MECHANISM OF RESPIRATION IN INVERTEBTRATES

Dr. Sunita Kumari Sharma
Associate Professor and Head
P.G. Department of Zoology
Maharaja College, Ara

All animals either aquatic or terrestrial demand a steady supply of oxygen into the cells to get the energy for their metabolic activities and a ready removal of the carbon dioxide released during metabolism. In small animals and at the cellular level, physical forces of diffusion alone affect these exchanges.

Animals with high rate of metabolism and impermeable protective body surfaces need special organs and physiological arrangements for the exchange of oxygen and carbon-dioxide between the external environment, and the cells and tissues of the body.

Many aquatic invertebrates take oxygen directly from the water through internal or external gills, directly through the skin or through the use of a bubble of air which is attached to their bodies and which they take with them below the water surface. Insects either breathe through gills or from the surface.

Three types of respiration include

Internal respiration: Internal respiration involves gas exchange between the blood and body cells.

External respiration: External respiration is the breathing process. It involves inhalation and exhalation of gases and

Cellular respiration: It includes glycolysis, Krebs' cycle, electron transport system and oxidative phosphorylation.

(1) Protozoa

Protozoa do not have any organelle for the process of respiration. The limiting permeable membrane acts as a respiratory surface. The free molecular oxygen from the surrounding media enters into the body by diffusion.

(2) Porifera

Sponges are a type of aquatic animal whose body is covered in tiny pores called ostia. The ostia allow water, oxygen and other nutrients to flow into the body and for waste products like ammonia and carbon dioxide to exit their body. The respiratory system of a sponge is based on the process of diffusion.

(3) Coelenterata

Instead, all of the cells in a cnidarians body are capable of absorbing oxygen from the water around them and expelling carbon dioxide back into the water through diffusion. Depending on the species, water enters through a mouth or through surface cells, and exits through either location.

(4) Ctenophora

Ctenophores also resemble cnidarians in relying on water flow through the body cavity for both digestion and respiration, as well as in having a decentralized nerve net rather than a brain.

(5) Platyhelminthes

Flatworms, as indicated by the name, are tiny, flat worms that absorb oxygen directly through the skin into their bodies' cells. This mechanism is known as cutaneous respiration, skin breathing or diffusion.

(6) Nematoda

Roundworms do not breathe in the sense that vertebrates. Instead, roundworms obtain the oxygen their bodies need through diffusion, a process of gas exchange commonly used among flatworms and earthworms as well.

(7) Annelida

Annelids have two kinds of respiration depending on different classes. If annelids live in sea or water like in class Polychaeta, they have gills to breathe. Some annelids do not have lugs like earthworm (class Oligochaeta) and they use their outer skin to exchange gas.

Respiration in annelids occurs primarily through their moist skin, although certain species have evolved specialized gills or use paired projections called parapodia in gas exchange. The annelid excretory system consists of paired nephridia found in each segment which function in excreting nitrogenous waste. Earthworms lack any kind of special respiratory organs. They breathe through a gas exchange through their skin. This occur using areas of the body cavity known as capillary beds. Gas exchange occurs between the capillary beds of the body surface and the environment.

(8) Onychophora

Onychophora possess a tracheal system for respiratory function, but oxygen-transport proteins have been considered unnecessary. Among these, the evolution of an efficient circulatory system was essential to sustain the large Metazoa with a sufficient amount of oxygen.

(9) Arthropoda

In Crustaceans and Xiphosurids, gaseous exchange takes place in the gills between the blood and the water. But in Insects, after diffusion the oxygen passes to the tracheal tubes.

In most Crustaceans, the gills are not covered within a special gill chamber. But in Decapods, the carapace extends laterally over the gills to house them in a special chamber.

In such forms with chamber, current of water enters through one end and after bathing the gills, passes out through another direction. The trachea ramifies into a number of fine networks of tracheoles which terminate into tissues where exchange of gases takes place by diffusion. Air is drawn in and forced out through the spiracles by the alternate con-

traction and expansion of the body. The spiracles remain closed most of the time and exchange of gases is probably due to diffusion and ventilation.

Recent studies indicate that the spiracles open very briefly but not all at a time due to reduction of haemocoelomic pressure. The spiracles are closed by valves, thus control the water loss, and opening of the spiracles is related to the high CO_2 concentration.

Gaseous exchange through the tracheae takes place by diffusion primarily and tracheoles are permeable to water and remain fluid-filled. This fluid is believed to be involved in the final O_2 transport to the tissues.

Again it is reported that the movement of trachea is facilitated by the alternate contraction and relaxation of the body sclerites. In the bed bugs, rigid and convex sternum does not take part in the respiratory movement, which is done only by the elastic tergum. In cockroaches the tergum and sternum of the segments are separated by inter-segmental membrane which bulges out during respiration.

(10) Mollusca

Basically all molluscs breathe by gills that are called ctenidia (comb-gills) because of their comb-like shape. In terrestrial molluscs this respiration organ is reduced, but still respiration takes place in the pallial cavity. To inhale, the snail widens the respiratory cavity by lowering the cavity floor.

The movement of water is effected through the mantle cavity by the beating of cilia. Each ctenidium contains afferent and efferent blood vessels which run through the ctenidial axis.

The body of the ctenidium receives deoxygenated blood from the body of the animal through the afferent blood vessel and after oxygenation in the gill filaments the oxygenated blood is sent back to the heart through the efferent blood vessel.

(11) Echinodernata

Echinoderms have a poorly developed respiratory system. They use simple gills and their tube feet to take in oxygen and pass out carbon dioxide. Echinoderms have a simple excretory system with no kidneys and use diffusion to rid their bodies of nitrogenous waste which is mainly ammonia gas.

In general, echinoderms typically respire by simple diffusion, using gills or specialized projections, like tube feet or pockets, to circulate water and oxygen through their bodies.

Gaseous exchange occurs via dermal branchiae or papulae in starfish, genital bursae in brittle stars, peristominal gills in sea urchins and cloacal trees in sea cucumbers. Exchange of gases also takes place through the tube feet.

(12) Hemichordara

The lateral cilia lining the gill-slits create a current of water (food-cum-respiratory current) that enters the pharynx through mouth, then passes through gill-slits into the branchial sacs and finally leaves through the gill-pores. The tongue bars are richly supplied with blood capillaries and take part in respiration. The blood of their capillary networks takes up oxygen dissolved in water and diffuses carbon dioxide to it.