Section Summary

Many unicellular organisms and a few multicellular organisms can produce genetically identical clones through a process called asexual reproduction. Other single-celled organisms and most multicellular organisms reproduce sexually. The variation introduced into the reproductive cells by meiosis appears to be one of the advantages of sexual reproduction that has made it so successful.

Exercises

1. What is a likely evolutionary advantage of sexual reproduction over asexual reproduction?
   a. sexual reproduction involves fewer steps
   b. less chance of using up the resources in a given environment
   c. sexual reproduction results in greater variation in the offspring
   d. sexual reproduction is more cost-effective
2. Explain the advantage that populations of sexually reproducing organisms have over asexually reproducing organisms?

Answers

1. (c)
2. The offspring of sexually reproducing organisms are all genetically unique. Because of this, sexually reproducing organisms may have more successful survival of offspring in environments that change than asexually reproducing organisms, whose offspring are all genetically identical. Also, the rate of adaptation of sexually reproducing organisms is higher because of their increased variation. This may allow sexually reproducing organisms to adapt more quickly to competitors and parasites, who are evolving new ways to exploit or outcompete them.

Glossary

asexual reproduction: produces genetically identical clones to the parent organism

sexual reproduction: requires that two different gametes come together to form a zygote

8.5 Meiosis

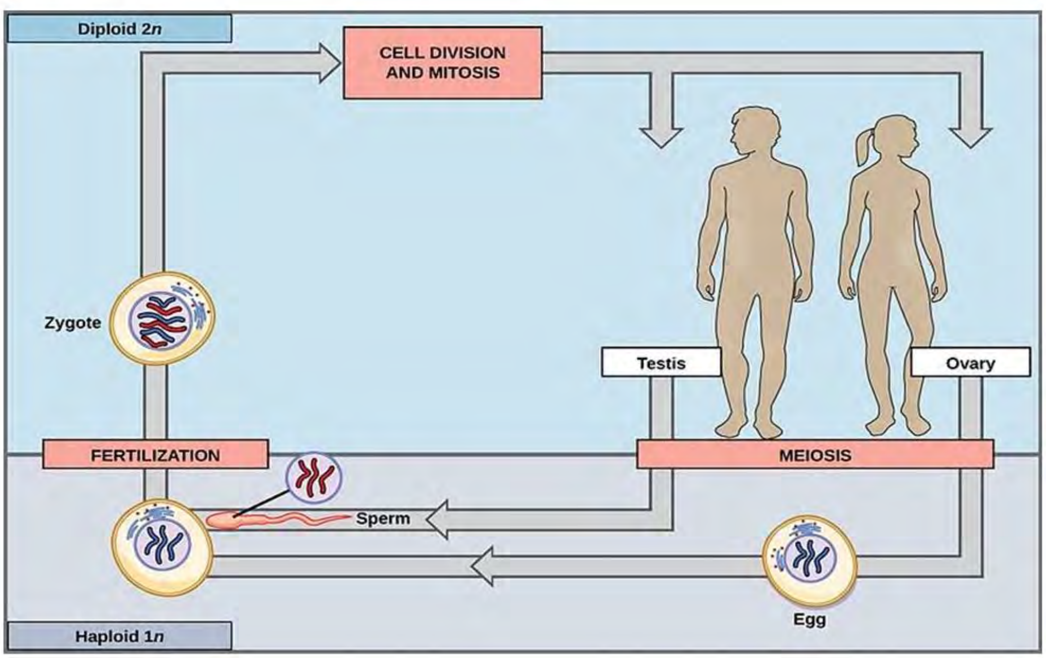
Learning objectives

By the end of this section, you will be able to:

- *Describe the behavior of chromosomes during meiosis*
- *Describe events that occur during meiosis*
- *Explain the similarities and differences between meiosis and mitosis*
- *Explain the mechanisms within meiosis that generate genetic variation*
- *Be able to define and explain all bolded terms*

Sexual reproduction requires **fertilization**, a fusion between two specialized cells, called **gametes**. Each gamete is **haploid,** meaning it contains one set of chromosomes. When gametes unite, they form a **zygote**, or fertilized egg (Figure 8.20). Each zygote is **diploid,** meaning that it contains two sets of chromosomes, one from each biological parent.

Most of the cells that make up the human body are called **somatic cells.** Each somatic cell, also called a body cell, should contain 46 chromosomes. **Germline cells** lead to the production of gametes and makeup only a small percentage of our overall cells. In humans, gametes are our sex cells, and should each contain 23 chromosomes. Female gametes are called **eggs,** whereas male gametes are called **sperm.**



8.20 In animals, sexually reproducing adults form haploid gametes from diploid germ cells. (credit: Biology OpenStax / Wikimedia Commons)

A typical diploid somatic cell contains two copies of each chromosome, called **homologous chromosomes**. Homologous chromosomes are the same length and have specific nucleotide sequences called **genes** in exactly the same location, or **locus** (Figure 8.21). Genes, the functional units of chromosomes, determine an organism's specific characteristics.

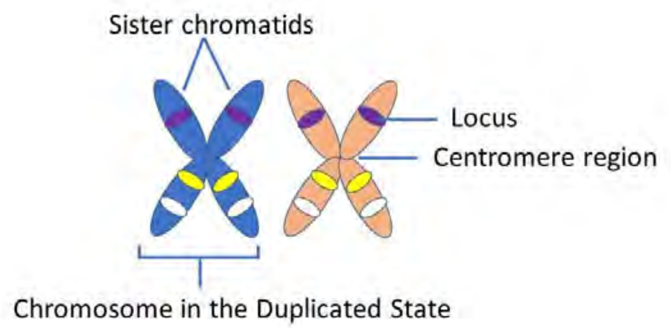


Figure 8.21: Homologous chromosomes. Each chromosome is in the duplicated state. (credit: Elizabeth O'Grady)

Homologous chromosomes may have different variations of the same gene at the same location. For example, on a homologous pair of chromosomes, one of the chromosomes may have a gene for attached earlobes at a specific location. On the other chromosome, at the same location, there may be a gene that causes earlobes to be unattached. In the end, it is the genes on the chromosome pairs that determine the physical characteristics of an individual.

Both human males and females have twenty-two pairs of homologous chromosomes called autosomes. **Autosomes** are chromosome pairs one through twenty-two and do not determine a person's biological sex (Figure 8.22). The twenty-third pair of chromosomes are referred to as the **allosomes** (Figure 8.22). Humans contain the allosomes X and Y. Some resources use the term "sex chromosomes" instead of allosomes. "Sex chromosome" is misleading. Many non-sex determining genes are found on the X chromosome and autosomes do contain genes involved in sex determination. In phenotypic females, the twenty-third pair of chromosomes are homologous, X and X. Phenotypic males, however, have a twenty-third pair, X and Y, that are not homologous (Figure 8.22). The genes found on the X and Y chromosomes do not code for the same characteristics. For example, on the Y chromosome, there is a set of genes called the SRY genes that allow males to develop testes. Those genes are not typically located on the X chromosome; thus, this pair is not homologous.

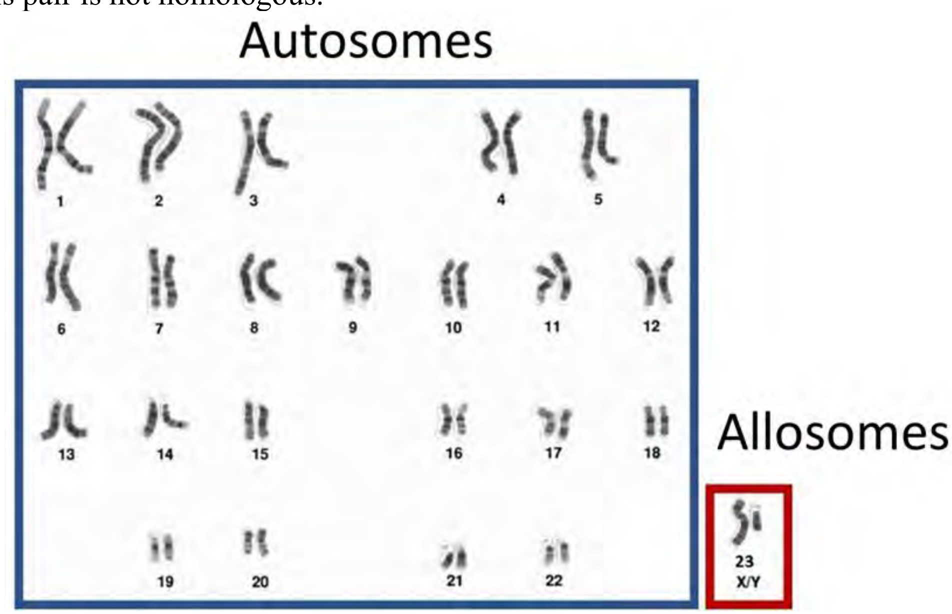


Figure 8.22 shows a human karyotype. (credit: Modified by Elizabeth O'Grady and Marsha Hay original work of National Human Genome Research Institute Public Domain)