

CUET · BIOLOGY · CLASS XI · CODE 304

Animal Kingdom

CUET unit: Diversity in Living World → Animal Kingdom

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Snapshot

- Establishes the framework for classifying ~1 million described animal species using fundamental shared features rather than superficial form.
- Five comparative axes drive the entire chapter: levels of organisation, body symmetry, diploblastic/triploblastic organisation, nature of coelom, segmentation and notochord.
- Walks through 11 phyla (Porifera → Chordata) and seven vertebrate classes (Cyclostomata, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia) with one or two NCERT-named examples each.
- A high-yield CUET chapter — examples (genus-to-common-name), exclusive features (water vascular system, radula, mammary glands, comb plates), and the master comparison Table 4.2 generate predictable questions.

Detailed Notes

2.1 Core concepts

- **Need for classification.** Over a million animal species have been described; classification is needed to give newly described species a systematic position (NCERT §4 intro, p. 37).
- **Basis of classification.** Five fundamental criteria are used despite diversity in structure and form: arrangement of cells, body symmetry, nature of coelom, and patterns of digestive, circulatory and reproductive systems (NCERT §4.1, p. 37).
- **Levels of organisation.** Sponges show **cellular level** (loose cell aggregates); coelenterates show **tissue level**; Platyhelminthes onward show **organ level**; Annelids, Arthropods, Molluscs, Echinoderms and Chordates show **organ-system level** (NCERT §4.1.1, pp. 37–38).
- **Digestive and circulatory complexity.** Incomplete digestive system (single opening serves as mouth and anus) occurs in Platyhelminthes; complete system has separate mouth and anus. Circulation is **open type** (cells/tissues bathed directly in blood) or **closed type** (blood circulates through arteries, veins, capillaries) (NCERT §4.1.1, p. 38).
- **Symmetry.** Sponges are **asymmetrical**; coelenterates, ctenophores and echinoderms are **radially symmetrical**; annelids, arthropods etc. are **bilaterally**

- symmetrical.** Echinoderms have radial adults but bilateral larvae (NCERT §4.1.2, p. 38; Fig. 4.4 footnote, p. 40).
- **Diploblastic vs triploblastic.** Diploblastic = two layers (ectoderm + endoderm) with an undifferentiated mesoglea in between, e.g., coelenterates. Triploblastic = three germinal layers including mesoderm, present from Platyhelminthes to Chordates (NCERT §4.1.3, pp. 38–39).
 - **Coelom.** Coelomates (mesoderm-lined cavity) include Annelida, Mollusca, Arthropoda, Echinodermata, Hemichordata, Chordata. Pseudocoelomates (mesoderm in scattered pouches) = Aschelminthes. Acoelomates (no body cavity) = Platyhelminthes (NCERT §4.1.4, p. 39).
 - **Segmentation.** Body divided externally and internally into segments with serial repetition of organs is called **metameric segmentation** (metamerism); first true example is the earthworm (NCERT §4.1.5, p. 39).
 - **Notochord.** A mesodermally derived dorsal rod-like embryonic structure; animals with it are **chordates**, those without are **non-chordates** (Porifera to Echinoderms) (NCERT §4.1.6, p. 39).
 - **Porifera.** Sponges — marine, asymmetrical, cellular level; water canal system via ostia → spongocoel → osculum; **choanocytes** line internal cavities; skeleton of **spicules** or **spongin** fibres; hermaphrodite; internal fertilisation with indirect development. Examples — **Sycon** (Scypha), **Spongilla** (fresh water sponge), **Euspongia** (Bath sponge) (NCERT §4.2.1, pp. 40–41).
 - **Coelenterata (Cnidaria).** Aquatic, mostly marine, radially symmetrical, diploblastic, tissue level; **cnidoblasts/cnidocytes** with nematocysts on tentacles; central gastro-vascular cavity with single opening (mouth on **hypostome**); two body forms — **polyp** (sessile, e.g., **Hydra**, **Adamsia**) and **medusa** (free-swimming, e.g., **Aurelia**); **Metagenesis** in **Obelia**. Corals have CaCO₃ skeleton. Examples — **Physalia**, **Adamsia**, **Pennatula**, **Gorgonia**, **Meandrina** (NCERT §4.2.2, p. 41).
 - **Ctenophora.** Exclusively marine, radially symmetrical, diploblastic, tissue level; eight rows of ciliated **comb plates** for locomotion; **bioluminescence** well-marked; hermaphrodite; only sexual reproduction; external fertilisation, indirect development. Examples — **Pleurobrachia**, **Ctenoplana** (NCERT §4.2.3, p. 42).
 - **Platyhelminthes.** Dorso-ventrally flattened flatworms; bilaterally symmetrical, triploblastic, acoelomate, organ level; mostly endoparasitic with hooks and suckers; **flame cells** for osmoregulation and excretion; **Planaria** shows high regeneration. Examples — **Taenia** (tapeworm), **Fasciola** (liver fluke) (NCERT §4.2.4, p. 42).
 - **Aschelminthes.** Roundworms — circular in cross-section; organ-system level; bilateral, triploblastic, **pseudocoelomate**; complete alimentary canal with muscular pharynx; **dioecious** with females longer than males; direct or indirect development. Examples — **Ascaris**, **Wuchereria** (filaria worm), **Ancylostoma** (hookworm) (NCERT §4.2.5, p. 43).

- **Annelida.** Aquatic or terrestrial, free-living or parasitic; organ-system level, bilaterally symmetrical, triploblastic, **metamerically segmented**, coelomate; longitudinal + circular muscles; *Nereis* has **parapodia**; **closed circulatory system**; **nephridia** for osmoregulation/excretion; double ventral nerve cord with paired ganglia; *Nereis* dioecious, earthworms and leeches monoecious. Examples — *Nereis*, *Pheretima* (earthworm), *Hirudinaria* (blood-sucking leech) (NCERT §4.2.6, p. 43).
- **Arthropoda.** Largest phylum — over two-thirds of all named species; organ-system level, bilateral, triploblastic, segmented, coelomate; chitinous **exoskeleton**; body has head, thorax, abdomen; **jointed appendages**; respiration via gills, book gills, book lungs or tracheal system; open circulation; **malpighian tubules** excrete; mostly dioecious, oviparous. Economically important: *Apis*, *Bombyx*, *Laccifer*; vectors: *Anopheles*, *Culex*, *Aedes*; gregarious pest: *Locusta*; living fossil: *Limulus* (king crab) (NCERT §4.2.7, p. 44).
- **Mollusca.** Second largest phylum; terrestrial or aquatic; organ-system level, bilateral, triploblastic, coelomate; calcareous shell; unsegmented body with head, muscular foot, visceral hump; **mantle** over hump with mantle cavity housing feather-like gills; rasping organ **radula** in mouth; dioecious, oviparous, indirect development. Examples — *Pila*, *Pinctada*, *Sepia*, *Loligo*, *Octopus*, *Aplysia*, *Dentalium*, *Chaetopleura* (NCERT §4.2.8, pp. 44–45).
- **Echinodermata.** Marine, organ-system level; **adults radially symmetrical, larvae bilaterally symmetrical**; triploblastic, coelomate; endoskeleton of calcareous ossicles; **water vascular system** unique to them — used for locomotion, food capture/transport and respiration; no excretory system; sexes separate; external fertilisation; indirect development. Examples — *Asterias* (starfish), *Echinus* (sea urchin), *Antedon* (sea lily), *Cucumaria*, *Ophiura* (NCERT §4.2.9, p. 45).
- **Hemichordata.** Small group of worm-like marine animals; organ-system level, bilateral, triploblastic, coelomate; **stomochord** in collar region (rudimentary, similar to notochord); body of proboscis, collar and trunk; open circulation; gill respiration; **proboscis gland** for excretion. Examples — *Balanoglossus*, *Saccoglossus* (NCERT §4.2.10, p. 45).
- **Chordata — fundamentals.** Defined by **notochord, dorsal hollow nerve cord, paired pharyngeal gill slits**, post-anal tail and closed circulatory system. Three subphyla: **Urochordata** (notochord only in larval tail, e.g., *Ascidia*, *Salpa*, *Doliolum*), **Cephalochordata** (notochord head-to-tail, persistent throughout life, e.g., *Branchiostoma*/*Amphioxus*), and **Vertebrata** (notochord replaced by vertebral column in adult) (NCERT §4.2.11, pp. 45–46; Table 4.1, p. 46).
- **Vertebrata structure.** Two divisions — **Agnatha** (no jaw — Cyclostomata) and **Gnathostomata** (with jaw), which has super-classes **Pisces** (fins — Chondrichthyes + Osteichthyes) and **Tetrapoda** (limbs — Amphibia, Reptilia, Aves, Mammalia) (NCERT §4.2.11, p. 47, classification flow chart).
- **Cyclostomata.** All living members are ectoparasites on fishes; elongated body; 6–15 pairs of gill slits; sucking circular **jawless** mouth; no scales, no paired fins;

- cartilaginous cranium and vertebral column; closed circulation; marine but spawn in fresh water and die. Examples — **Petromyzon** (lamprey), **Myxine** (hagfish) (NCERT §4.2.11.1, p. 47).
- **Chondrichthyes.** Marine, streamlined cartilaginous fishes; mouth ventral; notochord **persistent** throughout life; gill slits separate, **no operculum**; placoid scales; teeth = modified, backwardly directed placoid scales; powerful jaws, predaceous; **no air bladder** so must swim continuously; two-chambered heart; poikilothermous; males have **claspers** on pelvic fins; internal fertilisation; many viviparous. Examples — **Scoliodon**, **Pristis**, **Carcharodon**, **Trygon** (NCERT §4.2.11.2, pp. 47–48).
 - **Osteichthyes.** Marine and freshwater bony fishes; streamlined body, mostly terminal mouth; four pairs of gills covered by **operculum**; **cycloid/ctenoid** scales; **air bladder** regulates buoyancy; two-chambered heart; poikilothermous; sexes separate; usually external fertilisation; mostly oviparous, direct development. Examples — **Exocoetus**, **Hippocampus**, **Labeo**, **Catla**, **Clarias**, **Betta**, **Pterophyllum** (NCERT §4.2.11.3, p. 48).
 - **Amphibia.** Aquatic + terrestrial; head + trunk (tail in some); moist skin without scales; eyelids; **tympanum** = ear; **cloaca** is common opening for alimentary, urinary, reproductive tracts; respiration by gills, lungs and skin; three-chambered heart (2 auricles + 1 ventricle); poikilothermous; external fertilisation; oviparous, indirect development. Examples — **Bufo**, **Rana**, **Hyla**, **Salamandra**, **Ichthyophis** (limbless) (NCERT §4.2.11.4, p. 48).
 - **Reptilia.** Mostly terrestrial; dry cornified skin with epidermal **scales/scutes**; no external ear openings (tympanum = ear); two pairs of limbs when present; heart usually three-chambered but **four-chambered in crocodiles**; poikilothermous; shed scales as skin cast; internal fertilisation; oviparous, direct development. Examples — **Chelone**, **Testudo**, **Chameleon**, **Calotes**, **Crocodilus**, **Alligator**, **Hemidactylus**; venomous snakes **Naja**, **Bangarus**, **Vipera** (NCERT §4.2.11.5, p. 49).
 - **Aves.** Feathers and beak; forelimbs modified into **wings**; hind limbs with scales for walking/swimming/clasping; skin dry, only oil gland at tail base; bones hollow with **pneumatic** air cavities; crop and gizzard in digestive tract; **four-chambered heart**; **homoiothermous** (warm-blooded); lungs with **air sacs**; internal fertilisation; oviparous, direct development. Examples — **Corvus**, **Columba**, **Psittacula**, **Struthio** (flightless), **Pavo**, **Aptenodytes**, **Neophron** (NCERT §4.2.11.6, pp. 49–50).
 - **Mammalia.** Most varied habitat range; unique trait — milk-producing **mammary glands**; two pairs of limbs adapted for diverse locomotion; **hair** on skin; external ears (**pinnae**); heterodont (different types of teeth); four-chambered heart; homoiothermous; respire by lungs; internal fertilisation; **viviparous** with few exceptions (e.g., **Ornithorhynchus**); direct development. Examples — **Ornithorhynchus** (oviparous platypus), **Macropus**, **Pteropus**, **Camelus**, **Macaca**, **Rattus**, **Canis**, **Felis**, **Elephas**, **Equus**, **Delphinus**, **Balaenoptera**, **Panthera tigris**, **Panthera leo** (NCERT §4.2.11.7, pp. 50–51).

2.2 Definitions to memorise

Term	Definition	Page
Cellular level of organisation	Cells arranged as loose aggregates with some division of labour (e.g., sponges)	37
Organ-system level	Organs associated into functional physiological systems	38
Coelom	Body cavity lined by mesoderm	39
Pseudocoelom	Body cavity where mesoderm is present as scattered pouches between ectoderm and endoderm	39
Acoelomate	Animal with no body cavity (e.g., Platyhelminthes)	39
Diploblastic	Two embryonic germ layers — ectoderm and endoderm — with mesoglea between	38
Triploblastic	Three germ layers including mesoderm (Platyhelminthes to Chordates)	39
Metameric segmentation	Body divided externally and internally into segments with serial organ repetition	39
Notochord	Mesodermally derived dorsal rod-like structure formed during embryonic development	39
Choanocytes (collar cells)	Flagellated cells lining spongocoel and canals of sponges	40
Spongocoel	Central cavity of sponges into which water enters via ostia	40
Cnidoblasts/ cnidocytes	Cells of cnidarians containing stinging capsules (nematocysts)	41
Hypostome	Elevation bearing the mouth in cnidarians	41
Metagenesis	Alternation of generations between polyp (asexual) and medusa (sexual) forms, e.g., <i>Obelia</i>	41
Comb plates	Eight rows of ciliated locomotory plates in ctenophores	42
Bioluminescence	Property of a living organism to emit light; well-marked in ctenophores	42
Flame cells	Specialised cells of platyhelminths for osmoregulation and excretion	42
Parapodia	Lateral appendages of <i>Nereis</i> for swimming	43
Nephridia	Annelid organs for osmoregulation and excretion	43
Malpighian tubules	Excretory organs of arthropods	44
Radula	File-like rasping organ in mollusc mouth	44
Water vascular system	Echinoderm-specific system for locomotion, food capture/ transport and respiration	45

Term	Definition	Page
Stomochord	Rudimentary notochord-like structure in collar region of hemichordates	45
Operculum	Gill cover in Osteichthyes (absent in Chondrichthyes)	47–48
Placoid scales	Tough minute scales on Chondrichthyes skin; teeth are modified placoid scales	47
Cloaca	Common chamber for alimentary, urinary and reproductive tracts in amphibians (and reptiles)	48
Pneumatic bones	Hollow long bones with air cavities in birds	49
Mammary glands	Milk-producing glands unique to mammals	50

2.3 Diagrams / processes to remember

- **Figure 4.1 (p. 38).** Radial symmetry (starfish-style) vs bilateral symmetry (crab) — direct visual for the symmetry section.
- **Figure 4.2 (p. 38).** Diploblastic (ectoderm + mesoglea + endoderm) vs triploblastic (ectoderm + mesoderm + endoderm) cross-sections.
- **Figure 4.3 (p. 39).** Coelomate vs Pseudocoelomate vs Acoelomate sectional view — high CUET-yield diagram.
- **Figure 4.4 (p. 40).** Master flow chart classifying Animalia by level of organisation → symmetry → coelom → phylum. Footnote: Echinodermata exhibits radial or bilateral symmetry depending on stage.
- **Figure 4.5 (p. 40).** Porifera examples — Sycon, Euspongia, Spongilla.
- **Figure 4.6 + 4.7 (p. 41).** Aurelia (medusa) vs Adamsia (polyp), plus cnidoblast diagram.
- **Figure 4.8 (p. 42).** Pleurobrachia showing comb plates.
- **Figure 4.10 (p. 43).** Roundworm — male vs female (females longer).
- **Figure 4.15 (p. 45).** Balanoglossus with labelled proboscis, collar, trunk.
- **Figure 4.16 (p. 46).** Chordate characters — notochord, nerve cord, gill slits, post-anal part.
- **Table 4.1 (p. 46).** Five-row Chordata vs Non-chordata comparison — frequent MCQ source.
- **Vertebrata classification flow chart (p. 47).** Agnatha vs Gnathostomata → Pisces (Chondrichthyes, Osteichthyes) vs Tetrapoda (Amphibia, Reptilia, Aves, Mammalia).
- **Table 4.2 (p. 51).** Phylum-wise grid of level, symmetry, coelom, segmentation, digestive/circulatory/respiratory systems and distinctive features — single most exam-critical table here.

2.4 Common confusions / NTA trap points

- **Echinodermata symmetry.** Easy trap — NCERT explicitly notes adults are radially symmetrical but larvae are bilaterally symmetrical; the Figure 4.4 footnote underscores this (p. 40, 45).
- **Heart chambers.** Two in fishes, three in amphibians and most reptiles, four in crocodiles, birds and mammals — students often forget the crocodile exception under Reptilia (pp. 48–50).
- **Operculum.** Present in Osteichthyes, **absent** in Chondrichthyes — examiners flip this often (pp. 47–48).
- **Air bladder.** Present in Osteichthyes (buoyancy), absent in Chondrichthyes (must swim continuously) (pp. 47–48).
- **Notochord persistence.** In Urochordata — only in larval tail; in Cephalochordata — head to tail throughout life; in Vertebrata — only embryonic, replaced by vertebral column (p. 46).
- **Cellular vs tissue level.** Porifera = cellular; Coelenterata and Ctenophora = tissue; Platyhelminthes = organ. Many students misclassify Coelenterata as organ-system (pp. 37–38).
- **Phylum of Limulus.** Arthropoda (living fossil — king crab), not Crustacea-only species or a separate phylum (p. 44).
- **Acoelomate examples.** Only Platyhelminthes — Porifera, Coelenterata, Ctenophora are listed as "Absent" coelom in Table 4.2 but are not termed acoelomate in the strict sense used at Platyhelminthes (p. 39, Table 4.2 p. 51).
- **Monoecious vs dioecious in Annelida.** Nereis is dioecious; earthworms and leeches are monoecious (p. 43).
- **Birds' "pneumatic" bones.** NCERT specifically says long bones are hollow with **air cavities** (pneumatic) — not "filled with marrow". Distractors often replace "pneumatic" with "marrow-filled".
- **Mammary glands vs hair.** Both are technically unique to mammals, but NCERT names mammary glands as **the most unique** mammalian feature (§4.2.11.7, p. 50). When forced to pick the **most** unique, mammary glands wins.
- **Egg-laying mammal.** Ornithorhynchus (platypus) is the NCERT-named oviparous mammal — a classic single-fact question (§4.2.11.7, p. 50).
- **Phylum-of-Hydra trap.** Hydra is a polyp (Coelenterata), not Porifera; **Spongilla** is the freshwater sponge.

Practice MCQs

Q1. Which phylum is characterised by the presence of choanocytes lining the spongocoel and a body skeleton of spicules or spongin fibres?

- A. Coelenterata
- B. Porifera
- C. Ctenophora
- D. Platyhelminthes

Q2. In which of the following animals is the body cavity NOT lined by mesoderm, but the mesoderm is present as scattered pouches between ectoderm and endoderm?

- A. Annelida
- B. Platyhelminthes
- C. Aschelminthes
- D. Mollusca

Q3. Read the following statements about Phylum Arthropoda and choose the correct option: I. It is the largest phylum of Animalia and includes insects. II. Respiratory organs include gills, book gills, book lungs or tracheal system. III. Circulatory system is of closed type. IV. Excretion takes place through malpighian tubules.

- A. I, II and IV only
- B. I, III and IV only
- C. II, III and IV only
- D. I, II, III and IV

 **12 more MCQs + answer key**

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PYQ Alignment

Animal Kingdom is a perennial CUET (UG) Biology favourite — roughly 8–12 questions across CUET 2023–25 papers have come from this chapter, with a heavy bias toward (i) example-to-phylum matches (especially **Limulus**, **Pheretima**, **Wuchereria**, **Octopus**, **Pleurobrachia**), (ii) statement-based questions on Table 4.2 features (coelom, symmetry, segmentation), and (iii) class-level distinctions within Vertebrata (Chondrichthyes vs Osteichthyes, heart chambers, viviparous/oviparous mammals). Assertion-reason items on "all vertebrates are chordates but..." and unique-feature questions (radula, water vascular system, mammary glands, comb plates) appear almost every cycle. See </pyq/biology> for the full PYQ archive.

CUET 2023 — Actual PYQs from this chapter

Q.2 (CUET 2023) Out of the following which one is not a hermaphrodite?

- A) Sponge
- B) Earthworm
- C) Leech
- D) Cockroach

Tests: aligns with §2 (animal kingdom — hermaphroditism in invertebrates) **Answer:** Not in extracted key — verify against official NTA key

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