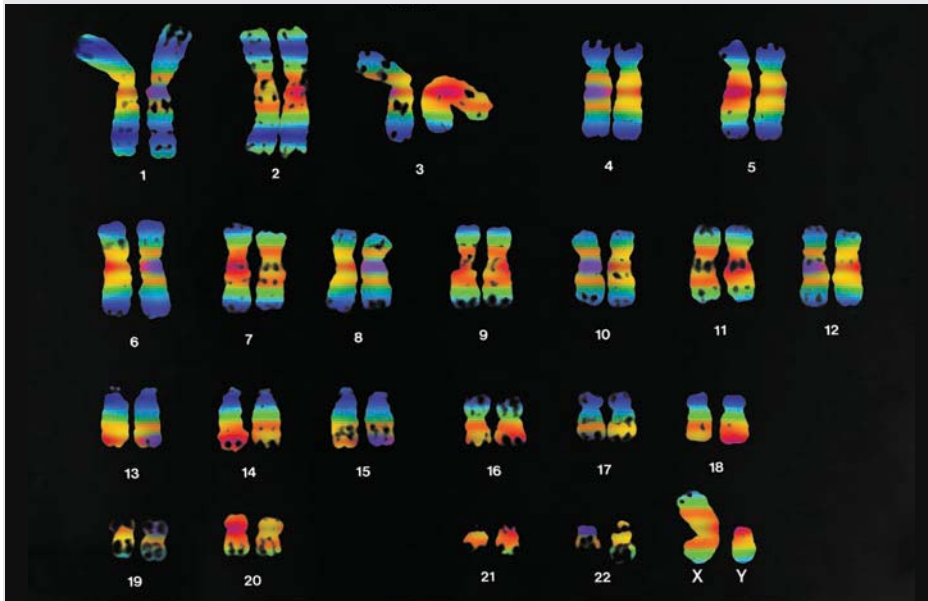


Chromosomes and Meiosis

DNA is the genetic material in organisms. DNA codes for proteins and contains the information that determines when proteins are made. In complex organisms, long strands of DNA are packaged together with proteins into chromosomes in the nucleus of the cell. Images like the one in Figure 2 can be analyzed to determine a karyotype, which shows the 23 pairs of chromosomes in a human cell. The brightly colored structures are pairs of highly condensed chromosomes formed during metaphase of mitosis.

FIGURE 2: Chromosomes in a Human Cell



Collaborate Write your answers to the following questions about the image in Figure 2. Compare your answers with a partner, and write down any new information that you had not previously recorded.

1. What patterns do you observe?
2. How many chromosomes do human body cells have?
3. What differences do you see among the different pairs of chromosomes and the chromosomes within a pair?

Chromosome Structure and Function

Each pair of chromosomes in your cells is referred to as a homologous pair.

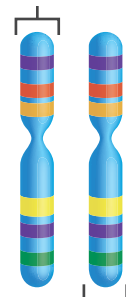
Homologous chromosomes are two chromosomes—one inherited from the mother, one from the father—that have the same length and general appearance. These chromosomes have copies of the same genes, although the two copies may differ.



Analyze What percentage of your genetic material is from your mother and what percentage is from your father?

FIGURE 3: Homologous chromosome pairs include one chromosome inherited from the father and another inherited from the mother.

father's chromosome



mother's chromosome



Analyze Do the chromosomes in Figure 2 on the previous page belong to a female or a male? Explain how you know.

Autosomes and Sex Chromosomes

You may have noticed that all of the chromosome sets in Figure 2 are labeled with a number except for one set, which is labeled with an X and a Y. Together, chromosome pairs 1 through 22 make up your **autosomes**, which are chromosomes that contain genes for characteristics not directly related to the sex of an organism.

Most sexually reproducing species also have sex chromosomes that directly control the development of sexual characteristics. Humans have two very different **sex chromosomes**: X and Y. In most mammals, including humans, an organism's sex is primarily determined by the XY system. An organism with two X chromosomes, or XX, is female. An organism with one X and one Y chromosome, or XY, is male.

FIGURE 4: Sex chromosomes control the development of sexual characteristics.



a Females have two X chromosomes.



b Males have an X chromosome and a Y chromosome.

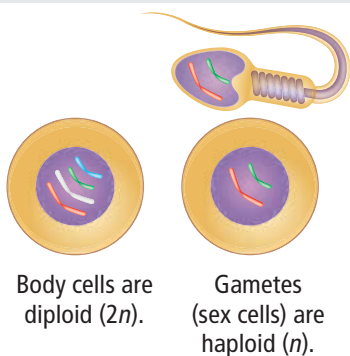
Body Cells and Germ Cells

The 23 pairs of chromosomes you analyzed earlier are from a body, or somatic, cell. Your body cells are called diploid cells because they contain two copies of every chromosome. However, the two copies are not exact copies because one is from your mother and one is from your father. Diploid cells can be represented as $2n$. In humans, the diploid chromosome number is 46.

In addition to body cells, you also have germ cells located in your reproductive organs. Germ cells form **gametes**, or sex cells. The male sex cells are sperm and the female sex cells are eggs. Unlike body cells, gametes have only one copy of each chromosome. These cells are called haploid and can be represented as n . Human gametes thus contain 23 chromosomes. Only DNA in gametes is passed down to the organism's offspring. The DNA in body cells is not.

Sexual reproduction involves the fusion of two gametes of different types, resulting in offspring that are a genetic mixture of both parents. The joining of these two gametes is called fertilization. When fertilization occurs, the nuclei of the egg and sperm fuse to form a single nucleus.

FIGURE 5: Body Cells and Gametes (Cells are not to scale.)



Explain Answer the following questions about body cells and gametes.

1. What is an example of a body cell in your body?
2. Why do gametes have half a set of DNA? What would happen if they had a full set of DNA? Explain your answer.