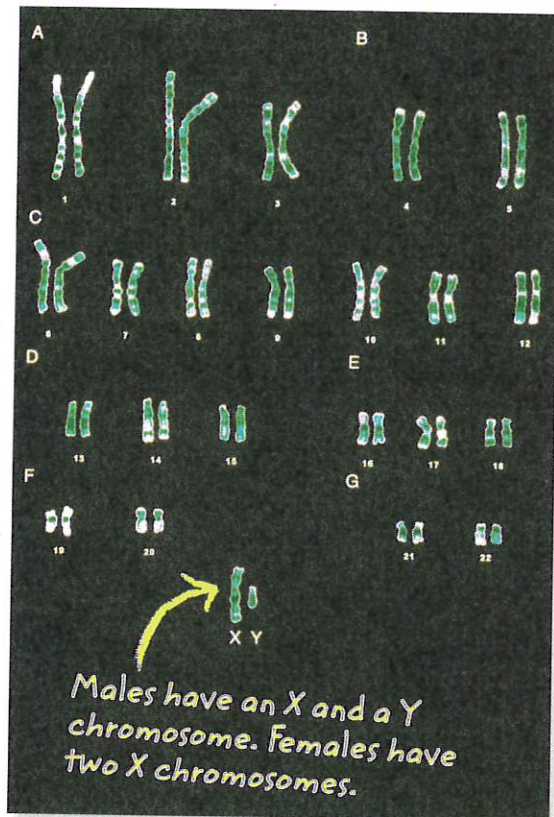


Number Off!

How do sex cells differ from body cells?

Before sexual reproduction can take place, each parent produces sex cells. *Sex cells* have half of the genetic information that body cells have. Thus, when the genetic information from two parents combines, the offspring have a full set of genetic information. The offspring will have the same total number of chromosomes as each of its parents.

This photo shows the 23 chromosome pairs in a human male. Body cells contain all of these chromosomes. Sex cells contain one chromosome from each pair.



ACTIVE READING

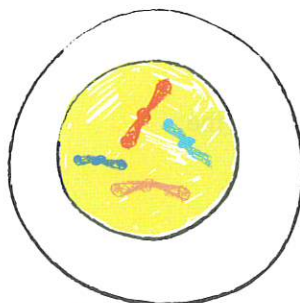
5 Relate Describe sex cells.

Chromosome Number

In body cells, most chromosomes are found in pairs that have the same structure and size. These **homologous chromosomes** (huh•MAHL•uh•guhs KROH•muh•sohmz) carry the same genes. A homologous chromosome pair may have different versions of the genes they carry. One chromosome pair is made up of *sex chromosomes*. Sex chromosomes control the development of sexual characteristics. In humans, these chromosomes are called X and Y chromosomes. Cells with a pair of every chromosome are called *diploid* (DIP•loyd). Many organisms, including humans, have diploid body cells.

Visualize It!

6 State Your Claim The cell shown is a body cell that has two pairs of homologous chromosomes. Make claim about how it is different than a sex cell by drawing a sex cell.



Body cell

Sex cell

Why do organisms need sex cells?

Most human body cells contain 46 chromosomes. Think about what would happen if two body cells were to combine. The resulting cell would have twice the normal number of chromosomes. A sex cell is needed to keep this from happening.

Sex cells are also known as *gametes* (GAM•eetz). Gametes contain half the usual number of chromosomes—one chromosome from each homologous pair and one sex chromosome. Cells that contain half the usual number of chromosomes are known as *haploid* (HAP•loyd).

Gametes are found in the reproductive organs of plants and animals. An egg is a gamete that forms in female reproductive organs. The gamete that forms in male reproductive organs is called a sperm cell.

How are sex cells made?

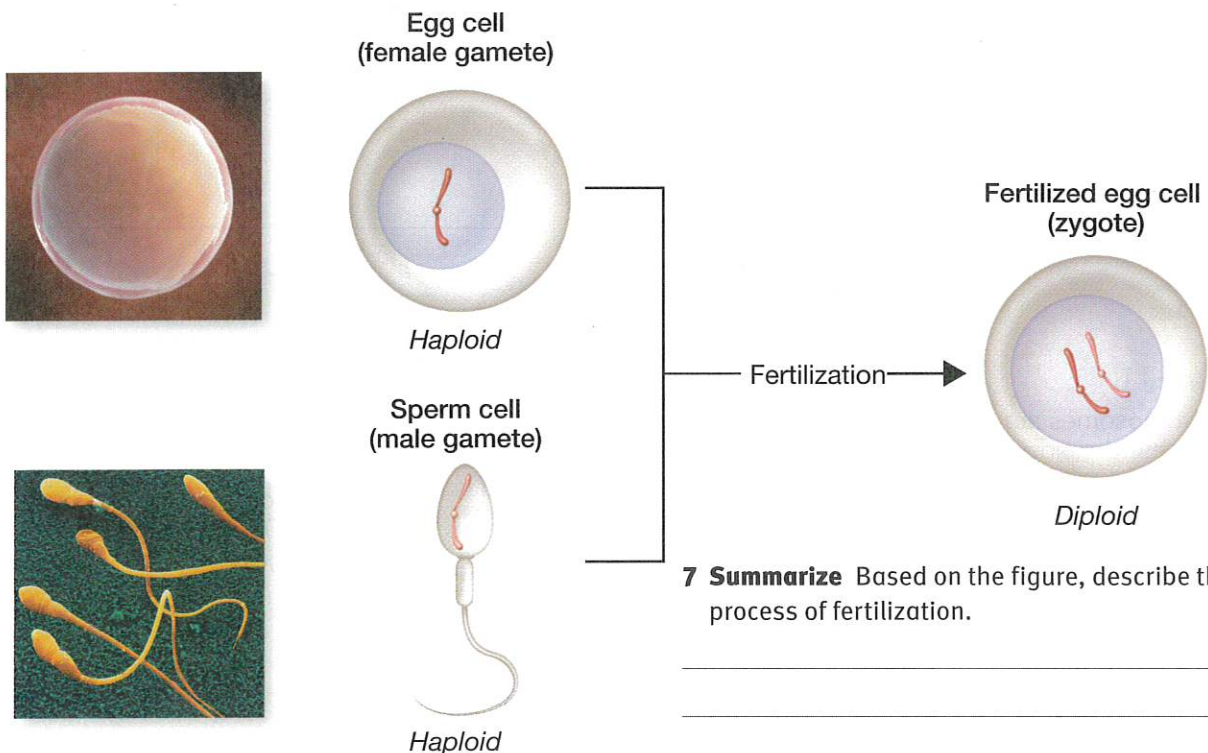
You know that body cells divide by the process of mitosis. Mitosis produces two new cells, each containing exact copies of the chromosomes in the parent cell. Each new cell has a full set of chromosomes. But to produce sex cells, a different kind of cell division is needed.

Meiosis

A human egg and a human sperm cell each have 23 chromosomes. When an egg is joined with, or *fertilized* by, a sperm cell, a new diploid cell is formed. This new cell has 46 chromosomes, or 23 pairs of chromosomes. One set is from the mother, and the other set is from the father. The newly formed diploid cell may develop into an offspring. **Meiosis** (my•OH•sis) is the type of cell division that produces haploid sex cells such as eggs and sperm cells.

Visualize It!

For the example of fertilization shown, the egg and sperm cells each have one chromosome.



7 Summarize Based on the figure, describe the process of fertilization.

One Step at a Time

What are the stages of meiosis?

Meiosis results in the formation of four haploid cells. Each haploid cell has half the number of chromosomes found in the original cell. Meiosis has two parts: meiosis I and meiosis II.

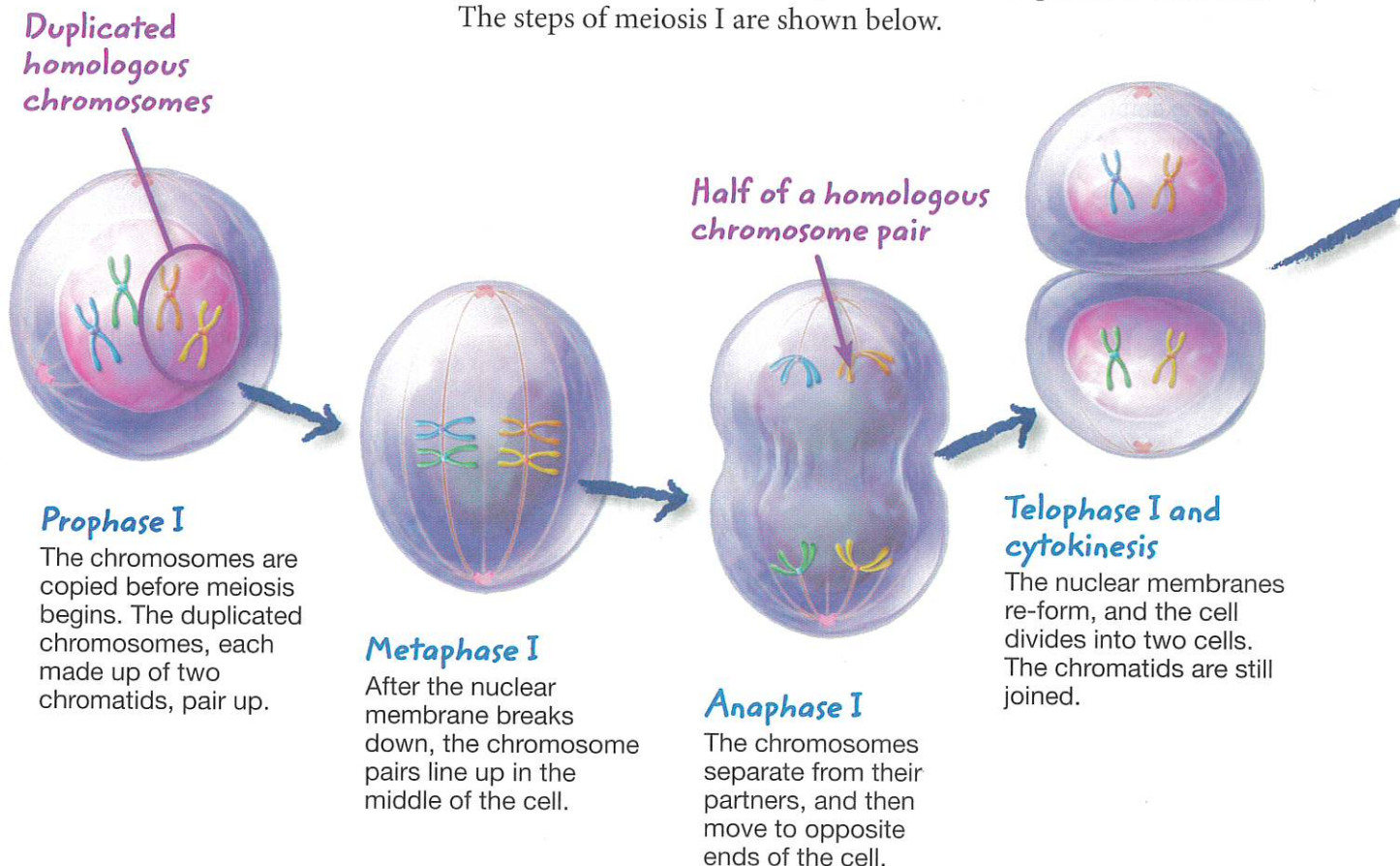
Meiosis I

Remember that homologous chromosomes have the same genes, but they are not exact copies of each other. Before meiosis I begins, each chromosome is duplicated, or copied. Each half of a duplicated chromosome is called a *chromatid* (KROH•muh•tid). Chromatids are connected to each other by *centromeres* (SEN•truh•mirz). Duplicated chromosomes are drawn in an X shape. Each side of the X represents a chromatid, and the point where they touch is the centromere.

During meiosis I, pairs of homologous chromosomes and sex chromosomes split apart into two new cells. These cells each have one-half of the chromosome pairs and their duplicate chromatids. The steps of meiosis I are shown below.

ACTIVE READING

8 Sequence As you read, underline what happens to chromosomes during meiosis.



Visualize It!

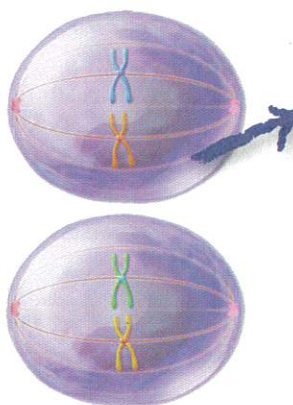
9 Claims • Evidence • Reasoning How does meiosis II differ from meiosis I? Summarize evidence to support your claim and explain your reasoning.

Centromere
Chromatid



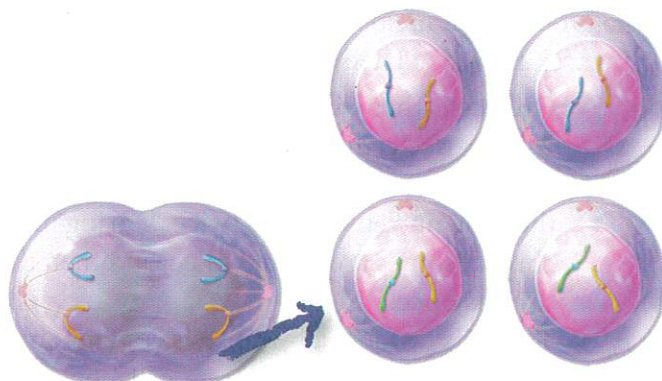
Prophase II

The chromosomes are not copied again before meiosis II. The nuclear membrane breaks down.



Metaphase II

The chromosomes line up in the middle of each cell.



Anaphase II

The chromatids are pulled apart and move to opposite sides of the cell.

Telophase II and cytokinesis

The nuclear membranes re-form and the cells divide. Four new haploid cells are formed. Each has half the usual number of chromosomes.

Think Outside the Book

10 Summarize Work with a partner to make a poster that describes all the steps of meiosis.

Meiosis II

Meiosis II involves both of the new cells formed during meiosis I. The chromosomes of these cells are not copied before meiosis II begins. Both of the cells divide during meiosis II. The steps of meiosis II are shown above.

Meiosis II results in four haploid sex cells. In male organisms, these cells develop into sperm cells. In female organisms, these cells become eggs. In females of some species, three of the cells are broken down and only one haploid cell becomes an egg.

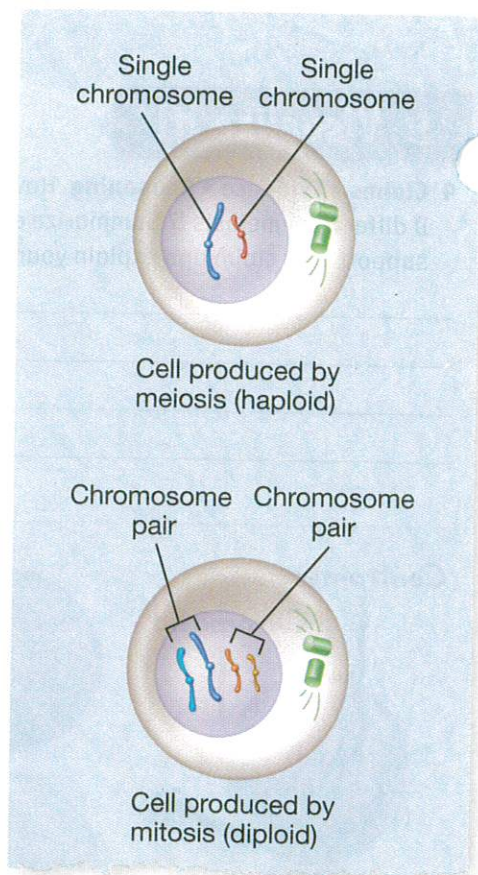
11 Identify At the end of meiosis II, how many cells have formed?



How does meiosis compare to mitosis?

The processes of meiosis and mitosis are similar in many ways. However, they also have several very important differences.

- Only cells that will become sex cells go through meiosis. All other cells divide by mitosis.
- During meiosis, chromosomes are copied once, and then the nucleus divides twice. During mitosis, the chromosomes are copied once, and then the nucleus divides once.
- The cells produced by meiosis contain only half of the genetic material of the parent cell—one chromosome from each homologous pair and one sex chromosome. The cells produced by mitosis contain exactly the same genetic material as the parent—a full set of homologous chromosomes and a pair of sex chromosomes.



12 Gather Evidence Using the table below, provide evidence that shows how meiosis and mitosis are alike and different.

Characteristic	Meiosis	Mitosis
Number of nuclear divisions		
Number of cells produced		
Number of chromosomes in new cells (diploid or haploid)		
Type of cell produced (body cell or sex cell)		
Steps of the process		

WHY IT MATTERS

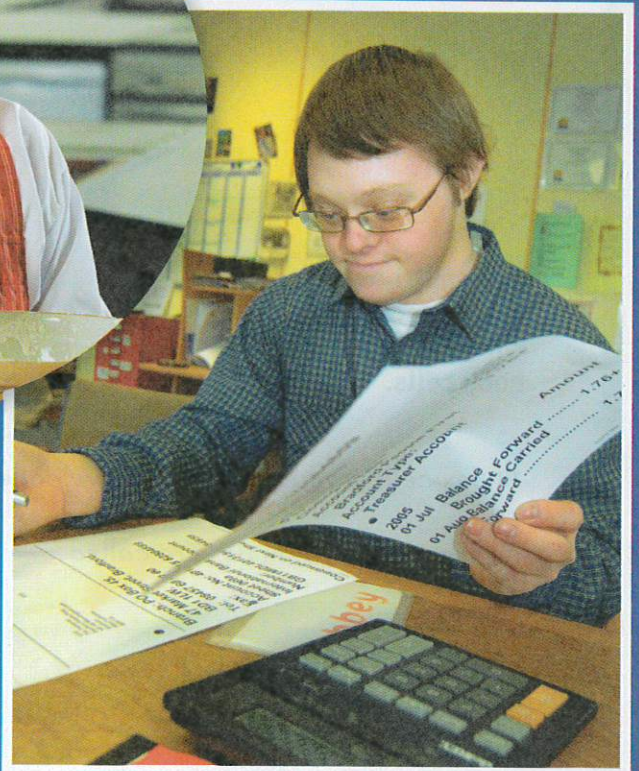
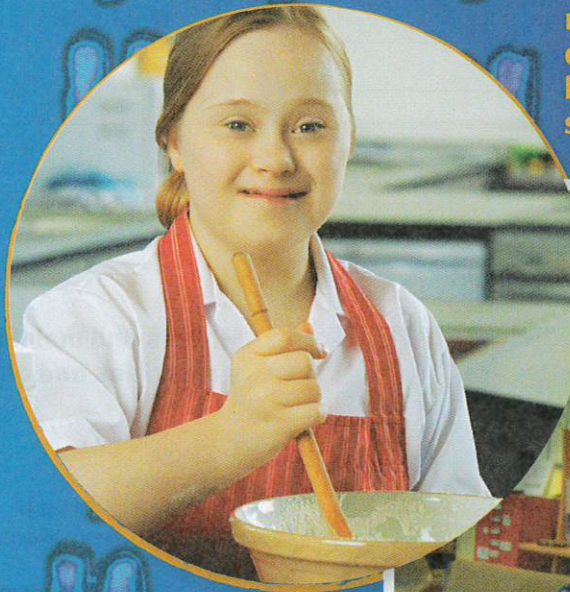
HEALTH WATCH

Down Syndrome

Down syndrome is a genetic disease. It is usually caused by an error during meiosis. During meiosis, the chromatids of chromosome 21 do not separate. So, a sex cell gets two copies of chromosome 21 instead of one copy. When this sex cell joins with a normal egg or sperm, the fertilized egg has three copies of chromosome 21 instead of two copies.

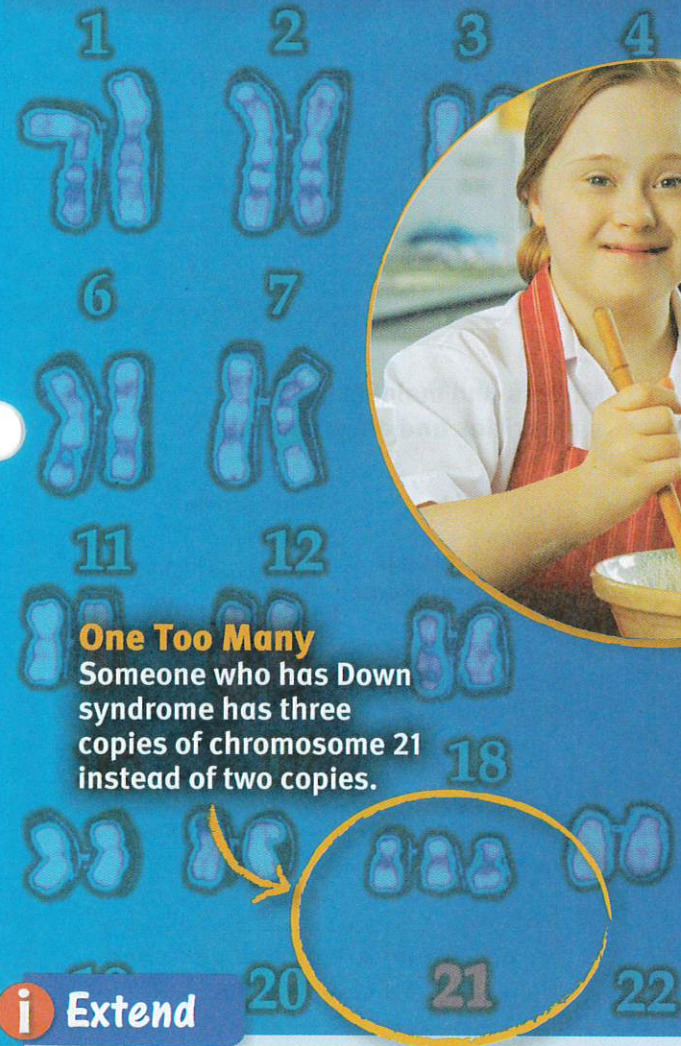
Beating the Odds

Down syndrome causes a number of health problems and learning difficulties, but many people with Down syndrome have fulfilling lives.



One Too Many

Someone who has Down syndrome has three copies of chromosome 21 instead of two copies.



i Extend

13 Identify What type of error in meiosis causes Down syndrome?

14 Claims • Evidence • Reasoning Research the characteristics of Down syndrome. Make a claim about how a person can overcome some of the difficulties caused by this disorder. Summarize evidence to support your claim

and explain your reasoning.

15 Recommend Research the Special Olympics. Then make an informative brochure, poster, or oral presentation that describes how the Special Olympics gives people with Down syndrome and other disabilities the chance to compete in sports.

Visual Summary

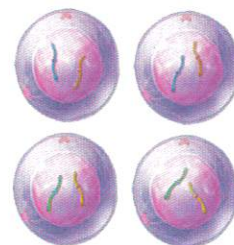
To complete this summary, fill in the blanks with the correct word or phrase. You can use this page to review the main concepts of the lesson.

Meiosis produces haploid cells that can become sex cells.



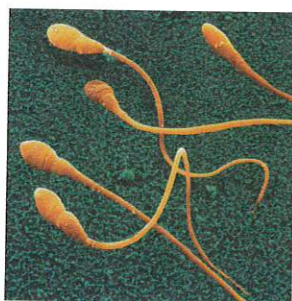
16 List the steps of meiosis I.

Meiosis



17 List the steps of meiosis II.

Sex cells have half as many chromosomes as body cells.



18 Sex cells produced by males are called _____, and sex cells produced by females are called _____

Mitosis and meiosis have similarities and differences.

Single chromosome



Cell produced by meiosis (haploid)

Chromosome pair



Cell produced by mitosis (diploid)

19 During _____, chromosomes are copied once and the nucleus divides twice.

20 During _____, chromosomes are copied once and the nucleus divides once.

21 Claims • Evidence • Reasoning What would happen if mitosis occurred in sex cells instead of meiosis? Summarize evidence to support your claim and explain your reasoning.

Lesson Review

LESSON 2

Vocabulary

Fill in the blanks with the term that best completes the following sentences.

- 1 _____ chromosomes are found in body cells but not sex cells.
- 2 The process of _____ produces haploid cells.

Key Concepts

- 3 **Compare** How does the number of chromosomes in sex cells compare with the number of chromosomes in body cells?

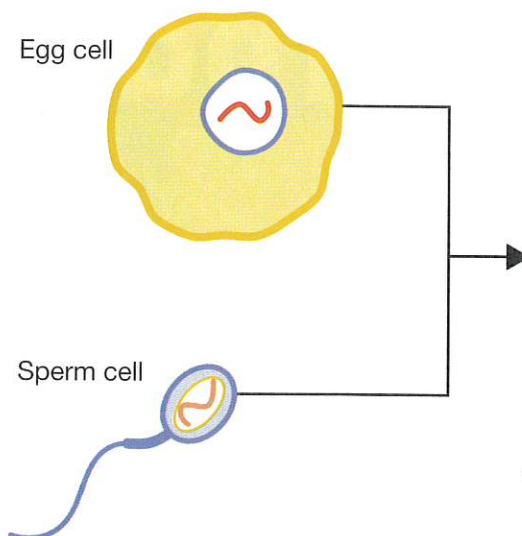
- 4 **Identify** What is the function of meiosis?

- 5 **List** Identify the steps of meiosis.

- 6 **Claims • Evidence • Reasoning** How are mitosis and meiosis alike and different? Summarize evidence to support your claim and explain your reasoning.

Critical Thinking

Use the figure to answer the following questions.



- 7 **Identify** By what process did these cells form?

- 8 **Identify** How many chromosomes does a body cell for the organism shown have?

- 9 **Predict** Draw a picture of the cell that would form if the sperm cell fused with the egg cell. What is this cell called?

- 10 **Claims • Evidence • Reasoning** What would happen if meiosis did not occur? State your claim. Summarize evidence to support this claim and explain your reasoning.
