

AGA 2110

ANIMAL SCIENCE DEPARTMENT

LECTURE 2 - GENERAL ANATOMY & PHYSIOLOGY OF THE CELL

THE CELL

- A cell is a basic unit of living things.
- A cell can exist either alone as a single, free-living plant or animal, or it can combine with other cells to form elaborate complex organisms, such as trees, animals & people.
- The cell is dynamic & performs all of the functions by which life is defined.
- There are 7 key functions or processes necessary for life

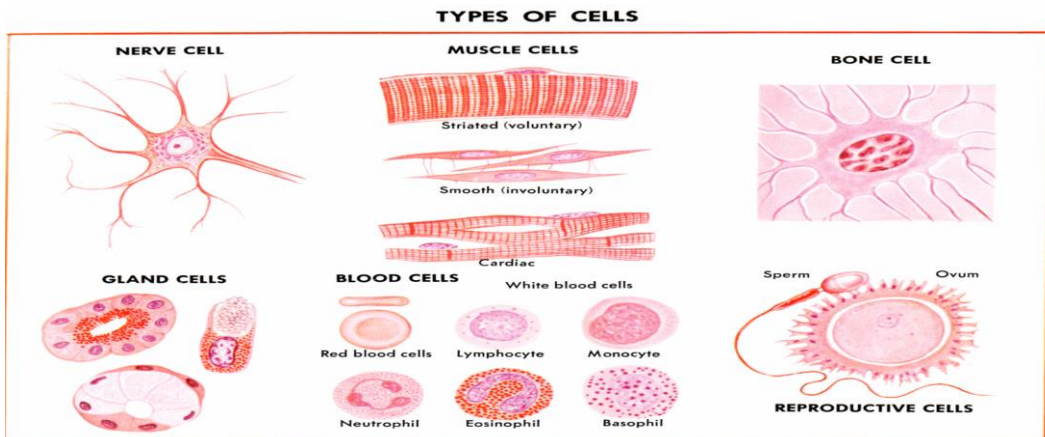
SEVEN FUNCTIONS OF LIVING THINGS

☐ To be categorised as a living thing, a cell just like any living organism must be able to do all the 7 things below;

1. **Movement** – flow of material within the organism or external movt
2. **Sensitivity** – response to conditions around it
3. **Respiration** – exchange of gases
4. **Nutrition** – require energy to survive
5. **Growth** – make new parts & materials
6. **Reproduction** – make new living things
7. **Excretion** – create waste & be able to dispose it

EXAMPLES OF CELLS

- ☐ Cells have diverse morphology (**shape & structure**)
- ☐ Shapes & sizes vary due to having specialised functions

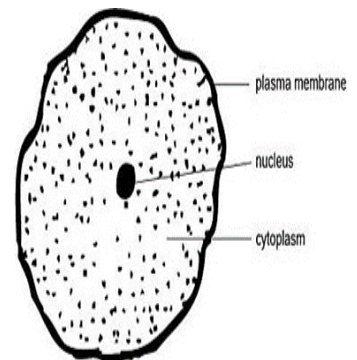


WHY STUDY ABOUT CELLS?

- ❑ In a **multicellular** organism eg cow, cells have differentiated & become grouped into specialized tissues that work collaboratively to sustain life for the animal as a whole.
- ❑ These tissues, as well as the systems they form, are the focus of anatomy & physiology, but it is important to remember that their **functional unit** is the cell
- ❑ It is in the cell that molecular messages are transmitted & received, electrical impulses generated, oxygen absorbed & energy manufactured.
- ❑ Thus we must first learn about cells before we can understand the anatomy & physiology of the tissues & systems they compose.

THE MAMMALIAN CELL – ANATOMY AND PHYSIOLOGY

- ❑ Despite the morphological differences in shape, sizes & function cells have 3 parts in common
- ❑ A typical cell consists of 3 main parts
 - A. Cell membrane** – surrounds & protects the cell
 - B. Nucleus** – The ‘brain’/control center of the cell
 - C. Cytoplasm** – watery (jelly-like), contains ions, proteins and organelles



CELL MEMBRANE (plasmalemma, plasma membrane)

- ❑ Controls movement of molecules into & out of the cell
- ❑ **is semipermeable** – only allows certain specific particles to enter or leave the cell through pores or protein channels
- ❑ Substances move across the cell membrane by
 - i. **Passive process** – diffusion, osmosis & facilitated diffusion (eg O₂ & CO₂)
 - ii. **Active processes** - pinocytosis, phagocytosis & exocytosis (movement against concentration gradient)

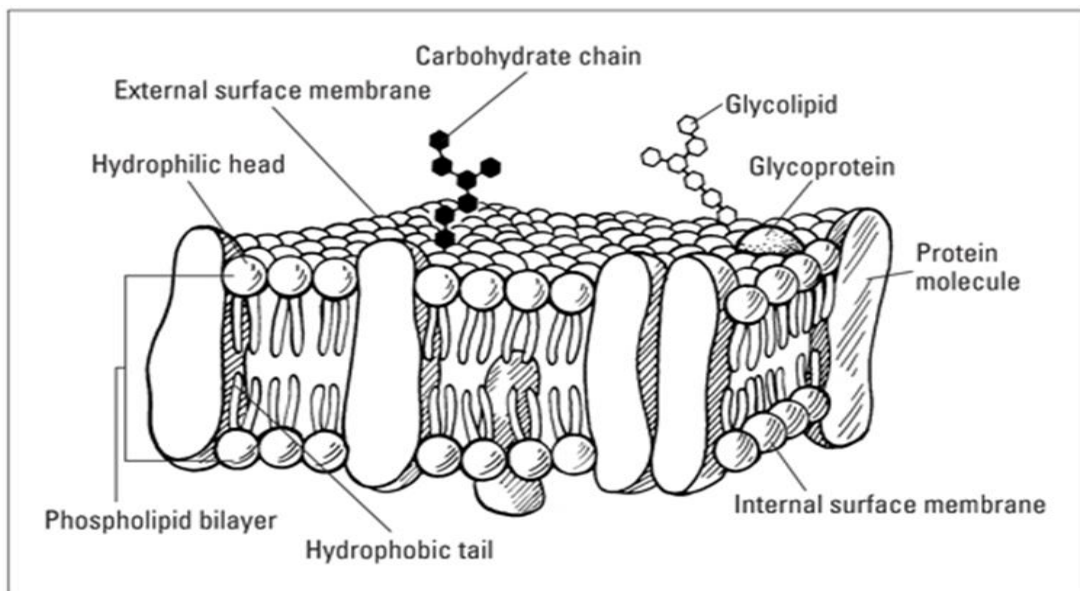
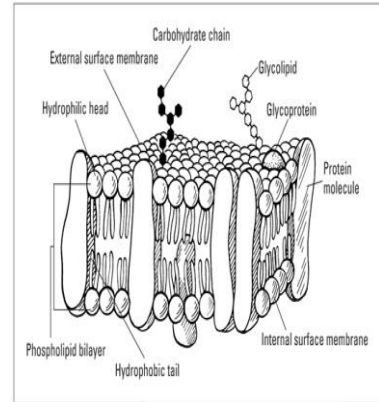
CELL MEMBRANE (plasmalemma, plasma membrane)

CELL MEMBRANE STRUCTURE

- ❑ It is a phospholipid bilayer – contains phospholipids & proteins
- ❑ Composition of the cell membrane;
 - Protein (55%)
 - Phospholipids (25%)
 - Cholesterol (13%),
 - Miscellaneous lipids (4%)
 - Carbohydrates (3%).

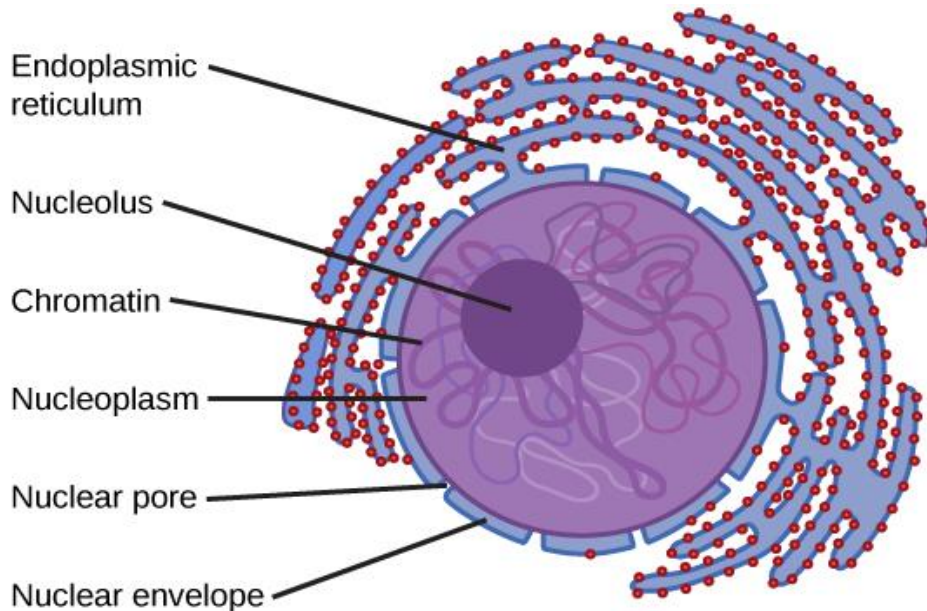
CELL MEMBRANE STRUCTURE

- ❑ Made up of phosphate heads and tails
Consisting of 2 fatty acids.
- ❑ **Hydrophobic fatty acids** – face inside
- ❑ **Hydrophilic head** – face outside
- ❑ Proteins are suspended in the bilayer & easily move throughout the membrane creating a changing pattern called **fluid mosaic**



NUCLEUS

- ❑ The **Control centre** of the cell
- ❑ Controls cell activity – eg protein synthesis
- ❑ Contains DNA(hereditary information) of the cell which enables cells to divide to produce identical cells or species.
- ❑ Contains **chromatin** (long strands of DNA) – which holds information to make protein
- ❑ Has a nucleolus which makes **ribosomes**.
- ❑ Nuclear membrane is composed of outer & inner parts
- ❑ The outer nuclear membrane is continuous with the **rough endoplasmic reticulum** (Rer)



CYTOPLASM

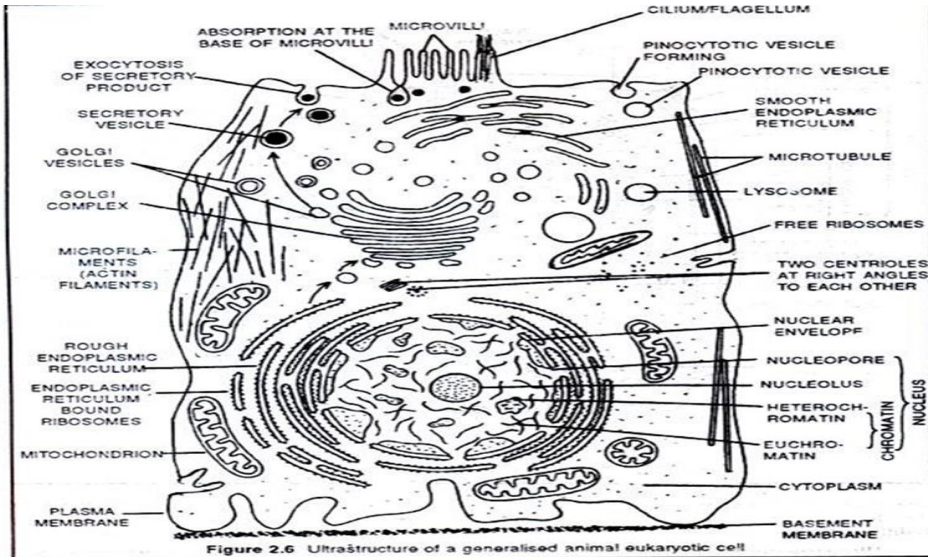
- The inner substance of the cell excluding the nucleus
- Gives support to the cell
- Cytoplasm is the location of diverse metabolic activities
- Cytoplasm has 2 parts – the **cytosol** and **cytoskeleton**
- Cytosol** – fluid part of the cell (contains dissolved amino acids & sugars, proteins are suspended as enzymes)
- Cytoskeleton** - **Has fibers** suspended in cytosol forming the **cytoskeleton** (microtubules, microfilaments) – it makes the structural frame of the cell

ORGANELLES WITHIN THE CYTOPLASM

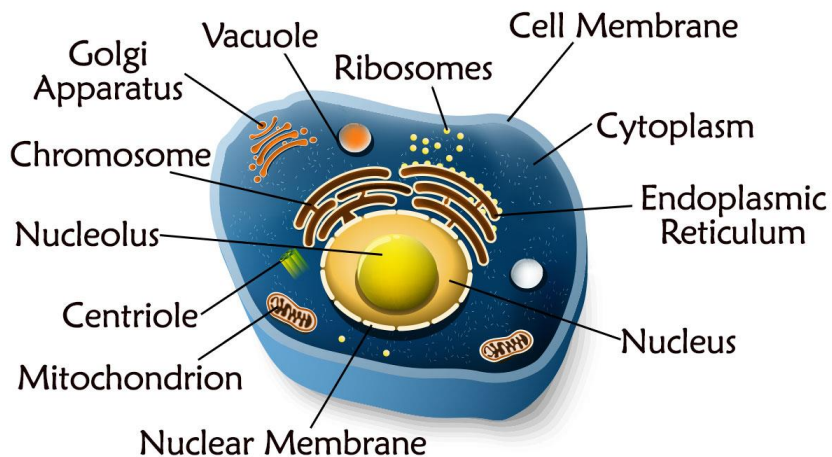
Organelle – “little organs,” are membrane-bound structures within the cytoplasm that possess specialized cellular functions. Following organelles are found in the cytoplasm;

- ✓ Ribosome
- ✓ Vacuoles
- ✓ Mitochondria
- ✓ Lysosome
- ✓ Endoplasmic reticulum
- ✓ Golgi body
- ✓ Cytoskeleton
- Organelles within the cytoplasm can only be seen using an electron microscope

CELL – AS SEEN WITH AN ELECTRON MICROSCOPE

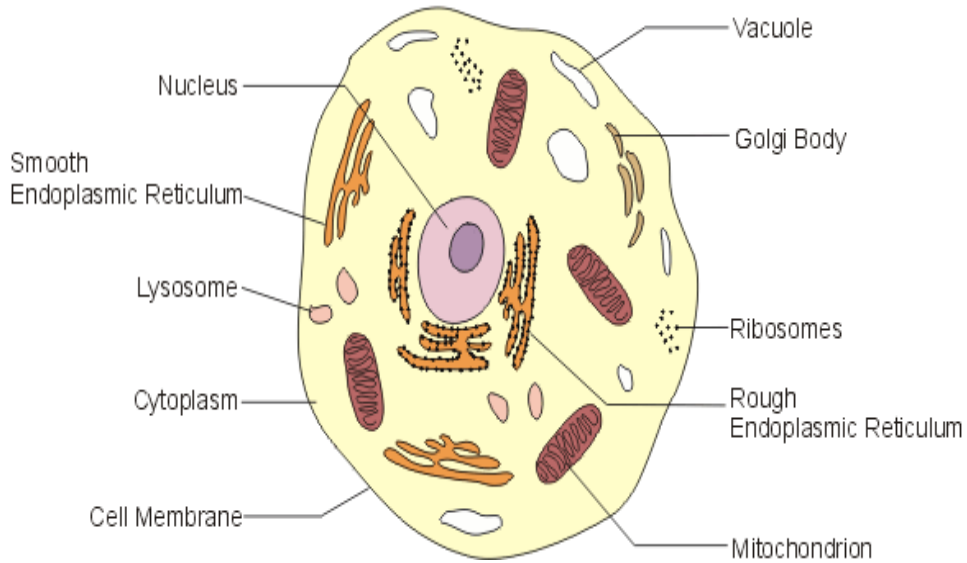


ORGANELLES WITHIN THE CYTOPLASM

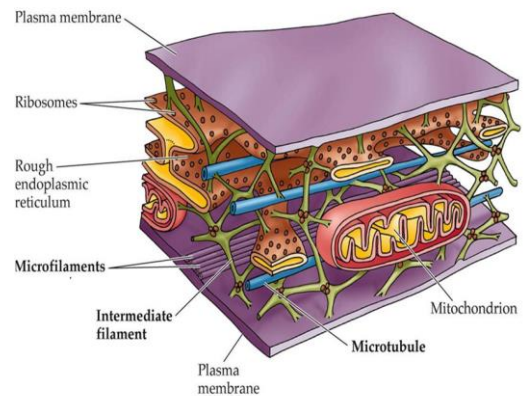
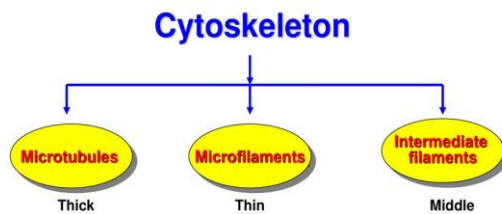


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ORGANELLES WITHIN THE CYTOPLASM

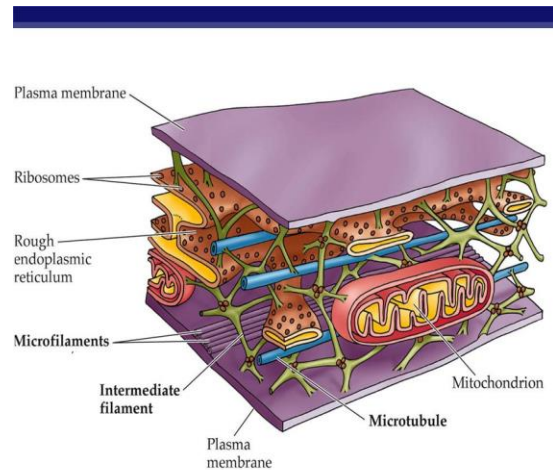


PARTS OF A CYTOSKELETON



CYTOSKELETON

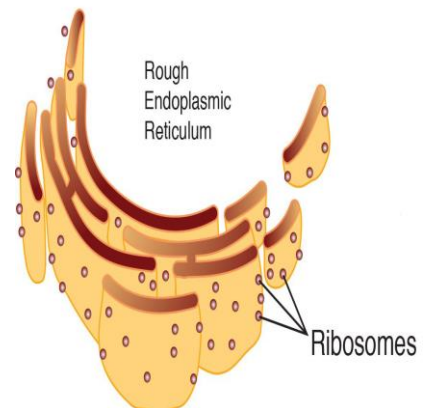
- ❑ It is a network of fibers that organize the structures & activities of the cell
- ❑ It provide mechanical support & maintains the shape of the cell
- ❑ It also provides anchorage for the organelles



ORGANELLES WITHIN THE CYTOPLASM

RIBOSOMES

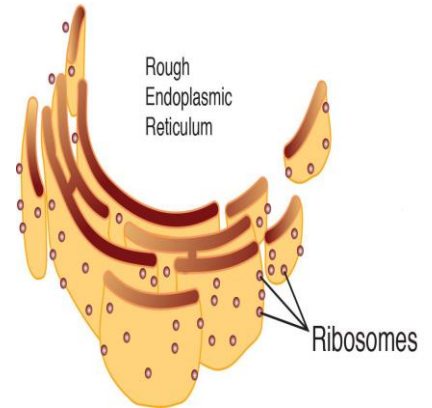
- ❑ Protein factory (protein synthesis)
- ❑ Are **scattered within the cell** or attached to a membrane channel system called the **endoplasmic reticulum** or ER
- ❑ Ribosomes assemble amino acids into protein
- ❑ Protein is processed in the rough ER
 - Proteins – enzymes, hormones, mucus, collagen
 - Ribosomes are flexible (can attach/detach from membranes)



ORGANELLES WITHIN THE CYTOPLASM

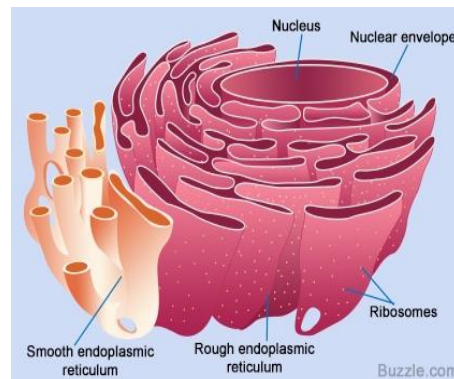
ROUGH ENDOPLASMIC RETICULUM

- ❑ A network of tubular & flat vascular structures or tubes
- ❑ Wall is continuous with the nucleus
- ❑ Rough ER is involved in the **processing** of protein, which is synthesised by the ribosomes.
- ❑ Here the proteins are **modified** before being moved on to the Golgi apparatus for further modification and packaging



ENDOPLASMIC RETICULUM

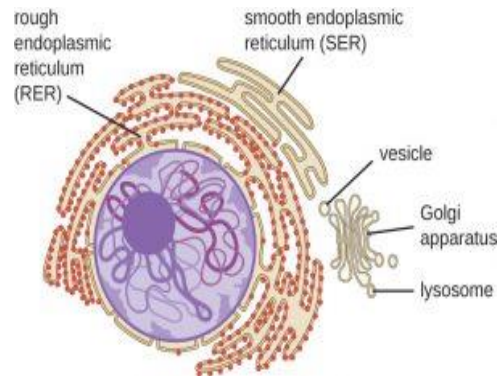
- ❑ The endoplasmic reticulum is a network of tubules and flattened sacs that serve a variety of functions



ORGANELLES WITHIN THE CYTOPLASM

SMOOTH ENDOPLASMIC RETICULUM (SER)

- Makes lipids & fats particularly phospholipids & steroids
- Has no ribosomes hence the name



ORGANELLES WITHIN THE CYTOPLASM

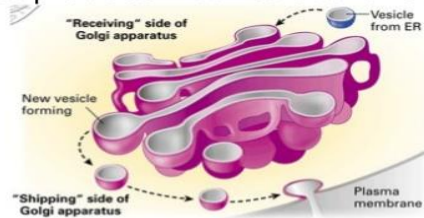
GOLGI BODY (golgi apparatus, golgi complex)

- composed of stacks of crescent-shaped folded membranes
- Receives proteins from the Rough ER
- modifies, sorts & packages** the received proteins & distributes to need part
 - eg sugar may be added to form glycoprotein
- The protein is packed in a protective **vesicle** which is transported to the cell membrane for release or to other parts of the cell membrane

ORGANELLES WITHIN THE CYTOPLASM

Golgi Body Function

- Modifies proteins and lipids
- Process materials to be removed from the cell
- Make and secrete mucus
- Packages products into vesicles for transport



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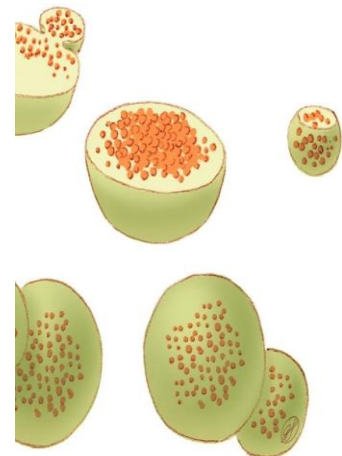
ORGANELLES WITHIN THE CYTOPLASM

LYSOSOME

- Is a specialized vesicle formed by the Golgi apparatus

Has 3 roles

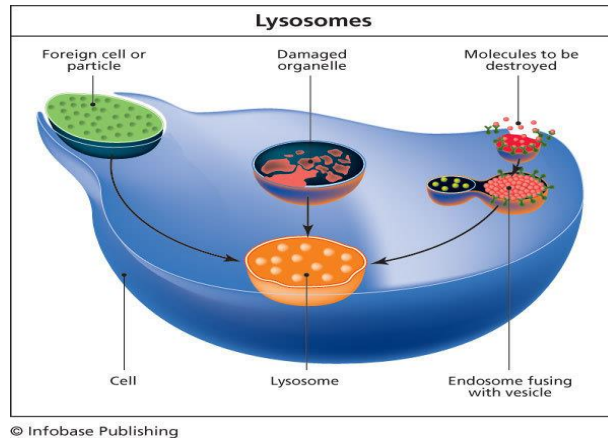
- Called "garbage man of the cell"
- Contains digestive enzymes (Hydrolytic) which breaks down food
- Kills pathogens
- Destroys dying cell by autolysis (self destruction by enzymes)



ORGANELLES WITHIN THE CYTOPLASM

LYSOSOME

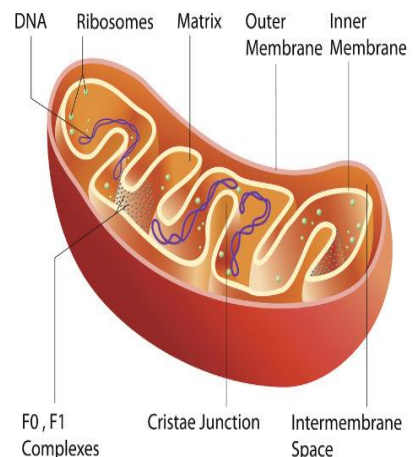
- All cell debris and waste are taken to the lysosome for destruction



ORGANELLES WITHIN THE CYTOPLASM

MITOCHONDRIA

- Mitochondrion (singular)
- Powerhouse of the cell
- Ovoid & has double membrane
- Creates ATP (energy molecule) by cellular respiration
- Has its own DNA & **ribosomes** (can make protein, reproduce & replicate)
- Replicates by fission when needed (↑ energy demand).



ORGANELLES WITHIN THE CYTOPLASM

VACUOLES

- Store food (nutrients), water and waste

CENTRIOLES

- help with cell division in animal cells
- Each cell has 2 centrioles

PARTS OF A CELL USED IN MOVEMENT

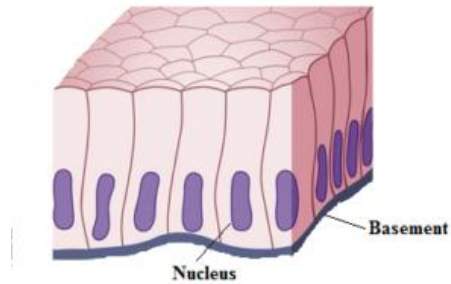
CILIA AND FLAGELLA

FUNCTION – movement

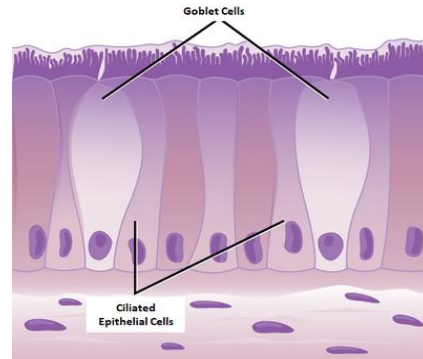
- cilia & flagella are extensions of plasma membrane
- Some cells have neither
- some cells have cilia, others may have flagella
- Cilia** – numerous hair like extensions on the surface of cells
- Flagella** – long whip-like extension (very few)

CELL SURFACE SPECIALISATIONS

Non-ciliated



Ciliated epithelium

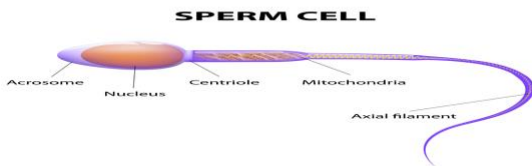


ROLE OF CILLIA

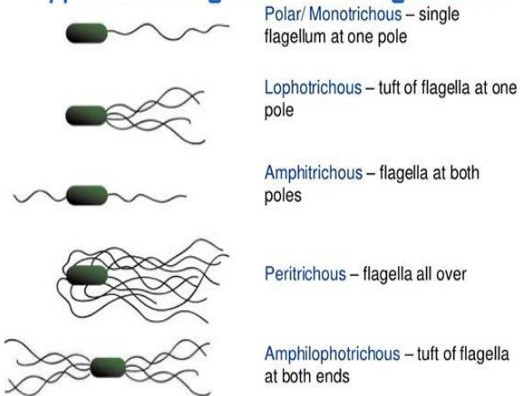
- Found in upper respiratory tract & oviduct
- cilia propels (moves) fluid, mucus or debris (waste) across cellular surfaces
- Propels mucus and bacteria away from the lungs
- in oviduct – propel eggs from the ovary into oviduct

FLAGELLA

- singular form of flagella is flagellum
- propels the cell forward by undulating movement
- Flagella move cells through fluid
- The tail of a sperm cell is an example of a flagellum.



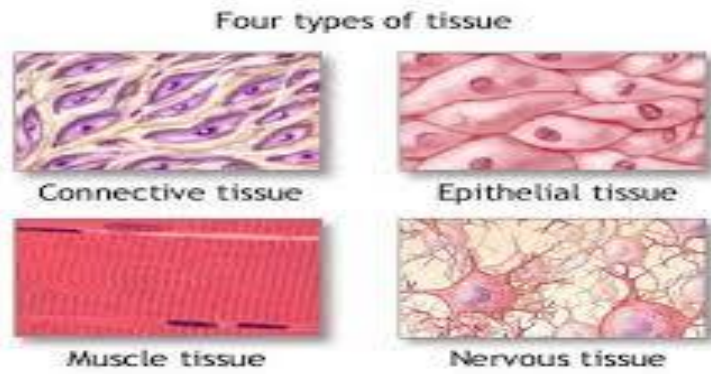
Types of Flagellar Arrangement



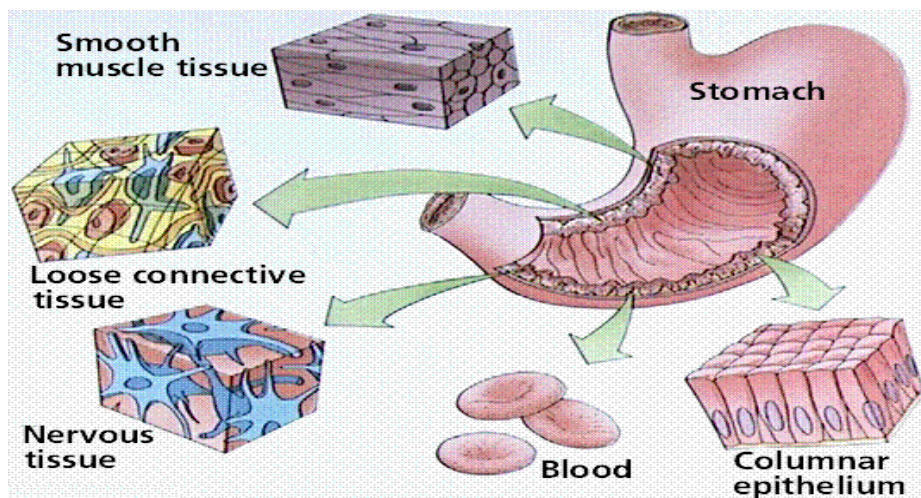
RECAP- LEVELS OF ORGANISATION OF AN ANIMAL'S BODY

- ❑ **Cell** – A functional unit of an animal
- ❑ **Tissue** –Tissues are groups (sheets) of similar cells that have a common function.
- ❑ **Organs** - structures made up of two or more tissues organized to carry out a particular function eg kidney, liver
- ❑ **Organ system** – A number of organs that work together to accomplish a common purpose. Eg digestive system, respiratory system

Examples of tissues



EXAMPLE OF AN ORGAN WITH DIFFERENT TISSUES IN IT



SUMMARY

In Animals

