Name_____ Grade 11
Date_____ Chapter 11

11.1 Cell Growth, Division, and Reproduction

Lesson Objectives

Explain the problems that growth causes for cells.

Compare asexual and sexual reproduction.

Lesson Summary

Limits to Cell Size There are two main reasons why cells divide:

Information "overload": The larger a cell gets, the more demands it places on its DNA. Eventually, the cell's DNA cannot meet the cell's needs.

Exchange of materials: Cells take in nutrients and eliminate wastes through the cell membrane.

- The larger a cell's volume, the more materials it needs to function and the more waste it creates.
- A cell's volume increases at a faster rate than its surface area. As a cell grows, its surface-area-to-volume ratio becomes too small.
- The larger a cell gets, the harder it is for enough materials to move across its cell membrane.

Cell division solves the information overload and materials exchange problems.

Cell Division and Reproduction Cell division is part of both types of reproduction:

Asexual reproduction:

- produces genetically identical organisms.
- occurs in many single-celled organisms and in some multicellular organisms.
- allows rapid reproduction of organisms in favorable environments.

Sexual Reproduction:

- produces organisms with genetic information from both parents.
- occurs in most animals and plants and in many single-celled organisms.
- increases genetic diversity, which aids species survival in changing environments.

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 <u>also increases</u>.

_____ 2. The amount of activity in a cell is related to its <u>volume</u>.

_____ 3. The smaller the cell, the <u>smaller</u> its ratio of surface area to volume.

_____ 4. The <u>information crisis</u> in a cell is solved by the replication of the DNA before cell division.

5. In the visual analogy of the growing town, what does the library represent? Identify two characteristics that make it a good choice for this analogy._____

_____

Cell Division and Reproduction

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

6. _____ is the formation of new individuals.

7. For single-celled organisms, cell division is a form of _____ reproduction.

8. Most multicellular organisms reproduce by _____ reproduction.

9. Use the table to compare and contrast asexual and sexual reproduction.

Asexual and Sexual Reproduction	
Similarities	Differences

10. 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.

11.2 The Process of Cell Division

Lesson Objectives

Describe the role of chromosomes in cell division.

Name the main events of the cell cycle.

Describe what happens during the four phases of mitosis.

Describe the process of cytokinesis.

Lesson Summary

Chromosomes Packages of DNA called **chromosomes** hold a cell's genetic information.

Prokaryotic chromosomes consist of a single, circular strand of DNA.

Eukaryotic chromosomes are highly organized structures.

- The DNA winds around histone proteins, forming **chromatin.**
- Chromosomes make the precise separation of DNA possible during cell division.

The Cell Cycle The **cell cycle** is the series of events in the growth and division of a cell.

In the prokaryotic cell cycle, the cell grows, duplicates its DNA, and divides by pinching in the cell membrane.

The eukaryotic cell cycle has four stages (the first three of which are referred to as **interphase**):

- In the G_1 phase, the cell grows.
- In the S phase, the cell replicates its DNA.
- In the G_2 phase, the cell produces organelles and materials for division.
- In the M phase, the cell divides in two stages—**mitosis**, the division of the nucleus, and **cytokinesis**, the division of the cytoplasm.

Mitosis The division of the nucleus, mitosis, occurs in four stages:

Prophase : a cell's genetic material condenses, a spindle starts to form, and the nuclear envelope breaks down.

Metaphase : the duplicated chromosomes line up and spindle fibers connect to the **centromeres**.

Anaphase : sister **chromatids** separate and move toward the **centrioles**.

Telophase : the chromosomes begin to unwind and a nuclear envelope reforms.

Cytokinesis: Division of the cytoplasm differs in plant cells and animal cells.

In animal cells, the cell membrane draws in and pinches off.

In plant cells, a cell plate forms, followed by a new cell membrane, and finally a new cell wall forms.

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.

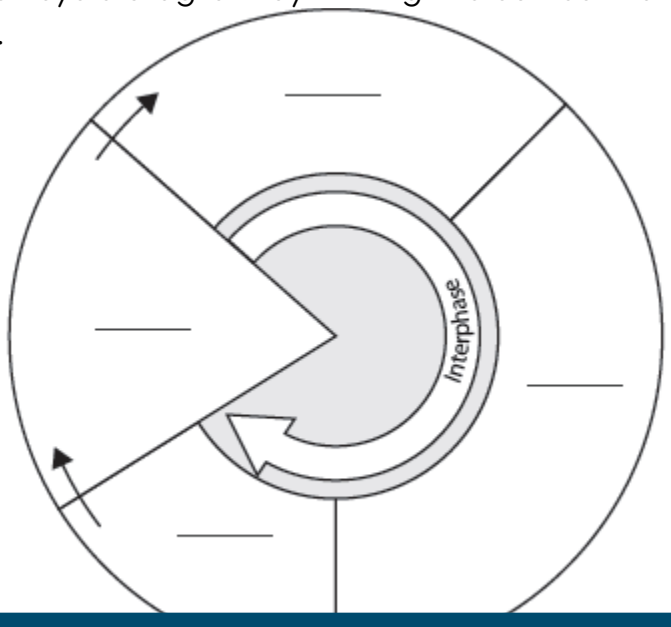
5. _____ make possible the precise separation of DNA during cell division.

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

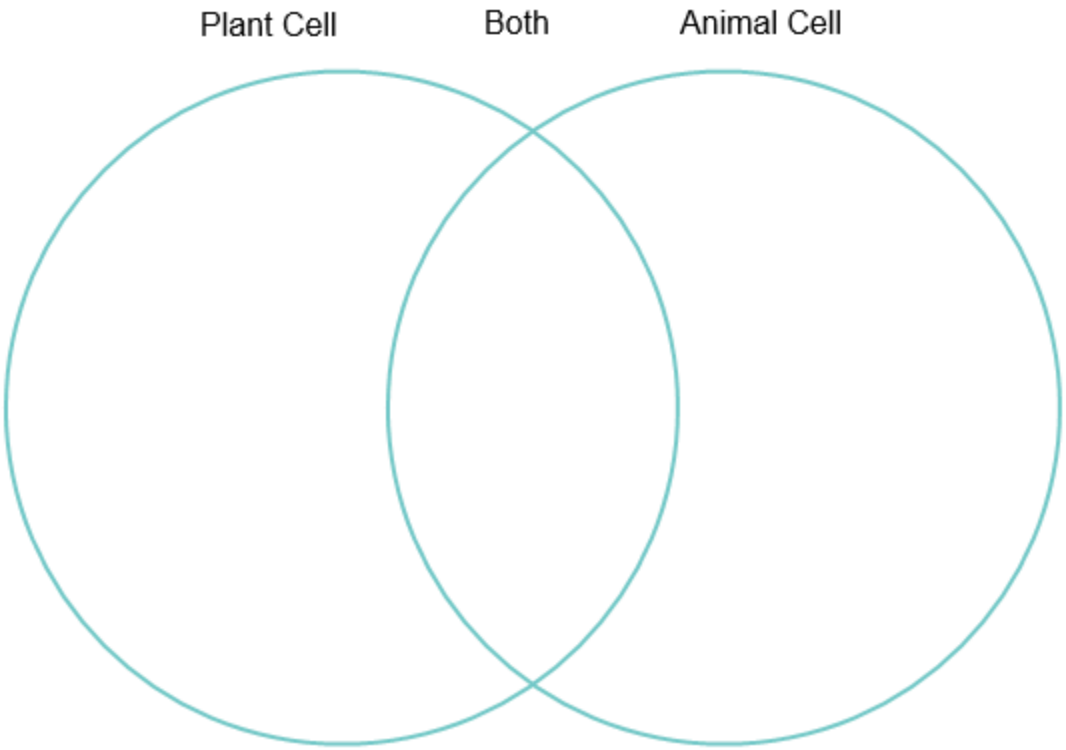
A. Telophase **B.** Prophase **C.** Metaphase **D.** Anaphase

17. Draw four circles below to 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.

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.

11.3 Regulating the Cell Cycle

Lesson Objectives

Describe how the cell cycle is regulated.

Explain how cancer cells are different from other cells.

Lesson Summary

Controls on Cell Division Dozens of proteins regulate the cell cycle.

Cyclins are proteins that regulate the timing of the cell cycle in eukaryotic cells.

Regulatory proteins work both inside and outside of the cell.

•Internal regulators allow the cell cycle to proceed when certain events have occurred within a cell.

•External regulators called growth factors stimulate the cell cycle. Other external regulators cause the cell cycle to slow down or stop.

Apoptosis is programmed cell death that plays a key role in the development of tissues and organs.

Cancer: Uncontrolled Cell Growth Cancer is a disorder in which cells divide uncontrollably, forming a mass of cells called a tumor.

Cancers are caused by defects in genes that regulate cell growth.

Treatments for cancer include:

•removal of cancerous tumors.

•radiation, which interferes with the copying of DNA in multiplying cancer cells.

•chemotherapy, which is the use of chemicals to kill cancer cells.

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 <u>continue</u> dividing when they come into contact with other cells. _____

2. Cell division <u>speeds up</u> when the healing process nears completion. _____

3. Proteins called <u>growth factors</u> 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 <u>slow down</u> the cell cycle. _____

6. Once apoptosis is triggered, a cell proceeds to <u>self-destruct</u>. _____

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

Cause	Effect
Cyclins	
Internal regulatory proteins	

External regulatory proteins	

Cancer: Uncontrolled Cell Growth

8. What is cancer?

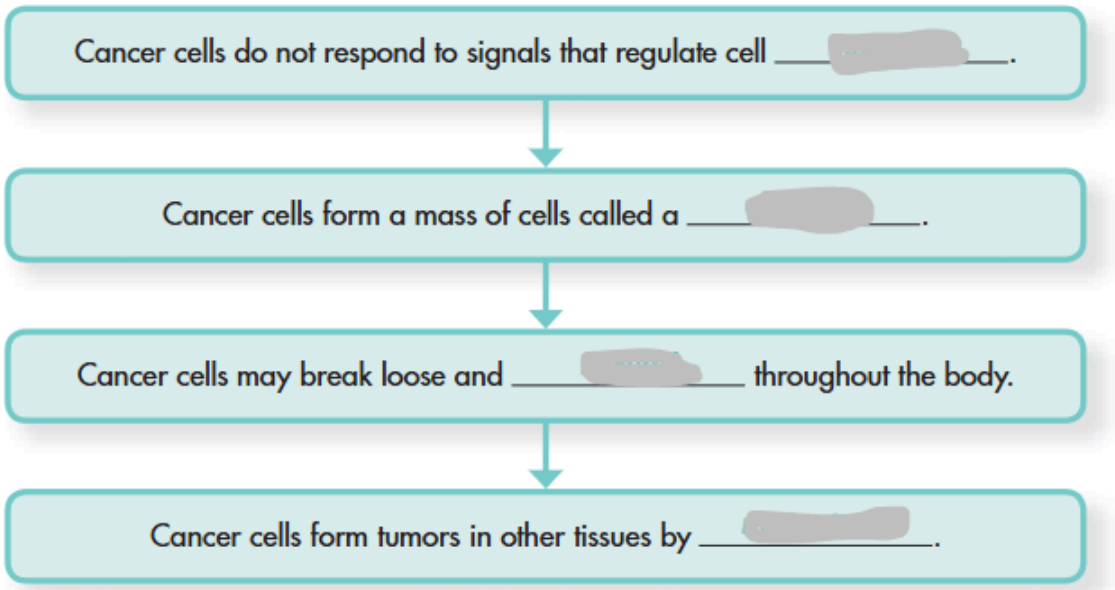
9. What are the two basic types of tumors? Explain how they are different.

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

Lesson Objectives

Describe the process of differentiation.

Define stem cells and explain their importance.

Identify the possible benefits and issues relating to stem cell research.

Lesson Summary

From One Cell to Many Multicellular organisms produced via sexual reproduction begin life as a single cell.

Early cell divisions lead to the formation of an embryo.

Then, individual cells become specialized in both form and function through the process of differentiation.

Once cells of a certain type, such as nerve cells or muscle cells, have formed, the cells cannot develop into a different type of cell.

Stem Cells and Development During an organism's development, some cells differentiate to become a wide variety of body cells.

A fertilized egg and the first few cells in an embryo are able to form any kind of cell and tissue. Such a cell is termed totipotent.

A blastocyst is an embryonic stage that consists of a hollow ball of cells. These cells are

able to become any type of body cell. Such cells are termed pluripotent.

Unspecialized cells that can develop into differentiated cells are called stem cells. Stem cells are found in embryos and in adults.

• Embryonic stem cells are the pluripotent cells of an early embryo.

• Adult stem cells are multipotent, which means they can produce many,

but not all, types of differentiated cells.

Frontiers in Stem Cell Research Scientists want to learn about the signals that tell a cell to become either specialized or multipotent.

Potential benefits of stem cell research include the repair or replacement of damaged cells and tissues.

Research with human stem cells is controversial because it involves ethical issues of life and death.

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.

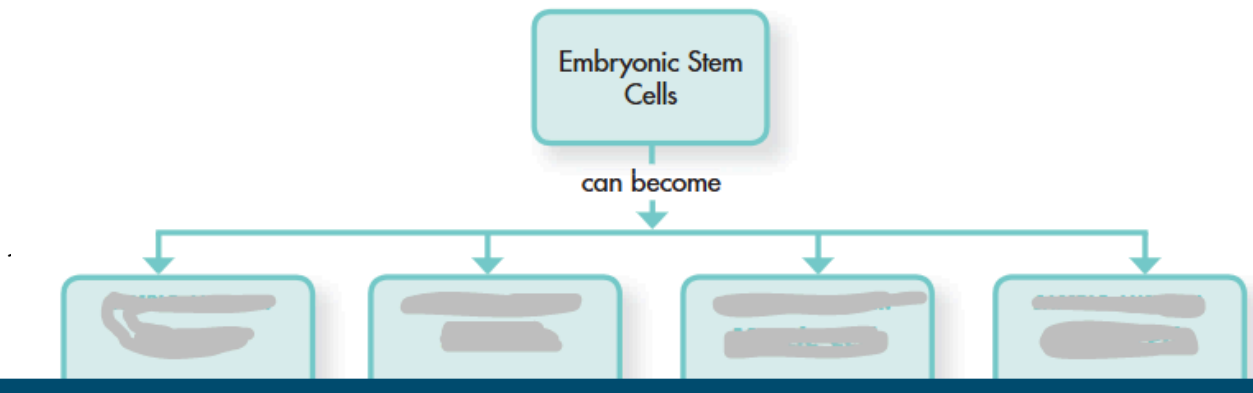
B. pluripotent.

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. Embryos contain totipotent cells.

B. Embryos are the result of sexual reproduction.

C. Embryos from many different organisms must be used.

D. Embryos are destroyed in the process.

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.