chapter 4

Cell Reproduction

section 2 Sexual Reproduction and Meiosis

What You'll Learn

- the stages of meiosis
- how sex cells are produced
- why meiosis is needed for sexual reproduction
- the names of the cells involved in fertilization
- how fertilization occurs in sexual reproduction

Before You Read

On the lines below, explain what makes you different from anyone else in your class.

_____

_____

_____

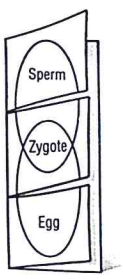
Study Coach

Make Journal Entries

As you read the section, write a question for each paragraph in a journal. Answer the question with information from the paragraph. Make a list of questions you have about the section that are still unclear and then find the answers.

FOLDABLES™

C Explain Make a three-tab book, as shown below. Use the Foldable to make a Venn diagram explaining sexual reproduction.



Read to Learn

Sexual Reproduction

A new organism can be produced through sexual reproduction. During **sexual reproduction**, two sex cells, sometimes called a sperm and an egg, come together. Usually the sperm and the egg come from two different organisms of the same species.

Sex cells are formed in reproductive organs. The male reproductive organ forms **sperm**. The female reproductive organ forms **eggs**. The joining of a sperm and an egg is called **fertilization**. The cell that forms from fertilization is called a **zygote** (ZI goht).

What two types of cells does your body make?

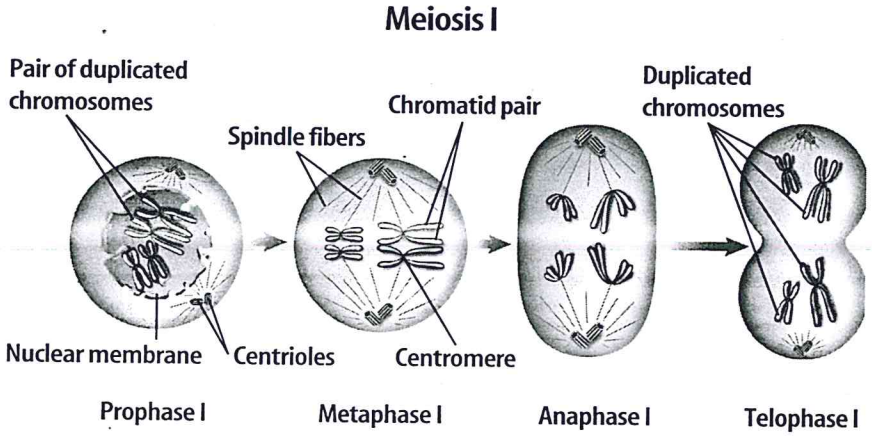
Your body makes body cells and sex cells. Body cells form your brain, skin, bones, and other tissues and organs. A human body cell usually has 46 chromosomes. Each chromosome has a mate that is similar in size and shape and has similar DNA, or hereditary information. This means that a body cell has 23 pairs of similar chromosomes. Cells that have pairs of similar chromosomes are called **diploid** (DIH ployd) cells.

What are haploid cells?

A sex cell has half the number of chromosomes found in a body cell, or 23 chromosomes. A sex cell has only one chromosome from each pair. A cell that does not have pairs of chromosomes is called a **haploid** (HA ploid) cell.

Meiosis and Sex Cells

A process called **meiosis** (mi OH sus) produces haploid sex cells. During meiosis, two divisions of the nucleus occur. These divisions are called meiosis I and meiosis II. The steps of each division of meiosis are named like the steps in mitosis—prophase, metaphase, anaphase, and telophase. The figure below shows what happens during meiosis I.



What happens to a cell during meiosis I?

Before meiosis begins, each chromosome is copied. When the cell is ready for meiosis, the two copies of each chromosome can be seen under a microscope as two chromatids. Follow the steps in meiosis I in the figure above. Notice that in prophase I, each pair of duplicated chromosomes comes together.

In metaphase I, the pairs of duplicated chromosomes line up in the center of the cell. As you can see, the centromere of each chromatid pair attaches to one spindle fiber.

In anaphase I, the two copies of the same chromosome, the chromatids, move away from each other to opposite ends of the cell. Notice that each duplicated chromosome still has two chromatids.

In telophase I, the cytoplasm divides and two new cells form. Each new cell has one duplicated chromosome from each similar pair.

Picture This

1. **Identify** How many cells form in meiosis I?

_____

Reading Check

2. **Explain** What happens in a cell before meiosis I begins?

_____

_____

_____

What happens in meiosis II?

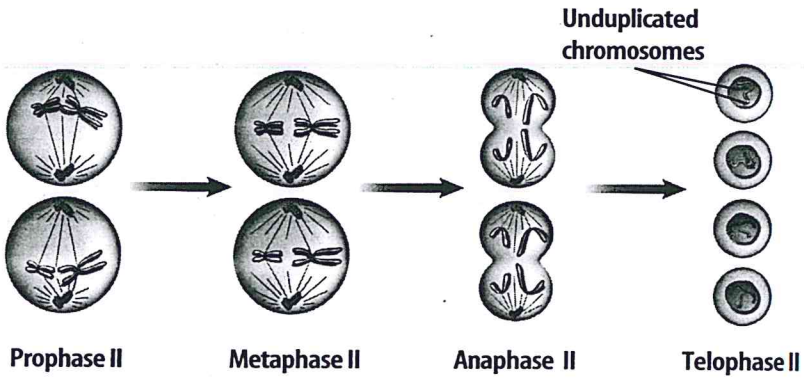
The two cells that formed in meiosis I now begin meiosis II. Follow the steps in meiosis II in the figure below. As you can see in prophase II, the duplicated chromosomes and spindle fibers reappear in each new cell.

In metaphase II, the duplicated chromosomes move to the center of each cell. The centromere of each chromatid pair attaches to two spindle fibers.

In anaphase II, the centromere in each cell divides. Then the chromatids separate and move to opposite ends of each cell. Each chromatid becomes an individual chromosome.

In telophase II, the spindle fibers disappear, and a nuclear membrane forms around the chromosomes at each end of the cell. When meiosis II is finished, the cytoplasm of each cell divides.

Meiosis II



What is the final result of meiosis?

During meiosis I, one cell divides into two cells. During meiosis II, those two cells divide. When meiosis II ends, there are four sex cells. Each sex cell has 23 unpaired chromosomes. This is one-half the number of chromosomes that were in the original nucleus—46 chromosomes.

What can go wrong in meiosis?

Mistakes sometimes occur during meiosis. These mistakes can produce sex cells with too many or too few chromosomes. Zygotes, cells that form from fertilized eggs, produced from these sex cells sometimes die. If the zygote lives, every cell that grows from the zygote will have the wrong number of chromosomes. Organisms with the wrong number of chromosomes usually do not grow normally. ☑

Think it Over

3. **Explain** how metaphase I and metaphase II differ.

Reading Check

4. **Explain** What is the usual result of too many or too few chromosomes?

After You Read

Mini Glossary

diploid (DIH ployd): cells that have pairs of similar chromosomes

egg: sex cell formed in the female reproductive organs

fertilization: the joining of a sperm and an egg

haploid (HA ployd): cells that do not have pairs of chromosomes, such as sex cells

meiosis (mi OH sis): a process that produces haploid sex cells

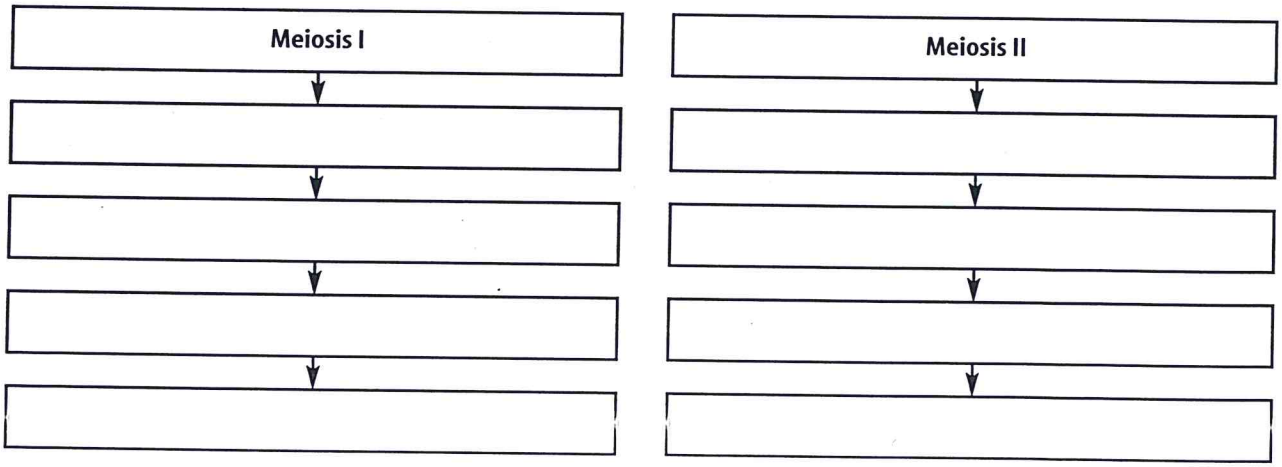
sexual reproduction: two sex cells come together to produce a new organism

sperm: sex cell formed in the male reproductive organs

zygote (ZI goht): the cell that forms from fertilization

1. Review the terms and their definitions in the Mini Glossary. Choose the terms that explain the process of sexual reproduction and write one or two sentences explaining how the process works.

2. Complete the graphic organizer below to label the steps that occur during meiosis I and meiosis II.



3. How do your journal entries help you understand sexual reproduction and meiosis?

ScienceOnline Visit **life.msscience.com** to access your textbook, interactive games, and projects to help you learn more about sexual reproduction and meiosis.

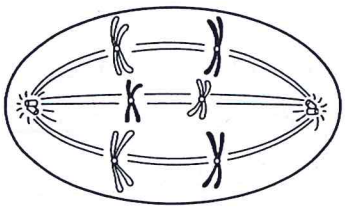
End of Section

Name Date Class

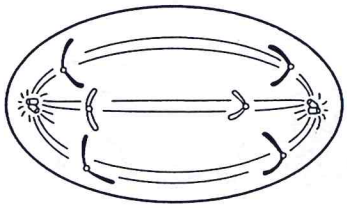
SECTION Reinforcement

Sexual Reproduction and Meiosis

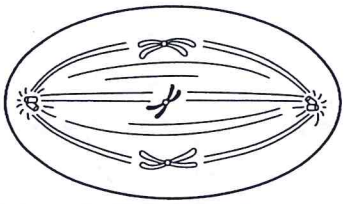
Directions: *Study the following diagrams. Then label the appropriate steps of meiosis.*



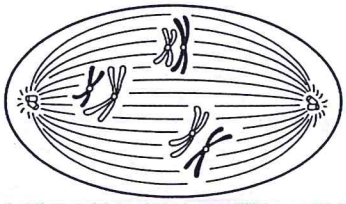
1. _____



2. _____



3. _____



4. _____

Directions: *Answer the following questions on the lines provided.*

5. In what way is meiosis II similar to mitosis?

_____

6. What is a cell with pairs of chromosomes called? A cell with no pairs (single set)? of chromosomes?

_____

7. Do centromeres divide at anaphase I or II?

_____

8. Starting with one diploid cell, how many haploid sperm cells have formed after both phases of meiosis have been completed?

_____

9. How are sex cells different from other cells in the body?

_____

10. What happens during fertilization?

_____

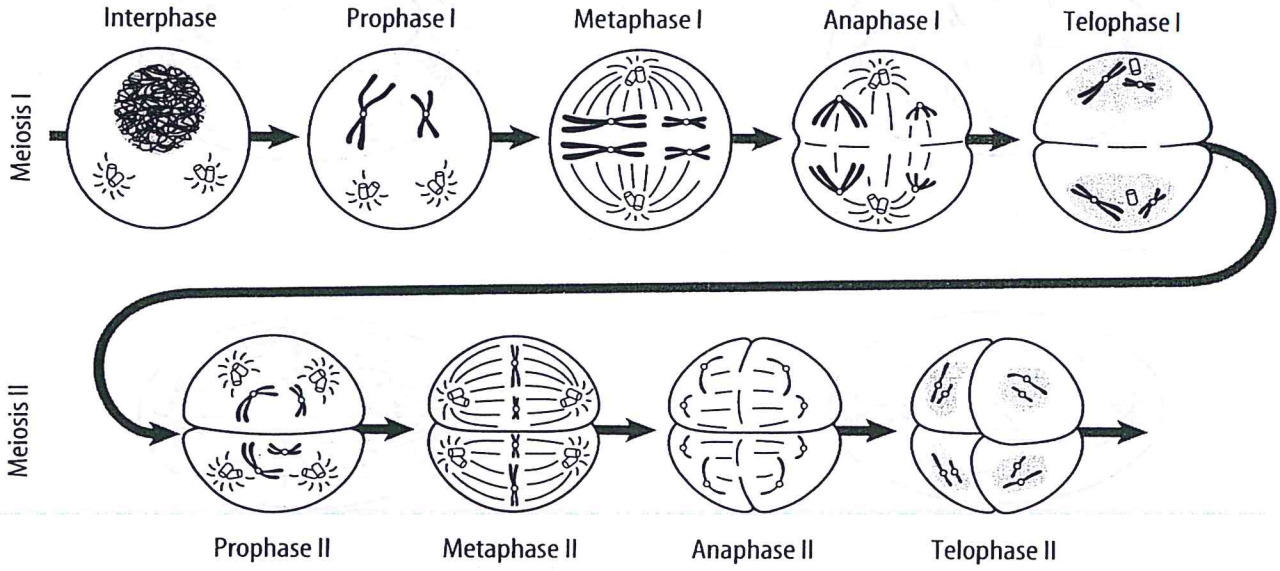
Meeting Individual Needs

Name Date Class

Directed Reading for Content Mastery

Section 1 ▪ Cell Division and Mitosis
Section 2 ▪ Sexual Reproduction and Meiosis

Directions: *Study the diagram. Then answer the following questions.*



1. Meiosis begins with one cell. How many cells are formed by the end of meiosis I? _____

2. What happens to the chromosomes of a cell in order for meiosis to begin?

_____

3. Meiosis I is the same as what other reproductive process?

_____

4. Meiosis I begins with one cell. How many cells are formed by the end of meiosis II?

_____

5. At the end of meiosis II, each of the haploid sex cells has only half the number of chromosomes as the original diploid cell. Why is this important?

_____

_____

Name Date Class

LAB 2 Laboratory Activity

Examining Models of Chromosomes

Models of the chromosomes of the imaginary Leksak bird can be found at the end of this lab. The dark bands on these chromosome models are genes. Most cells in this bird's body contain the same number and type of chromosomes. The importance of genes to all living things, and to the Leksak bird as well, is that they control all inherited traits. Chromosomes are important because they are the carriers of these genes.

Strategy

You will cut out and pair chromosome models of the Leksak bird.
You will determine what type of change occurs in the number of chromosomes when a cell divides by mitosis and meiosis.

Materials

scissors

Procedure/Data and Observations

1. Cut out each chromosome model in Figure 1.
2. Fold each paper model in half along dotted lines.
3. Match in pairs as many chromosome models as possible. A chromosome pair must match in length as well as in number and location of genes. The lines on the chromosome models represent genes.
4. Answer questions 1 through 4 in Questions and Conclusions before proceeding further.
5. Cut each chromosome model in half along the dotted line. Make two piles of chromosome halves. Put one half of each chromosome in one pile and the other half in the second pile.
6. Compare the chromosomes in the first pile with those in the second pile.

Cell division includes a process called mitosis that occurs in most living things. During mitosis, a cell's nucleus divides into two nuclei. The cutting of each chromosome model and separating them into two piles is similar to what happens in a living cell during cell division. The two piles of chromosome models represent two new cells. (Each chromosome duplicates itself and the two halves then separate.)

7. Before proceeding, answer questions 5 and 6 in Questions and Conclusions.
8. Place all identical chromosome models together in separate groups. You should have six groups of models.
9. Take a group of matched chromosomes and separate them into four piles. Take a second group of matched chromosomes and place one chromosome from the group into each of the four piles.
10. Continue this sorting until all chromosome models, including the unmatched chromosome models, have been separated into the four piles. Each pile of chromosome models represents a sex cell.

A process called meiosis occurs in some living things. During meiosis, a cell's nucleus divides twice so that one diploid cell divides to produce four haploid cells. Each new cell produced by this process is called a sex cell (egg or sperm).

Name _____ Date _____ Class _____

Laboratory Activity 2 (continued)

Questions and Conclusions

1. How many chromosomes can be found in each of the Leksak bird's cells?

_____

2. How many matched pairs of chromosomes are there in each cell?

_____

3. How many unmatched chromosomes are there in each cell?

_____

4. Do the genes on each matched pair of chromosomes also match?

_____

5. After separating the chromosome model halves into two piles, how many models are found in each pile?

_____

6. How many chromosomes are found in Leksak sex cells?

_____

7. Do any chromosomes match one another in a sex cell?

_____

8. Male Leksak birds have six matched pairs of chromosomes and one unmatched pair of chromosomes. Female Leksak birds have seven matched pairs of chromosomes. Were the chromosomes in our bird taken from a male or a female?

_____

9. Are all cells produced by mitosis exactly alike, chromosome for chromosome? Gene for gene? Explain why.

_____

_____

10. How does the number of chromosomes in sex cells compare to the number of chromosomes in cells formed during mitosis?

_____

_____

11. Explain two ways in which sex cells differ from all other cells.

_____

Strategy Check

_____ Did you cut out and match in pairs the chromosome models of the Leksak bird?

_____ Did you determine the types of changes that occur in the number of chromosomes when a cell undergoes mitosis or meiosis?

Laboratory Activity 2 (continued)

Figure 1

Models of chromosomes for the imaginary Leksak bird after duplication in the interphase period of the cell cycle.