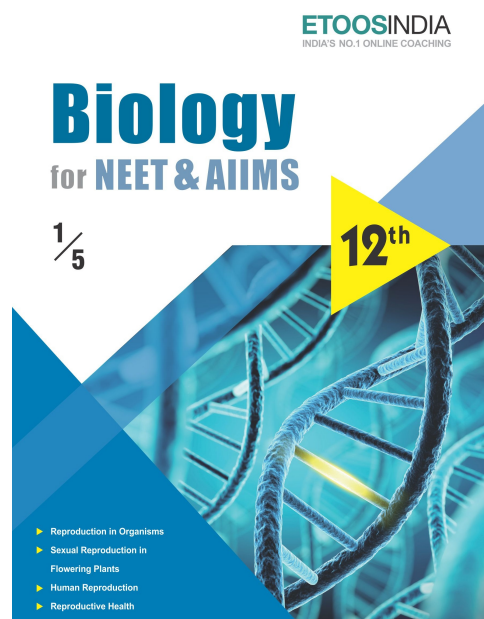
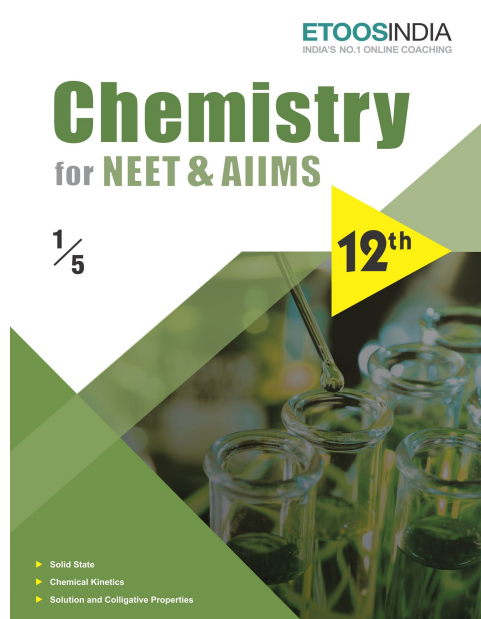
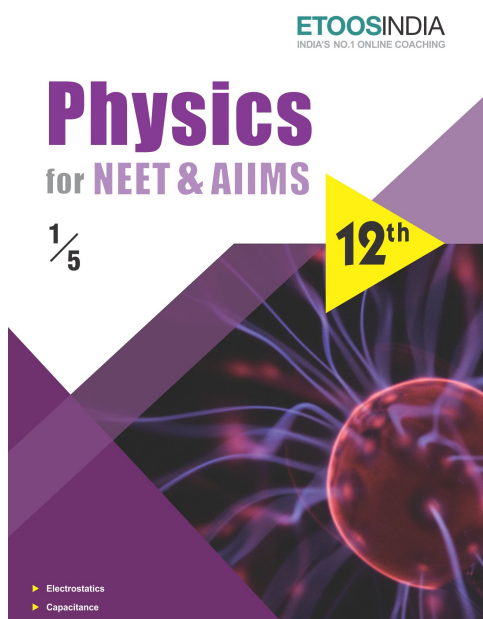
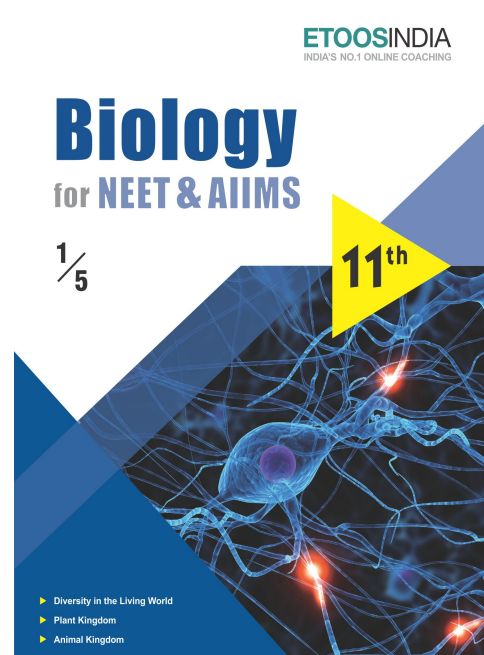
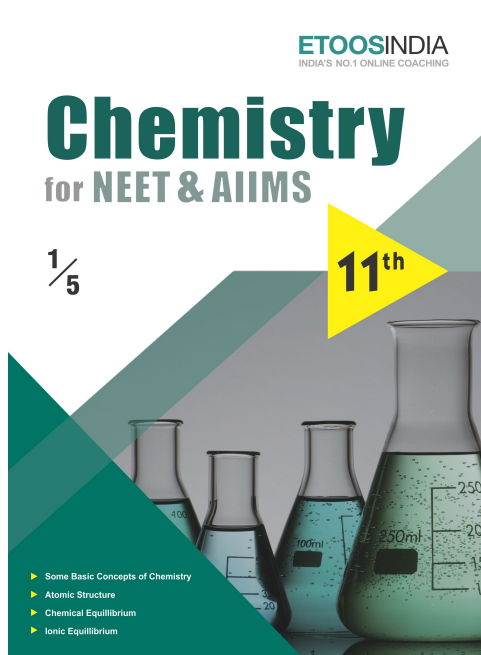
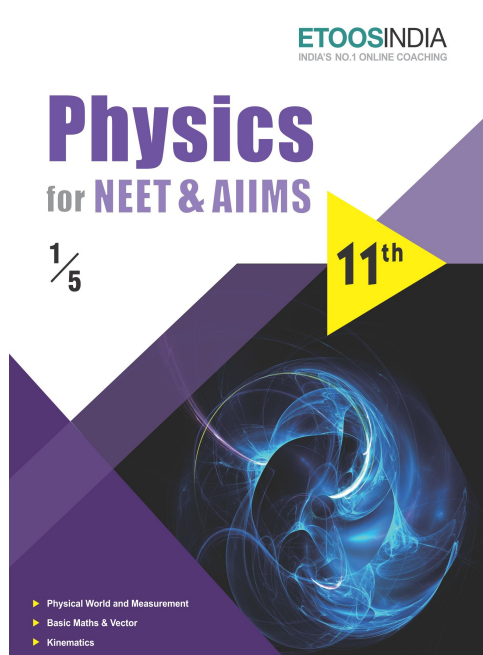


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REPRODUCTION IN ORGANISMS

“A man has always to be busy with his thoughts if anything is to be accomplished.”

“ANTONIE VAN LEEUWENHOEK (1632-1723)”

INTRODUCTION

As we all know that a vast number of plant as well as animal species have existed on the earth for several thousand of years. So to maintain this continuity living organism possess a process known as Reproduction. Reproduction is one of the most characteristic feature of living organisms. Reproduction is defined as a biological process in which an organism gives rise to young ones similar to itself. Thus there is cycle of birth , growth and death. Life will not exist if plants or animals will not reproduce. In this way an organism guarantees his survival. There is a large diversity among biological world and each organism in this world has evolves its own mechanism to multiply and produce offsprings. The organism’s habitat, its internal physiology and several other factors are collectively responsible for how it reproduces.

It is clear from above discussion that for a species of plant or animals to continue living on this earth, it must reproduce itself. This chapter deals with the life span of organism, basic feature of reproduction and types of reproduction.

Reproduction in Organism

Reproduction in Organisms

Reproduction is the process of producing offspring similar to itself. It is a characteristic of living organisms. The offspring grow, mature and in turn produce **new offspring**. Thus, there is a cycle of birth, growth and death. Reproduction enables the continuity of the species, generation after generation.

There is large diversity in the biological world and each organism has evolved its own mechanism to multiply and produce offspring. Based on whether there is participation of one organism or two in the process of reproduction, it is of two types. When offspring is produced by a single parent with or without the involvement of gamete formation, the reproduction is **Asexual**. When two parents (opposite sex) participate in the reproductive process and also involve fusion of male and female gametes, it is called **Sexual reproduction**. The organism's habitat, its internal physiology and several other factors are collectively responsible for how it reproduces.

Asexual Reproduction :- In this method, a single individual (parent) is capable of producing offspring. As a result, the offspring that are produced are not only identical to one another but are also exact copies of their parent.

Now the question arises that are these offspring produced are likely to be genetically identical or different? Therefore the term **clone** is used to describe such morphologically and genetically similar individuals. Let us see how widespread asexual reproduction is, among different groups of organisms. Asexual reproduction occurs in both single celled and multicelled individuals. The parent individual splits, buds or fragments to form identical daughter cells or individuals, e.g. *Amoeba*, *Paramecium*, *Euglena*, *Sycon*, *Hydra*, *Tubularia*, *Planaria*, *Ascidia*. In yeast, the division is unequal and small buds are produced that remain attached initially to the parent cell which eventually gets separated and mature into new yeast organisms (cells). Asexual reproduction is also called **agamogenesis or agamogeny**. While in animals and other simple organisms the term **asexual** is used unambiguously, in plants, the term **vegetative** reproduction is frequently used. In plants, the units of vegetative propagation such as *runner*, *rhizome*, *sucker*, *tuber*, *offset*, *bulb* are all capable of giving rise to new offspring. These structures are called vegetative propagules. Obviously, since the formation of these structures does not involve two parents, the process involved is asexual. The fleshy buds which produce new plants in bryophytes is called **Turion**.

Members of the kingdom Fungi and simple plants such as algae reproduce through special asexual reproductive structures. The most common of these structures are **zoospores** that usually are microscopic motile structures. Other common asexual reproductive structures are **conidia** (*Penicillium*), **buds** (*Hydra*) and **gemmules** (sponge). In mode of reproduction, somatic cells undergo mitosis during the formation of new individuals. Therefore it is also called **Somatogenic reproduction**. **Water hyacinth** (Terror of Bengal) which is one of the most invasive weeds found growing wherever there is standing water. It drains oxygen from the water, which leads to death of fishes.

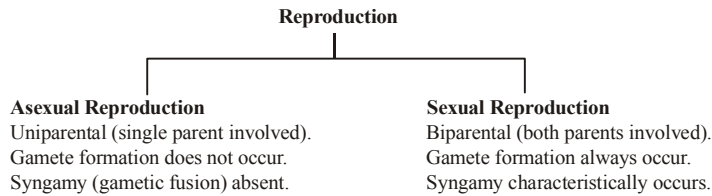
Asexual reproduction occurs by fission, budding and fragmentation.

Types:

1. **Fission** : It is a mode of asexual reproduction in which the body of a mature individual divides in two or more similar and equal sized daughter individuals. Fission can be binary fission or multiple fission.
 - a. **Binary fission**: It is the division of the body or an individual into two equal halves, each of which functions as an independent daughter individual. Depending on the plane of division the binary fission is of following types:
 - i. Simple Binary Fission: E.g. *Amoeba*
 - ii. Longitudinal Binary Fission: E.g. *Euglena*, *Vorticella*.
 - iii. Oblique Binary fission: E.g. *Ceratium*, *Gonyaulax*
 - iv. Transverse Binary Fission: E.g. *Paramecium*
 - b. **Multiple fission**: The nucleus divides several times by amitosis to produce many nuclei, without involving any cytokinesis. Later, each nucleus gathers a small amount of cytoplasm around it and the mother individual splits into many tiny daughter cells. E.g. *Plasmodium*, *Monocystis*.

Etoos Tips & Formulas

- Reproduction is the process of producing offspring similar to itself. It is a characteristic of living organisms. Biologically it means the **multiplication and perpetuation of the species**.
- According to the conditions available in environment, organisms have adapted the processes of reproduction. Generally, two types of reproduction mechanisms are present in organisms.

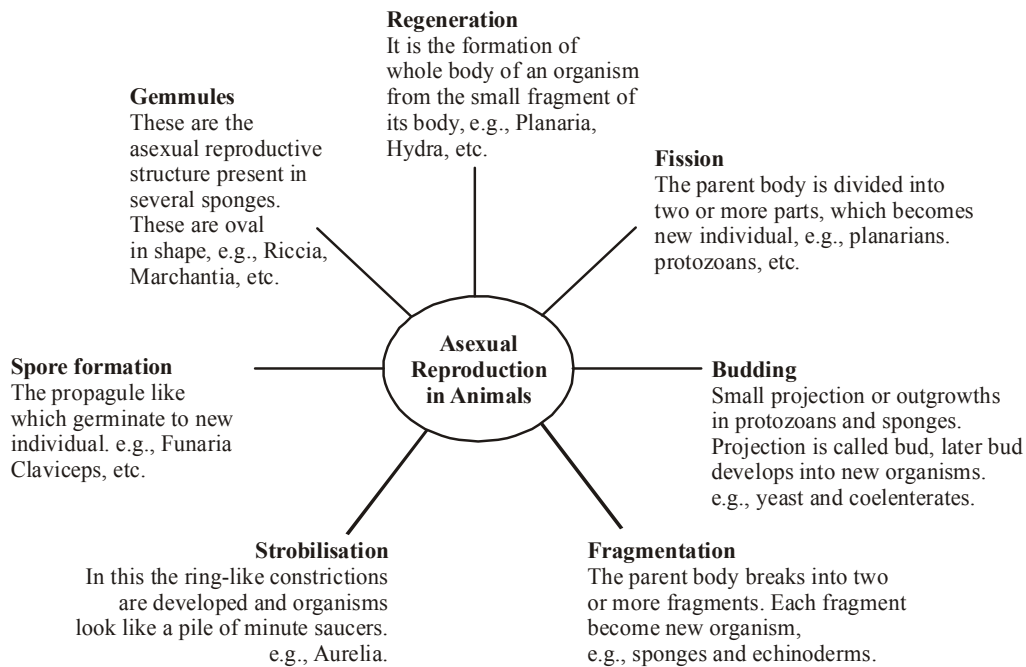


1. Reproduction in Animals

- Animal reproduce by both asexual and sexual methods.

2. Asexual Reproduction

- It is the primary means of reproduction among the protists, cnidarians and tunicates. The process of asexual reproduction can be occur though following mehtods.



3. Sexual Reproduction

- In animals the sexual reproduction occurs by the fertilisation of **haploid sperm and haploid egg**, generating a diploid offspring. In most individuals (i.e., **dioecious**), the female produce eggs, (i.e, large non-motile cells contain food reserve) and the male produce **sperms** (i.e., small, motile cell and have almost no food reserve).
- In other individual, (i.e., **monoecious**) such as **earthworm** and many **snails**, single individual produce both sperm and egg occurs in variety of ways, depending on the mobility and the breeding environment of individual.
- Sexual reproduction is two types

SOLVED EXAMPLE

- Ex.1** In Vorticella, the total number of micronuclei formed at the end of pre-zygotic nuclear division in female gamont is
(A) 4 (B) 6
(C) 8 (D) 5
- Sol.** (A)
- Ex.2** Which one of the following glands is absent in reproductive system of rabbit.
(A) Cowper's gland (B) Collateral gland
(C) Perineal gland (D) Prostate gland
- Sol.** (B)
- Ex.3** Drones in a colony of honey bees originate by
(A) Thelytoky
(B) Arrhenotoky
(C) Cyclic parthenogenesis
(D) Diploid parthenogenesis
- Sol.** (B) : Arrhenotoky is a type of parthenogenesis, in which the unfertilized eggs develop into males with haploid cells.
- Ex.4** Arrhenotoky is related to
(A) Parthenogenesis (B) Wax formation
(C) Both (A) and (B) (D) None of these
- Sol.** (A) : Parthenogenesis can be classified into arrhenotoky and thelytoky.
- Ex.5** Natural parthenogenesis occurs in
(A) Frog to form female
(B) Honeybee to produce drones
(C) Cockroach
(D) Vegetarian eggs
- Sol.** (B) : Parthenogenesis is the development of an individual from an unfertilized egg. In honey bees drones develop parthenogenetically.
- Ex.6** Which one of the following plants does not help in vegetative propagation by leaves
(A) Begonia (B) Kalanchoe
(C) Bryophyllum (D) Oxalis
- Sol.** (C)
- Ex.7** Development of embryo from the cells of the nucellus is called
(A) Parthenocarp (B) Apocarp
(C) Adventive embryony (D) Apospory
- Sol.** (C) : In adventive embryony embryo arises from diploid sporophytic cells such as nucellus or integuments (other egg) e.g., citrus.
- Ex.8** Grafting of tissue or organ between individuals of different species is called
(A) Autograft (B) Isograft
(C) Xenograft (D) Allograft
(E) Intergraft
- Sol.** (C)
- Ex.9** Carrot is micropropagated through
(A) Embryo (B) Embryoids
(C) Shoot culture (D) Callus
- Sol.** (D)
- Ex.10** What Apomixis is common between vegetative reproduction and Apomixis
(A) Both occur round the year
(B) Both produces progeny identical to the parent
(C) Both are applicable to only dicot plants
(D) Both bypass the flowering phase
- Sol.** (B)
- Ex.11** Why is reproduction essential for organisms?
Sol. Reproduction is a fundamental feature of all living organisms. It is a biological process through which living organisms produce offspring's similar to them. Reproduction ensures the continuance of various species on the Earth. In the absence of reproduction, the species will not be able to exist for a long time and may soon get extinct
- Ex.12** Why is the offspring formed by asexual reproduction referred to as clone?
Sol. A clone is a group of morphologically and genetically identical individuals. In the process of asexual reproduction, only one parent is involved and there is no fusion of the male and the female gamete. As a result, the offsprings so produced are morphologically and genetically similar to their parents and are thus, called clones.

Exercise # 1

SINGLE OBJECTIVE

NEET LEVEL

1. Which are exclusively viviparous
(A) Bony fishes
(B) Cartilaginous fishes
(C) Sharks
(D) Whales
2. The asexual process replaced by the sexual method is known as
(A) Semigamy (B) Amphimixis
(C) Apospory (D) Apomixis
3. In all the methods of asexual reproduction
(A) Offsprings produced are genetically identical to the parents
(B) Offsprings produced are genetically different from the parents
(C) Offsprings produced may or may not be identical to the parents
(D) None of the above
4. A person which shows the secondary sexual characters of both male and female is called
(A) Intersex (B) Hermaphrodite
(C) Bisexual (D) Gynandromorph
5. In sexual reproduction, offsprings resemble the parents
(A) Structurally but not functionally
(B) Functionally but not structurally
(C) Both structurally and functionally
(D) Neither structurally nor functionally
6. The polyestrous mammal is
(A) Man (B) Rabbit
(C) Cat (D) Horse
7. Viviparity is found in
(A) Frog (B) Lizard
(C) Snake (D) Rabbit
8. Common method of asexual reproduction is by
(A) Regeneration (B) Budding
(C) Archeocytes (D) Gemmulation
9. Asexual reproduction takes place in
(A) Higher animals (B) Lower animals
(C) Plants (D) All the above
10. As a result of binary fission number of individuals produced by one fission is
(A) Two (B) Three
(C) Four (D) Five
11. An alternation of asexual and sexual generations where both the generations are diploid and the haploid stage is represented only by the gametes is called
(A) Alternation of generation
(B) Metagenesis
(C) Paedogenesis
(D) Parthenogenesis
12. Differentiation in morphology of the two sexes of the same species is called
(A) Hermaphrodite (B) Heteromorphosis
(C) Sexual dimorphism (D) Unisexual
13. Fertilization is internal in
(A) Toads (B) Frogs
(C) Dog fish (D) Cat fish
14. Haploid parthenogenesis among insects is shown by order
(A) Hymenoptera (B) Homoptera
(C) Coleoptera (D) All the above
15. A person which shows the secondary sexual characters of both male and female is called
(A) Intersex (B) Hermaphrodite
(C) Bisexual (D) Gynandromorph
16. In some species parthenogenesis may alternate with sexual reproduction this process is called
(A) Complete parthenogenesis
(B) Incomplete or cyclic parthenogenesis
(C) Both the above
(D) None of the above
17. Product of sexual reproduction generally generates
(A) Large biomass
(B) Longer viability of seeds
(C) Prolonged dormancy
(D) New genetic combination leading to variation
18. Which is mode of reproduction in Amoeba
(A) Binary fission only
(B) Binary fission and multiple fission
(C) Binary fission and conjugation
(D) Multiple fission only
19. In Earthworms, self fertilization does not occur due to
(A) Hypogyny (B) Protogyny
(C) Protandry (D) Epigyny

Exercise # 2**SINGLE OBJECTIVE****AIIMS LEVEL**

1. The croaking sounds made by frogs is
 - (A) Hunger call
 - (B) Just a musical note
 - (C) Signaling call of danger
 - (D) Sex call for female partner
2. Which type of reproduction is found in Hydra
 - (A) Polyembryony
 - (B) Sexual and asexual
 - (C) Parthenogenesis
 - (D) Encystment
3. Gemmule formation in sponges is helpful in
 - (A) Parthenogenesis
 - (B) Sexual reproduction
 - (C) Only dissemination
 - (D) Asexual reproduction
4. Which is mode of reproduction in Amoeba
 - (A) Binary fission only
 - (B) Binary fission and multiple fission
 - (C) Binary fission and conjugation
 - (D) Multiple fission only
5. Which of the following shows the sexual dimorphism
 - (A) *Hydra* and *Ascaris*
 - (B) *Hydra* and *Oryctolagus*
 - (C) *Ascaris* and *Pheretima*
 - (D) *Ascaris* and *Oryctolagus*
6. Drones in a colony of honey bees originate by
 - (A) Thelytoky
 - (B) Arrhenotoky
 - (C) Cyclic parthenogenesis
 - (D) Diploid parthenogenesis
7. Arrhenotoky is related to
 - (A) Parthenogenesis
 - (B) Wax formation
 - (C) Both (A) and (B)
 - (D) None of these
8. Binary fission is found in
 - (A) *Amoeba*
 - (B) *Paramecium*
 - (C) *Planaria*
 - (D) All of these
9. Eutherian mammals are
 - (A) Oviparous
 - (B) Viviparous
 - (C) Ovoviviparous
 - (D) Both (A) and (C)
10. In Earthworms, self fertilization does not occur due to
 - (A) Hypogyny
 - (B) Protogyny
 - (C) Protandry
 - (D) Epigyny
11. In some species parthenogenesis may alternate with sexual reproduction this process is called
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 - (B) Homoptera
 - (C) Coleoptera
 - (D) All the above
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 - (C) Cockroach
 - (D) Vegetarian eggs
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 - (C) *Ascaris* and *Pheretima*
 - (D) *Ascaris* and *Oryctolagus*
16. Arrhenotoky is related to
 - (A) Parthenogenesis
 - (B) Wax formation
 - (C) Both (A) and (B)
 - (D) None of these

Exercise # 3

PART - 1

MATRIX MATCH COLUMN

i. Match the following with correct combination

Column - I

- A. Hyaluronidase
- B. Corpus luteum
- C. Gastrulation
- D. Capacitation
- E. Colostrum

Codes :

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

Column - II

- i. Acrosomal reaction
- ii . Morphogenetic movements
- iii. Progesterone
- iv. Mammary gland
- v. Sperm activation

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

ii. Match the items ABCD of table 'A' with that of items in table 'B' then the correct pairing sequence of ABCD will be

Column - I

- A. Cleavage
- B. Gastrulation
- C. Neurulation
- D. Organogenesis

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

Column - II

- i. Formation of iii germ layers
- ii. Formation of embryo spinal cord
- iii. Results in formation of skeleton and muscles from mesoderm
- iv. Pattern depends on the amount and distribution of yolk

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

iii. Match the following and choose the correct combination from the options given

Column - I

- (Organism)
- A. Butterfly
 - B. Crow
 - C. Parrot
 - D. Crocodile

- (A) A - i; B - ii; C - iii; D - iv
- (C) A - ii; B - iii; C - iv; D - i
- (E) A - iv; B - iii; C - ii; D - i

Column - II

(Approximately life span)

- i. 60 years
 - ii. iv0 year
 - iii. iv years
 - iv. i - ii weeks
- (B) A - iv; B - iii; C - i; D - ii
 - (D) A - iii; B - ii; C - i; D - iv

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

Column -I

- A. Sponge
- B. Yeast
- C. Potato
- D. Water hyacinth

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

Column - II

- i. Tuber
- ii. Offset
- iii. Gemmules
- iv. Budding

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

v. Match the organisms given in Column - I with their mode of reproduction in column -II and select the correct answer from the codes given below :

Column - I

- A.. Potato
- B. Spirogyra
- C. Rose
- D. Penicillium

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

Column - II

- i. Conjugation
- ii. Stem cutting
- iii. Conidiospores
- iv. Stem tubers

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

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

1. During regeneration modification of an organ to another organ is known as [CBSE AIPMT 2001]
(A) Morphogenesis
(B) Epimorphosis
(C) morphallaxis
(D) accretionary growth
2. In oogamy, fertilisation involves [CBSE AIPMT 2004]
(A) A small non-motile female gamete and a large motile male gamete
(B) A large non-motile female gamete and a small motile male gamete
(C) A large non-motile female gamete and a small non-motile male gamete
(D) A large motile female gamete and a small non-motile gamete
3. Why is vivipary an undesirable character for annual crop plants ? [CBSE AIPMT 2005]
(A) It reduces the vigour of the plant
(B) It adversely affects the fertility of the plant
(C) The seeds exhibit long dormancy
(D) The seeds cannot be stored under normal conditions for the next season
4. In which one pair both the plants can be vegetatively propagated by leaf pieces ? [CBSE AIPMT 2004]
(A) Agava and Kalanchoe
(B) Bryophyllum and Kalanchoe
(C) Asparagus and Bryophyllum
(D) Chrysanthemum and Agave
5. Vegetative propagation in mini occurs by [CBSE AIPMT 2009]
(A) Offset (B) Rhizome
(C) Sucker (D) Runner
6. Vegetative propagation in Pistia occurs by [CBSE AIPMT 2010]
(A) Stolon (B) Offset
(C) Runner (D) Sucker
7. The 'Eyes' of the potato tuber are [CBSE AIPMT 2011]
(A) Flower buds (B) Shoot buds
(C) Axillary buds (D) Root buds
8. Which one of the following is correctly matched ? [CBSE AIPMT 2012]
(A) Onion – Bulb
(B) Ginger – Sucker
(C) Chlamydomonas – Conidia
(D) Yeast – Zoospores
9. Product of sexual reproduction generally geneates [NEET 2013]
(A) Longer viability of seeds
(B) Prolonged dormancy
(C) New genetic combination leading to variation
(D) Large biomass
10. Select the wrong statement. [NEET 2013]
(A) Isogametes are similar in structure, function and behaviour
(B) Anisogametes differ either in structure, function and behaviour
(C) In oomycetes female gamete is smaller and motile, while male gamete is large and non-motile
(D) Chlamydomonas exhibits both isogamy and anisogamy and Fucus shows oogamy
11. Which of the following pairs is not correctly match ? [CBSE AIPMT 2015]
- | Mode of reproduction | Example |
|----------------------|----------------|
| (A) Offset | Water hyacinth |
| (B) Rhizome | Banana |
| (C) Binary fission | Sargassum |
| (D) Conidia | Penicillium |

MOCK TEST

- Which one of the following statements is not correct?
 - Offspring produced by the asexual reproduction are called clone.
 - Microscopic, motile, asexual reproductive structures are called zoospores.
 - In potato, banana and ginger, the plantlets arise from, the internodes present in the modified stem.
 - Water hyacinth, growing in the standing water, drains oxygen from water that leads to the death of fishes.
- Select the incorrect match out of the following.

(A) Offset	–	Potato
(B) Runner	–	Grass
(C) Stolon	–	Jasmine
(D) Sucker	–	<i>Chrysanthemum</i>
- Stock and scion are used in

(A) cutting	(B) grafting	(C) layering	(D) micropropagation
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- Vegetative propagation in water hyacinth takes place by

(A) rhizome	(B) bulbil	(C) leaf bud	(D) offset
-------------	------------	--------------	------------
- Which one of the following is correctly matched?

(A) Onion	–	Bulb
(B) Ginger	–	Sucker
(C) <i>Chlamydomonas</i>	–	Conidia
(D) Yeast	–	Zoospores
- Vegetative reproduction, in which new plants develop in the notches along the tip of intact leaves is seen in

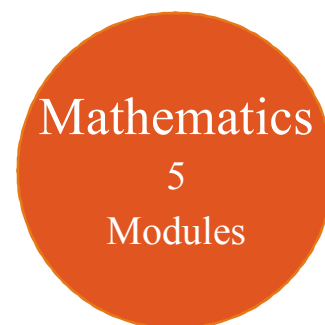
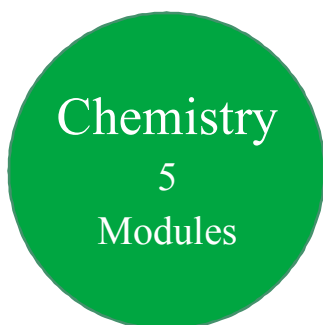
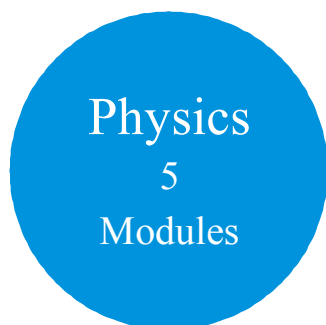
(A) <i>Asparagus</i>	(B) <i>Agave</i>	(C) <i>Chrysanthemum</i>	(D) <i>Bryophyllum</i>
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- Banana is vegetatively propagated by

(A) tubers	(B) rhizomes	(C) bulbs	(D) suckers
------------	--------------	-----------	-------------
- Find out order of vegetative propagules of plants like potato, ginger, *Agave*, *Bryophyllum* and water hyacinth.

(A) Offset, bulbil, leaf bud, rhizome and eyes	(B) Leaf bud, bulbil, offset, rhizome and eyes
(C) Eyes, rhizome, bulbil, leaf bud and offset	(D) Rhizome, bulbil, leaf bud, eyes and offset
(E) Offset, bulbil, leaf bud, rhizome and eyes	
- Which one of the following pairs is wrongly matched while the remaining three are correct?

(A) <i>Penicillium</i>	–	conidia
(B) Water hyacinth	–	runner
(C) <i>Bryophyllum</i>	–	leaf buds
(D) <i>Agave</i>	–	bulbils

11th Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics <p>Module-2</p> <ol style="list-style-type: none"> 1. Law of Motion & Friction 2. Work, Energy & Power <p>Module-3</p> <ol style="list-style-type: none"> 1. Motion of system of particles & Rigid Body 2. Gravitation <p>Module-4</p> <ol style="list-style-type: none"> 1. Mechanical Properties of Matter 2. Thermal Properties of Matter <p>Module-5</p> <ol style="list-style-type: none"> 1. Oscillations 2. Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Some Basic Concepts of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom <p>Module-2</p> <ol style="list-style-type: none"> 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals <p>Module-3</p> <ol style="list-style-type: none"> 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition <p>Module-4</p> <ol style="list-style-type: none"> 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases <p>Module-5</p> <ol style="list-style-type: none"> 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

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12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Electrostatics 2. Capacitance <p>Module-2</p> <ol style="list-style-type: none"> 1. Current Electricity 2. Magnetic Effect of Current and Magnetism <p>Module-3</p> <ol style="list-style-type: none"> 1. Electromagnetic Induction 2. Alternating Current <p>Module-4</p> <ol style="list-style-type: none"> 1. Geometrical Optics 2. Wave Optics <p>Module-5</p> <ol style="list-style-type: none"> 1. Modern Physics 2. Nuclear Physics 3. Solids & Semiconductor Devices 4. Electromagnetic Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Solid State 2. Chemical Kinetics 3. Solutions and Colligative Properties <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Electrochemistry 2. Surface Chemistry <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. P-Block Elements 2. Transition Elements (d & f block) 3. Co-ordination Compound 4. Metallurgy <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. HaloAlkanes & HaloArenes 2. Alcohol, Phenol & Ether 3. Aldehyde, Ketone & Carboxylic Acid <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Nitrogen & Its Derivatives 2. Biomolecules & Polymers 3. Chemistry in Everyday Life 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Reproduction in Organisms 2. Sexual Reproduction in Flowering Plants 3. Human Reproduction 4. Reproductive Health <p>Module-2</p> <ol style="list-style-type: none"> 1. Principles of Inheritance and Variation 2. Molecular Basis of Inheritance 3. Evolution <p>Module-3</p> <ol style="list-style-type: none"> 1. Human Health and Disease 2. Strategies for Enhancement in Food Production 3. Microbes in Human Welfare <p>Module-4</p> <ol style="list-style-type: none"> 1. Biotechnology: Principles and Processes 2. Biotechnology and Its Applications 3. Organisms and Populations <p>Module-5</p> <ol style="list-style-type: none"> 1. Ecosystem 2. Biodiversity and Conservation 3. Environmental Issues

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