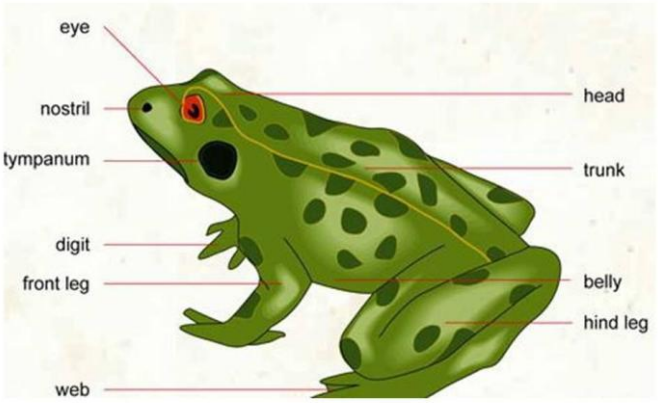
Frog – Rana tigrina

Systematic Position:

- **Phylum:** Chordata
- **Class:** Amphibia
- **Genus:** Rana
- **Species:** tigrina



Key Features:

- Cold-blooded (poikilotherms).
- Amphibious (land + water).
- Protective coloration (mimicry) for camouflage.
- Undergo **aestivation** (summer sleep) and **hibernation** (winter sleep).
- Exhibit sexual dimorphism: Male has **vocal sacs** and **copulatory pad**.

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1. Morphology

- **Body divisions:** Head + trunk; neck and tail absent.
- **Skin:** Moist, smooth, slippery due to mucous glands.
  - Dorsal: Olive green with irregular dark spots.
  - Ventral: Pale yellow.
- **Eyes:** Bulged, with **nictitating membrane** for protection in water.
- **Ears:** Membranous **tympanum**.
- **Limbs:**
  - Hind limbs: Longer, muscular, 5 digits, webbed (swimming).
  - Forelimbs: 4 digits.
- **Sexual dimorphism:** Male – **vocal sacs**, **copulatory pad**; Female – absent.

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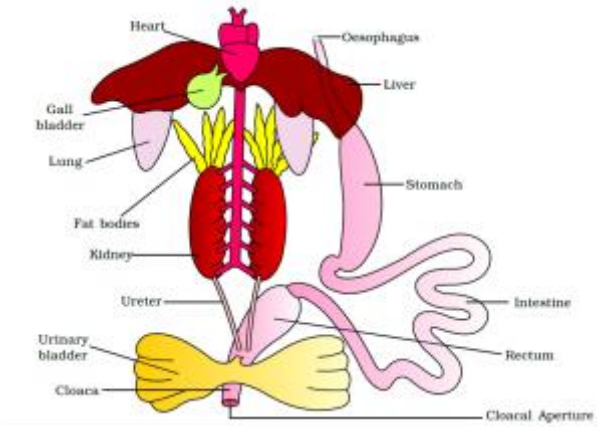
2. Digestive System

- **Type:** Carnivorous; alimentary canal **short**, small intestine is reduced.
- **Components:** Mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine, rectum, cloaca + digestive glands (liver, pancreas, gall bladder).
- **Food pathway:** Mouth → buccal cavity → pharynx → oesophagus → stomach → duodenum → small intestine → rectum → cloaca.



- **Food pathway and digestion:**
  - Food captured by **bilobed tongue**.
  - In stomach: Gastric juice + HCl partially digest food into **chyme**.
  - **Duodenum (1st part of small intestine):** Receives chyme; **common bile duct** delivers bile (emulsifies fat) and pancreatic juice (digests carbohydrates & proteins).
  - **Small intestine:** Final digestion occurs; nutrients absorbed by **villi and microvilli**.
  - **Undigested waste:** Moves to rectum → exits via **cloaca**.
- **Cloaca:** Common chamber for feces, urine, and reproductive products.
- **Digestive gland functions:**
  - Liver → bile (emulsifies fat).
  - Pancreas → pancreatic juice (carbohydrates & proteins).
  - Gallbladder → stores bile.

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3. Respiratory System

- **Aquatic:** Cutaneous (through skin).
- **Terrestrial:** Pulmonary (lungs), buccal cavity, skin.
- **Special:** During aestivation/hibernation → only cutaneous respiration.
- **Lungs:** Paired, sac-like; air enters nostrils → buccal cavity → lungs.

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4. Circulatory System

- **Type:** Closed, double circulation.
- **Heart:** 3-chambered (2 atria, 1 ventricle), pericardium-covered.
    - **Right atrium:** Receives deoxygenated blood via **vena cava**.
    - **Sinus venosus:** Thin-walled triangular structure; stores blood before entering right atrium.
    - **Ventricle:** Pumps mixed blood into **conus arteriosus**.
    - **Conus arteriosus function:** Ensures proper separation of oxygenated & deoxygenated blood → directs blood to systemic & pulmonary arches.
- **Blood:** Plasma + nucleated RBC, WBC, platelets.
- **Arteries:** Carry blood away from heart.
- **Veins:** Return blood to heart.
- **Special venous connections:** Hepatic portal system (liver & intestine), Renal portal system (kidney & posterior body).
- **Lymphatic system:** Lymph, lymph channels, lymph nodes.

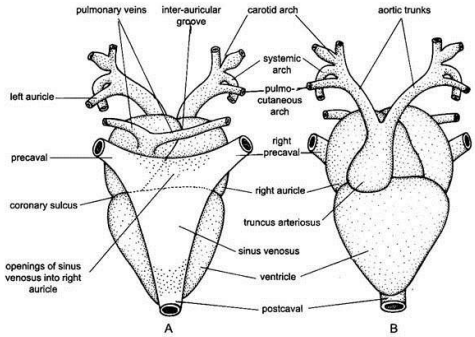

Fig. 18.40. Frog. Structure of heart. A–Dorsal view; B–Ventral view.

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5. Excretory System

- **Components:** Paired kidneys, ureters, urinary bladder, cloaca.
- **Functional unit:** Nephron (uriniferous tubules).
- **Male:** Ureters act as **urogenital ducts** (carry urine + sperm) → open into cloaca.
- **Female:** Ureters → cloaca; oviducts open separately.
- **Waste type:** Urea → ureotelic.

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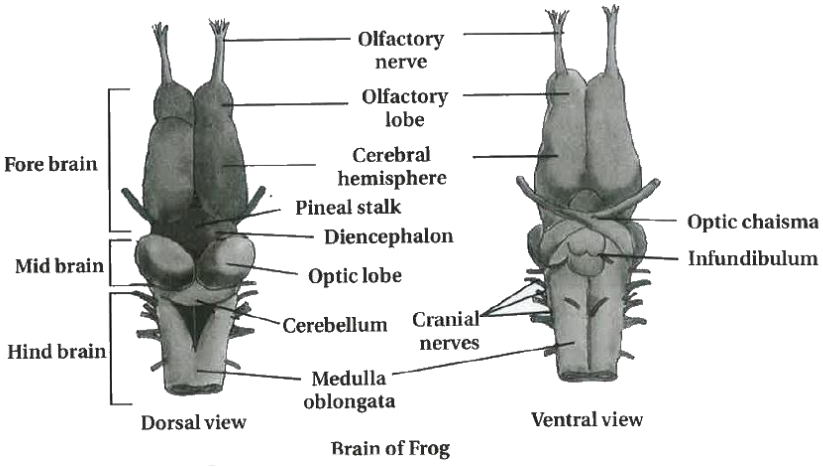
6. Nervous & Sense Organs

- **Endocrine glands:** Pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals, gonads.
    - **Adrenal gland function:** Secretes hormones controlling metabolism, stress response, salt & water balance.
- **Nervous system:**
    - CNS: Brain + spinal cord
    - PNS: Cranial + spinal nerves
    - ANS: Sympathetic + parasympathetic
- **Brain divisions:**
    - Forebrain: Olfactory lobes, cerebral hemispheres, diencephalon
    - Midbrain: Optic lobes
    - Hindbrain: Cerebellum, medulla oblongata
- **Cranial nerves: 10 pairs** arise from brain.
- **Sense organs:** Touch (papillae), taste (buds), smell (nasal epithelium), vision (eyes), hearing (tympanum + internal ear).



Brain of Frog

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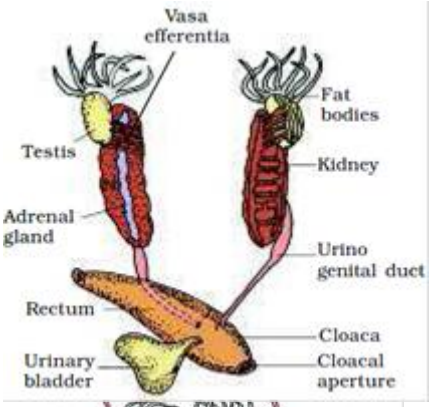
7. Reproductive System

Male

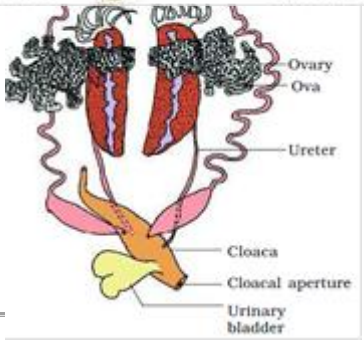
- Paired **testes**, attached to kidneys via **mesorchium**.

- **Vasa efferentia (10–12):** Arise from testes → kidneys → **Bidder's canal** → **urogenital duct (sperm duct)** → cloaca.
    - **Bidder's canal:** Connects testes to kidneys; carries sperm from testes to kidney → urogenital duct.
- **Cloaca:** Common chamber for feces, urine, sperm.
- **Accessory organs:** Vocal sacs, copulatory pad (forelimb).



Female

- Paired **ovaries** near kidneys; no connection with kidneys.
- Paired **oviducts** open separately into cloaca.
- **Oviduct function:** Receives eggs from ovaries, secretes albumin & jelly coat around eggs.
- **Eggs:** Large, yolky, **telolecithal (large yolk)**, spherical; laid in water (~2500–3000).
  Vitelline membrane: Inner, primary membrane.
  Jelly coat: Outer, thick, adhesive, secreted by oviduct.
  Functions of jelly coat: Protection, keeps moist, deters predators, aids fertilization, holds eggs in clusters.



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8. Fertilization & Development

- **Fertilization:** External, in water.
- **Development (Metamorphosis):**
    1. **Zygote → Early Tadpole → Late Tadpole → Adult Frog**
    2. **Tadpole stage:** Aquatic larva, gills, tail, herbivorous.
    3. **Metamorphosis:** Gradual development of limbs, lungs, loss of tail, development of carnivorous diet → adult frog.
- **Early tadpole:** Fish-like, aquatic, gills, tail present, herbivorous (algae).
- **Late tadpole:** Hind limbs develop first, then forelimbs; tail gradually resorbed.
- **Transition:** Lungs develop → tadpole becomes terrestrial.
- **Adult frog:** Carnivorous, lungs functional, limbs fully formed, tail absent.
- **Significance:** Adaptation to aquatic and terrestrial life.

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9. Digestive & Cloacal Functions

- **Cloaca:** Receives feces, urine, and reproductive products → exits to external environment.
- Digestive system: **Short intestine** due to carnivorous diet; nutrients absorbed by villi & microvilli in small intestine.

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10. Economic Importance

- Controls insect pests → protects crops.
- Maintains ecological balance (food chain & food web).
- Muscular legs used as food in some countries.