

10 Cell Growth and Division

Big idea Growth, Development, and Reproduction
Q: How does a cell produce a new cell?

	WHAT I KNOW	WHAT I LEARNED
10.1 Why do cells divide?		
10.2 How do cells divide?		
10.3 How does a cell control the process of cell division?		
10.4 How does a single, undifferentiated cell lead to a complex multicellular organism?		

10.1 Cell Growth, Division, and Reproduction

Limits to Cell Size

For Questions 1–4, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. As a cell's size increases, its amount of DNA also increases.
- _____ 2. The amount of activity in a cell is related to its volume.
- _____ 3. The smaller the cell, the smaller its ratio of surface area to volume.
- _____ 4. The information crisis in a cell is solved by the replication of the DNA before cell division.

Cell Division and Reproduction

For Questions 6–8, complete each statement by writing the correct word or words.

5. _____ is the formation of new individuals.
6. For single-celled organisms, cell division is a form of _____ reproduction.
7. Most multicellular organisms reproduce by _____ reproduction.
8. Use the table to compare and contrast asexual and sexual reproduction.

Asexual and Sexual Reproduction	
Similarities	Differences

9. Vascular tissue helps plants transport water against the force of gravity. Because of this, plants that lack vascular tissue do not grow very tall. How is this situation similar to the information you have learned in this lesson? Explain.

10.2 The Process of Cell Division

Chromosomes

For Questions 1–5, complete each statement by writing the correct word or words.

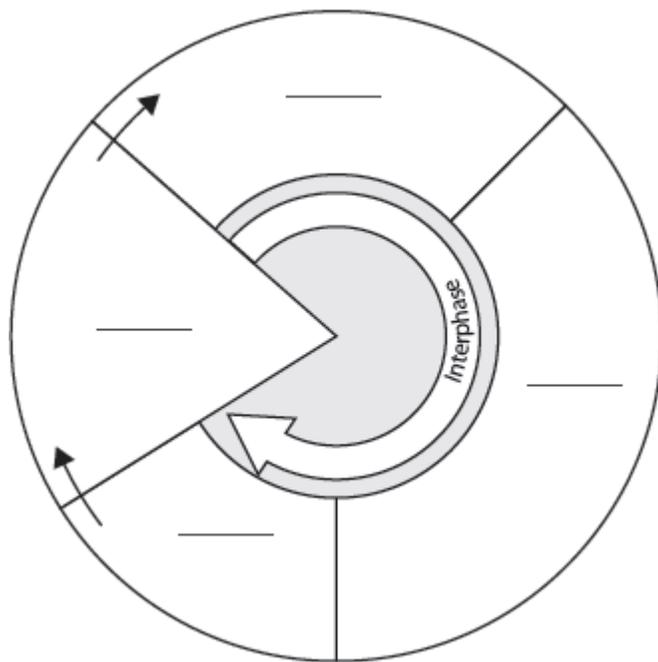
1. Cells carry genetic information in packages of DNA called _____.
2. Most _____ have only one circular strand of DNA.
3. In eukaryotic cells, the genetic structure consists of DNA and a tightly wound protein, which together form a substance called _____.
4. The beadlike structures formed by DNA wrapped around _____ molecules are called nucleosomes.
5. _____ make possible the precise separation of DNA during cell division.

The Cell Cycle

6. What is the name of the type of cell division that occurs in the prokaryotic cell cycle?

7. What happens during interphase?

8. Complete the cell cycle diagram by writing the correct name of a phase on each line.



9. In eukaryotic cells, what happens in the G_1 phase that differs from the G_2 phase?

10. In eukaryotic cells, what are the two main stages of cell division?

Mitosis

11. During prophase, when cell chromosomes become visible, what are the duplicated strands of DNA called? What is the name for the area in which these duplicated strands are joined?

12. What structures are spindle fibers attached to that help pull the paired chromosomes apart?

For Questions 13–16, match the description of the event with the phase of mitosis in which it occurs. Each phase may be used more than once.

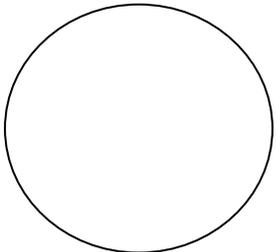
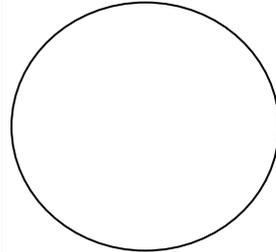
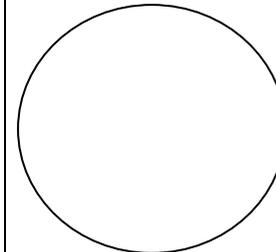
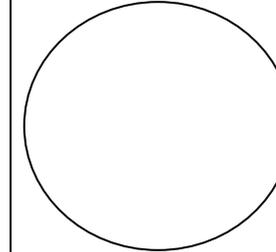
Event

- _____ 13. The chromosomes separate and begin to move to opposite sides of the cell.
- _____ 14. The chromosomes become visible. The centrioles take up positions on opposite sides of the nucleus.
- _____ 15. A nuclear envelope re-forms around each cluster of chromosomes. The nucleolus becomes visible in each daughter nucleus.
- _____ 16. The chromosomes line up across the center of the cell.

Phase of Mitosis

- A. Telophase
- B. Prophase
- C. Metaphase
- D. Anaphase

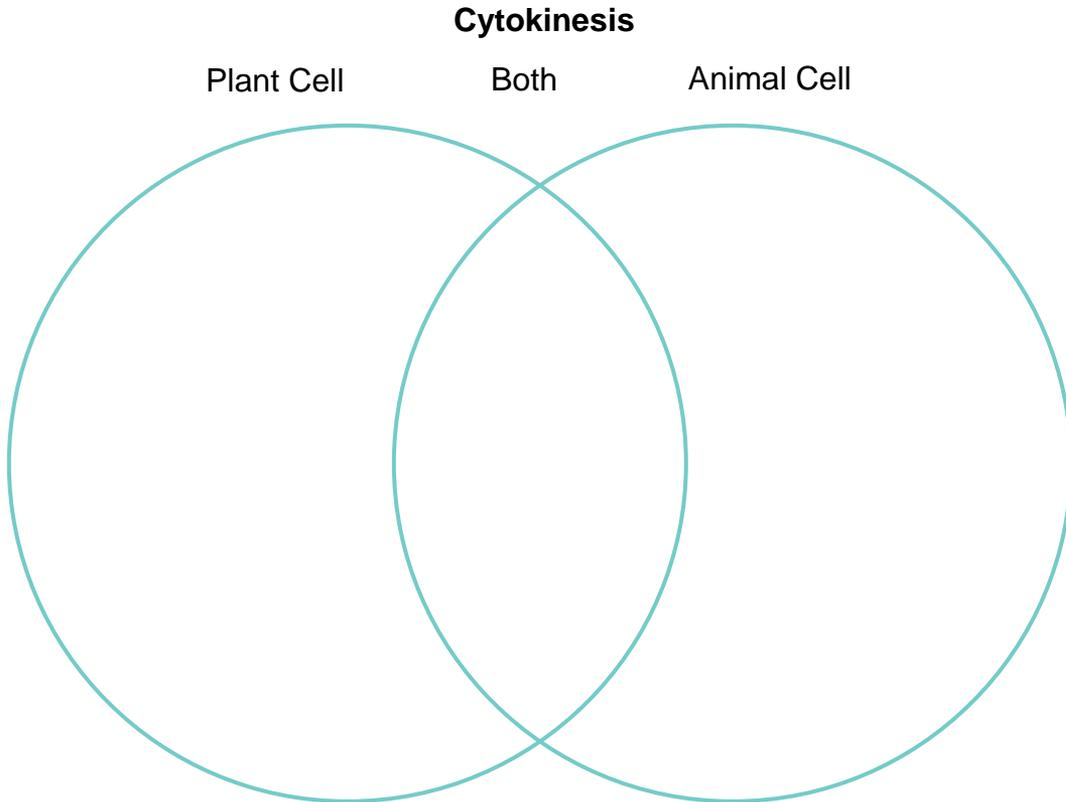
17. **THINK VISUALLY** The four circles below represent the nucleus of a cell going through mitosis. Draw four chromosomes as they go through each phase. Label each phase and describe what is happening to the DNA.

			
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Cytokinesis

18. What is cytokinesis?

19. Use the Venn diagram to compare and contrast cytokinesis in animal cells with cytokinesis in plant cells.



20. During certain stages of their life cycle, some cells repeatedly undergo mitosis but do not undergo cytokinesis. What would you expect to see if you looked at such cells, or a tissue made up of such cells, under a microscope? Explain your answer.

10.3 Regulating the Cell Cycle

Controls on Cell Division

For Questions 1–6, write *True* if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. Cells tend to continue dividing when they come into contact with other cells.
- _____ 2. Cell division speeds up when the healing process nears completion.
- _____ 3. Proteins called growth factors regulate the timing of the cell cycle in eukaryotic cells.
- _____ 4. If chromosomes have not attached to spindle fibers during metaphase, an internal regulatory protein will prevent the cell from entering anaphase.
- _____ 5. Growth factors are external regulatory proteins that slow down the cell cycle.
- _____ 6. Once apoptosis is triggered, a cell proceeds to self-destruct.

7. Complete the cause-and-effect chart by giving an example of an effect caused by each type of regulatory protein.

Factors Affecting the Cell Cycle	
Cause	Effect
Cyclins	
Internal regulatory proteins	
<i>External regulatory proteins</i>	

Cancer: Uncontrolled Cell Growth

8. What is cancer?

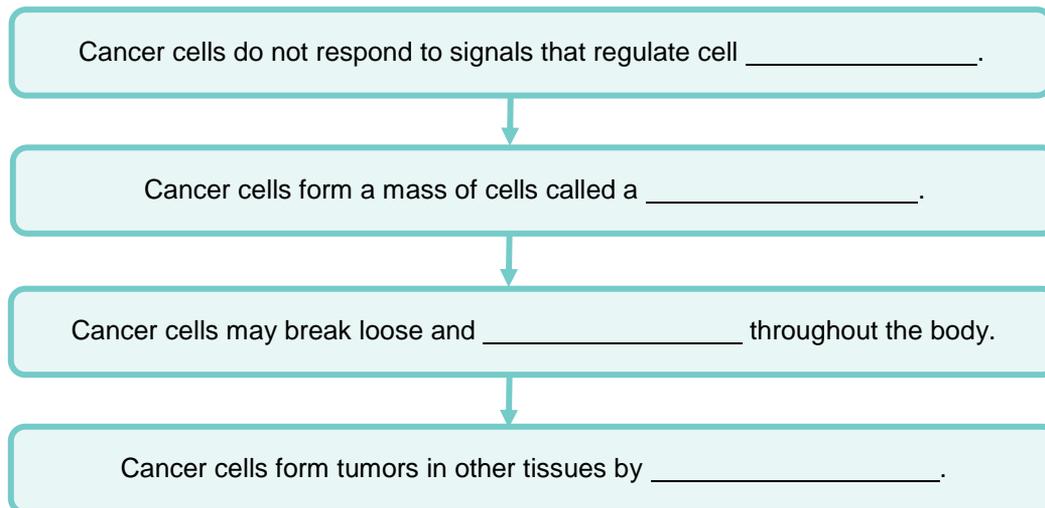
9. What are the two basic types of tumors? Explain how they are different.

10. Why can cancer be life threatening?

11. What is the cause of cancer?

12. How do radiation and chemotherapy affect cancer cells?

13. Fill out the flowchart by completing each statement with the correct word or words.



14. Hair grows from hair follicles, pockets of continually dividing cells in the outer layer of the skin. New cells are added to the base of a hair shaft, inside each follicle. Use what you have learned in this lesson to explain why cancer patients often lose their hair when receiving chemotherapy and grow more hair after chemotherapy stops.

10.4 Cell Differentiation

From One Cell to Many

For Questions 1–4, complete each statement by writing the correct word or words.

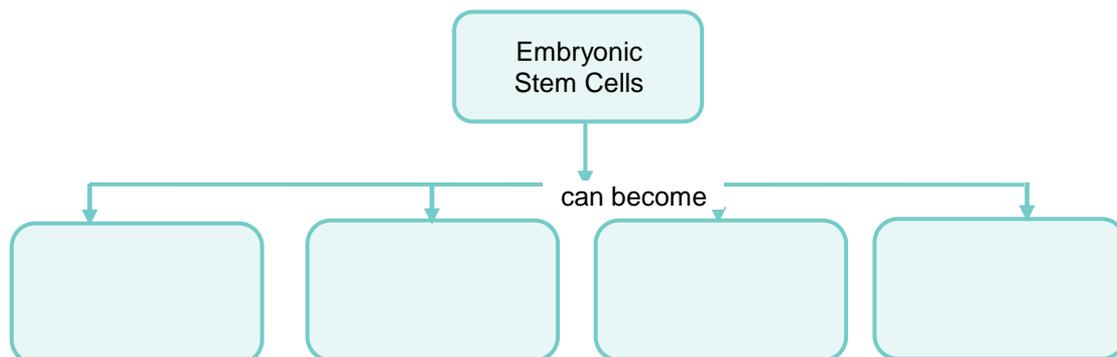
1. Humans, pets, and petunias all pass through an early stage of development called a(n) _____.
2. Cells become _____ through the process of differentiation.
3. Scientists have mapped the outcome of every _____ that leads to differentiation in the development of the microscopic worm *C. elegans*.
4. Most cells in the adult body are no longer capable of _____.

Stem Cells and Development

For Questions 5–7, write the letter of the correct answer on the line at the left.

- _____ 5. Which is an example of a totipotent cell?
- A. blastocyst
 - B. bone cell
 - C. fertilized egg
 - D. lymphocyte
- _____ 6. Cells that are pluripotent are unable to develop into the tissue that
- A. forms the skin.
 - B. lines the digestive tract.
 - C. produces blood cells.
 - D. surrounds an embryo.
- _____ 7. Adult stem cells are best described as
- A. multipotent.
 - B. pluripotent.
 - C. totipotent.
 - D. unable to differentiate.

8. Complete the concept map by identifying some of the types of cells that embryonic stem cells give rise to. Then explain how stem cells are like the stem of a plant.



Frontiers in Stem Cell Research

For Questions 9–11, write the letter of the correct answer on the line at the left.

- _____ 9. Which is not a new, potential benefit of stem cell research?
- A. growing new skin cells to repair a cut
 - B. replacing heart cells damaged by heart attacks
 - C. repairing breaks between nerve cells in spinal injuries
 - D. preventing suffering and death caused by cellular damage
- _____ 10. What is the main reason that embryonic stem cell research is considered ethically controversial?
- A. growing new skin cells to repair a cut
 - B. replacing heart cells damaged by heart attacks
 - C. repairing breaks between nerve cells in spinal injuries
 - D. preventing suffering and death caused by cellular damage
- _____ 11. What is one new technology that could make stem cell research less controversial?
- A. implanting skin cells instead of stem cells in damaged tissue
 - B. developing the ability to switch on the genes that make an adult cell pluripotent
 - C. replacing stem cells with cancer cells
 - D. using the Internet to get more people to accept stem cell research

12. Many plants such as orchids are grown by a technique called tissue culture. Small pieces of plant tissue from a leaf, stem, or root of a mature plant are placed in a medium that contains the proper nutrients. The cells first form a mass of undifferentiated cells, from which tiny roots, stems, and leaves eventually grow. How do the plant cells placed in a medium for tissue culture change in terms of their degree of specialization? What types of animal cells are most similar to the undifferentiated plant cells in a tissue culture? Explain your answer.

Chapter Vocabulary Review

1. Describe how the following terms are related to one another.

asexual reproduction, sexual reproduction: _____

binary fission, mitosis: _____

For Questions 2–5, complete each statement by writing the correct word or words.

2. _____ and growth factors are examples of regulatory proteins that control the cell cycle.

3. _____ is the controlled series of steps that lead to cell death.

4. The first few cells that form a(n) _____ are said to be _____ because they can become any type of cell.

5. The hollow ball of cells that forms in early embryonic development is called the _____.

For Questions 6–13, match the event with the phase of the cell cycle in which it takes place. A phase may be used more than once.

Event

_____ 6. A nuclear envelope forms around chromosomes.

_____ 7. The cell grows and replicates DNA.

_____ 8. A spindle forms.

_____ 9. Chromosomes line up across the center of the cell.

_____ 10. The genetic material condenses and Chromosomes become visible.

_____ 11. Chromosomes move to opposite sides of the cell.

_____ 12. The cytoplasm divides.

_____ 13. Sister chromatids separate.

Phase of the Cell Cycle

A. interphase

B. prophase

C. metaphase

D. anaphase

E. telophase

F. cytokinesis