

General organization of Dipnoi

Dipnoi (Gr. di-two, pnee-breathing) is a small order of fresh water bony fishes.

They respire by gills and lungs.

Dipnoi evolved during Devonian period.

They are characterized by short jaws, crushing plate like teeth, internal nares, reduced exo- and endo- skeleton, and diphycercal tail.

The air bladder so called 'lungs' are one or two. They are functional with related changes in the circulatory system and in the heart.

Primitive characters of Dipnoi

Unconstricted notochord.

Presence of cloaca.

Spiral valves in intestine.

Valves in the conus.

Diphycercal tail.

Ventral inferior nostril.

Persistent notochord without any constriction.

Cartilaginous autostylic skull.

Specialised characters of dipnoi:

Internal nares, possibly help in breathing through the nose.

Respiration by lungs (modified air bladder) in addition to gill-respiration.

Auricle is partly divided into two and nearly three-chambered heart.

One of the paired auricles receives oxygenated blood through a special pulmonary arch from the lungs.

Conus arteriosus spirally twisted and contractile in nature.

Separation of pulmonary and systemic circulation.

Large paired cerebral hemispheres.

Well-developed Mullerian duct.

Presence of characteristic tooth plates, used for crushing of shelled invertebrates.

Bones absent in the jaw.

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External Structures of Dipnoi:

The three extant dipnoans have elongated piscean body covered by overlapping cycloid scales.

The dorsal, anal and tail fins are continuous

The pectoral and pelvic fins are usually designated as the 'limbs'.

These are extremely elongated, filamentous structures and are devoid of fin rays.

The tail is diphyccercal (Protocercal or isocercal) in the living genera

The operculum and a slit-like branchial opening are present on either side.

The external nostrils are enclosed within the upper lip and two internal nostrils open into the mouth cavity.

The lateral line sensory system is well-developed.

The cloacal aperture lies at the root of the tail.

Two abdominal pores usually open into the cloaca.

Digestive System of Dipnoi

The teeth form characteristic tooth-plates for crushing the molluscan shells.

The tooth-plates are formed by the fusion of many small denticles.

The alimentary canal is a simple tube. The pharynx leads into an oesophagus.

The lung-fishes lack distinct stomach.

The intestine is ciliated and contains a spiral valve running along the entire length of the intestine and makes about six and a half turns.

The liver is a single massive gland which is slightly divided into two unequal lobes.

The gall-bladder is large and situated on the left margin of the liver.

The pancreas remains embedded within the walls of the gut. The islets of Langerhans are not seen in the pancreas of the dipnoans.

The spleen is composed of vascular tissue and is attached to the right dorsolateral wall of the stomach.

The alimentary canal is lined by columnar, ciliated and goblet cells

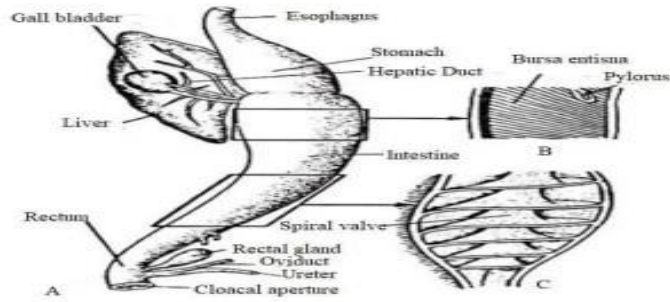


Fig. Digestive system of *Protopterus*: A. Showing the alimentary canal and its relation to the liver. B. A portion of the anterior part of the intestine is cut open to show bursa entisina. C. A part of the intestine is dissected to show the spiral valve

Respiratory System of Dipnoi

Both gill and pulmonary respiration take place in the lung-fishes. Although the dipnoans possess the gills as well as lungs, they use mostly the lungs.

The nostrils help in aerial respiration.

The swim-bladder is modified into the 'lung' which is similar to that of other tetrapods in structure and function.

The walls of the lungs contain muscle fibres and the internal cavity produces numerous alveoli which lead into minute alveolar sacs. In *Protopterus* and *Lepidosiren* the supply of blood to the lungs is elaborate.

Aquatic respiration takes place through the gills.

Neoceratodus, *Protopterus* and *Lepidosiren* obtain 98% of their oxygen from the air.

Circulatory System of Dipnoi:

The circulatory system is well developed.

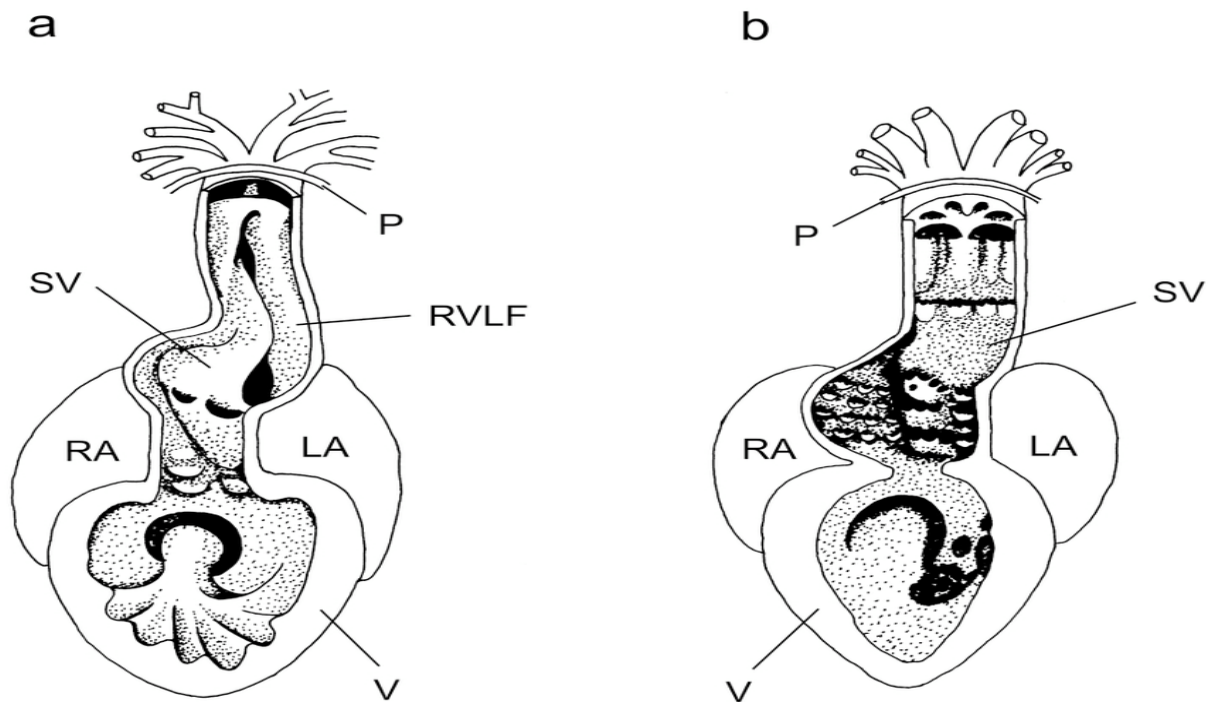
The heart is enclosed in a stiff pericardium.

The heart of the lung-fishes consists of three parts, the auricle, ventricle and conus arteriosus.

The auricle becomes dilated on either side of a thin and perforated inter auricular septum, i.e., the cavity of the auricle is almost divided.

The ventricle appears to be divided into two parts by the presence of septum, the ventricular cavity is single and lies anterior to the so-called interauricular septum.

The conus arteriosus becomes spirally twisted and the cavity becomes complicated by the presence of valves.



L.S. Heart of Protopterus and Neoceratodus

Nervous System of Dipnoi:

The telencephalon becomes evaginated into a pair of well-marked cerebral hemispheres.

The olfactory lobes are sessile and lie dorsal to the anterior ends of the cerebral hemispheres.

The diencephalon is relatively small and its roof is formed of a large mass of choroid tissue, the saccus dorsalis.

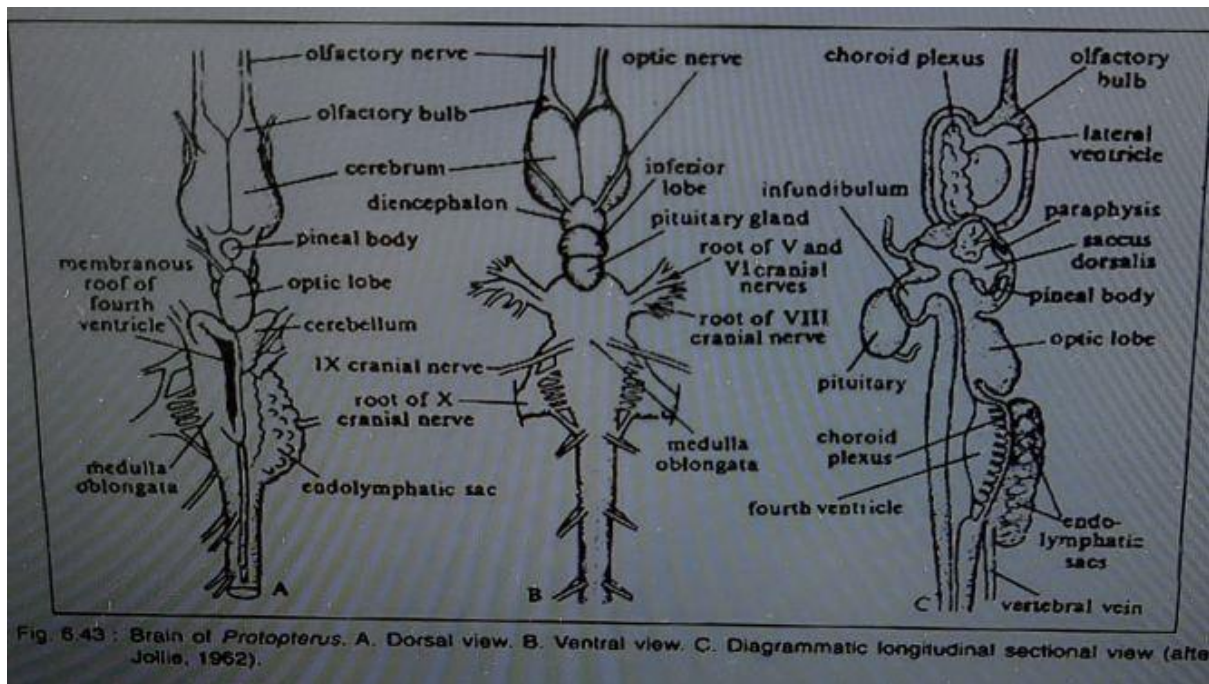
A pineal body is present on the saccus dorsalis and its stem extends back towards the posterior commissure.

The hypothalamus bears small inferior lobes.

The optic lobes are slightly developed and become fused to form single oval mass in front of the cerebellum.

A peculiarly lobes saccus endolymphaticus or endo-lymphatic sacs lies above the medulla oblongata. The cerebellum is small and forms a narrow transverse ridge.

A sympathetic nervous system is associated with the vagus nerve.



Excretory System of Dipnoi:

The excretory system comprises of a pair of elongated kidneys which are separate anteriorly but are usually fused at their posterior ends.

The kidneys are of mesonephric type and remain in intimate contact with the gonads.

The kidneys extend throughout the greater part of the visceral cavity.

Two thick-walled ducts, one from each kidney, may unite in *Neoceratodus* or may remain separate in *Protopterus* and *Lepidosiren* before opening into the cloaca.

The lung-fishes normally excrete 30-70% of nitrogenous waste products through the gills in the form of ammonia.

Reproductive System of Dipnoi

The sexes are separate.

The sexual dimorphism is absent excepting *Lepidosiren* where the males develop vascular papillae on the pelvic fins during breeding season.

Female Reproductive Organ

The ovaries are paired and elongated.

The ovaries are typically like that of other fishes and are kept in position in *Protopterus* by mesovarium but in *Neoceratodus* these are attached with the dorsal body wall.

The oviducts are located on the lateral side of the ovaries. Each oviduct (Mullerian duct) opens anteriorly into the body cavity by a fringed slit-like opening.

The eggs are shed free into the body cavity and carried out by the oviducts.

Male Reproductive Organs

There are two elongated testes in lung-fishes

In *Lepidosiren* and *Protopterus*, the testes are narrow bodies and appear round in cross-section. But in *Neoceratodus* the testes are thick and triangular in cross-section.

The testes are enclosed by fatty tissues and lie on the ventrolateral sides of the kidneys.

