



Government of Tamil Nadu

REFRESHER COURSE MODULE

2021-2022



BOTANY

Department of School Education



www.waytosuccess.org



BOTANY

S. No	Contents	Page no.
1	Reproduction In Plants	1
2	Pollination	3
3	Fertilization	5
4	Mendelism	8
5	Mendel's Experiments	10
6	Chromosome Theory of Heredity	13
7	Crossingover	15
8	Mutation	17
9	Genetic Engineering	19
10	Enzymes	21
11	Plasmids	23
12	Metabolites	25
13	Tissues	27
14	Ecology and Ecological Factors	30
15	Ecological Adaptations	32
16	Ecosystem	36
17	Decomposition and Bio Geo Chemical Cycle	39
18	Green House Effect and Global Warming	41
19	Forestry-Afforestation	43
20	Rainwater Harvesting	45
21	Organic Agriculture	47
22	Plant Breeding	49
23	Food Plants	51
24	Fibers and Timber	52
25	Dyes and Medicinal Plants	54
26	Structure and Replication of DNA	55
27	Entrepreneurial Botany	58



www.waytosuccess.org



1

REPRODUCTION IN PLANTS & POLLINATION



Learning Outcome

- ❖ To know the various types of reproduction
- ❖ Differentiate vegetative, asexual and sexual reproduction
- ❖ To describe the parts of flower and their function



Teachers Activity:

MOTIVATION:

Living organisms cannot survive for an indefinite period on earth. All Organisms have the ability to produce more of its own kind by the Process called reproduction.

There are three types of reproduction in plants namely,

- ❖ Vegetative reproduction
- ❖ Asexual reproduction
- ❖ Sexual reproduction



Teacher Activity: 1

VEGETATIVE REPRODUCTION:

Vegetative reproduction may take place through

- ❖ Leaves – e.g Bryophyllum
- ❖ Stem – e.g Straw berry
- ❖ Root – e.g Asparagus and Sweet potato
- ❖ Bulbils – e.g Agave



Teacher Activity: 2

ASEXUAL REPRODUCTION:

Asexual reproduction in living organisms occurs by spore formation. e.g.

- ❖ Conidia – Aspergillus, penicillium
- ❖ Budding – Yeast and Hydra
- ❖ Binary fission – Bacteria and Amoeba
- ❖ Fragmentation – Spirogyra
- ❖ Protonema – Mosses
- ❖ Regeneration – Planaria



Teacher Activity: 3

SEXUAL REPRODUCTION:

Sexual reproduction takes place by gamete formation. You have already learnt that the flower is a reproductive organ of a flowering plant. A flower consists of four whorls borne on a thalamus. These whorls are

- ❖ calyx – consisting of sepals
- ❖ corolla – consisting of petals.
- ❖ Androecium – consisting of stamens
- ❖ Gynoecium – consisting of carpels

Common Flower Parts



Student Activity:

- ❖ Take a shoe flower from a growing plant.
- ❖ Observe the floral parts calyx, corolla, Androecium and Gynoecium.
- ❖ Separate the stamens and carpels and observe the parts.
- ❖ Dust the pollen grain on a slide and observe under a microscope.

Evaluation

- The plant which propagates with the help of its leaves are _____
 a) Onion b) Neem c) Ginger d) Bryophyllum
- The essential parts of a flower are _____
 a) Calyx and Corolla b) Calyx and Androecium
 b) Corolla and Gynoecium d) Androecium and Gynoecium
- Asexual reproduction takes place through budding in _____
 a) Amoeba b) Yeast c) Plasmodium d) Bacteria
- Draw a neat labeled diagram of the parts of a flower

2

POLLINATION



Learning Objectives

THE LEARNER WILL BE ABLE TO

- ❖ Define pollination
- ❖ Describe the importance of pollination
- ❖ Explain the types of pollination
- ❖ Understanding about the pollinating agents



Teachers Activity:

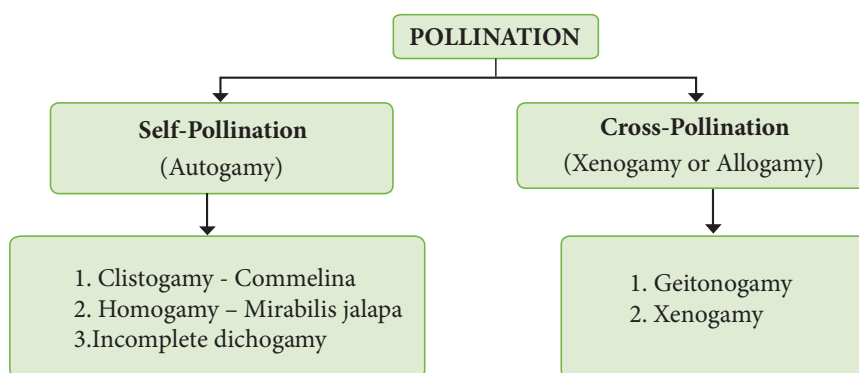
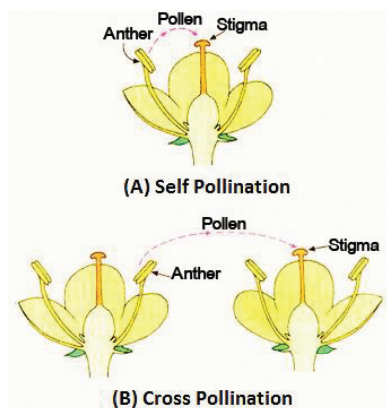
INTRODUCTION:

Definition

- ❖ Transfer of pollen grains from the anther to the stigma of a flower is called pollination.

Importance of pollination:

- ❖ After pollination only the fruits and seeds are formed
- ❖ No pollination there is no co-evolution among animals and plants



CONTRIVANCES OF CROSS-POLLINATION:

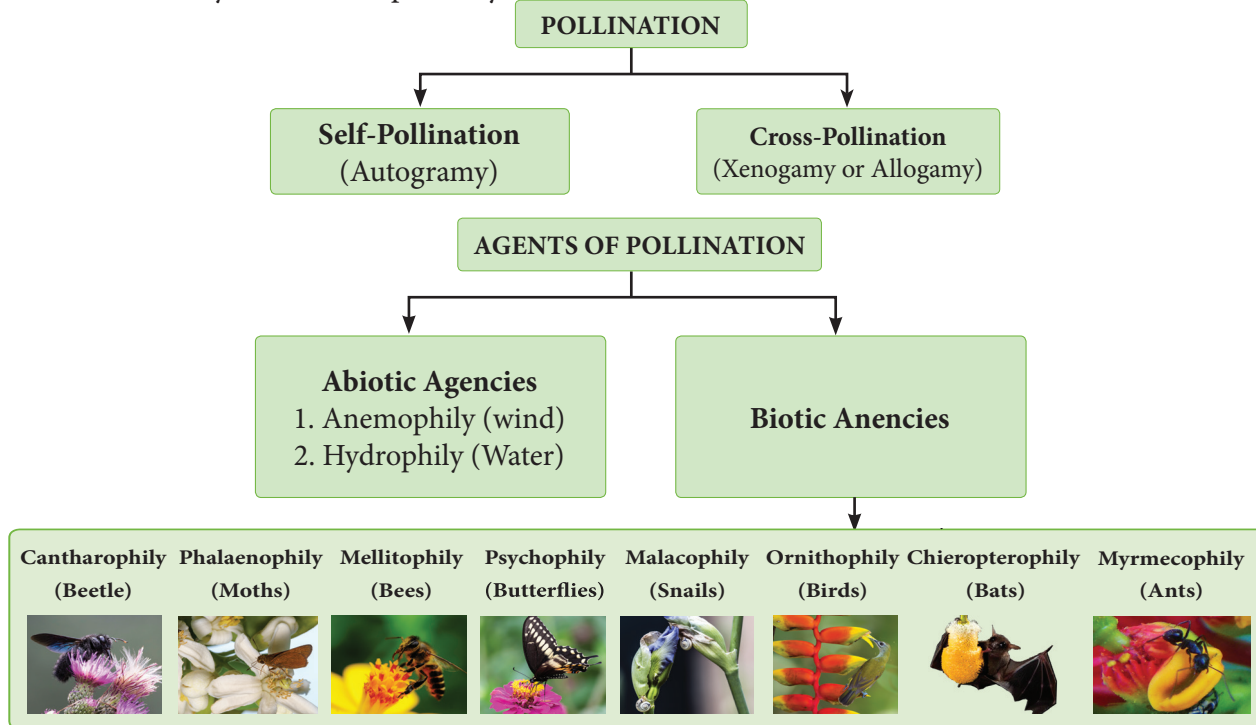
1. Dicliny or unisexuality:

- i. Monoecious – Coconut, Bitter gourd
- ii. Dioecious– Borassus, Carica papaya, Date palm

2. Monocliny or bisexuality

- i. Dichogamy:
 - a. Protandry – Helianthus, Clerodendrum
 - b. Protogyny– Scrophularia nodosa, Aristolochiabracteata

- ii. Herkogamy: Gloriosa superba, Hibiscus
- iii. Heterostyly:
 - a. Distyly - Primula
 - b. Tristyly - Lythrum
- iv. Self-sterility / self-incompatibility: Abutilon, Passiflora



Student Activity:

1. Draw the pictures of self and cross pollination without heading and ask the students to write the heading
2. Show the pictures of pollinating agents and ask the students to tell the pollination type

ASSESSMENT:

1. Define pollination
2. Pollination by wind is called as _____
3. Match the following

i. Mellitophily	a. beetle
ii. Cantharophily	b. Ants
iii. Myrmecophily	c. Bees
4. What is Malacophily
5. Write the odd one _____

a. Ornithophily	b. Hydrophily	c. Chiropterophily	d. Psychophily
-----------------	---------------	--------------------	----------------

3

FERTILIZATION



Learning Objectives

AFTER THIS LESSON THE LEARNER WILL BE ABLE TO

- ❖ Define Fertilization
- ❖ Describe Double Fertilization and Triple Fusion
- ❖ Know about Importance of Fertilization
- ❖ To Understanding the post Fertilization changes in a flower



Teachers Activity:

FERTILIZATION:

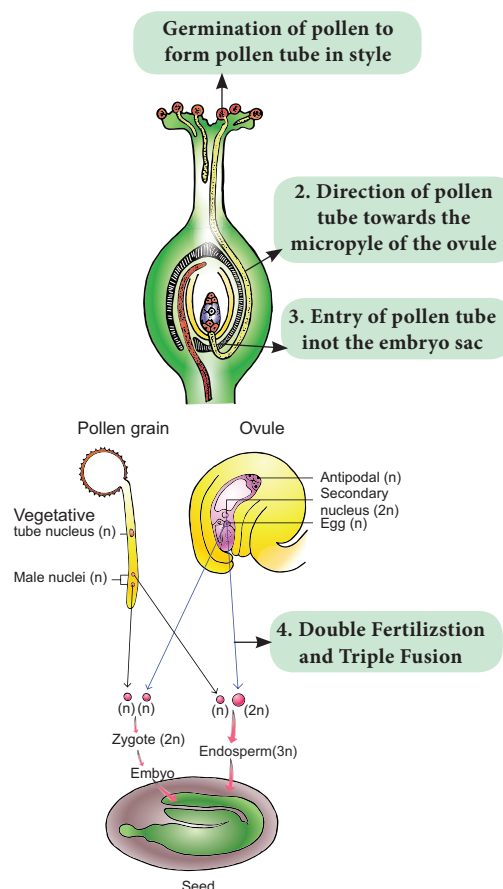
- ❖ The fusion of male and female gamete is called fertilization
- ❖ Fertilization in angiosperms is double fertilization.

EVENTS OF FERTILIZATION: (4 STAGES)

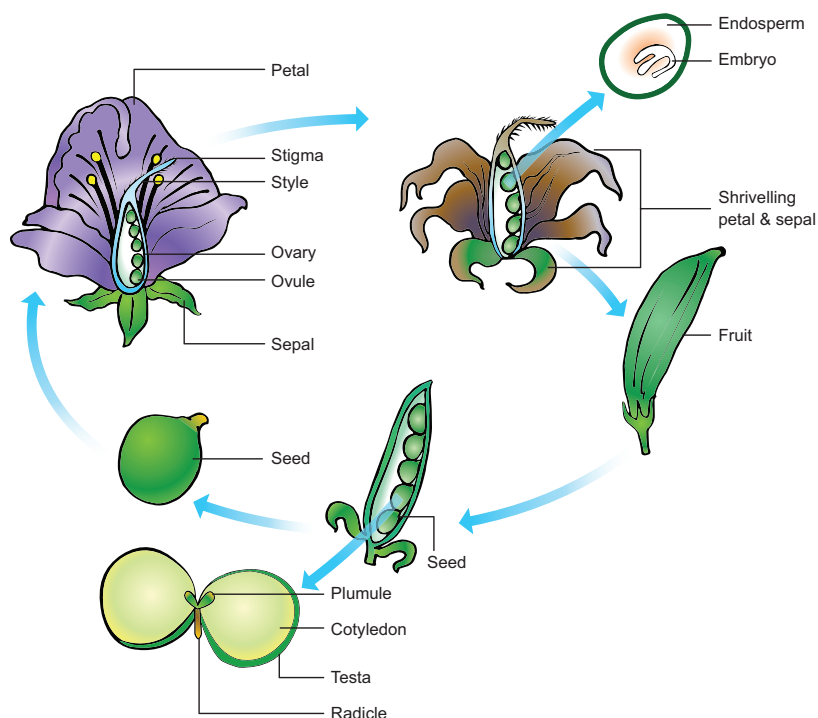
- ❖ The events from pollen Deposition on the stigma to the entry of pollen tube into the ovule is called pollen-pistil interaction.
- ❖ The extreme tip of pollen tube appears hemispherical and transparent this part is called Cap Block
- ❖ Types of Style:
 - i. Hollow Style – Open style
 - ii. Solid Style – Closed style
 - iii. Semi-solid Style – Half closed style
- ❖ Entry of pollen tube into the Ovule
 - i. 3 types
 - 1. Porogamy
 - 2. Chalazogamy
 - 3. Mesogamy
- ❖ Importance of Fertilization:
 - i. Without Fertilization the Seeds will not form

DOUBLE FERTILIZATION AND TRIPLE FUSION:

- ❖ S.G. Nawaschin and L.Guignard in 1898 and 1899 observed in Lilium and Fritillaria.
- ❖ Double Fertilization is unique to angiosperms.
- ❖ Both the male gametes are involved in fertilization.
- ❖ One of the male gametes fuses with the egg nucleus (Syngamy) to form zygote(2n).



- ❖ The second gamete migrates to the central cell where it fuses with the polar nuclei and forms primary endosperm nucleus (PEN (3n))



Parts before fertilization	Transformation after fertilization
Sepals, petals, stamens, style and stigma	Usually wither and fall off
Ovary	Fruit
Ovule	Seed
Egg	Zygote
Funicle	Stalk of the seed
Micropyle (ovule)	Micropyle of the seed (facilitates O ₂ and water uptake)
Nucellus	Perisperm
Outer integument of ovule	Testa (outer seed coat)
Inner integument	Tegmen (inner seed coat)
Synergid cells	Degenerate
Secondary nucleus	Endosperm
Antipodal cells	Degenerate



Student Activity:

- ❖ Ask the students to prepare a chart on fertilization events
- ❖ Teacher take a flower and dissect the parts, show the parts one by one and ask the students to tell the post fertilization change of the flower part

ASSESSMENT:

1. What is Fertilization?
2. Define Cap block:
3. Who discover double fertilization and triple fusion in angiosperms
4. Fill in the Blanks:

First Male gamete fuse with _____ and forms _____ and Second male gamete fuse with _____ and forms _____

5. Match the following:

- | | | |
|--------------|---|--------------|
| i. Ovary | - | a. Zygote |
| ii. Ovule | - | b. Perisperm |
| iii. Egg | - | c. Seed |
| iv. Nucellus | - | d. Fruit |

4

MENDELISM



Learning Objectives

- ❖ To know about the basic knowledge of genetics.
- ❖ To understand Mendel's work on genetics.
- ❖ To know the 7 properties of the pea plant used by Mendel.



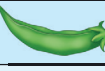













Teachers Activity:

- ❖ The branch of biology that deals with the genes, genetic variation and heredity of living organisms is called genetics.
- ❖ Heredity is transmission of characters, from one generation to the next generation.

GREGOR JOHANN MENDEL – FATHER OF GENETICS

- ❖ The contribution of Mendel to genetics is called Mendelism.
- ❖ Mendel was an Austrian monk who discovered the basic principles of heredity through his experiments. His experiments are the foundation for modern genetics.
- ❖ He was born in 1822 to a family of farmers in Silesian of Czechoslovakia.
- ❖ After finishing his high school at the age of 18, he entered the Augustinian Monastery at Brunn as a priest.
- ❖ From there he went to the University of Vienna for training in physics, mathematics and natural science.
- ❖ In his leisure time he started his famous experiments on the garden pea plant.
- ❖ He had worked on nearly 10000 pea plants of 34 different varieties.
- ❖ Mendel noted that they differ from one another in many ways.
- ❖ Thus Mendel had chosen 7 pairs of contrasting characters for his study.
- ❖ In 1900, the principles of genetics worked by Mendel were rediscovered by three botanists namely, Correns, De Vries and Tschermak.

Character	Gene	Dominant Trait	Recessive Trait
Stem length	Le	 Tall	 Dwarf
Pod Shape	V	 Inflated	 Constricted
Seed Shape	R	 Round	 Wrinkled
Seed colour	I	 Yellow	 Green
Flower position	Fa	 Axial	 Terminal
Flower colour	A	 Purple	 White
Pod colour	GP	 Green	 Yellow









REASONS FOR MENDEL'S SUCCESS

- ❖ He applied mathematics and statistical methods to biology and laws of probability to his breeding experiments.
- ❖ He followed scientific methods and kept accurate and detailed records that include quantitative data of the outcome of his crosses.
- ❖ His experiments were carefully planned and he used large samples.
- ❖ The pairs of contrasting characters which were controlled by factor (genes) were present on separate chromosomes. (Figure 2.4)
- ❖ The parents selected by Mendel were pure breed lines and the purity was tested by self crossing the progeny for many generations.



Student Activity:

1. To show the pictures of 7 different characteristics of the pea plant and identify which one is dominant and recessive.
2. Select the incorrect matching.

Characters	Dominant trait	Recessive trait
(a) Seed shape	 Round	 Wrinkled
(b) Seed colour	 Yellow	 Green
(c) Flower colour	 Purple	 White
(d) Pod shape	 Constricted	 Inflated

ASSESSMENT:

1. Mendel did his experiment on
(a) Apple (b) Garden pea (c) Groundnut (d) All of these
2. How many contrasting traits are chosen by Mendel?
(a) 7 (b) 14 (c) 21 (d) 21
3. What are the reasons for mendel's successes in his breeding experiment?
4. In 1900 CE, three biologists independently rediscovered Mendel's principles. They are
(a) De Vries, Correns and Tschermak (b) Sutton, Morgan, and Bridges
(c) Avery, macLeod and McCarty (d) Bateson, punnet and Bridges

5

MENDEL'S EXPERIMENTS



Learning Objectives

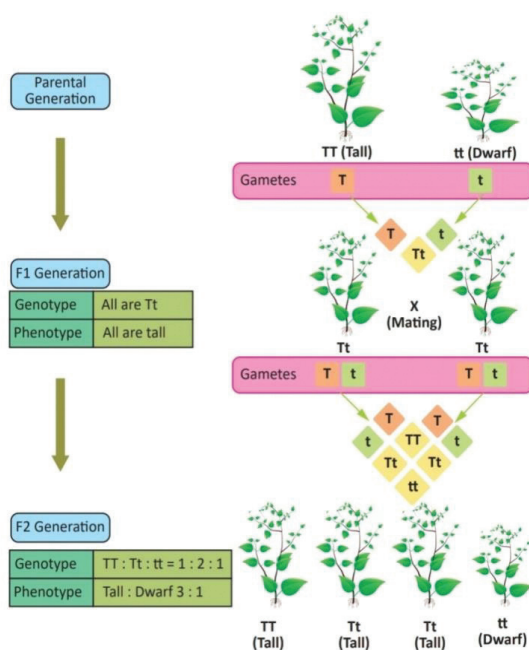
- ❖ To know about the basic knowledge of Mendel's experiments.
- ❖ To understand Mendel's monohybrid and dihybrid experiments.
- ❖ To know the Mendel's Laws of Heredity



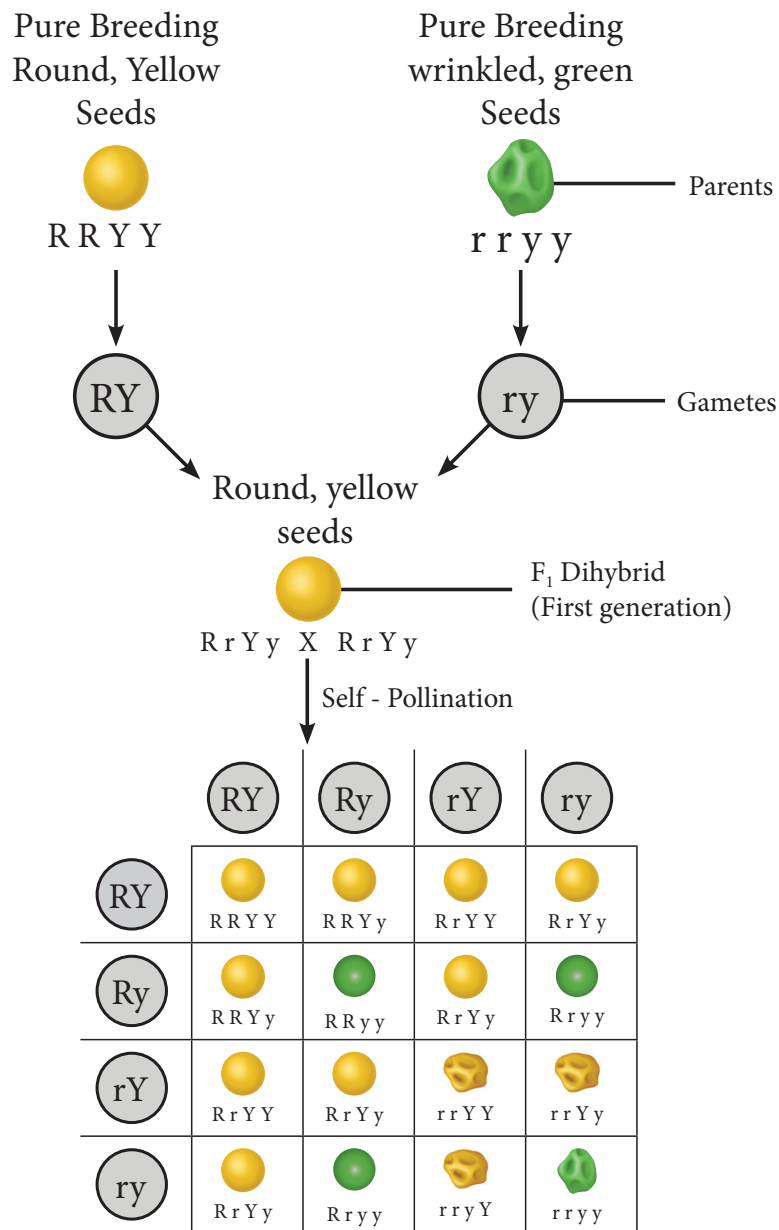
Teachers Activity:

MONOHYBRID CROSS

- ❖ Crosses involving inheritance of only one pair of contrasting characters are called monohybrid crosses.
- ❖ Mendel selected two pea plants, one with tall and the other with a dwarf. These plants were considered as parental plants (P).
- ❖ All the F₁ plants were tall and heterozygous
- ❖ Selfing of the F₁ monohybrids resulted in tall and dwarf plants respectively in the ratio of 3:1
- ❖ External expression of a particular trait is known as phenotype. So the phenotypic ratio is 3:1.
- ❖ In the F₂ generation 3 different types were obtained:
- ❖ Tall Homozygous – TT (Pure) – 1
- ❖ Tall Heterozygous – Tt – 2
- ❖ Dwarf Homozygous – tt – 1
- ❖ So the genotypic ratio 1:2:1. A genotype is the genetic expression of an organism.



DIHYBRID CROSS



Phenotypic ratio of F_2 generation- 9:3:3:1

Round, Yellow - 9 Wrinkled, Yellow - 3
Round, Green - 3 Wrinkled, Green - 1

- ❖ Dihybrid cross involves the inheritance of two pairs of contrasting characteristics (or contrasting traits) at the same time.
- ❖ Mendel first crossed pure breeding pea plants having round-yellow ($RRYY$) seeds with pure breeding pea plants having wrinkled ($rryy$) green seeds and found that only round yellow seeds were produced in the first generation (F_1). No wrinkled-green seeds were obtained in the F_1 generation.
- ❖ When the hybrids of F_1 generation pea plants having round-yellow seeds were cross-bred by self pollination, then four types of seeds having different combinations of shape and color were obtained in second generation or F_2 generation.

- ❖ They were round yellow (9), round-green (3), wrinkled yellow (3) and wrinkled-green (1) seeds. The ratio of each phenotype of seeds in the F₂ generation is 9:3:3:1
- ❖ A dihybrid cross produced four types of F₂ offsprings in the ratio of 9 with two dominant traits, 3 with one dominant trait and one recessive trait, 3 with another dominant trait and another recessive trait and 1 with two recessive traits.
- ❖ Based on his experiments of monohybrid and dihybrid cross, Mendel proposed three important laws which are now called as Mendel's Laws of Heredity

MENDEL'S LAWS OF HEREDITY

- ❖ Law of Dominance
- ❖ Law of Segregation
- ❖ Law of independent assortment



Student Activity:

1. Observe the punnet's square given below

		T	t
♂	T	TT	Tt
	t	Tt	tt

- (a) Identify the cross
- (b) Write the definition of the cross
- (c) Write the genotype and phenotype ratio of F₂

ASSESSMENT:

1. Which of the following is phenotypic ratio of Mendel's dihybrid cross ?
 - (a) 1 : 3
 - (b) 3 : 1
 - (c) 9 : 3 : 3 : 1
 - (d) 1 : 2 : 1
2. Explain the law of dominance in monohybrid cross.

6

CHROMOSOME THEORY OF HEREDITY



Learning Objectives

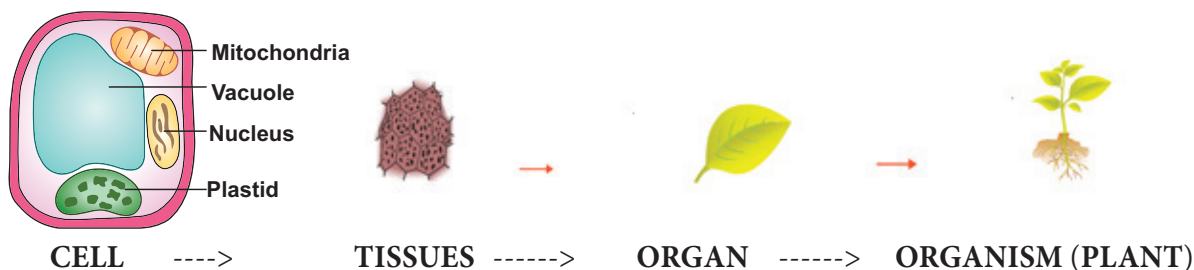
- ❖ Knowing about chromosome
- ❖ Understanding heredity
- ❖ Understanding chromosome characteristics
- ❖ Understanding genes



Teachers Activity:

MOTIVATION:

- ❖ Instruct the students observe the microscope.

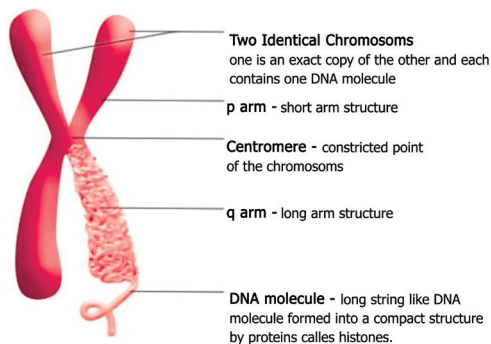


Teachers Activity: 1

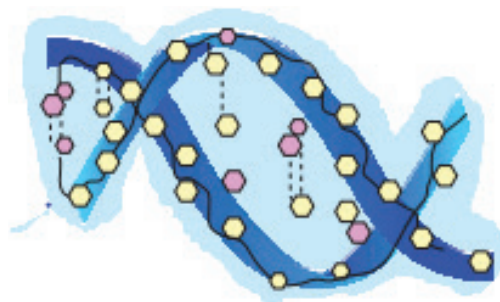
- ❖ The basic unit of life is the cell.
- ❖ It is a collection of many cells that makeup tissues and organs.
- ❖ The word cell was coined by Robert Hooke in 1662.
- ❖ Anton von Leeuwenhook, who called the cell Animal quills.
- ❖ Robert brown named the spherical structure found in the cell called as Nucleus.
- ❖ Schleiden and schwann formulated the cell theory.
- ❖ Burkinje called the protoplasm the sap found inside the plant cell.



Teachers Activity: 2



CHROMOSOME STRUCTURE



DNA STRUCTURE

- ❖ The chromosome is the thread like fiber inside the nucleus; these are thickened and shortened during cell division.
- ❖ Together with the two chromatids it is called a chromosome.
- ❖ Inheritance is the transmission of traits from one generation to the next. This because of the DNA on the chromosome.
- ❖ Total chromosome 46 found in the human body. Somatic chromosomes 44, reproductive chromosome 2 XX – Female, XY – Male
- ❖ Sutton and Bowery separately proposed the chromosome theory for inheritance.
- ❖ The body cell of an organism is formed from the Zygote by continuous cell division mitosis. These have two identical chromosome ($2n$) groups.

Organism	No of chromosome ($2n$)
Arabidopsis	10
Sugarcane	80
Rice	24
Potato	48
Corn	20
Onion	16



Student Activity:

- ❖ Chromosomes carry the genes that determine the individual characteristics of an organisms to the next generation.
- ❖ One of the adjacent genes found on a same chromosome and inherited together is traditionally called a binding gene or linked gene.
- ❖ If two genes found on same chromosome are located at a certain distance they are called unbound genes or syntenic genes.
- ❖ T.H.Morgan found two types of linkage
- ❖ 1. Complete linkage - ex : Drosophila
- ❖ 2. incomplete linkage – ex : Corn
- ❖ Hutchinson was the first to discover the incomplete linkage in corn
- ❖ Two elements of linkage are coupling and repulsion.
- ❖ Coupling or cis type obtained ratio : 7 : 1 : 1 : 7
- ❖ Repulsion or transe type obtained ratio : 1 : 7 : 7 : 1

ASSESSMENT:

1. What is the basic unit of life?
2. How many total chromosomes are found in the human body?
3. What is heredity?
4. What is syntenic genes?
5. Which plant was the first detected in incomplete linkage?

7

CROSSING OVER



Learning Objectives

- ❖ Knowing about cell division and type
- ❖ Knowing about the category and types of meiosis.
- ❖ Identify the changes that occur in meiosis I and prophase I.



Teachers Activity:

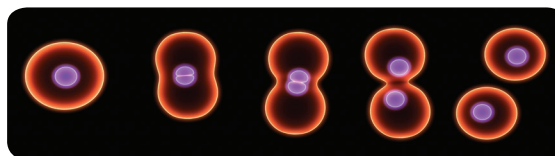
INTRODUCTION

- ❖ Cell divisions are classified into three types namely A mitosis, Mitosis and Meiosis.

1. A Mitosis

It is called direct or incipient cell division

- ❖ Karyokinesis – Involves division of nucleus.
- ❖ Cytokinesis - Involves division of cytoplasm

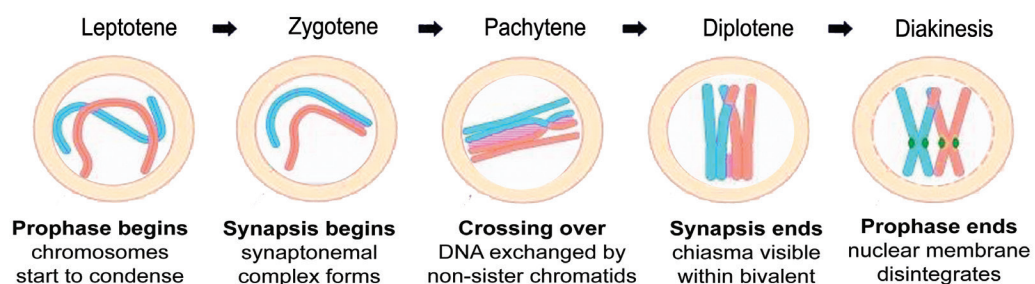


2. Mitosis (Nuclear division)

- ❖ It has four types, prophase, Metaphase, Anaphase, Telophase.
- ❖ Daughter cells have the same genetic makeup as the mother cell.

3. Meiosis (Reduction division)

- ❖ It is two types Meiosis – I, and meiosis II
- ❖ Meiosis – I: Prophase I, Metaphase I, Anaphase I, Telophase I.
- ❖ Prophase I are divided into 5 sub phases.
- ❖ Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis.



Leptotene:

- ❖ The chromosomes begin to condense and attain thread like structure.

Zygotene:

- ❖ Chromosomes start pairing together and this process is known as Synapsis.
- ❖ The complex formed by the homologous chromosomes is called bivalent or tetrad.

Pachytene:

- ❖ Crossingover takes place between non – sister chromatids of homologous chromosomes occurs at the recombination nodules.

Diplotene:

- ❖ Marks the dissolves of the synaptonemal complex.
- ❖ The X shaped structures are called chiasmata.

Diakinesis:

- ❖ Marked by the termination of chiasmata, the nucleolus disappears and the nuclear envelope breakdown.

Meiosis II:

- ❖ It is called mitotic meiosis because it occurs like mitosis. They are four division Prophase II, Metaphase II, Anaphase II, Telophase II.



Student Activity:

1. Make a cell division diagrams and their positions into concept diagrams.
2. Meiosis I, draw a picture of the five levels of prophase I, crossing over, and tetrad.

ASSESSMENT:

1. Crossing over occurs in _____ Stage.
2. Why Meiosis is called reduction division?
3. Write short notes: Synapsis, tetrad.

8

MUTATION



Learning Objectives

- ❖ Knowing the definition of mutation
- ❖ Understanding the chromosome and point mutation



Teachers Activity:

Introduction

Definition of mutation – A sudden change in the genitic material of an organisms is called mutation.

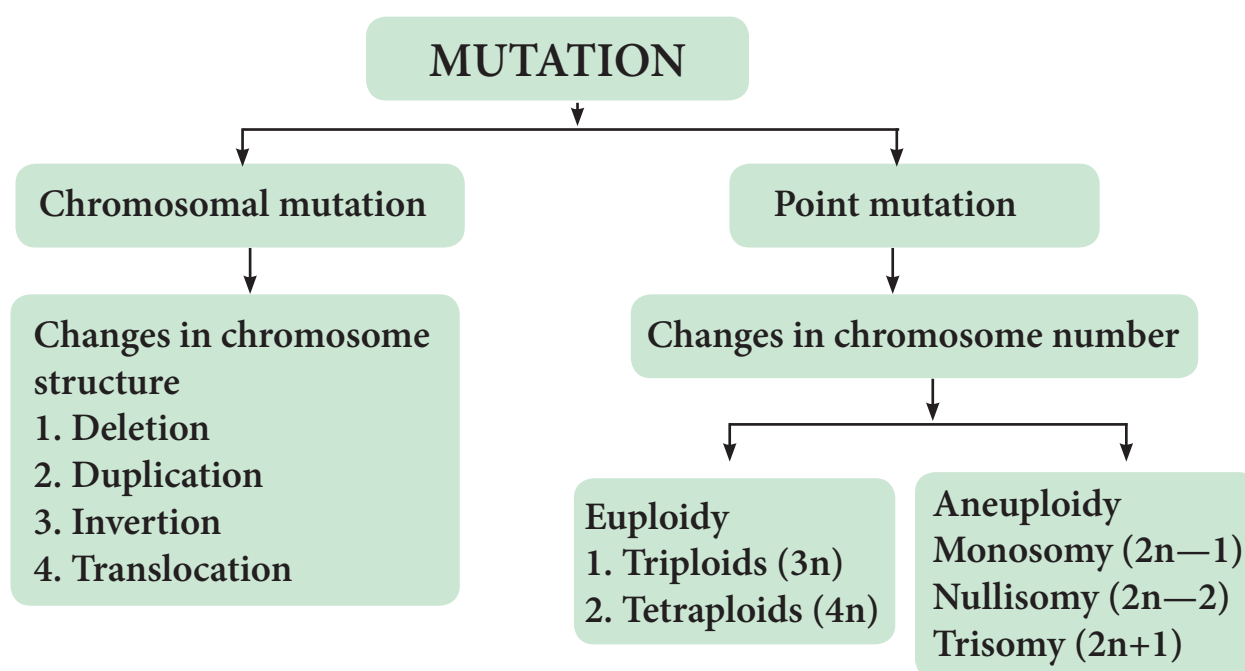
There are two types .

- ❖ Chromosomal mutation
- ❖ Point mutation.
- ❖ Identifying fruits formed by sudden changes

Chromosome Mutation :

Chromosomal mutations are divided into two groups

1. Changes in chromosome structure
2. Changes in chromosome number



Structural changes in chromosome

- ❖ Structural variations caused by addition or deletion or inversion or translocation of a part of chromosome leading to rearrangement of genes.

Changes in chromosome number :

- ❖ The chromosome number of somatic cells are changed due to addition or elimination of individual chromosome or basic set of chromosome.
- ❖ Ploidy is two type 1. Euploidy 2. Aneuploidy

Euploidy :

It is a condition where the organisms possess one or more basic sets of chromosomes

- ❖ Triploids ($3n$) have three set of its own genomes.
- ❖ Tetraploids ($4n$) have four copies of its own genomes.

Aneuploidy:

It is a condition in which diploid number is altered either by addition or deletion.

- ❖ Monosomy ($2n-1$), Nullisomy ($2n-2$), Trisomy ($2n+1$)

Point mutation :

mutations altering the number of copies of a small repeated nucleotide sequence within a gene .

- ❖ DNA that changes the reading frame for the translation process as a result of which there is complete loss of normal protein structure and function.



Student Activity:

1. Draw the flow chart of mutation its types
2. Asking to write down the types of aneuploidy.

ASSESSMENT:

1. Define mutation.
2. Types of aneuploidy ———, ———, ———.
3. Where the point mutation may occurs ?

9

GENETIC ENGINEERING



Learning Objectives

Acquiring the knowledge of Genetic Engineering .

Motivation:

1. Can a gene manipulated through Genetic Engineering ?
2. Can a new organism be made ?
3. Can a gene is transferred from one organism to another organism ?

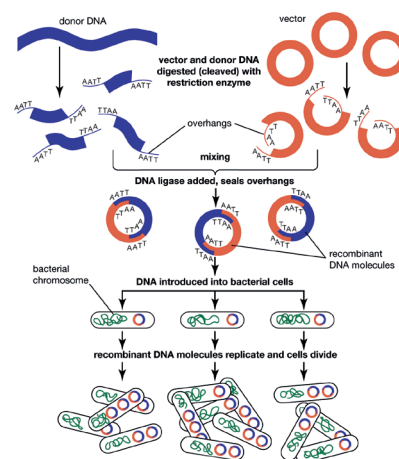


Teachers Activity:

Introduction

Explaining the basic techniques of Genetic Engineering:

- ❖ Isolation of desired DNA and plasmid .
- ❖ Restriction endonuclease → used to cut the desired DNA and plasmids .
- ❖ DNA ligase → join the DNA and plasmid fragments to produce rDNA
- ❖ Insertion of rDNA into a suitable vector (Plasmid) of bacterial host cell .
- ❖ Multiplication of rDNA in the bacterial host cell to get a clone.



Activity - 1

What is Genetic modification ?

Genetic modification refers to the alternation or manipulation of genes in the organisms .

- ❖ Plants expressing a modified gene are known as transgenic organism .
- ❖ The transgenic plants are much stable, with improved nutritional quality, resistant to diseases and tolerant to various environment conditions. eg :- Golden rice .

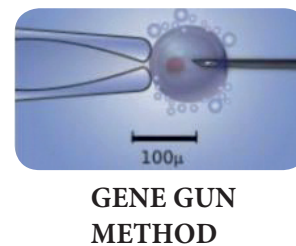
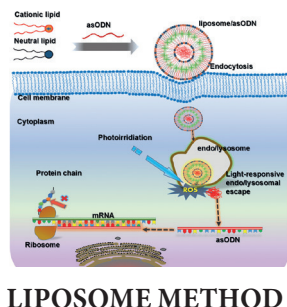
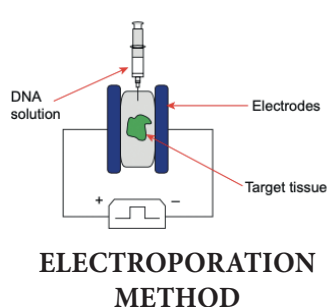


Activity - 2

Methods of Gene Transfer :

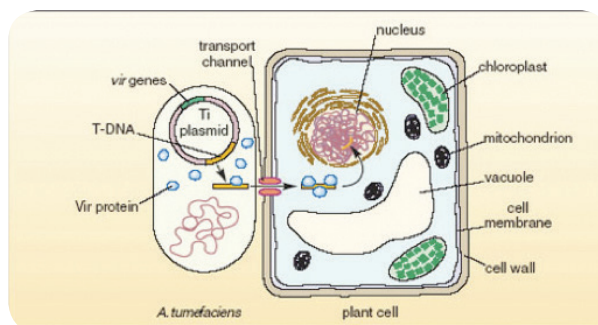
There are two kinds of gene transfer methods used to introduce the rDNA into the suitable host cell .

1. Direct Gene Transfer (or) Vectorless Gene Transfer



2. Indirect gene transfer :

Vector- mediated gene transfer (Ti-Plasmid)



Student Activity:

- ❖ Why gene transfer is done in plants and animals ?
- ❖ For what objectives Dolly was developed ?

Evaluation

1. We can cut the DNA with the help of _____
 a) scissors b) restriction endonuclease c) knife d) RNAase
2. rDNA is a _____
 a) vector DNA b) circular DNA
 c) recombinant of vector DNA and desired DNA d) satellite DNA
3. Golden rice ' is a hybrid - true / false
4. Molecular scissors refers to DNA ligase - true / false

10

ENZYMES



Learning Objectives

To enable students understand the properties and uses of enzymes

MOTIVATION

1. What is metabolism?
2. What is photosynthesis?
3. Is Photosynthesis anabolic process?
4. What is catabolic process?
5. Is digestion catabolic process?
6. Which is speed up metabolism?



Teachers Activity:

CONTENT INTRODUCTION:

1. Enzymes are biochemical catalysts that help start and speed up Bio-Chemical reaction
2. A chemical that interact with enzymes are called its substrates
3. A chemical that obtain at end chemical reaction is called product

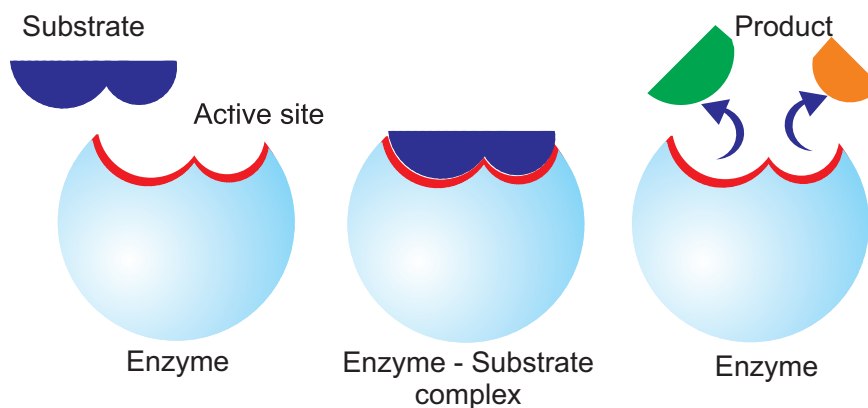
Properties of enzymes

1. Enzymes act as a catalytic and effective even in small quantity.
2. They are remain unchanged at end of reaction.
3. They are highly specific(separate enzyme for each substrate).
4. All are globular proteins.
5. Any reaction require certain amount of activation energy to activate substrate but enzymes lower activation energy requirements.
6. The enzyme contain specific site for the attachment of substrates is called active site.

TYPES OF ENZYMES

EXTRACELLULAR ENZYMES	INTRACELLULAR ENZYMES
This enzymes secrets by a cell and function outside that cell ,	This enzymes secrets by a cell and function inside that cell
Example: Digestive enzymes (Lipase, maltose, pepsin, and sucrose etc)	Example: ligase, alkaline phosphatase and restriction endonuclease

MECHANISM OF ENZYMES ACTION



USES OF ENZYMES

S.NO	ENZYMES	SOURCES	APPLICATION
01	Bacterial protease	Bacillus	Biological detergent
02	zymase	Saccharomyces cerevisiae	Fermentation(alcohol industry)
03	Restriction endonuclease	All bacterium	To cut nucleotide
04	ligase	T4 phage	To fuse fragmented nucleotide



Teachers Activity:

1. Dissolve 8gm dry yeast in 50ml warm water
 2. Take Two beaker and label it as A, B
 3. Add 5ml liquid soap in each beaker
 4. Then add 5 ml , 3%hydrogen peroxide in each beaker
 5. Gently swirl both the beaker until the liquid soap has dissolved
 6. Finally add 10ml of yeast solution beaker A and 15ml of yeast solution to beaker B
 7. Compare the level of foam in the beaker
- $(2H_2O_2 \rightarrow 2H_2O + O_2)$



Student Activity:

Ask students to Repeat the same experiment by changing the temperature of warm water

ASSESSMENT:

1. Enzymes are carbohydrate (True/false)
2. Name any two digestive enzymes
3. Which enzymes is used to cut nucleotide
4. What is fermentation?

11

PLASMIDS

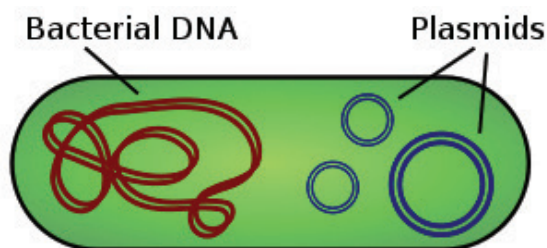


Learning Objectives

- ❖ Identifying the plasmid .
- ❖ Recognising the properties and functions of vectors .
- ❖ Knowing the type of plasmids .



Teachers Activity:



Plasmid is the small circular double stranded DNA molecule found in the cytoplasm of bacterial cell and separated from chromosomal DNA . It can replicate independently .

The fertility factor allows the genes to transfer from one bacterium to another bacterium through conjugation tube.

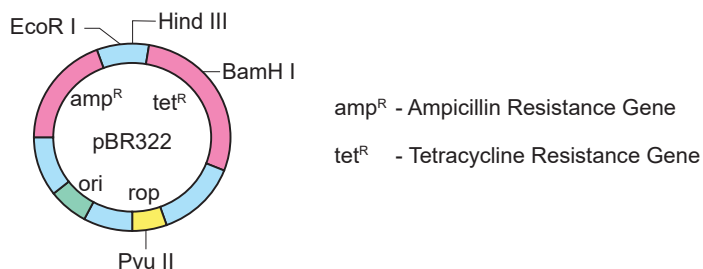
PROPERTIES OF PLASMID OR VECTORS

- ❖ It should be small in size and of low molecular weight less than 10kb .
- ❖ Easy to read and handle .
- ❖ Must contain origin of replication recognised in the host cell .
- ❖ Should contain a suitable marker that enable cells containing the vector to be selected .
- ❖ Should have cloning site to link the alien DNA .
- ❖ Plasmid can be constructed in the laboratory .

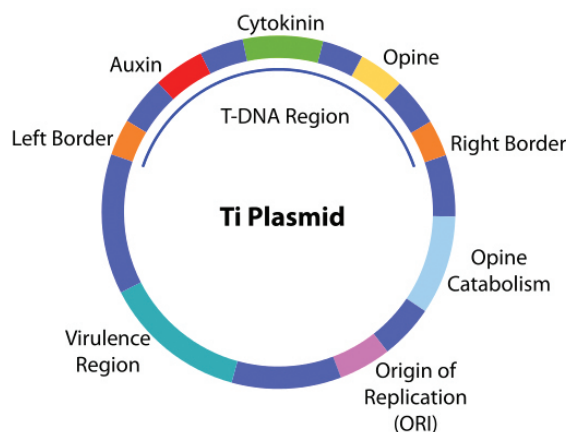
TYPES OF PLASMID

pBR 322 Plasmid

pBR 322 plasmid is a reconstructed plasmid and most widely used as cloning vector; it contains 4361 base pairs. In pBR, p denotes plasmid, Band R respectively the names of scientist Boliver and Rodriguez who developed this plasmid. The number 322 is the number of plasmid developed from their laboratory. It contains amp^r and tet^r two different antibiotic resistance genes and recognition sites for several restriction enzymes. (Hind III, EcoRI, BamH I, Sal I, Pvu II, Pst I, Cla I), ori and antibiotic resistance genes. Rop codes for the proteins involved in the replication of the plasmid



TI- PLASMID



- ❖ The large sized tumour inducing plasmid found in agrobacterium tumefaciens
- ❖ It direct crown gall formation in certain plant species .
- ❖ This Ti plasmid have been used for introduction of genes of desirable traits into plants .



Student Activity:

- ❖ Design a Ti plasmid on what you have learnt.

ASSESSMENT:

1. Plasmids are _____
 - a) circular protein molecules
 - b) required by bacteria
 - c) tiny bacteria
 - d) confer resistance to antibiotics.
2. P^{BR} 322, BR stands for
 - a) plasmid Bacterial Recombination
 - b) plasmid Bacterial Replication
 - c) plasmid Boliver and Rodriguez
 - d) plasmid Boldimore and Rodriguez
3. Match

1. cloning site	- origin of replication
2. selectable marker	- 10 kb
3. Ori	- link the alien DNA
4. low molecular weight of plasmid	- use the restriction enzyme

12

METABOLITES



Learning Objectives

To Enable students identifying and differentiating metabolites and recognize its benefits

MOTIVATION

1. Ask students to smell crushed eucalyptus leaves and ask reason for the smell
2. Ask students to taste Neem leaves and why they are felt for bitterness



Teachers Activity: 1

CONTENT INTRODUCTION

1. Most of the plants, fungi and microorganism synthesis metabolite
2. Metabolites are intermediates and end product of end of metabolism and a smaller organic compound
3. Based requirements of plants, they are divided into two types

Primary metabolites	Secondary metabolites
They are essential for basic metabolic and bio chemical activity	They are formed from primary metabolites. Not require for normal state of function. Stored in specialized cell and involve defense mechanism
Example: protein, carbohydrates, organic acid , vitamins and fatty acid	Example: pigments, Alkaloids and essential oil

4. We use secondary metabolites as medicines, flavoring compounds and fragrances
5. Now a days through tissue culture directly produces large quantities secondary metabolites

S.NO	COMPOUND	PLANT SPECIES	USES
01	Morphine	<i>Papaver somniferum</i>	Pain reliever
02	Quinine	<i>Cinchona officinalis</i>	Anti-malarial
03	Azadirachtin	<i>Azadirachta indica</i>	Insecticide antibacterial
04	Shikonin	<i>Lithospermum erythrorhizon</i>	Red pigment, used as lipstick



Teachers Activity: 2

Put the pomegranate peel on a watered plate and exhibit the student how the pigments exude from it and dissolve in the water



Student Activity:

1. Ask students to collect the resins produced in the plants
2. Ask students to List out what secondary metabolites used in their kitchen

ASSESSMENT:

1. Starch is a primary metabolites (True/false)
2. Name two secondary metabolites
3. Which plant yield morphine drug

13

TISSUES



Learning Objectives

1. To understand cell and tissue.
2. To understand the meristem tissues and permanent tissues.
3. Learn the plant regeneration pathway.
4. Define the plant tissue culture.
5. Learn virus free plants



Teachers Activity: 1

INTRODUCTION : TISSUES:

Tissues are the group of cells that are similar or dissimilar in structure and origin, but perform similar function. Plant tissues can be broadly classified into two, based on their ability to divide. They are

1. Meristematic tissue
2. Permanent tissue

MERISTEMATIC TISSUE:

CHARACTERS

The Meristematic cells are isodiametric and they may be oval, spherical or polygonal in shape.

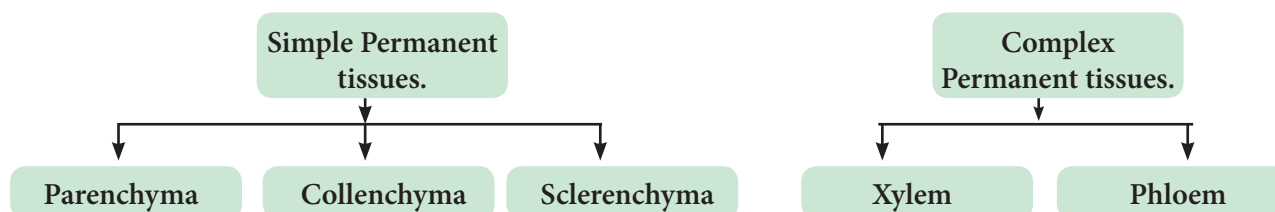
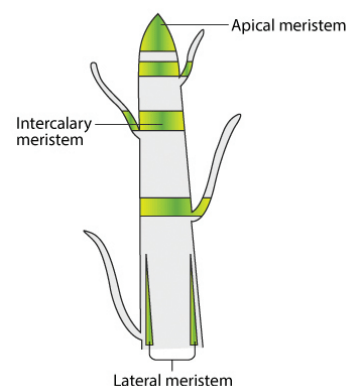
- ❖ They have generally dense cytoplasm with prominent nucleus.
- ❖ These are most actively dividing cells.
- ❖ Meristematic cells are self-perpetuating

CLASSIFICATION OF MERISTEM :

Meristem has been classified into several types on the basis of position, origin, function and division.

PERMANENT TISSUES:

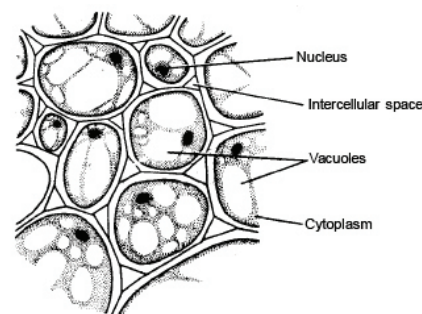
The permanent tissues develop from apical meristem. They lose the power of cell division either permanently or temporarily. They are classified into two types



SIMPLE PERMANENT TISSUES:

PARENCHYMA:

Parenchyma is generally present in all organs of the plant parenchyma is a living tissue and made up of thin walled cells. The cell wall is made up of cellulose.



T.S. of Parenchyma

ROLE OF CELLS AND TISSUE IN PLANT TISSUE CULTURE :

Technology in modern days to create thousands of plants from a single plant cell.

PLANT TISSUE CULTURE :

- ❖ Growing plant protoplasts, cells, tissues or organs away from their natural or normal environment under artificial condition is known as tissue culture.
- ❖ It is also known as in vitro growth of plant protoplasts, cells, tissues and organs. A single explant can be multiplied into several thousand plants in short time period and space under controlled conditions.
- ❖ Tissue culture techniques are often used for commercial production of plants as well as for plant research.
- ❖ Gottlieb haberlandt (1902) the german botanist the first person to culture plant cells in artificial conditions using the mesophyll cells in culture medium and obtained cell proliferation.
- ❖ He is regarded as the father of tissue culture.

TOTIPOTENCY:

The property of live plant cells that they have the genetic potential when cultured in nutrient medium to give rise to a complete individual plant.

EXPLANT :

The tissue taken from a selected plant transferred to a culture medium often to establish a new plant.

CALLUS:

Callus is a mass of unorganized growth of plant cells or tissues in invitro culture medium

APPLICATIONS OF PLANT TISSUE CULTURE :

1. Improved hybrids production through somatic hybridization.

2. Somatic embryoids can be encapsulated into synthetic seeds. These encapsulated seeds or synthetic seeds help in conservation of plant diversity.
3. Production of disease resistant plants through meristem and shoot tip culture.
4. Production of stress resistant plants.
5. Micropropagation technique to obtain large numbers of plantlets of both crop and tree species useful in forestry within a short span of time and all through the year. (ex. Banana)



Student Activity:

1. Know the characteristic of cells & tissues.
2. Identify the cells & tissues through microscope.
3. Draw the diagram "Meristem".
4. Taking the students to the field to view the micropropagation of banana trees.
5. Know about the uses of plant tissue culture.

Evaluation :

1. Draw the diagram "Meristem"?
2. What is tissue?
3. What is totipotency?
4. Define Callus?
5. What are virus-free plants?

14

ECOLOGY AND ECOLOGICAL FACTORS



Learning Objectives

The learner will be able to

- ❖ Understand the Definition of ecology
- ❖ Understand the Ecological hierarchy
- ❖ Understand the Branches of Ecology
- ❖ Understand the Ecological factors

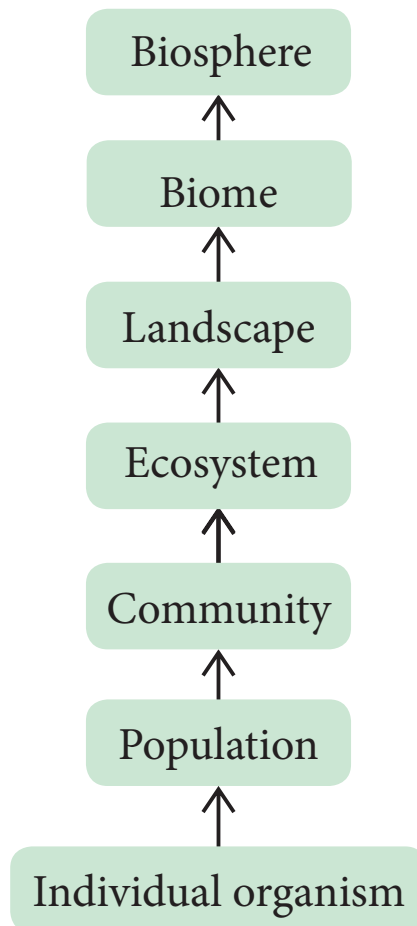


Teachers Activity:

1. DEFINITION OF ECOLOGY

The study of living organisms, both plants and animals, in their natural habitats or homes. - Reiter (1885).

2. ECOLOGICAL HIERARCHY



3. BRANCHES OF ECOLOGY

1. Autecology is the ecology of an individual species and is also called species ecology.
2. Synecology is the ecology of a population or community with one or more species and also called as community ecology.

4. ECOLOGICAL FACTORS

Ecological factors are meaningfully grouped into four classes, which are as follows:

- i. Climatic factors
- ii. Edaphic factors
- iii. Topographic factors
- iv. Biotic factors

i. Climatic factors

Climate is one of the important natural factors controlling the plant life. The climatic factors include light, temperature, water, wind and fire.

ii. Edaphic factors

Edaphic factors, the abiotic factors related to soil, include the physical and chemical composition of the soil formed in a particular area. The study of soils is called Pedology.

iii. Topographic factors

The surface features of earth are called topography. Topographic influence on the climate of any area is determined by the interaction of solar radiation, temperature, humidity, rainfall, latitude and altitude.

iv. Biotic factors

The interactions among living organisms such as plants and animals are called biotic factors, which may cause marked effects upon vegetation.



Student Activity:

1. Draw Ecological hierarchy and write the headings.
2. Students are divided into groups and list out the Ecological factors.
3. To display the Ecological factors to students and ask them to tell the name of Ecological factors.

Evaluation :

1. Arrange the correct sequence of ecological hierarchy starting from lower to higher level.
 - a) Individual organism → Population Landscape → Ecosystem
 - b) Landscape → Ecosystem → Biome → Biosphere
 - c) Community → Ecosystem → Landscape → Biome
 - d) Population → organism → Biome → Landscape
2. Pedogenesis refers to
 - a) Fossils
 - b) Water
 - c) Population
 - d) Soil
3. The study of an individual species in ecology is called?
4. Define ecology.
5. _____ is the ecology of a population or community with one or more species.

15

ECOLOGICAL ADAPTATIONS



Learning Objectives

- ❖ To learn various types of ecological adaptation
- ❖ Learn the structure of various fruits and seeds related to their dispersal mechanism.



Teachers Activity:

DEFINE ECOLOGICAL ADAPTATIONS

- ❖ The modifications in the structure of organisms to survive successfully in an environment are called adaptations of organisms.
- ❖ Based on the habitats and the corresponding adaptations of plants, they are classified as
 - i. hydrophytes,
 - ii. xerophytes,
 - iii. mesophytes,
 - iv. epiphytes and
 - v. halophytes.

Hydrophytes

- ❖ The plants which are living in water or wet places are called hydrophytes.
- ❖ According to their relation to water and air, they are sub-divided into following categories:

i) Free floating hydrophytes,

Examples: Eichhornia, Pistia and Wolffia.

ii) Rooted- floating hydrophytes,

Examples: Nelumbo, Nymphaea, Potamogeton and Marsilea.

iii) Submerged floating hydrophytes,

Examples: Ceratophyllum and Utricularia.

iv) Rooted -submerged hydrophytes,

Examples: Hydrilla, Vallisneria and Isoetes.

v) Amphibious hydrophytes.

Examples: Ranunculus, Typha and Sagittaria.



Pistia



Nelumbo



Vallisneria

XEROPHYTES

- ❖ The plants which are living in dry or xeric condition are known as Xerophytes.
- ❖ Xerophytic habitat can be of two different types.
- ❖ They are:

a. Physical dryness:

In these habitats, soil has a little amount of water due to the inability of the soil to hold water because of low rainfall.

b. Physiological dryness:

In these habitats, water is sufficiently present but plants are unable to absorb it because of the absence of capillary spaces. Example: Plants in salty and acidic soil.

- ❖ Based on adaptive characters xerophytes are classified into three categories.
- ❖ They are
 - i. **Ephemerals:** (drought escapers)
Examples: *Argemone*, *Mollugo*, *Tribulus* and *Tephrosia*.
 - ii. **Succulents:** (drought enduring plants)
Examples: *Opuntia*, *Aloe*, *Bryophyllum* and *Begonia*.
 - iii. **Non succulents:** (drought resistant plants)
Examples: *Casuarina*, *Nerium*, *Zizyphus* and *Acacia*.



OPUNTIA



ASPARAGUS



ZIZYPHUS

MESOPHYTES

- ❖ The plants which are living in moderate conditions (neither too wet nor too dry) are known as mesophytes.
- ❖ These are common land plants.

Example: Maize and Hibiscus.

EPIPHYTES

- ❖ Epiphytes are plants which grow perched on other plants (Supporting plants).
- ❖ They use the supporting plants only as shelter and not for water or food supply.
- ❖ These epiphytes are commonly seen in tropical rain forests.

Examples: Orchids, Lianas, Hanging Mosses and Money plant.

HALOPHYTES

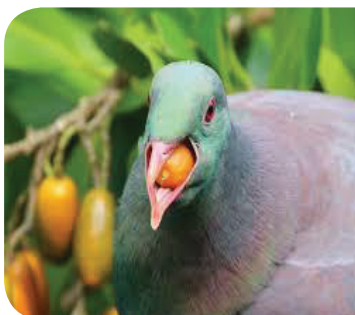
- ❖ There are special type of Halophytic plants which grow on soils with high concentration of salts.

Examples: Rhizophora, Sonneratia and Avicennia.

- ❖ Halophytes are usually found near the sea-shores and Estuaries.
- ❖ This vegetation is also known as mangrove forest and the plants are called mangroves.

DISPERSAL OF FRUITS AND SEEDS

- ❖ The dissemination of seeds and fruits to various distances from the parent plant is called seed and fruit dispersal.
- ❖ Both fruits and seeds possess attractive colour, odour, shape and taste needed for the dispersal by birds, mammals, reptiles, fish, ants and insects even earthworms.
- ❖ The seed consists of an embryo, stored food material and a protective covering called seed coat.
- ❖ It takes place with the help of ecological factors such as wind, water and animals.



DISPERSAL BY ANIMALS



DISPERSAL BY WIND



DISPERSAL BY WATER

DISPERSAL BY WIND (ANEMOCHORY)

- ❖ The individual seeds or the whole fruit may be modified to help for the dispersal by wind. Wind dispersal of fruits and seeds is quite common in tall trees.

Example: *Orchids*, *Dipterocarpus*, *Vernonia*

DISPERSAL BY WATER (HYDROCHORY)

- ❖ Dispersal of seeds and fruits by water usually occurs in those plants which grow in or near water bodies.

Example: Coconut.

DISPERSAL BY ANIMALS (ZOOCHORY)

- ❖ Birds and mammals, including human beings play an efficient and important role in the dispersal of fruit and seeds. They have the following devices.

Example: *Boerhaavia* and *Cleome*,

DISPERSAL BY EXPLOSIVE MECHANISM (AUTOCHORY)

- ❖ Some fruits burst suddenly with a force enabling to throw seeds to a little distance away from the plant.

Example: *Ecballium elatrium* (Squirting cucumber) *Gyrocarpus* and *Dipterocarpus*.

HUMAN AIDED SEED DISPERSAL

Seed Ball :

- ❖ Seed ball is an ancient Japanese technique of encasing seeds in a mixture of clay and soil humus (also in cow dung) and scattering them on to suitable ground, not planting of trees manually.
- ❖ This method is suitable for barren and degraded lands for tree regeneration and vegetation before monsoon period where the suitable dispersal agents become rare.



Student Activity:

- ❖ To collect and tabulated the seed dispersal by wind
- ❖ To collect some dicot seeds and prepare seed ball.

Assignment

1. Which one of the following is not a free floating plant

a) Eichhornia	b) Pistia
c) Wolffia	d) Marsilea.
2. Give an example for Non succulents plants

a) Opuntia	b) Aloe
c) Bryophyllum	d) Casuarina
3. The other name of mangrove forest and the plants

a) Deciduous forest	b) polar forest
c) mangrove	d) social forest
4. Which raw material used for to prepare seed ball

a) Clay	b) soil humus
c) cow dung	d) all the above
5. The dissemination of seeds and fruits to various distances from the parent plant is called

a) Seed dispersal	b) fruit dispersal
c) a and b	d) none of these

16

ECOSYSTEM



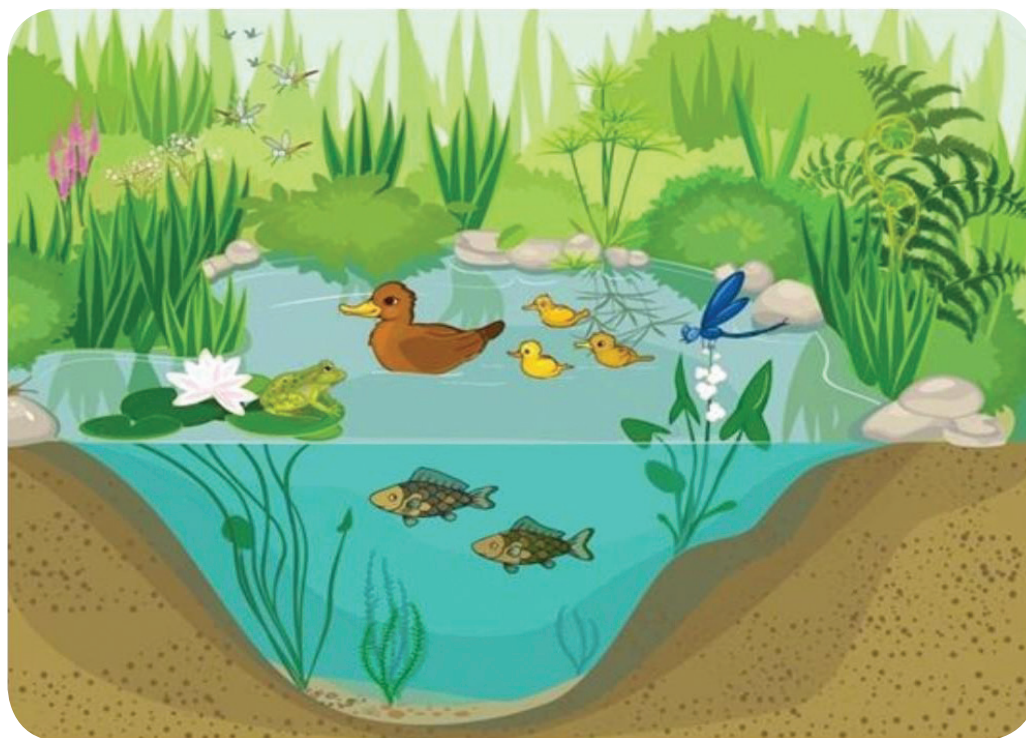
Learning Objectives

- ❖ To introduce ecosystem.
- ❖ Illustrate pond is a natural ecosystem.
- ❖ List out abiotic components.
- ❖ Recognise biotic components.
- ❖ List out the types of ecosystem.



Teachers Activity:

Ecosystem is the study of interaction between living and non living components.



See the pond ecosystem and list out abiotic components and biotic components.

❖ Abiotic components.

Water, soil, air, sunlight, temperature and chemical components dissolved in the water.

❖ Biotic component.

plants, animals, fungi and bacteria these biotic components are classified as follow

1. Producers or autotrophic components.
2. Consumers or heterotrophic components.

3. Decomposers or micro consumers.

❖ Producers

All green plants and phytoplanktons are capable of producing their own food by photosynthesis.
Eg. Anabaena, Chlamydomonas, Vallisneria.

❖ Consumers

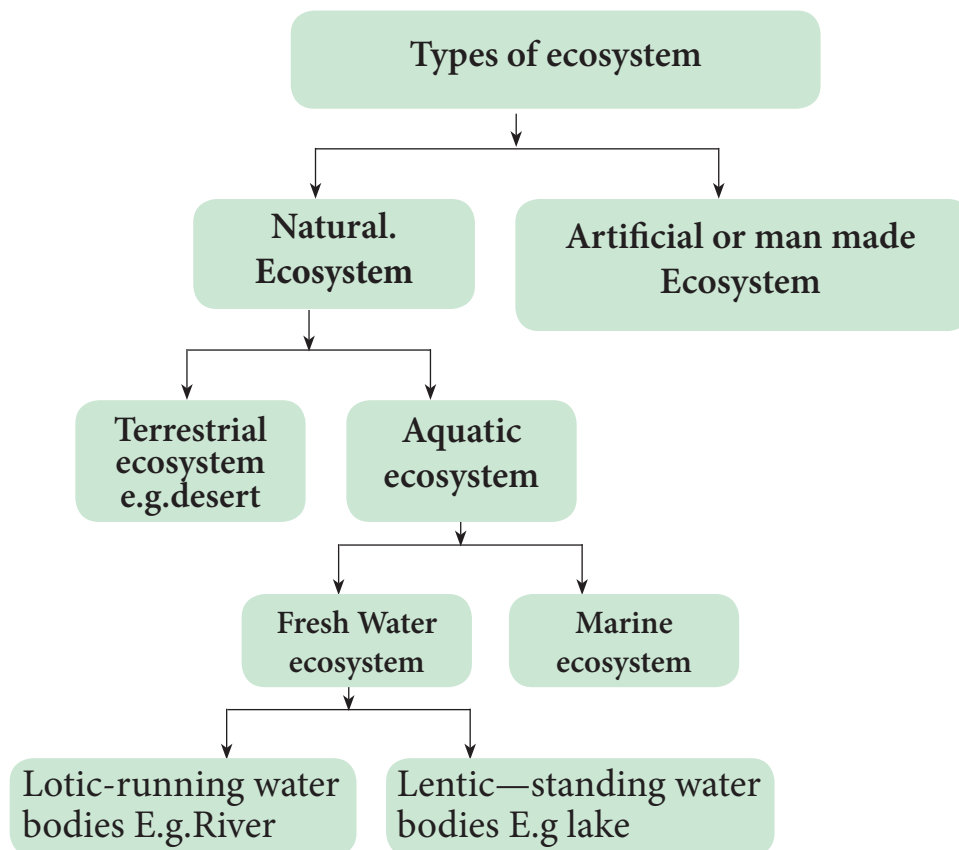
The organisms which consume the producers. They are classified into three categories.

- i. primary consumers or plant eaters and zooplanktons. Eg. Molluscs, annelids and Paramoecium.
- ii. secondary consumers Eg. water beetles and frogs.
- iii. tertiary consumers or carnivores Eg. duck, crane.
- iv. top carnivores like large fish, man.

❖ Decomposers or micro consumers.

Decomposers are organisms which decompose dead and decaying organisms.

They help to recycle the nutrients in the ecosystem present in mud water and bottom of the pond
example bacteria and fungi.



If we fail to protect environment we will fail to save posterity.



Student Activity:

Form two groups of students.

1. Draw pond ecosystem.
2. One group list out the a biotic components and another group list out the biotic components such as producers, primary, secondary, tertiary and top carnivores.
3. list out producers, primary, secondary, tertiary and top carnivores from biotic components.

Assignment

1. Draw pond ecosystem.
2. **Match**

a. Lotic	-	paddyfield
b. Lentic	-	desert
c. Terrestrial ecosystem	-	pond
d. Artificial ecosystem	-	stream
3. Are producers essential in an ecosystem ?give reason.
4. Are there any types in consumers?If yes. list out.
5. Do you know the importance of ecosystem?List out few.

17

DECOMPOSITION AND BIO-GEOCHEMICAL CYCLE



Learning Objectives

- ❖ To know about decomposition.
- ❖ Knowing essentiality of decomposition.
- ❖ To introduce bio geo- chemical cycle.



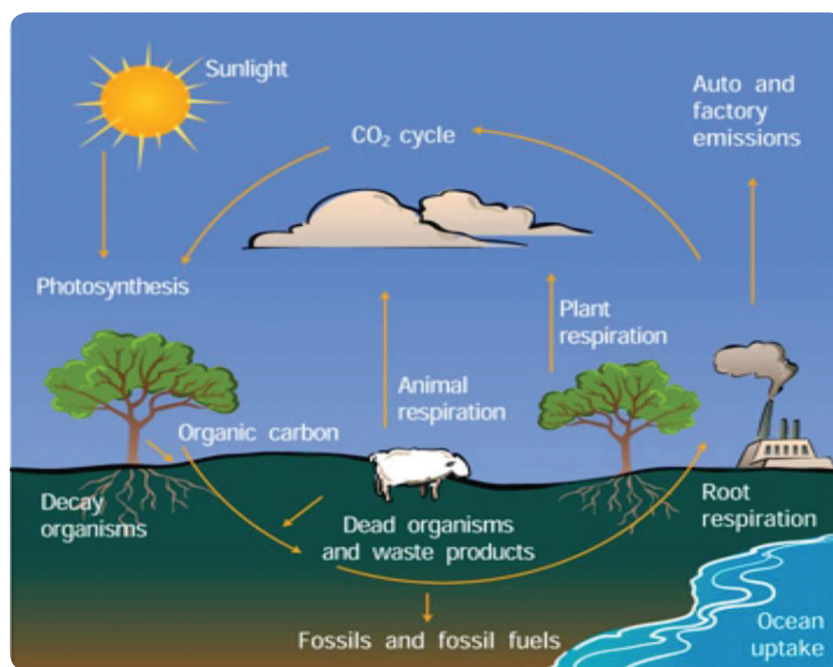
Teachers Activity: 1

- ❖ All organisms require nutrients for their growth, development, maintenance and reproduction.
- ❖ Decomposition is a process in which the detritus (plants, animals and their excreta) are broken down into simple organic matter by decomposers.
- ❖ Decomposition is an essential process for recycling and balancing the nutrient pool in an ecosystem.
- ❖ The process of decomposition occurs in the following steps.
 1. Fragmentation
 2. Catabolism
 3. Leaching
 4. Humification
 5. Mineralization.



Teachers Activity: 2

Circulation of nutrients within the ecosystem or biosphere is known as biogeochemical cycle. It occurs in



CARBON CYCLE

- ❖ Gaseous cycle includes atmospheric oxygen, carbon and nitrogen cycle
- ❖ Sedimentary cycle includes of phosphorus, sulphur and calcium present as sediments of earth.
 - i. Cycling of carbon between organisms and atmosphere is a consequence of two reciprocal processes of photosynthesis and respiration.



Student Activity:

1. Students create water cycle with the help of teacher.
2. Draw diagram for water cycle.
3. Form two groups of students and conduct debate.

Is bio-geo chemical cycle essential? or not.

Assignment

1. Is nutrient essential for an organism ? Justify your reason.
2. Name some decomposers.
3. Name the steps of decomposition.
4. The important processes involved in carbon cycle are photosynthesis and respiration. True/False.

18

GREENHOUSE EFFECT AND GLOBAL WARMING



Learning Objectives

- ❖ To know about the greenhouse effect.
- ❖ To know about the global warming
- ❖ Understanding the effects of global warming
- ❖ Learning about the strategies to deal with global warming.



Teachers Activity: 1

DEFINITION OF GREEN HOUSE EFFECT

- ❖ Radiant heat from the sun is captured by gases in the atmosphere that increase the temperature of the earth ultimately called greenhouse effect.

GREEN HOUSE GASES:

- ❖ The gases that capture heat are called greenhouse gases example CO_2 , N_2O , CFC, CH_4 .

EFFECTS OF GLOBAL WARMING

- ❖ Rise in global temperature which causes sea level to rise the polar ice caps and glaciers begin to melt causing submergence of many coastal cities in many parts of the world.
- ❖ change in weather patterns bringing more floods or droughts in some areas.
- ❖ Tropic and subtropics may face the problems of decreased food production.

STRATEGIES TO DEAL WITH GLOBAL WARMING

- ❖ Reducing the use of fossil fuels and greenhouse gases,
- ❖ Minimizing use of nitrogenous fertilizers and aerosols.
- ❖ Grow more trees.



Student Activity:

- ❖ Student draw the flowchart of relative contribution of greenhouse gases.
- ❖ Student made as separate two groups and ask them to discuss about the effect of global warming and strategies to deal with global warming.

Evaluation:

- 1) Human activities cause global warming True /False
- 2) Which of the following is not greenhouse gas?
 - i) Carbon dioxide (CO_2)
 - ii) methane (CH_4)
 - iii) Nitrous oxide (N_2O)
 - iv) Ethane (C_2H_6)
- 3) Mention the effect of global warming?
- 4) Bring out the alternatives to control global warming?
- 5) What are the green house gases?
- 6) What is meant by greenhouse effect.

19

FORESTRY-AFFORESTATION



Learning Objectives

- ❖ To know about the objectives of afforestation.
- ❖ Understanding the major activities of forestry extensions centres.
- ❖ Briefly understanding the effects of deforestation
- ❖ To describe the CHIPKO movement and APPIKO movement.
- ❖ To know about the benefits of agroforestry and social forestry:



Teachers Activity: 1

OBJECTIVES OF AFFORESTATION

- ❖ To increase forest cover planting work more tree.
- ❖ Regeneration of indigenous herbs/Shurbs

BENEFITS OF AGROFORESTRY AND SOCIAL FORESTRY:

AGROFORESTRY

- ❖ Soil and water conservation and also the stabilize the soil (salinity and water table) reduce landslide under water run-off problem.
- ❖ Multipurpose tree varieties like Acacia are used for wood pulp, tanning, paper and fire wood industries.

SOCIAL FORESTRY

- ❖ Providing indirect employment opportunity for the youth
- ❖ Trees grown outside forests by government and public organisation

MAJOR ACTIVITIES OF FORESTRY EXTENSION CENTERS :

- ❖ Training on tree growing methods raising and supply of seeding and subsidy.
- ❖ Awareness creation among school children and youth about the importance of forest through training and camps.

REASONS FOR DEFORESTATION

- ❖ Over population Industrialization, urbanization and increased global needs.
- ❖ Developmental activities like road construction electric power lines and dams.

EFFECTS OF DEFORESTATION

deforestation gives rise to ecological problems like floods, drought, soil erosion, loss of wildlife extinction of species imbalance of biogeochemical cycles, alternation of climatic condition and desertification.

CHIPKO MOVEMENT

- ❖ Indian history has witnessed many people movements for the protection of environment.
- ❖ Chipko movement by Sunderlalbahuguna in mantal village of Chamoli district in 1974.
- ❖ Main aim of Chipko movement was to give a slogan of five, food, fodder,fuel, fibre and fertilizer. to make the communities self sufficient in all their basic needs.



Student Activity:

- ❖ Dividing the students discuss about the major activities of forestry extension centers.
- ❖ Explain the effect of deforestation.

Evaluation:

1. Write about the forestation?
2. What is Chipko movement?
3. How do forests help in maintaining the climate.
4. Write about objectives of afforestation.

20

RAINWATER HARVESTING (RWH)



Learning Objectives

- ❖ Explanation about rainwater harvesting.
- ❖ To learn the methods of rainwater harvesting.
- ❖ To Groping the advantages of rainwater harvesting(RWH)



Teachers Activity: 1

Definition of rainwater harvesting:

- ❖ Rainwater harvesting is a technique of collecting and storing rainwater for future use.
- ❖ It is a traditional methods of storing rainwater in underground Tanks, Ponds, lakes, checkdams and used in future.
- ❖ The main purpose of rainwater harvesting is to make the rainwater percolate under the ground so as to recharge the groundwater level.
- ❖ The average rainfall in every year losses of the following ways (i.e)40% rainwater run off and reach towards seas, 35% of rain water evaporated by heat: and only 14 % observed as ground water.
- ❖ 10% of rainwater is responsible for soil moisture.
- ❖ In urban areas only 5% of rainwater observed as ground water.



Teachers Activity: 2

METHODS OF RAINWATER HARVESTING:

i) Roof Top rainwater harvesting:

Roof Tops are excellent rain catcher. The rain water that falls on the roof of the houses, apartments, commercial building etc, Is collected and stored in the surface tank and can be used for domestic purpose.

ii)Recharge pit:

In this method the rainwater is first collected from the rooftops open space and is directed into the percolation pits through pipes for filtration. After filtration the rain water enters the recharge fits or ground Wells.

- ❖ people living in rural areas are adapted for variety of water collecting methods to capture and store as rainwater.

iii) Digging of tanks or lakes(Eris):

It is one of the traditional water harvesting system in Tamil Nadu.

Eri are constructed in such a way that if the water in one Eri over flows, it automatically gets diverted to the other Eri of the next village, as the Eri are interconnected.

Example:

- i) Sholavaram lake
- ii) Chembarambakkam lake,
- iii) Puzhal Eri and
- iv) Maduranthagam lake etc.

iv) Ooranis:

These are small ponds to collect rainwater. The water is used for various domestic purposes such as drinking, washing and bathing.

v) Dams:

During the monsoon seasons, free run-off rain water is collected some dam in Tamil Nadu

Examples:

1. Mettur dam
2. Vaigai dam and
3. Mullai periyar dam etc.

Environmental Benefits of rainwater harvesting:

- ❖ Promote adequacy of under ground water and water conservation.
- ❖ Mitigates the effect of drought.
- ❖ Reduces soil erosion as surface run-off is reduced.
- ❖ Reduces flood hazards.
- ❖ Improve groundwater quality and water table.
- ❖ Avoid land wastage for storage purpose and
- ❖ No population displacement is involved.



Student Activity:

1. Ask to the students make a visit to the lakes, Ponds, ooranis near by their village with their parents.
2. Confirm and explain the students, rainwater harvesting system found near by houses and school campus,etc.

Assessment:

1. What is mean by rainwater harvesting?
2. Write the names names of important lakes located near by Chennai.
3. Write any two importance of lakes?
4. The _____ dam which constructed by the Uttama chola.
5. Due to rain water harvesting improves _____ level.

21

ORGANIC AGRICULTURE



Learning Objectives

- ❖ Learning about Organic forming
- ❖ Knowing the types of bio-fertilizers
- ❖ Learn about Rhizobium
- ❖ Knowing about Mycorrhizae
- ❖ Learn about Azolla



Teachers Activity: 1

ORGANIC FORMING

Organic forming is an alternative Agricultural system which originated early in the twentieth century in reaction to replay changing farming practices. It is a production system that sustains the health of the soils, ecosystems, and people.

It relies on ecological process, biodiversity and cycles adapted to local conditions rather than the uses of inputs with adverse effects.

TYPES OF BIO-FERTILIZERS:

1. Rhizobium
2. Mycorrhizae
3. Azolla

1. Rhizobium:

Bio-fertiliser containing rhizobium bacteria are called rhizobium Bio-fertilizer culture. Symbiotic bacteria that inside the root nodules convert the atmospheric nitrogen in to a bio available form to the plants. This nitrogen fixing bacteria in when applied to the soil undergoes multiplication and fixes the atmospheric nitrogen in to the soil.

2. Mycorrhizae:

Arbuscular mycorrhizae is formed by symbiotic association with the roots of vascular plants they dissolve and increase the availability and uptake of phosphorus easy

3. Azolla:

Is a free floating aquatic fern found on water surfaces having a cyanobacterial symbiotic association with Anabaena. It is live floating nitrogen factory using energy from photosynthesis to fix atmospheric nitrogen.



Student Activity:

1. list of leguminous plants
2. list the bio fertilizers used in organic farming in your garden .

Assessment:

1. Match
 - a. Rhizobium - aquatic fern
 - b. Mycorrhizae - soil bacteria
 - c. Azolla - fungal roots
2. What is organic farming
3. List of types of bio-fertilizers
4. What is Rhizobium
5. What is mycorrhizae

22

PLANT BREEDING



Learning Objectives

- ❖ Understand the different conventional method of plant breeding.
- ❖ Students can able to know about objectives of plant breeding.
- ❖ Students enable to understanding in steps of plant breeding.



Teachers Activity: 1

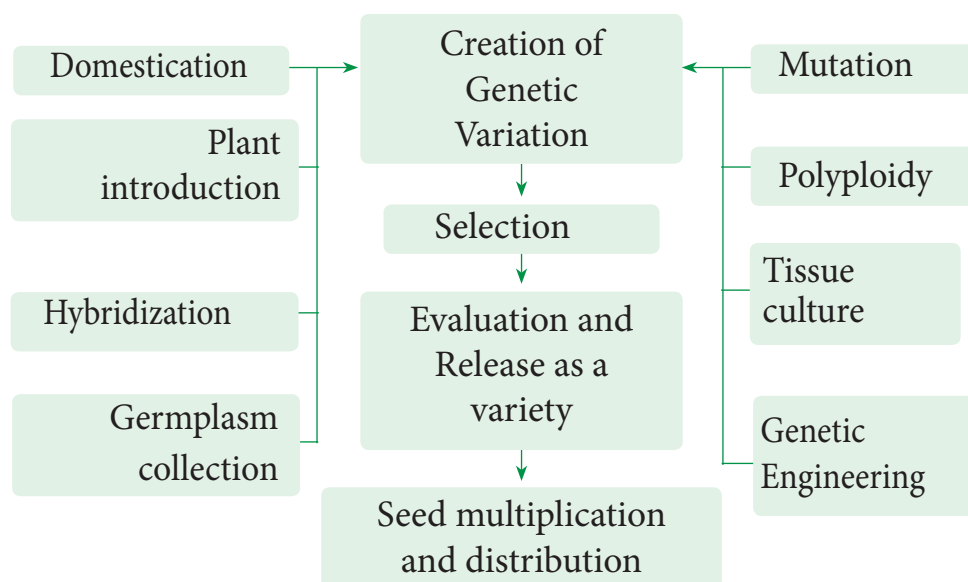
INTRODUCTION:

plant breeding is the science of improvement of crop varieties with higher yield better quality, residence to diseases and shorter durations which are suitable to particular environment.

OBJECTIVES OF PLANT BREEDING:

- i. To increase yield, vigour and fertility of the crop.
- ii. To increase tolerance to environmental condition, salinity temperature and drought. pests.
- iii. Prevent the premature falling of buds fruits.
- iv. Develop resistance to pathogens and pests

STEPS IN PLANT BREEDING:



HYBRIDIZATION

Hybridization is the method of producing new crop varieties in which two or more plants of unlike genetically constitution is all crossed together that result in a progeny called hybrid.



Student Activity:

- i. Students asked to do for Emasculation.
- ii. Students asked to discuss about uses of polyploidy
- iii. Short note on different types of hybridization

Evaluation

1. list out the new breathing techniques involved in developing new trials in plant breeding.
2. Define - mass selection?
3. what is polyploidy?
4. which of the following is incorrectly paired?
 - a) Wheat - Hiongiri b) Milk breed - sahiwal
 - c) Rice - Ratna d) Pusa komal - Brassica.

23

FOOD PLANTS



Learning Objectives

- ❖ To know about cereals
- ❖ To know about pulses
- ❖ To know about sugars



Teachers Activity: 1

Food plants

- ❖ Basic foods (Rice Wheat Maize) are derived from cereals.

Cereals

- i. Major Cereals - Paddy
- ii. Minor millet - Foxtail millet, Kodo millet
- iii. Millets - Ragi, Sorghum.

Pulses

- ❖ Rich proteins example black gram red gram green gram

Vegetables

- ❖ It includes potassium Fibres, folic acid and vitamin A, E, C, examples ladies fingers, potato.

Fruits types.

- ❖ contain more nutrients
 - i. Temperate fruits - Apple
 - ii. Tropical fruits - Mango

Sugars

- ❖ give sweet taste Eg: Sugar cane, Palm

Oil seeds

- i. Essential oil - evaporate rose oil.
- ii. Vegetable oils - Non evaporate - groundnut oil

Beverages

- ❖ It' Stimulate central nervous system, example coffee, tea.



Student Activity:

1. Collect the traditional varieties of paddy.
2. Tabulate the types and uses of minor millets
3. Identify and classify the oil plants.

Evaluation

1. Write the uses of Rice
2. Difference - Temperature and tropical fruits
3. Write the effect of coffee.

24

FIBERS AND TIMBER



Learning Objectives

- ❖ Knowing about fibre, timber.
- ❖ Study about uses of timber



Teachers Activity: 1

Fibre :

Fibres are very much elongated sclerenchyma cells with pointed tips. fibres are dead cells and have lignified walls with narrow lumen.

Types of fibres :

1. Xylary fibres
2. Libriformfibres
3. Bastfibres
4. Surface fibres
5. Mesocarp fibres
6. Leaf fibres

Uses

Fibres have a great commercial value in cottage and textile industries.



Teachers Activity: 1

Timber:

- ❖ Timber is mainly used for carpentry and building houses. In order to enrich the quality of timber seasoning of wood is done.
- ❖ Timber is the most important tissue that sequestrates atmospheric carbon and this reduces global warming.

Seasoning of wood

It is the process in which moisture content from the wood is removed. There are two types of seasoning.

1. Air seasoning
2. Kiln seasoning

IMPORTANT TIMBER PLANT:

S.No	Plant Name	Scientific name
1.	Teak	<i>Tectona grandis</i>
2.	Portia tree	<i>Thespesia populnea</i>
3.	Ebony	<i>Diaospyros ebenum</i>

TIMBER USES:

Table, chair, door, Trainbox, cot etc.



Student Activity:

- ❖ List out the uses of saw dust, savings and wood flour.
- ❖ Collect some pieces of plywood, analyse the layers and discuss yourself how it is made.

Evaluation

1. What is wood botonically?
2. Teak scientific name.
 - a) Thespesiapopunes b) Tectonagrandis
 - b) Diospyros d) Allium cepa
3. Write types of seasoning of wood
4. Fibre cells are_____

25

DYES AND MEDICINAL PLANTS



Learning Objectives

- ❖ Knowing about Dyes plant.
- ❖ Knowing about traditional system of medicines.



Teachers Activity: 1

The ability to perceive is a wonderful aspect of human eyes and dyes add colour to the good we use.

S.No	Scientific plant name	Uses
1	<i>Indigofera tinctoria</i> (Avuri)	indigo dye obtained from leaves
2	<i>Clitoria ternatea</i>	Blue dye is obtained from seeds
3	<i>Butea monosperma</i>	natural dye



Teachers Activity: 2

TRADITIONAL SYSTEM OF MEDICINE:

1. India as a rich medicinal heritage.
2. A number of traditional system of medicine for practiced in India some of which come from outside India.
 - i. Siddha
 - ii. Ayurveda

The traditional system of medicine focus on healthy lifestyle and healthy diet for maintaining good health and disease reversal.

MEDICINAL PLANTS:

Medicinal plants play a significant role in providing primary health care services to rural and tribal people.

- Eg:**
1. Keezhanelli-(*Phyllanthus amarus*)
 2. Adathodai-(*Justicia adhatoda*)
 3. Nilavembu-(*Andrographis paniculata*)



Student Activity:

- ❖ list out common medicinal plants.
- ❖ Discusses about Dyes plant with your friends.

Evaluation

1. A person got irritation while applying chemical dye. what would be your suggestion for alternative?
2. which is commonly known as “King of Bitters”
3. Keezhanelliscientific name is
 - a) *Justiciaadhatoda*
 - b) *Phyllanthus amarus*
 - c) *Cucumis indica*
 - d) *Tectonagrandis*.

26

STRUCTURE AND REPLICATION OF DNA



Learning Objectives

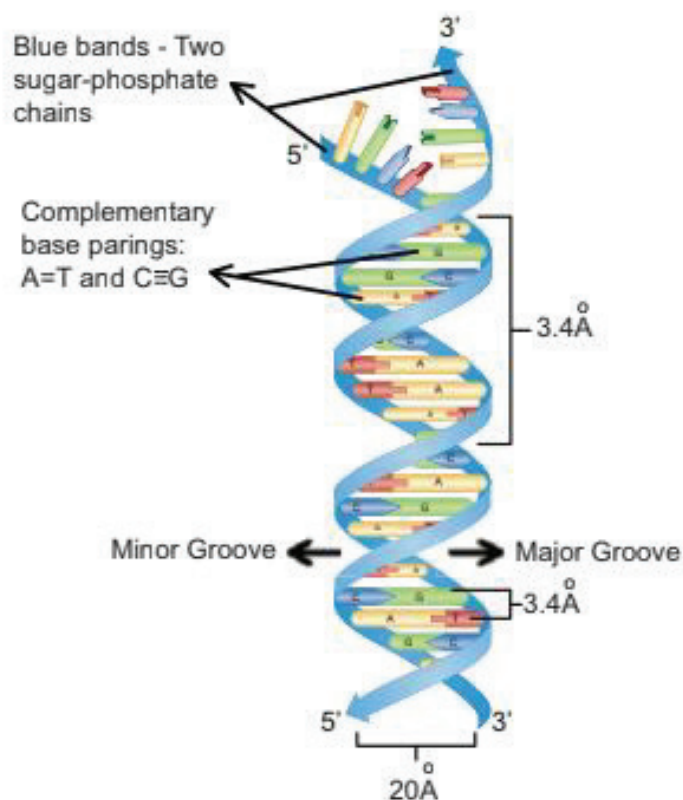
- ❖ Knowing about the DNA structure.
- ❖ Knowing about DNA replication and the enzymes involved in DNA replication



Teachers Activity: 1

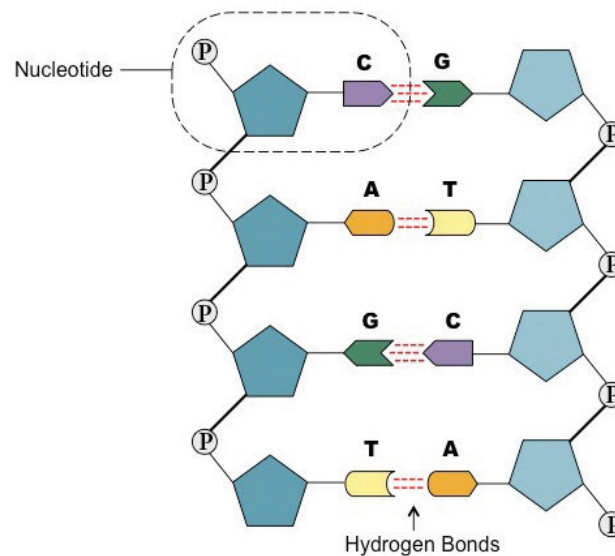
Introduction

- Explain the structure of DNA



- DNA three dimensional model structure released by Watson and Crick.
- Is the most widely accepted DNA sample.

The chemical structure of the DNA molecule



Antiparallel DNA Strands

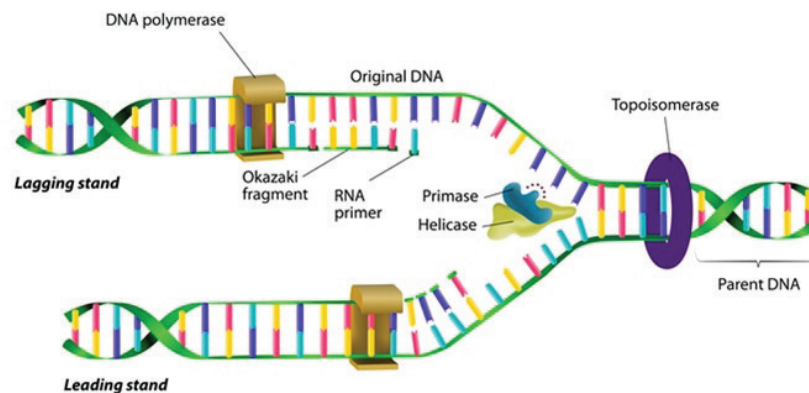
- It is the largest molecule containing millions of nucleotides
- A sugar molecule – Deoxyribose sugar
- Nitrogen bases :
Purine – Adenine, guanine.
Pyrimidine—Cytosine , Thymine
- A phosphate molecule
- Nucleoside ---> Nitrogen base + Pentose sugar molecule
- Nucleotide ---> Nitrogen base + Pentose sugar molecule + a phosphate molecule
- Two polynucleotide chain are coiled around a common axis to form a double helix structure
- Nitrogen bases combine at a certain ratio by hydrogen bonding.
 $A + T = C + G$



Teachers Activity: 1

Replication of DNA

1. The double helix strand of DNA separate and synthesis a new complementary strand
2. DNA replication is semiconservative



- ❖ Replication starts at a specific site on DNA it is origin of replication
- ❖ Replication fork is formed in the site of separation
- ❖ The enzyme helicases are involved in unwinding of DNA
- ❖ Topoisomerase an enzyme removes positive supercoiling
- ❖ DNA replication is initiated by DNA polymerase
- ❖ RNA primers synthesize by primase, it binds on both strands
- ❖ DNA synthesis takes place '5 → 3' direction
- ❖ DNA strands synthesized in pieces, short pieces are called Okazaki fragments
- ❖ DNA fragments joins by Ligase forming Phosphodiester bond.



Student Activity:

1. Draw the image of duplication DNA and lable the parts.
2. Draw the DNA molecular structure and specify the nucleoside and nucleotide
3. Draw a duplicate image of DNA and mark the enzymes that help in duplication.

Assessment :

1. The nucleoside is _____, _____
2. The nucleotide is _____, _____.
3. Write the function of the helicase enzyme and topoisomerase enzyme?
4. Make a note of the okasaki fragment?

27

ENTREPRENEURIAL BOTANY



Learning Objectives

- ❖ To know the mushroom cultivation.
- ❖ To learn the production of single cell protein
- ❖ To understand the organic farming



Teachers Activity:

MOTIVATION :

Entrepreneurial botany is the study of how new businesses are created using plant resources as well as the actual process of starting a new business.



Teachers Activity: 1

Few examples for activities of entrepreneurship are,

- Mushroom cultivation
- Single cell protein production
- Organic farming

MUSHROOM CULTIVATION:

- ❖ Plans, animals and industrial waste are used for mushroom cultivation
- ❖ Mushroom being a rich source of protein and other nutrients
- ❖ Mushrooms are the fruiting body of edible fungi
- ❖ Mushrooms are also called white vegetables

There are more than 3000 types of mushrooms e.g

- Button mushroom- *Agaricus bisporus*
- Oyster mushroom- *Pleurotus*
- Paddy straw mushroom- *Volvariella volvacea*



STEPS INVOLVED IN MUSHROOM CULTIVATION

- ❖ The straw used for composting should be ripe and golden yellow
- ❖ It should be cut into 2 to 4 inches and sterilized
- ❖ The spawn should be free from contamination .

**Teachers Activity: 2****SINGLE CELL PROTEIN PRODUCTION:**

Single cell proteins are the dried cells of micro organism, which are used as protein supplement in human foods or animal feeds.

Micro organisms used for the production of single cell protein are as follows,

- ❖ Bacteria- *Methylophilus methylotrophus*, *Cellulomonas*, *Algaligenes*
- ❖ Fungi – *Agaricus campestris*, *Saccharomyces cerevisiae*
- ❖ Algae – *Spirulina*, *Chlorella*, *Chlamydomonas*

**Teachers Activity: 2****ORGANIC FARMING:**

Uses of biofertilizer is one of the important components of integrated organic farm management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture'

BIO CONTROL METHODS:

1. Bio predators
2. Bio pesticides
3. Bio repellents
4. Bio fertilizer

**Student Activity:**

- ❖ Pluck leaves from the neem tree and chop the leaves finely.
- ❖ The chopped up leaves were put in a container and fill to half with water, put the lid on and leave it for 3 days to brew.
- ❖ Using another container, strain the mixture which has brewed for three days to remove the leaves through fine mesh sieve. The filtrate can be sprayed on the plants to repel pests.

Assessment :

1. What are the types of mushroom?
2. Define single cell protein.
3. What are the bio control methods?
4. What do you learn about entrepreneurial botany ?



www.waytosuccess.org

NOTE

