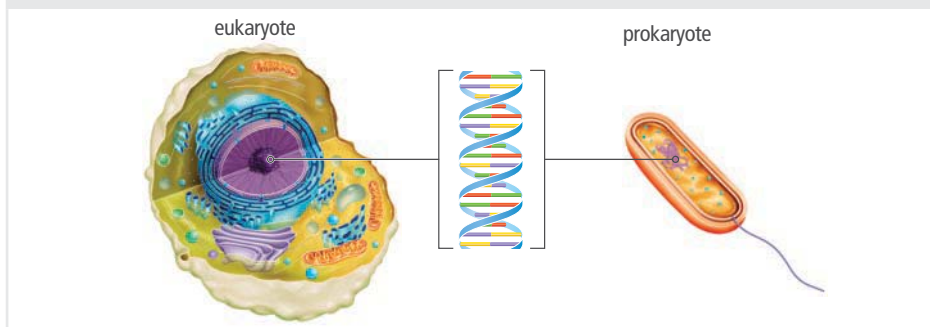


# Chromosomes

An important part of cell division is the replication and division of the cell's genetic material. In all organisms, **DNA** is the genetic material that contains information that determines an organism's inherited characteristics. This information provides instructions for not only the growth and development of each cell, but also for the organism as a whole.

**FIGURE 2:** DNA is the genetic material found in both prokaryotic and eukaryotic cells.



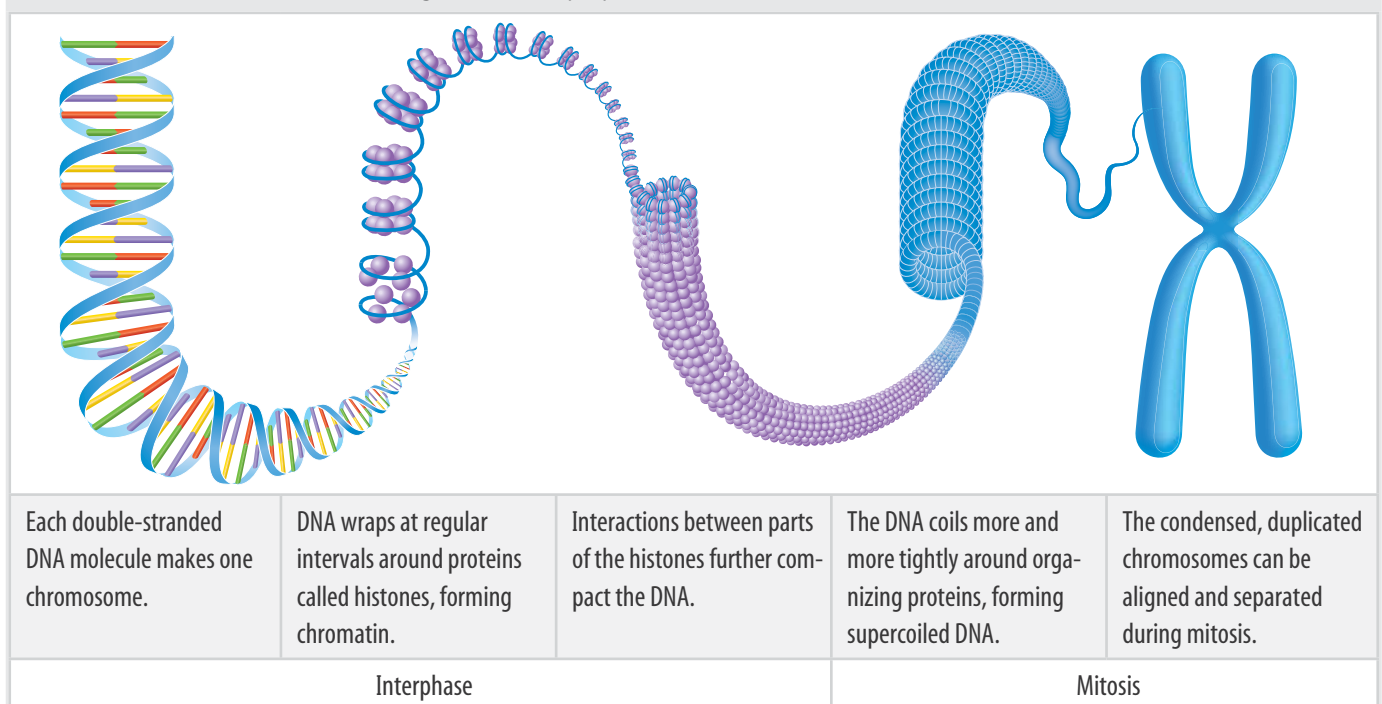
**Analyze** What does this model tell you about the structure and location of DNA in prokaryotic and eukaryotic cells?

## DNA and Chromosomes

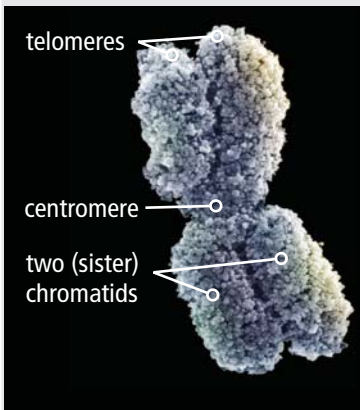
A **chromosome** is one long continuous thread of DNA that consists of many genes. Your body cells have 46 chromosomes each. If stretched out straight and laid end to end, the DNA in just one of your cells would be about 3 meters (10 feet) long! How does it fit inside the nucleus of a microscopic cell?

**Collaborate** Describe to a partner what happens to the chromosome as the cell progresses into mitosis.

**FIGURE 3:** Chromosome structure changes as the cell prepares for cell division.



**FIGURE 4:** A duplicated chromosome is made up of two sister chromatids held together at the centromere.



During interphase, the combination of DNA and proteins is loose—you can think of it like a plate of spaghetti. During this phase, proteins must access specific genes for a cell to make specific proteins or to copy the entire DNA sequence. However, changes start to occur in the structure of the DNA as a cell prepares to enter mitosis.

As a cell progresses into mitosis, chromatin condenses further. It continues to coil more and more tightly around organizing proteins, finally forming small, thick rods. Recall that each chromosome has already been copied during the previous S stage. Thus, the chromosome looks similar to an X in which the left and right halves are two identical DNA double helices. One half of a duplicated chromosome is called a chromatid. Together, the two identical chromatids are called sister chromatids. Sister chromatids are held together at the centromere, a region of the condensed chromosome that looks pinched.



**Model** Create a model to illustrate the meanings of these terms: DNA molecule, chromosome, chromatin, chromatid, and centromere.



## Engineering

**FIGURE 5:** Lobsters are referred to as “immortal” because they do not appear to die from old age.



## Can We Turn Back the Clock on Aging?

The ends of chromosomes form structures called telomeres, which are made of repeating nucleotides that do not form genes. They prevent the ends of chromosomes from accidentally attaching to each other, and they help prevent the loss of genes. A short section of nucleotides is lost from a new DNA molecule each time it is copied. It is important that these nucleotides are lost from telomeres, not from the genes themselves.

The loss of telomeres over time has been linked to aging in organisms. However, some organisms, such as lobsters, are able to regenerate their telomeres with the help of an enzyme called telomerase. Therefore, lobsters are able to remain “young” their entire lives, growing and maintaining a strong metabolism until they die. Scientists are currently studying ways to control telomere length in humans. These applications could be used to delay the aging process by preventing cell death from telomere loss, or they could be applied to diseases such as cancer by preventing the rebuilding of telomeres in cancer cells.



**Analyze** Scientists are currently studying ways telomerase could be used to slow down aging and fight diseases like cancer. How might these studies influence society?



**Explain** Answer the following questions about DNA and cell division.

1. DNA must be coiled into special structures before a cell divides. Why do you think it is necessary for the DNA to be structured this way before cell division occurs?
2. Every cell in your body originated from one cell. What does this mean about the DNA in each of your body cells?