ANIMAL KINGDOM

6.1 SOME GENERAL FEATURES OF ANIMALS

There are millions of species which make up the Animal kingdom and they all share a wide range of diversity. To study all these is a tough task so, we have classified organisms on the basis of arrangement of cells , symmetry of body , coelom nature and reproductive systems.

Levels of Organisation and Body Plan

Animals though show different shapes and sizes but possess either cellular, tissue, organ or organ system of organisation.

The cellular grade of organisation can be observed in all protozoans (unicellular or acellular) where all the vital activities of the body are performed by a single cell, for example *Amoeba.*

The next higher level of body organisation is observed in multicellular animals, which are called **metazoans**. Based on complexity of organisation, metazoans are further subdivided into two subkingdoms, the **Parazoa** and **Eumetazoa**.

In Parazoa (e.g. sponges), the cells are loosely aggregated and do not form tissues or organs.

In Eumetazoa, which includes the rest of the animals, the cells are organised into structural and functional units called tissues, organs and organ systems. The body plan of eumetazoans resembles either a blind sac (cnidarians like *Hydra* and platyhelminthes) or a tube within a tube plan (rest of eumetazoans).Figure 6.1 shows the different body plans.

Symmetry

The parazoan animals, sponges, lack any definite symmetry and such organisms are called asymmetric . The eumetazoan animals can be grouped into two categories based on symmetry (Fig. 6.2).
When any plane passing through the central axis of the body divides the organism into halves that are approximately mirror images it is called **radial** symmetry and the animals showing this symmetry are called **Radiata**. For example, cnidarians (sea anemone, jellyfish and corals) and ctenophorans (comb jellies).
When the body can be divided into identical left and right halves in only one plane. This kind of symmetry is called bilateral symmetry and such animals are called **Bilateria**..

Diploblastic and Triploblastic Organisation

In radiata, the cells are arranged into two fundamental layers, an external ectoderm and an internal endoderm with an intervening mesoglea. Such animals are, therefore, called **diploblastic**.
In Bilateria, a third germ layer, mesoderm, is present in between the ectoderm and endoderm. Hence, they are called **triploblastic** animals.

In these animals, embryonic blastopore forms mouth in prostomia and anus in deuterostomia.

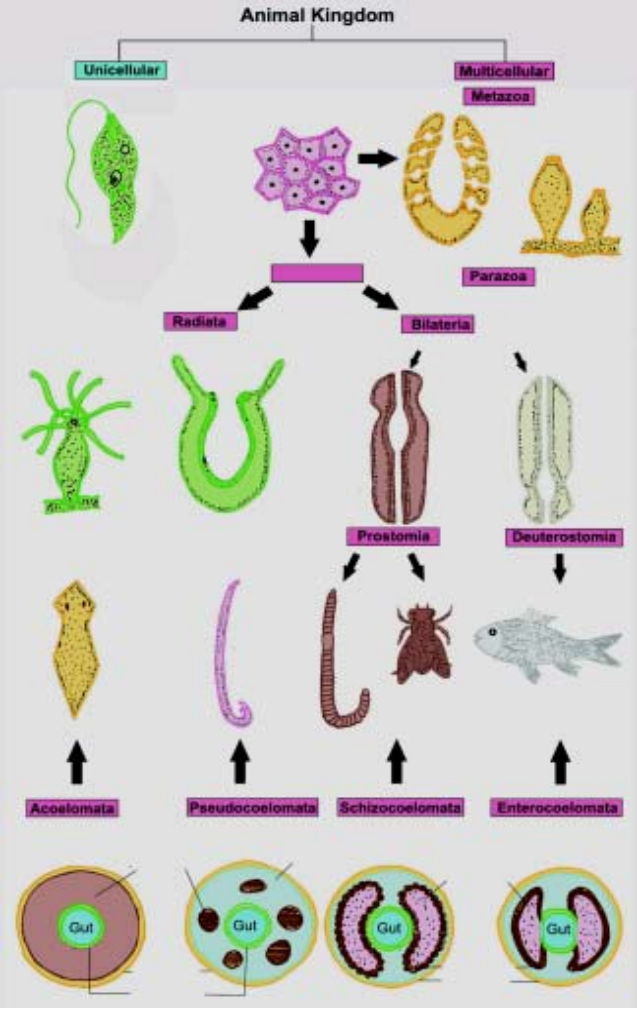


Fig. 6.1 *Diagrammatic representation showing body organisation (grades and symmetry) and developmental plan in protozoa and metazoa. Coelom is absent in acoelomates (a) Formation of coelom in other bilateria is shown in cross-sectional view. (b-d) In pseudocoelomata, the main body cavity is a pseudocoel, (b) Coelom formation takes place by splitting of mesodermal pouches present on the lateral sides of the prospective gut, and (c) by growth of lateral mesodermal pouches from the endoderm.*

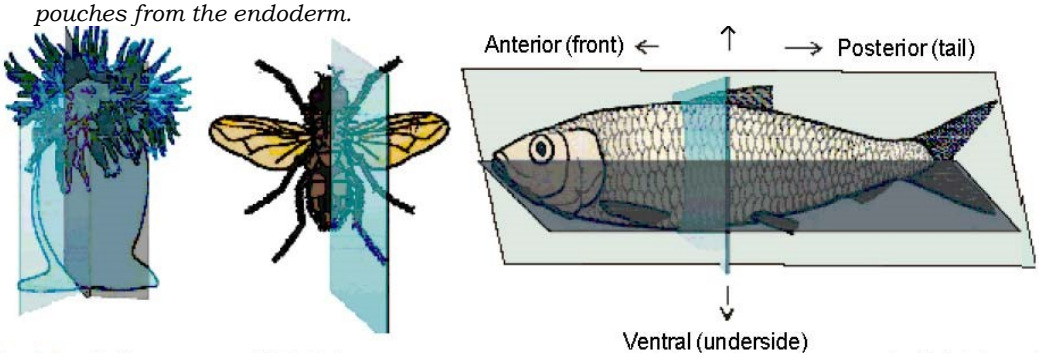


Fig. 6.2 Body symmetry (a) Radial symmetry in a sea anemone (b) Bilateral symmetry in a fly (c) A bilaterally symmetric (fish)

Segmentation

The kind of segmentation in which there is serial repetition of some body parts is called metameric segmentation and the phenomenon is known as **metamerism.** for example, earthworm.

Body Cavity or Coelom

there are three types of organisms on the basis of the three primary germ layers of their embryos, *viz.*, ectoderm, mesoderm and endoderm.
The animals in which the coelom is absent are called **acoelomates**.
for example flatworms.
In them, the space between ectoderm and endoderm is filled with parenchyma derived from mesoderm.
In some organisms mesoderm is present as scattered pouches in between the ectoderm and endoderm such a body cavity is called pseudocoelom and the animals (e.g. roundworms) are called as **pseudocoelomates.**
In most of organisms there are three germlayers and space between endoderm and ectoderm is lined by mesoderm and such organisms are called as true coelomates .

The space between body wall and alimentary canal (body cavity) remains lined by mesoderm and is called coelom. Visceral organs lie in the coelom.
Instead, the (See Fig.6.1).

Heterotrophic Mode of Nutrition

Plants synthesise their own food and are called **autotrophs**.

Animals that feed upon other living forms are called **heterotrophs**. The heterotrophs may be **herbivores** (eating plants), **carnivores** (eating animals) and **omnivores** (eating both animals and plants).

There are animals that depend on other organisms for food are called **parasites** and the relationship is known as host- parasitic relationship.

Active Movement

Animals perform a more rapid and complex way of movement called locomotion and it is the most striking characteristic of animals

Reproduction and Development

Most animals reproduce sexually through male gametes (spermatozoa) and female gametes (ova) and fusion of gametes (fertilization) results in the formation of a zygote which further

after sequential development produces a complete organism.

6.2 CLASSIFICATION OF ANIMALS

The animal kingdom includes 11 major Phyla.

Almost 99 per cent of animals are **invertebrates** (animals without backbone) and the remaining represents the **vertebrates** (animals with backbone). Also, the animals are categorised into two major groups, **non-chordates and chordates**, on the basis of the presence or absence of notochord at some stage in their life.

Phylum-Porifera
(Pore Bearing Animals)

1. Members of this Phylum are commonly known as sponges.
2. They are the most primitive group of multicellular animals.

3. Most of them are marine and remain attached to rocks (sessile). A few live in fresh water.
4. Some are radially symmetrical, but the larger ones are asymmetrical.
5. They are multicellular and represent cell aggregate body plans. As they have no tissue grade of organisation they are included in the subkingdom Parazoa.

(a) (b)

Shapes of some sponges : (a) radially symmetric and (b) asymmetric forms

6. Except the fresh water sponges, they are are sessile having various shapes.
7. Their body contains numerous minute pores (ostia; sing. ostium) that connect the outside to a central chamber present inside the body Several minute pores (ostia; sing. ostium) present on the body lead into canals (canal system) lined by flagellated collar cells (choanocytes). At the terminal point of the body a large aperture called osculum is present. Water along with food enters the canals through the ostia and comes out along with excretory materials, sperm and ova through the osculum.
8. Sponges are diploblastic.
9. They also contain amoebocytes, pinacocytes and other cell types.

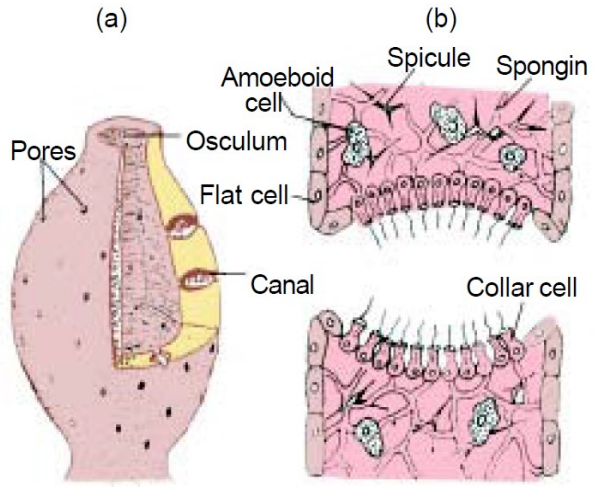


Fig. 6.5 *(a) A cut-away diagram of a simple sponge showing pores, canal, osculum and internal central chamber (b) Cross-section of a sponge wall showing flagellated collar cells lining a pore, flat and amoeboid cells and matrix material*

10. Their body contain internal skeleton formed of innumerable calcareous or siliceous spicules or proteinaceous spongin fibres.
11. Sponges reproduce asexually by fragmentation.
12. They exhibit great power of regeneration.
13. During sexual reproduction some cells become egg or sperm cells. After fertilisation, the zygote develops into a flagellated larva, which swims, settles in a new place and grows into a sponge.

Examples

Sycon (Scypha), *Spongilla*, *Poterion* (Neptune's cup), *Chalina* (Dead man's finger), *Euspongia* (Bath sponge) and *Euplectella* (Venus flower basket).

NEETprep Classes by Top Faculty

Phylum Coelenterata (Cnidaria)

1. They are mostly marine, few fresh water(Hydra).
2. The phylum got its name from the stinging cells or cnidoblasts present on the ectoderm of tentacles and body of these carnivorous animals.
3. Cnidarians have tissue levelof organisation and they exhibit a blind sac body plan and radial symmetry.
4. Cnidarians are diploblastic.
   It has oral aperture, for ingestion and egestion, leading into a gastrovascular cavity and anus is absent.

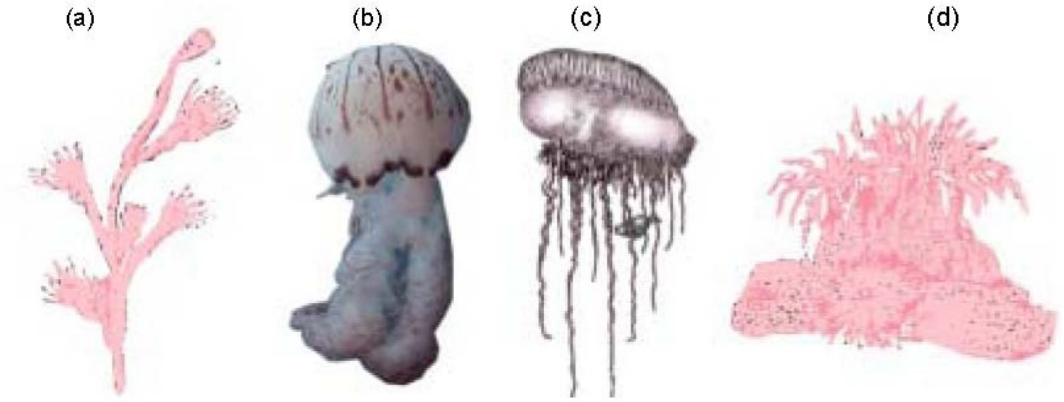


Fig. 6.6 Some cnidarians (a) Obelia (b) Jellyfish (c) Physalia (d) Sea anemone

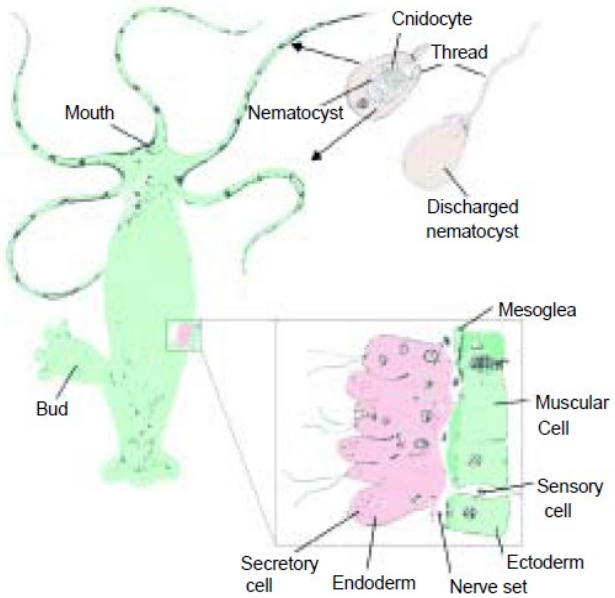


Fig. 6.8 *Polyp and medusa body forms (a) sessile polyp (b) swimming medusa*

5. Such an enteron with single opening is called coelenteron hence the previous name of the phylum was Coelenterata which used to include the Cnidarians along with Ctenophores. At present, the Ctenophores have been assigned a separate phylum status.
6. The endodermal cells lining the gastrovascular cavity are specialised for secreting digestive enzymes(intercellular digestion) and food is then passed for intracellular digestion in food vacuoles.
7. Undigested material is egested through the mouth.
8. Cnidarians exhibit two basic body forms, the **polyp** and **medusa** (Dimorphic)(Fig. 6.8).
9. The polyp is sessile, solitary or colonial and resembles a cylindrical stalk with mouth and tentacles facing upwards.
10. The medusa is a solitary and free-swimming. It is like a bell or an umbrella with mouth and tentacles facing downwards. The medusa can be regarded as an upside-down polyp with

reduced stalk, which can swim away.

11. In many cnidarians, polyps give rise to medusae by vegetative budding, and medusae form polyps following sexual reproduction.
12. Cnidarians like *Obelia*, pass through both polyp and medusa stages in their life cycles (dimorphism). Polyps reproduce asexually by budding whereas medusae liberate gametes into water during sexual reproduction.

13. Both asexual and sexual forms are diploid and the only haploid cells are gametes. Such alternation of asexual and sexual phases in the life cycle of Obelia is called **metagenesis**.
14. .
15. Some forms show division of labour by forming structurally and functionally different types of individual (zooids) within the same organism during its life history. This is called **polymorphism**.
16. Following fertilisation, the zygote forms a ciliated larva called planula, which swims, settles and grows into a sessile polyp.
17. Some cnidarians, like Hydra, do not have a medusa stage.

Examples

Hydra, *Porpita*, *Vellela*, *Physalia* (Portuguese man-of-war), *Aurelia* (Jellyfish), *Adamsia* (Sea anemone), *Pennatula* (Sea-pen) and *Gorgonia* (Sea-fan).

Phylum Ctenophora

1. Ctenophores are marine animals and pelagic(float on sea surface) with transparent and flat or oval body shape..
2. These are bilaterally symmetrical and devoid of cnidoblast cells. When the tentacles are present they are two in number and contain colloblast cells.
3. These animals move by cilia, which join together to form comb plates; there are eight median comb plates.
4. Gastrovascular cavity is branched and open to the exterior by stomodaeum.
5. They are diploblastic animals
6. The presence of a special sense organ at the opposite end of the mouth (aboral end) is the characteristic of of this phylum.
7. They reproduce only by sexual means and do not exhibit larval phase in their life cycle.

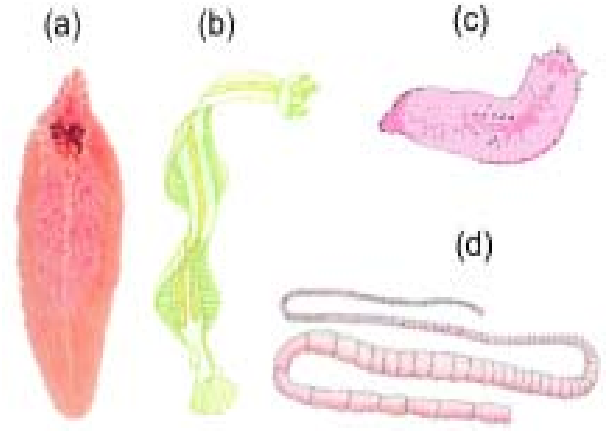
Examples

Hormiphora, *Ctenoplana* and *Beroe*.

Phylum Platyhelminthes

(Flatworms)

1. They are dorsoventrally flattened so called as flatworms.
2. These are mostly parasites.
3. Some are free-living forms, mainly aquatic-marine or freshwater.

4. 

5. *Some flatworms (a) Fluke (b) Turbellaria (c) Planaria (d) Tapeworm*

6. These are triploblastic and bilateral symmetric.
7. They are acoelomate and parenchyma cells originating from mesoderm fill up the cavities of the body.
8. Their bodies remain externally covered by cilia or cuticle. Platyhelminthes show organ-system grade of body organisation.
9. Alimentary canal is incomplete having mouth opening but no anus. The parasitic forms lack alimentary canal. They absorb nutrients of the host directly through their body surface.
10. The nervous system(ladder like) contains a concentration of nervous tissue in the head. Head begins from this phylum.
11. These worms have an exterior cuticle instead of an epidermis.
12. Head bears hooks and suckers.
13. Life history usually involves twohosts (Digenetic)
14. For example in case of Pork tapeworm
15. Primary host (Man)
16. Secondary hoat(Pig)
17. Flatworms have specialised cells called flame cells, for excretion and osmoregulation.

18. They reproduce both asexually and sexually.

19. Flatworms can regenerate the entire body(Power of regeneration) The phenomenon of regeneration is asexual reproduction.

20. They are hermaphrodite or bisexual, that is, both male and female sex cells are produced by the same individualbut the structure of body facilitates cross-fertilisation rather than self-fertilisation.

21. ***Examples***

22. *Taenia* (Tapeworm), *Fasciola* (Liver fluke), *Echinococcus*, *Schistosoma* and *Planaria*.

Phylum Nemathelminthes (Aschelminthes)
(Roundworms)

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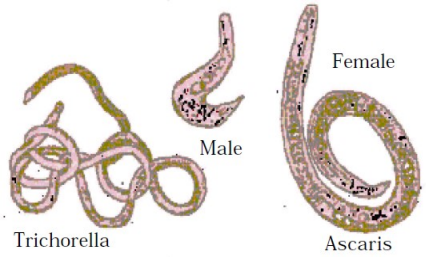
1. They appear circular in cross-section, hence, the name roundworm..
2. Nematodes are found everywhere in fresh water, sea water, humus rich soil . Many are parasites.



Some roundworms

3. Roundworms are bilaterally symmetrical, triploblastic and pseudocoelomate animals with an organ system grade of organization and tube-within-a-tube body plan.
4. They possess elongated body with pointed ends without segmentation.
5. The digestive tract is differentiated into mouth, pharynx, intestine and anus.

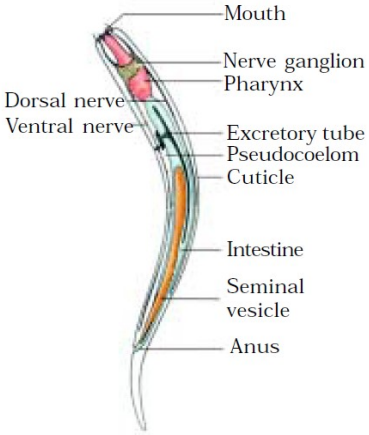


Fig. 6.11 *Structure of a roundworm (male)*

6.
7. The muscular pharynx allows the parasitic nematode to suck blood from the host. The body wall has longitudinal muscles and an elastic cuticle.
8. The false body cavity allows body wall muscles and digestive tract muscles to act independently of each other. Roundworms have a flexible body movement.
9. nervous system comprises of circular pharyngeal ring(Brain).
10. An excretory consist of gland cells or protonephridia.
11. Sexes are usually separate (dioecious) and morphologically distinct; often females are longer than the males(curved from caudal end).
12. Fertilized eggs have a thick wall and can survive in adverse conditions.

Examples

Ascaris, *Wuchereria* (Filaria worm), *Ancylostoma* (Hookworm), *Enterobius* (Pin worm) and *Rhabditis.*

Phylum Annelida

.
They are free living found in moist soil , fresh water, sea and few are parasite.
Annelids are triploblastic and bilaterally symmetrical animals with organ-system grade of organisation.
Eachsegment is externally divided into many parts by rings (Latin, *annulus*) and, hence, the name Annelida (Fig. 6.12).

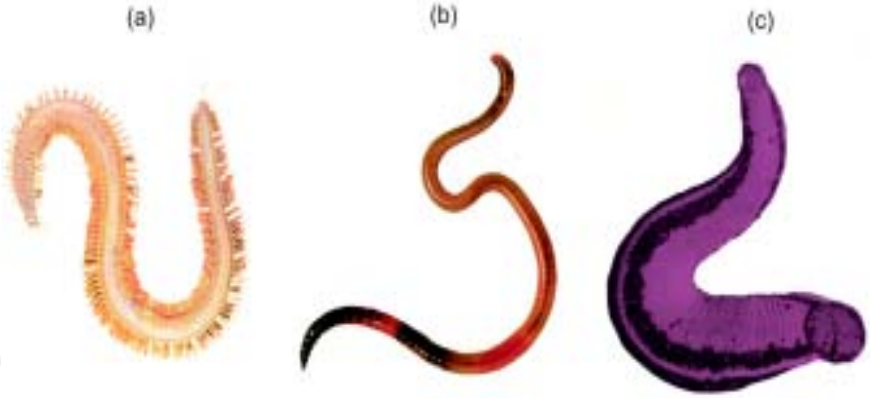


Fig. 6.12 Some annelids: (a) Neries (b) Earthworm (c) Leech

The body is covered by definite cuticle secreted from the ectoderm.

The body wall of annelids has both longitudinal and circular muscles..
Polychaetes (*Neries*) have numerous setae on lateral appendages called parapodia.
Leeches being ectoparasites do not possess either setae or parapodia and swim by undulatory movement by musculature.
The digestive system of annelids is more advanced than nematodes and contains distinct mouth and anus at opposite ends of the body.
It consists of a muscular pharynx to swallow food, an oesophagus to carry it to the stomach where it is churned and digested, and a long intestine to absorb nutrients. Undigested waste is compacted and expelled as worm castings through the anus.
A closed circulatory system of blood vessels, a heart to pump the blood is **found for the first time in annelids** Oxygenation of blood occurs through the moist skin. Therefore, the earthworm can live only in a moist condition.
The excretory organs are paired nephridia (sing. nephridium) in each segmentand help in maintaining water balance of the body (osmoregulation).
Body action is coordinated by a pair of cerebral ganglia (sing. ganglion), which are collection of nerve cell bodies.
Sexes are separate in polychaetes but earthworms and leeches are hermaphrodites.

Examples

Neries, *Aphrodite* (sea mouse), *Pheretima* (Earthworm), *Tubifex*, *Hirudinaria* (Leech), *Chaetopterus*, *Terebella*, and *Bonnellia*.

Phylum Mollusca (Soft Bodied Animals)

1. Phylum Mollusca (L. *Mollis* : soft-bodied) is the second largest animal phylum.

2. They are triploblastic coelomates and usually with bilateral symmetry.

3. They are terrestrial, marine or fresh water inhabitants (Fig. 6.13).

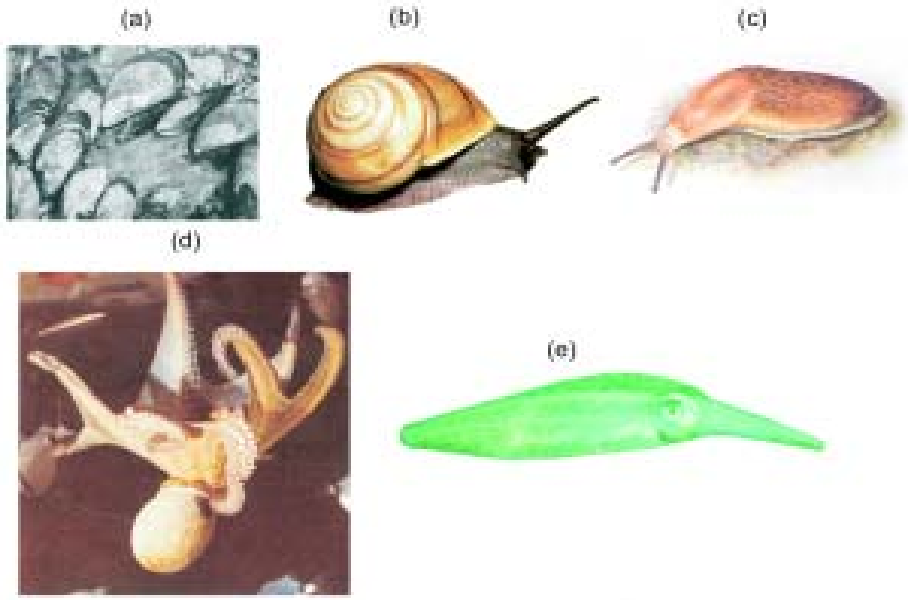


Fig. 6.13 Some molluscs: (a) Unio (b) Snail (c) Shell-less slug (d) Octopus (e) Squid

4. The body of molluscs is soft but protected by hard calcareous shell.

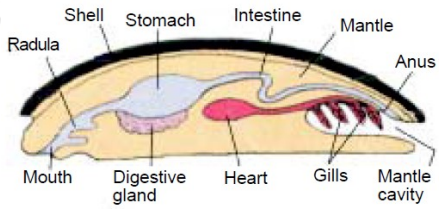


***Fig. 6.14** Body plan of a mollusc (hypothetical)*

5. . The body is unsegmented (Neopilina is exceptionally segmented) .
6. Body parts consist of
   - a head with sense organ.
   - a ventral soft and muscular foot for locomotion
   - dorsal visceral hump/hump containing organ system
   - t skin is soft and it forms a mantle over the hump.
7. Circulatory system is open (Cephalopoda is exception)
8. Below the mantle, it has a number of feather-like gillswhich have respiratory and excretory functions.
9. The anterior head region has sensory tentacles. The mouth contains a file-like rasping

organ for feeding, called radula.

10. Molluscs are basically oviparous and development is through a trochophore larva and development may be external or internal.

Examples

Pila (apple snail), *Achatina* (land snail), *Lamellidens* (mussel), *Pinctada* (pearl oyster), *Sepia* (cuttlefish), *Loligo* (squid), *Octopus* (devilfish), Doris (sea-lemon), *Aplysia* (sea-hare) and *Teredo* (shipworm).

Phylum Arthropoda

(Animals with jointed appendages)

1. The phylum Arthropoda (L. *Arthros* : jointed; *podos* : legs or appendages) is the largest phylum.
2. They are triploblastic, coelomate with organ system level of organisation and bilaterally symmetrical animals
3. (The body of arthropods is covered by chitinous cuticle, which forms the exoskeleton.
4. Arthropods have a segmented body, each segment bearing a pair of jointed appendages covered by a jointed exoskeleton.
5. The segments are not separated by septa as in annelids.
6. The body consists of head, thorax and abdomen while in some cases, head and thorax may be fused to form cephalothorax.
7. The head consists of several fused segments with appendages modified to serve as antennae (feelers), mouthparts or pincers (chelicerae). Arachnids have no antennae.
8. Thoracic segments have legs (and wings); the abdomen has no legs in insects.

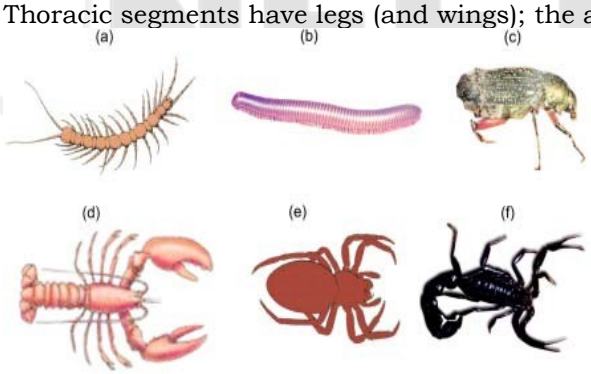


Fig. 6.15 Some common arthropods : (a) Centipede (b) Millipede (c) Beetle (d) Prawn (e) Spider and (f) Scorpion

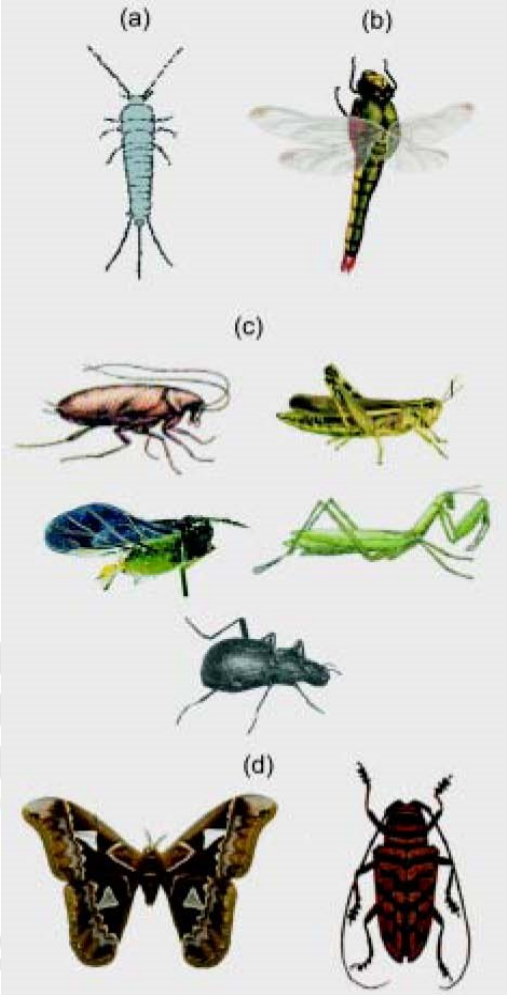


Fig. 6.16 A few common insects (a) Silverfish (wingless form) (b) Dragonfly (wings nonfoldable) (c) Cockroach, grasshopper, praying mantis, aphid (wings foldable) Bedbug (wingless) (d) Butterfly, beetle

9. Respiratory organs are
    - Gills (e.g Prawn),
    - book gills(e.g. king crab),
    - book lungs(e.g. scorpion),
    - tracheal system(e.g.Insects).
10. Excretory Organs are
    - malpighian tubules (e.g. Insects)
    - coxal gland(e.g. Arachnids)
    - maxillary gland or green glands(Crustaceans)
11. Sensory structures in arthropods are antennae for perceiving odour, eyes, statocysts or balance organs, receptors for taste (located in their feet in insects) and sound receptors.
12. The arthropod eyes may be simple or compound.
13. The heart is dorsal and circulatory system is open.
14. The central nervous system consists Of a circumcentric ring and a double ,solid midventral nerve cord bearing a pair of ganglia per segment or less(Ganglia).

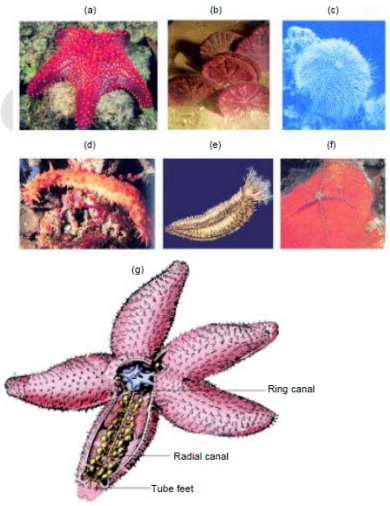
15. Arthropods are unisexual.
16. In a few aquatic arthropods, fertilisation is external, that is male and female sex cells fuse outside the body in waterwhile in others fertilisation is internal; the male deposits the sperm within the female sex organ.
17. In all land arthropods, fertilization is always internal.
18. Eggs are laid by most arthropods.and are called as oviparous.
19. In some, like the scorpion, the eggs hatch within the female body. They bring forth the young alive. They are viviparous.
20. In many arthropods, development is directand theyoung ones hatched from eggs, resemble the adult.
21. The process of transformation of a larva into an adult is called **metamorphosis**.

Examples

Araneus (garden spider), *Limulus* (king crab), *Buthus* (scorpion), *Eupagurus* (hermit crab), *Cancer* (common crab), *Macrobrachium* (prawn), *Lepisma* (silverfish), *Periplaneta* (cockroach), *Apis* (bee), *Anopheles* (mosquito), *Musca* (housefly), *Leptocorisa* (paddy pest: gandhi poka) *Triops* (tadpole fish), *Daphnia* (water flea), *Cyclops*, *Squilla*, *Astacus* (crayfish), *Lepas*, *and Balanus* (barnacle).

Phylum Echinodermata
(Spiny Animals)

1. Phylum Echinodermata (*L. echinos* : spiny, *dermatos* : skin); got its name because it bears spines on its body.
2. All are marine, triploblastic and coelomate (Fig. 6.17).
3. The adult echinoderms are radially symmetrical with body parts occurring in five axes (pentamerous radial symmetry).
4. Larvae are bilaterally symmetrical.
5. The exoskeleton is calcareous consisting of many plate-like structures called ossicles.



(f) Brittle star (g) Cut-away diagram to show the water-vascular system of a star fish

6. They have a mouth on the lower side called tube feet(to help in locomotion) and anus on the upper side. .
7. Respiration takes place by body surface.

8. Digestive system is complete and mouth is on lower side and anus is on upper side.
9. Circulatory system is reduced and open type without heart or pumping organ.
10. No excretory system or organ Nitrogenous waste (ammonia) diffuses out via gills, bursae, respiratory trees and tube feet. Amoeboid cells perform excretory function .
11. Nervous system is simple and less developed(No brain).
12. .
13. Sexes are separate with five pairs of sex organs, one pair in each arm.
14. In most cases fertilisation occurs in open water.
15. The development includes a free swimming larva. This larva undergoes metamorphosis and change into a young radial adult.

Examples

Asterias (star fish or sea star), *Echinus* (sea urchin), *Echinocardium* (heart urchin), *Antedon* (feather star or sea lily), *Cucumaria* (sea cucumber*)and Ophiura* (brittle star).

Phylum Chordata (Chordates)

1. **Chordata** refers to the group of animals, which possess notochord either throughout or during early embryonic life.
2. Non-chordates are animals without notochord
3. Notochord is a stiff and flexible rod of tissues lying ventral to nerve cord.
4. All the chordates are triploblastic, coelomate and bilaterally symmetrical. They possess a post anal tail and closed blood vascular system.
5. The other common features of chordates are:
   - a dorsal hollow nerve cord and
   - paired pharyngeal gill slits

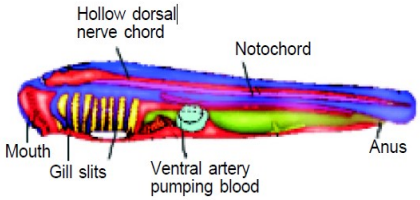
S.No.	Chordates	Non-chordates
1.	Notochord present	Notochord absent
2.	Central nervous system is dorsal, hollow and single	Central nervous system is ventral, solid and double
3.	Pharynx perforated by gill slits	Gill slits are absent
4.	Heart is ventral	Heart is dorsal
5.	A post-anal, metamerically segmented tail is present	Terminal part (pygidium) is unsegmented

.
Table 6.1 presents a comparison of salient features of chordates and non-chordates.

6. Phylum Chordata is divided into four subphyla,
   - Subphylum **Hemichordata** or **Stomochordata**,
   - Subphylum **Urochordata** or **Tunicata**,
   - Subphylum **Cephalochordata** or **Acrania**
   - and subphylum **Vertebrata**.
7. The first three subphyla are considered primitive and often referred to as

protochordates or **nonvertebrate chordates**.

8. All of them are marine and possess notochord but never form a vertebral column.
9. In Hemichordata or Stomochordata, true notochord is absent but gill slits are present;
10. In Urochordata or Tunicata, notochord is present only in larval tail;
11. In Cephalochordata or Acrania notochord extends from head to tail region.



Examples

Hemichordata or Stomochordata – *Balanoglossus* (acorn worm) and *Glossobalanus*.
Urochordata or Tunicata -*Ascidia*, *Ciona*, *Salpa* and *Doliolum*.

Cephalochordata or Acrania – *Branchiostoma* (Amphioxus or lancelet).

12. Table 6.1 Differences between Chordate and Non-chordate Animals

13. In **Vertebrata**, the notochord is present during the embryonic period and replaced by vertebral column in the adult. A series of vertebrae surround the notochord along with dorsal nerve cord.
14. Thus, all vertebrates are chordates but all chordates are not vertebrates.

15. Besides the three chordate characters, vertebrates have
    - A ventral muscular heart with two, three or four chambers,
    - kidneys for excretion and osmoregulation,
    - two pairs of lateral appendages, fins or limbs.

16. On the basis of absence or presence of jaw the sub-phylum Vertebrata is further subdivided into two sub group:

- **Agnatha**, which lacks jaws
- **Gnathostomata**, which bears jaws. Class Cyclostomata, represents the super class Agnatha.

17. All other vertebrates which possess jaws are included in the super class Gnathostomata. They are divided into six classes namely

- Chondrichthyes (fish with cartilaginous skeleton),
- Osteichthyes (fish with bony skeleton),
- Amphibia (dual amphibious life),
- Reptilia (dry scale covered body),
- Aves (feathered body),
- Mammalia (milk-producing gland).

18.Animals of classes Cyclostomata, Chondrichthyes and Osteichthyes bear fins for locomotion.

19.The animals of other four classes are four-limbed, called Tetrapods. These classes are Amphibia, Reptilia, Aves and Mammalia.

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Class Cyclostomata —

1. All living members of the class Cyclostomata are ectoparasites on some fishes.
2. Cyclostomes have an elongated body bearing 614 pairs of gill slits in their gill pouch for respiration and containing a sucking and circular mouth.
3. Their body is devoid of scales and paired fins.
4. A single dorsal nostril leads into a closed nasal sac.
5. A functional pineal eye is present just behind it. Single sex organ discharges gametes in the well-developed coelom.
6. Cranium and vertebral column are cartilaginous with persistent notochord. Heart is surrounded by a cartilaginous capsule.
7. Stomach is absent.
8. Circulation is a typical vertebrate type.
9. Lampreys are marine and migrate for spawning into rivers (Fig.6.19).

Fig. 6.19 *Jawless vertebrate- Agnatha (Lamprey).*

After spawning they stop feeding and within a few days they dieand larvae after metamorphosis migrate to the ocean.

Examples

Petromyzon (Lamprey) and *Myxine* (Hag fish).

Class Chondrichthyes —

1. All marine fishes with cartilaginous endoskeleton.
2. The body is streamlined with five pairs of gill slits without any gill cover(operculum).
3. Gill slits may be present either on the lateral or ventral side of the head.
4. The commonly known chondrichthyes are sharks, skates and rays. .

Fig. 6.20 Cartilaginous fish (a) Shark (b) Ray

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5. The skin is tough and covered with scales (placoid).sharks do not possess a swim bladder, the air sac, which, regulate buoyancyso sharks have to swim constantly else they will sink to the bottom.
6. Sharks are viviparous and bring forth their young alive.
7. The liver of shark is a rich source of vitamin A.
8. Skates and rays are equipped with specialized organs. For example, *Torpedo* (electric ray) possesses electric organs as modified musculature between eyes and pectoral fins.
9. Electric organs are capable of generating strong electric shock to paralyse the prey.
10. *Trygon*, the stingray possesses a poison sting on its tail.the poison so released is strong enough to stun an animal.

Examples

Scoliodon (Dog fish), *Scyllium* (Shark), *Torpedo* (electric ray), *Trygon* (sting ray) and *Pristis* (Saw fish).

Class Osteichthyes —

Classes by Top Faculty

1. They are marine and fresh water fishes with bony endoskeleton
2. The skin is covered by cycloid, or ctenoidscales.
3. . Most fishes used as food are bony fishes and maintained in aquaria in decorative purposes
4. The common Indian fresh water fishes which are used as food are catla, rohu, mrigal, kalbasu, and the marine fishes used in food are pomfret, Bombay duck and Indian salmon.
5. Bony fishes use pectoral, pelvic, dorsal, anal and caudal (tail fin) fins in swimming.
6. They are cold-blooded animals and have two-chambered heart.
7. In the flying fish *(Exocoetus)*, the pectoral fin is large and modified to use for gliding several metres in the air, as the fish leaps out of water.
8. Air bladder is present which helps in buoyancy. so it can stay at a particular depth without expending energy in swimming

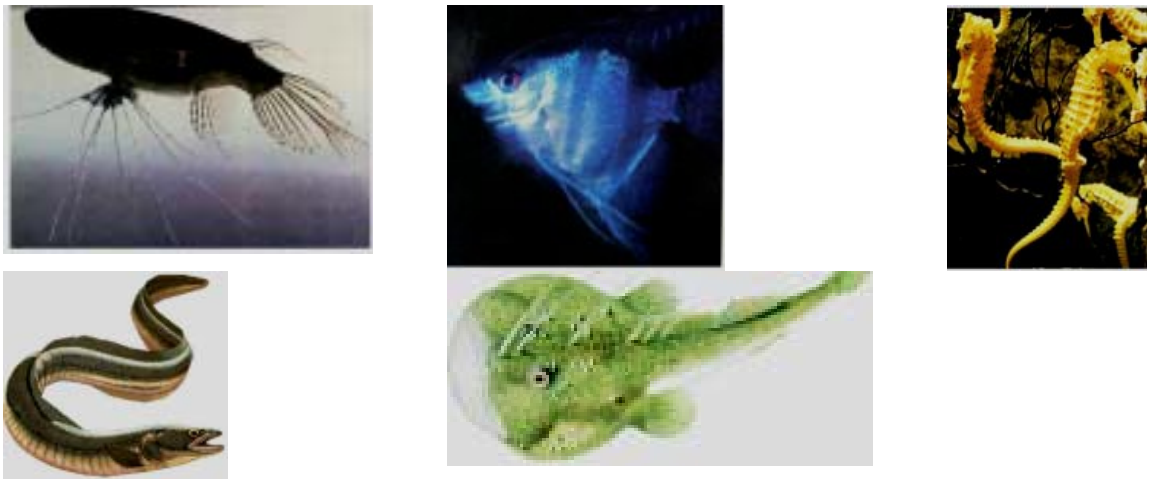

Fig. 6.21 *Bony fishes : (a) Flying fish (b) Flat fish (c) Sea horse (d) Eel (e) Angler fish*

9. They are mostly oviparous and having separate sexes.
10. Fertilisation is usuallu external and development is direct..

Examples

Labeo (Rohu), *Catla* (Katla), *Lates* (Bhetki), *Puntius* (Punti fish), *Heteropneustis* (Singhi), *Clarius* (Magur), *Anabus* (Koi), *Channa* (Lata fish), *Exocoetus* (Flying fish), *Remora* (Sucker fish), *Echeneis* (Sucker fish), *Lophius* (Angler fish) and *Hippocampus* (Sea horse).

Class Amphibia —

1.
2. Class amphibia includes animals which can live on both the places at ease i.e. under water and on the land.
3. They are not marine.
4. These are the first chordate animal which come out of the water but they are not able to live on land permanently as they require water for fertilization and fertilization is external.
5. They move using two pairs of limbs that contain four digits on the fore limb and five digits on the hind limb and digits are devoid of nailsor claws
6. Body is divided into head and trunk and some amphibians lack tail(frog, toad)there is no neck.
7. The amphibian skin is moist and naked (without scales) and Their eyes have eyelids.
8. A tympanum is present in place of external ear.
9. Alimentary canal, urinary and reproductive tracts open into a common chamber, the cloaca, which opens to the exterior through an aperture called vent.
10. The heart of frogs and toads are three-chambered(2 auricles and 1 ventricle)

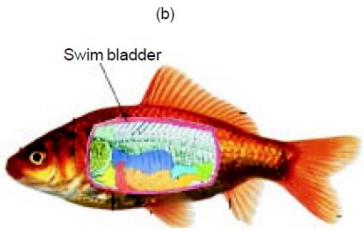

Fig. 6.22 (a) External features of a bony fish (b) Internal position of swim bladder

11. These are cold-blooded (poikilothermous).

12. skull has double occipital condyle and ten pairs of cranial nerves.

13. Respiration by gills,skin,lungs or buccopharyngeal cavity.

14. Sexes are separate, fertilisation is external and inside water and development through tadpole larva occurs in the aquatic environment.

A common Indian toad is shown in Fig. 6.23.

Fig. 6.23 Common Indian Toad

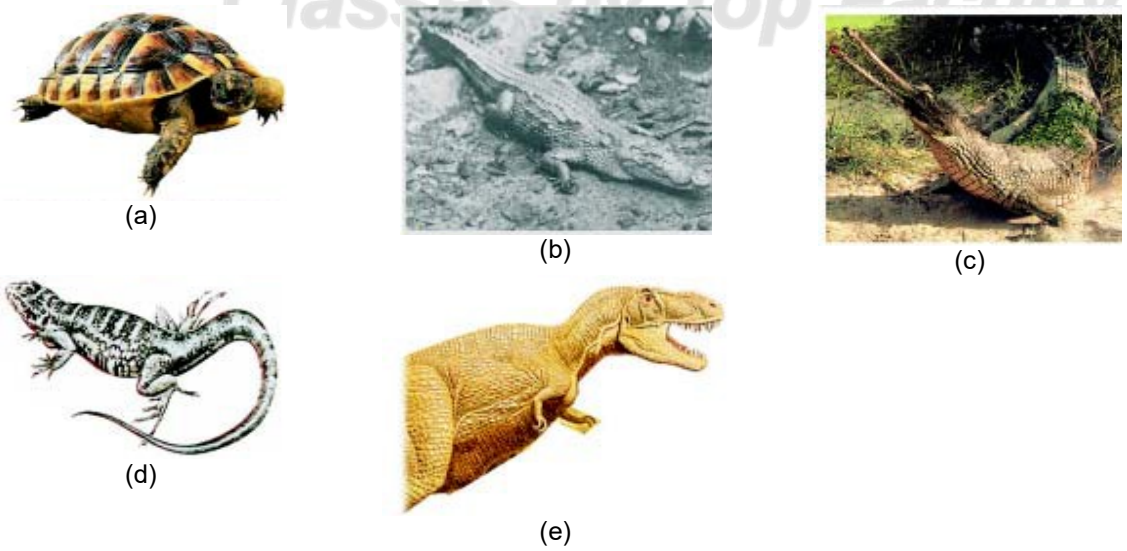

Fig. 6.24 Reptiles (a) Common tortoise (b) Crocodile (c) Indian gharial (d) Monitor (Indian goh)

(e) Tyranosaurus (extinct giant reptile)

Examples

Bufo (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Rhacophorus* (Flying frog), *Alytes* (Midwife toad) *Necturus, Salamandra* (Salamander, *Ambystoma* (Salamander), *Trilototriton* (Indian salamander) and *Ichthyophis* (Limbless amphibian).

Class Reptilia —

1. They are the first successful terrestrial animal
2. They are often found crawling around and therefore named as reptile
3. Body of reptiles is divided into head,neck,trunk and tail and is covered by dry and cornified ,rough, non-glanular skin that contains epidermal scales or scutes.
4. Reptiles do not have external ear openings.
5. They can walk with two pairs of limbs, absent in snakes, each with five digits (pentadactyl).
6. These are cold-blooded (poikilothermous).
7. they have single occipital condyle (monocondylic) and twelve pairs of cranial nerves.
8. The heart is three-chambered and contains two auricles and one incompletely divided ventricle butcompletely divided in crocodiles(4 chambered heart)
9. In most members respiration is by lungs through out the life.
10. Metanephric kineys help in excretion.
11. Endoskeleton is made up of bones.
12. Anal aperture is transverse, except in chelones and crocodiles.
13. Most present-day reptiles are carnivores or insectivores.
14. A few tortoises are herbivores.
15. Snakes and lizards shed their scales as skin cast.
16. features that make reptiles truly land animals:.
    - Development of internal fertilization.
    - The presence of a special membrane, amnion, around the developing embryo.

Examples

Chelone (Turtle), *T rionyx* (Turtle), *Testudo* (Tortoise), *Sphenodon* (Lizard - an example of Living fossil), *Hemidactylus* (House lizard), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Draco* (Flying lizard), *Anguis* (Limbless lizard), *Phrynosoma* (Horned-toad), *Varanus* (Monitor), *Python* (Mayal), *Naja* (Cobra, Kautia), *Crocodilus* (Crocodile), *Alligator* (Alligator) and *Gavialis* (Gharial).

Class Aves —

1. All types of birds are included in this class.
2. Body is divided into head,neck,trunk,and tail. Neck is long and flexible.
3. Their characteristic features are the presence of feathers and the power of flight.
4. Emu, ostrich and cassowaryare flightless birds
5. Birds have a reptilian ancestry.
6. scales are found on their hind limbs.
7. Their eggs resemble reptilian eggs in general design with a calcareous shell.

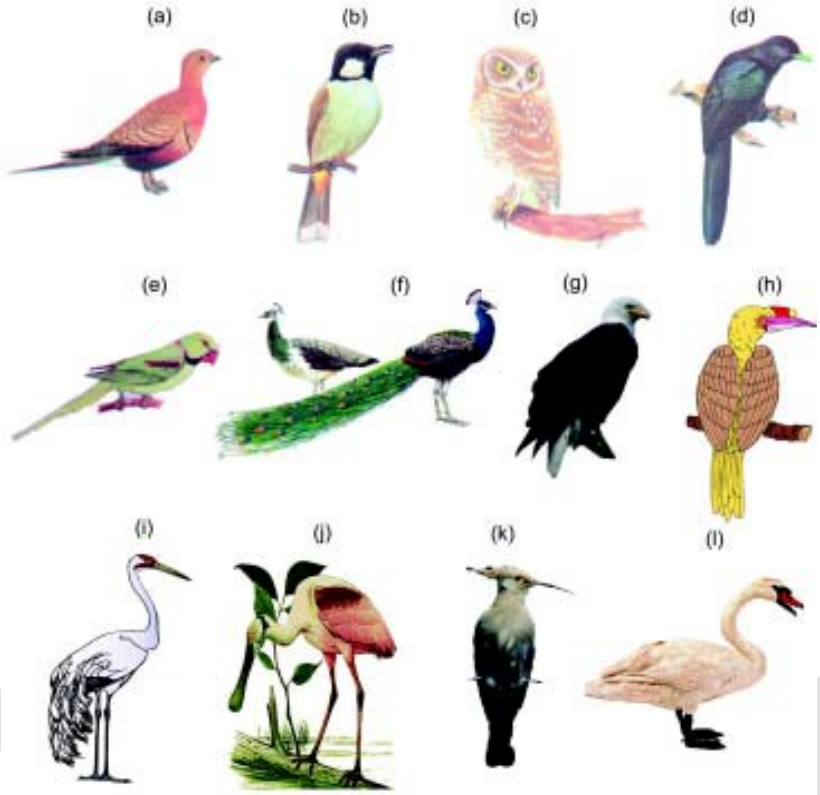

Fig. 6.26 Common Indian birds : (a) Pheasant (b) Bulbul (c) Owl (d) Koel (e) Parrot (f) Peafowl (g) Vulture (h) Hornbill (i) Crane (j) Spoonbill (k) Hoopoe (l) Swan

8. The forelimbs of birds are modified into wings which help in flying and conserving heat.
9. The forelimbs contain three claw less digits whereas the hind limbs have four digits with claws. The hind limbs are modified for walking, swimming or clasping the tree branches.
10. Skin is dry without glands but oil gland or Preen glands are found on the tail.
11. The long bones of the endoskeleton are hollow (pneumatic bones) and connected by air passageswhich lightens the body and help in flying..
12. They have single occipital condyle and twelve pairs of cranial nerves.
13. Birds are warm-blooded (homiothermous) and maintain a high metabolic rate and a constant body temperature.
14. The heart is four-chamberedRespiration is by lungs (spongy lungs)that contain air sacs which help in flying

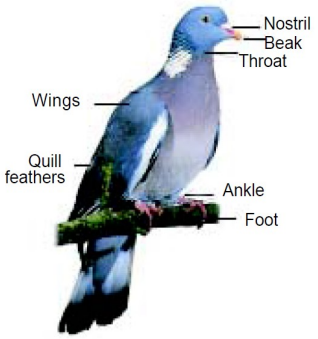

Fig. 6.27 External features of a bird

15. Birds have no teeth; beak helps in feeding in many ways such as seed crushing, fruit scooping, flesh tearing, nectar sipping, wood chiseling and so on.
16. The digestive tract has additional chambers, the crop and gizzard. The crop stores and softens food. The muscular gizzard helps in crushing and churning the food.
17. Birds have good sense of sight.
18. the brain is large, highly developed. Cerebellum is well developed for aerial mode of life. .
19. Birds lay large sized and yolky eggs (oviparous).
20. They are unisexual and lay eggs and fertikisation is internal and development is direct.

Examples

Ardea (Grey heron), *Corvus* (Crow), *Pavo* (Peafowl), *Gallus* (Fowl), *Alcedo* (King-fisher) *Columba* (Pigeon), *Psittacula* (Parrot), *Bubo* (Owl), *Phoenicopterus* (Flemingo), *Aqurilla* (Eagle), *Neophron* (Vulture), *Milvus* (Kites) and *Struthio* (Ostrich).

Class Mammalia —.

1. Mammals are perhaps the most successful and dominant animals today. (Figs. 6.28-6.33). They are cosmopolitan in nature.

2. The most unique mammalian characteristic is the milk-producing mammary glands by which the young ones are nourished and the presence of diaphragm which is present between thorax and abdomen

Fig. 6.28 Egg laying mammal – Platypus

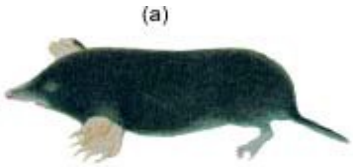

Fig. 6.29 Kangaroo with its young in pouch

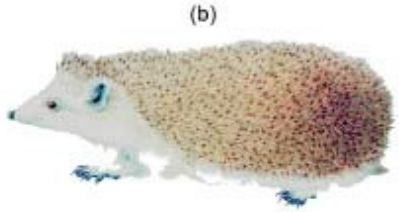

Fig. 6.30 Insectivores : (a) Mole (b) Hedgehog

Fig. 6.31 Flying mammal- Bat

Fig. 6.32 Whale

3. The skin of mammals is unique in possessing hair, thick waterproof glandular.
4. External ears or pinnae are present in most mammals.
5. Teeth are present in sockets. Such teeth are called thecodont. They are variously modified into incisors, canines, premolars and molars for the type of food ingested (heterodont).
6. Mammals have a set of milk teeth, which are replaced by permanent teeth (diphyodont).
7. A four-chambered heart ensures a continuous supply of oxygenated blood to all parts of the body.
8. The lungs are well-developed.
9. kRespiration, defaecation, micturition and parturition are enhanced by diaphragmMammals are generally terrestrial, found in a variety of habitats
10. Some mammals, however, have adapted to fly, for example bat (Fig.6.31), and live in water, for example whale (Fig 6.32).
11. The most advanced mammals are primates
12. Parental care is well marked in mammals and placenta attaches the embryo to uterus.
13. Fertilisation is internal and it takes place in the fallopian tube.
14. Mostly mammals are viviparous and some are oviparous

Fig. 6.33 *Some primates (a) Lemur (b) Tarsier Simians (c) Monkey (d) Orang-utan (e) Gorilla (ape)*

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