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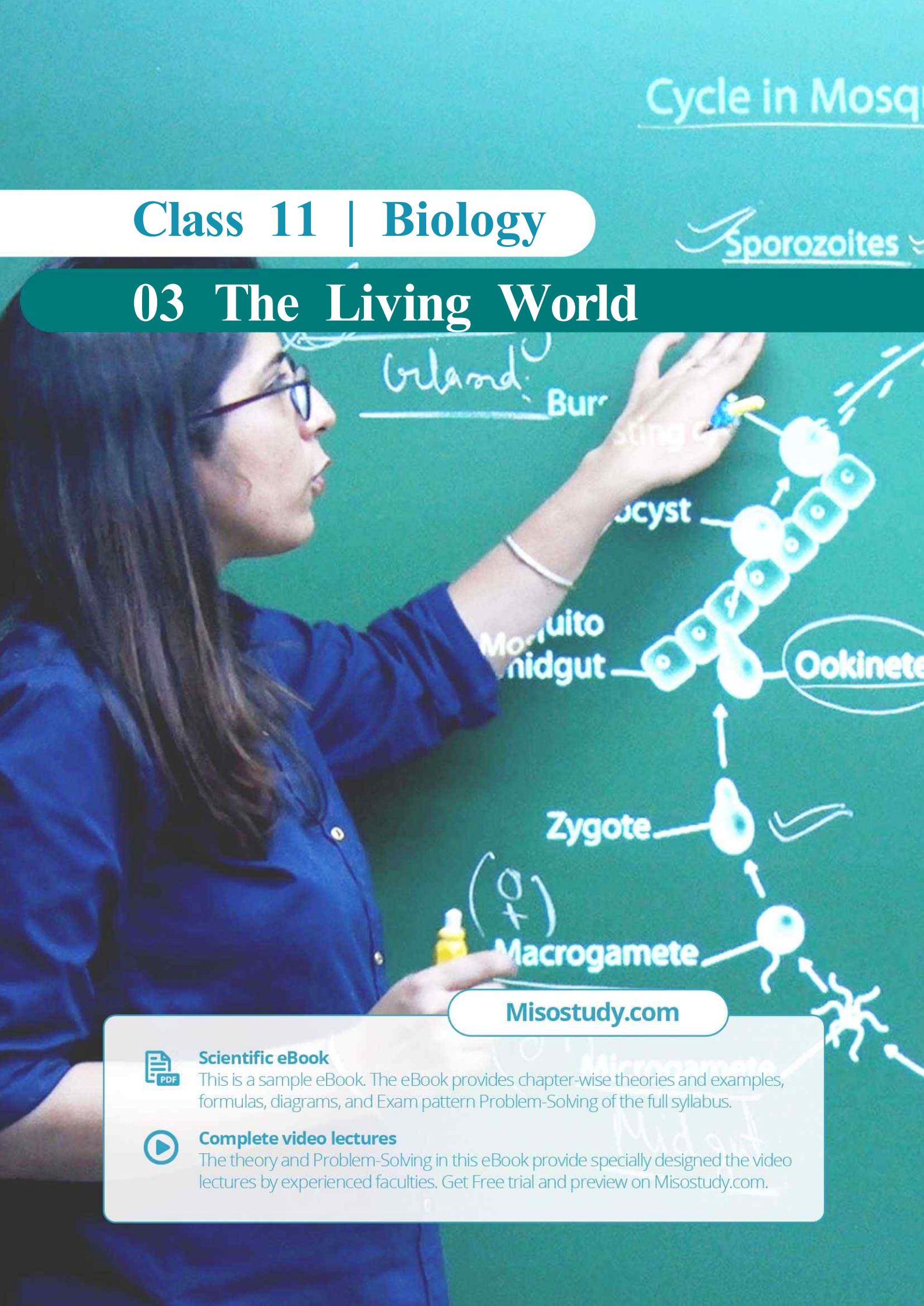
Class 11 | Biology

03 The Living World



01. Introduction

- Biology; Bios = life, Logos = Study, means study of life is biology.
- **"Biology** is the science of life forms and living processes"
- **Systematic** and **monumental** description of life forms made human to make a detailed system of identification, nomenclature and classification of organisms i.e. **Taxonomy.**
- Hence the study of identification, nomenclature and identification is called taxonomy.
- All the organisms have been evolved by a very long and complex process of **evolution**, so they all are related to each other by sharing of some **common genetic material** but up to varying degrees. This sharing may be less or more among different cases..
- When human came to know this fact then he humbled and led to cultural movements for conservation of **biodiversity.**
- Sharing of common characters was also proved when human studied the similarities among living organisms both **horizontally** and **vertically.**
- The living world is full of amazing diversity of living organisms.
- The diversity of habitats of organisms is also very vast and amazing.
- This diversity makes us deeply reflect on "What indeed is life" ? This question actually asks to solve two problems.
  - **(i)** First is a technical → What living is as opposed to the non living means **Living v/s Non living.**
  - **(ii)** Second is a philosophical one → what the **purpose of life** is?
    As scientists we will try to solve the first question, because the second question is more related to philosophy rather science.

02. Characters of Living Organism

Following are the main characters of "living"-

GROWTH, REPRODUCTION } Not the defining properties/characters/features

METABOLISM, CELLULARORGANISATION, CONSCIOUSNESS } Defining properties/characters/features

The character which has no exception is called as **defining property** of life.

Growth

- Increase in mass or overall size of a tissue or organism or its parts is called growth.
- Increase in mass and increase in number of individuals are twin characters of growth.
- Growth is an irreversible permanent increase in size of an organ or its parts or even of an individual cell.
- Growth is of two types :
  - **(a) Intrinsic growth :-** This growth is from inside of the body of living organisms.
  - **(b) Extrinsic growth :-** This growth is from outside i.e. accumulation of material on any body surface Non living exhibts this type of growth.

- Growth is of two types :
  - **(a) Indeterminate growth = Unlimited growth** → Growth which occurs continuously throughout their life span is indeterminate growth or unlimited growth. It occurs in plants and not in animals.
  - **(b) Determinate growth = Limited growth** → Growth which occurs only up to a certain age is determinate growth or Limited growth. It occurs in animals. However, cell division occurs in certain tissues to replace lost cells.
- In majority of higher plants and animals, growth and reproduction are mutually **exclusive events.**
- Because both living and nonliving exhibit growth so it can not be taken as defining property.
- Growth from inside (intrinsic growth) can be taken as **defining property.**

Reproduction

Reproduction is one of the fundamental characteristics of living organisms. It can be defined as the production of new individuals of same kind by the grown up individuals. It is characteristic exhibited by living organisms which can produce new young ones of their own kind. There are two modes of reproduction — **asexual** and **sexual.**

- In lower organisms like yeasts and Hydra, budding takes place in which new individuals are produced by the formation of an outgrowth known as 'bud'.
- Fragmentation is another mode of asexual reproduction, as in this, body of an organism (parent body) breaks up into two or more parts (known as fragments) each of which grows into a new individual. It is also quite common in filamentous algae, fungus, bryophytes (at protonema stage which occurs during life cycle in mosses).
- Planaria (flat worms) exhibit an extraordinary ability to regenerate its lost body parts completely (which is known as true regeneration).
- This is a method of reproduction as new planarians develop by splitting of parent planarian body either lengthwise or transversely. In higher organisms like plants, animals sexual mode of reproduction is quite common which involves formation of gametes (i.e., sex cells) from two parents of opposite sexes but same species. These gametes then fuse to form zygote (2n) which develops to form a new organism of same kind.
- Hence, reproduction is shown by all living organisms except a few which are either sterile or infertile, like mule, worker-bees, infertile human couples, etc. do not reproduce at all.
- Hence, reproduction can be regarded as characteristic of living organisms but it is not their exclusive defining characteristic.

Metabolism :

- The sum total all the chemical reactions occuring in our body is metabolism.
- All living organisms, both unicellular and multicellular exhibit metabolism.
- No non-living object shows metabolism.
- In this way metabolism is a defining character of living organisms because it has no exceptions.
- Now we have known most of the chemical or metabolic reactions occuring in our body so we can demonstrate many of them in a cell free medium or in a test tube in lab.

- The isolated metabolic reaction outside the body of an organism, performed in a test tube (in-vitro) is neither living nor nonliving.
- These isolated reaction can be regarded as living things, but they are definitely living reactions because they are similar to the reactions performing in our body.
- Here we should not forget the fact that metabolism is the total sum of all the chemical reactions performing in our body, it is not the sum of few or more living reactions.
- All organisms are made of small or big chemicals perform thousands of reactions and form some other chemicals also in the bodies of living organisms.
- All plants, animals, fungi and microbes exhibit metabolism.

Consciousness

- Most obvious and technically complicated feature of all living organism. All living organisms are able to detect changes, i.e., sense their surroundings and can also respond to them. This is known as sensitivity which is defined as the ability to detect changes in the environment and to give response towards it accordingly. Any change that can be detected by an organism is called stimulus. This can be physical (like intensity, duration, direction of light, sound, change in temperature, duration of day length, i.e., photoperiod, etc.), chemical (like acids, pollutants, etc.) or biological (like other organisms).
- Besides, human being is the only organism, who is aware of himself. He has self-consciousness too with awareness of the surroundings. He relate his mind to the changes taking place in the world. He is an intelligent animal with thoughts, feelings and self-hood. sensitivity or awareness is regarded as defining property of living organisms as non-living things do not have power of sensing their surroundings and give response according to it. However, patients lying in coma in hospitals virtually supported by machines which replace heart and lungs are neither living nor dead otherwise brain-dead.

03. Diversity In The Living World

- We consider vast areas like forest, desert, plateau etc. we find that number and kinds of living organisms increase many folds. These different kinds of plants, animals and other organisms are referred to as '**Biodiversity**' of this earth.
- **Biodiversity** is the number and various kinds of organisms found on earth. It stands for the variability found among living organisms inhabiting this world.
- **Biodiversity (Greek word bios = life; diversity = forms) or biological diversity** can be defined as the vast array of species of microorganisms, algae, fungi, plants, animals occuring on the earth either in the terrestrial or aquatic habitats and the ecological complexes of which they are a part.
- According to IUCN (International Union of Conservation of Nature and Natural resources), currently known and described species of all organisms are between **1.7-1.8 million**. These millions of plants, animals and other organisms in the world cannot be recognised, studied or described by an individual on its own.

- There is need to standardize the names of all living organisms after proper identification, in order to study such diverse life forms. Therefore, for better understanding of biodiversity scientists have established a definite system of principles, procedures and terms which identifies, categories and assigns specific name to each and every organism known to us. Such systems are acceptable to all biologists all over the world.
- The scientific need for simple, stable and internationally accepted systems for naming the living organisms of the world has generated, a process called **"Nomenclature"**. And, before assigning a specific name to an organism, one should determine or know its kind or features correctly, so that one can identify it in each every part of the world. This is known as **"Identification"**

04. Taxonomy

- This word was proposed by **A.P. De Candolle** in his book **"Theories elementaire de la botanique"** (Theory of elementary botany)
- **Taxonomy includes study of following 4 points**

Characterization	-	Identification of character
Identification	-	Identification of living organisms
Nomenclature	-	Nomenclature of living organisms
Classification	-	Classification of living organisms in groups

05. Systematics

(i) The term **"Systematics"** was pro posed by **Linnaeus**. The word systematics is derived from the latin word "systema" which means systematic arrangement of organisms.

(ii) **According to G. Simpson** : Systematics is the study of diversity of organisms and all their comparative and evolutionary relationship.

NOTE ☞ It includes description of external morphological characters of plants of living organisms.
eg. Morphological characters of Root, Stem, Leaves, Flowers.

06. New Systematics or Neosystematics or Biosystematics

- **Neo-systematics** – A new branch – Name given by **Julian Huxley (1940)**
- It includes description of all the characters **(external + internal)**
  e.g. Anatomical characters, Histological characters, Embryological characters, Identical characters

- It is used to know the **inter-relationship** between living organisms.

NOTE ☞ New systematics is mainly based on **evolutionary** as well as **genetic relationship** as compared to morphological characters.

07. Types of Taxonomy

- **Alpha taxonomy or classical taxonomy :** It is based on **external morphology** of plants.
- **Bete taxonomy or Explorative taxonomy :** Besides external **morphology** it also includes **internal** characters like embryological, cryological, anatomical characters etc.
- **Omega taxonomy or Encyclopaedic taxonomy :** Omega taxonomy have widest scope. It is based on **all the information** or data available about plants.
- **Chemotaxonomy :** The uses of chemical characters of plants in classification or in solving taxonomic problems is called chemotaxonomy or chemical taxonomy. It is based on the **chemical constituents** of plants. The fragrance and taste vary from species to species.

  The basic chemical compounds used in chemotaxonomy are **alkaloids, carotenoides, tannins,** polysaccharide, nucleic acids, fatty acids, amino acids, **aromatic compounds** etc.

- **Cytotaxonomy :** The use of cytological characters of plants in classification or in solving taxonomic problems is called cytotaxonomy.

- Following characters are used in cytotaxonomy
  - ❖ **Chromosome number.**
  - ❖ Chromosome morphology – including chromosome size, total length of chromatin, arms ratio, primary and secondary constriction.
  - ❖ Heterochromatin.
  - ❖ **Chromosome behaviour at meiosis.**
  - ❖ Polyploidy – autopolyploidy, allopolyploidy and aneuploidy.
  - ❖ Chromosomal aberrations.
  - ❖ Different type of cytochromes.

  Cytological data have been used in many cases to find out the affinities among genera.

- **Karyotaxonomy :** Based on characters of **nucleus and chromosomes.** Pattern of **chromosomal bands** (dark bands and light bands) is most specific character.
- **Adansonian system or Phenetic Classification or Numerical Classification.**
  - ❖ Proposed by **"Sokel** and **Sneath"**
  - ❖ In it plants are classified on the basis of number of similarities and dissimilarities.
  - ❖ In this, importance to any one character is not given, **all characters have same importance.**
    While in **natural** classification **floral characters** have importance than morphological characters.

08. Significance of Taxonomy

- Most significant feature is **identification** of living organism.
- With the help of taxonomy **diversity** of living being can be studied easily.
- Maximum diversity of living beings are found in **tropical rain forests.**
- These forest have heavy rain fall through out the year.
- In **India** maximum tropical rain forest are found in **Andaman & Nicobar** and in all **eastern states** (Assam, Meghalaya, West Bengal etc.)
- At present, 300 lakh **(30 million)** type of living organism are found on our earth.
- 17 lakh **(1.7 million)** type of living organism have been **discovered till now.**
- Out of them **12 lakh** types are **animal** and **5 lakh** types are **plants.**

09. Taxonomic Category

Classification is not a single step process but involves heirarchy of steps in which each step represent a rank or category.

- **Species :**
  Taxonomic studies consider a group of individual organism with fundamental similarities as a species. One should be able to distinguish one species from the other closely related species based on the distinct morphological difference.
- **Genus :**
  Genus comperises a group of related species which has more characters in common in comparison to species of other genera.
- **Family :**
  Family has a group of related genera with still less number of similarities as compared to genus and species. Families are characterized on the basis of both vegetative and reproductive feature of plant species.
  For example :Three different genera **Solanum, Petunia** and **Datura** are included in family solanaceae.
- **Order :**
  Order being a higher category is the assemblage of families which exhibit a few similar character.
  For example : Plant families like **convolvulaceae, Solanaceae** are included in the order **polymoniales mainly based on the floral characters.**
- **Class :**
  Class includes organism of related orders having less similarities than orders.
- **Division :**
  Division includes all organisms belonging to different classes having a few common characters. There 7 main taxonomic categories. They are obligate or essential or broad categories i.e. they are strictly used at the time of any plant classification. There are some extra or sub categories, like sub division, sub order, sub family, etc. They are used only when they are needed.

Biggest group →	Kingdom
	Division/Phylum
	Class
	Order - Cohort
	Family
	Genus
	Species

- ❖ The classification of any plant or animal is written in **descending** or ascending order.
- ❖ Hierarchy – **Descending** or ascending arrangement of taxonomic categories is known as hierarchy.
- ❖ **Species :** Smallest taxonomic category → It is basic unit of classification.

NOTE ☞ As we go higher from species to kingdom, number of common characters decreases. Lower the taxa more are the characteristics that the members with in the taxon share. Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

Suffix for taxa (Taxon)		
Division	—	phyta
Sub div	—	phytina
Class	—	opsida, phyceae, ae
Order	—	ales
Sub-order	—	ineae
Family	—	aceae
Sub Family	—	oideae

NOTE ☞ There is no suffix for Genus, Species and Kingdom.

10. Nomenclature

- **Polynomical system :**
  - ❖ According to this system name of any plant consists of many words.
  - ❖ For eg. Caryophyllum → Caryophyllum saxatilis folis gramineus umbellatis corymbis
  - ❖ Based of morphology mainly

- **Trinomical system :**
  - ❖ Proposed by **Lamarck.**
  - ❖ According to this system name of any plant or species is composed of three names-
    - **Generic name**
    - **Specific epithet**
    - **Subspecific name (Name of variety)**

- ❖ When members of any species have large variations then trinomial system is used.
- ❖ On the basis of dissimilarities this species is classified into sub species. eg.
  Brassica oleracea var. botrytis (Cauliflower)
  Brassica oleracea var. capitata (Cabbage)
  Brassica oleracea var. caulorapa (Knol-Khol)

- **Binomial system :**
  - ❖ Binomial system was first proposed by **Gaspard Bauhin** in his book -**"Pinax Theatre Botanica"**
  - ❖ **Carolus Linnaeus :** Linnaeus used this nomenclature system for the first time on large scale and proposed scientific name of all the plants and animals.
  - ❖ **Linnaeus** is the **founder** of binomial system.
  - ❖ Linnaeus proposed scientific name of plants in his book **"Species Plantarum"**
  - ❖ It was published on **1 May, 1753.** So this was the initiation of binomial system for plants.
  - ❖ So any name proposed (for plants) before this date is **not** accepted today.
  - ❖ **Linnaeus** proposed scientific name of animals in his book **"Systema Naturae"** (10^{th} edition).
  - ❖ This 10^{th} edition of **Systema Naturae** was first published on **1 August, 1758.**
  - ❖ So initiation of binomial system **for animals** is believed to be started on **1 August, 1758.**

11. ICBN

- **Main rules of ICBN :**
  - ❖ According to binomial system name of any species consists of two components or words.
    - Generic name Name of genus
    - Specific epithet

e.g. **Solanum tuberosum** (Potato) **Mangifera indica** (Mango)

↓ ↓ ↓ ↓

Generic name Specific epithet Generic name Specific epithet

- ❖ In plant nomenclature (ICBN) tautonyms are not valid i.e. generic name and specific epithet should not be same in plants.
  eg. Mangifera mangifera
  But tautonyms are valid in animal nomenclature (ICZN-International Code of Zoological Nomenclature)
  eg. Naja naja (Indian cobra), Rattus rattus (Rat)
- ❖ First letter of generic name should be in capital letter and first letter of specific epithet should be in small letter.
  eg. Mangifera indica

- ❖ But if specific epithet is based on the name of any person, its first letter should be in capital letter.
  eg. Isoetes Pantii
- ❖ When written with free hand or typed, then generic name and specific epithet should be separately underlined.
  But during printing name should be in italics to indicate their latin orgin.
- ❖ Name of scientist (who proposed nomenclature) should be written in short after the specific epithet.
  eg. Mangifera indica Linn.
- ❖ Name of scientist should be neither underlined nor in italics, but written in Roman letters (simple alphabets)
- ❖ Sciectific names should be derived from Latin (usually) or Greek languages because they are dead languages.
- ❖ Type specimen (Herbarium Sheet) of newly discovered plant should be placed in herbarium (Dry garden).

12. Classification

According to **"A.P. de Candolle",** Classification is of two types

(i) Empirical Classification **(ii) Rational Classification**

- **Empirical Classification :**
  - ❖ In this type, the actual nature or character of plants is not considered.
  - ❖ Plants are classified on the basis of their alphabetical order.
  - ❖ In this way plants are classified into 26 groups.

- **Rational Classification**
  In this classification, plants are classified on the basis of their actual character or nature i.e. by viewing the characters.

Types of rational classification

(iii) Practical classification
In this type of classification, plants are classified on the basis of their economic importance.
e.g. Oil yielding plants → Coconut, Walnut, Soyabean
Fibre yielding plants → Jute, Cotton
Medicinal plants → Rauwolfia, Cinchona, Eucalyptus

NOTE ☞ In this classification, any one plant can be a member of more than one group.
eg. Turmeric : Multi uses plant, it gives both medicines and spices.

(iv) Artificial classification :

In this type of classification plants are classified on the basis of one or two morphological characters. i.e. over all morphology is not considered.

for e.g. - Classification proposed by Linnaeus is Artificial

Linnaeus classified plant kingdom on the basis stamen into 24 classes.

NOTE ☞ Linnaeus classification is also called sexual classification.

NOTE ☞ Linnaeus divided flowering plants into 23 classed starting with class monandria with a single stamen (eg. Canna) and plants with twenty or more stamens attached with calyx were assigned to class **Icosandria.** He also included all non-flowering plants such as algae, fungi, mosses and ferns in a separate class called cryptogamia.

(v) Natural classification:

In this type, plants are classified on the basis of their complete morphological characters of stem, root, leaves, flowers etc.

Importance —

Natural classification is believed to be the best classification, because it represents the natural similarities and dissimilarities of plants i.e. it represents the interrelationship among plants.

In this classification, the plants belonging to the same group shows many similarities, while in artificial classification, the plants belonging to the same group shows only, 1 or 2 similar characters. They have many dissimilarities.

Natural classification is of two types

- **Natural formal**
- **Natural phylogenetic**

(a) Natural formal → In this classification, the phylogeny of the plant is not considered i.e. only the morphology of the plant is considered.

(b) Natural phylogenetic → In this classification, both morphology and phylogeny are considered. In phylogenetic classification, the plants are arranged on the basis of their evolution.

Thallophyta → Bryophyta → Pteridophyta → Gymnosperm → Angiosperm (most advanced plants)
Note : Phylogenetic classification also known as cladistic classification

(vi) Adansonian system or phenetic classification or Numerical classification :

In it plants are classified on the basis of numbers of similarities and dissimilarities. This classification is easily carried out by using computers and it is based on all observable characteristics. In this classification number and codes are assigned to all the characters and the data are prepared and then processed. Those organism which have maximum similarities are placed in same group. In this way each character is given equal importance and at the same hundreds of characters can be considered.

NOTE ☞ In this classification importance to any one character is not given, all characters have same importance. While in natural classification floral (reproductive) characters have more importance than vegetative (root, stem and leaves) characters.

13. Taxonomical Aids

- Accurate classification and identification of organisms is required which needs field studies and intensive laboratory work. This is done after collection of actual specimens of plants and animal species which is the primary source of all taxonomic studies.
- Hence, these taxonomical studies help in
  Fundamental study of different living organisms.
  Also aid in their systematic study.
  Information gathered is stored with specimens for future studies.

Herbarium

- It is defined as "store house of collected plant specimens that are dried, pressed and preserved on sheets". Further, these sheets are arranged in the sequence of a universally accepted system of classification.
- Such herbaria serve as quick source of reference in taxonomical studies. It also provides information about the local flora as well as flora of distant areas. This information is also useful in locating wild varieties and relatives of economically important plants.
  List of some Herbaria of the world :
  (i) Royal Botanical Gardens, Kew (England)
  (ii) Central National Herbarium, Calcutta

14. Botanical Gardens

Botanical garden is an institution located in an enclosed piece of land which grows numerous kinds of plants obtained from different places for botanical studies. Each plant is first identified and then labelled indicating its botanical/scientific name and its family.

List of some Botanical Gardens

(i) Royal Botanical Garden, Kew (England)
(ii) National Botanica Garden, Lucknow
(iii) Indian Botanical Garden, Howrah
(iv) Lloyd Botanical Garden, Darjeeling

15. Museum

- Museum is a place used for storing, preservation and exhibition of both plants and animals. All educational institutes and universities maintain museums in their Botany and Zoology departments.
- A commonly used preservative solutions is "Formalin". Plants and animals specimen may also be preserved as dry specimens. For instances, insects are collected, killed and pinned before preserving them in special insect boxes while larger animals like reptiles, birds and mammals are usually stuffed and then preserved.
- National Museum of Natural History (NMNH) in Delhi is important from natural science point of view.

16. Zoological Parks

- Zoological parks commonly known as zoos are the places where live wild animals are kept in protected environment which is made similar to their natural habitats as much as possible. Here, they are provided with protection and care by human beings.
- These parks serve as ideal means to study and learn different food habits and behaviour of variety of animals. So, students should visit nearby zoos for knowledge and entertainment both.
- National Zoological Park (Delhi) is one of the finest zoos of Asia.

17. Key

- Key is an important taxonomic aid used for identification of plants and animals based on the **similarities** and **dissimilarities.** Actually, it is a set of alternate characters of different types arranged sequence wise in such a fashion that by selection and elimination one can quickly find out the name of the organism.
- The keys are based on the set of contrasting characters generally in a pair known as **"couplet".** Each character of the couplet or statement in the key is called as **"lead".**
- One has to choose correct option between two statements of characters of definite species so that the animal or plant is identified accurately. **Keys are generally analytical in nature.**

18. Flora, Manuals, Monographs and Catalogues

- These flora, manuals, monographs, etc. are recorded descriptions of plants, animals and other organisms. They provide correct identification and description of variety of living organisms.
  - ❖ **Flora :** It is a book containing information about plants found in a particular area. It gives the actual account of habitat and distribution of various plants of a given area. These provide the index to the plant species found in a particular area. For example, Flora of Delhi by J.K. Maheshwari.

- ❖ **Manual :** It is a book containing complete listing and description of the plants growing in a particular area. They provide useful information for identification of names of various species found in an area.
- ❖ **Monograph :** It contains information of any one taxon.
- ❖ **Catalogue :** It include the alphabetical arrangement of species of a particular place describing their features.

19. Species concept

John Ray : Proposed the term and concept of species.

- **Biological concept of species**
  - ❖ **Ernst Mayr** (Darwin of 20th century) proposed the biological concept of species.
  - ❖ Mayr defined the "species" in the form of biological concept.
  - ❖ According to Mayr "All the members that can interbreed among them self and can produce fertile offsprings are the members of same species"

    But this definition of Mayr was incomplete because this definition is applicable to sexually reproducing living beings because there are many organisms that have only asexual mode of reproduction.
    eg. Bacteria, Mycoplasma, BGA

  - ❖ The main character in determination of any species is interbreeding. But this character is not used in taxonomy. In taxonomy, the determination of species is mainly based on morphological characters.
  - ❖ In higher plants, the determination of species is mainly based on the morphology of flower (floral morphology). Because floral (reproductive) characters are more conservative as compared to vegetative (Root, Stem, Leaf) characters i.e. they do not show major changes.

- **Typological Concept**
  - ❖ It was proposed by **"Aristotle"** and **"Plato".**
  - ❖ This concept is based on single individual of a species.
  - ❖ According to this concept, **"There is a definite type or pattern of characters in the each species and every living organisms** and **all the members of species shows maximum resemblance with this pattern".**
  - ❖ The species in which one foxed pattern of characters is present are called as **monotypic** species.
    eg. Bacteria, Blue green algae
  - ❖ In many species, **more than one type** of pattern of characters are present. These are called **"Polytypic species"** or **"Macrospecies".**
    eg. **Brassica oleracea → Cauliflower, Cabbage, Knol-Khol.**

NEET Pattern
Exercise (1)

1. Which one of the following scientist's name is correctly matched with the theory put forth by him?
   (a) Weismann – Theory of continuity of germplasm
   (b) Pasteur – inheritance of acquired characters
   (c) De Vries – Natural selection
   (d) Mendel – Theory of pangenesis

2. Carbohydrates the most abundant biomolecules on earth, are produced by
   (a) all bacteria, fungi and algae
   (b) fungi, algae and green plant cells
   (c) some bacteria, algae and green plant cells
   (d) viruses, fungi and bacteria

3. Age of fossils in the past was generally determined by radio-carbon method and other methods involving radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary periods for different groups of organism, include
   (a) study of carbohydrates/proteins in fossils
   (b) study of the conditions of fossilisation
   (c) Electron Spin Resonance (ESR) and fossil DNA
   (d) study of carbohydrates/proteins in rocks

4. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth?
   (a) Methane
   (b) Oxygen
   (c) Hydrogen
   (d) Water vapour

5. There is no life on moon due to the absence of
   (a) O_2
   (b) water
   (c) light
   (d) temperature

6. First life on earth was
   (a) cyanobacteria
   (b) chemoheterotrophs
   (c) autotrophs
   (d) photoautotrophs

7. If there was no CO_2 in the earth's atmosphere the temperature of earth's surface would be
   (a) higher than the present
   (b) less than the present
   (c) the same
   (d) dependent on the amount of oxygen in the atmosphere

8. The CO_2 content by volume, in the atmospheric air is about
   (a) 0.0314%
   (b) 0.34%
   (c) 3.34%
   (d) 4%

9. Glycogen is a polymer of
   (a) galactose
   (b) glucose
   (c) fructose
   (d) sucrose

10. A nucleotide is formed of
   (a) purine, pyrimidine and phosphate
   (b) purine, sugar and phosphate
   (c) nitrogen base, sugar and phosphate
   (d) pyrimidine, sugar and phosphate

Answer & Solution

Q1 (a)
Pasteur gave the Theory about the Germ Plasm, De Vries give the Theory about Mutation and mendel works on Theory of Inheritance. So the Weismann give the Theory of Continuity of germplasm, according to the germ-plasm theory, inheritance in a multicellular organism only takes place by means of the germ cells: the gametes, such as egg cells and sperm cells. Genetic information cannot pass from soma to germ-plasm and on to the next generation.

Q2 (c)
Some Photosynthetic Bacteria such as Rhodopseudomonas can prepare carbohydrates. but during this type of food synthesis O_2 is not evolved because in this case hydrogen donor is other than H_2O. Algae (blue and green-blue) and all green plant cells prepare their food (carbohydrate) through photosynthesis. Here, hydrogen ions are donated by water molecules by the process of photolysis of water, i.e. O_2 is released during this type of food synthesis.

Q3 (c)
Electron Spin Resonance (ESR) is a technique used to date newly formed materials, which Radiocarbon dating cannot, like carbonates, tooth enamel, or materials that have been previously heated like igneous rock. The age of substance can be determined by measuring the dosage of radiation since the time of its formation. DNA in ices and DNA in hydrated solids give nearly identical results, suggesting that the DNA strands in ices are as closely packed as those in the hydrated solid DNA samples. Our results suggest that previous reports of extensive electron-transfer distances for DNA in icy media are found to be better explained by substantial inter-double-strand electron transfer. this was best method which were used recently for study the evolutionary periods for different groups of organism.

Q4 (b)
According to Oparin, in the primitive Earth's surface, carbon, hydrogen, water vapour, and ammonia reacted to form the first organic compounds. He believed that organic molecules could be formed from abiogenic materials in the presence of an external energy source (e.g., ultraviolet radiation) and that the primitive atmosphere was reducing (having very low amounts of free oxygen) and contained ammonia and water vapour, among other gases. Both also suspected that the first life-forms appeared in the warm, primitive ocean and were heterotrophic (obtaining preformed nutrients from the compounds in existence on early Earth) rather than autotrophic (generating food and nutrients

from sunlight or inorganic materials). So in the primitive environment Oxygen is absent.

Q5 (b)
Water is an essential constituent of cytoplasm of all living organisms it helps in distribution of substances within the organism elimination of waste products, body temperature maintenance etc. It is absent on moon. Anaerobic organisms can live in the absence of O_2. Light and temperature are already known to exist on moon. Lack of liquid water: Life, as we know it, requires liquid water to thrive. The lack of atmosphere means no greenhouse effect and very low pressure. The surface temperature is either extremely cold, or extremely hot- water cannot exist in a liquid state on the lunar surface.

Q6 (b)
Chemoautotrophs does carbon fixation on their own and chemoautotrophs gets the carbon from outside. If you consider the process of evolution, traits evolve over long periods of time and applying the principle of incremental complexity, the complex will follow simpler. Since autotrophs need more time to evolve complex mechanisms to synthesize carbon on their own compared to get it somewhere else, heterotrophs would have evolved first on the earth.

Q7 (b)
CO_2 keeps our earth warm by not letting earth's terrestrial radiation escape into space. It acts like a greenhouse. Remove this layer of insulation, out earth will become really cold. The amount of atmospheric CO_2, or carbon dioxide, is inextricably linked to climate. Average global carbon dioxide levels and average global temperatures go hand in hand, and temperature changes cause changes in precipitation. Concentrations of carbon dioxide in the atmosphere tend to fluctuate in a cyclical pattern over tens of thousands of years, as do worldwide periods of cold including Ice Ages and warmth.

Q8 (a)
Carbon dioxide (CO_2) is the 5^{th} most abundant gas in the atmosphere and, together with water vapor, probably the best known of the greenhouse gases. Carbon dioxide levels in the atmosphere are not constant -- they have risen by nearly 40 percent since the Industrial Revolution, according to climate scientist Todd Sanford. They are small compared to the main atmospheric components of nitrogen and oxygen. Scientists express them as parts per million, or ppm. In March 2014, carbon dioxide levels were at 314 ppm, which is 0.0314 percent of the atmosphere. This roughly corresponds to a mass of 3 trillion tons. After nitrogen, oxygen, water vapor and argon, carbon dioxide is the fifth most abundant gas in the atmosphere.

Q9 (b)
Glycogen is a *readily mobilized storage form of glucose.* It is a very large, branched polymer of glucose residues that can be broken down to yield glucose molecules when energy is needed. Most of the glucose residues in glycogen are linked by α-1, 4-glycosidic bonds. Branches at about every tenth residue are created by α-1, 6-glycosidic bonds. Recall that α-glycosidic linkages form open helical polymers, whereas β linkages produce nearly straight strands that form structural fibrils, as in cellulose.

Q10 (c)
DNA is just a pattern made up of four different nucleotides. Each chain of the double helix is made up of repeating units called nucleotides. Each nucleotide consists of a sugar (deoxyribose) in

the middle of a phosphate group and a nitrogenous base. Nucleotides form a pair in a molecule of DNA where two adjacent bases form hydrogen bonds. The nitrogenous bases of the DNA always pair up in specific way, purine with pyrimidine (A with T, G with C), held together by weak hydrogen bonds. A single nucleotide is composed of three functional groups: a sugar, a triphosphate, and a nitrogenous (nitrogen-containing) base.

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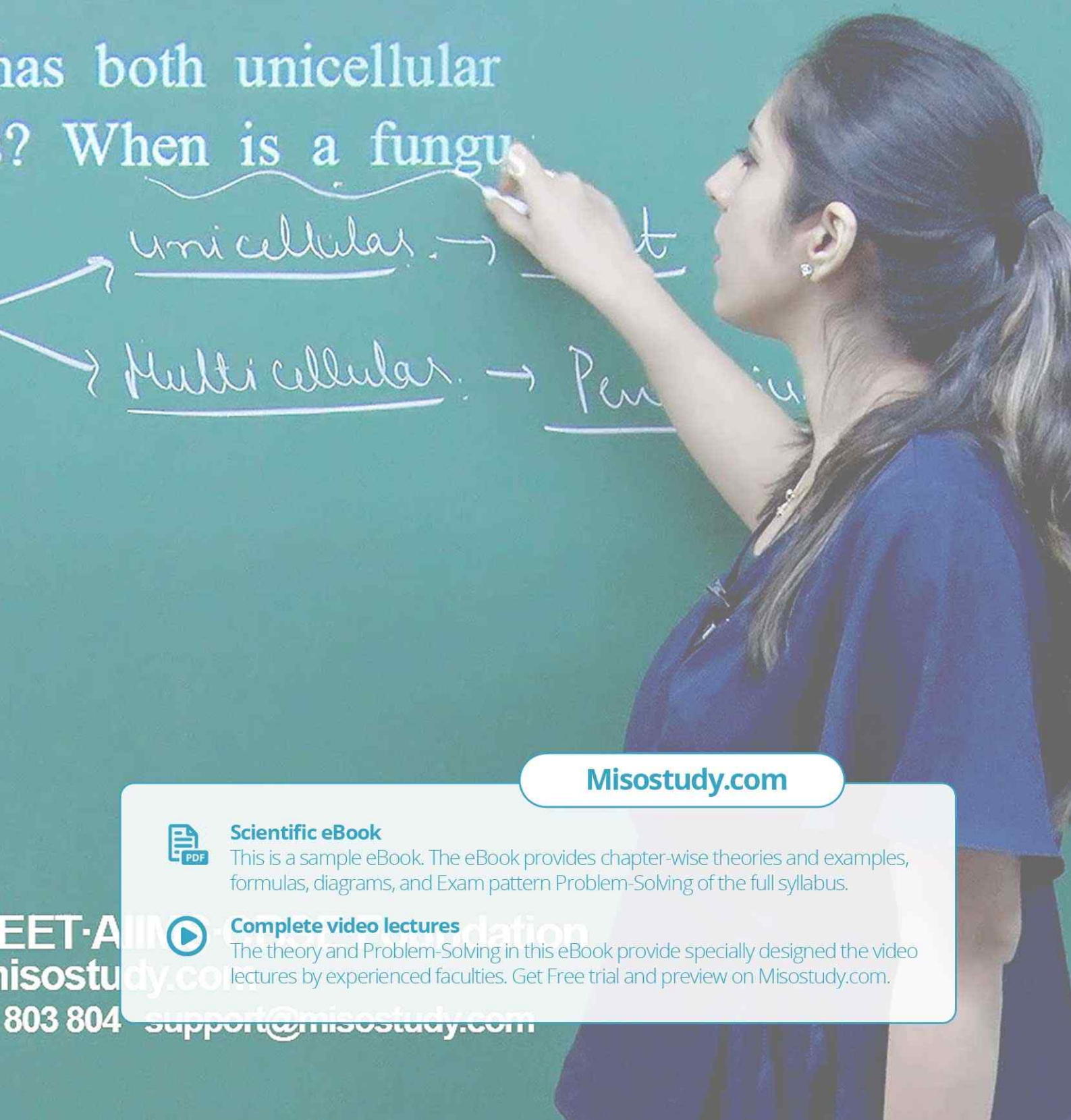
Class 12 | Biology

03 Reproduction in Organisms



01. Introduction

A vast number of plant and animal species have existed on the earth for several thousand of years. The process in living organisms that ensures this continuity is Reproduction. Reproduction is one of the most characteristic feature of living organisms. Life will not exist on the earth if plants and animals do not reproduce to make offsprings.

02. Life span

Life span can be defined as the period from birth to the natural death of an organism. It can vary from as short as few days to as long as a number of years.

Maximum Life Span : Maximum life span is the maximum number of years survived or the greatest age reached by any member of a species. The average life span refers to the average number of years survived or age reached by the members of a population. The maximum life span of a domestic dog is about 20 years and that of a laboratory mouse is 4.5 years. The maximum life span of humans has been estimated to be about 121 years. This rests on the fact that a man in Japan, Shirechiyo lzymi, reached the age of 120 years and 237 days in 1986. He died after developing pneumonia. Average life span and life expectancy of humans have grown dramatically. In general the rate of mortality of humans has gone down and the life span has increased. It is 56 in India whereas in the United State, it is 78.

03. Reproduction

Reproduction is the means of self perpetuation of a race in which new, young, similar looking individuals are formed by the grown up or adult individuals. The adults which give rise to young ones are called parents.

Functions of Reproduction :

(i) It replaces the individuals dying due to senescence or ageing.

(ii) Individuals removed from population due to predation or disease are replaced through reproduction.

(iii) It introduces variations essential for adaptability and struggle for existence.

Basic Features of Reproduction :

(i) Replication of DNA.

(ii) Division of cells. It may or may not involve meiosis.

(iii) Growth due to synthesis of more protoplasm.

(iv) Formation of reproductive units.

(v) Elaboration and development of reproductive units to form new young individuals.

04. Types of Reproduction

Broadly speaking, there are two types of reproduction, asexual and sexual. Asexual reproduction does not involve gamete formation and fusion. It is uniparental. On the other hand, sexual reproduction consists of formation and fusion of gametes of opposite sexes. It is mostly biparental with two types o parents of different sexes but can be single/uniparental also, as in case of bisexual or hermaphrodite animals.

I. Asexual Reproduction

It is the mode of reproduction in which new individuals develop directly from specialised or unspecialised parts of a single parent without involving fusion of gametes or sex cells. 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, Paramoecium, Euglena (acellular protists), Sycon, Hydra, Tubularia, Planaria, Ascidia (metazoans). Asexual reproduction is also called agamogenesis or agamogeny. In this mode of reproduction, somatic cells undergo mitosis during the formation of a new individual. Therefore, it is also called somatogenic reproduction. Young ones resulting from asexual reproduction are exactly identical with the parent except in size and are called clones. Each individual of a clone is referred to as a ramet.

Asexual reproduction occurs by fission, budding and fragmentation.

(A) Fission : It is a mode of asexual reproduction in which the body of a mature individual divides into 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 of an individual into two equal halves, each of which functions as an independent daughter individual. In unicellular organisms, binary fission is accompanied by mitotic division of nucleus followed by cytokinesis. In metazoans. The organisms which undergo binary fission seldom die of senescence or old age because as soon as they mature, they divide into two daughters. They are, therefore, nearly immortal. Depending on the plane of division, binary fission is of the following types:

(i) **Simple Binary Fission (Irregular Binary Fission) :** Division can occur through any plane e.g., Amoeba.

(ii) **Longitudinal Binary Fission :** The plane of fission passes along the longitudinal axis of the organism, e.g., Euglena, Vorticella.

(iii) **Oblique Binary Fission :** The plane of binary fission lies at an angle to the transverse axis e.g., Ceratium, Gonyaulax.

(iv) **Transverse Binary Fission :** The plane of binary fission runs along the transverse axis of the individual, e.g., Paramoecium, diatoms, bacteria. In Paramoecium, transverse binary fission is preceeded by a mitotic division of meganucleus and mitotic division of micronucleus. In it, binary fission produces two dissimilar daughters, one proter (anterior) and the other opisthe (posterior). Both develop the deficient components and become similar.

(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., Amoeba, Plasmodium, Monocystis, etc). In course of time, each of these daughter cells starts a free life and transforms into an adult individual. This kind of fission is called multiple fission.

Cyst formation : In response to unfavourable living conditions, an Amoeba withdrawn its pseudopodia and secretes a three-layered hard covering or cyst around itself. This phenomenon is termed as **encystation.** During favourable conditions, the encysted Amoeba divides by multiple fission and produces many minute amoubae or pseudopodiospores; the cyst wall bursts out and the spores are liberated in the surrounding medium to grow up into many Amoebae. This phenomenon is known as sporulation. Acellular protists like sporozoans (e.g., Monocystis, Plasmodium, etc.) typically exhibit sporulation in their life cycles.

(B) Budding : In budding, new individuals are formed by mitosis. Initially, a small outgrowth of the parent's body develops into a miniature individual. It then separates from the mother to lead a free life (e.g., Hydra). This type of budding is known as exogenous budding. Sometimes, the buds do not get separated from the mother individual and form a colony. For example, in Obelia, the colony consists of a number of individuals jor zooids that perform different functions. In all fresh water sponges (e.g., Spongilla) and some marine sponges (e.g., Sycon), the parent individual releases a specialized mass of cells enclosed in a common opaque envelope, called the gemmule. On germination, each gemmule gives rise to offspring and the archeocytes present in it give rise to various cells of the body of sponge as they are **totipotent**. Gemmules are thought to be **internal buds**.

(C) Fragmentation : The body of the parent breaks into distinct pieces, each of which can produce an offspring (e.g., Hydra, some marine worms, sea-stars).

Advantages of Asexual Reproduction :

(a) It is uniparental.
(b) It is a rapid mode of reproduction.
(c) The young ones are exact replicas of their parent.
(d) Asexual reproduction is simpler than sexual reproduction.

Disadvantages of Asexual Reproduction :

(a) As there is rapid multiplication, a large number of young ones are formed which causes overcrowding.
(b) There is no mixing of genetic material, so no new combination or variation takes place.
(c) There is no crossing over, hence hew linkages are not formed.
(d) It has no role in evolution.
(e) Adaptability to changes in environment is low due to absence of new variations.

05. Sexual Reproduction

Sexual reproduction involves formation and fusion of gametes to form the zygote which develops to form a new organism.

Characteristics :

(a) Two fusing gametes can be produced by same individual or different individuals.
(b) Offsprings produced are not identical to parents.
(c) It involves meiosis and syngamy (fusion or gametes).
(d) It is a slow, elaborate or complex process, so multiplication is not so rapid.

06. Phases in Life Cycle

(a) Juvenile phase
(b) Reproductive phase
(c) Senescent phase

(a) **Juvenile phase/Pre-reproductive phase :** During this phase organism will show growth so that it can attain certain maturity to perform the sexual reproduction. This phase is known as vegetative phase in plants. It is of variable durations in different organisms.
(b) **Reproductive phase :** Reproductive organs develop and mature during this phase. In the higher plants (Angiosperms). end of juvenile phase or onset of reproductive phase is easily marked. In the higher plants during this phase, there is formation of reproductive structures i.e., flowers.
(c) **Senescent phase :** It is a post-reproductive phase. It involves structural and functional deterioration of body by accumulation of waste metabolites which ultimately leads to death.

07. Events in Sexual Reproduction

After attainment of maturity, all sexually reproducing organisms exhibit events and processes that have remarkable fundamental similarity, even though the structures associated with sexual reproduction are indeed very different. These sequential events may be grouped into three distinct stages, namely, the pre-fertilization, fertilization and the post-fertilization events.

A. Pre-fertilization Events

These are events in sexual reproduction which occur prior to the process of fertilization. The two main pre-fertilization events are **gametogenesis** and **gamete transfer.**

(a) Gametogenesis : It refers to the process of formation of gametes – male and female.

Categories of Gametes :

(i) **Isogametes :** When the fusing gametes are morphologically similar they are known as isogametes or homogametes. They are produced in some algae and fungi.

- Algae : Cladophora, Chlamydomonas debaryana, Ulothrix
- Fungi : Synchytrium, Rhizopus

(ii) **Heterogametes :** When the fusing gametes are morphologically distinct types, they are known as heterogametes. It is the feature of majority of sexually reproducing organisms. e.g.

(a) Algae : Fucus, Volvox, Chara

(b) All Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.
In such organisms, male gamete is called antherozoid or sperm and the female gamete is called egg or ovum

Cell Division During Gamete Formation : Gametes are always haploid i.e., they possess only one set of chromosomes or genome though the parent body producing gametes may be either haploid or diploid. As gametes are always haploid so surely in haploid parent, gametes are produced by mitotic division.

In plants belonging to group pteridophytes, gymnosperms and angiosperms and animals the parental body is diploid. Here reductional division occurs before or at the time of gamete formation. The cells which undergo meiosis ar called meiocyte. If meiocyte is indulged in gamete formation, then it is called gamete mother cell.

In haploid organisms, gametes are produced through mitosis but you must not think that meiosis never occurs in life cycle of haploid organisms. This could be made clear from what you have learnt in previous classes. In these organisms like haploid algae and some fungi, meiosis occurs in zygote or zygospore which is called zygotic meiosis.

08. Sexuality in Organisms :

Lower Organisms : In most of the lower sexually reproducing organisms, two fusing gametes are morphologically similar. If these gametes belong to the same parent then such organisms are called homothallic, e.g., fungi (Mucor mucedo). When these gametes belong to different parents then these organisms are called heterothallic.

Higher Organisms : In higher plants there are well-developed sex organs and there is clear distinction between male and female sex organs. Angiosperms possess flowers as reproductive structures. The male sex organ is called stamen and female sex organ is carpel or pistil. If male and female sex organs occur in the same flower then these plants are called bisexual, e.g., China rose. If flowers possess only stamen or carpel then these plants are called unisexual. When male flower (staminate) and female flower (pistillate) are present on same plant body such plants are monoecious, e.g., cucurbits, coconut and maize. However, if they are present on separate plant body then these plants are known as dioecious, e.g., date palm and papaya.

09. Gamete Transfer :

After the formation of male and female gametes, compatible gametes must be physically brought together to facilitate fusion (fertilisation or syngamy). In few fungi and algae, both types of gametes are motile. But in majority of organisms male gamete is motile and the female gamete is non-motile. So there is a need of a medium through which the male gametes move.

In seed plants both male and female gametes are non-motile. Here pollen grains are the carrier of male gametes and ovule has the egg. As the male gamete is non-motile so it cannot swim through water medium to reach female gamete rather pollen tube serve this purpose.

For this pollen grain produced in anther (♂ part) are transferred to the stigma of female organ i.e., carpel through the process of pollination. Pollination is of two type i.e., self pollination and cross pollination. Self pollination is the transfer of the pollen grains from anther of a flower to the stigma of same flower or different flower of the same plant. Cross pollination is transfer of the pollen grain from anther of one flower to the stigma of different flower of other plant.

10. Fertilization

The most vital event of sexual reproduction is the fusion of gametes. This process is called syngamy or fertilization which results in the formation of a diploid zygote.

(a) **External fertilization :** Syngamy occurs outside the body of organism in external medium (water). It is shown by majority of aquatic organisms like most of algae, fishes as well as amphibians.

(b) **Internal fertilization :** Syngamy occurs inside the body of organisms. It is present in majority of plants like bryophytes, pteridophytes, gymnosperms and angiosperms. It occurs in few algae like spirogyra. In all these organisms egg is formed inside the female body where syngamy occurs.

11. Post-Fertilization Events

Events in sexual reproduction after the formation of zygote are called post-fertilization events.

Zygote : It is the first cell of the new generation in all sexually reproducing organisms. Zygote is always diploid. It is formed in the external aquatic medium in those organisms which perform external fertilization. Zygote is produced inside the body in cases where fertilization in internal.

In many algae and fungi, the zygote secretes a thick wall that is resistant to desiccation and damage, which help organisms to tide over unfavourable conditions. During unfavourable conditions it undergoes a period of rest until a swing back to sustainability occurs.

Embryogenesis : Embryogenesis is the process of development of embryo from zygote. Embryo is a multicellular stage in the life cycle of a plant or animal prior to formation of an independent individual.

In embryogenesis, the zygote undergoes repeated cell divisions through mitosis. Cell differentiation occurs at specific locations resulting in production of different tissues, organs and organ systems. Development of different external and internal structures is called morphogenesis. Embryo formation is present in all plant groups, except algae. In flowering plants, zygote develops into embryo. The food for development of embryo comes from a special tissue known as endosperm. Ultimately, the fertilized ovule matures into a seed. Inside the mature seed is the progenitor of the next generation, the embryo. A number of seeds develop in an ovary depending upon the number of ovules. Meanwhile, wall of the ovary also proliferates. It produces pericarp or fruit wall. The pericarp can be dry or fleshy. The ripened ovary with pericarp and seeds is called fruit.

Differences between Asexual and Sexual Reproduction

Asexual Reproduction	Sexual Reproduction
i. New individuals are formed from a single parent.	i. Commonly two parents are involved in the formation of new individuals through sexual reproduction.
ii. Asexual reproduction does not require the production of sex organs.	ii. Formation of sex organs is a pre-requisite for sexual reproduction.
iii. It does not involve meiosis. All divisions are mitotic.	iii. Sexual reproduction involves meiosis at one or the other stage. In higher plants, it occurs at the time of spore formation or sporogenesis.
iv. Asexual reproduction does not involve fusion of cells or gametes.	iv. It involves fusion of gametes.
v. New individual develops from one cell or a part of one parent.	v. New individual develops from zygote i.e., fusion product of two gametes.
vi. New individuals are genetically similar to the parents.	vi. Offspring or new individuals are genetically different from either of the two parents.
vii. It does not introduce variability. Hence, asexual reproduction has no evolutionary importance.	vii. It introduces variability and is, hence of evolutionary importance.
viii. It is quick method of multiplication.	viii. Sexual reproduction is a slower method of multiplication.
ix. It is simple process.	ix. It is elaborate or complex process.

NEET Pattern
Exercise (1)

1. Which one of the following shows isogamy with non-flagellate gametes?
   (a) Sargassum
   (b) Ectocarpus
   (c) Ulothrix
   (d) Spirogyra

2. Select the wrong statement.
   (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 larger and non-motile
   (d) Chlamydomonas exhibits both isogamy and anisogamy and Fucus shows oogamy

3. Product of sexual reproduction generally generates
   (a) longer viability of seeds
   (b) prolonged dormancy
   (c) new genetic combination leading to variation
   (d) large biomass

4. Which one of the following is correctly matched?
   (a) Onion - Bulb
   (b) Ginger - Sucker
   (c) Chlamydomonas - Conidia
   (d) Yeast - Zoospores

5. The 'Eyes' of the potato tuber are
   (a) flower buds
   (b) shoot buds
   (c) axillary buds
   (d) root buds

6. Why is vivipary an undesirable character for annual crop plants?
   (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

7. During regeneration modification of an organ to other organ is known as
   (a) morphogenesis
   (b) cpimorphosis

(c) morphallcixis
(d) acretopmaruy growth

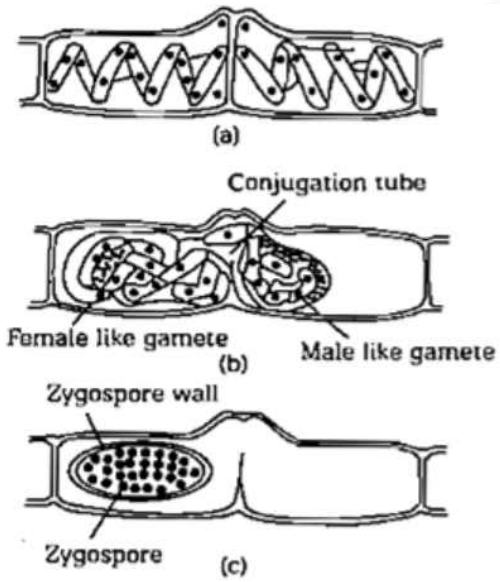
8. The process of series of changes from larva to adult after embryonic development is called
(a) regeneration
(b) metamorphosis
(c) growth
(d) ageing

9. A population of genetically identical individuals, obtained from asexual reproduction is
(a) callus
(b) clone
(c) deme
(d) aggregate

10. New banana plants develop from
(a) rhizome
(b) sucker
(c) stolon
(d) seed

Answer & Solution

1. (d)
Isogamy with non-flagellated of gametes is seen is *Spirogyra* can reproduce both by sexual and asexual (vegetative) means.



They reproduce sexually by conjugation in which two non-flagellated morphologically similar but physiologically different gemetes (isogamous) fuse together. One filament acts as male like gamete and passes through the conjugation tube of another filament which acts as female like gamete.

2. (c)
Oomycetes include water moulds, white rusts and downy mildews. In these female gamete is larger and non-motile, wherease, male gamete is smaller and motile. whereas, male gamete is algae like Uiothrix, Chalmydomonas, Spirogyra etc., which are similar in structure, function and behaviour. Anisogametes are found in Chlamydomonas in which one gamete is larger and non-motile and the other one is motile egg with motile sperm. The gametes, differ both morphologically as well as physiologically It occurs in chalamydomonas, Fucus, Chara, volvox etc.

3. (c)
Sexual reproduction leads to new genetic combination leading to variation in new products. Longer viability of seeds prolonged dormancy and large biomass are not related to sexual reproduction.

4. (a)
The correctly matched pair to onion-bulb. Onion is a simple tunicated layered bulb while ginger is a straggling rhizome having uniparous cyme reproduces by budding and Chlamydomonas by zoospores,

5. (c)
Tuber is oval or spherical swollen underground modified stem lacking adventitious roots. It possesses a number of spirally arranged depression called eyes. Each eye represents node and consists of 1-3 axillary bus in the axils of small scally leaves.

6. (d)
Vivipary is the condition when seeds germinate on the plant, It an undesirable character for annual crop plants because germinated seeds cannot be stored under normal condition for the next season.

7. (b)
Epimorphosis is the replacement of a lost organ of the body by proliferating new cells from the surface of the wound or injured part. Morphogenesis (Gr. morhe = form and genesis = origin) is the growth, shaping and arrangement of body parts according to genetically predefined patterns. The extent direction and rate of morphogenesis depend on genetic controls and environmental factors.

8. (b)
Matamorphosis (meta = change, morphe = form) is a process by which an animal undergoes a comparatively rapid change from larval to adult form Regeneration is regrowth of the part of body which has been removed due to the injury or other causes Growth is an increase in dry mass of an organism. Ageing is progressive deteriortion in activity of cell tissues organs, etc.

9. (b)
Clone refers to the population of genetically identical individuals obtained from asexual reproduction or produced vegetatively from single organism. An individual member of a clone is called ramete.

10. (b)
New banana plants develop through sucker. Sucker is the sub-aerial modification of stem which originates from the basal and underground portion of main stem. It also occurs in mint, Chrysanthemum, etc