6.3 CHROMOSOMES

DNA is a large molecule, meaning from thousands to tens of millions (and more) of nucleotides long. Since DNA contains all the information for an organism to look and function the way it does, the larger and more complex in structure and function an organism is, the more DNA it contains. (This is a general rule; there are some exceptions.) Prokaryotes are unicellular organisms. They are microscopic and do not perform as many complicated functions as eukaryotes, so the necessary instructions to build a prokaryote are less than those for a eukaryote. Prokaryotes, therefore, do not have as much DNA as eukaryotes, and their DNA can be stored as a single molecule. Eukaryotes, though, have a more complex cell structure, organism structure and function than prokaryotes, and this increased complexity requires more instructions—more DNA—to build and control.

Trying to manage a single molecule that's even a couple hundred thousand nucleotides long, much less hundreds of millions, is rather unwieldy; therefore, eukaryotic DNA is housed in smaller pieces called **chromosomes**, which makes it easier for eukaryotic cells to store and manipulate DNA.

Figure 6.3.1

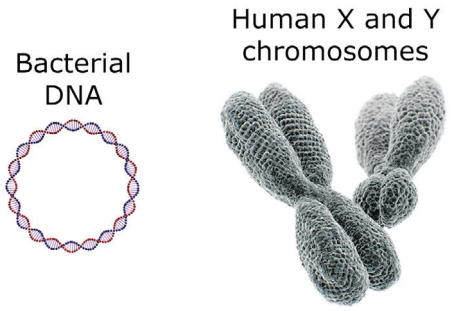
Selected Organisms and the Number of Chromosomes
Fruit flies contain the fewest chromosomes of any type of eukaryote. Ferns contain the most. Note that the number of chromosomes is not always a measure for how "complex" or "big" an organism is. Some organisms have very short chromosomes, and others have very long ones.

Organism	Number of chromosomes
fruit fly	8
rye	14
earthworm	32
pig	40
wheat	42
human	46
fern	>1200

Every kind of eukaryotic organism has its DNA broken into a specific number of chromosomes. For example, a human has forty-six individual chromosomes. This means our entire amount of DNA is broken into forty-six smaller pieces, which each one of our cells contains. A fruit fly has eight chromosomes, the fewest of any eukaryote. Every fruit fly cell has eight chromosomes.

Figure 6.3.2

Eukaryotic and Prokaryotic DNA
A typical bacterial cell contains DNA that's about five thousand nucleotides long. Human DNA is a little over three billion nucleotides (that's the same number of letters you would encounter if you read the Lord of the Rings trilogy books four hundred times). A graphic of what a circular molecule of bacterial DNA looks like when it is removed from its cell is shown to the immediate right. The image on the far right is of two human chromosomes, the sex chromosomes. The X is the bigger one and the Y the smaller one (more on this shortly). Humans have 46 total chromosomes, arranged in pairs (so, 23 pairs), so realize that all human cells have forty-six chromosomes arranged in twenty-three pairs.



To keep track of chromosomes, we do something pretty simple—number them. An important property of eukaryotic chromosomes is they are paired. Humans have 46 total chromosomes, so that means we have twenty-three pairs of chromosomes (23 x 2 = 46)—one pair of chromosome number 1, one pair of chromosome number 2, one pair of chromosome 3, etc. Each pair of chromosomes has similar information, and one set of chromosomes is inherited from the female parent and the other set from the male parent. When an organism has paired chromosomes, it is called **diploid** ("di-" means two, and "-ploid" refers to chromosomes). A diploid organism, then, has paired chromosomes, one set of the pair inherited from the female parent and one set inherited from the male parent.