

READING WARM-UP

Objectives

- Explain how cells produce more cells.
- Describe the process of mitosis.
- Explain how cell division differs in animals and plants.

Terms to Learn

cell cycle
 chromosome
 homologous chromosomes
 mitosis
 cytokinesis

READING STRATEGY

Paired Summarizing Read this section silently. In pairs, take turns summarizing the material. Stop to discuss ideas that seem confusing.

cell cycle the life cycle of a cell

chromosome in a eukaryotic cell, one of the structures in the nucleus that are made up of DNA and protein; in a prokaryotic cell, the main ring of DNA

The Cell Cycle

In the time that it takes you to read this sentence, your body will have made millions of new cells! Making new cells allows you to grow and replace cells that have died.

The environment in your stomach is so acidic that the cells lining your stomach must be replaced every few days. Other cells are replaced less often, but your body is constantly making new cells.

The Life of a Cell

As you grow, you pass through different stages in life. Your cells also pass through different stages in their life cycle. The life cycle of a cell is called the **cell cycle**.

The cell cycle begins when the cell is formed and ends when the cell divides and forms new cells. Before a cell divides, it must make a copy of its deoxyribonucleic acid (DNA). DNA is the hereditary material that controls all cell activities, including the making of new cells. The DNA of a cell is organized into structures called **chromosomes**. Copying chromosomes ensures that each new cell will be an exact copy of its parent cell. How does a cell make more cells? It depends on whether the cell is prokaryotic (with no nucleus) or eukaryotic (with a nucleus).

Making More Prokaryotic Cells

Prokaryotic cells are less complex than eukaryotic cells are. Bacteria, which are prokaryotes, have ribosomes and a single, circular DNA molecule but don't have membrane-enclosed organelles. Cell division in bacteria is called *binary fission*, which means "splitting into two parts." Binary fission results in two cells that each contain one copy of the circle of DNA. A few of the bacteria in **Figure 1** are undergoing binary fission.

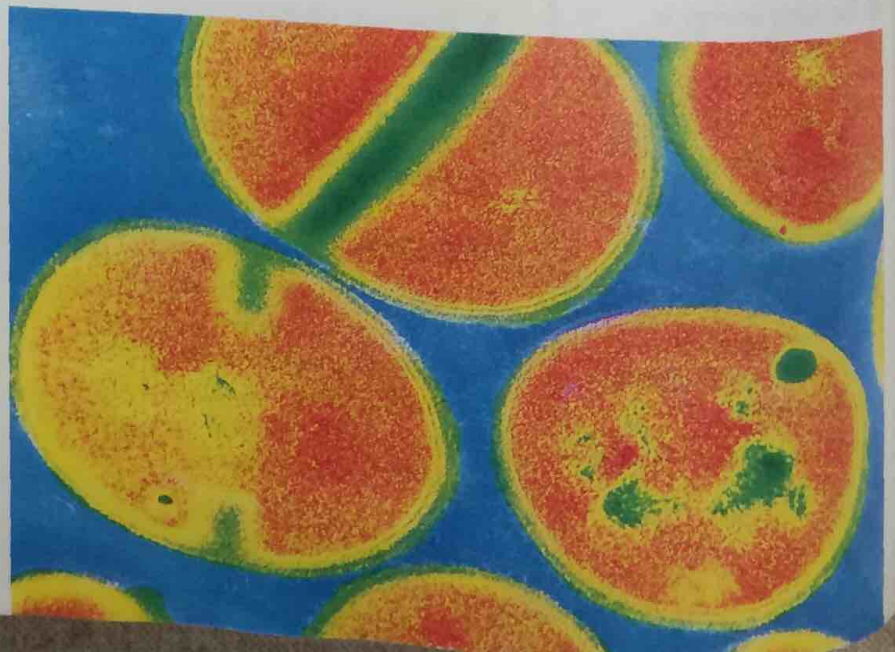


Figure 1 Bacteria reproduce by binary fission.

Eukaryotic Cells and Their DNA

Eukaryotic cells are more complex than prokaryotic cells are. The chromosomes of eukaryotic cells contain more DNA than those of prokaryotic cells do. Different kinds of eukaryotes have different numbers of chromosomes. More-complex eukaryotes do not necessarily have more chromosomes than simpler eukaryotes do. For example, fruit flies have 8 chromosomes, potatoes have 48, and humans have 46.

Figure 2 shows the 46 chromosomes of a human body cell lined up in pairs. These pairs are made up of similar chromosomes known as **homologous chromosomes** (hoh MAHL uh guhs KROH muh SOHMZ).

Reading Check Do more-complex organisms always have more chromosomes than simpler organisms do? (See the Appendix for answers to Reading Checks.)

Making More Eukaryotic Cells

The eukaryotic cell cycle includes three stages. In the first stage, called *interphase*, the cell grows and copies its organelles and chromosomes. After each chromosome is duplicated, the two copies are called *chromatids*. Chromatids are held together at a region called the *centromere*. The joined chromatids twist and coil and condense into an X shape, as shown in **Figure 3**. After this step, the cell enters the second stage of the cell cycle.

In the second stage, the chromatids separate. The complicated process of chromosome separation is called **mitosis**. Mitosis ensures that each new cell receives a copy of each chromosome. Mitosis is divided into four phases, as shown on the following pages.

In the third stage, the cell splits into two cells. These cells are identical to each other and to the original cell.

Figure 3 This duplicated chromosome consists of two chromatids. The chromatids are joined at the centromere.

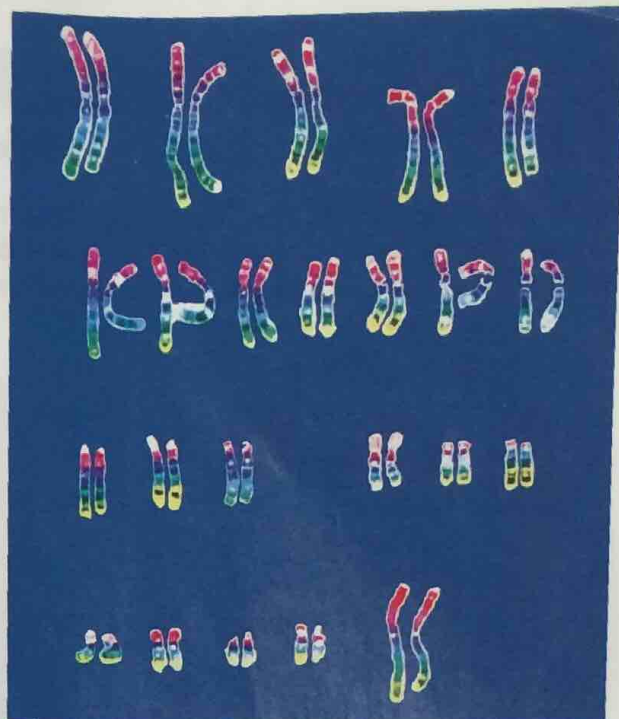
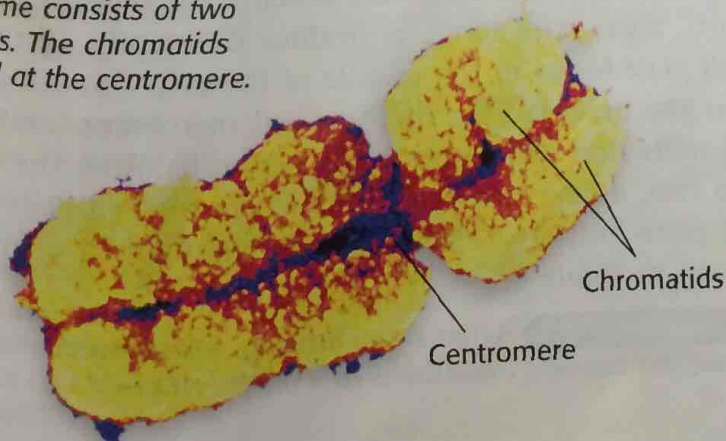


Figure 2 Human body cells have 46 chromosomes, or 23 pairs of chromosomes.

homologous chromosomes

chromosomes that have the same sequence of genes and the same structure

mitosis in eukaryotic cells, a process of cell division that forms two new nuclei, each of which has the same number of chromosomes

CONNECTION TO Language Arts

Picking Apart Vocabulary

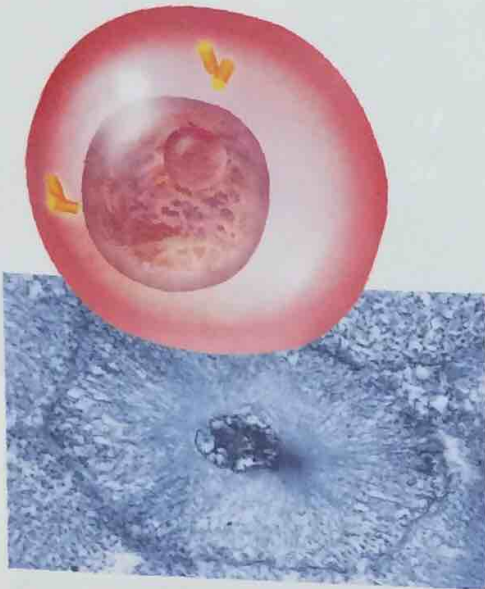
Brainstorm what words are similar to the parts of the term *homologous chromosome*. What can you guess about the meaning of the term's root words? Look up the roots of the words, and explain how they help describe the concept.

ACTIVITY

Figure 4 The Cell Cycle

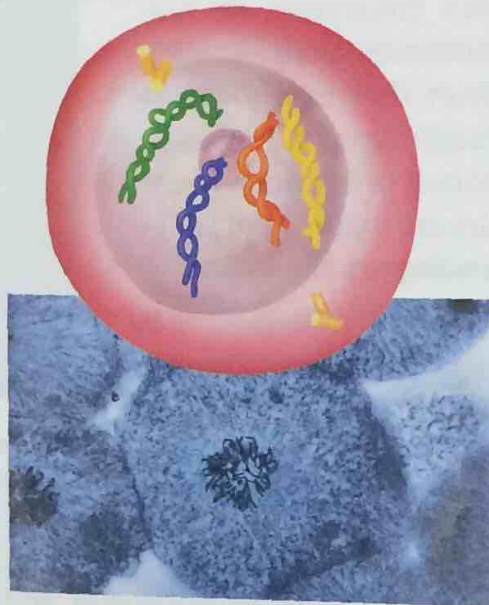
Copying DNA (Interphase)

Before mitosis begins, chromosomes are copied. Each chromosome is then two chromatids.



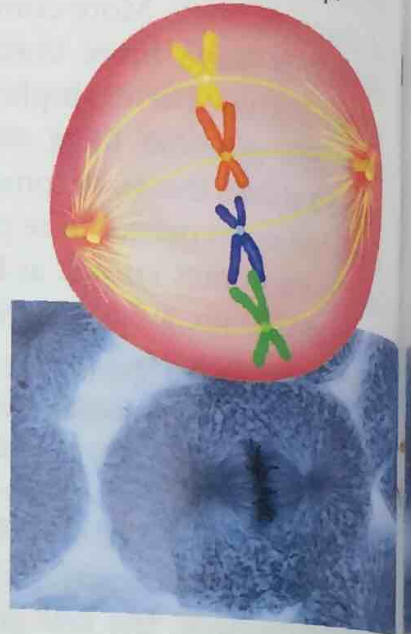
Mitosis Phase 1 (Prophase)

Mitosis begins. The nuclear membrane dissolves. Chromosomes condense into rodlike structures.



Mitosis Phase 2 (Metaphase)

The chromosomes line up along the equator of the cell. Homologous chromosomes pair up.



cytokinesis the division of the cytoplasm of a cell

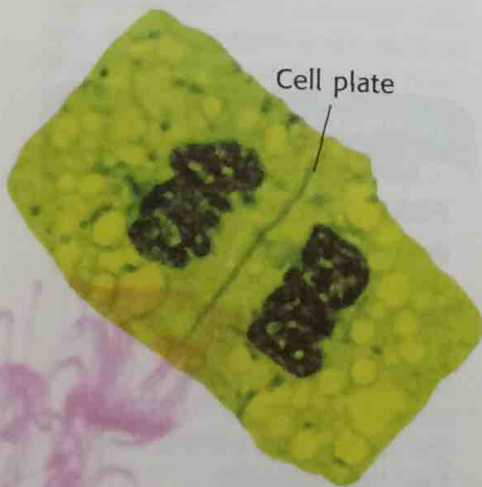


Figure 5 When a plant cell divides, a cell plate forms and the cell splits into two cells.

Mitosis and the Cell Cycle

Figure 4 shows the cell cycle and the phases of mitosis in an animal cell. Mitosis has four phases that are shown and described above. This diagram shows only four chromosomes to make it easy to see what's happening inside the cell.

Cytokinesis

In animal cells and other eukaryotes that do not have cell walls, division of the cytoplasm begins at the cell membrane. The cell membrane begins to pinch inward to form a groove, which eventually pinches all the way through the cell, and two daughter cells form. The division of cytoplasm is called **cytokinesis** and is shown at the last step of **Figure 4**.

Eukaryotic cells that have a cell wall, such as the cells of plants, algae, and fungi, reproduce differently. In these cells, a **cell plate** forms in the middle of the cell. The cell plate contains the materials for the new cell membranes and the new cell walls that will separate the new cells. After the cell splits into two, a new cell wall forms where the cell plate was. The cell plate and a late stage of cytokinesis in a plant cell are shown in **Figure 5**.

Reading Check What is the difference between cytokinesis in an animal cell and cytokinesis in a plant cell?

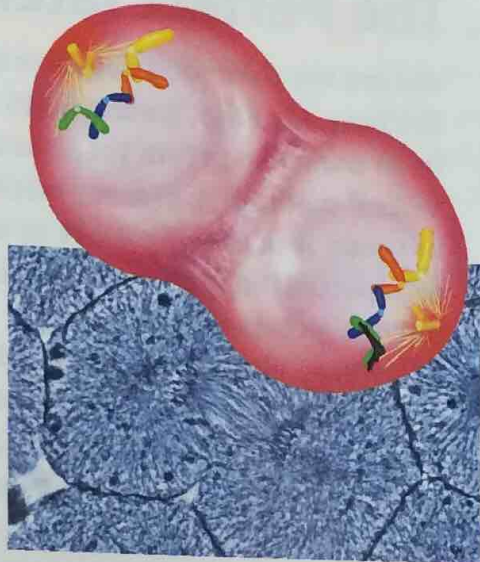
Mitosis Phase 3 (Anaphase)

The chromatids separate and move to opposite sides of the cell.



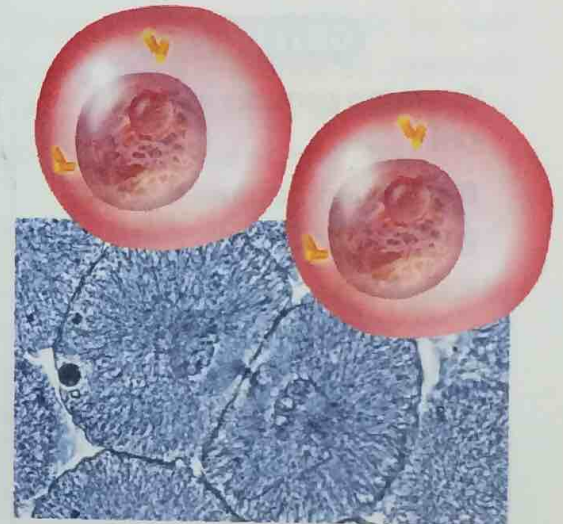
Mitosis Phase 4 (Telophase)

A nuclear membrane forms around each set of chromosomes, and the chromosomes unwind. Mitosis is complete.



Cytokinesis

In cells that lack a cell wall, the cell pinches in two. In cells that have a cell wall, a cell plate forms between the two new cells.



SECTION Review

Summary

- A cell produces more cells by first copying its DNA.
- Eukaryotic cells produce more cells through the four phases of mitosis.
- Mitosis produces two cells that have the same number of chromosomes as the parent cell.
- At the end of mitosis, a cell divides the cytoplasm by cytokinesis.
- In plant cells, a cell plate forms between the two new cells during cytokinesis.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *cell cycle* and *cytokinesis*.

Understanding Key Ideas

2. Eukaryotic cells
 - a. do not divide.
 - b. undergo binary fission.
 - c. undergo mitosis.
 - d. have cell walls.
3. Why is it important for chromosomes to be copied before cell division?
4. Describe mitosis.

Math Skills

5. Cell A takes 6 h to complete division. Cell B takes 8 h to complete division. After 24 h, how many more copies of cell A would there be than cell B?

Critical Thinking

6. **Predicting Consequences** What would happen if cytokinesis occurred without mitosis?
7. **Applying Concepts** How does mitosis ensure that a new cell is just like its parent cell?
8. **Making Comparisons** Compare the processes that animal cells and plant cells use to make new cells. How are the processes different?

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Topic: Cell Cycle

SciLinks code: HSM0235