

Biology

Animal kingdom

General Characteristics

- Commonly known as **sponges**.
- Mostly marine; a few are freshwater.
- Body is generally asymmetrical.
- They are primitive multicellular animals.
- Show cellular level of organisation.

Canal System

- Body has a water transport (canal) system.
- Water enters through **ostia** (minute pores).
- It passes into the **spongocoel** (central cavity).
- Water comes out through the **osculum**.
- Functions of the canal system:
 - Food collection
 - Respiration
 - Removal of wastes

Special Cells

- Choanocytes (collar cells)** line the canals and spongocoel.
- They help in food capture and water movement.

Digestion

- Digestion is **intracellular**.

Skeleton

- Skeleton is made of **spicules** or **spongin fibres**.
- It provides support and protection.

Reproduction

- They are **hermaphrodites** (same individual produces eggs and sperms).
- Asexual reproduction occurs by **fragmentation**.
- Sexual reproduction occurs by the formation of **gametes**.
- Fertilisation is **internal**.
- Development is **indirect** and includes a **larval stage**.

Examples

Sycon (Scypha), Spongilla (Freshwater sponge), Euspongia (Bath sponge).

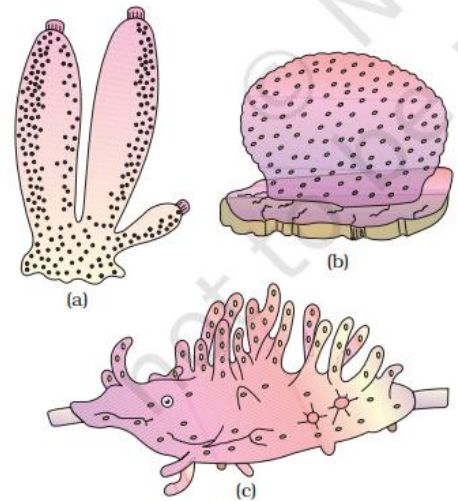


Figure Examples of Porifera : (a) Sycon (b) Euspongia (c) Spongilla

❖ **Phylum Cnidaria (Coelenterata)**

Phylum – Cnidaria (Coelenterata)

General Characteristics

- Mostly aquatic and marine animals.
- They are sessile or free-swimming.
- Body shows radial symmetry.
- Tissue level of organisation is present.
- They are diploblastic animals.

Cnidocytes (Cnidoblasts)

- The name *Cnidaria* is derived from cnidocytes (cnidoblasts).
- These cells contain nematocysts (stinging capsules).
- They are present on the tentacles and body.
- Functions:
 - Anchorage

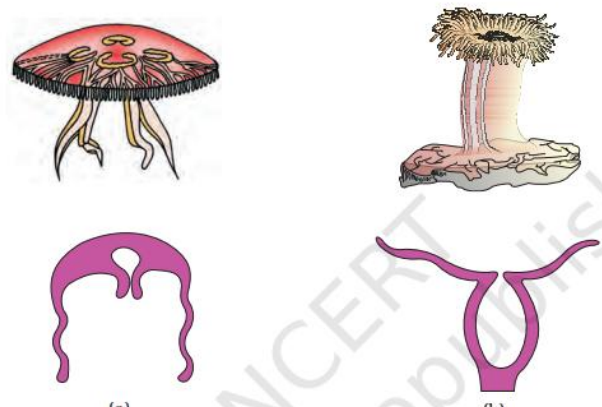


Figure Examples of Coelenterata indicating outline of their body form : (a) Aurelia (Medusa) (b) Adamsia (Polyp)

- Defence
- Capture of prey

Body Structure

- Body has a gastrovascular cavity.
- There is only one opening (mouth) on the hypostome.

Digestion

- Digestion is extracellular and intracellular.

Skeleton

- Corals have a calcium carbonate (CaCO_3) skeleton.

Body Forms

1. Polyp

- Sessile and cylindrical.
- Examples: **Hydra**, **Adamsia**

2. Medusa

- Free-swimming and umbrella-shaped.
- Examples: **Aurelia (Jellyfish)**

Metagenesis

- Seen in **Obelia**.
- Polyp produces Medusa by asexual reproduction.
- Medusa produces Polyp by sexual reproduction.

Examples

Physalia, Adamsia, Pennatula, Gorgonia, Meandrina, Aurelia, Hydra, Obelia.

❖ Phylum – Ctenophora (Comb Jellies)

General Characteristics

- Commonly known as **Sea walnuts** or **Comb jellies**.
- They are exclusively marine animals.
- Body shows radial symmetry.
- They are diploblastic.
- Show tissue level of organisation.

Body Structure

- Body has **eight rows of ciliated comb plates**.
- Comb plates help in locomotion.

Digestion

- Digestion is both **extracellular** and **intracellular**.

Special Feature

They show **bioluminescence** (ability to produce light).

Reproduction

- They are hermaphrodites (sexes are not separate).
- Reproduction is only by **sexual method**.
- Fertilisation is **external**.
- Development is **indirect**.

Examples **Pleurobrachia, Ctenoplana.**

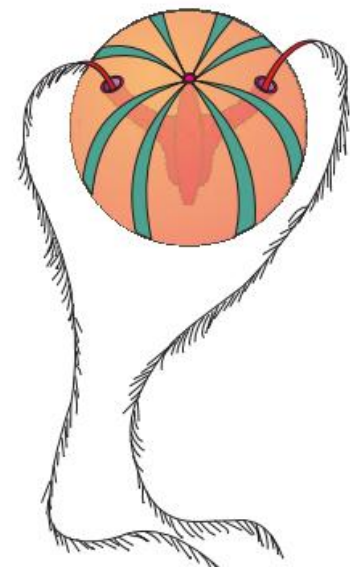


Figure 1 Example of Ctenophora (Pleurobrachia)

❖ Phylum – Platyhelminthes (Flatworms)

General Characteristics

- Body is dorsoventrally flattened.
- Commonly called **Flatworms**.
- Mostly endoparasites found in animals and humans.
- Body shows bilateral symmetry.
- They are triploblastic.
- They are acoelomate.
- Show organ level of organisation.

Special Features

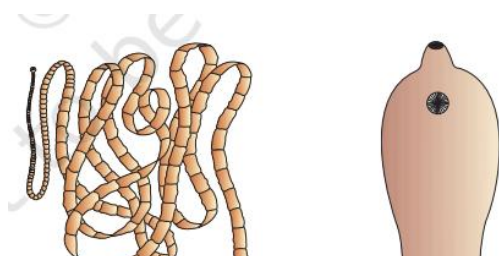


Figure Examples of Platyhelminthes : (a) Tape worm (b) Liver fluke

- Parasitic forms possess **hooks and suckers**.
- Some absorb nutrients directly through the body surface.
- **Flame cells** help in excretion and osmoregulation.

Reproduction

- They are hermaphrodites (sexes are not separate).
- Fertilisation is **internal**.
- Development occurs through **many larval stages**.

Special Character : **Planaria** has a high power of regeneration.

Examples

Taenia (Tapeworm), Fasciola (Liver fluke), Planaria.

❖ Phylum – Aschelminthes (Roundworms)

General Characteristics

- Body is circular in cross-section.
- Commonly called **Roundworms**.
- They may be free-living or parasitic.
- Found in aquatic, terrestrial habitats, and inside plants and animals.
- Show organ-system level of organisation.
- They are bilaterally symmetrical.
- They are triploblastic.
- They are pseudocoelomate animals.

Body Structure

- Alimentary canal is complete.
- Muscular pharynx is well developed.
- Excretion takes place through an **excretory tube** and **excretory pore**.

Reproduction

- Sexes are separate (**dioecious**).
- Females are usually longer than males.
- Fertilisation is **internal**.
- Development may be **direct** or **indirect**.

Examples

Ascaris (Roundworm), Wuchereria (Filaria worm), Ancylostoma (Hookworm).



Example of Aschelminthes: Roundworm

❖ Phylum – Annelida (Segmented Worms)

General Characteristics

- They may be aquatic (marine and freshwater) or terrestrial.
- They are free-living or parasitic.
- Show organ-system level of organisation.
- Body shows bilateral symmetry.
- They are triploblastic.
- They are coelomate animals.
- Body is metamerically segmented.

Body Structure

- Body is divided into ring-like segments called **metameres**.
- Longitudinal and circular muscles help in locomotion.
- Aquatic forms like **Nereis** possess **parapodia** for swimming.

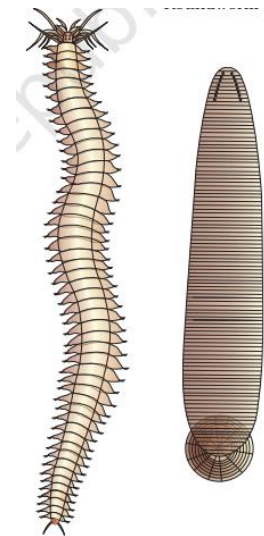
Organ Systems

- Closed circulatory system is present.
- **Nephridia** help in excretion and osmoregulation.
- Nervous system consists of paired ganglia and a double ventral nerve cord.

Reproduction

- **Nereis** is dioecious (sexes separate).
- **Earthworm** and **Leech** are monoecious (hermaphrodites).
- Reproduction is sexual.

Examples: Nereis, Pheretima (Earthworm), Hirudinaria (Blood-sucking leech).



Examples of Annelida : (a) Nereis (b) Hirudinaria

❖ Phylum – Echinodermata

General Characteristics

- Commonly called **spiny-skinned animals**.
- They are exclusively marine.
- Show organ-system level of organisation.
- Adults are **radially symmetrical**.
- Larvae are **bilaterally symmetrical**.
- They are triploblastic and coelomate animals.

Body Structure

- Endoskeleton is made of **calcareous ossicles**.
- Digestive system is complete.
- Mouth is present on the **ventral (lower)** side.
- Anus is present on the **dorsal (upper)** side.

Special Feature

- **Water vascular system** is present.
- It helps in:
 1. Locomotion
 2. Food capture and transport
 3. Respiration

Excretion

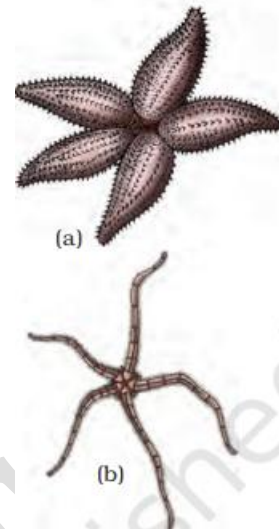
- Excretory system is absent.

Reproduction

- Sexes are separate (**dioecious**).
- Reproduction is sexual.
- Fertilisation is usually **external**.
- Development is **indirect** with a free-swimming larva.

Examples

Asterias (Starfish), Echinus (Sea urchin), Antedon (Sea lily), Cucumaria (Sea cucumber), Ophiura (Brittle star).



Examples of Echinodermata : (a) Asterias (b) Ophiura

❖ Phylum – Hemichordata

General Characteristics

- They are worm-like marine animals.
- Show organ-system level of organisation.
- They are bilaterally symmetrical.
- They are triploblastic.
- They are coelomate animals.
- They possess a **stomochord** in the collar region.

Body Structure

- Body is cylindrical.
- Body is divided into:
 - Proboscis
 - Collar
 - Trunk

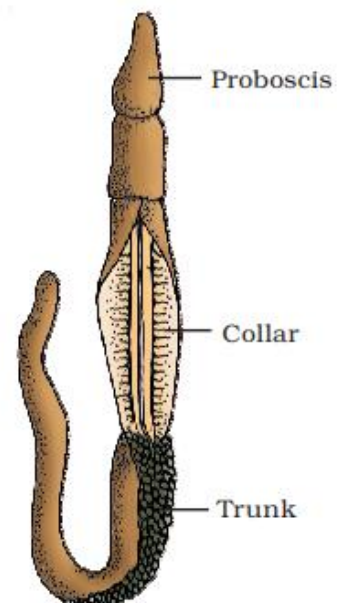
Organ Systems

- Circulatory system is **open type**.
- Respiration takes place through **gills**.
- Excretory organ is the **proboscis gland**.

Reproduction

- Sexes are separate (**dioecious**).
- Fertilisation is **external**.
- Development is **indirect**.

Examples : Balanoglossus, Saccoglossus.

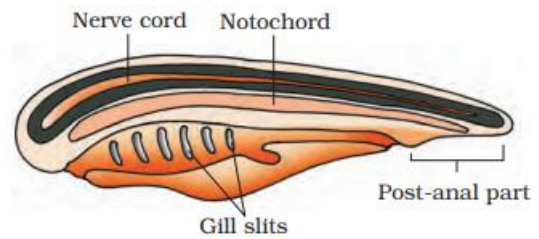


Balanoglossus

❖ Phylum – Chordata

General Characteristics

- Notochord is present at least in the embryonic stage.
- Dorsal hollow nerve cord is present.
- Paired pharyngeal gill slits are present.
- Post-anal tail is present.
- Show organ-system level of organisation.
- They are bilaterally symmetrical.
- They are triploblastic.
- They are coelomate animals.
- Circulatory system is **closed type**.



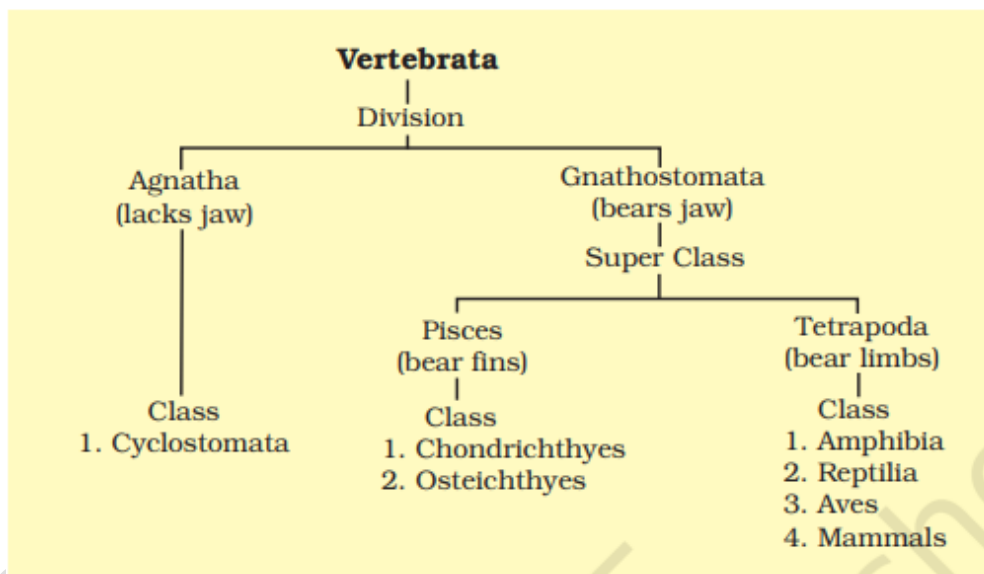
Chordata characteristics

Examples

Urochordata, Cephalochordata and Vertebrata (Fishes, Amphibians, Reptiles, Birds and Mammals).

❖ Difference between chordates and non chordates

Feature	Chordates	Non-chordates
1. Notochord	Present	Absent
2. Central nervous system	Dorsal, hollow and single	Ventral, solid and double
3. Pharynx	Perforated by gill slits	Gill slits absent
4. Heart	Ventral	Dorsal, if present
5. Post-anal tail	Present	Absent



❖ Classes of Vertebrata

1. Class – Cyclostomata

- They are **jawless vertebrates**.
- Most are **ectoparasites** on fishes.
- Body is **long and cylindrical**.
- They have **6–15 pairs of gill slits** for breathing.
- Mouth is **circular and sucking**, without jaws.
- Body has **no scales** and **no paired fins**.
- Skeleton is made of **cartilage**.
- They have **closed blood circulation**.
- They live mainly in the **sea**.
- They migrate to **freshwater for spawning**.
- After spawning, they usually **die**.
- Larvae change their form (**metamorphosis**) and return to the sea.



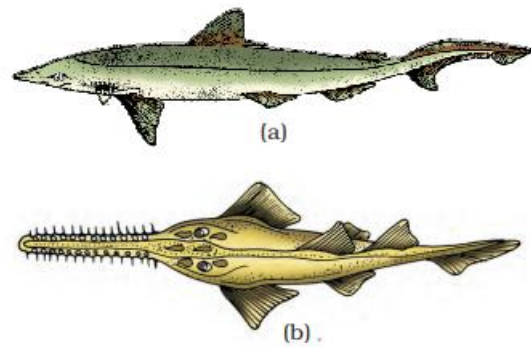
jawless vertebrate - Petromyzon

Examples:

- *Petromyzon* – Lamprey
- *Myxine* – Hagfish

2. Class – Chondrichthyes

- These are **cartilaginous** fishes.
- They are mostly **marine**.
- Their endoskeleton is made of **cartilage**.
- Body is **streamlined**.
- Mouth is present on the **ventral side**.
- **Notochord** remains throughout life.
- They have **separate gill slits**.
- Gill slits have **no operculum (gill cover)**.
- Skin has **placoid scales**.
- Their teeth are modified placoid scales and point **backwards**.
- Jaws are **strong**, and most are **predators**.
- They have **no air bladder**, so they must keep swimming to avoid sinking.
- Heart is **two-chambered**: one auricle + one ventricle.
- They are **cold-blooded**.
- Sexes are separate.
- Fertilisation is **internal**.
- Males have **claspers** on pelvic fins.
- Some have **electric organs** (*Torpedo*).
- Some have a **poisonous sting** (*Trygon*).



Example of Cartilaginous fishes : (a) *Scoliodon* (b) *Pristis*

Examples:

- *Scoliodon* – Dog fish
- *Pristis* – Saw fish
- *Carcharodon* – Great white shark
- *Trygon* – Sting ray

3. Class – Osteichthyes

- These are **bony** fishes.
- They live in **marine as well as freshwater**.
- Endoskeleton is made of **bone**.
- Body is generally **streamlined**.
- Mouth is mostly **terminal**.
- They have **four pairs of gills**.
- Gills are covered by an **operculum (gill cover)**.
- Skin has **cycloid or ctenoid scales**.
- **Air bladder is present** and helps in maintaining buoyancy.
- Heart is **two-chambered**.
- They are **cold-blooded**.
- Sexes are separate.
- Fertilisation is usually **external**.
- They are mostly **oviparous** (lay eggs).
- Development is generally **direct**.

Examples:

- Marine: *Exocoetus* – Flying fish, *Hippocampus* – Sea horse
- Freshwater: *Labeo* – Rohu, *Catla* – Katla, *Clarias* – Magur
- Aquarium: *Betta* – Fighting fish, *Pterophyllum* – Angel fish

4. Class – Amphibia

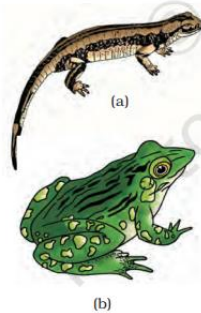
Amphibia = animals that can live in both water and on land.

- They live in **aquatic as well as terrestrial habitats**.

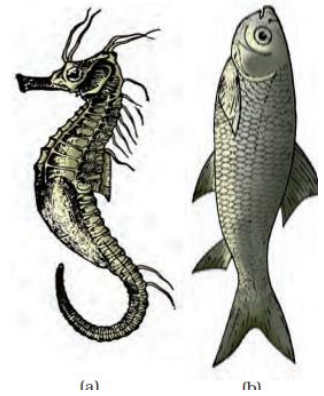
- Most have **two pairs of limbs**.
- Body is divided into **head and trunk**.
- Tail may be present or absent.
- Skin is **moist and without scales**.
- Eyes have **eyelids**.
- **Tympanum** acts as the ear.
- Alimentary, urinary and reproductive systems open into a common chamber called **cloaca**.
- Respiration occurs through **gills, lungs and skin**.
- Heart is **three-chambered**: two auricles + one ventricle.
- They are **cold-blooded**.
- Sexes are separate.
- Fertilisation is usually **external**.
- They are **oviparous**.
- Development is **indirect**.

Examples:

- *Bufo* – Toad
- *Rana* – Frog
- *Hyla* – Tree frog
- *Salamandra* – Salamander
- *Ichthyophis* – Limbless amphibian



Examples of Amphibia : (a) *Salamandra* (b) *Rana*



Examples of Bony fishes : (a) *Hippocampus* (b) *Catla*

5. Class – Reptilia

- Reptiles are mostly **terrestrial animals**.
- They move by **creeping or crawling**.
- Body is covered with **dry, cornified skin**.
- Skin has **epidermal scales or scutes**.
- They have **no external ear opening**.
- **Tympanum** represents the ear.
- Limbs are usually **two pairs**, but may be absent in snakes.
- Heart is usually **three-chambered**.
- **Crocodiles have a four-chambered heart**.

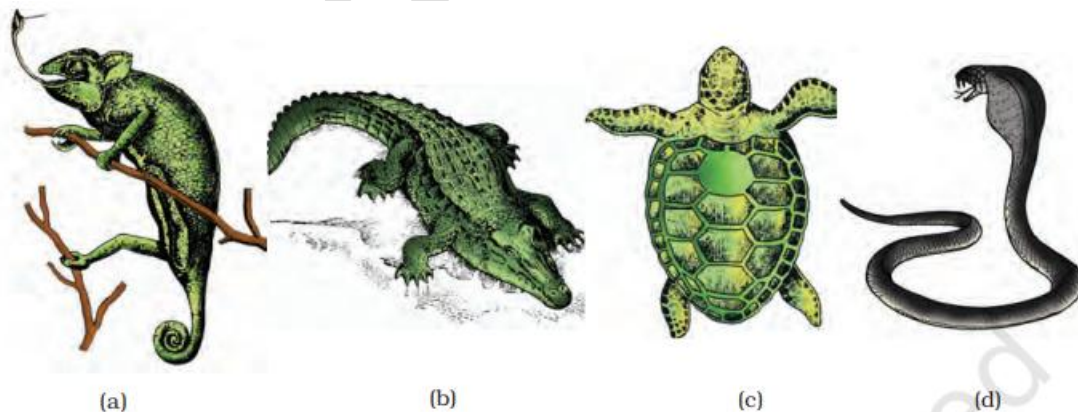


Figure 4.22 Reptiles: (a) *Chameleon* (b) *Crocodilus* (c) *Chelone* (d) *Naja*

- They are **cold-blooded**.
- Snakes and lizards **shed their skin/scales**.
- Sexes are separate.
- Fertilisation is **internal**.
- They are mostly **oviparous**.
- Development is **direct**.

Examples:

- *Chelone* – Turtle
- *Testudo* – Tortoise

- *Chameleon* – Tree lizard
- *Calotes* – Garden lizard
- *Crocodilus* – Crocodile
- *Naja* – Cobra
- *Bangarus* – Krait
- *Vipera* – Viper

6. Class – Aves

- Aves are **birds**.
- Their body is covered with **feathers**.
- Most birds can **fly**, but some, like the **Ostrich**, cannot.
- They have a **beak**.
- Forelimbs are modified into **wings**.
- Hind limbs are used for **walking, swimming or holding branches**.
- Skin is **dry**.
- They have an **oil gland** at the base of the tail.
- Endoskeleton is **bony and fully ossified**.
- Long bones are usually **hollow and contain air cavities**.
- Digestive system has special chambers called **crop and gizzard**.
- Heart is **four-chambered**.
- They are **warm-blooded** and maintain a constant body temperature.

Examples: Sparrow, pigeon, crow, ostrich, eagle, etc.

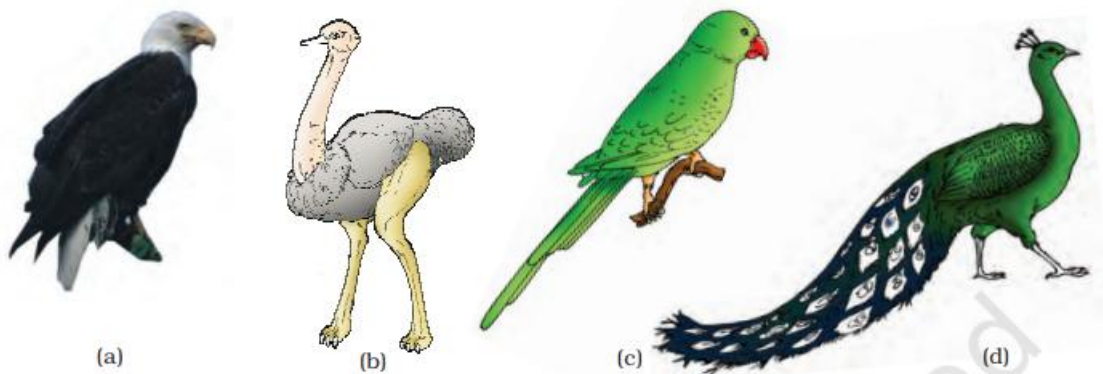


Figure 4.23 Some birds : (a) *Neophron* (b) *Struthio* (c) *Psittacula* (d) *Pavo*

❖ Class-Mammalia

Main Features

- Mammals are found in **many different habitats**:
 - Polar regions
 - Deserts
 - Mountains
 - Forests
 - Grasslands
 - Caves
- Some mammals are adapted for **flying** or **living in water**.
- The most important feature of mammals is the presence of **mammary glands**.
- Mammary glands produce **milk to feed their young ones**.
- They have **two pairs of limbs**.
- Limbs are modified for different activities such as:
 - Walking
 - Running



Figure 4.24 Some mammals : (a) *Ornithorhynchus* (b) *Macropus* (c) *Pteropus* (d) *Balaenoptera*

- Climbing
- Burrowing
- Swimming
- Flying
- Their skin has **hair**, which is a characteristic feature.
- **External ears (pinnae)** are usually present.
- They have **different types of teeth** in their jaws.
- Heart is **four-chambered**.
- They are **warm-blooded (homoiothermous)**.
- Respiration takes place through **lungs**.
- Sexes are **separate**.
- Fertilisation is **internal**.
- Most mammals are **viviparous**, meaning they give birth to young ones.
- A few mammals are **oviparous**, meaning they lay eggs.
- Development is **direct**.

❖ **Oviparous Mammal**

Ornithorhynchus – Platypus

It **lays eggs**, but it is still a mammal because it has mammary glands and feeds its young with milk.

Viviparous Mammals

Examples:

- *Macropus* – Kangaroo
- *Pteropus* – Flying fox
- *Camelus* – Camel
- *Macaca* – Monkey
- *Rattus* – Rat
- *Canis* – Dog
- *Felis* – Cat
- *Elephas* – Elephant
- *Equus* – Horse
- *Delphinus* – Common dolphin
- *Balaenoptera* – Blue whale
- *Panthera tigris* – Tiger
- *Panthera leo* – Lion

TABLE 4.2 Salient Features of Different Phyla in the Animal Kingdom

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Porifera	Cellular	Various	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.
Platyhelminthes	Organ & Organ-system	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organ-system	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often worm-shaped, elongated.
Annelida	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Absent	Body segmentation like rings.
Arthropoda	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.
Mollusca	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton of shell usually present.
Echinodermata	Organ-system	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system, radial symmetry.
Hemichordata	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.