TO IMPROVE THE UNDERSTANDING OF TROPISM IN PLANTS AMONG IX STANDARD STUDENTS THROUGH ACTIVITIES AND EXPERIMENTS

ACTION RESEARCH REPORT

Submitted by

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CERTIFICATE

This is to certify that the action research entitled "***To improve the understanding of Tropism in plants among IX Standard Students through Activities and Experiments***" is the independent research work done by Mrs.S**.NIRMALA DEVI**,M.Sc.,M.Ed., ***Lecturer,*** Block Institute of Teacher Education, Manjakuppam, Cuddalore under my supervision at this institute during the period 2023-24 as per the requirement of the State Council of Educational Research and Training, Chennai.

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(S. NIRMALA DEVI)

Introduction

The branch of Science that deals with the study of structure and function of plants and its parts is known as Plant Physiology. Plants' importance is equal to any other living organism that is present on our planet earth. Plants basically are the reasons by which most of the organisms are surviving on earth. Plants provide us with oxygen in which we breathe. Besides this there are a number of sources we are going to get from plants. We even get our food from the plants. Plants fulfill all the basic necessities of an organism. Plant physiology is a branch of botany that studies how plants work, Plant morphology (shape), plant ecology (interactions with the environment), phytochemistry (biochemistry of plants), cell biology, genetics, biophysics, and molecular biology are all closely connected sciences. Plant physiologists research fundamental processes like photosynthesis, respiration, plant nutrition, plant hormone functions, tropisms, nastic movements, photo periodism , photo morphogenesis, circadian rhythms, environmental stress physiology, seed germination, dormancy, and stomata function, which are both parts of plant water relations.

Plant physiology is the study of all of a plant's internal functions, including the chemical and physical processes that are connected with life in plants. This involves research on a wide range of size and time scales. Molecular interactions

of photosynthesis and internal diffusion of water, minerals, and nutrients occur at the smallest scale. Plant development, seasonality, dormancy, and reproductive control are all activities that occur on a huge scale. Phytochemistry (the study of plant biochemistry) and phytopathology are two major sub disciplines of plant physiology (the study of disease in plants). Plant physiology as a discipline can be broken down into three primary research topics.

Plant physiology, third, is concerned with the interactions of cells, tissues, and organs inside a plant. Physically and chemically, different cells and tissues are special to fulfill different roles. The purpose of the roots and rhizoids is to anchor the plant and acquire minerals from the soil. In order to create nutrition, leaves capture light. Minerals from the roots must be delivered to the leaves, and nutrients generated in the leaves must be transported to the roots, for both of these organs to remain alive. Plants have created a variety of mechanisms to perform this transport, such as vascular tissue, and plant physiologists study how these varied forms of transport work.

Plant physiologists, on the other hand, investigate how plants govern and regulate their internal activities. Hormones are created in one area of the plant to tell cells in another section of the plant to respond, just as they are in mammals. Because of light-sensitive chemicals that respond to the length of the night, many

blooming plants bloom at the right time, a phenomenon known as photoperiodism. The plant's production of the gas ethylene regulates the ripening of fruit and the loss of leaves in the winter.

Finally, environmental physiology is a branch of plant physiology that studies how plants respond to different environmental situations and how they change. Water loss, changes in air chemistry, and crowding by other plants can all cause a plant's function to change. Genetic, chemical, and physical factors may all influence these alterations. Hormones and other growth regulators are produced by plants to indicate physiological responses in their tissues. They also create light-sensitive chemicals like phytochrome, which help to induce growth or development in response to environmental signals.

Plant physiology is an important topic in horticulture and agriculture, as well as food science, when it comes to fruits, vegetables, and other consumable sections of plants. Climate needs, fruit drop, nutrition, ripening, and fruit set are among the topics researched. The study of plant physiology, which includes themes like optimal planting and harvesting periods, post-harvest storage of plant products for human consumption, and the creation of secondary goods like pharmaceuticals and cosmetics, is also important in the production of food crops. Crop physiology takes a step back and examines an entire field of plants rather than individual plants.

Crop physiology studies how plants interact with one another and how to maximise outcomes such as food production by controlling factors like planting density. Plants, like mammals, fungi, bacteria, and even viruses, are made up of the same chemical elements as all other life forms: carbon, oxygen, hydrogen, nitrogen, phosphorus, sulphur, and so on. Only the specifics of their chemical architectures differ. Plants develop a broad assortment of chemical molecules with unique qualities that they use to adapt with their environment, despite their fundamental similarities. Plants employ pigments to absorb or detect light, and people extract them to use in dyes. Other plant products could be used to make economically valuable rubber or biofuel. Plant chemicals with pharmacological activity, such as salicylic acid, which is used to make aspirin, morphine, and dioxin, are among the most well-known. Phytopathology, the study of plant illnesses and the ways in which plants resist or cope with infection, is one of the most economically important areas of research in environmental physiology. Plants are vulnerable to the same pathogens that affect animals, such as viruses, bacteria, and fungus, as well as physical invasion by insects and roundworms.

The discovery of Bordeaux mixture in the nineteenth century was one of the most significant developments in the control of plant disease. The mixture, which consists of copper sulphate and lime, is the first known fungicide. The mixture was

used to prevent the spread of downy mildew, which was threatening to destroy the French wine industry.

We know that plants are the organisms that prepare their own food, that is, they are autocross. Plants prepare their food through chlorophyll with the help of sunlight. There are certain structures in plants that help them to prepare their own food. In this topic you are going to learn about these structures. Plant Physiology will give you a brief detail about all the plant parts along with their functions that they perform. In this way you can easily learn the way in which food is being prepared on its own by plants.

Plants have various parts including stems, leaves, roots and other parts that have different functions which enable them to survive. They release oxygen as a by-product of their respiration. For survival with water and carbon dioxide plants need to develop mechanisms which result in the release of oxygen in the atmosphere. There are various plant processes like mineral and nutrition, transportation, respiration and plant growth and development. In this topic of Plant Physiology you will get the information about the Ecole process along with the parts in the plants.

Plant Parts and Functions

Plants have different body parts like Roots, Stem, Leaves, Flowers, and Fruits. Following are the different parts of plants and their functions: -

1.Roots

Roots are known as the foundation system for the plants and keep the plants firmly grounded in the soil. The main function of the root is water and minerals absorption from the soil. It helps to synthesize plant growth and regulates reserve food material. Roots help to keep plants fixed on a particular place. The plants cannot move from one place to another, that is, they cannot show locomotion. The main reason is these roots which not only make them still but also provide them with nutrition.

2. Stem

The stem is a part of the plant found above the ground. The color of the tree stem is brown, while the younger stems are green. The important functions performed by the stem are: - It facilitates the important process of photosynthesis in plants.It offers a proper structure to a plant, which later helps it develop into a tree.Another important function of the stem is to carry up leaves, flowers, buds, and fruits to the plant. It transports water, minerals, and ready food from the leaves to other parts of the plant.The stem also helps to

protect phloem and xylem and also allows them to perform their normal functions.Minerals and nutrition is the water that the root carries from the soil is transferred to other parts of the body with the help of the stem. Stem has xylem and phloem that helps in conduction of food and water both. The water is conducted from roots to other body parts while the nutrition or food from leaves is conducted to other body parts with the help of stem.

3.Leaves

Leaves are another essential part of a plant. They contain chlorophyll that helps the plant with the process of photosynthesis using sunlight, carbon dioxide, and water. The food that the whole plant needs is made up in this part , that is in the leaves. The food from this part is carried to other body parts of the plant through the stem. Food is prepared in our leaves. A leaf has three main parts- leaf base, lamina, and petiole.

The main function of leaves are:

1) Transpiration: Apart from photosynthesis, leaves play an essential role within the removal of far more than water from plants through tiny pores called stomata. There is excess water in the plant's body and this excess water is removed out from the plant through leaves by the proceeds of transpiration.

2) Photosynthesis: Green leaves prepare the food with the help of water and

carbon dioxide in the presence of sunlight with the process of photosynthesis. Water from the roots come into these leaves through the stem then the leaves gather carbon dioxide from the atmosphere along with this in the presence of sunlight the food is prepared in the leaves. This is the reason that plants are autographs because they prepare their own food.

3) Reproduction: Leaves of some plants also help with the reproduction. For e.g., leaves of Bryophyllum produce a brand new Bryophyllum plant. Anther and filament are the respective male and female kart that will help in the reproduction in plants. These reproductive parts are present mainly on the flowers. In the presence if these parts a plant is characterized as asexual, bisexuality and unisexual plant.

4.Flowers

Flowers are the foremost beautiful and vibrant part of a plant. They are, in fact, the part of a plant that reproduces. A flower has four major components: petals, sepals, stamens, and carpels. Petals are the colorful part of the flower that makes it look more attractive. Sepals are the greenish color part of the flower. Carpels and stamens are the male and female reproductive part of the plants. These parts together make a flower.

5.Fruits

Fruits are the most important of a seed plant. The mature ovary in the plant when fertilized with the other segments commonly known as pollen grains produces a seed. This seed further develops into a fruit. Some of the fruits that develop without fertilization are commonly referred to as Parthenocarpy fruits, that means the fruit without fertilization.

Mineral Nutrition in Plants

It is essential for the growth of the plant. It gives insight to methods to identify the essential elements of the plants. These minerals in plants spot their essentiality, deficiency symptoms, and mechanism of absorption elements. It also conveys the importance of the biological process. Macro and micronutrients present in plants do essential processes like cell-membrane permeability, osmotic concentration of cell sap and its maintenance, enzyme activity, and then on.

Nutrition Transportation in Plants

Plants have a definite system (xylem and phloem), which helps in transporting nutrients and water from roots to any or all the parts of the plant through translocation. Transport of water and nutrients in rooted plants is unidirectional or multidirectional. Modes of transportation can either be passive, which occurs through diffusion, facilitated diffusion to be precise, or maybe through effective methods meted out by specific membrane proteins, which are called pumps.

Photosynthesis in Higher Plants

Photosynthesis is essential because it is the primary source of food for all living entities on earth. It releases oxygen within the atmosphere, which all living organisms inhale to breathe. It takes place in chloroplasts through light and dark reactions using four pigments i.e. xanthophyll, chlorophyll, chlorophyll, carotenoids. Extracting energy from oxidizable substances and storing within the kind of bond energy is phosphorylation. In plants, cyclic and non-cyclic photophosphorylation occur.

Respiration in Plants

Food that's required for keeping processes comes from photosynthesis. Metastasis ends up in the discharge of energy, which is employed for the synthesis of ATP, which involves glycolysis. Aerobic respiration ends up in complete oxidation of organic substances within the presence of oxygen, which is common in higher organisms. Another vital aspect of respiration is the ratio of the degree of CO_2 released to the quantity of oxygen consumed.

What is Tropism?

Tropism is the natural ability of an organism to transform or change in response to a stimulus. Natural responses are genetically programmed rather than acquired abilities. Tropism causes an organism to spontaneously move towards a

stimulus. Individual tropisms can be any signal from the setting, which are also called after the stimulus that triggers the movement. In an optimistic tropism, the animal would transform towards stimulation. In a negative tropism, the animal would move away from the tropism. Since certain stimuli are either beneficial or harmful to an organism, they are genetically ingrained. Tropism triggers the taxis which are said to be in movements.

Types of Tropism in Virus

- **Wide Host Range:** amphotropic (e.g. infects many species or cell types)
- **Small Host Selection:** ecotropism (e.g. infects only one species or cell type)
- HIV tropism refers to how a particular strain of HIV enters cells.
- A virus that preferentially infects the nervous system of the host is known as neurotropism.

Plant hormones or phytohormones

They are responsible for the control and coordination of plants. There are different types of hormones, which affect the growth of a plant. Phytohormones are chemical compounds which are released by stimulated cells. These hormones are diffused around the plant cells. They have a role to play in the cell division,cell enlargement,

cell differentiation, fruit growth, falling of leaves, ripening of fruits, ageing of plants etc.

The different types of phytohormones are:

1. Auxins
2. Gibberellins
3. Cytokinins
4. Abscisic acid

Auxins – They help in the cell growth at the shoot tips. By elongating the cells, they help in the growth process.

Gibberellins – These hormones are responsible for the cell growth in the stem, seed germination, and flowering.

Cytokines – They promote cell division in plants. They also promote the opening of the stomata and delay ageing in leaves.

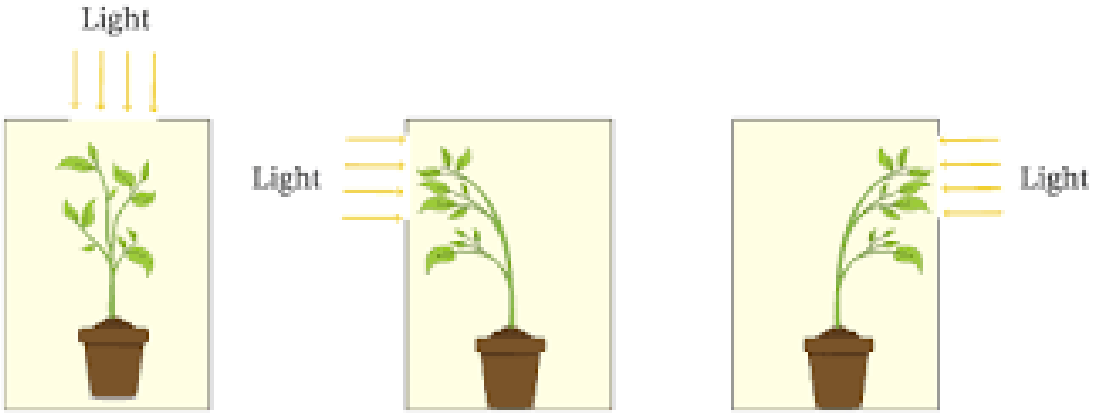
Abscisic acid – This hormone inhibits the growth of the plant. And therefore, it promotes dormancy in seeds and buds. The detachment of fruits, flowers, and falling of leaves etc. are promoted by this hormone.

Different Types of Tropism

- Phototropism
- Gravitropism
- Chemotropism
- Thigmotropism
- Hydrotropism
- Thermotropism
- Magnetotropism

Phototropism

In response to light plants generally grow towards or away from the light, this type of tropism is called phototropism. In plants, the stems and leaves show positive phototropism, and roots show negative phototropism.

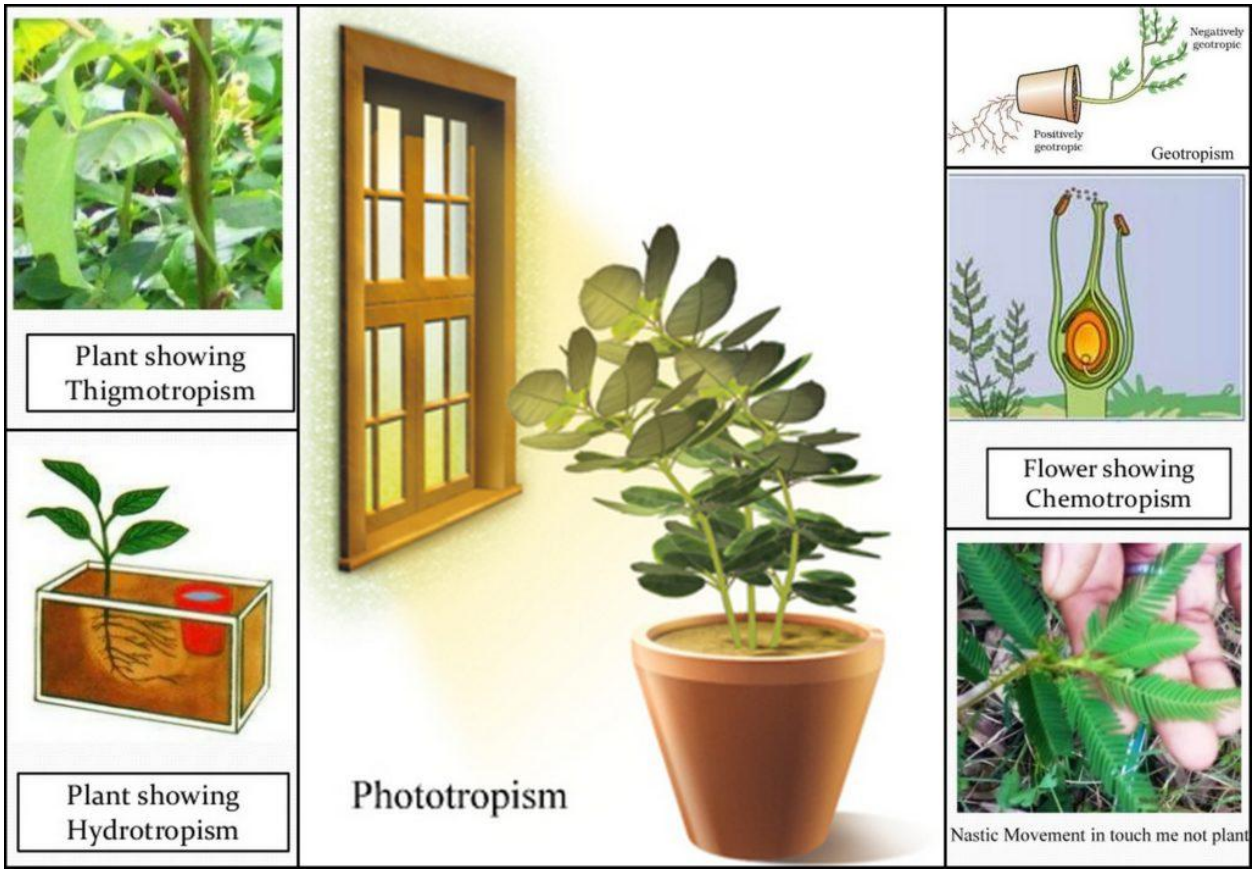


Gravitropism

In response to gravity, certain plants show some growth in response to gravity, this type of tropism is called Gravitropism. Stems respond negatively to gravitropism and roots respond positively to gravitropism. This is also called geotropism. Among different parts of plants, the roots show positive geotropism when directed towards the center of gravity. The stems show negative geotropic as they grow against the center of gravity.

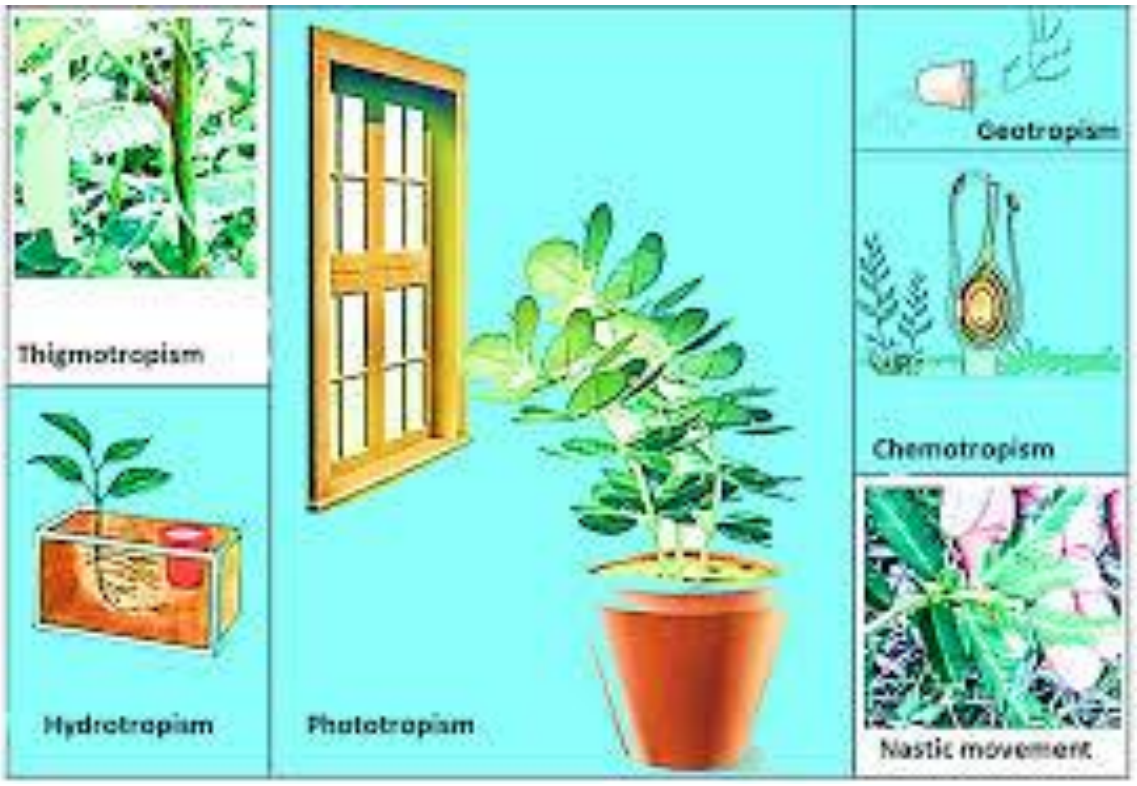
Chemotropism

The chemical substances in a plant that are responsible to bring a curvature movement in plant organs. When plants start to grow in response to certain chemicals, then it is called chemotropism. A few instances of chemotropic movements are the transformation of the flower into fruit, the tentacles movement in Drosera, etc.



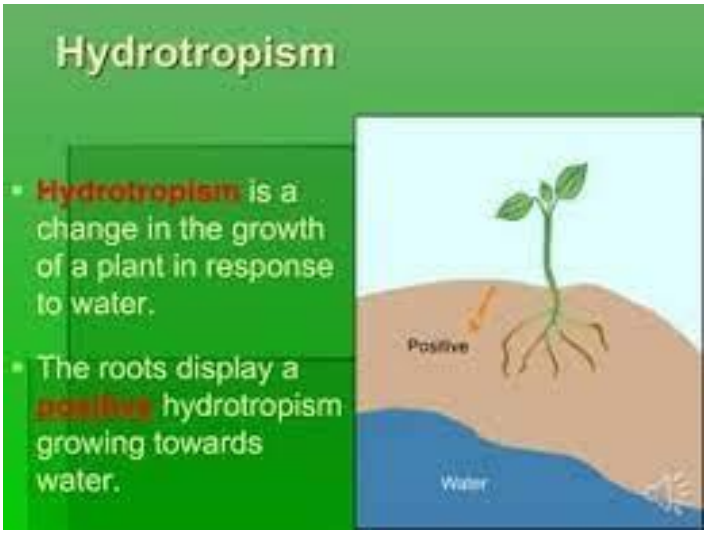
Thigmotropism

The growth or development of movements made through plants in response to a solid object contact is called thigmotropism. These types of movements are common in tendrils and twiners. This movement is known as Haptotropism.



Hydrotropism

In relation to the stimulus of water, the movement or the growth of a plant is called hydrotropic movement is called hydrotropism. In this type of movement, roots respond positively, as they move and grow towards the water.



Thermotropism

In response to the changing atmospheric temperature, tropic movement of plants or a part of the plant is called Thermotropism. For example, the Rhododendron plant.

Magnetotropism

Many animals may be attracted to certain poles by magnetic fields that serve as a source of direction.

Nastic Movement:

If the direction of response in a plant isn't determined by stimulus direction, it's called nastic motion. Nastic movement is not plant-based directional movement.

Whatever the direction of the stimulus, all the parts of the plant move equally in the same direction in nastic motion. This type of movement usually occurs in leaves, flower petals, etc.

There are two types of Nasty movements. They are:

- Thigmonasty
- Photonasty

Thigmonasty:

The movement of a part of a plant in response to an object's touch is called thigmonasty. In this case the motion of a part of a plant is non – directional.An example of thigmonasty is the responsive plant mimosa pudica which is also known as touch-me-not. If we touch this plant's leaves they immediately fold up and droop down.This is the most common example of thigmotropism as you can easily find the touch me not, plant in your gardens or herbal garden around you for your study about the touch me not plant.

Photomonasty

The motion of a part of a plant, usually flower petals, is called photonasty in response to light. Non-directional movement. In photonasty the stimulus is light. Examples of photonasty include dandelions and moonflowers.

Growth movements are the opening and closing of flower petals as a response to light. This is root, stem or root shows differential growth.

The hyphae of the fungi are chemotropic.

Examples of Nasty movements:

Diurnal leaf movement and insectivorous plant response to prey, such as the Venus fly trap.In all the above mentioned examples you can observe photonasty movements that are basically the plant's movement or response to a particular stimulus

For example:

Some plants, such as the pea plant, use tendrils to climb up other plants or fences. Those tendrils are touch-sensitive. The part of the tendril in interaction with the object does not grow as quickly as the part of the tendril away from the object when they come in contact with any supports.

This instigates the tendril to circle around and therefore cling to the object. More generally, by rising in a particular direction, the plants respond to stimuli gradually. Because this development is lateral, it appears as though the plant is growing.

Just like these tendrils are sensitive to the sense of touch, there are many other examples in plants that depend upon other examples. The most common example that we can see everyday is of sunflower plants. The plant, if a sunflower, changes its position constantly as the sun changes its position throughout the day. This example will give you more insight on the topic of plant movement. Further details are discussed below .Depending on their growth there are two types of Movement in Plants. They are Tropic and Nastic movements

Plants in a Lab

The idea of a tropism was first established in botany, as it was seen that plants would move in response to different stimuli. Scientists notice that no matter how you plant a seed, the roots always establish themselves toward gravity, known as geotropism. The roots are also inherently attracted to water, and will move and turn toward the most water. This hydrotropism is obviously beneficial to plants. In studying this phenomena, scientist found that plants have another tropism. When the water is oxygen deprive, the roots will seek oxygen as well. This is known as

aerotropism, and the stimulus is oxygen. As seen by these plant examples, a tropism often has a deep evolutionary base, and is filling an essential need of the organism.

Examples of Nasty movements:

Diurnal leaf movement and insectivorous plant response to prey, such as the Venus fly trap.In all the above mentioned examples you can observe photonasty movements that are basically the plant's movement or response to a particular stimulus

Types of photosynthetic processes

Photosynthesis is the process plants, algae and some bacteria use to turn sunlight, carbon dioxide and water into sugar and oxygen. Photosynthesis is the process used by plants, algae and some bacteria to turn sunlight into energy. The process chemically converts carbon dioxide (CO_2) and water into food (sugars) and oxygen. The chemical reaction often relies on a pigment called chlorophyll, which gives plants their green color. Photosynthesis is also the reason our planet is blanketed in an oxygen-rich atmosphere .There are two types of photosynthesis: oxygenic and an oxygenic. They both follow very similar principles, but the former is the most common and is seen in plants, algae and cyanobacteria**.**

During oxygenic photosynthesis, light energy transfers electrons from water (H_2O) taken up by plant roots to CO_2 to produce carbohydrates. In this transfer, the CO_2 is "reduced," or receives electrons, and the water is "oxidized," or loses electrons. Oxygen is produced along with carbohydrates.

This process creates a balance on Earth, in which the carbon dioxide produced by breathing organisms as they consume oxygen in respiration is converted back into oxygen by plants, algae and bacteria.Anoxygenic photosynthesis, meanwhile, uses electron donors that are not water and the process does not generate oxygen, according to. The process typically occurs in bacteria such as green sulfur bacteria and phototrophic purple bacteria.

The Photosynthesis equation

Though both types of photosynthesis are complex, multistep affairs, the overall process can be neatly summarized as a chemical equation.

The oxygenic photosynthesis equation is:

$$6CO_2 + 12H_2O + \text{Light Energy} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Here, six molecules of carbon dioxide (CO_2) combine with 12 molecules of water (H_2O) using light energy. The end result is the formation of a single carbohydrate

molecule ($C_6H_{12}O_6$, or glucose) along with six molecules each of oxygen and water.

Similarly, the various anoxygenic photosynthesis reactions can be represented as a single generalized formula:

$$CO_2 + 2H_2A + \text{Light Energy} \rightarrow [CH_2O] + 2A + H_2O$$

. How is carbon dioxide and oxygen exchanged?

Plants absorb CO_2 from the surrounding air and release water and oxygen via microscopic pores on their leaves called stomata.

When stomata open, they let in CO_2; however, while open, the stomata release oxygen and let water vapor escape. Stomata close to prevent water loss, but that means the plant can no longer gain CO_2 for photosynthesis. This tradeoff between CO_2 gain and water loss is a particular problem for plants growing in hot, dry environments.

How do plants absorb sunlight for photosynthesis?

Plants contain special pigments that absorb the light energy needed for photosynthesis.Chlorophyll is the primary pigment used for photosynthesis and gives plants their green color, according to science education site Nature

Education. Chlorophyll absorbs red and blue light and reflects green light. Chlorophyll is a large molecule and takes a lot of resources to make; as such, it breaks down towards the end of the leaf's life, and most of the pigment's nitrogen (one of the building blocks of chlorophyll) is resorbed back into the plant, When leaves lose their chlorophyll in the fall, other leaf pigments such as carotenoids and anthocyanins begin to show. While carotenoids primarily absorb blue light and reflect yellow, anthocyanins absorb blue-green light and reflect red light, according to Harvard University's The Harvard Forest.

Where in the plant does photosynthesis take place?

Photosynthesis occurs in chloroplasts, a type of plastid (an organelle with a membrane) that contains chlorophyll and is primarily found in plant leaves.

Chloroplasts are similar to mitochondria, the energy powerhouses of cells, in that they have their own genome, or collection of genes, contained within circular DNA. These genes encode proteins that are essential to the organelle and to photosynthesis.

Inside chloroplasts are plate-shaped structures called thylakoids that are responsible for harvesting photons of light for photosynthesis, The thylakoids are stacked on top of each other in columns known as grana. In between the grana is

the stroma — a fluid containing enzymes, molecules and ions, where sugar formation takes place.

Ultimately, light energy must be transferred to a pigment-protein complex that can convert it to chemical energy, in the form of electrons. In plants, light energy is transferred to chlorophyll pigments. The conversion to chemical energy is accomplished when a chlorophyll pigment expels an electron, which can then move on to an appropriate recipient.

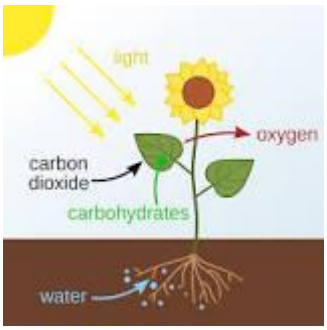
The pigments and proteins that convert light energy to chemical energy and begin the process of electron transfer are known as reaction centers.

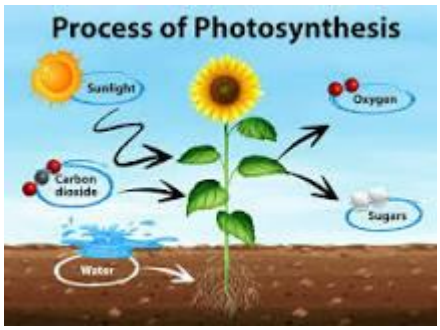
Light-dependent reactions

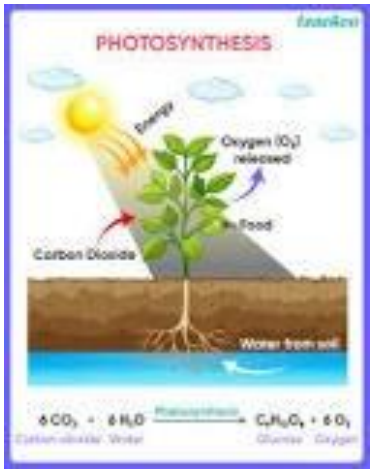
When a photon of light hits the reaction center, a pigment molecule such as chlorophyll releases an electron.

The released electron escapes through a series of protein complexes linked together, known as an electron transport chain. As it moves through the chain, it generates the energy to produce ATP (adenosine triphosphate, a source of chemical energy for cells) and NADPH — both of which are required in the next stage of photosynthesis in the Calvin cycle. The "electron hole" in the original chlorophyll

pigment is filled by taking an electron from water. This splitting of water molecules releases oxygen into the atmosphere.







Light-independent reactions: The Calvin cycle

The Calvin cycle is the three-step process that generates sugars for the plant, and is named after Melvin Calvin, the Nobel Prize-winning scientist who discovered it decades ago. The Calvin cycle uses the ATP and NADPH produced in chlorophyll

to generate carbohydrates. It takes plate in the plant stroma, the inner space in chloroplasts.

In the first step of this cycle, called carbon fixation, an enzyme called RuBP carboxylase/oxygenase, also known as rubiso, helps incorporate CO2 into an organic molecule called 3-phosphoglyceric acid (3-PGA). In the process, it breaks off a phosphate group on six ATP molecules to convert them to ADP, releasing energy in the process, according to LibreTexts.

In the second step, 3-PGA is reduced, meaning it takes electrons from six NADPH molecules and produces two glyceraldehyde 3-phosphate (G3P) molecules.

One of these G3P molecules leaves the Calvin cycle to do other things in the plant. The remaining G3P molecules go into the third step, which is regenerating rubisco. In between these steps, the plant produces glucose, or sugar.

Three CO2 molecules are needed to produce six G3P molecules, and it takes six turns around the Calvin cycle to make one molecule of carbohydrate, according to educational website Khan Academy.

Types of photosynthesis

There are three main types of photosynthetic pathways: C3, C4 and CAM. They all produce sugars from CO2 using the Calvin cycle, but each pathway is slightly different.

C3 photosynthesis

Most plants use C3 photosynthesis, according to the photosynthesis research project Realizing Increased Photosynthetic Efficiency (RIPE). C3 plants include cereals (wheat and rice), cotton, potatoes and soybeans. This process is named for the three-carbon compound 3-PGA that it uses during the Calvin cycle.

C4 photosynthesis

Plants such as maize and sugarcane use C4 photosynthesis. This process uses a four-carbon compound intermediate (called oxaloacetate) which is converted to malate, according to Biology Online. Malate is then transported into the bundle sheath where it breaks down and releases CO2, which is then fixed by rubisco and made into sugars in the Calvin cycle (just like C3 photosynthesis). C4 plants are better adapted to hot, dry environments and can continue to fix carbon even when their stomata are closed (as they have a clever storage solution), according to Biology Online.

CAM photosynthesis

Crassulacean acid metabolism (CAM) is found in plants adapted to very hot and dry environments, such as cacti and pineapples, according to the Khan Academy. When stomata open to take in CO2, they risk losing water to the external environment. Because of this, plants in very arid and hot environments have adapted. One adaptation is CAM, whereby plants open stomata at night (when temperatures are lower and water loss is less of a risk). According to the Khan Academy, CO2 enters the plants via the stomata and is fixed into oxaloacetate and converted into malate or another organic acid (like in the C4 pathway). The CO2 is then available for light-dependent reactions in the daytime, and stomata close, reducing the risk of water loss.

Transpiration in higher plants accounts for about three-quarters of the water that is vaporized at the global land surface and one-eighth of that vaporized over the entire globe. The availability of water is one of the major factors restricting terrestrial plant production on a global scale. Since plants do not have membranes that are both permeable to CO_2 and impermeable to water, transpiration is an inevitable consequence of photosynthesis. To control water loss, plants are covered with relatively water-impermeable surfaces that are punctuated by stomatal pores. Almost all of the CO_2 fixed by terrestrial plants and most of the water transpired

pass through these stomatal pores. The degree of opening of these pores is modulated by variation in the turgor status of the two surrounding guard cells. The regulation of stomatal aperture determines the compromise between increasing CO_2 fixation and reducing transpiration to prevent desiccation. At the same time, plant transpiration provides evaporative cooling, forming a major component of the leaf energy balance. Transpiration also provides the driving force for transport of water and nutrients from roots to shoots. Consequently, transpiration processes affect the yield and survival of agricultural species, and impact on the global carbon and hydrological cycles. These in turn feed back on climate and have a direct effect on global warming and climate change.

In the past five years, there have been rapid advances at several organizational levels in the understanding the biology of transpiration, many of which have been the direct result of significant advances in the measurement of parameters associated with transpiration. Many of these research areas have developed separately, yet frequently advances in one area have potentially major implications for many other areas. The driving force for this Focus Issue on the Biology of Transpiration was the recent meeting on the same topic held at Snowbird Mountain Resort in Utah. To catalyze the required interactions among scientists working in the diverse areas associated with plant transpiration, all aspects of water transport were covered at levels spanning from gene expression to global modeling.

The regulation of stomatal aperture is dynamic, reversible, and responsive to a number of environmental and intrinsic signals, such as light, CO_2, air humidity, and stress hormones such as abscisic acid. As a consequence, the guard cell has become an important model cell type in the field of plant cell signaling. At present, numerous genetic mutants in Arabidopsis (*Arabidopsis thaliana*) with alterations in the production, sensing, or response to major plant hormones provide an exciting resource for the study of the regulation of transpiration. In their *Update*, Nilson and Assmann review the role the model species Arabidopsis currently plays in elucidation of some of these signal transduction pathways. The development of stomata is also providing an exciting focus for the study of integration of genetic and environmental inputs into developmental decisions. Studies of stomatal development also provide insights into past climates. Since the concentration of carbon dioxide in the atmosphere exerts a significant control over stomatal development, stomatal frequency in fossil plants is currently being used as a way of tracking atmospheric CO_2 concentrations over the last 400 million years.

At present, models used to predict weather and climate use empirical functions to approximate the response of stomata to environment. Improving our understanding of stomatal responses and the development of more functional mathematical models of stomatal behavior will help facilitate the development of improved climate models. The regulation of nighttime stomatal conductance is one such

example that impacts on estimation of global transpiration, and this is addressed by Caird et al. in their *Update* article.

Isotopic compositions of CO_2, O_2, and water vapor have also become an important global signal used in climate models. For example, leaf water is generally enriched in ^{18}O relative to soil water due to a tendency for the heavier molecules to accumulate in leaves during transpiration. Since atmospheric CO_2 undergoes isotopic exchange with leaf water and soil water, the ^{18}O composition of CO_2 can be used to study spatial and temporal variation in the net exchange of CO_2 in terrestrial ecosystems. These issues, which highlight a need for better understanding of water movement within plants, are addressed in the *Update* article by Farquhar et al.

We hope that this Focus Issue on the Biology of Transpiration draws particular attention to the importance of interconnecting research across scales ranging from cellular to global levels, and that it will further stimulate cross-disciplinary research in the fields of stomatal function and development, water uptake and transport, and global water exchange processes.

Types of Transpiration

There are three kinds of transpiration: stomatal transpiration, cuticular transpiration and lenticular transpiration. Mechanism of stomatal transpiration involves

following steps:

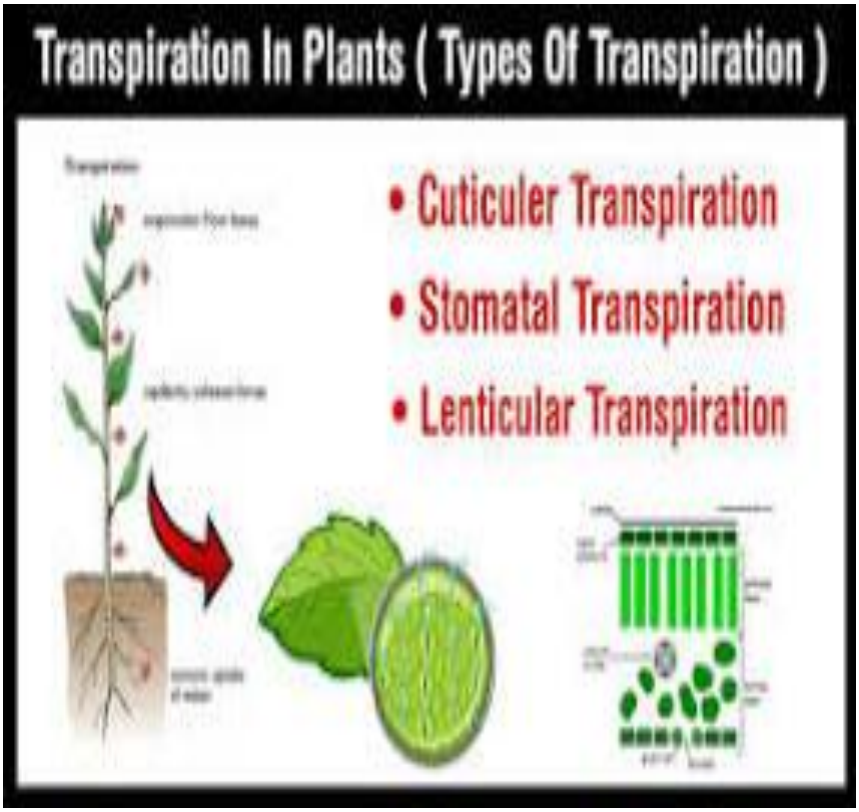
1. Osmotic diffusion of water from xylem to inter cellular spaces through mesophyll cells.
2. Opening and closing of stomata.

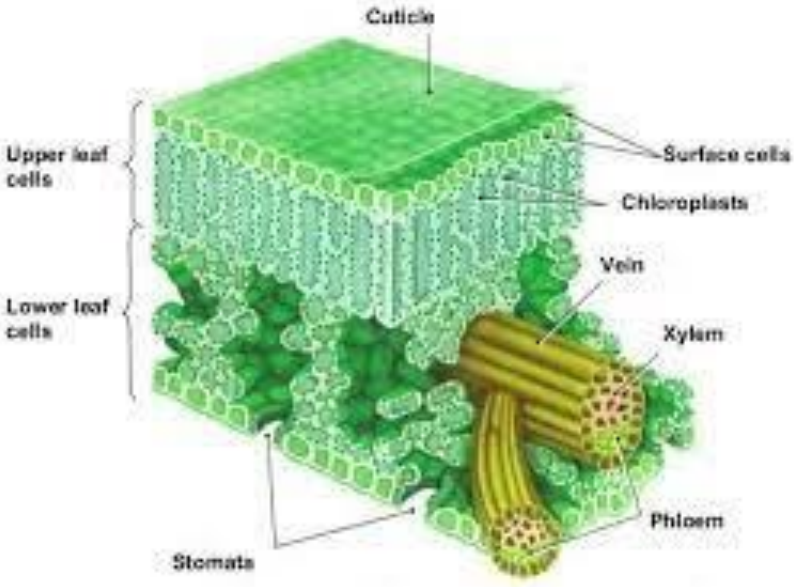
Cuticular transpiration

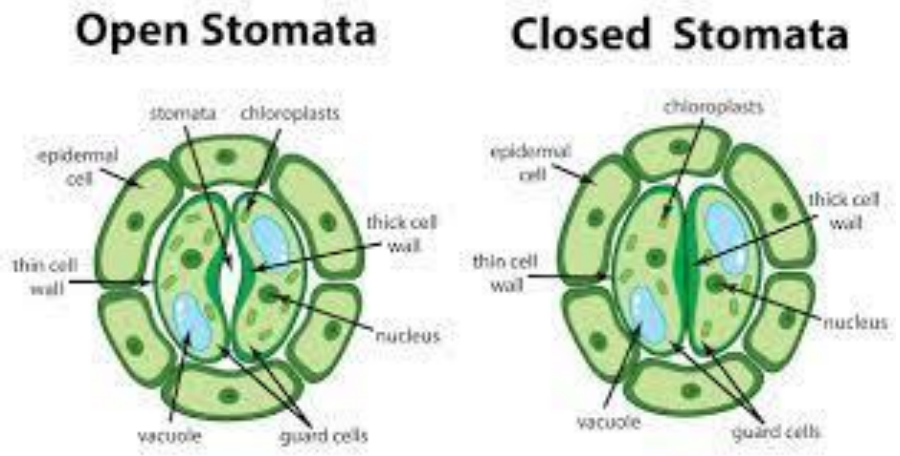
- It occurs through the cuticle or epidermal cells of the leaves and other exposed parts of the plant.
- The greater the thickness of the cuticle, the lesser is the evaporation.

Lenticular transpiration

- This type of transpiration is the loss of water from plants as vapor 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.


Transpiration In Plants (Types Of Transpiration)
• Cuticuler Transpiration
• Stomatal Transpiration
• Lenticular Transpiration


Cuticle
Upper leaf cells
Surface cells
Chloroplasts
Vein
Lower leaf cells
Xylem
Phloem
Stomata


Open Stomata
stomata
chloroplasts
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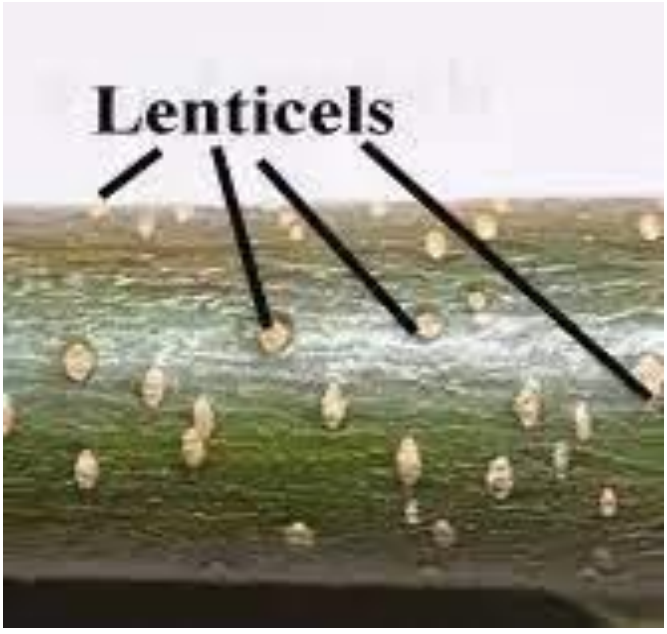

Lenticels

1.1.Need for the study

Plant physiology is a branch that deals with the structures of the plants. It enables analyzing the process in plants, namely photosynthesis, mineral nutrition, respiration, transpiration and the overall growth of the plants. In short it is the study of plant function and behavior. Out of this tropism of plants is an interesting part. Tropism is a unidirectional movement of a whole or part of a plant towards the direction of a stimuli. Phototropism, geotropism, hydrotropism, thigmotropism and chemotropism are different types. Students of this century are very curious , enthusiastic ,energetic and active. So the present study aims to provide a good situation to engage the young minds. So the investigator motivate and create a platform to learn ,to identify, to enrich the knowledge on different aspects of plant physiology mainly on tropism of plants. Teachers also assist in all activities for a better learning .Hence the present study aims to provide necessary attitude on the plant physiology, provide many activities to improve the understanding of tropism of plants.

1.2 Objectives of the study.

- ✓ Students acquire knowledge on plants.
- ✓ Students able to understand the structures of plants.
- ✓ Students describe the functions of plants.
- ✓ Students able to know about the tropism of plants.

- ✓ Students develop the ability to distinguish between the types of tropism

1.3 .Probable cause:

Learning beyond classrooms is necessary to learn about the world and skills. Science experiments are a great way of learning not just about sciences but also about collaboration, experimentation, and teamwork. Many students are not interested science subjects, and they think that doing science experiments is boring. But it is not true! Science experiments can be really fun and interesting, and they can even be more interactive than traditional classroom lectures. Teaching children science through practical experiments is one of the most surefire ways to pique their interest in the subject. Practical experiments are especially helpful for children who are not academically inclined because they allow them to learn about science in a way that they can process. Practical experiments are not only engaging, but they teach skills that will be necessary for future careers. For example, understanding how to read scientific graphs will be essential for many jobs in the sciences and related fields.

II Action Plan

The chapter contains the core component of action research like the nature of the samples.

2.0 Design of the study

The research design involves the experimental method. Experimental research attempts to establish cause and effect among the variables. The study includes a pre-test and a post test. Pre-test has been conducted after tradition teaching learning process. Post test is conducted after the instruction .

2.1 Sample

The sample taken for action research is 30 students from IX –Std class from GGHSS, Kurinjipadi, Cuddalore District.

2.2 Time Chart

Altogether 60 days were spent to action research. The number of days allotted for the action research is listed below.

Preparation of class	- 20 days
Execution of teaching strategies	- 10 days
Conduct of test	- 02 days
Report preparation	- 28 days

2.3 Title of the study

To improve the understanding of Tropism in plants among IX Standard Students through Activities and Experiments

2.4 Tools used

A brief test questionnaire was prepared with objective type questions for 25 marks section I consists of 10 choose the best answer,section II consists of 5 fill in the blanks , section III consists of 5match the following and the section IV consists of 5 true or false. Objective questions each carry one mark

2.5 Problem Identified

The knowledge of plant physiology is very less among IX std students which were tested by simple questions from their book. Very few answered and many of the students found difficult in the content level and also do not understand the basic physiology of plants and their growth. Hence the content is enriched by activities and experiments. During activities the students enjoy and learn with interest and lead to a better performance level.

2.6 Intervention

What is a Science Experiment?

A science experiment involves a set of observations and hypotheses that are formed as we explore how the world around us operates. For example, if you want to use vinegar and dishwashing liquid to clean a bathtub, you might want to add some baking soda to see what happens. This would be considered a science experiment that would involve variables as well as the time period for observation hours as you spray part of the bathtub with your first concoction in the second half with your mixture that includes the baking soda. The baking soda will fizzle, and it helps lift dirt and grime easier than the first mixture without it. This would be a more concrete experiment since you can see the results right away and there are also exploratory experiments that students can do to understand, for instance, why milk spoils when it gets hot when it is heated. Science experiments are a great way to test new ideas and collect data so that we can all make informed decisions about the world around us.

Different Types of Science Experiments

There are several different types of science experiments, but they all include comparing at least two different types of materials to one that has a greater mass to measure. Science experiments also involve collecting data and then testing out new

ideas and theories by observing what happens when you make changes to something during your science experiment.

There are two main types of science experiments, and we will examine each of those further below.

Lab Experiments

Lab experiments are one of the top two types of science experiments you can do. These are conducted in a laboratory setting and most of the time, scientists and other specialists analyze the results. This is how many types of medications and even cures and vaccines for certain diseases are discovered.

Exploratory Science Experiments

An exploratory science experiment is the other main type of experiment when it comes to science, and it is a way to test out a new idea or theory about how something works. Since this type of experiment is only for testing purposes, it does not have to be repeated.

There are two other types of scientific experiments that you can conduct and those are listed below.

Practical Scientific Experiments

A practical scientific experiment will involve the observation of changes that can occur if you manipulate variables. This could be an experiment involving a change in temperature. Many times, these types of science experiments can lead to innovation and new products in new ways of doing things.

Fieldwork Science Experiments

Fieldwork science experiments involve doing the project outside a classroom or laboratory under more natural conditions. Students will have to collect data and then track their particular subjects, which could be animals, plants, or some other type of organism, then see how their experiment works out over time.

What are the Benefits of Science Experiments?

There are many benefits of science experiments for students, including the fact that they can help students develop a scientific vocabulary, learn about new concepts, provide an opportunity for learning, and allow teachers to be able to assess the knowledge of their students.

Experiments can be used to introduce new ideas or to clarify puzzling aspects of topics with which students typically struggle.If the result of an experiment is

surprising yet convincing, students are in position to build ownership of the new idea and use it to scaffold learning.

Activity1

Take a glass trough and fill it with sand. Keep a flower pot containing water, plugged at the bottom at the centre of the glass trough. Place some soaked pea or bean seeds around the pot in the sand. What do you observe after 6

or 7 days? Instructed to record the observation.

Activity 2

Take pea seeds soaked in water overnight. Wait for the pea seeds to germinate. Once the seedling has grown put it in a box with an opening for light on one side. After few hours, you can clearly see how the stem has bent and grown towards the light.

Activity 3

Pluck a variegated leaf from Coleus plant kept in sunlight. De-starch it by keeping in dark room for 24 hours. Draw the picture of this leaf and mark the patches of cholorphyll on the leaf. Immerse the leaf in boiling water followed by alcohol and test it for starch using iodine solution. Record the observation.

Activity 4

Place a potted plant in a dark room for about 2 days to de-starch its leaves. Cover one of its leaves with the thin strip of black paper as shown in the picture. Make sure that the leaf is covered on both sides. Keep the potted plant in bright sunlight for 4 to6 hours. Pluck the selected covered leaf and remove the black paper. Immerse the leaf in boiling water for a few minutes and then in alcohol to remove chlorophyll. Test the leaf now with iodine solution for the presence of starch. The covered part of the leaf does not turn blue-black whereas the uncovered part of the leaf turns blue-black color. Why are the changes in color noted in the covered and uncovered part of the leaf?

III.Analysis and Interpretation

Before adapting the new methodology to find the improvement in the performance of the students in the pre-test was conducted. After the intervention a post test was conducted. The performance of the students in the pretest and post test is given in appendix A. The mean, median and mode were calculated for both the pre -test and post -test.

Analysis of the pre- test

From the pre-test it is evident that overall performance of 30 students was poor, The marks scored by the students in the pre-test are given below in ascending order.

16,20,24,24,24,24,24,28,28,28,

32,32,36,40,40,32,44,44,48,48,

48,48,48,56,56,60,60,64,72,76.

Table I

Frequency distribution -based on the marks scored by the students in the Pre-test.

C.I	Frequency
0-10	0
11-20	2
21-30	8
31-40	6
41-50	7
51-60	4

61-70	1
71-80	2
81-90	0
91-100	0

Mean - 40.8

Median - 40

Mode - 24

The average of the pre- test score was 40.8

From the table one could observe the fact that the overall performance of the students is low. Out of 30 students 2 student scored the marks between the range 11-20. 8 students scored the marks between 21-30. 6 students scored the marks between 31-40. 7 students scored the marks between 41-50. 4 1students scored the marks between 51-60.1 student scored mark between the range 61-70 and 2 student scored the highest mark between the range respectively .

Figure 1 : Bar Diagram showing the pre-test score of the students

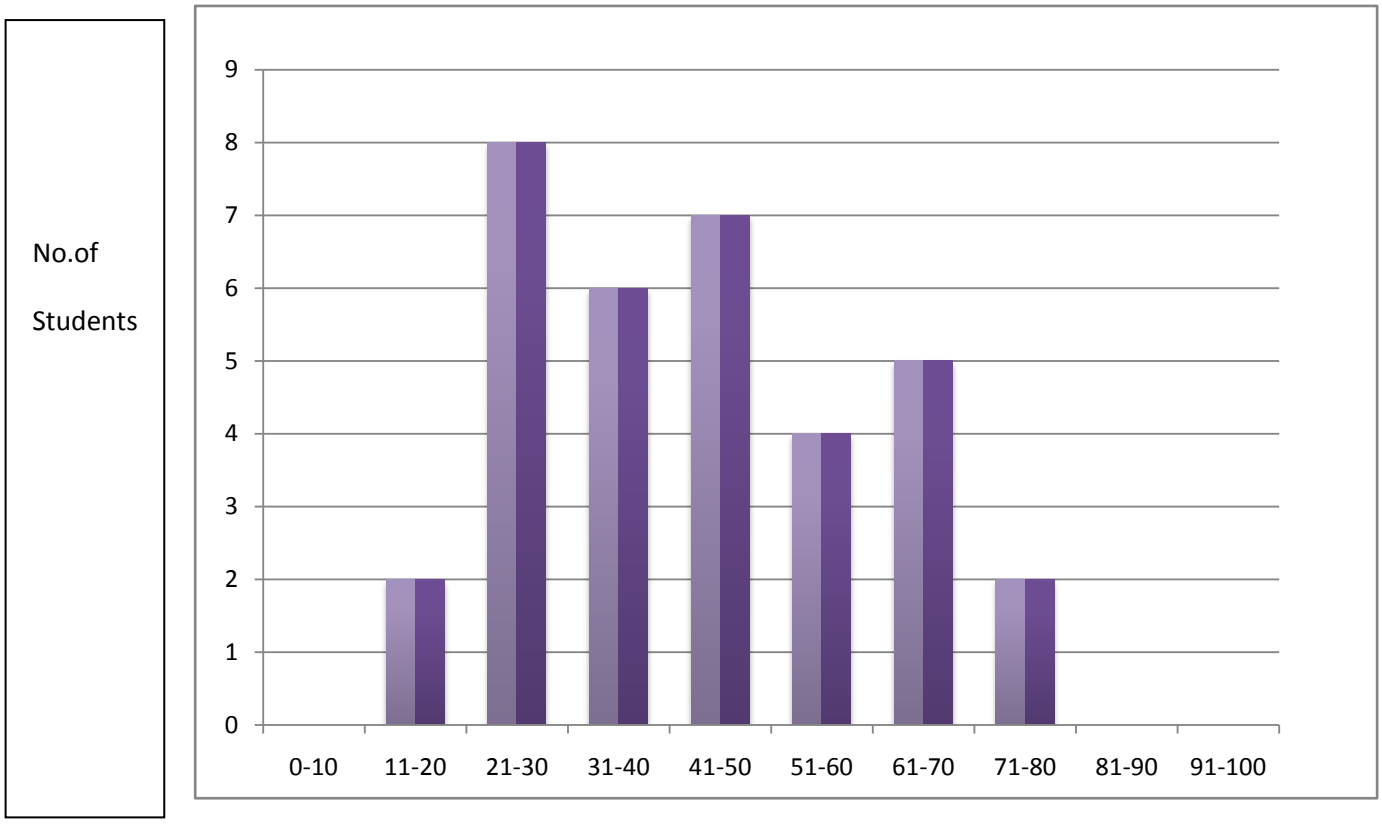
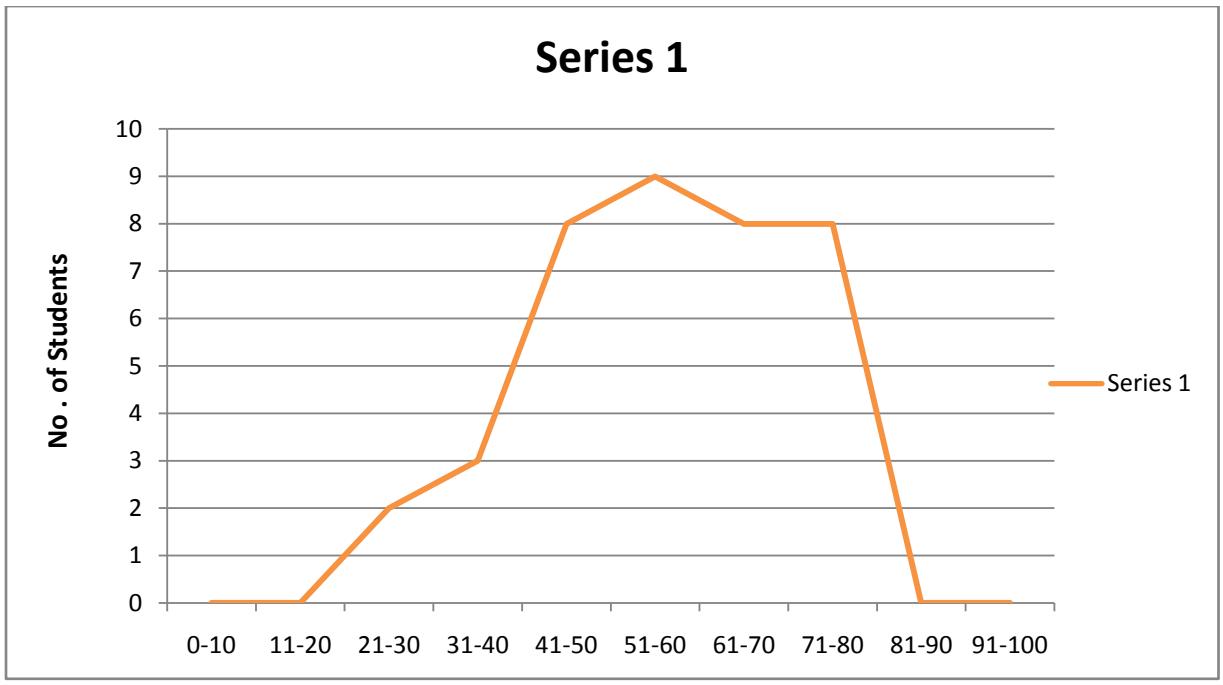


Figure 2

Frequency curve showing the pre-test score of the students



Marks

The frequency curve clearly depicts the fact that all the 30 samples scored the marks between 20-80 only. It is evident that the entire sample has scored below 80%.

Analysis of the post-test

From the post- test it is evident that the over all performance of 30 students is good. The marks scored by the students in the post- test are given below is ascending order.

40,44,48,48,48,52,52,52,56,60,

60,60,60,64,64,64,64,64,64,68,

68,68,72,72,76,76,76,76,76,80

Table -2

Frequency distribution; based on the marks scored by the students in the post test.

C.I	Frequency
0-10	0
10-20	0
21-30	0
31-40	2
41-50	3
51-60	8
61-70	9
71-80	8
81-90	0
91-100	0

Mean = 62.9

Median = 64

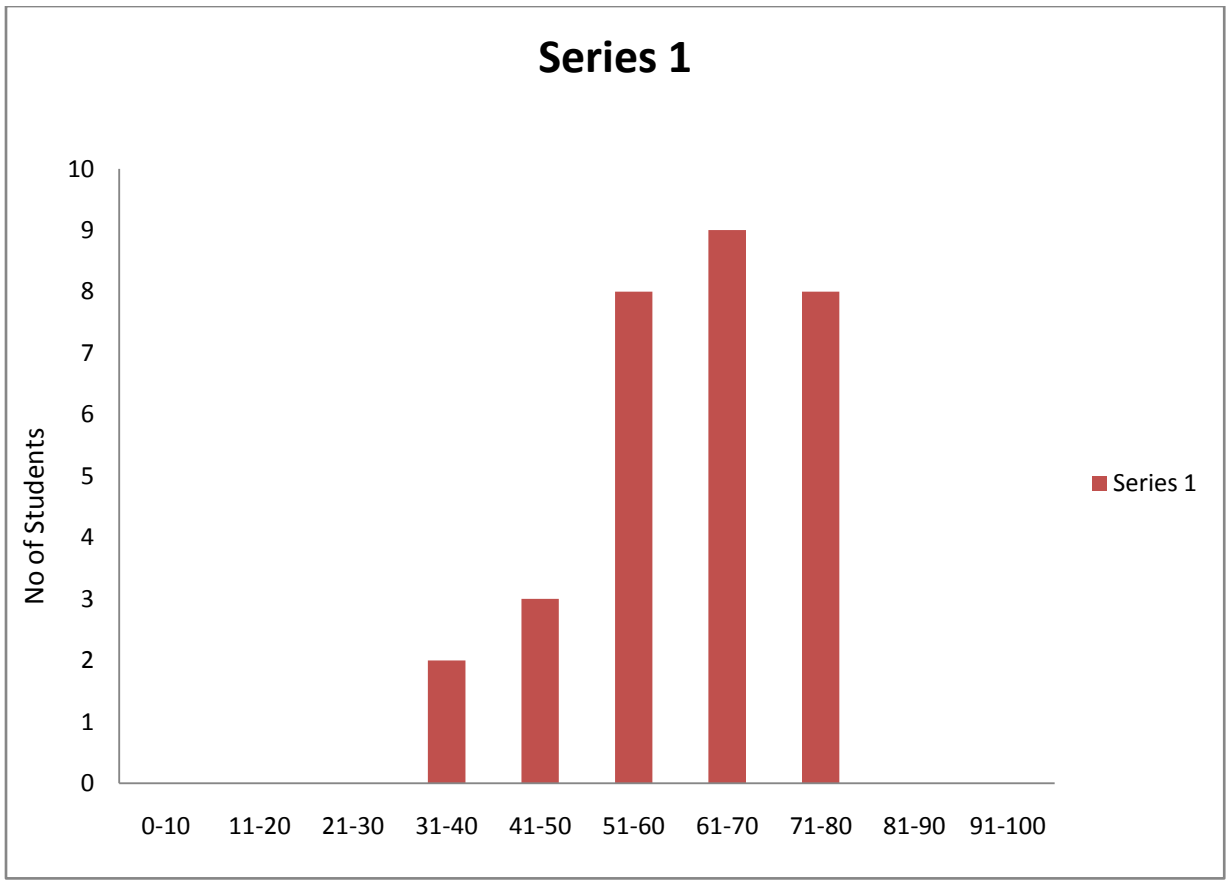
Mode = 64

The average of the post test score was 62.9

From the table one could observe the fact that the overall performance of the students is 80% and it is due the usage of activities and experiments for the teaching learning process. 2 students scored the marks in the range 31-40. 3 students scored the marks between 41-50. 8 students scored the marks between the range 51-60.9 students scored scores marks between61-70.As the maximum of 8 students performed well and scored the marks between 71 -80 .

Figure -3

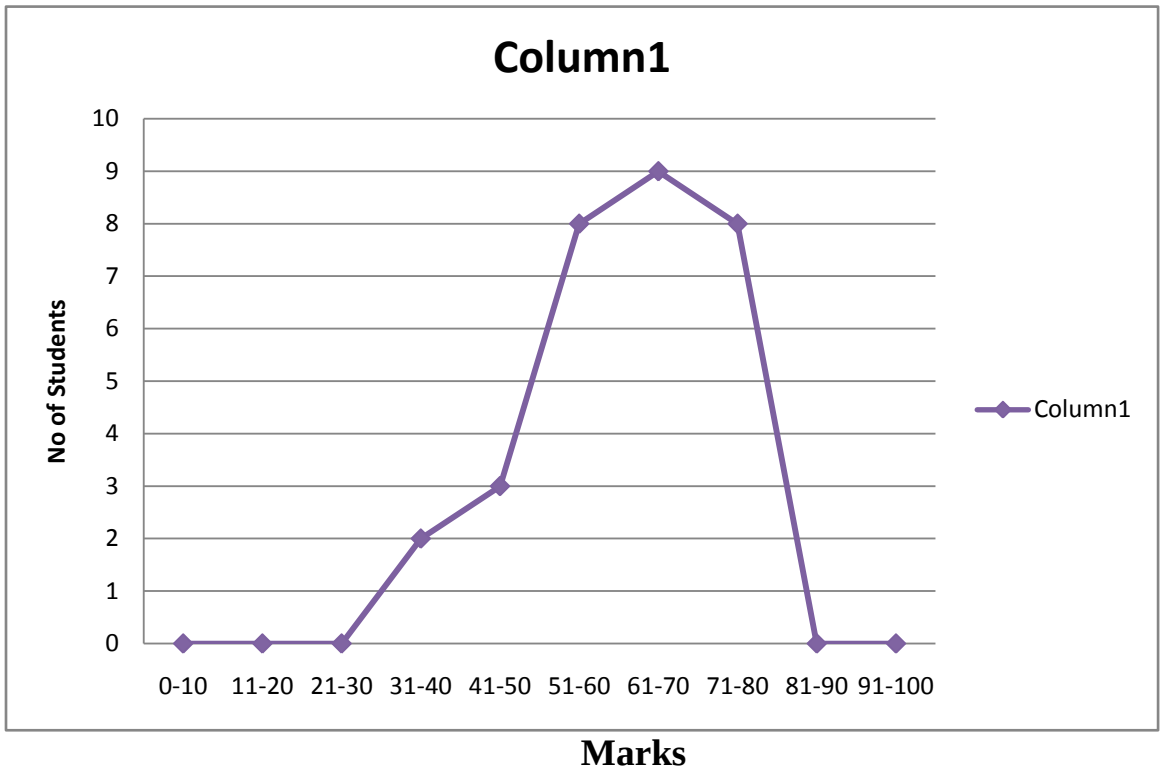
Bar diagram showing the post test score of the students



Marks Post -test score of the students

Figure 4

Frequency curve showing the post test score of the students



IV SUMMARY AND FINDINGS

The performance of the students was better in the post test. The study revealed the fact that activities and experiment could boost up the energy of the learners to concentrate much in the learning process. This strategy is good to students to improve their knowledge and the application skill. The student is very

curious to know the results of their own experiments. This helps them to think well This technique filled the gap in the regular class room practices and helped in handling wider range of activities. The study motivated the students to pursue higher education related to environmental science. The average of the test score of students has raised from 40.8 to 62.9 in the post test. This showed that the execution of the action research has made a breakthrough in the attainment of the objectives of the study. The performance of the students was better in post-test when compared to pre-test. The present study finds the fact that experiment and activities helps the active participation of students in the lab activities rather than the class room. They prefer a good learning environment where, they are active and enthusiastic.

Recommendations

(i)Learning process involves many strategy, teacher should be aware of experiments

(ii) Teacher should become as an adviser, content expert and coach.

(iii) Teachers engage the students with creative and innovative teaching strategies to meet their students individual needs in learning.

(iv) The teacher should make the students realize their role in the class room science activities.

Conclusion

The attitude of the students is the important factor in learning process. Present students aspire more and learn more, they seek different, mode of learning, and interested in the participatory learning, peer leaning and group learning through experiment and activities .Hence usage of learning and doing methodology in science motivate the students for better learning. All these activities and strategies aim to create a change in the learning behavior of the students. Hence, the present study revealed the fact that, the performance level of the post-test is for better than the pre-test. It proved that teachers should engage young minds as a researcher and scientist to do the experiments and to record the cause and effect of the results. The implementation of the inductive and deductive method in teaching learning process evoke students and create a new environment, that leads to a good outcome.

V SUGGESTIONS

The aim of the teaching should be to raise the level of acquisition of the given competencies and desirable behavioral changes. Experiments can be used to introduce new ideas at which student typically struggle. It improve the learners attitude towards why, how changes occur and analyse various reason behind the experiments and conceptual fact has been proved. Exploratory science experiment

test out new ideas or theories. The teacher should have in depth knowledge on the topic irrespective of her major subject .To explain the first hand experience should be given to the students. Establishing classroom, lab, and field trip rules and regulations and ensuring that all students understand what is expected of them.Teacher should allow children to discover the world around them.of knowing things and have new and wonderful ideas. . Most teachers believe that scientific learning that takes place in classrooms alone is not true learning. For fostering scientific learning in early childhood, active, hands-on learning is very important. And this can best be achieved through science lab experiments. Teachers promote the development of scientific thinking in students. Rather than making the kids memorize the facts, they are made to think and understand things and the world around them. Teachers allow students to ask questions, probe for answers, conduct investigations, and collect data. They are engaged in the investigative nature of scientific learning. Children in fact do science in science labs than simply learning science through textbooks in classrooms.

Difference in pre-test and post-test score of the test

Sl.No.	Name of the student	Pre-test score	Post –test score	Difference
1	V.Sivaranjani .	44	60	16
2	E.Vinothini	24	48	24
3	K.Akshyadevi	16	48	32
4	V.Swetha	76	76	0
5	S.Srimathi	44	56	12
6	N.Nanthini	56	48	08
7	D.Rajapriya	48	64	16
8	M.Janani	28	52	24
9	N.Kaviya	24	40	24
10	Keerthiga	20	64	44
11	S.Rajarajeswari	24	68	44
12	I.Aarthi	48	68	20
13	C.Aarthi	56	60	16
14	P.Gajalakshmi	48	64	16
15	B.Hariharshini	24	64	40
16	N.Nandhini	40	52	12
17	S.Sugupriya	24	80	60
18	A.Aarthi	48	72	24
19	D.Niranjana	36	76	40
20	R.Deepika	32	76	44
21	P.Amirtha	28	52	24
22	T.Thirumalar	28	72	44
23	C.Vishnupriya	40	68	28
24	B.Dhaniska	32	60	32
25	M.Vishmitha	32	64	32
26	V.Nisha	48	76	28
27	N.Nithiska	60	60	0
28	V.Sivadharshini	60	64	4
29	S.Jeevitha	64	76	12
30	A.Vinitha	72	60	12

ACTION RESEARCH ABSTRACT

Title of the study

To improve the understanding of Tropism in plants among IX Standard Students through Activities and Experiments

Need for the study

Plant physiology is a branch that deals with the structures of the plants. It enables analyzing the process in plants, namely photosynthesis, mineral nutrition, respiration, transpiration and the overall growth of the plants. In short it is the study of plant function and behavior. Out of this tropism of plants is an interesting part. Tropism is a unidirectional movement of a whole or part of a plant towards the direction of a stimuli. Phototropism, geotropism, hydrotropism, thigmotropism and chemotropism are different types. Students of this century are very curious , enthusiastic ,energetic and active. So the present study aims to provide a good situation to engage the young minds. So the investigator motivate and create a platform to learn ,to identify, to enrich the knowledge on different aspects of plant physiology mainly on tropism of plants. Teachers also assist in all activities for a better learning .Hence the present study aims to provide necessary attitude on the plant physiology, provide many activities to improve the understanding of tropism of plants.

Objectives of the study

- ✓ Students acquire knowledge on plants.
- ✓ Students able to understand the structures of plants.
- ✓ Students describe the functions of plants**.**
- ✓ Students able to know about the tropism of plants.
- ✓ Students develop the ability to distinguish between the types of tropism

Sample

The sample taken for action research is 30 students from IX –Std class from GGHSS, Kurinjipadi, Cuddalore District.

Tools used

A brief test questionnaire was prepared with objective type questions for 25 marks section I consists of 10 choose the best answer,section II consists of 5 fill in the blanks , section III consists of 5match the following and the section IV consists of 5 true or false. Objective questions each carry one mark

Design of the study

The research design involves the experimental method. Experimental research attempts to establish cause and effect among the variables. The study

includes a pre-test and a post test. Pre-test has been conducted after tradition teaching learning process. Post test is conducted after the instruction

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The knowledge of plant physiology is very less among IX std students which were tested by simple questions from their book. Very few answered and many of the students found difficult in the content level and also do not understand the basic physiology of plants and their growth. Hence the content is enriched by activities and experiments. During activities the students enjoy and learn with interest and lead to a better performance level.

Intervention

A science experiment involves a set of observations and hypotheses that are formed as we explore how the world around us operates. For example, if you want to use vinegar and dishwashing liquid to clean a bathtub, you might want to add some baking soda to see what happens. This would be considered a science experiment that would involve variables as well as the time period for observation hours as you spray part of the bathtub with your first concoction in the second half with your mixture that includes the baking soda. The baking soda will fizzle, and it helps lift dirt and grime easier than the first mixture without it. This would be a more concrete experiment since you can see the results right away and there are

also exploratory experiments that students can do to understand, for instance, why milk spoils when it gets hot when it is heated. Science experiments are a great way to test new ideas and collect data so that we can all make informed decisions about the world around us.

Outcome

The performance of the students was better in the post test. The study revealed the fact that activities and experiment could boost up the energy of the learners to concentrate much in the learning process. This strategy is good to students to improve their knowledge and the application skill. The student is very curious to know the results of their own experiments. This helps them to think well This technique filled the gap in the regular class room practices and helped in handling wider range of activities. The study motivated the students to pursue higher education related to environmental science. The average of the test score of students has raised from 40.8 to 62.9 in the post test. This showed that the execution of the action research has made a breakthrough in the attainment of the objectives of the study. The performance of the students was better in post-test when compared to pre-test. The present study finds the fact that experiment and activities helps the active participation of students in the lab activities rather than the class room. They prefer a good learning environment where, they are active and enthusiastic.

Recommendations

(i)Learning process involves many strategy, teacher should be aware of experiments

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implementation of the inductive and deductive method in teaching learning process evoke students and create a new environment, that leads to a good outcome

ஒன்றிய ஆசிரியர் கல்வி பயிற்சி நிறுவனம்
மஞ்சக்குப்பம், கடலூர்

முன்/பின் தேர்வு

நேரம் : 30 நிமிடங்கள் **மதிப்பெண் :** 25
பெயர் : **வகுப்பு :**

I. சரியான விடையை தேர்ந்தெடு: **1 X 10 = 10**

1. புவி ஈர்ப்பு விசைக்கு ஏற்ப தாவர பாகம் நகர்தல்.

அ) தாவரத்தின் தண்டுப்பகுதி ஆ) தாவரத்தின் வேர் பகுதி
இ) தாவரத்தின் கொடி ஈ) தாவரத்தின் இலை

2. சார்பிசைவானது தூண்டலின் தசையை நோக்கி இருந்தால் அது.

அ) நேர் அசைவு ஆ) எதிர் சார்பசைவு
இ) தொடு சார்பசைவு ஈ) ஒளி சார்பசைவு

3. உவர் தாவரங்கள் எதிர் புவிச்சார்பசைவு உடையவை அவை _____ கோணத்தில் செங்குத்தான வேர்களை கொண்டவை.

அ) 200^0 ஆ) 260^0
இ) 100^0 ஈ) 180^0

4. நடுக்கமுறு வளைதல் எடுத்துக்காட்டு.

அ) தொட்டாச் சினுங்கி ஆ) ஐபோமியா ஆல்பா
இ) வர்தாவரங்கள் ஈ) டாராக்சம்

5. தாவரத்தில் ஒரு பகுதி வெப்பநிலைக்கேற்ப தன் துலங்களை வெளிப்படுத்துவது.

அ) ஒளியுறு விளைதல் ஆ) நடுக்கமுறு வளைதல்
இ) ஒளி சார் பசைவு ஈ) நீர்ச்சார் பசைவு

6. ஏறும் கொடிகள் தங்களுக்கு பொருத்தமான ஆதரவைக் கண்டறிய உதவும் இயக்க அசைவுகள் _____

அ) ஒளி சார்பசைவு ஆ) புவி சார்பசைவு
இ) தொடு சார்பசைவு ஈ) வேதி சார்பசைவு

7. ஒளிச்சேர்க்கையின் போது நடைபெறுவது

அ) CO_2 இழுக்கப்பட்டு O_2 வெளியேற்றப்படுகிறது

ஆ) நீர் ஒடுக்கமடைதல் மற்றும் CO_2 ஆக்ஸிகரணம் அடைதல்.

இ) நீர் மற்றும் CO_2 இரண்டுமே ஆக்ஸிகரணம் அடைதல்.

ஈ) CO_2 மற்றும் நீர் இரண்டுமே உற்பத்தி செய்யப்படுகின்றன.

8. நீர் தூண்டலுக்கு ஏற்ப தாவர வேர் வளைவது _____ எனப்படும்.

அ) நடுக்கமுறு வளைதல்

ஆ) ஒளி சார்பசைவு

இ) நீர்சார்பசைவு

ஈ) ஒளியுறு வளைதல்

9. இளம் நாற்றுகளை இருட்டறையில் வைக்க வேண்டும். பிறகு அதன் அருகில் எரியும் மெழுகுவர்த்தியினை சில நாட்களுக்கு வைக்க வேண்டும். இளம் நாற்றுகளின் மேல் முனைப்பகுதி எரியும் மெழுகுவர்த்தியை நோக்கி வளையும். இவ்வகை வளைதல் எதற்கு எடுத்துக்காட்டு?

அ) வேதி சார்பசைவு

ஆ) நடுக்கமுறு வளைதல்

இ) ஒளி சார்பசைவு

ஈ) புவி ஈர்ப்பு சார்பசைவு

10.தாவரத்தின் வேர் _____ ஆகும்.

i. நேர் ஒளிச்சார பசைவு ஆனால் எதிர் புவி ஈர்ப்பு சார்பசைவு.
ii. நேர் புவிஈர்ப்பு சார்பசைவு ஆனால் எதிர் ஒளி சார்பசைவு.
iii. எதிர் ஒளி சார்பசைவு ஆனால் நேர் நீர் சார்பசைவு.
iv. எதிர் நீர் சார்பசைவு ஆனால் நேர் ஒளி சார்பசைவு

அ) I மற்றும் II

ஆ) II மற்றும் III

இ) III மற்றும் IV

ஈ) I மற்றும் IV

II. கோடிட்ட இடங்களை நிரப்பு: 1 X 5 = 5

1. நீராவிப் போக்கு _____ல் நடைபெறும்.
2. இலையில் காணப்படும் பச்சையம் _____க்கு தேவைப்படும்.
3. _____இன் துலங்கலால் தண்டுத் தொகுப்பு மேல் நோக்கி வளர்கிறது.
4. சூரியகாந்தி பலர் சூரியனின் பாதைக்கு ஏற்ப வளைவது _____ எனப்படும்.
5. புறத்தோலின் மேற்புரம் உள்ள _____ வழியாக நீராவிபோக்கு நடைபெறுகிறது.

III. பொருத்துக: 1 X 5 = 5

1. ஒளிச்சேர்க்கை	-	தாவர வேர் பகுதி
2. நீராவி போக்கு	-	கார்பன்டை ஆக்ஸைடு
3. புவிச்சார்பசைவு	-	எதிர் ஒளி சார்பசைவு
4. திசை சாரா தூண்டல்	-	ஒளியுறு வளைதல்
5. தண்டு மேல் நோக்கி வளர்வது	-	இலைச்துளைகள்.

IV. சரியா? தவறா? 1 X 5 = 5

1. சார்பசைவானது தூண்டலின் திசையை நோக்கி இருந்தால் அது எதிர் சார்பசைவு எனப்படும்.
2. திசையை நோக்கி நடைபெறாத தாவர பகுதியின் அசைவுகளுக்கு திசை சாரா தூண்டல் எனப்படும்.
3. ஒளிச்சேர்க்கையின் போது ஒளி ஆற்றல் வேதி ஆற்றலாக மாற்றப்படுகிறது.
4. வாயு பரிமாற்றம் இலைத்துளை மூலம் நடைபெறுகிறது.
5. ஒளிச்சேர்க்கையின் போது குளுக்கோஸ் மற்றும் CO_2 உற்பத்தியாகும்.