

Faculty Manual

FOR THE TELECOURSE

Cycles of Life EXPLORING BIOLOGY

Third Edition

Produced by

The Office of Instructional Systems Development,
Coastline Community College, for
Coast Community College District

in association with

Brooks/Cole (a division of Wadsworth Group/Thomson Learning)
New Jersey Community College Telecommunications Consortium
NILRC

Oregon Community College Distance Education Consortium
and Texas Consortium for Educational Telecommunications

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The Test Bank includes questions written by Larry G. Sellers for the test banks prepared to accompany *Biology: Concepts and Applications*, Third Edition, by Cecie Starr, © 1997 Wadsworth Publishing Company / A Division of International Thomson Publishing Inc. and *Biology: The Unity and Diversity of Life*, Seventh Edition, by Cecie Starr and Ralph Taggart, © 1995 Wadsworth Publishing Company / A Division of International Thomson Publishing Inc.

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Lesson 3—Cell Structure and Function

Video Program: “*Secrets of the Cell*”

Program Description. What is a cell and why is it crucial to the understanding of life processes? Dr. Dwayne Simmons describes how a vast universe of cells works together to form living beings. For example, a football player’s separate populations of cells in his ears and brain enable him to focus on important sounds amid the din of background noise from the crowd.

In the next segment, Dr. Robert Heath discusses the role of membranes in cells and the importance of molecular movements in plants.

Finally, the program compares wholly different types of cells: the cells of prokaryotes versus those of eukaryotes. Dr. Dennis Focht tells why bacteria are self-contained living cells that envelop and permeate almost everything around us. He also describes the incredibly complex world of prokaryotes. Included in the program are discussions of the various organelles found in eukaryotic cells.

Reading Assignments

- Read the Overview and Learning Objectives for this lesson. Use the Learning Objectives to guide your reading, viewing, and thinking.
- Read Chapter 4, “Cell Structure and Function,” pages 50–73, in the Starr textbook. Also read Chapter 5, “Ground Rules of Metabolism,” pages 80 and 86–89.

Or read, in the Starr/Taggart textbook, Chapter 4, “Cell Structure and Function,” pages 52–77, and Chapter 5, “A Closer Look at Cell Membranes,” pages 78–93.

- Read the Viewing Notes in this lesson.

Learning Objectives

When students have completed all assignments for this lesson, they should be able to:

1. Understand the basic tenets of *cell theory*, and identify the scientific contributions that led to its development.
2. Use the term *fluid mosaic model* to describe the general structure and function of a cell’s membranes, and identify the importance of membranes as a structural component of cells.
3. Define the terms *solute*, *solvent*, and *solution*, and relate them to the concentration of a solution.
4. Describe *diffusion*, including *osmosis*. Explain what causes diffusion, and identify the factors that influence its rate.
5. Define and give examples of *hypertonic*, *hypotonic*, and *isotonic* solutions, and note the direction of solute and solvent movement when any two of these solutions are separated by a selectively permeable membrane.
6. Distinguish those mechanisms by which substances move across membranes passively (without the use of energy) from active mechanisms (that require energy).
7. Contrast the general features of *prokaryotic* and *eukaryotic* cells.

8. Describe the membranous and nonmembranous *organelles* found in eukaryotic cells, and explain the general function of each.
9. Identify those features that generally distinguish plant cells from animal cells.
10. Identify some of the variations that create diversity of cells between organisms or specialization within one organism.

Study Matrix

Lesson 3: Cell Structure and Function

Please Note: Use this matrix to guide your study and achieve the learning objectives of this lesson. It will also help you to view the video, which defines and demonstrates important concepts and objectives as they relate to everyday life and actual case studies.

Learning Objective	Starr Textbook	Telecourse Student Guide
Understand the basic tenets of <i>cell theory</i> , and identify the scientific contributions that led to its development.	pp. 50–51	Completion Exercise 1; Self-Test Question 1.
Use the term <i>fluid mosaic model</i> to describe the general structure and function of a cell's membranes, and identify the importance of membranes as a structural component of cells.	pp. 52–53	Completion Exercise 2; Self-Test Question 2.
Define the terms <i>solute</i> , <i>solvent</i> , and <i>solution</i> , and relate them to the concentration of a solution.	p. 86	Matching Exercise III; Self-Test Question 3.
Describe <i>diffusion</i> , including <i>osmosis</i> . Explain what causes diffusion, and identify the factors that influence its rate.	pp. 80, 88	Matching Exercise III; Completion Exercise 2; Self-Test Question 4.
Define and give examples of <i>hypertonic</i> , <i>hypotonic</i> , and <i>isotonic</i> solutions, and note the direction of solute and solvent movement when any two of these solutions are separated by a selectively permeable membrane.	pp. 88–89	Matching Exercise III; Completion Exercise 2; Self-Test Question 5.
Distinguish those mechanisms by which substances move across membranes passively (without the use of energy) from active mechanisms (that require energy).	pp. 86–87	Matching Exercise III; Completion Exercise 2; Self-Test Question 6.
Contrast the general features of <i>prokaryotic</i> and <i>eukaryotic</i> cells.	pp. 52, 70	Completion Exercise 3; Self-Test Question 7.
Describe the membranous and nonmembranous <i>organelles</i> found in eukaryotic cells, and explain the general function of each.	pp. 56–67	Matching Exercises I and II; Completion Exercise 3; Self-Test Question 8.

Identify those features that generally distinguish plant cells from animal cells.	p. 56	Matching Exercises I and II; Completion Exercise 4; Self-Test Question 9.
Identify some of the variations that create diversity of cells between organisms or specialization within one organism.	pp. 68–69	Completion Exercise 4; Self-Test Question 10.

Study Matrix

Lesson 3: Cell Structure and Function

Please Note: Use this matrix to guide your study and achieve the learning objectives of this lesson. It will also help you to view the video, which defines and demonstrates important concepts and objectives as they relate to everyday life and actual case studies.

Learning Objective	Starr/Taggart Textbook	Telecourse Student Guide
Understand the basic tenets of <i>cell theory</i> , and identify the scientific contributions that led to its development.	pp. 52–53	Completion Exercise 1; Self-Test Question 1.
Use the term <i>fluid mosaic model</i> to describe the general structure and function of a cell's membranes, and identify the importance of membranes as a structural component of cells.	pp. 80–81	Completion Exercise 2; Self-Test Question 2.
Define the terms <i>solute</i> , <i>solvent</i> , and <i>solution</i> , and relate them to the concentration of a solution.	pp. 29, 84	Matching Exercise III; Self-Test Question 3.
Describe <i>diffusion</i> , including <i>osmosis</i> . Explain what causes diffusion, and identify the factors that influence its rate.	pp. 88–89	Matching Exercise III; Completion Exercise 2; Self-Test Question 4.
Define and give examples of <i>hypertonic</i> , <i>hypotonic</i> , and <i>isotonic</i> solutions, and note the direction of solute and solvent movement when any two of these solutions are separated by a selectively permeable membrane.	p. 89	Matching Exercise III; Completion Exercise 2; Self-Test Question 5.
Distinguish those mechanisms by which substances move across membranes passively (without the use of energy) from active mechanisms (that require energy).	pp. 86–87	Matching Exercise III; Completion Exercise 2; Self-Test Question 6.
Contrast the general features of <i>prokaryotic</i> and <i>eukaryotic</i> cells.	p. 54	Completion Exercise 3; Self-Test Question 7.
Describe the membranous and nonmembranous <i>organelles</i> found in eukaryotic cells, and explain the general function of each.	pp. 58–71	Matching Exercises I and II; Completion Exercise 3; Self-Test Question 8.

Identify those features that generally distinguish plant cells from animal cells.	p. 58	Matching Exercises I and II; Completion Exercise 4; Self-Test Question 9.
Identify some of the variations that create diversity of cells between organisms or specialization within one organism.	pp. 72–73	Completion Exercise 4; Self-Test Question 10.

LESSON

3

Secrets of the Cell

Objective 1: Understand the basic tenets of cell theory, and identify the scientific contributions that led to its development.

- E 1. One portion of the cell theory states that
- all cells have a nucleus.
 - all cells divide by meiosis.
 - all living organisms are made up of cells.
 - growth is solely the result of cell division.
- E 2. The cell theory was proposed by
- Robert Hooke.
 - Theodor Schwann and Matthias Schleiden.
 - Rudolf Virchow.
 - Antony van Leeuwenhoek.
- E 3. The idea that all living cells come from preexisting living cells was proposed by
- Robert Hooke.
 - Robert Brown.
 - Theodor Schwann.
 - Rudolf Virchow.
- E 4. The highest magnification generally used to study cells is provided by the
- transmission electron microscope.
 - compound light microscope.
 - phase contrast microscope.
 - scanning electron microscope.

Objective 2: Use the term fluid mosaic model to describe the general structure and function of a cell's membranes, and identify the importance of membranes as a structural component of cells.

- M 5. The phospholipid molecules of most membranes have a
- hydrophobic head and a hydrophilic tail.
 - hydrophobic head and a hydrophobic tail.
 - hydrophobic head and two hydrophobic tails.
 - hydrophilic head and two hydrophobic tails.
- E 6. Hydrophobic reactions of phospholipids may produce clusters of their fatty acid tails, which form
- a lipid bilayer.
 - hydrolysis of the fatty acids.
 - a protein membrane.
 - a nonpolar membrane.

- M 7. Unsaturated tails of lipids
- are hydrophilic.
 - are unstable and tend to break apart.
 - have kinks in them and lessen the interaction between adjacent fat.
 - are all of the above.
- M 8. The relative impermeability of membranes to water-soluble molecules is a result of the
- nonpolar nature of water molecules.
 - presence of large proteins that extend through both sides of membranes.
 - presence of inorganic salt crystals scattered through some membranes.
 - presence of phospholipids in the lipid bilayer.
- D 9. Which of the following statements is true?
- When lipids and water are mixed, it is the water molecules that isolate themselves into droplets.
 - When lipids and water are mixed, the lipids dissolve and enter into a solution.
 - Lipids are classified as nonpolar substances and will not mix with water.
 - Polar substances are able to pass through a plasma membrane more readily than nonpolar substances.
- D 10. The fluid mosaic model helps to explain
- the structure of DNA.
 - plasma membrane structure and function.
 - antibiotic production in the cytoplasm.
 - carbohydrate metabolism in the nucleus.
- M 11. The fluid mosaic model describes an ever-changing membrane composed of all the following **EXCEPT**
- carbohydrate.
 - silicon.
 - lipid.
 - protein.

Objective 3: Define the terms solute, solvent, and solution, and relate them to the concentration of a solution.

- M 12. A pH of 10 is how many times as basic as a pH of 7?
- 3
 - 10
 - 100
 - 1,000
- M 13. A salt will dissolve in water to form
- acids.
 - ions.
 - bases.
 - polar solvents.
- M 14. A reaction of an acid and a base will produce water and
- a buffer.
 - a salt.
 - gas.
 - solute.

- M 15. Cellular pH is kept near a value of 7 because of
- salts.
 - buffers.
 - acids.
 - bases.
- D 16. Which statement is true?
- The movement of solvent occurs from a hypotonic solution to an isotonic solution.
 - The net movement from an isotonic to a hypotonic solution involves the movement of solute molecules only.
 - The concentration of the solute is greater in an isotonic solution than in a hypertonic solution.
 - The concentration of the solvent is greater in a hypertonic solution than in an isotonic solution.

Objective 4: Describe diffusion, including osmosis. Explain what causes diffusion, and identify the factors that influence its rate.

- D 17. Which affects the rate of diffusion through a semipermeable membrane?
- steeper concentration gradients
 - higher temperatures
 - membrane pore size
 - all of the above
- D 18. The rate of diffusion through a semipermeable membrane will be lowest when which of the following are true?
- Concentration gradients are steep.
 - Temperatures are low.
 - Solutes are small molecules.
 - All of the above statements are true.
- M 19. In simple diffusion
- the rate of movement of molecules is controlled by temperature and pressure.
 - the movement of individual molecules is random.
 - the net movement is away from the region of highest concentration.
 - all of the above occur.
- D 20. The net direction that an ion or molecule moves is
- dependent upon the size of the molecule.
 - controlled by the temperature of the medium.
 - controlled by the membranes in the vicinity.
 - the result of concentration differences.

Objective 5: Define and give examples of hypertonic, hypotonic, and isotonic solutions, and note the direction of solute and solvent movement when any two of these solutions are separated by a selectively permeable membrane.

- M 21. A single-celled freshwater organism, such as a protistan, is transferred to salt water. Which of the following is likely to happen?
- The cell bursts.
 - Salt is pumped out of the cell.
 - The cell shrinks.
 - Enzymes flow out of the cell.
- M 22. Which statement is true?
- A cell placed in an isotonic solution will swell.
 - A cell placed in a hypotonic solution will swell.
 - A cell placed in a hypotonic solution will shrink.
 - A cell placed in a hypertonic solution will remain the same size.
- M 23. A red blood cell will swell and burst when placed in which of the following kinds of solution?
- hypotonic
 - hypertonic
 - isotonic
 - any of the above
- M 24. If a plant cell is placed in a hypotonic solution
- the entire cell will not swell or shrink.
 - the entire cell will shrink.
 - the turgor pressure will decrease.
 - the cell wall prevents the cell from exploding.
- M 25. Wilting of a plant occurs
- if the plant is placed in an isotonic solution.
 - if there is a rise in turgor pressure.
 - as a result of facilitated diffusion.
 - when a plant with flexible cell walls is placed in a hypertonic solution.

Objective 6: Distinguish those mechanisms by which substances move across membranes passively (without the use of energy) from active mechanisms (that require energy).

- M 26. Which of the following is **NOT** a form of active transport?
- sodium-potassium pump
 - endocytosis
 - exocytosis
 - diffusion
- E 27. Movement of a molecule against a concentration gradient is
- simple diffusion.
 - facilitated diffusion.
 - active transport.
 - passive transport.
- M 28. The method of movement that requires the expenditure of ATP molecules is
- simple diffusion.
 - facilitated diffusion.
 - osmosis.
 - active transport.

- E 29. The sodium-potassium pump is an example of
- simple diffusion.
 - osmosis.
 - active transport.
 - passive transport.
- M 30. The carrier molecules used in active transport are
- calcium ions in the calcium pump.
 - proteins.
 - carbohydrates.
 - lipids.
- M 31. The use of hydroponics can demonstrate all of the following **EXCEPT**
- diffusion.
 - selective membrane function.
 - ribosomal function.
 - passive transport.
- M 32. Cells can transfer larger amounts of material into or out of the cell using
- exocytosis.
 - mononucleosis.
 - endocytosis.
 - a and c only.
- D 33. When proteins in a cell membrane act as channels for certain molecules, that is an example of
- active transport.
 - an energy pump.
 - passive transport.
 - nonselective diffusion.

Objective 7: Contrast the general features of prokaryotic and eukaryotic cells.

- E 34. Which are examples of prokaryotes?
- Protozoa
 - Bacteria
 - Algae
 - Fungi
- M 35. Prokaryotic cells do **NOT** have
- nucleoid regions.
 - membrane bound nuclei.
 - cytoplasm.
 - plasma membrane.
- E 36. Prokaryotes
- have DNA regions.
 - are unicellular.
 - have cell walls.
 - possess all of the above.

- D 37. The organelle that pinches off portions of its membrane to form a vesicle for storage or transport is the
- mitochondrion.
 - chloroplast.
 - nucleolus.
 - Golgi body.
- E 38. Generally, prokaryotes differ from eukaryotes because of
- size and simplicity.
 - rate of reproduction.
 - lack of organelles.
 - all of the above.
- D 39. Prokaryotic cells are important in all the following **EXCEPT**
- cross-pollination of flowering plants.
 - the nitrogen cycle.
 - the sulfur cycle.
 - oxygen production through photosynthesis.

Objective 8: Describe the membranous and nonmembranous organelles found in eukaryotic cells, and tell the general function of each.

- E 40. Organelles composed of a system of canals, tubes, and sacs that transport molecules inside the cytoplasm are
- Golgi bodies.
 - ribosomes.
 - mitochondria.
 - endoplasmic reticula.
- M 41. Which of the following are the primary cellular sites for the recapture of energy from carbohydrates?
- Golgi bodies
 - ribosomes
 - mitochondria
 - lysosomes
- M 42. Which of the following are the primary structures for the packaging of cellular secretions for export from the cell?
- Golgi bodies
 - ribosomes
 - mitochondria
 - lysosomes
- E 43. The cell part responsible for maintaining cell shape, internal organization, and cell movements is the
- vesicle.
 - nucleus.
 - endoplasmic reticulum.
 - cytoskeleton.
- D 44. Which of the following are found in both plant and animal cells?
- nucleus, Golgi body, chloroplasts
 - ribosomes, mitochondria, plasma membranes
 - centrioles, cell walls, nucleolus
 - vacuoles, nucleolus, starch grains

- M 45. All of the following are cellular organelles found in eukaryotic organisms **EXCEPT**
- mitochondria.
 - endoplasmic reticulum.
 - cytoplasm.
 - nuclei.
- E 46. ATP molecules are primarily manufactured in the
- Golgi bodies.
 - plasma membrane.
 - flagella.
 - mitochondria.

Objective 9: Identify those features that generally distinguish plant cells from animal cells.

- M 47. Which is **NOT** found as a part of all cells?
- cell membrane
 - cell wall
 - ribosomes
 - RNA
- D 48. Plasmodesmata are
- used in energy transformations within the cell.
 - typical of animal cells more than plant cells.
 - cross connections between cell walls.
 - both a and b.
- D 49. Animal cells dismantle and dispose of waste materials by
- using centrally located vacuoles.
 - several lysosomes fusing with a sac that encloses the wastes.
 - microvilli packaging and exporting the wastes.
 - mitochondrial breakdown of the wastes.
- E 50. What cell organelle is found in plant cells but **NOT** in animal cells?
- nucleoplasm
 - cell wall
 - plasma membrane
 - Golgi body
- E 51. Organelles in plant cells that function in photosynthesis or storage are called
- stroma.
 - plastids.
 - vacuoles.
 - mitochondria.
- D 52. The cell wall
- provides skeletal support for plants.
 - controls what enters and leaves a cell.
 - replaces the plasma membrane of animal cells in plant cells.
 - is found in all eukaryotes.

Objective 10: Identify some of the variations that create diversity of cells between organisms or specialization within one organism.

- M 53. Fluid-filled sacs that may store food or water in cells are called
- plastids.
 - vacuoles.
 - microvilli.
 - nucleoli.
- E 54. Stroma and grana are portions of
- chloroplasts.
 - mitochondria.
 - ribosomes.
 - chromosomes.
- M 55. Organelles that dramatically increase the cell size and internal surface area are
- plastids.
 - vacuoles.
 - chloroplasts.
 - microfilaments.
- E 56. The organelle that is compared to a whip is a
- microfilament.
 - cilium.
 - microvillus.
 - flagellum.
- D 57. Plasmodesmata are related to
- gap junctions in animal cells.
 - tight junctions in bacteria.
 - wall junctions in plants.
 - adhering junctions.
- E 58. The sensory cells of the ear, also known as hair cells, are an example of
- cell diversity.
 - cell regeneration.
 - cell specialization.
 - a and c only.

Answer Key

Lesson 3

Cell Structure and Functions

To the right of each correct answer are the page numbers indicating where in the Starr textbook and Starr/Taggart textbook information on the question can be found.

		Starr	Starr/Taggart			Starr	Starr/Taggart
1.	c	51	53	30.	b	85	87
2.	b	51	53	31.	c	video	video
3.	d	51	53	32.	d	video	90, video
4.	a	54–55	56	33.	c	video	86, video
5.	d	52–53	54	34.	b	70	74
6.	a	52–53	54	35.	b	70–71	74
7.	c	53	54	36.	d	70–71	74
8.	d	52–53	54	37.	d	62	64
9.	c	52–53	54	38.	d	video	74, video
10.	b	video	video	39.	a	video	video
11.	b	video	video	40.	d	62–63	64
12.	d	30	30	41.	c	64	66
13.	b	31	29	42.	a	62	64
14.	b	31	31	43.	d	66	68
15.	b	30–31	30	44.	b	57	58
16.	a	89	89	45.	c	video	54, video
17.	d	86	89	46.	d	video	66, video
18.	b	86	89	47.	b	69	72
19.	d	86	84	48.	c	69	73
20.	d	86	84	49.	b	63	65
21.	c	88–89	89	50.	b	69	72
22.	b	88–89	89	51.	b	65	67
23.	a	88–89	89	52.	a	68	72
24.	b	88–89	89	53.	b	65	67
25.	d	88–89	89	54.	a	65	67
26.	d	86–87	84	55.	b	65	67
27.	c	86	87	56.	d	67	70
28.	c	85	87	57.	c	69	73
29.	d	85	87	58.	d	video	video