



Cellular Reproduction

section 9 Mitosis and Cytokinesis



Biology/Life Sciences 1.c Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure. **Also covers: Biology/Life Sciences 1.a, 1.j**

MAIN Idea

Eukaryotic cells reproduce by mitosis and cytokinesis.

What You'll Learn

- the events of each stage of mitosis
- the process of cytokinesis

● Before You Read

Recall the last time you got a cut. Skin heals itself with the help of cell division. Skin cells divide, creating new cells to replace the damaged cells. On the lines below, list some other times when your body might need to create new cells. In this section, you will read about two ways that cells reproduce.



Identify Details As you read, highlight or underline the events of each stage of mitosis.

● Read to Learn

Mitosis

You learned in the last section that the life cycle of a cell has three stages: interphase, mitosis, and cytokinesis. Recall that during interphase, the cell copies its DNA in preparation for cell division. Mitosis follows interphase. During mitosis the two identical copies of DNA separate. Each copy will become part of a new cell, called a daughter cell. Daughter cells are genetically identical because they each have the same DNA.

Mitosis increases the number of cells as a young organism grows to its adult size. Mitosis also replaces damaged cells, such as skin cells that are damaged when you get a cut.

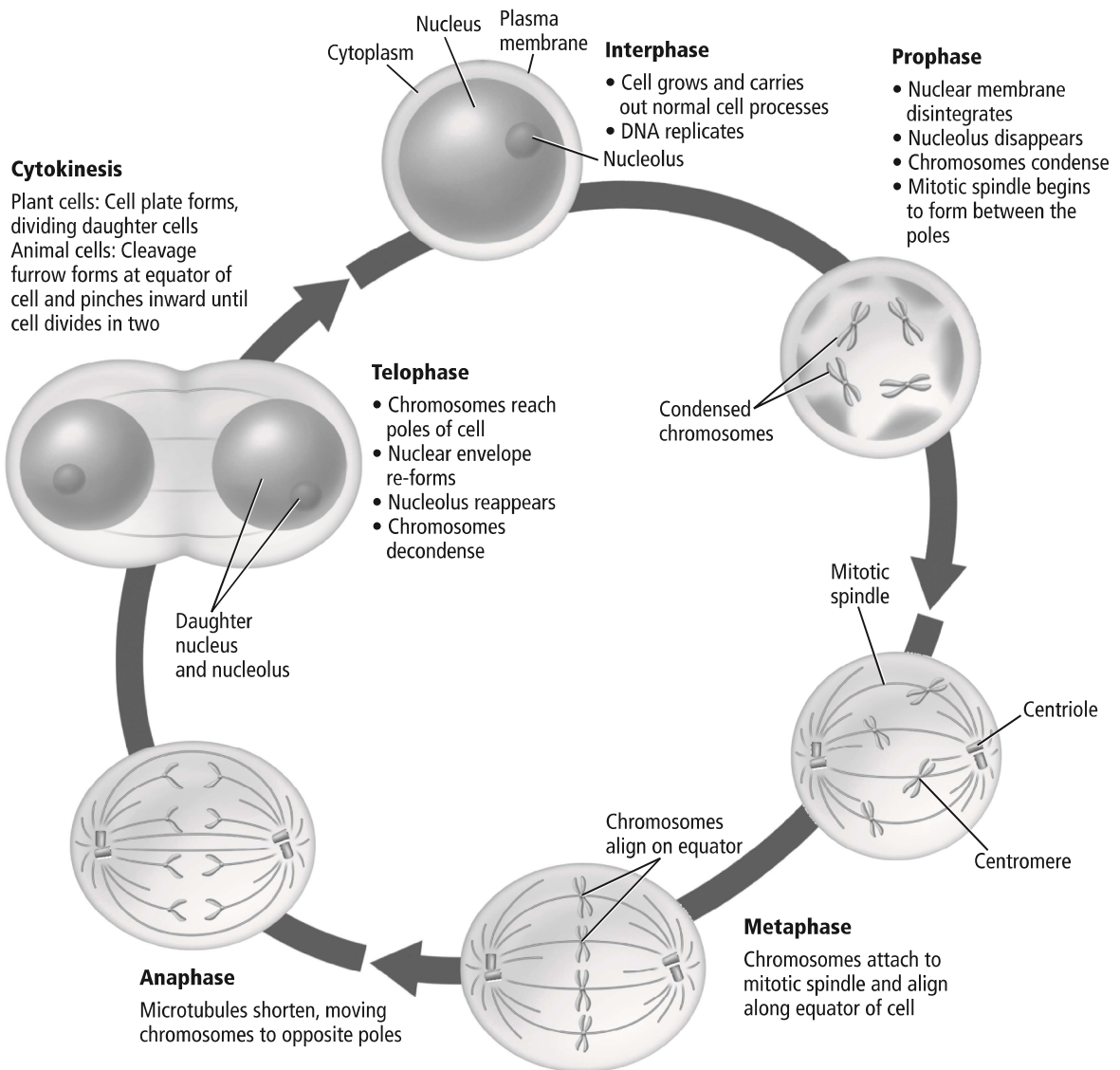
The Stages of Mitosis

Like interphase, mitosis is divided into stages. These four stages are prophase, metaphase, anaphase, and telophase. The figure on the next page shows the four stages of mitosis. Follow the diagram as you read about each stage.

✓ Reading Check

- Name** What is one function of mitosis in a multicellular organism?

Stages of Mitosis



What happens during prophase?

The first and longest stage of mitosis is called **prophase**. Before prophase, DNA is in a relaxed, or unwound, form known as chromatin. During prophase, chromatin becomes tightly wound, or condenses, into chromosomes.

During prophase, each chromosome is X-shaped. The left half of the X is one copy of DNA. The right half is the other identical copy. Each half of the X is a **sister chromatid** containing identical copies of DNA. The sister chromatids are attached at the center of the chromosome by a structure called the **centromere**. The centromere ensures that a complete copy of the DNA copy becomes part of the daughter cell at the end of the cell cycle. ✓

Picture This

- 2. Label** Circle the picture that shows the sister chromatids being pulled to opposite ends of the cell.

✓ Reading Check

- 3. Identify** How are the sister chromatids attached?

What happens at the end of prophase?

As prophase continues, the nucleolus seems to disappear. Structures called spindle fibers form in the cytoplasm. In animal and protist cells, centrioles migrate to the ends, or poles, of the cell. Star-shaped aster fibers come out of the centrioles. Spindle fibers, centrioles, and aster fibers are all made of microtubules. These structures form the **spindle apparatus** which helps move and organize the chromosomes before cell division. Centrioles are not present in plant cells.

As prophase ends, the nuclear envelope disappears. The spindle fibers attach to the sister chromatids of each chromosome on both sides of the centromere and attach to opposite poles of the cell. One spindle fiber connects the centromere to one pole of the cell. The other spindle fiber connects the centromere to the opposite pole of the cell. This ensures that each new cell gets one copy of the DNA.

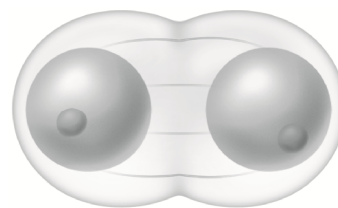
How are the chromosomes arranged?

During the second stage of mitosis, **metaphase**, the chromatids are pulled by motor proteins along the spindle apparatus toward the center of the cell. The chromatids line up in the middle, or the equator, of the cell. If metaphase is completed successfully, each daughter cell will have a copy of each chromosome. ✓

During **anaphase**, the chromatids are pulled apart. The microtubules of the spindle apparatus begin to shorten and pull at the centromere of each sister chromatid to separate into two identical chromosomes. At the end of anaphase, the microtubules move each identical chromosome toward the poles of the cell.

What happens during telophase?

Telophase is the final stage of mitosis. During **telophase**, the chromosomes arrive at the poles of the cell and begin to relax, changing back into chromatin. Two new nuclear membranes form around each set of chromosomes, the nucleoli reappear, and the spindle apparatus is taken apart, as shown below.



✓ Reading Check

4. Describe What happens to the chromatids during metaphase?

Picture This

5. Identify What does the cell still need to do at the end of telophase?

Cytokinesis

Near the end of mitosis, cytokinesis begins. During cytokinesis, the cytoplasm divides. The result of cytokinesis is two daughter cells, each with an identical nucleus.

What is the result of cytokinesis?

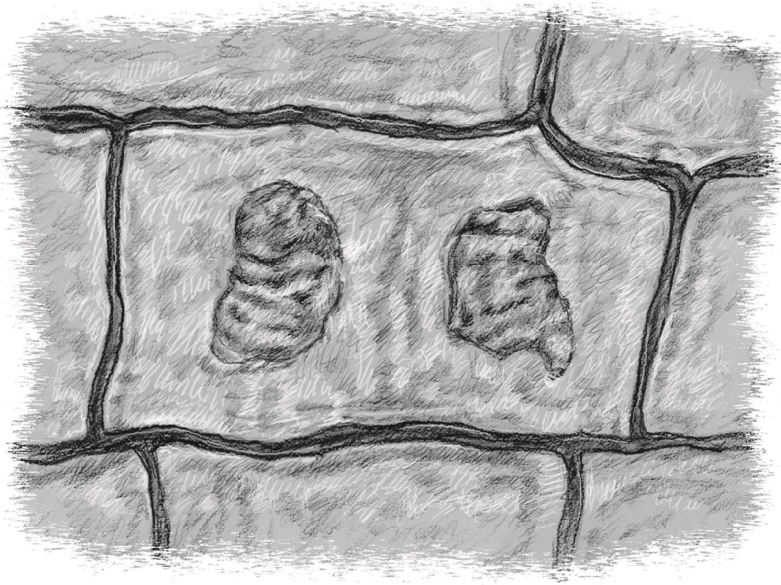
In animal cells, cytokinesis is accomplished by using microtubules to constrict, or pinch, the cytoplasm of the cell in half. The cell splits into two daughter cells. ✓

How is cytokinesis different in plant cells?

Plant cells complete cell division a different way, as shown in the figure below. Recall that plant cells are surrounded by a rigid cell wall. During cytokinesis, plant cells form a new structure, called the cell plate, between the two daughter nuclei. New cell walls then form on either side of the cell plate, dividing the cell into two identical daughter cells.

How is cell division different in prokaryotic cells?

Prokaryotic cells undergo cell division in a different way. Recall that prokaryotic cells divide by a process known as binary fission. When prokaryotic DNA is copied, both identical copies of DNA attach to the plasma membrane. As the plasma membrane grows, the attached DNA molecules are pulled apart. The cell completes fission, producing two new prokaryotic cells.



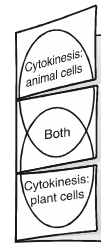
✓ Reading Check

6. **Name** the cell structure that pinches the cytoplasm in half.

FOLDABLES™

Compare and Contrast

Make a Venn diagram Foldable, as shown below. As you read, compare and contrast cytokinesis in plant and animal cells.



Picture This

7. **Identify** What features in the figure can you use to identify this cell as a plant cell?

