

Study Tip

Divide the class into pairs, and have students quiz each other about the Vocabulary words and the chapter Key Concepts.

Thinking Visually

1. The cell grows and replicates its DNA and centrioles.
2. The chromosomes line up across the middle of the cell.
3. The sister chromatids separate into individual chromosomes and move apart.
4. The cell membrane pinches the cytoplasm in half.

10-1 Cell Growth**Key Concept**

- The larger a cell becomes, the more demands the cell places on its DNA. In addition, the cell has more trouble moving enough nutrients and wastes across the cell membrane.

Vocabulary

cell division, p. 243

10-2 Cell Division**Key Concepts**

- During the cell cycle, a cell grows, prepares for division, and divides to form two daughter cells, each of which then begins the cycle again.
- Biologists divide the events of mitosis into four phases: prophase, metaphase, anaphase, and telophase. Mitosis insures that each daughter cell has the same genetic information as the parent cell.
- During prophase in animal cells, the centrioles separate and take up positions on opposite sides of the nucleus. In addition, chromosomes condense and the spindle appears.
- During metaphase, the chromosomes line up across the center of the cell. Microtubules connect the chromosome to each pole of the spindle.
- During anaphase, the centromeres that join the sister chromatids split, and the sister chromatids separate and become individual chromosomes.
- In telophase, the chromosomes, which were distinct and condensed, uncoil and disperse as the nuclear envelope re-forms.
- Cytokinesis is the division of the cytoplasm.

Vocabulary

mitosis, p. 244
cytokinesis, p. 244
chromatid, p. 244
centromere, p. 245
interphase, p. 245
cell cycle, p. 245
prophase, p. 246
centriole, p. 246
spindle, p. 247
metaphase, p. 248
anaphase, p. 248
telophase, p. 248

10-3 Regulating the Cell Cycle**Key Concepts**

- Cyclins regulate the timing of the cell cycle in eukaryotic cells.
- Cancer cells do not respond to the signals that regulate the growth of most cells.

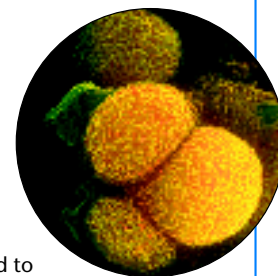
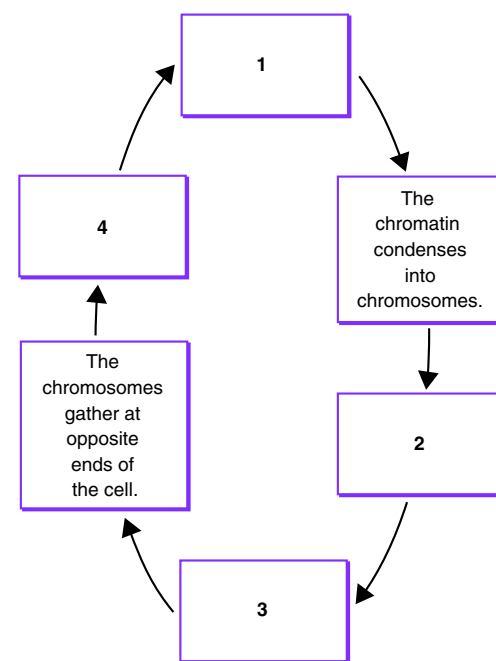
Vocabulary

cyclin, p. 251

cancer, p. 252

Thinking Visually

Using the information in this chapter, complete the following cycle diagram of the cell cycle.

**Chapter 10 Assessment****Reviewing Content**

- | | | |
|------|------|-------|
| 1. d | 5. c | 9. a |
| 2. c | 6. a | 10. a |
| 3. b | 7. b | |
| 4. c | 8. b | |

Understanding Concepts

11. During cell division, a cell divides into two new daughter cells.
12. When a cell is small, the information stored in its DNA is able to meet all of the cell's needs. But if a cell were to grow without limit, an "information crisis" would occur.
13. Cell volume is the amount of material inside the cell. Surface area is the total area of the cell's membrane. Ratio of surface area to volume is the surface area divided by the volume.
14. A cell's ratio of surface area to volume decreases as it grows larger. This means that the area available for diffusion also decreases. Thus, if a cell grows too large, it is unable to take in all needed materials and expel all its wastes. These problems impose limits on the growth of a cell.
15. Well before cell division, each chromosome is replicated. At the beginning of cell division, each chromosome consists of two identical sister chromatids.
16. Together, interphase and cell division make up the cell cycle.

**CHAPTER RESOURCES****Print:**

- **Teaching Resources**, Chapter Vocabulary Review, Graphic Organizer
- **Chapter Tests: Levels A and B**, Chapter 10 Test
- **Laboratory Assessment**, Laboratory Assessment 3

Technology:

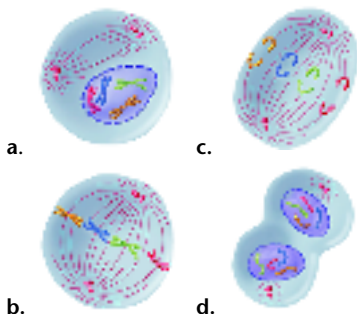
- **Computer Test Bank**, Chapter 10 Test
- **iText**, Chapter 10 Assessment

Chapter 10 Assessment

Reviewing Content

Choose the letter that best answers the question or completes the statement.

- The rate at which materials enter and leave through the cell membrane depends on the cell's
 - volume.
 - weight.
 - mass.
 - surface area.
- The process of cell division results in
 - sister chromatids.
 - mitosis.
 - two daughter cells.
 - unregulated growth.
- Sister chromatids are attached to each other at an area called the
 - centriole.
 - centromere.
 - spindle.
 - chromosome.
- If a cell has 12 chromosomes, how many chromosomes will each of its daughter cells have after mitosis?
 - 4
 - 6
 - 12
 - 24
- At the beginning of cell division, a chromosome consists of two
 - centromeres.
 - centrioles.
 - chromatids.
 - spindles.
- The phase of mitosis during which chromosomes become visible and the centrioles separate from one another is
 - prophase.
 - anaphase.
 - metaphase.
 - telophase.
- Which of the illustrations below best represents metaphase of mitosis?



- The timing of the cell cycle in eukaryotic cells is believed to be controlled by a group of closely related proteins known as
 - chromatids.
 - cyclins.
 - centromeres.
 - centrioles.

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- In the cell cycle, external regulators direct cells to
 - speed up or slow down the cell cycle.
 - remain unchanged.
 - proceed and then stop the cell cycle.
 - grow uncontrollably.
- Uncontrolled cell division occurs in
 - cancer.
 - mitosis.
 - cytokinesis.
 - cyclin.

Understanding Concepts

- Summarize what happens during the process of cell division.
- Explain how a cell's DNA can limit the cell's size.
- Describe what is meant by each of the following terms: cell volume, cell surface area, ratio of surface area to volume.
- How is a cell's potential growth affected by its ratio of surface area to volume?
- Describe how a cell's chromosomes change as a cell prepares to divide.
- What is the relationship between interphase and cell division?
- Summarize what happens during interphase.
- Explain how the following terms are related to one another: DNA, centromere, chromosome, chromatid.
- List the following events in the correct sequence, and describe what happens during each event: anaphase, metaphase, prophase, and telophase.
- How does the number of chromosomes in the two new cells compare with the number in the original cell at the end of cell division?
- Summarize what happens during the cell cycle.
- When some cells are removed from the center of a tissue culture, will new cells replace the cells that were removed? Explain.
- Describe the role of cyclins in the cell cycle.
- Why is it important that cell growth in a multicellular organism be regulated so carefully?
- How do cancer cells differ from noncancerous cells? How are they similar?



If your class subscribes to the iText, use it to review the Key Concepts in this chapter.

(Continued from page 256)

17. During interphase, a cell increases in size, synthesizes new proteins and organelles, replicates its chromosomes, and prepares for cell division by producing needed spindle proteins.

18. The genetic information that is passed on from one generation of cells to the next is carried by chromosomes, which are made up of DNA. Before cell division, chromosomes are replicated, so that each chromosome consists of two identical "sister" chromatids. Sister chromatids are attached at an area called the centromere.

19. Prophase: Chromatin condenses into chromosomes; centrioles separate; spindle begins to form; nuclear membrane breaks down. Metaphase: Chromosomes line up across middle of cell with spindle fibers connected to their centromeres. Anaphase: Sister chromatids separate and move apart. Telophase: Chromosomes gather at opposite ends of cell and lose distinct shape; new nuclear membranes form.

20. The number of chromosomes in each of the two cells equals the number in the original cell.

21. A cell grows, prepares for division, and divides to form two daughter cells, each of which then begins the cycle again.

22. Yes, new cells will replace the removed cells because of the process of cell division, which will continue until the new cells come in contact with other cells. When that occurs, cell division will stop.

23. Cyclins regulate the timing of the cell cycle in eukaryotic cells.

24. The consequences of uncontrolled cell growth are severe, as in cancer, for example.

25. Cancer cells do not respond to the signals that regulate the growth of most cells. As a result, they form masses of cells called tumors that can damage the surrounding tissues.



HOMEWORK GUIDE

Section:	Questions:
Section 10-1:	1, 2, 11-14, 26, 27
Section 10-2:	3-7, 15-21, 28-34
Section 10-3:	8-10, 22-25

Critical Thinking

26. Students' models should demonstrate that as the size of a cube increases, its volume increases faster than its surface area. As a result, the ratio of surface area to volume decreases as the size of the cube increases.

27. Surface area = $5 \text{ mm} \times 5 \text{ mm} \times 6 = 150 \text{ mm}^2$. Volume = $5 \text{ mm} \times 5 \text{ mm} \times 5 \text{ mm} = 125 \text{ mm}^3$.

Ratio of surface area to volume = $150/125 = 6 : 5$.

28. A typical experiment might suggest comparing the rate of cell division over time in the same kind of plant cell at various temperatures.

29. a. The cell is in metaphase. It most resembles that of an animal because there is no evidence of a cell wall, as there would be in the cell of a plant. Also, this cell has centrioles at opposite ends of the spindle, and plant cells do not have centrioles.
b. The two strands carry the same genetic information, which is important because the cell needs this information to function.

30. The presence of many nuclei indicates that mitosis has occurred repeatedly without cytokinesis having occurred, because there is still only one cell.

31. Cell division is similar in animal and plant cells. In prophase, though, plant cells do not have centrioles, as animal cells do. Plant cells organize their mitotic spindles from regions known as centrosomes. Also, during cytokinesis in most animal cells, the cell membrane moves inward until the cytoplasm is pinched into two nearly equal parts. In plant cells, a cell plate forms midway between the divided nuclei and gradually develops into a separating membrane. A cell wall then appears in the cell plate.

32. Because nerve cells seldom undergo mitosis, the body is usually unable to repair damage to parts of the nervous system. Thus, complete recovery may not occur.

33. If the pattern were not constant, each type of organism could not stay the same, and there would be no species continuity.

34. Students might mention that organisms are made of units called cells and that organisms grow and develop as their cells divide.

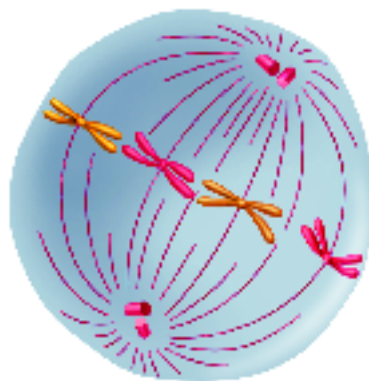
Critical Thinking

26. **Using Models** Use paper, blocks, or another material to create three-dimensional models demonstrating how the ratio of surface area to volume changes as the size of a cube changes.

27. **Calculating** Calculate the surface area, volume, and ratio of surface area to volume of an imaginary cubic cell measuring 5 mm on each side.

28. **Designing Experiments** A classmate suggests that temperature might affect the rate of mitosis in plant cells. Design an experiment to test this hypothesis.

29. **Interpreting Graphics** The diagram below shows a phase of mitosis. Use the diagram to answer the questions.



- a. Identify the phase and indicate whether the cell most resembles that of a plant or an animal. Explain your answer.
 - b. The four chromosomes shown in the center of this cell each have two connected strands. Explain how the two strands on the same chromosome compare with regard to the genetic information they carry. In your answer, be sure to explain why this is important to the cell.
30. **Formulating Hypotheses** Some cells have several nuclei within the cytoplasm of a single cell. Considering the events in a typical cell cycle, which phase of the cell cycle is not operating when such cells form?
31. **Comparing and Contrasting** Describe the differences between cell division in an animal cell and cell division in a plant cell.

32. **Applying Concepts** The nerve cells in the human nervous system seldom undergo mitosis. Based on this information, explain why complete recovery from injuries to the nervous system may not occur.

33. **Formulating Hypotheses** Each type of eukaryotic organism has a characteristic number of chromosomes. Human cells, for example, generally have 46 chromosomes in their nuclei; fruit fly cells have 8 chromosomes. How might a particular type of organism be affected if this pattern were not repeated in each generation?

34. **Connecting Concepts** Recall what you learned about the characteristics of life in Chapter 1. How is cell division related to one or more of those characteristics?

Writing in Science

In this chapter, you learned that cells can reproduce asexually by mitosis. In some cases, animals have the ability to reproduce asexually by a process called regeneration. If a planarian is cut into pieces, for example, it can regenerate an entire body from each piece. If large mammals were capable of regeneration, how do you think this would affect ecosystems?

Performance-Based Assessment

Demonstrate the Cell Cycle A flip-book consists of pages of sequential drawings that, when flipped, appear to move. Create a flip-book movie of the steps in the cell cycle. Be sure to show what happens to the chromosomes at each step. Exchange your flip-book with another student. Look at the other student's movie, and write a review of it.

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Writing in Science

Explain that a planarian is a flatworm, a tiny animal with a very simple body plan, which students will study in Chapter 27. Students' responses to the question may vary. A typical response may assert that if mammals were capable of regeneration, populations would tend to increase more rapidly than they would otherwise, and such population growth would have effects throughout a food web.