

RESPIRATION IN ARTHROPODA

Arthropods constitute three-fourth of the animal kingdom and inhabit a variety of habitats. They breathe air as well as water and some are accomplished amphibians. Their respiratory organs vary according to their way of living as described below.

RESPIRATORY ORGANS OF CRUSTACEANS (e.g. Prawn)

In smaller crustaceans, such as Copepods and Ostracods oxygen simply diffuses through the body surface since small animals have larger surface area as compared to the body mass. In majority of crustaceans gills are the chief respiratory organs. In prawn gills are enclosed in a gill chamber on each side of the cephalothorax and are covered by a carapace, inner side of which is called branchiostegite and has vascularised respiratory epithelium.

Epipodites are highly vascularised leaf-like membranous structures attached on the coxa of the three maxillipedes. They carry out respiratory function.

The gills are regarded as primary respiratory organs and they are three types in prawn, namely podobranchs, arthrobranchs and pleurobranchs.

Podobranchs are one pair of small gills that are attached on the coxa of the second maxillipedes.

Arthrobranchs are two pairs, one smaller and the other larger, attached to the arthrodistal membrane of the third maxillipedes.

Pleurobranchs are 5 pairs of arched gills attached in the gill chamber on the outer margin of cephalothorax, just dorsal to the walking legs. The gill lamellae are flat, plate-like arranged parallel to each other like the pages of a book.

Water current flows through the gill chamber by the action of **scaphognathite** which is a fan-like appendage of maxilla and lies near the entrance of the gill-chamber. It is also

called baler as it forces water over the gill chamber. Fresh water enters the gill chamber from behind in the form of a current. The highly vascularised gill-plates are covered with permeable membrane for the passage of gases.

RESPIRATORY ORGANS OF ARACHNIDS (e.g. Scorpion)

Scorpion breathes air through four pairs of book lungs or pulmonary sacs that open to the outside through four pairs of stigmata on the ventral side of mesosoma.

Book lungs are sac like structures, within which there are delicate folds that are arranged like the leaves of a book. These folds are richly supplied with blood. The four pairs of book lungs are located in the third, fourth, fifth and sixth mesosomal segments. Each book lung consists of an air cavity or **atrial chamber** on the ventral side which opens to the outer side by a slit-like spiracle or **stigmata** that opens on the ventro-lateral side of the sternum. Dorsal part of book lung consists of nearly 150 vertical folds or **lamellae** arranged like leaves of a book. Each lamella is a hollow structure, made of two thin layers of respiratory epithelium.

The air breathing in the book-lungs is effected by the action of the **dorso-ventral** and **atrial** muscles. Contraction of the dorso-ventral muscles compresses the pulmonary chamber so that the air from the chamber is forced out through the stigmata. When the atrial muscles contract the book-lungs expand creating vacuum and sucking fresh air in through the stigmata.

RESPIRATORY ORGANS OF INSECTS (COCKROACH)

Great majority of insects breathe air by means of an elaborate and most efficient gas exchange system made of branching elastic air tubes or tracheae called the **tracheal system**. In majority of insects tracheal system serves for transport of oxygen and carbon dioxide. Each trachea is an air tube lined with epithelial cells and spiral ridges called the **taenidia**. Tracheae open externally by small openings called **spiracles** through which the air enters the system. The tracheae are branched into finer branches called **tracheoles** which are air capillaries without inner taenidial ridges. Breathing is

affected by the paired **tergo-sternal muscles** which connect dorsal side of body with the ventral side and hence their contraction compresses the abdominal cavity forcing air to move out. Relaxation of these muscles brings the abdominal cavity into its original shape, sucking the air into the tracheal tubes.

In many aquatic insects such as mayfly and dragon fly larvae there are tracheal gills for respiration in water. Tracheal gills are leaf-like extensions on the terminal abdominal segments that carry respiratory epithelium.

Inside the body of cockroach there are three pairs of parallel longitudinal **tracheal trunks**, one dorsal, one ventral and one pair lateral in position, which are connected together by transverse commissures. The cuticular lining of these tracheae is spirally thickened to form **taenidia** which prevent the tracheal tubes from collapsing. **Tracheoles** profusely branch and anastomose and penetrate in all parts of body and connect to the muscle and tissue cells. Tracheoles have a diameter of only 1 micron only and their cavities are intracellular and walls are very thin and devoid of cuticular thickenings. Instead they are lined by a protein called **trachein** and are usually filled with a fluid in which oxygen dissolves and diffuses to the tissues. The tracheal system carries oxygen directly to the body cells and does not require blood to transport it. Generally there are 10 pairs of spiracles in insects, two pairs are thoracic and eight pairs are abdominal.