

London School of Massage



“Massage to a Higher Level”

Anatomical Descriptions, Cell & Tissues

At the end of this section you will understand and appreciate:

- Atoms, elements and molecules
- The anatomical position and anatomical planes
- Describe atoms and molecules
- Cell division, mitosis and its stages
- Functions of the organelles of the cell
- Structure and function of tissues
- Structure and function of membranes

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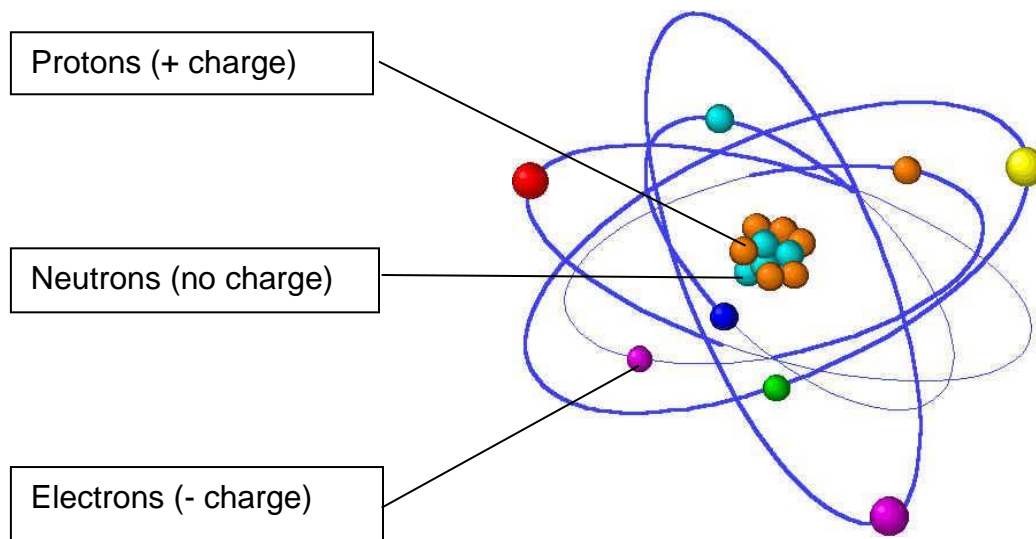


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Atoms & Molecules

ATOMS & MOLECULES

ATOM: This is the smallest particle of matter. All matter is made up of atoms. An atom is like a tiny solar system. In the centre of the atom is the nucleus which is a cluster of **protons (positively charged)** and **neutrons (no charge)**. Whirling at fantastic speeds around the nucleus are smaller and lighter particles called **electrons (negatively charged)**.



A good way to visualise the structure of the atom is to think of the electrons orbiting around the nucleus in a number of concentric circles (or shells). Each circle can only hold a certain number of electrons before it becomes full and stable. Thus:

- Innermost circle (or shell) = 2
- Second circle (or shell) = 8

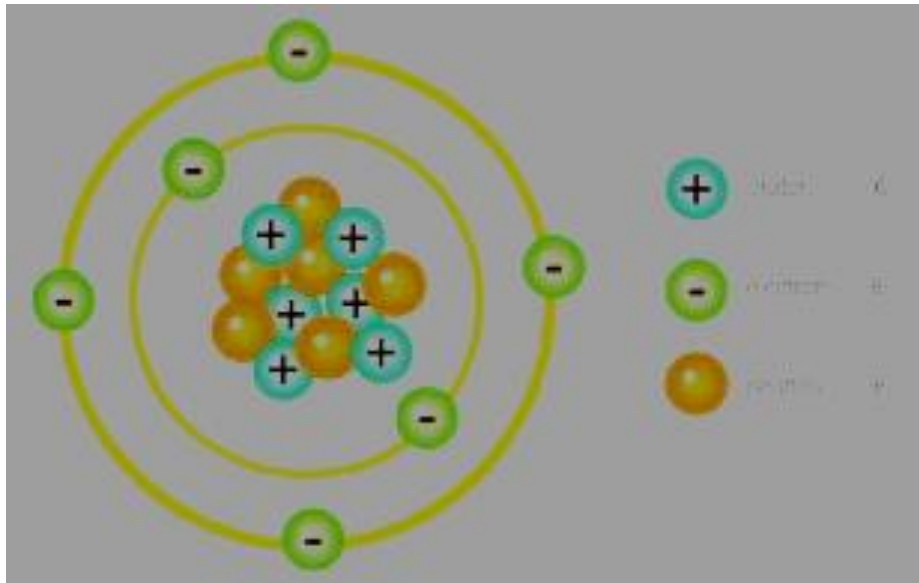
It is important to note that it is the electrons in the outermost shell that take part in chemical bonding.

A **chemical element** is a pure chemical substance consisting of one type of atom distinguished by its **ATOMIC NUMBER, which is the number of protons in its nucleus**.

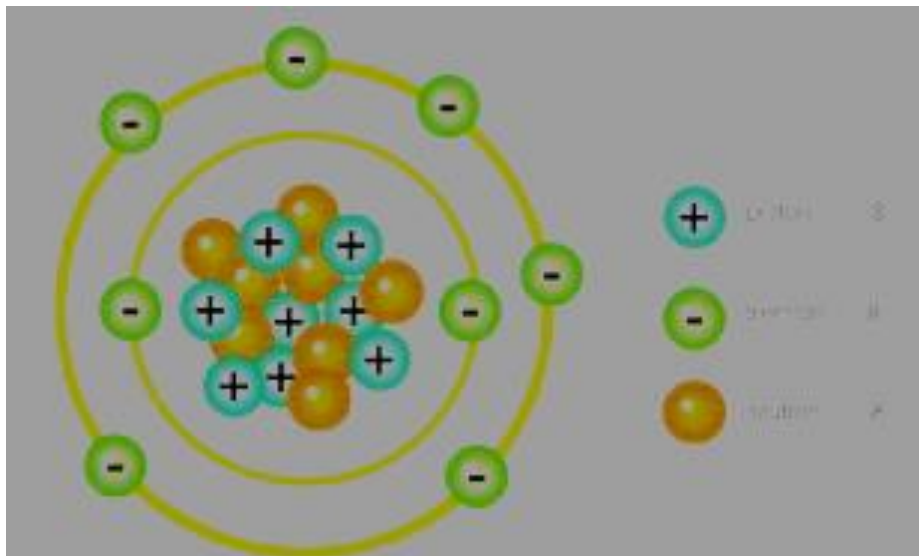
MOLECULE: Molecule is formed when two or more atoms join together chemically e.g. Oxygen.

EXAMPLES OF ATOMS

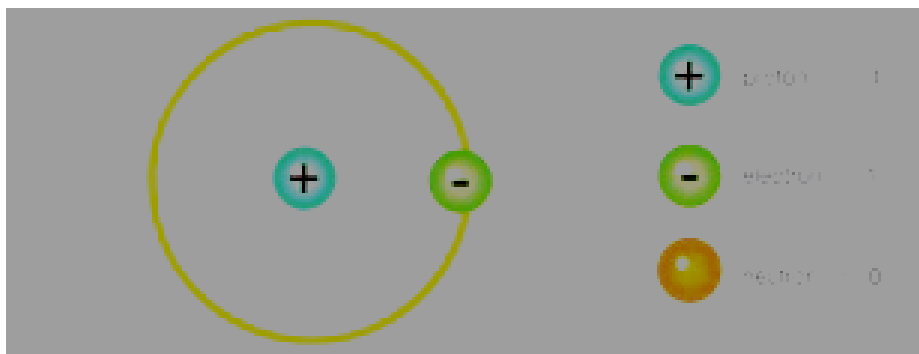
CARBON



OXYGEN



HYDROGEN



ORGANIC & INORGANIC COMPOUNDS

When different elements join together they form a substance called a **compound**.

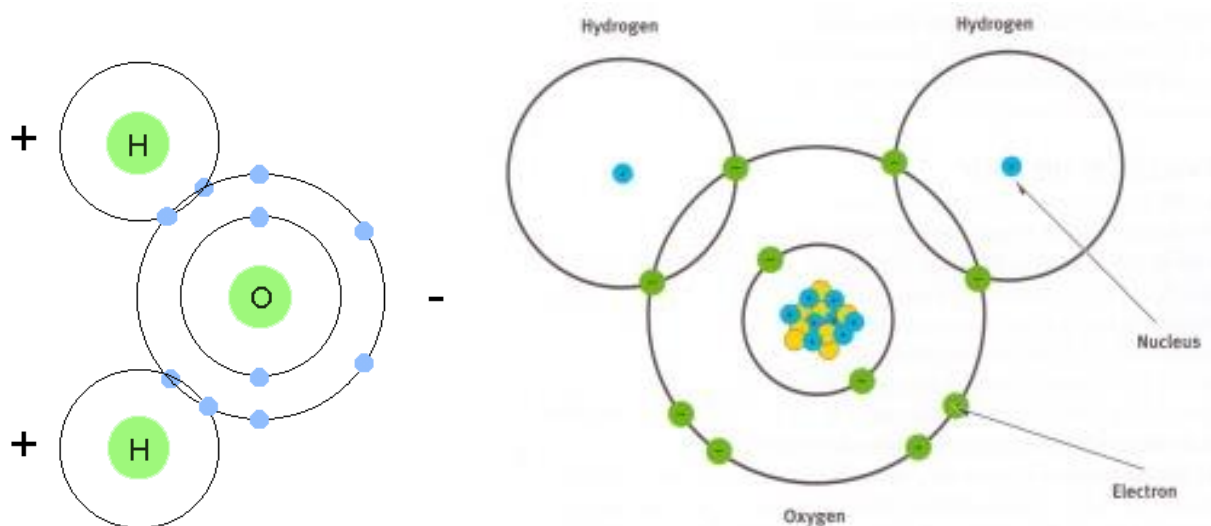
Compounds are divided into two categories:

- **ORGANIC** – complicated compounds containing several elements. One of the elements always contains **carbon** e.g. carbohydrates.
- **INORGANIC** – small compounds e.g. water (H_2O) and ammonia (NH_3)

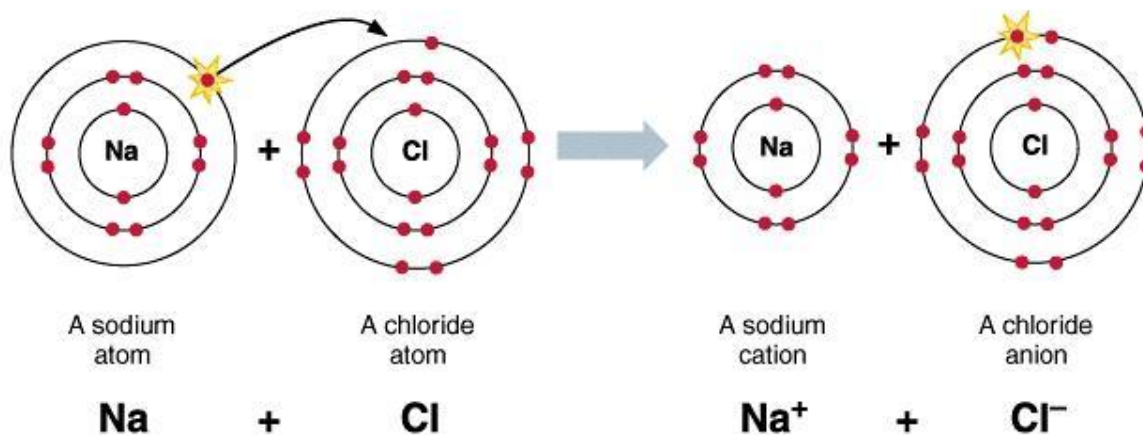
CHEMICAL BONDS

There are principally two types of chemical bonds:

COVALENT BONDS: this type of bond comes from the sharing of electrons in outer ring of two or more atoms.



IONIC BONDS: this type of bond arises when an electron is donating from one atom to another. This results in one of the atoms becoming negatively charged and the other positively charged. E.g. Sodium chloride ($NaCl$).



Anatomical Descriptions

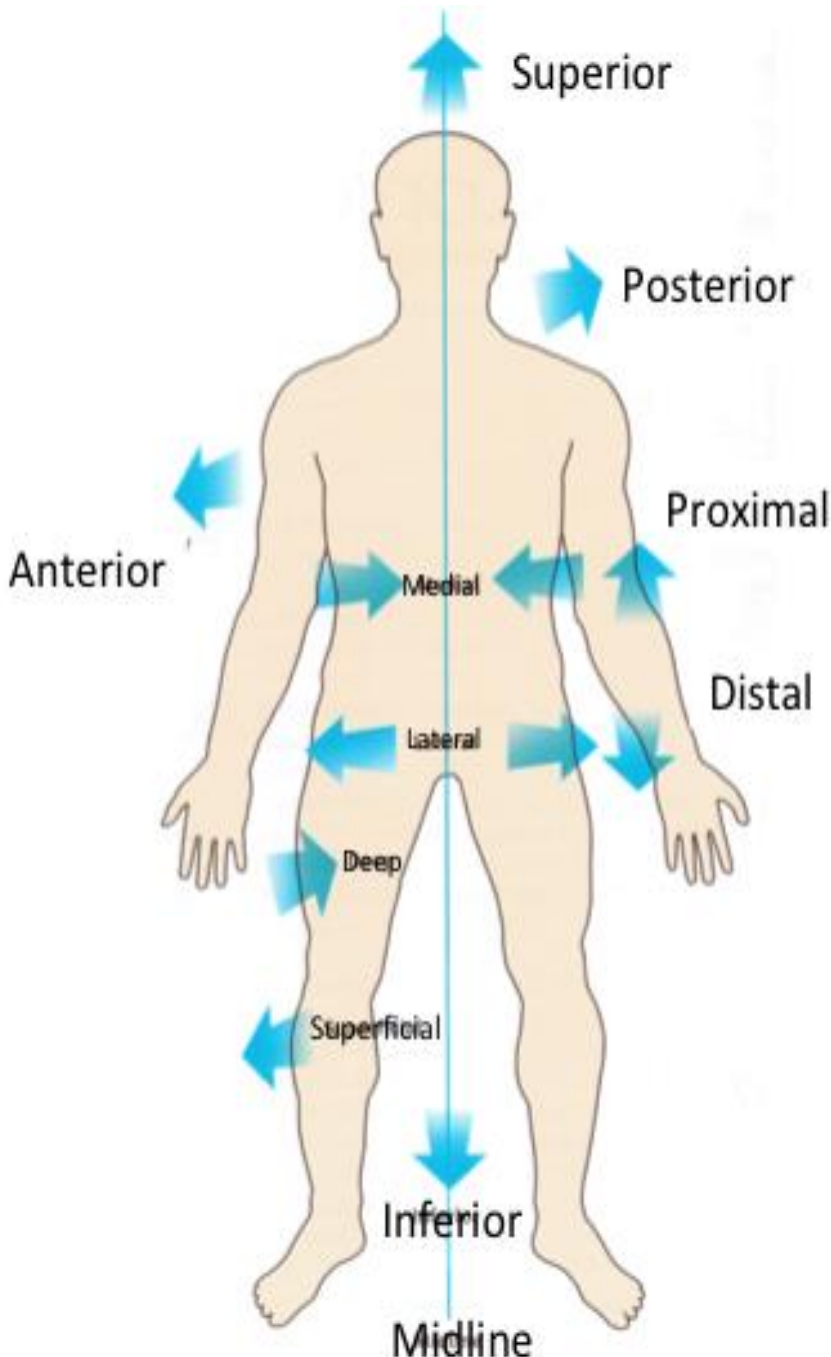
When we locate parts or structures in the human body, specific terms are used to describe their position. For example, the head is *superior* to the neck (or the neck is *inferior* to the head), the fingers are *distal* to the elbow (or the elbow is *proximal* to the fingers).

ANATOMICAL DIRECTIONS

The terms are as follows:

Note that the terms are opposites and each has a counterpart:

That is, parts are described **RELATIVE** to each other.



ANATOMICAL BODY PLANES

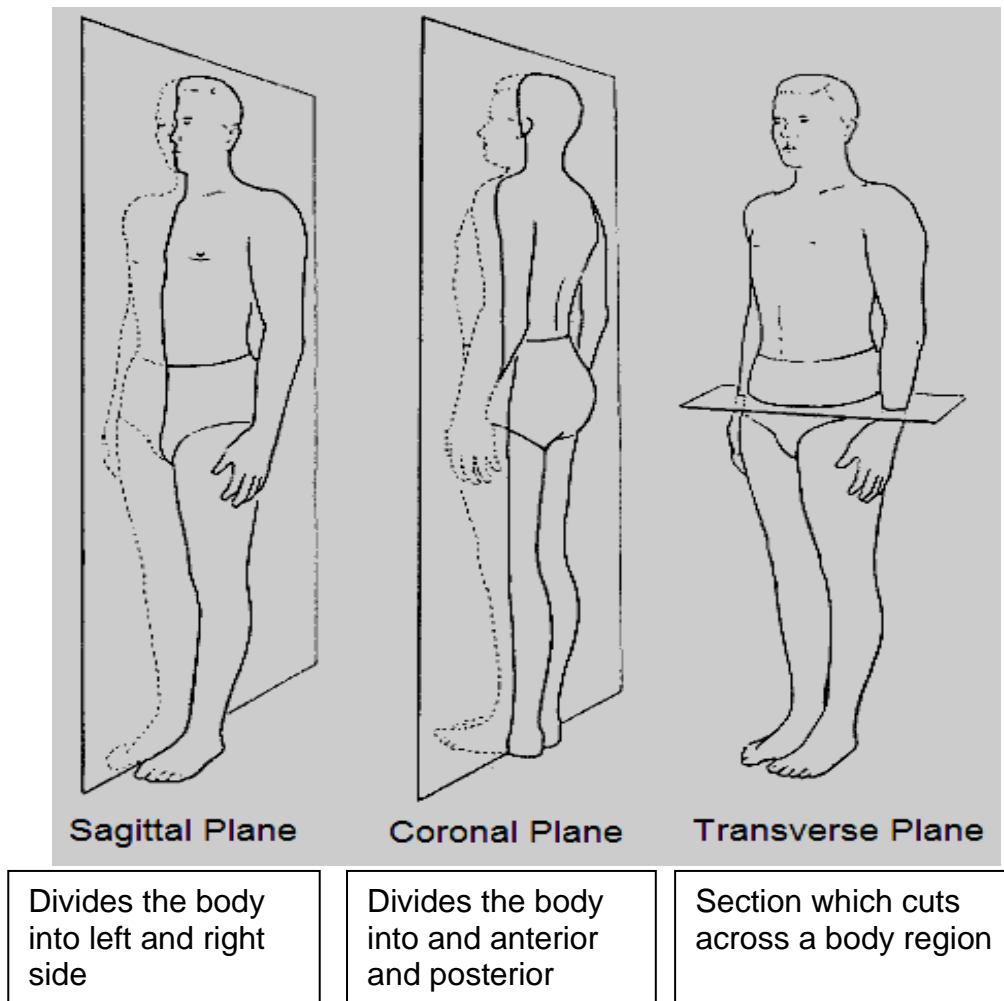
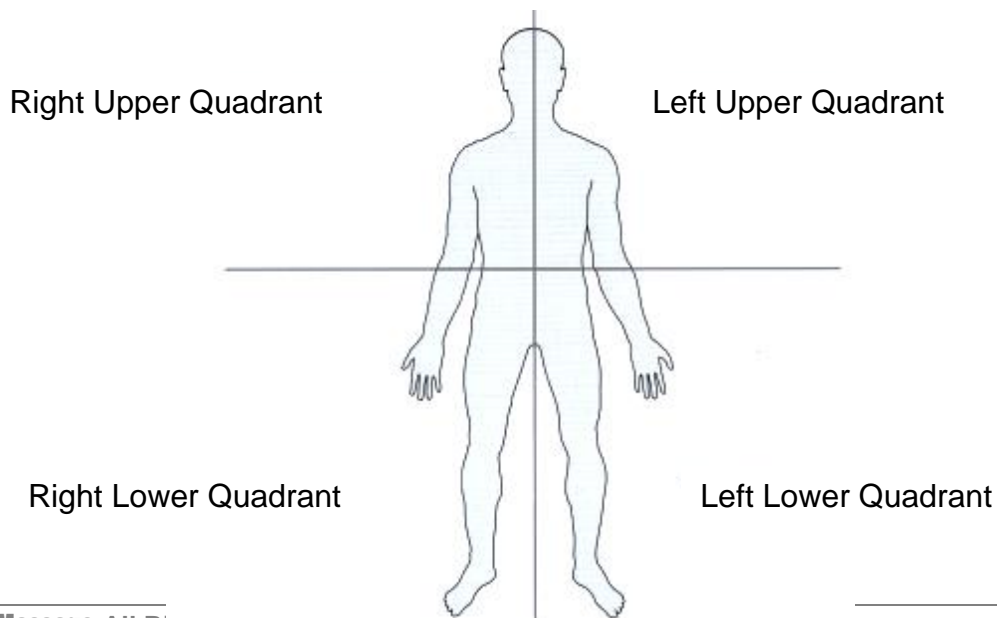


Diagram showing Anatomical Body Planes

BODY QUADRANTS

The intersection of the sagittal and transverse planes of the navel gives the four quadrants of the body.



Body Types

The basics of body types are listed below:



Ectomorph



Endomorph

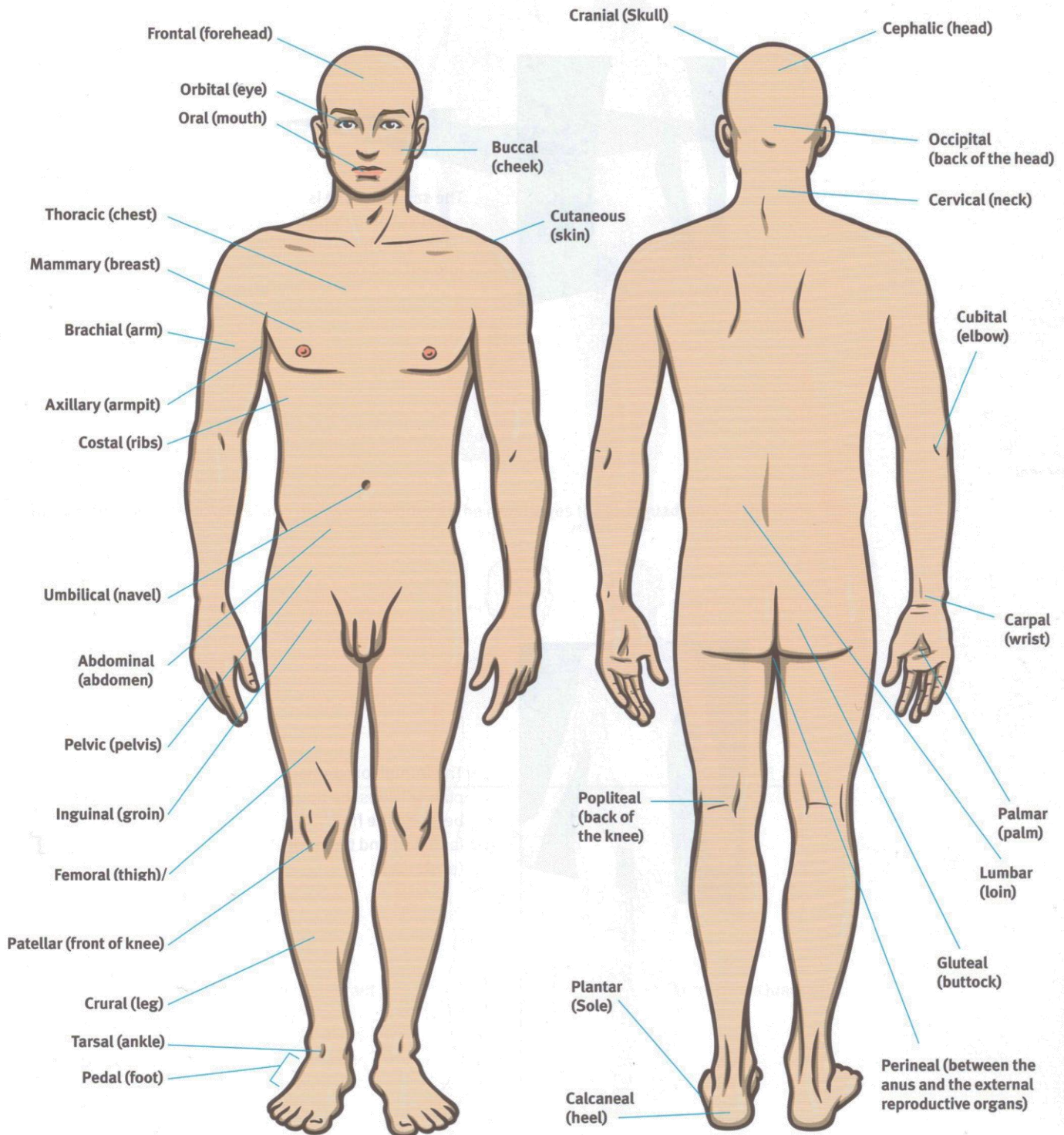


Mesomorph

ECTOMORPH	ENDOMORPH	MESOMORPH
<ul style="list-style-type: none"> • Definitive "Hard Gainer" • Delicate Built Body • Flat Chest • Fragile • Lean • Lightly Muscled • Small Shouldered • Takes Longer to Gain Muscle • Thin 	<ul style="list-style-type: none"> • Soft Body • Underdeveloped Muscles • Round Physique • Weight Loss is Difficult • Gains Muscle Easily Like the Mesomorph. 	<ul style="list-style-type: none"> • Athletic • Hard Body • Hourglass Shaped (Female) • Rectangular Shaped (Male) • Mature Muscle Mass • Muscular Body • Excellent Posture • Gains Muscle Easily • Gains Fat More Easily Than Ectomorphs • Thick Skin
<p>Famous Ectomorphs Kate Moss, Brad Pitt,</p>	<p>Famous Endomorphs John Goodman, Roseanne, Jack Black.</p>	<p>Famous Mesomorphs Bruce Willis, Sylvester Stallone, most Mr. Universe winners.</p>

Anatomical Regions

Anatomic or anatomical terms describe the directions within the body as well as the body's reference planes, cavities and regions. The following diagrams describe the body's regions



Definitions & Human Cellular Organisation

ANATOMY: Study of the structures of the body

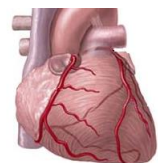
PHYSIOLOGY: Study of the processes that occur in the body

HISTOLOGY: Study of structure and function of cells & tissues

A human body is a multi-celled organism consisting of millions of different types of cells.

Masses of similar cells are grouped together to form tissues and organs, each of which have special functions.

CELL: single unit of matter that can live independently and reproduce.



TISSUES: group of cells of similar type and function

ORGAN: is made up of tissues of related function, e.g. heart, kidney, liver.

SYSTEM: Organs form part of a system e.g. cardiovascular system, respiratory system.

FUNCTIONS OF THE CELL

For something to be classed as living, it must exhibit the following properties:

	Property	Description
M	Movement	Move from one place to another.
R	Respiration	Be able to breathe.
S	Sensitivity	Able to respond to a stimulus which can be mechanical, electrical, thermal or chemical.
G	Growth	Be able to grow.
R	Reproduction	Be able to reproduce.
E	Excretion	Be able to excrete.
M	Metabolism	The chemical reactions, which occur inside the cell. Anabolism: Chemical activity involved in the building up of new products Catabolism: Chemical activity involved in the breakdown of complex substances into simple forms.

Human Cell

The human body has many different types of cells. It is made up of:

- Organic & inorganic salts
- Carbohydrates
- Lipids (fatty substances)
- Nitrogen containing substances

The structure of a typical cell consists of:

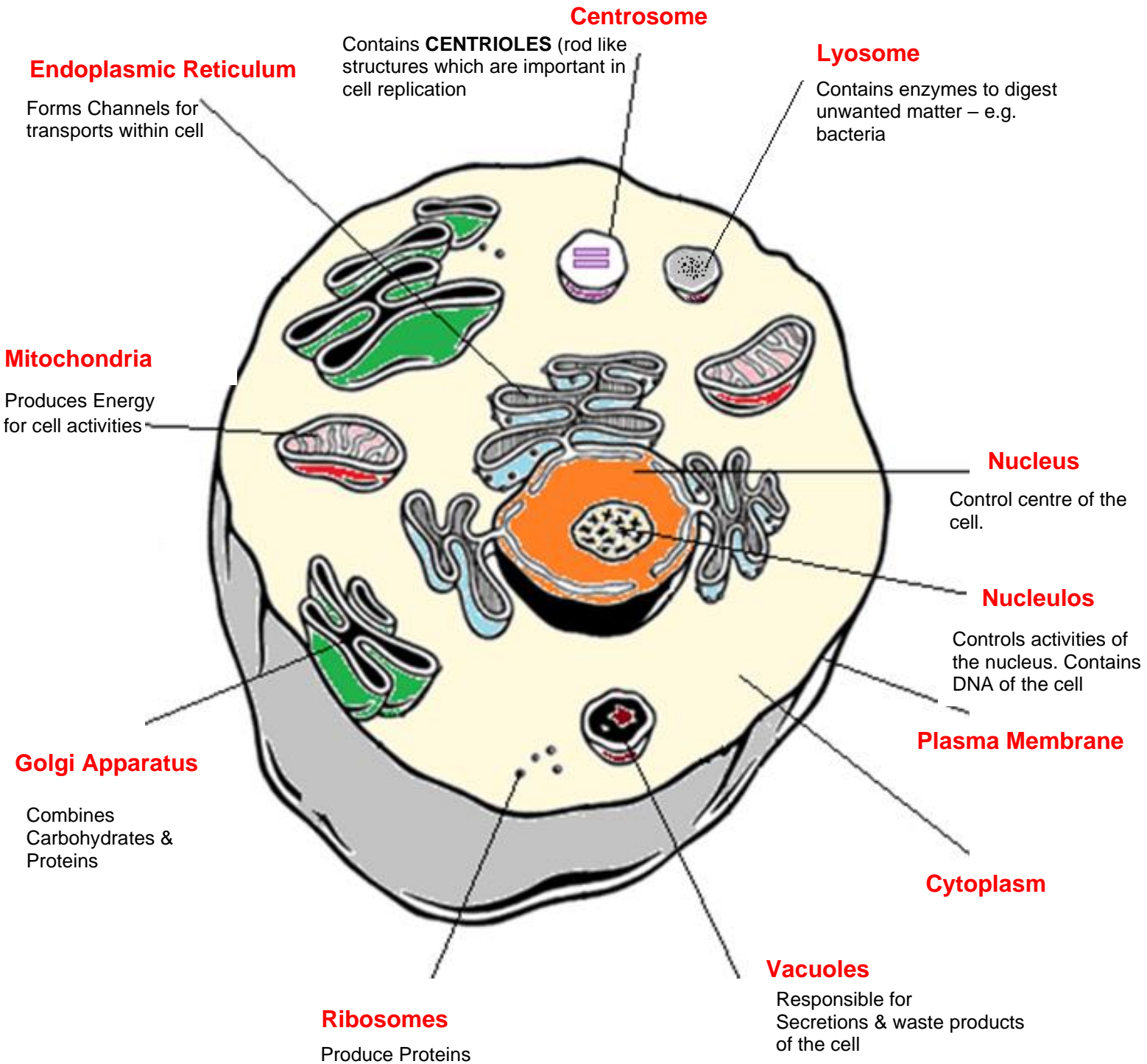










Diagram of a cell

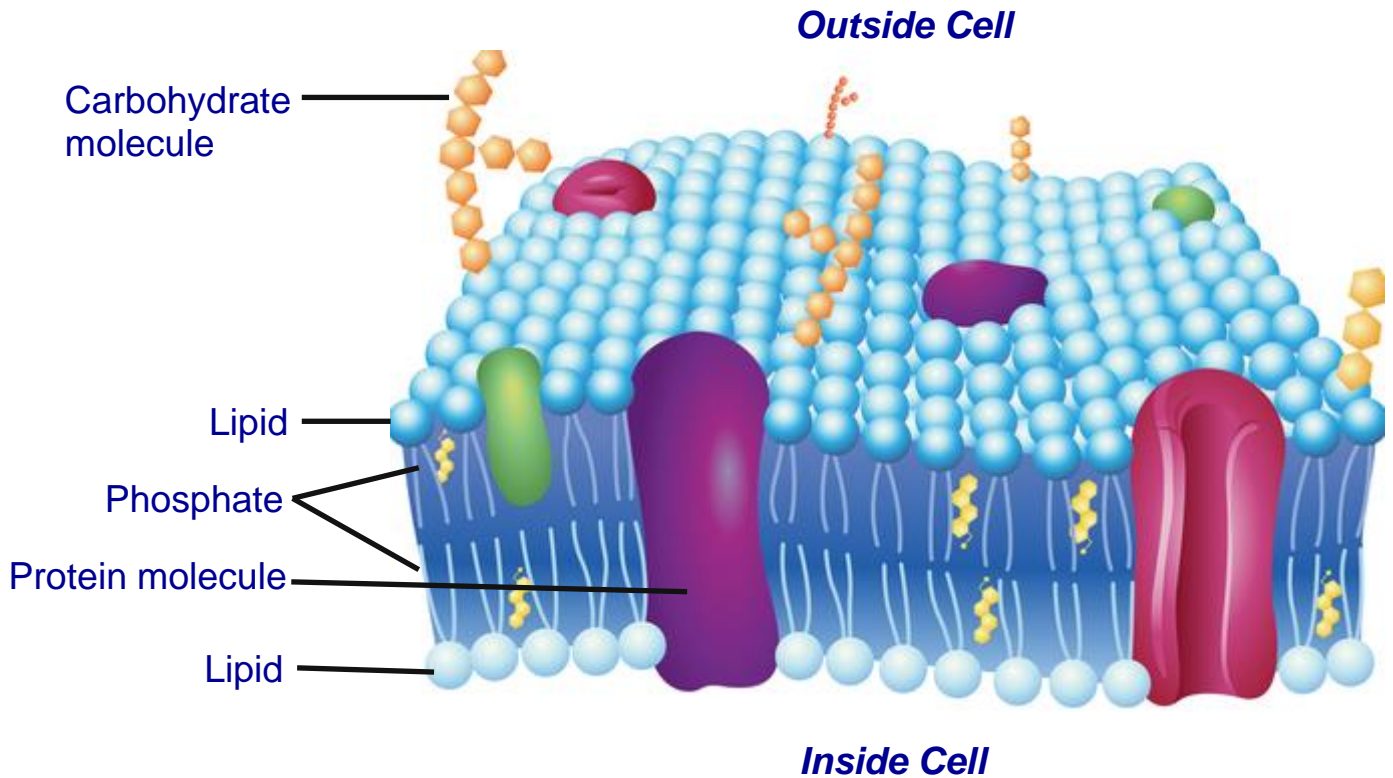
THE CELL ORGANELLES

The small-formed structures, which lie within the cell, are called **organelles**.

ORGANELLE	DIAGRAM
<p>NUCLEUS – Is the largest organelle of the cell. Is the control centre of the cell controlling all the functions from growth, repair to reproduction. The nucleus contains DNA (deoxyribonucleic acid), which carries the cells genetic code and chromatin, the material needed to form chromosomes.</p>	
<p>MITOCHONDRIA - these are the “POWER HOUSE” of the cell. They contain enzymes, which are involved in the production of energy for cellular activity through the formation of ATP (adenosine triphosphate).</p>	
<p>ENDOPLASMIC RETICULUM (ER) – network of canals and sacs connected with the nucleus and cell membrane. It forms the CHANNELS of the cell, allowing movement of different substances.</p>	
<p>RIBOSOMES - they are responsible for PROTEIN synthesis in the cell.</p>	
<p>LYSOSOMES - contain enzymes that digest and remove particles which are useless or may be harmful to the cell.</p>	
<p>VACUOLES - these are empty spaces within the cytoplasm. They contain WASTE material and SECRETIONS formed by the cytoplasm and are used for storage or digestion.</p>	
<p>GOLGI APPARATUS - this consists of closely packed membranous sacs and is especially prominent in secretory cells. They function in COMBINING CARBOHYDRATES AND PROTEINS for use to other parts of the cell.</p>	
<p>CENTRIOLES - these are paired rod like structures which play an important part in cell replication (mitosis). They are contained within the CENTROSOME</p>	

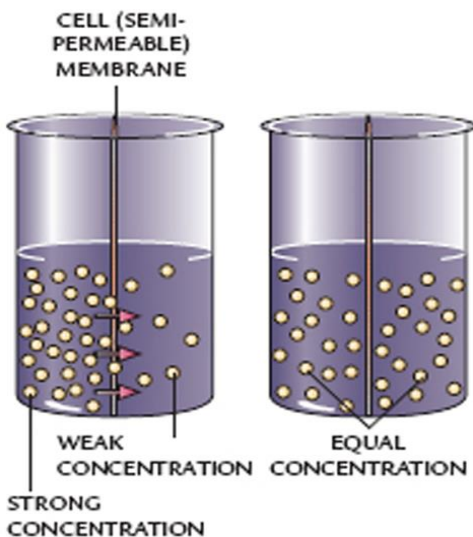
THE CELL MEMBRANE & TRANSPORT PROCESSES

The cell membrane is a structure that is made up of **fats (lipids)**, **phosphate** and **protein** molecules. It is a “**BILAYER**” - two-layered structure.



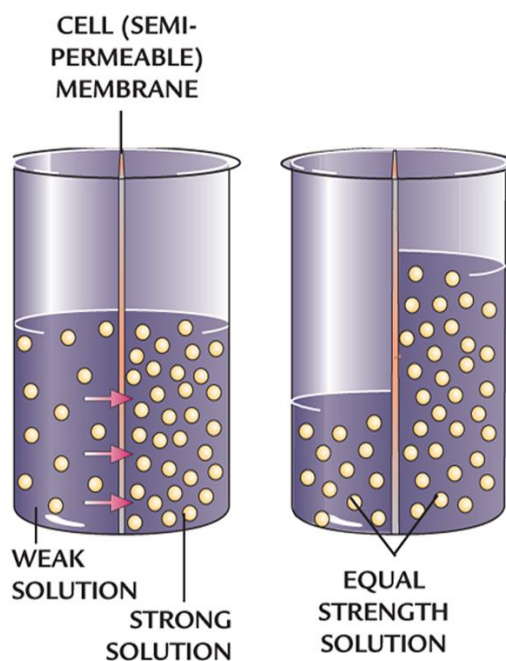
It is **SEMI-PERMEABLE**, meaning that it allows the entry of some particles, but not others. Substances are transferred across the membrane via several different processes:

- **Diffusion** – process where dissolved substances cross the semipermeable membrane until equal concentration is achieved on both sides. Note that the particles of the dissolved substance are smaller than the pores of the membrane and that their movement is random.

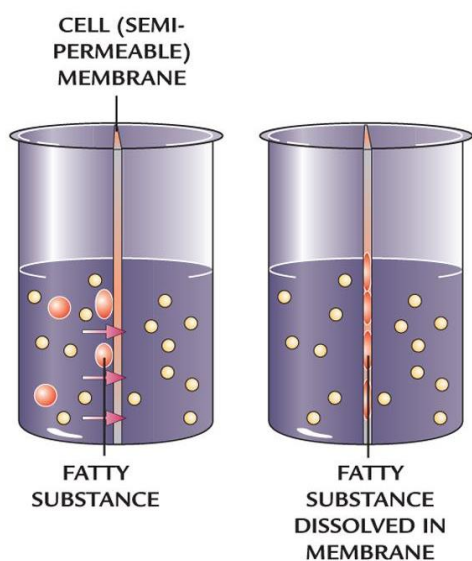


- **Osmosis** – passage of water across the cell membrane from a weaker concentration to a higher concentration until equal concentrations are achieved on both sides. Note that it is water that moves here, as the particles of the substance are too big to go across the membrane.

Note: The term **Osmotic Pressure** is used to denote the “pull” of water to the more concentrated side)

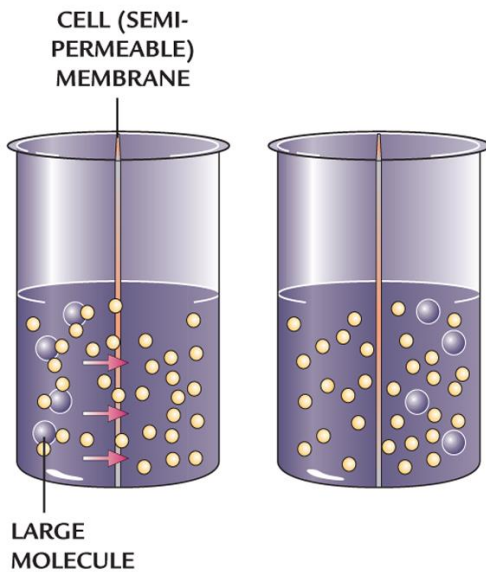


- **Dissolution** – as fat molecules are too big to pass through the cell membrane pores, they transport into the cell by dissolving into fatty part of the cell membrane.

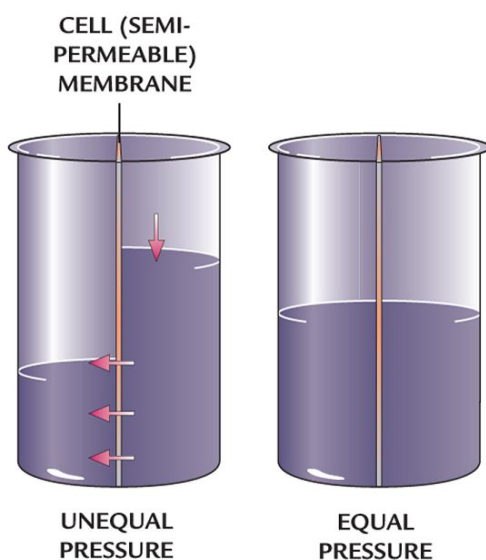


- **Active Transport** – transfer of large particles through the cell membrane using energy and a carrier protein in the cell membrane.

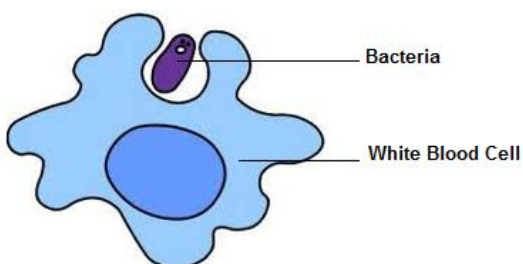
Example: Pulling of a substance (like a sugar molecule) into a cell which is going against a concentration gradient.



- **Filtration** – passage of substances through cell membrane due to pressure differences on either side of the membrane



Phagocytosis – process in which phagocytes (white blood cells) engulf and digest microorganisms and cellular debris thereby protecting the body against infection.



CHROMOSOMES

This is the unique protein structure that is contained within the nucleus. It contains all the genetic information which is inherited from our parents.

CHROMOSOME - two strands of chromatids held together by a centromere.

CENTROMERE - the point where two chromatids are held

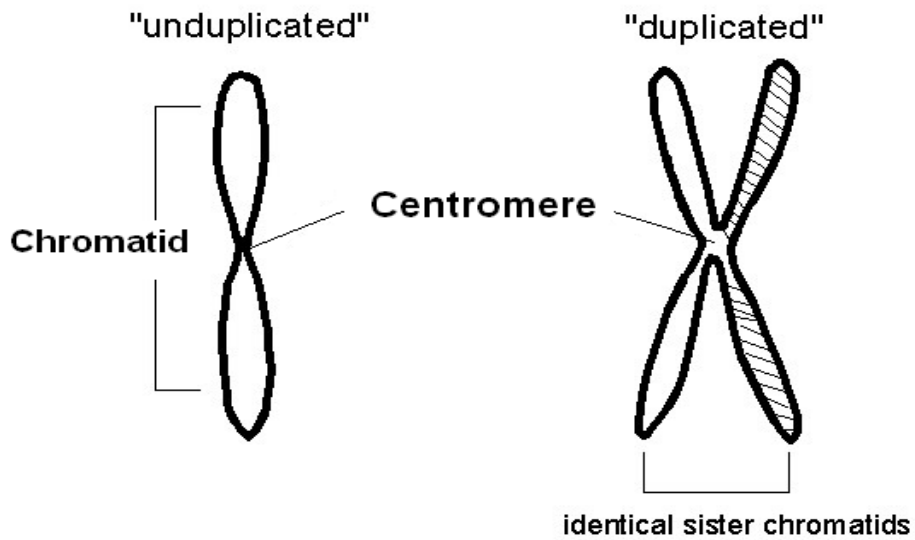


Diagram of a Chromosome

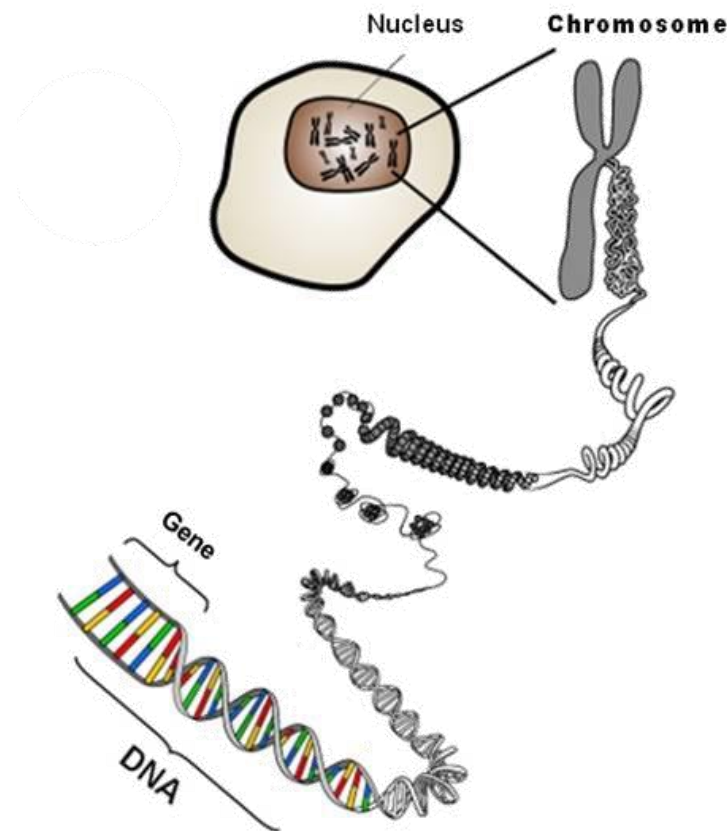


Diagram of a Chromosome

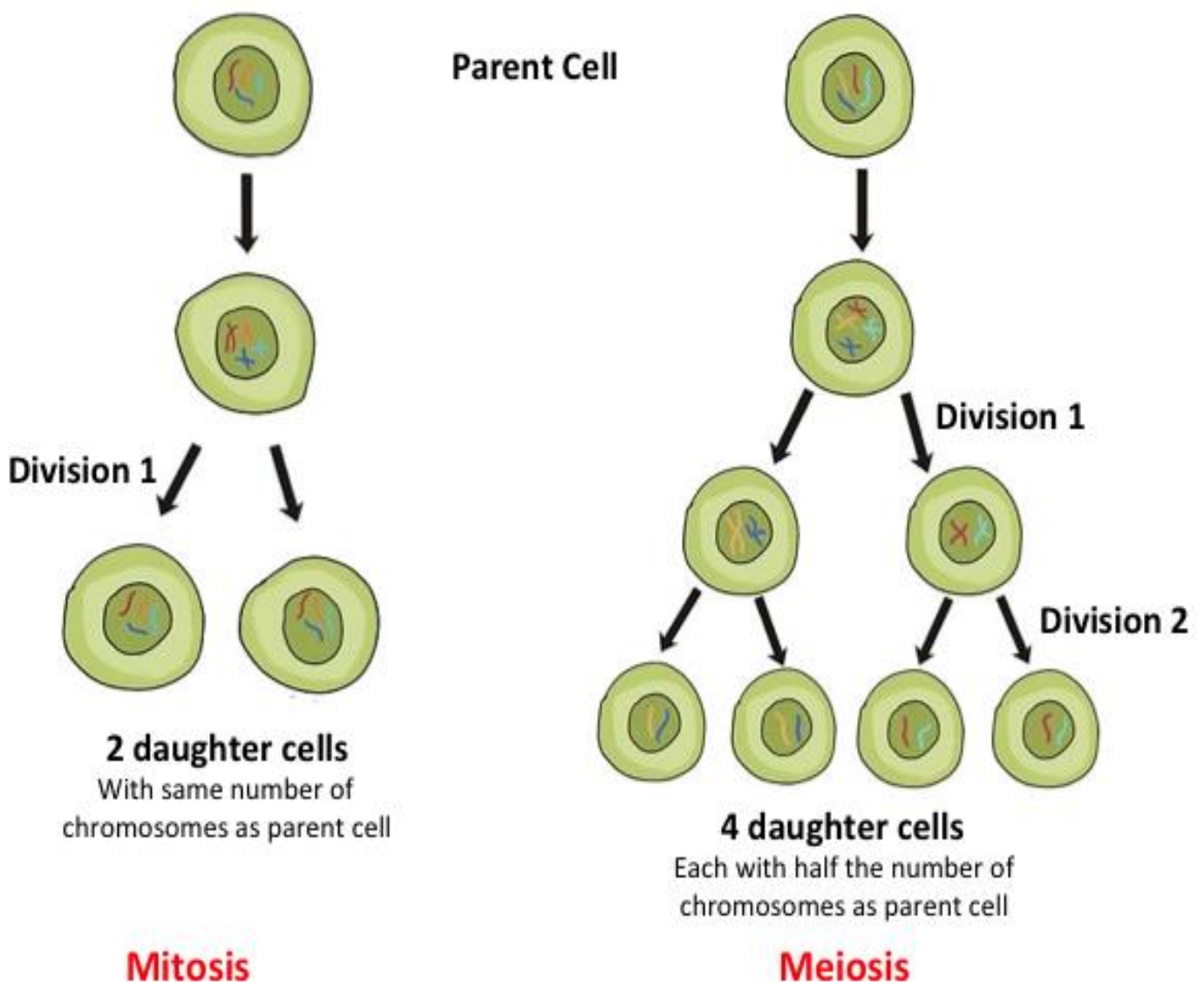
CELLULAR REPRODUCTION

Cellular reproduction is essential to keep the body alive since no single cell will live indefinitely. Therefore a replica must be produced to ensure that normal body function continues.

There are 2 types of cell division,

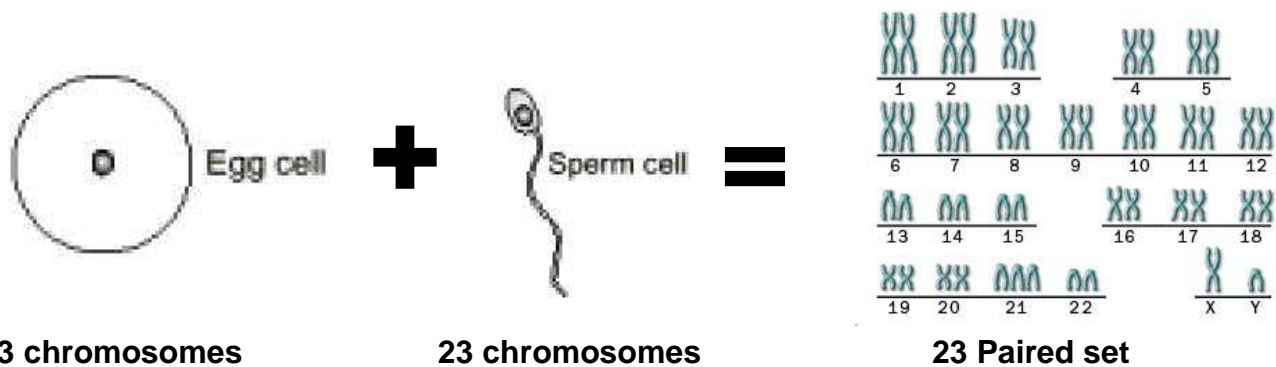
1. **Mitosis** - this type of reproduction is for **growth**
2. **Meiosis** - this type of reproduction is for formation of **sex** cells (**gametes**)

COMPARISON BETWEEN MITOSIS & MEIOSIS



Before learning about Mitosis, appreciate:

- All human cells have **23 PAIRED** Chromosomes (except sex cells, i.e. sperm & egg).
- On fertilization:



- To create an identical chromosome, it has to duplicate itself before it splits into two.

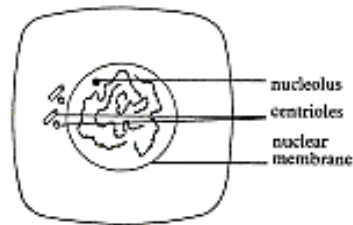
MITOSIS

Cell division, the cell cycle, is a 2 stage process in which cellular replication occurs maintaining the 23 pairs of chromosomes. **Phase 1 Interphase:** where the cell grows, develops and functions and where preparation for division will take place if required. **Phase 2 Mitosis:** a 4 phase process of division and replication. It takes about 2 ½ hours.

Remember: I Pro M A T

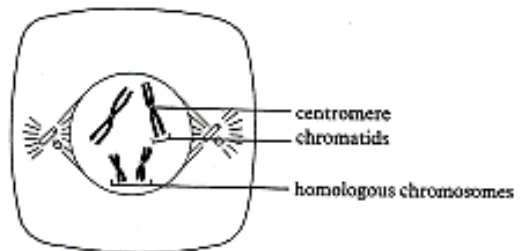
Interphase

- DNA is reproduced
- Nuclear protein is synthesised
- Cell size increases



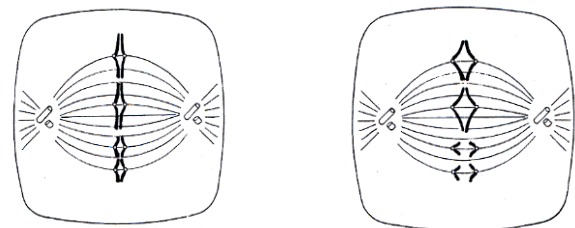
Prophase

- Centrosome divides into 2 centrioles
- Chromatin in nucleus becomes visible forming chromosomes
- Chromosome consists of 2 chromatids joined by centromere (duplication has taken place)
- **Nucleolus disappears**



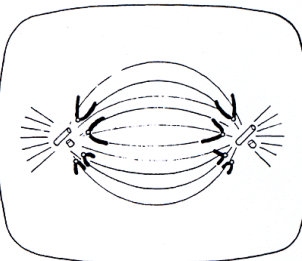
Metaphase

- Nuclear membrane of nucleus disappears
- Chromosomes arrange in centre of cell
- A "spindle network" forms
- **End stage of Metaphase is when each chromatid begins to pull apart**



Anaphase

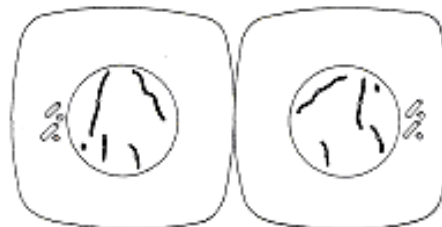
- Centromere stretches as centrioles are drawn apart.
- Pairs of chromatids divide & identical halves move to opposite ends of the cell
- Spindles and centrioles divide to form new centromere
- Cell membrane constricts in centre



Telophase

- A new nuclear membrane appears around each set of chromosome
- Spindle fibre disintegrate and **centrioles replicate**
- Cell membrane continues to constrict to form two identical cells.

Final product is 2 daughter cells



The frequency with which cell division occurs varies with different types of cells.

Tissues of the Body

There are 4 types of tissue in the body:

1. Epithelial (Epithelium)

a. ***Simple***

- Squamous
- Cuboidal
- Columnar
- Ciliated

b. ***Compound***

- Stratified
 - Keratinised (dry)
 - Non-keratinised (wet)
- Transitional

2. Connective

- a. Areolar
- b. Adipose
- c. White Fibrous
- d. Yellow Elastic
- e. Blood
- f. Bone
- g. Cartilage
- h. Lymphoid

3. Muscular

- a. Striated (Voluntary / Skeletal)
- b. Smooth (Involuntary)
- c. Cardiac

4. Nervous

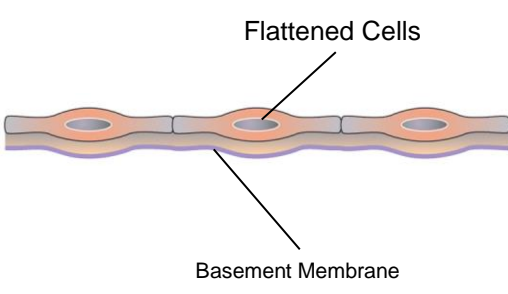
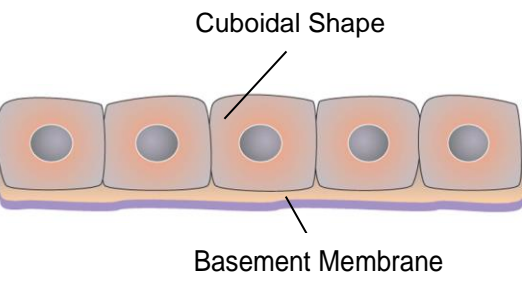
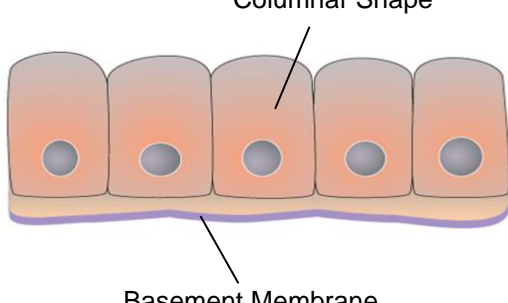
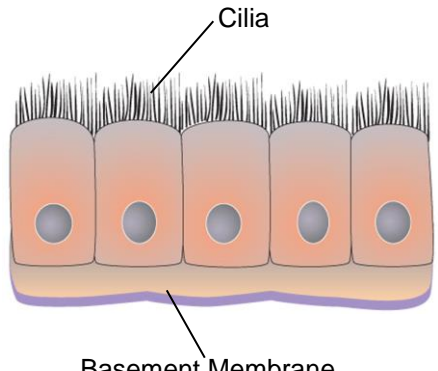
1. EPITHELIAL TISSUE

There are 2 categories of epithelial tissue:

A. Simple Epithelium - functions as a **COVERING** or **LINING** tissue.

It has **1** layer of cells and a **BASEMENT** membrane.

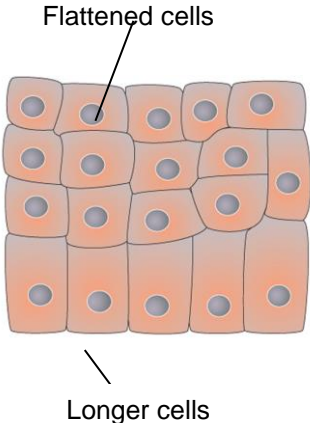
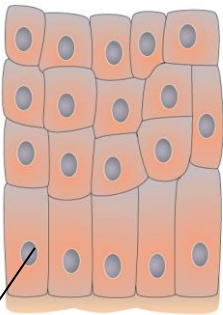
There are 4 types of Simple Epithelium

	Name	Structure	Function
1	Squamous		Forms a smooth lining – e.g. inside of blood vessels, heart, lungs , etc. to help reduce any friction and turbulence in flow of substances.
2	Cuboidal		Forms lining of kidney tubules as well as some glands . <u>Can secrete substances and absorb them.</u>
3	Columnar		Forms lining in very active parts of the body e.g. stomach, intestine and urethra . Some cells are specialised to secrete mucus.
4	Ciliated		The cilia help to move mucus, foreign matter etc by WAVE like motion, helping keep the passageway clear. Found in the trachea and fallopian tubes.

B. Compound Epithelium - functions to **PROTECT**.

It is made up of many layers of columnar cells which are flattened cells towards the surface. There is usually no basement membrane.

There are 2 types of Compound Epithelium.

	Name	Structure	Function
1	Stratified	 <p>Flattened cells</p> <p>Longer cells</p> <p>There are 2 types:</p> <ol style="list-style-type: none"> 1. Keratinised (Dry) – eg Hair, Skin, Nails. 2. Non Keratinised (Wet) – eg Lining of the mouth, oesophagus, conjunctiva. 	<p>Keratin is a fibrous Protein which is waterproof.</p> <p>It acts as a protective layer and prevents deeper cells from drying out.</p>
2	Transitional	 <p>Longer cells</p>	<p>Similar to Stratified Epithelium, but cells are not flattened and can thus change shape.</p> <p>Found in organs that need a waterproof and expandable lining e.g. Bladder</p>

2. CONNECTIVE TISSUE

These are the supporting tissues of the body and mostly have a mechanical function.

They can range from being **LIQUID**, **SEMI-SOLID** to **SOLID**

	Tissue Type	Structure	Function
1	Areolar	Loose connective tissue. Most general connective tissue found in body.	Semi solid and permeable □ allows fluid to pass through it. Connects and supports other tissue.
2	Adipose	Fatty tissue Made up of Fat cells. Found in-between muscle fibres and with areolar tissue under skin	Protective Insulates – helps retain heat. Food reservoir
3	White Fibrous	Strong, but not elastic. Consists of Collagen (protein) fibres which run in the same direction.	Connection and protection of parts of body, e.g. ligaments , dura membranes (membranes surrounding brain), fascia of muscle.
4	Yellow Elastic	Mainly composed of elastic fibres, giving the tissue the ability to stretch and recoil.	To enable stretch and recoil in a tissue e.g. lungs , arteries, stomach etc.
5	Blood	Fluid connective tissue 45% Cells 55% Plasma	Transport: Increases circulation of nutrients to tissues like glucose & oxygen . Increases drainage of waste from tissues like lactic acid & urea
6	Bone	Two types: 1. Compact 2. Cancellous Composition: 25% water 30% organic material 45% inorganic salts	1. Supports 2. Protects 3. Produces cells in bone marrow 4. Act as a reservoir of minerals 5. Help movement / locomotion

7	Cartilage	Firm tough Tissue 3 types: <ul style="list-style-type: none"> ● Hyaline → ● Yellow Elastic → ● White Fibrocartilage → 	- found around joints - found where flexibility is needed - ear - Found where shock absorption is needed – in between vertebra
8	Lymphoid	Semi-solid tissue. Majority of cells are LYMPHOCYTES which help kill BACTERIA	Forms lymphatic system cells and blood cells and thus protects against diseases. Found in: 1. LYMPH NODES 2. TONSILS 3. THYMUS 4. SPLEEN 5. APPENDIX 6. Glands of the SMALL INTESTINE 7. Wall of LARGE INTESTINE

3. MUSCULAR TISSUE

Tissue Type	Structure	Function
Muscular	3 Types: 1. Striated (Voluntary) 2. Smooth (Involuntary) 3. Cardiac	Striated – voluntary motion Smooth – involuntary motion , e.g. peristalsis, vasoconstriction & vasodilation Cardiac – Pumps blood around the body

4. NERVOUS TISSUE

Nervous	Arranged in bundles of fibres composed of NERVE cells.	Capable of transmitting nerve impulses to and from the BRAIN .
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MEMBRANES (COVERINGS)

Membrane	Description	Location in Body
Mucous Membrane	Produces slimy, sticky fluid called mucus, which lubricates the surfaces and prevents them from drying out.	Lines the surfaces in the body that open to the outside such as the digestive tract and air passages.
Synovial Membrane	Produces a thick fluid called synovial fluid which lubricates and cushions the ends of bones.	Lines the spaces around certain joints such as the hip and knee.
Serous Membrane	Produces a watery fluid called serous fluid which enables organs to slide freely against each other to prevent friction .	Surrounds the lungs the heart and organs in the abdomen

EFFECTS OF MASSAGE ON CELLS & TISSUES

1. Increases blood supply and aids better cellular metabolism
2. Helps rid tissues of waste, enabling better function
3. Reduce adhesions between tissues
4. Helps cell replication (skin level)

DISORDERS AND DISEASES TERMS

Term	Description
Inflammatory Condition (...itis)	Condition which is marked by Redness, Heat, Swelling, Pain and loss of function
Acute Condition	Condition of recent origin, usually first 24-48 hours of an injury or disease.
Chronic Condition	Long-term condition. Usually weeks, months to years.
Emergency Condition	Condition requiring urgent assistance. Usually life threatening.