

## **Circulatory System of Insects**

Insects have an open circulatory system with the blood occupying the general body cavity, which is known as hemocoel. It differs in both structure and function from the closed circulatory system found vertebrates. In a closed system, blood is always contained within vessels whereas in an open system, blood (usually called hemolymph) is flowing freely within body cavities where it makes direct contact with all internal tissues and organs. The circulatory system is responsible for movement of nutrients, salts, hormones, and metabolic wastes throughout the insect's body. In addition, it plays critical role in immune system.

Dorsal Vessel is the major structural component of an insect's circulatory system. It is a long tube running longitudinally through the thorax and abdomen, along the inside of the dorsal body wall. In most insects, it is a fragile, membranous structure that collects hemolymph in the abdomen and conducts it forward to the head.

In the abdomen, the dorsal vessel is called the heart. It is divided segmentally into chambers that are separated by valves (ostia) to ensure one-way flow of hemolymph. A pair of alary muscles are attached laterally to the walls of each chamber. Peristaltic contractions of these muscles force the hemolymph forward from chamber to chamber. During each diastolic phase (relaxation), the ostia open to allow inflow of hemolymph from the body cavity. The heart's contraction rate varies considerably from species to species -- typically in the range of 30 to 200 beats per minute. The rate tends to fall as ambient temperature drops and rise as temperature (or the insect's level of activity) increases.

In front of the heart, the dorsal vessel lacks valves or musculature. It is a simple tube called the aorta which continues forward to the head and empties near the brain. Hemolymph bathes the organs and muscles of the head as it emerges from the aorta, and then haphazardly percolates back over the alimentary canal and through the body until it reaches the abdomen and re-enters the heart.

To facilitate circulation of hemolymph, the body cavity is divided into three compartments called blood sinuses by two thin sheets of muscle and/or membrane known as the dorsal and ventral diaphragms. The dorsal diaphragm is formed by alary muscles of the heart and related structures; it separates the pericardial sinus from the perivisceral sinus. The ventral diaphragm usually covers the nerve cord; it separates the perivisceral sinus from the perineural sinus.

In some insects, pulsatile organs are located near the base of the wings or legs. These muscular "pumps" do not usually contract on a regular basis, but they act in conjunction with certain body movements to force hemolymph out into the extremities.

About 90% of insect hemolymph is plasma: a watery fluid -- usually clear, but sometimes greenish or yellowish in color. Compared to vertebrate blood, it contains relatively high concentrations of amino acids, proteins, sugars, and inorganic ions. Overwintering insects often sequester enough ribulose, trehalose, or glycerol in the plasma to prevent it from freezing during the coldest winters. The remaining 10% of hemolymph volume is made up of various cell types (collectively known as hemocytes); they are involved in the clotting reaction, phagocytosis, and/or encapsulation of foreign bodies. The density of insect hemocytes can fluctuate from less than 25,000 to more than 100,000 per cubic millimetre. With the exception of a few aquatic midges, insect hemolymph does not contain hemoglobin (or red blood cells). Oxygen is delivered by the tracheal system, not the circulatory system.

DORSAL VESSEL (HEART) OF INSECT

