

8. AMPHIBIA

8.1 Characters

The primitive amphibians were the first vertebrates to initiate the conquest of land in the Devonian period. They arose from the crossopterygian fishes.

Characteristic Features

1. The integument is moist, glandular and devoid of scales (except Apoda).
2. Two pairs of limbs are present.
3. Limbs are pentadactyle (five-digitated).
4. Paired fins are absent.
5. Paired nostrils are present.
6. The eyelids are movable.
7. Teeth are present in the jaws.
8. The skeleton is mostly bony.
9. The skull possesses two occipital condyles.
10. Ribs, when present, are never attached to the sternum.
11. The heart is three-chambered, with two auricles and a ventricle.
12. RBC are oval and nucleated.
13. Respiration is by means of gills, lungs, integument or the buccal cavity, separately or in combination.
14. Renal portal and hepatic portal systems are well developed.
15. Kidney is mesonephric and urinary ducts open into the cloaca which also receives the genital ducts.
16. A urinary bladder developed from the hind region of the gut is present.
17. There are ten pairs of cranial nerves arising from the brain. The cerebral hemispheres are large but the cerebellum is ill developed.
18. Ova are small and numerous.
19. Fertilization may be external or internal.
20. Cleavage is holoblastic but unequal.
21. Mostly oviparous, i.e., lay eggs.
22. Development is indirect, and usually there is metamorphosis.

23. Embryonic membranes are absent.
24. They are poikilothermous animals, i.e., the body temperature is variable depending upon the temperature of the environment.
25. They lead an amphibious life living both on land and in water (some are permanently aquatic).

11 Classification of Amphibia

The classification of class Amphibia has been a matter of controversy and various authors have classified it differently. Boulenger, Niedeu, Watson, Sible and others have worked extensively on the taxonomy of Amphibia. The scheme of classification as adopted by Noble (1954) is presented here.

11 Outline Classification

Class Amphibia

(A) Extinct Orders

1. Order Labyrinthodontia

Suborder—Embolomeri, e.g., *Palaeogyrius*

Suborder—Rachitomi, e.g., *Eryops*

Suborder—Stereospondyli, e.g., *Cyclortosaurus*

2. Order Phyllospondyli, e.g., *Branchiosaurus*

3. Order Lepospondyli

Suborder—Aistopoda, e.g., *Ophiderpteron*

Suborder—Nectridia, e.g., *Diplocaulus*

Suborder—Adelospondyli, e.g., *Lysorophus*

Suborder—Gastrocentrophori, e.g., *Microbranchus*

(B) Living Orders

4. Order Gymnophiona (Apoda), e.g., *Ichthyophis*

5. Order Urodela (Caudata)

Suborder—Cryptobranchoidea, e.g., *Cryptobranchus*

Suborder—Salamandroidea, e.g., *Amphiuma*, *Desmognathus*

Suborder—Ambystomoidea, e.g., *Ambystoma*

Suborder—Meantes, e.g., *Siren*

Suborder—Proteida, e.g., *Necturus*, *Proteus*

6. Order Salientia (Anura)

Suborder—Amphicoela, e.g., *Liopelma*

Suborder—Opisthocoela, e.g., *Pipa*, *Alytes*

Suborder—Procoela, e.g., *Hyla*, *Bufo*

Suborder—Anomocoela, e.g., *Scaphopus*

Suborder—Diplaslocoela, e.g., *Rana*, *Rhacophorus*

Suborder (i) Amphicoela

- (i) Vertebrae with amphicoelous centrum
 Example *Liopelma*

Suborder (ii) Opisthocoela

- (i) Vertebrae typically opisthocoelous (ii) Ribs free
 Example *Alytes, Pipa*

Suborder (iii) Procoela

- (i) Vertebrae procoelous and Urostyle with double condyles
 Example *Bufo, Hyla*

Suborder (iv) Anomocoela

- (i) Sacral vertebrae procoelous (ii) Pre-sacral vertebrae eight, procoelous or with free inter-vertebral discs
 Example *Pelobates* and *Scaphiopus*

Suborder (v) Diplaslocoela

- (i) First seven vertebrae procoelous, 8th vertebra biconcave and vertebra convex anteriorly with a double condyle posteriorly (ii) Ribs absent
 Example *Rana* and *Rhacophorus*

8.6 Origin of Amphibia (Tetrapoda)

The most spectacular event in the phylogenetic history of vertebrates is the emergence of Amphibia (Tetrapoda) from piscine ancestors. The event took place nearly 300 million years ago in the background of the dry and arid Devonian period. The close anatomical resemblances and palaeontological evidences provided by Romer, Watson, Stensio, Jarvik and others clearly establish that the amphibians arose from some fish-like ancestors.

The structural and functional adaptations that were acquired by the amphibians while invading land to face the problems of terrestrial life are as follows.

- (1) Head and lower jaw developed powerful musculature.
- (2) Pectoral girdle well developed with strong scapula and pelvic girdle tri-radiate with elaborate ilium
- (3) Limbs well developed with powerful muscles to lift the body from ground
- (4) Vertebral column rigid and strong
- (5) Well-developed lungs for aerial respiration. Moist skin serves as an accessory respiratory organ.
- (6) Vascular system well developed incorporating a pulmonary circuit

(f) Middle ear cavity with columella auris for transmission of sound waves

(g) Skin keratinized to prevent desiccation on land

I. Time of origin The discoveries of the fossil footprints of *Thrinacosaurus*, an amphibian, and of skeletal remains of *Elphistostege*, an intermediate form between the crossopterygian osteolepid and the tetrapod, *Ichthyostega*, from the Devonian stratum strongly suggest that the tetrapods originated in the Devonian. There is no fossil record of Amphibia during the Silurian period and in the Carboniferous three major groups of Amphibia—the Labyrinthodontia, Phyllospindylia and Lepospondylia were dominating the earth. So, the Devonian must be the period of amphibian emergence.

II. Factors of origin The climatic and ecological conditions of the Devonian period provide us with the impelling causes of the emergence of amphibians. The Devonian was a dry period when streams and ponds tended to dry up seasonally. Ancestors of amphibians (crossopterygians) with their fleshy fins could move from drying pools where water was available. According to Huxley, 'land-limbs were developed to reach water and not to leave it'. Huxley (1955) believes that the enemies in water forced the crossopterygians to explore land. Other factors were the abundance of food on land, availability of atmospheric oxygen and especially, the recurrence of unfavourable environment.

III. Possible ancestors During the Devonian period the dominating fresh-water fishes were Actinopterygii, Aberrant-sharks, Dipnoi and Crossopterygii.

(A) Actinopterygii They cannot be the ancestors of amphibians because they lack two important characters—(a) internal nares and (b) fleshy lobed fins.

(B) Shark It is a specialized branch and cannot be regarded as the ancestor of amphibians.

(C) Dipnoi Dipnoans were regarded for long as the ancestors of amphibians on the basis of certain similarities such as the respiratory structures and their blood supply. The other features are as follows.

(i) Pectoral girdle of *Necturus* similar to that of dipnoans

(ii) Arrangement of muscles in the paired fins of the dipnoans resembles the musculature of the paired limbs of amphibians.

(iii) Single bony piece articulating the paired appendages with the pectoral and pelvic girdles is comparable with the humerus or femur of amphibian limbs.

But dipnoans exhibit many specialized features and cannot be the ancestors of amphibians. The similarities are due to convergence for living under similar conditions of life.

(D) Crossopterygii The crossopterygians or the lobe-finned fishes