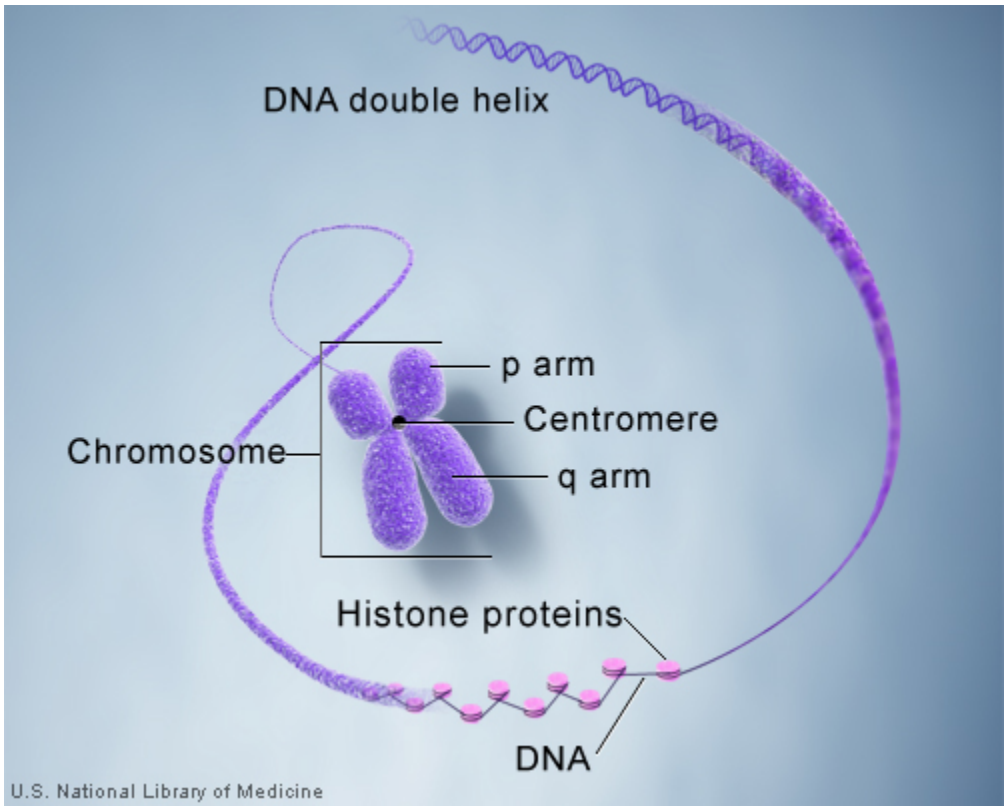
Chromosome

In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.

Chromosomes are not visible in the cell's nucleus—not even under a microscope—when the cell is not dividing. However, the DNA that makes up chromosomes becomes more tightly packed during cell division and is then visible under a microscope. Most of what researchers know about chromosomes was learned by observing chromosomes during cell division.

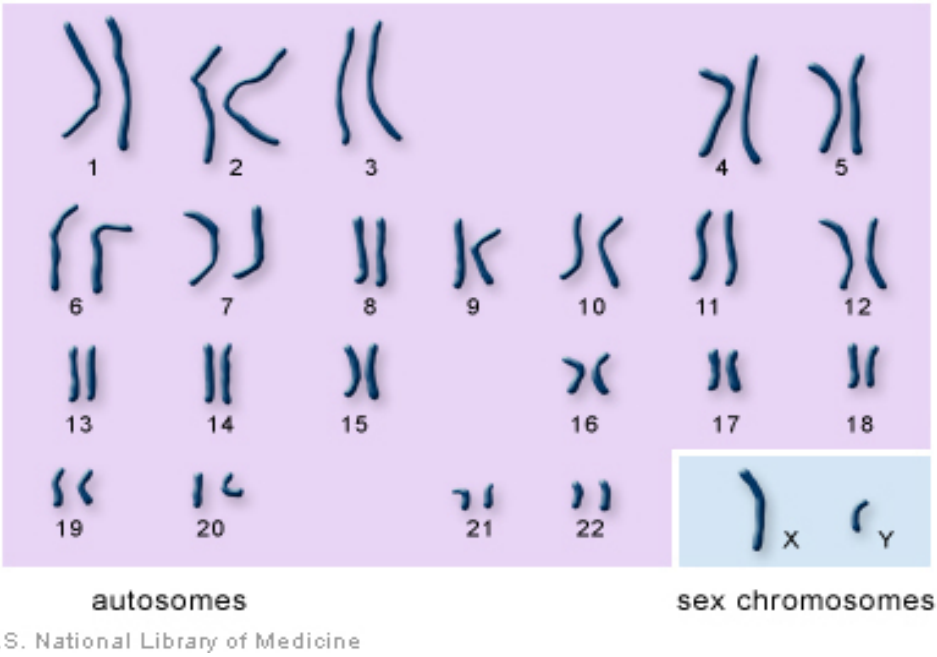
Each chromosome has a constriction point called the centromere, which divides the chromosome into two sections, or "arms." The short arm of the chromosome is labeled the "p arm." The long arm of the chromosome is labeled the "q arm." The location of the centromere on each chromosome gives the chromosome its characteristic shape, and can be used to help describe the location of specific genes.



DNA and histone proteins are packaged into structures called chromosomes.

How many chromosomes do people have?

In humans, each cell normally contains 23 pairs of chromosomes, for a total of 46. Twenty-two of these pairs, called autosomes, look the same in both males and females. The 23rd pair, the sex chromosomes, differ between males and females. Females have two copies of the X chromosome, while males have one X and one Y chromosome.



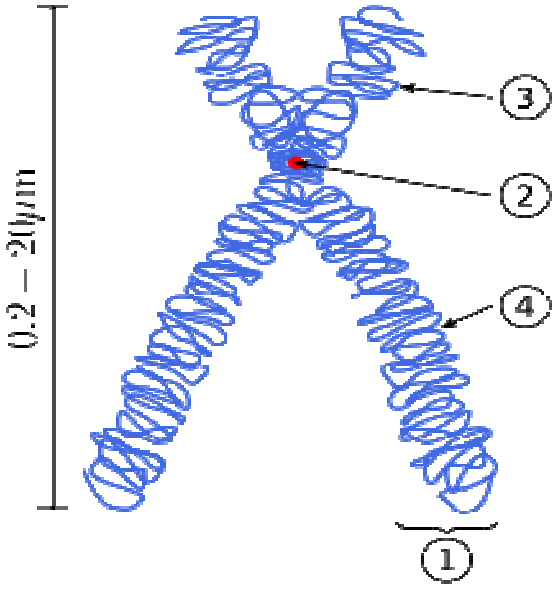
The 22 autosomes are numbered by size. The other two chromosomes, X and Y, are the sex chromosomes. This picture of the human chromosomes lined up in pairs is called a karyotype.

chromatid

A **chromatid** holds the replicated DNA of each individual chromosome, which are joined by a centromere, for the process of cell division (mitosis or meiosis). They are normally identical ("homozygous") but may have slight differences in the case of mutations, in which case they are heterozygous. They are called sister chromatids so long as they are joined by the centromeres. When they separate (during anaphase of mitosis and anaphase 2 of meiosis), the strands are called daughter chromosomes (although having the same genetic mass as the individual chromatids that made up its parent, the daughter "molecules" are still referred to as chromosomes much as one child is not referred to as a single twin). Before replication, one chromosome is composed of one

DNA molecule and after there are two DNA moles. This is due to the fact that DNA replication increases the amount of DNA and does not increase the number of chromosomes.

In other words, a chromatid is "one-half of two [normally] identical copies of a replicated chromosome". The two copies may have slight differences due to mutations. A chromatid is simply a copied chromosome which is paired with a (normally) identical chromosome at the centromere. It should not be confused with the ploidy of an organism, which is the number of homologous versions of a chromosome.



Chromatin

Chromatin is the combination of DNA and proteins that make up the contents of the nucleus of a cell. The primary functions of chromatin are: to package DNA into a smaller volume to fit in the cell, to strengthen the DNA to allow mitosis, prevent DNA damage, and to control gene expression and DNA replication. The primary protein components of chromatin are histones that compact the DNA. Chromatin is only found in eukaryotic cells: prokaryotic cells have a very different organization of their DNA which is referred to as a genophore (a chromosome without chromatin).

The structure of chromatin depends on several factors. The overall structure depends on the stage of the cell cycle: during interphasethe chromatin is structurally loose to

allow access to RNA and DNA polymerases that transcribe and replicate the DNA. The local structure of chromatin during interphase depends on the genes present on the DNA: DNA coding genes that are actively transcribed ("turned on") are more loosely packaged and are found associated with RNA polymerases (referred to as euchromatin) while DNA coding inactive genes ("turned off") are found associated with structural proteins and are more tightly packaged (heterochromatin). Epigenetic chemical modification of the structural proteins in chromatin also alter the local chromatin structure, in particular chemical modifications of histone proteins by methylation and acetylation. As the cell prepares to divide, i.e. enters mitosis or meiosis, the chromatin packages more tightly to facilitate segregation of the chromosomes during anaphase. During this stage of the cell cycle this makes the individual chromosomes in many cells visible by optical microscope.