#424883
Topic: Means of transport in plant

What are the factors affecting the rate of diffusion?

Solution

Diffusion is the passive movement of substances from a region of higher concentration to a region of lower concentration. Diffusion of substances plays an important role in cellular transport in plants. The rate of diffusion is affected by the concentration gradient, membrane permeability, temperature, and pressure. Diffusion takes place as long as there is a difference between the concentrations of a substance across a barrier. However, diffusion stops, when the concentrations of the substance on either side of the barri become equal. The permeability of a membrane affects the rate of diffusion. Diffusion rate increases as membrane permeability increases. Changes in temperature and pressu values also affect the diffusion of substances. Pressure plays an important role in the diffusion of gases as gases diffuse from a region of higher partial pressure to a region of lower partial pressure.

#424885
Topic: Means of transport in plant

Describe the role played by protein pumps during active transport in plants.

Solution

In plant cells, active transport occurs against the concentration gradient, i.e., from a region of lower concentration to a region of higher concentration. The process of active transport involves specific protein pumps. The protein pumps are made up of specific proteins called trans-membrane proteins. These pumps first make a complex with the substance to be transported across the membrane, using the energy derived from ATP. The substance finally gets liberated into the cytoplasm as a result of the dissociation of the protein–substance complex.

#424886
Topic: Plant water relation

Explain why pure water has the maximum water potential.

Solution

Water potential quantifies the tendency of water to move from one part to the other during various cellular processes. It is denoted by the Greek letter Psi or Ψ. The water potential of pure water is always taken as zero at standard temperature and pressure.
It can be explained in terms of the kinetic energy possessed by water molecules. When water is in liquid form, the movement of its molecules is rapid and constant. Pure water has the highest concentration of water molecules. Therefore, it has the highest water potential. When some solute is dissolved in water, the water potential of pure water decreases.

#424887
Topic: Means of transport in plant

Differentiate between the following:
(a) Diffusion and Osmosis
(b) Transpiration and Evaporation
(c) Osmotic Pressure and Osmotic Potential
(d) Imbibition and Diffusion
(e) Apoplast and Symplast pathways of movement of water in plants.
(f) Guttation and Transpiration.

Solution

(a) Diffusion and Osmosis

Diffusion	Osmosis
1. Diffusion is the passive movement of particles, ions, and molecules along the concentration gradient.	1. Osmosis is the process in which the diffusion of a solvent (water) occurs across a semi-permeable membrane.
2. It can occur in solids, liquids, and gases.	2. It occurs in the liquid medium.
3. It does not require a semi-permeable membrane.	3. It requires a semi-permeable membrane.

(b) Transpiration and Evaporation

Transpiration	Evaporation
1. It occurs in plants.	1. It occurs from any free surface and involves living and non-living surfaces.
2. It is a physiological process.	2. It is a physical process.
3. It occurs mainly through the stomatal pores on plant leaves.	3. It is occurs through any free surface.
4. It is controlled by environmental factors as well as physiological factors of plants such as root-shoot ratio and number of stomata.	4. It is entirely driven by environmental factors.

(c) Osmotic pressure and Osmotic potential

Osmotic pressure	Osmotic potential
1. It is expressed in bars with a positive sign.	1. It is expressed in bars with a negative sign.
2. It is a positive pressure.	2. It is a negative pressure.
3. Its value increases with an increase in the concentration of solute particles.	3. Its value decreases with an increase in the concentration of solute particles.

(d) Imbibition and Diffusion:

Imbibition	Diffusion
1. Imbibition is a special type of diffusion. In this process, water is absorbed by solids and colloids, causing an enormous increase in volume.	1. Diffusion is the passive movement of particles, ions, and molecules along the concentration gradient.
2. It usually involves water.	2. It involves solids, liquids, and gases.

(e) Apoplast and Symplast pathways of water in plants

Apoplast pathway	Symplast pathway
1. The apoplast pathway involves the movement of water through the adjacent cell walls of the epidermis and cortex. The movement of water is restricted at the casparian strips of the root endodermis.	1. The symplast pathway involves the movement of water through the interconnected protoplasts of the epidermis, cortex, endodermis, and root pericycle.
2. It is a faster process of water movement and water moves through mass flow.	2. It is a slower process of water movement.

(f) Guttation and Transpiration

Guttation	Transpiration
1. It occurs usually at night.	1. It occurs usually during the day.
2. Water is lost from the leaves in the form of liquid droplets.	2. Water is lost from the leaves in the form of water vapour.
3. It occurs through the vein endings of leaves.	3. It occurs through the stomata.
4. It is an uncontrolled process.	4. It is a controlled process.

#424888

Topic: Plant water relation

Briefly describe water potential. What are the factors affecting it?

Solution

Water potential quantifies the tendency of water to move from one part to the other during various cellular processes such as diffusion, osmosis, etc. It is denoted by the Greek letter Psi or Ψ and is expressed in Pascals (Pa). The water potential of pure water is always taken as zero at standard temperature and pressure.

Water potential (Ψw) is expressed as the sum of solute potential (Ψs) and pressure potential (Ψp).

$\Psi w = \Psi s + \Psi p$

When some solute is dissolved in water, the water potential of pure water decreases. This is termed as solute potential (Ψs), which is always negative. For a solution at atmospheric pressure, $\Psi w = \Psi s$.

The water potential of pure water or a solution increases on the application of pressure values more than atmospheric pressure. It is termed as pressure potential. It is denotec by Ψp and has a positive value, although a negative pressure potential is present in the xylem. This pressure potential plays a major role in the ascent of water through the ste

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#424889

Topic: Plant water relation

What happens when a pressure greater than the atmospheric pressure is applied to pure water or a solution?

Solution

The water potential of pure water or a solution increases on the application of pressure values more than atmospheric pressure. For example, when water diffuses into a plant cell, it causes pressure to build up against the cell wall. This makes the cell wall turgid. This pressure is termed as pressure potential and has a positive value.

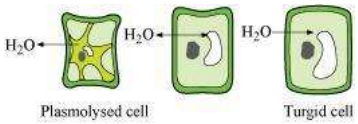
#424890
Topic: Plant water relation

(a) With the help of well-labelled diagrams, describe the process of plasmolysis in plants, giving appropriate examples.

(b) Explain what will happen to a plant cell if it is kept in a solution having higher water potential.

Solution

(a) Plasmolysis can be defined as the shrinkage of the cytoplasm of a plant cell, away from its cell wall and toward the centre. It occurs because of the movement of water from the intracellular space to the outer-cellular space. This happens when the plant cell is placed in a hypertonic solution (i.e., a solution having more solute concentration than the cell cytoplasm). This causes the water to move out of the cell and toward the solution. The cytoplasm of the cell shrinks and the cell is said to be plasmolysed. This process car be observed in an onion peel kept in a highly concentrated salt solution.



Process of plasmolysis

(b) When a plant cell is placed in a hypertonic solution or a solution having higher water potential, the water diffuses into the cell (i.e., the movement is observed from higher to lower water pressure region). The entry of water in the plant cell exerts pressure on the rigid cell wall. This is called turgor pressure. As a result of its rigid cell wall, the plant ce does not burst.

#424891
Topic: Plant water relation

Explain what will happen to a plant cell, if it is kept in a solution having higher water potential.

Solution

Water potential is the hydrostatic pressure exerted by water due to its kinetic energy. The hypotonic solution has a greater concentration of water so they have high water potential.
When a plant cell is placed in a hypotonic solution or a solution having higher water potential, the water diffuses into the cell (i.e., the movement is observed from higher to low water pressure region). The entry of water into the plant cell exerts pressure on the rigid cell wall. This is called turgor pressure.

#424893
Topic: Absorption of water and ascent of sap

What role does root pressure play in water movement in plants?

Solution

Root pressure is the positive pressure that develops in the roots of plants by the active absorption of nutrients from the soil. When the nutrients are actively absorbed by root hairs, water (along with minerals) increases the pressure in the xylem. This pressure pushes the water up to small heights. Root pressure can be observed experimentally by cutting the stem of a well-watered plant on a humid day. When the stem is cut, the solution oozes from the cut end.
Root pressure is also linked to the phenomenon of guttation, i.e., the loss of water in the form of liquid droplets from the vein endings of certain herbaceous plants.
Root pressure is only able to transport water up to small heights. However, it helps in re-establishing the continuous chains of water molecules in the xylem. Transpirational pul maintains the flow of water molecules from the roots to the shoots.

#424894
Topic: Absorption of water and ascent of sap

Describe transpiration pull model of water transport in plants. What are the factors influencing transpiration? How is it useful to plants?

Solution

In tall trees, water rises with the help of the transpirational pull generated by transpiration or loss of water from the stomatal pores of leaves. This is called the cohesion-tension model of water transport. During daytime, the water lost through transpiration (by the leaves to the surroundings) causes the guard cells and other epidermal cells to become flaccid. They, in turn, take water from the xylem. This creates a negative pressure or tension in the xylem vessels, from the surfaces of the leaves to the tips of the roots, throug the stem. As a result, the water present in the xylem is pulled as a single column from the stem. The cohesion and adhesion forces of the water molecules and the cell walls of the xylem vessels prevent the water column from splitting.

In plants, transpiration is driven by several environmental and physiological factors. The external factors affecting transpiration are the wind, speed, light, humidity, and temperature. The plant factors affecting transpiration are canopy structure, number and distribution of stomata, water status of plants, and a number of open stomata. Althougr transpiration causes water loss, the transpirational pull helps water rise in the stems of plants. This helps in the absorption and transport of minerals from the soil to the various plant parts. Transpiration has a cooling effect on plants. It helps maintain plant shape and structure by keeping the cells turgid. Transpiration also provides water for photosynthesis.

#424895

Topic: Absorption of water and ascent of sap

Discuss the factors responsible for ascent of xylem sap in plants.

Solution

The transpiration pull is responsible for the ascent of water in the xylem. This ascent of water is dependent on the following physical factors :

• Cohesion – Mutual attraction between water molecules

• Surface tension – Responsible for the greater attraction between water molecules in liquid phase than in gaseous phase

• Adhesion – Attraction of water molecules to polar surfaces

• Capillarity – Ability of water to rise in thin tubes.

These physical properties of water allow it to move against gravity in the xylem.

#424896

Topic: Absorption of water and ascent of sap

What essential role does the root endodermis play during mineral absorption in plants?

Solution

In plants, nutrients are absorbed through the active and passive transports. The endodermal cells of the roots containing suberin allow only selected minerals to pass through them. The transport proteins present in the membranes of these cells act as checkpoints for the various solutes reaching the xylem.

#424899

Topic: Translocation of organic solutes

Explain pressure flow hypothesis of translocation of sugars in plants.

Solution

According to the pressure flow hypothesis, food is prepared in the plant leaves in the form of glucose. Before moving into the source cells present in the phloem, the prepared food is converted into sucrose. Water moves from the xylem vessels into the adjacent phloem, thereby increasing the hydrostatic pressure in the phloem. Consequently, the sucrose moves through the sieve cells of the phloem. The sucrose already present in the sink region is converted into starch or cellulose, thereby reducing the hydrostatic pressure in the sink cells. Hence, the pressure difference created between the source and the sink cells allows sugars to be translocated from the former to the latter. This starch or cellulose is finally removed from the sink cells through active transport.

#424907

Topic: Absorption of water and ascent of sap

How are the minerals absorbed by the plants?

Solution

The absorption of soil nutrients by the roots of plants occurs in two main phases – apoplast and symplast.

During the initial phase or apoplast, there is a rapid uptake of nutrients from the soil into the free spaces of plant cells. This process is passive and it usually occurs through trans-membrane proteins and ion channels.

In the second phase or symplast, the ions are taken slowly into the inner spaces of the cells. This pathway generally involves the expenditure of energy in the form of ATP.

#464528

Topic: Plant water relation

What is osmosis?

Solution

Osmosis is diffusion of water or solvent through a semi-permeable membrane from the region of lower solute concentration to that of higher solute concentration, i.e., down th concentration gradient.

#464529

Topic: Plant water relation

Carry out the following osmosis experiment:

Take four peeled potato halves and scoop each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,

(a) Keep cup A empty.

(b) Put one teaspoon sugar in cup B.

(c) Put one teaspoon salt in cup C.

(d) Put one teaspoon sugar in the boiled potato cup D.

Keep these for two hours. Then observe the four potato cups and answer the following:

(i) Explain why water gathers in the hollowed portion of B and C.

(ii) Why is potato A necessary for this experiment?

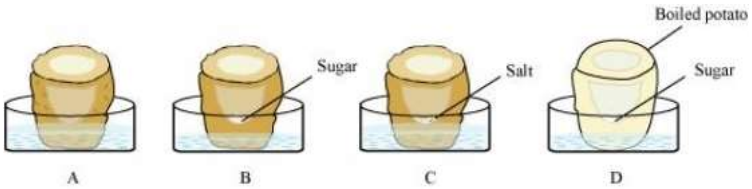
(iii) Explain why water does not gather in the hollowed out portions of A and D.

Solution

(i) Since, sugar and salt was present in B and C respectively, water from the trough gathered in the hollowed portions of potato in B and C by the process of osmosis.

(ii) Potato A is necessary for carrying out this experiment because it act as a control experiment. Control helps us to check what changes occurred during the course of the experiment and helps us to compare the results.

(iii) Water does not gather in the hollowed portion of potato A as it was empty. Water also does not gather in the cup D because the potato used was boiled which makes it inactive as after boiling its protein structure were denatured, resulting in the disruption of cell membrane.



#464809

Topic: Translocation of organic solutes

What are the differences between the transport of materials in xylem and phloem?

Solution

Difference between xylem and phloem transport:

Xylem transport	Phloem transport
1. Xylem tissues include tracheids, vessels, fibres and parenchyma and serve in ascent of sap/water and minerals.	1. Phloem tissues is a composed of four elements namely, sieve tube elements, companion cell, phloem fibres and phloem parenchyma and serve in translocation of organic nutrients.
2. Due to defined source and sink relationship, the movement is unidirectional.	2. The movement is multidirectional as source sink relationship keeps changing.
3. Xylem transport is not influenced by metabolic inhibitors.	3. Phloem transport is inhibited by metabolic inhibitors.
4. Xylem vessels and tracheids are main component of transport.	4. Sieve tube are main component of transport which are assisted by companion cells.
5. Major driving forces are transpiration pull and diffusion.	5. Being active transport, it uses ATP.