

CUET · BIOLOGY · CLASS XI · CODE 304

Structural Organisation in Animals

CUET unit: Structural Organisation in Plants and Animals →
Structural Organisation in Animals

By UniDrill · NCERT-grounded study material

WWW.UNIDRILL.IN

UniDrill

Snapshot

- The 2026-27 reprint of this chapter restricts itself to a single representative vertebrate — the frog (**Rana tigrina**) — and uses it to illustrate how tissues organise into organs and organ systems in a multicellular animal.
- The opening section establishes the cell → tissue → organ → organ system hierarchy and notes that all complex animals are built from only four basic tissue types (epithelial, connective, muscular, neural), with the heart given as the example organ containing all four.
- The bulk of the content (§7.2) is the morphology and anatomy of the frog: external features, digestive, respiratory, circulatory & lymphatic, excretory, neural/endocrine, sense organs, and male/female reproductive systems.
- Distinctive frog facts the NCERT repeatedly emphasises — three-chambered heart (2 atria + 1 ventricle), nucleated RBCs, ureotelic excretion, hepatic and renal portal systems, 10 pairs of cranial nerves, 10–12 vasa efferentia, female lays 2500–3000 ova — are precisely the kind of recall CUET tests.
- CUET treats this chapter as high-yield because every paragraph yields a clean, single-answer fact (numbers, names, locations), making it ideal for NTA-style MCQs.

Detailed Notes

2.1 Core concepts

- In multicellular animals, a group of similar cells along with intercellular substances performing a specific function is called a **tissue**; tissues organise in specific proportion and pattern to form organs, and two or more organs performing a common function form an organ system (NCERT §7 intro, p. 79).
- All complex animals consist of only four basic types of tissues — epithelial, connective, muscular and neural — and the heart is an organ that contains all four (NCERT §7.1, p. 80).
- **Morphology** is the external appearance of organs/body parts in animals; **anatomy** is the study of morphology of internal organs (NCERT §7.1, p. 80).
- Frogs belong to class **Amphibia** of phylum **Chordata**; the common Indian species is **Rana tigrina**; they are **poikilotherms** (cold-blooded), exhibit **mimicry** (protective

camouflage), undergo **aestivation** in summer and **hibernation** in winter (NCERT §7.2, p. 80).

- External morphology: skin is smooth, moist and slippery due to mucus; dorsal side olive green with dark irregular spots, ventral side pale yellow; frog never drinks water but absorbs it through the skin; body divisible only into **head and trunk** — neck and tail are absent (NCERT §7.2.1, pp. 80–81).
- Eyes are bulged and covered by a **nictitating membrane**; tympanum on either side of eyes receives sound; **hind limbs have 5 webbed digits** and are larger/muscular, **forelimbs have 4 digits**; sexual dimorphism — males have **vocal sacs** and a **copulatory pad on the first digit of the forelimb** (NCERT §7.2.1, p. 81).
- Digestive system: alimentary canal is short because frogs are carnivores; sequence — mouth → buccal cavity → pharynx → oesophagus → stomach → intestine → rectum → cloaca; **bilobed tongue** captures food; stomach secretes **HCl and gastric juices**; bile from gall bladder and pancreatic juice from pancreas reach the **duodenum** via a **common bile duct**; bile emulsifies fat, pancreatic juice digests carbohydrates and proteins; absorption occurs via **villi and microvilli** (NCERT §7.2.2, pp. 81–82).
- Respiration is by three routes: (a) **cutaneous** through skin in water (and during aestivation/hibernation), (b) **buccopharyngeal** through buccal cavity on land, and (c) **pulmonary** through a pair of pink, elongated, sac-like lungs in the thorax (NCERT §7.2.2, p. 82).
- Vascular system is **closed**; heart is three-chambered (two atria + one ventricle), enclosed in **pericardium**; **sinus venosus** (triangular) joins the right atrium and receives blood via the **vena cava**; ventricle opens into a sac-like **conus arteriosus** on the ventral side; **hepatic portal** (liver–intestine) and **renal portal** (kidney–lower body) systems are present; **RBCs are nucleated** and contain haemoglobin; **lymph lacks a few proteins and RBCs**, and the lymphatic system consists of lymph, lymph channels and lymph nodes (NCERT §7.2.2, p. 82).
- Excretory system: paired kidneys (compact, dark red, bean-like, on both sides of vertebral column), ureters, urinary bladder, cloaca; functional unit is the **uriniferous tubule / nephron**; in **males** the ureters function as **urinogenital ducts** opening into cloaca, in **females** the ureters and oviducts open separately into the cloaca; frog is **ureotelic** (NCERT §7.2.2, pp. 82–83).
- Nervous system has three divisions — **central** (brain + spinal cord), **peripheral** (cranial + spinal nerves) and **autonomic** (sympathetic + parasympathetic); **10 pairs of cranial nerves**; brain enclosed in cranium and divided into forebrain (olfactory lobes + paired cerebral hemispheres + unpaired diencephalon), midbrain (pair of optic lobes) and hindbrain (cerebellum + medulla oblongata); medulla passes through the **foramen magnum** into the spinal cord (NCERT §7.2.2, p. 83).
- Endocrine glands listed in frog: **pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals and gonads** (NCERT §7.2.2, p. 83).

- Sense organs of frog: touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes — simple, single-unit), hearing (tympanum + internal ear); **external ear is absent**, only tympanum is visible externally; the ear functions in both hearing and balance/equilibrium (NCERT §7.2.2, p. 83).
- Male reproductive system: pair of yellowish ovoid **testes** attached to the upper part of kidneys by a double fold of peritoneum called **mesorchium**; **10–12 vasa efferentia** arise from the testes, enter the kidneys, open into **Bidder's canal**, and ultimately drain into the urinogenital duct → cloaca, which is a small median chamber passing faeces, urine and sperms (NCERT §7.2.2, pp. 83–84).
- Female reproductive system: pair of ovaries situated near kidneys with **no functional connection** to them; a pair of **oviducts** opens **separately** into the cloaca; a mature female lays **2500–3000 ova** at a time; fertilisation is **external** in water; development passes through a **tadpole larval stage** that undergoes **metamorphosis** into adult (NCERT §7.2.2, p. 84).
- Ecological/economic value: frogs eat insects and protect crops, serve as an important link in the food chain/web; in some countries their muscular legs are eaten (NCERT §7.2.2, p. 84).

2.2 Definitions to memorise

Term	Definition	Page
Tissue	Group of similar cells along with intercellular substances performing a specific function	79
Organ system	Two or more organs that perform a common function by physical and/or chemical interaction	79
Morphology (in animals)	External appearance of organs or parts of the body	80
Anatomy	Study of morphology of internal organs in animals	80
Poikilotherm	Animal whose body temperature varies with the environment (cold-blooded)	80
Mimicry	Protective coloration that allows the frog to hide from enemies (camouflage)	80
Aestivation	Summer sleep — shelter in deep burrows to escape extreme heat	80
Hibernation	Winter sleep — shelter in deep burrows to escape extreme cold	80
Nictitating membrane	Membrane covering the bulged eyes of the frog, protecting them while in water	80
Cutaneous respiration	Gas exchange through the skin (used in water and during aestivation/hibernation)	82
	Gas exchange through lungs on land	82

Term	Definition	Page
Pulmonary respiration		
Sinus venosus	Triangular structure joining the right atrium of frog heart; receives blood via vena cava	82
Conus arteriosus	Sac-like structure on the ventral side of the heart into which the ventricle opens	82
Hepatic portal system	Venous connection between liver and intestine	82
Renal portal system	Venous connection between kidney and lower parts of the body	82
Ureotelic	Animal that excretes urea as its nitrogenous waste (e.g., frog)	83
Mesorchium	Double fold of peritoneum that attaches testes to the upper part of kidneys	83
Bidder's canal	Canal in the kidney into which vasa efferentia open before draining into the urinogenital duct	84
Cloaca	Small median chamber that passes faecal matter, urine and sperms to the exterior	84

2.3 Diagrams / processes to remember

- **Figure 7.1, p. 80** — External features of frog: labels head, trunk, eye, forelimb, hind limb. Memorise that neck and tail are absent.
- **Figure 7.2, p. 81** — Internal organs of frog with complete digestive system: heart, oesophagus, liver, gall bladder, lung, stomach, fat bodies, kidney, ureter, urinary bladder, intestine, rectum, cloaca, cloacal aperture. Note the relative positions — heart and lungs above, kidneys ventral to fat bodies, urinary bladder ventral to rectum.
- **Figure 7.3, p. 83** — Male reproductive system: testis, vasa efferentia, kidney, adrenal gland, urinogenital duct, urinary bladder, rectum, cloaca, cloacal aperture. The urinogenital duct (a single tube) is the key male-specific feature.
- **Figure 7.4, p. 83** — Female reproductive system: ovary with ova, oviduct, ureter (separate from oviduct), urinary bladder, cloaca, cloacal aperture. The separateness of ureter and oviduct is the key female-specific feature.
- **Process — pathway of food:** mouth → buccal cavity → pharynx → oesophagus → stomach → duodenum → intestine → rectum → cloaca (p. 81–82).
- **Process — brain divisions:** forebrain (olfactory lobes + cerebral hemispheres + diencephalon) → midbrain (optic lobes) → hindbrain (cerebellum + medulla oblongata) → spinal cord through foramen magnum (p. 83).

2.4 Common confusions / NTA trap points

- **Four digits vs five digits** — Forelimbs end in 4 digits, hind limbs in 5 webbed digits. NTA loves to flip these.
- **Heart chambers** — The frog heart is **three-chambered (2 atria + 1 ventricle)**, not four. The sinus venosus and conus arteriosus are accessory chambers but the chamber count is three.
- **RBCs of frog are nucleated** — A common distractor states "non-nucleated like mammals." NCERT explicitly states frog RBCs are nucleated (p. 82).
- **Male vs female urogenital plumbing** — In males the ureter doubles as the urinogenital duct (sperm + urine share the same exit); in females ureters and oviducts open **separately** into the cloaca. Ovaries have **no functional connection** with kidneys (pp. 83–84).
- **Vasa efferentia count** — 10–12 (not 10 pairs). Cranial nerves are **10 pairs**. NTA mixes these two "tens."
- **Aestivation vs hibernation** — Aestivation = summer sleep, hibernation = winter sleep. During **both**, gas exchange takes place through skin (p. 82).
- **Bile route** — Bile is **secreted by liver, stored in gall bladder**, and reaches the duodenum via the **common bile duct** along with pancreatic juice (p. 82).
- **Skin respiration vs lung respiration** — Skin is the only respiratory surface in water and during hibernation/aestivation; lungs operate on land along with skin and buccal cavity (p. 82). A common trap is "only lungs on land."
- **Tongue attachment** — The frog's tongue is bilobed at the tip and attached to the front of the floor of the buccal cavity (free posteriorly), allowing it to be flicked out (p. 81).
- **Hepatic vs renal portal system** — The frog has both a hepatic portal system (intestine to liver) and a renal portal system (hind limbs to kidneys) (p. 82); the renal portal system is **absent in mammals** — an NTA contrast trap.

2.5 Quick comparison table — frog systems at a glance

#	Feature	Detail (NCERT)	Page
1	Class	Amphibia	80
2	Scientific name	<i>Rana tigrina</i>	80
3	Body divisions	Head + trunk (no neck/tail)	80
4	Skin type	Smooth, moist, slippery, glandular	80
5	Forelimb digits	4	80
6	Hind limb digits	5, webbed	80
7	Heart chambers	3 (2 atria + 1 ventricle)	82

#	Feature	Detail (NCERT)	Page
8	RBC nucleus	Nucleated	82
9	Respiratory surfaces	Skin, buccal cavity, lungs	82
10	Excretory product	Urea (ureotelic)	83
11	Kidney type	Mesonephric, dark red, bean-shaped	82
12	Vasa efferentia	10–12 from testes	83
13	Male urinogenital duct	Single (ureter = vas deferens)	83
14	Female ducts	Ureter & oviduct open separately	84
15	Fertilisation / development	External; indirect (tadpole)	84

Practice MCQs

Q1. The frog heart consists of:

- A.** Two atria and two ventricles
- B.** One atrium and two ventricles
- C.** Two atria and one ventricle
- D.** One atrium and one ventricle

Q2. Which of the following statements about the frog's reproductive plumbing is correct?

- A.** In males, ureters and the genital duct open separately into the cloaca.
- B.** In females, the oviduct and ureter open separately into the cloaca.
- C.** Ovaries are functionally connected to the kidneys via vasa efferentia.
- D.** Vasa efferentia arise from the ovaries and open into Bidder's canal.

Q3. Match the following structures of the frog with their descriptions: | Column I | Column II | |---|---| | (i) Sinus venosus | (1) Sac-like structure on ventral side of heart | | (ii) Conus arteriosus | (2) Membrane covering the heart | | (iii) Pericardium | (3) Triangular structure joining right atrium | | (iv) Mesorchium | (4) Double fold of peritoneum attaching testes to kidneys |

- A. i-3, ii-1, iii-2, iv-4
- B. i-1, ii-3, iii-2, iv-4
- C. i-3, ii-2, iii-1, iv-4
- D. i-4, ii-1, iii-2, iv-3

 **9 more MCQs + answer key**

Get UniDrill Pro · ₹199/year · unidrill.in/pricing

PYQ Alignment

This chapter is a perennial CUET favourite: in every CUET (UG) cycle from 2023 to 2025, recall MCQs from the frog section have appeared — typically targeting heart chambers, vasa efferentia count, the ureotelic nature of the frog, sexual dimorphism (vocal sacs, copulatory pad, digit count), and labelling-style questions on the male/female reproductive diagrams (Figures 7.3 and 7.4). Statement-based "which of the following is correct" items on RBC nucleation, hepatic vs renal portal systems, and the brain-region table are also routinely set.