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CHAPTER 5 The Cell in Action

SECTION 2

The Cell Cycle

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How are new cells made?
- What is mitosis?
- What happens when cells divide too quickly?

California Science Standards

7.1.b, 7.1.e, 7.2.e

How Are New Cells Made?

As you grow, you pass through different stages in your life. Cells also pass through different stages in their life cycle. These stages are called the **cell cycle**. The cell cycle starts when a cell is made, and ends when the cell divides to make new cells.

Before a cell divides, it makes a copy of its DNA (deoxyribonucleic acid). *DNA* is the molecule that contains all the instructions for making new cells. The DNA is stored in structures called **chromosomes**. The chromosomes are copied to make sure that each new cell has all the DNA of the parent cell. Although all cells pass through a cell cycle, the process differs in prokaryotic and eukaryotic cells. ☑

STUDY TIP

Summarize As you read this section, make a diagram showing the stages of the eukaryotic cell cycle.

READING CHECK

1. Explain What must happen before a cell can divide?

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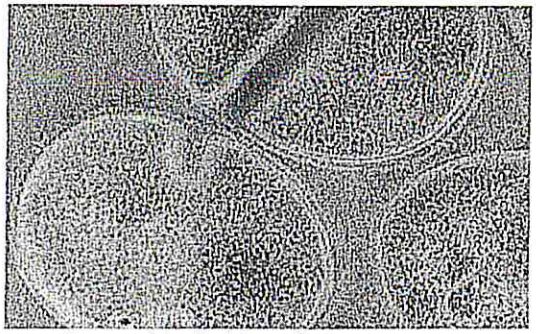
How Do Prokaryotic Cells Divide?

Prokaryotes are made of only one cell. Prokaryotic cells have no nucleus. They also have no organelles that are surrounded by membranes. The DNA for prokaryotic cells, such as bacteria, is found on one circular chromosome. The cell divides by a simple process called *binary fission*. Binary fission splits the cell into two parts. Each part has one copy of the cell's DNA.



Bacteria reproduce by binary fission.

TAKE A LOOK

2. Complete Prokaryotic cells divide by _____

_____.

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How Do Eukaryotic Cells Divide?

Cell division in eukaryotic cells is more complex than in prokaryotic cells. The cell cycle of a eukaryotic cell has three stages: interphase, mitosis, and cytokinesis.

The first stage of the cell cycle is called *interphase*. During interphase, the cell grows and makes copies of its chromosomes and organelles. The two copies of a chromosome are called *chromatids*. The two chromatids are held together at the *centromere*.

Critical Thinking

3. Compare What is the difference between a chromosome and a chromatid?

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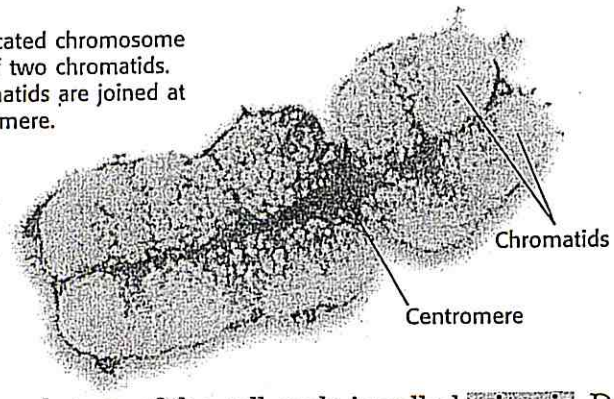
This duplicated chromosome consists of two chromatids. The chromatids are joined at the centromere.



The second stage of the cell cycle is called **mitosis**. During this stage, the chromatids separate. This allows each new cell to get a copy of each chromosome. Mitosis happens in four phases: prophase, metaphase, anaphase, and telophase.

The third stage of the cell cycle is called **cytokinesis**. During this stage, the cytoplasm of the cell divides to form two cells. These two cells are called *daughter cells*. The new daughter cells are exactly the same as each other. They are also exactly the same as the original cell.

CALIFORNIA STANDARDS CHECK

7.1.e Students know cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.

Word Help: process
a set of steps, events, or changes

4. Identify After one cell goes through mitosis and cytokinesis, how many cells are there?

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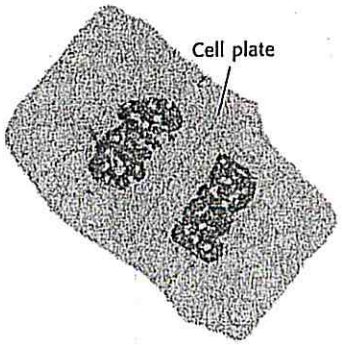

When a plant cell divides, a cell plate forms. The cell then divides into two cells. After the cell divides, a new cell wall forms where the cell plate was.

How Does the Cell Cycle Work?

The figure on the following page shows the cell cycle. In this example, the stages of the cell cycle are shown in a eukaryotic cell that has only four chromosomes.

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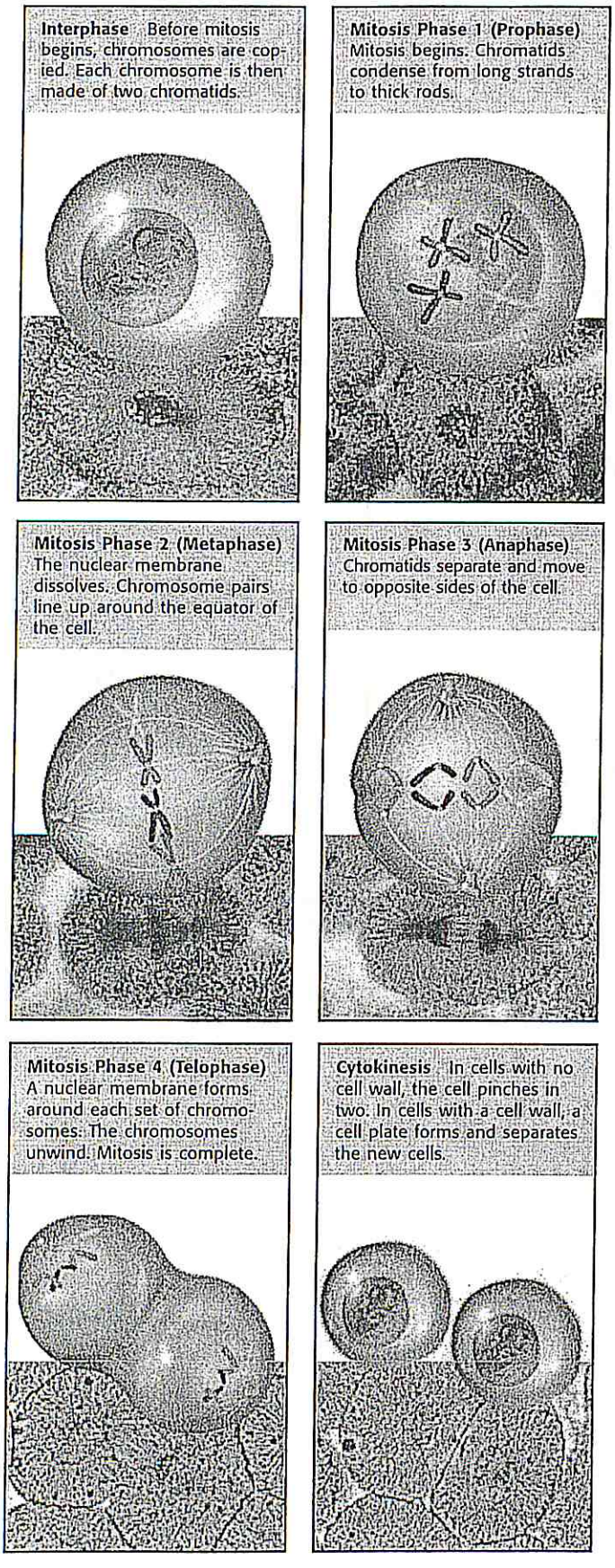
SECTION 2 The Cell Cycle *continued*



TAKE A LOOK

5. List What are the four phases of mitosis?

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6. Identify What structure do plant cells have during cytokinesis that animal cells do not have?

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What Tells a Cell When to Divide?

After cytokinesis is complete, each new cell is an exact copy of the parent cell. How did the parent cell know when to start copying its chromosomes?

As a baby, you cried when you were hungry. Crying was your way of reporting your condition to others. Cells also report conditions. This is called *feedback*. Cells use feedback to control the stages of the cell cycle, as shown below.

In a cell, feedback is used to turn on switches that work like red and green traffic lights. A cell spends most of its life in interphase, when it is not dividing. During this time, the cell grows. When feedback messages report that the cell is large and healthy, proteins in the cell get the "green light." The cell starts to copy its organelles and chromosomes. ☑

READING CHECK

7. Identify In which stage of the cell cycle does a cell spend most of its life?

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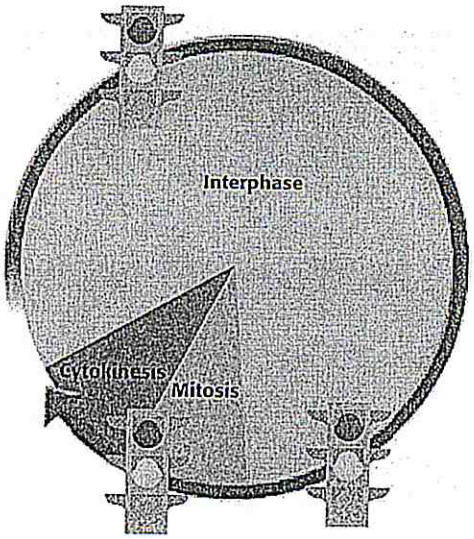

The cell cycle in eukaryotes is controlled at three points. Feedback at each point determines whether the cell will get a "red light" or a "green light" to continue cell division.

What Happens When Cell Division Is Not Controlled?

The molecules that control the "red light-green light" signals are proteins. The information for making these proteins is found in a cell's DNA. If the DNA mutates, or changes, the proteins the cell makes could be changed. The changed protein may not control the cell correctly. This can cause cancer to occur. **Cancer** is the uncontrolled growth of cells.

There are different ways cancer can begin in a cell. Some mutations in DNA cause too many molecules that make a cell grow. This speeds up the cell cycle. Other mutations turn off the proteins that stop a cell from dividing. This would allow cells to divide constantly.

Math Focus

8. Calculate Cell A normally divides once every two days. If its control mechanisms aren't working correctly, cell A divides six times faster than normal. How many hours does it take cell A to divide when its control mechanisms aren't working correctly?

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