CLASS 9 SCIENCE

CHAPTER 12

PATTERNS IN LIFE: DIVERSITY AND CLASSIFICATION

NCERT QUESTIONS & ANSWERS

Chapter coverage: Biodiversity and biodiversity hotspots; evolution of biodiversity; criteria for classification; need for classification; historical classification systems; Whittaker's five kingdoms; Monera, Protista, Fungi, Plantae and Animalia; plant groups; animal groups; adaptations; classification hierarchy; binomial nomenclature; three-domain system; fossils; biodiversity threats.

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CHAPTER-END QUESTIONS & ANSWERS

Revise • Reflect • Refine — Chapter 12

1. Meena and Hari observed an animal in their garden. Hari called it an insect while Meena said it was an earthworm. Choose the correct option which confirms that it is an insect: (i) Bilateral symmetrical body (ii) Body with jointed legs (iii) Cylindrical body (iv) Body with little segmentation.

Answer: (ii) Body with jointed legs.
Jointed appendages are a defining feature of **Arthropoda**, the group that includes insects. An earthworm belongs to Annelida and has a segmented cylindrical body but does not have jointed legs.

2. Sponges represent one of the simplest animal body plans. Their bodies lack true tissues and organs. Which feature of sponge cells supports its classification under the animal kingdom? (i) Absence of mitochondria (ii) Ability to photosynthesise (iii) Presence of a cell membrane (iv) Presence of a cell wall.

Answer: (iii) Presence of a cell membrane.
Sponges are animals and are made of eukaryotic cells. The presence of a cell membrane is a characteristic of animal cells, while a rigid cell wall is not a feature of animal cells. Sponges are multicellular even though their cells are not organised into true tissues and organs.

3. Observe two different animals in your immediate environment. What features help you distinguish between them? How do these features help place them into different groups?

Answer: Animals can be distinguished using observable and structural features such as **body shape and organisation, presence or absence of segmentation, type of skeleton, appendages, symmetry, habitat and body covering**. Internal features such as tissues, organs, body cavity and the presence or absence of a notochord are also useful. These characteristics help scientists place organisms into groups because organisms with shared features are classified together and those with significant differences are placed in different groups.

4. How would a scientist justify choosing cellular organisation as a more fundamental characteristic for the basis of classification rather than the presence of xylem and phloem?

Answer: Cellular organisation is a much broader and more fundamental characteristic because it can be applied to **all living organisms**. Scientists can distinguish organisms as prokaryotic or eukaryotic and as unicellular or multicellular, and can examine cell-wall features and other cellular characteristics. Xylem and phloem, however, are specialised transport tissues found in certain plants and cannot be used to classify organisms such as bacteria, protists, fungi or animals. Therefore, cellular organisation provides a more universal basis for classification.

Exam Tip: Remember the strongest classification clues: **cell type**, **number of cells**, **cell wall**, **mode of nutrition**, **level of organisation**, and **ecological role**.

5. You find an unlabelled slide of a single-celled organism that has a well-defined nucleus and multiple cilia. Which group would it most likely belong to? Give reasons.

Answer: Kingdom Protista.
The organism is **single-celled** and has a **well-defined, membrane-bound nucleus**, so it is a unicellular eukaryote. Protista includes unicellular eukaryotic organisms such as **Paramecium**, which uses numerous cilia for movement. These features support its placement in Protista.

6. How does the diversity of organisms contribute to the balance and stability of an ecosystem?

Answer: Different organisms perform different ecological roles. Plants and other producers capture energy and prepare food; animals act as consumers and participate in pollination and seed dispersal; fungi and bacteria decompose dead matter and recycle nutrients. Biodiversity therefore creates interconnected food webs and nutrient cycles. A diverse ecosystem can also be more resilient because the loss or decline of one organism may be partly balanced by other organisms performing related ecological functions.

7. If all unicellular organisms were grouped into a single kingdom, what problems would arise?

Answer: Unicellular organisms are not all alike. Some are **prokaryotic**, such as bacteria and cyanobacteria, while others are **eukaryotic**, such as Amoeba, Paramecium and Euglena. They also differ in nutrition, cell-wall structure, ecological roles and genetic characteristics. Putting all unicellular organisms into one kingdom would hide these important differences and make it harder to understand their relationships, evolution and ecological roles. This is one reason classification systems changed as scientific knowledge improved.

8. Viruses were studied in earlier classes. Why are they not placed in any of the five kingdoms? Give reasons.

Answer: Viruses are **acellular**; they do not have cellular organisation. They contain genetic material but cannot carry out the complete set of life processes independently and depend on host cells for reproduction. Since the five-kingdom system is based on characteristics of cellular organisms, viruses do not fit naturally into any of its five kingdoms.

Exam Tip: Remember the strongest classification clues: **cell type**, **number of cells**, **cell wall**, **mode of nutrition**, **level of organisation**, and **ecological role**.

9. If you were asked to revise the five kingdom classification, would you create a separate category for viruses or keep them outside the system? Justify your answer and explain what this indicates about the evolving nature of scientific classification.

Answer: I would keep viruses **outside the five-kingdom classification** rather than treating them as a conventional kingdom, because they lack cellular organisation and depend on host cells for replication. However, they can be studied as a distinct group of acellular biological entities. This also shows that scientific classification is **not fixed forever**. As new evidence, tools and genetic information become available, scientists refine classification systems to represent living diversity more accurately.

10. Viruses contain genetic material like living organisms but lack cellular organisation. Which features prevent them from fitting into the five kingdom system? What does this tell us about the limitations of classification systems?

Answer: Viruses lack **cellular organisation**, do not have the typical structures of cells and depend on a host cell for reproduction. The five kingdoms classify cellular organisms using features such as cell type, level of organisation, cell wall and mode of nutrition. Because viruses do not satisfy these cellular criteria, they do not fit into the system. This shows that classification systems are useful models based on available evidence, but no single system necessarily captures every biological entity perfectly.

11. Both pteridophytes and bryophytes lack flowers and seeds, yet they are placed in different groups. Explain this classification using their key features.

Answer: Bryophytes have a less differentiated plant body, lack true roots, stems and leaves, and do not have vascular tissues. They usually live in moist and shady places and require water for reproduction, so they are called the 'amphibians' of the plant kingdom.
Pteridophytes have true roots, stems and leaves and possess specialised vascular tissues—**xylem and phloem**—for transporting water and food. They still require water for reproduction and do not produce seeds. Thus, their body organisation and transport system clearly distinguish them.

12. In the classification hierarchy, which group — class or genus — has fewer members but more features in common? Explain your answer.

Answer: Genus.
The hierarchy becomes progressively more specific from **Kingdom** → **Phylum** → **Class** → **Order** → **Family** → **Genus** → **Species**. A genus contains fewer organisms than a class, and its members share more common characteristics. At the species level, organisms are even more closely related. Thus, **genus** has fewer members and more features in common than class.

Exam Tip: Remember the strongest classification clues: **cell type**, **number of cells**, **cell wall**, **mode of nutrition**, **level of organisation**, and **ecological role**.

13. A scientist discovers a new organism with the characteristic features of locomotion and autotrophic nutrition. Which character(s) would help the scientist identify the organism belonging to Protista according to the five kingdom classification?

Answer: The scientist should first determine whether the organism is **unicellular and eukaryotic**. Protista includes unicellular eukaryotes, and some protists are autotrophic while others are heterotrophic. Locomotion alone is not sufficient for placement. If the organism is a unicellular eukaryote and shows autotrophic nutrition, it could fit Protista; an organism such as **Euglena** illustrates this combination of characteristics.

14. A researcher identified a unicellular eukaryotic organism as fungi. What identification key would you suggest according to the five kingdom classification to keep a unicellular organism in the Kingdom Fungi?

Answer: The organism should be checked for the key features of fungi: it should be a **eukaryote**, obtain food **heterotrophically by absorption**, and have a **cell wall made of chitin**. The chapter specifically states that **yeast is unicellular** and is placed in Fungi because its cell wall is made of chitin. Therefore, unicellularity does not automatically exclude an organism from Fungi; its cellular and nutritional characteristics must also be considered.

15. During a long-term ecological study, organisms P, Q, R, S and T were described by their structural, cellular and nutritional features. Answer the following:
(i) Identify one organism that clearly belongs to Kingdom Fungi and give one supporting observation.
(ii) Which organism belongs to Kingdom Monera and why?
(iii) Organisms R and Q are both eukaryotic, yet they are placed in different kingdoms. Analyse the criteria separating them.
(iv) Explain why organism S cannot be classified using mode of nutrition alone.
(v) Organism T does not fit into any of the five kingdoms. Which fundamental characteristic does it lack and what does this reveal about limitations of classification systems?

(i) Q — Kingdom Fungi. Q is multicellular and filamentous, has a cell wall, lacks chlorophyll and grows on dead organic matter. These features match fungi, which are heterotrophic eukaryotes with chitinous cell walls and commonly act as decomposers.

(ii) P — Kingdom Monera. P is microscopic, has **no true nucleus** and has a rigid cell covering. The absence of a membrane-bound nucleus identifies it as a prokaryote, matching Monera.

(iii) R and Q: Both are eukaryotic, but Q is **multicellular** and filamentous with a cell wall and heterotrophic nutrition, while R is **unicellular**, has a true nucleus and shows features such as movement and photosynthesis in light. Thus, level of organisation, mode of nutrition and other cellular features separate them.

(iv) S: S is multicellular, has well-differentiated tissues and a backbone, and has aquatic respiration during its early life stage. Its classification depends on structural features such as **vertebral column, body organisation and developmental characteristics**, not merely on nutrition. Many animals are heterotrophic, so nutrition alone cannot identify the group.

(v) T: T is **acellular**. The five kingdoms are designed to classify cellular forms of life, so T does not fit into them. This demonstrates that classification systems have limits and may need refinement when scientific knowledge reveals entities that do not fit existing categories.

QUICK REVISION — CHAPTER 12

High-priority concepts and classification map

Biodiversity: The immense variety of living organisms on Earth. Biodiversity supports ecosystems through food production, pollination, decomposition, nutrient cycling and many other interactions.

Five Kingdoms: Monera — unicellular prokaryotes; Protista — mainly unicellular eukaryotes; Fungi — heterotrophic eukaryotes with chitinous cell walls; Plantae — multicellular autotrophic eukaryotes with cellulose cell walls; Animalia — multicellular heterotrophic eukaryotes.

Plant sequence: Thallophyta → Bryophyta → Pteridophyta → Gymnosperm → Angiosperm. Across these groups, plant structure becomes increasingly specialised, with vascular tissues, seeds and flowers appearing as major adaptations.

Animal classification: Non-chordates include Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca and Echinodermata. Protochordates possess a notochord at least once. Vertebrates possess a backbone and include fish, amphibians, reptiles, birds and mammals.

Hierarchy: Kingdom → Phylum → Class → Order → Family → Genus → Species. Moving downward makes groups smaller and members more similar.

Binomial nomenclature: Every scientific name has two parts — genus followed by species. The genus begins with a capital letter, the species name with a lowercase letter, and the complete name is italicised when printed.

Key examples: Tiger — *Panthera tigris*; Mango — *Mangifera indica*. Three domains proposed by Carl Woese: Bacteria, Archaea and Eukarya.

Fossils: Preserved remains of organisms in rock, sand or mud. They provide evidence for how life has changed over long periods of time.

Biodiversity threat: Pollution, deforestation, overuse of resources and climate change can reduce biodiversity. Conservation is important because organisms are interconnected within ecosystems.

Answer key — objective items: Q1 (ii) • Q2 (iii) • Q5 Protista • Q8 Outside five kingdoms • Q11 Bryophyta vs Pteridophyta • Q12 Genus • Q13 Unicellular eukaryote + autotrophic nutrition can indicate Protista • Q15 (i) Q, (ii) P, (iii) multicellular vs unicellular plus other criteria, (iv) structural features matter, (v) acellular.