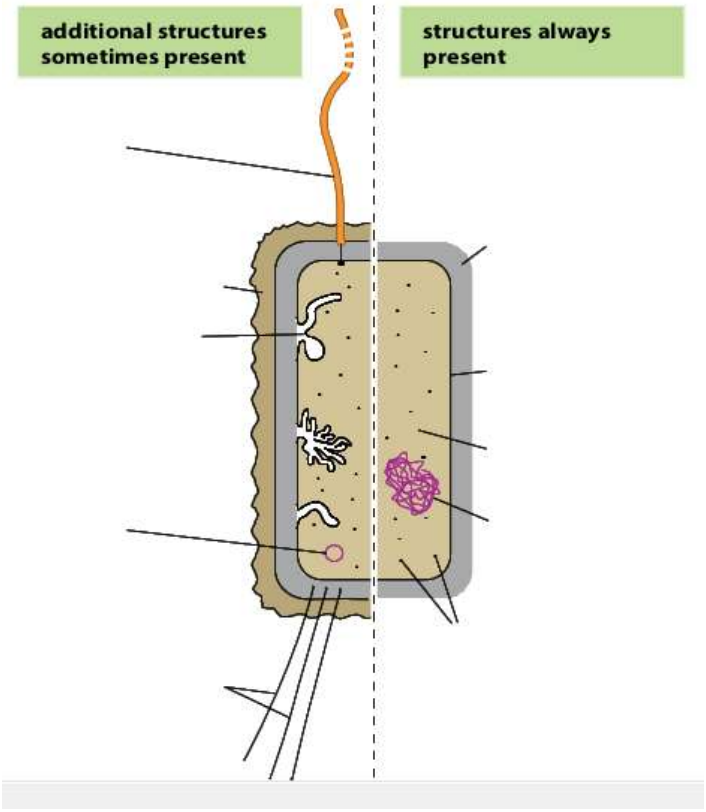
Cell structure and function

- Cells are the basic units of structure and function of all living things.
- Most cells are very small, and their structures can only be seen by using a microscope.

Define a cell

- Types of cells
  - Prokaryote
  - Eukaryote
- Label missing parts of a prokaryote cell

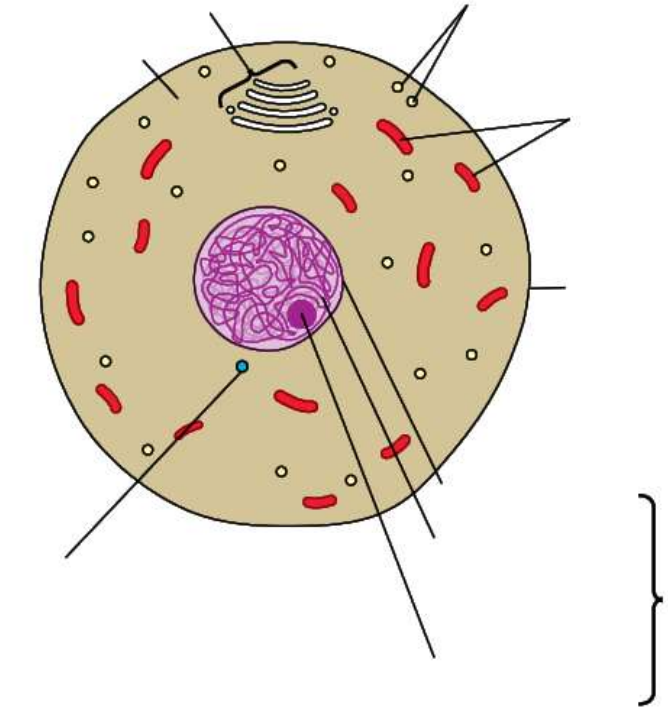


- Size of a prokaryote cell
- Where does nitrogen fixation occurs in bacteria
- Name partially permeable structure
- State a role of a plasmid
- State a role of flagellum
- State the name of structure involved in sexual reproduction
- State the process of cell division in prokaryotes

Eukaryote

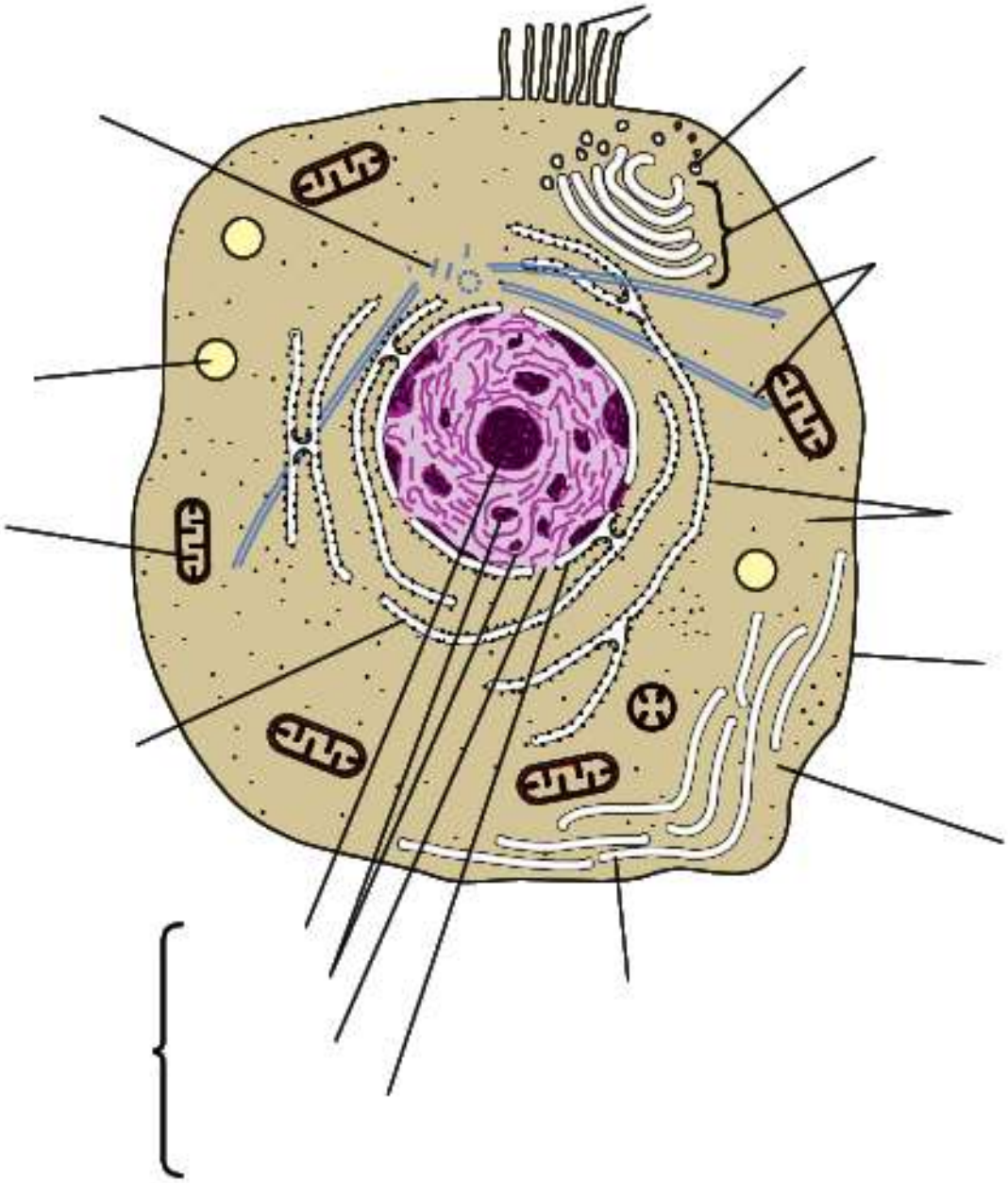
- There are many types of eukaryote cells
  - Animal cell
  - Plant cell
  - Yeast
  - Algae

Animal cell seen under light microscope



- Size of an animal cell
- Name structures not seen under light microscope
- Label the different parts of an animal cell seen under a high power light microscope
- Name structures seen a prokaryote but not in an animal cell
- If actual size of this cell is 20um, calculate the magnification of this cell

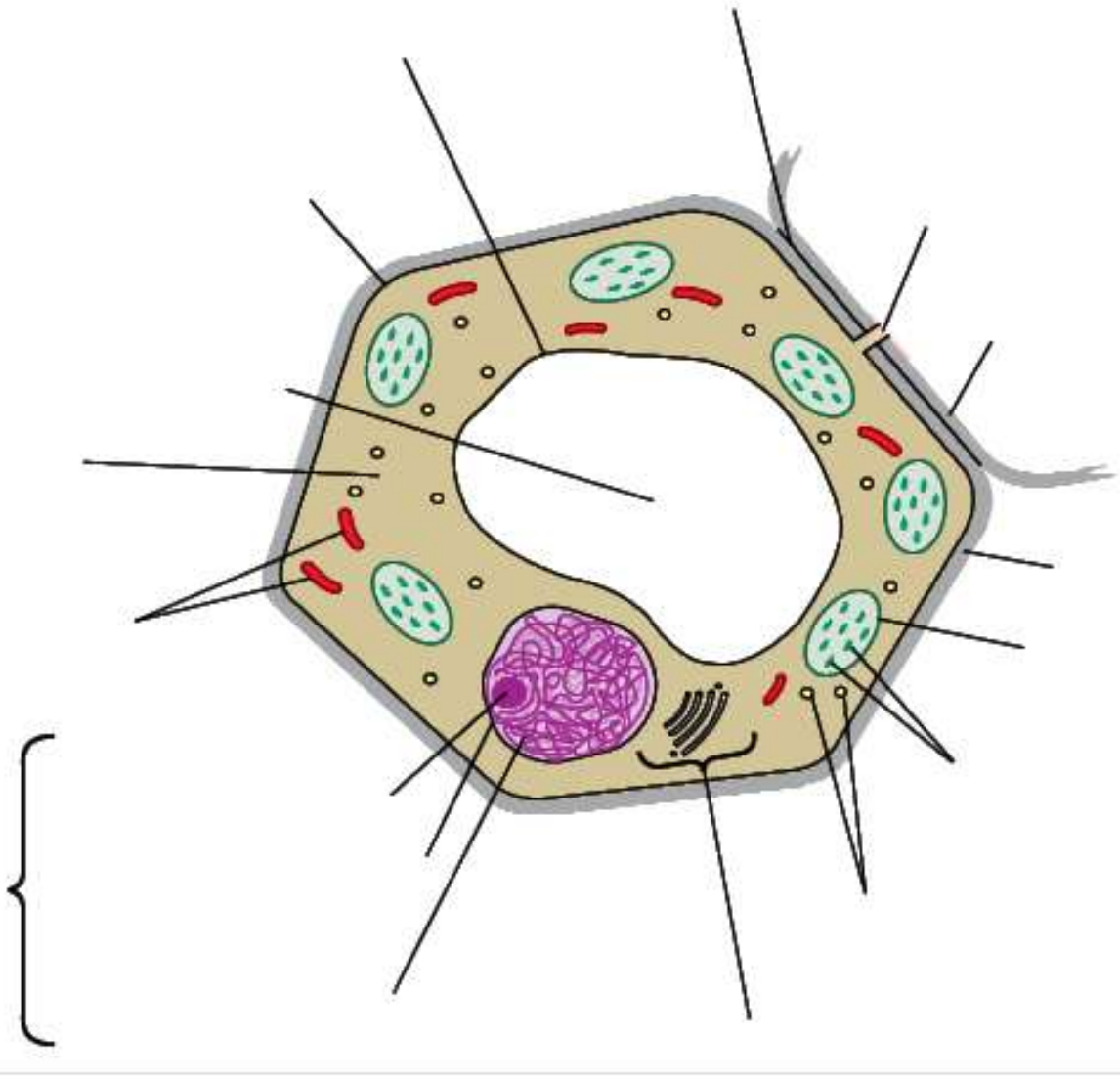
Animal cell seen under an electron microscope



- Label parts of an animal cell
- Name the structure not seen under a high power light microscope
- State a role of each structure of an animal cell
  - Cell surface membrane
  - Cytoplasm
  - Nucleus
  - Mitochondrion

○ Golgi bodies
○ Golgi vesicles
○ RER,
○ SER
○ Lysosome
○ Centrioles
○ Ribosomes
○ Microvilli
○ Cytoskeleton

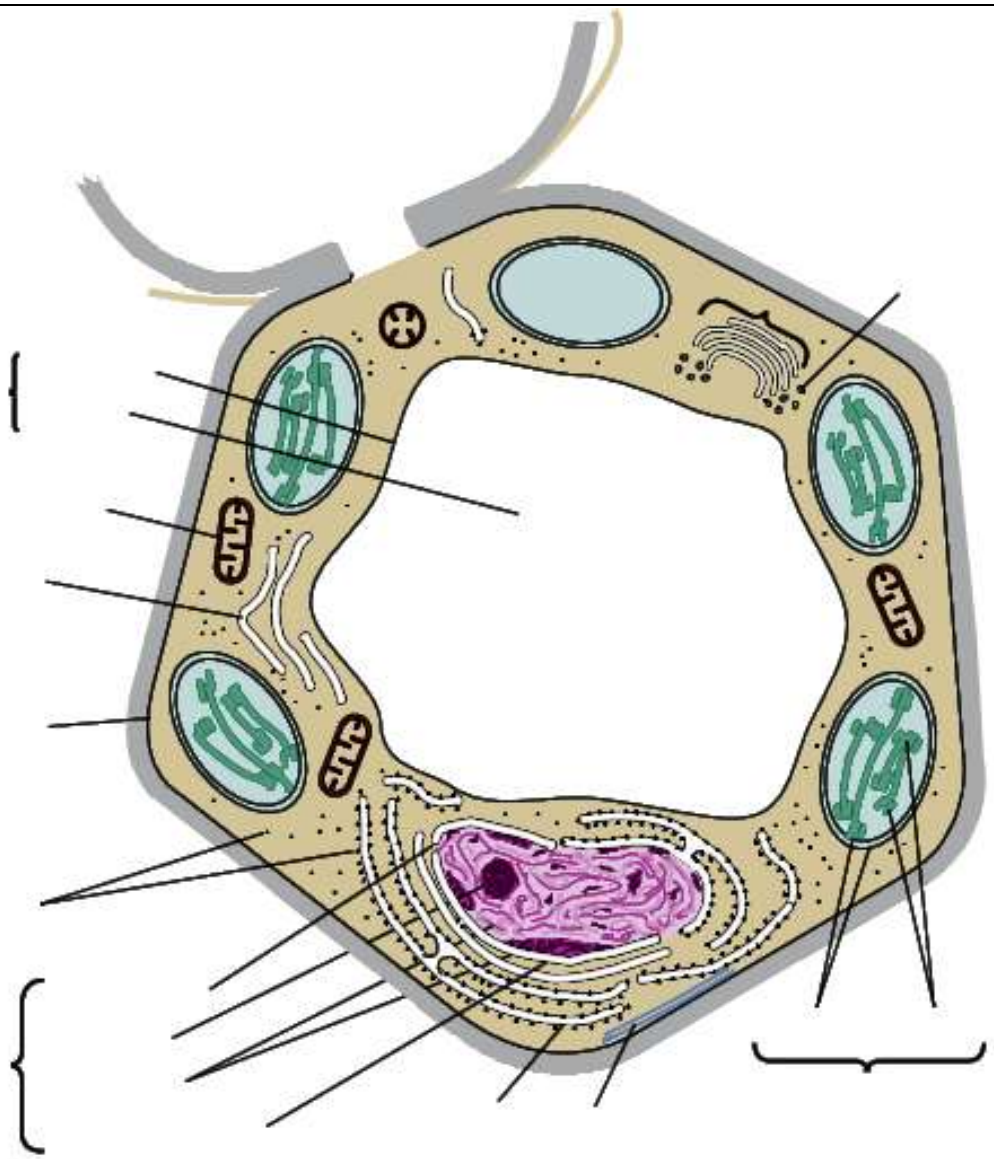
Plant cell seen under a high power light microscope



- Size of a plant cell
- Label parts of a plant cell seen under a high power light microscope
- Name structures of a plant cell not seen under a light microscope
- State a role of each
  - Cell wall
  - Chloroplast
  - Sap vacuole

Calculate the magnification of this plant cell if actual size has been 40 um

Plant cell seen under an electron microscope

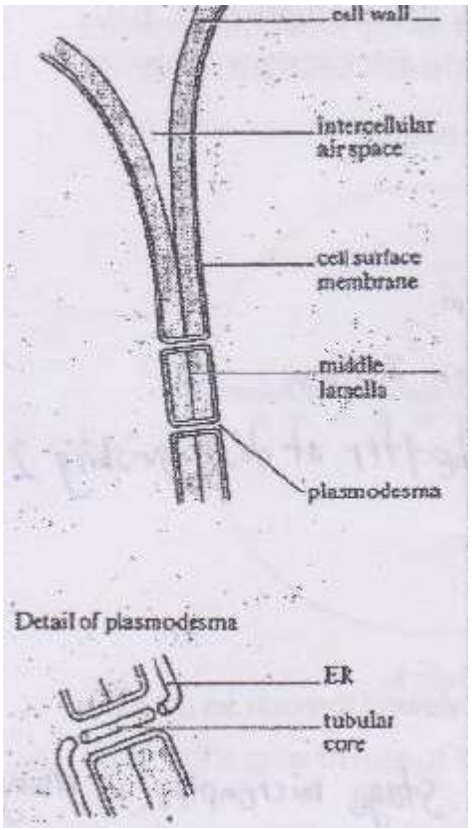
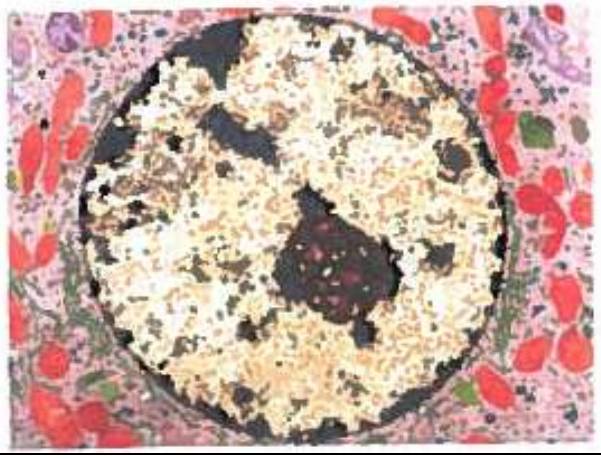


- Label parts of a plant cell seen under an electron microscope

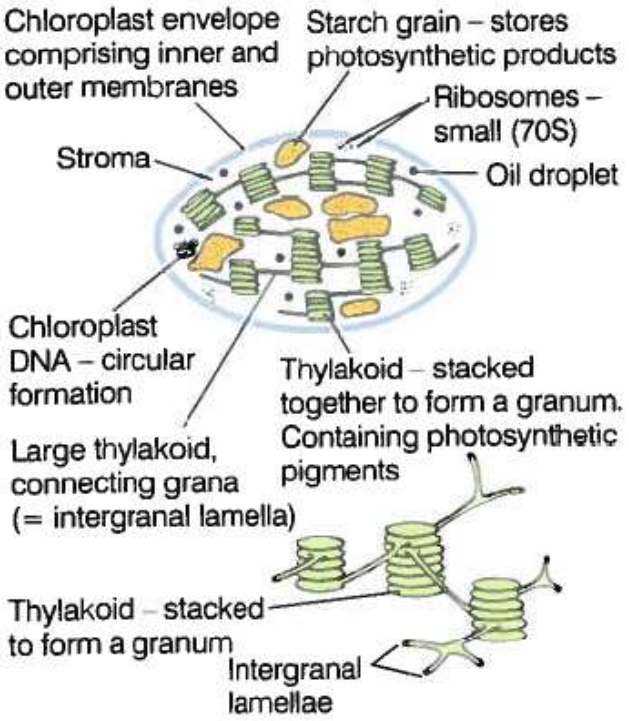
Differences between prokaryotes and Eukaryotes

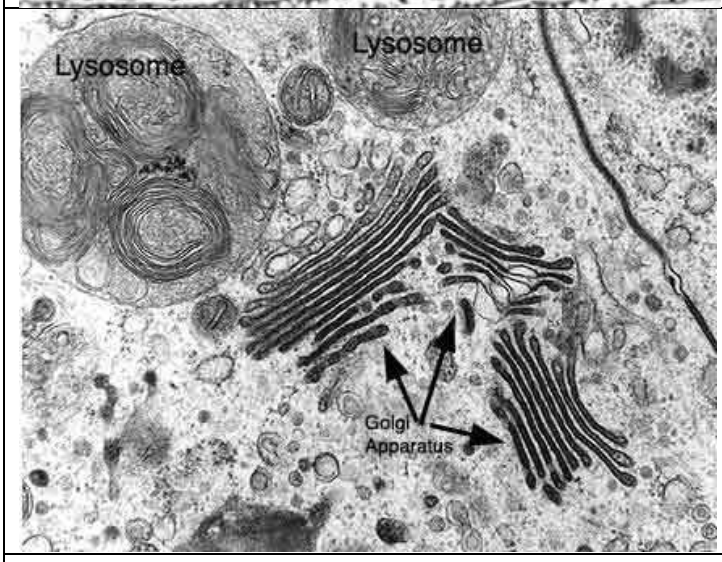
Feature	Prokaryote	Eukaryote
Organism		
Size		
Form		
Cell wall		
Cell organelles		
Chromosomes		
Protein synthesis		
Cell division		
Flagella		
Respiration		
Photosynthesis		
Nitrogen fixation		

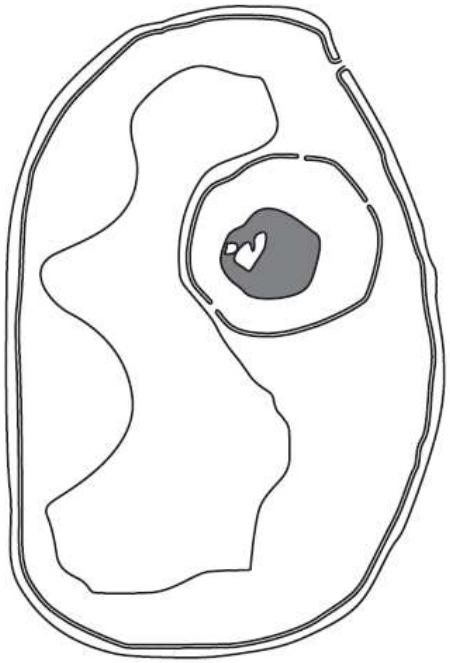
Components of a cell

Cell component	Redraw and Describe structure and function
Cell membrane 	
Cell wall 	**<u>Cell wall</u>** A rigid cell wall surrounding the cell consisting of cellulose microfibril running through a matrix of other complex polysaccharides. May be secondarily thickened in some cells by lignin or other substances. **<u>Middle lamella</u>** Thin layer of pectic substances ie. Calcium and magnesium pectate. **<u>Plasmodesmata</u>** A fine cytoplasmic thread linking the cytoplasm of two naeghbouring cells through fine pores in their cell walls. The pore is lined with the cell surface membrane and has a central tubular core, often associated with ER
Nucleus 	

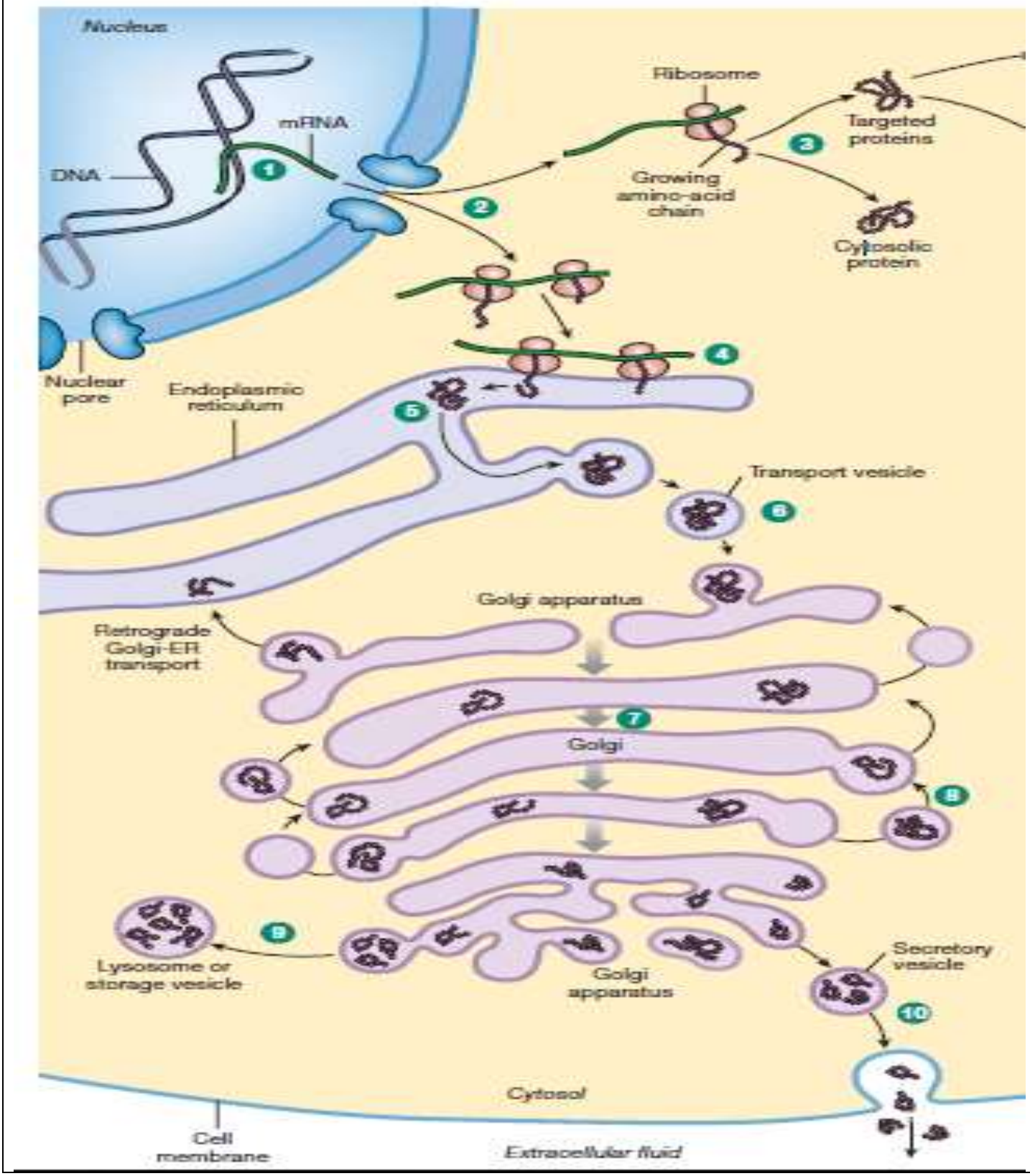
Chloroplast



	**Mitochondrion**
	
Sap Vacuole Plant cells have a large permanent vacuole that is surrounded by a membrane called the tonoplast and contains a fluid known as cell sap. The vacuole stores water , ions, sugars and pigments and pushes chloroplasts to the edges of the cell and gives turgidity to the cell to help support the plant **Draw and label the following plant cell. Also label tonoplast and sap vacuoe**	

Role of different cell organelles in synthesis and transport of proteins



Describe the role of nucleus, endoplasmic reticullum, ribosomes and golgi bodies in synthesis and transport of proteins.

1.

2.

3.

4.

5.

6.

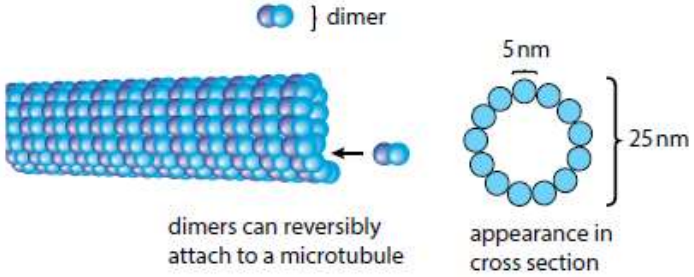
7.

8.

9.

10

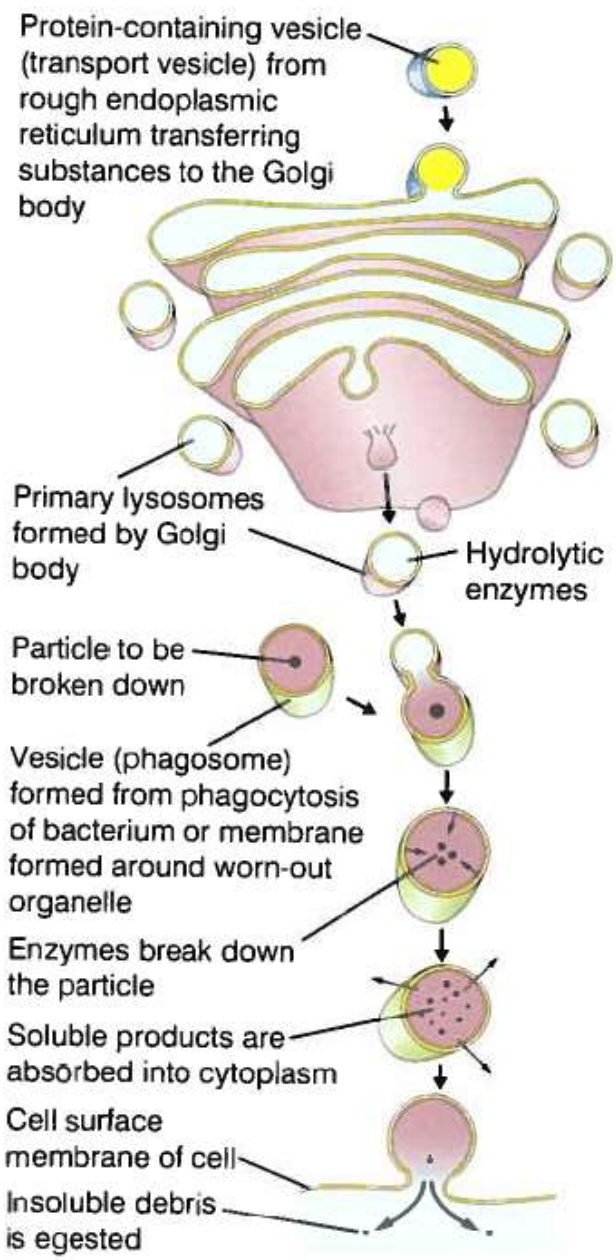
Centrioles



<u>Describe structure and Role of centrioles</u>

Microvilli	

Lysosomes



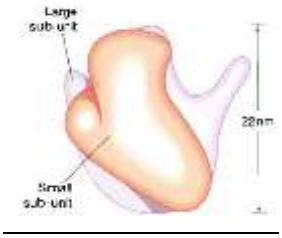
Describe formation and role of lysosomes

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Lysosmes are used to destroy foreign materials inside and outside a cell. The roles of lysosomes are

1. Breakdown materials ingested by phagocytosis by macrophages and neutrophils
2. Digest worn out cell organelles like damaged mitochondria
3. Completely break down cells after their death

Ribosomes



There are two types of ribosomes

1. **80 S ribosomes**
2. **70 S ribosomes**

Cell component	Size	Functions	Found in
Cell wall	**2um**	Fully permeable. Prevents cells from bursting	Plant cell
Cell membrane	**7nm**	Partially permeable Controls movement of substances into and out of cells. Prevents mixing	Both
Nucleus	**7um**	Controls cellular activities like proteins synthesis and cell division	**Both**
Nucleolus	**2.5um**	Synthesis of ribosomes	**Both**
Cytoplasm		Cellular reactions take place	**Both**
Endoplasmic reticulum	**0.2um** **Each cistern**	**R.E.R** Synthesis and transport of proteins **S.E.R** synthesis of lipids and detoxification	**Both**
Golgi bodies	**7 nm** **Each cisterna**	Sorting, assembling, and sorting of proteins	**Both**
Chloroplast	**4um**	Trap light energy convert into chemical energy ie ATP synthesis and synthesis of sugars	**Plant cells**
Mitochondria	**3um**	Synthesis of ATP during respiration	**Both**
Secretory vesicles	**3um** **Vary in size**	Contains substances to exported out of cells	**Both**
Lysosomes	**1.0um**	Contain hydrolytic enzymes Autolysis Phagocytosis apoptosis	**Animal cells**
Centrioles	**200 nm dia** **500 nm length**	organise microtubules spindle formation help in cell division	**Animal cells**
ribosomes	**18nm** **22nm**	Synthesis of proteins	**Both**

Inside a cell, a damaged mitochondrion can be surrounded and enclosed by a membrane to form a vesicle.

What happens after the fusion of a lysosome with the vesicle?

A ATP production by the mitochondrion increases.

B Enzymes from the lysosome repair the mitochondrion.

C Hydrolytic enzymes catalyse the breakdown of the mitochondrion.

D The mitochondrion is released from the cell by exocytosis.

Complete the following table of componenets of cells

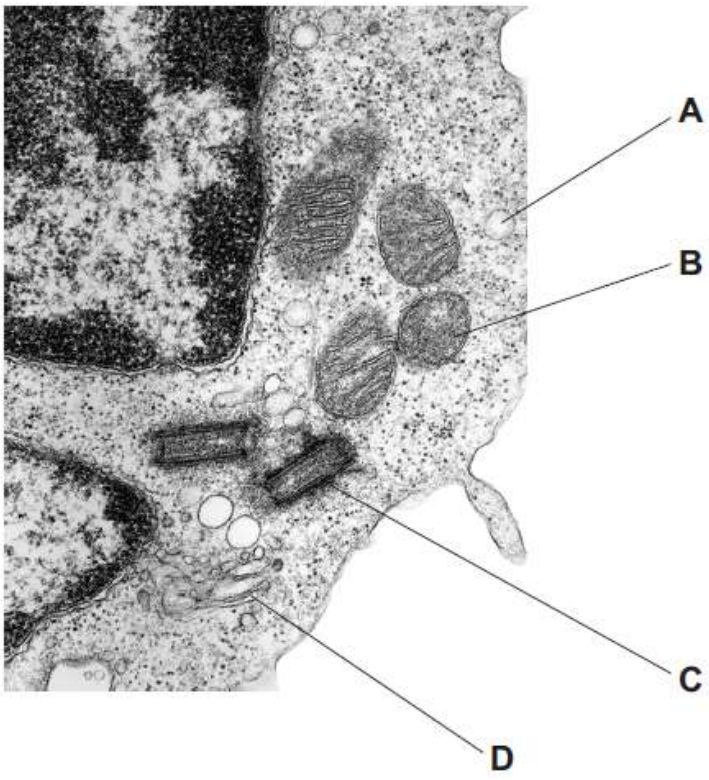
Structure	Description of structure	Function
Cell surface membrane	Trilaminar appearance A central pale layer(_____Layer) sandwitched inbetween two dark layers_____layer)	Partially permeable controls movement of substances into and out of a cell
Nucleus	_____size cell organelle. Enclosed by an envelop of _____ membranes that is perforated by _____. It contains _____ which is extended form taken by _____ during _____ in the cell cycle. It contains a _____(a small darkly stained region)	Chromosomes contain _____, the molecule of inheritance, DNA is organized into _____ which control all the activities of the cell. DNA_____ is the basis of cell division and hence reproduction. The nucleolus manufactures_____. Nuclear pores allow movent of substances, _____, _____, _____ into the nucleus and movement of substances, _____, _____ out of the nucleus
Endoplasmic reticulum	Consists of a system of single membrane bound flattened sacs or tubules called, _____, which lies continuously with outer membrane of the nucleus.	If _____ are found attached on outer surface of cisternae, then it is called _____ endoplasmic reticulum and that transports proteins made by the _____, SER ,(_____) ER is without _____ and produces lipids and steroids.
Ribosomes		
Mitochondria		
Golgi bodies		

Lysosomes		
Cell wall Middle lamella Plasmodesmata		
Chloroplast		

Large central vacuole Sap vacuole		
Centrioles		

The electron micrograph shows part of a eukaryotic cell.

Which of the labelled organelles is a site of protein synthesis?



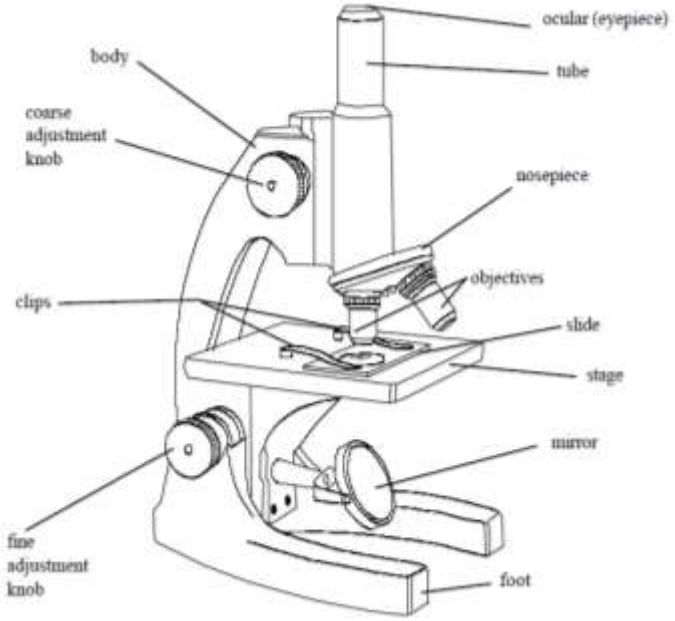
Differences between a plant and an animal cell

Feature	Plant cell	Animal cell
Cell wall		
Pits and Plasmodesmata		
Vacuole		
Chloroplasts		
Centrioles		
Cilia and flagella		
Reserve food material		
Lysosomes		

Endosymbiosis
Prokaryotic cells are far older and more diverse than eukaryotic cells. Prokaryotic cells have probably been around for 3.5 billion years - 2.5 billion years longer than eukaryotic cells. It is thought that eukaryotic cell organelles like mitochondria and chloroplasts are derived from prokaryotic cells that became incorporated inside larger prokaryotic cells. This idea is called endosymbiosis, and is supported by these observations:
· organelles contain circular DNA, like bacteria cells.
· organelles contain 70S ribosomes, like bacteria cells.
· organelles have double membranes, as though a single-membrane cell had been engulfed and surrounded by a larger cell.

Microscopy
Study of cells involves use of microscopes
Two types of microscopes
Light microscope

Structure of a light microscope



Use of light microscope

1.

2

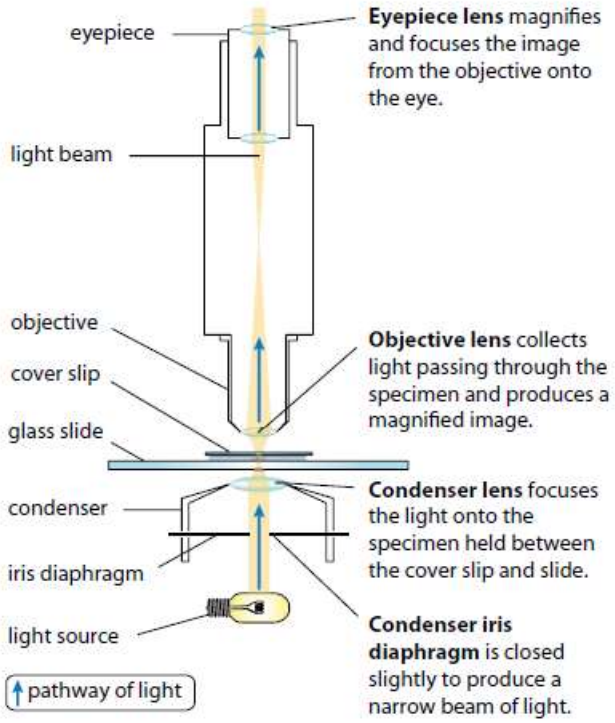
3

4

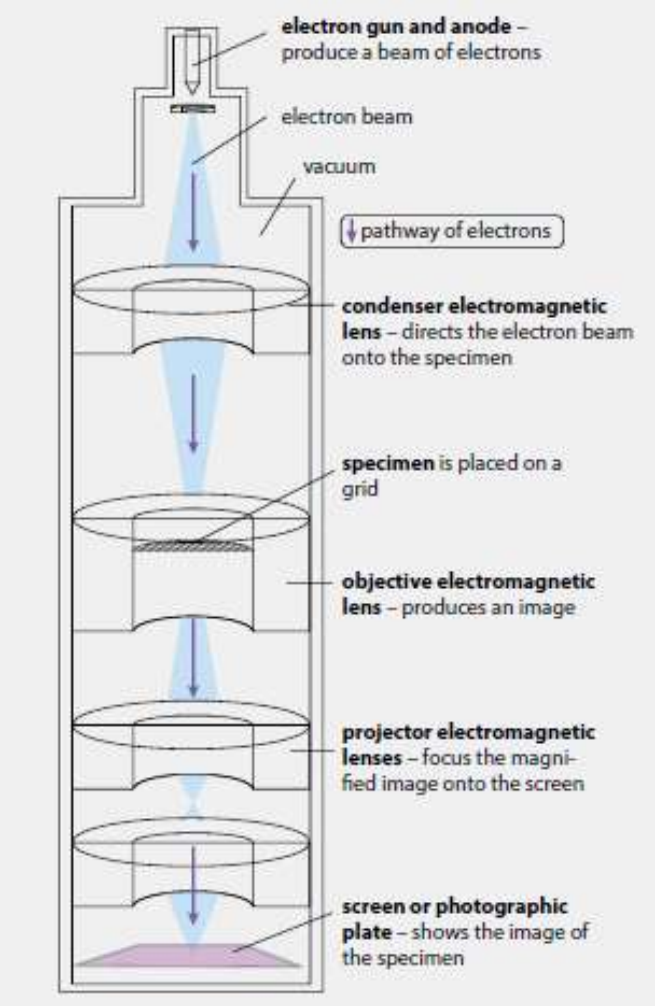
5

6

Working of a light microscope



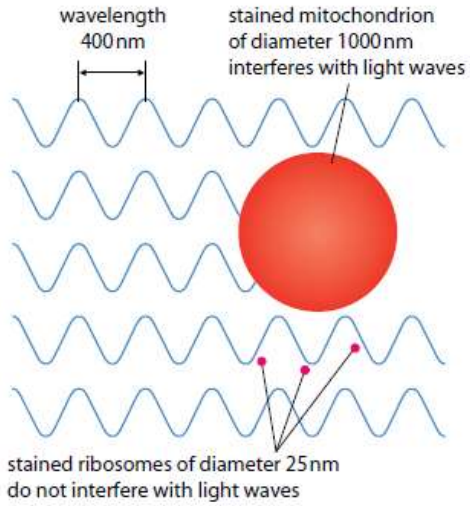
Electron microscope



Feature	Light microscope	Electron microscope
Radiations used		
Radiation source		
Radiation medium		
Nature of lenses		
Wave length of radiations used		
Resolution		
Magnification		
Way the Image is seen		
Image formed		
Example structures that can or can not be seen		

Resolution

- Ability to distinguish two objects separate from each other
- Resolution of an object is half of the wavelength of radiations used
- Why



- Does the power of a lens effect resolution of a microscope
- What does a resolution of 200 nm means

- The smaller the objects that can be distinguished, the higher the resolution.
- Resolution is half of the wavelength of the rays that are being used to view the specimen.
- The wavelength of a beam of electrons is much smaller than the wavelength of light.
- An electron microscope can therefore distinguish between much smaller objects than a light microscope – in other words, an electron microscope has a much higher resolution than a light microscope.
- We can therefore see much more fine detail of a cell using an electron microscope than using a light microscope.

Magnification

- Number of times an image is larger than the actual size of an object
- Formula

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size.}}$$ or M=I/A

- Does power of a lens effect the magnification of a microscope

- Does change of wave length of light rays used effect the magnification of a microscope

Units of measurement of length

Measurement	Symbol	Number per meter	Number of meters
Kilometer	Km	0.001	10^{3}
Meter	M	1	1
Millimeter	Mm	1000	10^{-3}
Micrometer	Um	1000000	10^{-6}
Nanometer	Nm	1000000000	10^{-9}

Measuring cells

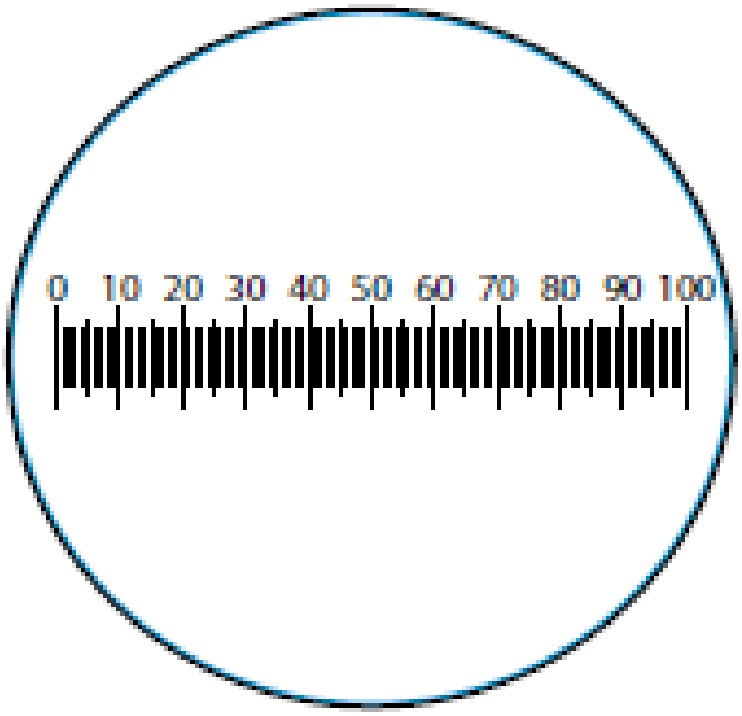
Eyepiece graticule**.**

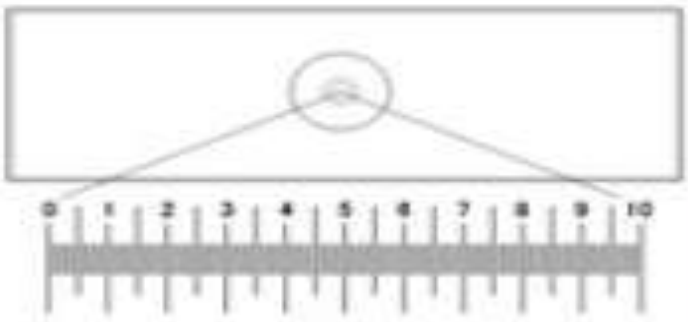
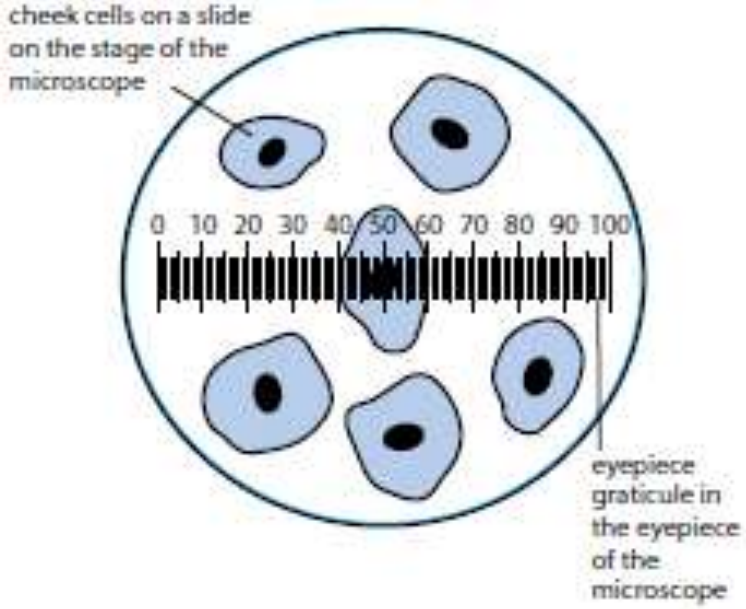
a transparent scale.

Usually has 100 divisions but an unknown scale

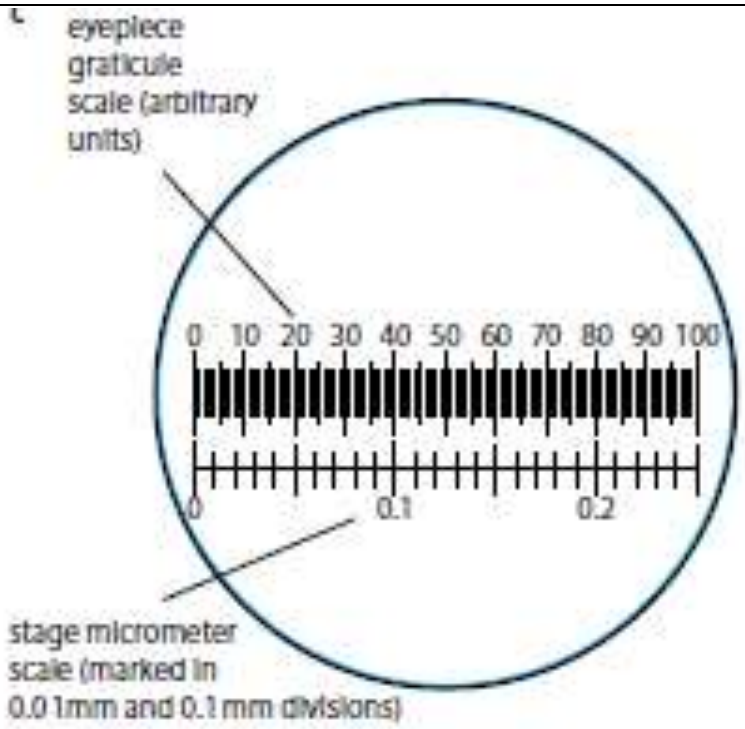
placed in the microscope eyepiece

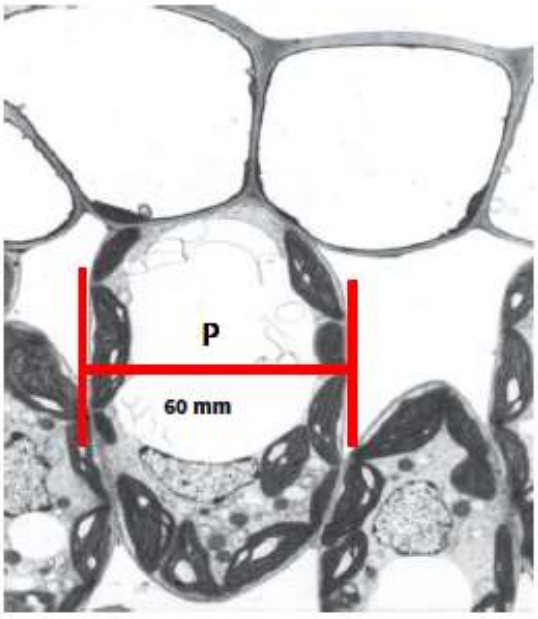
it is seen at the same time as the object to be measured.



Stage micrometer
Placed on the microscope stage
and is brought into focus.
may be etched onto a glass slide or printed on a transparent film.
It has subdivisions of 0.1 and 0.01 mm printed on it.
it is used to calibrate the eyepiece graticule scale ,

Measure the diameter of a cheek cell using EPG
Place the cheek cells slide on the stage
Focus at X40
You will view both the cheek cells and EPG together
Align the scale from one edge of a cell to other edge of a cell
Count number of divisions of EPG overlapping from one edge to other edge of the cell

There are 20 Div of EPG overlapping from one edge to the other edge from 40 div to 60 div. As EPG has an unknown scale so there are no units with these divisions. To calculate the length of 20 Div of EPG we should know the length of 1 div of EPG which is calibrated by using SM stage micrometer

Caliberation

Replace the slide of the cheek cells with the SM slide
view through the eye piece again.
bring both the scales EPG and SM to overlap each other
The images of the two scales can then be superimposed as shown below

Count how many divisions of EPG overlap with how many divisions of SM
From the Figure above 5 small divisions of SM= 20 divisions of EPG
1 small division of SM= 0.1mm
so 5 X 0.1 = 20 divisions of EPG
1 division of EPG = 5X 0.1/20 or 0.0025 mm or 2.5 um
The diameter of the cell shown superimposed on the scale in Figure 1.8b measures 20 eyepiece units and so its actual diameter is:
20 × 2.5 μm = 50 μm

Calculating the magnification of a photograph or image
Step 1 Measure the length in mm of the cell in the photograph using a ruler.
You should find that it is about 60 mm.
 ×750.
Step 2 Convert mm to μm.
1 mm = 1000 μm so
60 mm = 60 × 1000 μm
= 60 000 μm
Step 3 Use the equation to calculate the magnification.
Magnification=Image /Actual
OR
Actual=Image /Magnification
=60000/75**0**
=80um

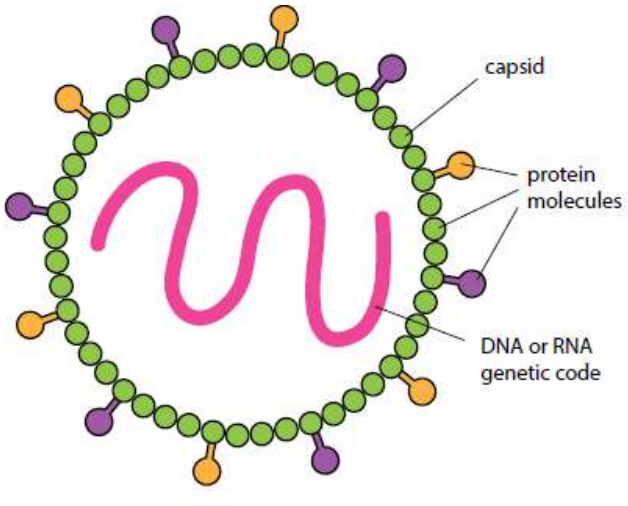
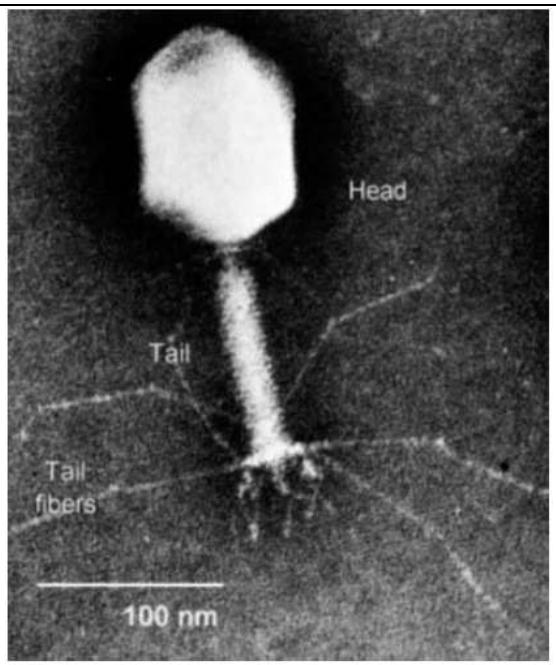
A student has drawn a cell structure as seen using a light microscope.

The magnification of the drawing is ×600.

The length of the structure on the drawing is 6 mm.

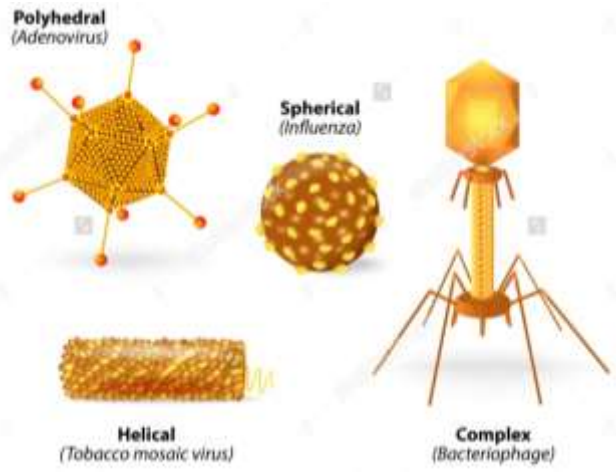
What is the actual length of the cell structure?

A 1×10^{-1} µm **B** 1×10^{0} µm **C** 1×10^{1} µm **D** 1×10^{2} µm

Viruses
 
Viruses do not fit in the cell theory.
They have no cell membrane
No cytoplasm
No cell organelles
No chromosomes
Viruses consist of a protein coat or capsid which surrounds a core of nucleic acid, DNA or RNA
Viruses multiply with in the host cell so they are strictly parasites
They have size of 20nm to 300nm

Shape of Viruses

Viruses have three distinct shapes



How are viruses named?

Named after the disease it causes. For example, rabies viruses or polio viruses

Named after the tissues they infect. For example, Adenoviruses cause common cold found in the adenoids tissues between the back of the throat and the nasal cavity.

Today viruses are given a genus name ending in the word virus and a species name.

If a virus affects bacteria it is called a bacteriophage or phage.

Examples of Viruses

HIV - RNA virus called retrovirus. HIV in a human host affects white blood cells. People with HIV eventually will get AIDS because more white blood cells become infected and produce new viruses. Remember white blood cells are used to fight diseases leaving the body unable to protect itself.

Cancer - Some viruses are linked to cancer. Hepatitis B is a virus that can cause liver cancer and disrupts the normal growth and division of cells.

Plant viruses - Plant viruses require wounds or bites to enter the host. ex. Tobacco mosaic virus – disease in tobacco plants which stunts plant growth.