

Respiratory System of *Pila globosa*

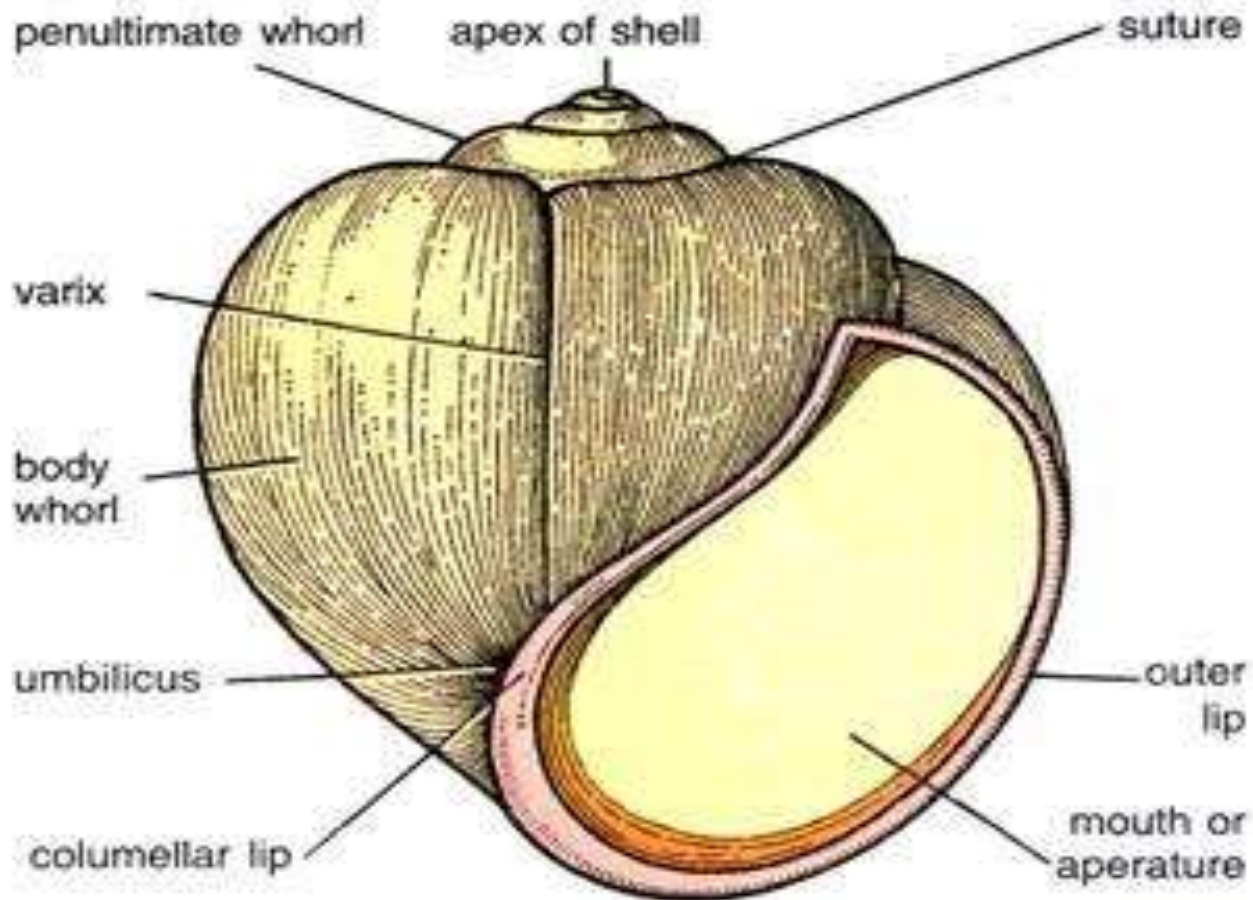


Fig. 60.1. *Pila globosa*. Shell seen from ventral surface.

TDC I
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Group C

Respiratory System of *Pila globosa*:

- *Pila* exhibits double mode of respiration, i.e., it can absorb oxygen dissolved in water by ctenidium and can also utilise atmospheric oxygen by the pulmonary sac. Respiration through ctenidia are called as Branchial Respiration.
- The mantle cavity is incompletely divided into right chamber (branchial) and left chamber (pulmonary) by the presence of epitaenia.
- Aquatic respiration is performed by the single ctenidium or gill situated on the dorsolateral wall of the right portion of the mantle cavity .

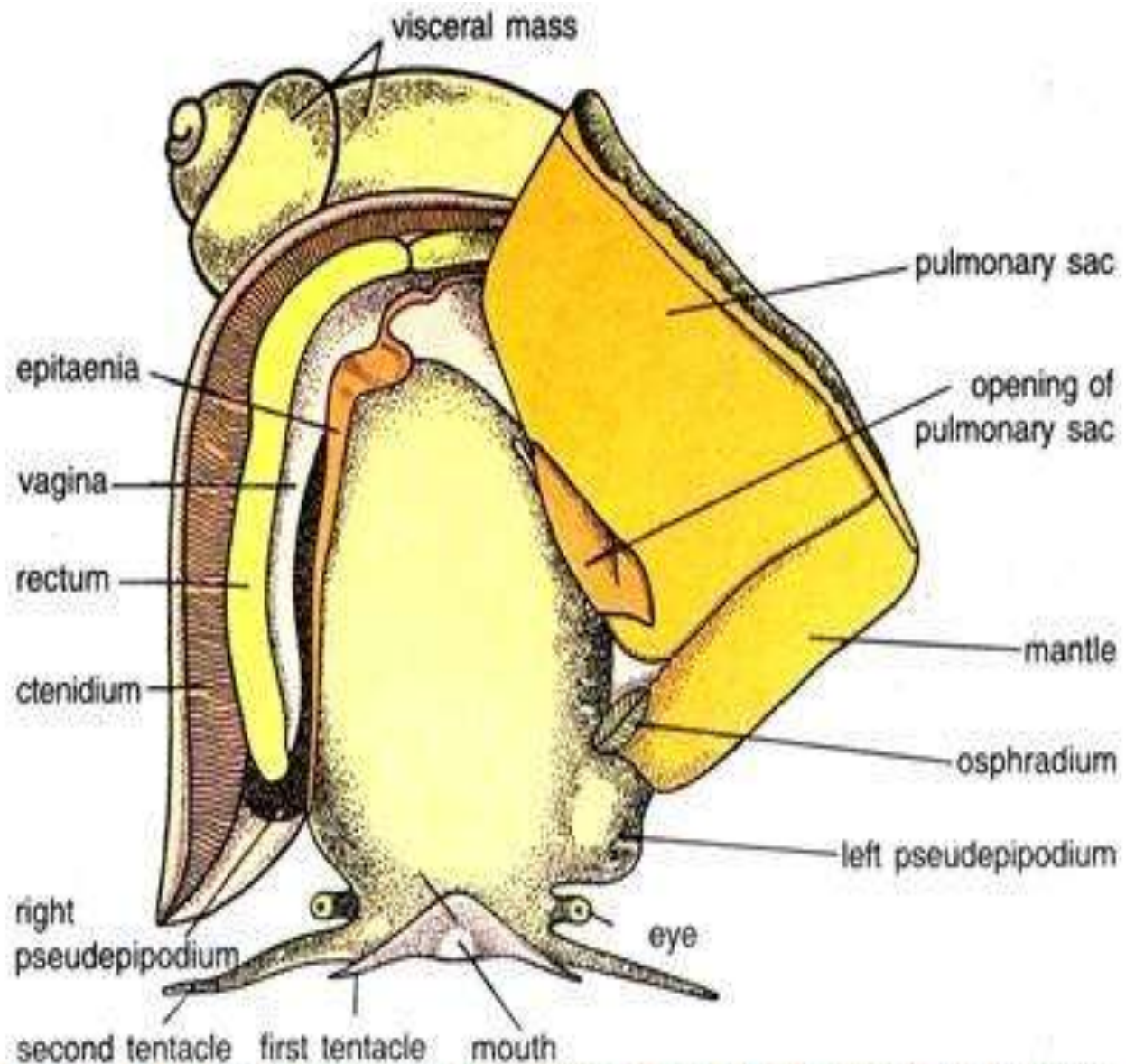


Fig. 60.6. *Pila globosa*. A female individual dissected to show the organs of the pallial cavity.

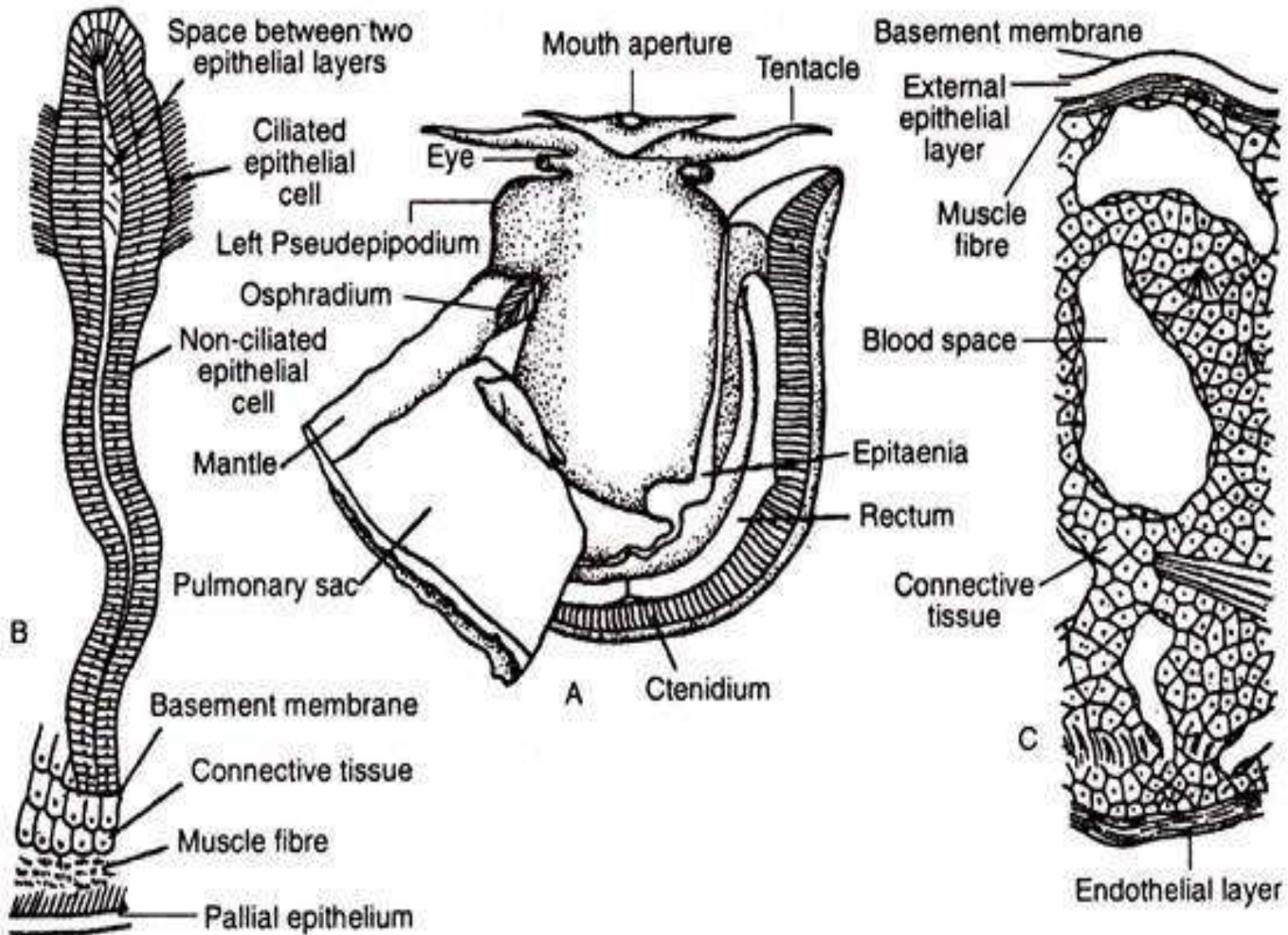


Fig. 16.13: Respiratory organs in *Pila*. A. The mantle is partially displaced to show the position of ctenidium. B. Transverse section of a branchial lamella. C. Diagrammatic sectional view of the outer wall of the pulmonary sac.

The Ctenidium

- The ctenidium is situated on the dorsolateral wall of the branchial chamber of the mantle cavity. It is composed of a long series of numerous thin triangular flattened leaflets or lamellae, lying parallel to each other, which are attached to the mantle wall by their broad bases but have their apices hanging free in the branchial chamber. The line of attachment of the lamellae to the wall of the mantle forms the ctenidial axis. The ctenidial axis is provided with an afferent blood vessel (carrying deoxygenated blood) and an efferent blood vessel (carrying oxygenated blood) from gills to heart.
- These lamellae are arranged in a single row running only one side along the ctenidial axis of the gill. This type of the ctenidium is known as **monopectinate type**. On its axis lamellae are present on one side only. It looks like a comb.
- The basal end of each lamella is attached to the pallial epithelium and the other end hangs freely.
- The ctenidial lamellae are not of same size. The lamellae are large in the middle of the ctenidium, while the lamellae decrease in size towards the two ends. Each lamella bears transverse ridges or pleats on both its anterior and posterior surfaces.

The Gill Lamella

- Each branchial (ctenidial) lamella is composed of two layers of epithelia supported by muscle fibres and connective tissue. Two epithelial layers enclose a narrow space.

Each epithelial layers consists of three types of cells:

- (i) Ciliated columnar cells,
 - (ii) Non-ciliated columnar cells and
 - (iii) Few glandular cells.
- The ctenidium is supplied with blood vessels. The right side of lamella is smaller called afferent side and the left side is longer called efferent side.
 - The ctenidial axis of the afferent side carries the afferent blood vessel that collects deoxygenated blood and left side of the ctenidial axis carries efferent blood vessel that supplies oxygenated blood. Each lamella is provided with many transverse ridges or pleats . These pleats are low ridges gradually decreasing in size from the base of the lamella to its apex. Each ridge contains branches of blood vessels. Each lamella has a smaller right side, which receives blood from the afferent vessel, is called the afferent side and a longer left side, from which blood goes into the efferent vessel, is called the efferent side.

- The ctenidium of Pila, though situated on the right side of the animal, is morphologically the gill of the left side, which has shifted to the right on account of the development of an extensive pulmonary sac on the left side. This is shown by the blood supply and the innervation of the ctenidium and is further confirmed by the situation of the osphradium which still retains its original position on the left side of the animal.
- Histologically, each lamella appears to be a hollow cavity lined on either side by the epithelium containing non-ciliated columnar cells, ciliated columnar cells and a few glandular cells. The epithelial layer is followed by a thin basement membrane below which are found connective tissue cells having scattered nuclei and oblique muscle fibres.

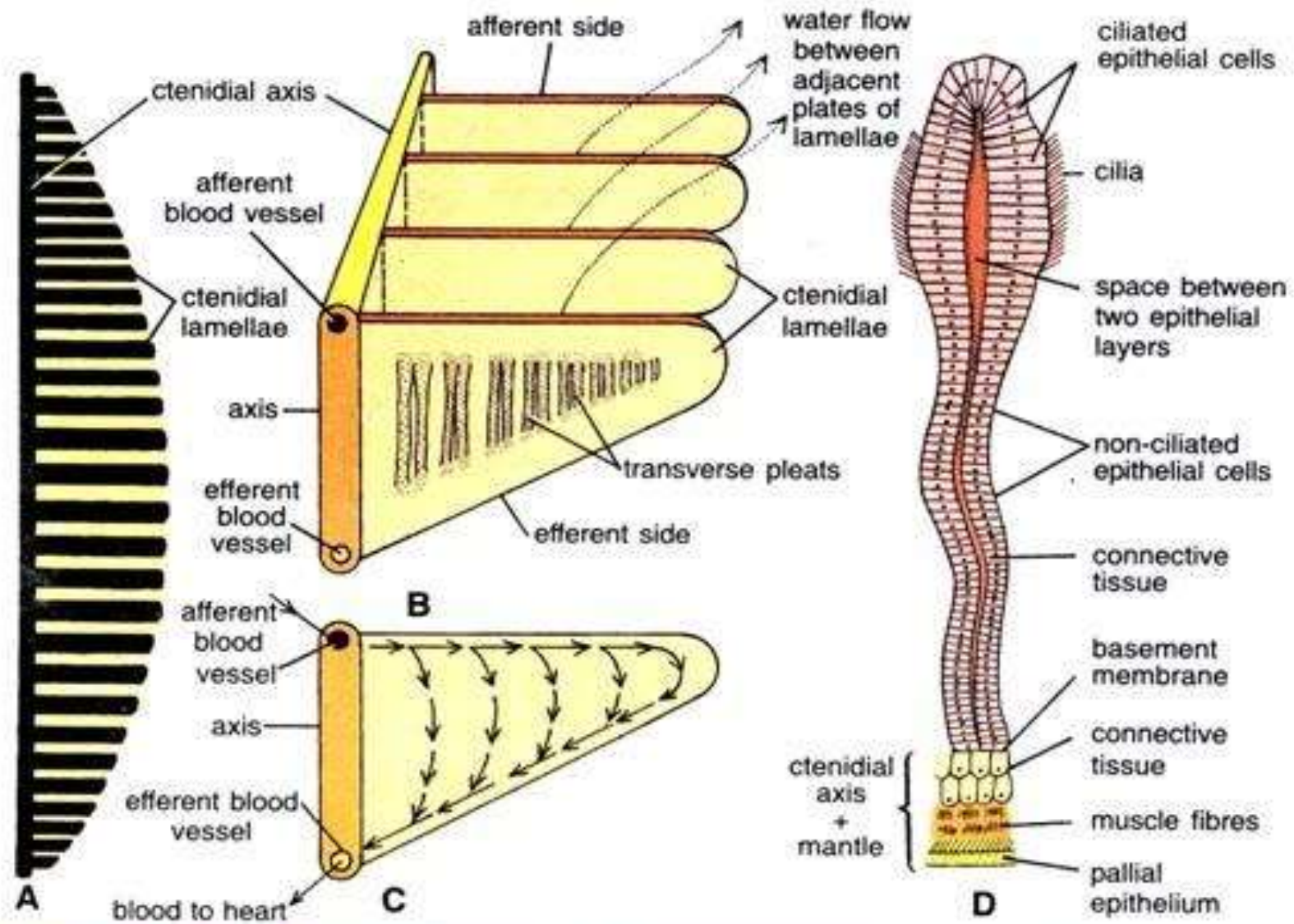


Fig. 60.14. *Pila globosa*. Respiratory organs. A—A monopectinate ctenidium; B—Stereogram to show water current through gill-lamellae; C—A single lamella to show flow of blood within it; D—A lamella in T.S.

A. Aquatic respiration/ Branchial Respiration

Mechanism of Respiration

- In aquatic respiration, a current of water containing oxygen is drawn in by the extended left siphon (left nuchal lobe). The water reaches the osphradium which tests the nature of water. Ultimately the respiratory water current reaches the pulmonary chamber and flows into the right branchial cavity crossing the epitaenia.
- Here the water bathes the ctenidium and passes out through the right nuchal lobe. The gaseous exchange takes place between oxygen dissolved in water and carbon dioxide which is produced during respiration, diffuses into water.

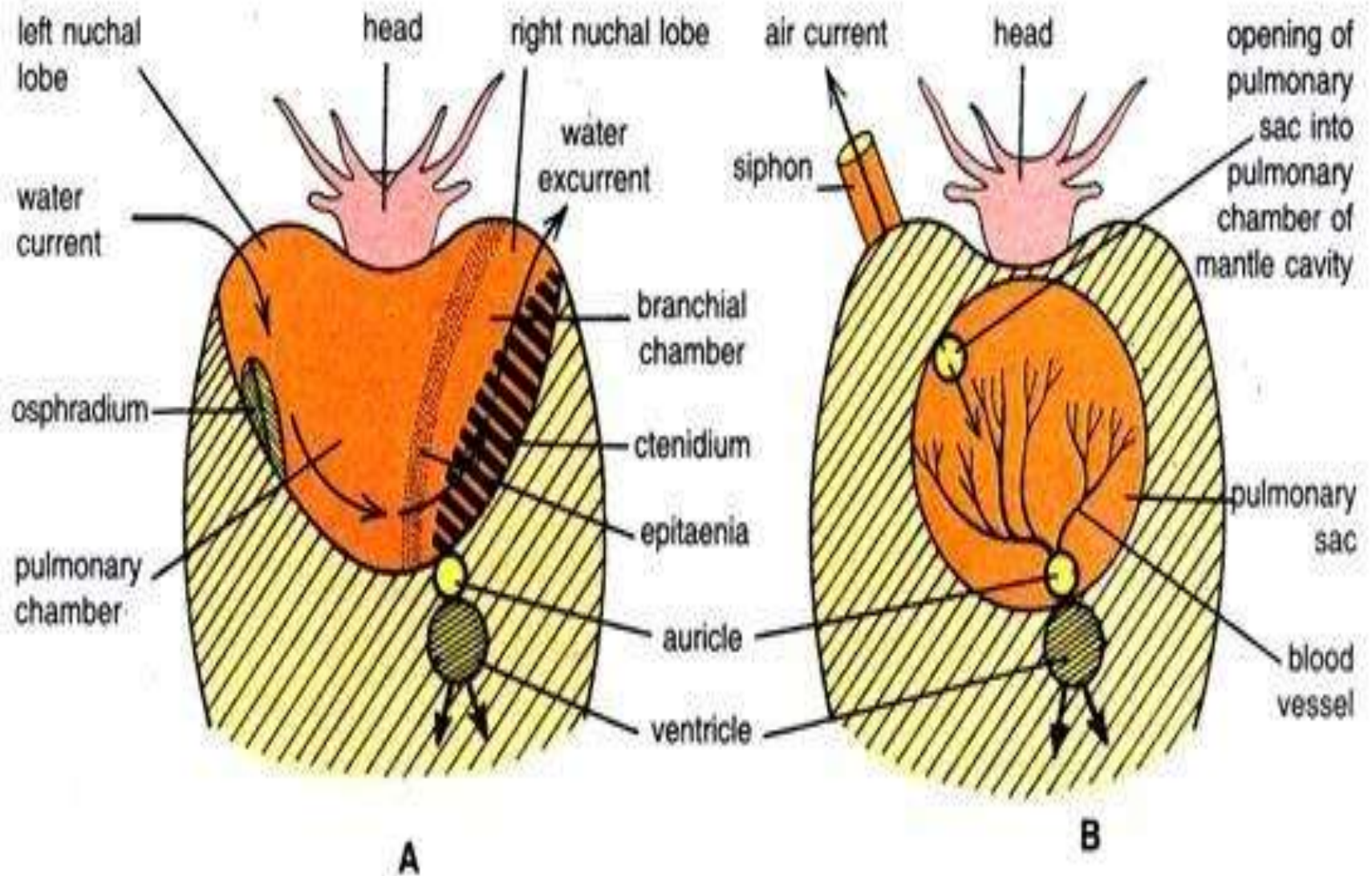
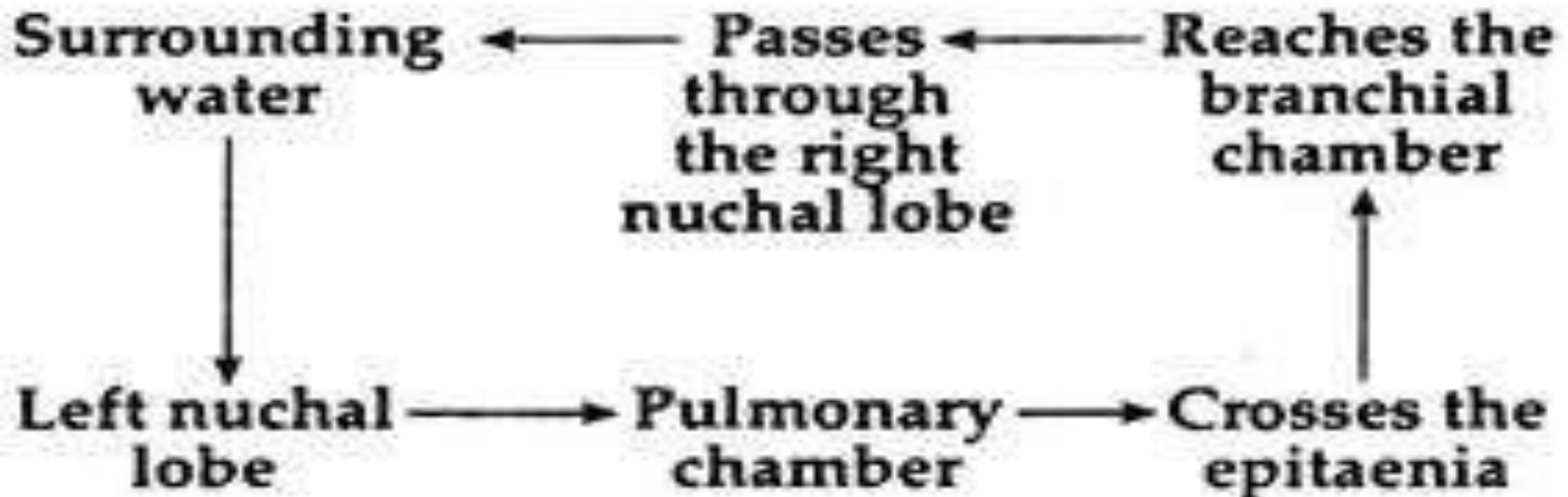


Fig. 60.16. *Pila globosa*. Diagrams showing mechanism of respiration. A—During aquatic respiration; B—During aerial respiration.

Nuchal Lobes

- The two fleshy, muscular nuchal lobes or pseudopodia are situated, one on either side of the head. The right and left pseudopodia or nuchal lobes are fleshy and highly contractile processes of the mantle on either side of the head. They form elongated funnels or siphons during respiration for the entry and exit of water. The mantle is prolonged into highly contractile nuchal lobes. The left lobe is highly developed while the right lobe is less developed and both form as extended funnels or siphons. Both the lobes help in respiration.
- **The course of water current in aquatic respiration in *Pila* is being represented here:**



B. Aerial respiration

Pulmonary sac:

- The pulmonary sac is a closed cavity which hangs from the dorsal wall of the mantle in the pulmonary chamber. The pulmonary sac in *Pila globosa* is a new attainment in response to its aerial respiration.
- The dorsal wall of the pulmonary sac is densely pigmented, while the ventral wall is creamy white. The walls of the sac are highly vascular, i.e., richly supplied with blood vessels. The pulmonary sac communicates with the pulmonary chamber of the branchial cavity by an aperture known as the pneumostome which is guarded by two valves. The wall, specially the dorsal wall of the pulmonary sac, is highly vascular and helps directly in gaseous exchange.

Mechanism: On land, the pulmonary sac becomes filled up with atmospheric air and carries on the process of respiration. *Pila* can also respire through the pulmonary sac while it remains in water.

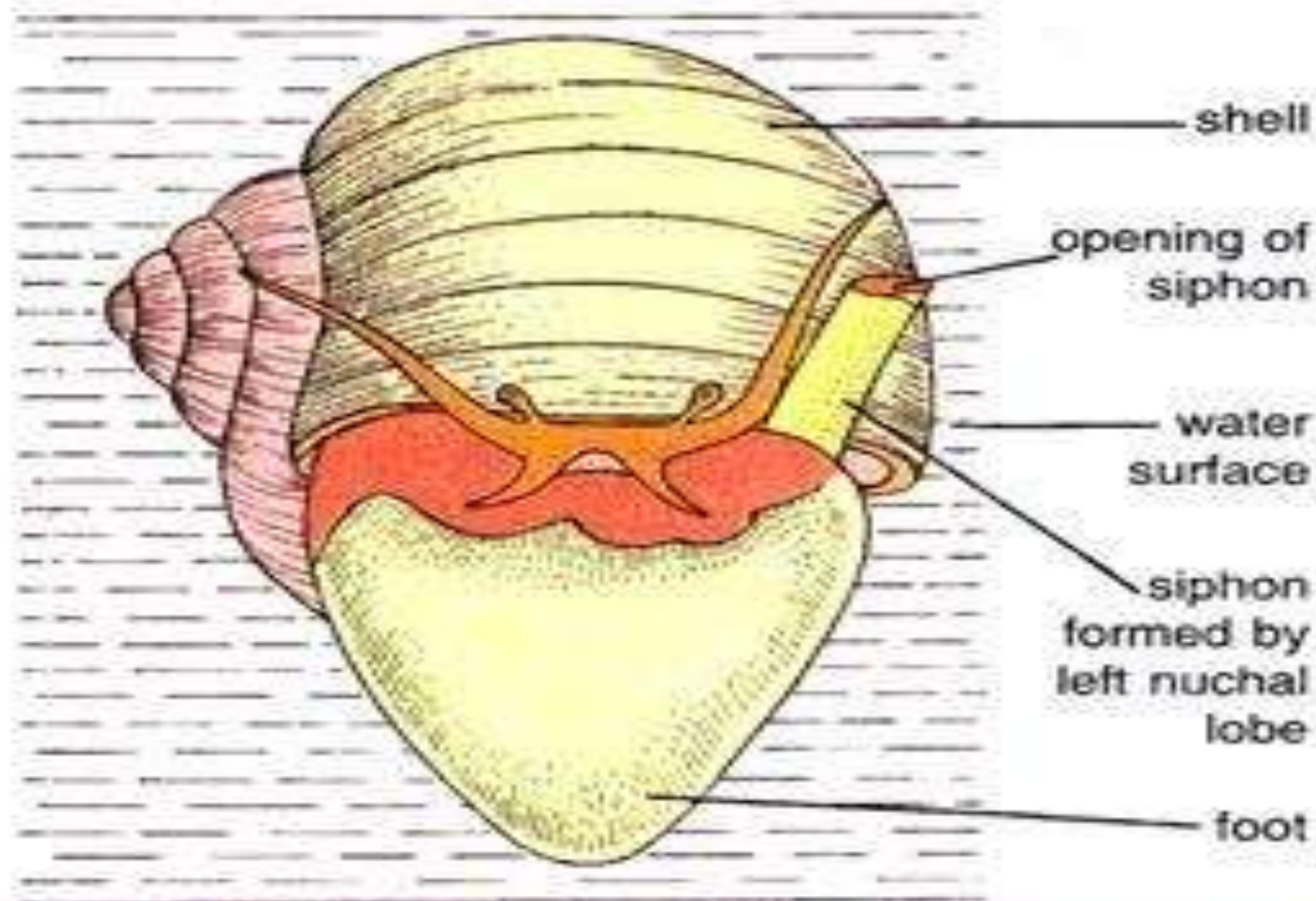


Fig. 60.17. *Pila globosa* with its siphon up for breathing air.

- To inhale atmospheric air, *Pila* comes to the surface of the water. Before reaching the surface, *Pila* begins to expand the size of the left nuchal lobe (left siphon). It increases its size both in length and breadth and rolls up to form an elongated respiratory tube.
- The outer end of the tube extends beyond the level of water and sucks in air from atmosphere. The inner end of the tubes comes in an immediate contact with the opening of the pulmonary sac. The alternate contraction and dilatation of the mantle wall as well as of the pulmonary sac help in the process of respiration.

- After gaseous exchange the expelled air goes out of the pulmonary chamber by the same route. During this process the branchial chamber remains completely shut off from the pulmonary chamber by the epitaenia which comes in contact with the roof of the mantle.
- Aquatic respiration takes place when *Pila globosa* remains either submerged in water or remains attached to the aquatic weeds. When the water of the pond becomes foul, *Pila* comes to the surface of water, or on land they perform aerial respiration.