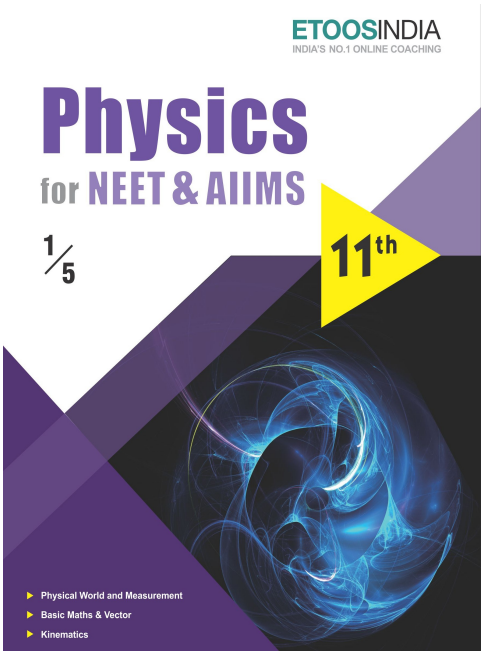
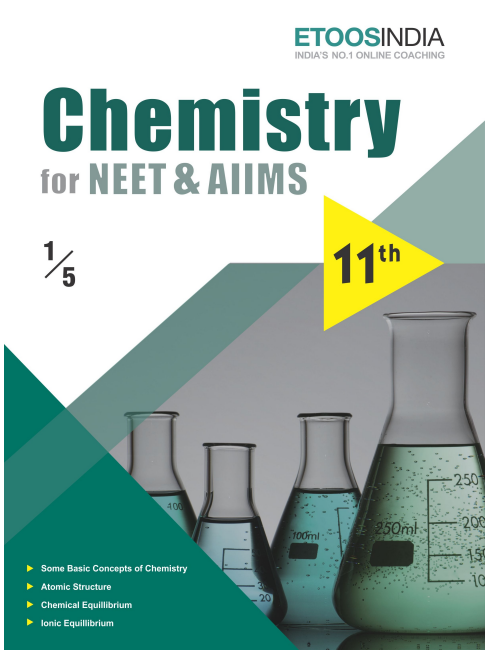
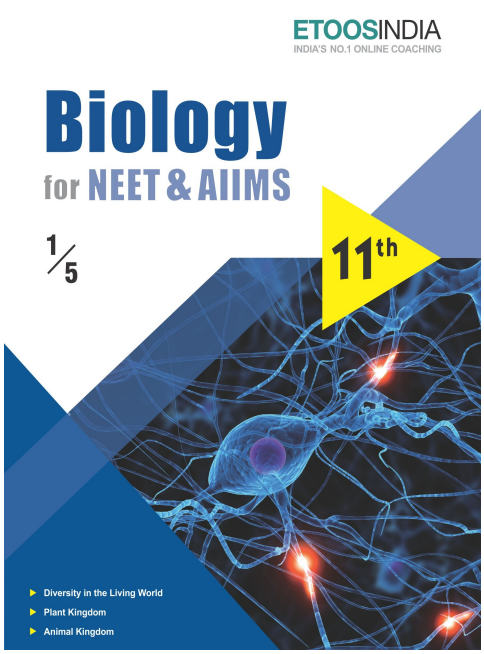
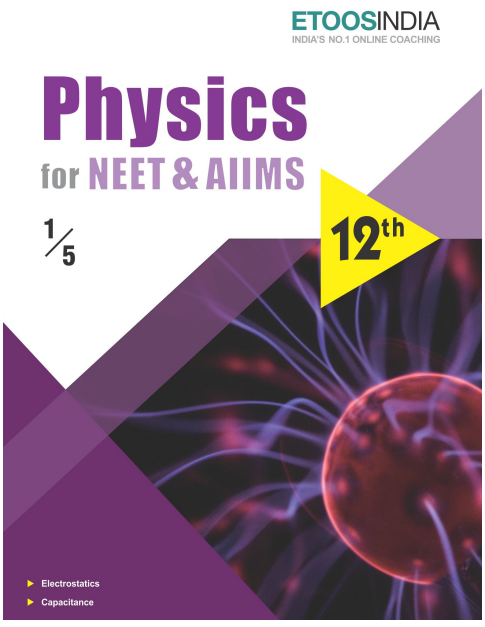
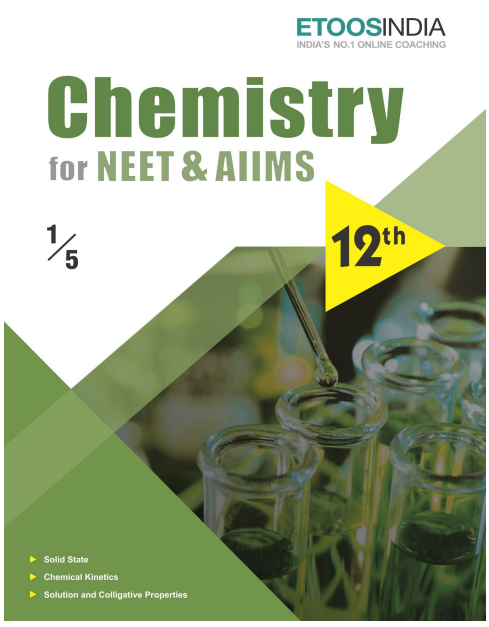
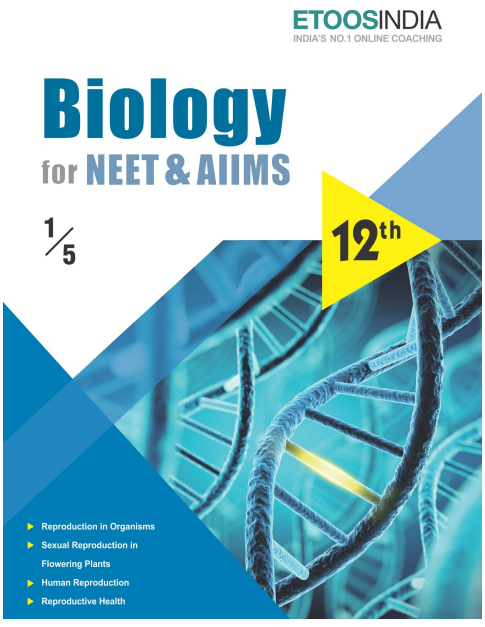












CHAPTER 14

PLANT GROWTH AND DEVELOPMENT

"The true laboratory is the mind, where behind illusions we uncover the laws of truth.."

"J.C. BOSE (1858-1937)"

INTRODUCTION

Growth is a characteristic feature of all living organisms. It is also a vital process, which brings about permanent and irreversible change in any plants or its part. Development is the sum of two processes: growth and differentiation. To begin with, it is essential and sufficient to know that a mature plant develops from a single-celled zygote which divides and differentiates to form various types of cell.

The structures like flowers, leaves or fruits show limited growth and dimensions due to which these appear and fall periodically whereas other strutures like roots and stem remain intact and show unlimited growth. This chapter will let you know about the various factors involve in govern and control of development processes.

PLANT GROWTH & DEVELOPMENT

INTRODUCTION :

- Growth is a characteristic feature of all living organisms.
- Growth is a vital process, which brings about **permanent** and **irreversible change** in any plant or its part.
- Growth in plants means increase in shape, size, weight and volume of a plant or plant part.
- Growth leads to increase in fresh weight, dry weight, length, area, volume and cell number. All these are controlled externally (by environmental factors) and internally (by Genetics).
- Growth is **diffused in animals,** but in **plants growth is localised & irregular** (nail in plant stem, occupies same height till several years of growth).
- Seed germination is the first step of plant growth. Almost all the plants face a period of suspended growth.
- If the suspension of growth is due to **exogenously controlled factors** (environmental factors) then it is called **quiescence**. Development is a part of growth.
- When the suspension of growth is due to the **endogenously controlled factors** (hormonal, genetic) then it is termed as **dormancy**.
- Weight increased during growth but exceptions are **potato** & **seed germination,** where weight decrease.

PHASES OF GROWTH

(1) **Phase of cell division or cell formation** :- Number of cells is increases by cell division.

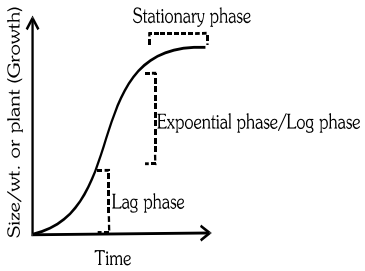
(2) **Phase of cell enlargement or cell elongation** :- Size of cells increases due to **vacuolization** & TP (turgor pressure).

(3) **Cell maturation or differentiation phase** :- (Also called as **morphogenetic, organogenic** phase) Development or qualitative change is important feature of this phase.

Pattern or course of plant growth : (growth curve)

- The pioneering work on growth was done by **Von Sachs.**
- He plotted a growth curve between time & growth, which is known as **sigmoid curve** or **S–curve** or GP (Grand period)–curve.
- Growth pattern of cell, organisms is uniform under favourable conditions. Thus following phases of growth are recognized.

(1) **Lag phase :-** In lag period the growth is slow.



(2) **Log phase :-** Also called as exponential phase. During this phase growth is maximum & most rapid.

(3) **Steady** or **stationary phase :-**

Time taken in growth phases (mainly log phase) is called as **"grand period of growth".**

+ve ex : Stem

(a) **Phototropism** [

–ve ex : Root

Definite direction in relation to light

+ve Ex : Root

(b) **Geotropism** [(Root cap percept stimulus)

–ve Ex : Stem & Mangrove plant roots.

Definite direction in relation to gravity, (root cap percept stimulus).

(c) **Chemotropism :-** Ex.Pollen tubes & fungal hyphae

Definite direction in relation to chemicals.

(d) **Thigmotropism (haptotropism) :-** Ex : **Tendrils, haustoria** of **Cuscuta**.

Definite direction in response to contact or support.

(e) **Hydrotropism :-** Ex : Roots of seedlings

(ii) **Nastic movement (External stimulus but diffused type or nondirectional) :-**

(a) **Nyctinasty :-** Ex : Flowers, leaves, stomata, daily movement (Sleep movements)

Due to rhythemicity of day and night.

(b) **Thigmonasty or haptonasty :-** Tentacles of insectivorous plants

(c) **Chemonasty :-** Ex : Tentacles of insectivorous plants

(d) **Seismonasty :-** Ex : **Mimosa** (**touch me not plant**) turgor change in pulvinus leaf base

K^+ ion also involved in this movement.

ETOOS KEY POINTS

Many plant parts specially leaves exhibits nastic movement and involves differential growth, this type of movement is known as movement of gwowth. This movement, is caused due to unequal growth in plant organs.

Ex : Epinasty, hyponasty, Nutation.

Epinasty & hyponasty :- Ex : Leaves, flower (petal) opening & closing respectively.

Epinasty - More growth on upper surface of plant parts.

Hyponasty - More growth on lower surface of plant parts.

Both epinasty & hyponasty are example of autonomic growth movements.

Nutation :- Zig zag growth of plant organ mainly shoot, is called as nutation

Circumnutation :- Spiral growth of plants in tendrils

Portulaca is known as **compas plant**.

Rhizomes diageotropic (90° to gravitation force)

Clinostat :- used for nullifying geotropism

Xerochasy :- Due to loss of water

Hygroscopic movement [**Ex :-** Dehiscence of legume fruits

Etoos Tips & Formulas

→ Development is the sum of two processes -Growth and differentiation
→ Growth is irreversible permanent increase in size of an organ or it's parts or even of an individual cell.
→ Growth is accompanied by metabolic processes-both catabolic and anabolic, that occur at the expense of energy. → Plants show open form of growth -new cells are always being added to the plant body
→ Apical meristem -contribute primary growths
→ Lateral meristem (vascular cambium and cork cambium) contribute lateral growth and causes increase in girth.
→ Growth at cellular level is principally a consequence of increase in the amount of protoplasm.
→ Growth is measured by a variety of parameters like -increase in fresh weight, dry weight, lengths, areas, volume and cell number
→ Period of growth is generally divided into three phases -"Meristematic"Elongation"Maturation"Cells in meristematic phase are rich in protoplasm, possess large conspicuous nuclii."Their cell walls are primary"Phase of elongation charaterised by increased vacuolation, cell enlargement and new cell wall deposition
→ Cell of maturation phase attain theirs maximal size in terms of wall thickening & protoplasmic modification.
→ The increased growth per unit time is termed as growth rate.
→ The growth rate shows an increase that may be arithmetic or geometrical.
→ In Arithmetic growth only one daughter cell continuous to divide while other differentiate and matures. Root elongation at constant rate is the expression of arithmetic growth
→ It proved linear growth and can be expressed as $L_t = L_o + rt$
→ In Geometrical growth -both daughter cells continuously divide. It attain sigmoid curve if space and food is limited. trees with seasonal activities show sigmoids curve.
→ Exponential growth (log phase of sigmoid curve) can be expressed as -
→ Here r is referred as efficiency index
→ Quantitative comparisons between the growth of living system cans also be made in two ways -
(1) Absolute growth rate → measurement and comparision of total growth per units time
(2) Relative growths rate → per unit initial parameter. increase/initial parameter × 100
→ Water, oxygen and nutrients are essential for growth
→ Plant growth and furthers development is intimately linked to the water status of plant
→ Water helps in -Turgidity, enzyme activation
→ Oxygen → helps in releasing metabolic energy
→ Nutrients → helps in synthesis of protoplasm and act as source of energy.
→ Optimum temperature range and environmental signals such as light and gravity also affect growth.
→ Plant growth is open - can be determinate (Plant organs) or Indeterminate (Shoot & root apices).
→ Plant differentiation is also open - Same meristem have differents structures at maturity
→ Final structure at maturity of cell/tissue is also determined by location of cell within.
→ Development includes all changes from seed germination to senescence.
→ Plant follow different pathway in response to environment or phases of life to form different kinds of structure, this ability called Plasticity
→ Heterophylly in Butter cup, cotton, coriander and larkspur is an examples of plasticity
→ Development in plants is under control of extrinsic (light, Temperature, water, oxygens & nutrition) and Intrinsic (Intracellular - genetic/intercellular - PGR) factors
→ Plant growth regulators are small, simple molecules of diverse chemical composition

SOLVED EXAMPLE

Ex.1 Maximum growth in roots occurs
(A) At apex **(B)** In presence of light
(C) Behind the apex **(D)** In presence of soil
Sol. **(C)** : Apex portion of root is made up of protective tissue 'root cap' and region of cell division is situated below the root cap.

Ex.2 The rate of growth of any organism follows
Or
Typical growth curves in plants is
(A) Hyperbola curve **(B)** J-shaped curve
(C) Sigmoid curve **(D)** Parabola curve
Sol. **(C)** : The growth of an organism/organ passes through different phases. If the growth rate of a plant part is plotted against time on a graph paper, a sigmoid/S-shaped growth curve is obtained.

Ex.3 Exponential growth occurs in
(A) Yeast
(B) Asexual reproduction
(C) Bacterial
(D) All of these
Sol. **(B)**

Ex.4 Given below is a graph drawn on the parameterrs of growth versus time A, B, C respectively represent
(A) Exponential phase, log phase and steady state phase
(B) Steady state phase, log phase and lag phase
(C) Slow growing phase, lag phase and Steady state phase
(D) Lag phase, steady state phase and logarithmic phase
(E) Lag phase, steady state phase and logarithmic phase
Sol. **(B)**

Ex.5 The instrument by which the rate of growth of stem is accurately measured is
(A) Hydrometer **(B)** Auxanometer
(C) Osmometer **(D)** Potometer
Sol. **(B)** : Auxanometer can register total, rate of growth at specific time and overall pattern of growth. In arc auxanometer actual growth in length of a plant is measured as Actual growth =

$$\frac{\text{distance travelled by pointer} \times \text{radius of pulley}}{\text{Length of pointer from centre of pulley}}$$

Ex.6 To induce formation of organs in a callus it is necessary to provide
(A) Growth hormones **(B)** Water
(C) Soil **(D)** Antibiotics
Sol. **(A)**

Ex.7 Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps. Of what significant is this experiment
(A) It supports the hypothesis that IAA is auxin
(B) It demonstrate polar movement of auxins
(C) It made possible the isolation and exact identification of auxin
(D) It is the basis for quantitative determination of small amounts of growth-promoting substances
Sol. **(C)** : F.W. went isolated auxin from Avena coleoptile tip.

Ex.8 Which one of the following plants function is not generally governed or controlled by auxin
(A) Apical dominance **(B)** Phototropism
(C) Photosynthesis **(D)** Growth
Sol. **(C)** : Because photosynthesis is enzymatic reaction and it is anabolic process

Ex.9 One of the synthetic auxin is
Or
Flowering in pineapple is promoted by
(A) NAA **(B)** IAA
(C) GA **(D)** IBA
Sol. **(A)**

Ex.10 Both is callus and suspension cultures commonly used auxin is
(A) NAA
(B) IBA
(C) 2, 4-D
(D) 2, 4, 5-Trichlorophenoxy acetic acid
(E) Abscisic acid
Sol. **(C)**

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. Fruit drop is caused by -
(A) Less auxin in fruit than in stem
(B) More auxin in fruit than in stem
(C) Equal distribution of auxin in stem and fruit
(D) Absence of auxin in stem and fruit

2. In plants growth is -
(A) Restricted to certain regions or structure
(B) Irreversible
(C) Change in size
(D) All the above

3. Growth is primarily affected by two climatic factors which are ?
(A) Light and temperature
(B) Temperature and relative humidity
(C) Light and wind
(D) Rainfall and temperature

4. Which of the following instrument can be used to record plant growth by seconds ?
(A) Arc auxanometer (B) Arc indicator
(C) Space marker disc (D) Crescograph

5. In a growing plant, the first phase during the process of growth is -
(A) Cell division (B) Cell enlargement
(C) Cell differentiation (D) Cell maturation

6. The natural plant hormones were first isolated from
(A) Cotton fruits, spinach leaves and rice plant
(B) Avena coleoptiles, spinach leaves and fungus Gibberella
(C) Human urine and corn germ oil
(D) Human urine and rice plant

7. Which one of the following nutrients is concerned with the growth of the plants in view of their role in synthesis of auxin -
(A) S (B) Mn
(C) Zn (D) K

8. Plants bend toward the light because -
(A) They need light for photosynthesis
(B) They need light for respiration
(C) Light attracts them
(D) Cells on the shaded side elongate more

9. Clinostat is used in study for -
(A) Photosynthesis (B) Respiration
(C) Geotropism (D) Osmosis

10. Which of the following exerts profound effect on the reproductive growth of a flowering plant ?
(A) Quality of light
(B) Quantity of light
(C) Direction of light
(D) Duration of light cycles

11. Which one of the following hormone is concerned chiefly with root initiation?
(A) IBA (B) GA_3
(C) ABA (D) Kinetin

12. If the tip of a seedling is cut off growth as well as bending ceases because it hampers
(A) Respiration
(B) Photosynthesis
(C) Perception of light stimulus
(D) Transpiration

13. An apparatus used to demonstrate phototropism is :-
(A) Luxmeter (B) Solarometer
(C) Clinostate (D)Heliotropic chamber

14. Phytohormone term was coined by -
(A) Gregory and Purvis (B) F.W. went
(C) Thieman (D) L.J. Audus

15. The growth regulator that retards ageing of plant organ is -
(A) Auxin (B) Gibberellin
(C) Cytokinin (D) Abscisic acid

16. Which of the following breaks the dormancy of seeds ?
(A) IAA (B) GA_3
(C) Ethylene (D) All the above

17. First natural cytokinin was discovered by :-
(A) Miller (B) Letham
(C) Calvin (D) Govindii

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Avena coleoptile test to find out the quantity of growth promoting hormones was discovered by
(A) F.W. Went (B) L.J. Oudus
(C) K.V. Thimann (D) F. Skoog

2. Primary precursor of I.A.A is :-
(A) Phenyl alanine (B) Tyrosine
(C) Tryptophan (D) Leucin

3. Indole, 3 acetic acid, called as auxin was first isolated from :-
(A) Human urine (B) Corn germ oil
(C) Fusarium (D) Rhizopus

4. Which of the following effects of auxins is of wide application ?
(A) Induction of fruit development
(B) Induction of root initiation
(C) Prevention of abscission
(D) All of the above

5. Apical dominance means :-
(A) Suppression of growth of apical bud by axillary buds
(B) Suppression of growth of axillary buds by the presence of apical bud.
(C) Stimulation of growth of axillary buds by removal of apical bud
(D) Inhibition of growth of axillary buds by removal of apical bud.

6. Auxin inhibits the growth of -
(A) Apical bud
(B) Lateral axillary buds
(C) Roots on stem cutting
(D) Parthenocarpic development of fruits

7. Which of the following is not natural occuring plant hormone ?
(A) 2 , 4 - D (B) GA_2
(C) Gibberellin (D) I.A.A

8. Leaf fall occurs when the content of :-
(A) Auxin increases
(B) Auxin decreases
(C) Abscisic acid decreases
(D) Gibberellic acid decreases

9. Substance which originate at the tip of stem to control growth :-
(A) Vitamins (B) Enzymes
(C) Food materials (D) Auxins

10. Which of the growth substance acts as a stimulant during nodule formation in leguminous plant
(A) Ethylene (B) ABA
(C) IAA (D) Morphactin

11. Auxanometer is meant for measuring -
(A) Respiratory activity
(B) Photosynthetic activity
(C) Growth activity
(D) Osmotic pressure

12. Apical dominance in higher plants is due to -
(A) Phyto hormones (B) Enzymes
(C) Carbohydrates (D) Photoperiodism

13. Auxin is mainly produced by -
(A) Apical root meristem
(B) Root cambium
(C) Apical shoot meristem
(D) Phloem in shoot tip

14. Indole acetic acid generally inhibits the growth of
(A) Roots (B) Leaves
(C) Shoots (D) Plants in general

15. Native auxin (Endogenous) is transported in the plant
(A) From the shoot tip in the downward direction
(B) From the root tip in the upward direction
(C) Through vascular systems in plants
(D) By a special transport system in the root

16. The formula of Auxin–A is -
(A) $C_{18}\ H_{30}\ O_7$ (B) $C_{18}\ H_{32}\ O_5$
(C) $C_{12}\ H_{30}\ O_6$ (D) $C_{20}\ H_{30}\ N_5$

17. Which growth hormone is responsible for apical dominance ?
(A) Auxin (B) Cytokinin
(C) Gibberellin (D) Ethylene

18. 2 , 4 - D is a synthetic -
(A) Auxin (B) Gibberellin
(C) Cytokinin (D) Florigen

Exercise # 3

PART - 1 MATRIX MATCH COLUMN

1. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. C. Darwin and F. Darwin	i. Cytokinin
B. Miller and Skoog	ii. ABA
C. Letham	iii. Zeatin
D. Kurosawa	iv. Auxin
	v. GA

(A) A-(iv), B-(i), c-(iii), D-(v) (B) A-(iv), B-(i), C-(ii), D-(iii)
(C) A-(iii), B-(i), C-(ii), D-(iv) (D) A-(v), B-(iv), C-(ii), D-(i)

2. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. Natural auxin	i. NAA
B. Synthetic auxin	ii. Zeatin
C. Bakane disease of rice	iii. IAA
D. Natural cytokinin	iv. GA
	v. Kinetin

(A) A-(iii), B-(i), C-(iv), D-(ii) (B) A-(i), B-(iii), C-(iv), D-(v)
(C) A-(iii), B-(i), C-(iv), D-(v) (D) A-(iv), B-(i), C-(v), D-(ii)

3. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. Auxins	i. Breaking seed dormancy
B. Gibberellins	ii. Inducing fruit repening
C. Cytokinins	iii. Formation of abscission layer
D. Ethylene	iv. Root initiation
	v. Chloroplast development in leaves

(A) A-(iv), B-(i), C-(v), D-(ii) (B) A-(iv), B-(v), C-(iii), D-(ii)
(C) A-(i), B-(iii), C-(ii), D-(iv) (D) A-(iii), B-(iv), C-(i), D-(v)

4. Match Column - I with Column - II and select the correct option fro the codes given below.

Column - I	Column - II
A. IAA	i. Tissues undergoing senescence
B. Cytokinins	ii. Shoot apices
C. Ethylene	iii. Root apices

(A) A-(ii), B-(iii), C-(i) (B) A-(iii), B-(ii), C-(i)
(C) A-(i), B-(ii), C-(iii) (D) A-(ii), B-(i), C-(iii)

5. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. Auxin	i. Fruit ripening
B. Cytokinins	ii. Phototropism
C. Abscisic acid	iii. Antagonist to GAs
D. Ethylene	iv. Growth of lateral buds

(A) A-(iv), B-(ii), C-(iii), D-(i) (B) A-(ii), B-(iv), C-(iii), D-(i)
(C) A-(ii), B-(iii), C-(iv), D-(i) (D) A-(iii), B-(iv), C-(ii), D-(i)

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. Geocarpic fruits are produced by : [CBSE AIPMT 2000,02]
(A) Onion (B) Watermellon
(C) Ground nut (D) Carrot

2. What reason will you assign for coconut milk used in tissue culture [CBSE AIPMT 2000, 03]
(A) Gibberellin (B) Cytokinin
(C) Auxin (D) Ethylene

3. The method that renders the seed coat permeable to water so that embryo expansion is not physically retarded, is [CBSE AIPMT 2000]
(A) vernalisation (B) startification
(C) denudation (D) scarification

4. Proteinaceous pigment which control the activities concerned with light : - [CBSE AIPMT 2001]
(A) Phytochrome (B) Chlorophyll
(C) Anthocyanin (D) Carotenoids

5. Which plant is a long-day plant : - [CBSE AIPMT 2001]
(A) Tobacco (B) Glycine max
(C) Mirabilis jalapa (D) Spinach

6. Which breaks dormancy of potato tuber : - [CBSE AIPMT 2001]
(A) Gibberellin (B) IAA
(C) ABA (D) Zeatin

7. Which of the following prevents the fall of fruits : - [CBSE AIPMT 2001]
(A) GA_3 (B) NAA
(C) Eethylene (D) Zeatin

8. Hormone responsible for senescence : - [CBSE AIPMT 2001]
(A) ABA (B) Auxin
(C) GA (D) Cytokinin

9. Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone - [CBSE AIPMT 2003]
(A) Abscissic acid (B) Auxin
(C) Cytokinin (D) Ethylene

10. Differentiation of shoot is controlled by : - [CBSE AIPMT 2003]
(A) High gibberellin : cytokinin ratio
(B) High auxin : cytokinin ratio
(C) High cytokinin : auxin ratio
(D) High gibberellin : auxin ratio

11. One set of a plant was grown at 12 hours day and 12 hours night period cycles and it flowered while in the other set night phase was interrupted by flash of light and it did not produce flower. Under which one of the following categories will you place this plant ? [CBSE AIPMT 2004]
(A) Long day (B) Darkness neutral
(C) Day neutral (D) Short day

12. Anthesis is a phenomenon which refers to - [CBSE AIPMT 2004]
(A) Reception of pollen by stigma
(B) Formation of pollen
(C) Development of anther
(D) Opening of flower bud

13. Cell elongation in internodal regions of the green plants takes place due to :- [CBSE AIPMT 2004]
(A) Indole acetic acid (B) Cytokinins
(C) Gibberellins (D) Ethylene

14. Treatment of seed at low temperature under moist conditions to break its dormancy is called - [CBSE AIPMT 2006]
(A) Vernalisation (B) Chelation
(C) Stratification (D) Scarification

15. An enzyme that can stimulate germination of barley seeds is- [CBSE AIPMT 2006]
(A) Lipase (B) Protease
(C) Invertase (D) α- amylase

16. How does pruning help in making the hedge dense ? [CBSE AIPMT 2006]
(A) It frees axillary buds from apical dominance
(B) The apical shoot grows faster after pruning
(C) It released wound hormones
(D) It induces the differentiation of new shoots from the rootstock

17. Which one of the following pairs, is not correctly matched? [CBSE AIPMT 2007]
(A) Abscissic Acid – Stomatal closure
(B) Gibberellic Acid – Leaf fall
(C) Cytokinin – Cell division
(D) IAA – Cell wall elongation

18. 'Foolish Seedling' disease of rice led to the discovery of : [CBSE AIPMT 2007]
(A) GA (B) ABA
(C) 2, 4 D (D) IAA

MOCK TEST

1. The cell derived from meristems differentiate and regain the capacity to divide by a phenomenon called
(A) differentiation **(B)** dedifferentiation **(C)** redifferentiation **(D)** totipotency
(E) regeneration

2. A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become white-coloured like albinos. Which of the following terms will you use to describe them?
(A) Mutated **(B)** Embolised **(C)** Etiolated **(D)** Defoliated

3. Auxanometer is used to measure
(A) the growth in length of a plant organ **(B)** the growth in breadth of a plant organ
(C) population of the pests attacking a plant **(D)** both **(A)** and **(B)**.

4. The *Avena* curvature is used for bioassay of
(A) IAA **(B)** ethylene **(C)** ABA **(D)** GA_3

5. Auxin can be bioassayed by
(A) potometer **(B)** lettuce hypocotyl elongation
(C) *Avena* coleoptile curvature **(D)** hydroponics

6. **Assertion :** Plant growth regulators (PGRs) are very important for plant growth and development.
Reason : Auxins do not induce flowering in gymnosperms.
(A) If both assertion and reason are true and reason is the correct explanation of assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) If both assertion and reason are false.

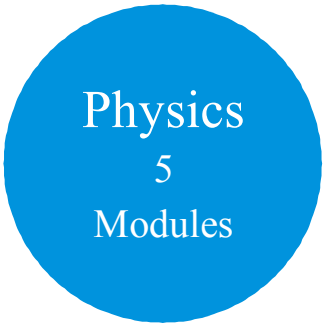
7. Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly-cut coleoptile stumps. Of what significance is this experiment?
(A) It made possible the isolation and exact identification of auxin.
(B) It is the basis for quantitative determination of small amount of growth-promoting substances.
(C) It supports the hypothesis that IAA is auxin.
(D) It demonstrated polar movement of auxins.

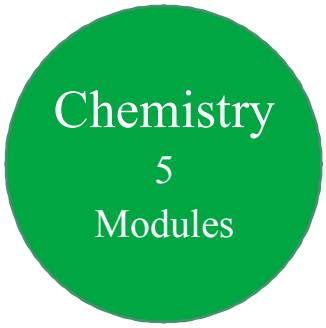
8. The pineapple which under natural condition is difficult to blossom has been made to produce fruits throughout the year by application of
(A) NAA, 2, 4-D **(B)** phenyl acetic acid **(C)** cytokinin **(D)** IAA, IBA

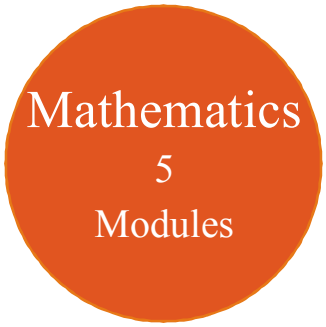
9. One of the commonly used plant growth hormone in tea plantation is
(A) ethylene **(B)** abscisic acid **(C)** zeatin **(D)** indole - 3-acetic acid

10. Compare the statements A and B
Statement A : Auxins promote apical dominance by suppressing the activity of lateral buds.
Statement B : In moriculture, periodic pruning of shoot tips is done to make mulberry plants bushy.
Select the correct description
(A) statement A is wrong and B is correct
(B) both the statements A and B are correct and A is not the reason for B
(C) both the statements A and B are correct and A is the reason for B.
(D) statement A is correct and B is wrong.

11th Class Modules Chapter Details







PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

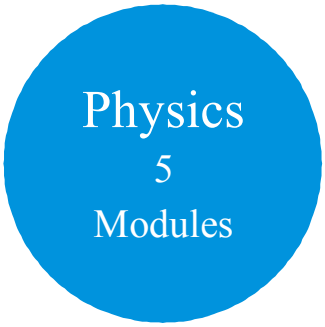
Module-4

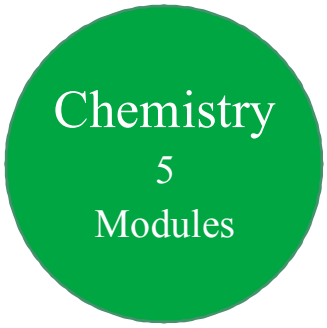
1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

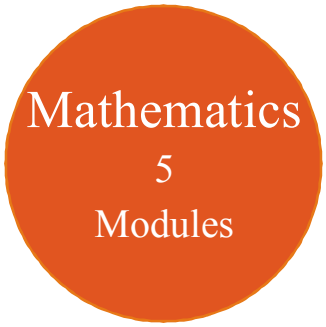
Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details







PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues