Section 4.1 – Cell Division and Reproduction

SBI3U

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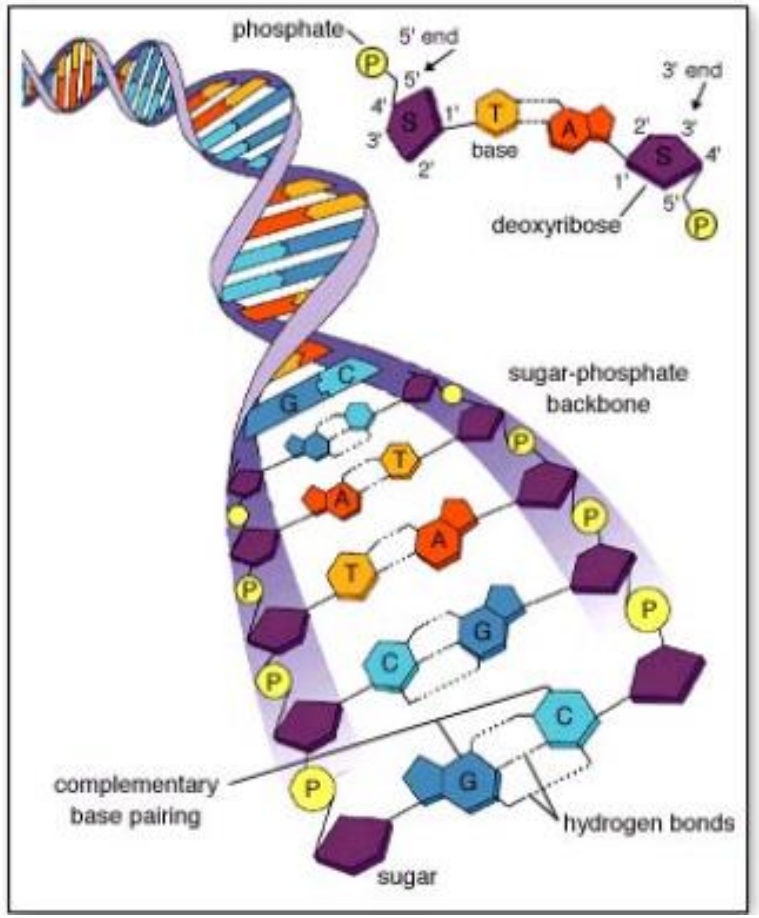
DNA Structure

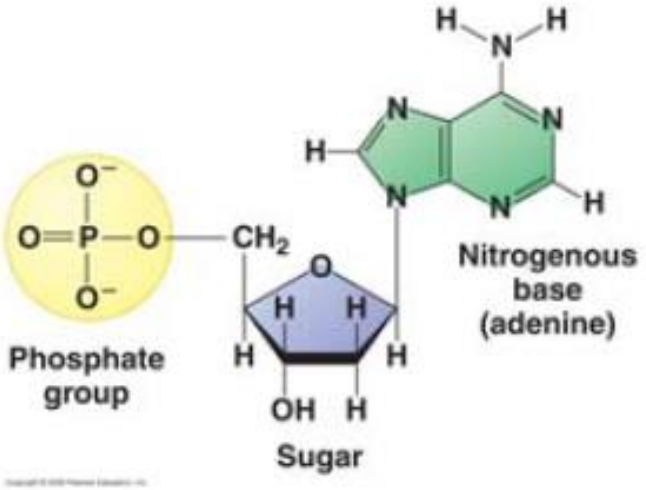
DNA is the genetic information that an individual inherits from his/her parents.

DNA is double stranded and is known as a "double helix".

During cell division (mitosis), DNA is replicated so that each new cell receives an identical copy of the genetic information.

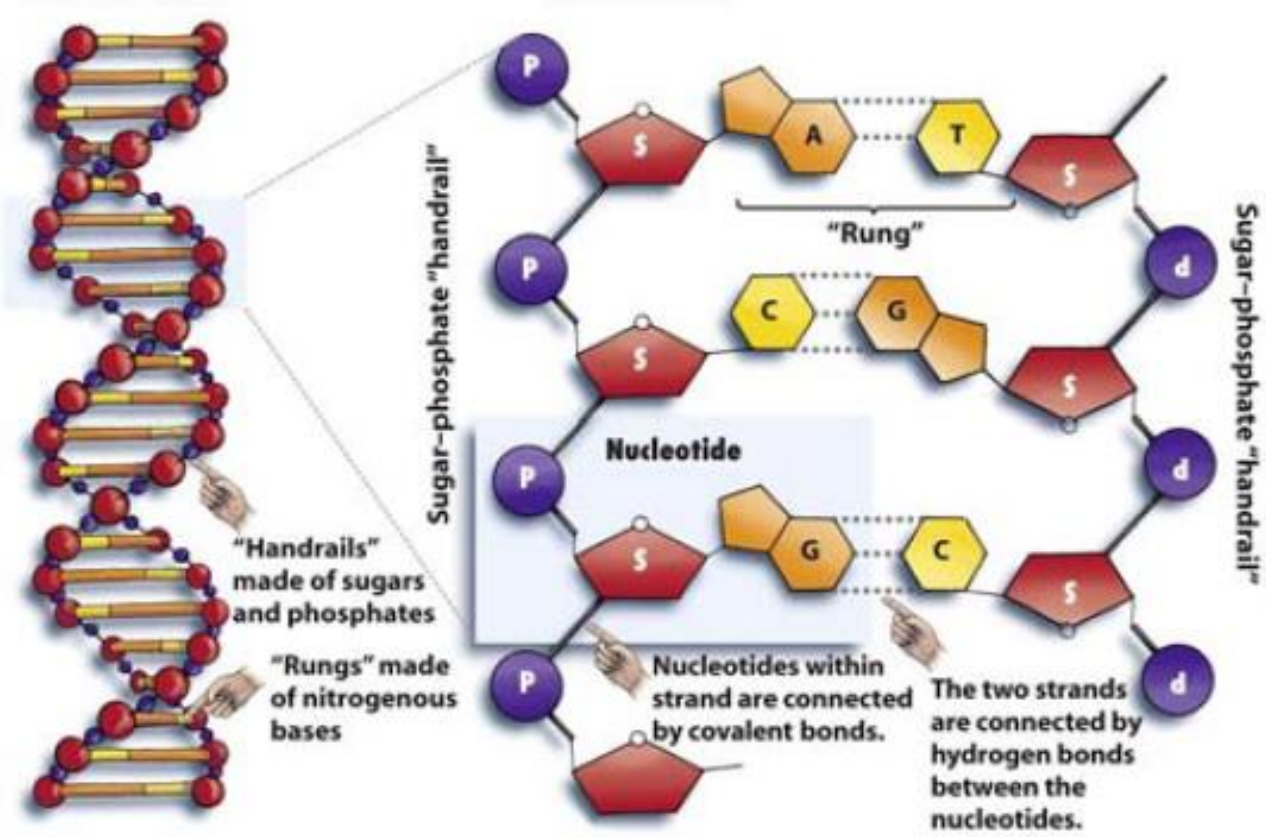
DNA Structure





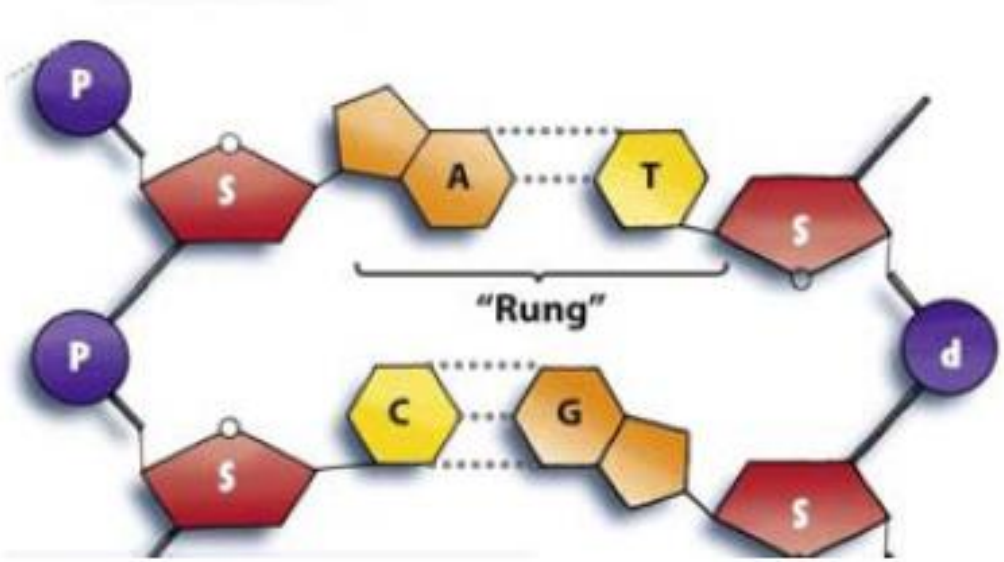
Nucleotides *are the monomer subunits and they join together to form a long polynucleotide chain (a.k.a nucleic acid)*

DNA Structure



DNA Structure

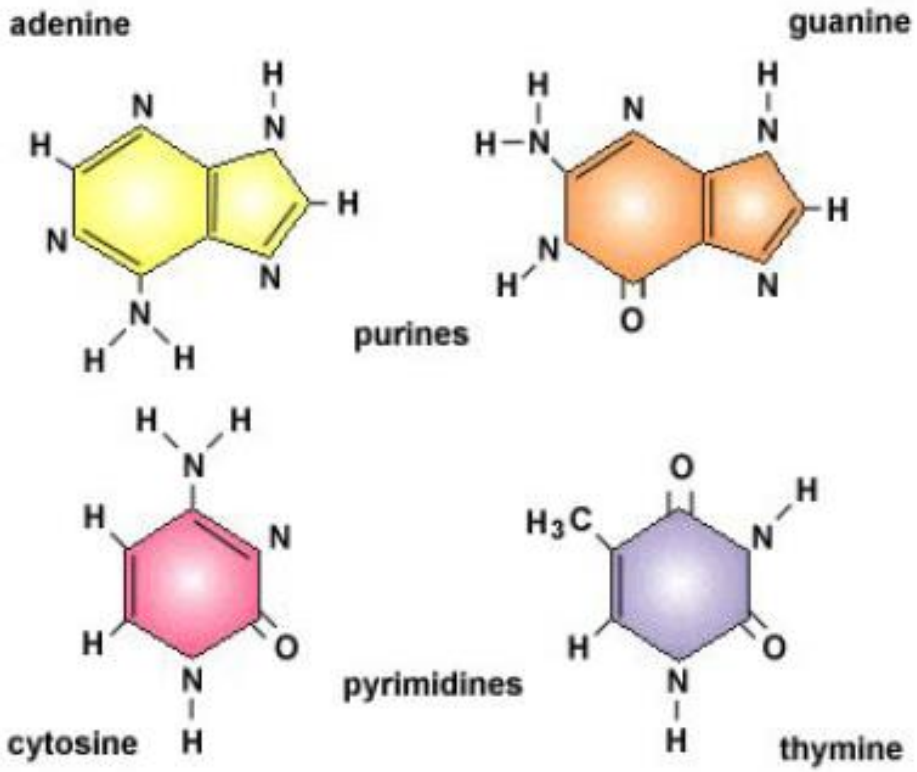
Nitrogenous bases are complementary to one another and are held together by hydrogen bonds.



Adenine always pairs with **Thymine** and forms 2 H-bonds.

Cytosine always pairs with **Guanine** and forms 3 H-bonds.

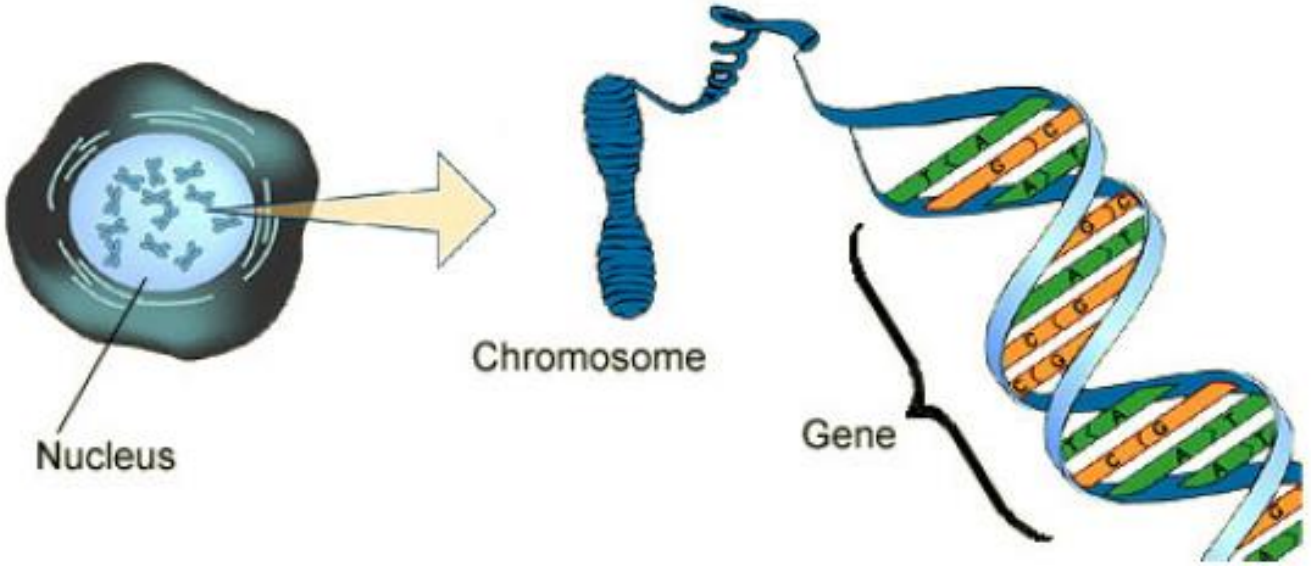
DNA Structure



Purines *can only bind with* ***Pyrimidines*** *and vice versa. This enables DNA to adopt its perfect helical structure.*

DNA Structure and Function

There are multiple genes along the DNA strand that code for particular proteins that are responsible for traits in the human body.



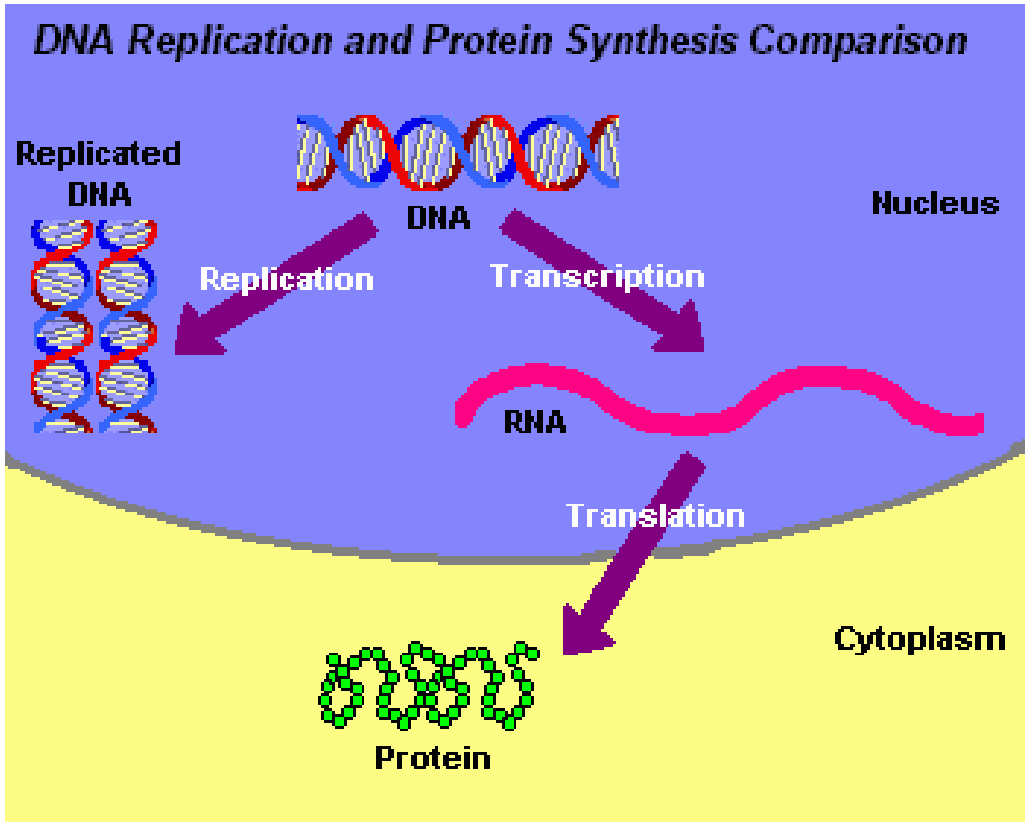
Each protein that is produced from the gene has a particular role in the cell or human body.

DNA Structure and Function

DNA in contained in the nucleus and can either go through the process of '***Replication***' or '***Transcription***'.

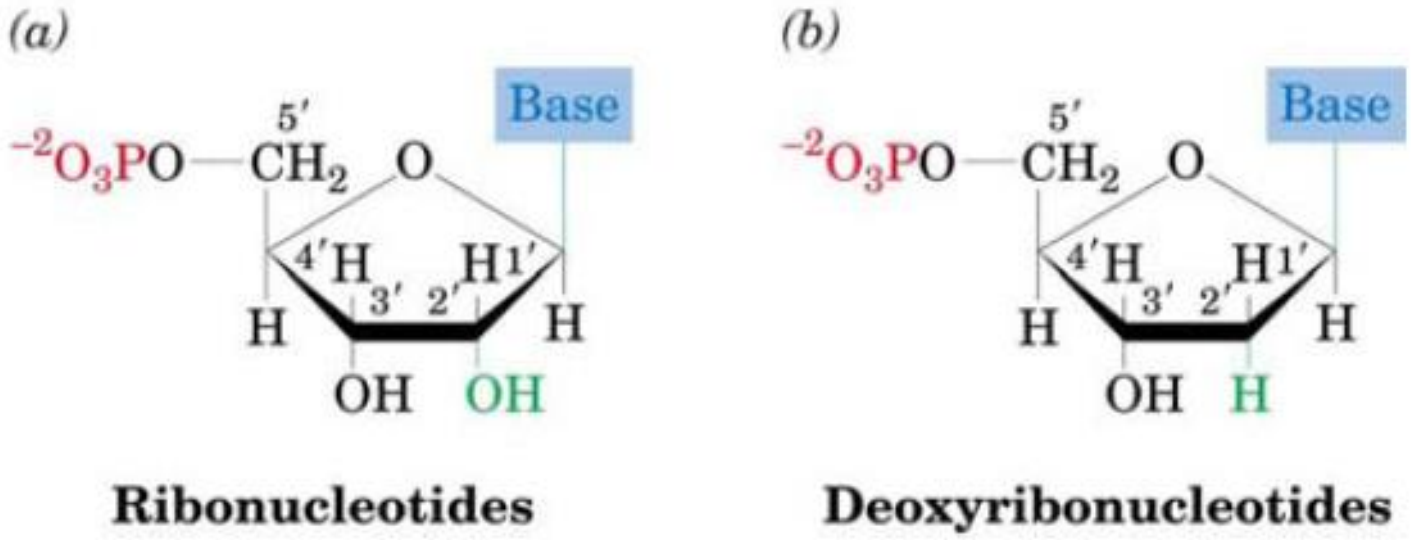
Replication: DNA is copied during mitosis

Transcription: RNA is made and travels to the cytoplasm whereby specific proteins are made.



DNA vs. RNA

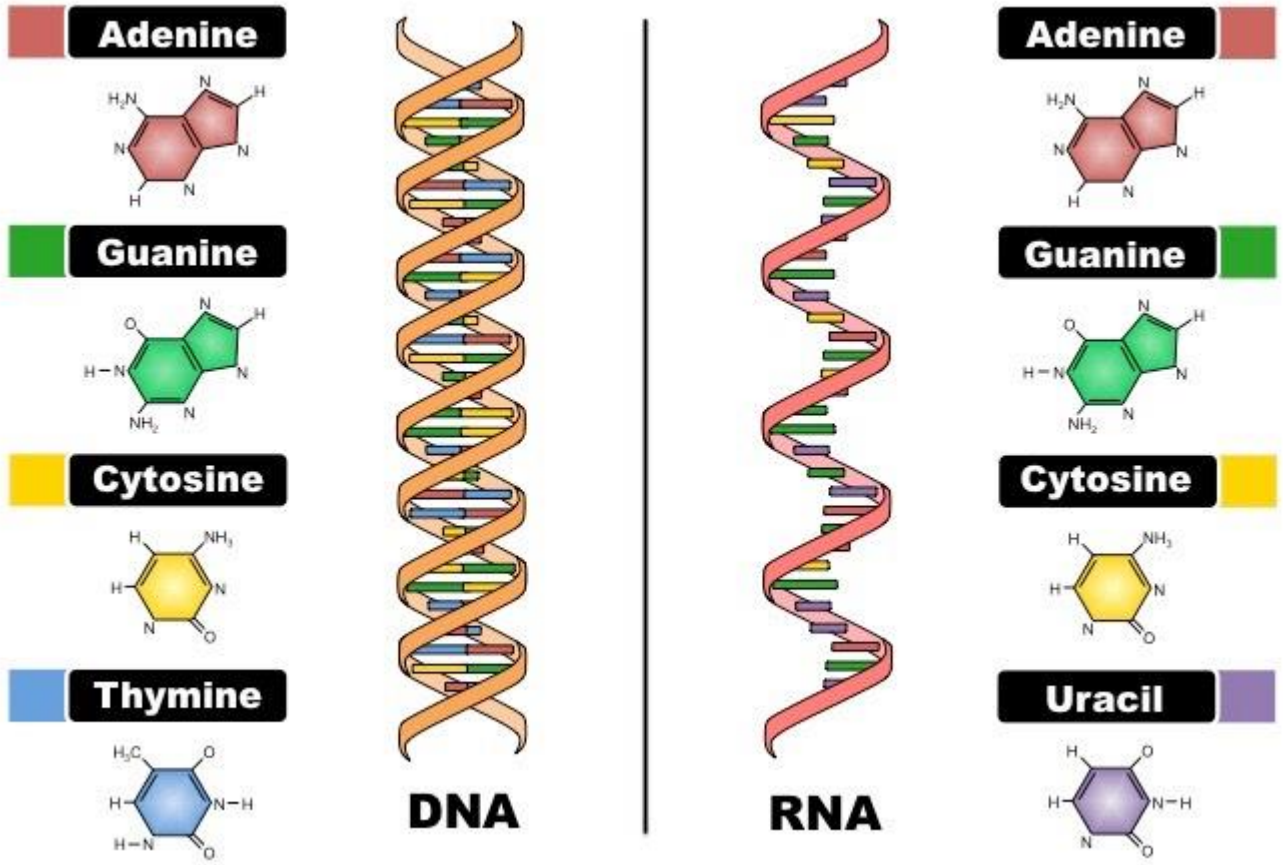
DNA is known as 'Deoxyribonucleic acid', due to the –OH that is lacking on the 2' carbon of the sugar. RNA is another molecule that contains genetic information and contains a –OH group on the 2' carbon.



Ribonucleotides **Deoxyribonucleotides**

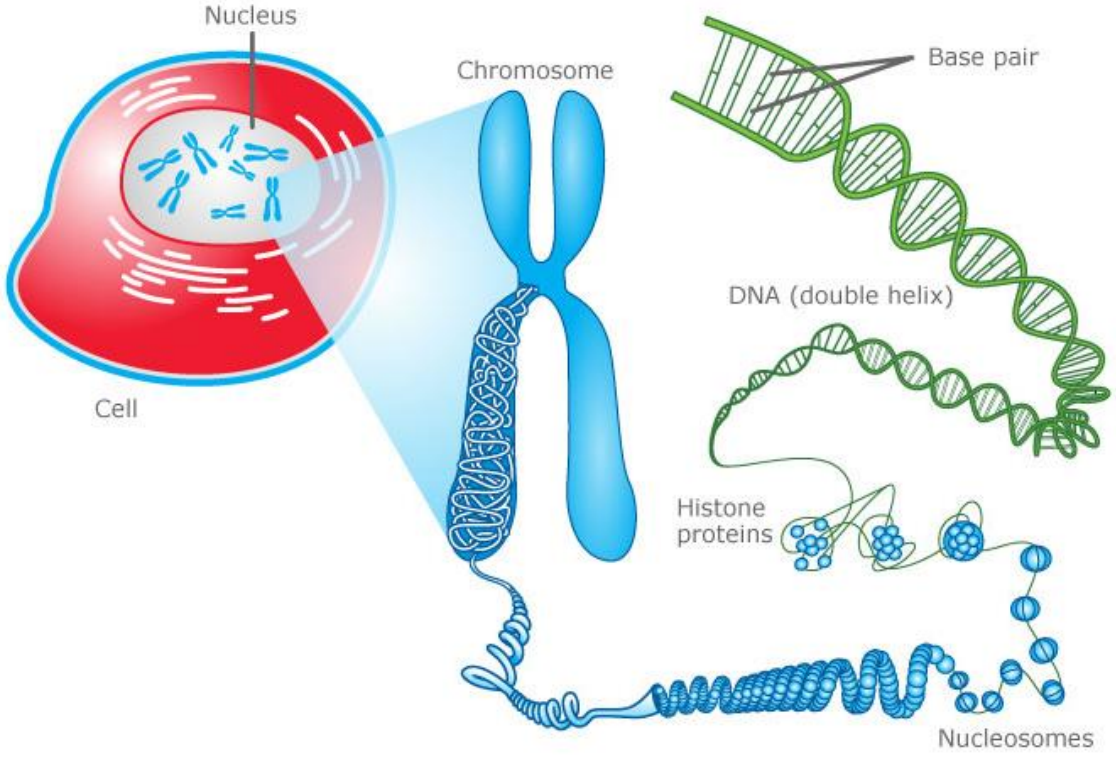
DNA vs. RNA

In addition to the sugar of the nucleotide, their structure and nitrogenous bases also differ.

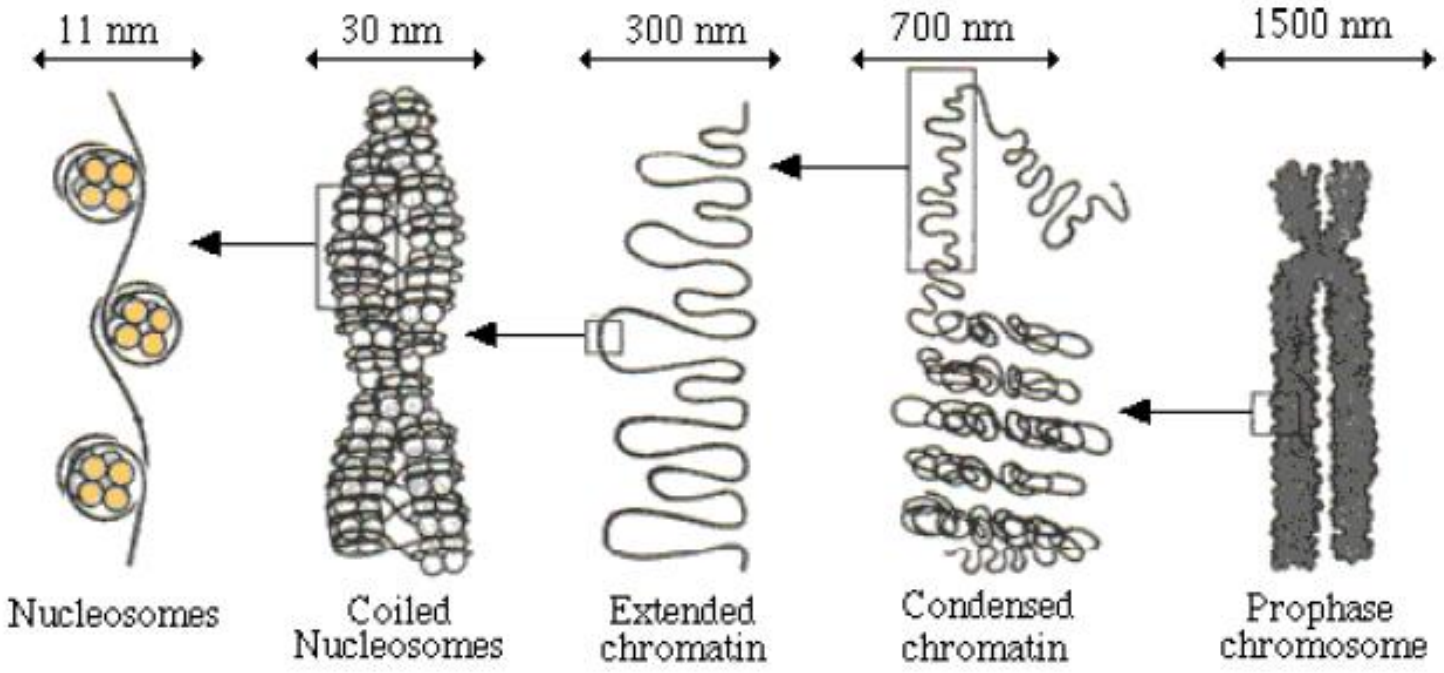


DNA Structure

DNA is approximately 2m long and must condense to fit into the nucleus of a cell.



DNA – Levels of Organization



DNA needs to coil in order to fit into the small nucleus of the cell. At different points of the cell cycle the DNA molecule will be more coiled then others.

DNA – Levels of Organization

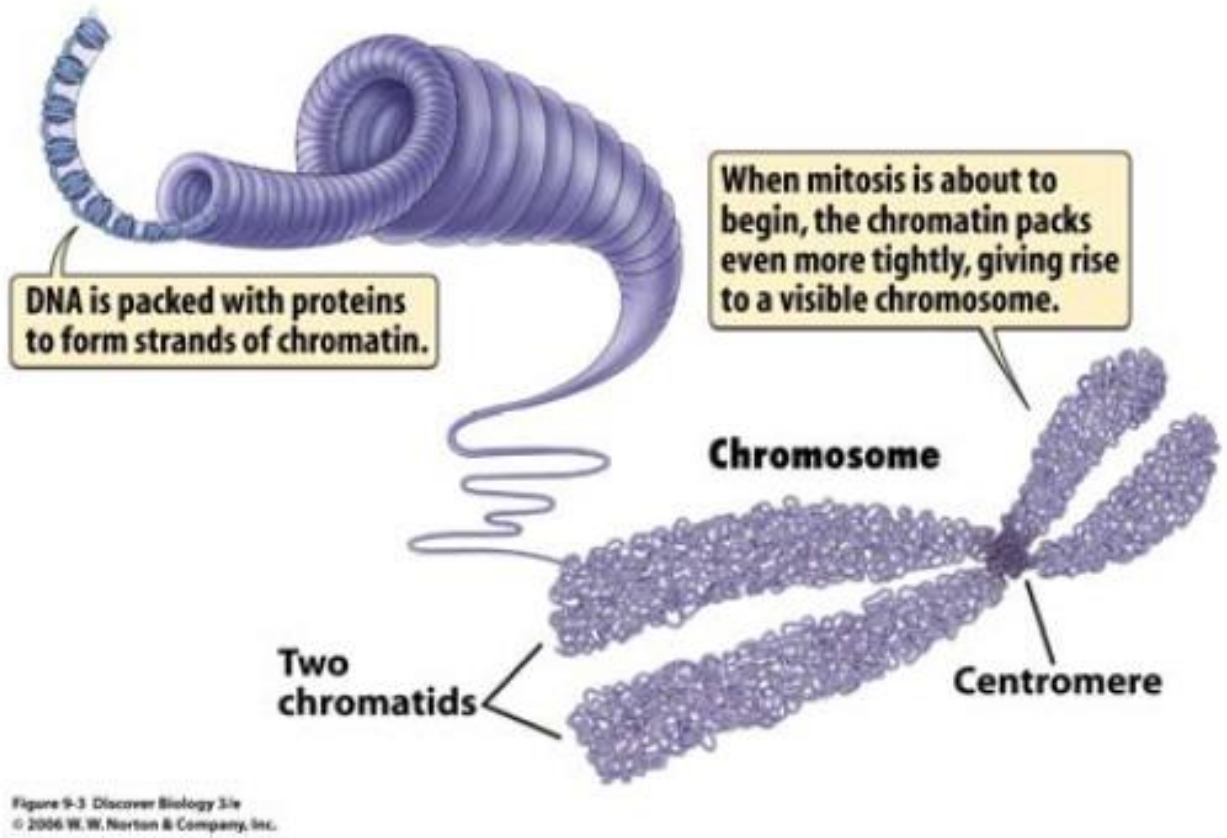


Figure 9-3 Discover Biology 3/e
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Sister chromatids are present after the DNA has been replicated and mitosis is about to begin.

Types of Cells in the Human Body

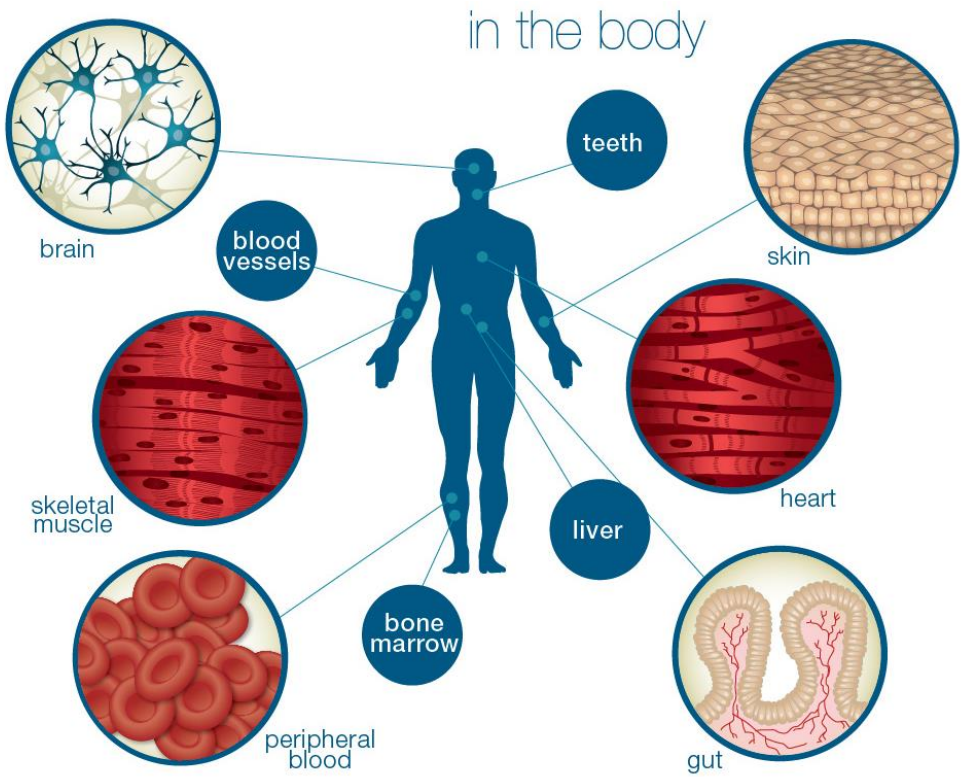
Multicellular organisms are made up of more than one cell. Each cell plays a specific role in the overall functioning of the organism. The human body is multicellular and contains two types of cells.

Types of Cells:

1. Somatic Cells

2. Gametic Cells

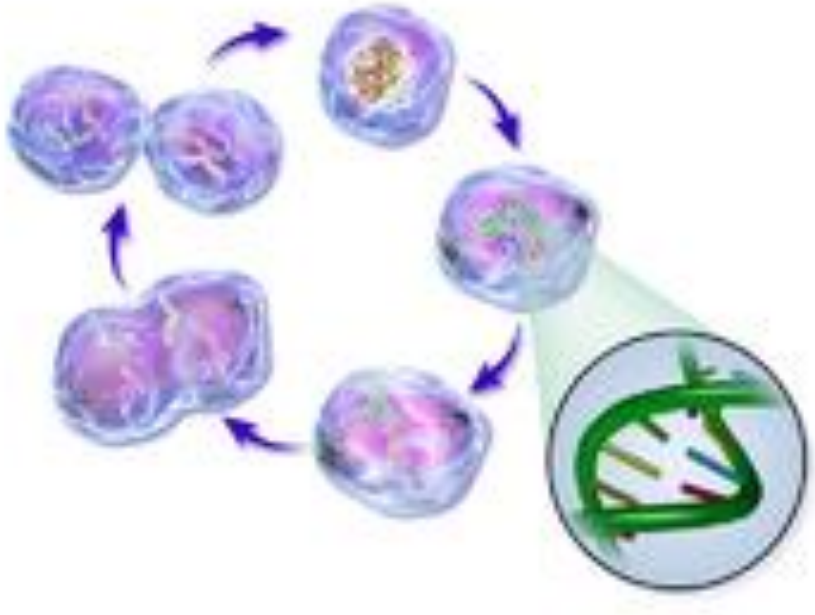
1. Somatic Cells

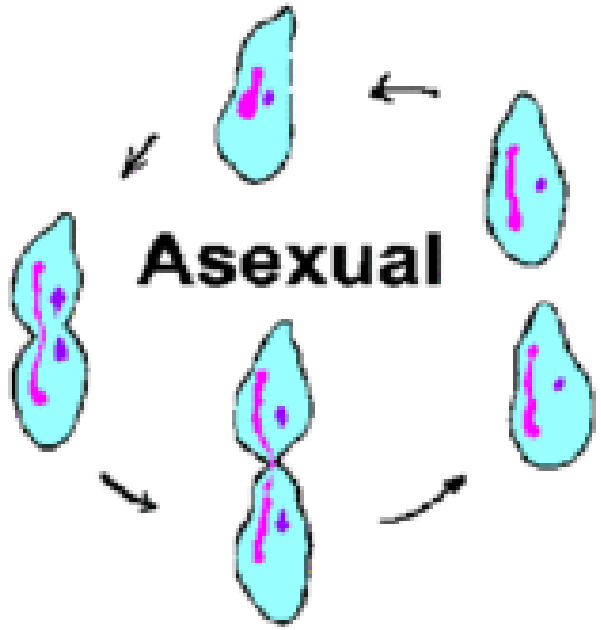


All cells in the body that are not involved in reproduction are known to be 'somatic cells'. They contain 46 chromosomes.

1. Somatic Cells

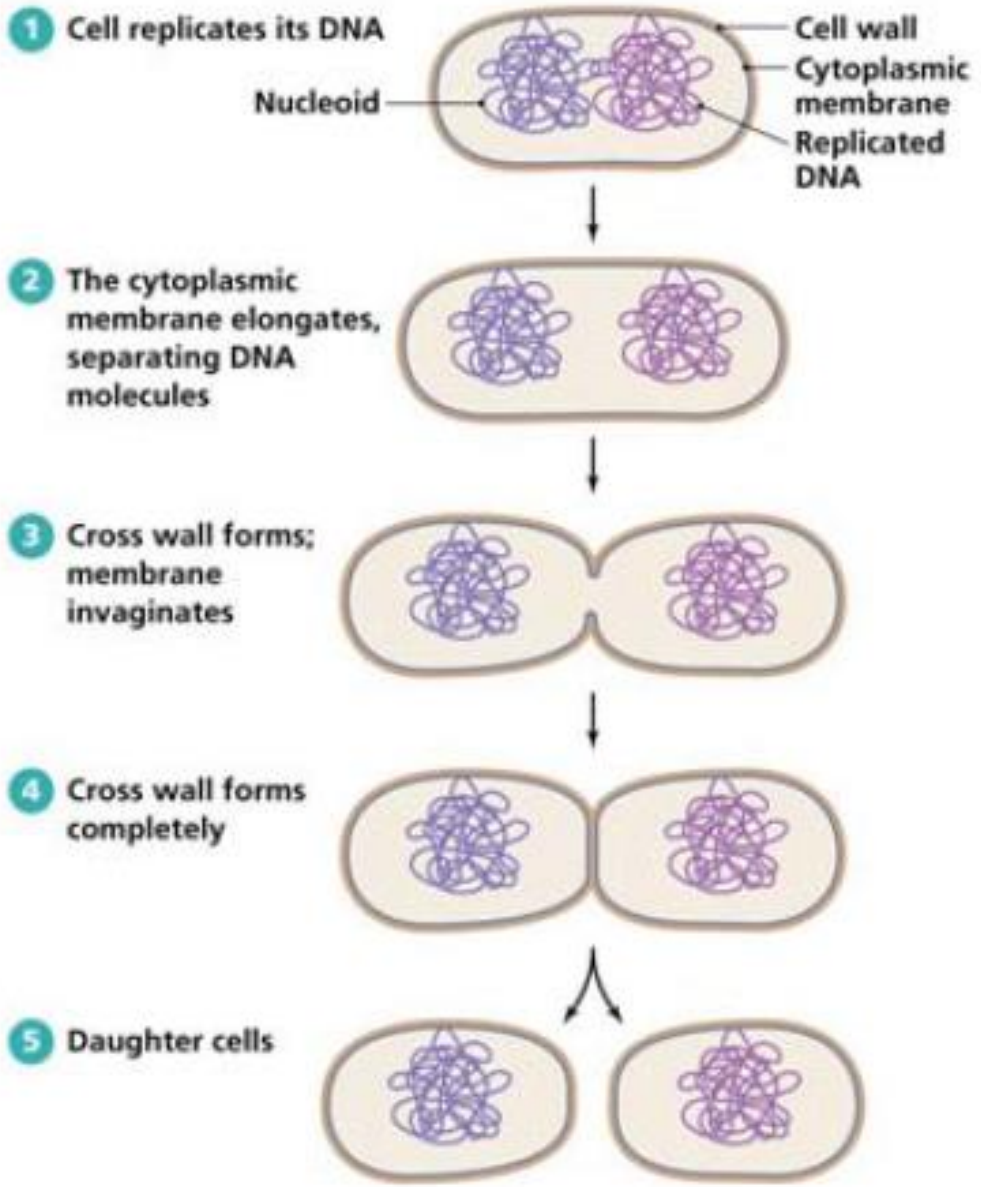
Somatic Cells go through asexual reproduction. Each cell will go through its own cell cycle and will proliferate when needed.



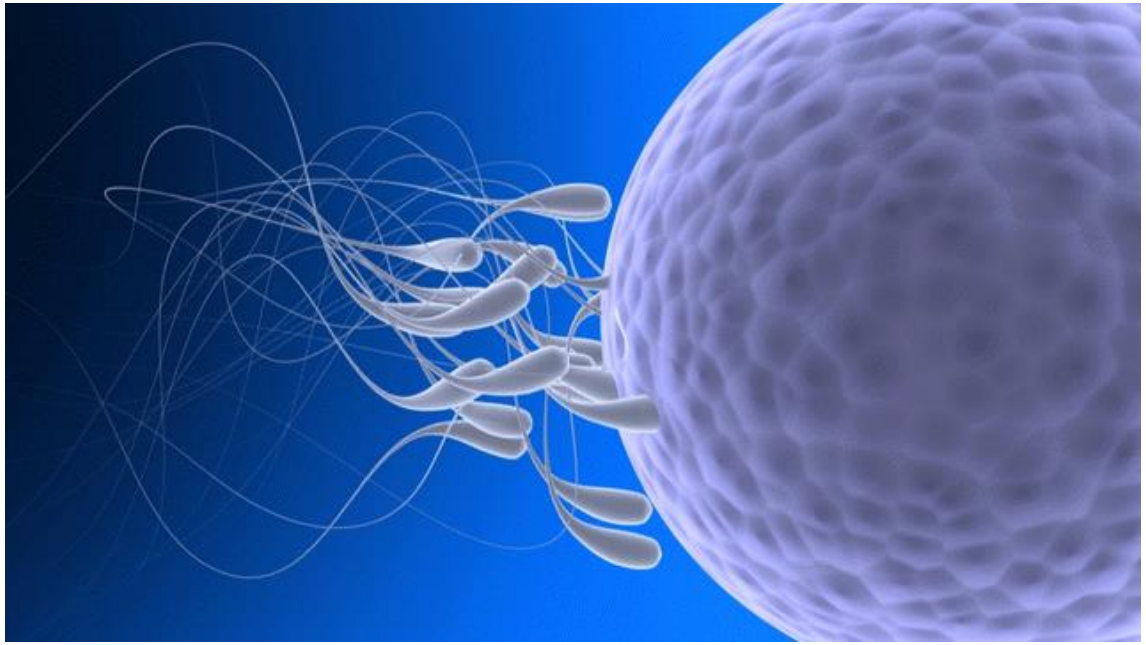


Asexual Reproduction

Bacteria reproduce by a process known as binary fission. Unlike somatic cells (found in humans), bacterial cells are able to reproduce rapidly and exponentially.



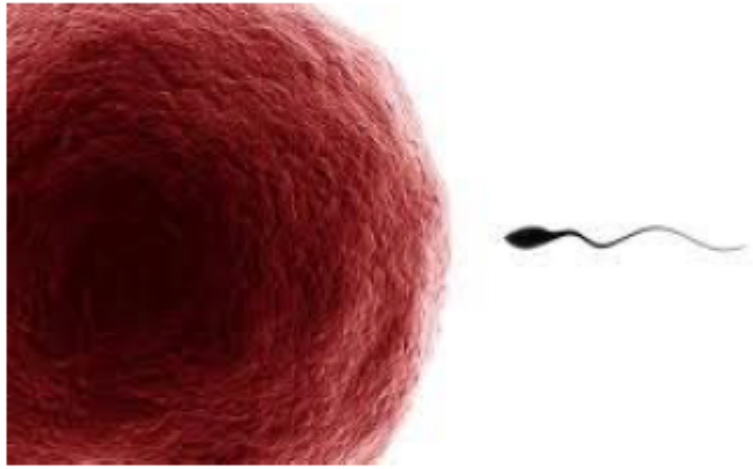
2. Gametic Cells



The cells that involved in the process of reproduction are known as 'gametes'. These cells only contain half the number of chromosomes found in somatic cells and they are only found in the reproductive organs.

2. Gametic Cells

Involves the fusion of two specialized cells (i.e. gametes) which result in an offspring with a lot of genetic variation.



Each offspring created will be genetically different from one another due to the random combinations of gametes.

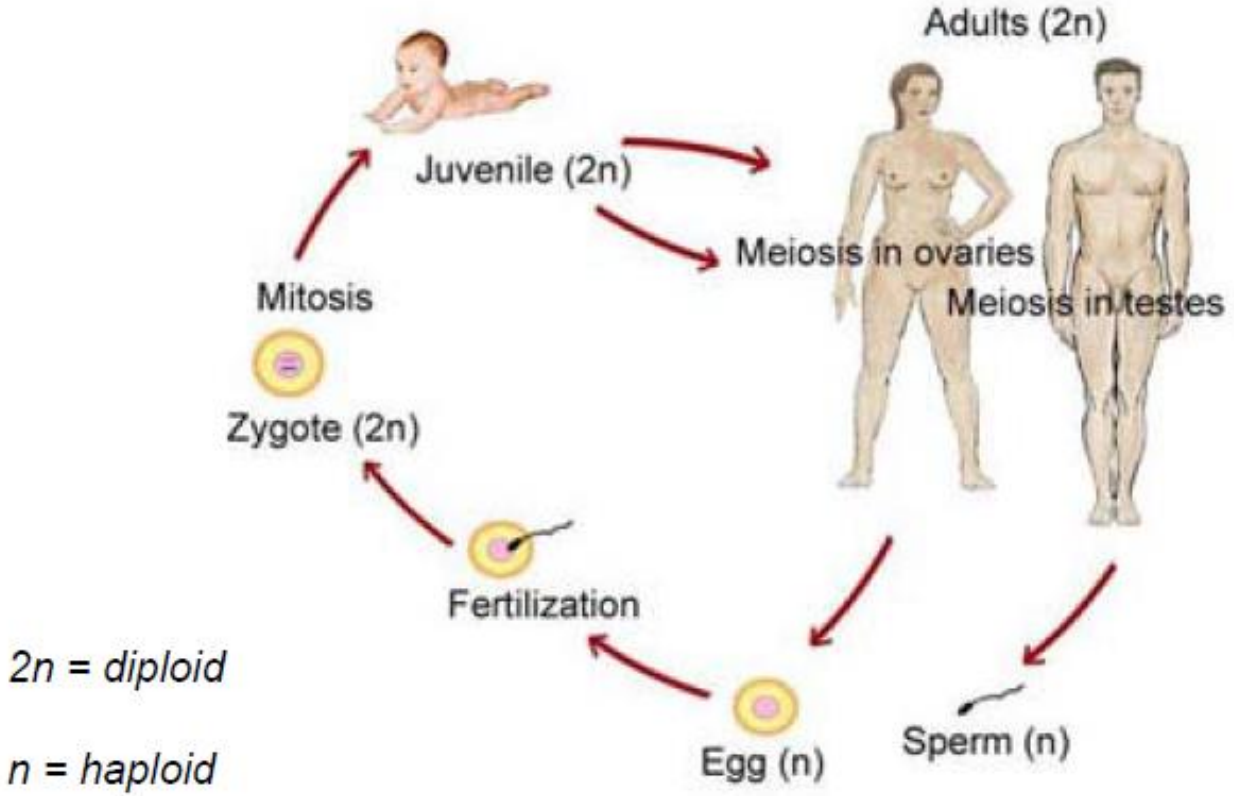
The gametes themselves are created through a process known as meiosis which causes each egg or sperm to be genetically different.

Sexual Reproduction and Chromosome Numbers

Haploid:

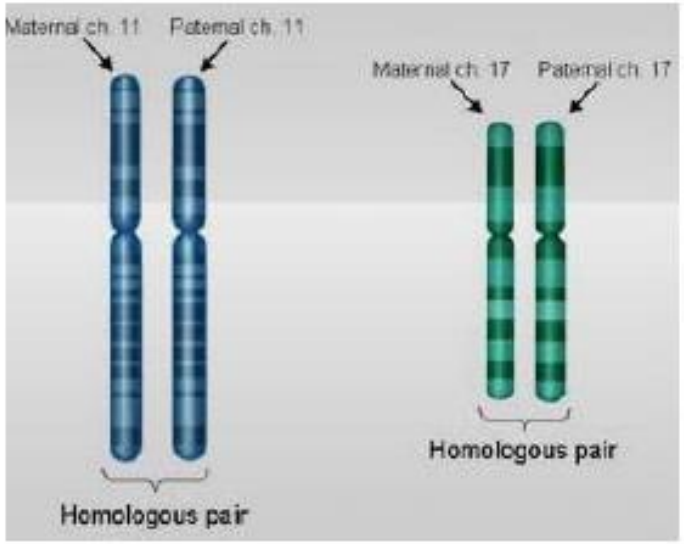
Diploid:

Zygote:



Homologous Chromosomes

Somatic cells contain two sets of chromosomes that are arranged according to similarities.

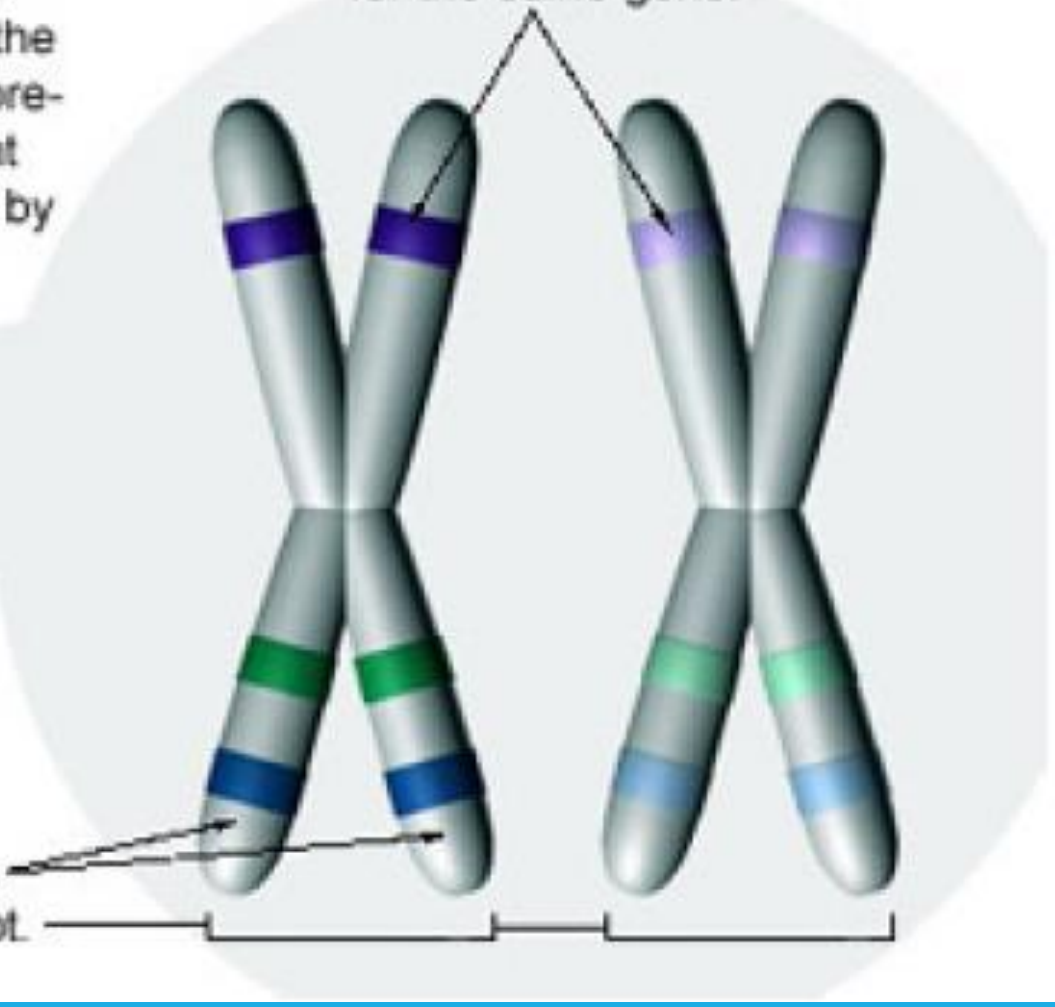


Homologous chromosomes are similar in terms of length, centromere location and banding patterns.

When the chromosome coming from the mother pairs with the chromosome from the father they are known as a homologous pair.

Figure B-11: Homologous Chromosomes

- Homologous chromosomes contain DNA that codes for the same genes. In this example, both chromosomes have all the same genes in the same locations (represented with colored strips), but different 'versions' of those genes (represented by the different shades of each color).



Homologous Chromosomes

Somatic cells contain 23 pairs of homologous chromosomes.There are 22 of these chromosomes that are autosomal and 1 pair that is a sex chromosome.

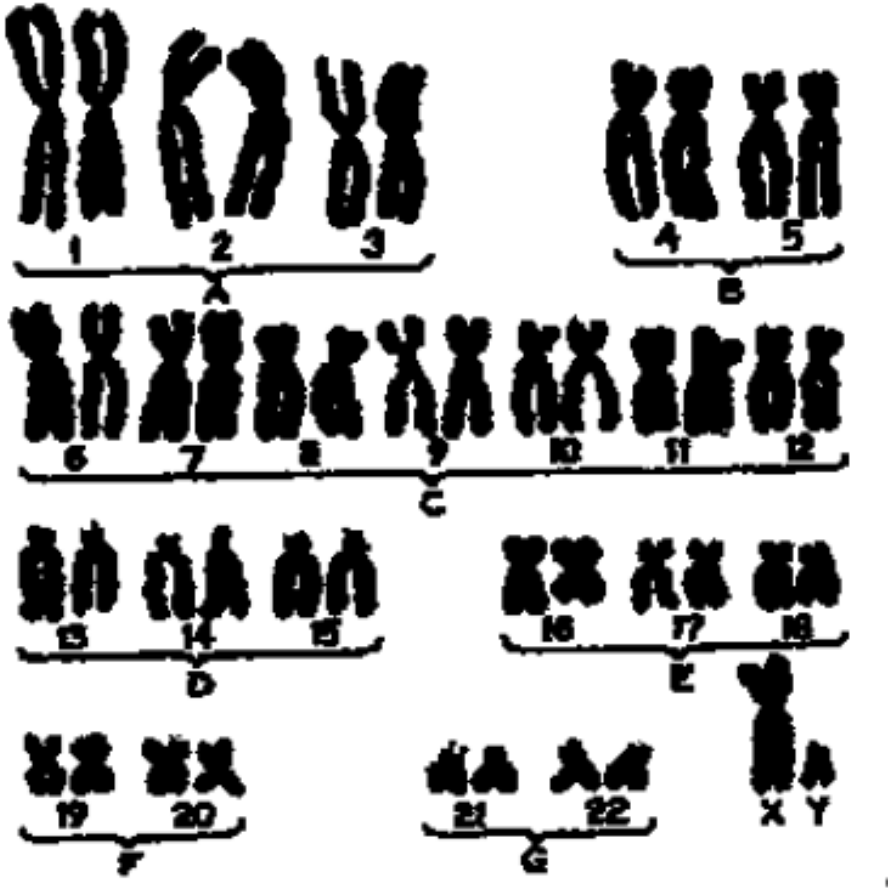
Karyotype of the 23 chromosomes

Autosomal chromosomes code for every trait that is not involved in sex determination.

Sample Karyotype

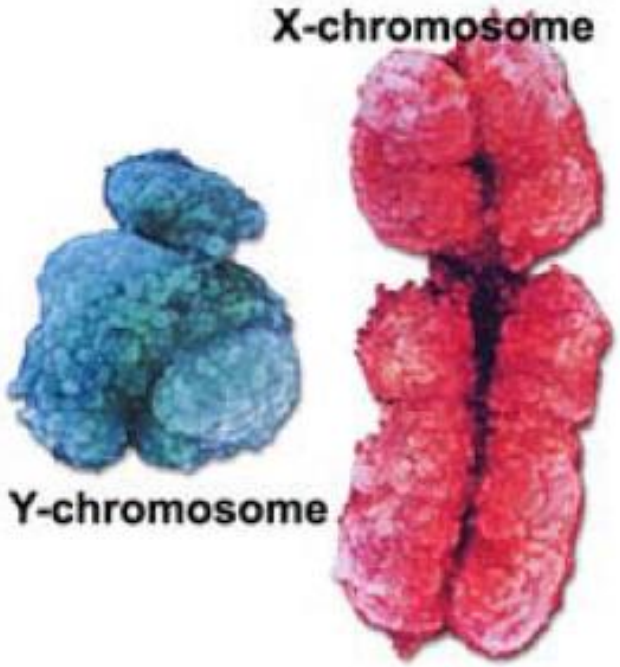
Sex chromosomes are identified as 'X' or 'Y' and are the last pair of chromosomes shown on the karyotype.

The chromosomes are ordered from largest to smallest and each chromosomes is paired with its homologue.



Sex Chromosomes

Sex chromosomes contin an X or Y chromosome which helps to determine the sex of an individual. The x-chromosome is generally larger than the Y-chromosome because it contains more genes.



Checking for Understanding

1. What are the components of a nucleotide?

A) a centromere and two sister chromatids

B) a sugar and a phosphate group

C) a base and a phosphate group

D) a sugar, a phosphate group and a base

E) None of the above

Checking for Understanding

2. Which of the following characteristics of homologous chromosomes in somatic cells is false?

A) They are of similar size.

B) Genes are in the same location on each chromosome

C) They contain the same alleles

D) The contain the same genes

E) They have similar banding patterns when dyed.

Homework

Textbook: p. 168 # 12, 13, 16, 17 & 18