KEY CONCEPT

17.2 Cell division is part of the cell cycle.

BEFORE, you learned

- Cells come from other cells through cell division
- A cell must have a full set of genetic material to function
- Cell division enables multi-cellular organisms to develop, grow, and repair themselves

NOW, you will learn

- About two main stages in the cell cycle
- About the changes that occur in cells before mitosis
- About the events that take place during mitosis

VOCABULARY

cell cycle p. 572
interphase p. 573
mitosis p. 573
cytokinesis p. 573

THINK ABOUT

What is a cycle?

Many things in your everyday life are cycles. A cycle is any activity or set of events that regularly repeats. Cycles can be short, like the sequence of events that make your heart beat, or they can be very long, like the turning of our galaxy. One example of a cycle is shown at the right. The photographs show a tree during four seasons in a northern climate. How are these seasons a cycle?

The cell cycle includes interphase and cell division.

All living things live, grow, reproduce, and die in a process called a life cycle. The life cycle of a tree, for example, begins with a seed. Under the right conditions, the seed begins to grow. It produces a very small plant, which may grow over many years into a towering tree. When it is mature, the tree makes its own seeds, and the cycle begins again.

Cells have a life cycle too, called the cell cycle. The **cell cycle** is the normal sequence of development and division of a cell. The cell cycle consists of two main phases: one in which the cell carries out its functions, called interphase, and one in which the cell divides, which can include mitosis and cytokinesis. All cells divide, but only eukaryotes undergo mitosis. Each phase in the cell cycle requires a certain period of time—from hours to days or years, depending on the type of cell.

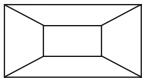
RESOURCE CENTER
CLASSZONE.COM
Learn about the cell cycle.

Interphase

Interphase is the part of the cell cycle during which a cell is not dividing. Much activity takes place in this phase of the cell's life. During interphase, the cell grows to about twice the size it was when it was first produced. The cell also engages in normal life activities, such as transporting materials in and transporting wastes out. Also, cellular respiration occurs, which provides the energy the cell needs.

Changes that occur during interphase prepare a cell for division. Before a cell can divide, it duplicates its DNA exactly. Correct copying of the DNA is very important. It ensures that, after cell division, each new cell gets a complete set of DNA.

VOCABULARY
Make a frame game diagram for *interphase*.



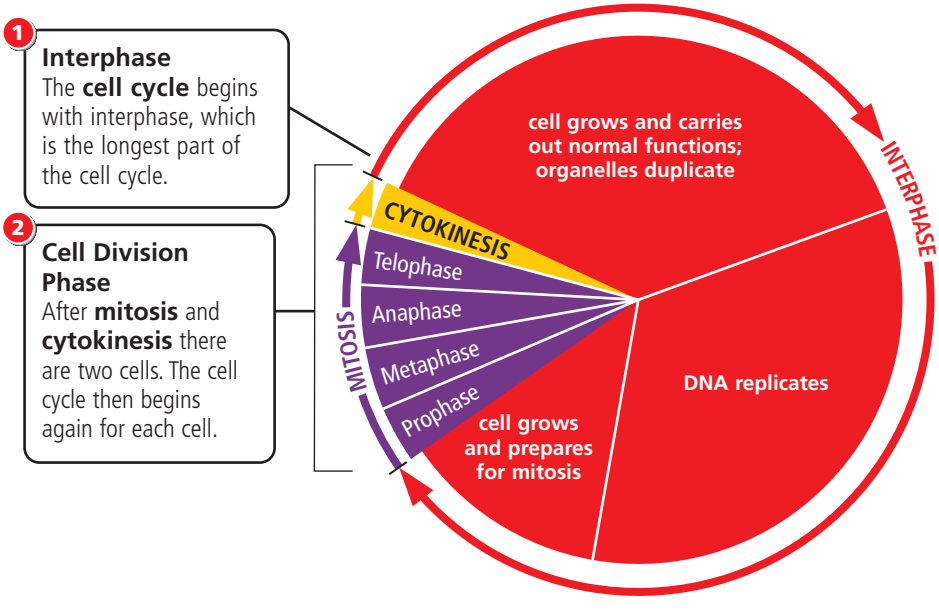
CHECK YOUR READING What cell processes occur during interphase?

Cell Division Phase

Mitosis is the part of the cell cycle during which the nucleus divides. Prokaryotes do not undergo mitosis because they have no nucleus. In most cells, mitosis is the shortest period in the life cycle. The function of mitosis is to move the DNA and other material in the parent cell into position for cell division. When the cell divides, each new cell gets a full set of DNA and other cell structures. **Cytokinesis** (SY-toh-kuh-NEE-sihs) is the division of the parent cell's cytoplasm. Cytokinesis occurs immediately after mitosis.

Cell Cycle

The events that happen during the life of a cell are called the cell cycle.



READING TIP
The arrows in the Cell Cycle diagram represent the passage of time. Interphase is in red, mitosis is in purple, and cytokinesis is in yellow.

As a result of mitosis and cytokinesis, the original—or parent—cell splits into two genetically identical daughter cells. In this case, the term *daughter cell* does not imply gender. It is a term scientists use to refer to these new cells. Each daughter cell receives a complete set of DNA from the parent cell.

Cell division produces two genetically identical cells.

COMBINATION NOTES
As you read, begin to take combination notes on the main idea: *Cell division produces two genetically identical cells.*

Recall that many cells in your body are continually dividing into new cells. The new cells help your body grow, develop, repair itself, and replace worn-out parts. Though your body cells divide at different rates, the same process—mitosis—divides their genetic material.

Cell division produces daughter cells that are genetically identical to each other, as well as to their parent cell, which no longer exists. Being genetically identical to their parent cell helps the new cells function properly. A skin cell, for example, divides and produces skin cells genetically identical to it.

CHECK YOUR READING How are daughter cells like the parent cell?

Steps of Mitosis

VISUALIZATION CLASSZONE.COM
Watch the process of mitosis in action.

The process of mitosis is essential in evenly dividing the genetic material between the daughter cells. Although mitosis is a continuous process, scientists divide the events of mitosis into four phases.

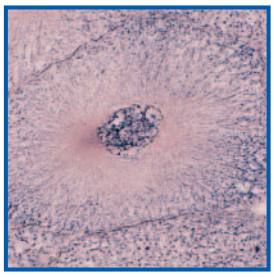
1. **Chromosomes form.** During prophase, the DNA in the nucleus of a cell condenses and becomes visible under a light microscope. Each chromosome consists of two identical chromatids held together by a centromere. The membrane around the nucleus disappears.
2. **Chromosomes line up.** The chromosomes line up in the middle of the cell. This stage is called metaphase.
3. **Chromosomes separate.** During the stage called anaphase, the chromatids split, resulting in two separate identical chromosomes. These chromosomes are pulled to opposite sides of the cell.
4. **Nuclei form.** A new nuclear membrane forms around each group of chromosomes during telophase. The chromosomes return to their threadlike form.

Mitosis is finished, and the cell's genetic material has been divided. Following telophase the parent cell's cytoplasm is divided to complete the parent cell's division into two entirely separate daughter cells.

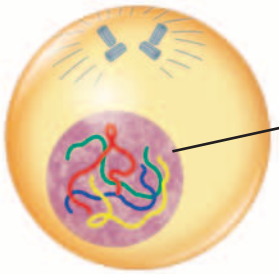
Cell Division

Before mitosis, the cell's DNA is copied during interphase.

Interphase



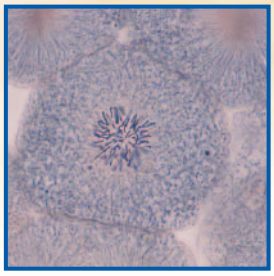
The cell has grown and is ready to divide.



The nucleus contains two complete copies of DNA.

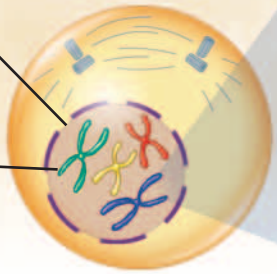
Mitosis produces two new cells with identical copies of DNA.

1 Chromosomes condense.
Prophase

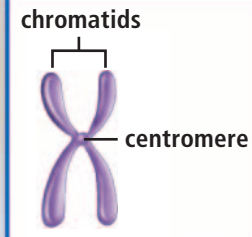


The nuclear membrane disappears.

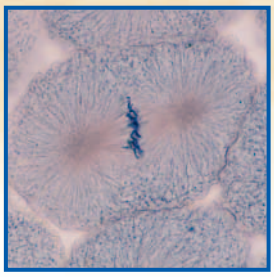
Long strands of DNA condense to distinct chromosomes, each with two chromatids that are exact copies of each other.

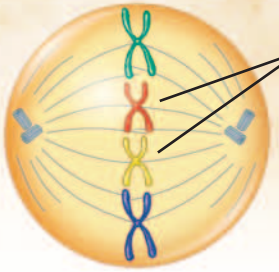


Chromosome



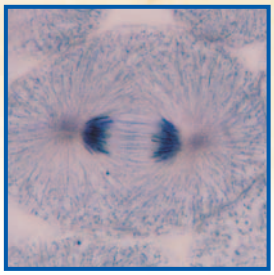
2 Chromosomes line up.
Metaphase



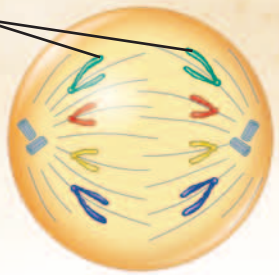


Chromosomes line up in the middle of the cell.

3 Chromosomes separate.
Anaphase

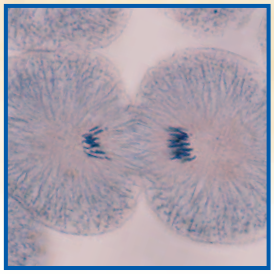


Chromatids of each chromosome split into two separate chromosomes.

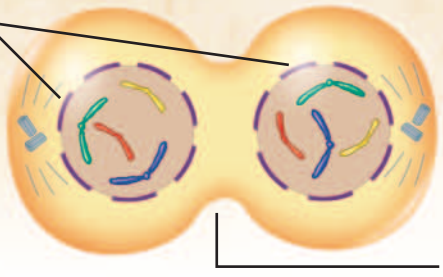


Separated chromosomes pull to the opposite ends of the cell.

4 Nuclei form.
Telophase, Cytokinesis



New nuclear membranes form.



Cell pinches and divides

Division of the Cytoplasm

READING TiP
As you read about cytokinesis refer to the images of plant and animal cells on page 577.

Cytokinesis, or the division of the parent cell's cytoplasm, immediately follows mitosis in eukaryotic cells. Cytokinesis differs slightly in animal cells and plant cells.

During cytokinesis in an animal cell, a fiber ring forms in the center of the dividing cell. The fiber ring contracts, pulling the cell membrane inward. Eventually, the cell is pinched into two daughter cells.

In a plant cell, the cell wall prevents the cell membrane from being pulled inward. A structure called a cell plate grows between the two new nuclei. The cell plate develops into a membrane and eventually becomes part of the cell wall of each of the new cells.

CHECK YOUR READING How does cytokinesis differ in plant cells and animal cells?

INVESTIGATE Cell Division

How can you model mitosis?

PROCEDURE

1. Divide the poster board into six spaces, and draw arrows from one space to the next to indicate a cycle. Label the spaces, in order, "Interphase," "Prophase," "Metaphase," "Anaphase," "Telophase," and "Cytokinesis."
2. In each space, make a model of a cell and its DNA in the indicated phase. Make sure you represent the cell membrane, the nuclear membrane—when it is present—and the DNA.

WHAT DO YOU THINK?

- In which phases is the nuclear membrane present?
- In which phases are the chromosomes condensed?
- What do the arrows in your model show?

CHALLENGE How do you think cell division would differ in prokaryotic cells? Do you think cell division in prokaryotic cells would be more or less complex than in eukaryotic cells? Make drawings to show how you think a prokaryotic cell might divide.

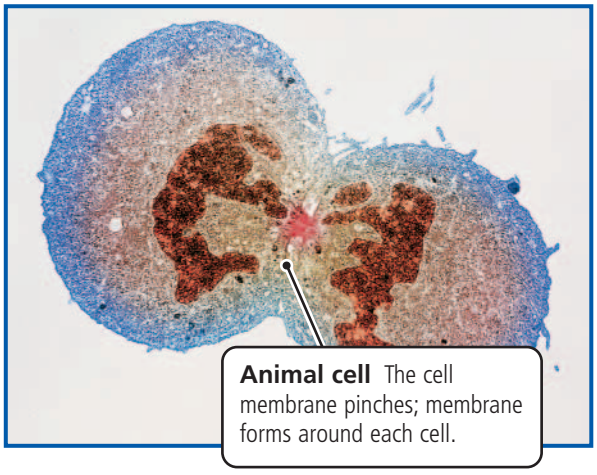
SKILL FOCUS
Making models

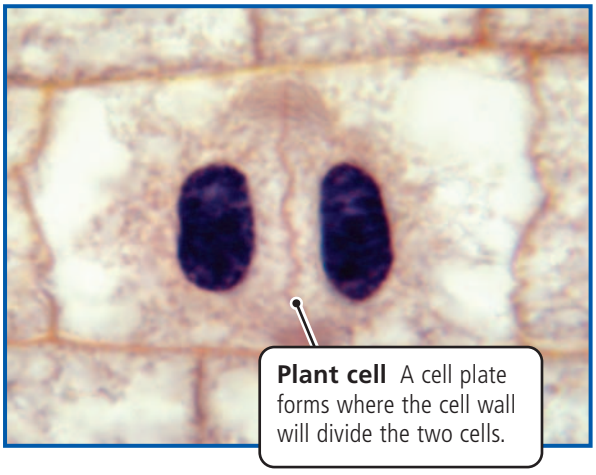
MATERIALS
- poster board
- markers
- pipe cleaners
- packing peanuts
- glue
- scissors
- yarn

TIME
30 minutes

Cytokinesis

Cytokinesis happens in both plant and animal cells.





READING VISUALS **COMPARE AND CONTRAST** How does the process of cytokinesis in the animal cell on the left differ from that of the plant cell on the right?

The two daughter cells are now completely separated. Each is surrounded by a cell membrane. Each daughter cell has some of its parent cell's cytoplasm. Though daughter cells are genetically identical to their parent cell, they are smaller. After division, cells may enter a period of growth, during which they take in the resources they need to increase the amount of their cytoplasm and to grow to full size. When cells are fully grown, they are about the same size as the parent cell was before division.

CHECK YOUR READING What happens to cells after cytokinesis?

17.2 Review

KEY CONCEPTS

1. What are the two main parts of the cell cycle?
2. Describe the state of a cell about to start mitosis.
3. How is the genetic material in two daughter cells similar to the genetic material in a parent cell?

CRITICAL THINKING

4. **Sequence** Describe in order the steps that occur during mitosis.
5. **Compare and Contrast** How is cytokinesis in plant cells similar to cytokinesis in animal cells? How is it different?

CHALLENGE

6. **Infer** You know that mitosis does not happen in prokaryotes. Do you think cytokinesis happens in prokaryotes? Explain your answer.