

Chapter 1

- CELL STRUCTURE AND ORGANISATION -

1.1 What are cells?

- made up of living things (billions of cells in living things)
- building blocks of life
- simplest structural & functional units of life

A cell takes raw materials, processes them to make molecules, which can be used by the cell or be transported to other parts of the body.

A cell can be studied with:

- light microscopes;
 - ↳ up to 1000x
 - ↳ light micrographs are formed (colour)
- electron microscopes;
 - ↳ magnify up to 200 000x
 - ↳ electron micrographs are formed (black and white, can be artificially coloured)

To get a clearer picture of the cells, ~~these~~^{we} may cut up/make a section of a cell at different planes;

→ longitudinal section (L.S.)

↳ cut along the length of the cell

→ transverse section

↳ cut across the length of the cell

A cell consists of a mass of living matter called protoplasm.

Protoplasm is a jelly-like substance, many chemical activities that allow the cell to survive and grow are carried out in the protoplasm.

Protoplasm refers to all living matter in the cell.

The protoplasm is made out of the:

→ cell membrane (cell surface membrane)

→ cytoplasm

→ nucleus

→ cell membrane

protoplasm is a mass of living matter.
→ cell wall is not a part of the protoplasm

cell membrane:

- surrounds the cytoplasm of the cell
- made up of lipids and proteins

1. selectively

small and soluble

- partially permeable membrane, only allows some substances to pass through
- controls the movement of substances in and out of the cell, part of protoplasm

cell wall:

- the plant cells also have a cell wall that encloses the entire cell
- made of cellulose/fibre

- protects the cell from injury, gives it a fixed shape

- fully permeable

- absent in animal cells

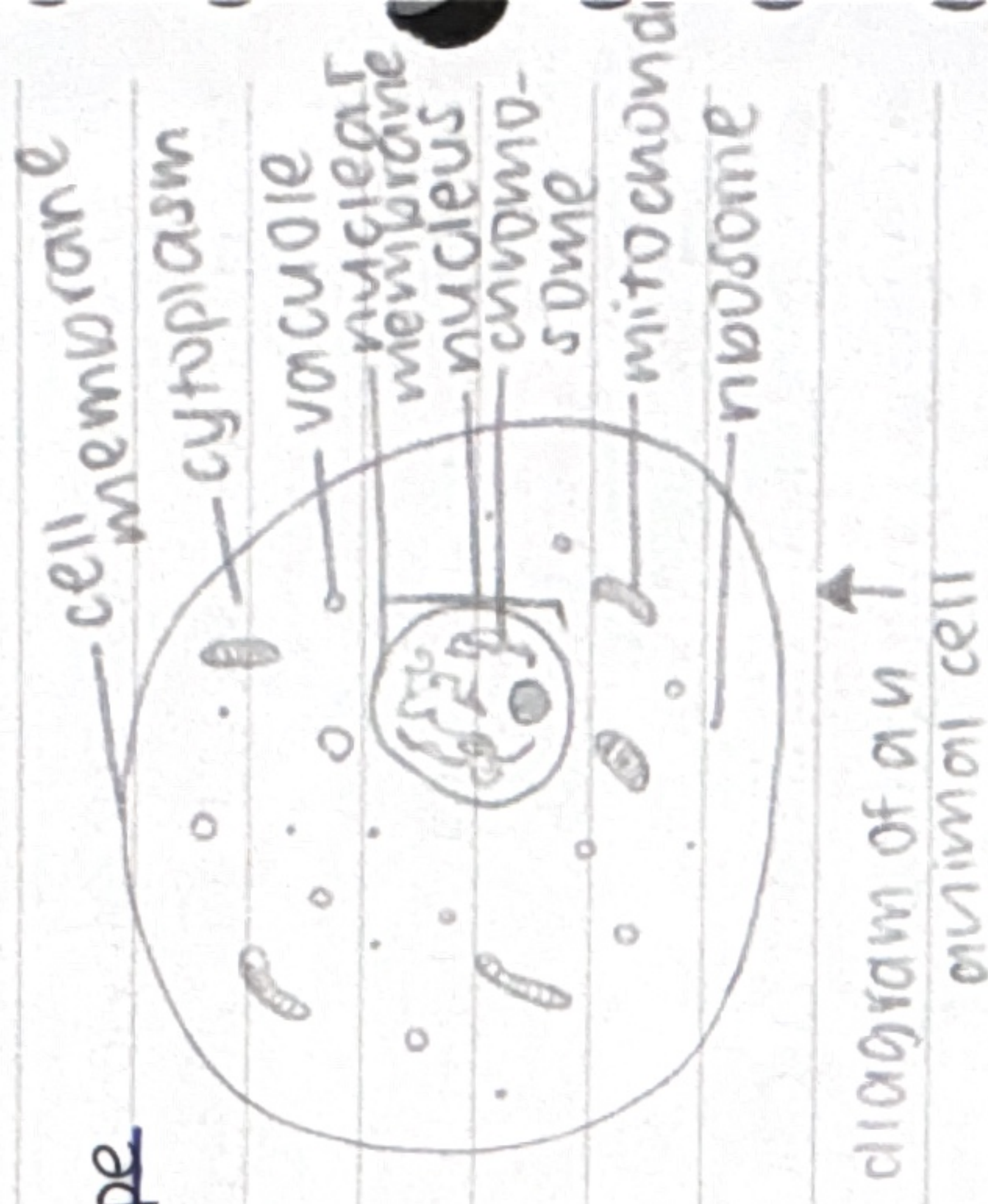
Cytoplasm

- jelly like substance, enclosed by the cell membrane

- part of the protoplasm

- where most of the cellular activities occur

- contains organelles.



(the organelle is a cellular structure that performs a specific type of job.)

Parts of the cytoplasm:

- NUCLEUS

- Rough endoplasmic reticulum (RER)

- Ribosomes

- Smooth endoplasmic reticulum (SER)

- Golgi body

- Mitochondria

- Chloroplasts

- Vacuoles

→

Each of these parts in the cytoplasm is called organelles. They can only be seen with an electron microscope.

NUCLEUS:

- surrounded by the nuclear membrane
- contains genetic information in the form of chromosomes.

FUNCTIONS OF A NUCLEUS:

- controls cell activities, e.g. repairs worn-out parts, cell growth etc.
- essential for cell division.

to see the individual parts of the nucleus, an electron microscope must be used.

PARTS OF THE NUCLEUS:

- chromosomes
- nuclear membrane

Nuclear membrane;

- function: separates the contents of the nucleus from the rest of the cytoplasm

Chromosomes:

- a long thread-like structure found within the nucleus
- a human ^{cell} has 46 chromosomes
- ~~each~~ made up of proteins and a compound called deoxyribonucleic acid (DNA)
 - ↳ hereditary information is stored in DNA
 - ↳ DNA carries instructions that a cell needs for carrying out its activities
- during cell division, the chromosomes condense and become thick, rod-shaped, shorter structures.

ROUGH ENDOPLASMIC RETICULUM (RER)

- consists of a network of flattened spaces lined with a membrane
- surface appears rough under an electron microscope due to the ribosomes attached to its outer surface
- outer surface of RER is ~~at~~ continuous with the nuclear membrane

FUNCTION:

- to produce proteins for the rest of the cell to function with the help of ribosomes.
- to transport proteins made by ribosomes to the golgi body for secretion out of the cell.

Ribosomes:

- small and round structures
- either attached to the outer surface of the RER or lying freely in the cytoplasm.

Functions:

- needed to synthesise proteins in the cell
- ↳ ribosomes attached to the RER make proteins that are usually transported out of the cell

- ↳ ribosomes lying freely in the cell/cytoplasm make proteins that are used within the cytoplasm of the cell.

Synthesis:
the process of building compounds from more elementary substances by means of one or more chemical reactions.

Smooth endoplasmic reticulum (SER)

- does not have ribosomes attached to the outer surface
- SER is more tubular than the RER

Functions:

- SER synthesises substances such as fats and steroids (sex hormones in mammals)
- converts harmful substances into harmless substance through detoxification.

Golgi body (golgi apparatus):

- shaped like a disc.
- consists of a stack of flattened spaces surrounded by ~~ves~~ membranes, called vesicles.
- vesicles can be seen fusing w one side of the golgi body and pinching off from the opposite side.

Functions:

- chemically modifies substances made by the ER
- stores & packages the substances in vesicles for ~~the~~ secretion out of the cell.

How substances made by the endoplasmic reticulum (ER) enter the golgi body & are secreted out of the cell:

1. vesicles transport substances within the ~~cell~~ cell. small vesicles containing substances made by ER are pinched off from the ER.
2. the vesicles then fuse with the golgi body and releases its contents into it. substances made by ER get modified in the golgi body.
3. secretory vesicles containing the modified substances are pinched off from the golgi body. They move to the cell membrane.
4. secretory vesicles fuse w the cell membrane & its contents are released out of the cell.

Mitochondria:

→ small oval, sausage shaped organelles

Function:

- carry out aerobic respiration (it occurs in the mitochondria)
- During aerobic respiration, food substances are broken down to release energy, which is used to perform cell activities such as growth and reproduction.

Chloroplasts:

→ oval structures found in plant cells

→ contain a green pigment called chlorophyll.

Function:

- chloroplasts are essential for photosynthesis, as chlorophyll is present in chloroplasts. Photosynthesis allows plants to make food (produce glucose) for respiration.

chlorophyll → protoplasm,
not organelle
chloroplast → both
protoplasm & organelle

Vacuole:

→ fluid-filled space enclosed by a partially permeable membrane,

function:

→ stores substances within the cell.

→ Plant cells: they have a large central vacuole that contains a liquid called sap. Cell sap contains sugars, mineral salts and amino acids.

→ Animal cells: they have many small vacuoles that contain water and food substances, and the vacuoles exist temporarily.

Differences between plant and animal cells:

Plant cells:	Animal cells:
cell wall	no cell wall
large central vacuole	small vacuoles
chloroplasts	no chloroplasts.

1.2 How are cells adapted to their functions?

→ different cells carry out different functions. Hence, they develop special functions or use certain structures to carry out those functions. This is called differentiation.

Differentiation: the process by which a cell becomes specialised for a certain / specific function.

Examples:

Red blood cell:

- thinner ~~the~~ central portion
- ~~the~~ cytoplasm containing haemoglobin
- no nucleus.
- biconcave shape.

Adaptation to function:

- contains haemoglobin which binds O_2 and transports it around the body.
- has a circular, biconcave shape which increases the surface area to volume ratio so that O_2 can diffuse in and out at a faster rate.
- lacks a nucleus, enabling the cell to store more haemoglobin for the transport of O_2 .
- flexible, can squeeze through capillaries easily.

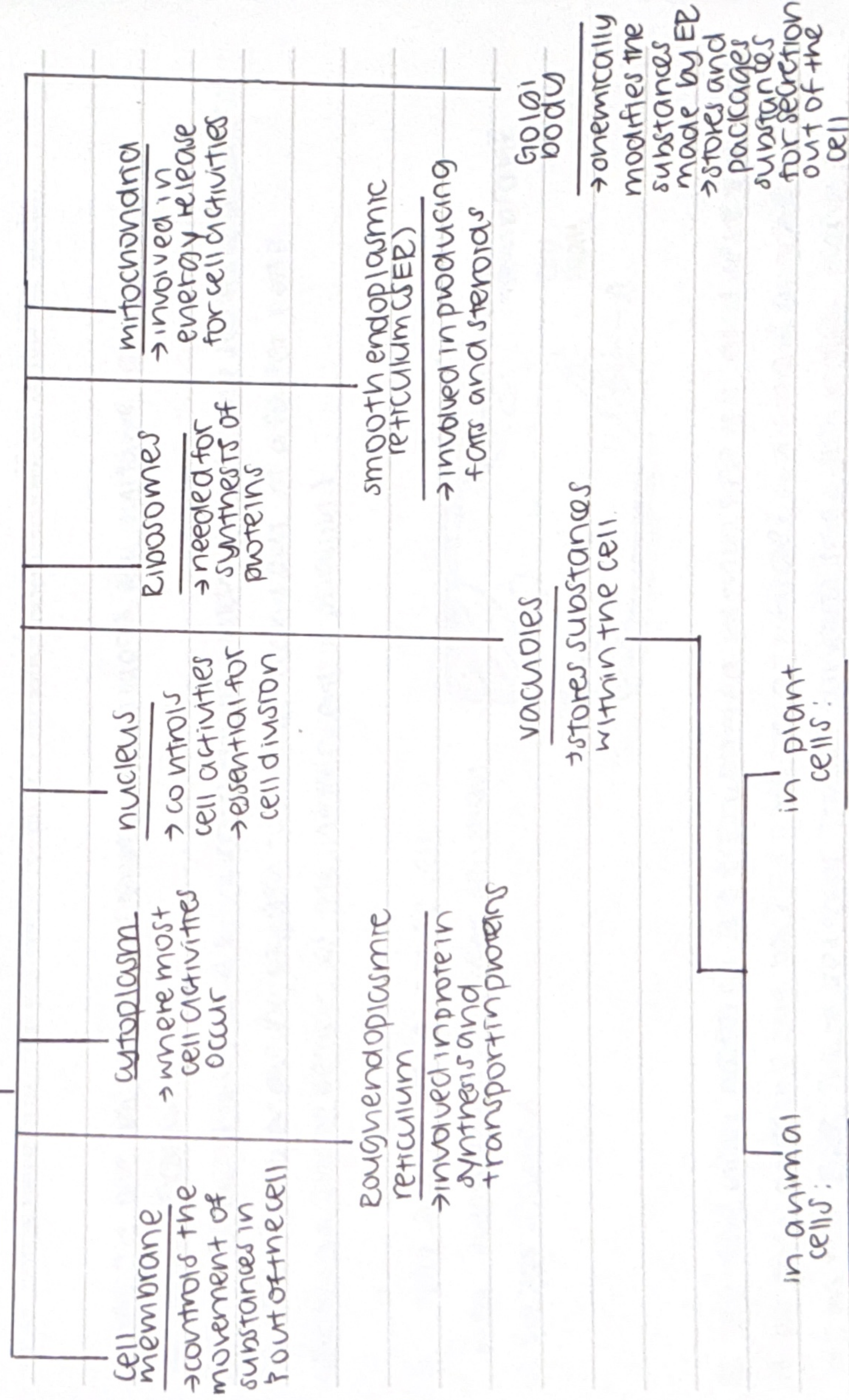
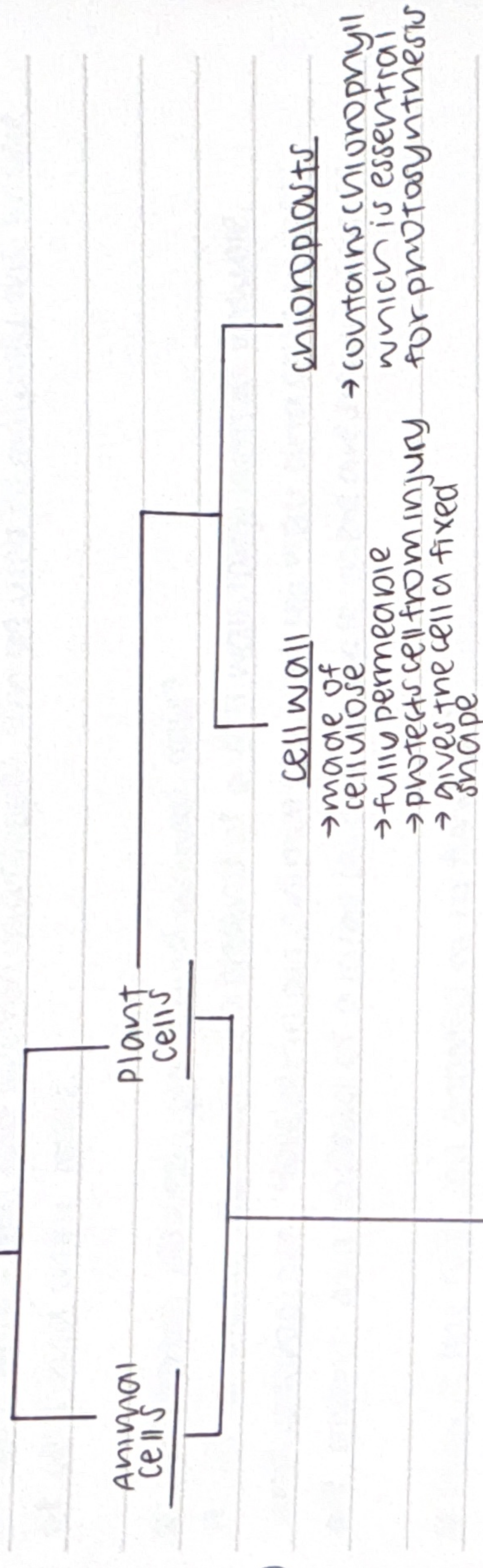
Muscle cell:

- is elongated and cylindrical in shape, contains many ~~a~~ nuclei and mitochondria.
- has mitochondria to provide energy for the contraction of the muscle cell.

Root hair cell:

- has a long and narrow extension / root hair to increase the surface area to volume ratio to absorb water and mineral salts at a higher rate.

cells



Questions

CHAPTER 1 → cell structure and organisation

Q: how can we study parts of the cell?

A: light microscopes and electron microscopes can be used to magnify the image of cells and their parts.

Q: differences between plant and animal cells?

A: in a plant cell, there is a presence of a cell wall, large central vacuole, and chloroplasts. However in an animal cell, the cell wall and chloroplasts are absent, and instead of a large central vacuole, there are small vacuoles.

Q: How is the root cell adapted to its function?

A: The root hair cell has a long and narrow root hair to increase the surface area-to-volume ratio, increasing the rate of absorption of water and mineral salts, to allow the plant to photosynthesise at a faster rate.

Q: How are the physical characteristics of red blood cells suitable to support their functions? Explain.

A: The red blood cell has a biconcave shape which increases the surface area-to-volume ratio, enabling oxygen to diffuse in and out at a faster rate. (Biconcave shape because of the thinner central portion.)

Q: Name substance A, if the cell

was submerged in sugar solution.

A: Sugar solution.



Q: Describe how proteins are transported within the cell and secreted out.

A: Firstly, proteins are packed into small vesicles, which are pinched off from the RER. These vesicles travel toward the Golgi body, fusing with it to release their contents. The proteins then get chemically modified, packaged and stored in the Golgi body. Secretory vesicles formed from the Golgi body travel to the cell membrane, and fuse with it. The modified proteins are then secreted out of the cell.

~~Free~~

Q: State one structural difference between the SER and RER. While there are no ribosomes attached to the RER while there are no ribosomes attached to the SER.