

## Chromosomes

In eukaryotic cells, the majority of DNA is found within the nucleus and associated with proteins (**chromatin**) that will help the DNA condense into organized structures called chromosomes. In humans, the 3.2 billion nucleotides that make up DNA can be arranged into 46 chromosomal structures which in turn can be separated into 23 pairs (in males, 22 pairs and a mismatched sex chromosome pairing). This pairing is possible because of unique similarities in the DNA that come from the fact that half of the DNA comes from the mother (maternal) and the other half comes from the father (paternal). The similarities between the two sources of DNA are found within distinct sequences of nucleotides called **genes**. More specifically, DNA contains instructions (genes) to make the same types of proteins from two different sources (maternal and paternal). When the DNA condenses into chromosomes, maternal and paternal genes will arrange themselves in a particular order within a chromosome essentially creating a maternal and a paternal chromosome. Since the same types of genes from either source are arranged similarly, the chromosomal arrangement will be close to the same, because in some cases those gene sequences between maternal and paternal sources differ by only one nucleotide! Thus, maternal DNA gene sequences will arrange themselves into 23 chromosomes, and paternal DNA gene sequences will be arranged into 23 chromosomes in a very similar pattern so that the chromosomes can be paired. This pairing is known as **homologous** pairing. In males, although the X and Y sex chromosomes contain different genes, they pair as homologous chromosomes much like the two X chromosome pair in females. This pairing is also referred to as a set and sets of chromosomes are organized by the number of sets that a cell contains, a concept called **ploidy**. For example, if a cell contains one set of chromosomes (maternal only) it is called **haploid**. One set of chromosomes is represented by  $N$ . Since humans have two sets, one maternal set ( $N = 23$  total chromosomes) and one paternal set ( $N = 23$  total chromosomes), humans are **diploid** ( $2N$ ) which means that the total number of chromosomes would be 46 where  $2N = 46$  and  $N = 23$ . Cells that contain complete sets of chromosomes are called **euploid** ( $2N$ ) and cells with missing or additional chromosomes are called **aneuploid** ( $2N-1$ ; Turner syndrome,  $2N+1$ ; Down syndrome, etc.). The  $N$  represents the number of sets, and the  $-1$  or  $+1$  represents a single chromosome missing or added.



This content is provided to you freely by BYU-I Books.

Access it online or download it at [https://books.byui.edu/bio\\_180/1211\\_chromosomes](https://books.byui.edu/bio_180/1211_chromosomes).

