SCHOOL STRONG TOWER ACADEMY

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CLASS S. S. S. 1.

SUBJECT: BIOLOGY

TOPIC: CELL AS A LIVING UNIT

CONTENT

BIOPHYSICAL PROCESS

The physical and biophysical processes by which materials are exchanged between the cell and its environment are.

I. Diffusion
II. Osmosis
III. Plasmolysis
IV. Haemolysis

DIFFUSION

Diffusion is the movement of molecules of substances (such as liquid, gaseous, or solutes) randomly from a region of higher concentration to a region of lower concentration until it is evenly distributed or equilibrium is reached.

The movement of such molecules starts from a region where the molecules are in high concentration to parts where the molecules are in low concentration. The molecu les move to any space available to them.

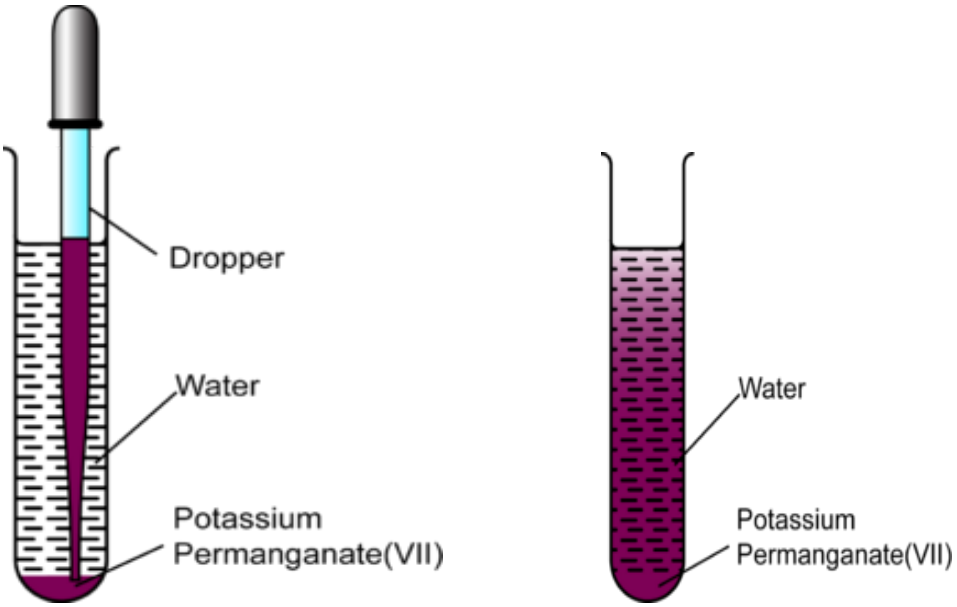
Gases can diffuse through air or liquids.
Liquids can diffuse through their liquids
Vapours can diffuse from aromatic solid compounds through air
solids molecules can also diffuse through liquid if they can dissolve in such liquids

EXPERIMENT TO DEMONSTRATE THE DIFFUSION OF A SOLID IN A LIQUID .

MATERIAL REQUIRED **;** Permanganate crystals, distilled water, test tube, spatula.

Procedure:
Pour water into the test tube until it is 2/3 full
using the spatula; a crystal of potassium permanganate was gently dropped into the test tube or beaker. The following was observed.

S/N	TIME (Mm)	OBSERVATION
1	Immediately after dropping	The crystals of potassium permanganate sinks to the bottom of the beaker
2	After five minutes	The crystal dissolves forms a dense layer at the bottom and a light layer above
3	After ten minutes	Three distinct layers are formed deep purple at the bottom, light purple in the middle and the top layer is very light purple
4	After fifteen minutes	The whole water is purple with deep purple at the bottom, light purple at the middle and lighter purple above
5	After one hour	The whole water is uniformly purple.



EXPERIMENT TO DEMOSTRATE DIFFUSION IN GASES

MATERIALS REQUIRED : Ammonia solution, a bottle of perfume.

PROCEDURE

a bottle of strong solution of ammonia was opened and placed on the table in front of the laboratory for about fifteen minutes, it was observed that the molecules of the ammonia/ perfumed spread from the container into the air and the smell was perceived in laboratory showing that the molecules of ammonia/ perfume have diffused from the container into the entire laboratory

or

To demonstrate diffusion in gases

Soak cotton wool in a solution of ammonia
get a glass tube, some wet red litmus paper was put inside the tube

The soaked cotton wool was put in the mouth of the tube. After few minutes the wet red litmus paper turned blue. Because the solution had diffused from the cotton wool into the tube thereby turning the red litmus to blue

Conclusion: This showed that gases diffused from a region of high concentration to region of low concentration.

Diffusion occurs in solids.

For example if a white bar of soap and a red bar are wrapped together for some weeks, the colours of the two soaps would diffuse into each other.

FACTORS THAT AFFECT DIFFUSION.

1. *Molecules size* : The smaller the size of the molecules, the faster the rate of diffusion.
2. *State of substances* : Molecules of a gas diffuse faster than molecules of a solid.
3. Temperature: The higher the temperature of a substance, the faster the rate of diffusion.
4. *Concentration gradient* : the steeper the diffusion gradient, the faster the rate of diffusion. The higher the concentration of molecules, the faster the rate of diffusion.
5. *Surface volume ratio* : When the ratio is high, diffusion is higher
6. *Stirring/ shaking/mixing* facilitate the diffusion of molecules.

BIOLOGICAL IMPORTANCE/ significance/ LIFE PROCESSES OF DIFFUSION IN PLANTS

1. Movement of Carbon dioxide from the atmosphere through the stomata into the leaf during photosynthesis
2. Movement of Oxygen through the stomata during respiration.
3. Movement of Carbon IV oxide from the leaf to the atmosphere during

respiration.

4. Movement of water vapour out of the leaf during transpiration.

BIOLOGICAL INPORTANCE/ significance/LIFEPROCESSES OF DIFFUSION IN ANIMALS

1. Gaseous exchange in the body cells during respiration.
2. Absorption of digested food in the villi 0f small intestine into the blood stream and lacteal
3. Exchange of materials between mother and foetus through the placenta and waste products from the foetus to the mother
4. Transport of materials within the cell and out of the cell e.g. in Amoeba
5. Absorption of Oxygen by the red blood cells in the respiratory organs.

OSMOSIS

Osmosis is the movement of molecules of water, from a solution of lower concentration to a solution of higher concentration through a semi-permeable membrane until equilibrium is reached.
A*semi-permeable membrane* is one which allows certain types of substances to pass through and not all or other substances depending on the size of the molecules of which the substances are composed.
OR

Osmosis is defined as the flow of water or solvent molecules from a region of dilute or weaker solution through a selectively or differently permeable membrane

HYPOTONIC SOLUTION: When a cell of a living plant or animal is

surrounded by solution whose concentration is lower, water passes into the cell by osmosis. The solution is said to be Hypotonic.
HYPERTONIC: When the cell is surrounded by a stronger solution, water will be lost by the cell. The solution is said to be Hypertonic.

ISOTONIC: when the solution concentration of the cell and its surrounding medium are the same. The solution is said to be isotonic.

EXPERIMENT TO DEMONSTRATION THE PROCESS OF OSMOSIS USING A LIVING TISSUE

APPARATUS: Irish potato tuber/ Yam tuber, Unripe Pawpaw fruit, glass trough, sugar or salt solution.

METHOD

Potato tuber/ Yam tuber/ Unripe Pawpaw fruit was peeled and cut into two pieces.

- The bottom of each half was flattened. Large cavity was made in the middle of each half of potato and yam
- For the paw Pawpaw fruit the inside was cleaned.

The two halves were labeled A and B concentrated salt solution or sugar solution was poured into A and the level noted with a pin water was poured into B and the level noted also.
Each Yam/ Irish Potato/ Pawpaw fruit was placed in glass troughs containing water. A is the test experiment while B is the control experiment. Both experiments were left for 3-24 hours.

OBSERVATION

It was observed that solution in A has increased higher than the initial state while the level of water in B remained the same.

CONCLUSION:
Solvent molecules have moved from a less concentrated region (water) to a more concentrated region (strong sugar) solution through a semi-permeable membrane i.e. yam tuber/ unripe pawpaw fruit/ Irish potato in A while B remained the same due to the isotonic nature of both solution/ both are water

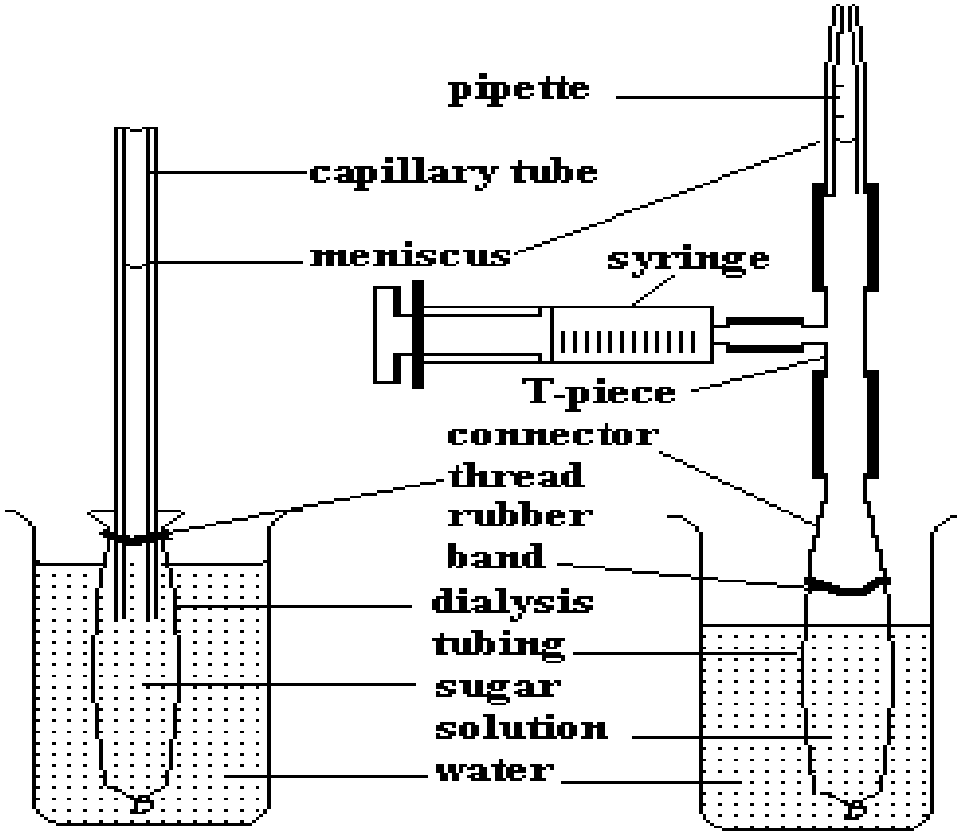
EXPERIMENT TO DEMONSTRATE OSMOSIS USING A NON-LIVING MEMBRANE.

APPARATUS:
Thistle funnels, Beakers, Rubber band, Retort stand, cellophane paper/ Pigs bladder/ sheep's bladder, water, strong salt/ sugar solution.

METHOD:
The mouth of two thistle funnel was covered with cellophane paper and tied with elastic bond and seal the edge with melted candle wax to make it air tight.
Sugar solution was poured inside the thistle funnel as set up A. the original level of the sugar solution was marked/ noted.
Water was put into a beaker. The mouth of the funnel was inverted into the beaker of water. The funnel was supported by a retort stand as shown in set up A.
Control experiment was set up by putting water into both the beaker and thistle funnel as is set up B.
The level of the funnel was noted and recorded at the beginning of the experiment.
Both set ups were left to stand for about 1-4 hours.

OBSERVATION:
At the end of the experiment the level of sugar solution in the funnel will rise in A while no change occurs in the control experiment B.
The increase in sugar solution level in A shows that water have moved from the beaker into the thistle funnel by osmosis.

Since the cellophane paper served as a semi-permeable membrane.



BIOLOGICAL IMPORTANCE OF OSMOSIS TO PLANTS

1. Absorption of water from the soil through the root hairs of plants is by osmosis.
2. Movement of water from cell to cell of plants to become turgid
3. Opening and closing of stomata
4. Facilitates loss of water by transpiration

BIOLOGICAL IMPORTANCE OF OSMOSIS TO ANIMAL

1. Reabsorption of water in the kidney tubules of mammals is by osmosis

2. The absorption of water from the undigested food materials in the large intestine is by osmosis
3. The entry of water into cytoplasm of unicellular animals e.g. Amoeba
4. Turgidity to animal's cells.

DIFFERENCE BETWEEN DIFFUSION AND OSMOSIS

S/N	DIFFUSION	OSMOSIS
1	Diffusion occurs in gases and liquids and solid	Osmosis occurs in liquid medium only
2	Differentially permeable membrane is not required	Differentially permeable membrane is required
3	It occurs in living and non-living organisms naturally molecules move from higher concentration to lower concentration	It occurs naturally in living organisms molecules of water move from lower concentration to higher concentration

Similarities between Diffusion and osmosis

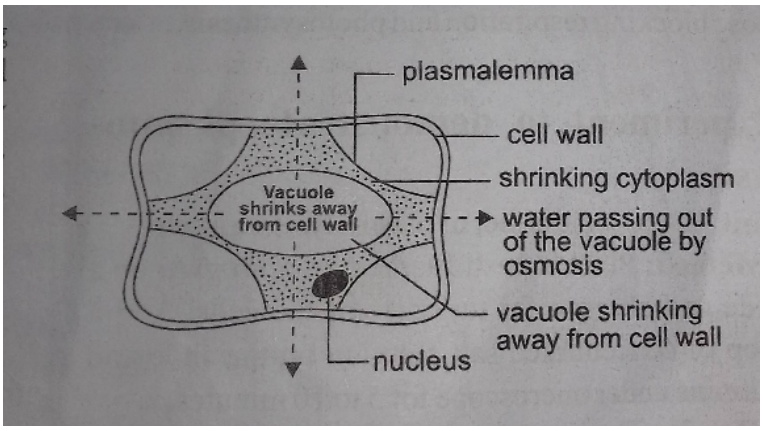
1] both diffusion and osmosis involve movement of molecules
2] in both diffusion and osmosis, the movement of molecules is down a concentration gradient i.e. from region of high to region of low concentration of molecules

PLASMOLYSIS

Plasmolysis is the shrinkage of the vacuole / protoplasm and pulling away of the cytoplasmic linings from the cell wall due to loss of water when

placed in hypertonic solution.

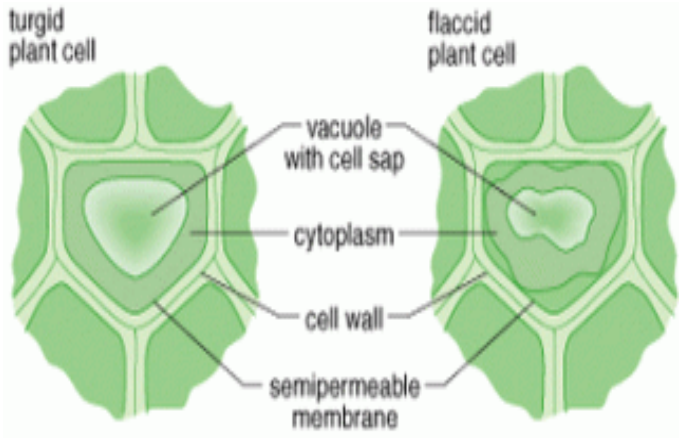
A PLASMOLYSED PLANT CELL



The process occurs as follows.
When a plant cell is placed in a more concentrated salt or sugar solution, water is lost by osmosis (exosmosis). As a result of exit of water from the cell the vacuole shrink and the cytoplasmic lining are pulled from the cell wall. The cell becomes plasmolysed.

On the hand, when the plasmolysed cell is again placed in distilled water, water moves into the cell sap by osmosis (endosmosis).
The vacuole increases in volume and extends towards the cytoplasm and cell wall.

Plasmolysis may be temporary or partial if the collapsed cells recovered when a placed in a hypotonic solution. But if the collapsed cells do not recover then it may be*total or permanent* .



EXPERIMENT TO DEMONSTRATE PLASMOLYSIS IN PLANT CELL

APPARATUS:

Spirogyra filament/ onion epidermal cells, salt solution/ sugar solution, slide, cover slip, microscope

METHOD:

Fresh filament of spirogyra/ onion are mounted in water and observed under the microscope.
Some cells were put in salt solution/ sugar solution for 2-5 minutes which is the test experiment. Some are put in water / isotonic solution for 2-5 minutes which is the control experiment.
Both were observed again under the microscope.

OBSERVATION:

It was observed that when strong salt/ sugar solution was added to the spirogyra, the cell shrink and the cell membrane tears away from the cell wall.
When water was added, the cytoplasm expanded and returned to its original position.

CONCLUSION

Plasmolysis: takes place when salt/ sugar solution was added.
Cell of spirogyra was restored when water was added.

USES OF PLASMOLYSIS TO FARMER

Knowledge of plasmolysis helps the farmer to*know the amount of fertilizer to add to the soil or not to add too close to the cells of the plant* to avoid the cells being plasmolysed and prevent death of the plant.

HAEMOLYSIS OF RED BLOOD CELL

Haemolysis is the process by which red blood cells placed in hypotonic solution take in so much water thereby burst releasing the haemoglobin.

Or the rupturing of the red blood cell in the plasma to release its haemoglobin when placed in hypotonic solution

When the red blood cells are placed in hypotonic solution, water enters the red blood cells by osmosis (also called endosmosis) through the cell membrane.

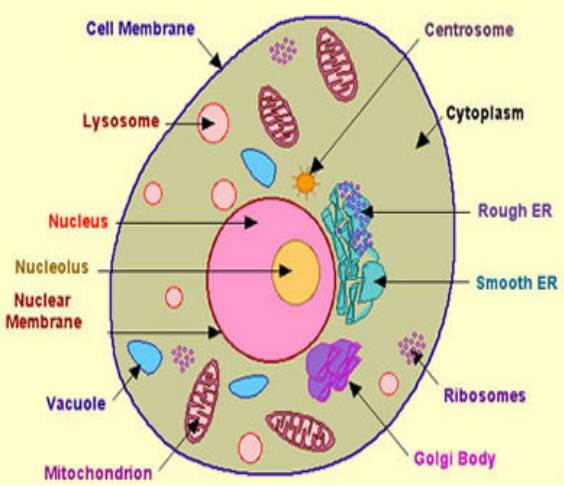
As water continues to enter the cell, it swells and burst releasing the haemoglobin which escapes .

If the red blood cells are put in hypertonic solution, water leaves the cell by osmosis (also called exosmosis) and the red cells shrink and wrinkle the cells become plasmolysed.

The shrinking of the red blood cells is called CRENATION.

Frequent laxative causes crenation. Animal cells have no cellulose cell wall to resist the turgidity hence the bursting.

Haemolysis leads to anemia which may eventually cause death if not checked



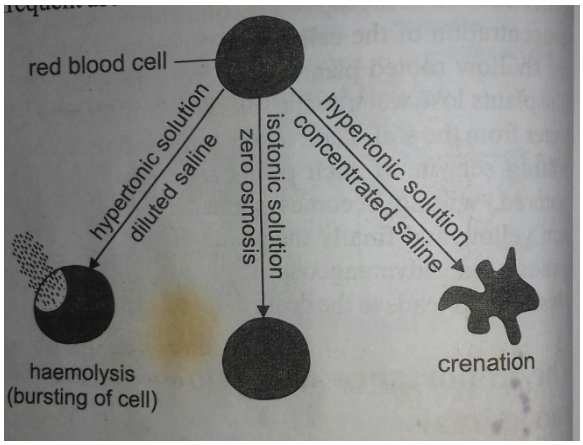
CONDITION THAT MAY CAUSE HAEMOLYSIS

1. Diseases or infection
2. Drug/ Food abuse
3. Poisoning 4. Pollution

DIFFERENCES BETWEEN PLASYMOLYSIS AND HAEMOLYSIS

S/N	PLASYMOLYSIS	HAEMOLYSIS
1	It occurs in plant cells	It occurs in red blood cell
2	Plant cell shrinks	Red blood cell burst
3	It occurs in hypertonic solution	It occurs in hypotonic solution

THE BEHAVIOUR OF RED BLOOD CELL TO DIFFERENT CONCENTRATION OF SOLUTIONS



TURGIDITY

Turgidity is the state in which a living cell absorbs water and assumes its maximum size and become fully stretched and strong due to the balance between the turgor pressure [pressure within] and the wall pressure of the cell. At this point, the cell is said to be turgid. It occurs when a cell is put into a hypotonic medium.

The process occurs as follows.
The cell absorbs water by endosmosis increases in size.
Hydrostatic pressure generated in the cell becomes equal in magnitude but opposite in direction to the wall pressure (in plant cell only). Cells assume full size and become turgid.
Turgidity is the state in which the pressure exerted by the cell contents outward in equal to the resistance of the cell inwards. Or turgidity occurs

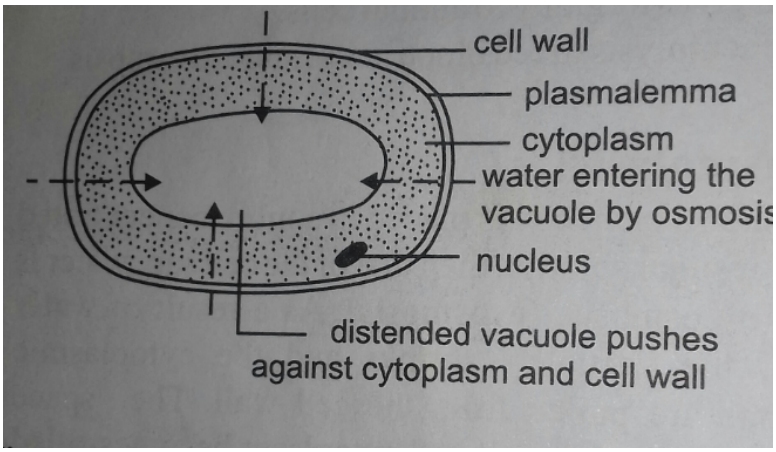
where the turgor pressure of the cell balance the wall pressure of the cell Turgidity occurs both in plant cell and animal cells.

Once a plant cell is turgid further entry of water into it is restricted by the cell wall. The cell wall prevents the cell from bursting.

Turgor pressure is the pressure exerted by the cell content, against the cell wall at turgidity.

Osmotic pressure is the total force that drives water into a cell.

A TURGID PLANT CELL



IMPORTANCE / SIGNIFICANCE OF TURGIDITY

1] Turgidity is useful to the plants because it makes them stand erect, give support to the stem, leaves, flowers and guard cells.

2] Turgidity helps animal cells to maintain their shapes

3] All cells carry out their physiological processes effectively when turgid

FLACCIDITY

Flaccidity is defined as the condition in which plants lose water to their surrounding faster than they can absorb and become weak and soft.
It results in the withdrawal of water from the vacuoles. The cells are said to be flaccid.
Plants usually experience flaccidity when there is drought, and then they drop, become weak, limp and soft. Continuous or prolonged flaccidity can cause a plant to die.

WILTING IN PLANTS

This is a condition whereby more water is loss through transpiration or evaporation than the plant can absorb from the soil.

USES OF WILTING TO FARMER.

The knowledge helps the farmer to irrigate or water his crops during the dry season to avoid witting and death of the crops.

ACTIVE TRANSPORT

This is the movement of the molecule of a substance from a region of lower concentration to a region of higher concentration with helps of energy or the use of energy to move the molecules of a substance against the concentration gradient.