

DNA and Genes

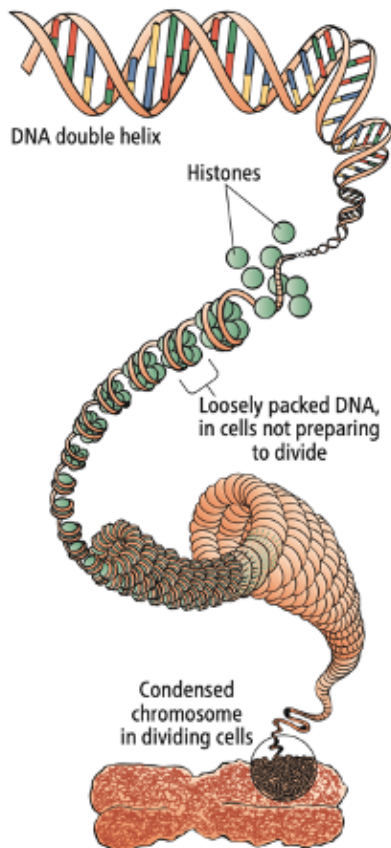
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Photo credit: Geoff Gallice

5.2 Chromosomes

In eukaryotes, DNA is found in the cell nucleus, where it is packaged in structures called chromosomes (Figure 5.2). Each chromosome consists of a long DNA molecule wrapped around small proteins called histones. The histones keep DNA from getting tangled when it is not being used. This is needed because cells have a lot of DNA—if all the DNA in a single human cell were unwound, it would stretch to a length of seven feet! DNA is unwound from the histones when the cell needs to use it. Chromosomes are loosely packed most of the time, but they become condensed when a cell is dividing, something we will learn more about later.



(a)

Figure 5.2

(a) Chromosomes consist of DNA wrapped around histone proteins. Chromosomes are loosely packed most of the time but become condensed when a cell is dividing.

(b) This photo shows chromosomes that are condensed in preparation for cell division.



(b)



Most cells have two of each kind of chromosome, like a pair of matched shoes. Cells with two of each kind of chromosome are **diploid**, and their matched chromosomes are called homologous chromosomes. Some cells—such as sperm and eggs—have only one of each kind of chromosome. These cells are **haploid**. Different organisms have different numbers of chromosomes. Chickens have 78 (39 pairs), mosquitoes have 6 (3 pairs), and yeast have 32 (16 pairs). In humans, there are 46 chromosomes, or 23 pairs (Figure 5.3). The last pair are called sex chromosomes because they determine sex. Females have two X chromosomes, whereas males have one X and one Y chromosome. The rest of the chromosomes are known as autosomes.

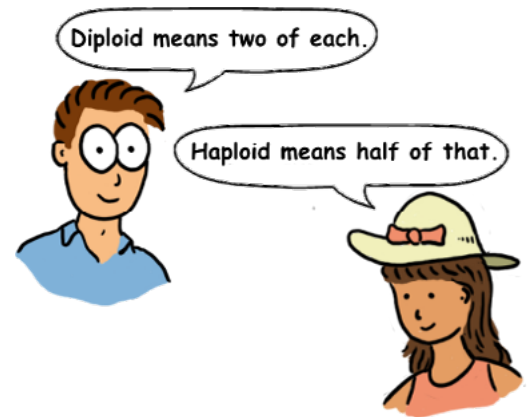
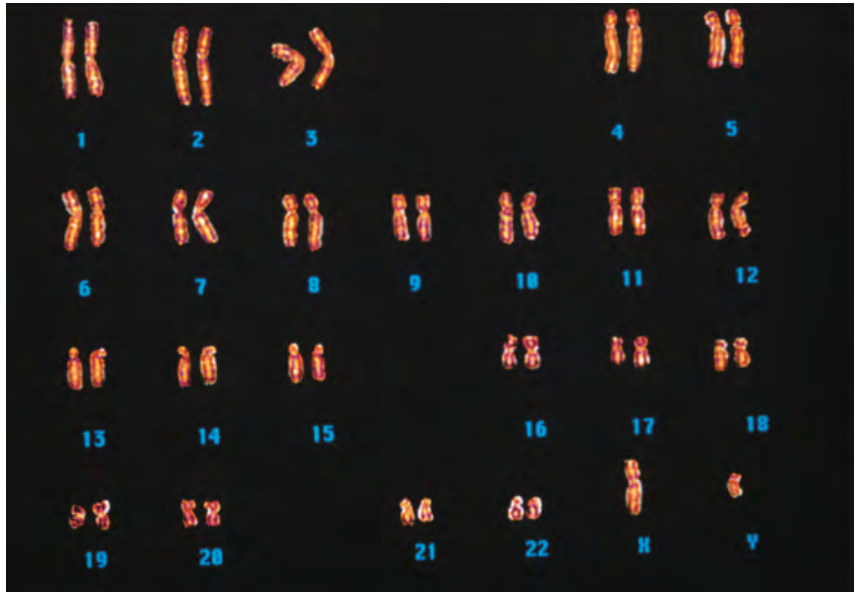


Figure 5.3

Humans have 23 pairs of chromosomes. The last pair, the sex chromosomes, determine whether a person is male or female.

Most of our cells (except our haploid sperm and eggs) have the same 46 chromosomes, with the same DNA and the same genes. This might make you wonder: If all our cells have the same genes, what makes different kinds of cells so different? For example, what makes a brain cell so different from a muscle cell? The answer is that different genes are expressed in each type of cell. The proteins a brain cell makes from its DNA are very different from the proteins a muscle cell makes. To see how proteins are made from DNA, let's start at the beginning. What is the structure of DNA?

READING CHECK

1. If a cell contains the chromosomes shown in Figure 5.3, is the cell haploid or diploid?
2. Do the chromosomes in Figure 5.3 belong to a male or female?

To read more about chromosomes, you can look at this website:

<https://www.genome.gov/about-genomics/fact-sheets/Chromosomes-Fact-Sheet>



CHECK YOUR ANSWERS

1. The cell is diploid because it contains two of each kind of chromosome.
2. They belong to a male because there is an X chromosome and a Y chromosome.

