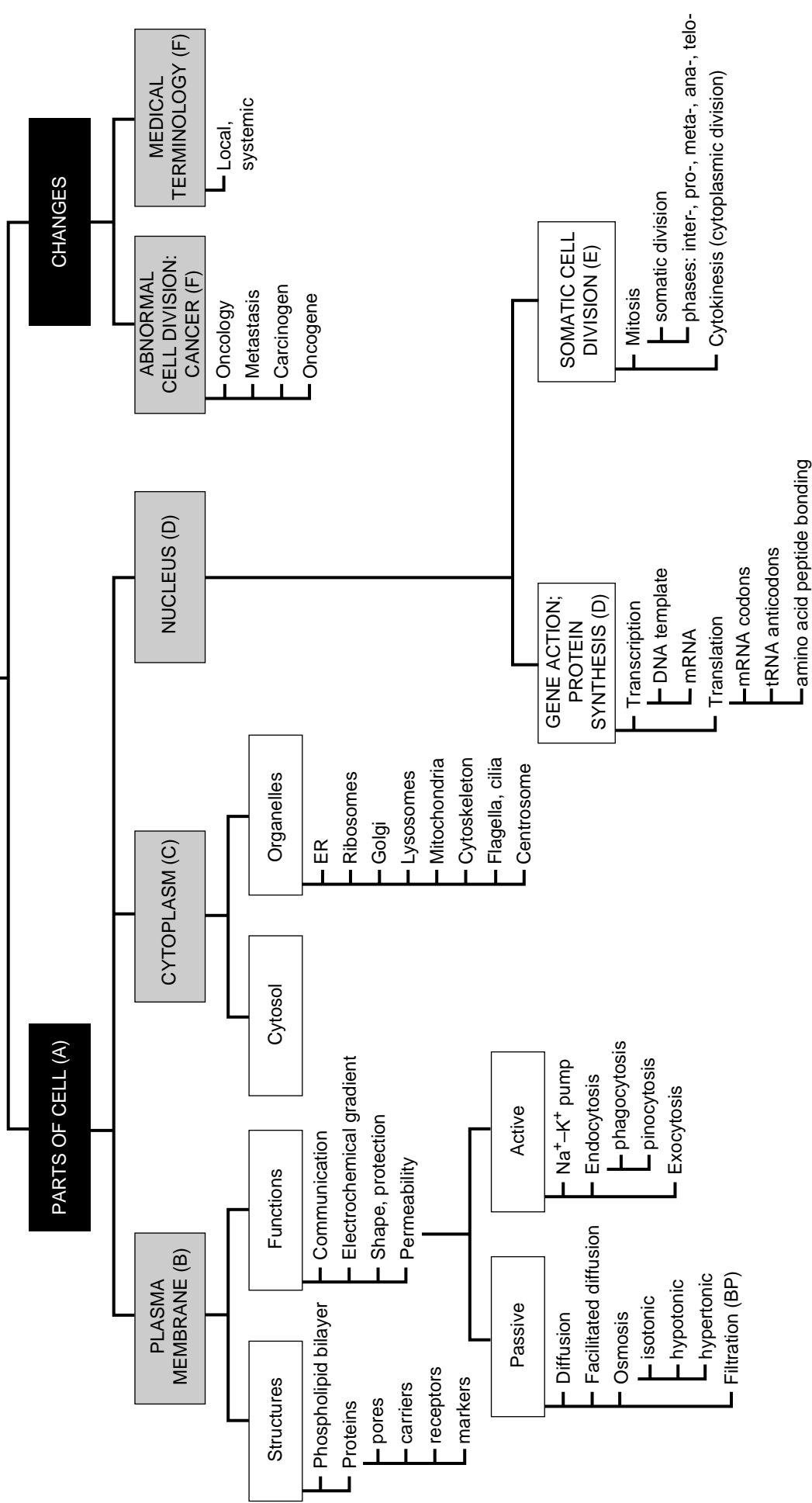


# FRAMEWORK 3

## Cells



Cells are the basic structural units of the human body, much as buildings make up the cities of the world. Every cell possesses certain characteristics similar to those in all other cells of the body. For example, membranes surround and compartmentalize cells, just as walls support virtually all buildings. Yet individual cell types exhibit variations that make them uniquely designed to meet specific body needs. In an architectural tour, the structural components of a cathedral, mansion, lighthouse, or fort can be recognized as specific for activities of each type of building. So too the number and type of organelles differ in muscle, nerve, cartilage, and bone cells. Cells carry out significant functions such as movement of substances into, out of, and throughout the cell; synthesis of the chemicals that cells need (such as proteins, lipids, and carbohydrates); and cell division for growth, maintenance, repair, and formation of offspring. Just as buildings change with time and destructive forces, cells exhibit aging changes. In fact, sometimes their existence is haphazard and harmful, as in cancer.

As you begin your study of cells, carefully examine the Chapter 3 Topic Outline and Objectives, noting relationships among concepts and key terms in the Framework.

## TOPIC OUTLINE AND OBJECTIVES

### A. Generalized view of the cell

- ☐ 1. Name and describe the three main parts of a cell.

### B. Plasma membrane; transport across the plasma membrane

- ☐ 2. Describe the structure and functions of the plasma membrane.
- ☐ 3. Describe the processes that transport substances across the plasma membrane.

### C. Cytoplasm

- ☐ 4. Describe the structure and functions of cytoplasm, cytosol, and organelles.

### D. Nucleus; gene action: protein synthesis

- ☐ 5. Describe the structure and functions of the nucleus.
- ☐ 6. Outline the sequence of events involved in protein synthesis.

### E. Somatic cell division

- ☐ 7. Discuss the stages, events, and significance of somatic cell division.

### F. Aging and cells; wellness; disorders; medical terminology

- ☐ 8. Explain the relationship of aging to cellular processes.

## WORDBYTES

Study each wordbyte, its meaning, and an example of its use in a term. Check your understanding by jotting meanings of wordbytes in margins. Identify other examples of terms that contain these wordbytes as you continue through the text and *Learning Guide*.

Wordbyte	Meaning	Example(s)	Wordbyte	Meaning	Example(s)
a-	without	<i>atrophy</i>	meta-	beyond	<i>metastasis</i>
auto-	self	<i>autophagy</i>	neo-	new	<i>neoplasm</i>
cyto-	cell	<i>cytologist</i>	-oma	tumor	<i>carcinoma</i>
-elle	small	<i>organelle</i>	-philic	loving	<i>hydrophilic</i>
homo-	same	<i>homologous</i>	-phobic	fearing	<i>hydrophobic</i>
hydro-	water	<i>hydrostatic</i>	-plasia, -plasm	growth	<i>dysplasia</i>
hyper-	above	<i>hypertonic</i>	-some	body	<i>lysosome</i>
hypo-	below	<i>hypotonic</i>	-stasis, -static	stand, stay	<i>metastasis</i>
iso-	equal	<i>isotonic</i>	-tonic	pressure	<i>hypertonic</i>
lyso-	dissolving	<i>lysosome</i>	-trophy	nourish	<i>hypertrophy</i>

## CHECKPOINTS

### A. Generalized view of the cell (pages 42–43)

- **A1.** List the three principal parts of a generalized cell.

**A2.** Contrast *cytoplasm* with *cytosol*.

### B. Plasma membrane; transport across the plasma membrane (pages 43–50)

- **B1.** Label parts A–E of the plasma (cell) membrane in Figure LG 3.1. Now write on the figure (at D) the chemicals listed below that are likely to pass through region D of the membrane:

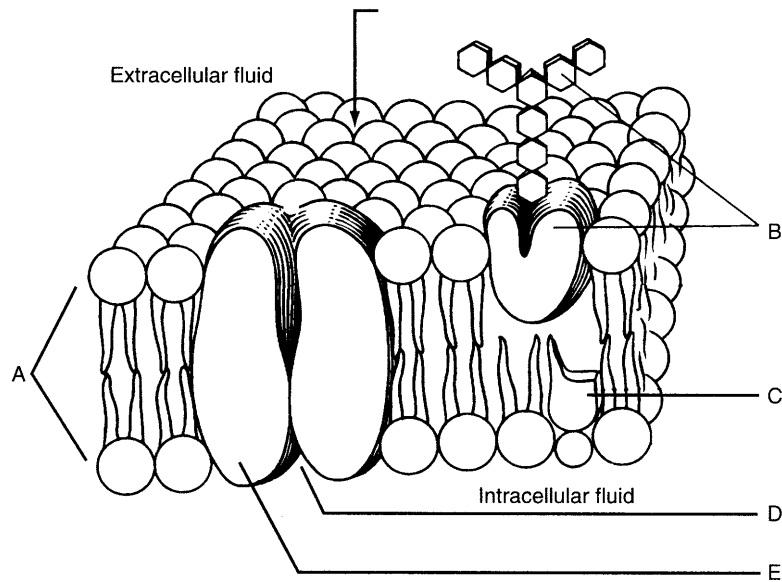
steroids      vitamin A or D      large proteins      water      ions      O<sub>2</sub>      CO<sub>2</sub>

Write next to the arrow on the figure the chemicals in the above list that are likely to pass through the membrane at the site of the arrow.

- **B2.** List four or more specific functions of proteins found in plasma membranes.

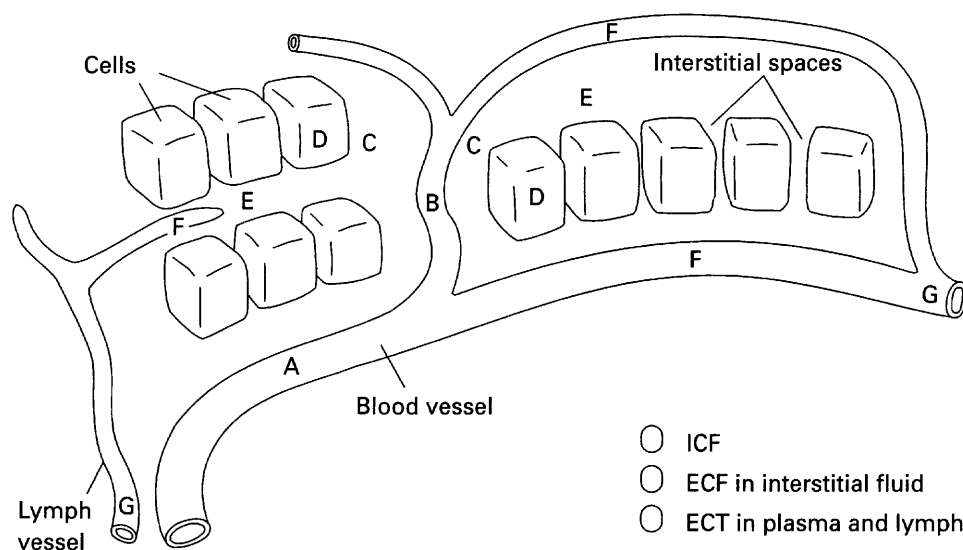
- **B3.** Describe the types of fluid in the body and their relationship to homeostasis by completing these statements and Figure LG 3.2.

a. Fluid inside cells is known as \_\_\_\_\_ fluid (ICF). Color areas containing this type of fluid yellow.



**Figure LG 3.1** Plasma (cell) membrane. Label as directed in Checkpoint B1.

- b. Fluid in spaces between cells is called \_\_\_\_\_. It surrounds and bathes cells and is one form of (*intracellular? extracellular?*) fluid. Color the spaces containing this fluid light green. The condition of maintaining this fluid in relative constancy is known as \_\_\_\_\_.
- c. Another form of extracellular fluid is that located in \_\_\_\_\_ vessels and \_\_\_\_\_ vessels. Color these areas dark green.
- d. The body's "internal environment" (that is, surrounding cells) is \_\_\_\_\_-cellular fluid (ECF) (all green areas in your figure).



**Figure LG 3.2** Internal environment of the body: types of fluid. Color as directed in Checkpoint B3. Areas labeled A to G refer to Checkpoint B4.

- **B4.** Refer again to Figure LG 3.2. Show the pattern of circulation of body fluids by drawing arrows connecting letters in the figure in alphabetical order (A → B → C, etc.). Identify the lettered areas.
- **B5.** The energy of molecular motion is known as \_\_\_\_\_ energy. Passive transport processes depend on (*ATP? kinetic energy?*), whereas active transport processes depend on (*ATP? kinetic energy?*). Diffusion and osmosis are (*active? passive?*) processes, whereas the  $\text{Na}^+/\text{K}^+$  pump is a(n) (*active? passive?*) process. Phagocytosis is an example of \_\_\_\_\_ transport.
- **B6.** Circle the factors that enhance diffusion rate of gases across plasma membranes of air sacs within lungs.
- Body temperature of: A. 98.6°F B. 102°F (as in fever)
  - Surface area of lungs that are: A. Normal size  
B. Reduced in size related to emphysema in which air sac walls are broken down
  - Mass of gas diffusion across lung membranes:  
A.  $\text{O}_2$  (molecular weight: 16) B.  $\text{CO}_2$  (molecular weight: 28)
- **B7.** Gases such as  $\text{O}_2$  and  $\text{CO}_2$  are (*water? lipid?*)-soluble, and they therefore diffuse across the (*lipid bilayer? pores in channels?*) of plasma membranes. Ions such as  $\text{K}^+$  diffuse primarily across the (*lipid bilayer? pores in channels?*) of plasma membranes. There are more channels in plasma membranes for passage of ( *$\text{K}^+? \text{Na}^+?$* ). Ion channels (*are never? may be?*) gated.
- **B8.** Select from the following list of terms to identify passive transport processes described below.

Fac. Facilitated diffusion	Pino. Pinocytosis	SD. Simple diffusion
O. Osmosis	Phago. Phagocytosis	

- \_\_\_\_\_ a. Net movement of any substance (such as cocoa powder in hot milk) from region of higher concentration to region of lower concentration; membrane not required
- \_\_\_\_\_ b. Same as (a) except movement across a semipermeable membrane with help of a transporter; ATP not required
- \_\_\_\_\_ c. Net movement of water from region of high water concentration (such as 2 percent NaCl) to region of lower water concentration (such as 10 percent NaCl) across semipermeable membrane; important in maintenance of normal cell size and shape
- \_\_\_\_\_ d. “Cell drinking”
- \_\_\_\_\_ e. Process of cellular ingestion of food by endocytosis
- \_\_\_\_\_ c. Net movement of water from region of high water concentration (such as 2 percent
- **B9.** Most sugars (such as glucose) are transported by the process of (*simple? facilitated?*) diffusion. The hormone named insulin helps to transport glucose (*into? out of?*) cells which (*raises? lowers?*) the level of glucose in blood.
- Insulin does this by inserting proteins that function as \_\_\_\_\_ into cell membranes.
- **B10.** Complete the following exercise about osmosis in blood.
- Human red blood cells (RBCs) contain intracellular fluid that is osmotically similar to \_\_\_\_\_ NaCl.  
A. 2.0 percent B. 0.9 percent C. 0 percent (pure water)
  - A solution that is hypertonic to RBCs contains (*more? fewer?*) solute particles and (*more? fewer?*) water molecules than blood.
  - Which of these solutions is hypertonic to RBCs?  
A. 2.0 percent NaCl B. 0.9 percent NaCl C. pure water
  - If RBCs are surrounded by hypertonic solution, water will tend to move (*into? out of?*) them, so they will (*crenate? hemolyze?*).
  - A solution that is \_\_\_\_\_-tonic to RBCs will maintain the shape and size of the RBC.  
An example of such a solution is \_\_\_\_\_.

- f. Which solution will cause RBCs to hemolyze?  
 A. 2.0 percent NaCl      B. 0.9 percent NaCl      C. pure water
- g. Which solution has the highest osmotic pressure?  
 A. 2.0 percent NaCl      B. 0.9 percent NaCl      C. pure water

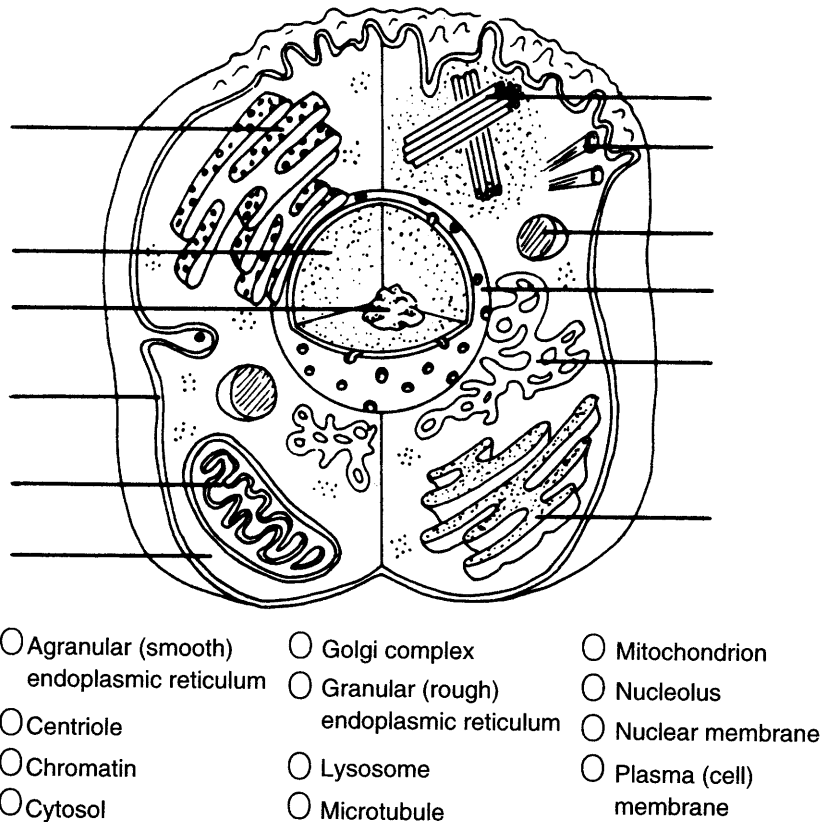
■ **B11.** Complete this exercise on active transport.

- a. Primary active transport utilizes energy generated by ATP (*directly? indirectly, related to  $\text{Na}^+$  gradients?*), whereas secondary active transport utilizes ATP (*directly? indirectly, related to  $\text{Na}^+$  gradients?*).
- b. Name several ions commonly transported across plasma membranes by primary active transport. \_\_\_\_\_ The most important primary active transport pump pumps  $\text{Na}^+$  (*into? out of?*) cells.  $\text{Na}^+$  (*does? does not?*) leak back into cells by diffusion, so the pump must perform (*only occasionally? continuously?*). As a result of this pump,  $\text{Na}^+$  is much more concentrated in (*intra? extra?*)-cellular fluid, whereas  $\text{K}^+$  is much more concentrated in (*intra? extra?*)-cellular fluid.
- c. Name three or more types of chemicals commonly transported across plasma membranes by secondary active transport.

C. **Cytoplasm** (pages 51–57)

C1. The cell is compartmentalized by the presence of organelles. Of what advantage is this?

■ **C2.** Color and then label all the parts of Figure LG 3.3 listed with color code ovals.



**Figure LG 3.3** Generalized cell. Color and label as directed in Checkpoint C2.

- **C3.** Identify organelles in the box that fit descriptions below. One answer will be used twice, all others, once.

Cen. Centrioles	G. Golgi complex	Mit. Mitochondria
Cil. Cilia	L. Lysosomes	RER. Rought endoplasmic reticulum
F. Flagella	Mf. Microfilaments	SER. Smooth endoplasmic reticulum
	Mt. Microtubules	

- |   |  |
|---|--|
| _____ a. Site of synthesis and brief storage of proteins  | _____ g. Form part of cytoskeleton, involved with cell movement and contraction  |
| _____ b. Site of synthesis of fatty acids, phospholipids, and steroids                                      | _____ h. Part of cytoskeleton, provide support and give shape to cell; form flagella, cilia, centrioles, and spindle fibers; made of protein tubulin |
| _____ c. Site of enzymes that detoxify alcohol and other harmful chemicals                                  | _____ i. Help organize mitotic spindle used in cell division   |
| _____ d. Stacks of cisterns with vesicular ends, involved in packaging and secretion of proteins and lipids | _____ j. Long, hairlike structures that help move entire cell, as in sperm cells   |
| _____ e. Release enzymes that lead to autolysis of the cell   | _____ k. Short, hairlike structures that move particles over cell surfaces   |
| _____ f. Cristae-containing structures, called “powerhouses of the cell” because ATP production occurs here |  |

- **C4.** *For extra review.* Considering the functions of organelles listed in the above exercise, choose the answers (organelles) that fit the following descriptions. Answers in that list may be used more than once.

- \_\_\_\_\_ a. Abundant in white blood cells, which use these organelles to help in phagocytosis of bacteria.
- \_\_\_\_\_ b. Present in large numbers of muscle and liver cells, which require much energy.
- \_\_\_\_\_ c. Located on surface of cells of the respiratory tract; help to move mucus.
- \_\_\_\_\_ d. More extensive in cells that secrete proteins into ECF.

**C5.** Write a summary of events in the synthesis, secretion, and discharge of protein in the cell. Be sure to state roles of *transport vesicles*, *cisterns*, *transfer vesicles*, *secretory vesicles*, and *storage vesicles*.

D. **Nucleus; gene action: protein synthesis** (pages 56–61)

- **D1.** Identify parts of the nucleus in the box that fit descriptions below.

C. Chromosomes	NE. Nuclear envelope	NU. Nucleolus
----------------	----------------------	---------------

- \_\_\_\_\_ a. These rod-shaped bodies contain DNA and protein.
- \_\_\_\_\_ b. Consists of RNA, DNA, and protein; site of assembly of ribosomes.
- \_\_\_\_\_ c. Large pores here permit passage of RNA and large proteins between nucleus and cytosol.

- D2.** Explain the significance of protein synthesis in the cell.

- **D3.** Review the structure of DNA and RNA in this exercise. Circle the correct answer to each question.

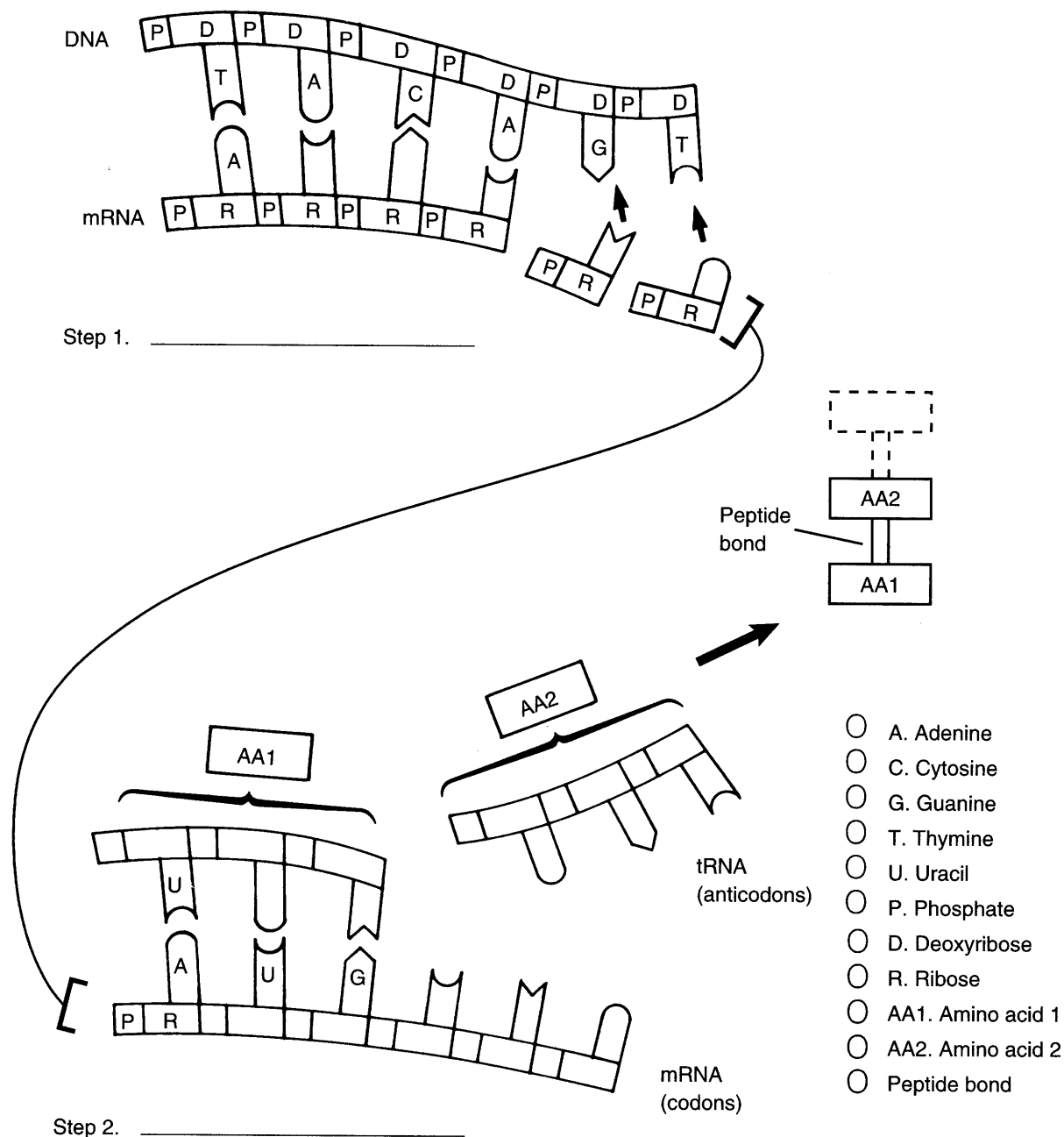
- a. Which base is found in RNA but not in DNA?  
A. Adenine      C. Cytosine      G. Guanine      U. Uracil      T. Thymine
- b. Which sugar is present in RNA but not in DNA?  
D. Dexoyribose      R. Ribose
- c. DNA and RNA consist of repeating units known as:  
A. Amino acids      N. Nucleotides
- d. One nucleotide consists of a base, a sugar, as well as a:  
K. Potassium      P. Phosphate

*For extra review, color sugars and phosphates in Figure LG 3.4, and also see Learning Guide, Chapter 2, Checkpoint D7.*

- **D4.** Refer to Figure LG 3.4 and describe the process of protein synthesis in this exercise.

- a. Write the names of the two major steps of protein synthesis on the two lines in Figure LG 3.4.
- b. Transcription takes place in the (*nucleus? cytoplasm?*). In this process, a portion (called a *gene*) of one side of a double stranded DNA is copied to form a complementary strand of (*DNA? RNA?*). Transcription requires the help of the enzyme RNA \_\_\_\_\_ which attaches to a section of DNA known as the (*promoter? terminator?*) close to the gene to be copied. The signal to stop transcribing occurs when RNA polymerase reaches the sequence of DNA nucleotides known as the (*promoter? terminator?*).
- c. Complete the strand of mRNA by writing letters of complementary bases. Then color the bases of both DNA and mRNA. The newly synthesized mRNA then (*stays in the nucleus? moves through a nuclear pore into the cytoplasm?*).
- d. The second step of protein synthesis is known as \_\_\_\_\_ because it involves translation of one “language” (the base code of \_\_\_\_\_ RNA) into another “language” (the correct sequence of the 20 \_\_\_\_\_ to form a specific protein).
- e. Translation begins when an mRNA attaches to the (*small? large?*) subunit of a ribosome. A (*promoter? initiator?*) tRNA attaches to a start codon (AUG) on mRNA. The ribosome becomes functional when the \_\_\_\_\_ ribosomal unit attaches to the small subunit.
- f. Each amino acid is transported to this site by a particular \_\_\_\_\_ RNA characterized by a specific three-base unit or (*codon? anticodon?*). This portion of tRNA (for example, U A C) binds to a complementary portion





**Figure LG 3.4** Protein synthesis. Label and color as directed in Checkpoint D4.

of mRNA (*codon? anticodon?*). In step 2 of Figure LG 3.4, complete the labeling of bases and color all components of tRNA and mRNA. Be sure you select colors that correspond to those used in step 1.

- g. As the ribosome moves along each mRNA codon, additional amino acids are transferred into place by \_\_\_\_\_ RNA. \_\_\_\_\_ bonds form between adjacent amino acids. Now color the amino acids and the peptide bonds that join them.
- h. As the ribosome moves on to the next codon on mRNA, what happens to the “empty” tRNA?
- i. When the protein is complete, synthesis is stopped by the \_\_\_\_\_ codon.

- **D5.** Check your understanding of protein synthesis by identifying roles of DNA and three types of RNA in protein synthesis. Choose from answers in the box.

D. DNA	M. mRNA	R. rRNA	T. tRNA
--------	---------	---------	---------

- |   |  |
|---|--|
| _____ a. Forms part of organelles that serve as sites of assembly of proteins.          | _____ f. Contains anticodons.  |
| _____ b. Formed in the transcription step of protein synthesis.                         | _____ g. Contains codons, including the STOP codon.  |
| _____ c. Copied in the transcription step of protein synthesis.                         | _____ h. A polyribosome refers to several ribosomes attached to the same _____ so that large quantities of a protein may be synthesized in a short time. |
| _____ d. Contains promoter and terminator regions.                                      |  |
| _____ e. Binds to an amino acid to direct it to the proper location during translation. |  |

E. **Somatic cell division** (pages 61–62)

**E1.** Once you have reached adult size, do your cells continue to divide (*Yes? No?*). Of what significance is this fact?

- **E2.** Describe aspects of cell division by completing this exercise.

- a. Division of any cell in the body consists of two processes: division of the \_\_\_\_\_ and division of the \_\_\_\_\_.
- b. In the formation of mature sperm and egg cells, nuclear division is known as \_\_\_\_\_. In the formation of all other body cells, that is, *somatic* cells, nuclear division is called \_\_\_\_\_.
- c. Cytoplasmic division in both somatic and reproductive division is known as \_\_\_\_\_. In (*meiosis? mitosis?*) the two daughter cells have the same hereditary material and genetic potential as the parent cell.

- **E3.** Carefully study the phases of the cell cycle shown in Figure 3.24, page 63, in your text. Then check your understanding of the process by identifying major events in each phase.

A. Anaphase	M. Metaphase	T. Telophase
I. Interphase	P. Prophase	

- |   |  |
|---|--|
| <p>_____ a. This phase immediately follows interphase.</p> <p>_____ b. Chromosomes condense into distinct chromosomes (chromatids) each held together by a centromere.</p> <p>_____ c. Nucleoli and nuclear envelope break up, the two centrosomes move to opposite poles of the cell, and formation of the mitotic spindle begins.</p> <p>_____ d. Chromatids line up with their centromeres along the equatorial plane.</p> | <p>_____ e. Centromeres divide; chromatids (now called daughter chromosomes) are moved by microtubules to opposite poles of the cell. Cytokinesis begins.</p> <p>_____ f. Events of this phase are essentially a reversal of prophase; cytokinesis is completed.</p> <p>_____ g. This phase of cell division is longest.</p> <p>_____ h. DNA and organelles are reproduced during this period.</p> |
|---|--|

- **E4.** Fill in the term that fits each description of structures involved in cell division. Choose from answers in the box.

Centromeres	Centrosomes	Chromatids	Chromatin
-------------	-------------	------------	-----------

- |  |  |
|--|--|
| <p>a. Tangled mass containing DNA during interphase; condenses into chromosomes during prophase:</p> <p>_____</p> <p>b. Name given to replicated chromosomes in prophase:</p> <p>_____</p> | <p>c. Holds chromatid pair together; these align on the metaphase plate: _____</p> <p>d. Form the mitotic spindle composed of microtubules:</p> <p>_____</p> |
|--|--|

**F. Aging and cells; wellness; disorders; medical terminology** (pages 62–66)

**F1.** Define these terms:

- a. Aging
  
  
  
  
  
  
  
- b. Geriatrics
  
  
  
  
  
  
  
- c. Carcinogenic
  
  
  
  
  
  
  
- d. Antioxidants

■ **F2.** List three types of cells that do not undergo mitosis from shortly after birth.

**F3.** Explain how *free radicals* may be associated with aging.

■ **F4.** Complete this exercise about cancer.

- a. The term \_\_\_\_\_ refers to the study of cancer. \_\_\_\_\_ and \_\_\_\_\_ nurses are health care providers who specialize in work with clients who have cancer.
- b. A term that means tumor or abnormal growth is \_\_\_\_\_. A cancerous growth is a (*benign?* *malignant?*) neoplasm, whereas a noncancerous tumor is a (*benign?* *malignant?*) neoplasm.
- c. Which type of growth is more likely to spread and to possibly cause death? (*Benign?* *Malignant?*) A term that means the spread of cancer cells is \_\_\_\_\_.
- d. In the process of metastasis, cancer cells compete with normal cells for \_\_\_\_\_.  
By what routes do cancers reach distant parts of the body?
- e. What may cause the pain associated with cancer?
- f. Explain how tissue angiogenesis factors (TAFs) enhance growth of cancer cells.

**F5.** Contrast terms in each pair:

- a. Carcinogens/mutations
- b. Oncogenes/proto-oncogenes
- c. Hyperplasia/metastasis

d. Atrophy/necrosis

e. Apoptosis/necrosis

■ **F6.** Match the terms in the box describing alterations in cells or tissues with the descriptions below.

D. Dysplasia	HP. Hyperplasia	HT. Hypertrophy	M. Metaplasia
--------------	-----------------	-----------------	---------------

- |  |  |
|--|--|
| _____ a. Increase in size of tissue or organ by increase in size (not number) of cells, such as growth of your biceps muscle with exercise       | _____ c. Change of one cell type to another normal cell type, such as change from single row of tall (columnar) cells lining airways to multilayers of cells as response to constant irritation of smoking |
| _____ b. Increase in size of tissue or organ due to increase in number of cells, such as a callus on your hand or breast tissue during pregnancy | _____ d. Abnormal change in cells in a tissue as due to irritation or inflammation; may revert to normal if irritant is removed, or may progress to neoplasia  |

■ **F7.** Match the terms in the box with the definitions below.

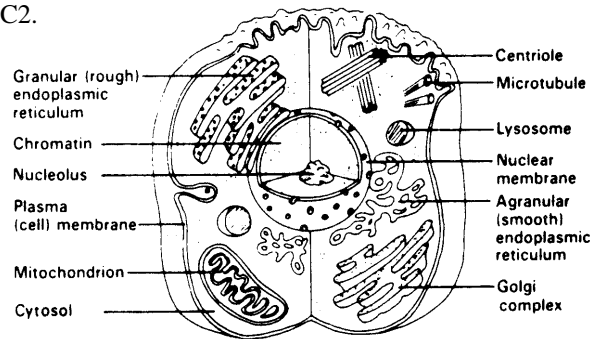
A. Atrophy	B. Biopsy	N. Necrosis
------------	-----------	-------------

- |   |   |
|---|---|
| _____ a. Death of a group of cells  | _____ c. Removal and examination of tissue from the living body for diagnosis |
| _____ b. Decrease in size of cells with decrease in size of tissue or organ |   |

## ANSWERS TO SELECTED CHECKPOINTS: CHAPTER 3

- |   |  |
|---|--|
| A1. Plasma cell membrane, cytoplasm (cytosol and organelles), nucleus.  | F, blood or lymph capillaries; G, venules and veins or lymph vessels.  |
| B1. A, phospholipid bilayer. B, glycoprotein. C, cholesterol. D, pore. E, integral protein. Region D (pore in integral protein): water, ions. Region with arrow (phospholipid layer): steroids, vitamins A and D, water, O <sub>2</sub> , CO <sub>2</sub> . | B5. Kinetic; kinetic energy, ATP; passive, active; vesicular.  |
| B2. Proteins form channels with pores, transporters (carriers), receptors, enzymes, cell identity markers (when combined with carbohydrates as glycoproteins), linkers (or anchoring proteins).   | B6. (a) B. (b) A. (c) A.   |
| B3. (a) Intracellular. (b) Interstitial fluid, extracellular; homeostasis. (c) Blood, lymph. (d) Extra.   | B7. Lipid, lipid bilayer; pores in channels; K <sup>+</sup> ; may be.  |
| B4. A, arteries and arterioles; B, blood capillaries; G, interstitial (intercellular) fluid; D, intracellular fluid; E, interstitial (intercellular) fluid again;   | B8. (a) SD. (b) Fac. (c) O. (d) Pino. (e) Phago.   |
|   | B9. Facilitated; into, lowers; transporters.   |
|   | B10. (a) B. (b) More, fewer. (c) A. (d) Out of, crenate. (e) Iso, 0.9 percent NaCl (normal saline) or 5.0 percent glucose. (f) C. (g) A.   |
|   | B11. (a) Directly; indirectly, related to Na <sup>+</sup> gradients. (b) Na <sup>+</sup> , K <sup>+</sup> , H <sup>+</sup> , Ca <sup>2+</sup> , I <sup>-</sup> , and Cl <sup>-</sup> ; out of; does, continuously; extra, intra. (c) Ions, glucose, amino acids. |

C2.

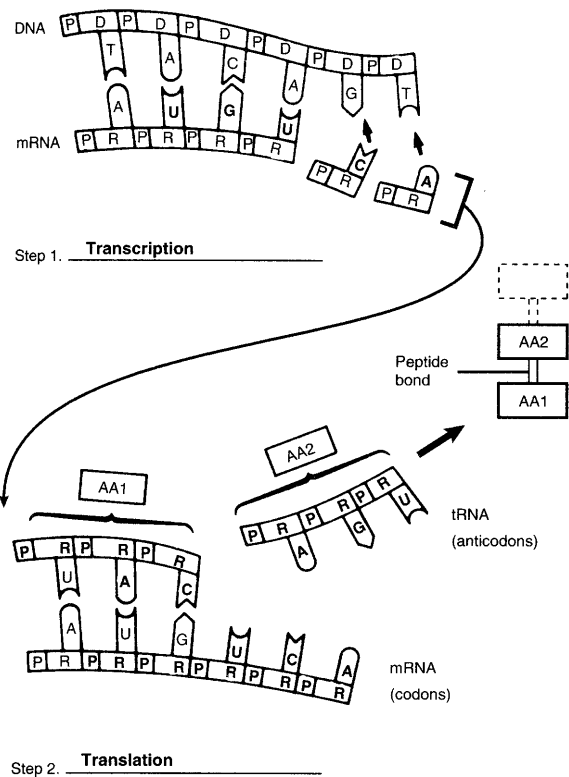


**Figure LG 3.3A** Generalized cell.

- C3. (a) RER. (b) SER. (c) SER. (d) G. (e) L. (f) Mit.  
 C4. (a) L. (b) Mit. (c) Cil. (d) G.  
 D1. (a) C. (b) NU. (c) NE.  
 D3. (a) U. (b) R. (c) N. (d) P.  
 D4. (a) See Figure LG 3.4A. (b) Nucleus; RNA; polymerase, promoter; terminator. (c) See Figure LG 3.4A; moves through a nuclear pore into the cytoplasm. (d) Translation, m (messenger), amino acids. (e) Small, initiator; large. (f) t (transfer), anticodon; codon (see Figure LG 3.4A). (g) t (transfer); peptide (see Figure LG 3.4A). (h) It is released and may be recycled to transfer another amino acid. (i) Stop.  
 D5. (a) R. (b) M. (c) D. (d) D. (e) T. (f) T. (g) M. (h) M.  
 E2. (a) Nucleus, cytoplasm. (b) Meiosis; mitosis. (c) Cytokinesis; mitosis.  
 E3. (a) P. (b) P. (c) P. (d) M. (e) A. (f) T. (g) P. (h) I.  
 E4. (a) Chromatin. (b) Chromatids. (c) Centromeres. (d) Centrosomes.  
 F2. Cardiac muscle, skeletal muscle, and neurons.  
 F4. (a) Oncology; oncologists, oncology. (b) Neoplasm; malignant, benign. (c) Malignant; metastasis.

## CRITICAL THINKING: CHAPTER 3

1. Cancers may grow rapidly when they produce huge quantities of proteins that allow cancer cells to outgrow their normal neighbor cells. Explain how exposure to environmental chemicals known as “promoters” of cancer (or even excessive promoters made within the body, such as estrogens) may lead to rapid growth of cancer cells.
2. Discuss whether interphase is a “resting” phase or a highly active phase in the cell cycle. State your rationale.



**Figure LG 3.4A** Protein synthesis.

- sis. (d) Nutrients and space; via blood or lymph vessels or invading a body cavity. (e) Pressure on nerve, obstruction of passageway, loss of function of a vital organ. (f) These chemicals stimulate growth of blood vessels that nourish and support development of cancer cells.  
 F6. (a) HT. (b) HP. (c) M. (d) D.  
 F7. (a) N. (b) A. (c) B.

3. Explain how replication of DNA during interphase differs from the transcription phase of protein synthesis.
4. Define phytochemicals and cruciferous vegetables, and explain how they may help to protect you against cancer.
5. Explain how DNA is the key to the uniqueness of each individual.
6. Explain how the structure of DNA is related to synthesis of a particular protein.

## MASTERY TEST: ■ CHAPTER 3

Questions 1–6: Circle the letter preceding the one best answer to each question.

1. The organelle that carries out the process of autophagy in which old organelles are digested so that their components can be recycled is:  
A. Golgi  
B. Mitochondrion  
C. Centrosome  
D. Lysosome  
E. Endoplasmic reticulum
2. Choose the *false* statement about protein synthesis.  
A. Translation occurs in the cytoplasm.  
B. Messenger RNA picks up and transports an amino acid during protein synthesis.  
C. Messenger RNA travels to a ribosome in the cytoplasm.  
D. Transfer RNA is attracted to mRNA due to their complementary bases.
3. All of the following structures are part of the nucleus *except*:  
A. Nucleolus                      C. Chromosomes  
B. Chromatin                      D. Centrosome
4. Choose the *false* statement about genes.  
A. Genes contain DNA.  
B. Genes contain information that controls heredity.  
C. Each cell in the human body has a total of 46 genes.  
D. Genes are transcribed by messenger RNA during the first step of protein synthesis.
5. Which term refers to increase in size of a tissue related to increase in number of cells?  
A. Atrophy                      C. Hyperplasia  
B. Hypertrophy                D. Dysplasia
6. Choose the one *false* statement.  
A. Cristae are folds of membrane in mitochondria.  
B. *Crenation* is a term that means bursting of red blood cells when they are placed in hypotonic solution.  
C. Plasma and interstitial fluid are both extracellular fluids (ECFs).  
D. Microtubules are components of the structure of flagella, cilia, centrioles, and the mitotic spindle.

Questions 7–8: Circle *T* (true) or *F* (false). If the statement is false, change the underlined word or phrase so that the statement is correct.

- T   F   7. Sperm move by means of lashing their long tails named cilia.  
T   F   8. A 5 percent glucose solution is hypotonic to a 15 percent glucose solution.

Questions 9–10: Arrange the answers in correct sequence.

- \_\_\_\_\_ 9. Stages in mitosis from first to last after prophase:  
A. Anaphase  
B. Metaphase  
C. Telophase
- \_\_\_\_\_ 10. Steps in protein synthesis from first to last after prophase:  
A. Formation of peptide bonds connecting amino acids  
B. Translation  
C. Transcription

Questions 11–15: Fill-ins. Write the word or phrase that best fits the description.

- \_\_\_\_\_ 11. Plasma membranes consist mainly of two types of chemicals. These are \_\_\_\_\_ and \_\_\_\_\_.
- \_\_\_\_\_ 12. Cytokinesis is another name for \_\_\_\_\_.
- \_\_\_\_\_ 13. Active processes involved in movement of substances across cell membranes are those that use energy from the splitting of \_\_\_\_\_.

- \_\_\_\_\_ 14. White blood cells engulf large solid particles by the process of \_\_\_\_\_ .
- \_\_\_\_\_ 15. The sequence of bases of mRNA that would be complementary to DNA bases in the sequence A-T-T-C-A-C would be \_\_\_\_\_ .

### ANSWERS TO MASTERY TEST: ■ CHAPTER 3

#### Multiple Choice

1. D
2. B
3. D
4. C
5. C
6. B

#### True or False

7. F. Flagella
8. T

#### Arrange

9. B A C
10. C B A

#### Fill-ins

11. Phospholipids and protein
12. Division of the cytoplasm
13. ATP
14. Phagocytosis
15. U-A-A-G-U-G