

Class Insecta

Class Insecta includes all insects and is the largest class of Phylum Arthropoda. Insects occupy a diversity of habitats; they are found on land, in the air, and in the sea. Examples of insects include silverfish, cockroaches, locusts, grasshoppers, dragonflies, bugs, lice, beetles, fleas, butterflies, bees, flies, and mosquitoes. In spite of their vast differences, all insects have certain characteristics in common.

Distinctive characteristics of Class Insecta

- (i) The body of an insect is divided into three general regions: the head, thorax, and abdomen as shown in Figure 3.14.
- (ii) Single pair of long antennae.
- (iii) They possess eyes which can be either simple or compound or even both, depending on the species. For instance, a dragonfly has two compound eyes, while houseflies have both simple and compound eyes.
- (iv) Gaseous exchange is through spiracles, which form part of the tracheal system; and excretion is via malpighian tubules.
- (v) They have specialized mouthparts that are used for chewing, sucking or even piercing, depending on the organism. For example, the grasshopper has a mandible that it uses for chewing grasses, while a flea has piercing and sucking mouthparts.
- (vi) They have three pairs of legs per segment of the thorax.
- (vii) Some insects have one or two pairs of wings attached to the thorax while some are wingless.
- (viii) Some insects undergo complete metamorphosis while others exhibit incomplete metamorphosis.
- (ix) Some insects (such as grasshoppers and locusts) are herbivorous while others (such as ants) are carnivorous.

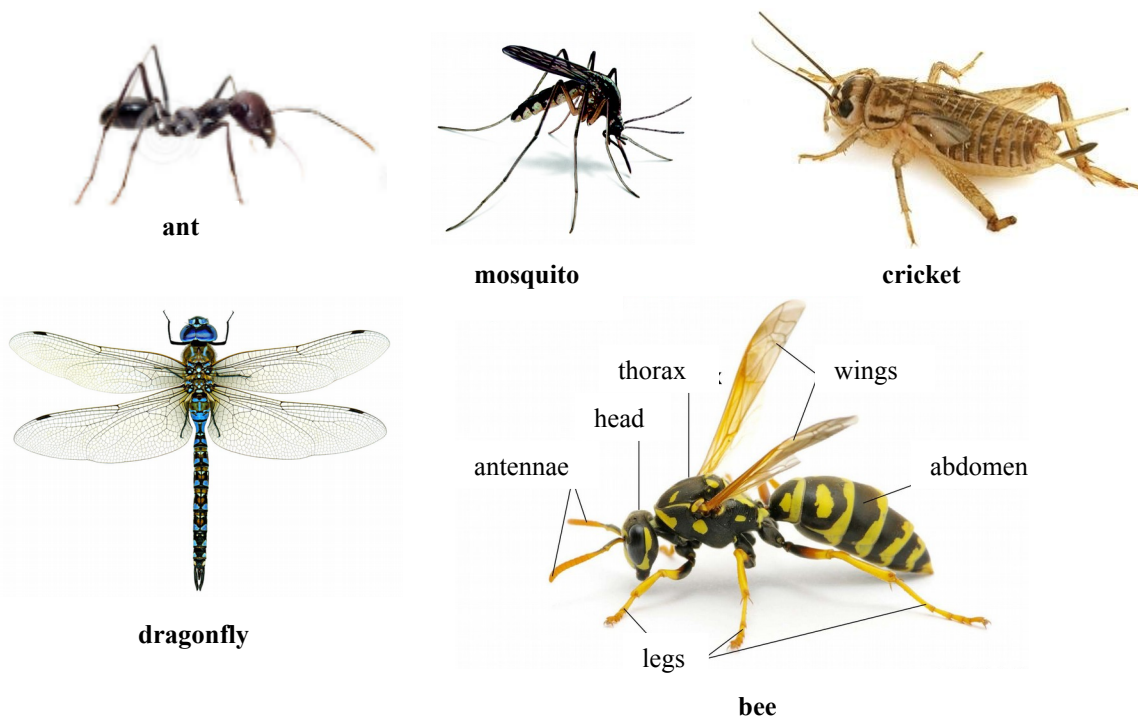


Fig 3.14 Insects

Economic importance of arthropods

Arthropods are economically important in many different ways. The ways in which arthropods are of great economic importance include the following:

- (i) **Source of food:** Arthropods are a source of food for many animals and human beings. They are a good source of protein, fat, minerals, and vitamins. A large number of arthropods are consumed by man, such as the lobsters, shrimps, prawns, crabs, crayfishes, locusts, grasshoppers, etc. Smaller species of crustaceans are eaten by fish and other aquatic organisms, forming a bulk of zooplankton which plays a vital role in food chains of fishes and other aquatic animals.
- (ii) **Spreading crop and animal diseases:** Some arthropods spread diseases to humans, plants and animals. Ticks act as vectors of protozoans which cause east coast fever in cattle and tick fever in man. Mosquitoes spread the protozoans which cause malaria, dengue fever and yellow fever. Tsetse flies transmit protozoans (trypanosomes) which cause sleeping sickness in humans and nagana in domestic and wild animals. Some arthropods may spread diseases to plants.
- (iii) **Source of employment:** Prawn and shrimp fishing is very much advanced in several countries giving employment to thousands of people.
- (iv) **Crop and livestock pests:** Many insects damage forest trees and cultivated crops by eating young crop plants. These include millipedes, locusts, aphids, grasshoppers, etc. Chicken lice, fleas and mites suck blood and cause poor growth of poultry. Ticks, tsetse flies, fleas, and lice suck the blood domestic animals such as horses, cattle, sheep, and goats and often cause haemorrhage.
- (v) **Improvement of soil fertility:** Arthropods have an important role in maintaining soil fertility. The major contribution of arthropods to the soil is through decomposition and humification of all organic matter. Insects are scavengers as they feed on dead organisms, thus helping to recycle nutrients and also prevent piling up of dead organisms.
- (vi) **Production of commercial products:** Insects which produce honey, wax, dyes and silk are commercially beneficial to humans. Honeybees produce millions of tons of honey every year and also beeswax from its combs. The larvae of silk moths produce raw silk which is used for making silk.
- (vii) **Pollination:** Some arthropods, such as bees, butterflies and ladybirds, bring about cross-pollination of flowers without which these plants could not reproduce and multiply. They thus play an important role in agriculture.
- (viii) **Biological control:** Certain species of arthropod are predaceous; they feed upon and destroy a large number of harmful insects which are injurious to crops. For example, the larvae and adults of a lady-bird beetle feed on aphids which infect cotton plants. This beetle also destroys scale worms which are pests of orange and lemon trees. *Calosoma*, a ground beetle preys upon many kinds of moth larvae which destroy cereals and cotton. Such

arthropods can be bred in large numbers by man and then used for biological control of crop pests and diseases.

- (ix) **Damage to food and other items:** Human food is spoiled by cockroaches, ants, flies and weevils. Larvae of moths eat and destroy clothes and feed on furs, carpets and dry fruits. Larvae of a carpet beetle destroy carpets and preserved biological specimens. Larvae of mealworm beetle eat food, flour and stored grains, such as rice. Silverfish and booklouse live in and destroy books. Termites cause destruction of books, carpets, furniture, and woods of buildings. Weevils destroy stored grains of maize, millet, wheat, etc.

Phylum Chordata

Phylum Chordata (chordates) includes all the vertebrates (animals with a backbone), and several invertebrates (organisms without a backbone). The most distinguishing characteristic that all animals belonging to this phylum have is the presence of notochord. A notochord is a cartilaginous skeletal rod running along the back in all embryonic and some adult chordates. It functions in supporting the body.

All chordates share the following four key features, at different stages in their life cycle:

- **Notochord** – Its main function is to support the nerve cord. In vertebrate animals, the vertebral column replaces the notochord.
- **Dorsal hollow nerve cord** – A bundle of nerve fibres which connects the brain to the muscles and other organs.
- **Post-anal tail** – This is an extension of the body beyond the anus. In some chordates, the tail has skeletal muscles, which help in locomotion.
- **Pharyngeal slits** – The openings which connect the mouth and the throat. These openings allow the entry of water through the mouth, without entering the digestive system.

In some chordates, some of these key features are present only during embryonic development and disappear as the embryo matures into an adult organism. In animals like vertebrates, the notochord develops into the vertebral column. In other animals like fish, the pharyngeal slits develop into gills.

Characteristics of Phylum Chordata

- (i) They are bilaterally symmetrical and triploblastic.
- (ii) Chordates are coelomate and show an organ system level of organisation.
- (iii) They have the characteristic notochord, dorsal nerve cord, pharyngeal slits, and post-anal tail at some stage during their development.
- (iv) The nerve cord is dorsal, hollow and single.
- (v) The heart is ventral, with a closed circulatory system.
- (vi) They have a tail which is behind the anus.

Phylum Chordata is again divided into three subphyla namely Urochordata, Cephalochordata, and Vertebrata.

The first two phyla have very few species in between them. The major subphylum is Vertebrata, which includes a variety of fishes, reptiles, birds and animals. Vertebrates have a distinguishing backbone that is made up of bone or cartilage. The brain is enclosed in a skull. There is a proper circulatory system, nervous system and a skeletal system that gives proper shape and support.

Subphylum Vertebrata is further divided into six classes. These are Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia

Class Chondrichthyes

Chondrichthyes is a class that contains the cartilaginous fishes (their skeletons are made of cartilage rather than bone). Cartilage is supportive tissue that does not have as much calcium as bones, which makes bones rigid. Cartilage is softer and more flexible than bone. Examples of cartilaginous fishes include sharks, skates, rays, dogfish, and chimaeras (ratfish). Figure 3.15 shows some cartilaginous fishes.

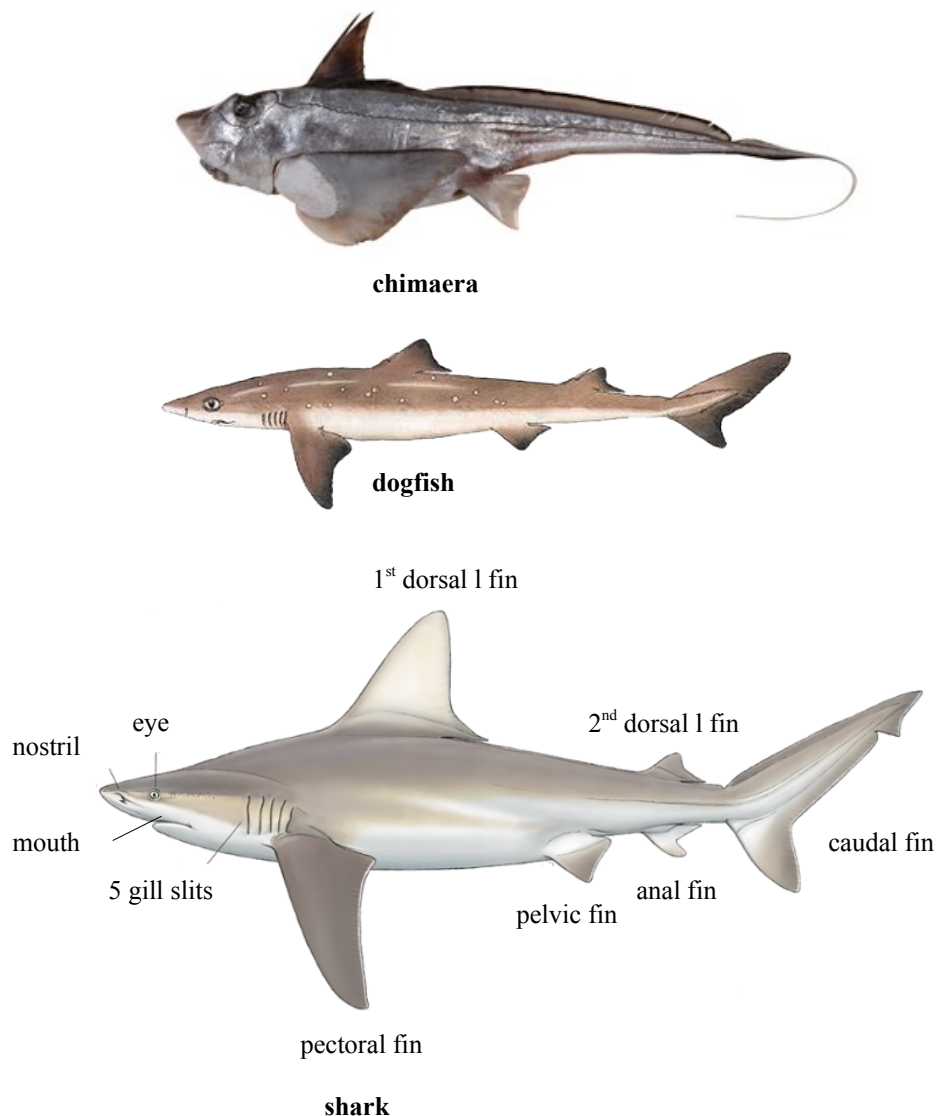


Fig 3.15 Cartilaginous fishes

Distinctive characteristics of Class Chondrichthyes

- (i) Their skeleton is made of cartilage rather than bone.
- (ii) They are jawed. Such an adaptation would allow fish to eat a much wider variety of food, including plants and other organisms.
- (iii) The body is covered with tooth-like projecting spines called **placoid** scales (or denticles).
- (iv) They have 5-7 pairs of gills for gaseous exchange, with no operculum. Each pair of gills is in a separate compartment.
- (v) The nervous system is composed of a small brain, 8-10 pairs of cranial nerves, and a spinal cord with spinal nerves.
- (vi) The mouth (with rows of teeth) and two nostrils are ventrally placed.
- (vii) The fins and nostrils are paired.
- (viii) They lack the air-filled swim bladder.
- (ix) The caudal fin has two lobes that differ in size (they are asymmetrical).
- (x) A cartilaginous fish's heart has four chambers, which occur in series. These are sinus venosus, atrium, ventricle, conus arteriosus.
- (xi) Males have copulatory structures called claspers.

Class Osteichthyes

Class Osteichthyes includes all bony fishes (their skeleton is made of bone). Examples of bony fishes include tilapia, Nile perch, lungfish, catfish, herring, and mackerel. Some bony fishes are shown in Figure 3.16.

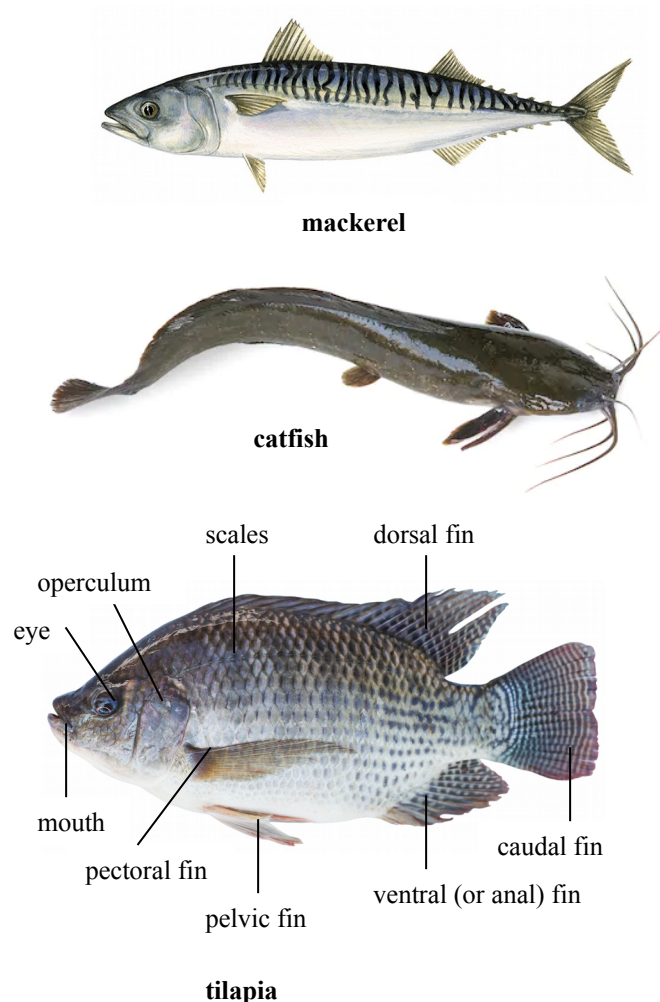


Fig 3.16 Bony fishes

Distinctive characteristics of Class Osteichthyes

- (i) The skeleton is made up of bones (bony skeleton).
- (ii) They bear paired (pectoral and pelvic fins) and unpaired fins (dorsal, anal, and tail fins).
- (iii) The body is covered with **cycloid**, **ctenoid** or **ganoid** scales.
- (iv) Their mouth is located at the anterior tip of the body (terminal mouth).
- (v) They have 4 pairs of gills or breathing organs which are covered by the operculum (gill covers) on each side.
- (vi) The caudal fin has lobes of the same size (symmetrical).
- (vii) They have swim bladder or air bladder which is used to maintain balance and to swim up and down.
- (viii) They have well developed lateral line system which contains sensory organs that help to sense both water pressure and vibrations.
- (ix) A bony fish's heart has two chambers: an atrium and a ventricle.

Class Amphibia

Class Amphibia consists of organisms (amphibians) capable of inhabiting both water and land. Most amphibians spend a part of their life in an aquatic environment and a part in the terrestrial environment for survival and reproduction. Shell-less eggs, a thin moist skin, and gilled larvae prevent most of them from ever being fully terrestrial. Examples of amphibians include frogs, toads, salamanders, newts, and caecilians. Figure 3.17 shows some amphibians.

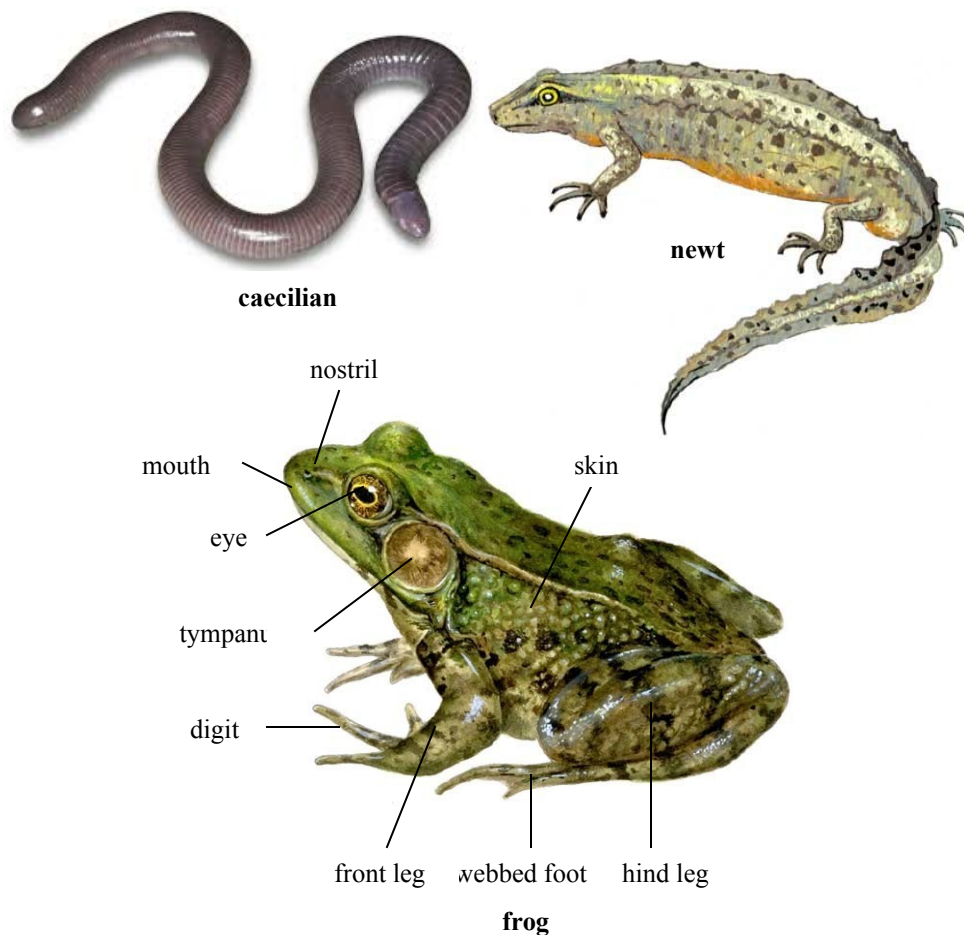


Figure 3.17 Amphibians

Distinctive characteristics of Class Amphibia

- (i) The heart is three-chambered with two auricles and one ventricle.
- (ii) Amphibians have a thin, moist, glandular skin without scales.
- (iii) The eggs of some amphibians such as frogs and toads are laid in water and fertilized externally. In some amphibians such as caecilians, newts, and salamanders, fertilization is internal.
- (iv) Gaseous exchange is through skin and/or lungs. But larval forms respire through the gills. In some cases, gills might be present externally in some adults.
- (v) Adults have simple sac-like (bag-like) lungs.
- (vi) Amphibians have a middle and inner ear, but no external ear. However, they possess a tympanum (eardrum).
- (vii) In some amphibians, such as frogs and toads, aquatic larva (tadpole) undergoes metamorphosis into a terrestrial adult.
- (viii) All amphibians have four pentadactyl legs (each leg having five digits) with the exception of caecilians, which are limbless.
- (ix) They are cool-blooded (ectothermic and poikilothermic) vertebrate animals.

Class Reptilia

Members of Class Reptilia (reptiles) are mainly terrestrial with the exception of a turtle which is aquatic. The representatives of reptiles include turtles and tortoises, crocodiles and alligators, snakes, and lizards. Some reptiles are shown in Figure 3.18.

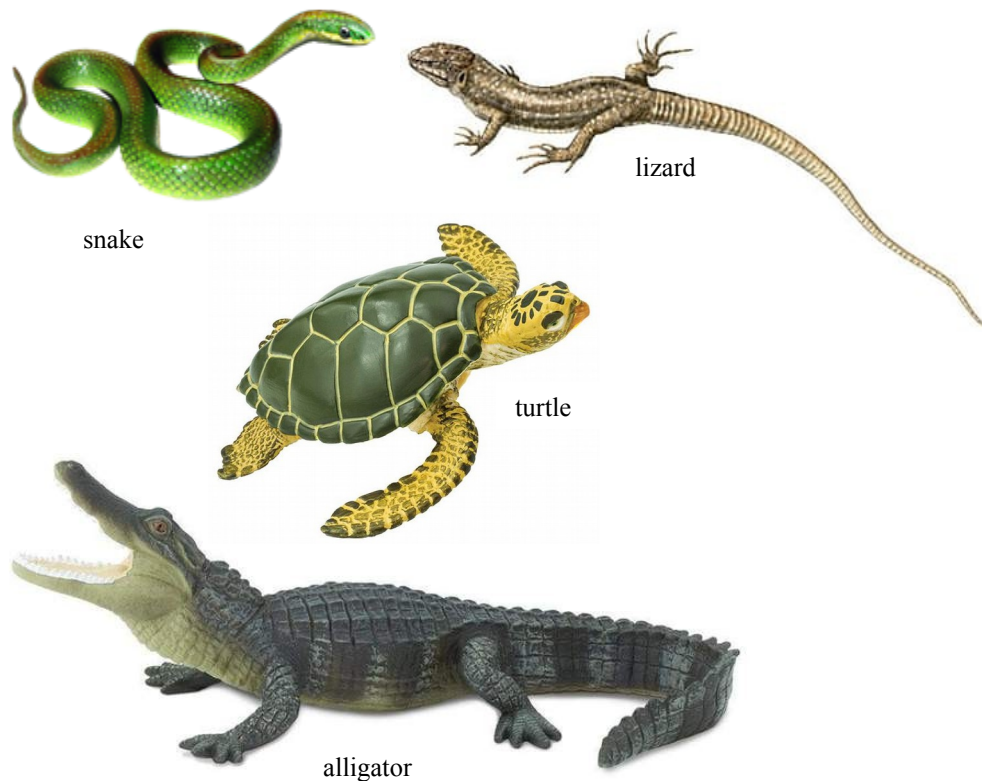


Fig 3.18 Reptiles

Distinctive characteristics of Class Reptilia

- (i) They have dry horny skin, usually with scales or scutes, without any glands. Scutes are horny keratinized plates that make up a turtle shell.
- (ii) Gaseous exchange is exclusively by lungs.
- (iii) Reptiles can reproduce sexually or asexually, utilize internal fertilization and lay amniotic eggs on land and are enclosed in a shell (**cleioidoic**). However, some species are ovoviviparous, with the eggs remaining in the mother's body until they are ready to hatch. Other species are viviparous, with the offspring born alive.
- (iv) They have two pairs of pentadactyl limbs (with exception of snakes and some lizards), each bearing claws and suited to running, crawling, or climbing.
- (v) The heart is three-chambered (two auricles and a ventricle). However, crocodiles have a four-chambered heart.
- (vi) Except for snakes, all the reptiles have well-developed ears.
- (vii) Reptiles are cold-blooded (ectothermic and poikilothermic) animals.

Class Aves

Class Aves includes all birds. Birds are bipedal (uses two legs for walking), feathered, and endothermic egg-laying animals. They are found worldwide, and their size ranges from 5 cm (bee hummingbird) to 2.75 m (ostrich). The representative members of birds include domestic fowl (chicken), weaver bird, sunbird, hawk, eagle, pigeon, gull, ostrich, and kiwi. Figure 3.19 shows some birds.

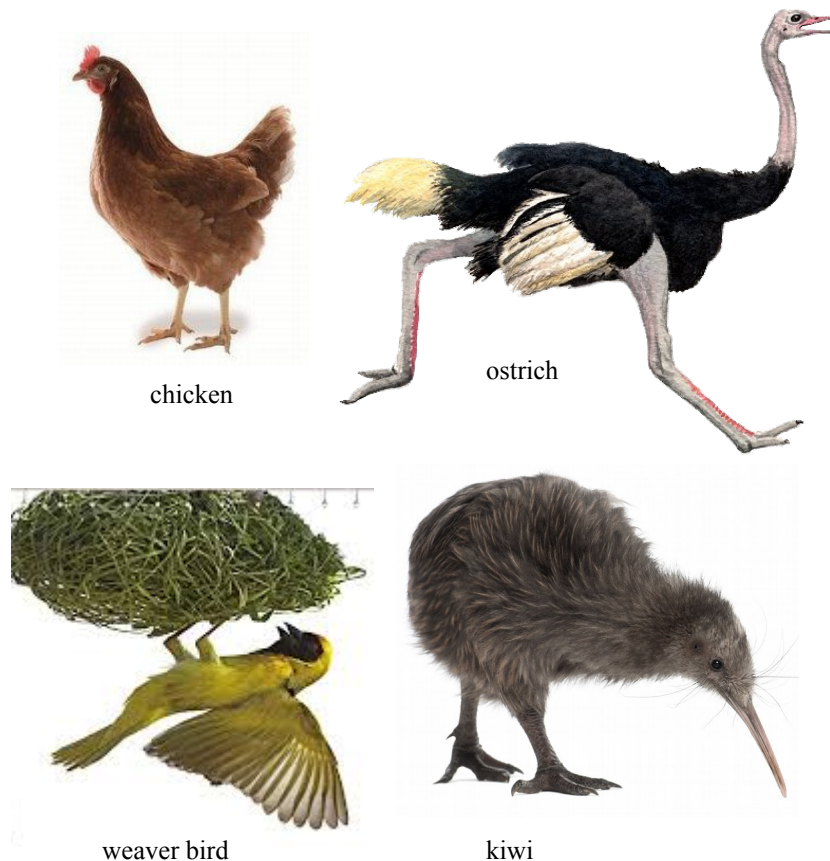


Fig 3.19 Birds

Distinctive characteristics of Class Aves

- (i) A large part of the bird's body is covered with feathers, except legs which have scales. Feathers are used for flight and for keeping the bird warm.
- (ii) They have two pairs of pentadactyl limbs: the forelimbs are modified into wings for flight and the hind limbs (legs) adapted for walking, perching, wading, or swimming.
- (iii) .They have a four-chambered heart with two ventricles and two atria.
- (iv) They have toothless jaws covered by a horny beak (bill), used for feeding.
- (v) The sternum of the pectoral girdle is expanded for the attachment of flight muscles.
- (vi) They are oviparous and lay well developed cleidoic eggs.
- (vii) The bones are hollow inside, which reduces the overall weight of the body, enabling the bird to fly.
- (viii) They have middle and inner ears, but no external ear. However, they have a tympanum (eardrum).
- (ix) The alimentary canal often contains additional chambers like crop and gizzard. The crop stores and softens food while the gizzard is muscular to crush and stir up the softened food.

Class Mammalia

Animals belonging to Class Mammalia are referred to as mammals. Mammals are one of the most evolved species in the Animal Kingdom. They are distributed worldwide but mostly occupy terrestrial habitats except a few which occupy aquatic habitats. Aquatic mammals include seals, dolphins, sea lions, whales, dugongs, sea otters and polar bears.

Whales, dolphins, porpoises, manatee and dugong are completely aquatic; seals, sea lions, walrus, hippopotamus, platypus, otters, beavers and nutria are semi-aquatic, spending part of their lives on land.

Terrestrial mammals include lion, zebra, cattle, rat, dog, and human beings.

The representative members of mammals are shown in Figure 3.20.



Fig 3.20 Mammals

Mammals show advanced characteristics which distinguish them from all other animals.

Distinctive characteristics of Class Mammalia

- (i) Most mammals give birth to live young ones. However, the spiny anteater and the duck-billed platypus lay eggs. These egg-laying mammals are called **monotremes** (Figure 3.21).

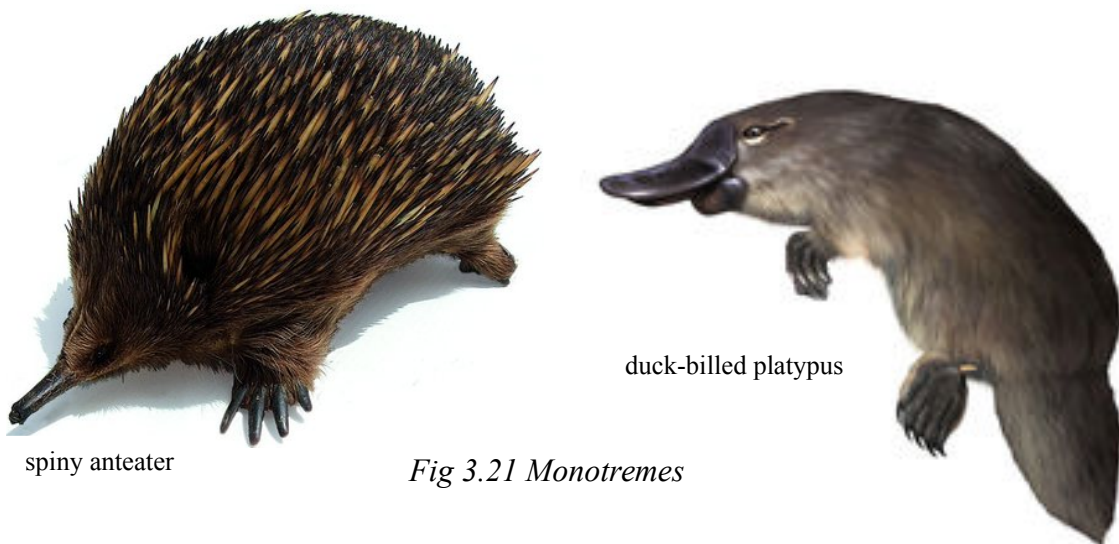


Fig 3.21 Monotremes

- (ii) The young are nourished by **milk** secreted by **mammary glands**.

- (iii) Their skin is typically covered with hair or fur, which insulates the body to help conserve body heat. The skin has oil glands (sebaceous glands) and sweat glands (sudoriferous glands).
- (iv) They exhibit heterodont dentition (they have four different types of teeth namely incisors, canines, premolars, and molars that serve different functions).
- (v) Mammals have a muscular diaphragm which separates the thoracic organs from the abdominal organs.
- (vi) The heart of a mammal consists of four chambers (two atria and two ventricles).
- (vii) They have two pairs of pentadactyl limbs which are used for walking, climbing, running, burrowing, flying or swimming.
- (viii) Their red blood cells have no nucleus.
- (ix) Gaseous exchange takes place through the lungs. Mammalian lungs have millions of tiny air sacs called alveoli, which provide a very large surface area for gas exchange.
- (x) They have a well-developed brain which is divided into cerebrum, cerebellum and medulla.
- (xi) Mammals have an external, middle and inner ear. The middle ear has three tiny bones that carry sound vibrations from the outer to the inner ear. These bones give mammals exceptionally good hearing ability.
- (xii) Mammals are homoeothermic animals (they keep their body temperature constant irrespective of changes in the environmental temperature).
- (xiii) Some female mammals such as kangaroo keep their premature young in a pouch (**marsupium**) where they are fed on milk from mammary glands until they are old enough (Figure 3.22). Such mammals are called pouched mammals or **marsupials**. Other marsupials include opossums, Tasmanian wolf, and koala bear.



Fig 3.22 Young kangaroo in a marsupium

Economic importance of chordates

Chordates play a big role in human life, other animals and plants. Chordates are economically important to human beings for many reasons as they have served or harmed man from earliest times. Some usefulness of chordates includes the following:

- (i) Many chordates like fish, chicken, cattle, poultry, etc are the main source of human food. Yet, some produce milk and eggs which are good sources of protein and vitamins.

- (ii) The skins and hides of some animals such as cattle, goat, and sheep are used for making shoes, bags, purses, belts, and other important items. The skins of crocodiles, newts, salamanders, alligators, pythons and other reptiles can serve the same purposes.
- (iii) Wool from sheep and mohair from goats are used for making garments such as blankets, jackets, coats, and bedsheets. Birds' feathers are used for decorations and clothes. Skin, horns, hoofs and bones of cattle are used for making glue, knife handles, buttons, and many other products. Eskimos in the Arctic use reindeer and bear skins for clothing, seal hides for footwear and skin of other species for boats.
- (iv) Wild animals such as zebras, gorillas, snakes, giraffe, elephants, lions, buffaloes, wildebeests are tourist attractions. Countries like Tanzania earn a lot of foreign currency from tourists who visit the country every year to view these chordates.
- (v) Chordates such as birds, bats, squirrels, monkeys, etc., visit one tree after another in search of fruits and incidentally help in the pollination of flowers. Birds also eat larvae that destroy crops and cause diseases; hence they serve as biological control of pests and diseases.
- (vi) Animals have been domesticated by man to serve as beasts of burden for transport, ploughing and draft of heavy loads. These animals include camels, cattle, horses, donkeys, and elephants.
- (vii) Manure obtained from domestic animals is used as raw materials for making biogas and in farming where it is used as fertilizer for improving soil fertility.
- (viii) Some chordates are ecologically important for eating dead animals and hence help to balance the ecosystem. Hyaenas and jackals are of great utility as scavengers in nature.
- (ix) Some chordates are used for recreation purposes when they are kept by man as pets, in zoos, and in sport hunting (hunting of wild game for human recreation).
- (x) Common animals such as rats, guinea pigs, rabbits, cats, pigs, monkeys, apes, dogs, etc., are extensively used in laboratories for research and scientific studies.
- (xi) Many chordates act as pests. Rodents destroy crops in fields. They are harmful in houses and buildings also. They consume all kinds of foodstuffs and destroy property.
- (xii) Some animals are carriers of diseases, pests and vectors that can be passed to human beings.
- (xiii) Several wild carnivorous, predatory animals and venomous reptiles are a constant menace to the lives of people and livestock. Lions, tigers, leopards, and wolves prey at times on domestic cattle, sheep, hogs, poultry, etc. Wolves and hyaenas sometimes attack persons. Some humans and animals are killed by snake venoms when bitten by these reptiles.