

RESPIRATORY SYSTEM OF PERIPLANETA

The blood of cockroach is colourless and it cannot carry oxygen to different tissues due to the absence of respiratory pigment. Therefore a tracheal system is developed to carry the air directly to the tissues. The respiratory system of cockroach consists of

1. Stigmata
2. Trachea and
3. Tracheoles.

1. STIGMATA or SPIRACLES:-

1. The tracheal system communicates with the exterior by ten pairs of openings called stigmata or spiracles.
2. The first two pairs of stigmata are present in the thoracic segments, one pair in mesothorax and one pair in the metathorax.
3. The remaining eight pairs of spiracles are present in the first eight abdominal segments.
4. Spiracles are located in the pleura of their respective segments.
5. The spiracles of cockroach are polyneustic and holopneustic.
6. All spiracles are valvular.
7. Each spiracle is surrounded by a chitinous ring called peritreme.
8. Each spiracle bears small hair-like structures called trichomes. They filter the dust.

2. TRACHEAE:-

1. From the atrium of each thoracic spiracle several tracheae run inside. They join with each other in the thorax to form many tracheal trunks like dorsal cephalic, ventral cephalic trunks and their branches. These branches enter all organs of the head.
2. From the atrium of each abdominal spiracle three tracheal tubes arise. They are
A. Dorsal tracheal tube
B. Ventral tracheal tube
C. Lateral tracheal tube.
3. All these tracheal tubes of one side open into three separate longitudinal tracheal trunks. They are
A. Dorsal longitudinal trunk
B. Ventral longitudinal tracheal trunk
and
C. lateral longitudinal tracheal trunk.
4. The lateral longitudinal tracheal trunks are the longest tracheal trunks.
5. The three pairs of longitudinal tracheal trunks of both sides are interconnected by many commissural tracheae.
6. Several branches are given out from all the tracheal trunks and they enter different organs.

STRUCTURE OF TRACHEA

- A. The wall of the trachea is made of three layers. They are
an outer – basement membrane,
a middle – layer of epithelium and
an inner – layer of cuticle.
- B. The inner cuticle is called intima.
- C. The intima produced in to spiral thickenings called taenidia. The taenidia keep the tracheae always open and prevent it from collapsing.

3. TRACHEOLE:-

1. All the tracheal branches entering into an organ end in a special cell called tracheole.
2. The terminal cell has many intracellular tubular branches called tracheoles.
3. Tracheoles are formed of a protein called trachien. Tracheoles are devoid of intima and taenidia.
4. Tracheolar fluid is present inside the tracheoles. The level of the tracheolar fluid varies with the metabolic activity of the insect.
5. The level of the tracheolar fluid is more when the insect is inactive and it is less when the insect is more active.
6. Tracheoles penetrate the cell and are intimately associated with mitochondria to supply oxygen to them.

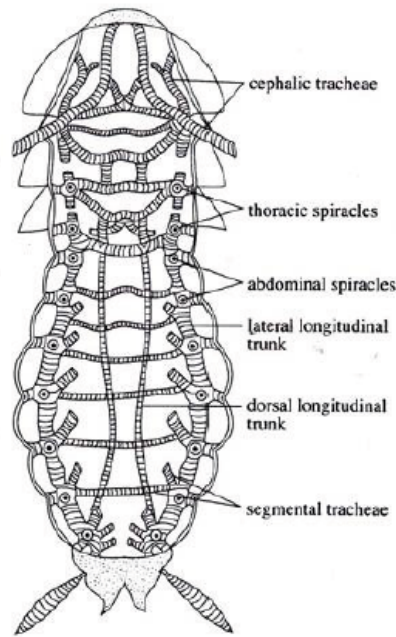


Fig. 2.53 : Tracheal system of *Blatella* (Dorsal view).

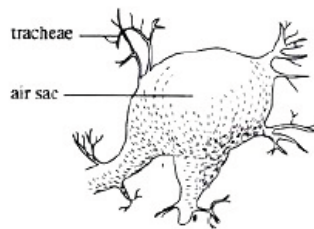


Fig. 2.54 : Air sac of cockroach.

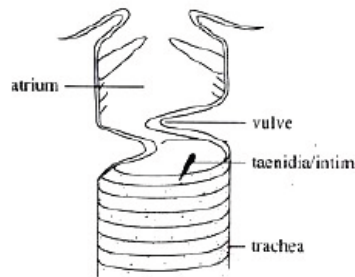


Fig. Junction of Atrium and trachea

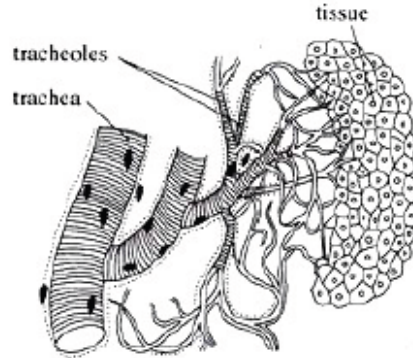


Fig. 2.56 : Branching of tracheae within the tissue of cockroach.

MECHANISM OF RESPIRATION:-

Respiration includes two events, they are

- I. Inspiration and
- II. Expiration.

The dorsoventral muscles and ventro longitudinal muscles helps in respiratory movements of periplaneta . Dorsoventral muscles are the principal muscles of respiration.

1. INSPIRATION:-

- A. Taking in of air is inspiration.
- B. During inspiration the thoracic spiracles are kept open and the abdominal spiracles are kept closed.
- C. It is affected by the relaxation of dorsoventral muscles and ventrolongitudinal muscles.
- D. Due to the relaxation of dorsoventral muscles body tergum is elevated and the volume of the body cavity increases.
- E. Due the relaxation of ventrolongitudinal muscles, the telescoped segments come to the normal position. So the volume of the body cavity increases in the longitudinal axis.
- F. Due to the relaxation of muscles this process is a passive process.

EXPIRATION:-

1. Sending out of air from the body is called expiration.
2. During expiration thoracic spiracles are closed and abdominal spiracles are kept open.
3. It is affected by the contraction of dorsoventral muscles and ventro longitudinal muscles.
4. On contraction of dorsoventral muscles depress the tergal plates. Body cavity decreases in size and pressure increases
5. Due to the contraction of the ventro longitudinal muscles , the segments are telescoped and the volume of the body cavity decreases in the longitudinal axis increasing the pressure further.
6. As the process involves the contraction of muscles, expiration is described as active process.

EXCHANGE OF GASES:-

- 1) The exchange of gases depends on the metabolic rate and temperature.
- 2) When air enters the tracheoles, oxygen diffuses faster into the tissues due to its high partial pressure.
- 3) At the same time the carbon dioxide of tissues, instead of passing into the tracheal system, goes into the haemolymph.
- 4) Carbon dioxide is carried more quickly into the haemolymph due to its greater solubility in it. This carbon dioxide accumulates near the spiracles and diffuses in to the atrial chambers near the spiracles and goes out in bursts through the abdominal spiracles.
- 5) Cockroach and some other insects such as grasshoppers and beetles exhibit the phenomenon of discontinuous ventilation. In this mode of respiration continuous exchange of gases is interrupted by extended periods during which spiracles remain closed. The expulsion of carbon dioxide from the body occurs in bursts, when the spiracles are open.