

9th Science Lesson 19 Notes in English

19] Plant Physiology

Introduction

Animals move in search of food, shelter and for reproduction. Do plants show such movement? Have you observed the leaves of *Mimosa pudica* (touch-me-not plant) closes on touching, whereas *Helianthus annuus* (sunflower) follows the path of the sun from dawn to dusk, (from east to west). These movements are triggered by an external stimuli. Unlike animals, plants do not move on their own from one place to another, but can move their body parts for getting sunlight, water and nutrients. They are sensitive to external factors like light, gravity, temperature etc. In this lesson, we will study about various movements in plants, photosynthesis and transpiration.

Tropism in Plants

Tropism is a unidirectional movement of a whole or part of a plant towards the direction of stimuli.

Types of Tropism

Based on the nature of stimuli, tropism can be classified as follows.

Phototropism: Movement of a plant part towards light. e.g. shoot of a plant.

Geotropism: Movement of a plant in response to gravity. e.g. root of a plant.

Hydrotropism: Movement of a plant or part of a plant towards water. e.g. root of a plant.

Thigmotropism: Movement of a plant part due to touch. e.g. climbing vines.

Chemotropism: Movement of a part of plant in response to chemicals. e.g. growth of a pollen tube in response to sugar present on the stigma.

Tropism is generally termed positive if growth is towards the signal and negative if it is away from the signal. Shoot of a plant moves towards the light, the roots move away. Thus the shoots are positively phototropic



Figure 19.1 Positive phototropism
(Negatively geotropic)

Usually shoot system of a plant is positively phototropic and negatively geotropic and root system is negatively phototropic and positively geotropic.



Figure 19.2 Negative phototropism
(Positively geotropic)

Some halophytes produce negatively geotropic roots (e.g. *Rhizophora*). These roots turn 180° upright for respiration.

Nastic Movements

Nastic movements are non-directional response of a plant or part of a plant to stimulus. Based on the nature of stimuli, nastic movements are classified as follows.

Photonasty: Movement of a part of a plant in response to light. e.g. *Taraxacum officinale*, blooms in morning and closes in the evening. Similarly, *Ipomea alba* (Moon flower), opens in the night and closes during the day



Night

Day

Figure 19.3 Photonasty in Moon flower

Thigmonasty: Movement of a part of plant in response to touch. e.g. *Mimosa pudica*, folds leaves and droops when touched. It is also known as Seismonasty



Figure 19.4 Thigmonasty in Mimosa pudica

The Venus Flytrap (Dionaea muscipula) presents a spectacular example of thigmonasty. It exhibits one of the fastest known nastic movement.



Table 19.1 Differences between Tropic and Nastic movements

Tropic movements	Nastic movements
Unidirectional response to the stimulus.	Non-directional response to the stimulus.
Growth dependent movements.	Growth independent movements.
More or less permanent and irreversible.	Temporary and reversible.
Found in all plants.	Found only in a few specialized plants.
Slow action.	Immediate action.

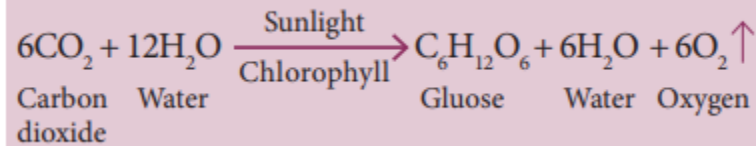
Thermonasty: Movement of part of a plant is associated with change in temperature. e.g. Tulip flowers bloom as the temperature increases.



Figure 19.5 Thermonasty in Tulip

Photosynthesis

'Photo' means 'light' and 'synthesis' means 'to build'. Thus photosynthesis literally means 'building up with the help of light'. During this process, the light energy is converted into chemical energy. Green plants are autotrophic in their mode of nutrition because they prepare their food materials through a process called photosynthesis. The overall equation of photosynthesis can be given as below:



Do the insects also trap solar energy? Tel Aviv University Scientists have found out that *Vespa orientalis* (Oriental Hornets) have similar capabilities to trap solar energy. They have a yellow patch on its abdomen and an unusual cuticle structure which is a stack of 30 layers thick. The cuticle does not contain chlorophyll but it contains the yellow light sensitive pigment called xanthopterin. This works as a light harvesting molecule transforming light energy into electrical energy

The end product of photosynthesis is glucose which will be converted into starch and stored in the plant body. Plants take in carbon dioxide for photosynthesis; but for its living, plants also need oxygen to carry on cellular respiration.

Requirements for Photosynthesis

These activities show that certain things are necessary for photosynthesis. They are:

1. Chlorophyll - Green pigment in leaves
2. Water
3. Carbon dioxide (from air)
4. Sun light

Transpiration

The loss of water in the form of water vapour from the aerial parts of the plant body is called as transpiration. The leaves have tiny, microscopic pores called stomata. Water evaporates through these stomata. Each stomata is surrounded by guard cells. These guard cells help in regulating the rate of transpiration by opening and closing of stomata.

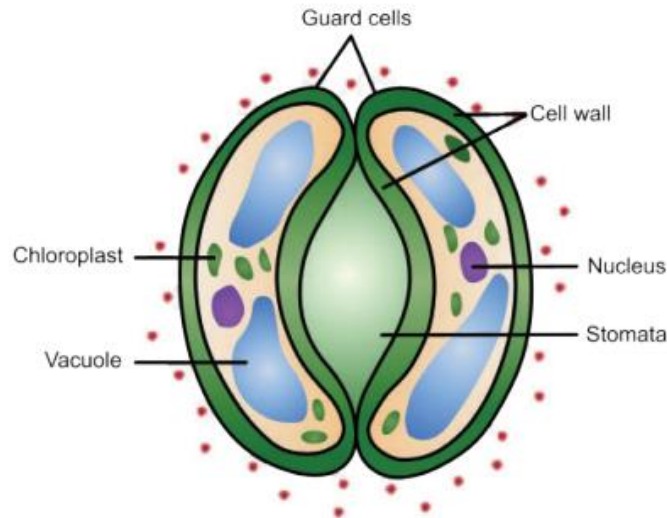


Figure 19.6 Structure of Stomata

Types of Transpiration

There are three types of transpiration:

Stomatal transpiration: Loss of water from plants through stomata. It accounts for 90- 95% of the water transpired from leaves.

Cuticular transpiration: Loss of water in plants through the cuticle.

Lenticular transpiration: Loss of water from plants as vapour through the lenticels. The lenticels are tiny openings that protrude from the barks in woody stems and twigs as well as in other plant organs.

But transpiration is necessary for the following reasons.

1. It creates a pull in leaf and stem.
2. It creates an absorption force in roots.
3. It is necessary for continuous supply of minerals.
4. It regulates the temperature of the plant.

Exchange of Gases

How does the plant get air? The leaves have minute pores called stomata through which the exchange of air takes place. These minute pores can be seen through a microscope. Air exchange takes place continuously through the stomata. Plants exchange gases (CO_2 to O_2) continuously through these stomata. You will study more about these physiological process in your higher classes.

Points to Remember

- Growth movement whose direction is determined by the direction of the stimulus is called Tropism.
- Non-directional, response of a plant part to stimulus is called nastic movement.
- The process by which plants prepare their food material is called photosynthesis.
- The loss of water in the form of water vapour from the aerial parts of the plant body is called transpiration. Stomata are minute opening on the leaves.

GLOSSARY

- Phototropism Unidirectional movement of a plant part to light stimulus.
- Geotropism Response of a plant part to gravity stimulus.
- Hydrotropism Response of a plant part to water stimulus.
- Thigmotropism Response of a plant part to touch stimulus.
- Chemotropism Response of a plant part to chemical stimulus.
- Thigmonasty Non-directional movement of a plant part in response to touch of an stimulus.
- Photonasty Non-directional movement of a plant part in response to light stimulus.