

Structure of DNA and Chromosomes

by Sophia



WHAT'S COVERED

In this lesson, you will learn to understand the structure of DNA. Specifically, this lesson will cover:

1. Chromosome Structure & Function

When a cell is getting ready to divide, genetic information in the form of DNA will condense into structures called **chromosomes**. This is how genetic information is passed from parent to offspring.

Homologous chromosomes are chromosomes that contain the same set of genes and are the same length and shape. One is from the mother of the offspring, and other is from the father.



There are two types of chromosomes within our body:

- **Sex chromosomes:** Chromosomes associated with sex and gender
- **Autosomes:** All the chromosomes in our body except for the sex chromosomes



TERMS TO KNOW

Chromosome

A condensed DNA structure.

Homologous Chromosomes

Chromosomes paired together that are the same length and shape and contain the same sets of genes; typically, one of the homologous pair is contributed by each parent.

Sex Chromosomes

Chromosomes associated with sex and gender.



Autosomes

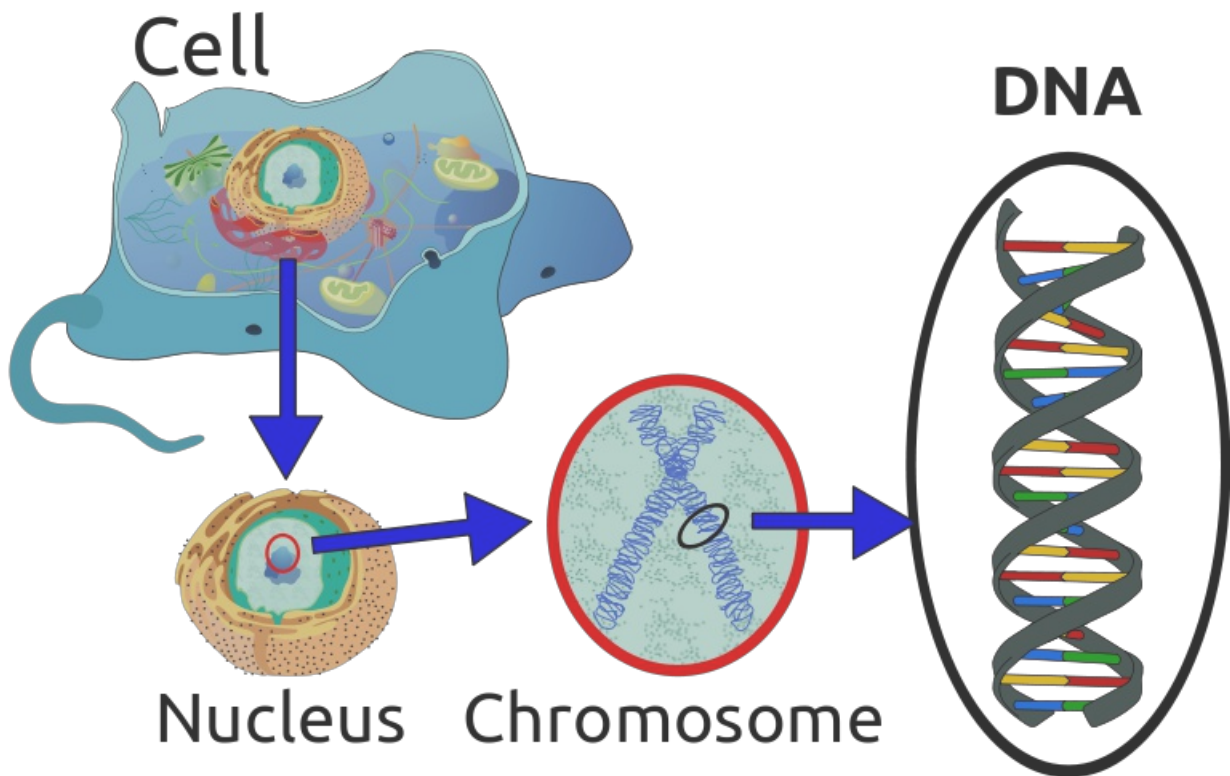
All of the chromosomes in the body except for sex chromosomes.

2. Chromosome Number & Location

The chromosome number is the number of chromosomes in a species' cells. Each species has its own number of chromosomes.

➔ **EXAMPLE** For humans, the chromosome number is 46. This means that we have 46 chromosomes, or 23 pairs of homologous chromosomes, in our cells. Of those 46 chromosomes, most of them are autosomes. Only two of those chromosomes are sex chromosomes. A mouse has a total of 40 chromosomes.

Chromosomes are only visible in this form when the cell is preparing to divide. The rest of the time, our genetic information can be found in the form of chromatin, which has a balled-up, thread-like form and is found within the cell's nucleus.

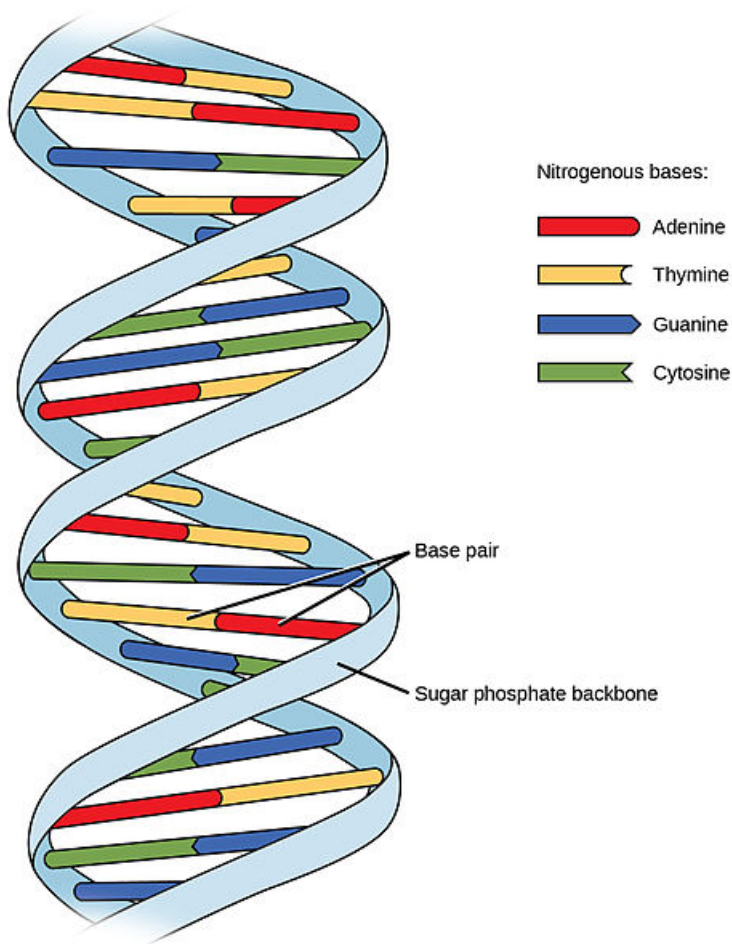


This makes sense; when the cell isn't dividing, the DNA is more stretched out so its information is physically accessible. When the cell is dividing, the DNA has to move all the way across the cell. It's not being accessed for much information, so it's better to be wound up tight with a bunch of protective proteins. It's like packing a suitcase: It's easier to take everything you need if all the clothes are rolled up tightly (just as the DNA is condensed into visible chromosomes) than if you just throw clothes in a pile in your suitcase (like when the DNA is stretched out).

3. DNA Structure

DNA is said to be in the structure of a **double helix**, or a "twisting ladder". The outside parts of the ladder (the "side rails") are made up of a phosphate-sugar backbone—that is, phosphate and deoxyribose sugar

molecules. In DNA, the sugar within its nucleotides is called deoxyribose; in RNA, the sugar within its nucleotides is called ribose.



TERM TO KNOW

Double Helix

The shape of the DNA molecule; often is referred to as the “twisted ladder” and is the title to the book about Watson & Crick's discovery of DNA's structure.

3a. Nitrogenous Bases

The "rungs" of the ladder are made up of four nitrogenous bases:

- Adenine
- Thymine
- Cytosine
- Guanine

These nitrogenous bases compose two base pairs. Adenine always pairs with thymine, and cytosine always pairs with guanine.



TERMS TO KNOW

Adenine (A)

A nucleotide building block of DNA and RNA, adenine is classified as a purine and complements thymine (T) in DNA and uracil (U) in RNA.

Thymine (T)

A nucleotide building block of DNA, thymine is classified as pyrimidine and complements adenine (A) in DNA; thymine is not found in RNA.

Guanine (G)

A nucleotide building block of DNA and RNA, guanine is classified as a purine and complements cytosine (C) in DNA and RNA.

Cytosine (C)

A nucleotide building block of DNA and RNA, it is classified as pyrimidine and complements guanine (G) in DNA and RNA.

3b. Base Pairs

The phosphate, the sugar, and the nitrogenous base together make a **nucleotide**, and each "rung" of the double helix (and the rung's small portion of "side rail") is made of two nucleotides facing each other. In DNA, the two nucleotides that make up a particular rung of the twisted ladder are called a **base pair**. Adenine always pairs with thymine, and cytosine always pairs with guanine.



TERMS TO KNOW

Nucleotide

Organic molecules that consist of a five-carbon sugar (ribose in the case of RNA and deoxyribose in the case of DNA), a phosphate group and a nitrogenous base; nucleotides are the building blocks of nucleic acids (DNA & RNA).

Base Pair

The way that nucleotides interact with one another, A bonds with T and C bonds with G in DNA, while C bonds with G and A bonds with U (uracil) in RNA; the sequence of base pairs creates the genetic code that is transcribed and translated into proteins.

3c. Nucleotide Sequence

If you follow one of the "rails" of the DNA's "twisting ladder", you will see the nucleotides' order (A, T, C, etc.). This is called a **nucleotide sequence**. The order of letters (nucleotides) in the nucleotide sequence is very important because the sequence contains instructions or "recipes" for all our thousands of proteins. These "recipes" for our proteins are called **genes**. Any change in the nucleotide sequence is a **mutation** and can have a negative impact on a protein's structure or production.

For example, one of the genes for making hemoglobin is 1,605 nucleotides long. Within that stretch of DNA, there is a sequence of three nucleotides that reads "GAG", but in some people, the nucleotide sequence at that location reads "GTG". It's like a typo; instead of saying, "Shall I compare thee to a summer's day" the gene says, "Shawl I compare thee to a summer's day".

Hemoglobin produced from this mutated gene is more likely to clump. If only one of the two copies of chromosome 11 (one of its two homologous pairs) has this mutation, it means only half of the hemoglobin the person produces is clumpy, and the person is less vulnerable to malaria. But if both of the homologous chromosomes have the mutated genes, all of the hemoglobin produced is clumpy, and the person will suffer from sickle cell anemia.



TERMS TO KNOW

Nucleotide Sequence

The arrangement of nucleotides (the order of A's, C's, G's and T's) that form genes in strands of

DNA.

Gene

A segment of DNA that codes for a specific protein, genes are a sequence of nucleotides.

Mutation

A change in the nucleotide sequence.



SUMMARY

Chromosomes are the form DNA takes when a cell is getting ready to divide, and are only visible during this time. Homologous chromosomes are chromosomes that contain the same set of genes. There are two types of chromosomes within our body: autosomes and sex chromosomes. The **chromosome number** is the number of chromosomes a species has in its cells. **DNA**, the genetic information that makes up chromosomes, come in the form of a double helix. It is made up of phosphate and deoxyribose sugar molecules as the backbone of the structure with adenine/thymine or cytosine/guanine base pairs in between.

Keep up the learning and have a great day!

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TERMS TO KNOW

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Autosomes

All of the chromosomes in the body except for sex chromosomes.

Base Pair

The way that nucleotides interact with one another. In DNA, A bonds with T, and C bonds with G. In RNA, C bonds with G, and A bonds with U (uracil). The sequence of base pairs creates the genetic code that is transcribed and translated into proteins.

Chromosome

A condensed DNA structure.

Cytosine (C)

A nucleotide building block of DNA and RNA, cytosine is classified as pyrimidine and complements guanine (G) in DNA and RNA.

Double Helix

The shape of the DNA molecule; often is referred to as the “twisted ladder” and is the title to the book about Watson & Crick's discovery of DNA's structure.

Gene

A segment of DNA that codes for a specific protein, genes are a sequence of nucleotides.

Guanine (G)

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Homologous Chromosomes

Chromosomes paired together that are the same length and shape and contain the same sets of genes. Typically, one of the homologous pair is contributed by each parent.

Mutation

A change in the nucleotide sequence.

Nucleotide

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Nucleotide Sequence

The arrangement of nucleotides (the order of A's, C's, G's, and T's) that form genes in strands of DNA.

Sex Chromosomes

Chromosomes associated with sex and gender.

Thymine (T)

A nucleotide building block of DNA, thymine is classified as pyrimidine and complements adenine (A) in DNA; thymine is not found in RNA.