NOS

المدرسة
الوطنية الأرثوذكسية
الشميساني

The National
Orthodox School
Shmaisani

BIOLOGY

CELLS /Recap

Accredited by

Cambridge Assessment International Education
Cambridge International School

edexcel

CIS

معتمدة من

Eco-Schools

Objective *:-*

- Understand the cell theory .

- Be able to use a light microscope to investigate the structure of cells and tissues, with drawing of cells.

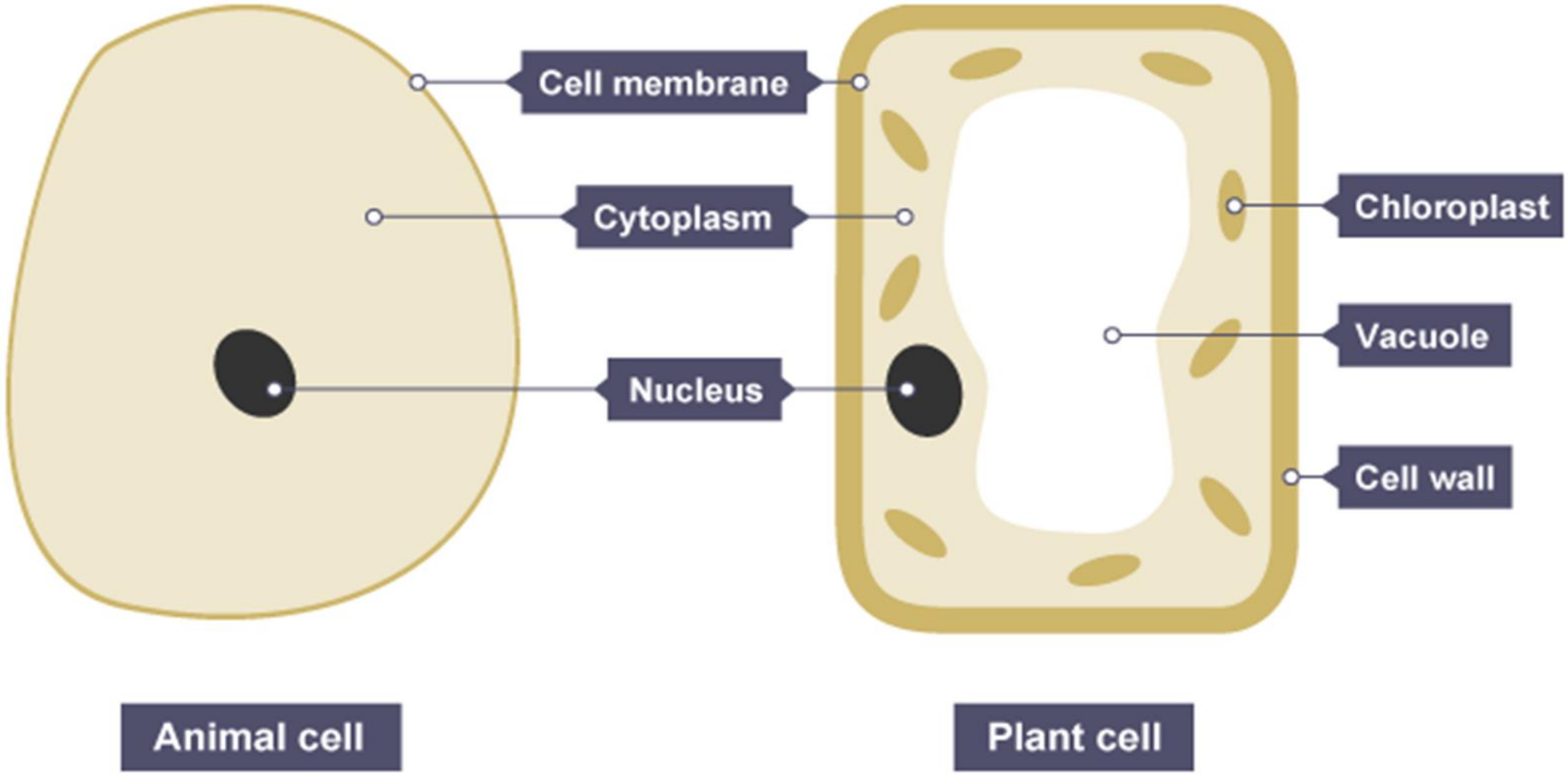
- Be able to calculate the magnification of drawings and the actual size of structures and ultrastructure shown in drawings or micrographs.

Resources :

Student book page 8 .

https://www.youtube.com/watch?v=D2XWBkVoKnc&t=1s ***cell theory***

https://www.youtube.com/watch?v=192M4oDLTdc&t=2s animal and plant cells


Cell membrane
Cytoplasm
Nucleus
Chloroplast
Vacuole
Cell wall
Animal cell
Plant cell

The table summarizes the main parts and their functions of animal and plant cells :

You will study more details in the upcoming topics

Part	Function	Found in
Cell membrane	Controls the movement of substances into and out of the cell	Plant and animal cells
Cytoplasm	Jelly-like substance, where chemical reactions happen	Plant and animal cells
Nucleus	Carries genetic information and controls what happens inside the cell	Plant and animal cells
Mitochondria	Where most respiration reactions happen	Plant and animal cells
Vacuole	Contains a liquid called cell sap, which keeps the cell firm	Plant cells only
Cell wall	Made of a tough substance called cellulose, which supports the cell	Plant cells only

what is a theory ?

A theory is **a carefully thought-out explanation for observations of the natural world that has been constructed using the scientific method, and which brings together many facts and hypothesis**

Cell theory :

Since the 17th century, microscopes have been used to examine tissues from different living organisms. This resulted in the development of the cell theory, which states that:

1. All living organisms are composed of cells.
2. Cells are the smallest unit of life.
3. Cells come from pre-existing cells and cannot be created from non-living material.

Division of cells results in the formation of new cells.

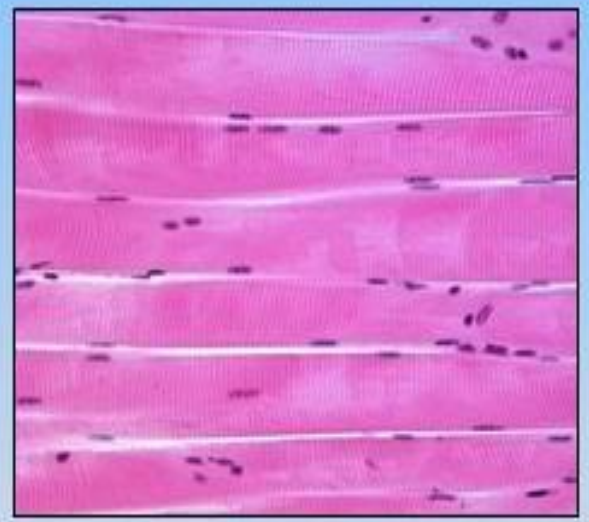
Regardless of the differences between cells, all cells share some common features. All cells are surrounded by a plasma membrane, which separates the contents of the cell from its surroundings. All cells contain genetic material, which holds the information needed for the cell to carry out its activities. All cells contain cytoplasm where chemical reactions take place.

Trends and discrepancies - cases that do not fit the theory

Most organisms conform to cell theory, some do not.

The cell theory was based on the work of several scientists over many years where various trends among the cells of living organisms were discovered.
Some discrepancies have been discovered but they were not enough to discard the cell theory. Many organisms consist of cells that are considered atypical. Examples of atypical cells include:

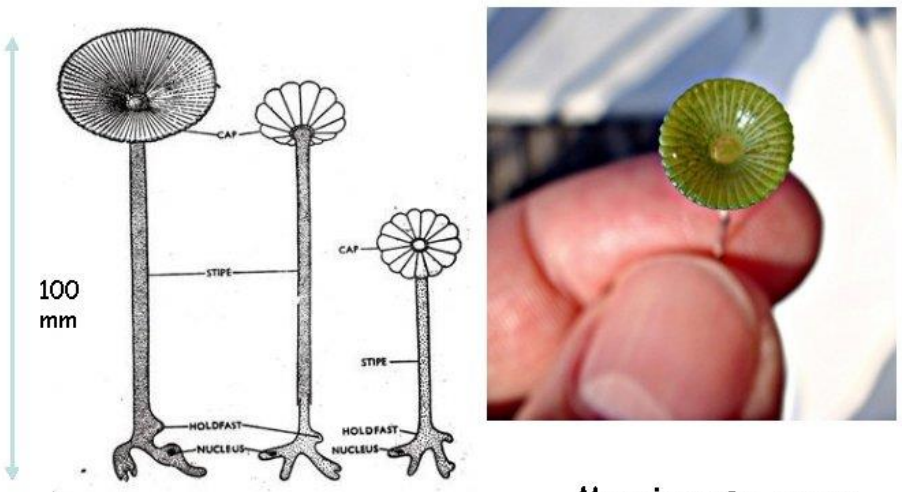
- ✓ The **striated muscle fibres** ***which are larger than most animal cells and have many nuclei.***
- ✓ **Giant algae** (such as Acetabularia) which are ***single-celled organisms with a much larger size than a normal cell***.
- ✓ **Aseptate fungi** consist of thread-like structures called hyphae. These hyphae are not divided up into sub-units containing a single nucleus. Instead ***there are long undivided sections of hypha which contain many nuclei.***



Our **striated muscle cells** have an average length of 30 mm and can have as many as several hundred nuclei…in a single cell! (most human cells are 0.03 mm in length)

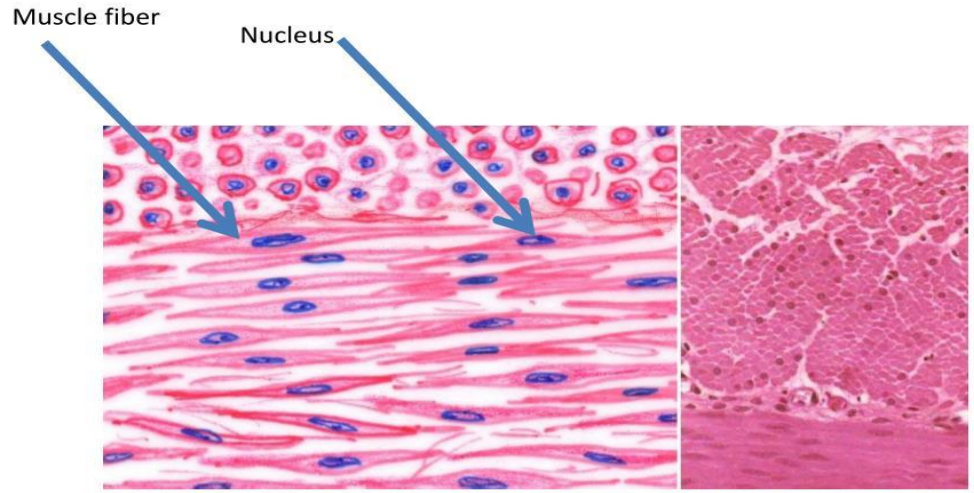
Most algae are single-celled and microscopic. Not this one! Some species grow up to 100 mm and is **a single cell with one nucleus!**

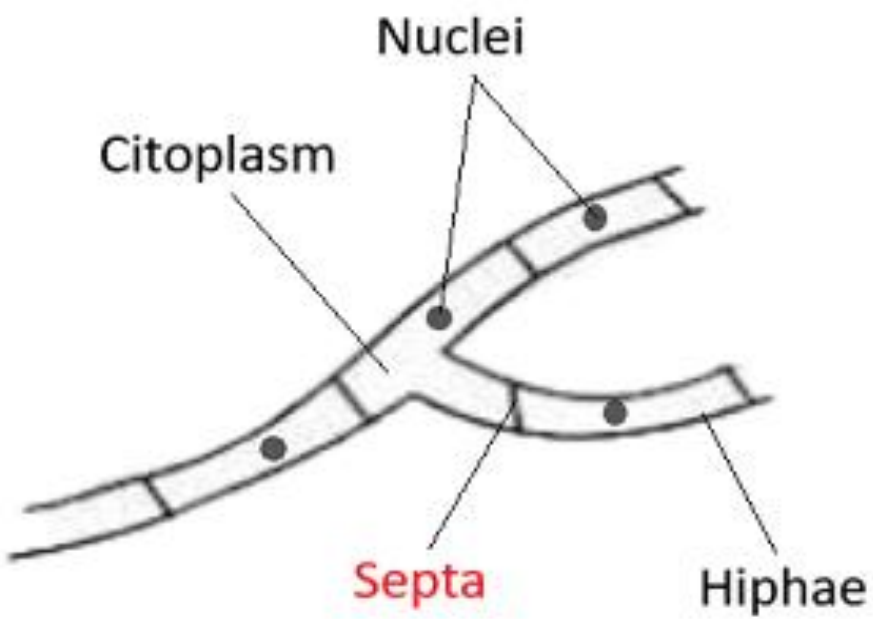
Acetabulgaria – Giant Algae



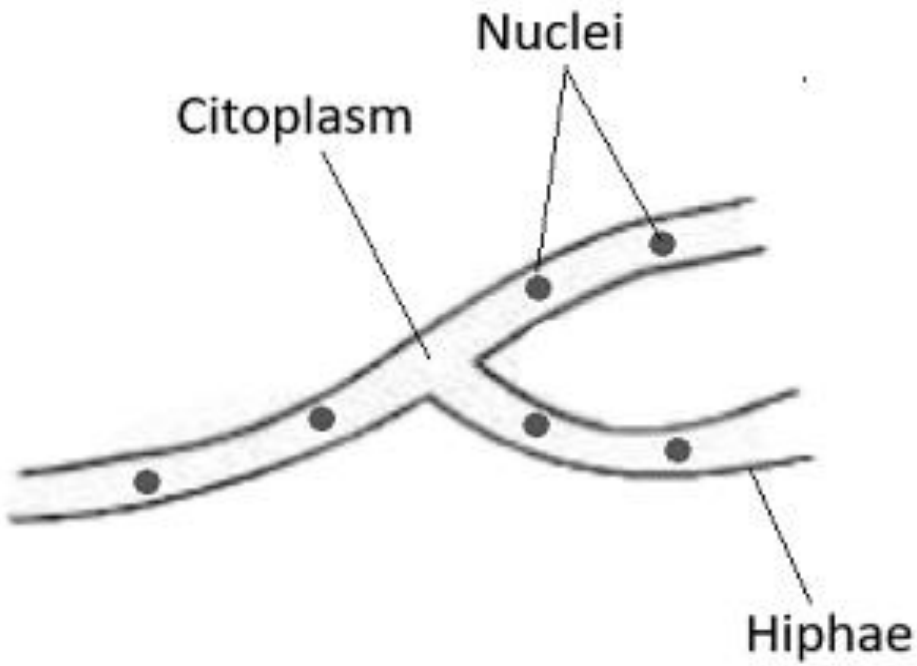
Massive – Can grow up to 10cm even though it's a single cell with one nuclei

Striated Muscle





Septate Hiphae



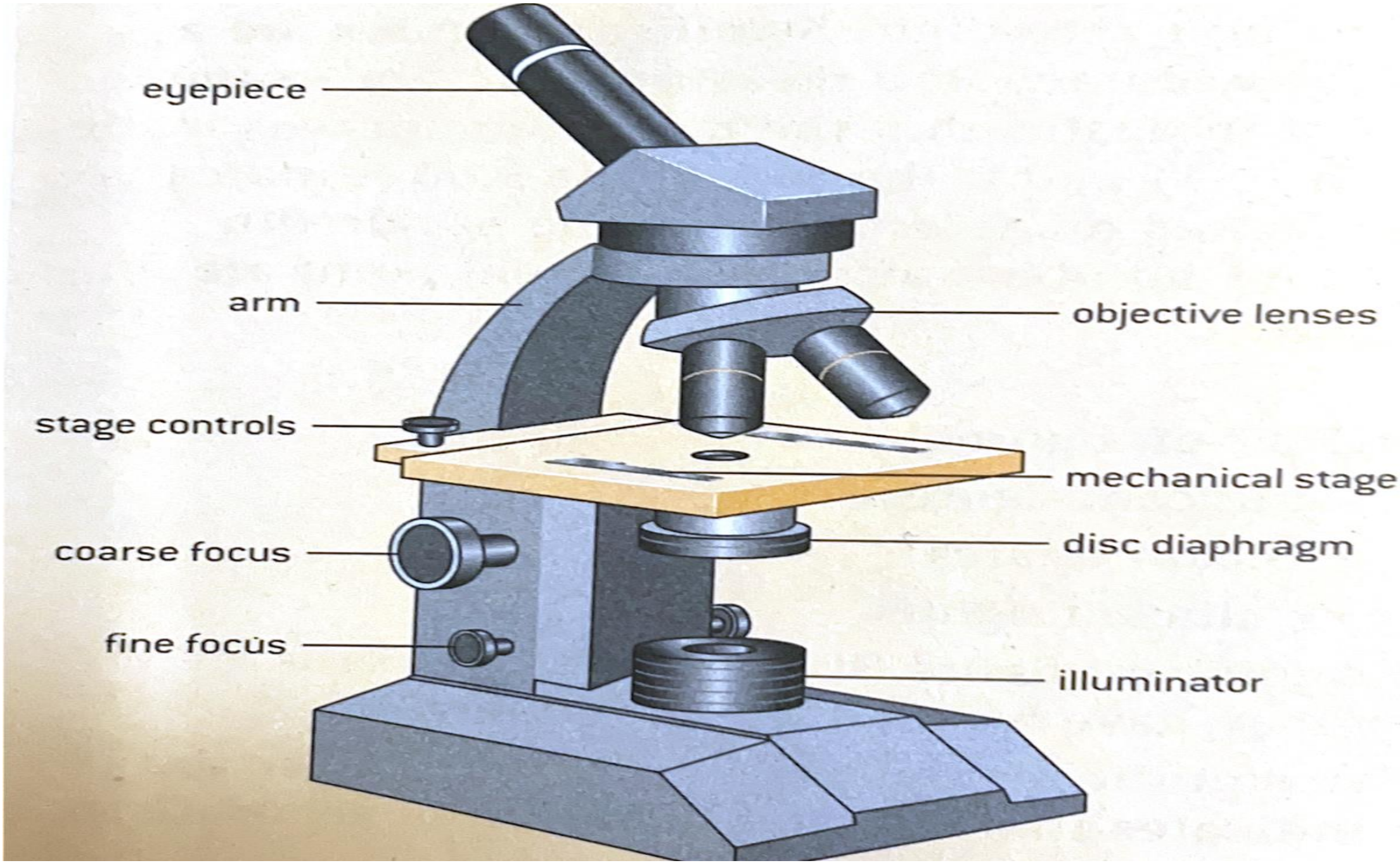
Aseptate Hiphae

What is a microscope :

A microscope is a laboratory instrument used to examine objects that are too small to be seen by the naked eye. It is derived from Ancient Greek words and composed of mikrós, “small” and skopeîn,”to look” or “see”.

Microscopes **magnify** or enlarge small objects such as cells, microbes, bacteria, viruses, microorganisms etc. at a viewable scale for examination and analysis.

Microscopes consist of one or more magnification lenses to enlarge the image of the microscopic objects placed in the focal plane.


eyepiece
arm
stage controls
coarse focus
fine focus
objective lenses
mechanical stage
disc diaphragm
illuminator

Microscope Parts	Microscope Parts Functions
Base	Supports the microscope
Arm	Used to carry the microscope
Stage	Platform where the slide with the specimen is placed
Stage Clips	Holds the slide in place on the stage
Eyepiece (containing ocular lens)	Magnifies the image for the viewer
Revolving nose piece	Contains the objective lenses; rotates to allow the user to switch between different objective lenses

Objective lenses	Low-, medium-, and high-power lenses that further magnify the specimen at different intensities
Coarse adjustment knob	Large knob used for focusing the image under low power (general focusing)
Fine adjustment knob	Smaller knob used for focusing the image with the medium- and high-power objectives (fine-tuning)
Diaphragm	Controls the amount of light that passes through the specimen
Light source	Provides light for viewing the specimen

Using light microscope to observe onion cells

Onion cells are often chosen as an example of plant cells since they can be easily seen using a light microscope.

To prepare the slide to be observed, you need to

- cut the onion open
- use forceps to peel a thin layer from the inside.
- Spread the thin layer on a microscope slide.
- Add a drop of iodine solution **to stain the layer to make it easier to view its parts.**
- Carefully place a cover slip over the layer and ensure no bubbles are trapped inside.
- To view the slide, ensure that you move from one objective lens to another very carefully while adjusting the fine or coarse focus.

Troubleshooting (*reading only)*

Problem: Nothing is visible when I try to focus.

Solution: Make sure the specimen is actually under the lens, by carefully positioning the slide. It is easier to find the specimen if you focus at low power first .

Problem: A circle with a thick black rim is visible.

Solution: There is an air bubble on the slide. Ignore it and try to improve your technique for making slides so that there are no air bubbles.

Problem: There are blurred parts of the image even when I focus it as well as I can.

Solution: Either the lenses or the slide have dirt on them. Ask your teacher to clean it.

Problem: The image is very dark.

Solution: Increase the amount of light passing through the specimen by adjusting the diaphragm.

Problem: The image looks rather bleached.

Solution: Decrease the amount of light passing through the specimen by adjusting the diaphragm.

5 Human cheek cell

Scrape cells from the inside of your cheek with a cotton bud. Smear them on a slide and add methylene blue to stain.

Maths skills: Calculating magnification and the actual size of cells

$$\text{Magnification} = \frac{\textit{image size}}{\textit{actual size}}$$

Image size is the measured size and can be found by measuring the micrograph size using a ruler.

Actual size is the real size of the cell which is either given or to be calculated.

Magnification will be given or must be calculated.

When solving questions, ensure that the same units are used for both the image and actual size.

Convert units when needed:

cm ⇄ (×10 / ÷10) mm ⇄ (×1000 / ÷1000) μm ⇄ (×1000 / ÷1000) nm

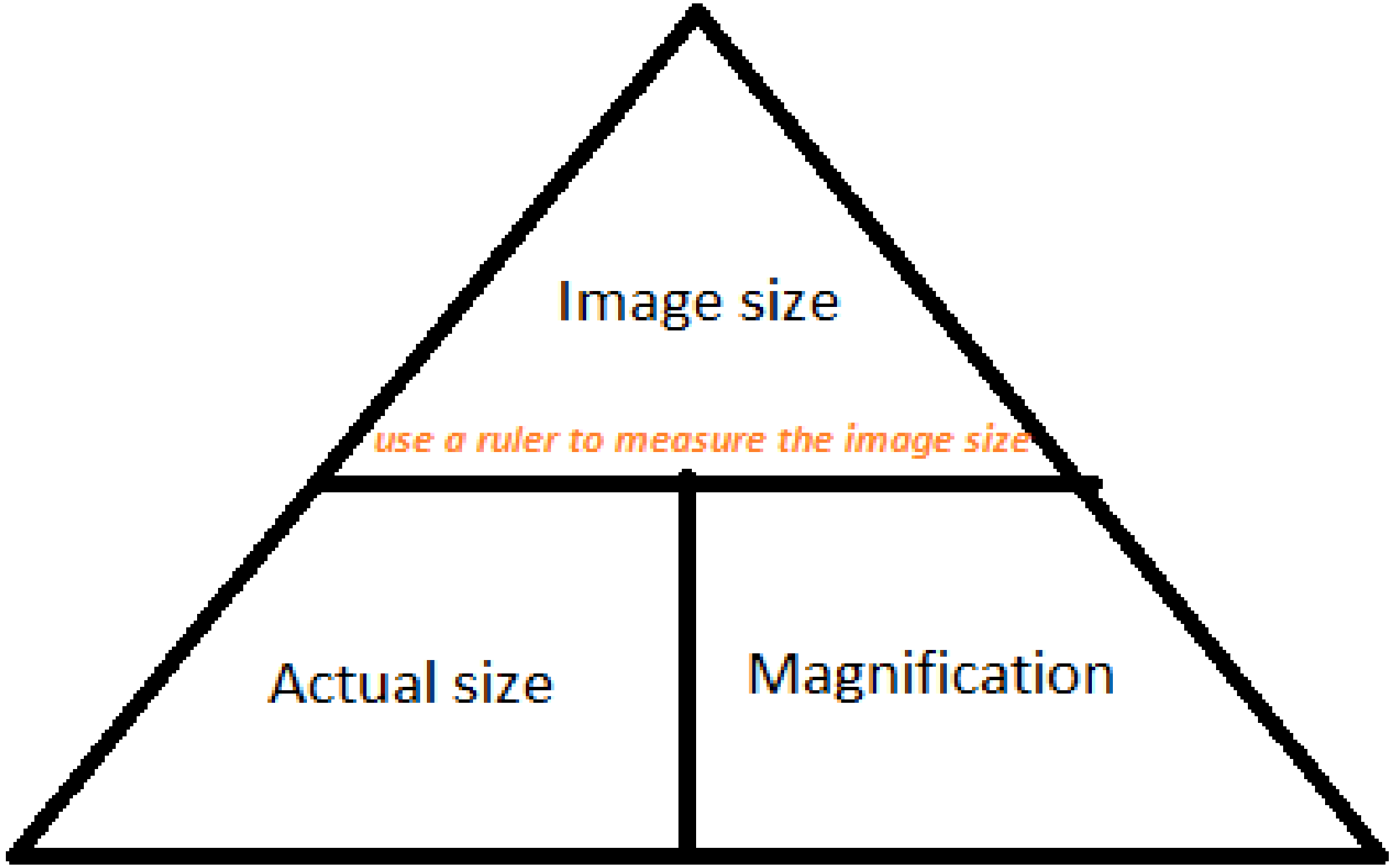


Image size
use a ruler to measure the image size
Actual size
Magnification

Worked example: Calculations involving magnification

WE

1. Calculate the actual size of the dividing bacteria cell shown in figure 5.

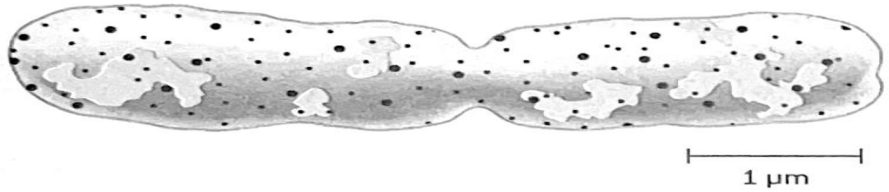


Figure 5. A prokaryote undergoing binary fission

Solution

The first step is always to find the magnification. Since the magnification is not given, it must be calculated using the scale bar given.

$$\text{Magnification} = \frac{\textbf{\textit{image size}}\ (\textit{of the scale bar – measured})}{\textbf{\textit{actual size}}\ (\textit{of the scale bar – indicated on the diagram})}$$

$$\text{Magnification} = \frac{\textbf{1.5 cm}}{\textbf{1 µm}}$$

Make sure the units are the same: 1.5 cm = 15 mm = 15 000 µm

$$\text{Magnification} = \frac{\textbf{15 000 µm}}{\textbf{1 µm}}$$

$$\text{Magnification} = 15\,000\times$$

After finding the magnification, the actual size of the bacterium can be calculated by rearranging the formula used above, but this time using size of the amoeba.

$$\text{Actual size of the dividing bacterium} = \frac{\textbf{\textit{image size}}}{\textbf{\textit{Magnification}}}$$

$$\text{Actual size of the dividing bacterium} = \frac{\textbf{7.5 cm}}{\textbf{×15 000}}$$

$$\text{Actual size of the dividing bacterium} = 0.0005\text{ cm}$$

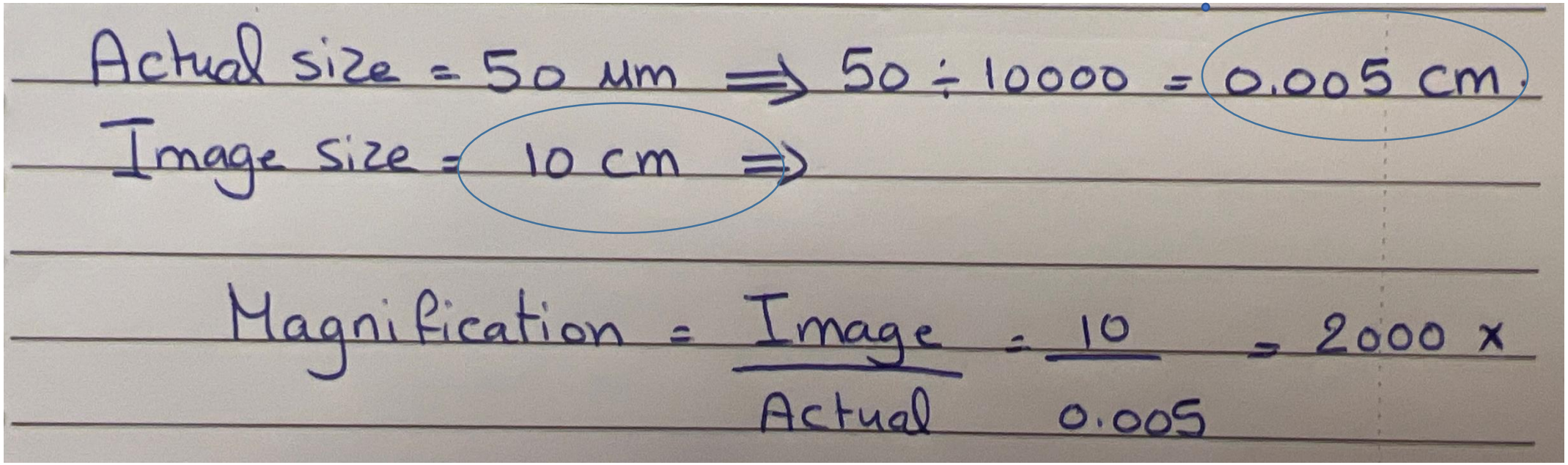
$$= 0.005\text{ mm} = 5\text{ µm}$$

Student book page 9

Check your understanding

Questions 7 ,8,9 page 9

Question 7 : The length of a chloroplast is 50 um and a drawing of it is 10 cm in length. Determine the magnification of the drawing.



Question 8 :

Find the maximum length of the cheek cell in figure 6.

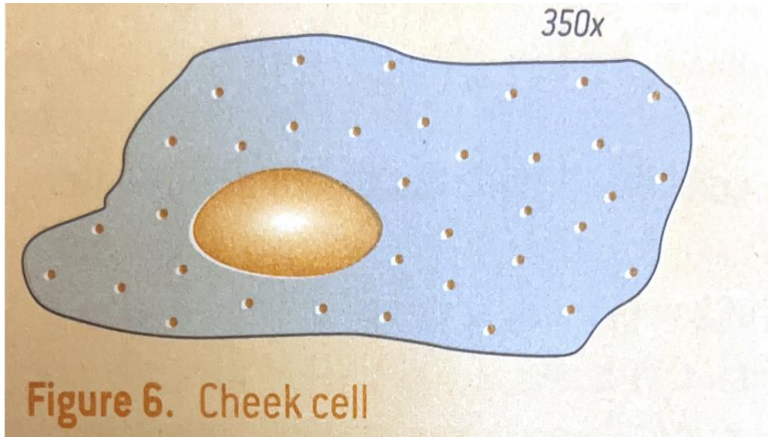


Figure 6. Cheek cell

Actual size = ??

Image size = 6 cm.

Magnification = 350 x

$$\text{Actual size} = \frac{\text{Image size}}{\text{Magnification}} = \frac{6}{350} = 0.01714286\,\text{cm}$$

$= 171.42\ \mu m$

$= 171\ \mu m$

Question 9 :

The magnification of an image is 2000x . The length of the drawn image is 30 mm. Calculate the actual length of the image.