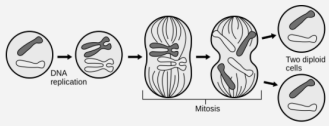
Differences Between Mitosis and Mitosis

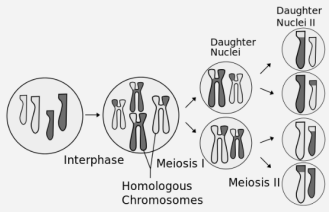
Differences	Mitosis	Meiosis
Number of Cell Divisions	1	2
Number of Daughter Cells	2	4
Role in Animals	Tissue Growth and Asexual Reproduction	Formation of Gametes (For Sexual Reproduction)
Role in Plants	Plant Grows or Produces Gametes	Sporophytes Produces Spores

Mitosis



Mitosis is the process of asexual reproduction. Mitosis ensures that each daughter cell contains chromosomes that are exact copies.

Meiosis



Meiosis is the process of sexual reproduction. Meiosis ensures that each gamete contains exactly half of the chromosomes of the parent cell; It also contains two divisions - Meiosis I and Meiosis II.

Human Chromosomes

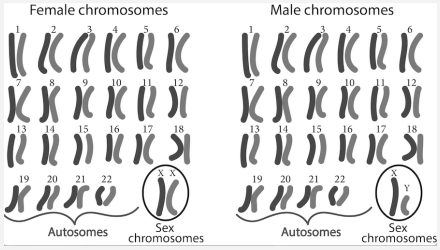
Male	Female
Males have 22 Identical chromosome pairs. This consists of 1 X chromosome and 1 Y Chromosome.	Females have 22 Identical pairs of chromosomes, Plus a pair of X chromosomes.

Human Chromosomes (cont)

Although X and Y are different, These chromosomes in Men are able to behave as though they are pairs.

X and Y chromosomes are how we Identify Sex in Humans.
Healthy Humans have a total of 46 Chromosomes, This comprises of 22 Pairs (Known as Autosomes), Plus two sex chromosomes, X and Y (Or 2 X chromosomes for Females.)

Human Chromosomes



Chromosome Abnormalities

Down Syndrome

Babies with Down syndrome have an extra copy of chromosome 21. A medical term for having an extra copy of a chromosome is 'trisomy.'

Turner Syndrome

Turner syndrome is a female-only genetic disorder.A girl with Turner syndrome only has 1 normal X sex chromosome, rather than the usual 2.

Klinefelter Syndrome

Chromosome Abnormalities (cont)

Klinefelter syndrome (sometimes called Klinefelter's, KS or XXY) is where boys and men are born with an extra X chromosome.

Triple-X Syndrome

Trisomy X, also called triple X syndrome or 47,XXX, is characterized by the presence of an additional X chromosome in each of a female's cells.

Edwards Syndrome

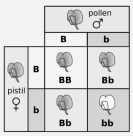
Edwards Syndrome (Trisomy 18) is a genetic disorder caused by the presence of a third copy of all or part of chromosome 18. Many parts of the body are affected. Babies are often born small and have heart defects.

Patau syndrome

Trisomy 13 (also called Patau syndrome) is a genetic disorder in which a person has 3 copies of genetic material from chromosome 13, instead of the usual 2 copies. Causes a list of health problems.

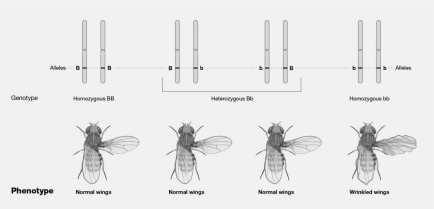
The most common type of chromosomal abnormality is known as aneuploidy, an abnormal chromosome number due to an extra or missing chromosome.

Genotype



A genotype is an organisms genetic information also known as the genetic makeup of a cell, an organism, or an individual usually with reference to a specific characteristic. Genotypes are the information stored in a complete set of genes.

Phenotype



A Phenotype refers to inherited traits that can be physically observed. Phenotypes is the end product, it is the result of the genetic information.

Cell Structure

Cell Membrane	The cell membrane supports and protects the cell. It controls the movement of substances in and out of the cells. It separates the cell from the external environment. The cell membrane is present in all the cells.
	The cell membrane is the outer covering of a cell within which all other organelles, such as the cytoplasm and nucleus, are enclosed. It is also referred to as the plasma membrane.
Cell Wall	The cell wall is the most prominent part of the plant's cell structure. It is made up of cellulose, hemicellulose and pectin.
	The cell wall is present exclusively in plant cells. It protects the plasma membrane and other cellular components. The cell wall is also the outermost layer of plant cells.
	It is a rigid and stiff structure surrounding the cell membrane.
Cytoplasm	The cytoplasm is a thick, clear, jelly-like substance present inside the cell membrane.
	Most of the chemical reactions within a cell take place in this cytoplasm.
	The cell organelles such as endoplasmic reticulum, vacuoles, mitochondria, ribosomes, are suspended in this cytoplasm.
Nucleus	The nucleus contains the hereditary material of the cell, the DNA.
	It sends signals to the cells to grow, mature, divide and die.
	The nucleus is surrounded by the nuclear envelope that separates the DNA from the rest of the cell.

Cell Organelles

Nucleolus	The nucleolus is the site of ribosome synthesis. Also, it is involved in controlling cellular activities and cellular reproduction.
Nuclear membrane	The nuclear membrane protects the nucleus by forming a boundary between the nucleus and other cell organelles.

Cell Organelles (cont)

Chromosomes	Chromosomes play a crucial role in determining the sex of an individual. Each human cells contain 23 pairs of chromosomes.
Endoplasmic reticulum	The endoplasmic reticulum is involved in the transportation of substances throughout the cell. It plays a primary role in the metabolism of carbohydrates, synthesis of lipids, steroids and proteins.
Golgi Bodies	Golgi bodies are called the cell's post office as it is involved in the transportation of materials within the cell
Ribosome	Ribosomes are the protein synthesisers of the cell.
Mitochondria	The mitochondrion is called "the powerhouse of the cell." It is called so because it produces ATP – the cell's energy currency.

Cell Organelles (cont)

Lysosomes	Lysosomes protect the cell by engulfing the foreign bodies entering the cell and help in cell renewal. Therefore, they are known as the cell's suicide bags.
Chloroplast	Chloroplasts are the primary organelles for photosynthesis. It contains the pigment called chlorophyll.
Vacuoles	Vacuoles store food, water, and other waste materials in the cell.

Phases of Mitosis

Prophase I

Metaphase I

Anaphase I

Telophase I

Prophase II

Metaphase II

Anaphase II

Telophase II

Phases of Meiosis

Interphase

Prophase I

Metaphase I

Anaphase I

Telophase I + Cytokinesis

Meiosis is divided into 6 stages.

Prokaryote and Eukaryote

Eukaryote	Prokaryote
Eukaryotes are organisms whose cells contain a nucleus and other membrane-bound organelles. There is a wide range of eukaryotic organisms, including all animals, plants, fungi, and protists, as well as most algae. Eukaryotes may be either single-celled or multicellular.	Prokaryotes are organisms whose cells lack a nucleus and other organelles. Prokaryotes are divided into two distinct groups: the bacteria and the archaea
Only Eukaryotes have Mitochondria	A single celled organism, in which DNA is not contained within a nucleus.

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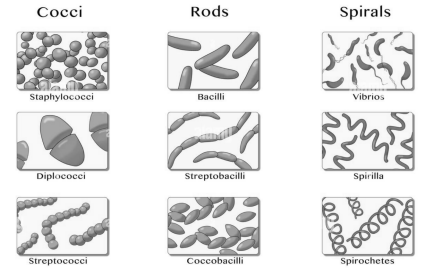
Prokaryote and Eukaryote (cont)

Only *autotrophic* eukaryotes (Plants and Algae) contain Chloro-plasts	The hereditary material can either be DNA or RNA.
The size of the cells ranges between 10–100 µm in diameter.	The cell size ranges from 0.1 to 0.5 µm in diameter.
Eukaryotic cells are charac-terised by a true nucleus.	Prokaryotic cells have no nucleus. ome prokaryotes such as bacteria have a region within the cell where the genetic material is freely suspended. This region is called the nucleoid.
This broad category involves plants, fungi, protoz-oans, and animals.	Prokaryotes generally reproduce by binary fission, a form of asexual reproduction.
They reproduce sexually as well as asexually.	-

Shapes of Bacterial Cells



Binary Fusion

Stages of Binary Fusion

1. Parent Cell
2. DNA Duplicates
3. Cytoplasm divides
4. Two Daughter Cells

When a bacterial cells starts to grow, once it reaches a certain size the cell splits in half to form two identical, smaller ones (Daughter Cells). As long as conditions are maintained, it will continue to grow and split. One cell becomes Two, Two cells become Four, Four cells become Eight and so on, at a constant rate.

Steps involved in Transcription

mRNA (Messenger RNA)	RNA molecule carries the code for a protein
Ribosomes	Protein synthesisers within a cell

Steps involved in Transcription (cont)

RNA Polymerase	Enzyme that synthesises RNA and copies a DNA sequence into a RNA sequence
tRNA (Transfer RNA)	RNA molecules that helps translate an mRNA sequence into a protein

The process by which a cell makes an RNA copy of a piece of DNA. This RNA copy, called messenger RNA (mRNA), carries the genetic information needed to make proteins in a cell. It carries the information from the DNA in the nucleus of the cell to the cytoplasm, where proteins are made.

Transcription

1. RNA Polymerase attaches to the start of a gene

2. RNA Polymerase moves along the DNA, Making strands of mRNA out of free bases in the nucleus

3. The DNA code determines the order that the free bases are added to mRNA

4. mRNA moves out of the nucleus into the cytoplasm

Translation

1. Protein factories called ribosomes bind to mRNA

2. A ribosome reads the code in the mRNA three bases at a time

Translation (cont)

3. tRNA molecules carry amino acids to the ribosomes

4. As each triplet is read, tRNA delivers the corresponding amino acid and a chain of amino acids is built

5. The last amino acid is added and the chain folds into a 3D shape to form a protein.

Characteristics of Cells

1. Cells provide structure and support to the body of an organism.

2. The cell interior is organised into different individual organelles surrounded by a separate membrane.

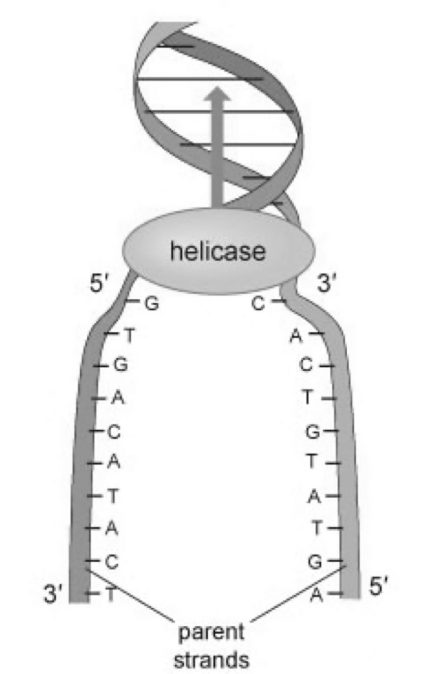
3. The nucleus (major organelle) holds genetic information necessary for reproduction and cell growth.

4. Mitochondria, a double membrane-bound organelle is mainly responsible for the energy transactions vital for the survival of the cell.

5. Lysosomes digest unwanted materials in the cell

6. Endoplasmic reticulum plays a significant role in the internal organisation of the cell by synthesising selective molecules and processing, directing and sorting them to their appropriate locations.

DNA Helicase



DNA Helicase blinds two double stranded DNA and moves along it. As DNA Helicase moves, it seperates the DNA into two strands. The point at which the double stranded DNA is separated into two singe stands is known as a Replication Fork. DNA Helicase leaves the bases of the parent stands unpaired and exposed.

Glossary

Diploid	A word used to describe an organism that carries two copies of its genome, with a copy received from each parents.
Gametes	Haploid cells produced by meiosis for the specific purpose of sexual reproduction. In humans these are egg cells in females and sperm in males.
Haploid	A word used to describe an organism or cell that carries a single copy of its genome.
Enzyme	Proteins that act as biological catalysts, greatly increasing the rates of chemical reactions.
Erythrocytes	Red blood cells; small, circular cells with no nuclei that are responsible for transporting oxygen from the lungs to the rest of the body.

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Glossary (cont)

Lag phase	Phase of bacterial growth in which the population of cells adapts to the environment. This may require the cells to make metabolic changes before optimal growth rates can be achieved
Log phase	Phase of bacterial growth in which the population is able to grow at an optimum rate (logarithmically)
Lysine	One of the 20 amino acids used to make proteins in most organisms
Macrom-olecule	Literally a large molecule. Used in biology to describe the four major categories of large molecules found in living things, namely nucleic acids, proteins, fats and carbohydr-ates.
Monomers	Describes a smaller molecule that, when polymerised into a chain with other monomers, forms a larger polymeric molecule.

Glossary (cont)

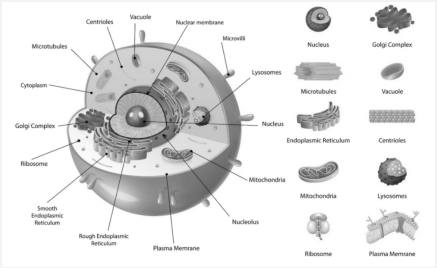
Phenotype	A trait displayed by an organism that is passed between generations by genetic inheritance.

The Cell Cycle

M Phase (Mitosis and Cytokinesis)	
GI Phase (Gap I)	Interphase
G2 Phase (Gap 2)	Interphase
S Phase (Synthesis)	Interphase

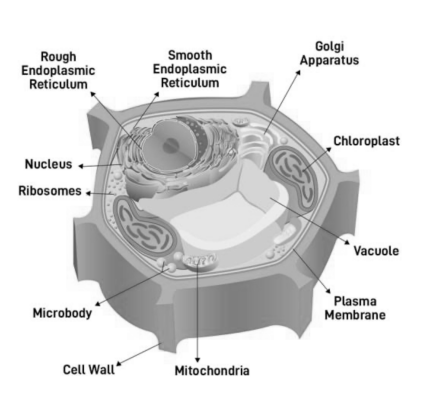
A continuous process, divided into 4 phases.
The cell cycle can take anything from a few hours to many weeks to complete. The rate depends on many factors: Type of organism, type of cell (and its size) and the environment in which the cells are growing.

Animal Cell



Animal cells are Eukaryotic cells surrounded by a cell membrane (Plasma membrane). All animal cells have a large organelle called the nucleus, which is surrounded by a double membrane called the nuclear envelope. The nucleus contains the hereditary material DNA, which is a packaged into chromosomes. The Cytoplasm is the gel-like substance within the cell membrane in which all intracellular organelles sit.

Plant Cell



Plant cells are eukaryotic cells. Plant cells are surrounded by a cell wall, this is a barrier outside the cell membrane. Plant cells have a large central vacuole, a water filled space enclosed by a membrane. The cytoplasm includes organelles called plastids. These are molecules which are synthesised or stored. Chloroplasts are plastids that contain chlorophyll (a green pigment used in photosynthesis). Chloro-plasts are found only in plant cells.

Differences between DNA and RNA

DNA	RNA
Contains two stands of nucleo-tides joined together by hydrogen bonds to create a Double-Stranded Helix	RNA is a single stranded molecule

Differences between DNA and RNA (cont)

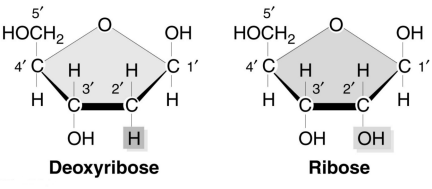
DNA has 4 bases: Adenine, Guanine, Cytosine and Thymine.	Instead of Thymine, it contains Uracil instead.
Sugar Component in DNA is Deoxyribose	Sugar Component in RNA is Ribose
DNA is Missing an Oxygen Atom, it only has 2 Oxygen Atoms	Has 3 Oxygen Atoms
Base Pairing in DNA is A-T and C-G	Base Pairing in RNA is A-U and C-G

'Deoxy' is a term that means an oxygen atom is missing.
Tymine contains an extra carbon atom that is also bonded to 3 hydrogen atoms - A CH_3 group.

Complimentary Sequences

DNA	TGACATACT
RNA	ACUGUAUGA

DNA and RNA



Biomolecules

The four major classes of Biomolecules

Carbohydrates	Carbohydrates are chemically defined as polyhydroxy aldehydes or ketones or compounds which produce them on hydrolysis. They are structurally very important for many living organisms as they form a major structural component, e.g. cellulose is an important structural fibre for plants.
Proteins	Proteins are polymers of amino acids arranged in the form of polypeptide chains. Proteins play both structural and dynamic roles. Myosin is the protein that allows movement by contraction of muscles. Most enzymes are proteinaceous in nature.

Biomolecules (cont)

Nucleic acids	Nucleic acids refer to the genetic material found in the cell that carries all the hereditary information from parents to progeny. There are two types of nucleic acids namely, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The main function of nucleic acid is the transfer of genetic information and synthesis of proteins by processes known as translation and transcription. The monomeric unit of nucleic acids is known as nucleotide and is composed of a nitrogenous base, pentose sugar, and phosphate. The nucleotides are linked by a 3’ and 5’ phosphodiester bond. The nitrogen base attached to the pentose sugar makes the nucleotide distinct.

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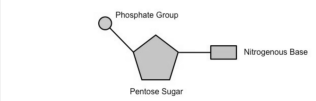
Biomolecules (cont)

Lipids Lipids are organic substances that are insoluble in water, soluble in organic solvents, are related to fatty acids and are utilized by the living cell. Lipids are not polymeric molecules. Lipids play a great role in the cellular structure and are the chief source of energy.

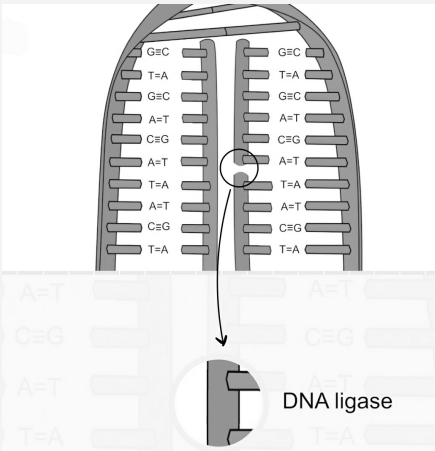
Biomolecules are the most essential organic molecules, which are involved in the maintenance and metabolic processes of living organisms.

Nucleotide

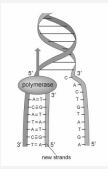


A molecule consisting of a nitrogen-containing base (adenine, guanine, thymine, or cytosine in DNA; adenine, guanine, uracil, or cytosine in RNA), a phosphate group, and a sugar (deoxyribose in DNA; ribose in RNA).

DNA Ligase



DNA Polymerase



DNA Polymerase converts nucleotide monomers into DNA Polymers. It is the enzyme responsible for synthesising new DNA.DNA Polymerase moves along the parental strand, using unpaired bases of the parent strand as a template to synthesis a new strand of DNA by base pairing. *I.E* Where there is an unpaired Thymine in the parent stand, DNA Polymerase adds a complementary Adenine to the new stand. DNA Polymerase can only move in one direction following the parent stand from its 3' end to its 5' end.