

JURONG WEST SECONDARY SCHOOL
SECONDARY THREE – SCIENCE BIOLOGY
Chapter 1: CELLS

Learning Outcomes:

Candidates should be able to:

(a) **identify (label)** and **state the functions** of the following cell structures (including organelles) of typical plant and animal cells from diagrams, light micrographs and as seen under the **light microscope** using prepared slides and fresh material treated with an appropriate temporary staining technique:

- cell wall
- cell membrane
- cytoplasm
- nucleus
- cell vacuoles (large, sap-filled in plant cells, small, temporary in animal cells)
- chloroplasts

(b) **identify** and **state the functions** of the following organelles from diagrams and electron micrographs:

- mitochondria
- ribosomes

(c) **compare** the structure of typical animal and plant cells

(d) **explain** how the structures of specialised cells are **adapted to their functions** (e.g. **muscle cell** – many mitochondria to supply more energy, **root hair cell** – large surface area of cell membrane for greater absorption, **red blood cell** – lack of nucleus allowing it to transport more oxygen)

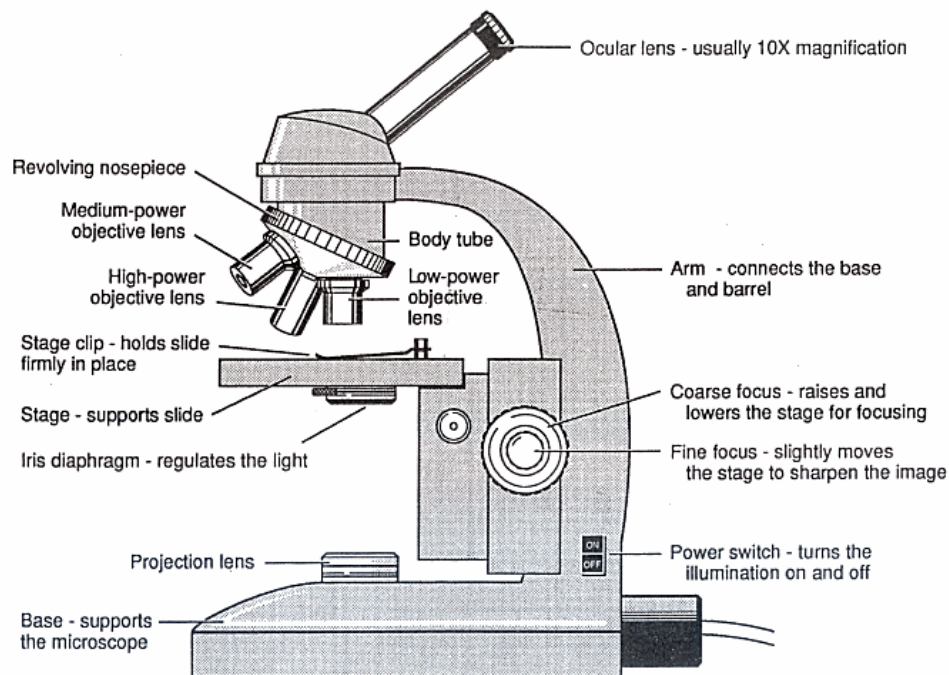
RECAP:

1. A cell is a unit of life.
2. All organisms are composed of one or more cells.
3. Each living cell consists of living material called **protoplasm**.
 - a. Protoplasm of a cell is made up of three parts: cell surface membrane, cytoplasm and nucleus.

4. Most cells are too small to be seen with our eyes. We use light or electron microscopes to help us see the cells.

a. Light Microscope

- Colour image
- Magnification ~ x600



<http://moziru.com/images/light-microscopy-clipart-labeled-11.gif>

b. Magnification

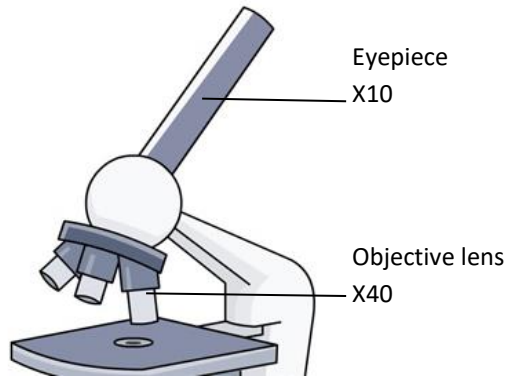
- One crucial parameter that all microscopes depends on is its magnification.
- Magnification is the extend to which an object is enlarged.
- Calculation of magnification
 - Magnification can be claculated in two ways and should be recorded as ONE decimal place.
 1. Magnification provided by a light microscope can be calculated as:

$$\text{Magnification} = \text{magnification of eyepiece lens} \times \text{magnification of objective lens}$$
 2. Magnification undergone by the specimen to produce the image/drawing can be calculated as:

$$\text{Magnification} = \frac{\text{Size of drawing (mm)}}{\text{actual size of specimen (mm)}}$$

worked Example 1

a. What is the total magnification provided by a light microscope?

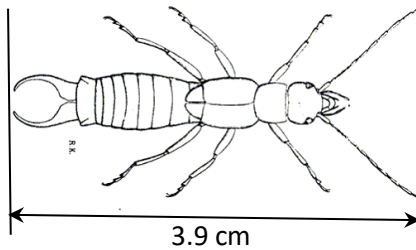


*Magnification =
magnification of eyepiece lens X
magnification of objective lens
(Substitute known values into equation)*

=

=

b.



The actual length of the ant is 0.9cm.
Calculate the magnification of the
drawings.

*Magnification =
Size of drawing (mm) / actual size of
specimen (mm)
(Substitute known values into equation)*

c. Electron Microscope

- Black and white image
- Magnification ~ x500 000

(a) identify and state the functions of the following cell structures (including organelles) of typical plant and animal cells from diagrams, light micrographs and as seen under the light microscope using prepared slides and fresh material treated with an appropriate temporary staining technique:

- cell wall
- cell membrane
- cytoplasm
- nucleus
- cell vacuoles (large, sap-filled in plant cells, small, temporary in animal cells)
- chloroplasts

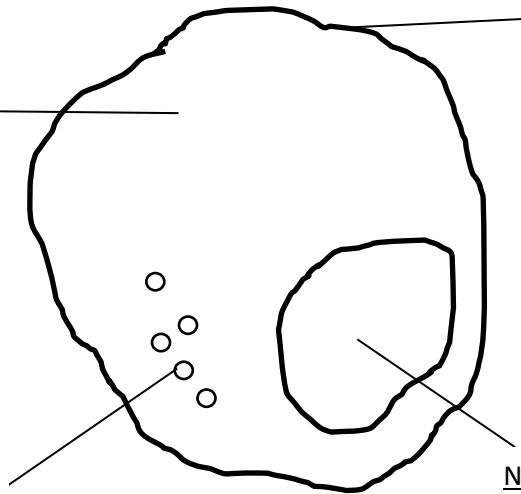
ANIMAL CELL - DIAGRAM

Cytoplasm

- Part of the protoplasm
- Function:
 - Contains specialised cell structures called **organelles** such as **mitochondria** and **ribosomes**.
 - **Site where most cell activities occur.** (Function)

Vacuole

- Numerous, small, temporary
- Function:
 - Stores **water** and **nutrients**



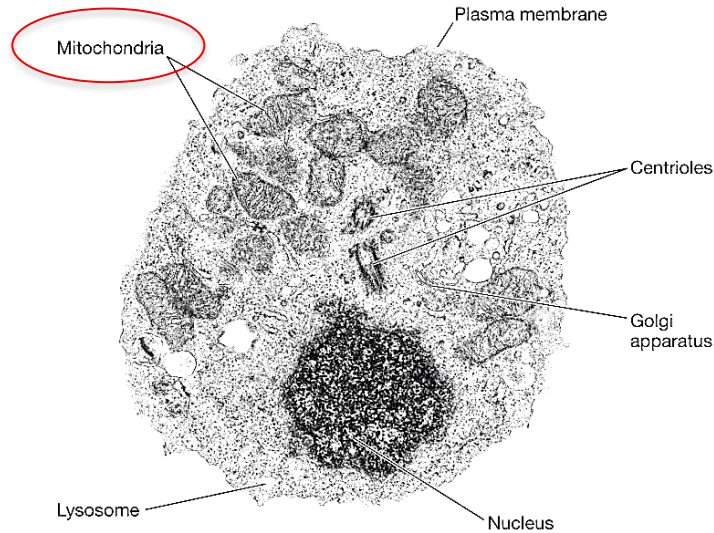
Cell surface membrane

- Also known as plasma membrane
- Is made up of lipids (**fats**) and proteins
- Is partially permeable
- **Allows only some substances to pass through**
 - Some examples are **glucose**, **water**, minerals etc (**small substances**)
- **Function:**
 - Control substances entering or leaving the cell.

Nucleus

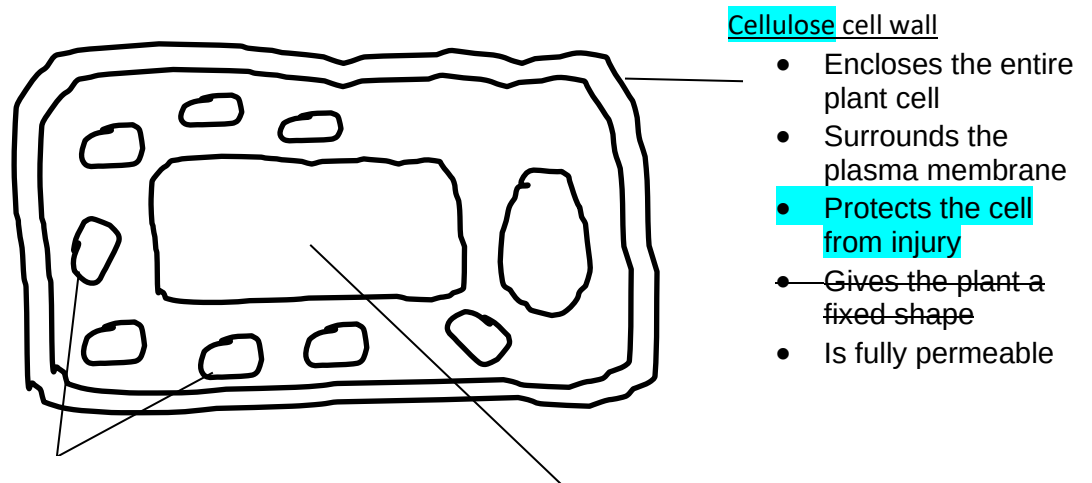
- Contains **nucleolus** and **chromatin** (**made of DNA**)
- Surrounded by the membrane called the nuclear envelope.
- **Function:**
 - Controls **cell activities** such as **cell growth**, **cell division** and **repair of worn-out parts**.
 - Contains **DNA** which stores **genetic information**.

ANIMAL CELL - PHOTOMICROGRAPH



<http://innolearn.weebly.com/uploads/2/5/9/3/25936499/166866785.jpg>

PLANT CELL - DIAGRAM



Cellulose cell wall

- Encloses the entire plant cell
- Surrounds the plasma membrane
- Protects the cell from injury
- Gives the plant a fixed shape
- Is fully permeable

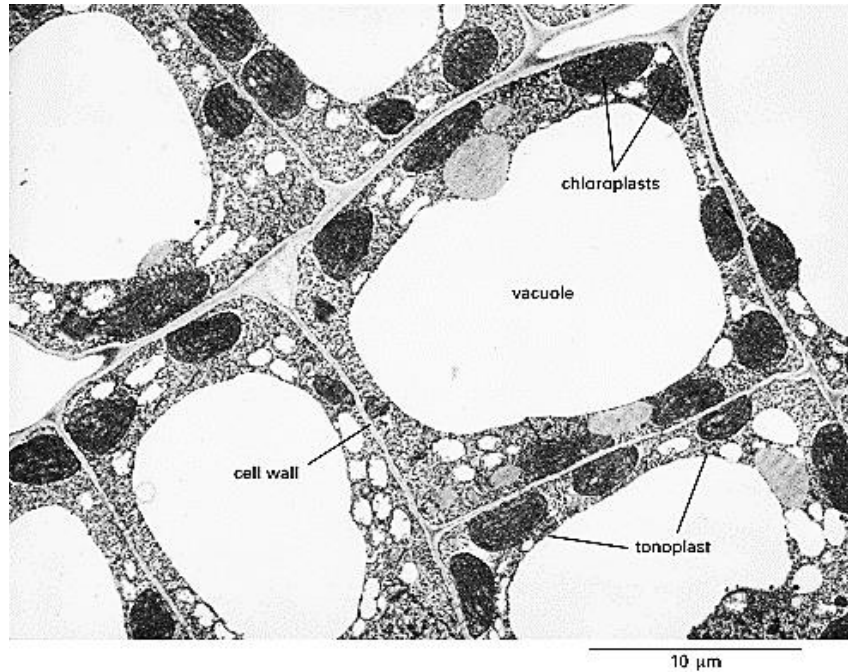
Chloroplast

- Oval structures
- Site (place) for photosynthesis
- Contain green pigment called chlorophyll essential for photosynthesis
- Chlorophyll traps light energy and is converted to chemical energy. This occurs in the presence of water and carbon dioxide, and produces glucose and oxygen.

Large Central Vacuole/ Sap Vacuole

- Contains a liquid called cell sap
- cell sap contains dissolved substances such as sugars, minerals salts and amino acids
- enclosed by a partially permeable membrane called tonoplast

PLANT CELL - PHOTOMICROGRAPH

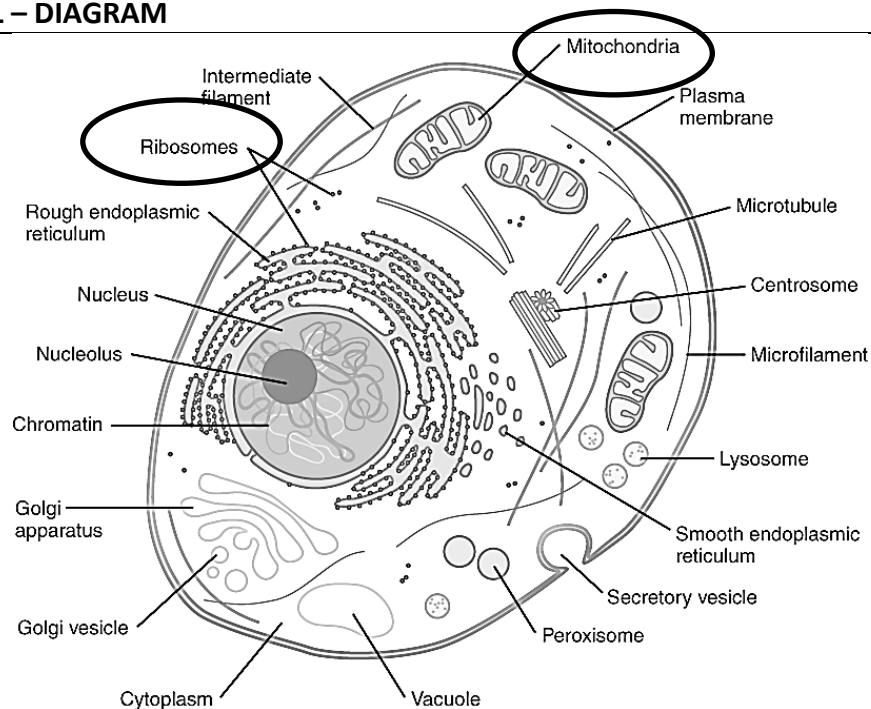


<http://middletownhighschool.wikispaces.com/file/view/ch13f20.jpg/173915407/ch13f20.jpg>

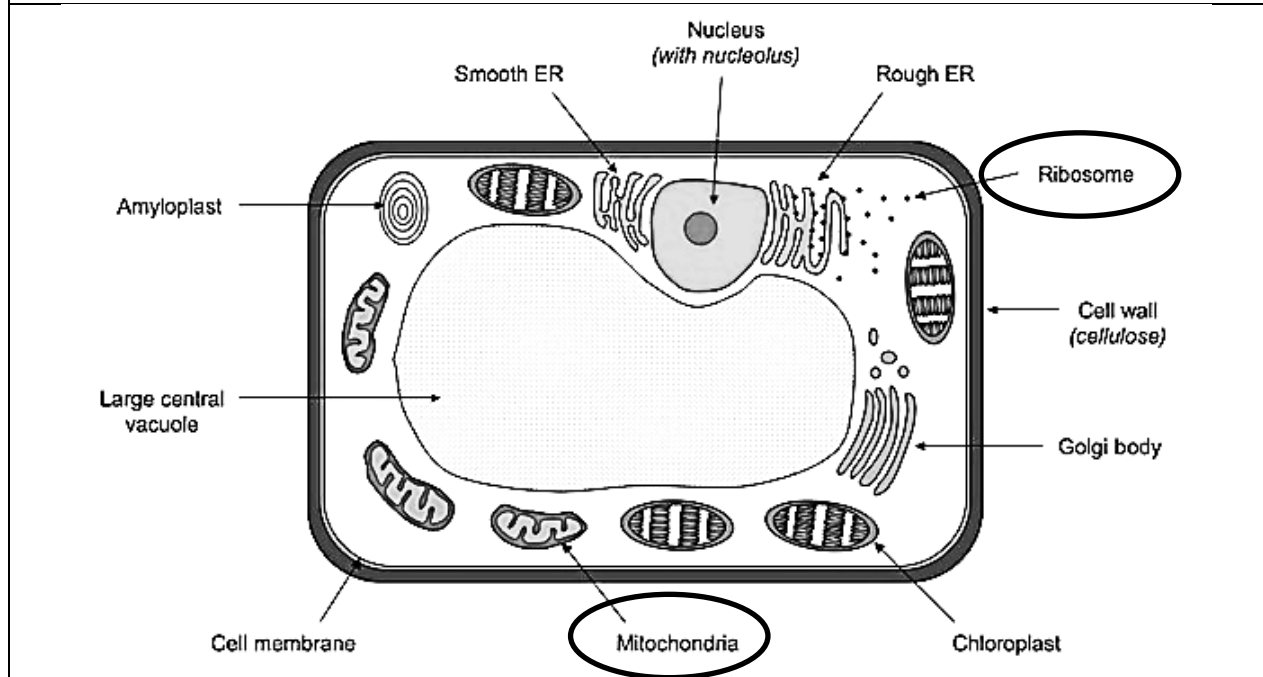
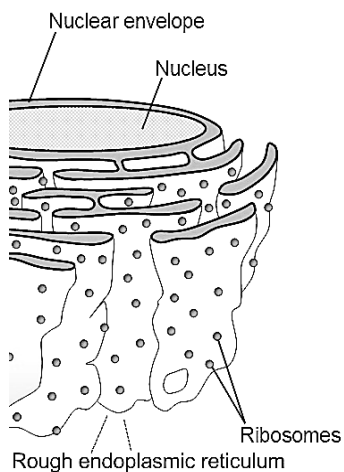
(b) **identify** and state the **functions** of the following organelles from diagrams and electron micrographs:

- **mitochondria**
- **ribosomes**

ANIMAL CELL – DIAGRAM

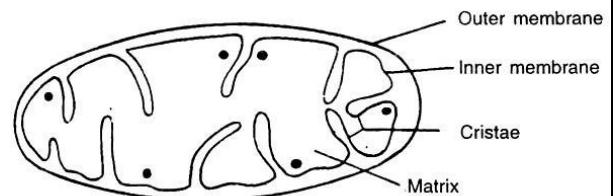


https://upload.wikimedia.org/wikipedia/commons/0/0d/0312_Animal_Cell_and_Components.jpg

PLANT CELL - DIAGRAM**RIBOSOMES**

https://biologyofcells2011.weebly.com/uploads/8/9/4/4/8944187/7010596_orig.jpg

- Small round structures either (1) attached to membrane of the endoplasmic reticulum (ER) OR (2) lie freely in the cytoplasm or mitochondria
- **Function:**
 - Needed for the synthesis (make) of protein in the cell
- Ribosomes attached to ER makes proteins that are transported out of the cell

MITOCHONDRIA

http://cdn.biologydiscussion.com/wp-content/uploads/2016/07/clip_image007-20.jpg

- Small oval or sausage shaped organelles
- **Function:**
 - Aerobic respiration occurs in the mitochondria
 - During respiration, glucose is oxidised to release energy used to perform cell activities such as growth and reproduction

DON'T WRITE PRODUCE ENERGY

- Ribosomes that lie freely make proteins that are **used in** the cell

Functions of the various organelles:



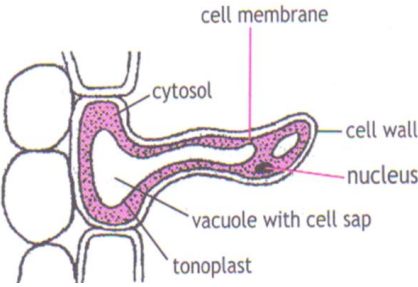
No	Organelle	Functions
1	Chloroplast	• Site (place) for photosynthesis • Contain green pigment called chlorophyll essential for photosynthesis
2	Cell surface membrane	• Control substances entering or leaving the cell.
3	Cellulose cell wall	• Protects the cell from injury • Gives the plant a fixed shape
4	Cytoplasm	• Contains specialised cell structures called organelles such as mitochondria and ribosomes. • Site where most cell activities occur.
5	Vacuole	• Stores water and nutrients (Animal) • Contains a liquid called cell sap which contains dissolved substances such as sugars, minerals salts and amino acids (Plant)
6	Nucleus	• Controls cell activities such as cell growth, cell division and repair of worn-out parts. • Contains DNA which stores genetic information.
7	Mitochondria	• Aerobic respiration occurs in the mitochondria • During respiration, glucose is oxidised to release energy used to perform cell activities such as growth and reproduction
8	Ribosome	a) Needed for the synthesis of protein in the cell

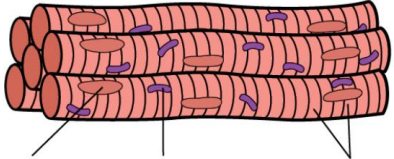
(c) compare the structure of typical animal and plant cells

ANIMAL CELL	SIMILARITIES	PLANT CELL
Both have a nucleus, cytoplasm, plasma membrane, mitochondria, endoplasmic reticulum and ribosomes		
ANIMAL CELL	DIFFERENCES	PLANT CELL
Does not have a fixed shape	SHAPE	Has a fixed shape
Does not have a cell wall	CELL WALL	Has a cell wall
Has numerous small vacuoles	VACUOLES	Has a large central vacuole containing cell sap
<i>Does not have chloroplasts</i>	CHLOROPLAST	<i>Has chloroplasts</i>
Stores food as glycogen	FOOD STORAGE	Stores food as starch
Has centrioles	CENTRIOLES	Does not have centrioles

Centrioles: help with cell division.

(d) **explain how** the structures of specialised cells are **adapted (structure)** to their **functions** (e.g. **muscle cell** – many mitochondria to supply more energy, **root hair cell** – large surface area of cell membrane for greater absorption, **red blood cell** – lack of nucleus allowing it to transport more oxygen)

SPECIALISED CELL	CELL STRUCTURE	CELL FUNCTIONS
<u>Root Hair Cell</u> 	a) Numerous root hair cells b) Long and narrow protrusion c) Large sap vacuole contains sugars, amino acids and salts. d) Contains many mitochondria.	a) To absorb water faster. b) This increases surface area to volume ratio of the cell so that water and mineral salts can be absorbed at a faster rate. c) Cell sap has a lower water potential than the soil. Water can then enter the root hair by osmosis. d) Aerobic respiration in mitochondria releases energy for active transport of ions / mineral salts into the cell.
<u>Red blood cells (RBC)</u> 	a) Contains the pigment haemoglobin. (red) b) It is circular, flattened biconcave disc. c) It does not possess a nucleus. d) <i>*It is elastic and can turn into a bell shape (note that this is not a good answer for SAF questions, and will not be accepted)</i>	a) Haemoglobin binds reversibly with oxygen to enable RBC to transport oxygen from the lungs to all cells in the body. b) This increase surface area to volume ratio to absorb and release oxygen at a faster rate. c) It is to carry more haemoglobin and THEREFORE more oxygen. d) <i>*This ensures it is able to squeeze through blood vessels smaller than itself in diameter.</i>

<u>Muscle cell</u>  nucleus mitochondrion protein fibres Function: Muscle cells are responsible for all the movement in your body	a) Contains many nuclei and mitochondria	a) Aerobic respiration in mitochondria releases large amount of energy for contraction of muscle cells.
---	--	--

FOR YOUR INFORMATION:

Cell	Basic structural and functional unit of a living organism	Example: RBC, xylem vessels, root hair cells, liver cells, nerve cells, phloem cells, skin cells, guard cells
Tissue	A group of cells with similar structures which work together to perform a specific function	Example: - muscular tissue – muscle cells - epithelial tissue (Skin) – skin cells - epidermis tissue – epidermal cells - mesophyll tissue – spongy mesophyll and palisade mesophyll cells blood - RBC, WBC, plasma and platelets - xylem tissues – xylem vessels and dead cells - phloem tissues – sieve tubes and companion cells
Organs	An organ contains more than one type of tissue, all working together for a specific function	Example: Stomach – Gland tissues (secrete gastric juice), muscular tissues (contract and relax to churn/mix the food), nervous tissues Leaf – Mesophyll tissues, xylem tissues, phloem tissues
Organ system	Consists of several organs working together for a common purpose	Example: Circulatory system Digestive system Skeletal system 