



## 2 ORGANISATION OF THE ORGANISM

### CONTENTS:

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- 2.2 SPECIALISED CELLS
- 2.3 LEVELS OF ORGANISATION
- 2.4 SIZE OF SPECIMENS

[VIEW EXAM QUESTIONS](#)

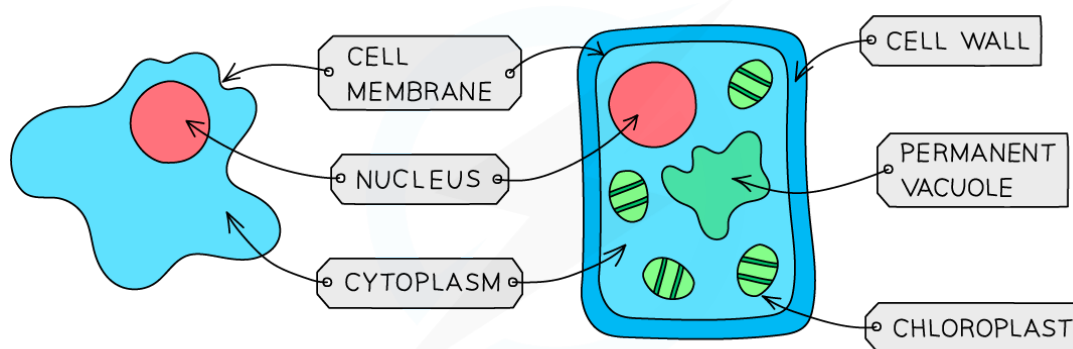
YOUR NOTES



### 2.1 CELL STRUCTURE & ORGANISATION

#### Structures: Basics

- **Cytoplasm** is found inside the cell and contains all the other cell structures
- The large **nucleus** is surrounded by a nuclear membrane to separate it from the cytoplasm
- The **cell membrane** surrounds the cell
- The **cell wall** is made of cellulose and surrounds the cell membrane in plant cells
- **Chloroplasts** are organelles found in the cytoplasm that are packed with the pigment **chlorophyll** and so are green in colour
- **Vacuoles** are large vesicles that take up a large part of the interior of plant cells



An animal and plant cell as seen under a light microscope



## 2 ORGANISATION OF THE ORGANISM

## 2.1 CELL STRUCTURE &amp; ORGANISATION cont...

YOUR NOTES

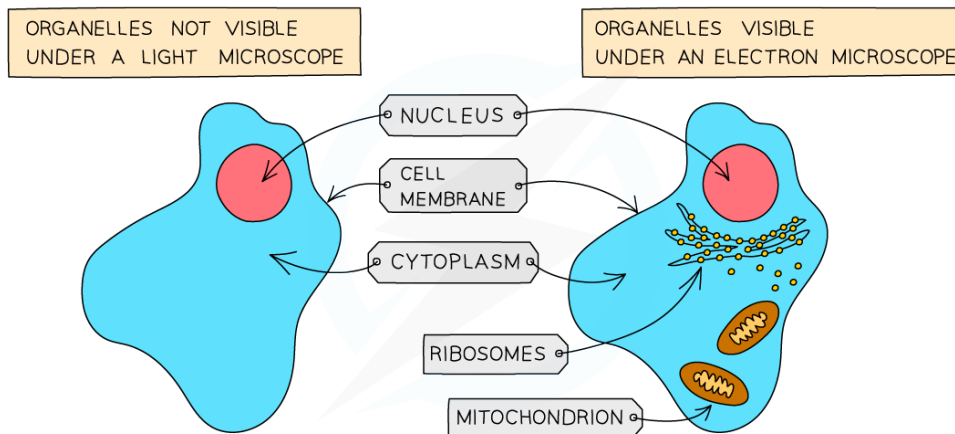


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## Structures

Within the cytoplasm, the following organelles are visible in **almost all cells except prokaryotes** when looking at **higher magnification** (ie using an **electron microscope**):

- **Mitochondria** (singular: mitochondrion) are organelles found throughout the cytoplasm
- **Ribosomes** are tiny structures that can be free within the cytoplasm or attached to a system of membranes within the cell known as **Endoplasmic Reticulum**
- Endoplasmic reticulum studded with ribosomes looks **rough** under the microscope; this gives rise to its name of **Rough Endoplasmic Reticulum** (often shortened to **R.E.R.**)
- **Vesicles** can also be seen using a higher magnification – these are small circular structures found moving throughout the cytoplasm



Structures in an animal cell visible under a light microscope and an electron microscope

2 ORGANISATION OF THE ORGANISM

2.1 CELL STRUCTURE & ORGANISATION cont...

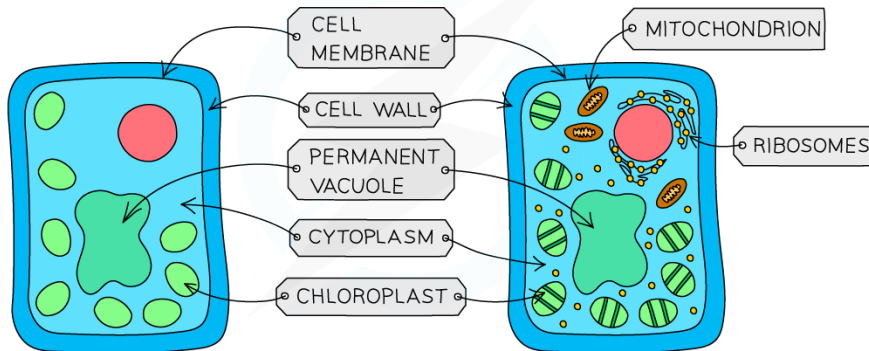
YOUR NOTES



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PLANT CELL VIEWED UNDER A LIGHT MICROSCOPE

PLANT CELL VIEWED UNDER AN ELECTRON MICROSCOPE



Structures in a plant cell visible under a light microscope and an electron microscope

Functions: Basics

STRUCTURE	FUNCTION
NUCLEUS	<ul style="list-style-type: none"> <li>- CONTAINS GENETIC MATERIAL IN CHROMOSOMES WHICH CONTROL HOW CELLS GROW AND WORK</li> <li>- CONTROLS CELL DIVISION</li> </ul>
CYTOPLASM	<ul style="list-style-type: none"> <li>- SUPPORTS CELL STRUCTURES</li> <li>- SITE OF MANY CHEMICAL REACTIONS</li> <li>- CONTAINS WATER AND MANY SOLUTES</li> </ul>
CELL MEMBRANE	<ul style="list-style-type: none"> <li>- HOLDS THE CELL TOGETHER</li> <li>- CONTROLS SUBSTANCES ENTERING AND LEAVING THE CELL</li> </ul>
CELL WALL	<ul style="list-style-type: none"> <li>- GIVES THE CELL EXTRA SUPPORT AND DEFINES ITS SHAPE</li> </ul>
CHLOROPLASTS	<ul style="list-style-type: none"> <li>- SITE OF PHOTOSYNTHESIS, PROVIDING FOOD FOR PLANTS</li> <li>- THE CHLOROPHYLL PIGMENTS ABSORB LIGHT ENERGY NEEDED FOR THE REACTION TO OCCUR</li> </ul>
VACUOLE	<ul style="list-style-type: none"> <li>- CONTAINS CELL SAP</li> <li>- USED FOR STORAGE OF CERTAIN MATERIALS</li> <li>- ALSO HELPS SUPPORT THE SHAPE OF THE CELL</li> </ul>



## 2 ORGANISATION OF THE ORGANISM

## 2.1 CELL STRUCTURE &amp; ORGANISATION cont...

YOUR NOTES



EXTENDED ONLY

## Functions

STRUCTURE	FUNCTION
MITOCHONDRIA	<ul style="list-style-type: none"><li>– SITE OF AEROBIC RESPIRATION, PROVIDING ENERGY FOR THE CELL</li><li>– CELLS WITH HIGH RATES OF METABOLISM (CARRYING OUT MANY DIFFERENT CELL REACTIONS) WILL HAVE SIGNIFICANTLY HIGHER NUMBERS OF MITOCHONDRIA THAN CELLS WITH LOWER NUMBERS OF REACTIONS TAKING PLACE IN THEM</li></ul>
RIBOSOMES	<ul style="list-style-type: none"><li>– SITE OF PROTEIN PRODUCTION IN PROTEIN SYNTHESIS</li></ul>
VESICLES	<ul style="list-style-type: none"><li>– USED TO SAFELY TRANSPORT SUBSTANCES FROM ONE PART OF THE CELL TO ANOTHER</li></ul>

## 2.2 SPECIALISED CELLS

## Adaptations of Specialised Cells

- Specialised cells are those which have **developed certain characteristics** in order to **perform particular functions**. These differences are controlled by genes in the nucleus
- Cells specialise by undergoing **differentiation**: this is a process by which cells develop the structure and characteristics needed to be able to carry out their functions



## 2 ORGANISATION OF THE ORGANISM

## 2.2 SPECIALISED CELLS cont...

YOUR NOTES



Examples of specialised cells in animals:

CELL	FUNCTION	ADAPTATIONS
CILIATED CELL	MOVEMENT OF MUCUS IN THE TRACHEA AND BRONCHI	<ul style="list-style-type: none"> <li>– EXTENSIONS OF THE CYTOPLASM AT THE SURFACE OF THE CELL FORM HAIR-LIKE STRUCTURES CALLED <b>CILIA</b> WHICH <b>BEAT TO MOVE MUCUS</b> AND TRAPPED PARTICLES UP TO THE THROAT</li> </ul>
NERVE CELL	CONDUCTION OF IMPULSES	<ul style="list-style-type: none"> <li>– <b>LONG</b> SO THAT NERVES CAN RUN TO AND FROM <b>DIFFERENT PARTS OF THE BODY</b> TO THE CENTRAL NERVOUS SYSTEM</li> <li>– THE CELL HAS <b>EXTENSIONS AND BRANCHES</b>, SO THAT IT CAN <b>COMMUNICATE</b> WITH OTHER NERVE CELLS, MUSCLES AND GLANDS</li> <li>– THE AXON (EXTENSION OF CYTOPLASM AWAY FROM THE CELL BODY) IS COVERED WITH A <b>FATTY SHEATH</b>, WHICH <b>INSULATES</b> THE NERVE CELL AND <b>SPEEDS UP</b> THE NERVE IMPULSE</li> </ul>
RED BLOOD CELL	TRANSPORT OF OXYGEN	<ul style="list-style-type: none"> <li>– <b>BICONCAVE DISC SHAPE INCREASES SURFACE AREA</b> FOR MORE EFFICIENT DIFFUSION OF OXYGEN</li> <li>– CONTAINS <b>HAEMOGLOBIN</b> WHICH <b>JOINS WITH OXYGEN</b> TO TRANSPORT IT</li> <li>– CONTAINS <b>NO NUCLEUS</b> TO <b>INCREASE AMOUNT OF SPACE</b> AVAILABLE FOR HAEMOGLOBIN INSIDE CELL</li> </ul>
SPERM CELL	REPRODUCTION	<ul style="list-style-type: none"> <li>– THE HEAD CONTAINS THE GENETIC MATERIAL FOR FERTILISATION IN A <b>HAPLOID NUCLEUS</b> (CONTAINING HALF THE NORMAL NUMBER OF CHROMOSOMES)</li> <li>– THE <b>ACROSOME</b> IN THE HEAD CONTAINS <b>DIGESTIVE ENZYMES</b> SO THAT A SPERM CAN PENETRATE AN EGG</li> <li>– THE MID-PIECE IS PACKED WITH <b>MITOCHONDRIA</b> TO RELEASE <b>ENERGY</b> NEEDED TO SWIM AND FERTILISE THE EGG</li> <li>– THE <b>TAIL</b> ENABLES THE SPERM TO <b>SWIM</b></li> </ul>
EGG CELL (OVUM)	REPRODUCTION	<ul style="list-style-type: none"> <li>– CONTAINS A LOT OF <b>CYTOPLASM</b> WHICH HAS <b>NUTRIENTS</b> FOR THE GROWTH OF THE EARLY EMBRYO</li> <li>– <b>HAPLOID NUCLEUS</b> CONTAINS THE GENETIC MATERIAL FOR FERTILISATION</li> <li>– CELL MEMBRANE <b>CHANGES AFTER FERTILISATION</b> BY A SINGLE SPERM SO THAT <b>NO MORE SPERM</b> CAN ENTER</li> </ul>



## 2 ORGANISATION OF THE ORGANISM

## 2.2 SPECIALISED CELLS cont...

YOUR NOTES



Examples of specialised cells in plants:

ROOT HAIR CELL	ABSORPTION OF WATER AND MINERAL IONS FROM SOIL	<ul style="list-style-type: none"> <li>- <b>ROOT HAIR INCREASES SURFACE AREA OF CELL TO ENSURE MAXIMUM ABSORPTION OF WATER AND MINERAL IONS</b></li> <li>- WALLS ARE <b>THIN</b> TO ENSURE WATER MOVES THROUGH <b>QUICKLY</b></li> <li>- NO CHLOROPLASTS PRESENT</li> </ul>
XYLEM VESSEL	CONDUCTION OF WATER THROUGH THE PLANT; SUPPORT OF THE PLANT	<ul style="list-style-type: none"> <li>- <b>NO TOP AND BOTTOM WALLS</b> BETWEEN XYLEM VESSELS, SO THERE IS A <b>CONTINUOUS COLUMN OF WATER</b> RUNNING THROUGH THEM</li> <li>- CELLS ARE <b>DEAD</b> WITHOUT ORGANELLES OR CYTOPLASM TO ALLOW <b>FREE PASSAGE OF WATER</b></li> <li>- THEIR WALLS BECOME <b>THICKENED</b> WITH A SUBSTANCE CALLED <b>LIGNIN</b> WHICH MEANS THEY ARE ABLE TO HELP <b>SUPPORT</b> THE PLANT</li> </ul>
PALISADE MESOPHYLL CELL	PHOTOSYNTHESIS	<ul style="list-style-type: none"> <li>- <b>COLUMN SHAPED</b> TO MAXIMIZE ABSORPTION OF SUNLIGHT AND <b>FIT AS MANY IN A LAYER</b> UNDER THE UPPER EPIDERMIS OF THE LEAF AS POSSIBLE</li> <li>- CONTAINS <b>MANY CHLOROPLASTS</b> FOR MAXIMUM PHOTOSYNTHESIS</li> </ul>

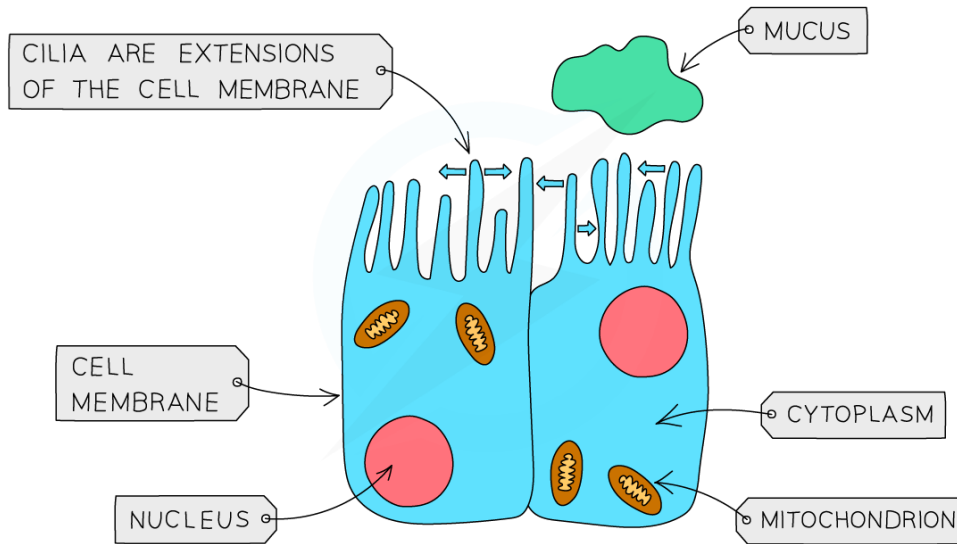
2 ORGANISATION OF THE ORGANISM

2.2 SPECIALISED CELLS cont...

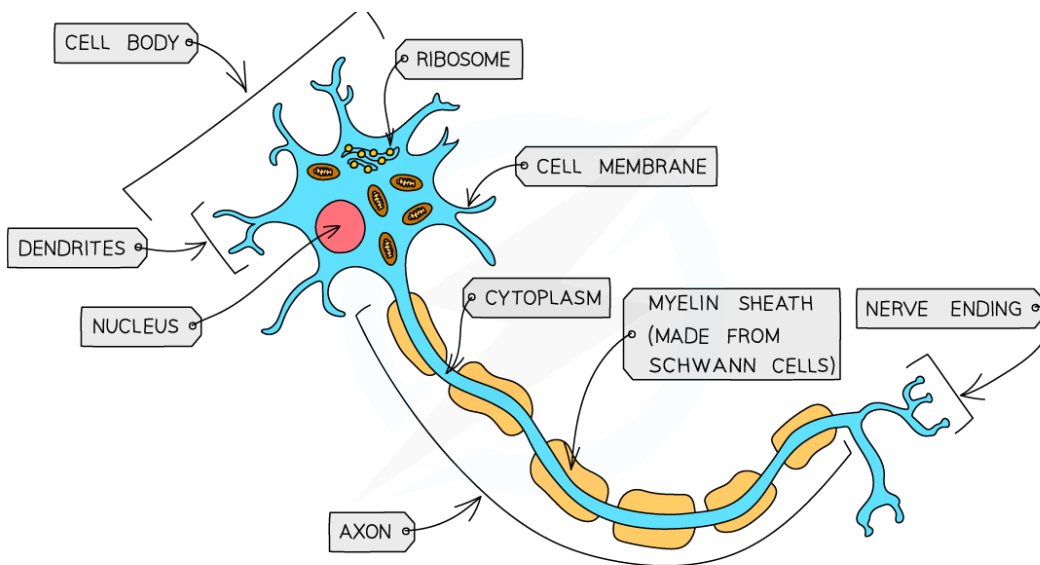
YOUR NOTES



Diagrams of specialised cells in animals:



Ciliated cell

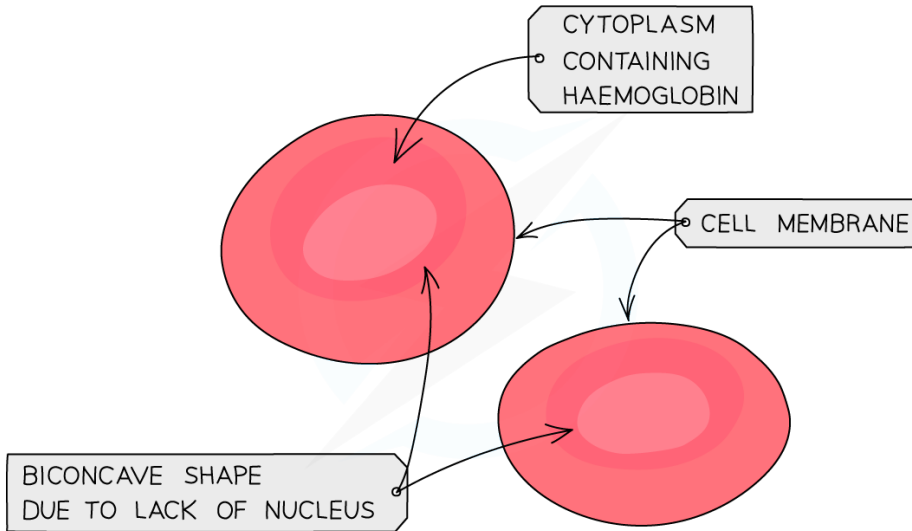


Nerve cell

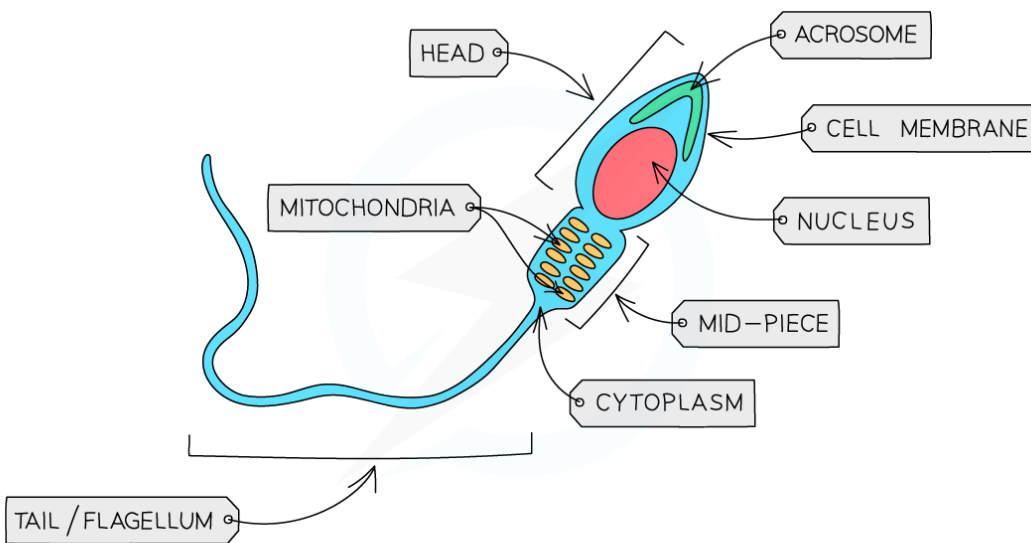
2 ORGANISATION OF THE ORGANISM

2.2 SPECIALISED CELLS cont...

YOUR NOTES



Red blood cell



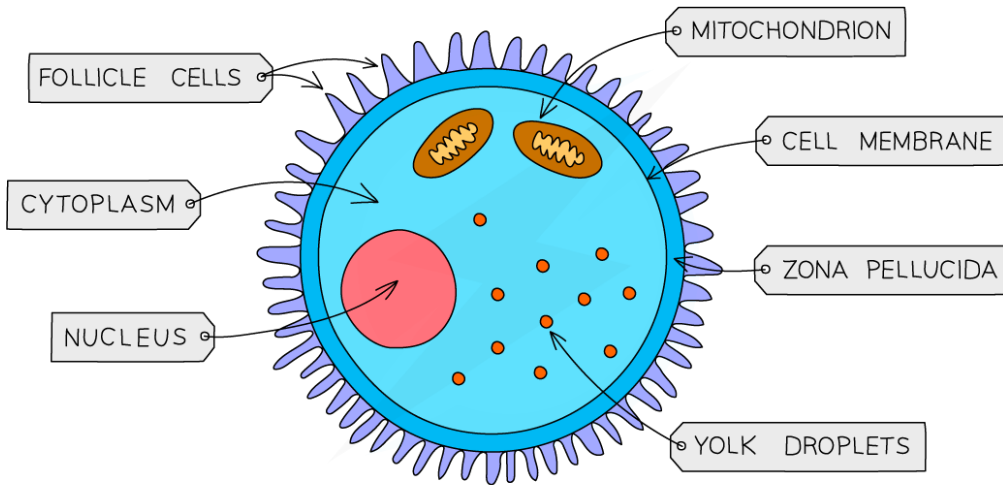
Sperm cell



2 ORGANISATION OF THE ORGANISM

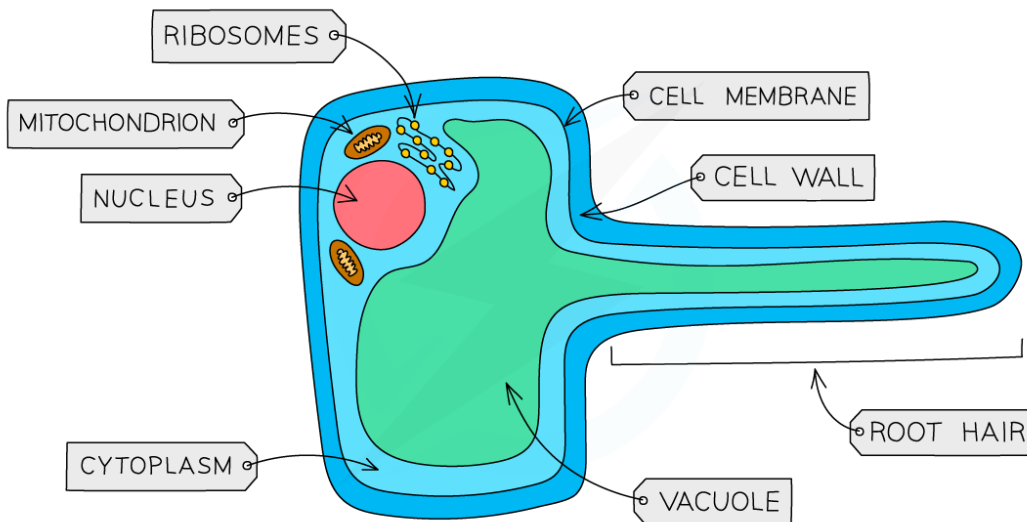
2.2 SPECIALISED CELLS cont...

YOUR NOTES



Egg cell

Diagrams of specialised cells in plants:

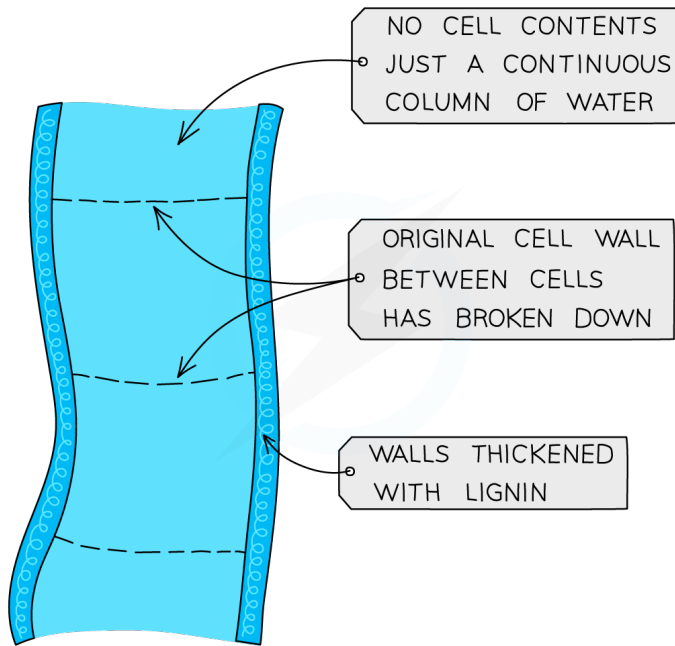


Root hair cell

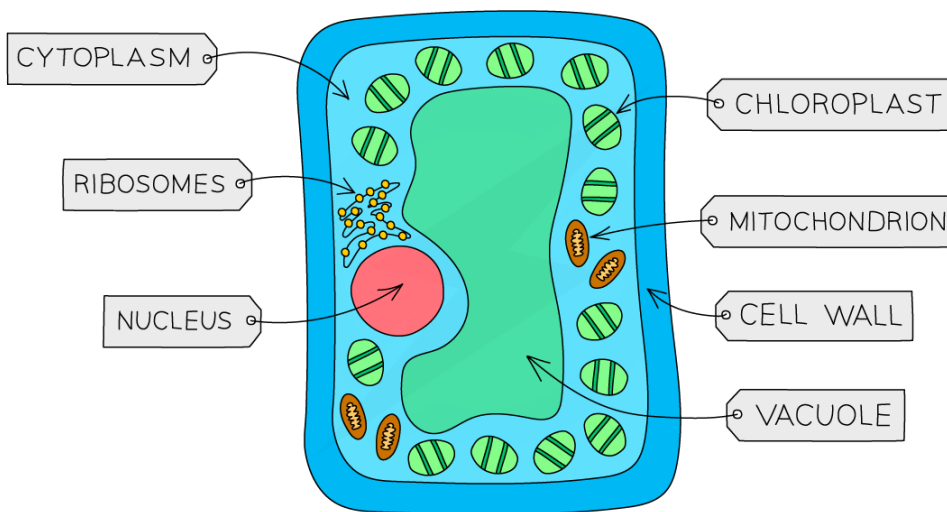
2 ORGANISATION OF THE ORGANISM

2.2 SPECIALISED CELLS cont...

YOUR NOTES



Xylem structure



Palisade mesophyll cell

2 ORGANISATION OF THE ORGANISM

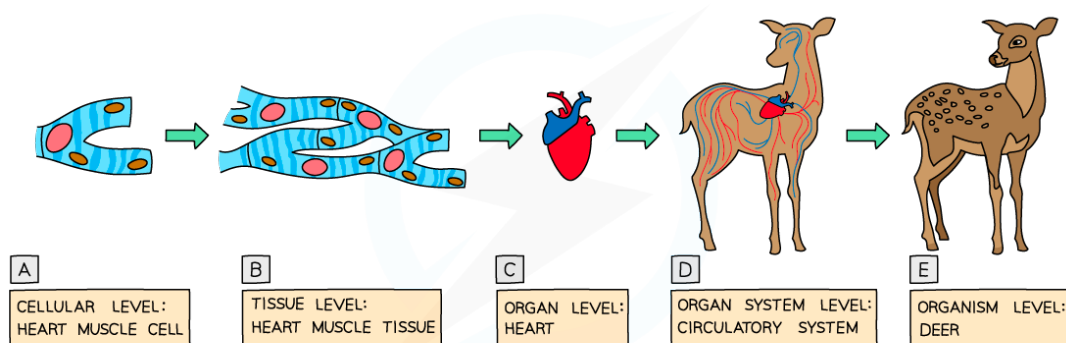
2.3 LEVELS OF ORGANISATION

Cells, Tissues, Organs & Organ Systems

YOUR NOTES



LEVEL	DESCRIPTION
CELLS	BASIC FUNCTIONAL AND STRUCTURAL UNITS IN A LIVING ORGANISM
TISSUES	GROUPS OF CELLS OF SIMILAR STRUCTURE WORKING TOGETHER TO PERFORM THE SAME FUNCTION
ORGANS	MADE FROM DIFFERENT TISSUES WORKING TOGETHER TO PERFORM SPECIFIC FUNCTIONS
ORGAN SYSTEMS	GROUPS OF ORGANS WITH RELATED FUNCTIONS, WORKING TOGETHER TO PERFORM BODY FUNCTIONS



Levels of organisation



EXAM TIP

Most incorrect answers here come from not being able to identify a tissue, so it's worth making sure you understand and remember that **tissues are always made up of only one type of cell.**



## 2 ORGANISATION OF THE ORGANISM

## 2.3 LEVELS OF ORGANISATION cont...

YOUR NOTES



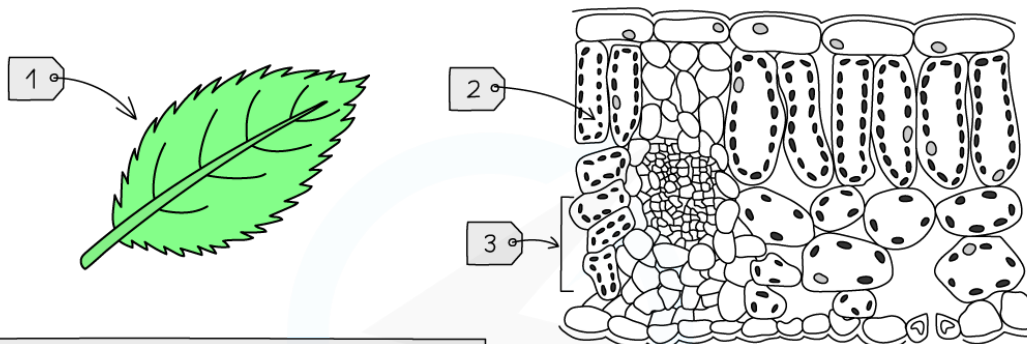
ORGAN SYSTEM	ORGANS	TISSUE EXAMPLES
SHOOT SYSTEM	LEAF, STEM, FLOWER, FRUIT	- EPIDERMIS - MESOPHYLL - XYLEM - PHLOEM
ROOT SYSTEM	ROOT, TUBER	- XYLEM - PHLOEM - GROUND TISSUE
DIGESTIVE SYSTEM	OESOPHAGUS, STOMACH, SMALL INTESTINE, LARGE INTESTINE	- MUSCLE - CONNECTIVE - NERVE - EPITHELIAL
CIRCULATORY SYSTEM	HEART, VEINS, ARTERIES	- MUSCLE - CONNECTIVE - NERVE - EPITHELIAL
IMMUNE SYSTEM	THYMUS, SPLEEN	- BONE MARROW
RESPIRATORY SYSTEM	TRACHEA, BRONCHI, LUNGS	- CONNECTIVE - MUSCLE - EPITHELIAL
EXCRETORY SYSTEM	LIVER, KIDNEY, SKIN, LUNGS	- MUSCLE - CONNECTIVE - EPITHELIAL - NERVE
NERVOUS SYSTEM	BRAIN, SPINAL CORD	- NERVE
REPRODUCTIVE SYSTEM	OVARY, CERVIX, UTERUS, VAGINA, TESTES, PENIS	- MUSCLE - CONNECTIVE - NERVOUS - ERECTILE

## 2 ORGANISATION OF THE ORGANISM

### 2.3 LEVELS OF ORGANISATION cont...

- Your syllabus states that you should be able to identify the different levels of organisation in drawings, diagrams and images of familiar material
- An example of this is shown in the exam question below

THE DIAGRAMS SHOW A LEAF AND ITS INTERNAL STRUCTURE



WHAT ARE THE LEVELS OF ORGANISATION OF THE LABELLED STRUCTURES?

	1	2	3
A	CELL	TISSUE	ORGAN SYSTEM
B	ORGAN	CELL	TISSUE
C	ORGAN SYSTEM	TISSUE	CELL
D	TISSUE	CELL	ORGAN

Typical levels of organisation question



#### EXTENDED EXAM TIP

Your syllabus requires you to identify the different levels of organisation in drawings, diagrams and images of **unfamiliar material**, ie structures you may not have seen before. In order to ensure the best chance of success, make sure you are very clear on the difference between a cell, a tissue and an organ and practise identifying these in past paper questions (they come up most frequently in the **multiple choice paper**).

YOUR NOTES





## 2 ORGANISATION OF THE ORGANISM

## 2.4 SIZE OF SPECIMENS

YOUR NOTES



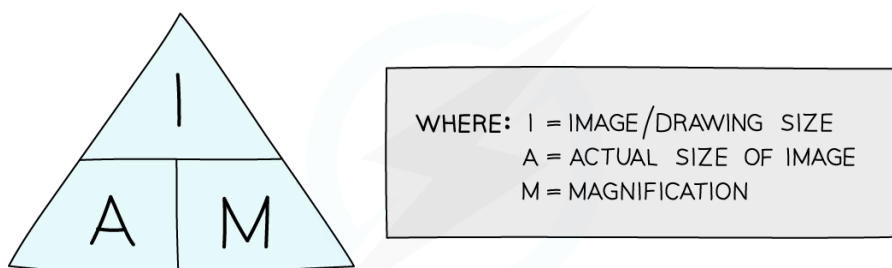
## Calculating Magnification &amp; Specimen Size: Basics

Calculating magnification and specimen size using millimetres as units

- Magnification is calculated using the following equation:

$$\text{MAGNIFICATION} = \frac{\text{IMAGE (DRAWING) SIZE}}{\text{ACTUAL SIZE}}$$

- A better way to remember the equation is using an **equation triangle**:



Magnification equation

- Rearranging the equation to find things other than the magnification becomes easy when you remember the triangle - **whatever you are trying to find, place your finger over it and whatever is left is what you do**, so:
  - Magnification = image size / actual size
  - Actual size = image size / magnification
  - Image size = magnification x actual size
- Remember magnification **does not have any units** and is just written as 'x 10' or 'x 5000'



## 2 ORGANISATION OF THE ORGANISM

YOUR NOTES

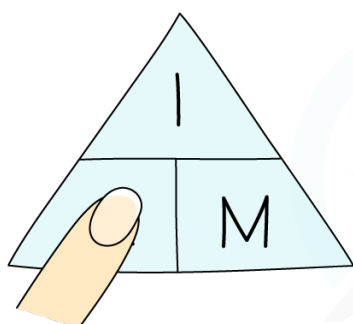


- Let's look at an example:

An **image** of an animal cell is 30 mm in size and it has been **magnified** by a factor of x 3000.

What is the **actual** size of the cell?

To find the **actual** size of the cell:



$$A = \frac{I}{M} = \frac{30 \text{ mm}}{3000} = 0.01 \text{ mm}$$
$$0.01 \text{ mm} = 10 \mu\text{m}$$

Worked example using the magnification equation



## EXAM TIP

This skill most frequently comes up in paper 5 and 6 (although it also comes up in the multiple choice and occasionally the theory paper) and you will **definitely** have to calculate either magnification, drawing size or actual size in a least one paper. To ensure you do not lose marks:

- Always look at the units** that have been given in the question - if you are asked to measure something, most often you will be expected to measure it in millimetres NOT in centimetres - double check the question to see!
- Learn the equation triangle** for magnification and write it on the page straight away
- Don't forget that **magnification has NO UNITS** - students often lose a mark because they put one in



## 2 ORGANISATION OF THE ORGANISM

## 2.4 SIZE OF SPECIMENS cont...

YOUR NOTES



EXTENDED ONLY

## Calculating Magnification &amp; Size of Specimens

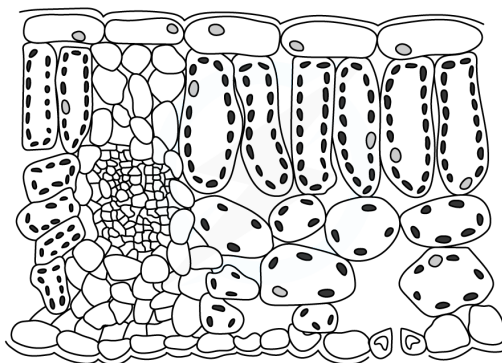
## Using millimetres and micrometres as units

- The table below shows how millimetres are related to two other measures of length

UNIT	LENGTH IN mm
1 CENTIMETRE (cm)	10 mm
1 MILLIMETRE (mm)	1 mm
1 MICROMETRE (μm)	0.001 mm

- What this basically means is that **1mm = 1000μm** and **1cm = 10,000μm**
- This usually comes up in questions where you have **two different units** and you need to ensure that you **convert them both into the same unit** before proceeding with the calculation
- For example:

THE ACTUAL THICKNESS OF THE LEAF BELOW IS 2000μm, BUT THE IMAGE SIZE OF THE LEAF IN THE DIAGRAM IS 50mm



WHAT IS THE MAGNIFICATION OF THE DIAGRAM?  
 A x0.025   **B x25**   C x100   D x100 000

Example extended magnification question





## 2 ORGANISATION OF THE ORGANISM

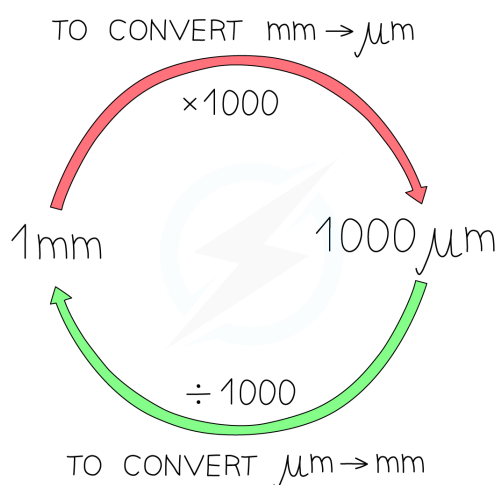
YOUR NOTES



## EXTENDED ONLY cont...

- Remember  $1\text{mm} = 1000\mu\text{m}$
- $2000 / 1000 = 2$  so the actual thickness of the leaf is 2mm and the drawing thickness is 50mm
- Magnification = image size / actual size =  $50 / 2 = 25$
- So the magnification is  $\times 25$  (NO UNITS)

The following diagram may help with unit conversion between mm and  $\mu\text{m}$ :



Converting units



## EXAM TIP

If you are given a question with **two different units** in it, make sure you **convert them to the same unit** before doing your calculation.

If you don't, there is a good chance that your answer will be the same as one of the incorrect options in a multiple choice question so you may think you got it right when, in fact, you haven't!

> NOW TRY SOME EXAM QUESTIONS



## 2 ORGANISATION OF THE ORGANISM

## EXAM QUESTIONS

YOUR NOTES

**? QUESTION 1**

Which row of the table below correctly matches functions to some of the components in a root hair cell?

	cell wall	cell membrane	mitochondria
A	support	active transport	energy release
B	energy release	active transport	nutrition
C	support	active transport	nutrition
D	active transport	support	energy release

**? QUESTION 2**

Which of the following orders would be correct showing the size of structures from biggest to smallest?

- A chromosome → red blood cell → stomach → gene → nucleus
- B stomach → red blood cell → gene → chromosome
- C stomach → red blood cell → nucleus → chromosome → gene
- D gene → chromosome → red blood cell → stomach

**? QUESTION 3**

A list of subcellular structures is given below.

- 1 Nucleus
- 2 Ribosomes
- 3 Vacuole
- 4 Chloroplast

A plant cell and an animal cell are observed under a light microscope.

Which of the above structures would always be visible in a plant cell?

- A 1, 2 & 4    B 1, 3 & 4    C 1 & 3 only    D 1 & 4 only



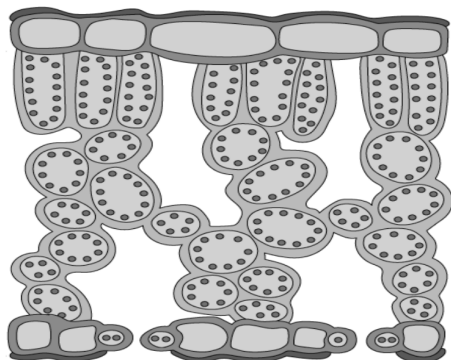
## 2 ORGANISATION OF THE ORGANISM

## EXAM QUESTIONS cont...

YOUR NOTES

**? QUESTION 4**

Some of the processes carried out by living organisms are illustrated in the diagram below.



What would be the correct magnification of the image?

- A x 5
- B x 184
- C x 0.184
- D x 500

**? QUESTION 5**

Which of the following terms would be correct to describe a leaf, a root and stem?

- A Cell
- B Tissue
- C Organ
- D Organ system

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