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## English – Tamil Terminology

### Unit VI – Reproduction in plants

Apomixis	கருவுறா இனப்பெருக்கம்
Apospory	கருவுறா வித்து
Archeporium	முன்வித்து திசு
Cleistogamous flower	மூடிய பூ
Cryopreservation	குளிர்்பாதுகாப்பு
Embryo sac	கருப்பை
Floral primordium	மலர் தோற்றுவி
Funiculus	தல் காம்பு
Microsporogenesis	நுண் வித்துருவாக்கம்
Polyembryony	பல்கருநிலை
Scion	ஒட்டுத் தண்டு
Stock	வேர்கட்டை

### Unit VII - Genetics

Allele	அல்லீல்
Allopolyploidy	அயல்பன்மடியம்
Alternative splicing	மாற்று இயைத்தல்
Autopolyploidy	தன்பன்மடியம்
Backcross	பிற்கலப்பு
Blending inheritance	கலப்பு பாரம்பரியம்
Branch migration	கிளைவழி இடம்பெயர்தல்
Codominance	இணைஒங்குத்தன்மை
Complete linkage	முழுமையான பிணைப்பு
Complementation test	நிரப்பு சோதனை
Coupling	இணைப்பு
Crossing over	குறுக்கேற்றம்
DNA metabolism	DNA வளர்சிதை மாற்றம்
Dominance	ஒங்குத்தன்மை
Duplication	இரட்டிப்பாதல்
F <sub>1</sub> generation (first filial generation)	முதல் மகவுச்சந்ததி

Frame shift mutation	கட்ட நகர்வு சடுதி மாற்றம்
Gene interaction	மரபணு இடைச்செயல்
Gene mapping	மரபணு வரைபடம்
Genome	மரபணுத்தொகையம்
Genotype	மரபணுவகையம்
Haploidy	ஒருமடியம் (பன்மம்)
Heredity	பாரம்பரியம்
Heterozygous	மாறுபட்ட பண்பிணைவு
Homologous chromosome	ஒத்த அமைவிட குரோமோசோம்
Incomplete dominance	முழுமைபெறா ஒங்குத்தன்மை
Incomplete linkage	முழுமையற்ற பிணைப்பு
Independent assortment	சாராஒதுங்கு விதி
Internal methylation	அக மெத்திலாக்கம்
Inversion	தலைகீழ் திருப்பம்
Jumping genes	தாவும் மரபணுக்கள்
Linkage group	பிணைப்புத் தொகுதி
Locus	நிலையிடம்
Map unit	வரைபட அலகு
Mis-sense mutation	தவறாக வெளிப்பாட்டடையும் சடுதிமாற்றம்
Monohybrid	ஒரு பண்புக்கலப்புயிரி
Multiple alleles	பல்கூட்டு அல்லீல்கள்
Mutagen	சடுதிமாற்றக் காரணி
Mutation	சடுதிமாற்றம்
Non-sense mutation	வெளிப்பாட்டடையாத சடுதி மாற்றம்
Palindrome	முன்பின் ஒத்தவரிசை
Phenotype	புறத்தோற்றவகையம்
Purity of gametes	இனச்செல்கலப்பற்றது
Recessive	ஒடுங்குத்தன்மை
Repulsion	விலகல்



Restriction enzymes	தடைக்கட்டு நொதிகள்
Saltation	திலர் மாற்றம்
Segregation	தனித்தொதுங்குதல்
Sequence	தொடர்வரிசை
Sex linkage	பால் பிணைப்பு
Silent mutation	அமைதி சடுதிமாற்றம்
Split genes	பிளவுறு மரபணு
Synaptonemal complex	இணைப்பிணைப்புக் கூட்டமைப்பு
Synopsis	இணைச் சேர்தல்
Tassel seed	கதிர் குஞ்சுவிதை
Test cross	சோதனைக்கலப்பு
Tetrad stage	நான்மய நிலை
Three point test cross	முப்புள்ளி சோதனைக் கலப்பு
Translocation	இடம்பெயர்தல்

### UNIT VIII - Biotechnology

Artificial seeds	செயற்கை விதைகள்
Aseptic condition	நுண்ணுயிர் அற்ற நிலை
Autoradiography	கதிரியக்க படமெடுப்பு
Biochip	உயிரி சில்லு
Biomass	உயிரி கூளம்
Biopharming	உயிரி மருந்தாக்கம்
Biopiracy	உயிரிபொருள் கொள்ளை
Bioreactor / Fermentor	உயிரி வினைகலன் / நொதிகலன்
Biosynthesis	உயிரி உற்பத்தி
Buffer	தாங்கல் கரைசல்
Carriers	கடத்தி
Cloned Plants	நகலொத்த தாவரங்கள்
Cloning	நகல்பெருக்கம்
Cloning Site	நகலாக்க களம்
Cryoconservation	உறைகுளிர் வெப்பநிலை பேணல்
Cybrids	கலப்பின பிளாஸ்மிட்கள்

Dedifferentiation	வேறுபாடு இழத்தல்
Differentiation	வேறுபாடுறுதல்
DNA Bank	DNA வங்கி
Downstream Process	கீழ்காற் பதப்படுத்தம்
Embryogenesis	கரு உருவாக்கம்
Embryoids	சிறுகருக்கள்
Explant	பிரிகூறு
Fermentation	நொதித்தல்
Gel Electrophoresis	இழும மின்னாற் பிரித்தல்
Gene	மரபணு
Gene Bank	மரபணு வங்கி
Gene Gun	மரபணு துப்பாக்கி
Gene Manipulation Technique	மரபணு கையாளும் தொழில்நுட்பம்
Genetically modified plants	மரபணு மாற்றப்பட்ட தாவரங்கள்
Genome	மரபணு தொகையம்
Green Fluorescence Protein	பசுமை ஒளிர் புரதம்
Hardening	வன்மையாக்குதல்
Human Genome Sequence	மனித மரபணு தொகைய தொடர் வரிசை
Inoculation	உள்நுழைத்தல்
Insert	செருகி
invitro culture	ஆய்வுகூட சோதனை வளர்ப்பு
Isolation	தனிமைபடுத்துதல்
Laminar air flow chamber	சீரடுக்கு காற்று பாய்வு அறை
Liquid medium/ liquid culture	திரவ ஊடகம் / திரவ வளர்ப்பு
Marker	அடையாளக்குறி
Microinjection	நுண்செலுத்துதல்
Micropropagation	நுண்பெருக்கம்
Mycoremediation	பூஞ்சை சீரமைப்பாக்கம்
Nutritional medium	ஊட்ட ஊடகம்
Organogenesis	உறுப்புக்களாக்கம்
Palindrome Sequence	முன்பின் ஒத்த வரிசை
Phytoremediation	தாவர சீரமைப்பாக்கம்



Pollen Bank	மகரந்த வங்கி
Probe	துருவி
Recombinant DNA	மறுகூட்டிணைவு DNA
Recombinant	மறுகூட்டிணைவு
Redifferentiation	மறுவேறுபாடுறுதல்
Regeneration	மீள் உருவாக்கம்
Replica Blotting Technique	நகல் முலாம் தொழில்நுட்பம்
Restriction Enzyme	தடை கட்டு நொதி
Somatic Embryoids	உடல் கருவுருக்கள்
Sterile condition	நுண்ணுயிர் நீக்கிய நிலை
Sterilization	நுண்ணுயிர் நீக்கம்
Tissue culture	திசு வளர்ப்பு
Totipotency	முழு ஆக்குத்திறன் பெற்றவை
Transfection	தொற்றுதல்
Transposon	இடமாற்றிக் கூறுகள்
Upstream Process	மேல்காற் பதப்படுத்தம்
Vector	தாங்கி கடத்தி
Virus free plants	வைரஸ் அற்றத் தாவரங்கள்
Walking Genes	நடக்கும் மரபணுக்கள்

Carbon foot print	கார்பன் தடம்
Carbon sequestration	கார்பன் ஒதுக்கமடைதல்
Carbon sink	கார்பன் தேக்கி
Co-evolution	கூட்டுப் பரிணாமம்
Decomposers	சிதைப்பவைகள்
Ecological hierarchy	தூழ்நிலைப்படிக்கள்
Ecotone	இடைச்சூழலமைப்பு
Ecotope	தூழல் நில அமைவு
Frugivores	பழ உண்ணிகள்
Gnaw	கடல் அருகு வாழ் பறவைகளின் எச்சம்
Habitat	புவி வாழிடம்
Humus	மட்கு
Latitude	விரிவகலம்
Mimicry	பாவனை செயல்கள்
Niche	செயல் வாழிடம்
Ozone depletion	ஓசோன் குறைதல்
Photosynthetically active radioactive	ஒளிச்சேர்க்கை சார் செயலூக்கக் கதிர்வீச்சு
Plant Ecology	தாவர தூழ்நிலையியல்
Predation	கொன்றுண்ணும் வாழ்க்கை முறை
Sacred groves	கோயில் காடுகள்
Seedball	விதைப்பந்து
Social forestry	சமூகக்காடுகள்
Soil profile	மண்ணின் நெடுக்குவெட்டு விவரம்
Standing crops	நிலைப்பயிர்
Standing quality	நிலைத்தரம்
Succession	வழிமுறை வளர்ச்சி
Synecology	கூட்டுச் சூழ்நிலையியல்
Topographic factors	நிலப்பரப்பு வடிவமைப்பு காரணிகள்
Trophic level	உண்பட்டஞ்சார் மட்டம்

### UNIT IX – Plant Ecology

Agroforestry	வேளாண்காடுகள்
Alien Invasive species	அயல் ஊடுருவும் சிற்றினங்கள்
Allelopathic chemicals	வேதியத்தடைப் பொருட்கள்
Altitude	குத்துயரம்
Autecology	சுய சூழ்நிலையில்
Benthic	ஆழ்மிகு மண்டலம்
Benthos	ஆழ் உயிரிகள்
Biochar	உயிரித்தொகுப்பு
Biome	உயிர்மம்
Biotope	உயிரி நில அமைவு



## UNIT X - Economic Botany

Acclimatization	புதிய தட்பவெப்ப நிலைக்கு பழகுதல்
Archeological records	தொல்லியல் பதிவுகள்
Bio medicine	உயிரிமூலக்கூறு மருந்து
Biofertilizers	உயிரி உரம்
Culinary	சமையல்
Decoction	வடிநீர்
Domestication	வளர்ப்புச் சூழலுக்கு உட்படுத்துதல்
Emasculation	மகரந்தத்தாள் நீக்கம்
Entrepreneur	தொழில் முனைவோர்
Essential oil	நறுமண எண்ணெய்
Gluten	பசையம்
Green manuring	தழை உரம்
Kelp	பழுப்பு பாசி
Organic agriculture	இயற்கை வேளாண்மை
Plant pathology	தாவர நோயியல்
Pseudo cereal	பொய் தானியம்
Pungent	நெடி (அல்லது) காரம்
Resin	பிசின்
Sapwood	மென்கட்டை
Saturated fatty acids	நிறைவுற்ற கொழுப்பு அமிலம்
Stimulant	தூண்டி
Tillering	புல் கிளைத்தல்
Unsaturated fatty acids	நிறைவுறா கொழுப்பு அமிலம்
Vigour	வீரியம்
Volatile oil	எளிதில் ஆவியாகும் எண்ணெய்

## Competitive Examination Questions

### UNIT VI - Reproduction in plants

- Which of the following plant reproduces by leaf (DPMT 2003)
  - Agave
  - Bryophyllum
  - Gladiolus
  - Potato
- Advantage of cleistogamy (NEET 2013)
  - Higher genetic variability
  - More vigorous offspring
  - No dependence on pollinators**
  - Vivipary
- An example for edible underground stem is (NEET 2014)
  - Carrot
  - Groundnut
  - Sweet potato
  - Potato**
- Pollen tablets are available in the market for (NEET 2014)
  - invitro fertilization
  - Breeding programmes
  - supplementing food**
  - ex situ conservation
- Geitonogamy involves (NEET 2014)
  - Fertilization of a flower by pollen from another flower of a same plant**
  - Fertilization of a flower by pollen of the same flower
  - Fertilization of a flower by pollen from a flower of another plant in a same population
  - Fertilization of a flower by the pollen from a flower of another plant belongs to distant population.
- Which one of the following generates new genetic combinations leading to variations? (NEET 2016)
  - vegetative reproduction
  - parthenogenesis
  - Sexual reproduction**
  - Nucellar polyembryony



7. Functional megaspore in angiosperm develops into an (NEET 2017)  
a) endosperm                      b) **Embryo sac**  
c) embryo                          d) ovule
8. Which of the statement is not true. (NEET 2016)  
a) Pollen grain of many species cause severe allergies  
b) Stored pollen in liquid nitrogen can be used in crop breeding programmes  
c) **Tapetum helps in the dehiscence of anther**  
d) Exine of pollen grains is made up of sporopollenin
- 9) When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is (AIPMT 2004)  
a) pentaploidy                      b) diploidy  
c) triploidy                          d) **tetraploidy**
- 10) Which one of the following pairs of plant structures has haploid number of chromosomes? (AIPMT 2008)  
a) Egg nucleus and secondary nucleus  
b) Megaspore mother cell and antipodal cells  
c) **Egg cell and antipodal cells**  
d) Nucellus and antipodal cells
- 11) The arrangement of nuclei in a normal embryo sac in the dicot plant is (AIPMT 2006)  
a) 2 + 4 + 2                          b) 3 + 2 + 3  
c) 2 + 3 + 3                          d) 3 + 3 + 2
- 12) Wind pollinated flowers are (AIPMT PRE 2010)  
a) Small, producing nectar and dry pollen  
b) small, brightly colored, producing large number of pollen grains  
c) **small, producing large number of pollen grains**  
d) large, producing abundant nectar and pollen
- 13) Function of filiform apparatus is to (AIPMT 2014)  
a) recognize the suitable pollen at stigma  
b) stimulate division of generative cell  
c) produce nectar  
d) **guide the entry of pollen tube**
- 14) The coconut water from tender coconut represents (NEET 2016)  
a) endocarp  
b) fleshy mesocarp  
c) free nuclear proembryo  
d) **free nuclear endosperm**
- 15) Pollination in water hyacinth and water lily is brought about by the agency of (NEET 2016)  
a) **insects or wind**                      b) birds  
c) bats                                  d) water
- 16) Perisperm differs from endosperm in (NEET 2013)  
a) being haploid tissue  
b) having no reserve food  
c) **being a diploid tissue**  
d) its formation by fusion of secondary nucleus with several sperms
- 17) Male gametes in angiosperms are formed by the division of (AIPMT 2007)  
a) microspore mother cell      b) microspore  
c) **generative cell**                      d) vegetative cell
- 18) In a type of apomixes known as adventive polyembryony, embryo develop directly from the (AIPMT 2005)  
a) synergids or antipodals in an embryo sac  
b) **nucellus or integuments**  
c) zygote  
d) accessory embryo sac in the ovule
- 19) In a cereal grain the single cotyledon of the embryo is represented by (AIPMT 2006)  
a) coleorhizae                          b) **scutellum**  
c) prophyll                              d) coleoptiles

- 20) An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is (AIPMT 2004)
- a) camyotropous    b) anatropous  
c) orthotropous    d) **hemianatropous**
- 21) Endosperm is formed during the double fertilization by (AIPMT 2000)
- a) **two polar nuclei and one male gamete**  
b) one polar nuclei and one male gamete  
c) ovum and male gametes  
d) two polar nuclei and two male gametes

### UNIT VII – Genetics

1. Genes for cytoplasmic male sterility in plants are generally located in (AIPMT 2005)
- a) **Mitochondrial genome**    b) Cytosol  
c) Chloroplast genome    d) Nuclear genome
2. In which mode of inheritance do you expect more maternal influence among the offspring (AIPMT 2006)
- a) Autosomal    b) **Cytoplasmic**  
c) Y-linked    d) X-linked
3. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance? (AIPMT 2010)
- a) Factors occur in pairs  
b) The discrete unit controlling a particular character is called a factor  
c) Out of one pair of factors one is dominant and the other is recessive  
d) **Alleles does not show any blending and both the characters recover as such in F<sub>2</sub> generation**
4. F<sub>2</sub> generation in a Mendelian cross shows that both genotypic and phenotypic ratios are same as 1:2:1. It represents a case of (AIPMT 2012)
- a) **Monohybrid crosses with incomplete dominance**  
b) Co-dominance    c) Dihybrid cross  
d) Monohybrid cross with complete dominance
5. A Pleiotropic gene (AIPMT 2015 – Re-exam)
- a) **Controls multiple traits in an individual**  
b) Is expressed only in primitive plants  
c) Is a gene evolved during Pliocene  
d) Controls a trait only in combination with another L gene
6. A true breeding plant is (NEET Phase II 2016)
- a) **Near homozygous and produces offspring of its own kind**  
b) Always homozygous recessive in its genetic construction  
c) One that is able to breed on its own  
d) Produced due to cross pollination among unrelated plants
7. Mendel obtained wrinkled seeds in pea due to the deposition of sugars instead of starch. It was due to which enzyme? (AIPMT 2001)
- a) Amylase    b) Invertase    c) Diastase  
d) **Absence of starch branching enzyme**
8. Ratio of complementary gene is (AIPMT 2001)
- a) 9:3:4    b) 12:3:1    c) 9:3:3:4    d) **9:7**
9. If there are 999 bases in an RNA that codes for a protein with 333 amino acid and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered? (NEET 2017)
- a) 1    b) 11    c) 33    d) **333**
10. If a homozygous red flowered plant is crossed with a homozygous white flowered plant, then the off-springs will be (AIIMS 1999, 2002, 2007)
- a) Half-white flowered    b) Half-red flowered  
c) All white flowered    d) **All red flowered**
11. The ratio in a dihybrid test cross between two individuals is given by (AIIMS 2001)



- a) 2:1    b) 1:2:1    c) 3:1    d) **1:1:1:1**
12. Pure line breed refers to  
(AIIMS 2002, AIIMS 2007)
- a) Heterozygosity only  
b) Heterozygosity and linkage  
c) **Homozygosity only**  
d) Heterozygosity and self assortment
13. How many different types of gametes can be formed by  $F_1$  progeny, resulting from the following cross  $AABBCC \times aabbcc$   
(AIIMS 2004)
- a) 3    b) **8**    c) 27    d) 64
14. Which of the following conditions represents a case of co-dominant genes?  
(AIIMS 2009)
- a) A gene expresses itself, suppressing the phenotypic effect of its alleles  
b) Genes that are similar in phenotypic effect when present separately, but when together interact to produce a different trait  
c) Alleles both of which interact to produce a trait which may or may not resemble either of the parental type  
d) **Alleles, each of which produces an independent effect in a heterozygous condition.**
15. If 'A' represents the dominant gene and 'a' represents its recessive allele, which of the following would be most likely result in the first generation off spring when  $Aa$  is crossed with  $aa$ ?  
(AIIMS 2016)
- a) All will exhibit dominant phenotype  
b) All will exhibit recessive phenotype  
c) **Dominant and recessive phenotypes will be 50% each**  
d) Dominant phenotype will be 75%
16. In *Pisum Sativum*, there are 14 chromosomes. How many types of homologous pairs can be prepared?  
(JIPMER 2010)
- a) 14    b) **7**    c)  $2^{14}$     d)  $2^{10}$
17. The year 1900 AD is highly significant for geneticists due to  
(JIPMER 2013)
- a) Discovery of genes  
b) Principle of linkage  
c) Chromosomal theory of heredity  
d) **Rediscovery of Mendelism**
18. The phenotypic ratio of trihybrid cross in  $F_2$  generation is  
(JIPMER 2016)
- a) **27:9:9:9:3:3:3:1**    b) 9:3:3:1  
c) 1:4:6:4:1    d) 27:9:3:3:9:1:2:1
19. In a mutational event when adenine is replaced by guanine, it is the case of  
(AIPMT 2004)
- a) Frameshift mutatin    b) Transcription  
c) **Transition**    d) Transversion
20. Mutations can be induced with  
(AIPMT 2011)
- a) **Gamma radiations**    b) Infrared radiations  
c) IAA    d) Ethylene
21. The mechanism that causes a gene to move from one linkage group to another is called  
(AIPMT 2015, NEET (Phase – II) 2016)
- a) **Translocation**    b) Crossing over  
c) Inversion    d) Duplication
22. A point mutation comprising the substitution of a purine by pyrimidine is called  
(AIIMS 2002)
- a) Transition    b) Translocation  
c) Deletion    d) **Transversion**
23. Frameshift mutation occurs when  
(AIPMT 2008)
- a) Base is substituted  
b) **base is deleted or added**  
c) Anticodons are absent  
d) None of these
24. The distance between two genes in a chromosome is measured in cross-over units which represent  
(AIIMS 2008)
- a) Ratio of crossing over between them  
b) **Percentage of crossing over between them**  
c) Number of crossing over between them  
d) None of these



25. When a cluster of genes show linkage behaviour they (AIPMT 2003)
- do not show a chromosome map
  - show recombination during meiosis
  - do not show independent assortment**
  - induce cell division
26. Genetic map is one that (AIPMT 2003)
- Establish sites of the genes on a chromosome**
  - Establishes the various stages in gene evolution
  - Shows the stages during the cell division
  - Shows the distribution of various species in a region
27. After a mutation at a genetic locus of the character of an organism changes due to the change in (AIPMT 2004)
- DNA replication
  - Protein synthesis pattern
  - RNA transcription pattern
  - Protein structure**
28. In a hexaploidy wheat, the haploid (n) and basic (x) numbers of chromosomes are (AIPMT 2007)
- n = 21 and x = 7**
  - n = 7 and x = 21
  - n = 21 and x = 21
  - n = 21 and x = 14
29. Point mutation involves (AIPMT 2009)
- Deletion
  - Insertion
  - Change in single base pair**
  - duplication
30. Which one of the following is a wrong statement regarding mutations? (AIPMT 2012)
- UV and Gamma rays are mutagens
  - Change in a single base pair of DNA does not cause mutation**
  - Deletion and insertion of base pairs cause frame shift mutations.
  - Cancer cells commonly show chromosomal aberrations.
31. Which of the following statement is not true of two genes that show 50% recombination frequency? (NEET 2013)
- The genes may be on different chromosomes
  - The genes are tightly linked**
  - The genes show independent assortment
  - If the genes are present on the same chromosome, they undergo more than one crossover in every meiosis.
32. Haploids are more suitable for mutation studies than the diploids. This is because (AIPMT 2008)
- All mutations, whether dominant or recessive are expressed in haploids**
  - Haploids are reproductively more stable than diploids
  - Mutagens penetrate in haploids more effectively than diploids
  - Haploids are more abundant in nature than diploids
33. Crossing over that results in genetic recombination in higher organisms occurs between (AIPMT 2004)
- Non-sister chromatids of a bivalent**
  - Two daughter nuclei
  - Two different bivalents
  - Sister chromatids of bivalents

#### UNIT VIII - Biotechnology

1. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis? (NEET 2017)
- The smaller the fragment size, the farther it moves.**
  - Positively charged fragments move to farther end.
  - Negatively charged fragments do not move.
  - The larger the fragment size, the farther it moves.



2. Stirred-tank bioreactors have been designed for (NEET – II 2016)
  - a) Purification of product.
  - b) Addition of preservatives to the product
  - c) **Availability of oxygen throughout the process**
  - d) Ensuring anaerobic conditions in the culture vessel.
3. Which of the following is not a component of downstream processing? (NEET-II 2016)
  - a) Separation
  - b) Purification
  - c) Preservation
  - d) **Expression**
4. Which of the following is not a feature of the plasmids? (NEET-I 2016)
  - a) Transferable
  - b) **Single-stranded**
  - c) Independent replication
  - d) Circular structure
5. Which of the following is not required for any of the techniques of DNA fingerprinting available at present? (NEET-I 2016)
  - a) Restriction enzymes
  - b) DNA-DNA hybridization
  - c) Polymerase chain reaction
  - d) **Zinc finger analysis**
6. Which vector can clone only a small fragment of DNA? (AIPMT 2014)
  - a) Bacterial artificial chromosome
  - b) Yeast artificial chromosome
  - c) **Plasmid**
  - d) Cosmid
7. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of (NEET 2013)
  - a) Insertional inactivation of alpha galactosidase in recombinant bacteria.
  - b) Inactivation of glycosidase enzyme in recombinant bacteria.
  - c) **Non-recombinant bacteria containing beta galactosidase.**
  - d) Insertional inactivation of alpha galactosidase in non-recombinant bacteria.
8. During the process of isolation of DNA, chilled ethanol is added to (Karnataka NEET 2013)
  - a) **Precipitate DNA**
  - b) Break open the cell to release DNA
  - c) Facilitate action of restriction enzymes
  - d) Remove proteins such as histones.
9. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of (AIPMT 2012)
  - a) Silver or platinum
  - b) Platinum or zinc
  - c) Silicon or platinum
  - d) **Gold or tungsten.**
10. Biolistics (gene-gun) is suitable for (AIPMT Mains 2012)
  - a) disarming pathogen vectors
  - b) **transformation of plant cells**
  - c) constructing recombinant DNA by joining with vectors
  - d) DNA fingerprinting.
11. Genetic engineering is possible because (CBSE 1998)
  - a) phenomenon of transduction in bacteria understood
  - b) we can see DNA by electron microscope
  - c) we can cut DNA at specific sites by endonuclease like DNAase I
  - d) **restriction endonuclease purified from bacteria can be used invitro**
12. Genetic Engineering is (BHU 2003)
  - a) Making artificial genes
  - b) **Hybridisation of DNA of one organism to that of the others**
  - c) Production of alcohol by using microorganisms
  - d) Making artificial limbs, diagnostic instruments such as ECG, EFG, etc.
13. Ligase is used for (AMU 2006)
  - a) **Joining of two DNA fragments**
  - b) Separating DNA
  - c) DNA polymerase reaction
  - d) All of these



14. In genetic engineering, gene of interest is transferred to the host cell through a vector. Consider the following four agents (1-4) in this regard and select the correct option about which one or more of these can be used as vectors

1. A bacterium                      2. Plasmid  
3. Plasmodium                    4. Bacteriophage  
(AIPMT Main 2010)
- a) 1 and 4 only                    b) **2 and 4 only**  
c) 1 only                            d) 1 and 3 only

15. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it? (AIPMT 2014)

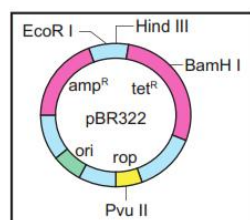
5'---GAATTC---3'            3'---CTTAAG---5'

- a) **Palindromic sequence of base pairs**  
b) Replication completed  
c) Deletion mutation  
d) Start codon at the 5'end

16. There is a restriction endonuclease called EcoRI. What does "co" part in it stand for? (AIPMT 2011)

- a) Coelom                            b) Colon  
c) **Coli**                                d) Coenzyme

17. The figure below is the diagrammatic representation of the vector pBR322. Which one of the given options correctly identifies its certain components? (AIPMT 2012)



- a) Ori-original restriction enzyme  
b) rop-reduced osmotic pressure  
c) Hind III, EcoRI – selectable markers  
d) **ampR, tetR – antibiotic resistance genes**

18. A mixture containing DNA fragments a,b,c,d with molecular weights of  $a+b=c$ ,

$a>b$  and  $d>c$ , was subjected to agarose gel electrophoresis. The position of these fragments from cathode to anode sides of the gel would be (DPMT 2010)

- a) **b,a,c,d**                            b) a,b,c,d  
c) c,b,a,d                            d) b,a,d,c

19. An analysis of chromosomal DNA using the southern hybridisation technique does not use (AIPMT 2014)

- a) Electrophoresis  
b) Blotting  
c) Autoradiography  
d) **PCR**

20. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of (NEET 2013)

- a) Non-recombinant bacteria containing beta galactosidase  
b) Insertional inactivation of  $\alpha$ -galactosidase in non-recombinant bacteria  
c) **Insertional inactivation of  $\beta$ -galactosidase in recombinant bacteria**  
d) Inactivation of glycosidase enzyme in recombinant bacteria

21. Which one of the following palindromic base sequence in DNA can be easily cut at about the middle by some particular restriction enzyme? (AIPMT 2010)

- a) 5'CGTTCG3'                    3'ATCGTA 5'  
b) 5' GATATG 3'                    3' CTACTA 5'  
c) 5' **GAATTC 3'**                    3' **CTTAAG 5'**  
d) 5' CACGTA 3'                    3' CTCAGT 5'

22. Silencing of mRNA has been used in producing transgenic plants resistant to (AIPMT, 2011)

- a) Boll worms                      b) **Nematodes**  
c) White rusts                      d) Bacterial blights

23. Some of the characteristics of Bt cotton are (AIPMT,2010)

- a) Long fibre and resistant to aphids



- b) Medium yield, long fibre and resistant to beetle pests  
c) High yield and production of toxic protein crystals which kill dipteran pests  
d) **High yield and resistant to boll worms**
24. An improved variety of transgenic basmati rice (AIPMT,2010)  
a) Does not require chemical fertilisers and growth hormones  
b) **Gives high yield and is rich in vitamin A**  
c) Is completely resistant to all insect pests and diseases of paddy  
d) Gives high yield but no characteristic aroma
- 25) Consumption of which one of the following foods prevent the kind of blindness associated with vitamin A deficiency? (AIPMT 2012)  
a) Flavr Savr                      b) Canola  
c) **Golden rice**                      d) Bt brinjal
26. A protoplast is a cell (NEET 2016)  
a) undergoing division  
b) **without cell wall**  
c) without plasma membrane  
d) without nucleus.
27. A technique of micropropagation is (NEET 2015)  
a) Protoplast fusion  
b) embryo rescue  
c) somatic hybridization  
d) **somatic embryogenesis**
28. To obtain virus-free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken? (AIPMT 2014)  
a) Apical meristem only  
b) Palisade parenchyma  
c) **Both apical and axillary meristems**  
d) Epidermis only.
29. Cellular totipotency was demonstrated by (AIPMT 1991)  
a) Theodore Schwann  
b) A.V. Leeuwenhoek  
c) **F.C. Steward**  
d) Robert Hooke
30. Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is raising. (Karnataka NEET 2013)  
a) **genetically uniform population identical to the original parent.**  
b) homozygous diploid plants  
c) new species  
d) variants through picking up somaclonal variations
31. Which of the following statements is not true about somatic embryogenesis? (Karnataka NEET 2013).  
a. The pattern of development of a somatic embryo is comparable to that of a zygotic embryo.  
b) **Somatic embryos can develop from microspores.**  
c) Somatic embryo is induced usually by an auxin such as 2, 4-D.  
d) A somatic embryo develops from a somatic cell.
32. Which one of the following is a case of wrong matching? (AIPMT 2012)  
a) Somatic                      -                      Fusion of two diverse hybridization cells  
b) **Vector DNA                      -                      Site for tRNA synthesis**  
c) Micropropagation                      -                      *in vitro* production of plants in large numbers  
d) Callus                      -                      Unorganised mass of cells produced in tissue culture.
33. Polyethylene glycol method is used for (AIPMT 2010)  
a) biodiesel production  
b) seedless fruit production  
c) energy production from sewage  
d) **gene transfer without a vector.**

34. Somaclones are obtained by (AIPMT 2009)
- Plant breeding
  - Irradiation
  - genetic engineering
  - tissue culture.**
35. The technique of obtaining large number of plantlets by tissue culture method is called
- Plantlet culture (AIPMT 2005)
  - Organ culture
  - Micropropagation**
  - Macropropagation
36. Coconut milk is used in tissue culture in which present (AIPMT 2000)
- cytokinin**
  - auxin
  - gibberellins
  - ethylene.
37. Haploid plants can be obtained by culturing. (AIPMT 1994)
- pollen grains**
  - root tips
  - young leaves
  - endosperm.

### UNIT IX - Plant Ecology

- Plants which produce characteristic pneumatophores and show vivipary belong to (NEET 2017)
  - Halophytes**
  - psammophytes
  - hydrophytes
  - mesophytes
- Mycorrhizae are the example of (NEET I 2017)
  - amensalism
  - antibiosis
  - mutualism**
  - fungistasis
- If '+' sign is assigned to beneficial interaction, '-' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '-' refers to (NEET 2016)
  - mutualism
  - amensalism
  - commensalism
  - parasitism**
- Which of the following is correctly matched? (NEET Phase 2 – 2016)
  - Aerenchyma - *Opuntia*
  - Age pyramid - Biome
  - Parthenium hysterophorus* - Threat to biodiversity**
  - Stratification - Population
- An association of individuals of different species living in the same habitat and having functional interactions is (Re-AIPMT 2015)
  - Population
  - Ecological niche
  - Biotic community**
  - Ecosystem
- Roots play in significant role in absorption of water in (Re-AIPMT 2015)
  - Wheat
  - Sunflower
  - Pistia***
  - Pea
- If we uncover half of the forest covering the earth, what crisis will be produced at most and the first? (AIPMT 1996)
  - Some species will be extinct**
  - Population and ecological imbalance will rise up
  - Energy crisis will occur
  - Rest half forests will maintain this imbalance.
- Most animals are tree dwellers in a (AIPMT 2015)
  - Tropical rain forest**
  - Coniferous forest
  - Thorn woodland
  - Temperate deciduous fo
- Cuscuta* is an example of (AIPMT Mains 2012)
  - Ectoparasitism**
  - Brood parasitism
  - Predation
  - Endoparasitism
- Large woody vines are more commonly found in (AIPMT Prelims 2011)
  - Alphine forests
  - Temperate forests
  - Mangroves
  - Tropical rain forests**



11. Niche overlap indicates  
(AIPMT Prelims 2006)
- Active co-operation between two species
  - Two different parasites on the same host
  - Sharing of one or more resources between the two species**
  - Mutualism between two species
12. Which one of the following pairs is **mismatched**? (AIPMT Prelims 2005)
- Savanna – Acacia trees
  - Prairie – Epiphytes**
  - Tundra – Permafrost
  - Coniferous forest – Evergreen trees
13. Which ecosystem has the maximum biomass? (NEET 2017)
- Grassland ecosystem
  - Pond ecosystem
  - Lake ecosystem
  - Forest ecosystem**
14. Which of the following would appear as the pioneer organisms on bare rocks? (NEET 2016)
- Mosses
  - Green algae
  - Lichens**
  - Liverworts
15. In which of the following both pairs have correct combination? (NEET 2015)

a)	Gaseous nutrient cycle Sedimentary nutrient cycle	Nitrogen and Sulphur Carbon and Phosphorous
b)	Gaseous nutrient cycle Sedimentary nutrient cycle	Sulphur and Phosphorous Carbon and Nitrogen
c)	<b>Gaseous nutrient cycle Sedimentary nutrient cycle</b>	<b>Carbon and Nitrogen Sulphur and Phosphorous</b>
d)	Gaseous nutrient cycle Sedimentary nutrient cycle	Carbon and Sulphur Nitrogen and Phosphorous

16. Secondary succession takes place on / in  
(NEET 2015 cancelled)
- newly created pond
  - newly cooled lava
  - bare rock
  - degraded forest**
17. In an ecosystem the rate of production of organic matter during photosynthesis is termed as (NEET 2015 cancelled)
- Secondary productivity
  - net productivity
  - Net primary productivity
  - gross primary productivity**
18. Natural reservoir of phosphorous is  
(NEET 2013)
- rock**
  - fossils
  - sea water
  - animal bones
19. Secondary productivity is rate of formation of new organic matter by (NEET 2013)
- consumers**
  - decomposers
  - producers
  - parasites
20. Which one of the following processes during decomposition is correctly described?  
(NEET 2013)
- Catabolism – Last step in the decomposition under fully anaerobic condition
  - Leaching – Water soluble inorganic nutrient rise to the top layers of soil
  - Fragmentation – Carried out by organisms such as earthworms.**
  - Humification – Leads to the accumulative of a dark coloured substance humus which undergoes microbial action in a very fast rate.
21. Which one of the following is not a functional unit of an ecosystem?  
(AIPMT 2012)
- Energy flow
  - decomposition
  - Productivity
  - stratification**
22. The upright pyramid of number is absent in  
(AIPMT 2012)
- Pond
  - forest**
  - lake
  - grassland

23. The rate of formation of new organic matter by rabbit in a grassland is called  
(Mains 2012)

- a) net productivity
- b) **secondary productivity**
- c) net primary productivity
- d) gross primary productivity

24. The second stage of hydrosere is occupied by plants like  
(Mains 2012)

- a) *Azolla*                      b) *Typha*
- c) *Salix*                        d) *Vallisneria*

25. Which one of the following is a characteristic feature of cropland ecosystem?  
(NEET 2016)

- a) Ecological succession
- b) Absence of soil organisms
- c) **Least genetic diversity**
- d) Absence of weeds

26. Most animals that live in deep oceanic waters are  
(Re-AIPMT 2015)

- a) **Detritivores**
- b) Primary consumers
- c) Secondary consumers
- d) Tertiary consumers

27. During ecological succession  
(Re-AIPMT 2015)

- a) The changes lead to a community that is in near equilibrium with the environment and is called pioneer community.
- b) **The gradual and predictable change in species composition occurs in a given area.**
- c) The establishment of a new biotic community is very fast in its primary phase.
- d) The number and types of animals remain constant.

28. The mass of living material at a trophic level at a particular time is called (AIPMT 2015)

- a) **Standing crop**
- b) Gross primary productivity
- c) Standing state
- d) Net primary productivity

29. Match the following and select the correct option  
(AIPMT 2014)

**Column I**

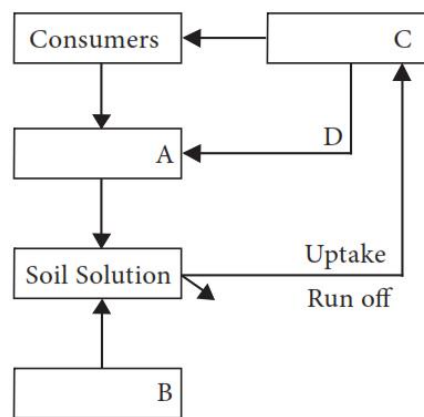
- (I) Earthworm
- (II) Succession
- (III) Ecosystem service
- (IV) Population growth

**Column II**

- (i) pioneer species
- (ii) Detritivore
- (iii) Nataliy
- (iv) Pollination

	I	II	III	IV
a)	i	ii	iii	iv
b)	iv	i	iii	ii
c)	iii	ii	iv	i
d)	<b>ii</b>	<b>i</b>	<b>iv</b>	<b>iii</b>

30. Given below is a simplified model of phosphorous cycling in a terrestrial ecosystem with four blanks (A – D). Identify the blanks.  
(AIPMT 2014)



	A	B	C	D
a)	Rock minerals	Detritus	Litter fall	Producers
b)	Litter fall	Producers	Rock minerals	Detritus
c)	<b>Detritus</b>	<b>Rock minerals</b>	<b>Producers</b>	<b>Litter fall</b>
d)	Producers	Litter fall	Rock minerals	Detritus

31. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?  
(AIPMT 2014)

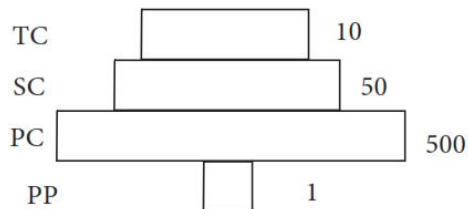
Plant → Mice → Snake → Peacock

- a) **0.02 J**
- b) 0.002 J
- c) 0.2 J
- d) 0.0002 J



32. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels ?

(AIPMT Prelims 2012)



- a) Level one PP is 'pipal trees' and the level SC is 'sheep'.  
b) Level PC is 'rats' and level SC is 'cats'  
c) **Level PC is 'insects' and level SC is 'small insectivorous birds'**  
d) Level PP is 'phytoplanktons' in sea and 'whale' on top level TC
33. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct? (AIPMT Prelims 2011)
- a) It is upright in shape  
b) Its base is broad  
c) It shows energy content of different trophic level organisms  
d) **It is inverted in shape**
34. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time? (AIPMT Mains 2011)
- a) Goat                      b) Frog  
c) **Sparrow**                      d) Lion
35. Both hydrarch and xerarch successions lead to (AIPMT Mains 2011)
- a) Highly dry conditions  
b) Excessive wet conditions  
c) **Medium water conditions**  
d) Xeric conditions
36. Of the total incident solar radiation the proportion of PAR is (AIPMT Prelims 2011)
- a) More than 80%              b) About 70%  
c) About 60%                  d) **Less than 50%**
37. The breakdown of detritus into smaller particles by earthworm is a process called (AIPMT Mains 2011)
- a) Mineralisation              b) Catabolism  
c) Humification                d) **Fragmentation**
38. The biomass available for consumption by the herbivores and the decomposers is called (AIPMT Prelims 2010)
- a) Gross primary productivity  
b) **Net primary productivity**  
c) Secondary productivity  
d) Standing crop
39. The correct sequence of plants in a hydrosere is (AIPMT Prelims 2009)
- a) **Volvox → Hydrilla → Pistia → Scirpus → Lantana → Oak**  
b) Pistia → Volvox → Scirpus → Hydrilla → Oak → Lantana  
c) Oak → Lantana → Volvox → Hydrilla → Pistia → Scirpus  
d) Oak → Lantana → Scirpus → Pistia → Hydrilla → Volvox
40. About 70% of the total global carbon is found in (AIPMT Prelims 2008)
- a) Forests                      b) Grasslands  
c) Agro ecosystems              d) **Oceans**
41. Consider the following statements concerning food chains
- i) Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.  
ii) Removal of most of the carnivores resulted in an increased population of deers.  
iii) The length of food chains is generally limited to 3 – 4 trophic levels due to



- energy loss.
- iv) The length of food chains may vary from 2 to 8 trophic levels.
- Which two of the above statements are correct? (AIPMT Prelims 2008)
- a) i and ii                      b) **ii and iii**  
c) iii and iv                    d) i and iv
42. Which one of the following is not used for construction of ecological pyramids? (AIPMT Prelims 2006)
- a) Dry weight  
2) Number of individuals  
c) Rate of energy flow  
4) **Fresh weight**
43. The UN Conference of Parties on climate change in the year 2012 was held at (NEET 2015)
- a. Lima                              b. Warsaw  
c. Durban                         d. **Doha.**
44. Which of the following are most suitable indicators of SO<sub>2</sub> pollution in the environment? (NEET 2015)
- a. Algae                            b. Fungi  
c. **Lichens**                        d. Conifers
45. Which of the following is not one of the prime health risks associated with greater UV radiations through the atmosphere due to depletion of stratospheric ozone? (NEET 2015)
- a. Damage to eyes  
b. **Increased liver cancer**  
c. Increased skin cancerd.  
d. Reduced Immune system
46. A location with luxuriant growth of lichens on the trees indicates that the (AIPMT 2014)
- a. trees are very healthy  
b. trees are heavily infested  
c. location is highly polluted  
d. **location is not polluted.**
47. The ozone of atmosphere in which the ozone layer is present is called (AIPMT 2014)
- a. ionosphere                    b. mesosphere  
c. **stratosphere**                d. troposphere
48. Which one of the following is a wrong statement? (AIPMT 2012)
- a. Most of the forests have been lost in tropical areas.  
b. **Ozone in upper part of atmosphere is harmful to animals.**  
c. Greenhouse effect is a natural phenomenon.  
d. Eutrophication is a natural phenomenon in freshwater bodies.
49. Good ozone is found in the (Mains 2011)
- a. mesosphere                  b. troposphere  
c. **stratosphere**                d. ionosphere
50. Chipko movement was launched for the protection of (AIPMT 2009)
- a. **forests**                         b. livestock  
c. wetlands                        d. grasslands
51. Identify the correctly matched pair. (AIPMT 2005)
- a. Basal convention        - Biodiversity conservation  
b. **Kyoto protocol**            - **Climatic change**  
c. Montreal protocol      - Global warming  
d. Ramsar convention     - Ground water pollution
52. Common indicator organism of water pollution is (AIPMT 2004)
- a. *Lemna panicostata*  
b. *Eichhornia crassipes*  
c. ***Escherichia coli***  
d. *Entamoeba histolytica*
53. Which country has the greatest contribution for the hole formation in ozone layer? (AIPMT 1996)
- a. **Russia**                        b. Japan  
c. USA                              d. Germany

## UNIT X - Economic Botany

- The name of Dr. Norman Borlaug is associated with (JIPMER 2007)
  - Green revolution**
  - Yellow revolution
  - White revolution
  - Blue revolution
- Which of the following is generally used for induced mutagenesis in crop plants (JIPMER 2007)
  - Alpha
  - X-ray
  - UV ray
  - Gamma ray**
- A man-made allopolyploid cereal crop is (OJEE 2010)
  - Hordeum vulgare*
  - Triticale**
  - Raphanus brassica*
  - Zea mays*
- Objective of plant breeding is (MP PMT 2001)
  - better yield
  - better quality
  - disease / stress resistance
  - All of the above**
- Selection is a method of (MP Pmet 2001)
  - cytology
  - plant phycology
  - plant breeding**
  - genetics
- Green revolution in India occurred during (AIPMT 2012)
  - 1960's**
  - 1970's
  - 1980's
  - 1950's
- Jaya and ratna developed for green revolution in India are the varieties of (AIPMT 2011)
  - maize
  - rice**
  - sugarcane
  - wheat.
- First man-made cereal triticale is (HPMT 2008)
  - Octaploid
  - hexaploid**
  - Both a & b
  - diploid
- In plant breeding programmes, the entire collection (of plants / seeds) having all the diverse alleles for all genes in a given crop is called (NEET 2013)
  - cross hybridization among the selected parents
  - evaluation is selection of parents
  - germplasm collection**
  - selection of superior recombinants
- An example for semi dwarf variety of wheat is (HPPMT 2012)
  - IR 8
  - Sonalika**
  - Triticum*
  - Saccharum*
- Himgiri developed by hybridization is selection for disease resistance against rust pathogen is a variety of (AIPMT 2011)
  - Chilli
  - Maize
  - Sugarcane
  - Wheat**
- Breeding of crops with high levels of minerals, vitamins and proteins is called (CBSE AIPMT 2010)
  - somatic hybridization
  - biofortification**
  - bio magnification
  - micro propagation
- The reason for vegetatively reproducing crop plants to suit for maintaining hybrid vigour is that (AIPMT 1998)
  - they are more resistant to disease
  - once a desired hybrid produced, no chances of losing it**
  - they can be easily propagated
  - they have a longer life span.
- Wonder wheat is a new wheat variety developed by (AIIMS 2009)
  - Mexico's International Wheat and Maize improvement centre**
  - Indian National Botanical Research Institute
  - Australian crop Improvement centre
  - African Crop Improvement centre



# HIGHER SECONDARY - SECOND YEAR BIOLOGY: BOTANY PRACTICALS

## INTRODUCTION

Laboratory is a place where ideas and concepts can be tested through experiments. Laboratory investigations in biology increase the reasoning abilities, brings scientific attitude in a learner and also helps in acquisition of skills of scientific processes. Hence, a biology student too, is obliged to attend practical in laboratory with utmost sincerity, honesty and inquisitiveness. The practical work includes

- ❖ Study of permanent slides
- ❖ Microscopic preparation of slides
- ❖ Study of preserved and fresh specimens
- ❖ Section, cutting and mounting
- ❖ Analysing the problem and solving it
- ❖ Physiological experiments, etc.

## GENERAL INSTRUCTIONS

In order to perform experiments successfully, a learner needs to go to the Biology Laboratory well prepared. This includes the following.

1. Laboratory record book
2. Dissection box
3. Laboratory manual
4. A laboratory coat or apron
5. A hand towel
6. Drawing pencil (HB) and pencil eraser to record various experiments and to draw diagrams
7. Any item more as per the instructions of the teacher



While in the laboratory, a student should be very careful and methodical. One should listen carefully to the instructions given by the teacher / instructor before performing an experiment. Maintain a complete silence and working atmosphere in the laboratory. Record keeping is most important in practical. Diagrams should be correctly drawn and well labelled. Always get the signature of the teacher in the practical note book on each day after the practical class.

However, it is important that every student of Botany / Biology may pay proper attention to the practical work and should try to acquire basic laboratory skills and develop a keen sense of observation and acquire a sound training in the reporting of the work done.

If the material suggested for a particular experiment is not available, a suitable alternate material may be used.

## BIOLOGY BOTANY PRACTICALS

### MODEL QUESTION

I.	Identify the given slide 'A' and give any two reasons. Draw a neat labelled diagram.
II.	Identify the given specimen / model / photograph 'B' and give any two reasons.
III.	Analyse the given ecological / genetic problem 'C'. Solve it by giving appropriate reasons.
IV.	Write the aim, procedure, observation and inference of the given experiment 'D'.
V.	Identify the economically important plant product 'E'. Mention its Botanical name, useful part and their uses.

### MARKS ALLOTMENT-PRACTICAL EXAMINATION

I.	A	Identification – ½ , Reason (any two) – ½ , Diagram – ½ , Labelling – ½	2
II.	B	Identification – ½ , Reason (any two) – ½	1
III.	C	Identification – ½ , Solve/ Construct– ½, Reason/ Observation and Inference/ Answer – ½	1 ½
IV.	D	Aim – ½ , Procedure – ½ , Table (Observation and Inference) – ½	1 ½
V.	E	Identification and Botanical name – ½ , Useful part – ½, use – ½.	1 ½

**Total 7 ½ marks**

**Record 1 ½ marks**

**Skill 1 marks**

**Maximum marks 10 marks**



### QUESTION No- I (A) - Preparation and Demonstration of Slides

**Note:** Teacher has to prepare a temporary slide using fresh specimen for demonstration. (During examination permanent slides can be used if temporary slide preparation is not possible).

Exercise 1	T.S. of Mature anther
Exercise 2	L.S. of an Angiospermic ovule
Exercise 3	T.S. of <i>Nerium</i> leaf

### QUESTION No- II (B) - Fresh or preserved specimens and Models / Photographs / Charts

Exercise 4	Adaptations of flowers for pollination by different agents – Wind, Insects.
Exercise 5	Structure of Dicotyledonous seed – Gram ( <i>Cicer</i> ).
Exercise 6	Picture of a vector (pBR 322)
Exercise 7	Plant tissue culture – Callus with plantlets
Exercise 8	Types of ecological pyramids – Number, Biomass, Energy

### QUESTION No- III (C) - Problems – Genetics and Ecology

Exercise 9	To verify Mendel's Monohybrid cross
Exercise 10	Analysis of seed sample to study Mendelian Dihybrid Ratio
Exercise 11	Flow of energy and Ten percent law
Exercise 12	Determination of population density and percentage frequency of different plant species of given area by Quadrat method
Exercise 13	Chromosomal aberration – Deletion, Duplication, Inversion
Exercise 14	Genetic / Linkage maps

### QUESTION No- IV (D) - Experiments

Exercise 15	Study of pollen germination on a slide
Exercise 16	Study of pH of different types of soils
Exercise 17	Isolation of DNA from plant material

### QUESTION No- V (E) -Economic importance of plants

Exercise 18	Economically important plant products and their uses: Sesame / Gingelly oil, Rubber, Aval (Flaked rice), Rose water, Henna powder, Aloe gel
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# BIOLOGY BOTANY PRACTICALS

## I - Preparation and Demonstration of Slides

**Note:** Teacher has to prepare a temporary slide using fresh specimen for demonstration. (During examination permanent slides can be used if temporary slide preparation is not possible)

### Exercise 1: T.S of Anther

**Aim:** To study and identify the given slide – T.S of Anther

**Principle:** Androecium is made up of stamens. Each stamen possesses an anther and a filament. Anther bears pollen grains which represent the male gametophyte.

**Requirements:** Anther of *Datura metel*, glycerine, safranin, slide, cover slip, blade, brush, needle to prepare temporary slides, permanent slide of T.S. of mature anther and compound microscope.



Collect buds and opened flowers of *Datura metel*. Dissect the stamens, separate the anthers and take thin sections and observe the structure under the microscope. Record the various stages of anther from your observation.

### Diagnostic Features

- A mature anther is bilobed (dithecous) and the two lobes are joined by a connective.
- Each anther lobe has two pollen chambers in which pollen grains are produced.
- A microsporangium or pollen sac is surrounded by four wall layers. They are epidermis, endothecium, middle layers and tapetum.
- Centre of the microsporangium (pollen sac) is filled with haploid pollen grains.

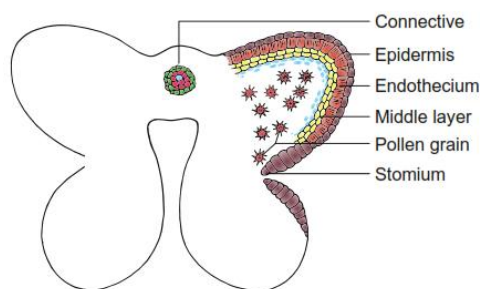


Figure 1: Pollen grain stage of anther

### Exercise 2: L.S of an Angiospermic ovule.

**Aim:** To study and identify the L.S. of an Angiospermic Ovule.

**Principle:** In female reproductive part of a flower, the basal swollen part is ovary. The ovules are present inside the ovary, later they develop to seed.

**Requirement:** Permanent slide of L.S. of Ovule, microscope

### Diagnostic Features

- Ovule or megasporangium is protected by one / two coverings called integuments.
- The stalk of the ovule is called funicle.
- The point of attachment of funicle to the body of the ovule is known as hilum.
- The body of the ovule is made up of a central mass of parenchymatous tissue called nucellus.
- The integuments form a pore called micropyle and the region opposite to the micropyle is called as chalaza.
- The nucellus has a large, oval, sac like structure towards the micropylar end called embryo sac.
- A mature ovule, has 8 nuclei in its embryo sac.

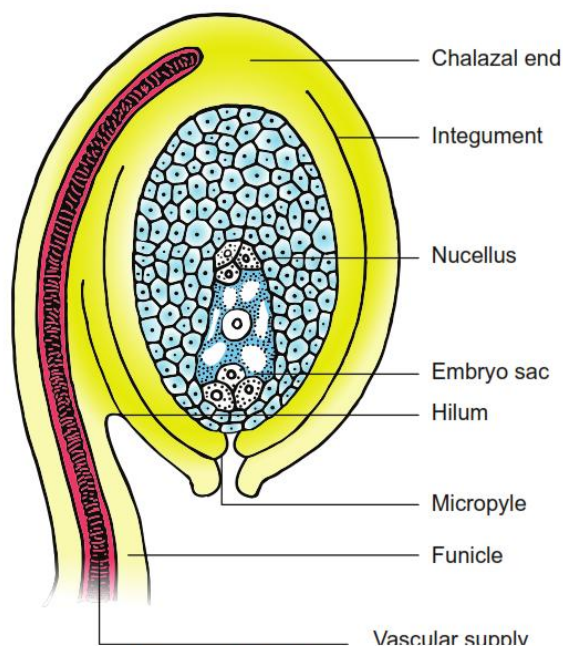


Figure 2: L.S of ovule

### Exercise 3: T.S. of *Nerium* Leaf

**Aim:** To observe and understand the xerophytic adaptations found in *Nerium* leaves for living in dry or xeric habitat.

**Principle:** The plants which are living in dry or xeric condition are known as Xerophytes.

**Requirements:** *Nerium* leaf, few pieces of carrot / pith / styrofoam, blade, brush, needle, compound microscope, glycerine, coverslip, wash glass, microslide, saffranin solution, petri dish, etc.



Start cutting transverse sections of *Nerium* leaf placing it in between a piece of carrot. Select the thinnest section of the material with the help of a delicate brush. Take a clean watch glass with water, transfer thin sections of the material. Put a few drops of saffranin stain in the watch glass with water. Leave it for 3-5 minutes. Drain off stain and wash with water if necessary. Put the thinnest section in the centre of the slide. Put a drop of glycerine over the material. Cover it with a coverslip with the help of needle. Observe it under a compound microscope.

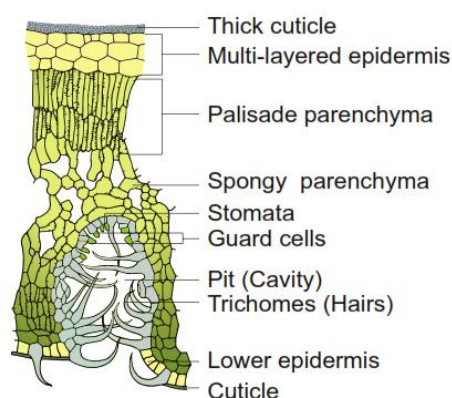


Figure 3: T.S. of *Nerium* leaf

### Diagnostic Features

- Presence of multilayered epidermis with thick cuticle.
- Sunken stomata are present only in the lower epidermis.
- Mesophyll is well differentiated into palisade and spongy parenchyma.
- Mechanical tissues are well developed.

## II - Fresh or preserved specimens and Models / Photographs / Charts

### Exercise 4: Adaptations of flowers for pollination by different agents.

**Aim:** To study the adaptations in flowers for pollination by different agents (wind and insects)

**Principle:** The process of transfer of pollen grains from the anther to stigma of a flower is called **pollination**.

**Requirements:** Fresh flowers of maize or any other cereal / gram, any insect pollination flowers like *Salvia*, *Calotropis*, *Ocimum* and Asteraceae flowers.

Place the given flower on a slide and observe it with the help of hand lens. Note down the adaptations of the flowers meant for pollination by the external agents.

### 5 A. Wind Pollinated Flowers - Anemophily

#### Diagnostic Features

- The flowers are small, inconspicuous, colourless, odourless and nectarless.
- Anthers and stigmas are commonly exerted.
- Pollen grains are light, small, powdery and produced in large numbers.
- The stigmas are large, sometimes feathery and branched adapted to catch the pollens.

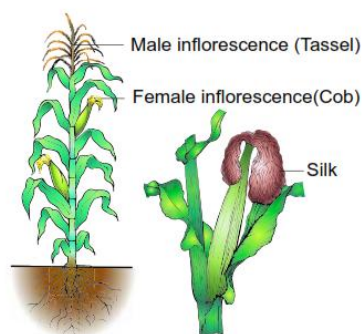


Figure 4a: Maize

### 5 B. Insect Pollinated Flowers - Entemophily

#### Diagnostic Features

- The flowers are showy, brightly coloured and scented.
- The flowers produce nectar or edible pollen.
- Anthers and stigmas are commonly inserted.
- Stigmas are usually unbranched and flat or lobed.

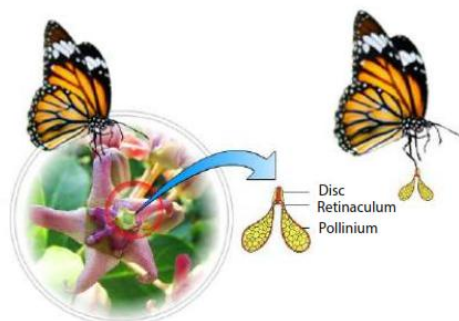


Figure 4b: *Calotropis*

### Exercise 5: Dicot seed

**Aim:** To study and identify the Dicot seed

**Principle:** The fertilized ovule is called seed and possesses an embryo, endosperm and a protective coat. Seeds may be endospermous or non endospermous.

**Requirements:** Chick pea, bowl, water

Soak the seeds of chick pea or gram in water for 2 – 3 hours. Drain the water and place the seeds in a moist cotton cloth for 2 – 3 days. Observe for germination. Select some sprouted seeds, observe under a dissection microscope and record the parts.

#### Diagnostic Features

- Seeds of gram have two cotyledons and an embryonal axis.
- Each seed is covered by two seed coats (a) Testa – outer coat and (b) Tegmen – inner coat.
- The embryonal axis consists of radicle and plumule.
- The portion of the embryonal axis above the level of cotyledons is called epicotyl. It terminates into the plumule.
- The portion of the embryonal axis below the level of cotyledons is called hypocotyl. It terminates into the radicle or root tip.

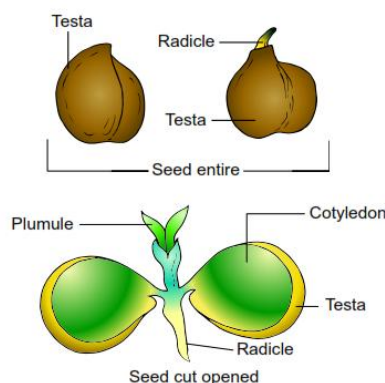


Figure 5: Dicot seed – Gram (*Cicer*)

### Exercise 6: E.coli cloning vector (pBR 322)

**Aim:** To study and identify the features of cloning vector – pBR 322

**Principle:** Vectors are used as carriers to deliver the desired foreign DNA into a host cell.

**Requirements:** Models/ Photographs / Pictures of E.coli Cloning vector pBR 322.

#### Diagnostic Features

- pBR 322 plasmid is a reconstructed plasmid containing 4361 base pairs and most widely used as cloning vector.
- In pBR, p denotes plasmid and B and R respectively the notes of scientists Boliver and Rodriguez who developed the plasmid. The number 322 is the number of plasmids developed from their laboratory.
- It contains two different antibiotic resistance genes and recognition site for several restriction enzymes (Hind III, Eco R I, Bam H I, Sal I, Pvu II, Pst I, Cla I), Ori and antibiotic resistance genes ( $amp^R$  and  $tet^R$ ).  $rop$  codes for the proteins involved in the replication of the plasmid.

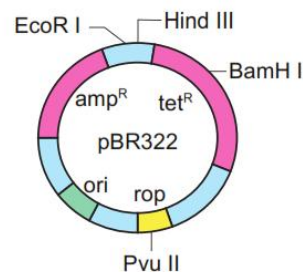


Figure 6: E-coli cloning vector (pBR 322)

### Exercise 7: Plant tissue culture – Callus with plantlets

**Aim:** To study and identify the Callus with plantlets.

**Principle:** Growing the plant cells, tissues and organs in an artificial, synthetic medium under controlled conditions is called plant tissue culture. The technique of cloning plant is easier than animals because plant cells are simple in structure and most plant cells shows totipotency (i.e) ability to regenerate from cells.

**Requirements:** Model / Photograph / Picture of callus with plantlets.

#### Diagnostic Features

- The callus is an unorganized mass of undifferentiated tissue.
- The mechanism of callus formation is that auxin induce cell elongation and cytokinin induces cell division as a result of which masses of cells are formed.
- Roots and shoots are differentiated from the callus.

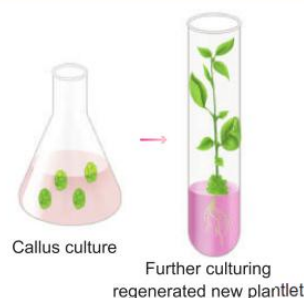


Figure 7: Callus with plantlets

### Exercise 8: Types of ecological pyramid

**Aim:** To study and identify the different types of ecological pyramids

**Principle:** The relationship between different trophic levels in an ecosystem when shown diagrammatically appear as 'ecological pyramids'. In these ecological pyramids, the successive tiers represent successive trophic levels towards the apex. The base of the pyramid is of producers, the next one above it is of herbivores and the top tiers are of carnivores. The top most or apex represents the tertiary or top level consumers.

**Requirements:** Models / Photographs / Pictures of different types of ecological pyramid.

#### 8 A. Pyramid of numbers

##### Diagnostic Features

- The number of organism that are present in successive trophic levels of an ecosystem is shown in the pyramid of numbers of a grassland ecosystem.
- There is a gradual decrease in the number of organisms in each trophic level from producers to primary consumers, then to secondary consumer, and finally to tertiary consumers.
- Therefore, pyramid of number in grassland ecosystem is always upright.

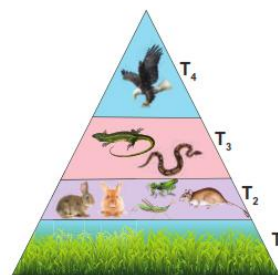


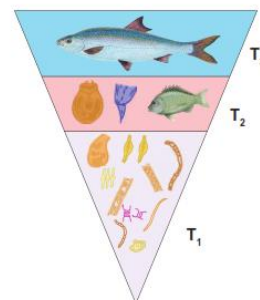
Figure 8 a: Pyramid of numbers in grassland ecosystem

T<sub>1</sub> - Producers | T<sub>2</sub> - Herbivores | T<sub>3</sub> - Secondary consumers | T<sub>4</sub> - Tertiary consumers

## 8 B. Pyramid of biomass

### Diagnostic Features

- Pyramid of biomass represents the total biomass or standing crop (dry weight) of organisms in each trophic level at a particular time.
- In aquatic ecosystem, the bottom of the pyramid is occupied by the producers, which comprises very small organisms (algae and phytoplanktons) possessing the least biomass and so the value gradually increases towards the tip of the pyramid.
- Therefore, here the pyramid of biomass is always inverted in shape.



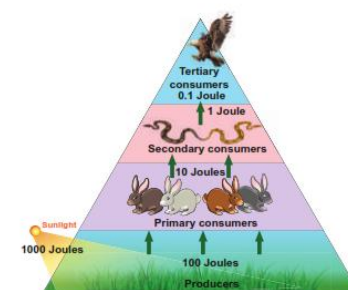
**Figure 8 b:** Pyramid of biomass in aquatic ecosystem

T<sub>1</sub> - Producers | T<sub>2</sub> - Herbivores | T<sub>3</sub> - Secondary consumers |

## 8 C. Pyramid of energy

### Diagnostic Features

- Pyramid of energy represents the number of joules transferred from one trophic level to next.
- The bottom of the pyramid of energy is occupied by the producers. There is a gradual decrease in energy transfer at successive trophic levels from producers to the upper levels.
- Therefore pyramid of energy is always upright.



**Figure 8 c:** Pyramid of Energy

## III - Solving the Problems

### Exercise 9: To verify Mendel's Monohybrid cross

**NOTE:** Student have to work in pairs to perform this experiment and record the data in the observation and record note book with the help of the teacher.

**Need not consider this Monohybrid cross experiment for Board Practical Examination.**

#### Aim:

To verify Mendel's Monohybrid cross.

#### Principle:

When two purelines with contrasting traits of a particular character (phenotype) are crossed to produce the next generation (F<sub>1</sub> generation), all the members of the progeny are of only one phenotype, i.e. of one of the two parents. The phenotype that appears is called dominant and the one that does not appear is called recessive. When the F<sub>1</sub> plants are selfed, the progeny i.e. the F<sub>2</sub> generation, is in the ratio of 3 dominant : 1 recessive ( $\frac{3}{4}$  :  $\frac{1}{4}$  of 75% : 25%). This reappearance of the recessive phenotype in F<sub>2</sub> generation, verifies Mendel's Monohybrid cross.

#### Requirements:

64 yellow and 64 green plastic beads, all of exactly same shape and size (when beads are not available, pea seeds may be painted and used). Plastic beakers, petri dish and a napkin / hand towel.

### Procedure

Make the student to work in pairs to perform the experiment. Follow the steps in given sequence.

- Put 64 yellow beads in one beaker and 64 green beads in the other to represent male and female gametes respectively. Let the yellow bead be indicated by 'Y' and the green bead by 'y'
- Take a bead from each container and place them together (it represents fertilization) on the hand towel spread before you on the table.
- Just like the previous step, continue to pick beads and arrange them in pairs. Thus 64 pairs of beads are obtained representing the 64 heterozygous F<sub>1</sub> progeny.
- Put 32 F<sub>1</sub> progeny in one petridish and the remaining 32 in another petridish (representing the F<sub>1</sub> males and females).
- To obtain the F<sub>2</sub> generation, the student should withdraw one bead from one beaker labelled male and one from the other beaker labelled female keeping his / her eyes closed (to ensure randomness) and put them together on the hand towel spread over the table. Continue this process till all the beads are paired. Thus 64 offsprings of F<sub>2</sub> progeny are obtained.
- Note the genotype (YY or Yy or yy) of each pair and their possible phenotype.
- Pool all the data and calculate the genotypic and phenotypic ratios.

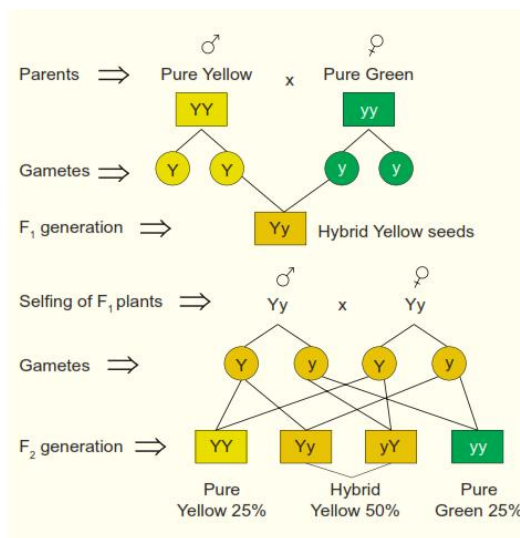


Figure 9 : Monohybrid cross

### Observation:

Record the result in the following table:

Generation	Total Number of individuals	Genotypes			Phenotype(s)
		YY	Yy	yy	
F <sub>1</sub>					
	Total				
F <sub>2</sub>					
	Total				

Phenotypic ratio : in F<sub>1</sub> \_\_\_\_\_

in F<sub>2</sub> \_\_\_\_\_

Genotypic ratio : in F<sub>1</sub> \_\_\_\_\_

in F<sub>2</sub> \_\_\_\_\_

### Inference:

The results are so because when the F<sub>1</sub> individuals are crossed together to raise the F<sub>2</sub> generation, each F<sub>1</sub> individual produces two types of gametes: 50% having dominant allele and the remaining 50% having recessive allele. These gametes undergo random fusion during fertilization to produce the F<sub>2</sub> generation. According to simple probability of mixing of opposite sex gametes, offsprings of three genotypes are likely to appear as follows:

Among these, proportion of dominant phenotype would be YY + Yy = yellow and recessive phenotype yy = green, which occur in 3 : 1 or 75% : 25% ratio.

This ratio of 3 : 1 in the F<sub>2</sub> suggests that the hybrids or heterozygotes of F<sub>1</sub> generation have two contrasting factors or alleles of dominant and recessive type. These factors, though remain together for a long time, do not contaminate or mix with each other. They separate or segregate at the time of gamete formation so that a gamete carries only one factor, either dominant or recessive.

**Precautions:**

1. Take a sufficiently large number of seeds for analysis to minimise the error.
2. Observe the contrasting form of trait carefully.

**Exercise 10: Analysis of seed sample to study Mendelian dihybrid ratio**

**Aim:**

To analyse seed sample of pea for Mendelian dihybrid ratio of 9 : 3 : 3 : 1.

**Principle:**

In a dihybrid cross, the segregation of one gene pair is independent of the segregation of the other pair. It means that when the factors (genes) for different characters inherited from parents do not remain linked in the offsprings, but their distribution in the gametes and in the progeny of subsequent generations is independent of each other.

**Requirement:**

Plastic beakers, Pea seed samples or plastic beads, tray, petri dishes, notebook, pencil / pen.

Teachers should select the Pea seed or plastic beads which represents the four types of traits such as yellow round, yellow wrinkled, green round and green wrinkled in the ratio of 9:3:3:1

**Procedure:**

1. Take a lot of about 160 Pea seeds or plastic beads in a tray.
2. Separate out yellow round, yellow wrinkled, green round and green wrinkled and put them in separate petridishes.
3. Note down the number of seeds in each plate and find out their approximate ratio.

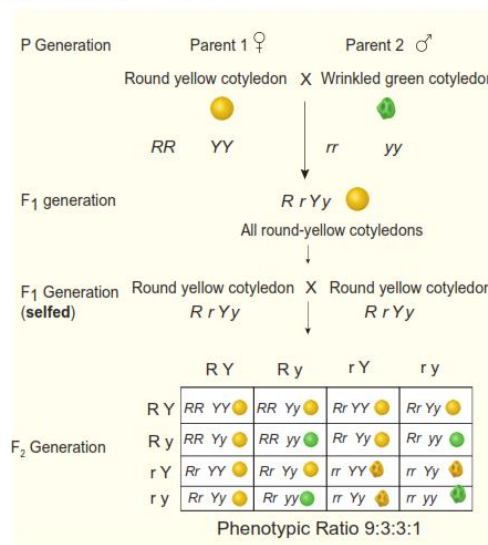
**Observation:**

Present your finding in the form of a table.

Total Number of seeds observed	No. of yellow round seeds	No. of yellow wrinkled seeds	No. of green round seeds	No. of green wrinkled seeds	Approximate ratio
160	90	30	30	10	9 : 3:3:1

**Inference:**

The ratio of yellow round : yellow wrinkled : Green round : green wrinkled is approximately 9 : 3 : 3 : 1 which is exactly the same as obtained by Mendel for a dihybrid cross. This indicates that the contrasting genes for seed colour and seed shape show an independent assortment in the population of pea seeds.



**Figure 10 : Dihybrid cross**

### Exercise 11: Flow of energy and Ten percent law

#### Aim:

To understand the unidirectional flow of energy in an ecosystem and transfer of energy follows the 10% law.

#### Principle:

The student studies about flow of energy and that only about 10% of energy is made available to the next trophic level. Large amount of energy about 90% is lost at each trophic level in a food chain.

#### Requirements:

Problems to be given to students based on different examples with alternating food chain and amount of energy.

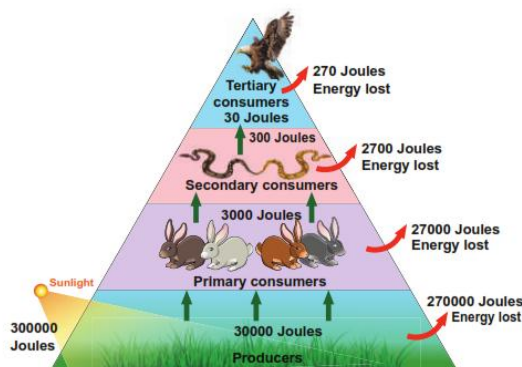
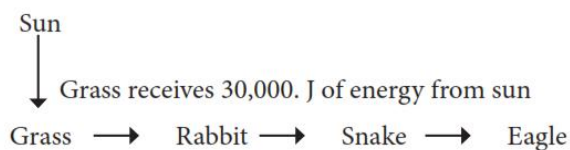


Figure 11: Ten percent law

The teacher must train the student by giving them various kinds of food chain with different values.

#### Problem

Analyse the food chain given below and find out the amount of energy received by the organism in third trophic level.



**Given:** The amount of energy in the producers, i.e. grass = 30,000 J.

**Solution:**

Grass	→	Rabbit	→	Snake	→	Eagle
T <sub>1</sub>		T <sub>2</sub>		T <sub>3</sub>		T <sub>4</sub>
Producer		Primary Consumer		Secondary Consumer		Tertiary Consumer

T<sub>1</sub> – Grass (Producer) = 30,000 J of energy

T<sub>2</sub> – Rabbit (Primary Consumer) = ?

T<sub>3</sub> – Snake (Secondary Consumer) = ?

According to the ten percent law, during the transfer of energy, only about 10% of the energy flows from each trophic level to the next lower trophic level. So 10% of energy from T<sub>1</sub> gets transferred to T<sub>2</sub>

So T<sub>2</sub> - Rabbit (primary consumer) receives  $30000 \times \frac{10}{100} = 3000 \text{ J}$

Similarly, 10% of energy from T<sub>2</sub> gets transferred to T<sub>3</sub>

So T<sub>3</sub> – Snake (Secondary consumer) receives  $3000 \times \frac{10}{100} = 300 \text{ J}$

#### Answer:

- The third trophic level T<sub>3</sub> – (Snake) receives 300 J of energy.

## Exercise 12: Determination of Population density and Percentage frequency by Quadrat method.

**NOTE:** Teachers can take the students to open space and teach them how to construct plot/quadrats and to record the number of individuals of each plant species occurring in the quadrat. The percentage frequency should be calculated and entered in the practical observation and record note book. Examiner need not consider this experiment for Board Practical Examinations.

### Aim:

To study population density and percentage frequency of different plant species of a given area by quadrat method.

### Principle:

The number of individuals in a population never remains constant. It may increase or decrease due to many factors like birth rate, death rate, migration, etc. The number of individuals of a species presents per unit area or space of a given time is called population density. The population density and percentage frequency of different plant species can be determined by laying quadrats / segments of suitable size and recording of the number of individuals of each species occurring in the quadrat.

### Requirements:

Metre scale, string or cord, hammer, nails, paper, pencil, etc.

### Procedure:

1. In the selected site of study, hammer the nails firmly in the soil without damaging the vegetation.
2. Fix four nails to make a square plot.
3. Tie each end of the nails using a thread, to make 1 m X 1 m plot.
4. If the number of plants in the plot is large, the plot can be divided into quadrats.
5. Count the number of individuals of a species "A" present in the first quadrat and record the data in the table.
6. Similarly count the individuals of the species "A" in other quadrats respectively and record the data in the table.
7. Count the number of individuals of a species "B" present in the all quadrats and record the data in the table.
8. Repeat the same procedure for other species and record the data in the table.

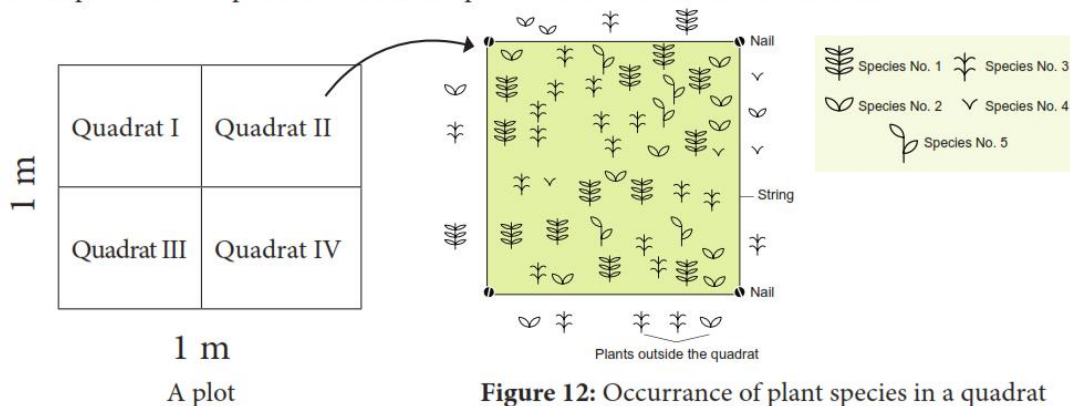


Figure 12: Occurrence of plant species in a quadrat

$$\text{Population Density} = \frac{\text{Total number of individuals in all the quadrats studied}}{\text{Total number of quadrats studied}}$$

$$\text{Percentage frequency} = \frac{\text{Total number of quadrats in which species occurred}}{\text{Total number of quadrats studied}} \times 100$$

### Observation and Inference:

Different plant species, their population density and percentage frequency occurring in a given area.

S. No.	Plant species	No. of individuals per quadrat				Total number of individuals in all the quadrats studied (N)	Total number of quadrats in which each species occurred (A)	Total Number of quadrats studied (B)	Population Density (N/B)	Frequency percentage (A/B) x 100
		I	II	III	IV					
1										
2										
3										
4										
5										

### Precautions:

1. The measurement of quadrat should be accurate.
2. The string or cord used should not be very thick.

## Exercise 13: Chromosomal aberrations – Deletion, Duplication and Inversion

### Problem:

Given below is the representation of a kind of chromosomal aberration such as deletion, duplication and inversion. Identify and give reasons for identification. Also mentions its significance.

### Aim:

To understand the abnormality in the chromosomal structure in an organism.

### Principle:

To study about the chromosomal aberration which can occur due to ionizing radiations or chemicals. On the basis of breaks and reunions in the chromosomal segment different types of aberrations can be recognized.

### Requirements:

Copper wire, Alphabets marked ( A to H ) yellow colour beads denotes gene, and red colour bead without alphabet denote centromere. Using this materials make different kinds of chromosomal segments with specific gene sequence, that can be given to the students and asked to analyse the aberration involved in it.

### Procedure:

1. Make a normal chromosome model using copper wire and yellow beads and place it on the table. In the model chromosome with gene sequence A to H, along with centromere ( red bead).
2. For Deletion - Give yellow colour beads without one or more marked alphabets A to H (The lack



of any one or more beads denotes deletion type of chromosomal aberration).

3. For Duplication – Give yellow colour beads with addition of one or more marked alphabets A to H (The repetition of one or more beads denotes duplication type of chromosomal aberration).
4. For Inversion – Give yellow colour beads which marked alphabets from A to H as in normal chromosome. (There is no addition or deletion of beads (A to H) given, so the students can construct the inverted segment of the chromosome using the given beads).

Based on the type of beads given the student has to identify and construct the relevant chromosomal aberration.

### 13 A. Chromosomal Aberration – Deletion

#### Reasons:

1. The deletion of the chromosomal segment A and D. (Refer figure 13a)
2. When there is a loss of a segment of the genetic material in a chromosome it is called deletion.

#### Significance:

Most of the deletions lead to death of an organism.

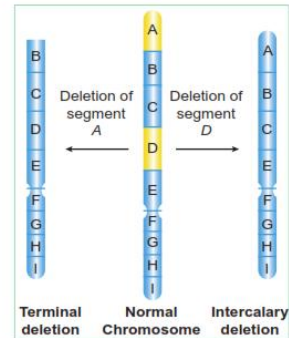


Figure 13 a: Deletion

### 13 B. Chromosomal Aberration - Duplication

#### Reasons:

1. When a segment of a chromosome is present more than once in a chromosome, then it is called duplication (Tandem duplication)
2. The order of the genes in a chromosome is A, B, C, D, E, F, G, H and I. Due to aberration, the genes B and C are duplicated and the sequence of genes becomes A, B, C, B, C, D, E, F, G, H and I. (Refer figure 13b)

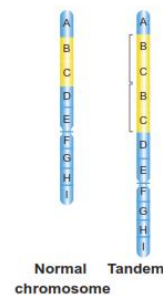


Figure 13 b: Duplication

### 13 C. Chromosomal Aberration - Inversion

#### Problem:

Given below is the representation of a kind of chromosomal aberration. Identify it giving reasons for your identification. Also mentions its significance.

#### Identification:

The given genetic problem is identified as inversion type of chromosomal aberration.

#### Reasons:

1. When the order of genes in a chromosomal segment is reversed due to rotation by an angle of 180°, it is called inversion.
2. The order of genes in a chromosome is A, B, C, D, E, F, G, H and I. Due to aberration, the sequence of genes become A, D, C, B, E, F, G, H and I (Refer figure 13c)

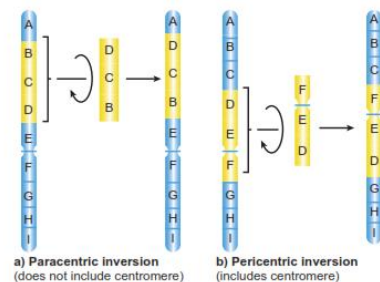


Figure 13 c: Inversion

### Significance:

Sometimes inversion is responsible for evolution of the organism.

**NOTE:** Likewise the teacher can give different types of chromosomal aberrations with various gene sequence to students for practise. The external examiner can also use the same technique by giving different gene sequence.

### Exercise 14: Genetic / linkage maps

#### Aim:

To understand the frequency of recombination between the gene pairs on the same chromosome.

#### Principle:

To analyse the relative distance between the various genes and map their position in the chromosome, which is called genetic or linkage maps.

#### Requirements:

Different kinds of linkage / genetic maps can be constructed by giving the students the relative distance between the linked genes of a chromosome. A diagrammatic representation can be drawn showing the location and arrangement of genes and their relative distance between them.

#### Solve the Problem

**Problem:** There are three linked genes A, B and C in a chromosome. Percentage of crossing over (recombination frequency) between A and B is 20, B and C is 28 and A and C is 8. What is the sequence of genes on the linkage map?

**Given:** Percentage of crossing over between the 3 linked genes A – B = 20%, B – C = 28% and A – C = 8%.

#### Solution



Figure 14: Linkage Map

#### Reasons:

1. The frequency of crossing over is directly proportional to the relative distance of the genes on the chromosomes.
2. More crossing over = More distance between two genes and  
Less crossing over = Less distance between the two genes.

In the above problem, the sequence of the genes on the linkage map is B, A, C

**NOTE:** Teachers can give different crossing over percentage between its linked genes in a chromosome and make the students construct the linkage maps. The external examiner can also do the same for the Board Practical Examinations.

## IV - Experiments

### Exercise 15: Study of Pollen germination on a slide

**NOTE:** Pollen germination can be studied by dusting some pollens from common flowers like *Crotalaria*, *Hibiscus*, *Pisum*, etc. on a glass slide containing a drop of 10% sugar solution or tender coconut water or any nutrient medium.

Observe the slide after about 10 – 15 minutes under the low power of compound microscope. You will be able to observe the pollen tubes coming out of the pollen grains.

**Aim:** To study the pollen germination on a slide.

**Requirements:** Fresh seasonal flowers, cavity slide, cover slip, compound microscope, sucrose, boric acid, distilled water, beakers, etc.

#### Procedure:

1. Prepare a nutrient solution by dissolving 1 gm. of sucrose / 1 gm. of boric acid in 100 ml. of distilled water.
2. Take a clean cavity slide and put a few drops of nutrient solution in the cavity of the slide.
3. Dust a few pollen grains from the stamen of a mature flower on it.
4. View the slide in the microscope after 5 minutes and then observe it regularly for about half an hour.

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

**Inference:** Different stages of germinating pollens are observed. Some pollens are in their initial stage of germination while others have quite long pollen tube containing tube nucleus and two male gametes.

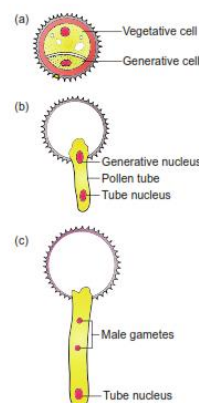
**Precautions:** 1. Flowers should be freshly plucked. 2. Use clean cavity slide to observe the pollen grains. 3. The slides should not be disturbed, otherwise position of pollen grains will get changed.

### Exercise 16: Study of pH of different types of soil

Some nutrients become toxic in higher concentration. Therefore pH of the soil is an important chemical property of the soil. Plants thrive well in neutral or slightly acidic soils. The pH of the soil determines the types of soil organisms and also controls the solubility of different nutrients. The pH of soil ranges from 0 - 14.

- a. pH level 7 - Neutral soil
- b. pH level below 7 - Acidic soil
- c. pH level above 7 -Alkaline soil
- d. Optimum pH for plant growth ranges from 5.5 to 7.

Most plants thrive best in neutral pH. Slight acidity favours tree growth and forms forests. Slight alkalinity is favourable for grasses and legume crops.



**Figure 15:** Pollen germination

**Aim:**

To study pH of different types of soil.

**Requirements:**

Soil samples (from two different sites such as crop soil, garden soil, roadside soil, pond soil, river bank soil), test tubes, funnel, filter papers, pH papers of different range, distilled water, beaker.

**Procedure:**

Dissolve one tablespoon or 1 gram of soil from each soil sample in 100 ml of distilled water in separate beakers. Stir the solutions well and keep aside for half an hour to settle down the suspended particles. Filter off each solution separately in different test tubes. Dip a small piece of broad range pH paper on each of the solution. Match the colour of the pH paper with the colour scale given on the pH paper booklet. This gives an approximate pH.

**Observation:**

Record the pH of different soil samples in the observation table.

S. No.	Soil sample	pH Value
1		
2		
3		

**Inference:**

Thus the pH value of different soil samples required for plant growth can be determined.

**Precautions:**

1. Wash the glassware thoroughly and get it dried before the experiment.
2. Dry the pH papers before comparing the colour with the colour scale.
3. Match the colour carefully and determine pH accurately.



**Figure 16:** Study of pH of different types of soil

### Exercise 17: Isolation of DNA from plant materials

DNA is one of the nucleic acids found in living systems. DNA acts as the genetic material in most of the organisms.

**Principle:** Recombinant DNA technology has allowed breeders to introduce foreign DNA in other organisms including bacteria, yeast, plants and animals. Such organisms are called Genetically Modified Organisms (GMOs). Thus rDNA technology involves isolation of DNA from a variety of sources and formation of new combination of DNA.

**Aim:** To isolate DNA from available plant materials such as spinach leaves, fresh green pea seeds, green papaya, etc.

**Requirements:** Plant materials, mortar and pestle, beakers, test tubes, ethanol, etc.

**Procedure:** Take a small amount of plant material and grind it in a mortar with a little amount of water and sodium chloride. Make it into a solution and filter it. To this filtrate, add liquid soap solution or any detergent solution and mix it with a glass rod. Then tilt the test tube and add

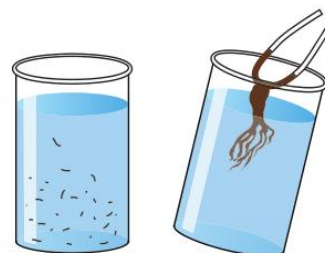
chilled ethanol and leave it aside in the stand. After half-an-hour we can observe the precipitated DNA as fine threads. DNA that separates can be removed by spooling

**Observation:** DNA appears as white precipitate of very fine threads on the spool.

**Inference:** Thus DNA can be isolated from the plant cell nucleus by this technique.

**Precautions:**

1. All the glasswares must be thoroughly cleaned and dried.
2. The chemicals used for the experiments must be of standard quality.
3. If ordinary ethanol is used, the time duration for obtaining precipitated DNA may extend further.



**Figure 22:** Isolation of DNA

## V - Economic Importance of Plants

### Exercise 18: Economically important plant products

S. no	Identification (Product name)	Botanical Name	Useful parts	Uses
1.	Sesame/ Gingelly oil	<i>Sesamum indicum</i>	Seeds	1. Sesame oil is mostly used for culinary purposes. 2. Lower grades are used in manufacture of soaps, in paint industries, as a lubricant and as an illuminant.
2.	Rubber	<i>Hevea brasiliensis</i>	Latex	1. Rubber is used in the manufacture of footwear, wire and cable insulations, rain coat, sports goods, erasers, adhesives, rubber bands, household and hospital goods and shock absorbers. 2. Concentrated latex is used for making gloves and balloons. 3. Foamed latex is used in the manufacture of cushions, pillows and life-belts.
3.	Flaked Rice (Aval)	<i>Oryza sativa</i>	Seeds	1. Flaked rice (aval) is used as breakfast cereal or as snacks.
4.	Henna Powder	<i>Lawsonia inermis</i>	Leaves	1. An orange dye “henna” obtained from leaves and young shoots is used to dye skin, hair and fingernails. 2. It is also used for colouring leather, tails of horses and hair.
5.	Aloe Gel	<i>Aloe vera</i>	Leaves	1. Aloe gel is used as skin tonic. 2. Because of its cooling effect and moisturizing characteristics, it is used in the preparation of creams, lotions, shampoos, shaving creams and allied products. 3. It is used in gerontological applications for rejuvenation of ageing skin.

# Biology: Botany - Class XII

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