Lab 1: Solution and colloidal system

Why we study the solution?

The various physiological activities of the cell take place in a medium of water. They actually operate in dilute aqueous solutions suspensions and colloidal phases. A study of the properties of solutions, suspensions and colloidal system is therefore, necessary for a better understanding of the different physiological processes like protoplasm which found in complex colloidal system.

Solution

The solution known as homogeneous mixture composed of two or more substances related each together physically and chemically which have some chemical composition and physical properties. In such a mixture, a **solute** is dissolved in another substance, known as a **solvent.** After the solute is put in the solvent, it breaks to an atomic, ionic or molecular level and can no longer be seen as a separate entity. For example, mixing the solid material salt into the liquid water results in the salt dissolving into water and creating the salt water solution. The salt breaks into Sodium ($\mathbf{Na^+}$) and Chlorine ($\mathbf{Cl^-}$) ions within the water solvent.

If we solvent the some sugar in water or adding the alcohol to the water it causes to produce homogenous mixture called solution.

The term (**solvent**) refer to the substances that presents in large amounts, and other substances or (material) called as (**solute**).

For Example when we add the small amount of alcohol to large amount of water, the water are (solvent) and small amount of alcohol are (solute), and in different case which adding the small amount of water into the large amount of alcohol, The water are (solute) And Alcohol known as (solvent).

Colloid= when the solid particles in the liquid are suspended (heterogeneous).

Solution= when the solid particles in the liquid are totally dissolved (homogenous).

The nature of solution

Dilution and Saturated

1. When a solution contains a relatively small amount of solute such as salt and sugar, the ions of sugar and salt (Na+ and Cl-) dissolved gradually and equal between the water molecules, In this state, the (sugar and salt) act as **solute** and water act as **solvent**, in this case which solves the small amount of sugar and salt in water are caused to produce dilute solution, said to be **dilute (unsaturated)** solution.

2. On the other hand, a solution with a relatively large amount of solute is said to be **saturated** or **concentrated**, in fixed and equal temperatures and pressures.

3. If we add more solute substance to the saturated solution the crystal of this substances precipitate in button of tube at this time the solution in **super saturated** state, the solution that contain larger amount of solute than the amount which is require to saturation.

Type of solution

A-According to the type of solute and solvent. There are 9 types:

Solute	Solvent	Example
Gas	Liquid	(CO_2) in (H_2O) carbon dioxide in water.
Liquid	Liquid	Alcohol in water
Solid	Liquid	Salt or sugar in water
Gas	Gas	CO_2 in air or O_2 in air
liquid	Gas	Very small drops of water in air
Solid	Gas	Smoke in air
Gas	Solid	Air in soil or air in chalk part
Liquid	Solid	Absorption of water in wood or ink through the paper
Solid	Solid	Mixture of soil and sand

B-According to the size of (atoms or molecules or ions) of solute material in solution

1. **True solution**: The dispersed partical are generally less than (0.001) micron and cannot seen its molecule by microscope or other tools. True solution characterized by stability which are not precipitate by time periods (Sugar and salt in water), can't

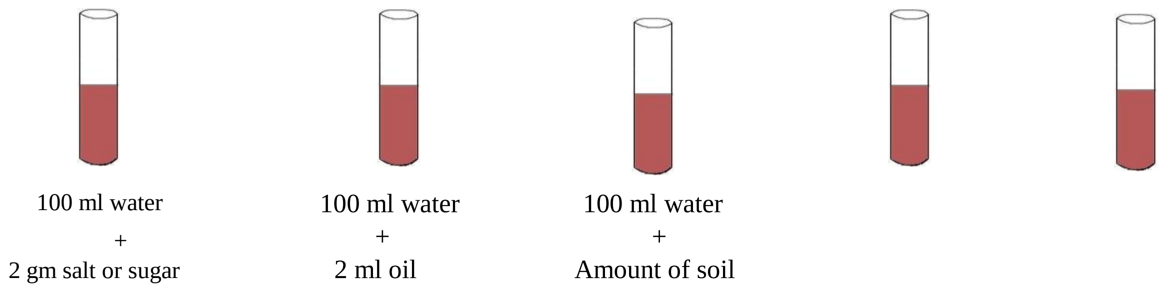
differentiate between the solute and solvent molecules even at the microscopic level and it is completely homogeneous.

2. **Suspension and Emulsions:** The solute particles don't dissolve in solvent but they are distributing in solvent, if the solute material are solid so it is called **Suspension** (ex: soil particle in water) but if the solute material are liquid so it is called **Emulsions** such as (oil in water). The size of its particle greater than (0.1) micron can be seen by the naked eye. It is unstable solution, fast precipitate and large size particles.

3. **Colloidal system:** When particle substance is distributed throughout water in a stable manner the system is called colloidal. The size of the particles as well as the properties of the system is intermediate between true solutions and suspensions. Like suspension, the dispersed particles are not in the molecular form but are present as aggregates of molecules, which are not so large as to settle down. The particle remains stable throughout the liquid like true solutions. In general the dispersed particle of a colloidal system is between 0.001- 0.1 micron in diameter. ex: enzymes, proteins, stains, cytoplasm of cells.

Procedure

1. Preparation of true solution
2. Preparation of emulsion
3. Preparation of suspension
4. Saturated Solution
5. Super Saturated Solution



Lab 2: Osmosis Demonstration

Objectives: the student will:

Observe the effects of different concentrations of salt solutions on potato cores.
Infer the relationship between weight loss and rate of osmosis.

Background

Osmosis is the process whereby water moves across a cell membrane by diffusion. Diffusion takes place when the molecules of substance tend to move from areas of higher concentration to areas of lower concentration. The process of osmosis must be tightly controlled by cells, otherwise they will die. For example, if you place a red blood cell in pure (distilled) water, it will quickly take up water until it bursts. That is why plasma, the liquid portion of our blood is made of water with proteins and salts dissolved in it, preventing the unnecessary gain of water by our blood cells.

In plants, osmosis is just as important. Plants with too little water will wilt. This happens when water moves out of the cell by osmosis. Without this water there is little pressure inside the cells and the plant can no longer support itself against the pull of gravity.

However, after watering the plant, the cells become reinflated with water and the plant stands upright. The effect of water loss on plant cells is shown in the diagram below.

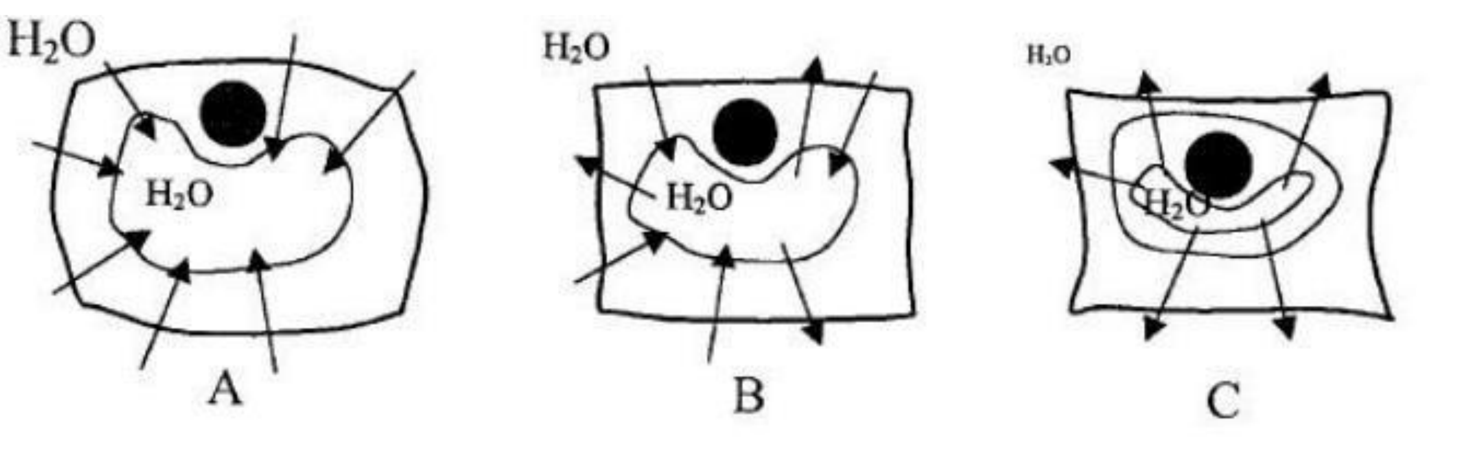


Figure 1. *A.* Plant cell placed in pure water. This cell will become inflated because the water outside the cell is at a higher concentration than the water inside the cell. As water moves in by osmosis the vacuole fills up and presses out against the cell wall. **B.** *The same cell in water equal to the concentration inside the cell.* This cell has no overall gain or loss of water because whatever moves out will be replaced by water moving in. **C.** *A cell placed in a salt solution.* This cell will lose water as the water moves by diffusion from higher to lower concentration. The cytoplasm of this cell has shrunken in a process called plasmolysis. (The size of the symbols for water represent the relative concentration: larger symbol = more water.)

Lab 3. Diffusion in plants

Diffusion is the net flow of molecules from region of high concentration to a region to low concentration. The difference in concentration of a substance across space is called a concentration gradient. Diffusion is due to the random movement of particles. All objects in motion have energy of motion. Particles of matter move in straight lines until they collide with other particles. After colliding, the particles rebound, move off in straight lines until the next collision. There is no loss of energy. In diffusion, molecules move randomly colliding with one another until they become evenly distributed. For example, if one puts a teaspoon of a purple dye, potassium permanganate, into a beaker of water, then the dye molecules, or solute, will collide randomly with the water molecules.

Factors affecting of diffusion

1. The size and mass of solute
2. The temperature and pressure
3. Concentration of gradient
4. The nature of the diffusion medium
5. The permeability of the separating membrane

Diffusion plays a key role in photosynthesis, where carbon dioxide enters the plant through the stomata, diffuses into the leaves, and ultimately into the cells. Similarly, during transpiration, water and oxygen exit from the leaves and diffuse into the surrounding environment.

Importance of diffusion in plants

1. It is an essential step in exchange of gases during respiration & photosynthesis.
2. Transmission of water, salts and other solute from the soil to the plant through the root group.

Types of Diffusion in Plants

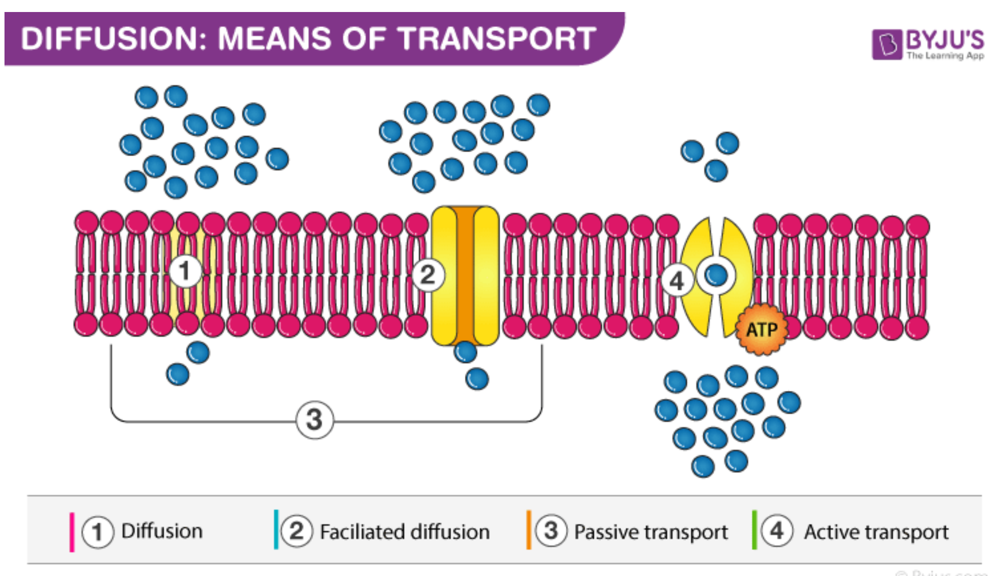
There are two main types of diffusion in plants:

1. Simple Diffusion

Simple diffusion is a type of diffusion that does not rely on membrane proteins for support. In essence, the particle or substance travels from a greater concentration to a lower concentration. However, its mobility does not necessitate the presence of a membrane protein that aids in the transport of things downward.

2. Facilitated Diffusion

With the assistance of a transport molecule, chemicals can be transported across a biological membrane from a region of higher concentration to an area of lower concentration..



Lab 4. Soil texture and textural class

Introduction

Soil texture is one of the most important properties of a soil, and it greatly affects land use and management. Soil texture is defined as the relative proportion of sand, silt and clay. It affects the amount of water and nutrients that a soil can hold and supply to plants. Soil physical properties such as structure and movement of air and water through the soil are affected by texture. Texture is a relatively permanent physical property under natural conditions.

The ranges of diameters of the three separates are: sand (2.0-0.05 mm), silt (0.05-0.002 mm), and clay (<0.002 mm). Soil textures can be determined in laboratory analyses where the amount of sand, silt, and clay are measured quantitatively. The soil textural class is determined using the **Textural triangle (Figure 1).** In the field, the soil's texture may be determined by the "feel" method

Soil textural classes are based on the relative proportions of the various soil separates (sand, silt, and clay). There are 12 different soil textural classes. The percentage units (0-100%) of sand, silt. and clay are listed along the sides of the triangle. Also notice that the relative proportion of sand, silt, and clay always adds up to 100%. These 3 separates are the only particles used to determine soil texture. Soil texture refers only to the mineral fraction of the soil. Organic matter is not considered when determining texture or textural class. A precise analysis of soil texture requires that organic matter be removed.

Sand: Is the largest of the mineral particles, particles creating large pore space that improving aeration water flow quickly through large pore space. Sandy soil lacks the ability to hold nutrient and are generally well drained, also are not fertile.

Silt: medium size soil particles. It has good water-holding ability and fertility characters.

Clay: Is the smallest size soil particles. It has ability to hold both nutrient and water that can be use by plants. It creates very small pore space resultingin poor aeration and poor water drainage.

Using the Soil Texture Chart:

To determine the texture class of a soil, you will first determine the % sand, silt, and clay in the sample. Using these values you consult the chart above to determine the texture class. To read the triangular chart draw lines from points on each axes that correspond to the values you obtained from mechanical analysis. The texture class in which the lines intersect is the texture class of your soil.

Determining Soil Texture by the Ribbon Method

Materials: 1. Soil samplers 2. Tap water

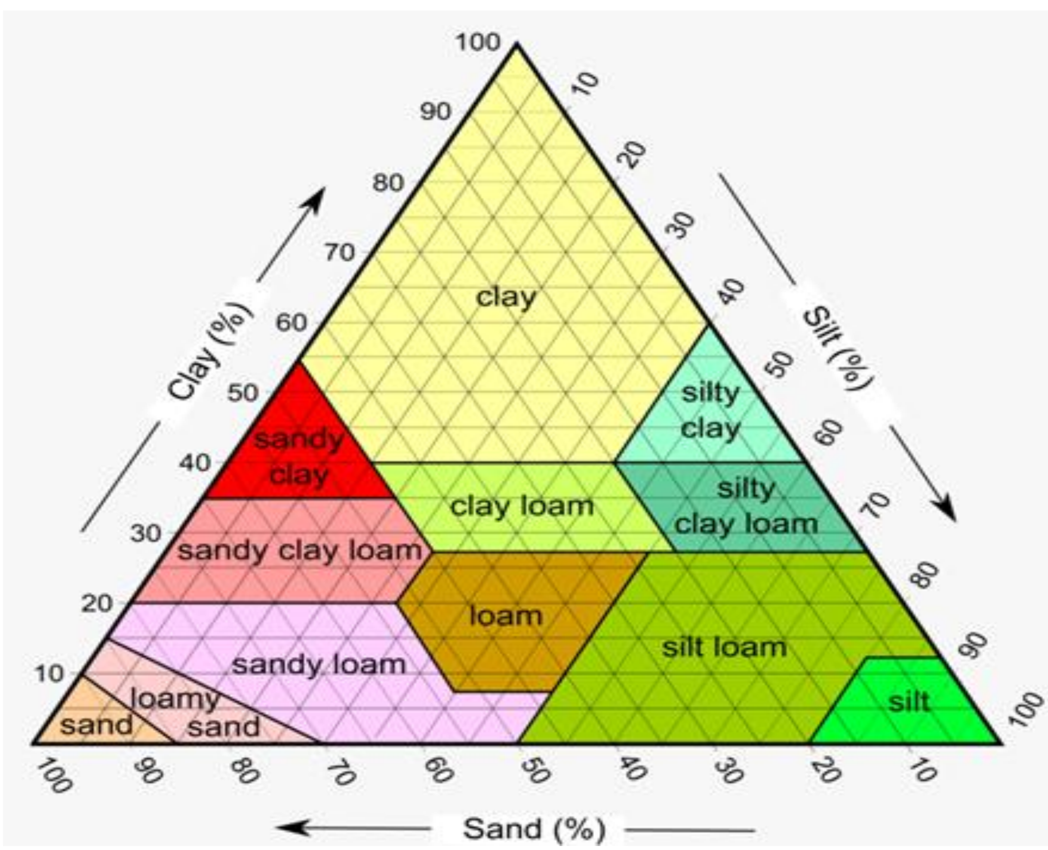
Using the Ribbon Test to Estimate Soil Texture

Step 1: Collect a small amount of dry soil in your palm.

Step 2: Add water drop wise to the dry soil until it takes on the consistency of modeling clay.

Table 1: Diameter ranges of the soil separates (sand, silt, and clay).

Soil Fraction	Soil Separate	Particle Diameter in mm
Sand	Very coarse sand	1 to 2
	Coarse sand	0.5 to 1
	Medium sand	0.25 to 0.5
	Fine sand	0.10 to 0.25
	Very fine sand	0.05 to 0.10
Silt	Silt	0.002 to 0.05
Clay	Clay	< 0.002



Lab 5. Imbibition

Objective

The objective of doing this experiment is to determine the percentage of water imbibed by raisins.

The Theory

Raisins when soaked in water swell up due to imbibition. As a result of absorption or imbibition of water, the size of the raisins increases. The difference in mass between the swollen and dry raisins gives the amount of water imbibed by the raisins.

Transportation of water in plants

Water is the most important constituent of plants and is essential for the maintenance of life, growth and development. Transportation of water into and through a plant takes place by different processes like osmosis, diffusion and imbibition.

What is Imbibition?

Imbibition is the process of adsorption of water by substances without forming a solution. Swelling of seeds when immersed in water is an example of imbibition. Imbibition is the temporary increase in the volume of the cell. Imbibition is a passive transport of materials that does not require energy during the process.

The substance that imbibes water is called imbibant and the liquid which is imbibed is called adsorbent. The process of imbibition occurs mainly due to the presence of hydrophilic or lyophilic colloids. Water is imbibed through the sub microscopic capillaries present on the surface of the body. Substances such as cellulose and starch are hydrophilic and are imbibants.

(Hydrophilic means ' water loving, or readily absorbing moisture).

The movement of water into the plant parts continues until a dynamic equilibrium is attained. Imbibition of water increases the volume of the imbibant, which results in imbibitional pressure. This pressure can be of tremendous magnitude. This fact can be demonstrated by a method used to split rocks. Here, dry wooden stalks are inserted into the crevices of the rocks and soaked in water, a technique used by early Egyptians to cleave stone blocks.

Imbibing does not necessarily mean the ability to imbibe all kinds of liquids. For example, dry plant parts immersed in ether do not swell appreciably, however, a rubber plant imbibes ether and swells if submerged in it. On the other hand, the product rubber does not imbibe water.

Factors affecting the rate of Imbibition

- Nature of imbibant: Different types of organic substances have different imbibing capacities. Proteins have a very high imbibing capacity, starch has less capacity and cellulose is the weakest imbiber. That is why proteinaceous pea seeds swell more on imbibition than starchy wheat seeds
- Temperature: The rate of imbibition increases with the increase in temperature.
- Concentration of the solute: Increase in concentration of the solute decreases imbibition due to a decrease in the diffusion pressure gradient between the imbibant and the liquid being imbibed.
- Surface area of imbibant: The imbibition will be greater when the surface area of imbibant is larger.

Biological importance of Imbibition

- Imbibition is dominant in the initial stage of water absorption by roots.
- Seed germination is initiated by imbibition.
- Imbibition force is useful in adhering water to the walls of xylem elements.
- Fruits retain water by imbibition.
- The movement of water into ovules that are ripening into seeds is made possible by the process of imbibition.

Lab 6. Pollination

Our Objective

Our aim is to study pollen germination on a slide.

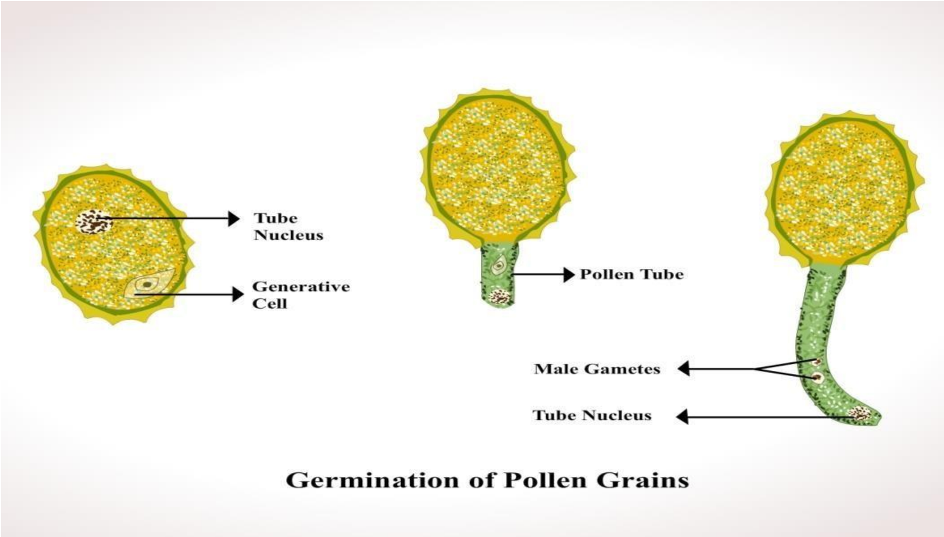
What is pollination?

Pollination is a very important part of the life cycle of a flowering plant. Pollination is the transference of pollen grain from the anthers of a flower to the stigma of the same or another flower, mediated by abiotic or biotic means. Abiotic means the pollen is not carried by organisms, but through means such as wind or water. Biotic pollination occurs through agents like animals, insects or birds. The majority of plants are pollinated through biotic pollination.

Let's see how pollen germinates

In flowering plants, however, the ovules are contained within a hollow organ called the pistil, and the pollen is deposited on the pistil's receptive surface, the stigma. On the stigma, the germination of pollen grains begins by absorption of water and nutrients and the pollen grain produces a tiny pollen tube through the style to the ovary. The tube cell enlarges and comes out of the pollen grain through one of the germ pores to form a pollen tube. The tube nucleus descends to the tip of the pollen tube.

The generative cell also passes into it. It soon divides into two male gametes. In an act of double fertilization, one of the two sperm cells within the pollen tube fuses with the egg cell of the ovule, making possible the development of an embryo, and the other cell combines with the two subsidiary sexual nuclei of the ovule, which initiates formation of a reserve food tissue, the endosperm. The growing ovule then transforms itself into a seed. We can stimulate pollen germination in vitro with the help of a nutrient medium.



Lab Procedure

- Prepare the pollen germination medium by dissolving 10 grams sucrose, 10 milligrams boric acid, 30 milligrams magnesium sulphate and 20 milligrams potassium nitrate in 100ml of distilled water.
- Using a glass rod, stir the solution to mix it well.
- Using a dropper, take some nutrient solution and put two drops on a clean glass slide.
- Take a mature flower and dust a few pollen grains from its stamen on to the drop on the slide.
- After 5 minutes, place the glass slide on the stage of the compound microscope.
- Observe the slide through the microscope regularly for about half an hour.

Observations

The pollen grain is uninucleate (has one nucleus) in the beginning. At the time of liberation, it becomes 2 celled, with a small generative cell and a vegetative cell.

In the nutrient medium, the pollen grain germinates. The tube cell enlarges and comes out of the pollen grain through one of the germ pores to form a pollen tube. The tube nucleus descends to the tip of the pollen tube. The generative cell also passes into it. It soon divides into two male gametes.

Lab 7. Transpiration

Loss of water in the form of vapor from living plants, particularly from the aerial parts (parts which is exposed to the air), this process is in principle one of evaporation & diffusion.

Leaf surfaces are dotted with openings called stomata, which pores that are bordered by guard cells .The rate of transpiration is directly related to the degree of stomatal opening. The amount of water lost by a plant depends on its size , along with the surrounding light intensity ,temperature , humidity,& wind speed ,soil water supply &soil temperature can influence stomatal opening, & thus transpiration rate.

The transpiration occurs as a result of water potential differences among the parts of system (soil, root, stem, leaf, and atmosphere).

Soil Wp.> Root > stem> leaves>atmosphere Wp.

Most the transpiration rate occur through the mesophyll tissue of the leaf, particularly through their parenchymal cells, because they have thin walls, no pectin materials is found , more inter space between the cells for their non re gularly shapes

Types of transpiration

1. Stomatal t. → 90-95%
2. Cuticular t. → 1- 10%
3. Lenticular t. → 2-8%

Lenticles are the minute openings on the surface of stems &twigs, replaced the stomata in thesecondary plant tissue.

Q/what is the importance of transpiration in plants?

1. cooling the plant tissue in the leaf (each gram of water to evaporated through the stomataneeds (580 calorie)which absorbed this heat from the plant tissue).

2. promotes absorption & translocation of solutes.
3. Exude the increasing water from the plant &kept the optimum turgor for the plants cells.

Factors affect the rate of transpiration:

a. Environmental factors

1. Light 2. Temperature 3. Air humidity 4. Wind speed 5. Soil water content

b. Plant factors

1. Leaf area 2. Root-shoot ratio 3. Leaf structure &stomata

Practice part

Cobalt chloride paper method

Transpiration is estimated by a change in color rather than by a change in weight. Pieces of filter paper are soaked in cobalt chloride solution (3%) then dried in oven at (60 c) . papers colored with blue when dry and turn pink when moist .