

Diffusion:

It is the movement of particles from region of higher concentration to region of lower concentration through random motion. The movement of molecules of any substances is due to their kinetic energy and the process continues until the equilibrium mentioned.

The rate and direction of diffusion depends upon the concentration of diffusing particles and independent to the presence of other particles.

Factors affecting diffusion:

- 1. Diffusion Pressure gradient:** The pressure exerted by the diffusing particles is known as diffusion pressure. The minimum change in diffusion pressure along higher and lower concentration is known as diffusion pressure gradient. Diffusion of a particle is only possible when there is presence of diffusion pressure gradient. The rate of diffusion is proportional to the diffusion pressure gradient.
- 2. Size of substance:** The diffusion rate is high in case of small particles.
- 3. Density:** The rate of diffusion is inversely proportional to the density of diffusing particles.
- 4. Temperature:** With the increase in temperature, the free energy in the diffusion particle increases resulting the increase in diffusion.

Significance in diffusion:

1. It is an essential step in the exchange of gases during respiration and photosynthesis. It helps to diffuse in O_2 and diffuse out CO_2 during respiration; and diffuse in CO_2 and diffuse out O_2 during photosynthesis.
2. It helps in pollination by the diffusing of aromatic compounds that attracts insects.
3. It helps in transporting food, waste and other substances in and out of the cells.
4. It helps in transportation of glucose in liver cells and RBCs.
5. Diffusion is essential in the absorption of ions during passive salt uptake.

Osmosis:

It is defined as movement of solvent particles from higher concentration to lower concentration through semi-permeable membrane. Semi-permeable membrane is defined as partially permeable membrane through which solvent molecules easily pass but solute does not.

Osmosis is of two types.

- 1. Exosmosis:** The water moves out from the cell when is placed in a hypertonic solution then is known as exosmosis.

- 2. Endosmosis:** The water moves in the cell when is placed in a hypotonic solution, then is known as endosmosis.

Plasmolysis: When a cell placed in hypertonic solution, the exosmosis takes place where water molecules are diffuse out. Due to the loss of water by cells, the protoplasm is shrink by which it losses the contact with cell wall. This condition of cell is called flaccid cell.

The process of shrinkage of cell membrane due to loss of water when placed in hypertonic solution is known as plasmolysis.

Deplasmolysis: When the same plasmolysed cell placed in hypotonic solution, endosmosis occur. Here the liquid re-entered into cell and cell becomes full. This condition of cell is known as turgid cell.

The process of expansion of cell membrane of plasmolysed cell when kept in hypotonic solution is known as deplasmolysis.

Factors affecting Osmosis:

- 1. Temperature:** When two solutions having different temperature are separated by semi-permeable membrane, the water molecule diffuses from higher temperature to the lower temperature.
- 2. Pressure:** When two solutions having different pressure are separated by semi-permeable membrane, the water molecule diffuses from higher pressure to lower pressure.
- 3. Concentration of solution:** When two different concentrated solutions are separated by semi-permeable membrane, the water molecule diffuse from lower concentrated solution to higher concentrated solution.

Significance of Osmosis:

1. The absorption of water by the root hairs from the soil and the movement of water from one cell to another within the plant are due to osmosis.
2. It helps to keep young stem and leaves erect and extended.
3. Opening and closing of stomata depends upon the turgidity of guard cells.
4. It maintains turgidity of the plant cells contributing in the growth of the plant.
5. High osmotic concentration of cells greatly increases the resistance to drought and frost.

Transpiration:

Plant absorbs large quantity of water from the soil through root. The absorb water is either utilized in the plant for various purposes or lost in the form of water vapour from aerial part of plants. Such loss of water in the form of water vapour from the aerial parts of the plant is called transpiration.

In other words, transpiration is also defined as loss of excess water from aerial part of plants in the form of water vapour. The amount of transpired water is greater than the utilized one. A plant utilized less than 2 percent of absorbed water in its various metabolic activities.

Mechanism of Transpiration:

Transpiration occurs due to turgor pressure. Turgor pressure is generated inside mesophyll cells of the leaf. This forces water outwards through the cell wall in the intercellular spaces. Water is collected in the intercellular spaces, which later diffuses out of the stomata into the atmosphere.

Types of Transpiration:

On the basis of occurrence of transpiration, it is of following types.

- 1. Stomatal transpiration:** The transpiration which occurs through stomata is called stomatal transpiration. About 90% of total transpiration takes place through stomata. The stomata are commonly found on leaves but are also present in young stem, flower etc.
- 2. Cuticular transpiration:** If the loss of water from cuticle or epidermal layer of plant parts, then is called cuticular transpiration. About 3 – 10% of total transpiration occurs through it.
- 3. Lenticular transpiration:** Lenticels are the opening on epidermal layer in woody stem (branches). The transpiration occurs through lenticels is called lenticular transpiration. About 0.5% of total transpiration occurs through it.
- 4. Bark transpiration:** Bark is corky covering of the stem. The transpiration occurs through it is called bark transpiration.

Factors affecting Transpiration:

A. External Factors:

- 1. Relative humidity:** The rate of transpiration is inversely proportional to relative humidity of air.
- 2. Atmospheric pressure:** Low atmospheric pressure increases evaporation. It helps to increase the rate of transpiration.
- 3. Temperature:** High temperature of surrounding helps opening of stomata. It reduces the relative humidity and increase transpiration.
- 4. Movement of air:** The movement of air increases the rate of transpiration.
- 5. Light:** The rate of transpiration directly proportional to light. It helps in opening of stomata.
- 6. Availability of water:** Transpiration is equivalent with the rate of absorption. The different factors as soil temperature, soil water, soil air etc

influence the absorption of water which also influences the transpiration rate.

B. Internal Factors:

1. **Leaf area:** Transpiration directly proportional to leaf area. Larger area of leaf contains more stomata that increase transpiration.
2. **Leaf structure:** The different structures of leaf influence the transpiration rate. The factors as thick cuticle, reduced number of stomata, sunken stomata, compact mesophyll cells, modification of leaves into spine, scales etc reduce the transpiration rate.
3. **Root/Shoot ratio:** High root/shoot ratio increase the rate of transpiration.
4. **Plant age:** As the plant becomes mature, the rate of transpiration also increases.

Significance of Transpiration:

A. Advantages:

1. It exerts a suction force that helps in ascent of sap.
2. It helps to remove excess water that enables plants to absorb extra water.
3. It lowers the temperature of plants.
4. It helps in the development of mechanical tissue.
5. It helps to increase the concentration of mineral salts in plants.
6. It helps in hardening of tissue and makes plant resistant to drought.

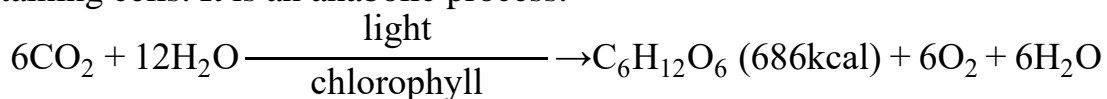
B. Disadvantages:

1. If transpiration occurs excessively, wilting of leaves occurs that reduce photosynthesis and other metabolic activities.
2. It reduces water availability inside the plant.
3. It losses the energy used in absorption and conduction.

Guttation: The loss of water in liquid form.

Photosynthesis:

It is the process by which energy rich compound is formed by the combination of simple inorganic compound as CO₂ and H₂O in presence of sunlight in chlorophyll containing cells. It is an anabolic process.



It is an important physiological process by which food is prepared and oxygen is evolved as byproduct. It uses huge amount of CO₂ from the atmosphere so it helps to reduce global warming. The food prepared by plant consumed by different organism from which energy produce by oxidation. Fuel is also indirect source of photosynthesis.

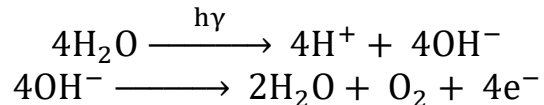
The green plants are independent to prepare their food by themselves. They are not dependent on other organisms for their food materials. Hence, they are also known as autotrophic organisms.

They prepare large amount of food and supplied to other living organisms in different forms. Thus, all living organisms are directly or indirectly depend upon plants for food. Hence, they are ecologically known as producers.

Photosynthesis a complex oxidation and reduction process which is completed in two main stages.

1. Light reaction: It is the first stage of photosynthesis which requires light to complete. It is also known as Hill reaction after the name of Robin Hill (1937). It takes place in granum of chloroplast. In this reaction, chlorophyll absorbs light to split H_2O .

The breaking down of water and produce O_2 in presence of light is called photolysis of water.



In this reaction, one electron is produced per water molecule. Thus produce electron is accepted by different intermediates.

2. Dark reaction: In this reaction, fixation and reduction of CO_2 takes place by utilization of ATP and $NADPH_2$ (Nicotinamide adenine dinucleotide dihydrogen phosphate). It takes place in stroma of chloroplast. It was discovered by Calvin, Benson and their colleagues in USA. Hence, is called Calvin cycle that do not require light.

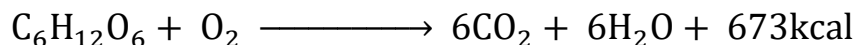
Importance of photosynthesis:

1. It is the primary source of organic food and food energy (ATP) for all forms of life, either directly or indirectly.
2. Excess sugars produced in photosynthesis are either stored in the form of carbohydrates or used in the biosynthesis of other organic compounds.
3. They are most essential biotic components in ecosystem as they are producers.
4. It helps to purify air and it maintains balance of oxygen and carbondioxide in the ecosystem.
5. The energy stored in fossil fuels is basically solar energy which was trapped and stored during photosynthesis.

Respiration:

It is the process by which carbohydrate is breaking down into carbondioxide and water in presence of oxygen. In other words, respiration is defined as cellular oxidation of carbohydrate by which carbondioxide and water are produced as final

product. It is the oxidative process occurring within the living cells. It is a catabolic process.



Various organic compounds such as carbohydrates, fats, proteins etc are oxidized to release energy during respiration. Among them, glucose is commonest. These compounds are called 'respiratory substrates'.

The energy produced by respiration is stored in the form of ATP. It is made up of one molecule of adenine, ribose sugar and inorganic phosphate. On hydrolysis of ATP, it release high amount of energy.



Types of Respiration:

On the basis of using molecular oxygen, it is of two types.

- 1. Aerobic respiration:** Here, organic food is breaking down in presence of molecular oxygen.
- 2. Anaerobic respiration:** Here, organic food is breaking down in absence of molecular oxygen.

Difference between Aerobic and Anaerobic respiration:

Aerobic respiration	Anaerobic respiration
1. It is the breaking down of carbohydrate in presence of oxygen.	1. It is the breaking down of carbohydrate in absence of oxygen.
2. The release energy is stored in terms of ATP.	2. The release energy is not stored for further utilization.
3. Here, the electron acceptor is oxygen.	3. Here, the electron acceptors are sulphate, nitrate, sulphur etc.
4. It occurs inside the mitochondria.	4. It occurs at cytoplasm.
5. Huge amount of energy is release (673kcal or 38ATP).	5. Few amount of energy is release (28kcal or 2ATP).
6. Organic food is completely broken down.	6. Organic food is partially breakdown.
7. The final product is inorganic.	7. The final product is organic.
8. It consists of 4 different phases.	8. It consists of 2 different phases.

Fermentation:

The process of extracting energy from the oxidation of organic compounds using electron acceptor is known as fermentation.

The fermentation occurs either naturally or industrially. The fermentation which occurs naturally does not involve any organisms whereas in industrially involves different organisms. The common organism which involve in fermentation is yeast.

- » Yeast (*Saccharomyces* spp.), *Mucor indicus*, *Rhizopus oryzae* are used for alcohol fermentation.
- » Lactic acid bacteria (*Lactobacillus*, Streptococcus) are used for lactic acid fermentation.
- » *Acetobacter* is used for acetic acid fermentation.
- » *Clostridium* is used for acetone fermentation.

Importance of Fermentation:

1. Yeasts are used to produce alcoholic beverages.
2. Fermentation is used in bakery industry.
3. Cheese, yogurt are formed by fermentation of milk by lactic acid bacteria.
4. Fermentation produces lactic acid in sour foods such as dry sausages, kimchi and vinegar for use in pickling foods.
5. It is also used to produce 12 different amino acids industrially.
6. Antibiotics (Penicillin, Ustilagic acid, Fumagillin, Fumigatin etc) are one of the important compound produce by fermentation.
7. Different enzymes (Amylase, Protease, Lipase, Pectic enzymes etc) and vitamins (vit. B, vit. A, Ergosterol, Riboflavin etc) are produce by fermentation.
8. Bio fuels are produced by fermentation process.