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Pollen Structure

Pollen grains are microscopic (25 - 50 um) male gametophyte structures of plants with a two-layered wall: the hard, outer exine and the inner, thin intine.

- **Sporoderm (Pollen Wall)**
  - **Exine (outer layer)** - Extremely durable, made of Sporopollenin, resisting heat, acids, and decay: often sculptured with unique patterns (reticulate, echinate) and features germ pores.
  - **Intine (Inner layer)**: Thin, continuous, made of cellulose and pectin, crucial for pollen tube formation.
- **Internal Cells (Male Gametophyte)**
  - **Vegetative cell (Tube cell)**: Large, with abundant food, forms the pollen tube for Sperm transport.
  - **Generative cell**: Divides to form two sperm cells, which travel down the pollen tube to the ovule.

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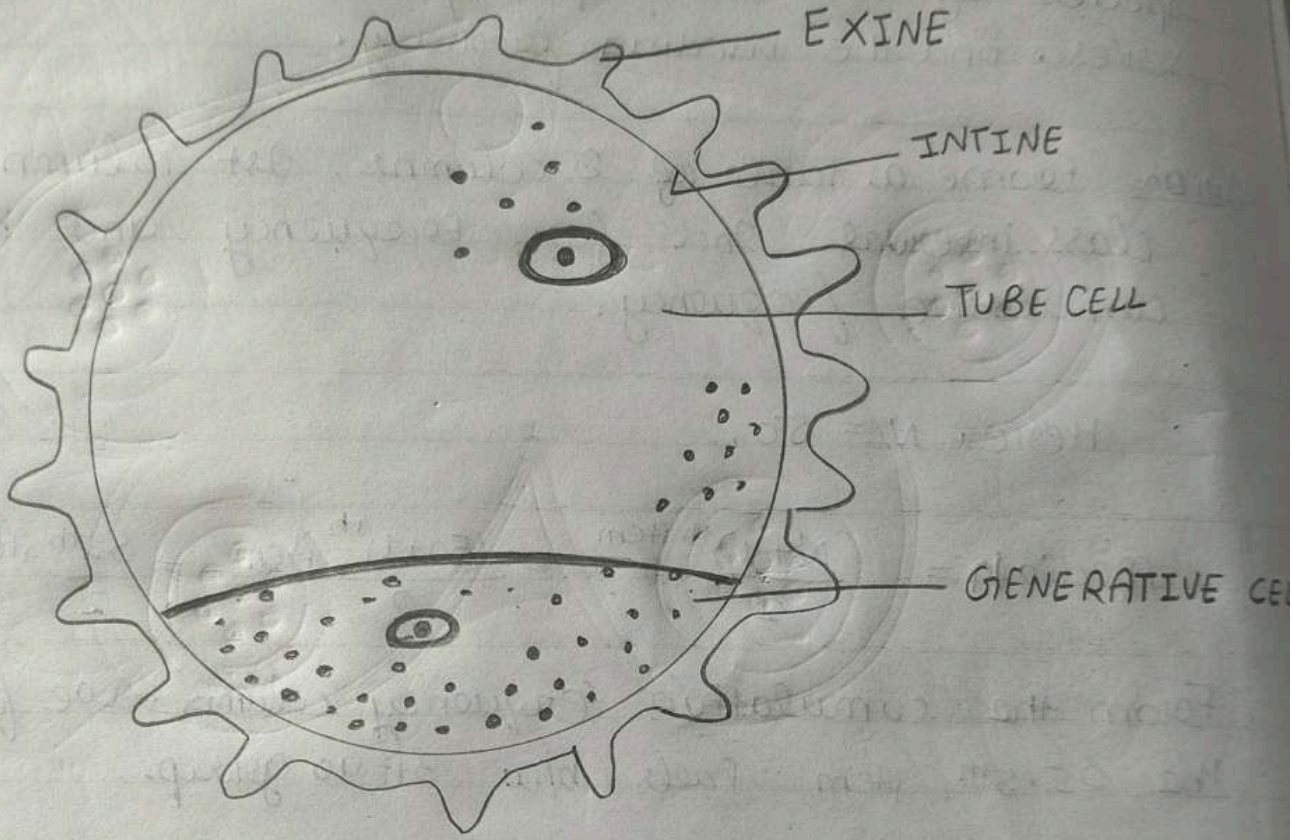

Fig: Pollen grain

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Anther Structure

- **Anther Lobes / Theca**: The main body, often containing four microsporangia (pollen sacs) where pollen grains mature.
- **Connective**: A sterile tissue that connects the two lobes and contains vascular bundle for nutrient transport.
- **Filament**: The stalk that supports the anther.
- **Stomium**: A specific area of the anther wall that breaks open to release mature pollen.

Anther Wall Layers (Outer to Inner)

1. **Epidermis**: The outermost, single layered, protective layer.
2. **Endothecium**: Located beneath the epidermis, these cells are radially elongated and develop fibrous, hygroscopic bands (made of cellulose)
3. **Middle layer**: 1-3 layers of cells, usually thin-walled and ephemeral.
4. **Tepetum**: The innermost, nutritious layers that surround the sporogenous tissue,

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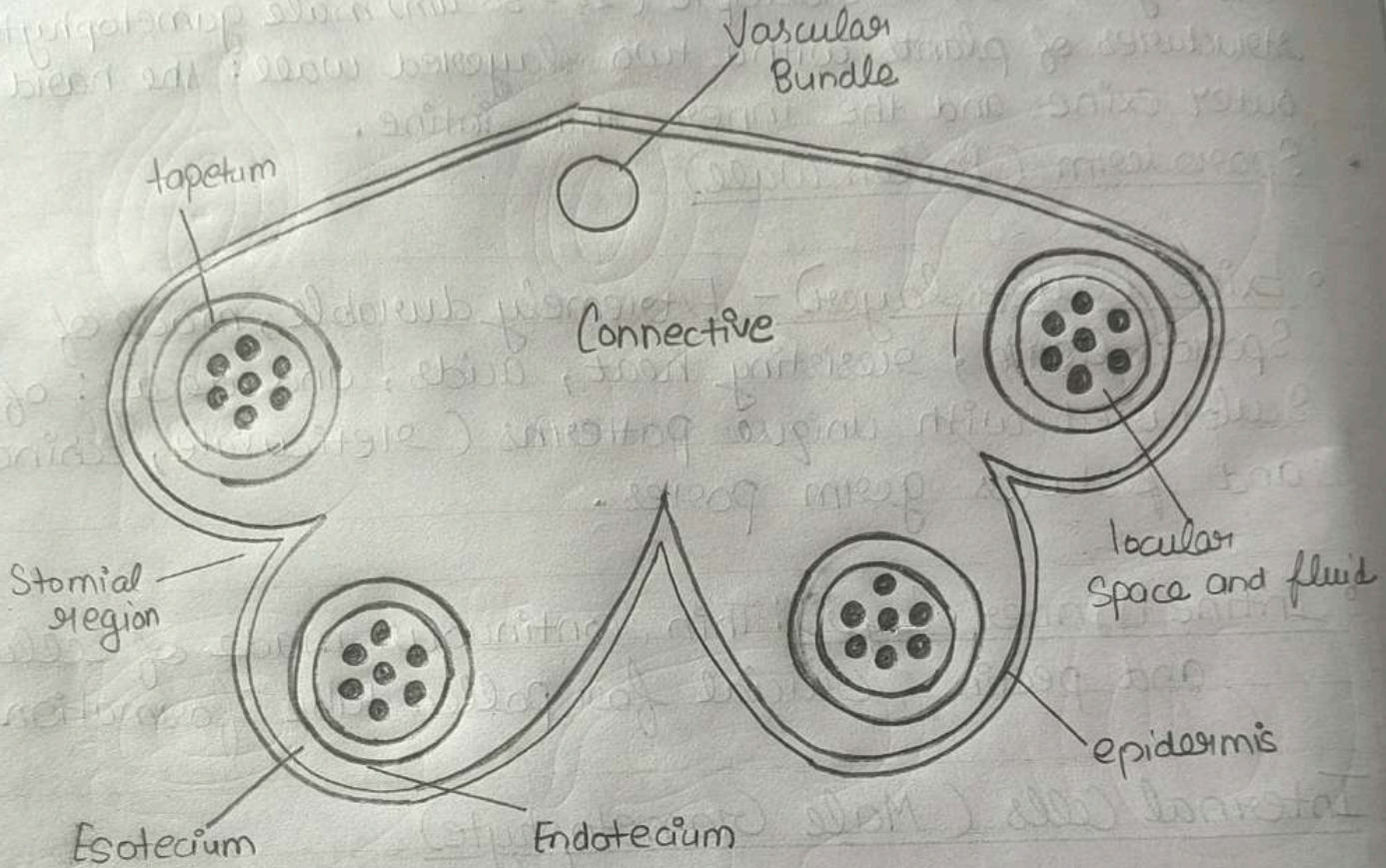
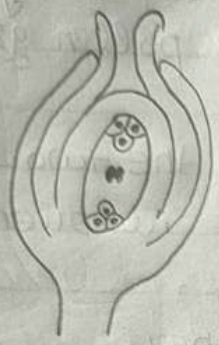
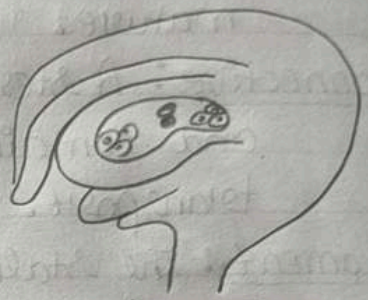

Vascular Bundle
tapetum
Connective
Stomial region
locular space and fluid
epidermis
Esotecium
Endotecium

Fig: Anther

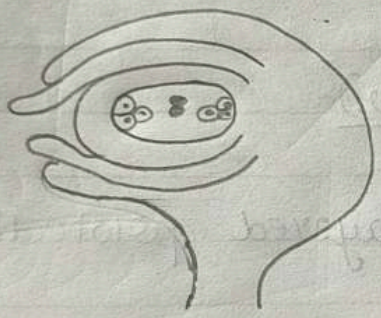


Atropous

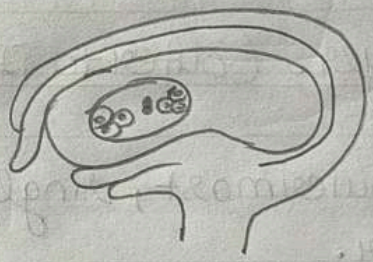
Anatropous



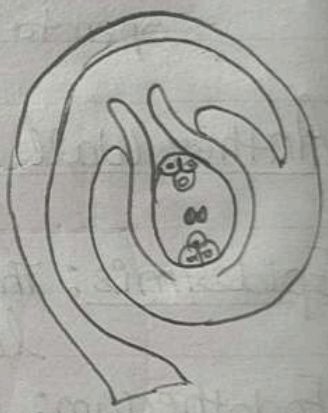
Amphitropous



Hemianatropous



Campilotropous



Circinotropous

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Type of Ovule

Based on Position (Orientation)

- **Orthotropous**: Straight; micropyle, chalaza, and funicle are aligned (primitive type)
- **Anatropous**: Inverted 180°; micropyle and funicle are close (most common in angiosperms)
- **Hemitropous (Hemianatropous)**: Body at 90° to funicle; micropyle and chalaza align.
- **Campylotropous**: Bent at right angles; micropyle and chalaza not aligned. (e.g. legumes)
- **Amphitropous**: Curved and inverted, with a horseshoe-shaped embryo sac.
- **Circinotropous**: Funicle is long, causing the ovule to curve around it, making a complete circle (e.g., Opuntia)

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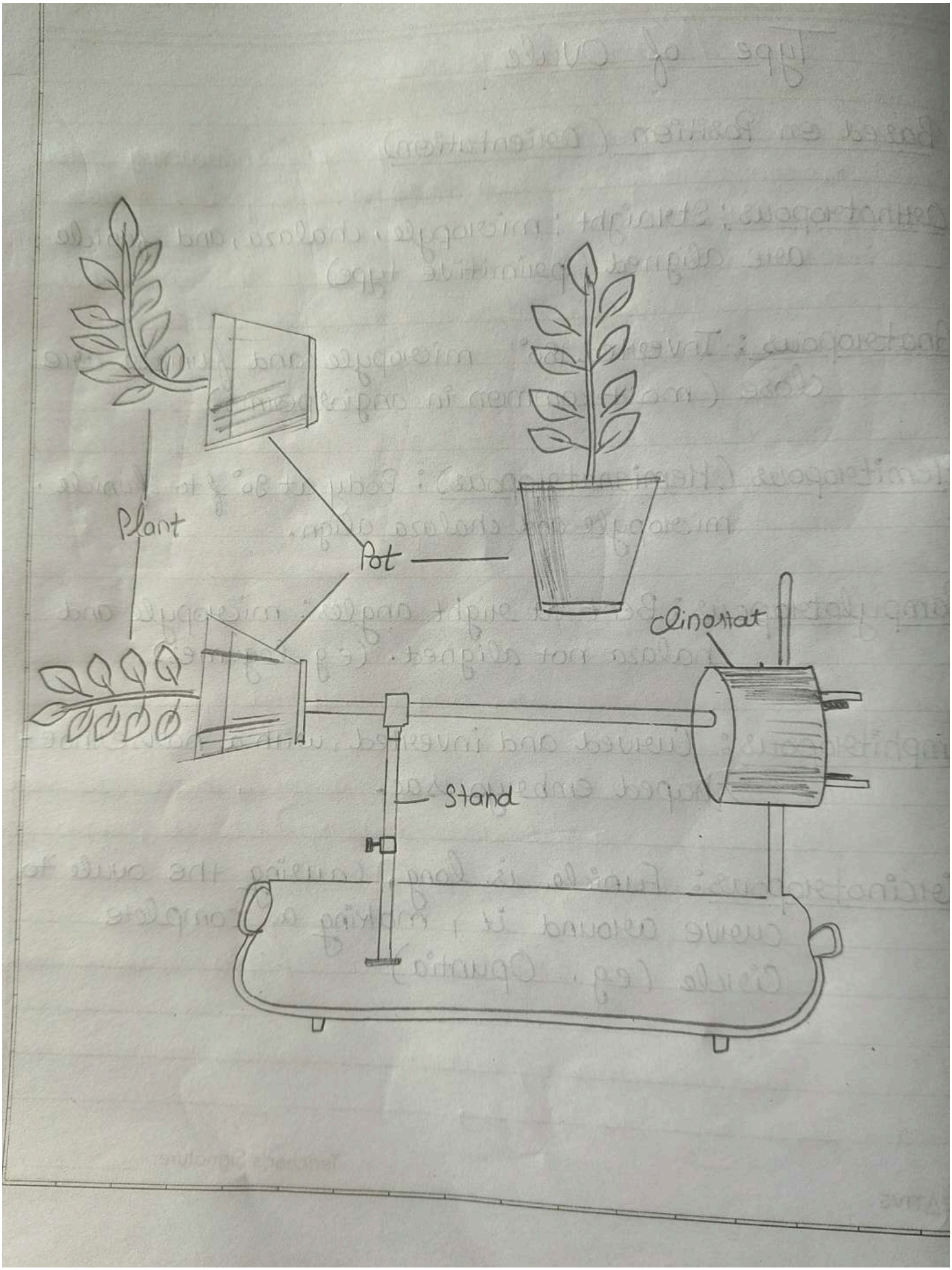
Plant
Pot
Clinostat
Stand

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Geotropism

* **Object:** To demonstrate the phenomenon of geotropism with the help of clinostat.

* **Requirements** A potted-plant and clinostat.

* **Method:**

1. Fix the clinostat, which consist of a rod with a disc attached on it, on a plate. Clinostat can rotate due to the clock-work mechanism.

2. At the end of the rotating rod, fix a potted plant in the horizontal position, and rotate it either by hand or by electric mechanism, and observe for some time.

3. Now, fix the plant in the same horizontal position but do not use clock-work mechanism and do not rotate it. observe after two three days.

* **Observations:** In the plant, where the clinostat is rotating, there is no curvature in the roots or shoot. In the second stage, when the plant is attached

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with the clinostat like first stage but not rotating. there is curvature in the stem towards the upper side, and in the roots towards the lower side i.e. gravity.

* **Result**:- In the first case, there is no curvature in roots or shoot because all the sides of the plant are successively coming to recieve the geotropic stimulus equally. In the second case, when there is no rotation, due to the phenomenon of positive geotropism roots turn towards lower side, and due to the negative geotropism the shoot turns towards the upper.

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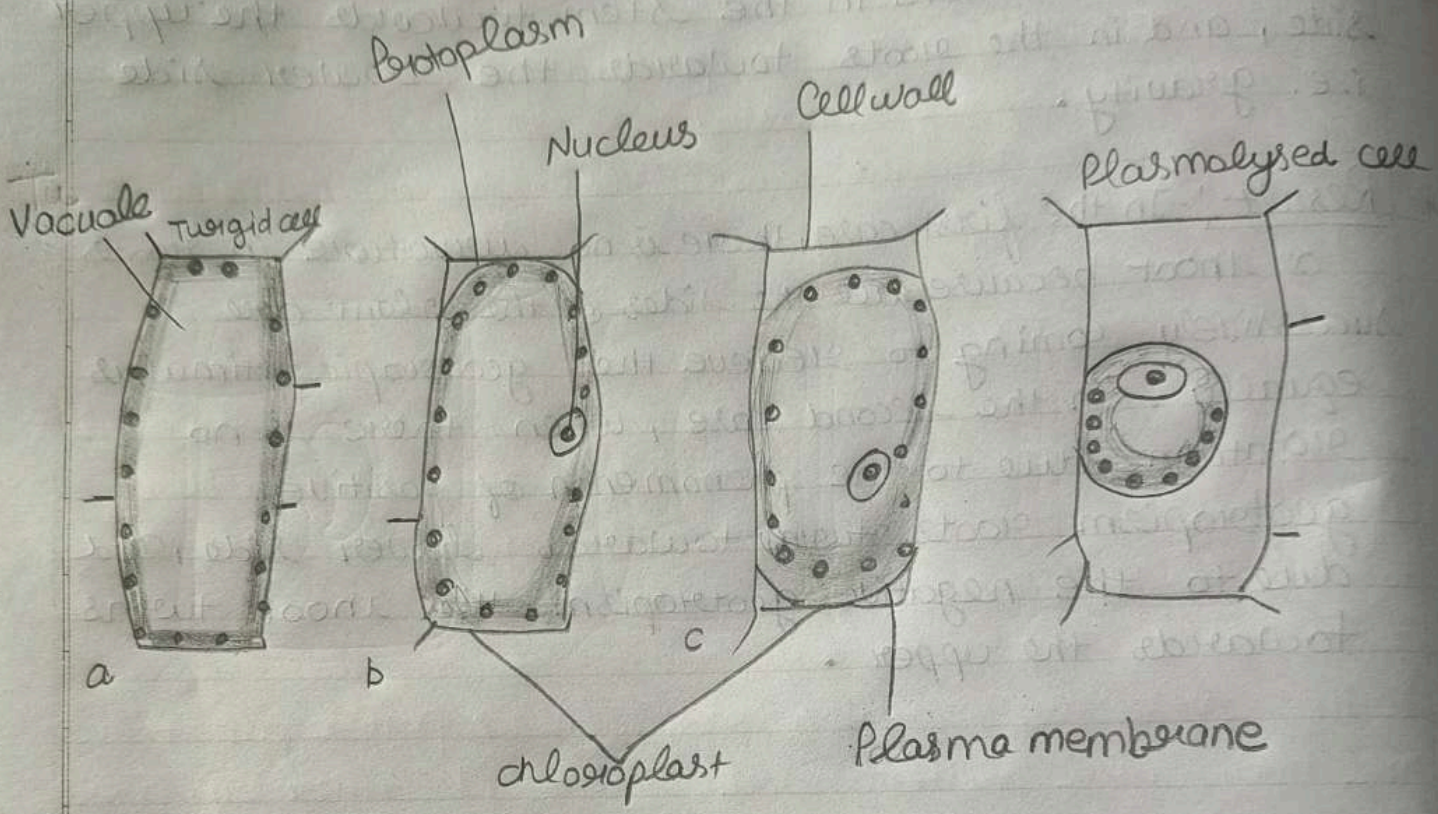
Protoplasm
Nucleus
Cell wall
Plasmolysed cell
Vacuole
Turgid cell
a
b
c
chloroplast
Plasma membrane

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Plasmolysis

Object: To demonstrate the phenomenon of plasmolysis.

Requirements: Tradescantia leaf, water, sugar solutions, slides, cover glass, microscope, blade,

Method:- 1. From the lower surface of the leaf of Tradescantia, peal off small segments of epidermis with the help of blade.

2. Put a few peelings on a slide, mount in a drop of water and cover with a cover glass. Study the peelings under the microscope.

3. Mount some of the peelings in the drops of sugar solutions of different concentrations. Study under the microscope.

Observations: Peelings mounted in the water show clear cell structure. But the peelings placed in the sugar solutions show the concentration in their cell contents. More the concentration of sugar solution higher is the concentration and shrinkage of cell contents.

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Peelings mounted in very high concentration sugar solution if observed under microscope, show complete shrinkage of their cell contents, which become round or ball-like.

Result: Shrinkage of the cell contents in the peelings mounted in conc. sugar solution is due to the fact that osmotic pressure of the outer sugar solution is higher than that of the osmotic pressure of the cell sap. So, the water from the cell sap diffuses to the external sugar solution through the semipermeable plasma membrane of the cell. Thus, there is a shrinkage of the cell contents, and this phenomenon is known as plasmolysis

If slightly plasmolysed cells are now kept in pure water, these will show the phenomenon of endosmosis and the cells will recover soon. This indicates the phenomenon of deplasmolysis.

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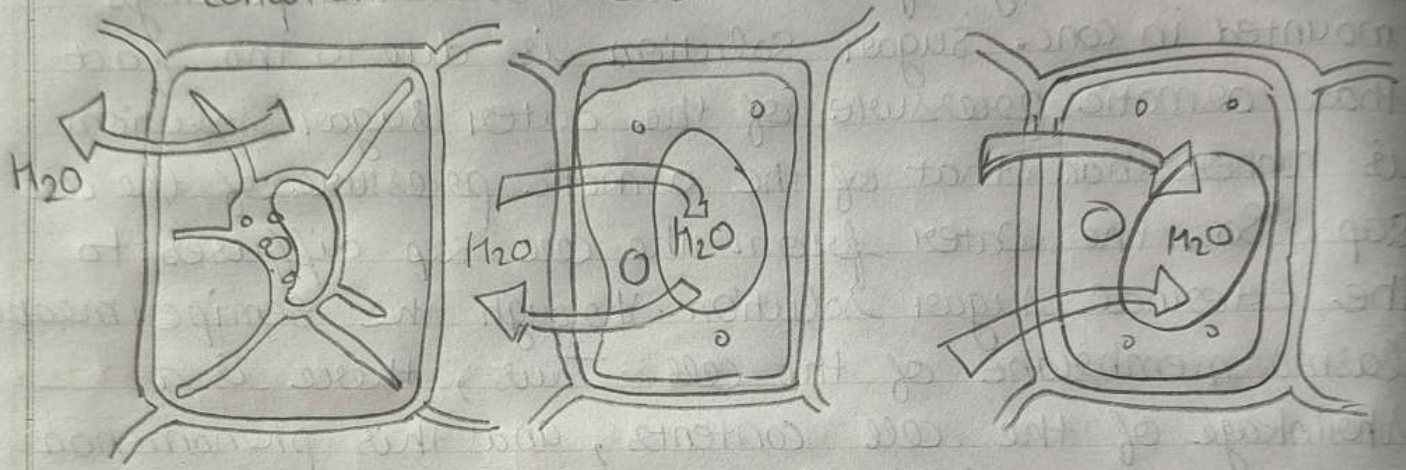
Hypertonic Condition

Isotonic Condition

Hypotonic Condition



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Hypertonic, Isotonic, Hypotonic Solution

1. **Hypotonic Solution (e.g. Distilled water)**

- **Setup** - Place plant tissue (e.g onion epidermis, potato slice) in distilled water.
- **observation** Water enters the cells via osmosis. The cell membrane pushes against the rigid cell wall, making the cell turgid (swollen and firm)
- **Result**:
  Plant tissue becomes firm (e.g. crisp lettuce)

2. **Hypertonic Solutions (e.g. 10% Salt/ Sugar Solution)**

- **Setup**; Place plant tissue in a concentrated salt or sugar solution.
- **Observation**: Water leaves the cells, moving to the higher solute concentration outside. The cytoplasm shrinks pulling the cell membrane away from the cell wall a process called plasmolysis.
- **Result**:- Plant tissue wilts, becomes flaccid (limp) and loses turgor.

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3. Isotonic Solutions (e.g 0.9% NaCl or Isotonic Sugar Solution)

- Setup: Place plant tissue in a solution with the same solute concentration as the cell sap.
- observation: There is no net movement of water. Water enters and leaves at the same rate, maintaining the cell's normal volume and shape.
- Result:

Plant tissue remains in its original state, neither turgid nor plasmolyzed.

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