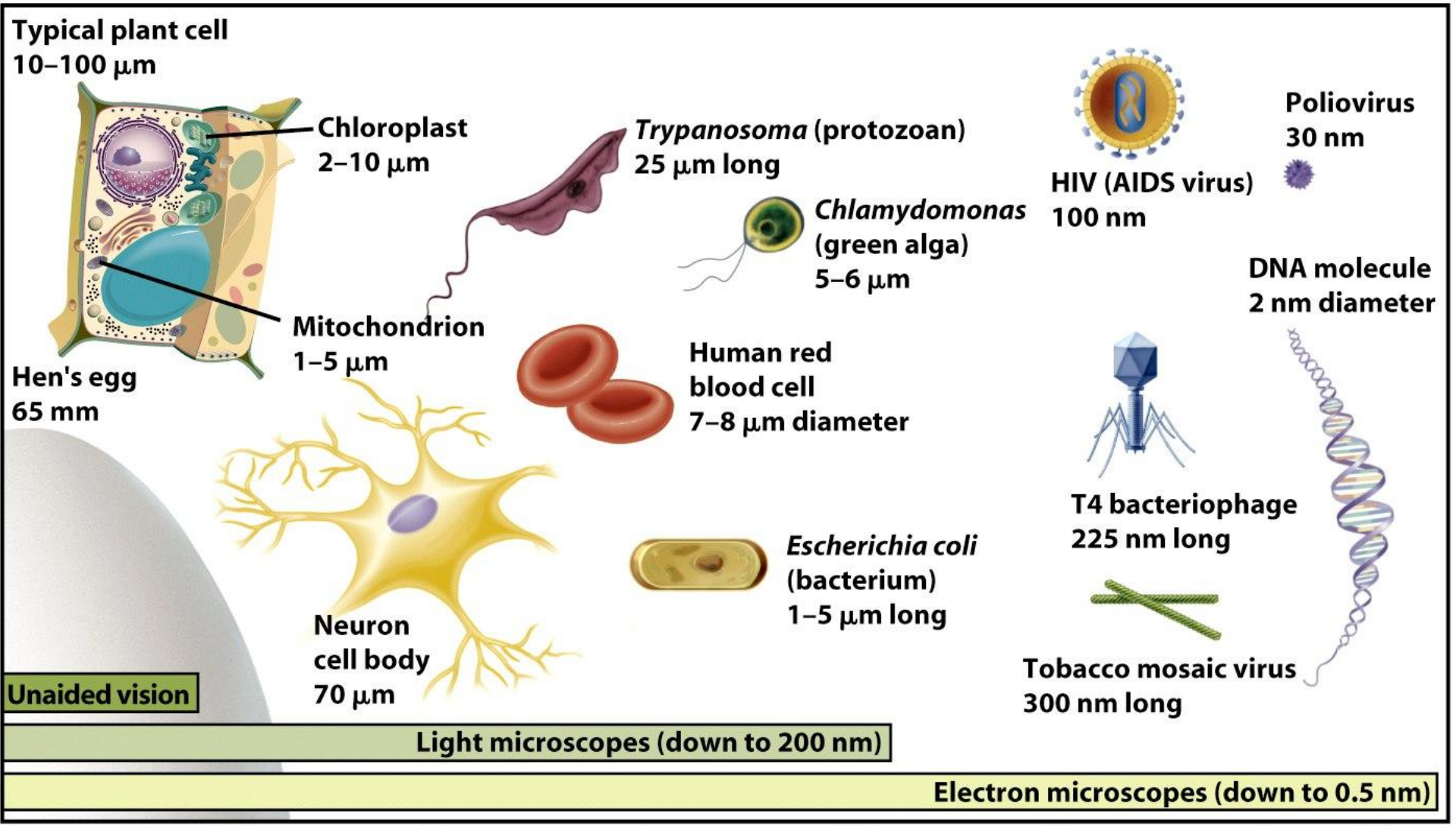
Cell Size

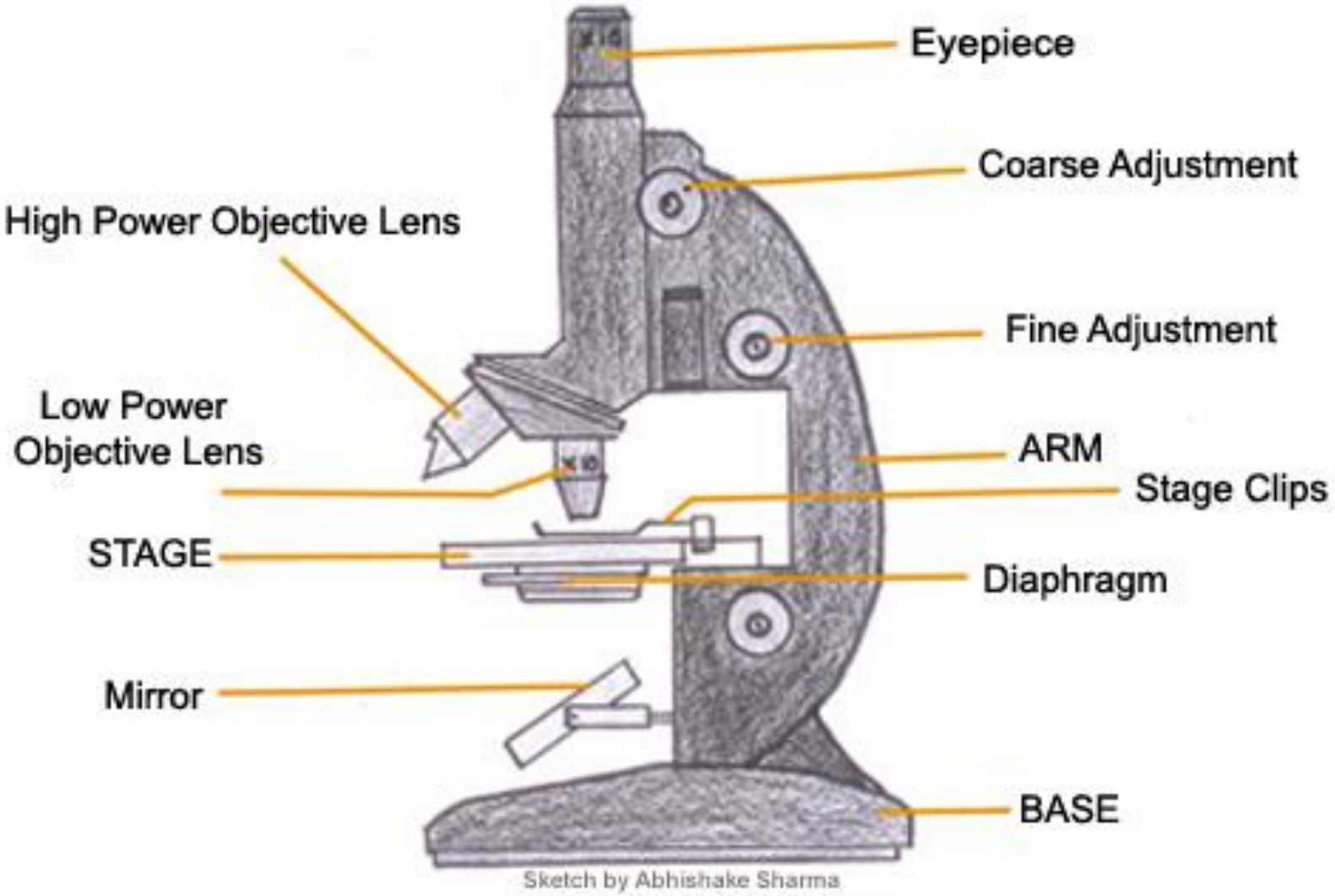

Typical plant cell
10–100 μm
Chloroplast
2–10 μm
Mitochondrion
1–5 μm
Hen's egg
65 mm
Trypanosoma (protozoan)
25 μm long
Chlamydomonas
(green alga)
5–6 μm
HIV (AIDS virus)
100 nm
Poliovirus
30 nm
DNA molecule
2 nm diameter
Human red
blood cell
7–8 μm diameter
T4 bacteriophage
225 nm long
Escherichia coli
(bacterium)
1–5 μm long
Neuron
cell body
70 μm
Tobacco mosaic virus
300 nm long
Unaided vision
Light microscopes (down to 200 nm)
Electron microscopes (down to 0.5 nm)
1 mm
100 μm
10 μm
1 μm
100 nm
10 nm
1 nm
0.5 nm

Microscope Measurement

How big is that object in the microscope?

Lesson Objectives

- Calculate the magnification using different objective lens.
- Differentiate between eyepiece graticule and the stage micrometer.
- Convert mm to micrometers.
- Calculate the cell length and breadth using the relationship between the size of the image, actual size and magnification.
- The structure and function of different parts of the microscope
- The difference between a light microscope and an electron microscope.



Labeled Microscope Diagram

1. Give the name and function of each structure labeled.

A – Ocular lens/eyepiece: used to look at specimen

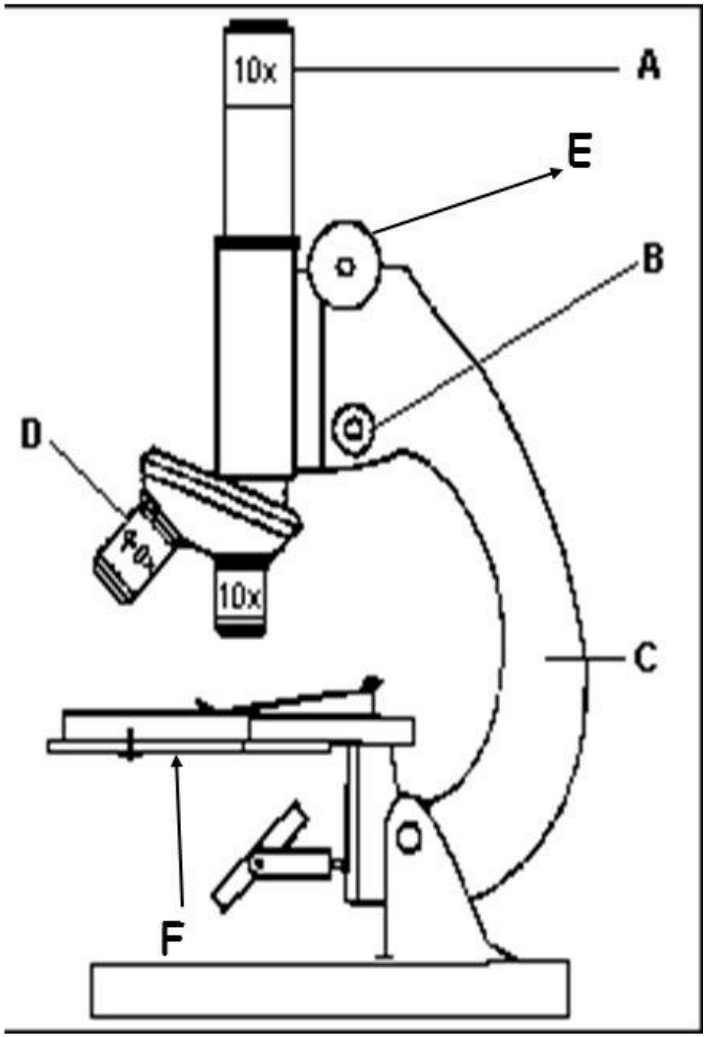
B – Fine adjustment: to focus specimen under high power

C – Arm: to hold microscope

D – Objective lens: used to magnify image

E – Coarse adjustment: to focus specimen under low power

F – Diaphragm – adjust amount of light

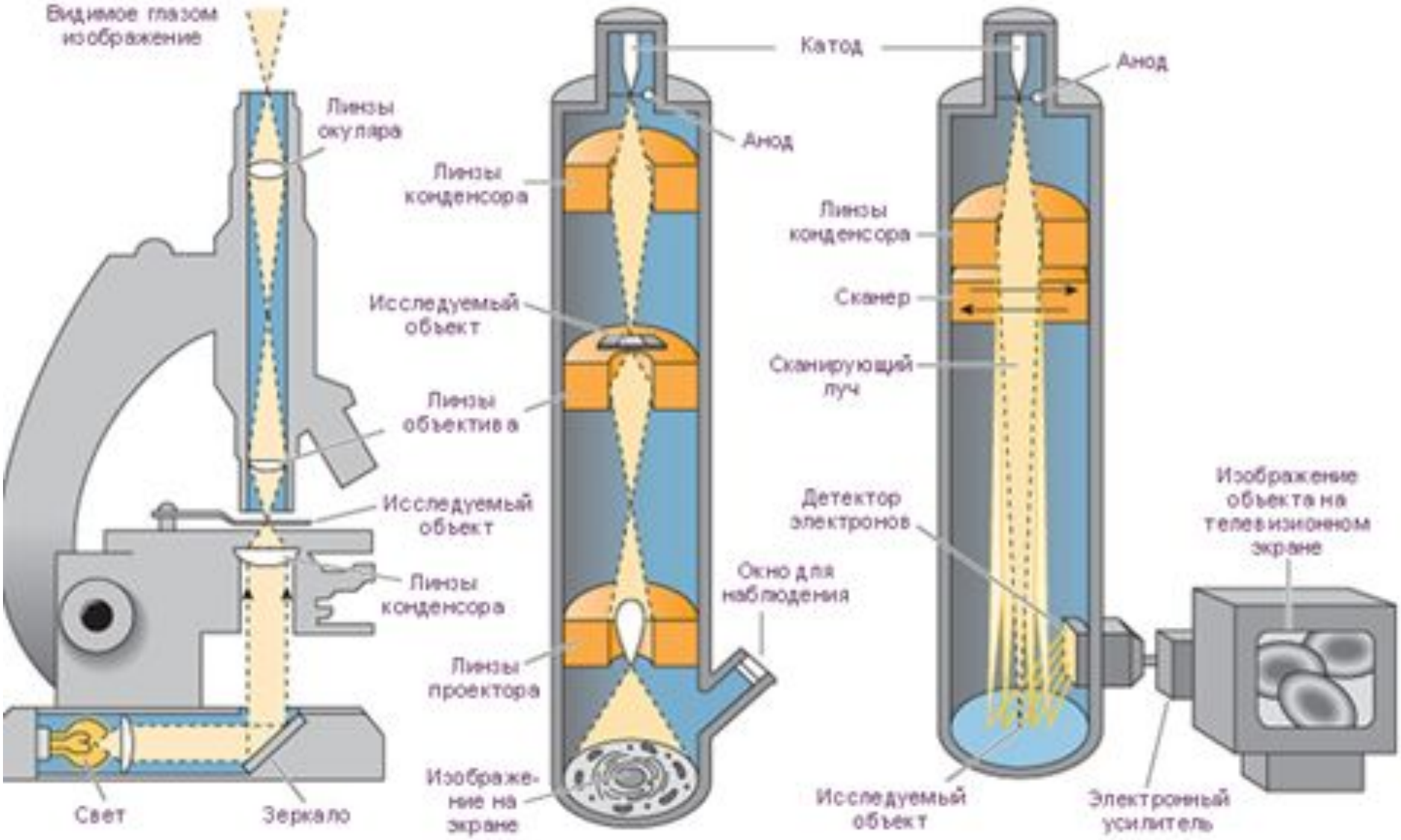


Light Microscope

A light microscope (also, **optical microscope**) is an optical instrument used to make objects larger in order to view their details. It uses light to illuminate the objects under view

Electron Microscope

An electron microscope is an optical instrument that uses a beam of electrons to make objects larger for a detailed view



Световой микроскоп

Трансмиссионный электронный микроскоп

Сканирующий электронный микроскоп

Light microscope vs Electron microscope

- What is the difference between a light microscope and an electron microscope? A number of differences such as the source of light they use, their magnification level, cost, resolving power, among other factors sets these two types of microscopes apart from each other.
- **VIDEO**

What is happening to the image as you increase the power of the objective lens?

Calculating total magnification

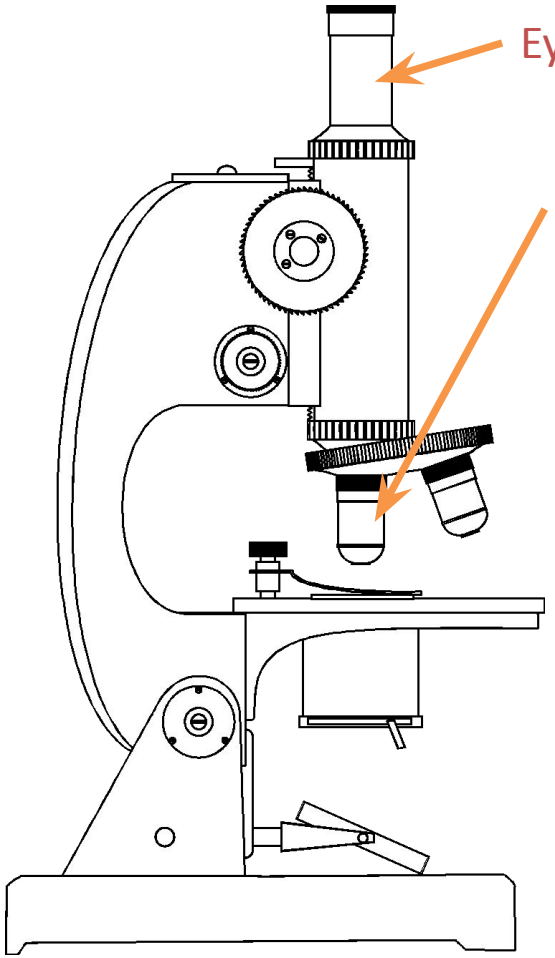
- If two lenses are always magnifying the specimen, how do you figure out the total magnification being used ?

- Total Magnification = ocular x objective

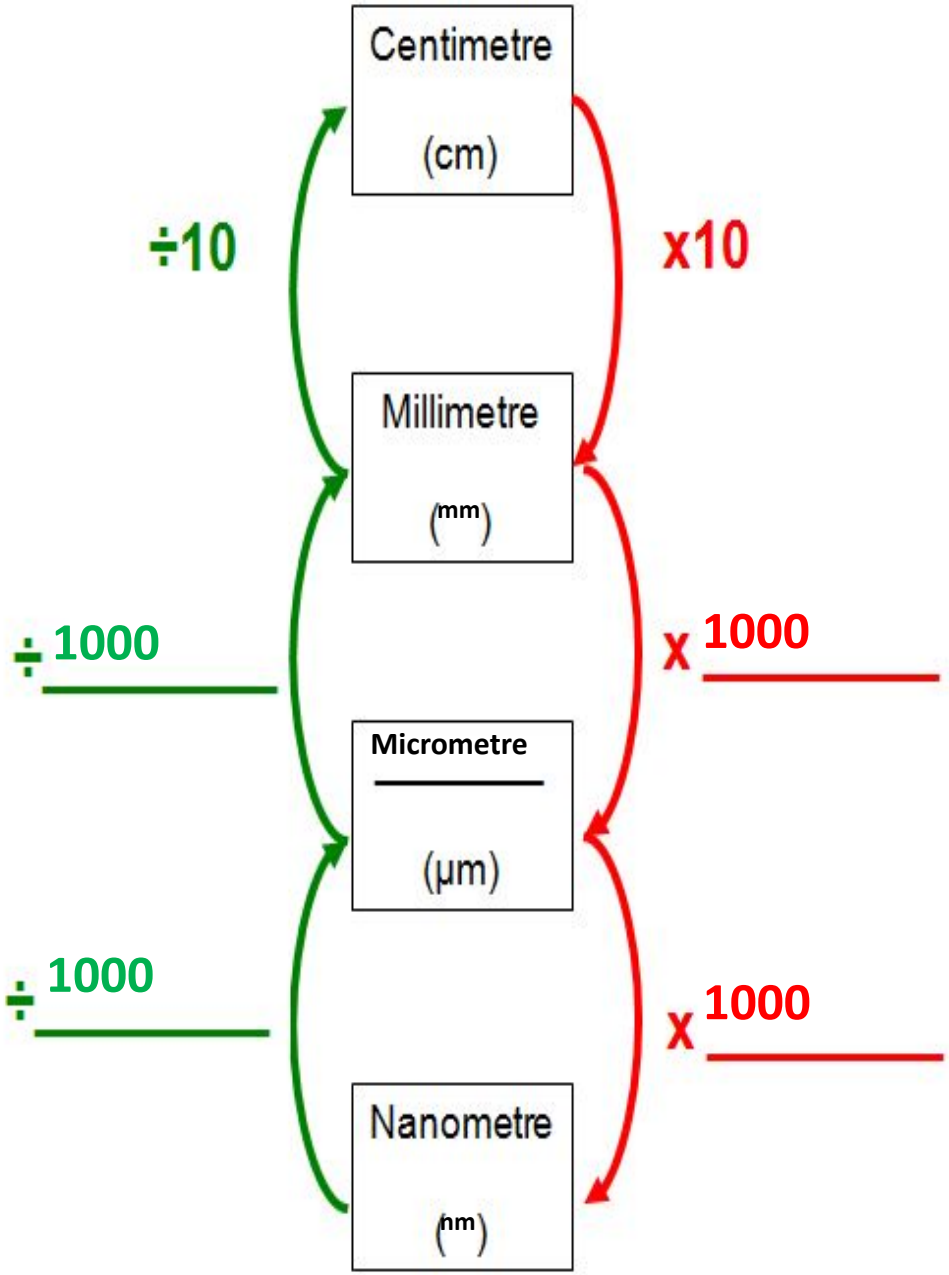
  = 10 x 4 (low power)

  = 40 (low power)

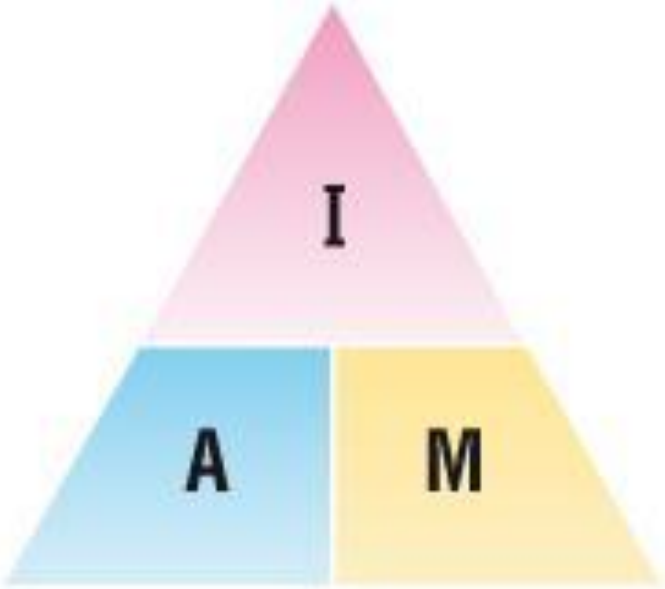
How do we find the overall magnification of a light microscope?



Eyepiece Magnification	Objective Magnification	Overall Magnification
X10	X4	40
X10	X10	100
X10	X40	400
X10	X100	1000


Centimetre
(cm)
÷10
x10
Millimetre
(mm)
÷ 1000
x 1000
Micrometre
(µm)
÷ 1000
x 1000
Nanometre
(nm)

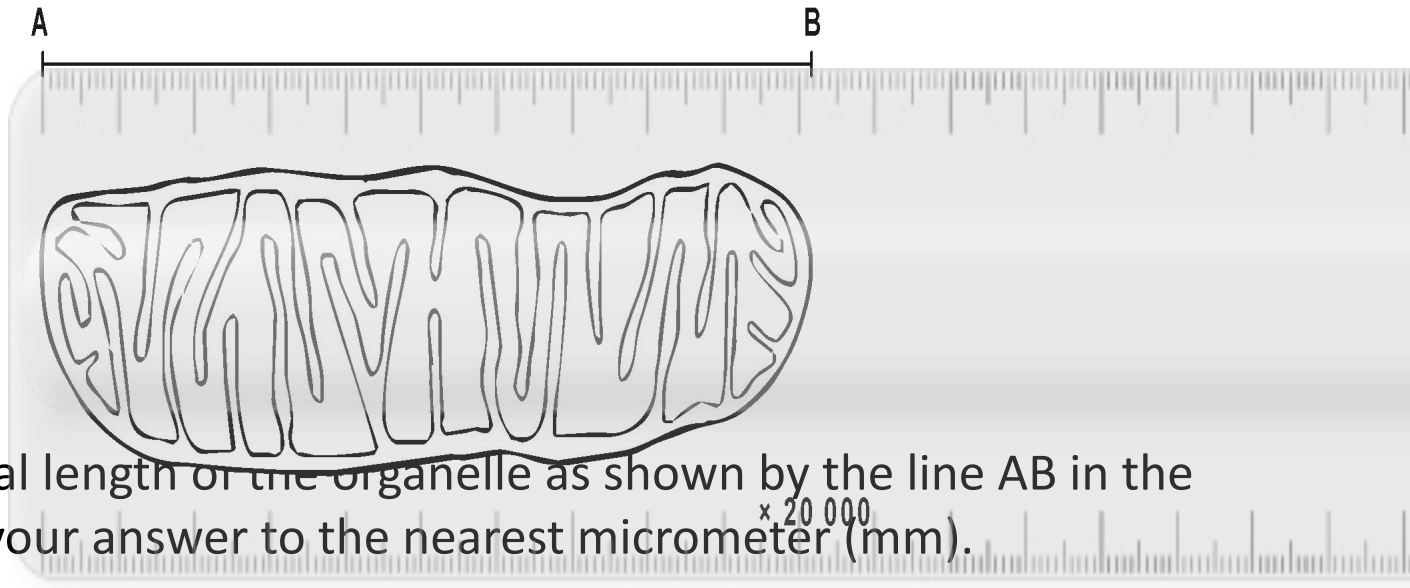
Nanometre	Micrometre	Millimetre
5	0.005	0.000005
1	0.001	0.000001
1000	1	0.001
1 000 000	1000	1
3000	3	0.003
7	0.007	0.000007
500 000	500	0.5



$$\text{Actual size} = \frac{\text{Image size}}{\text{Magnification}}$$

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size}}$$

The diagram below is a drawing of an organelle from a ciliated cell as seen with an electron microscope.



Calculate the actual length of the organelle as shown by the line AB in the diagram. Express your answer to the nearest micrometer (mm).

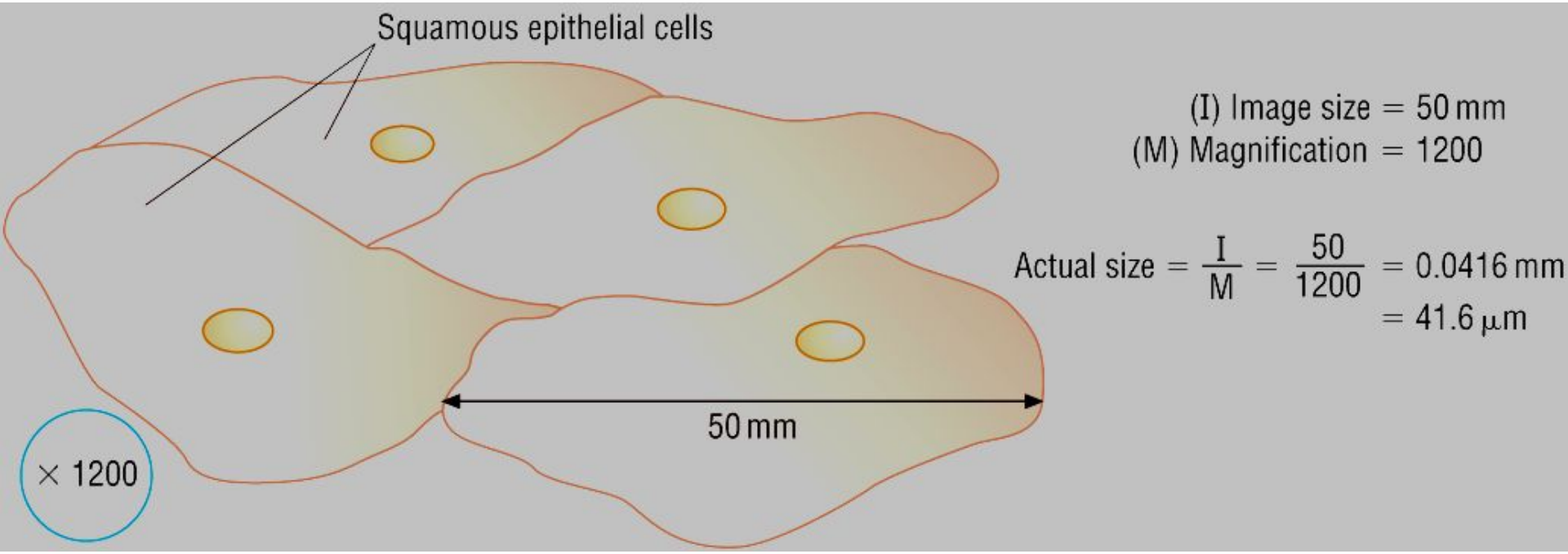
Show your working.

Answer = ... µm

$$A = \frac{I}{M} = \frac{102mm}{20000} = \frac{102000\mu m}{20000}$$

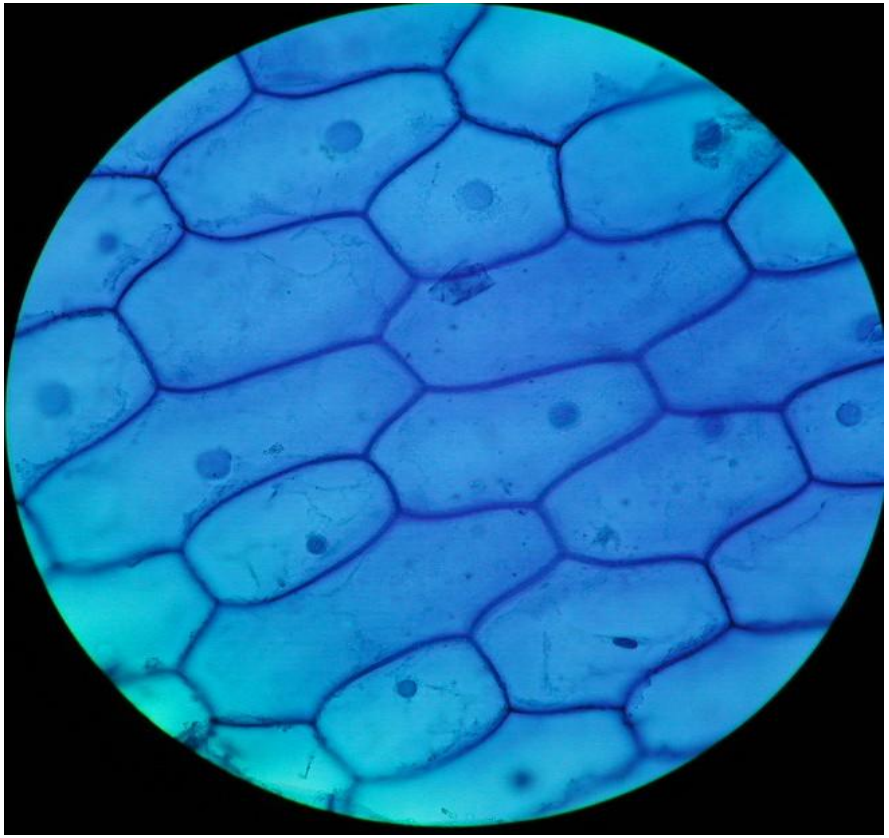
5.1

Calculating actual size:



Size of the magnified image > actual size

To accurately measure the size of cellular structures we need a suitable scale:



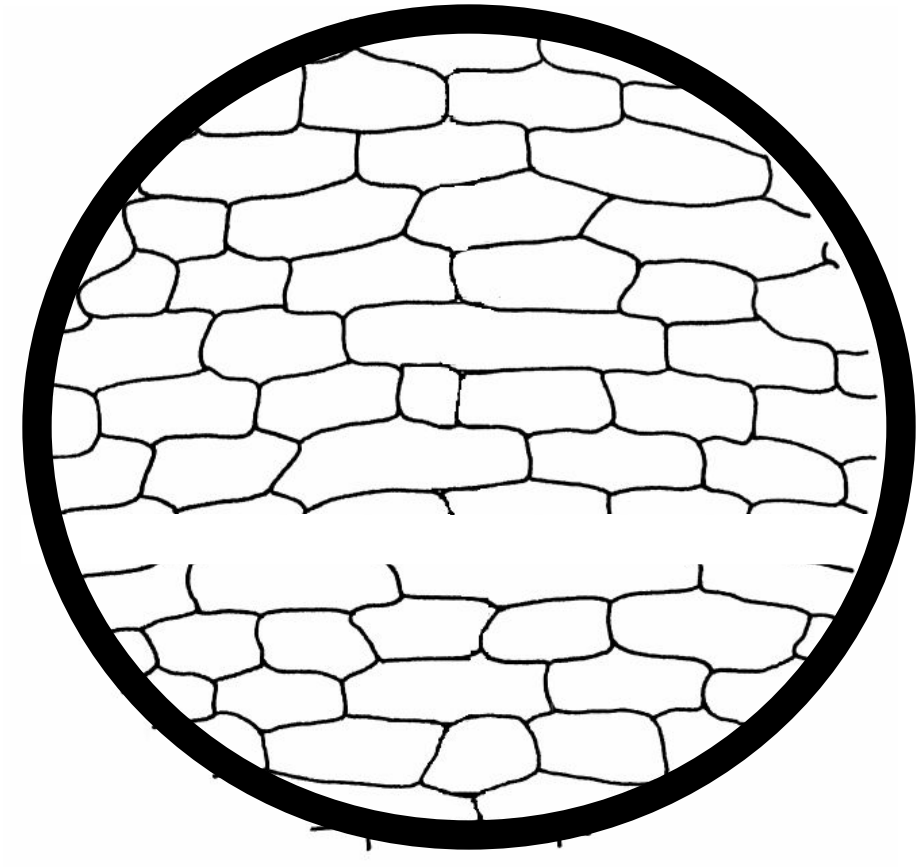
Field of View

- When you look into a microscope, the “field of view” is the visible circular area.
- What happens to your field of view when you increase the power of the objective lens?
- By knowing the size of the field of view (diameter), you can measure the size of objects in the microscope.
- The size of objects in the field of view is different at each magnification you have to calculate the diameters of the fields of view at each magnification.
- This process is called “calibrating your microscope”

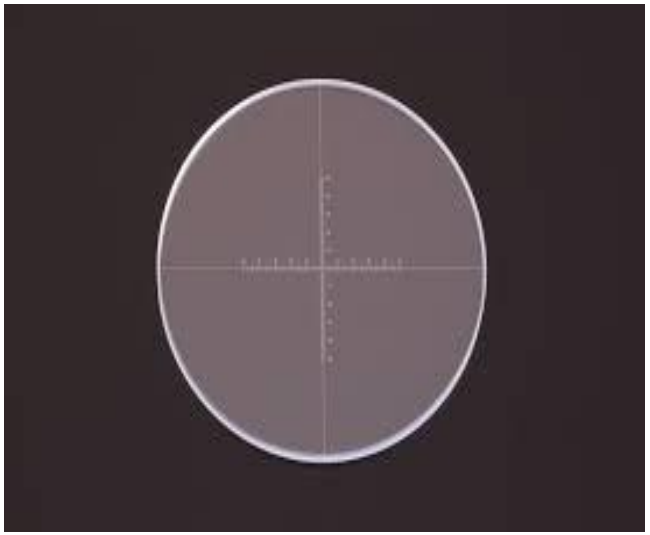
Estimating Specimen Size

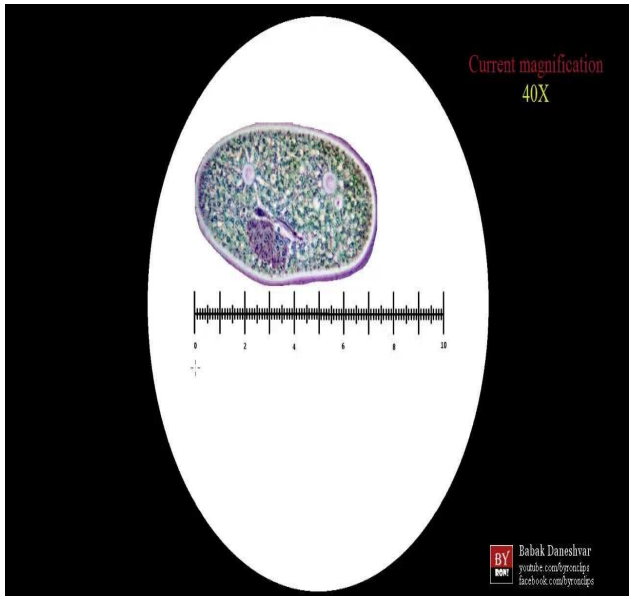
- The area of the slide that you see when you look through a microscope is called the "Field of View".
- If you know how wide your field of view is, you can estimate the size of things you see in the field of view.

Ideally, we need a scale we can see directly alongside the cells we are observing:



Eye piece graticule or reticule





- It is a glass or plactic disc with 8 divisions etched on to its surface and fitted into one eyepiece.
- The size of the eyepiece reticule is constant despite the change in magnification of the object.
- The value of each division varies with the change in magnification.

Stage Micrometer

- simply a microscope slide with a finely divided scale marked on the surface.
- 1 division= 0.01 mm
- 10 divisions= 0.1 mm
- 100 divisions = 1 mm
- 1 mm = 1000 micrometers.

Instructions

- Take sample of onion cell (peel of the onion)
- Add a drop of water
- Cover the subject glass with cover slip
- Fix it with the stage clips.
- Focus the specimen on low power objective lens.
- Now change to medium power objective lens and observe.
- Change to high power objective lens and observe.

IMPORTANT FORMULA!

$$\text{Object Size} = \frac{\text{field of view (in mm)}}{\text{number of "fits"}} \cdot 1000$$

Object Size = ? μm

** Remember that the field of view changes with each objective!.