

**Class: 11th**

**Subject: Biology**

**Chapter 1: Biodiversity  
and Classification**

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## ❖ Important Mcqs:

**1. The five-kingdom classification system was proposed by:**

- A) Carl Woese
- B) Charles Darwin
- C) Robert Whittaker
- D) Linnaeus

**2. Robert Whittaker proposed the five-kingdom system in:**

- A) 1959
- B) 1969
- C) 1975
- D) 1990

**3. In the five-kingdom system, prokaryotes were placed in:**

- A) Protista
- B) Fungi
- C) Monera
- D) Plantae

**4. The three-domain system was proposed by:**

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A) Robert Whittaker

B) Carl Woese

C) Darwin

D) Mendel

**5. The three domains are:**

A) Monera, Protista, Fungi

B) Archaea, Bacteria, Eukarya

C) Plantae, Animalia, Fungi

D) Protista, Plantae, Animalia

**6. The evolutionary relationship among organisms is called:**

A) Taxonomy

B) Morphology

C) Phylogeny

D) Ecology

**7. A diagram showing evolutionary relationships is called:**

A) Food chain

B) Phylogenetic tree

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C) Pyramid

D) Flow chart

**8. Archaea are:**

A) Eukaryotes

B) Multicellular organisms

C) Prokaryotes

D) Viruses

**9. Archaea reproduce by:**

A) Mitosis

B) Meiosis

C) Binary fission

D) Fertilization

**10. The cell membrane of Archaea contains:**

A) Ester linkage

B) Ether linkage

C) Peptide bond

D) Glycosidic bond

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**11. Bacterial cell walls contain:**

- A) Cellulose
- B) Chitin
- C) Peptidoglycan
- D) Lignin

**12. Archaea cell wall lacks:**

- A) Protein
- B) Peptidoglycan
- C) Polysaccharide
- D) Lipid

**13. Methanogenesis occurs in:**

- A) Bacteria
- B) Eukarya
- C) Archaea
- D) Plants

**14. Halobacteria live in:**

- A) Fresh water

B) Dry soil

C) Salty environments

D) Forest

**15. The true bacteria belong to domain:**

A) Archaea

B) Bacteria

C) Protista

D) Fungi

**16. Bacterial DNA is found in:**

A) Nucleus

B) Nucleoid

C) Ribosome

D) Mitochondria

**17. Small circular DNA in bacteria is called:**

A) Chromosome

B) Plasmid

C) RNA

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D) Histone

**18. Bacteria reproduce mainly by:**

A) Budding

B) Meiosis

C) Binary fission

D) Fragmentation

**19. Spherical bacteria are called:**

A) Bacilli

B) Spirilla

C) Cocci

D) Vibrios

**20. Rod-shaped bacteria are called:**

A) Bacilli

B) Cocci

C) Spirilla

D) Diplococci

**21. Comma-shaped bacteria are known as:**

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A) Spirilla

B) Vibrios

C) Cocci

D) Bacilli

**22. Hair-like structures used for attachment in bacteria are:**

A) Flagella

B) Pili

C) Ribosomes

D) Capsules

**23. Movement in bacteria is due to:**

A) Pili

B) Capsule

C) Flagella

D) Nucleus

**24. Organisms with true nucleus belong to domain:**

A) Bacteria

B) Archaea

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C) Eukarya

D) Monera

**25. Eukaryotic DNA is:**

A) Circular

B) Single

C) Linear

D) Free in cytoplasm

**26. Sexual reproduction in eukaryotes involves:**

A) Binary fission

B) Meiosis

C) Budding

D) Fragmentation

**27. The theory explaining origin of mitochondria is:**

A) Cell theory

B) Endosymbiosis

C) Germ theory

D) Mutation theory

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**28. Cyanobacteria belong to domain:**

- A) Archaea
- B) Bacteria
- C) Eukarya
- D) Protista

**29. Mycobacterium tuberculosis belongs to group:**

- A) Firmicutes
- B) Actinobacteria
- C) Cyanobacteria
- D) Spirochaetes

**30. Archaea are more closely related to:**

- A) Bacteria
- B) Viruses
- C) Eukarya
- D) Fungi

**31. The highest level of biological classification is:**

- A) Kingdom

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B) Phylum

C) Domain

D) Class

**32. The term "taxa" refers to:**

A) Species only

B) Levels of classification

C) Animals only

D) Plants only

**33. How many domains are currently recognized?**

A) Two

B) Three

C) Four

D) Five

**34. Kingdom is ranked just below:**

A) Phylum

B) Domain

C) Class

D) Order

**35. In domain Eukarya, which of the following is a kingdom?**

A) Monera

B) Animalia

C) Archaea

D) Bacteria

**36. Organisms in the same phylum share similar:**

A) Color

B) Habitat

C) Basic body plan

D) Size

**37. The phylum Chordata is characterized by the presence of:**

A) Hair

B) Notochord

C) Wings

D) Fins

**38. The class Mammalia is included in the phylum:**

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A) Arthropoda

B) Mollusca

C) Chordata

D) Annelida

**39. Humans belong to the order:**

A) Carnivora

B) Primates

C) Rodentia

D) Chiroptera

**40. The most specific level of classification is:**

A) Genus

B) Family

C) Species

D) Order

**41. Domain Eukarya includes organisms with:**

A) Prokaryotic cells

B) No nucleus

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C) Eukaryotic cells

D) No organelles

**42. Domain Eukarya consists of how many kingdoms?**

A) Two

B) Three

C) Four

D) Five

**43. Kingdom Protista includes organisms that are mostly:**

A) Prokaryotic

B) Multicellular only

C) Unicellular

D) Without nucleus

**44. Simple multicellular protists lack:**

A) Cell wall

B) Nucleus

C) Multicellular sex organs

D) Chlorophyll

**45. Protozoa are:**

- A) Plant-like protists
- B) Animal-like protists
- C) Fungi-like protists
- D) Bacteria

**46. Protozoa are mostly:**

- A) Autotrophic
- B) Heterotrophic
- C) Photosynthetic
- D) Saprophytic

**47. Paramecium and Amoeba belong to kingdom:**

- A) Fungi
- B) Protista
- C) Plantae
- D) Animalia

**48. Algae are considered:**

- A) Animal-like protists

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B) Fungi-like protists

C) Plant-like protists

D) Bacteria

**49. The cell wall of algae is made of:**

A) Chitin

B) Peptidoglycan

C) Cellulose

**50. Myxomycota and Oomycota are:**

A) Animal-like protists

B) Plant-like protists

C) Fungi-like protists

D) Bacteria

**51. The cell wall of fungi is made of:**

A) Cellulose

B) Chitin

C) Peptidoglycan

D) Lignin

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**52. Fungi obtain food by:**

- A) Photosynthesis
- B) Ingestion
- C) Absorption
- D) Hunting

**53. Rhizopus belongs to group:**

- A) Ascomycota
- B) Basidiomycota
- C) Zygomycota
- D) Bryophyta

**54. Fungi with septate hyphae are included in:**

- A) Zygomycota
- B) Ascomycota
- C) Both B and C
- D) None

**55. Mushrooms belong to group:**

- A) Zygomycota

B) Ascomycota

C) Basidiomycota

D) Bryophyta

**56. Plants are:**

A) Heterotrophic

B) Autotrophic

C) Saprophytic

D) Parasitic

**57. The cell wall of plants is composed of:**

A) Chitin

B) Cellulose

C) Peptidoglycan

D) Lipid

**58. Non-vascular plants are called:**

A) Gymnosperms

B) Angiosperms

C) Bryophytes

D) Ferns

**59. Seed-producing vascular plants with naked seeds are:**

A) Angiosperms

B) Bryophytes

C) Gymnosperms

D) Mosses

**60. Animals are characterized by:**

A) Photosynthesis

B) Cellulose cell wall

C) Ingestion of food

D) Chitin cell wall

**61. Phylum Porifera includes:**

A) Flatworms

B) Sponges

C) Jellyfish

D) Roundworms

**62. The numerous small pores in sponges are called:**

- 
- A) Osculum
  - B) Ostia
  - C) Spongocoel
  - D) Tentacles

**63. The large opening in sponge body is called:**

- A) Ostium
- B) Mesohyle
- C) Osculum
- D) Collar cell

**64. Sponges lack:**

- A) Skeleton
- B) Nervous system
- C) Pores
- D) Collar cells

**65. The skeleton of sponges is made of:**

- A) Chitin
- B) Cellulose

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C) Calcium carbonate or silica

D) Keratin

**66. Cnidarians possess special stinging cells called:**

A) Choanocytes

B) Pinacocytes

C) Cnidocytes

D) Flame cells

**67. Cnidarians are:**

A) Bilaterally symmetrical

B) Radially symmetrical

C) Asymmetrical

D) Segmented

**68. The digestive system of cnidarians is:**

A) Complete

B) Tube-like

C) Sac-like

D) Absent

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**69. The free-swimming form of cnidarians is called:**

- A) Polyp
- B) Medusa
- C) Larva
- D) Planula

**70. Flatworms are scientifically called:**

- A) Nematoda
- B) Porifera
- C) Platyhelminthes
- D) Cnidaria

**71. Platyhelminthes are:**

- A) Coelomates
- B) Pseudocoelomates
- C) Acoelomates
- D) Segmented

**72. Excretory organs of flatworms are:**

- A) Nephridia

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B) Flame cells

C) Malpighian tubules

D) Kidneys

**73. Roundworms belong to phylum:**

A) Platyhelminthes

B) Nematoda

C) Cnidaria

D) Annelida

**74. Nematodes are called pseudocoelomates because they have:**

A) True body cavity

B) No body cavity

C) False body cavity

D) Segmented body

**75. Nematodes have a digestive system with:**

A) No opening

B) Single opening

C) Two openings

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D) Three openings

**76. Molluscs have:**

A) Segmented body

B) Soft unsegmented body

C) Jointed legs

D) Radial symmetry

**77. The body of mollusc is divided into:**

A) Head, thorax, abdomen

B) Head, visceral mass, foot

C) Cephalothorax and abdomen

D) Trunk only

**78. The calcareous shell in molluscs is secreted by:**

A) Foot

B) Radula

C) Mantle

D) Nephridia

**79. The rasping organ in molluscs is called:**

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A) Radula

B) Tentacle

C) Setae

D) Spiracle

**80. Molluscs (except cephalopods) have:**

A) Closed circulatory system

B) Open circulatory system

C) No heart

D) Double circulation

**81. Excretory organs of molluscs are:**

A) Flame cells

B) Malpighian tubules

C) Nephridia

D) Metanephridia

**82. Annelids are commonly known as:**

A) Flatworms

B) Roundworms

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C) Segmented worms

D) Spiny worms

**83. Segmentation in annelids is called:**

A) Tagmata

B) Metamerism

C) Fusion

D) Molting

**84. Setae in annelids are made of:**

A) Calcium

B) Protein

C) Chitin

**85. Annelids possess which type of circulatory system?**

A) Open

B) Closed

C) Absent

D) Mixed

**86. Excretory organs of annelids are:**

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A) Nephridia

B) Flame cells

C) Spiracles

D) Renette cells

**87. Arthropods have:**

A) Soft body

B) Jointed appendages

C) Radial symmetry

D) No exoskeleton

**88. The exoskeleton of arthropods is made of:**

A) Cellulose

B) Chitin

C) Silica

D) Calcium carbonate

**89. Shedding of exoskeleton in arthropods is called:**

A) Regeneration

B) Ecdysis

C) Metamerism

D) Budding

**90. Excretory organs of arthropods are:**

A) Nephridia

B) Flame cells

C) Malpighian tubules

D) Kidneys

**91. Blood of arthropods is called:**

A) Plasma

B) Lymph

C) Haemolymph

**92. Echinoderms are exclusively:**

A) Freshwater

B) Terrestrial

C) Marine

D) Parasitic

**93. Adult echinoderms show:**

- 
- A) Bilateral symmetry
  - B) Radial symmetry
  - C) Asymmetry
  - D) Segmentation

**94. The sieve-like plate in echinoderms is called:**

- A) Ossicle
- B) Madreporite
- C) Spiracle
- D) Radula

**95. The locomotory structures in echinoderms are:**

- A) Setae
- B) Tentacles
- C) Tube feet
- D) Jointed legs

**96. Chordates are:**

- A) Protostome coelomates
- B) Acoelomates

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C) Deuterostome coelomates

D) Pseudocoelomates

**97. The rod-like supporting structure present in chordates during embryonic life is called:**

A) Vertebral column

B) Notochord

C) Nerve cord

D) Endoskeleton

**98. In chordates, the tubular nerve cord is located:**

A) Ventral to gut

B) Lateral to heart

C) Dorsal to notochord

D) Inside coelom

**99. In Urochordata, the notochord is present:**

A) Throughout life

B) Only in adult stage

C) Only in larval stage

D) Never present

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**100. Amphioxus belongs to subphylum:**

- A) Urochordata
- B) Vertebrata
- C) Cephalochordata
- D) Hemichordata

**101. Members of Class Pisces are exclusively:**

- A) Terrestrial
- B) Aquatic
- C) Arboreal
- D) Amphibious

**102. The skeleton of sharks and rays is:**

- A) Bony
- B) Cartilaginous
- C) Mixed
- D) Absent

**103. In bony fishes, gills are usually covered by:**

- A) Scales

B) Operculum

C) Skin

D) Fins

**104. Heart of fishes is:**

A) Three-chambered

B) Four-chambered

C) Two-chambered

D) Five-chambered

**105. Circulation in fishes is:**

A) Double

B) Single

C) Complete

D) None

**106. Amphibians respire by:**

A) Only gills

B) Only lungs

C) Lungs and skin in adults, gills in larvae

D) Trachea only

**107. Skin of amphibians is:**

A) Scaly

B) Rough

C) Smooth and moist

D) Dry and leathery

**108. Heart of amphibians has:**

A) Two chambers

B) Three chambers

C) Four chambers

D) One chamber

**109. Amphibians are:**

A) Endothermic

B) Ectothermic

C) Homeothermic

D) Viviparous only

**110. Reptiles are the first vertebrates to possess:**

- A) Gills
- B) Amniotic eggs
- C) Mammary glands
- D) Feathers

**111. The skin of reptiles is:**

- A) Smooth
- B) Scaly and dry
- C) Moist
- D) Feathered

**112. Circulation in reptiles is:**

- A) Single
- B) Double, incompletely separated ventricle
- C) Complete four-chambered
- D) Open

**113. Reptiles are:**

- A) Homeothermic
- B) Poikilothermic

C) Endothermic

D) Warm-blooded

**114. Fertilization in reptiles is:**

A) External

B) Internal

C) Both

D) None

**115. Birds are:**

A) Ectothermic

B) Endothermic

C) Poikilothermic

D) Cold-blooded

**116. Birds' bones are:**

A) Heavy and solid

B) Light with air spaces

C) Cartilaginous

D) Incomplete

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**117. The forelimbs of birds are modified into:**

- A) Legs
- B) Wings
- C) Fins
- D) Claws

**118. Birds have a specialized organ for voice called:**

- A) Larynx
- B) Syrinx
- C) Trachea
- D) Pharynx

**119. Heart of birds is:**

- A) Two-chambered
- B) Three-chambered
- C) Four-chambered
- D) Single

**120. Birds' eggs are:**

- A) Viviparous

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B) Oviparous

C) Internal development

D) Without shell

**121. Mammals are unique because they have:**

A) Feathers

B) Hair and mammary glands

C) Scales

D) Gills

**122. Mammals' heart is:**

A) Two-chambered

B) Three-chambered

C) Four-chambered

D) Incomplete

**123. Mammals are:**

A) Ectothermic

B) Endothermic

C) Poikilothermic

D) Cold-blooded

**124. Monotremes are:**

A) Viviparous mammals

B) Egg-laying mammals

C) Marsupials

D) Placental mammals

**125. Marsupials:**

A) Lay eggs

B) Give birth to immature young that develop in pouch

C) Are fully developed at birth

D) Are aquatic mammals

**126. Placental mammals:**

A) Lay eggs

B) Give birth to fully developed young

C) Lack mammary glands

D) Are monotremes

**127. Example of monotreme:**

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A) Kangaroo

B) Duckbill platypus

C) Dolphin

D) Human

**128. Example of marsupial:**

A) Elephant

B) Kangaroo

C) Bat

D) Rat

**129. Example of placental mammal:**

A) Opossum

B) Echidna

C) Human

D) Platypus

**130. Birds that cannot fly are called:**

A) Pigeons

B) Running birds

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C) Flying birds

D) Raptors

**131. Viruses are not considered living organisms because they are:**

A) Multicellular

B) Acellular

C) Eukaryotic

D) Prokaryotic

**132. The genetic material of a virus can be:**

A) DNA only

B) RNA only

C) DNA or RNA

D) Protein only

**133. Viruses depend on \_\_\_\_\_ to replicate and synthesize proteins.**

A) Sunlight

B) Host cell

C) Water

D) Air

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**134. Virus that infects bacteria is called:**

- A) Plant virus
- B) Animal virus
- C) Bacteriophage
- D) Archaea virus

**135. Which of the following is an example of a plant virus?**

- A) Influenza virus
- B) Tobacco mosaic virus
- C) Rabies virus
- D) HIV

**136. Viruses with a capsid in a helical structure are called:**

- A) Icosahedral viruses
- B) Helical viruses
- C) Complex viruses
- D) Enveloped viruses

**137. Adenoviruses belong to which type of viral morphology?**

- A) Helical

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B) Icosahedral

C) Enveloped

D) Complex

**138. Viruses that have an outer lipid envelope derived from the host are:**

A) Non-enveloped viruses

B) Helical viruses

C) Enveloped viruses

D) Complex viruses

**139. Poliovirus is classified as:**

A) DNA virus

B) Enveloped virus

C) Non-enveloped virus

D) Reverse-transcribing virus

**140. Retroviruses like HIV replicate through:**

A) Positive-sense RNA

B) Negative-sense RNA

C) DNA intermediate using reverse transcriptase

D) dsRNA

**141. Biodiversity refers to:**

A) Only the number of species

B) Variety of life forms including species, genes, and ecosystems

C) Only genetic variation

D) Only ecosystem types

**142. At the species level, biodiversity assessment includes:**

A) Number of ecosystems

B) Species richness and distribution

C) Genetic variations

D) Soil types

**143. Genetic diversity is important because it:**

A) Helps in flight of birds

B) Ensures adaptability and survival of species

C) Determines the climate

D) Reduces biodiversity

**144. Ecosystem-level biodiversity assessment includes:**

- 
- A) Counting only animals
  - B) Range of habitats and their ecological functions
  - C) Only plants
  - D) Only microbes

**145. Random sampling is used in biodiversity studies to:**

- A) Reduce bias
- B) Increase bias
- C) Destroy ecosystems
- D) Count only rare species

**146. One advantage of random sampling is that it:**

- A) Provides unreliable estimates
- B) Provides reliable estimates of species richness and abundance
- C) Only works for aquatic species
- D) Prevents reproduction of organisms

**147. Quadrat sampling is particularly useful for studying:**

- A) Mobile animals
- B) Sessile organisms and plants

C) Birds in flight

D) Large mammals

**148. Transect sampling involves:**

A) Counting individuals from a single point

B) Laying a line and recording species at intervals

C) Using drones only

D) Capturing and releasing animals

**149. Aerial surveys are used to:**

A) Observe soil microbes

B) Record distribution of organisms over large areas

C) Count insects only

D) Sample water quality

**150. Point counts are commonly used for:**

A) Plants

B) Birds and other mobile animals

C) Fish only

D) Soil bacteria

**151. Mark-recapture method helps to:**

- A) Estimate population size and density
- B) Identify plant species
- C) Measure genetic variation
- D) Assess ecosystem productivity

**152. Capture-recapture methods account for:**

- A) Only plant distribution
- B) Varying capture probabilities and movement between areas
- C) Air temperature
- D) Soil type

**153. Remote sensing in biodiversity studies uses:**

- A) Satellite or drone imagery
- B) Only microscopes
- C) Hand counters
- D) Soil samples

**154. Biodiversity assessment at the ecosystem level helps to:**

- A) Study only one species

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B) Understand how ecosystems function and contribute to ecological health

C) Remove species from habitats

D) Replace natural habitats

**155. Random sampling enhances representativeness because it:**

A) Covers only the edges of the study area

B) Ensures sample represents the diversity of the entire area

C) Focuses on rare species only

D) Ignores abundant species

**156. The term "biodiversity" is derived from:**

A) Biological division

B) Biological diversity

C) Bio-degradation

D) Bio-energy

**157. Quadrat counts estimate:**

A) Only distribution

B) Number of individuals of a species within sampled quadrats

C) Only soil type

D) Only genetic variation

**158. Species diversity includes:**

A) Number of species only

B) Number, relative abundance, and distribution of species

C) Only genetic diversity

D) Only ecosystem variety

**159. Biodiversity is important for:**

A) Stability of ecosystems

B) Reducing species interactions

C) Increasing pollution

D) Eliminating habitats

**160. Random sampling supports conservation efforts because it:**

A) Provides biased data

B) Helps identify areas of high conservation value

C) Destroys rare species

D) Measures only genetic diversity

**161. A species is defined as a group of individuals that:**

- 
- A) Live in the same habitat only
  - B) Can interbreed and produce fertile offspring
  - C) Have similar size only
  - D) Are genetically identical

**162. Members of the same species share:**

- A) Common characteristics and genetic makeup
- B) Only habitat
- C) Only diet
- D) Only color patterns

**163. Cryptic species are:**

- A) Genetically identical species
- B) Morphologically similar but genetically distinct species
- C) Species that cannot reproduce
- D) Fossil species only

**164. The key criterion for species identification suggested by Ernst Mayr is:**

- A) Morphological similarity
- B) Reproductive isolation

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C) Geographical location

D) Diet

**165. Members of different species:**

A) Can always produce fertile offspring

B) Typically do not mate or produce fertile offspring

C) Share all genetic traits

D) Live in the same environment only

**166. Speciation is:**

A) The process of extinction

B) The evolutionary process by which new species arise

C) Only hybrid formation

D) Genetic mutation only

**167. Speciation involves:**

A) Accumulation of genetic changes and reproductive isolation

B) Only geographical separation

C) Only environmental changes

D) Immediate extinction

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**168. Allopatric speciation occurs due to:**

- A) Polyploidy
- B) Geographical separation
- C) Niche differentiation
- D) Adjacent populations

**169. An example of allopatric speciation is:**

- A) Anthoxanthum odoratum adaptation
- B) Darwin's finches on Galápagos Islands
- C) Polyploid plants
- D) Bacterial mutation

**170. Peripatric speciation involves:**

- A) A large population
- B) A small isolated population at the edge of a larger population
- C) Adjacent populations
- D) Sympatric populations

**171. Peripatric speciation often occurs in:**

- A) Continental forests

B) Islands

C) Deserts only

D) Arctic regions only

**172. Parapatric speciation occurs when populations are:**

A) Geographically separated

B) Adjacent but occupy different environments along a gradient

C) In the same exact niche

D) Polyploid

**173. An example of parapatric speciation is:**

A) Darwin's finches

B) *Anthoxanthum odoratum* with soil adaptations

C) Polyploid wheat

D) Human populations

**174. Sympatric speciation occurs:**

A) In different continents

B) Within the same geographical area without physical barriers

C) Only in aquatic species

D) Only in mammals

**175. A common mechanism of sympatric speciation in plants is:**

A) Gene flow

B) Polyploidy

C) Allopatry

D) Migration

**176. Niche differentiation in sympatric speciation refers to:**

A) Different populations exploiting different resources

B) Populations migrating

C) Geographical separation

D) Only mutations

**177. Polyploidy results in:**

A) Immediate reproductive isolation

B) Geographical separation

C) Loss of genetic variation

D) Only morphological changes

**178. Sympatric speciation can occur in:**

- A) Animals only
- B) Plants and animals
- C) Microbes only
- D) Fossils only

**179. Ernst Mayr defined species based on:**

- A) Morphology
- B) Reproductive compatibility
- C) Diet
- D) Habitat

**180. The main factor driving speciation is:**

- A) Random mating
- B) Accumulation of genetic changes and reproductive isolation
- C) Climate only
- D) Size of organisms



# Exercise

**1. Which domain of life is characterized by organisms that often inhabit extreme environments and have cell membranes with ether-linked lipids?**

(a) Bacteria

(b) Archaea

(c) Eukarya

(d) Protista

**2. What is a key difference between the domains Bacteria and Archaea?**

(a) Bacteria have membrane-bound organelles, while Archaea do not.

(b) Bacterial cell walls have peptidoglycan, while Archaeal cell walls do not have it.

(c) Archaea are only found in extreme environments, while Bacteria are not.

(d) Bacteria are all unicellular, while Archaea include multicellular organisms.

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**3. Which of the following kingdoms includes organisms that are mostly unicellular, eukaryotic, and can be autotrophic or heterotrophic?**

- (a) Fungi
- (b) Animalia
- (c) Plantae
- (d) Protocista

**4. In which kingdom are organisms predominantly multicellular, autotrophic, and have cell walls made of cellulose?**

- (a) Animalia
- (b) Fungi
- (c) Plantae
- (d) Protocista

**5. Which of the following criteria is commonly used to classify viruses?**

- (a) Their ability to cause specific diseases
- (b) The type of nucleic acid they contain
- (c) The colour of the virus particles
- (d) Their mode of transmission

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**6. Which virus group includes viruses such as Coronaviruses and influenza viruses?**

- (a) Double-stranded DNA viruses
- (b) Single-stranded DNA viruses
- (c) Double-stranded RNA viruses
- (d) Single-stranded RNA viruses

**7. At which level of biodiversity assessment do we evaluate the variety of different species within a particular habitat or ecosystem?**

- (a) Genetic diversity
- (b) Ecosystem diversity
- (c) Species diversity
- (d) Functional diversity

**8. Which method is best suited for assessing the distribution of species across a gradient of environmental conditions within a single geographical area?**

- (a) Quadrat Sampling
- (b) Point Counts
- (c) Transect Sampling
- (d) Remote Sensing

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**9. Which of the following statements is true regarding the concept of a species?**

- (a) A species is always defined by its physical characteristics alone.
- (b) Different species can interbreed and produce fertile offspring.
- (c) Members of the same species are reproductively isolated from members of other species. ✓
- (d) The concept of a species can be defined solely based on genetic similarity.

**10. What type of speciation occurs when populations are geographically separated by a physical barrier?**

- (a) Sympatric Speciation
- (b) Parapatric Speciation
- (c) Allopatric Speciation ✓
- (d) Peripatric Speciation

## **SECTION 2: SHORT QUESTIONS**

**1. What are the three domains of life and how do they differ in terms of cellular structure?**

**Answer:**

The three domains of life are Bacteria, Archaea, and Eukarya.

**Bacteria** are prokaryotic organisms. They do not have a true nucleus or membrane-bound organelles. Their cell wall contains peptidoglycan.

**Archaea** are also prokaryotic and lack a true nucleus, but their cell wall does not contain peptidoglycan. Their cell membranes have unique ether-linked lipids.

**Eukarya** includes organisms with eukaryotic cells. These cells have a true nucleus and membrane-bound organelles such as mitochondria and endoplasmic reticulum. Examples include plants, animals, fungi, and protists.

## **2. Describe one key feature that differentiates Archaea from Bacteria.**

**Answer:**

One important difference is the composition of the cell wall.

**Bacteria** have peptidoglycan in their cell walls, whereas **Archaea** lack peptidoglycan and have a different chemical composition.

**Additionally, Archaea** have ether-linked lipids in their cell membranes, which help them survive in extreme environments.

## **3. How do sponges reproduce asexually?**

**Answer:**

Sponges reproduce asexually mainly by budding. In budding, a small outgrowth develops on the body of the parent sponge. This bud grows and eventually detaches to form a new sponge.

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They can also reproduce by fragmentation, where a broken piece of the sponge develops into a new individual, and by gemmule formation, especially in unfavorable conditions.

#### 4. Differentiate the following:

**Answer:**

##### (i) Sac-like and Tube-like Digestive System

###### **Sac-like Digestive System:**

- It has only one opening which serves as both mouth and anus. Food enters and waste leaves through the same opening. It is less efficient.

###### **Tube-like Digestive System:**

- It has two separate openings: a mouth and an anus. Food moves in one direction, making digestion more efficient.

##### (ii) Polyps and Medusae

###### **Polyps:**

- They have a cylindrical body shape. The mouth faces upward. They are usually sessile (attached to a surface). **Example:** Hydra.

###### **Medusae:**

- They have an umbrella-shaped body. The mouth faces downward. They are free-swimming. **Example:** Jellyfish.

### **(iii) Urochordata and Cephalochordata**

#### **Urochordata:**

- The notochord is present only in the larval stage and is found in the tail region. In adults, it disappears.

#### **Cephalochordata:**

- The notochord extends from head to tail and remains present throughout life.

### **(iv) Ectotherms and Endotherms**

#### **Ectotherms:**

- They depend on external heat sources to regulate their body temperature. Their body temperature changes with the environment. **Example:** Reptiles.

#### **Endotherms:**

- They produce heat internally through metabolic processes and maintain a constant body temperature. Example: Birds and mammals.

### **(v) Marsupial and Placental Mammals**

#### **Marsupial Mammals:**

- They give birth to immature young which complete their development in a pouch (marsupium). Example: Kangaroo.

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**Placental Mammals:**

- The embryo develops inside the uterus and is nourished through a placenta. Young are born well developed. Example: Human.

**(vi) Gymnosperms and Angiosperms****Gymnosperms:**

- They produce naked seeds that are not enclosed in a fruit. They do not produce true flowers. **Example:** Pine.

**Angiosperms:**

- They produce seeds enclosed within a fruit and have flowers. **Example:** Mango, Wheat.

**5. Which kingdom is characterized by organisms with chitin in their cell walls and that are mostly decomposers?****Answer:**

- The **kingdom Fungi** is characterized by organisms that have chitin in their cell walls.
- **Chitin** is a **strong** structural material that provides support and protection.
- **Most fungi are decomposers**, meaning they break down dead plants and animals into simpler substances. This process recycles nutrients back into the environment and maintains ecological balance.

**Examples** of fungi include mushrooms, molds, and yeast.

## 6. What type of speciation occurs when populations are geographically separated?

### Answer:

The type of speciation that occurs due to geographic separation is called Allopatric Speciation.

**In this process**, a physical barrier such as mountains, rivers, or oceans separates a population into two groups.

**Because the groups cannot interbreed**, they gradually develop genetic differences over time. Eventually, they become separate species.

## 7. What is the role of genetic drift in the process of speciation?

### Answer:

- Genetic drift is the random change in allele frequencies in a population.
- It has a strong effect in small or isolated populations.
- **Due to chance events**, certain genes may become more common, while others may disappear. Over time, these genetic changes can make the population significantly different from the original group.

If the differences become large enough to prevent interbreeding, a new species may form.

## 8. What is the primary method used to assess species distribution along an environmental gradient?

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**Answer:**

The primary method used is Transect Sampling.

**In this method**, a straight line (transect) is placed across a habitat. Scientists record the types and numbers of species at regular intervals along this line.

**This helps in studying** how species distribution changes according to environmental factors like temperature, light, moisture, or altitude.

**9. Which level of biodiversity assessment involves evaluating the variety of ecosystems in a region?**

**Answer:**

The level of **biodiversity** that evaluates the variety of ecosystems in a region is called Ecosystem Diversity.

It measures the different habitats and **ecological systems** present in an area, such as forests, deserts, wetlands, and oceans.

Greater **ecosystem** diversity usually supports a greater number of species.

## **SECTION 3: LONG QUESTIONS**

★ Q1: Compare and contrast the domains Archaea and Bacteria and discuss how these differences reflect their evolutionary histories.

❖ Introduction

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Archaea and Bacteria are the two domains of prokaryotic organisms, meaning they do not have a nucleus or membrane-bound organelles.

At first glance, they may appear similar because both are unicellular and reproduce asexually.

However, detailed studies of their genetics, biochemistry, and habitats show that they are very different and evolved along separate paths.

### Similarities Between Archaea and Bacteria

- Both are unicellular organisms.
- **Both are prokaryotic**, having no true nucleus.
- Both reproduce by binary fission, a simple asexual process.
- **Both have circular DNA**, rather than linear chromosomes like Eukarya.
- **Both lack membrane-bound organelles**, such as mitochondria or endoplasmic reticulum.

These similarities indicate that Archaea and Bacteria share a common ancestral prokaryote in the early history of life.

### ◆ Differences Between Archaea and Bacteria

#### Cell Wall Composition

- **Bacteria**: Cell walls contain peptidoglycan, a molecule that provides structural support.
- **Archaea**: Cell walls do not have peptidoglycan; instead, they have pseudopeptidoglycan or other unique substances.

#### Cell Membrane Structure

- 
- **Bacteria:** Membranes contain ester-linked lipids.
  - **Archaea:** Membranes contain ether-linked lipids, which are more stable and allow them to survive extreme environments like high temperature, high salinity, or acidity.

### Habitat

- **Bacteria:** Found everywhere, including soil, water, and inside living organisms.
- **Archaea:** Many are extremophiles, living in hot springs, salt lakes, deep-sea vents, or acidic environments.

### Genetic Machinery

- **Bacteria:** Simple RNA polymerase and ribosomes.
- **Archaea:** RNA polymerase and ribosomes are more similar to Eukarya, showing a molecular link to eukaryotic cells.

### Evolutionary Relationship

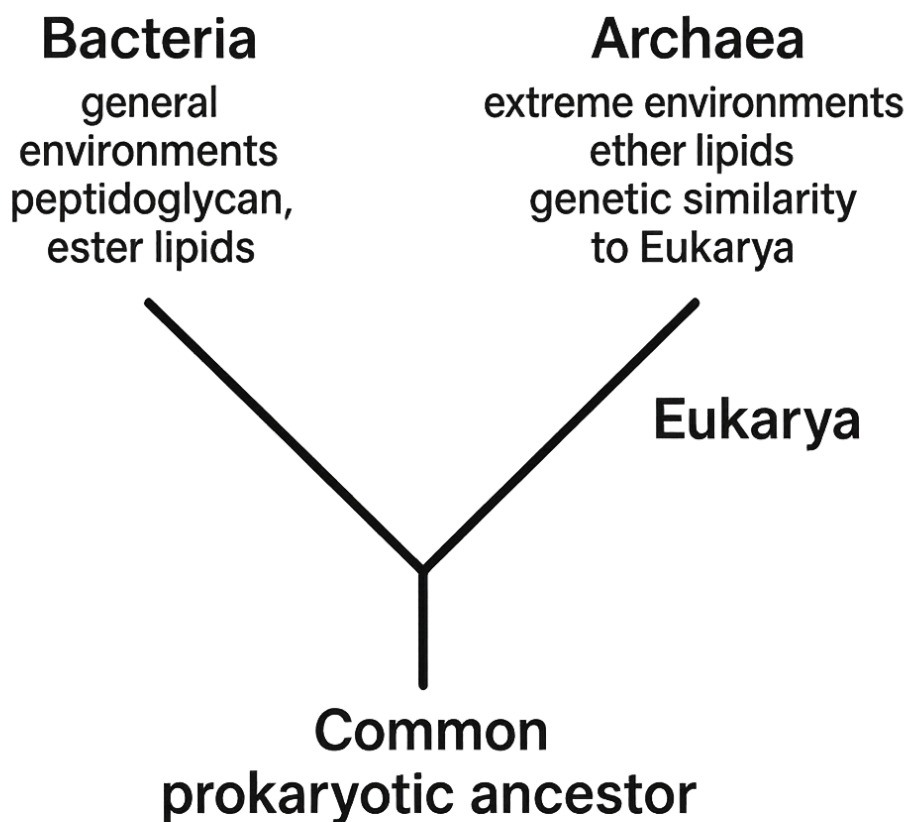
- **Bacteria:** Form a separate early prokaryotic lineage.
- **Archaea:** Closer to Eukarya than to Bacteria, indicating that Eukaryotes may have evolved from an archaeal ancestor.

### Evolutionary Significance

- Both Archaea and Bacteria diverged from a common ancestral prokaryote very early in life's history.
- Archaea evolved unique adaptations, such as ether-linked membranes and specialized enzymes, to survive harsh environments.

- The genetic and biochemical similarity of Archaea with Eukarya shows that Archaea are more closely related to Eukaryotes, while Bacteria followed a separate evolutionary path.

**Diagram:**



◆ **Summary**

- **Similarities:** unicellular, prokaryotic, binary fission, circular DNA, no organelles.
- **Differences:** cell wall composition, membrane lipids, habitats, genetic machinery, evolutionary relationships.

Archaea and Bacteria are two separate domains, with Archaea showing a closer evolutionary link to Eukarya.

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☀ **Q2: Explain the concept of a species according to the biological species concept. How does this definition help in understanding species boundaries and the process of speciation? Provide examples to illustrate your points.**

❖ **Answer:**

The biological species concept (BSC) defines a species as a group of organisms that can naturally interbreed and produce fertile offspring, and are reproductively isolated from other such groups. Unlike definitions based only on appearance, this concept emphasizes reproductive compatibility as the key criterion for identifying species.

This definition helps in understanding species boundaries because it distinguishes populations that cannot exchange genes. Organisms that cannot mate successfully or produce fertile offspring belong to different species, even if they look similar.

### **Examples of species boundaries:**

- **Horse** (*Equus ferus caballus*) and **Donkey** (*Equus africanus asinus*): They produce mules when crossed, but mules are sterile, indicating they are separate species.
- **Eastern and Western Meadowlarks** (*Sturnella magna* and *Sturnella neglecta*): They are visually similar but do not interbreed due to differences in mating songs.
- **The BSC also explains speciation**, the process by which new species form. When populations become reproductively isolated—through geographic barriers, behavioral changes, or genetic divergence—they accumulate differences over generations, eventually forming distinct species.

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## Example of speciation:

**Darwin's finches in the Galápagos Islands:** Different populations adapted to unique ecological niches on separate islands. Over time, reproductive isolation led to multiple distinct species.

### Key Points:

- Focus on fertile interbreeding and reproductive isolation.
- Helps define clear species boundaries.
- Explains the formation of new species.
- Mainly applicable to sexual organisms; less useful for asexual organisms or fossils.

☀ **Q3: Describe the major groups of Kingdom Protista and Kingdom Fungi.**

❖ **Answer:**

### ◆ **Kingdom Protista**

Kingdom Protista includes mostly unicellular or simple multicellular eukaryotic organisms. They are diverse in structure, nutrition, and habitat. Protists are usually aquatic or live in moist environments.

**The major groups of Protista are:**

#### 1. Protozoa (Animal-like Protists):

- **Characteristics:** Unicellular, heterotrophic, move using cilia, flagella, or pseudopodia.

- 
- **Examples:** Amoeba (moves by pseudopodia), Paramecium (moves by cilia), Euglena (can photosynthesize but also heterotrophic).

## 2. Algae (Plant-like Protists):

- **Characteristics:** Mostly autotrophic, contain chlorophyll, may be unicellular or multicellular.
- **Examples:** Chlamydomonas (unicellular green algae), Spirogyra (filamentous green algae), Kelps (large multicellular brown algae).

## 3. Slime Molds and Water Molds (Fungus-like Protists):

- **Characteristics:** Heterotrophic, absorb nutrients from decaying matter, often live in moist soil or water.
- **Examples:** Physarum (slime mold), Saprolegnia (water mold).

**Key Points:** Protists show characteristics of animals, plants, or fungi, making them a diverse and transitional group.

## ◆ Kingdom Fungi

Kingdom Fungi consists of eukaryotic, mostly multicellular organisms (except yeast which is unicellular). They are heterotrophic, obtain nutrients by absorption, and have cell walls made of chitin. Fungi are important decomposers in ecosystems.

### The major groups of Fungi are:

#### 1. Zygomycota (Zygomycetes):

- **Characteristics:** Mostly saprophytic, reproduce sexually by zygospores and asexually by sporangiospores.

- 
- **Examples:** Rhizopus (bread mold).

## 2. Ascomycota (Sac Fungi):

- **Characteristics:** Form sexual spores called ascospores in sac-like structures (ascus); asexual reproduction by conidia.
- **Examples:** Saccharomyces cerevisiae (yeast), Penicillium (used in antibiotics).

## 3. Basidiomycota (Club Fungi):

- **Characteristics:** Produce sexual spores called basidiospores on club-shaped structures (basidia); includes mushrooms and puffballs.
- **Examples:** Agaricus (edible mushroom), Puccinia (rust fungi).

## 4. Chytridiomycota (Chytrids):

- **Characteristics:** Mostly aquatic, produce motile spores with flagella; considered primitive fungi.
- **Examples:** Batrachochytrium dendrobatidis (causes amphibian disease).

**Key Points:** Fungi are decomposers, can be unicellular or multicellular, reproduce sexually and asexually, and play an important role in nutrient cycling.

★ **Q4: Describe the general characteristics of the following animal phyla:**

(i) Phylum Cnidaria

(ii) Phylum Platyhelminthes

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(iii) Phylum Mollusca

(iv) Phylum Arthropoda

(v) Phylum Echinodermata

❖ **Answer:**

### **(i) Phylum Cnidaria**

Phylum Cnidaria includes aquatic animals, mostly marine, that show radial symmetry, meaning their body parts are arranged around a central axis. They are diploblastic, having two germ layers: ectoderm and endoderm, with a gelatinous mesoglea in between. Their digestive system is incomplete, with only a mouth and no anus.

Cnidarians have specialized stinging cells called cnidocytes that contain nematocysts used for prey capture and defense. They exhibit two main body forms:

- **Polyp** – sessile, like Hydra.
- **Medusa** – free-swimming, like Jellyfish.

**They lack a brain**, but have a nerve net for simple responses to stimuli. Reproduction can be sexual or asexual.

**Examples:** Hydra, Obelia, Jellyfish, Coral.

### **(ii) Phylum Platyhelminthes**

Platyhelminthes are flatworms with bilateral symmetry, meaning they have a distinct head and tail region. They are triploblastic, with three

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germ layers: ectoderm, mesoderm, and endoderm, and are acoelomate, meaning they lack a body cavity.

Their digestive system is usually incomplete, with only one opening; some parasitic forms, like tapeworms, lack a digestive system entirely. Their nervous system is simple, with ladder-like nerve cords and a small concentration of nerve cells forming a primitive brain.

Flatworms move using muscular contractions and cilia. Many are parasitic, such as *Taenia* (tapeworm), while some, like *Planaria*, are free-living.

**Examples:** *Planaria*, *Taenia* (tapeworm).

### **(iii) Phylum Mollusca**

Mollusks are soft-bodied animals with bilateral symmetry and a coelomate body, meaning they have a true body cavity. They are triploblastic and have a complete digestive system with a mouth and anus.

**They have a muscular foot for locomotion**, a visceral mass containing organs, and a mantle that secretes the calcareous shell in many species. The nervous system varies from simple to highly developed, as in octopuses.

Most mollusks are marine, but some are freshwater or terrestrial. Reproduction is generally sexual.

**Examples:** Snail, Clam, Octopus, Squid.

### **(iv) Phylum Arthropoda**

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Arthropods are the largest and most diverse phylum. They have bilateral symmetry, a triploblastic coelomate body, and a complete digestive system. Their body is segmented, with jointed appendages for locomotion, feeding, and sensory functions.

They have an exoskeleton made of chitin that provides protection and support but must be molted for growth. Arthropods have a well-developed brain and ventral nerve cord. Circulation is open, and they breathe through gills, tracheae, or book lungs.

**Examples:**

- **Insects:** Grasshopper, Butterfly
- **Arachnids:** Spider, Scorpion
- **Crustaceans:** Crab, Lobster

**(v) Phylum Echinodermata**

Echinoderms are exclusively marine animals. Adults show radial symmetry, while larvae have bilateral symmetry, which indicates evolutionary transition. They are triploblastic coelomates with a complete digestive system.

Echinoderms have a water vascular system with tube feet used for locomotion, feeding, and gas exchange. They lack a brain, but a nerve ring around the central disc coordinates movements. Their endoskeleton is made of calcareous plates, and many can regenerate lost body parts.

**Examples:** Starfish, Sea urchin, Sea cucumber.

**Key Points Across Phyla:**

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**Cnidaria:** Radial symmetry, stinging cells, polyp and medusa forms.

**Platyhelminthes:** Flat, acoelomate, some parasitic.

**Mollusca:** Soft-bodied, coelomate, muscular foot, shell.

**Arthropoda:** Segmented, exoskeleton, jointed appendages.

**Echinodermata:** Marine, radial symmetry in adults, water vascular system.

Diagram Concept:

A simple flow diagram showing each phylum with body symmetry, digestive system, locomotion, and examples can help students quickly revise these characteristics.

🌟 **Q5: Describe the general characteristics of Phylum Cnidaria.**

❖ **Answer:**

Phylum Cnidaria includes mostly marine animals, although some, like Hydra, live in freshwater. Many cnidarians are colonial, such as Obelia, corals, and sea fans, while others are solitary. Most are sessile (attached to a surface), like Hydra and corals, but some, like jellyfish, are motile and swim freely.

Corals are colonial cnidarians that produce a hard exoskeleton made of calcium carbonate, which contributes to the formation of coral islands and coral reefs.

**Body Structure and Symmetry**

Cnidarians are radially symmetrical and diploblastic, meaning their body is made up of two tissue layers:

- **Epidermis** – outer layer derived from ectoderm
- **Gastrodermis** – inner layer derived from endoderm

Between these layers lies a jelly-like mesoglea containing amoeboid cells, which may originate from either tissue layer.

### **Specialized Cells**

Cnidarians possess cnidocytes, specialized stinging cells that contain nematocysts. These structures are used for prey capture and defense.

### **Digestive System**

They have a sac-like digestive system with a gastrovascular cavity (also called enteron) that has only one opening. The mouth acts both as the entry point for food and the exit for undigested material. Surrounding the mouth are tentacles that help capture prey.

### **Nervous System**

Cnidarians do not have a brain or spinal cord. Instead, their nervous system consists of a network of neurons in the body wall, allowing simple responses to stimuli.

### **Respiration, Excretion, and Circulation**

They lack specialized respiratory, excretory, and circulatory systems, relying on diffusion for gas exchange and waste removal.

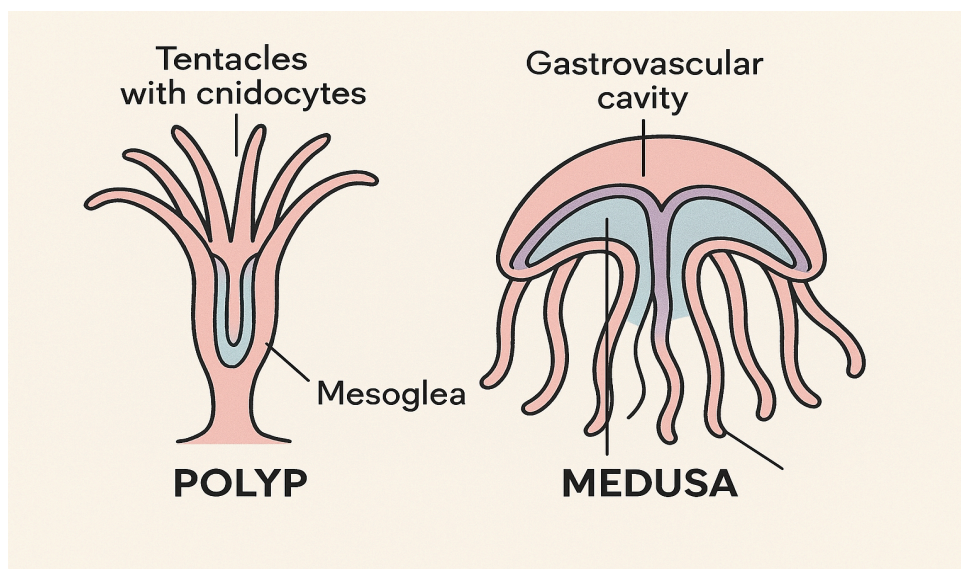
## Body Forms and Reproduction

Cnidarians exhibit two main body forms:

**1. Polyp:** Cylindrical, attached at the aboral end, and reproduces asexually (e.g., Hydra, Obelia).

**2. Medusa:** Umbrella-shaped, free-swimming, and reproduces sexually (e.g., jellyfish).

**Diagram:**



**Key Points:**

- Mostly marine, some freshwater
- Radial symmetry, diploblastic
- Cnidocytes with nematocysts for defense and feeding
- Sac-like digestive system
- Two body forms: polyp (asexual) and medusa (sexual)
- No brain, respiration, excretion, or circulation system

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★ Q6: Write detailed notes on the three groups of mammals.

❖ Answer:

Mammals are warm-blooded vertebrates that have hair or fur on their bodies, mammary glands for feeding their young, and a well-developed brain and sensory organs. They are triploblastic coelomates with complex circulatory, excretory, respiratory, and digestive systems. Mammals are classified into three major groups based on their reproductive strategies:

### 1. Monotremes (Egg-laying mammals)

- Monotremes are the most primitive group of mammals.
- They lay eggs instead of giving birth to live young.
- **Milk secretion:** They have mammary glands but lack nipples; milk is released through openings on the skin.
- **Body covering:** Hair or fur is present.
- **Circulation:** Warm-blooded.

**Examples:**

- **Platypus** – lays eggs in burrows, semi-aquatic
- **Echidna** – spiny anteater, lays eggs, found in Australia

**Key Feature:** Egg-laying and primitive reproductive method.

### 2. Marsupials (Pouched mammals)

Marsupials give birth to underdeveloped young, which continue developing in a pouch (marsupium) on the mother's body.

- 
- **Young attachment:** The newborn attaches to nipples inside the pouch for feeding and growth.
  - **Habitat:** Mostly found in Australia and nearby regions.
  - **Body covering:** Hair; warm-blooded.

**Examples:**

- **Kangaroo** – newborn crawls into the pouch after birth
- **Koala** – carries young in the pouch while feeding on leaves

**Key Feature:** Pouch for carrying and nurturing immature young.

### 3. Placental Mammals (Eutherians or True mammals)

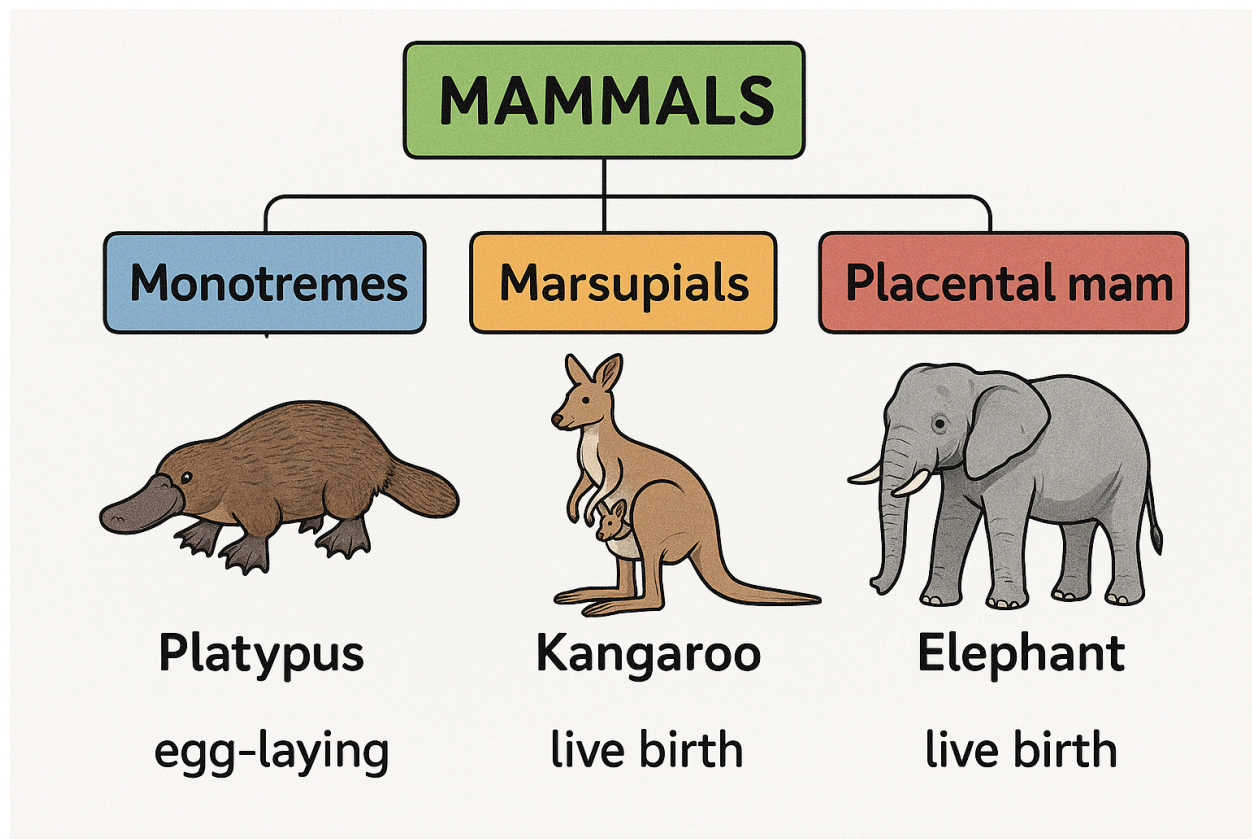
- Placental mammals give birth to fully developed young.
- **Placenta:** A specialized organ that allows the exchange of nutrients, oxygen, and waste between mother and embryo.
- **Gestation:** Long gestation period inside the uterus ensures development of the young.
- **Body covering:** Hair or fur; warm-blooded.
- **Brain and senses:** Highly developed brain and sense organs, allowing complex behaviors.

**Examples:**

- Lion, Elephant, Whale, Human

**Key Feature:** Young develop fully inside the mother's womb with placenta support.

**Diagram:**



◆ **Summary:**

- Mammals are vertebrates with hair, mammary glands, and warm-blooded metabolism.

**Divided into three groups based on reproduction:**

- **Monotremes** – egg-laying
- **Marsupials** – pouched, give birth to immature young
- **Placental mammals** – live-bearing, fully developed young

Classification highlights the evolutionary advancement in reproductive strategies from egg-laying to live-bearing with placenta.

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☀ **Q7: Discuss the mechanisms of allopatric and sympatric speciation.**

❖ **Introduction:**

Speciation is the process by which new species arise from existing ones. It occurs when populations become reproductively isolated, preventing gene flow between them. Two important mechanisms of speciation are allopatric speciation and sympatric speciation.

### **Allopatric Speciation**

Allopatric speciation occurs when a population is geographically separated by a physical barrier such as mountains, rivers, or oceans. The separated populations experience different environmental conditions and evolve independently. Over time, genetic differences accumulate, and even if the barrier is removed, the populations can no longer interbreed, forming new species.

**Example:**

- **Darwin's finches on the Galápagos Islands** – Different populations of finches became isolated on separate islands and evolved into distinct species with different beak shapes adapted to specific food sources.
- **Squirrels in the Grand Canyon** – Populations separated by the canyon evolved into distinct species over time.

### **Sympatric Speciation**

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Sympatric speciation occurs when new species evolve within the same geographical area, without a physical barrier. This can happen due to ecological, behavioral, or genetic factors that reduce gene flow between subpopulations. Mechanisms include:

**1. Polyploidy:** Organisms, especially plants, acquire extra sets of chromosomes, causing instant reproductive isolation.

**2. Behavioral isolation:** Differences in mating behavior prevent interbreeding.

**3. Niche differentiation:** Subpopulations exploit different resources within the same habitat, reducing interaction and gene flow.

**Example:**

- **Apple maggot flies** – Some flies shifted from laying eggs on hawthorn trees to apples, creating reproductive isolation even though they live in the same area.
- Certain **plants** develop polyploidy and cannot interbreed with the original population, forming a new species.

◆ **Summary:**

- Allopatric speciation occurs due to geographical separation, leading to independent evolution and new species.
- Sympatric speciation occurs within the same area due to genetic, behavioral, or ecological differences.
- Both mechanisms increase biodiversity and explain how species adapt to their environments over time.

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☀ **Q8: Outline the major classification systems for viruses based on their structural features and replication methods. Discuss the significance of these classifications in virology.**

❖ **Introduction:**

Viruses are acellular infectious agents that depend on host cells to replicate. Because they are not considered living organisms, they are classified differently from plants, animals, or bacteria. Virus classification is based on structural features, genetic material, replication strategy, and the type of host they infect. These classifications help scientists understand virus biology, predict disease outcomes, and develop treatments and vaccines.

### **Classification Based on Structural Features**

#### **1. Capsid Shape (Morphology):**

- **Helical viruses:** Capsid is cylindrical or rod-shaped. **Example:** Tobacco mosaic virus, Rabies virus.
- **Icosahedral viruses:** Capsid forms a symmetrical 20-sided shape. **Example:** Adenoviruses, Herpesviruses.
- **Complex viruses:** Capsid has a combination of icosahedral and helical features, sometimes with tails. **Example:** Bacteriophages.

#### **2. Envelope Presence:**

- **Enveloped viruses:** Have a lipid layer around the capsid. **Example:** Influenza virus, HIV.
- **Non-enveloped (naked) viruses:** Lack an outer lipid layer. **Example:** Poliovirus, Adenovirus.

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## Classification Based on Genetic Material

### 1. DNA Viruses:

- Contain DNA as genetic material, which can be single-stranded (ssDNA) or double-stranded (dsDNA).
- **Example:** Herpesvirus (dsDNA), Parvovirus (ssDNA).

### 2. RNA Viruses:

- Contain RNA as genetic material, either single-stranded (ssRNA) or double-stranded (dsRNA).
- **Example:** Coronavirus (ssRNA), Rotavirus (dsRNA).

## Classification Based on Replication Strategy

**1. Positive-sense RNA viruses:** RNA genome can be directly translated into proteins. Example: Poliovirus, Hepatitis C virus.

**2. Negative-sense RNA viruses:** RNA genome must be transcribed into mRNA before translation. Example: Rabies virus, Ebola virus.

**3. Reverse-transcribing viruses:** Replicate through a DNA intermediate using reverse transcriptase. Example: RNA genome – Retroviruses (HIV), DNA genome – Hepadnaviruses (Hepatitis B virus).

## Significance of Virus Classification

- **Helps understand virus biology**, including structure, replication, and host interactions.
- **Aids in diagnosis and treatment** by linking virus type with disease patterns.

- 
- **Guides vaccine development**, as viruses with similar structures may require similar strategies.
  - **Assists in epidemiology**, helping predict outbreaks and transmission pathways.

◆ **Summary:**

Viruses are classified based on structure, envelope presence, genetic material, and replication strategy. This classification allows scientists to study viral diversity, predict disease mechanisms, and develop effective treatments and vaccines.

✨ **Q9: Explain the different levels at which biodiversity can be assessed. How do these levels contribute to our understanding of biological diversity and conservation efforts?**

❖ **Introduction:**

Biodiversity refers to the variety of life forms on Earth, including the diversity of species, genes, and ecosystems. Assessing biodiversity is essential to understand the richness, distribution, and health of ecosystems, and to implement effective conservation strategies. Biodiversity can be assessed at three main levels: species, genetic, and ecosystem diversity.

## 1. Species Level

**Definition:** Species diversity measures the variety and abundance of different species within a given area.

**Importance:** It helps identify which species are common, rare, or endangered in a habitat.

**Example:** Counting the number of bird species in a wetland or plant species in a forest plot.

## 2. Genetic Level

**Definition:** Genetic diversity refers to the variety of genes within a species.

**Importance:** High genetic diversity allows species to adapt to environmental changes, resist diseases, and maintain healthy populations.

**Example:** Different breeds of rice or variations in DNA among tiger populations in different reserves.

## 3. Ecosystem Level

**Definition:** Ecosystem diversity measures the variety of habitats, communities, and ecological processes in a region.

**Importance:** Understanding ecosystem diversity helps in maintaining ecosystem services like clean water, pollination, and climate regulation.

**Example:** Forests, wetlands, grasslands, deserts, and coral reefs each represent distinct ecosystems.

### Contribution to Conservation

- Assessing biodiversity at all three levels allows scientists to identify areas of high conservation value.

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- Helps track changes in populations, genes, or habitats over time, providing early warnings of environmental stress or species decline.
  - Guides the management of protected areas, breeding programs, and restoration projects.

◆ **Summary:**

Biodiversity can be assessed at the species, genetic, and ecosystem levels. Each level provides valuable insights into the complexity and resilience of life on Earth. Together, these assessments support effective conservation strategies, ensuring the survival of species and the health of ecosystems for future generations.

★ **Q10: Discuss the importance of random sampling methods in ecological studies.**

❖ **Introduction:**

In ecological studies, it is often impossible to count or study every organism in a habitat due to large area size or the mobility of organisms. Random sampling methods allow ecologists to study a representative portion of the population or area, making data collection practical, reliable, and statistically meaningful.

◆ **Importance of Random Sampling**

**1. Reduces Bias:**

Random sampling ensures that every part of the study area has an equal chance of being sampled, preventing over- or under-representation of certain regions. This provides a more accurate picture of the population or ecosystem.

## **2. Provides Reliable Estimates:**

By sampling randomly, scientists can estimate species richness, abundance, and distribution of organisms, which can then be extrapolated to the whole area.

## **3. Facilitates Comparisons:**

Standardized random sampling allows comparisons between different areas or habitats, helping ecologists identify patterns in biodiversity and environmental health.

## **4. Enhances Representativeness:**

Covering multiple random points in a study area ensures that the sample represents the overall diversity rather than a localized portion.

## **5. Supports Conservation Efforts:**

Reliable data from random sampling help identify endangered species, monitor population trends, and plan protected areas effectively.

## **Examples of Random Sampling Methods**

- **Quadrat Sampling:** Dividing an area into squares (quadrats) and counting organisms in randomly selected quadrats. Commonly used for plants and sessile organisms.

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- **Transect Sampling:** Recording organisms along a randomly placed line to study distribution across gradients.
  - **Point Counts:** Observing and recording mobile animals, such as birds, from randomly chosen points.
  - **Mark-Recapture Method:** Marking individuals and recapturing them later to estimate population size.

◆ **Summary:**

Random sampling is essential in ecology because it ensures accuracy, reliability, and representativeness in studies of species distribution, abundance, and diversity. It enables ecologists to monitor ecosystems, make informed conservation decisions, and understand environmental changes effectively.

✨ **Q11: Describe the concept of an ecosystem and a niche.**

### **Concept of an Ecosystem**

An ecosystem is a functional unit of nature where living organisms (biotic components) interact with each other and with non-living factors (abiotic components) such as sunlight, water, soil, and temperature. Ecosystems can be natural, like forests, wetlands, and coral reefs, or artificial, like fish ponds or gardens. The interactions within an ecosystem involve energy flow and nutrient cycling, where organisms depend on each other for food, shelter, and survival.

**Example:**

A pond ecosystem includes plants like algae, animals like fish and insects, microorganisms, and abiotic factors like water, sunlight, and dissolved oxygen.

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## Concept of a Niche

A niche is the role or position of an organism in an ecosystem, including how it obtains food, interacts with other species, reproduces, and responds to environmental conditions. A niche is often called the “job” or “profession” of the organism in its habitat. Unlike a habitat, which is the physical place where an organism lives, a niche includes the functional interactions and activities of the organism.

### Example:

In a forest ecosystem, a woodpecker has the niche of feeding on insects inside tree bark, creating nesting holes, and controlling insect populations.

### ◆ Summary:

- An ecosystem is a community of organisms interacting with their abiotic environment, forming a functional unit.
- A niche is the specific role or function of an organism in its ecosystem, including its interactions, food habits, and contributions.
- Understanding both concepts is essential to study biodiversity, ecological interactions, and conservation strategies.

### Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

**Author: Muhammad Asghar**

**Purpose:** To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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