

# CELLS AS BASIC BUILDING BLOCKS

# Terminology list in back of w/b.

Term	Definition

# 1. Definition of a cell:

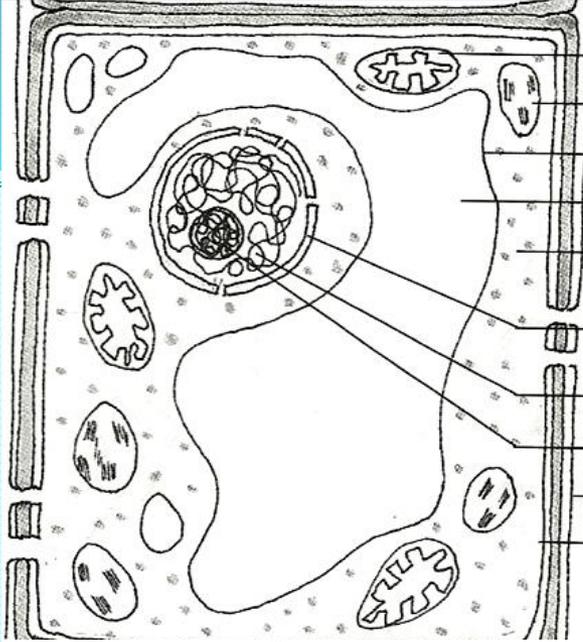
The **basic structural unit** of which **all living organisms** consist.

# Characteristics of living organisms

- 1 **Nutrition.** Living things take in **materials** from their surroundings that they use for **growth** or to provide **energy**. ...
- 2 **Respiration.** ...
- 3 **Movement.** ...
- 4 **Excretion.** ...
- 5 **Growth.**
- 6 **Reproduction.** ...
- 7 **Sensitivity.**

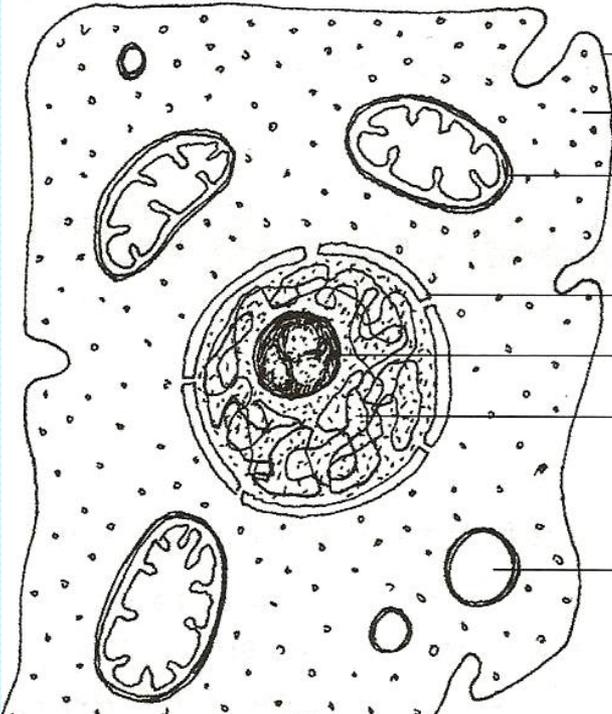
# Structure of cells

- Some cells can be seen with the **naked eye: frogs' eggs, fish eggs (caviar)**.
- **Most cells** are too small to be observed with the naked eye= **microscopic**.
- Cells are made up of even smaller parts such as molecules and atoms (which is non-living)



- mitochondrion
  - chloroplast
  - tonoplast
  - vacuole
  - cytoplasm
  - double nuclear membrane
  - nucleoplasm
  - nucleolus
  - cell wall
  - cell membrane
- } nucleus

Plant cell



- cell membrane
  - cytoplasm
  - mitochondrion
  - nuclear membrane
  - nucleolus
  - nucleoplasm
  - vacuole
- } nucleus

Animal Cell

# Similarities between plant- and animal cells

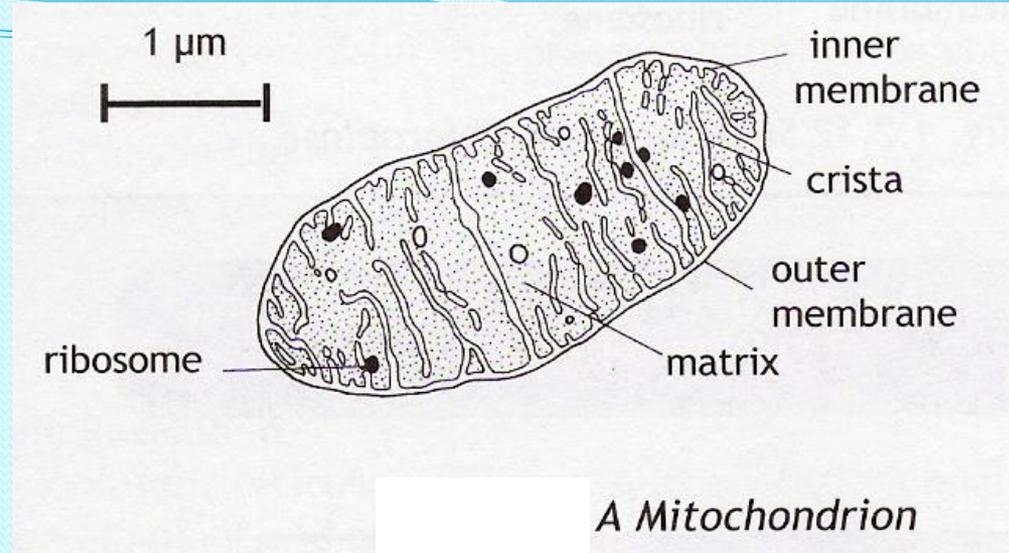
**Both cells have a:**

1. Cell membrane
2. Cytoplasm
3. Nucleus
4. Mitochondrion

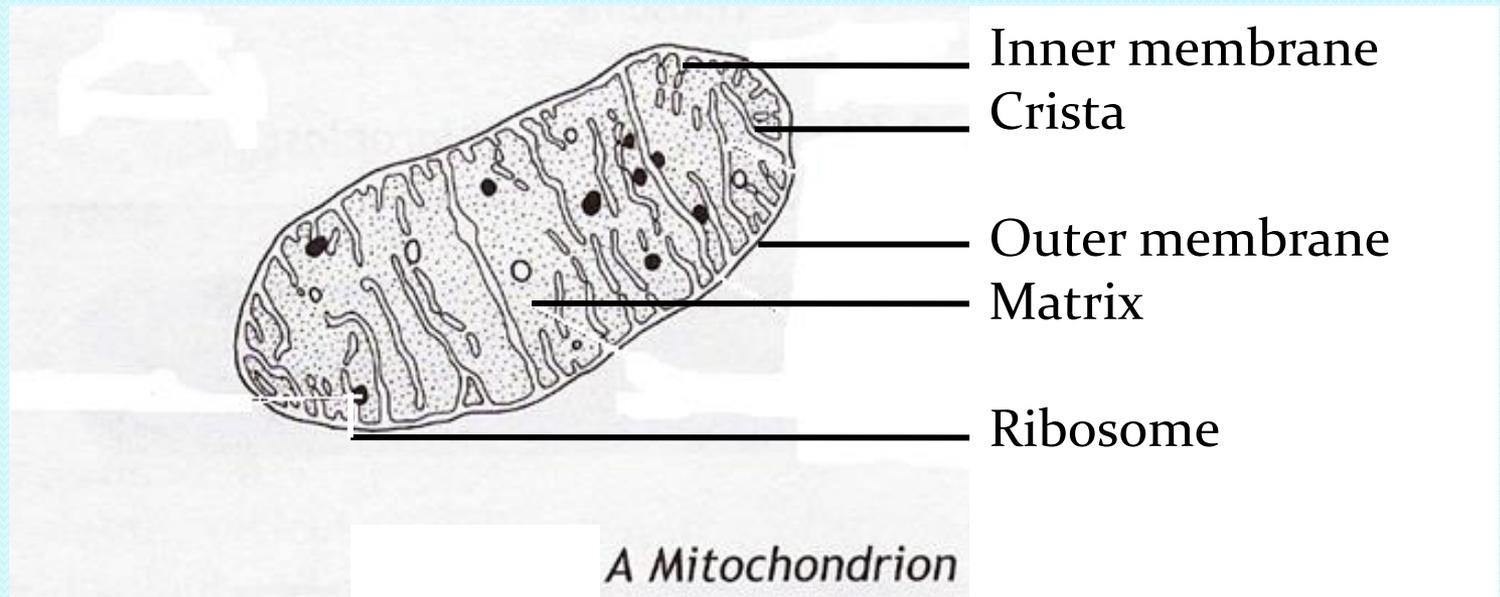
# VIDEO 1

## CELL SONG

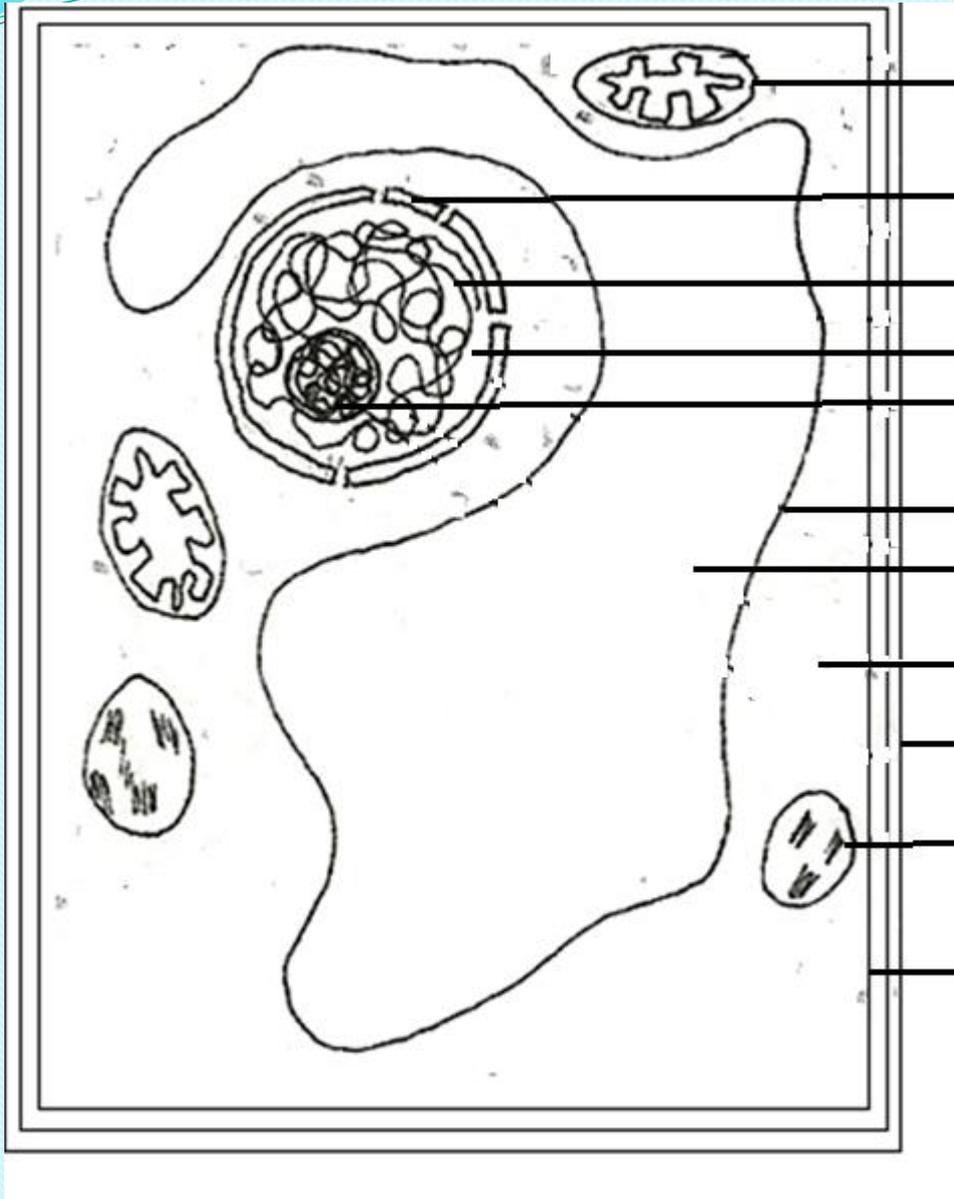
**WRONG**



**CORRECT**



# General structure of a plant cell



Mitochondrion

Nuclear membrane

Chromatin network

Nucleoplasm

**Nucleolus**

nucleus

Tonoplast

Cell sap

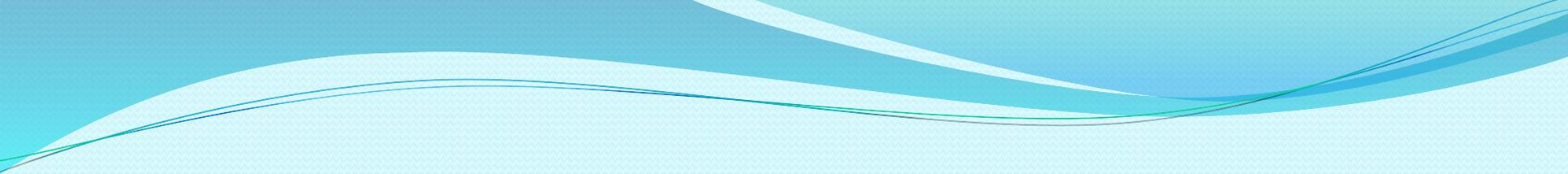
vacuole

Cytoplasm

Cell wall

Chloroplast

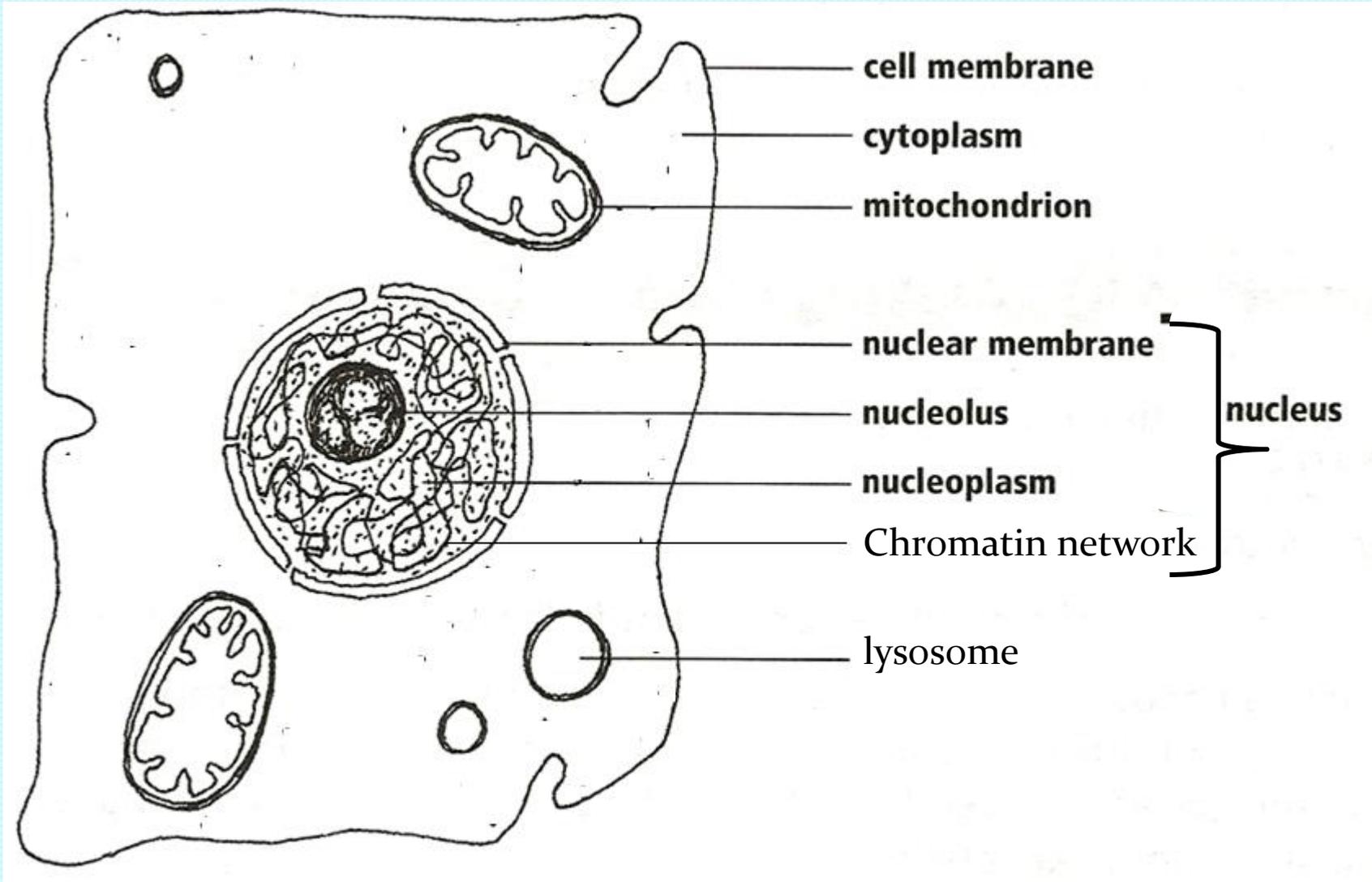
Cell membrane



# VIDEO 2

## Animal cells animation

# Basic structure of an animal cell



Tabulate the differences  
between plant and animal cells.

Heading with both variables and units

Column headings with **units**

Table 0. 2 The nutrients found in some food types

	NUTRIENTS		
FOOD TYPES	Carbohydrates (%)	Fats (%)	Proteins (%)
White bread	53	0	4
Chicken	0	10	60
Apple	8	0	0
Peanuts	4	50	12

Borders

Row headings

Horizontal lines must be present.

Vertical lines must be present

## 2. Differences between plant and animal cell.

PLANT CELL	ANIMAL CELL
Rigid and fixed or firm shape✓ due to the presence of a cell wall✓	Flexible or changeable shape✓ due to the absence of a cell wall.✓
Usually has one large vacuole✓	Usually no vacuole, however, if any present, it is many small ones✓.
Have chloroplasts✓	No chloroplasts✓
No lysosome✓	With lysosome✓

# Organelles found in both cells

## 2. Organelle

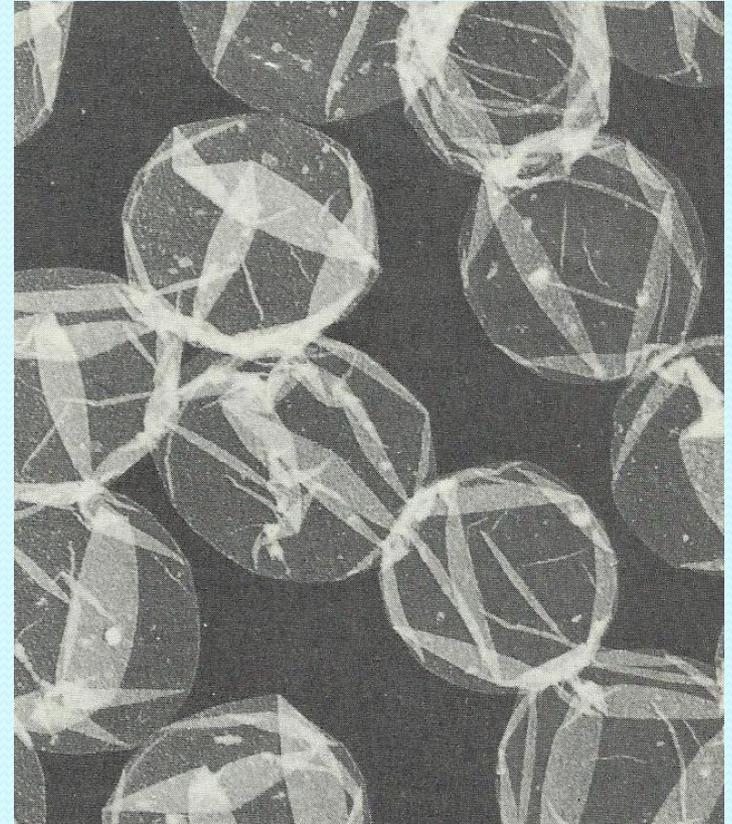
Small membrane-bound structure, with special functions, found inside cells.

# Cell membrane/plasma membrane

x 228 000



X 4500 Red blood cells



# Function of Cell Membrane

**Plant cell**

**Animal cell**

Control the movement of substances into and out of a cell by being *selectively permeable*.

Encloses and protects its contents.

# 3. Selectively permeable

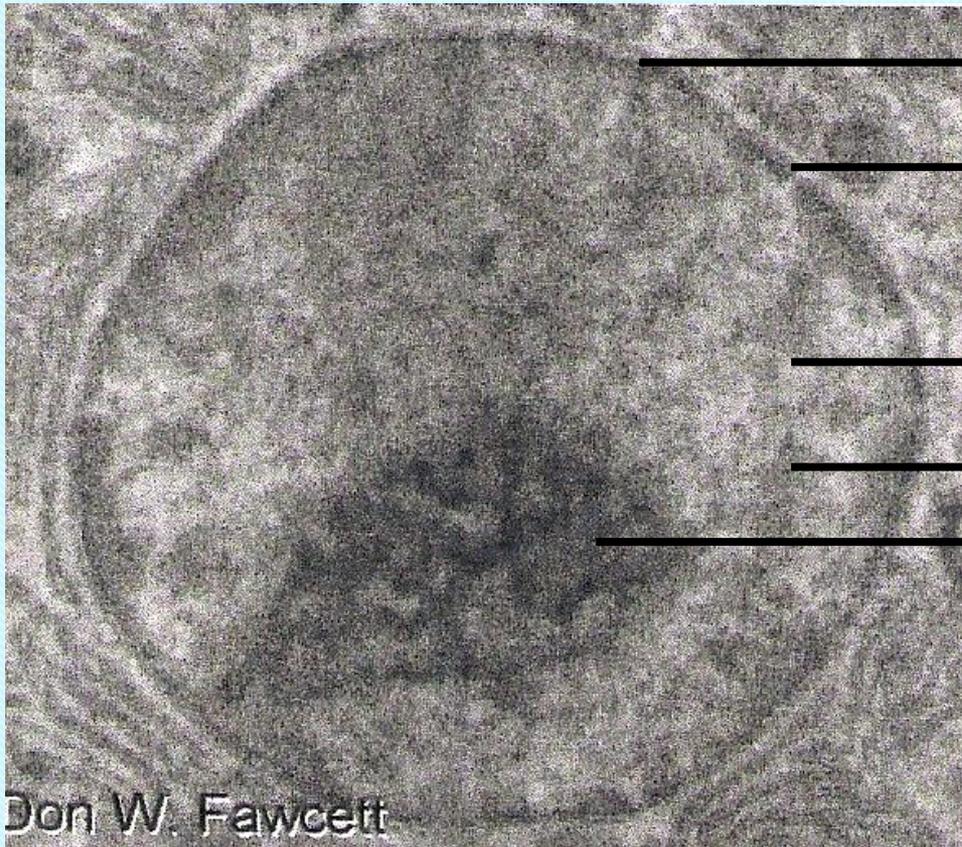
Only allow certain substances to pass through  
for example the cell membrane

# External view of Nucleus 63 500 x



Nuclear  
pores

# Nucleus as seen under electron microscope



Nuclear membrane

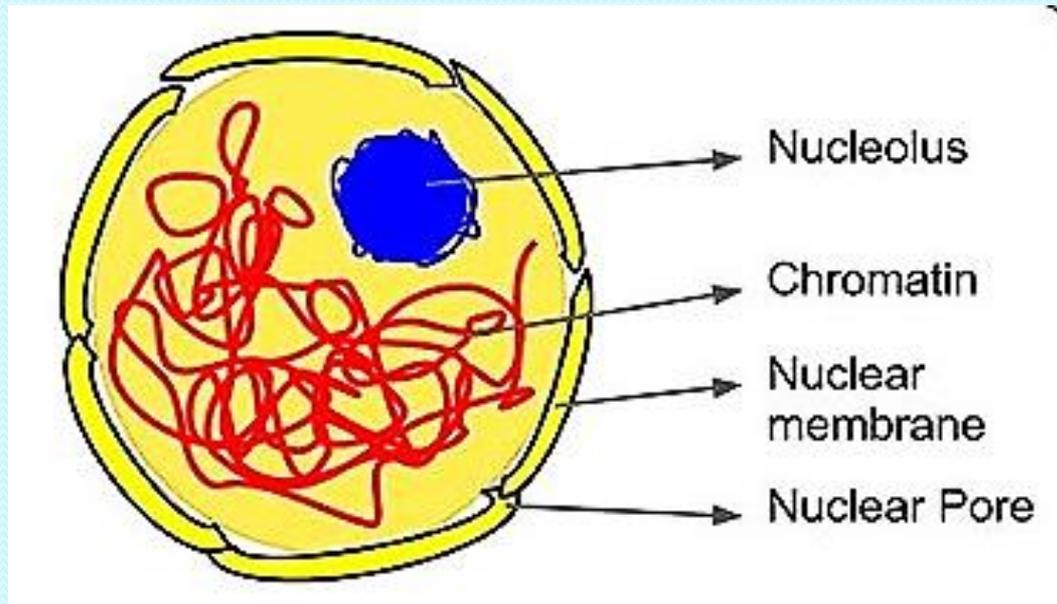
Nuclear pore

Nucleoplasm

Chromatin network

Nucleolus

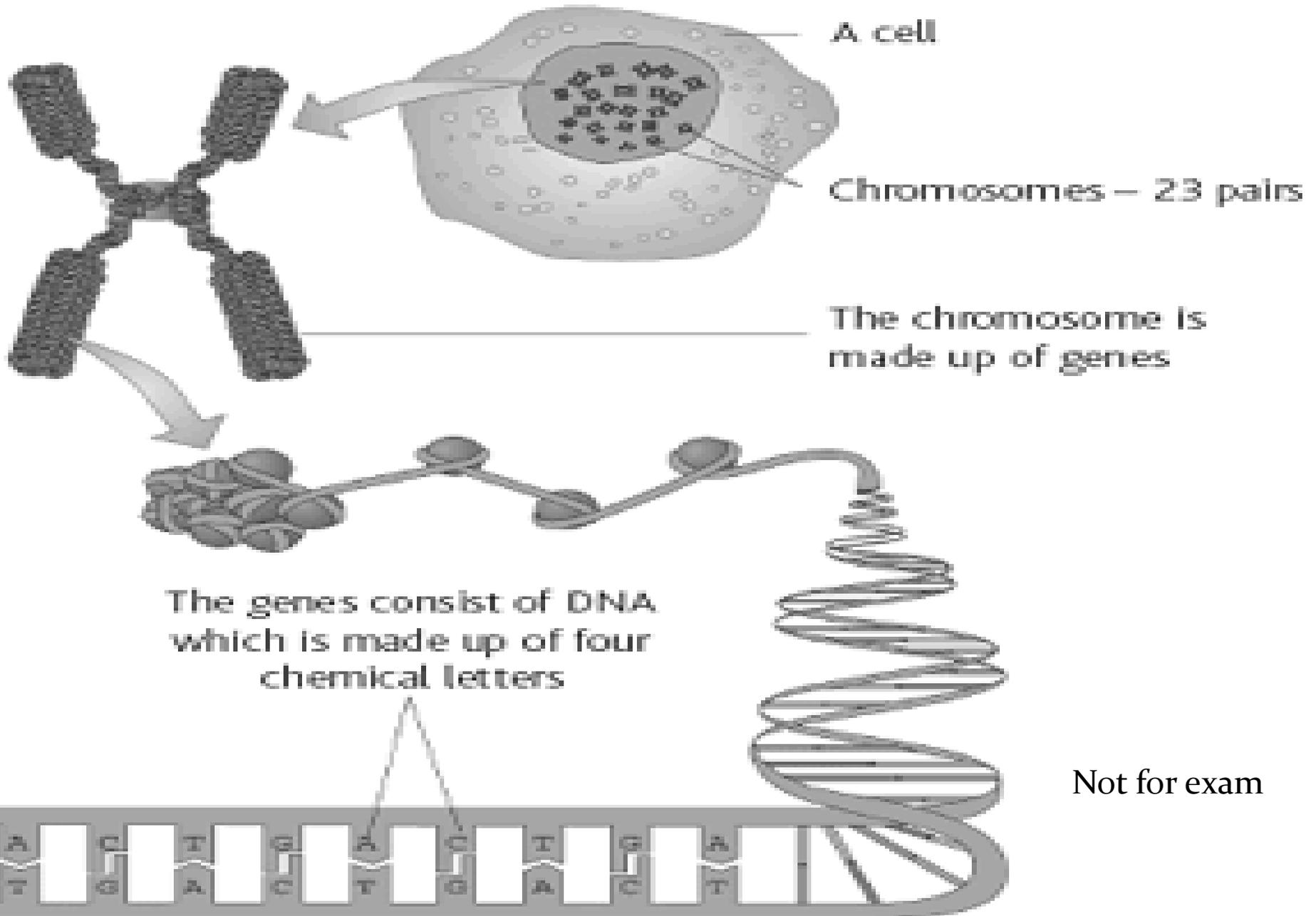
# Nucleus



# Chromosomes (40 000 X) found in the nucleus. (carry the heredity properties)



Not for exam



# Functions of Nucleus

- **Controls** all metabolic reactions / processes that takes place in the cell.
- DNA in nucleus carries **hereditary/ inherited characteristics** from parent to off-spring.
- **DNA is unique** to each person; this **variation** accounts for **differences** within species.

# 4. Hereditary characteristics

Inherited characteristics that is carried from parent to their offspring – for example whether eyes are blue / brown.

- *Each person's DNA is unique*
- *Genes are parts of DNA which carries a specific hereditary characteristic.*
- *Some traits come from your mother, some from father.*
- *This is why there is **variation** among individuals of plant- and animal species.*

# 5. Variation

Refer to the **differences** between members of the **same species**.

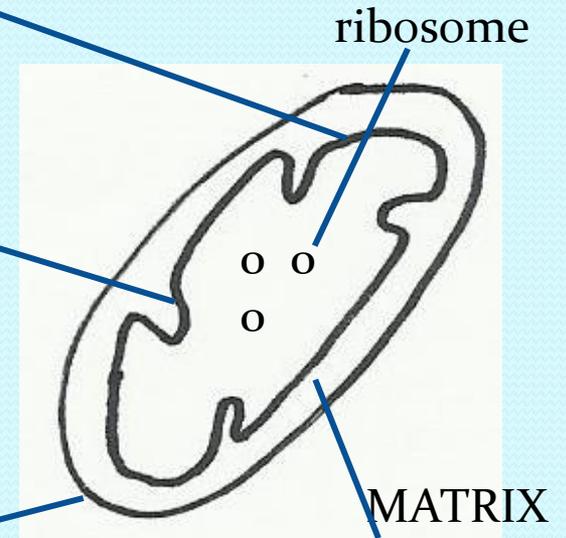
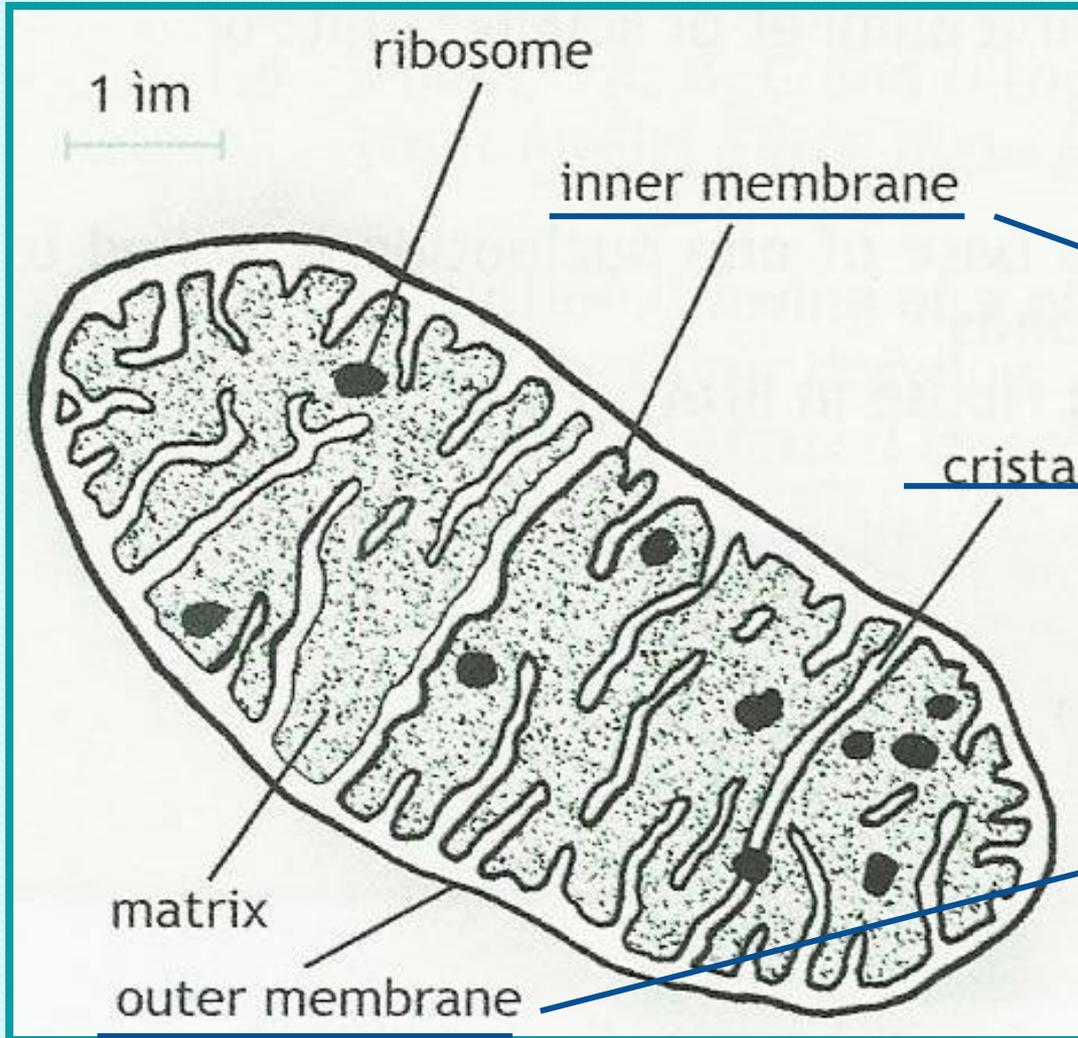
# 6. Cytoplasm

Is the jelly-like medium in plant- and animal cells in which many chemical reactions take place .

# Functions of cytoplasm

1. All the chemical reactions / metabolic processes takes places in cytoplasm
2. It also contains all the organelles (with its own specific function)
3. *Storage (salts, sugars, carbohydrates, gases)*

# Mitochondrion (Mitochondria)



# Function of mitochondria

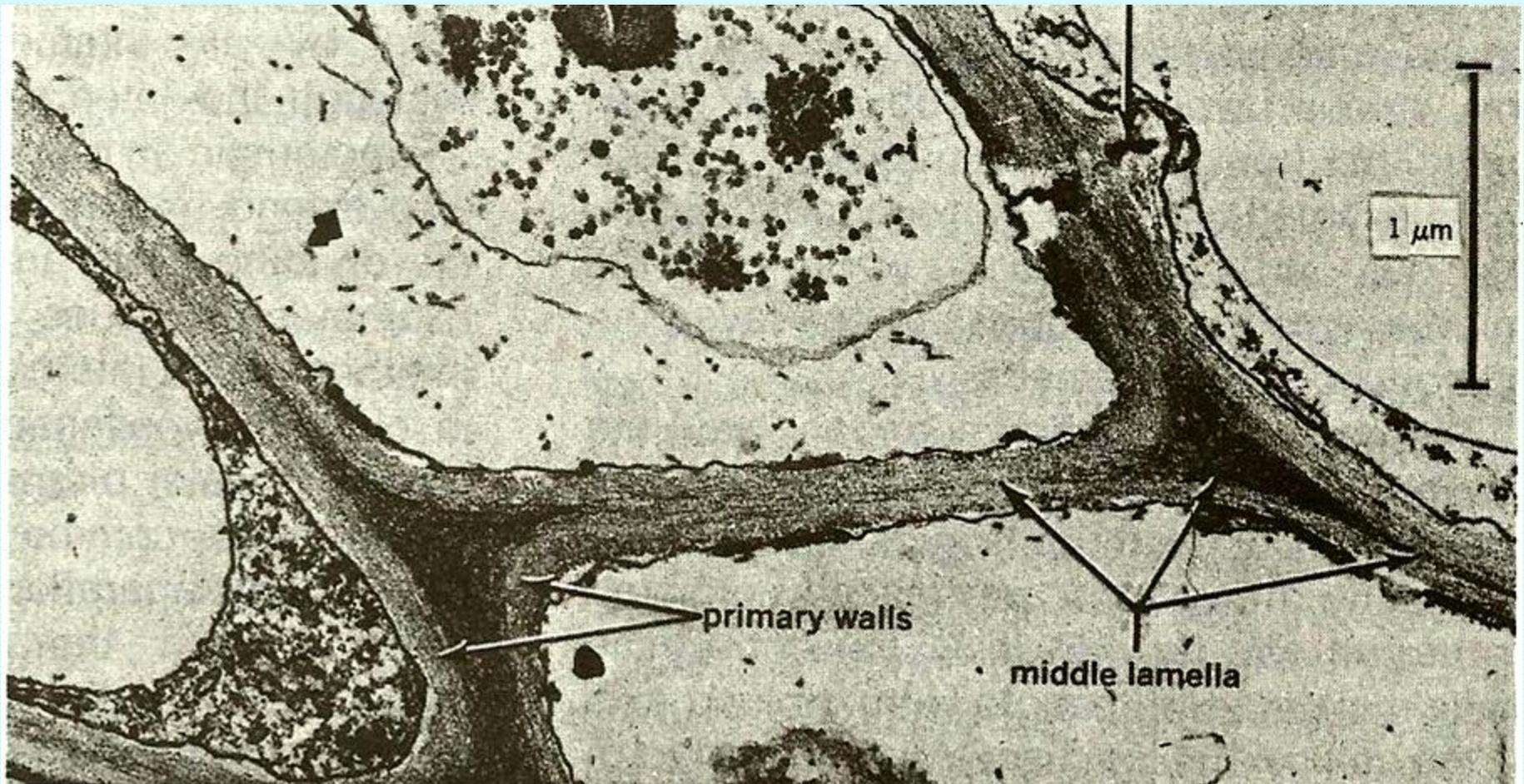
Cellular respiration to release energy from food.

**7. Cellular respiration** is a process during which **food (glucose)** is broken down to release **energy**.

# ORGANELLES ONLY FOUND IN PLANT CELL.

# Cell Wall

Rigid , made of cellulose (= characteristics)



# Function of cell wall

- Provide support
- Protects the plant cell from mechanical damage

# Vacuoles

- Plant cell has **one large vacuole**.
- Cavity filled with **cell sap**.

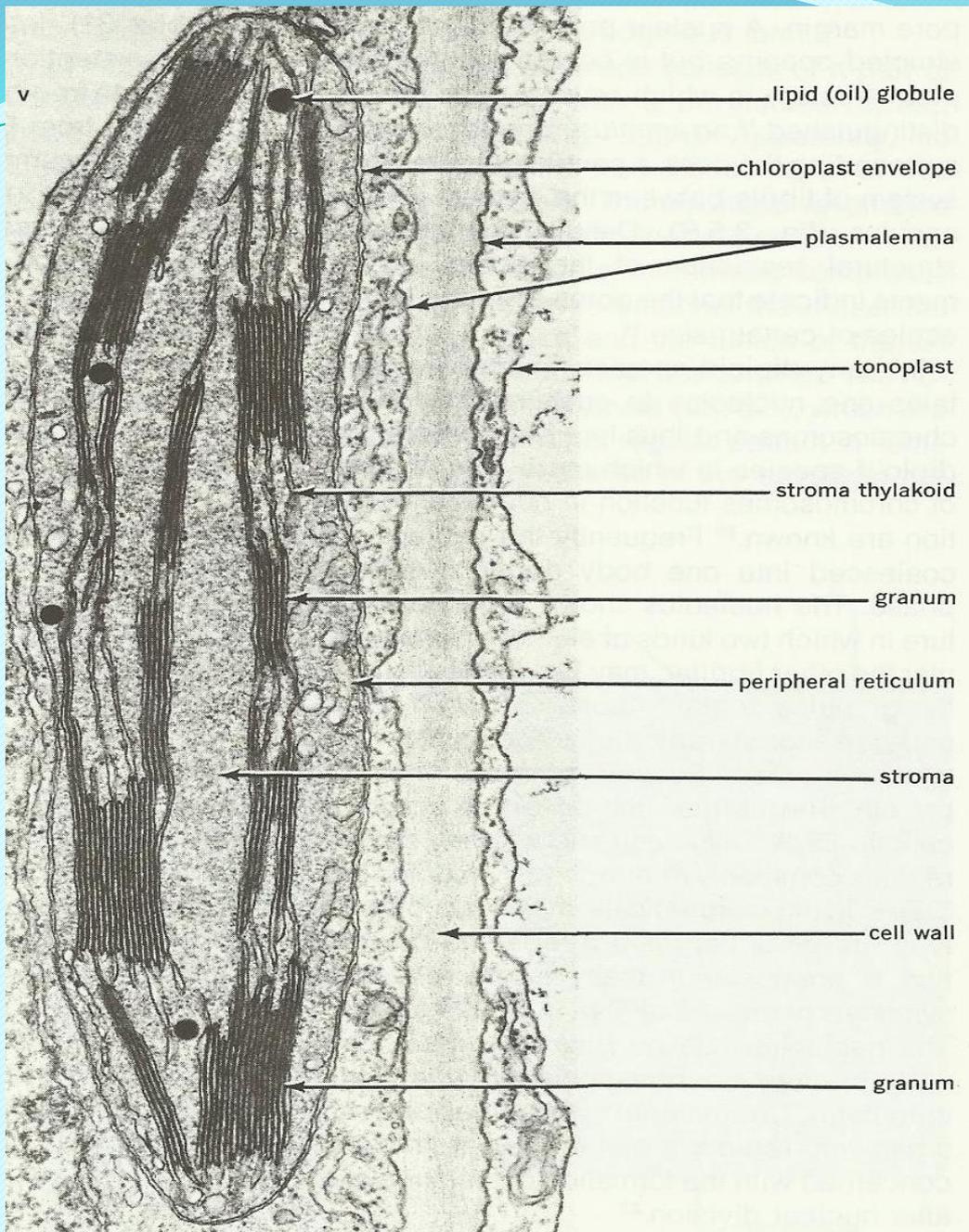
## Functions:

- **Store** water, soluble nutrients, mineral salts and waste products.(=cell sap)
- **Supports** the cell.
  - When it is full, it pushes outwards on the cell wall

## 8. Cell sap

Contents of a plant cell vacuole which consists of water, soluble nutrients, mineral salts and waste products

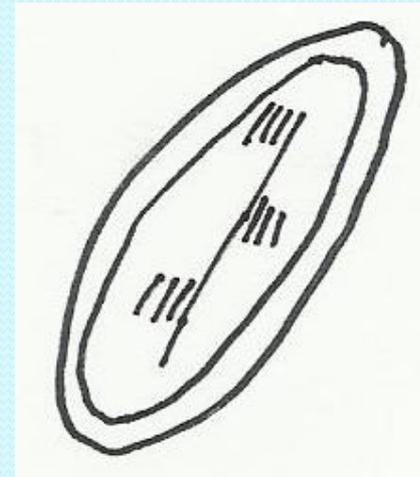
- Animal cells **usually don't have a vacuole**
  - if they do, they are small and many, with specific functions.



# Chloroplast

Contains green pigment called chlorophyll

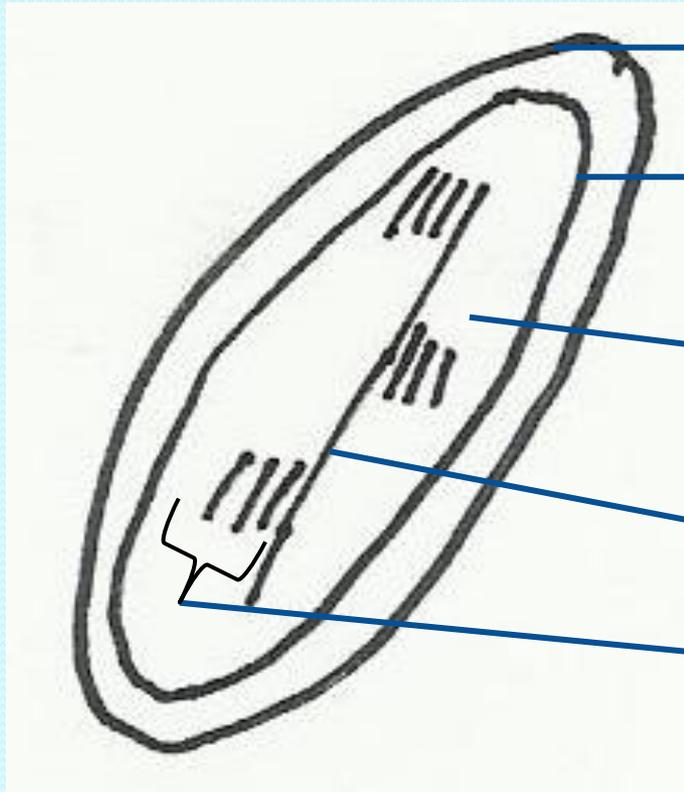
**Function:**  
Photosynthesis.



# 9. Photosynthesis

Process in plants by which radiant energy, carbon dioxide and water is converted into glucose and oxygen.

# Structure of a chloroplast



Outer membrane

Inner membrane

Stroma

Stroma lamellae

Granum (with chlorophyll)

# Activity 1

1. Give the similarities between plant and animal cells.
2. Tabulate the differences between plant- and animal cells.

# 1. Similarities between plant- and animal cells

**Both cells have a:**

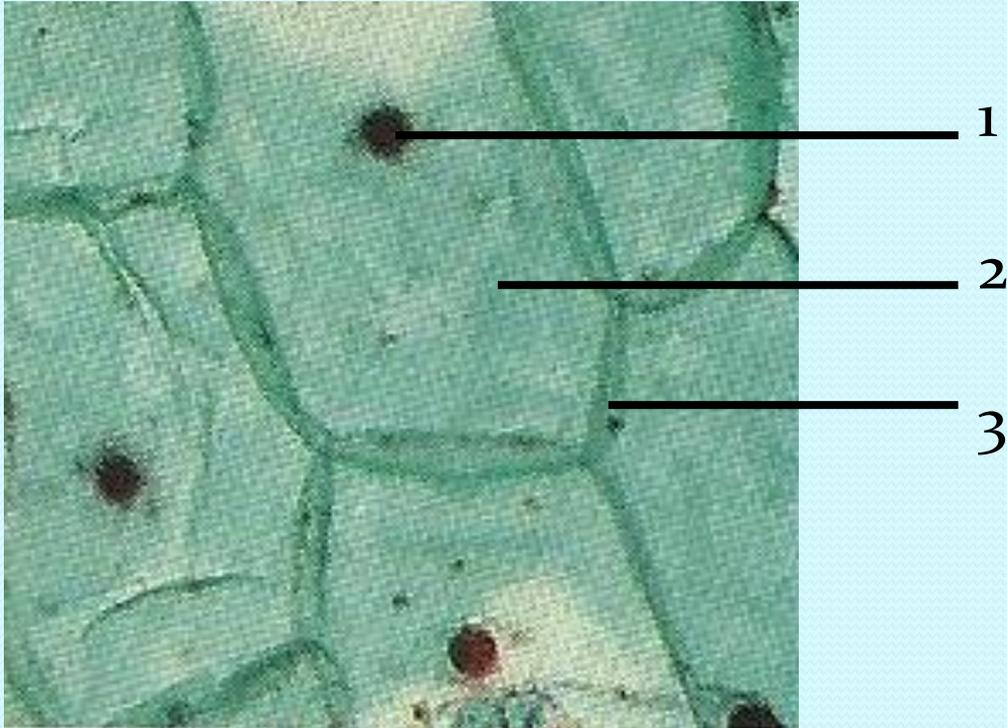
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4. Mitochondrion

## 2. Differences between plant and animal cell.

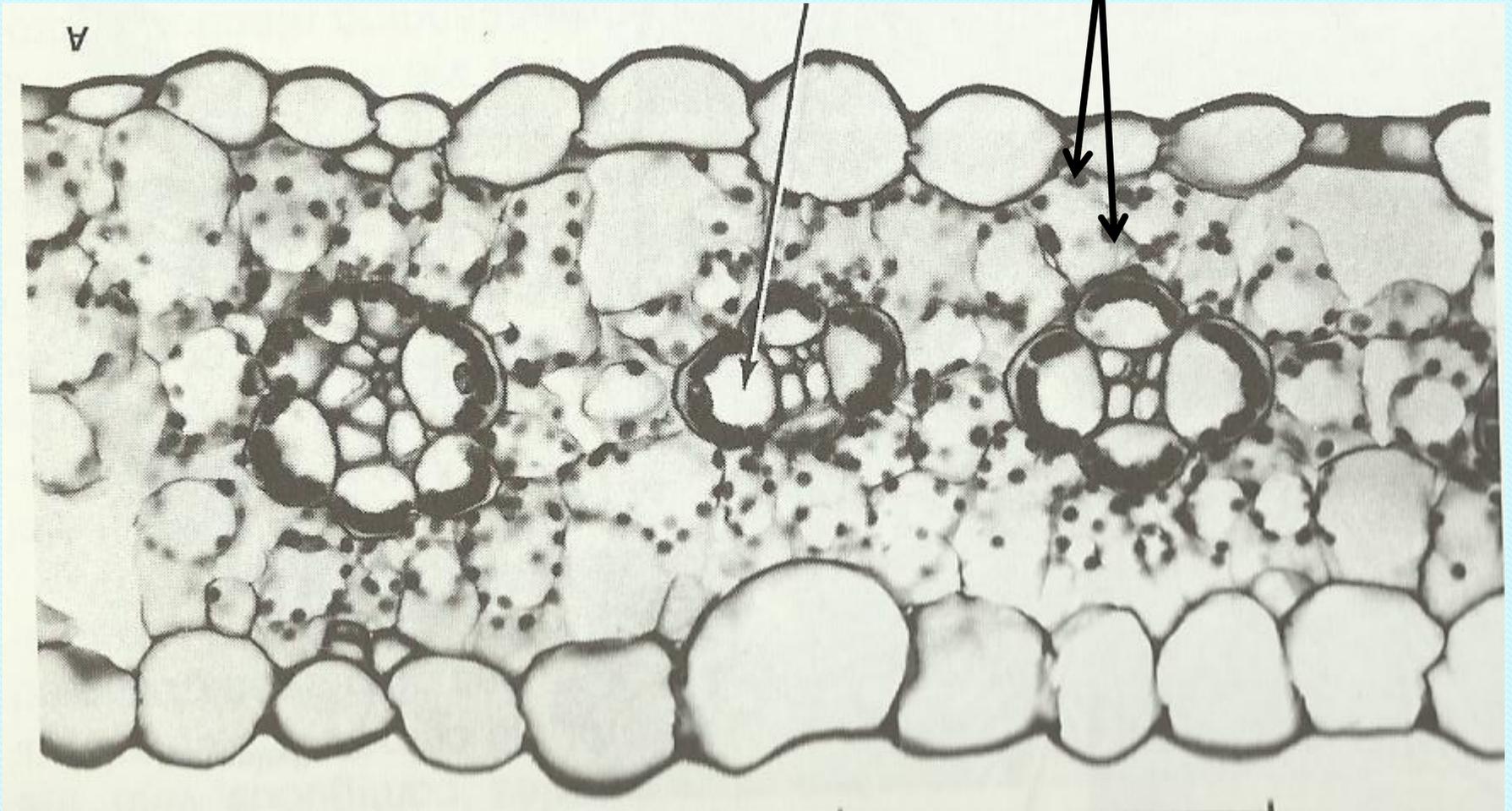
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Have chloroplasts✓	No chloroplasts✓
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# Examples of plant cells

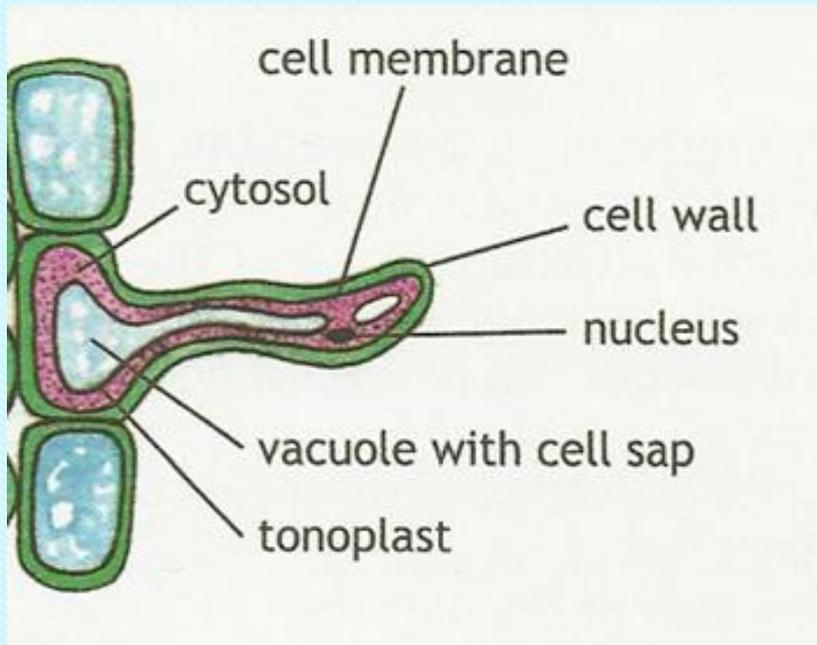
# Leaf epidermis as seen under compound microscope



# Leaf – showing chloroplasts



# Root hair



## **Location:**

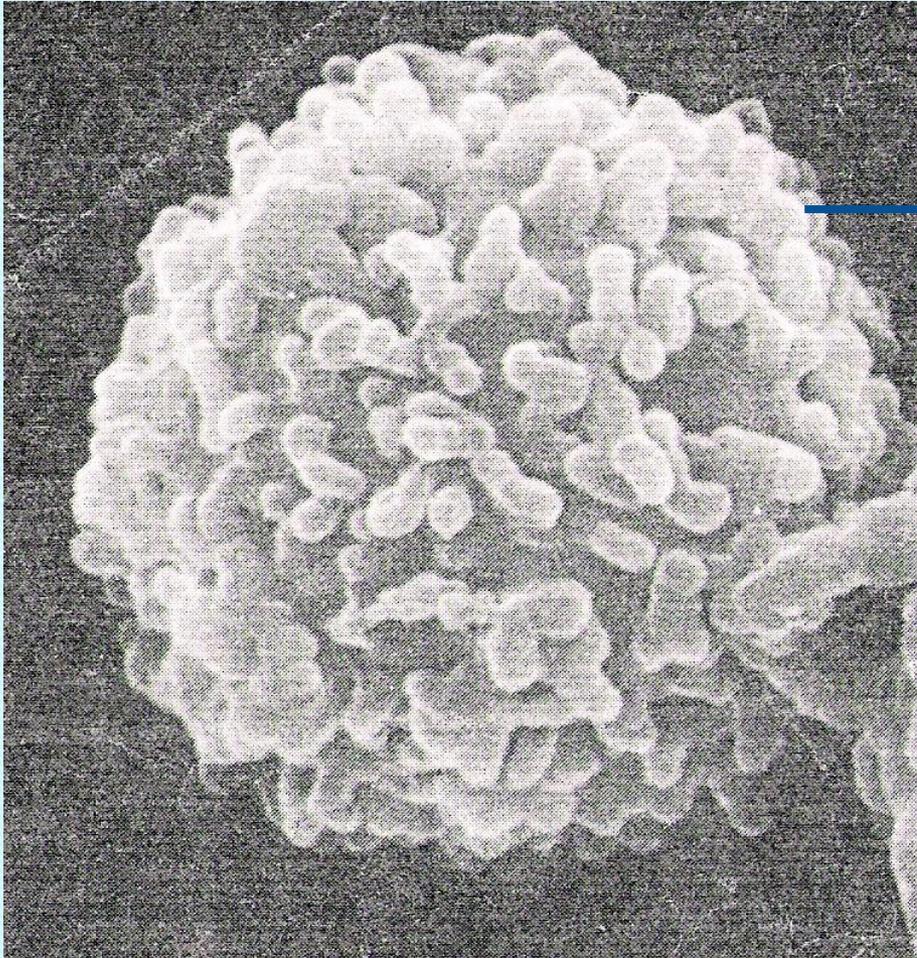
Plant roots

## **Adaption for function**

Large surface area allows water and minerals to pass into the cell.

# Examples of animal cells

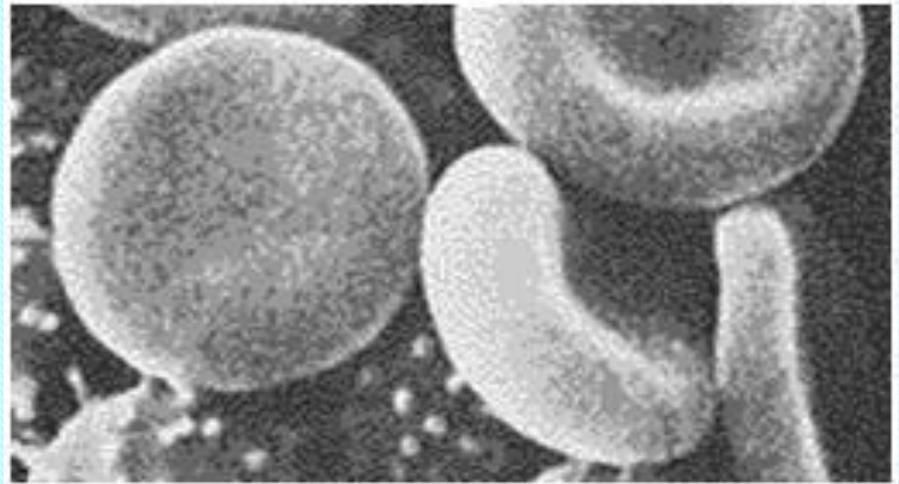
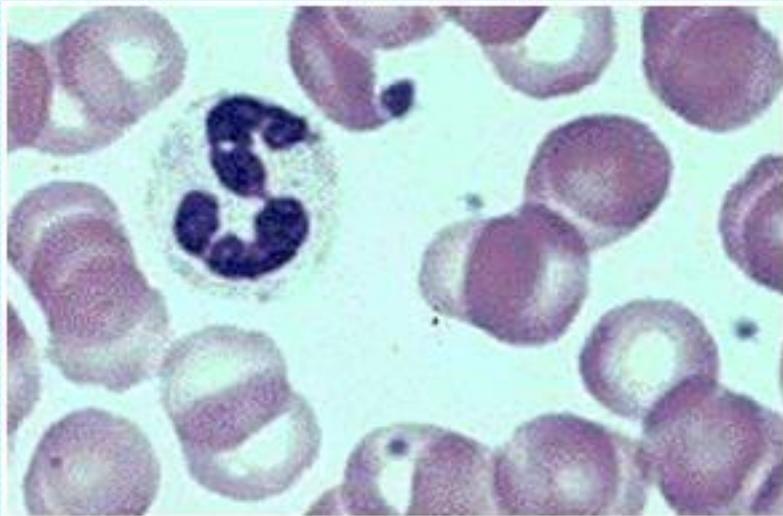
# Animal cell 14 500 x (Electron microscope)



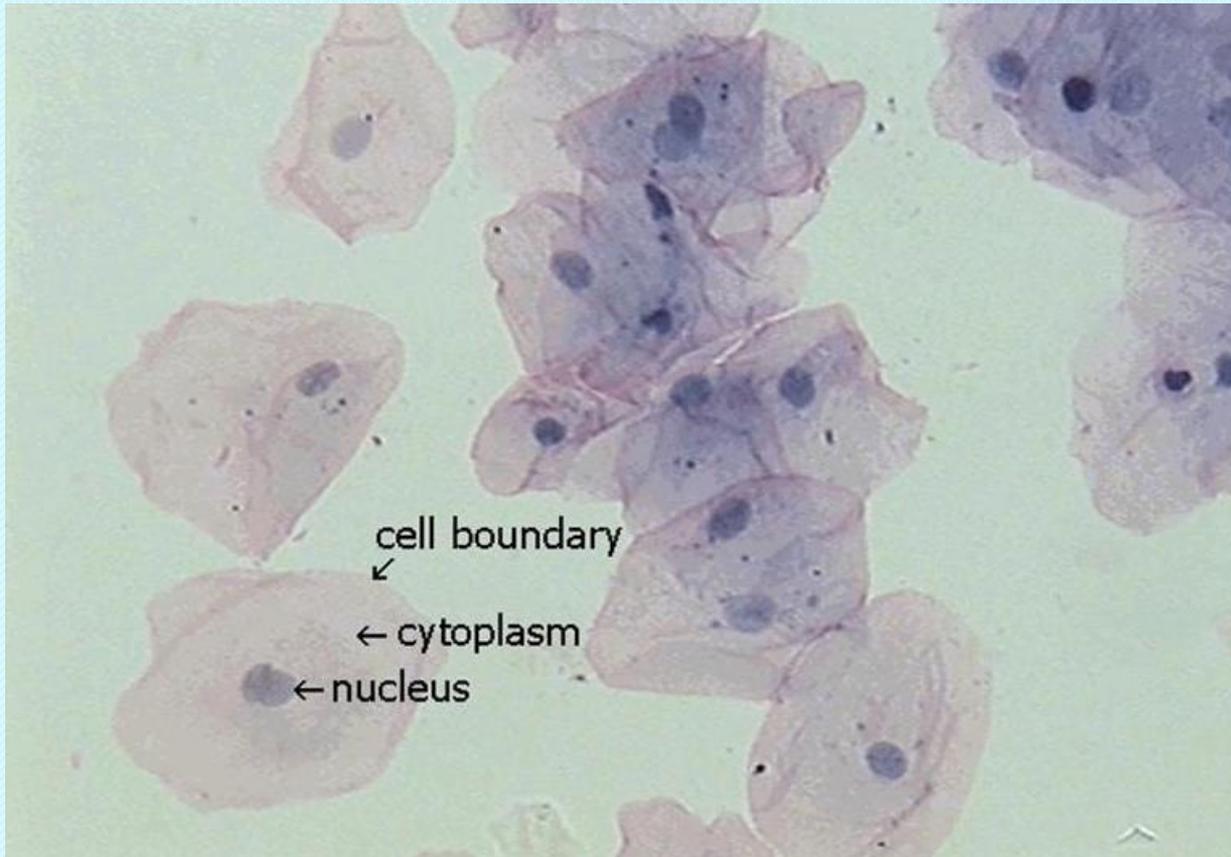
# Blood cells as seen under

**Compound microscope**

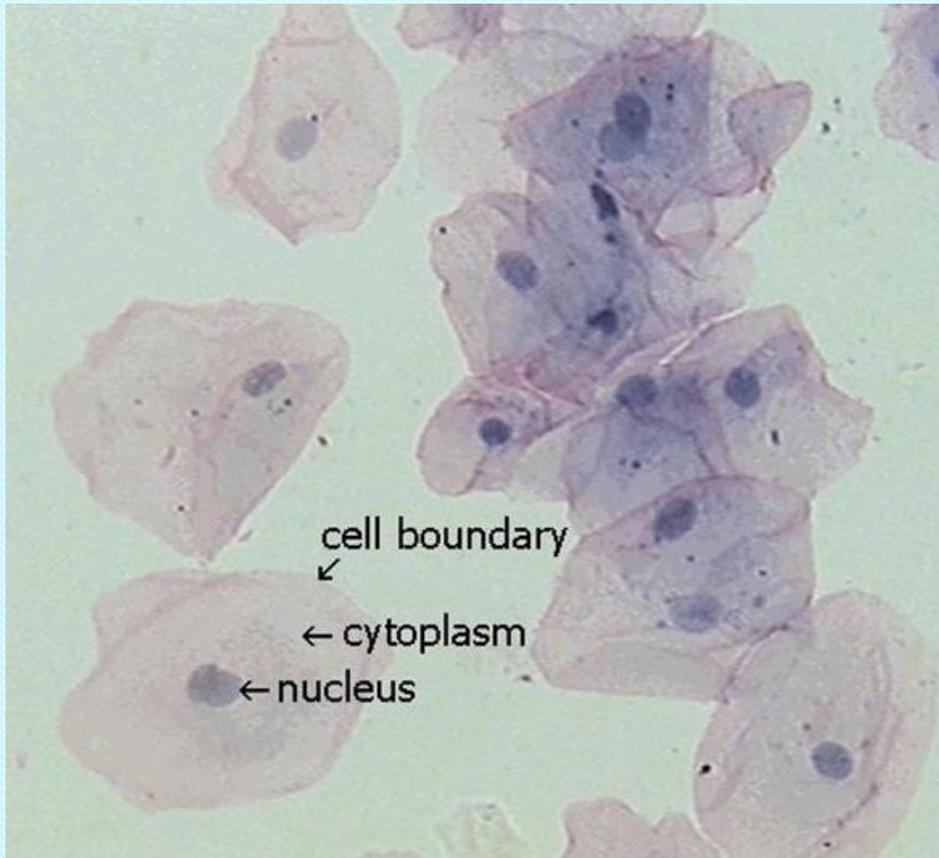
**Electron microscope**



# Cheek epithelium cells as seen under microscope.



# Cheek epithelium cells    Onion epidermis

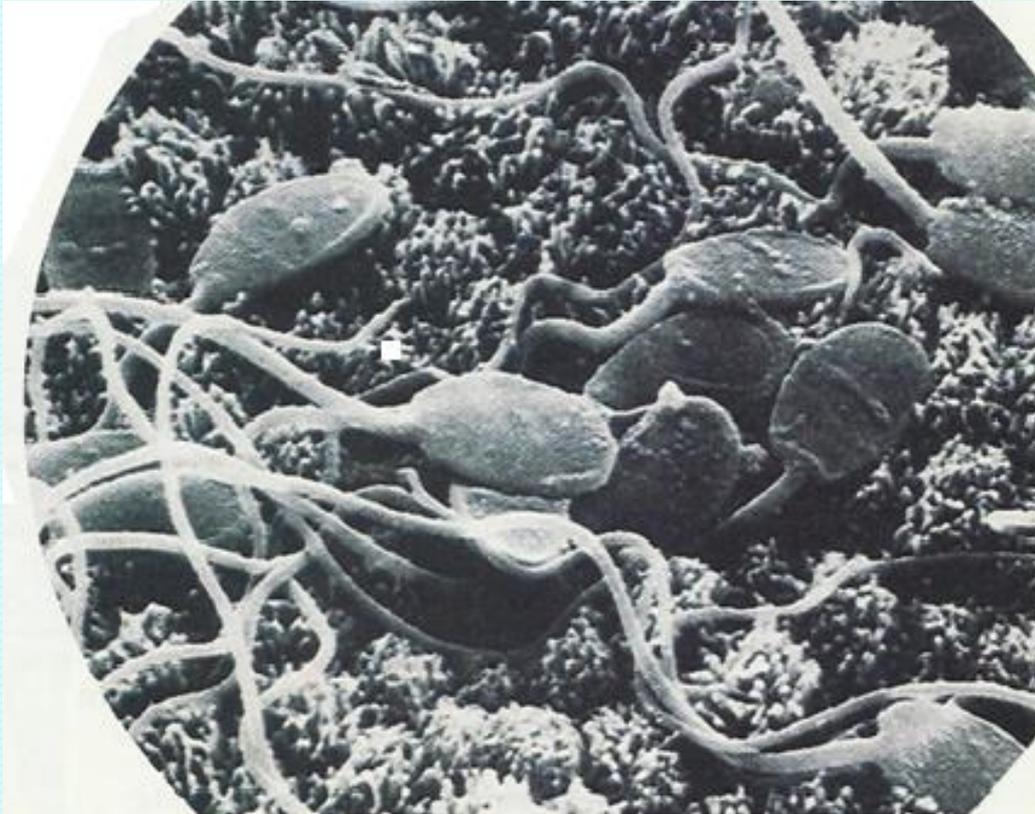


# Onion epidermis



- Nucleus
- Cell wall
- Cell membrane
- cytoplasm

# Sperm cells



**Adaption for function:**

Tail enables it to swim towards the egg cell so that fertilisation can happen.

- Microscopic organisms such as **bacteria** are made up of **one cell = unicellular**.
- Macroscopic organisms such as humans are made up a large **number of cells = multi cellular**
- Cells are adapted to perform **specific functions**, such as muscle cells which are specialised to contract and enable movement.

## 10. **Unicellular organisms:**

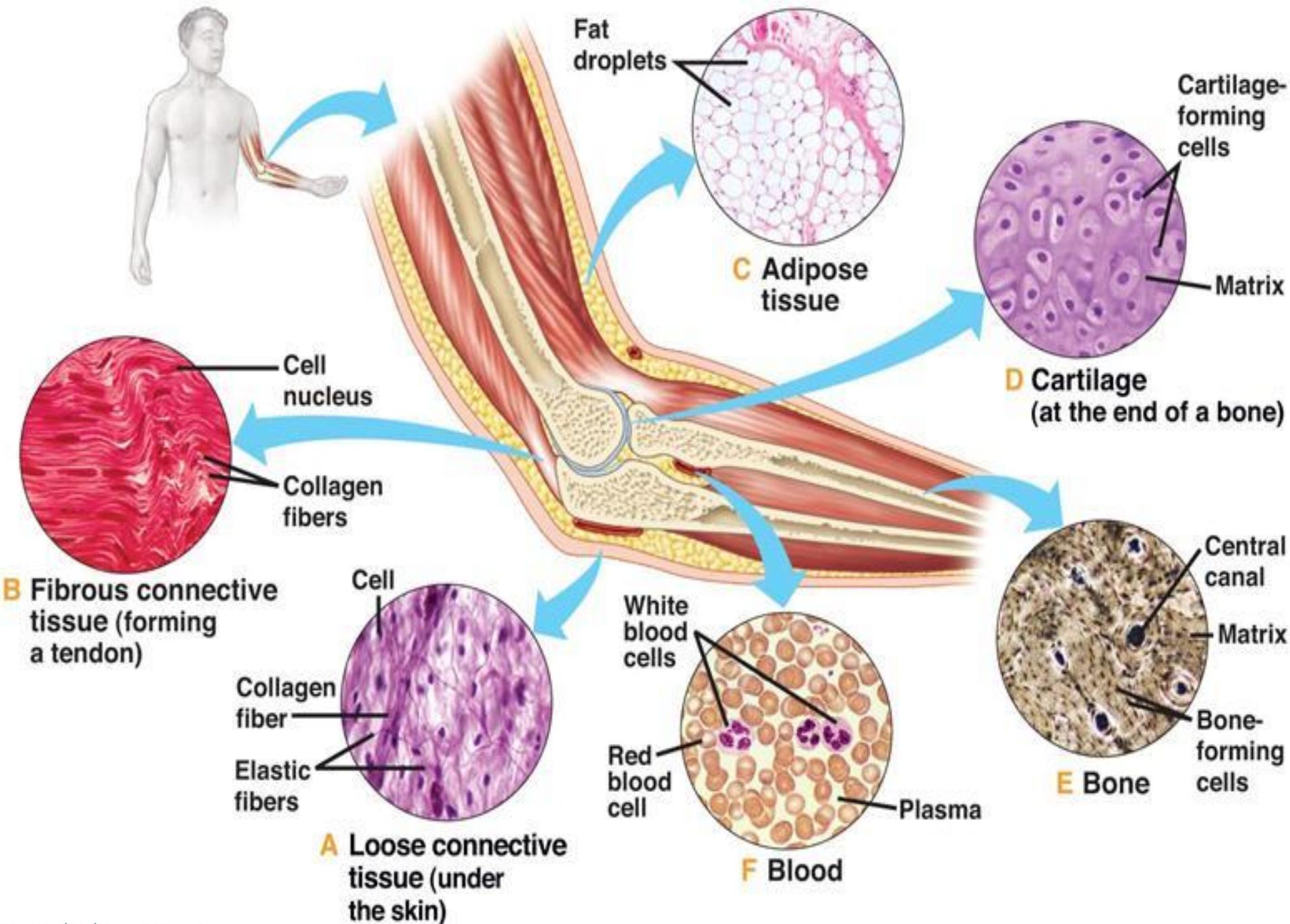
Organisms which consist of only **one cell**

## 11. **Multicellular organisms:**

Organisms which consist of **more than one cell**.

12. **Cell differentiation:** Cells in multi cellular organisms look **different** because they have **different** functions.

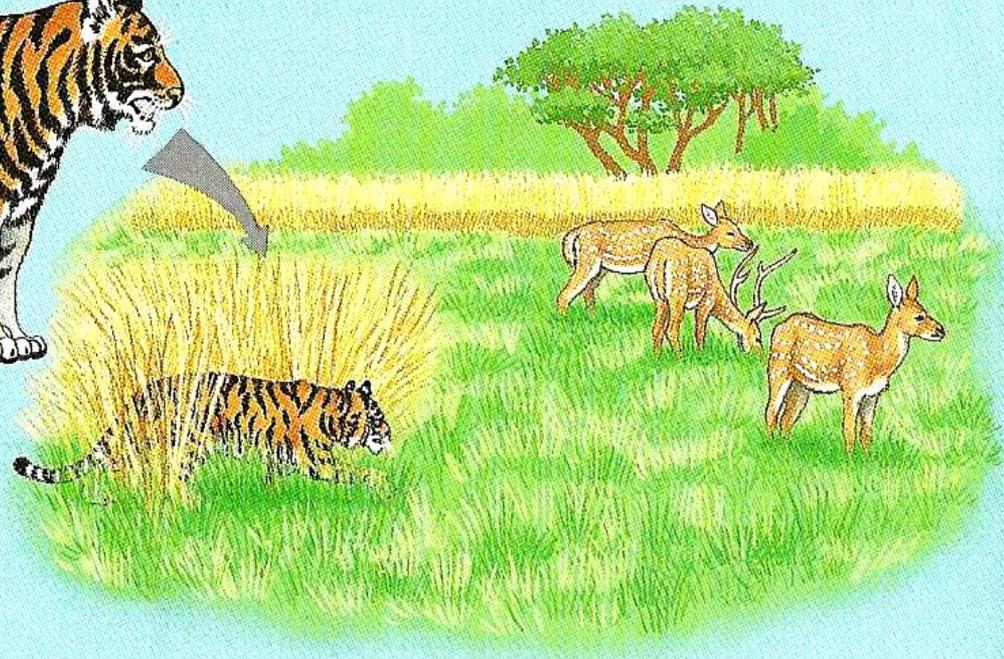
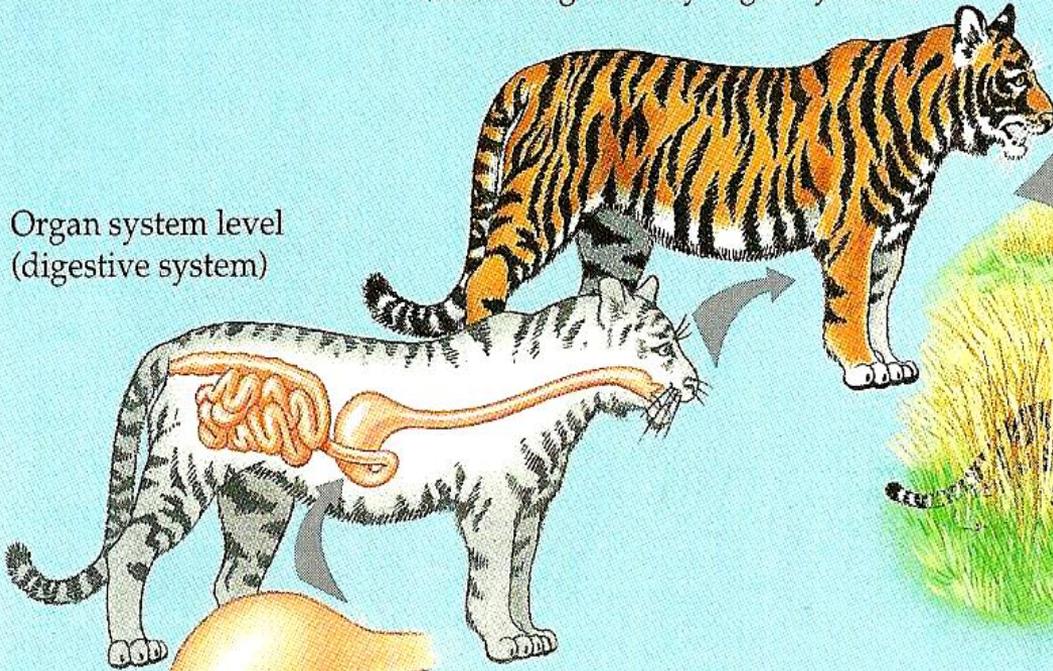
13. **Cell specialisation:** Cells are **adapted** to perform **specific** functions.



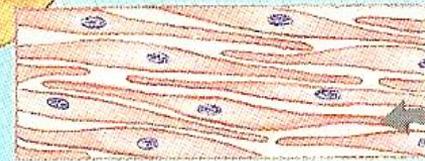
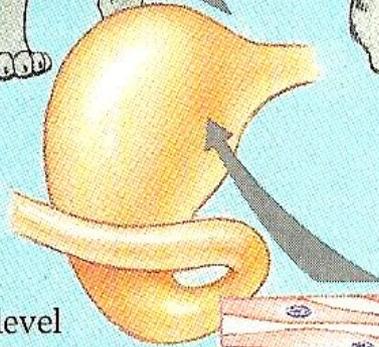
Organism level  
(consisting of many organ systems)

Higher levels  
(populations, communities, and ecosystems)

Organ system level  
(digestive system)

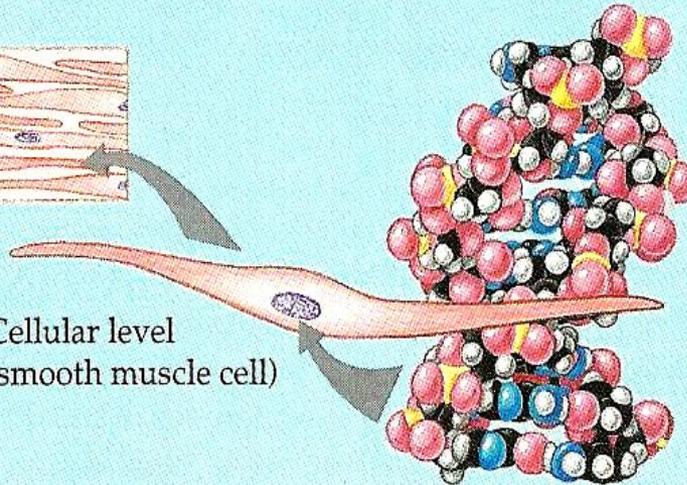


Organ level  
(stomach)



Tissue level  
(smooth muscle  
tissue)

Cellular level  
(smooth muscle cell)



Molecular level  
(DNA)

	<b>Definition p. 11</b>	<b>Example</b>
Cells	Basic unit of all living organisms	Blood cells; nerve cells, epithelium cells
Tissues	Group of similar, differentiated cells with a common function.	Blood, epidermis, muscle tissue
Organs	Made up of tissues	Eye, ear, intestines, stomach, heart Roots, leaves, stems
System	Organs working together	Digestive-, transport-, respiratory system
Organism	Different systems functioning together	Human, cat ...

# Stem cells

Cells that are not specialised that have the **ability** to develop into many **different cell types**.

VIDEO

# Can be harvested from

- umbilical cord blood
- Human embryo in early stage of development (embryonic stem cells = show more promise to treat diseases than adult stem cells)
- Bone marrow
- Stem cells were also discovered in the adult body in skin, hair, eyes and in the pulp of teeth.

# Use of stem cell therapy.

## Treatment of a variety of human diseases:

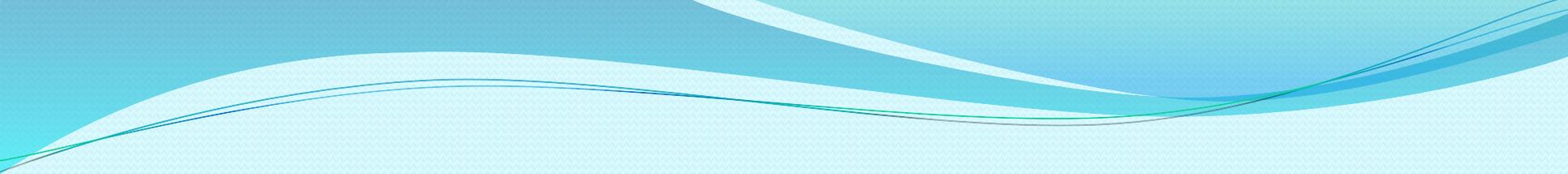
- Cancers like **Leukemia**
- Degenerative diseases like Multiple Sclerosis
- Diabetes mellitus where the pancreas no longer produces insulin
- Muscle damage
- Organ damage
- Certain genetic diseases in conjunction with gene therapy.

# Arguments in favour of stem cell research:

- Can be used to the benefit of mankind/ save life
- Can be used to cure diseases.
- Use of stem cells from cord blood is not immoral since it does not lead to the destruction of the embryos.

# Arguments against:

- We should not try to 'play God'
- Expensive, everybody cannot afford it.
- Money spent on stem cell research could rather spend on education / medical care / providing food for workless etc.
- Destroying an embryo is murder.
- Use of embryos and their destruction after use in stem cell research is immoral.
- In many African communities, the umbilical cord must be buried after birth because it is believed that anyone with access to it could exert some spiritual influence on the child.

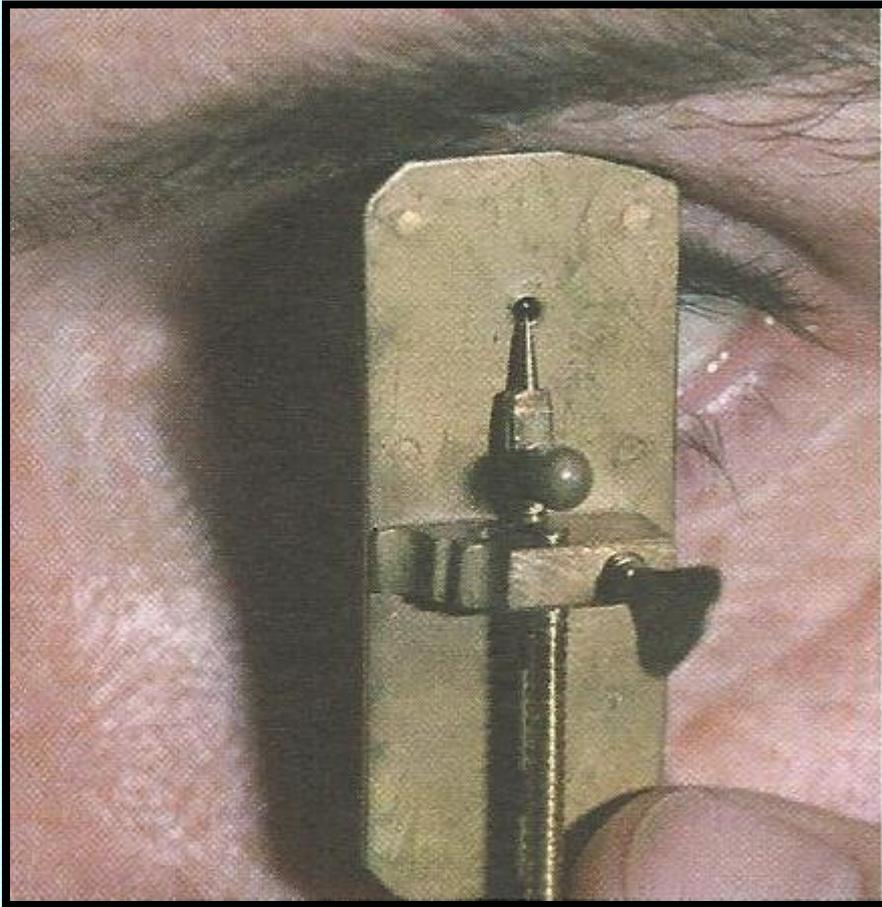


What is your view? Motivate your answer.

# Microscopes

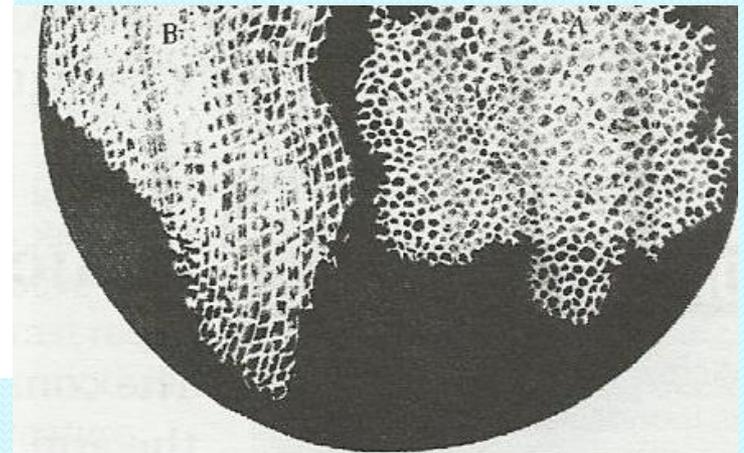
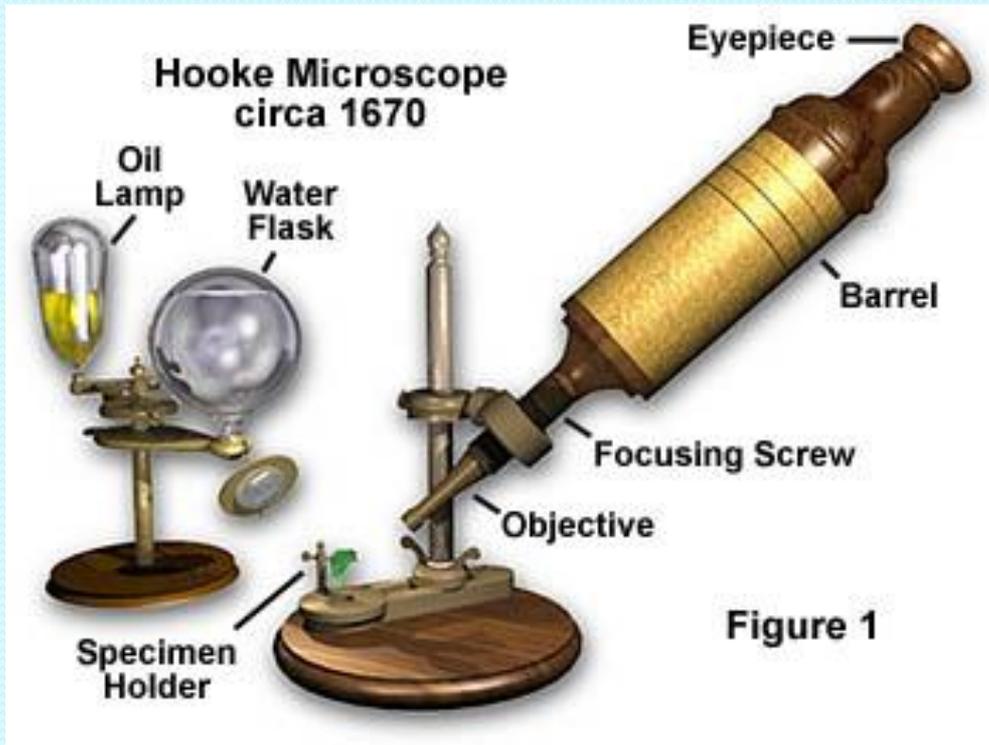
## Vi 7

# Original Leeuwenhoek microscope.(one lens)

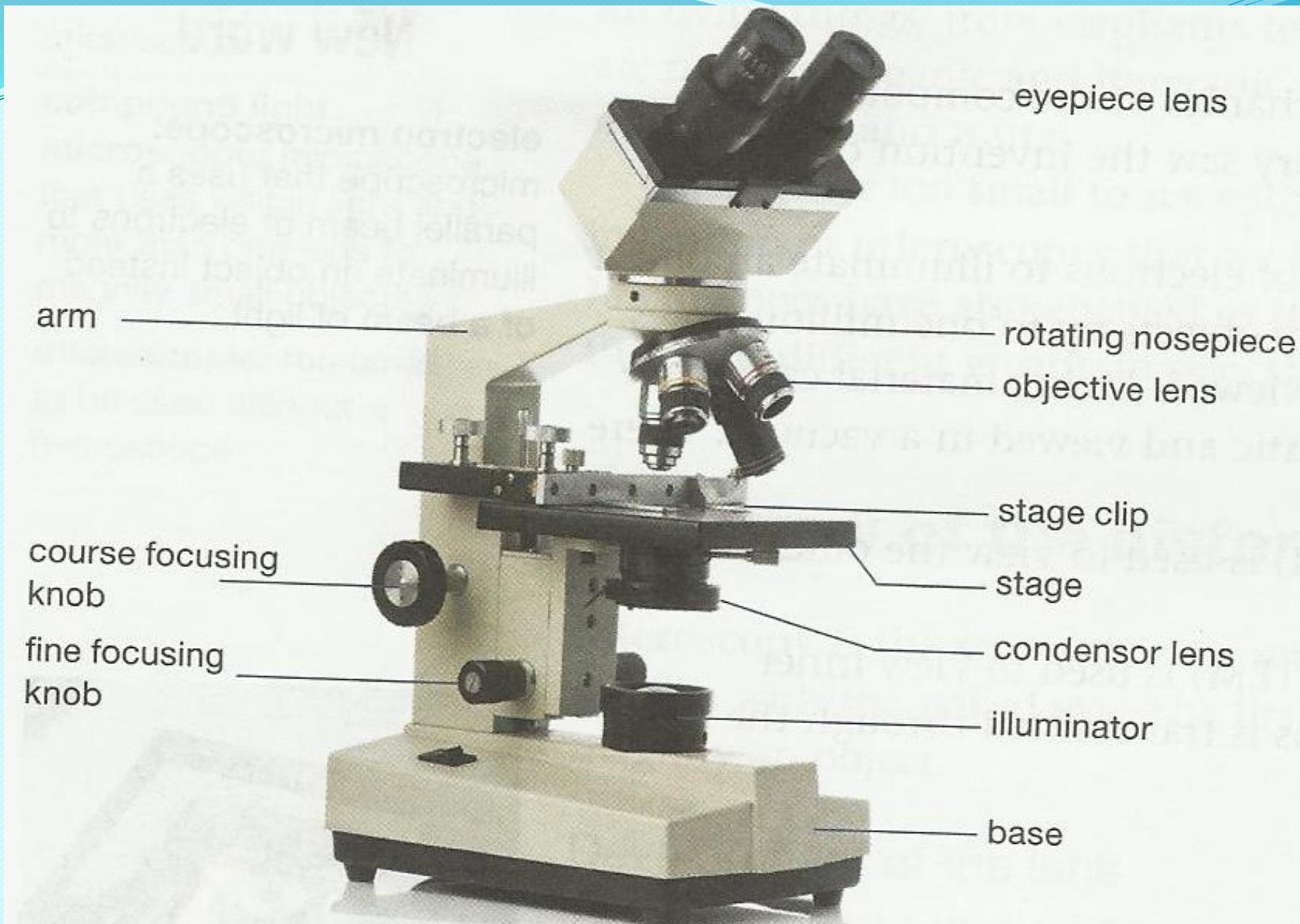


Lens was held between two brass plates with holes for the viewer to look through. The specimen was mounted on the tip of an adjustable pointer.

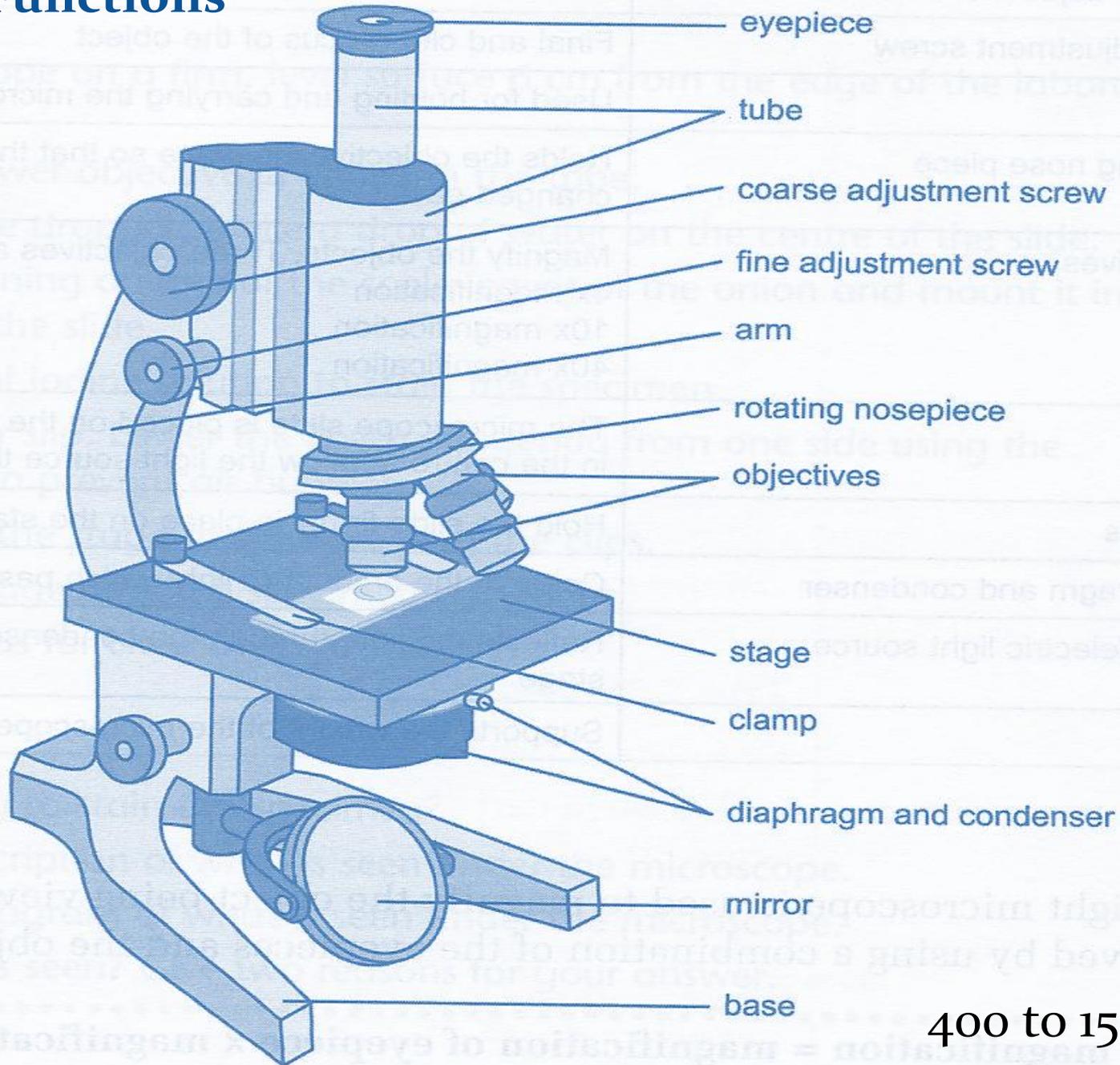
# Robert Hooke (1665) invented 1<sup>st</sup> compound microscope



**Figure 3** Robert Hooke's drawing of a section of cork seen under a microscope.



# Functions

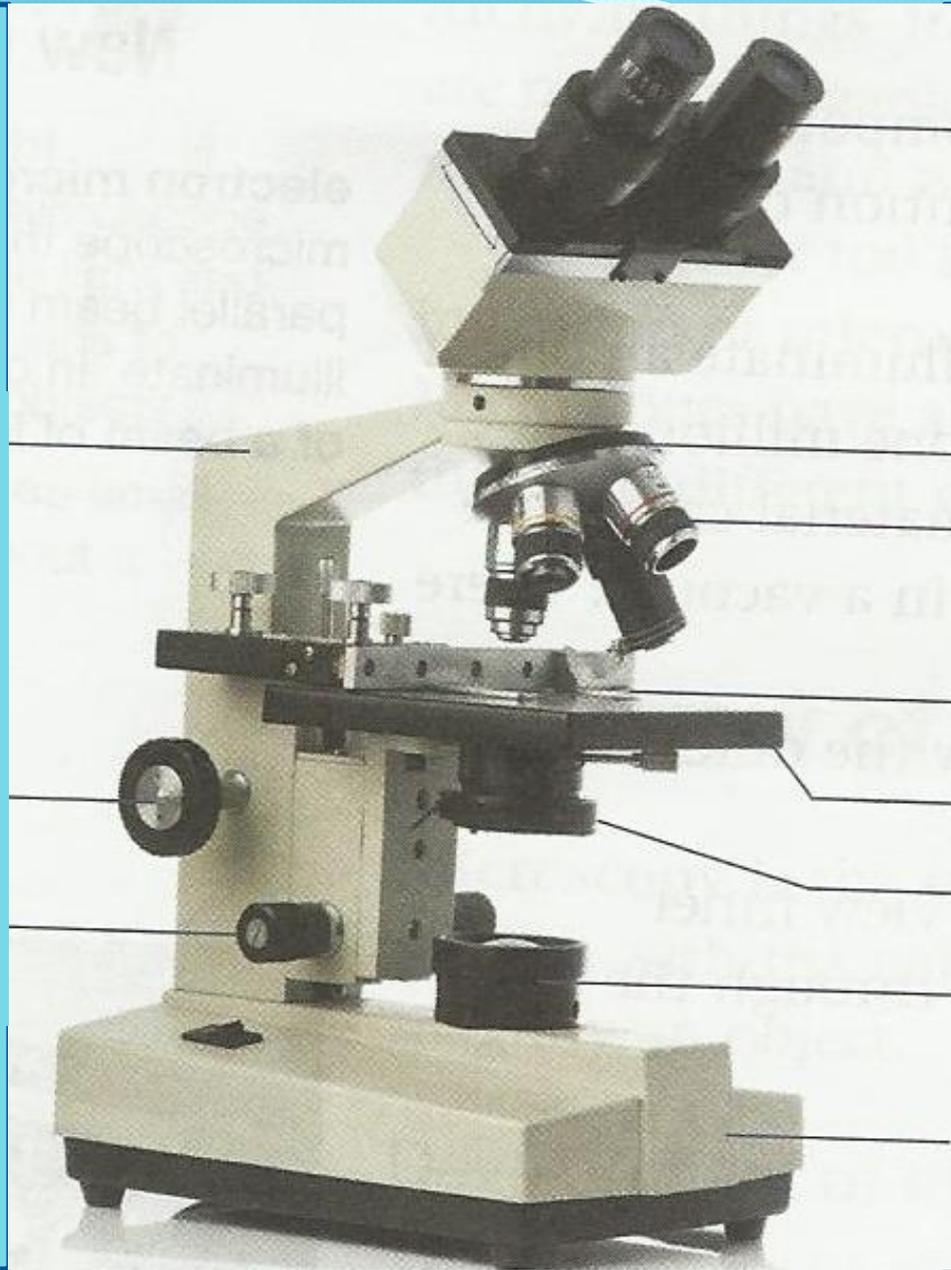


400 to 1500 X

Part	Function
Base	Steadies the microscope – thus there is less chance of it being knocked over
Tube	Hollow pipe which has convex lenses at its upper and lower ends.
Eyepiece/ <b>ocular</b>	Refracts/break light from the objective lens. It turns the image the right way up and makes it look bigger. (magnify 5x / 10x)

<b>Part</b>	<b>Function</b>
<b>Revolving nosepiece</b>	Objective lenses attached to it, by turning it you can change the objective lenses.
<b>Objective lenses</b>	Refract light from the object to form a large, upside down image. (magnify 4x, 10x / 40x)
<b>Coarse adjustment/focusing knob</b>	Brings the object roughly into focus Controls the sharpness and clarity of the image
<b>Fine adjustment/focusing knob</b>	Bring the object into sharp focus Controls the sharpness and clarity of the image

<b>Part</b>	<b>Function</b>
<b>Stage/ platform</b>	<b>Prepared slide</b> is placed on the stage. (NOT petri dish or watch glass)
<b>Stage clips</b>	Hold the prepared slide in place
Light source/ mirror	Reflects light through a hole in the stage onto the object.
<b>Diaphragm</b>	Allow more / less light through the hole
<b>Condenser</b>	Concentrates light rays on the object



1

2

3

4

5

6

7

8

9

10

11

# How to determine the total magnification factor of the microscope.

If the magnifying power of the eyepiece / ocular is **10 x** and that of the objective is **40 x**, the total magnification of the object being viewed is:

$$10 \times 40 = \mathbf{400 \text{ x.}}$$

# Electron microscope

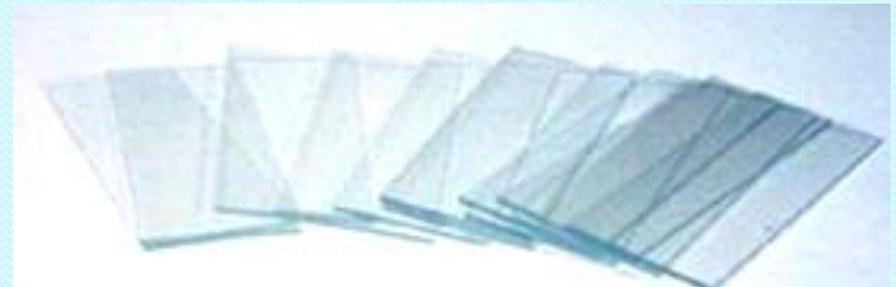
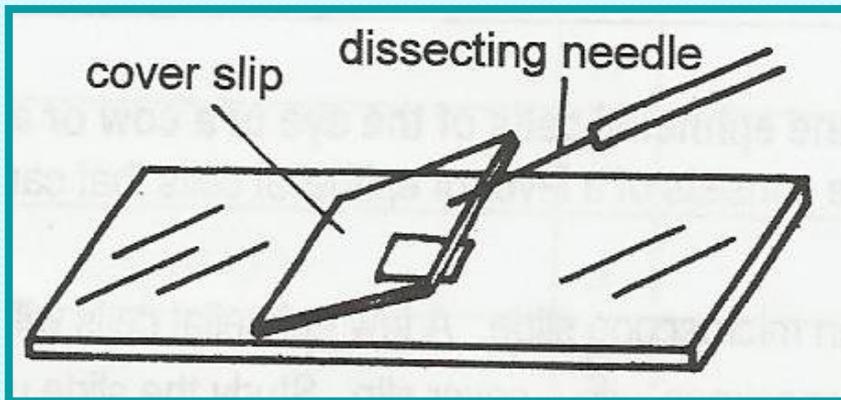
*Uses a parallel beam of electrons to illuminate the object instead of a beam of light.*

*Living material cannot be viewed because the specimen is fixed in plastic and viewed in a vacuum.*

50 000 to 100 000 X



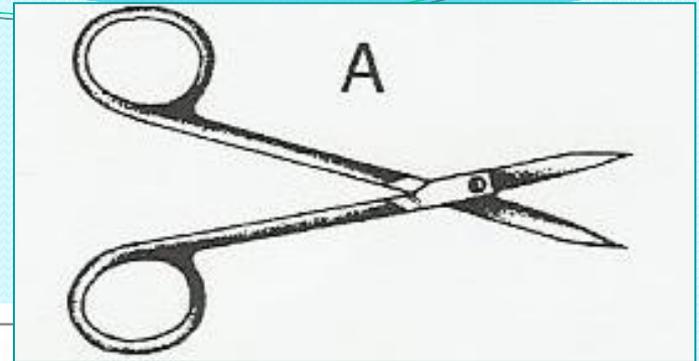
# Other apparatus you will have to use during practical's.



**Microscope slide:** Specimen is placed on it when you want to study it by using the microscope.

**Cover slip:** Covers the specimen on the microscope slide before you study it.

# Dissecting scissor



Cut and remove flaps of skin and other tissue.

# Dropper



For addition of liquids, drop by drop

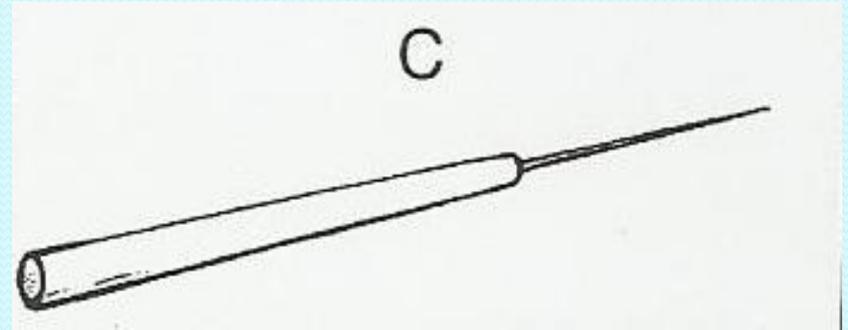
# Dissecting Forceps



For handling plant and animal material during dissection.



# Dissecting needle



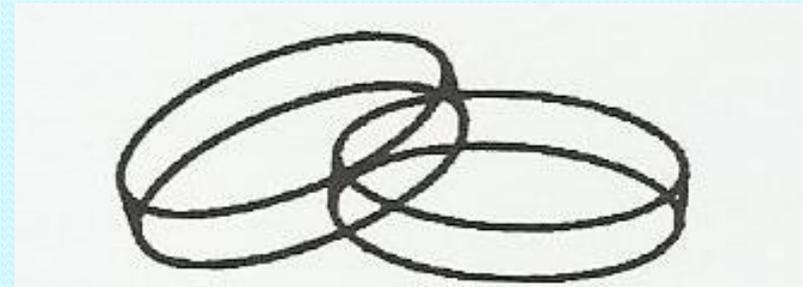
Used to probe, lift and push tissue during dissection.

# Dissecting Scalpel with blade

It is a small and extremely sharp bladed instrument used for cutting plant and animal material during dissection.



# Petri dishes



For holding small samples for observation under a dissecting microscope/lens

# Watch glass



For holding small samples for observation under a low-power microscope/lens

# Dissecting / stereo microscope

A low power stereoscopic microscope , mostly used in animal dissecting laboratory experiments . Petri dishes / watch glasses used.



# Use of microscope

- Turn the nosepiece so that the **lowest power** objective clicks into place.
- Slowly turn the coarse adjustment knob to focus the specimen.
- Move the slide so that the part of the specimen you wish to see is in the middle of the field of view.
- Carefully turn the nosepiece so that the next higher objective clicks into position.

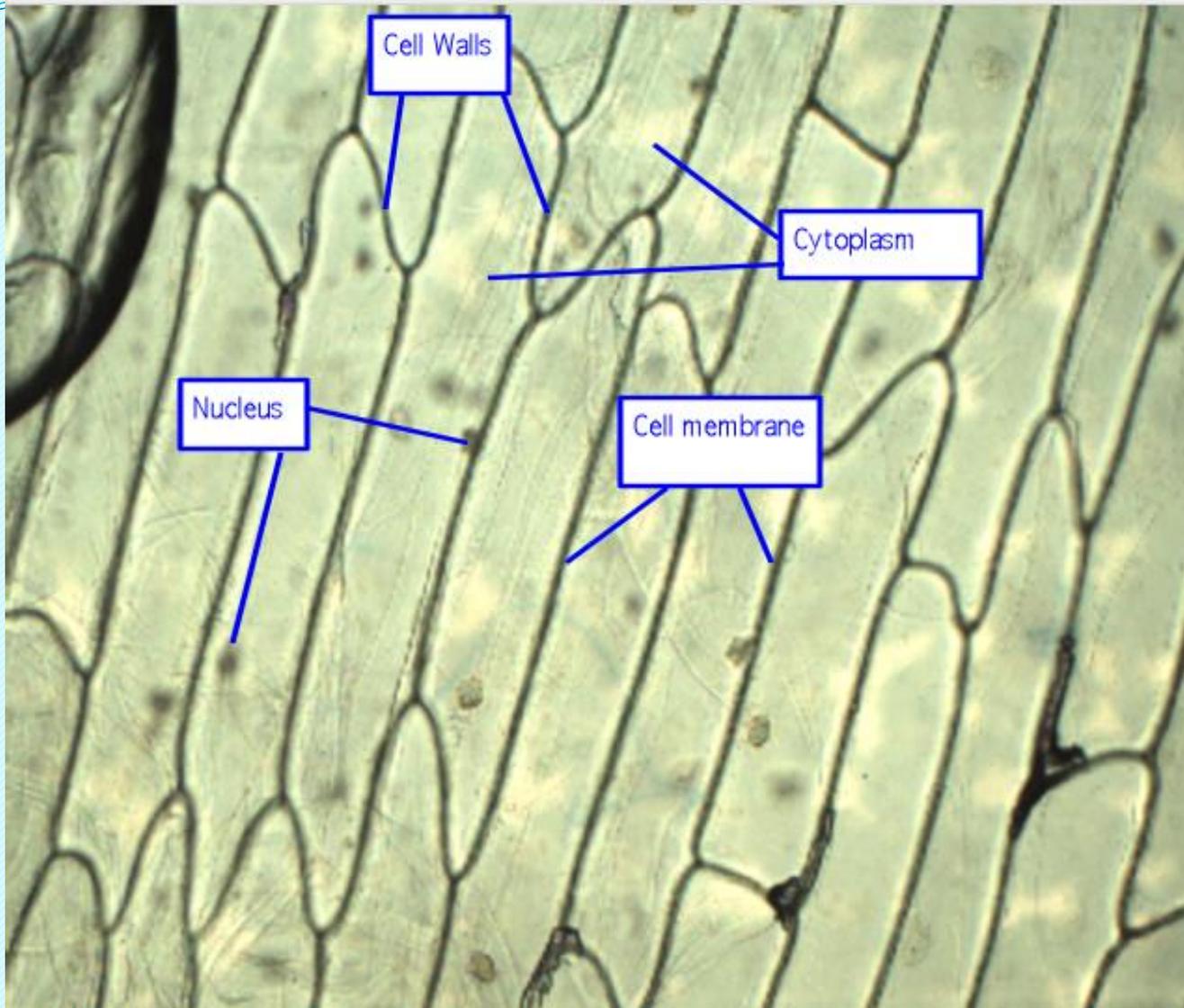
- Use the fine adjustment knob for final focus.
- Before you remove the slide, make sure the lowest power objective is back in position.
- Always cover the microscope after use, before you place it in its correct box.

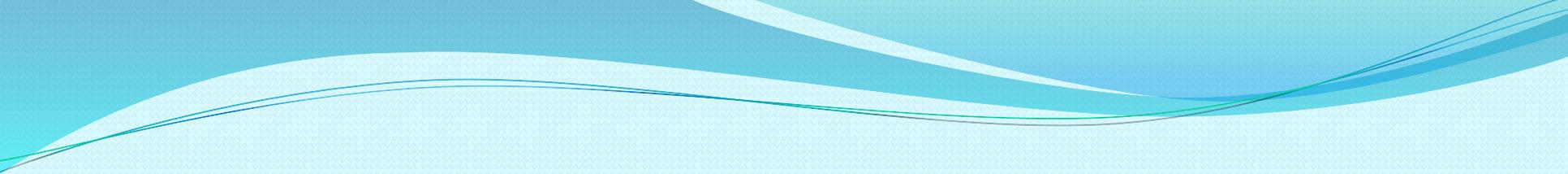
# Preparing a wet mount/ temporary slide.

- Separate the fleshy leaves of the onion bulb.
- Remove a very thin membrane on the hollow side of the leaf. (The tissue which is being studied must be a very thin section so that light can pass through it.)
- Place a small piece of the membrane on a slide, spread it out evenly.
- Add a few drops of Iodine.
- The membrane must be kept flat and should not become wrinkled or folded.
- Cover it with a coverslip.
- Remove any excess water using the paper towel.



# Onion epidermis (100x)





**TOPIC 1**  
**CELLS AS THE BASIC UNITS OF LIFE**  
**EXERCISE 3**

# Multiple choice

1. The material in a cell that carries hereditary information is called...
  - A. Hydrochloric acid
  - B. Deoxyribonucleic acid (DNA)
  - C. Sulfuric acid
  - D. Carbonic acid
2. The following process is not a characteristic of life
  - A. Photosynthesis
  - B. Respiration
  - C. Excretion
  - D. movement