveolar sacs, and the alveolar capillary membrane.
8. The respiration process: Define ventilation and its subcategories inhalation and exhalation, external respiration, and internal respiration. Explain the breathing process in terms of the role of the diaphragm and the external and internal intercostal muscles. Discuss the partial pressure of the gases oxygen and carbon dioxide in the blood and lungs. Discuss lung capacity.
9. Choose and discuss some of the problems that can happen in the system such as lung cancer, bronchitis, pneumonia, pertussis, and cystic fibrosis.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss how the blood, the cardiovascular system, and the muscular system as well as the respiratory system all contribute to respiration.
2. Discuss the unique anatomy of terminal bronchioles and relate this to the exchange of gases with the blood.
3. Discuss how breathed-in air pollutants, such as smoke or asbestos, interfere with the respiration process and may lead to cancer.

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CHAPTER 18: THE URINARY SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:

1. Define the function of the urinary system.
2. Name the external layers of the kidney.
3. Define the following internal parts of the kidneys: *cortex, medulla, medullary pyramids, renal papillae, renal columns,* and *major* and *minor calyces*.
4. Name the parts of a nephron and describe the flow of urine through this renal tubule.
5. List the functions of the nephrons.
6. Explain how urine flows down the ureters.
7. Describe micturition and the role of stretch receptors in the bladder.
8. Compare the length and course of the male urethra to the female urethra.
9. Name the normal constituents of urine.

LESSON PLAN

1. Introduction: Use a smart board to illustrate the organs and their positions. Introduce this system as the one that helps maintain homeostasis by both removing and restoring selected amounts of solutes and water from the blood. Mention that it is the two kidneys that perform this function and produce the collected waste called urine.
2. The functions of the urinary system: Discuss excretion, the maintenance of blood volume and concentration, pH regulation, blood pressure, erythrocyte concentration, and vitamin D production.
3. The external anatomy of the kidneys: Use a smart board showing both the external and internal anatomy of a kidney. Discuss the hilum, renal sinus, and the three layers of tissue that surround each kidney—renal capsule, adipose capsule, and renal fascia—and their function.
4. The internal anatomy of the kidneys: Explain the structure and functions of the cortex, medulla, renal pyramids, renal papillae, renal columns, minor calyces, major calyces, and the renal pelvis.
5. The anatomy of the nephrons: Use a smart board showing the detailed anatomy of a nephron. Explain the structure of Bowman's glomerular capsule, where water and solutes are filtered from the blood. Discuss the parts of the renal tubule—proximal convoluted tubule, descending limb, loop of Henle, ascending limb, distal convoluted tubule, and the papillary ducts.
6. Blood and nerve supply to the nephrons: Discuss the complex branching of the right and left renal arteries and veins that filter the blood 60 times a day. Explain that the renal plexus of the ANS innervates the kidneys.
7. The physiology of the nephrons: Discuss what happens during glomerular filtration, tubular reabsorption, and tubular secretion in producing the urine.
8. The ureters—anatomy and function: Use a smart board to illustrate the anatomy of a ureter. Discuss the tissue layers of a ureter. Explain how the ureters transport the urine from the renal pelvis to the urinary bladder by peristalsis, gravity, and hydrostatic pressure.

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9. The urinary bladder and the micturition reflex: Use a smart board or model of a bladder. Explain the position and internal anatomy of the trigone, detrusor muscle, internal urinary sphincter, and external urinary sphincter. Explain the micturition reflex and bladder volume.
10. The urethra—male and female positions: Compare the differences in both length and position of the male and female urethras.
11. Choose and discuss some of the problems that can occur in the system such as kidney stones, gout, cystitis, or renal failure.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Discuss how the nephrons of the kidney both filter and reabsorb materials from the blood; relate this to glomerular filtration, tubular reabsorption, and tubular secretion.
2. Discuss how the digestive, respiratory, and integumentary systems also contribute to excretion of waste products from the body.
3. Discuss why we would die if kidney failure occurs.

CHAPTER 19: THE REPRODUCTIVE SYSTEM

CHAPTER OBJECTIVES

After studying this chapter, you should be able to:
1. Name the internal parts of a testis.
2. Explain the effects of testosterone on the male body.
3. Describe the process of spermatogenesis.
4. Follow the path of a sperm from the seminiferous tubules to the outside.
5. Define *semen* and what glands contribute to its composition.
6. Name the three parts of the male urethra.
7. Describe the development of a follicle, before and after ovulation.
8. Describe the process of oogenesis.
9. Name the parts of the uterus.
10. Name the external genitalia of the female.
11. Describe the phases of the menstrual cycle.
12. Describe lactation and the function of the mammary glands.
13. Name the phases of labor.

LESSON PLAN

1. Introduction: Introduce this system as the one that produces the sex cells, transports them, and nurtures their development. The purpose of the system is to produce offspring and to ensure the perpetuation of the human species.

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2. The male reproductive system: Use a smart board to illustrate the organs of the male reproductive system; have an enlargement of the internal anatomy of the testes.
    a. The scrotum: Explain why it is an outpouching of the abdominal wall (for sperm survival and hormone production). Discuss its anatomy—raphe and cremaster muscle.
    b. The testes: Explain their anatomy. Discuss the seminiferous tubules and spermatogenesis and the role of the Sertoli cells and the interstitial cells of Leydig.
    c. The anatomy of the spermatozoa: Explain what constitutes the head, middle piece, and tail. Discuss the function of the acrosome.
    d. The functions of testosterone: Discuss the growth of the male sex organs and their maintenance. Give examples of and discuss secondary male sex characteristics—broad shoulders, narrow hips, deep voice, body hair patterns, and aggression.
    e. The ducts of the system: Discuss the role and location of the straight tubules, rete testis, efferent ducts, ductus epididymis, vas deferens, ejaculatory duct, and the parts of the urethra.
    f. The accessory glands: Discuss the location and role of the seminal vesicles, the prostate gland, and the bulbourethral glands.
    g. Semen: Discuss the composition of semen and the volume produced and ejaculated. Explain sterility.
    h. The penis: Explain its function and anatomy—shaft, glans penis, prepuce, and the three cylindrical masses of erectile tissue internally. Discuss why circumcision is sometimes performed.
3. The female reproductive system: Use a smart board to illustrate the organs of the female reproductive system; have an enlargement of the internal anatomy of an ovary.
    a. The ovaries: Explain the anatomy of suspensory ligaments, ovarian follicles, a graafian follicle, ovulation, corpus luteum, corpus albicans, and oogenesis.
    b. The uterine or fallopian tubes: Discuss their anatomy—the infundibulum, fimbriae, and the role of the ciliated epithelium to transport an egg.
    c. The uterus: Discuss its location and anatomy (use a model or smart board). Discuss fundus, body, cervix, isthmus, uterine cavity, cervical canal, internal and external os, and the three layers of tissue in its wall. Discuss what occurs in the three stages of the menstrual cycle—the menstrual phase, the preovulatory or proliferative stage, and the postovulatory or secretory phase.
    d. The menstrual cycle: Discuss the three phases: the menstrual phase, the preovulatory or proliferative phase, and the postovulatory or secretory phase.
    e. The functions of estrogen: Explain that there are several types of estrogens. Explain its effects, including enlargement of uterine tubes, uterus, and vagina, and the development of external genitalia and secondary female sex characteristics such as breast development, wide hips, and axillary hair.
    f. The vagina: Explain its functions and anatomy. Discuss how the fornices allow the use of a contraceptive diaphragm.

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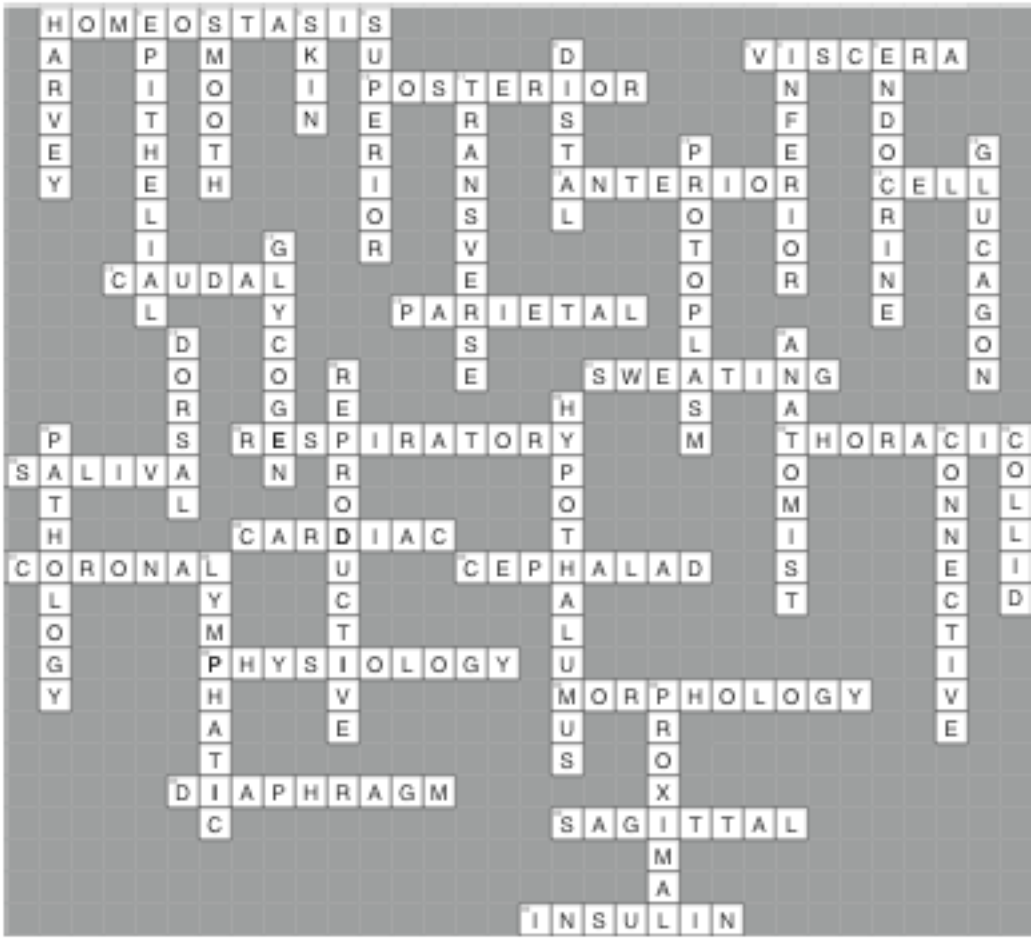
g. The external genitalia of the female: Explain the terms *vulva* or *pudendum*. Discuss the anatomy and function of the mons pubis, labia majora, labia minora, and the clitoris and its parts. Explain the vestibule and its vaginal and urethral orifices. Discuss the role of the lesser and greater vestibular glands.

4. The perineum: Explain and illustrate what the perineum is in both males and females and its anterior urogenital triangle and posterior anal triangle.
5. The anatomy and function of the mammary glands: Discuss their development and anatomic parts—lobes, lobules, alveoli, ampullae, lactiferous ducts, nipple, and areola.
6. Pregnancy and embryonic development: Discuss the development of the zygote into a blastula, the three germ layers of the embryo, the placenta, amnion, umbilical cord, and fetus. Discuss the three stages of labor—dilation, expulsion, and the placental stage.
7. Choose and discuss some of the problems that can occur in the system such as prostate cancer, cervical cancer, and sexually transmitted diseases such as syphilis and gonorrhea, genital herpes and warts, phimosis, and premenstrual syndrome.

CRITICAL THINKING QUESTIONS FOR CLASSROOM DISCUSSION

1. Compare the process of spermatogenesis with that of oogenesis; relate this to meiosis and the final end products.
2. Discuss how mental sexual stimulation affects the three cylindrical masses of spongy tissue in the male penis.
3. Discuss how various external factors could disrupt a female's menstrual cycle.
4. Discuss the effects a developing fetus has on a female body; relate this to the growth of the fetus.

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CHAPTER 2 THE CHEMISTRY OF LIFE

A. COMPLETION

1. sugars
2. adenosine triphosphate
3. matter
4. 92
5. Atoms
6. proton, neutron
7. John Dalton
8. carbon
9. isotopes
10. Oxygen
11. bonds

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12. compound
13. ionic
14. Negatively, positively
15. covalent
16. hydrogen
17. donors
18. acceptors
19. 60, 80
20. water
21. Carbon dioxide
22. Ammonia
23. simple sugars
24. ribose, deoxyribose
25. glucose, fructose
26. triglycerides
27. triacylglycerols
28. glycerol, fatty acids
29. Catalysts
30. thymine, cytosine, uracil
31. phosphate
32. diffusion
33. hypertonic
34. pH
35. buffer
36. 91
37. base
38. ATP

B. MATCHING

39. c
40. g
41. n
42. h
43. m

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44. p
45. d
46. a
47. f
48. s
49. e
50. r
51. i
52. o
53. j
54. l
55. t
56. b
57. q
58. k

C. KEY TERMS

Answers may vary.
59. A substance that dissociates and forms an excess of H^+ ions when dissolved in water
60. Transportation of materials against concentration gradient
61. High-energy fuel molecule the cell needs to function
62. NH_2 found in amino acids
63. Molecule that comes from the decomposition of proteins and conversion of amino acids
64. The number of protons or electrons in an atom
65. The smallest particle of an element that maintains all the characteristics of that element
66. A substance that combines with H^+ ions when dissolved in water
67. Formed when atoms combine chemically with one another
68. The random collision of diffusing molecules
69. A substance that acts as a reservoir for hydrogen ions
70. Made of atoms of carbon, hydrogen, and oxygen in a 1:2:1 ratio
71. Chemical produced as a waste product of cellular respiration
72. The COOH group found in amino acids and fatty acids
73. Substance that increases the rate of a chemical reaction without being affected by that reaction
74. Formed when two or more elements combine via bonding
75. A bond in which the atoms share electrons to fill their outermost energy levels
76. Genetic material of cells located in the nucleus of the cell that determines all the functions and characteristics of the cell
77. A five-carbon sugar found in DNA
78. The movement of molecules through a medium from an area of high concentration of those molecules to an area of low concentration of those molecules

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79. Molecules that gain electrons during a reaction
80. Molecules that gain electrons only to lose them to some other molecule in a very short time
81. Molecules furnishing electrons during a reaction
82. Negatively charged particle that orbits the nucleus of an atom at some distance from its center
83. A substance whose atoms all contain the same number of protons and electrons
84. The ability to do work
85. The levels in which electrons are grouped
86. Protein catalysts
87. Along with glycerol, a building block of fats
88. A six-carbon sugar
89. A six-carbon sugar
90. A simple molecule similar to a sugar except that it has only a three-carbon chain, part of a fat
91. Animal starch
92. A type of bond that helps hold water molecules together by forming a bridge between the negative oxygen atom of one water molecule and the positive hydrogen atoms of another water molecule
93. The OH group found in sugars
94. Solution in which water molecules will move out of a cell and the cell will shrink, as in a 5% salt solution
95. Solution in which water molecules will move into a cell and the cell will swell, as in pure distilled water
96. A bond that is formed when one atom gains electrons while the other atom loses electrons from its outermost energy level
97. Charged atom
98. Solution in which water molecules diffuse into and out of a cell membrane at equal rates, as in normal saline solution
99. Different kinds of atoms of the same element
100. Substances that are insoluble in water like fats
101. Composed of small ions; they are essential for the survival and functioning of the body's cells
102. Necessary to convert food into chemical energy (ATP)
103. The smallest combination or particle retaining all the properties of a compound
104. Part of the central nucleus that makes up an atom; carries no charge
105. The genetic material of a cell, either DNA or RNA
106. Complex molecules made up of a sugar, a phosphate, and a nitrogen base; the building blocks of nucleic acids
107. The paths that electrons travel in an energy level
108. Kind of diffusion that pertains only to the movement of water molecules through a selectively permeable membrane
109. Covalent bonds that form between different amino acids to form proteins
110. Table that arranges the elements in such a way that similar properties repeat at periodic intervals
111. The negative logarithm of the hydrogen ion concentration in a solution
112. Protein structure based on amino acid sequence
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114. Part of the central nucleus that makes up an atom; has a positive charge
115. A nitrogen base consisting of a fused double ring of nine atoms of carbon and nitrogen
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118. A type of nucleic acid

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119. A five-carbon sugar found in RNA
120. A fatty acid that contains only single covalent bonds
121. Protein structure determined by hydrogen bonds between amino acids, resulting in a helix or a pleated sheet
122. Allows only certain materials to pass through, like water through a plasma membrane
123. Substance that is dissolved in a solution
124. A medium allowing other reactions to occur in
125. Protein structure with a secondary folding
126. A type of RNA that translates the code of a DNA molecule that was copied by messenger RNA
127. Types of fats found in the human body
128. A fatty acid that contains one or more double covalent bonds between the carbon atoms
129. The most abundant substance in living cells

D. LABELING EXERCISE

130. Also refer to Figure 2-5 in the text.
    A. Nucleus
    B. Electron
    C. Hydrogen
    D. Oxygen
    E. Hydrogen
    F. Oxygen part
    G. Hydrogen part
    H. H_2O molecule

E. COLORING EXERCISE

There is no coloring exercise in this chapter.

F. CRITICAL THINKING

Answers may vary.

131. The body is like an internal combustion engine functioning through chemical reactions.
132. Because they just share or move electrons from place to place.
133. O_2 atom attracts electrons more strongly than hydrogen atoms.
134. Cold inhibits diffusion.
135. a. Primary is determined by amino acid sequence.
    b. Secondary is determined by hydrogen bonds between amino acids.
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    d. Quaternary is determined by spatial relationships between individual units.

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136. Sugar, amino acids, and other nutrients needed for cell metabolism moves into the cell by active transport, which needs ATP.

137. Chemical bonds are formed when electrons are gained, lost, or shared between atoms.

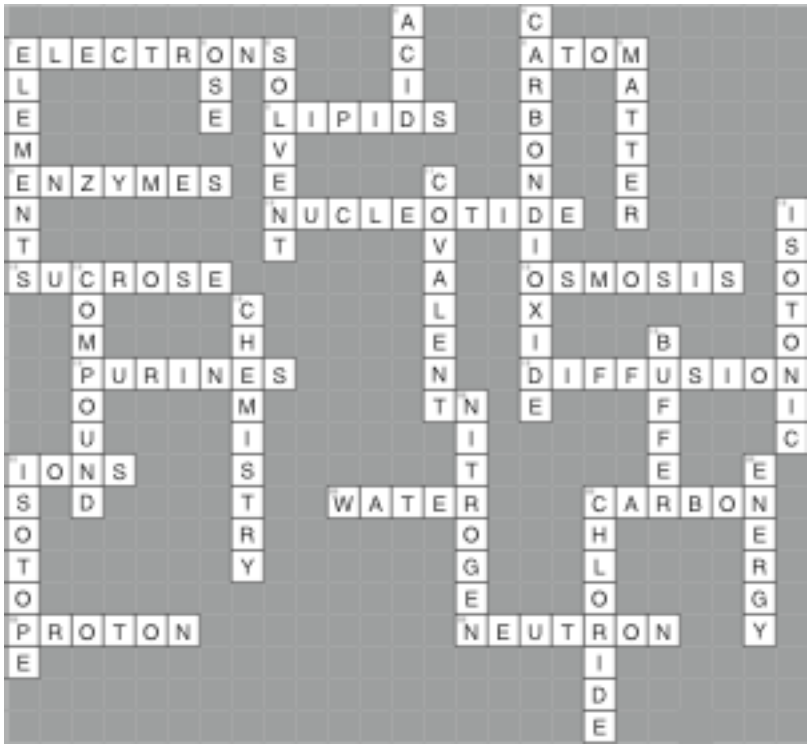
138. Like charges (negative electrons) repel.

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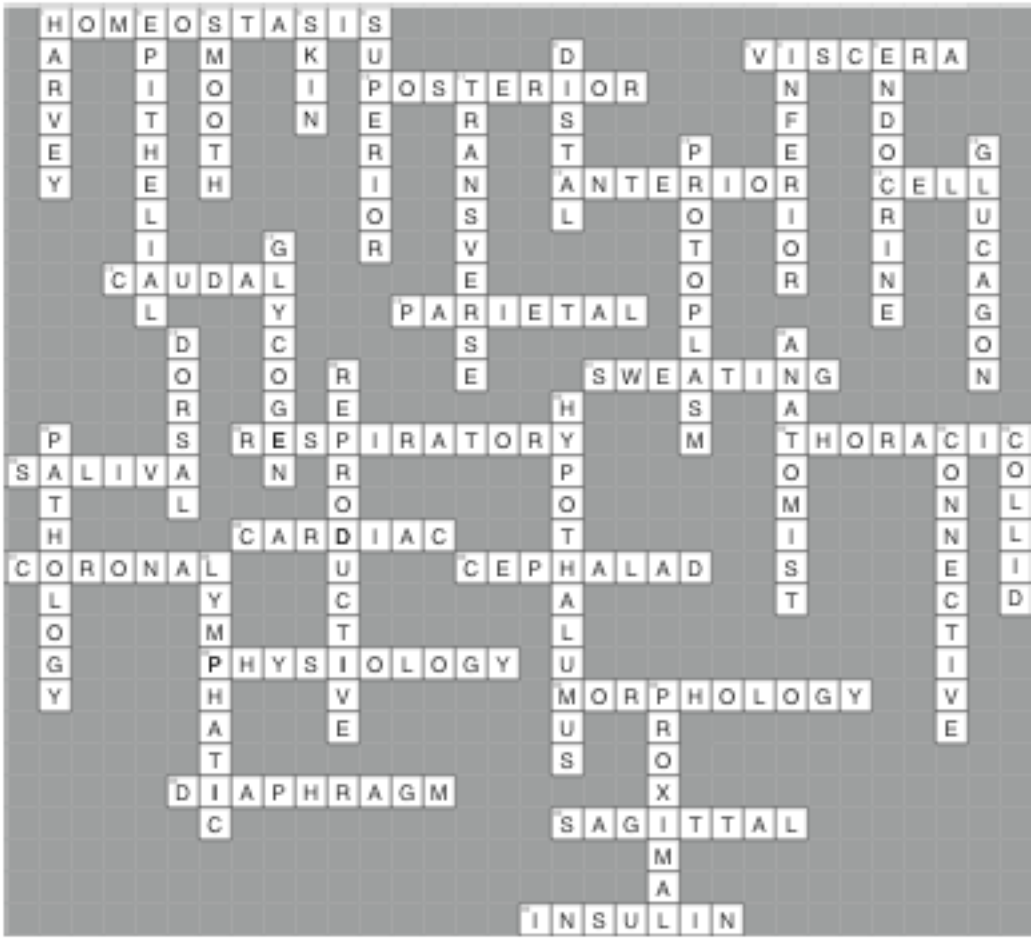


CHAPTER 3 CELL STRUCTURE

A. COMPLETION

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2. prokaryotic

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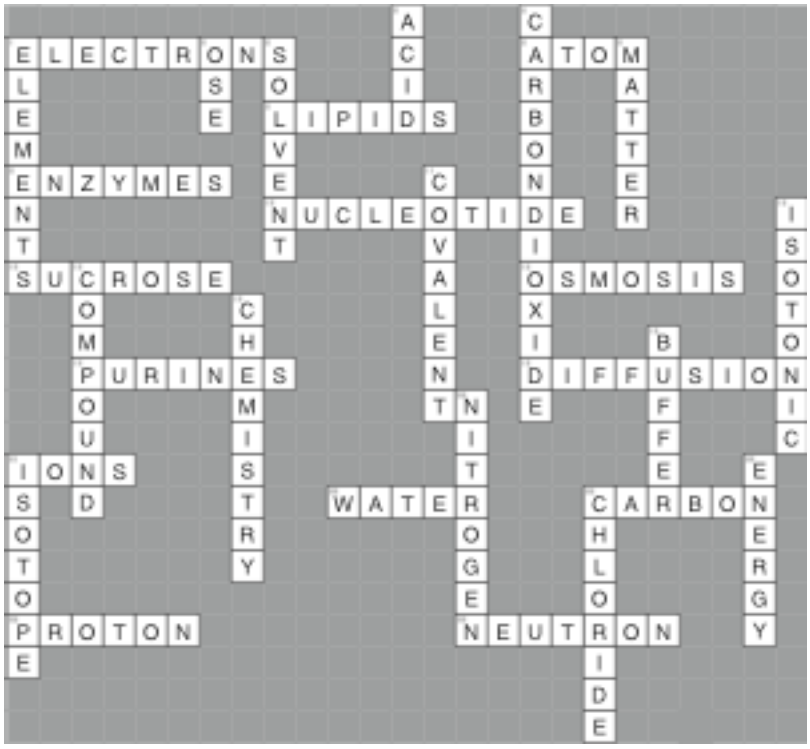
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