Chapter 12: Patterns in Life: Diversity and Classification

Exercises — Revise, Reflect, Refine

Q1 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

SOLUTION

Analyse each option against the distinguishing features of insects (Phylum Arthropoda) and earthworms (Phylum Annelida):

(i) Bilateral symmetrical body — Both insects and earthworms show bilateral symmetry, so this does not distinguish them.

(ii) Body with jointed legs — Insects belong to Phylum Arthropoda, whose defining feature is jointed appendages (legs). Earthworms (Annelida) have no legs. This feature uniquely identifies the organism as an insect.

(iii) Cylindrical body — Earthworms have a long, cylindrical body. Insects do not — their body is divided into head, thorax, and abdomen. This would point to an earthworm, not an insect.

(iv) Body with little segmentation — Earthworms show prominent segmentation (annuli). Insects also have segments, so 'little segmentation' does not help confirm it is an insect.

The correct option is (ii): Body with jointed legs.

Answer: (ii) Body with jointed legs. Insects belong to Phylum Arthropoda, which is defined by jointed appendages. Earthworms lack legs entirely, so jointed legs confirm the organism is an insect.

Q2 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

SOLUTION

The Kingdom Animalia is characterised by eukaryotic cells that have a cell membrane but no cell wall, are heterotrophic, and contain mitochondria.

Evaluate each option:

(i) Absence of mitochondria — Incorrect. All eukaryotes, including sponges and other animals, have mitochondria. Absence of mitochondria would disqualify a cell from being eukaryotic.

(ii) Ability to photosynthesise — Incorrect. Animals are heterotrophic and cannot photosynthesise. This ability would classify the organism in Kingdom Plantae or Protista, not Animalia.

(iii) Presence of a cell membrane — Correct. All animal cells are bounded by a cell membrane and notably lack a cell wall. The absence of a cell wall combined with the presence of a cell membrane is a key feature that places organisms in Animalia, distinguishing them from plants and fungi (which have cell walls).

(iv) Presence of a cell wall — Incorrect. Animal cells do not have a cell wall. If sponge cells had a cell wall, they would be excluded from the animal kingdom.

The correct option is (iii): Presence of a cell membrane.

Answer: (iii) Presence of a cell membrane. Animal cells possess a cell membrane but no cell wall. The absence of a cell wall is a fundamental criterion that places sponges (and all animals) in Kingdom Animalia, distinguishing them from plants, fungi, and most prokaryotes.

Q3 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?

SOLUTION

Example: a sparrow (bird) and a lizard (reptile) observed in a garden.

Features that distinguish them:

1. Body covering — The sparrow is covered with feathers; the lizard has dry,

scaly skin.
2. Limbs — The sparrow has wings (modified forelimbs) and two feet; the lizard has four limbs with claws.
3. Temperature regulation — The sparrow is warm-blooded (endothermic); the lizard is cold-blooded (ectothermic).
4. Reproduction — The sparrow lays eggs with hard shells and shows parental care; the lizard lays eggs with leathery shells with minimal care.

How these features help in classification:
— Feathers are a unique feature of Class Aves (birds). No other class of vertebrates has feathers, so the sparrow is placed in Class Aves.
— Dry, scaly skin and ectothermy are characteristic of Class Reptilia, so the lizard is placed in Class Reptilia.
— Both share the backbone and are placed in Phylum Chordata, Subphylum Vertebrata, but the specific body-covering and thermoregulation features separate them at the class level.

This illustrates how observable structural features form the basis for grouping organisms: shared features unite them at higher levels (phylum), while differing features distinguish them at lower levels (class, order, family).

Answer: Observable features such as body covering, limb structure, and thermoregulation distinguish animals and place them in different groups. For example, feathers place birds in Class Aves while scales place lizards in Class Reptilia, even though both share the vertebral column that unites them in Phylum Chordata.

Q4 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?

SOLUTION

Cellular organisation refers to whether an organism is prokaryotic or eukaryotic, unicellular or multicellular. Xylem and phloem are vascular tissues found only in higher plants.

Justification for cellular organisation being more fundamental:

1. Universality — Cellular organisation applies to ALL living organisms (bacteria, fungi, plants, animals, protists). Xylem and phloem are present only in vascular

plants (Tracheophytes), which form a small subset of life.

2. Evolutionary depth — The distinction between prokaryotes and eukaryotes arose about 2 billion years ago and represents one of the most ancient and deep-rooted divisions in the history of life. Vascular tissue evolved much later, only within the plant lineage.

3. Breadth of separation — Cellular organisation separates entire kingdoms (Monera vs. all others). Xylem and phloem separate only some plants from others (e.g., bryophytes from pteridophytes), which is a far narrower distinction.

4. Information content — The type of cellular organisation reflects fundamental differences in genetic machinery (presence/absence of nuclear membrane, organelles, chromosome structure) that have wide-ranging biological consequences.

Conclusion: Cellular organisation is a more fundamental, universal, and evolutionarily significant criterion than the presence of xylem and phloem, which is relevant only within a narrow group of plants.

Answer: Cellular organisation (prokaryotic vs. eukaryotic; unicellular vs. multicellular) is universal — it applies to all known life — and reflects the deepest evolutionary divergences. Xylem and phloem are restricted to vascular plants, so they can only classify a small subset of organisms. A characteristic used as a primary basis for classification must apply broadly; hence cellular organisation is more fundamental.

Q5 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.

SOLUTION

Key observations on the slide:
— Single-celled (unicellular)
— Well-defined nucleus => eukaryotic
— Multiple cilia for locomotion

Identifying the kingdom:

1. The presence of a well-defined (membrane-bound) nucleus rules out Kingdom Monera (prokaryotes have no nuclear membrane).

2. The organism is unicellular, which rules out Kingdom Plantae, Kingdom Animalia, and most of Kingdom Fungi (which are predominantly multicellular).
3. The presence of multiple cilia is a classic feature of ciliated protozoans in Kingdom Protista (e.g., Paramecium, a well-known ciliate).
4. In the five-kingdom classification, unicellular eukaryotes with locomotory organelles (cilia, flagella, pseudopodia) are placed in Kingdom Protista.

Therefore, the organism most likely belongs to Kingdom Protista, specifically the group of ciliated protozoans (e.g., similar to Paramecium).

Answer: The organism most likely belongs to Kingdom Protista. It is unicellular and eukaryotic (well-defined nucleus), which rules out Monera, Plantae, Animalia, and most Fungi. The presence of multiple cilia for locomotion is a characteristic feature of ciliated protozoans such as Paramecium, which are classified in Kingdom Protista.

Q6 How does the diversity of organisms contribute to the balance and stability of an ecosystem?

SOLUTION

Biodiversity (diversity of organisms) contributes to ecosystem balance and stability in several ways:

1. Trophic stability — Diverse food webs with multiple producers, consumers, and decomposers mean that if one species declines, others can partially fill its role. This redundancy prevents the collapse of energy flow.

2. Nutrient cycling — Different species perform different roles in nutrient cycles. Decomposers (bacteria, fungi) break down dead matter; nitrogen-fixing bacteria replenish soil nitrogen; plants fix carbon through photosynthesis. Loss of any group disrupts cycling.

3. Pollination and seed dispersal — Many plants depend on specific animals (bees, birds, bats) for pollination and seed dispersal. A diverse animal community ensures that plant populations are maintained.

4. Pest and disease regulation — Predators and parasites keep prey and host populations in check. A diverse predator community prevents any single species from over-multiplying and damaging the ecosystem.

5. Resistance to environmental change — Ecosystems with high biodiversity are

more resilient to disturbances (drought, disease, climate fluctuation) because at least some species can survive and rebuild the community.

In summary, biodiversity provides redundancy, functional variety, and resilience — all of which are essential for the long-term balance and stability of an ecosystem.

Answer: Biodiversity contributes to ecosystem balance by providing functional redundancy (multiple species performing similar roles), supporting nutrient cycling, enabling pollination and seed dispersal, regulating pest populations, and increasing resilience to environmental disturbances. A diverse ecosystem can withstand disturbances better than a species-poor one.

Q7 If all unicellular organisms were grouped into a single kingdom, what problems would arise?

SOLUTION

Grouping all unicellular organisms into a single kingdom would cause several serious problems:

1. Mixing prokaryotes and eukaryotes — Bacteria (prokaryotes, no nucleus) would be grouped with Amoeba and Paramecium (eukaryotes, with nucleus). These groups differ fundamentally in cell structure, genetic organisation, and evolutionary history — placing them together would obscure the most basic division in life.

2. Loss of evolutionary information — Unicellularity is a superficial similarity, not a sign of common ancestry. Bacteria, blue-green algae, and protists share unicellularity but diverged billions of years ago. Classification would lose its power to reflect phylogeny.

3. Contradictory nutrition modes — Within 'unicellular organisms' we find autotrophs (Chlamydomonas, Chlorella), heterotrophs (Amoeba, Paramecium), and saprotrophic forms. Lumping them hides these fundamentally different nutritional strategies.

4. Conflicting cell-wall chemistry — Bacterial cell walls contain peptidoglycan; fungal unicellular forms (e.g., yeast) have chitin walls; some protists have no wall at all. These differences reflect deep biochemical divergence that would be masked.

5. Practical misidentification — Medical and ecological applications depend on accurate classification. Grouping disease-causing bacteria with harmless protists in one kingdom would make it impossible to apply kingdom-level identification to diagnose or treat infections.

Conclusion: Unicellularity is a grade of organisation, not a clade. Using it as the sole basis for a kingdom would create a polyphyletic group that misrepresents evolutionary relationships and is biologically meaningless.

Answer: Serious problems would arise: prokaryotic bacteria would be mixed with eukaryotic protists despite fundamental differences in nuclear organisation; organisms with entirely different nutritional modes and cell-wall chemistry would be lumped together; and the classification would no longer reflect evolutionary relationships. Unicellularity is a structural grade, not a sign of common ancestry.

Q8 Viruses were studied in earlier classes. Why are they not placed in any of the five kingdoms? Give reasons.

SOLUTION

Viruses are excluded from all five kingdoms because they do not meet the fundamental criteria used to define living organisms in the classification system:

1. Acellular — Viruses are not composed of cells. All five kingdoms contain cellular organisms (Monera = prokaryotic cells; the rest = eukaryotic cells). Viruses have no cell membrane, no cytoplasm, and no metabolic machinery of their own.

2. No independent metabolism — Viruses cannot carry out any metabolic activity (respiration, nutrition, growth) outside a host cell. They are inert chemical packages until they infect a cell.

3. No ribosomes or organelles — Viruses lack ribosomes and other organelles required for protein synthesis. They hijack the host's ribosomes to replicate.

4. Obligate intracellular existence — Viruses can only reproduce inside a living host cell. Outside a host, they are essentially non-living crystalline particles.

5. Genetic material only — Viruses contain either DNA or RNA (not both), enclosed in a protein coat (capsid). This is not sufficient to qualify as a living cell.

Because they lack cell structure, independent metabolism, and the ability to grow or reproduce on their own, viruses do not fit into any of the five kingdoms, which

are all defined on the basis of cellular organisation.

Answer: Viruses are acellular — they lack cells, cell membranes, cytoplasm, ribosomes, and all metabolic machinery. Since all five kingdoms are defined on the basis of cellular organisation, viruses cannot be placed in any of them. They also cannot carry out metabolism or reproduce independently, which further excludes them from any kingdom of living organisms.

Q9 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.

SOLUTION

Recommendation: Create a separate, formally recognised category for viruses outside the five kingdoms, such as a 'Domain Acellularia' or a separate 'Realm Virus' (as proposed in modern virology).

Justification for a separate category:
— Viruses possess genetic material (DNA or RNA) and show heredity, mutation, and evolution — properties associated with living entities. Ignoring them entirely leaves a significant biological group unaccounted for.
— Viruses have profound ecological and medical importance (they infect every known form of life). A formal category acknowledges their existence in the tree of life without forcing them into a cellular framework.
— Modern discoveries (giant viruses like Mimivirus, which have genes for translation machinery) blur the boundary between viruses and cellular life further, making a formal category increasingly necessary.

What this indicates about the evolving nature of scientific classification:
— Scientific classification is not static. As new organisms and new data emerge, classification systems must be revised.
— The five-kingdom system was an improvement over the earlier two-kingdom system; the current three-domain system (Bacteria, Archaea, Eukarya) is already in use among researchers.
— The challenge posed by viruses shows that classification systems are human constructs designed to organise knowledge — they must adapt when the natural world reveals exceptions that do not fit existing categories.
— This flexibility is a strength of science: hypotheses and systems are revised in light of new evidence.

Answer: A separate, formally recognised category for viruses should be created (e.g., Realm Virus, as used in modern virology) because they possess genetic material, evolve, and have major biological importance, yet are acellular. This revision reflects the evolving nature of scientific classification: systems are human constructs that must be updated as new organisms and evidence emerge.

Q10 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?

SOLUTION

Features of viruses that prevent them from fitting into the five kingdoms:

1. Lack of cellular organisation — The five kingdoms are built on the cell as the basic unit of life. Viruses have no cells, no cytoplasm, no cell membrane, and no organelles.

2. No independent metabolism — Viruses cannot generate energy, synthesise proteins, or carry out any metabolic reactions on their own. All five kingdoms contain organisms that perform their own metabolism.

3. No ribosomes — Protein synthesis requires ribosomes. Viruses lack ribosomes and depend entirely on the host's machinery — this disqualifies them from all kingdoms.

4. Cannot reproduce independently — Viruses can only replicate inside a host cell. Reproduction outside a host is impossible.

5. Contain either DNA or RNA, not both — Cellular organisms always contain both DNA and RNA. Viruses contain only one type of nucleic acid, which is unusual.

What this tells us about the limitations of classification systems:

— Classification systems are built around a set of defining criteria (e.g., cellular organisation). When an entity meets some but not all of those criteria, it exposes the limits of the system.
— The existence of viruses reveals that life does not always fall into neat, discrete categories. There is a continuum between the living and non-living.
— Any classification system is a simplified model of reality. The natural world is more complex than our categories, and exceptions will always exist.
— Scientists must continually refine classification systems to accommodate new

knowledge, which is a hallmark of the self-correcting nature of science.

Answer: Viruses lack cellular organisation, have no ribosomes or metabolic machinery, cannot reproduce independently, and contain only one type of nucleic acid (DNA or RNA, not both). These features exclude them from all five kingdoms. This reveals a key limitation of classification systems: they are built around specific criteria (cells, metabolism) that do not apply to all biological entities, showing that natural diversity can outpace our categories.

Q11 Both pteridophytes and bryophytes lack flowers and seeds, yet they are placed in different groups. Explain this classification using their key features.

SOLUTION

Although both pteridophytes and bryophytes lack flowers and seeds, they differ in several fundamental features that justify their separation into different groups:

1. Vascular tissue:
— Bryophytes (mosses, liverworts, hornworts) have NO vascular tissue (no xylem or phloem). They lack specialised water- and food-conducting vessels.
— Pteridophytes (ferns, horsetails, club mosses) have WELL-DEVELOPED vascular tissue (xylem and phloem). This allows them to transport water and nutrients over greater distances and grow much taller.

2. Body differentiation:
— Bryophytes have poorly differentiated bodies — no true roots, stems, or leaves. They have rhizoids (root-like structures) for anchorage.
— Pteridophytes have true roots, stems, and leaves differentiated into distinct organs.

3. Dominant generation:
— In bryophytes, the gametophyte (haploid) is the dominant, photosynthetic generation. The sporophyte is dependent on the gametophyte.
— In pteridophytes, the sporophyte (diploid) is the dominant, independent generation. The gametophyte is small and short-lived.

4. Habitat and size:
— Bryophytes are small, grow in moist, shady habitats, and are often called 'amphibians of the plant kingdom' because they need water for fertilisation.
— Pteridophytes can grow in a variety of habitats; some, like tree ferns, grow quite tall.

Conclusion: The presence of vascular tissue and true organ differentiation in pteridophytes represents a more advanced body plan, justifying their placement in a separate, higher group from bryophytes.

Answer: Though both lack flowers and seeds, pteridophytes have well-developed vascular tissue (xylem and phloem) and true roots, stems, and leaves, while bryophytes lack vascular tissue and have only poorly differentiated body parts (rhizoids, not true roots). In pteridophytes the sporophyte is the dominant generation; in bryophytes it is the gametophyte. These structural differences are fundamental enough to place them in separate plant groups.

Q12 In the classification hierarchy, which group — class or genus — has fewer members but more features in common? Explain your answer.

SOLUTION

Answer: Genus has fewer members but more features in common.

Explanation using the classification hierarchy:

The hierarchy from broadest to most specific is: Kingdom > Phylum > Class > Order > Family > Genus > Species.

As we move from Kingdom down to Species:
— The number of organisms in each group decreases (fewer members).
— The number of characteristics shared by all members of the group increases (more features in common).

Class vs. Genus comparison:

Class — A class contains many orders, families, and genera. For example, Class Mammalia includes whales, bats, humans, dogs, etc. — thousands of species with only the broadest mammalian features in common (hair, mammary glands, warm-blooded).

Genus — A genus contains only a few (sometimes just one) species that are very closely related. For example, Genus Panthera includes lions (Panthera leo), tigers (Panthera tigris), leopards (Panthera pardus), and jaguars (Panthera onca). All members of a genus share a large number of morphological, physiological, and genetic features.

Therefore, Genus has fewer members than Class, but those members share far more features in common. This is a fundamental principle: specificity in

classification comes with greater similarity among members.

Answer: Genus has fewer members but more features in common. In the classification hierarchy, as we move from kingdom to species, the number of members decreases while the number of shared characteristics increases. A class such as Mammalia includes thousands of species with only broad features in common, whereas a genus such as Panthera includes just a few closely related species sharing many detailed morphological and genetic features.

Q13 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?

SOLUTION

The new organism shows: (1) locomotion and (2) autotrophic nutrition.

In the five-kingdom classification, we need to narrow it down to Protista:

1. Unicellular nature — Kingdom Protista consists of unicellular eukaryotes. If the organism is unicellular, it cannot belong to Plantae (which is multicellular and autotrophic) or Animalia (multicellular, heterotrophic). Unicellularity combined with eukaryotic cell organisation (well-defined nucleus) is the primary character for Protista.

2. Eukaryotic cell organisation — The organism must have a membrane-bound nucleus (eukaryotic). This rules out Kingdom Monera (prokaryotic), where some autotrophic and motile organisms (like cyanobacteria) also exist.

3. Locomotory organelles (flagella or cilia) — Members of Protista that are autotrophic and motile typically bear flagella. For example, Euglena is a flagellated protist that photosynthesises in light but can also be heterotrophic — a classic Protista. Chlamydomonas is another flagellated, autotrophic protist.

Characters that place it in Protista specifically:
— Unicellular + Eukaryotic (membrane-bound nucleus) + Locomotion (flagella/cilia) + Autotrophic (contains chlorophyll/photosynthetic pigments).

Autotrophic nutrition alone would suggest Plantae, and locomotion alone might suggest Animalia, but the combination of unicellularity, eukaryotic organisation, and locomotion alongside autotrophic nutrition is the hallmark of Protista (e.g.,

Euglena, Chlamydomonas).

Answer: The key characters that would place the organism in Kingdom Protista are: (1) unicellular body, (2) eukaryotic cell organisation (membrane-bound nucleus), and (3) presence of locomotory organelles such as flagella or cilia. The combination of autotrophic nutrition with locomotion and unicellular eukaryotic structure is characteristic of protists like Euglena, distinguishing them from multicellular Plantae and heterotrophic Animalia.

Q14 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?

SOLUTION

Kingdom Fungi can include unicellular forms (e.g., yeast, Saccharomyces cerevisiae). The following identification key would confirm placement in Kingdom Fungi:

Key characters to confirm a unicellular organism is a fungus:

1. Eukaryotic cell organisation — Must have a membrane-bound nucleus. (This eliminates Monera.)

2. Cell wall present and composed of chitin — Fungal cell walls are made of chitin, unlike plants (cellulose) and animals (no cell wall). A unicellular organism with a chitin cell wall is strongly indicative of fungi.

3. Heterotrophic nutrition by absorption (saprotrophic or parasitic) — Fungi do not photosynthesise. They secrete enzymes extracellularly and absorb digested nutrients (absorptive heterotrophy). If the unicellular organism is heterotrophic and absorbs nutrients rather than engulfing them (which would indicate a protozoan/Protista), it supports classification as fungi.

4. No chlorophyll or photosynthetic pigments — Confirms it is not an autotrophic protist.

5. Reproduction by budding or spore formation — Yeast reproduces asexually by budding, a characteristic mode in unicellular fungi.

Identification key (decision flow):
Is it eukaryotic? => Yes
Does it have a chitin cell wall? => Yes

Is it heterotrophic by absorption (saprotrophic)? => Yes
Does it lack chlorophyll? => Yes
=> Place in Kingdom Fungi

Answer: The identification key for placing a unicellular eukaryote in Kingdom Fungi: (1) eukaryotic (membrane-bound nucleus present), (2) cell wall made of chitin (not cellulose), (3) heterotrophic nutrition by absorption — secretes enzymes and absorbs digested products (not by photosynthesis or ingestion), (4) no chlorophyll, and (5) reproduces by budding or spore formation. All five criteria together confirm Kingdom Fungi (e.g., yeast).

Q15 During a long-term ecological study, students examined organisms collected from three different environments — a freshwater pond, damp soil near decaying logs and the digestive tract of animals. Scientists recorded only structural, cellular and nutritional features: P: Microscopic; no true nucleus; rigid cell covering; survives high salinity and temperature. Q: Multicellular; filamentous body; cell wall present; no chlorophyll; grows on dead organic matter. R: Unicellular; true nucleus; contractile vacuole present; moves using flagella; shows photosynthesis in light but heterotrophic in the absence of light. S: Multicellular; well-differentiated tissues; backbone present; aquatic respiration during early life stage. T: Acellular; contains genetic material; remains inactive outside a host cell. Answer: (i) Identify one organism that clearly belongs to the Kingdom Fungi. State one observation that supports your answer. (ii) Which organism would be placed in the Kingdom Monera? Mention one characteristic that justifies this placement. (iii) Organisms R and Q are both eukaryotic, yet they are placed in different kingdoms. Analyse the criteria that separate them. (iv) Explain why organism S cannot be classified using the mode of nutrition alone. (v) Organism T does not fit into any of the five kingdoms. Which fundamental characteristic used in classification does it lack and what does this reveal about the limitations of classification systems? (vi) If classification were based only on habitat, which organisms might be incorrectly grouped together? Explain the scientific consequences of such a classification. (vii) Imagine scientists discover a new organism that is multicellular, eukaryotic, lacks chlorophyll and absorbs nutrients from a host externally. Should it be placed under fungi or animalia? Justify your reasoning using classification criteria.

SOLUTION

Classification of the organisms in the table:

P — Kingdom Monera (prokaryote: no true nucleus, rigid cell covering = bacterial cell wall, extremophile traits)

Q — Kingdom Fungi (multicellular, filamentous, cell wall, no chlorophyll, saprotrophic)

R — Kingdom Protista (unicellular eukaryote, contractile vacuole, flagella, mixotrophic)

S — Kingdom Animalia (multicellular, well-differentiated tissues, backbone present, aquatic respiration in early life = tadpole stage → amphibian)

T — Virus (acellular, contains genetic material, inactive outside host)

(i) Organism that clearly belongs to Kingdom Fungi: Q

Q is multicellular with a filamentous body, has a cell wall, lacks chlorophyll, and

grows on dead organic matter (saprotrophic/absorptive nutrition). The combination of filamentous body + cell wall + no chlorophyll + saprotrophic nutrition is the defining profile of Kingdom Fungi.
Supporting observation: Q grows on dead organic matter — this indicates saprotrophic (absorptive heterotrophic) nutrition, which is the hallmark of Kingdom Fungi.

(ii) Organism placed in Kingdom Monera: P
P has no true nucleus (prokaryotic), which is the defining feature of Kingdom Monera. All organisms in Monera lack a membrane-bound nucleus.
Justifying characteristic: No true nucleus (prokaryotic cell organisation). Additionally, P's rigid cell covering (peptidoglycan-like bacterial cell wall) and ability to survive extreme conditions (high salinity and temperature, like archaea/bacteria) further support this placement.

(iii) Why R (Protista) and Q (Fungi) are placed in different kingdoms despite both being eukaryotic:
Both R and Q are eukaryotic (have membrane-bound nuclei), but they differ in:
— Cellular organisation: R is unicellular; Q is multicellular with a filamentous body.
— Nutrition: R can photosynthesise (autotrophic) in light and is heterotrophic in darkness (mixotrophic). Q is purely saprotrophic (absorptive heterotroph).
— Locomotion: R has flagella for movement; Q is non-motile.
— Cell structure: R has a contractile vacuole (a protist feature for osmoregulation); Q has a fungal cell wall.
The criteria separating them are: unicellularity + mixotrophic nutrition + locomotion (Protista) versus multicellularity + filamentous form + absorptive heterotrophy + cell wall (Fungi).

(iv) Why organism S cannot be classified using mode of nutrition alone:
S is multicellular with well-differentiated tissues, a backbone, and aquatic respiration during the early life stage (suggesting a larval/tadpole phase — characteristic of amphibians). All animals are heterotrophic by ingestion, so the mode of nutrition (heterotrophic) would group S with all of Kingdom Animalia (thousands of species with wildly different body plans).
Mode of nutrition alone gives no information about structural complexity, presence of backbone, tissue differentiation, or evolutionary relationships. To correctly classify S, we need structural features (backbone = Chordata, Vertebrata),

developmental features (aquatic respiration in early life = amphibian), and tissue-level organisation. Nutrition mode is too broad a criterion to distinguish classes or phyla within Animalia.

(v) Organism T does not fit into any five kingdom:
T is acellular — it has no cellular organisation whatsoever. The fundamental characteristic used in the five-kingdom system (and in all biological classification of living organisms) is cellular organisation: all five kingdoms consist of organisms made of one or more cells.
T (a virus) lacks cells, lacks metabolic machinery, and can only function inside a host cell.
What this reveals about limitations: Classification systems are built around agreed criteria (cells as the unit of life). When an entity like a virus possesses some properties of life (genetic material, evolution) but lacks others (cells, independent metabolism), it falls outside the system. This shows that: (a) our classification criteria are insufficient to encompass all biological entities, and (b) scientific classification systems must evolve as new forms of biological entities are discovered.

(vi) Organisms that might be incorrectly grouped if only habitat were used:
If classification were based only on habitat:
— P (prokaryote, from high-salinity environment), R (protist, from freshwater pond), and Q (fungus, from damp soil near decaying logs) all occur in aquatic or moist environments. Based on habitat alone, P and R (both found in aqueous environments) could be incorrectly grouped together despite being in entirely different kingdoms (Monera vs. Protista).
— Similarly, S (an animal, found near freshwater in its early life) and R (a protist in the freshwater pond) share the freshwater habitat but have nothing else in common.
Scientific consequences of habitat-based classification: It would group organisms that are evolutionarily unrelated (e.g., bacteria and protists), masking fundamental differences in cell structure, nutrition, and evolutionary history. Such a system would have no predictive power — knowing an organism's habitat would tell us nothing useful about its biochemistry, physiology, genetics, or relationships to other organisms. It would also fail to group organisms that share common ancestry but live in different habitats.

(vii) New organism: multicellular, eukaryotic, lacks chlorophyll, absorbs nutrients

from a host externally — Fungi or Animalia?
This organism should be placed in Kingdom Fungi.
Justification using classification criteria:
— Absorbs nutrients externally (absorptive heterotrophy): This is the defining nutritional mode of fungi. Fungi secrete digestive enzymes externally and absorb the products. Animals ingest food and digest it internally.
— 'Absorbs from a host externally' = parasitic absorptive nutrition, which is a fungal strategy (e.g., parasitic fungi on plants and animals).
— Lacks chlorophyll: consistent with both Fungi and Animalia, so this alone does not decide.
— Key distinguishing criterion: MODE OF NUTRIENT UPTAKE. Fungi = absorptive (external digestion + absorption). Animals = ingestive (engulf food, digest internally). Since this organism absorbs nutrients externally, it belongs to Kingdom Fungi, not Animalia.
— Additional check: if it has a chitin cell wall (a fungal feature), this would confirm Kingdom Fungi.

Answer: (i) Q — belongs to Kingdom Fungi; it grows on dead organic matter (saprotrophic absorptive nutrition), has a filamentous body and cell wall, and no chlorophyll. (ii) P — Kingdom Monera; it has no true nucleus (prokaryotic). (iii) R (Protista) is unicellular, motile, and mixotrophic; Q (Fungi) is multicellular, filamentous, non-motile, and saprotrophic absorptive — unicellularity, locomotion, and nutrition mode separate them. (iv) S is an animal (backbone present, well-differentiated tissues); all animals are heterotrophic, so mode of nutrition cannot distinguish among the many animal classes — structural and developmental features are needed. (v) T (a virus) is acellular — it lacks cellular organisation, the fundamental criterion of all five kingdoms. This reveals that classification systems built on cells cannot accommodate acellular biological entities, exposing a limitation that requires systems to evolve. (vi) P and R share aquatic/moist habitats but belong to entirely different kingdoms (Monera vs. Protista); habitat-based grouping would erase fundamental evolutionary distinctions and produce a system with no predictive power. (vii) Kingdom Fungi — because it absorbs nutrients externally (absorptive heterotrophy, a defining fungal trait), unlike animals that ingest and digest food internally.