Name _____ Class _____ Date _____

CHAPTER 4 The Cell in Action

SECTION 3

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?
- How is cell division different in animals and plants?

National Science Education Standards
LS 1c, 2d

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 cycles. 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 a molecule that contains all the instructions for making new cells. The DNA is stored in structures called **chromosomes**. Cells make copies of their chromosomes so that new cells have the same chromosomes as the parent cells. 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?

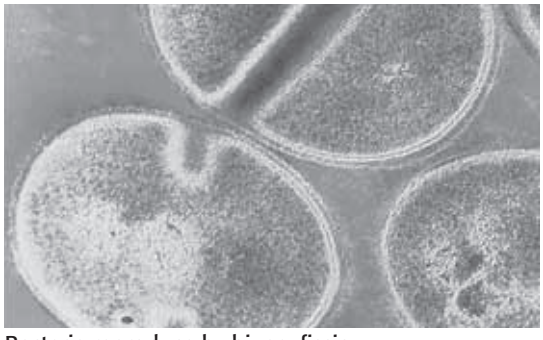
_____

_____

_____

How Do Prokaryotic Cells Divide?

Prokaryotes have 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 process called *binary fission*. During binary fission, the cell splits 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 _____ _____.

How Do Eukaryotic Cells Divide?

Different kinds of eukaryotes have different numbers of chromosomes. However, complex eukaryotes do not always have more chromosomes than simpler eukaryotes. For example, potatoes have 48 chromosomes, but humans have 46. Many eukaryotes, including humans, have pairs of similar chromosomes. These pairs are called **homologous chromosomes**. One chromosome in a pair comes from each parent.

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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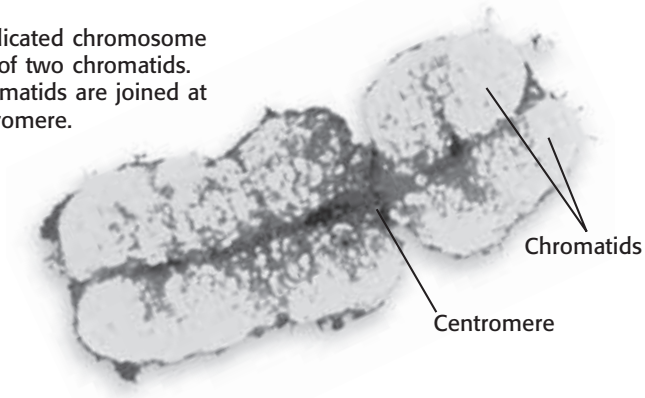
_____

_____

_____

_____

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, as shown in the figure on the next page: 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. ☑

READING CHECK

4. Identify What are the three stages of the eukaryotic cell cycle?

_____

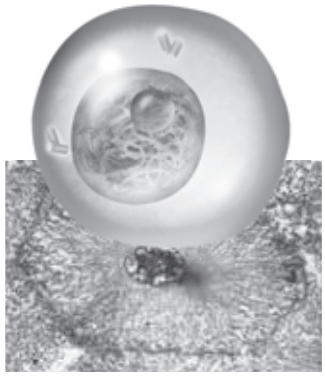
_____

_____

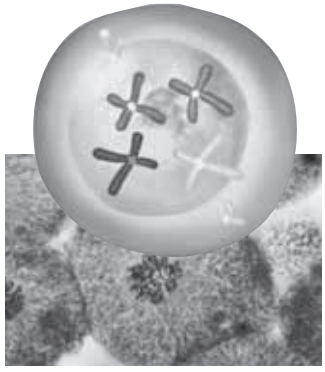
THE CELL CYCLE

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.

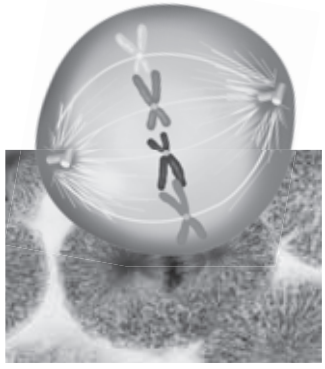
Interphase Before mitosis begins, chromosomes are copied. Each chromosome is then made of two chromatids.



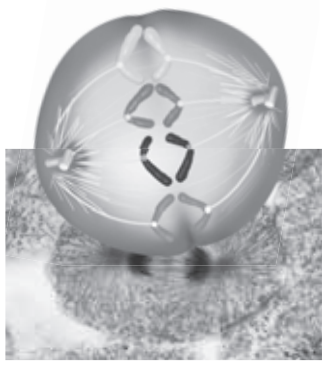
Mitosis Phase 1 (Prophase) Mitosis begins. Chromatids condense from long strands to thick rods.



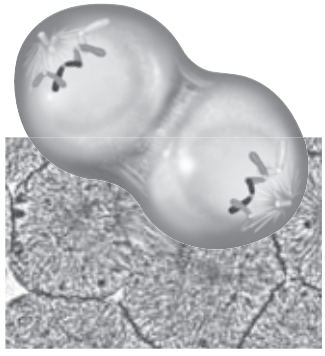
Mitosis Phase 2 (Metaphase) The nuclear membrane dissolves. Chromosome pairs line up around the equator of the cell.



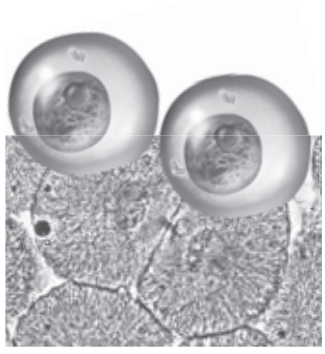
Mitosis Phase 3 (Anaphase) Chromatids separate and move to opposite sides of the cell.



Mitosis Phase 4 (Telophase) A nuclear membrane forms around each set of chromosomes. The chromosomes unwind. Mitosis is complete.



Cytokinesis In cells with no cell wall, the cell pinches in two.



In cells with a cell wall, a cell plate forms and separates the new cells.

Math Focus

5. Calculate 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 than cell B will there be?

_____

TAKE A LOOK

6. List What are the four phases of mitosis?

_____

_____

_____

_____

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

_____

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Section 3 Review

NSES LS 1c, 2d

SECTION VOCABULARY

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

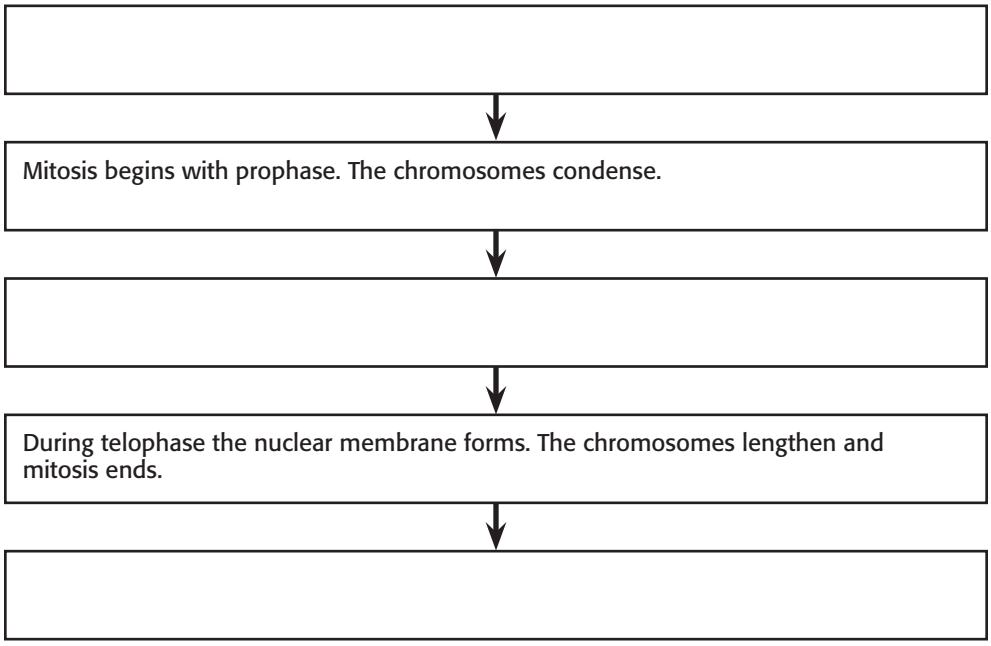
cytokinesis the division of cytoplasm of a cell

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

1. Compare How does the DNA of prokaryotic and eukaryotic cells differ?

2. Summarize Complete the Process Chart to explain the three stages of the cell cycle. Include the four phases of mitosis.



3. Explain Why does a cell make a copy of its DNA before it divides?

4. Infer Why is cell division in eukaryotic cells more complex than in prokaryotic cells?

4. Each process gives the other the materials it needs. Cellular respiration uses oxygen and glucose and produces carbon dioxide, water, and ATP. Photosynthesis uses carbon dioxide, water, and sunlight and produces glucose and oxygen.
5. Cellular respiration uses oxygen to break down food. Fermentation does not. Cellular respiration produces more energy than fermentation.
6. No, if cells don't have enough oxygen, they break down glucose using fermentation. When you exercise, for example, your muscle cells use up oxygen quickly. When there is not enough oxygen left, the muscle cells use fermentation.

SECTION 3 THE CELL CYCLE

1. The cell must make a copy of its DNA.
2. binary fission
3. Chromatids are copies of chromosomes that are held together at the centromere.
4. interphase, mitosis, cytokinesis
5. eight more
6. prophase, metaphase, anaphase, telophase
7. cell plate

Review

1. In prokaryotic cells, the DNA is on a single, circular chromosome. The DNA of eukaryotes is stored on many chromosomes.
2. During interphase, chromosomes are copied.

   Mitosis begins with prophase. The chromosomes condense.

   During metaphase, the nuclear membrane dissolves. The chromosomes align.

   During anaphase, the chromatids separate and move to opposite sides of the cell.

   During telophase, the nuclear membrane forms. The chromosomes lengthen, and mitosis ends.

   During cytokinesis, the cytoplasm divides.
3. A cell makes a copy of its DNA before it divides so that each new cell will receive a copy. Each new cell will be an exact copy of the parent cell.
4. Eukaryotic cells have more chromosomes to copy than prokaryotic cells. The nuclear membrane of a eukaryotic cell also has to break down before the cell can divide.

Chapter 5 Heredity

SECTION 1 MENDEL AND HIS PEAS

1. the study of how traits are inherited
2. They grow quickly, and they have many traits that are easy to see.
3. In cross-pollination, sperm from one plant fertilize eggs of another. In self-pollination, sperm fertilize eggs of the same plant.
4. Pollen can be carried by organisms, such as insects, or by the wind.
5. Traits are the different forms of a characteristic.
6. Mendel removed the anthers from the flower of the plant with round seeds.
7. the dominant trait
8. dominant and recessive
9. Correct ratios, from top to bottom:

   3.00:1, 2.96:1, 2.82:1, 2.95:1, 3.14:1, 2.84:1
10. 3:1

Review

1. A true-breeding plant is one that will produce offspring with all its same traits when it self-pollinates.
2. Dominant; in the first generation, a recessive trait disappears.
3. True-breeding plants with white flowers were crossed to produce plants that all had purple flowers. When self-pollinated, they produced three plants with purple flowers and one with white.

SECTION 2 TRAITS AND INHERITANCE

1. a version of a gene
2. the appearance of an organism
3. one recessive allele and one dominant allele
4. Homozygous; both of its alleles are the same
5. *PP*, *Pp*, and *pp*
6. They all have at least one dominant allele.
7. 50% of the offspring are homozygous.

	P	*p*
P	*PP*	*Pp*
p	*Pp*	*pp*

8. There are only two alleles for each trait.
9. The offspring would probably be one color. They would be the color of the dominant allele.