All About Insects

Victorian Curriculum Links

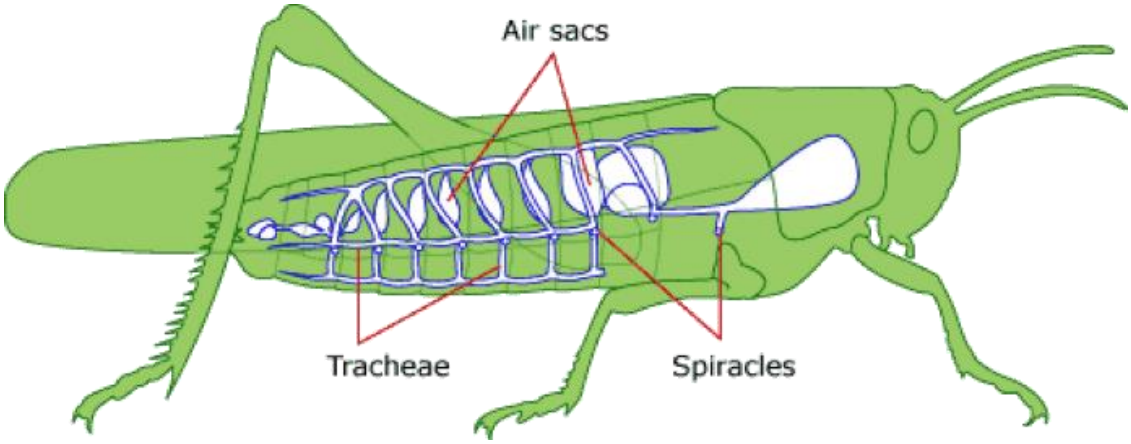
VCSSU094

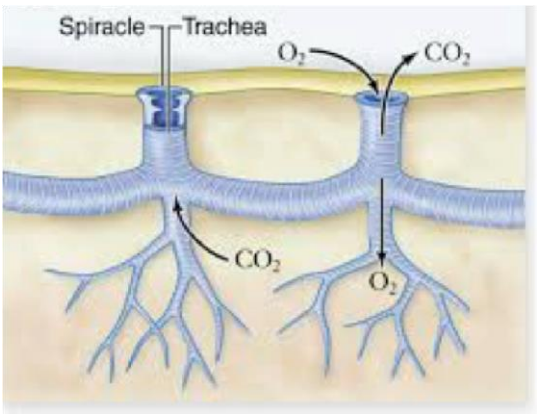
Multicellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce examining the specialised cells and tissues involved in structure and function of particular organs

- describing the structure of each organ in a system and relating its function to the overall function of the system
- identifying the organs and overall function of a system of a multicellular organism in supporting life processes
- comparing reproductive systems of organisms
- comparing similar systems in different organisms, for example, digestive systems in herbivores and carnivores, respiratory systems in fish and mammals

How Do Insects Breathe?

Insects require oxygen to live, and produce carbon dioxide as a waste product, just as we do. To say that insects breathe, though, might be a stretch. They don't have lungs, nor do they transport oxygen through their circulatory systems. Instead, insects use a series of tubes called a tracheal system to perform gas exchange throughout the body.





Gas exchange, or what we think of as breathing, is accomplished mostly by simple diffusion through the cell walls. Air enters the spiracles (small holes in the abdomen) and moves through the tracheal system. Each tracheal tube ends in a moist tracheole, a specialized cell for exchanging gases with another cell in the body.

When air reaches the tracheole, oxygen dissolves into the tracheole liquid. Through simple diffusion, oxygen then moves to the living cell and carbon dioxide enters the tracheal tube. Carbon dioxide, a metabolic waste, exits the body through the spiracles.

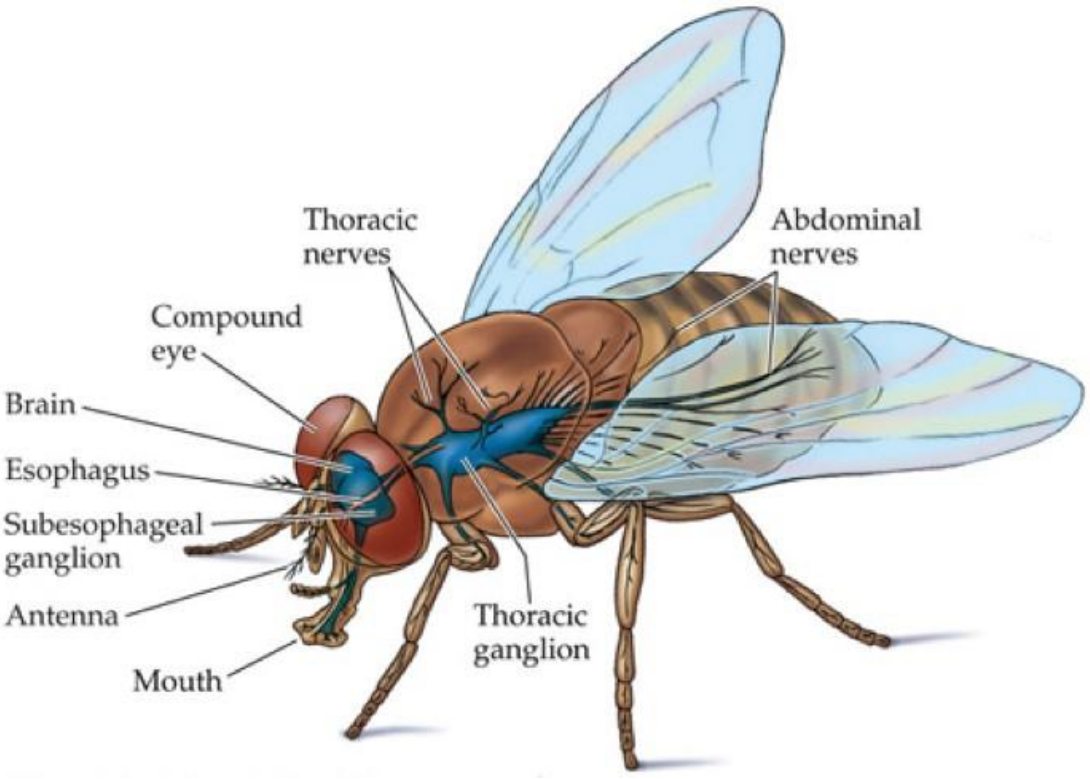
The Nervous System of Insects

In common with other animals, the basic component of the nervous system is the neuron, or nerve cell, which consists of a cell body with two extensions, the axon and the dendrite. The dendrite receives stimuli while the axon transmits impulses either to another neurone or to an organ such as a muscle. Various chemicals such as acetylcholine are involved in the transmission of impulses across the synapse.

The insect central nervous system consists of a brain, sub-oesophageal ganglion and a ventral nerve chord. The ventral nerve chord primitively consists of ganglia (aggregations of nerve tissue) joined by a pair of longitudinal nerve chords. Various nerves extend from these ganglia to other organs.

Primitively there is a pair of ganglia per body segment but there has been progressive fusion of ganglia both within and between segments.

The three pairs of fused ganglia of the head region, form the brain.
The three pairs of ganglia from the segments bearing the mouthparts have coalesced to form the sub-oesophageal ganglion. Circulatory systems. Instead, insects use a series of tubes called a tracheal system to perform gas exchange throughout the body.



Let's compare some of the features of vertebrate and invertebrate nervous systems:

- **Basic plan**. All vertebrates and most invertebrates share a basic plan that consists of central nervous system and a peripheral nervous system.

- **Brain**. All vertebrates and many invertebrates including molluscs and insects, have brains. The general evolutionary trend in both vertebrates and invertebrates is toward increasing brain control over ganglia at lower levels of the body.

- **Number of neurons**. Whereas vertebrate brains usually have many neurons devoted to information processing, invertebrate brains usually have fewer but larger and more complicated neurons to integrate information.

- **Ganglion structure**. Vertebrate ganglia have the cell bodies on the inside and the dendrites and axons on the outside. Ganglia in invertebrate nervous systems have a different structure: an outer rind of cell bodies and an inner core consisting of extensions of the cell bodies forming a dense neuropil (a network of axons and dendrites).

- **Axons and neural conduction**. Many axons of mammalian neurons are surrounded by myelin, which helps them conduct impulses faster than unmyelinated axons can. Invertebrates have no myelin to speed nerve conduction, but as we mentioned in the previous section, many have a few giant axons to convey messages rapidly.

- **Structural changes**. The structure of the nervous system undergoes large-scale changes in some invertebrates during metamorphosis. Vertebrates show important changes in neural structure during development, but these changes are not as dramatic as the changes during invertebrate metamorphoses.

- **Location in the body**. In vertebrates the central nervous system is encased in the bony skull and spinal column. In many invertebrates, the nervous system is built around the digestive tract.

Insect Digestion

Although many species of insects may take advantage of different types of diet at different stages of their life cycle, diets may be classified as **saprophytic, phytophagous or carnivorous.**

Saprophytic insects consume plant or animal remains. They are important in recycling nutrients. Examples include fly and beetle larvae.

Phytophagous insects, such as grasshoppers and butterflies, attack living plants. Their mouthparts are primitively of the chewing type, but many specialised insects have piercing and sucking and/or lapping mouthparts.

Carnivorous insects consume animal tissues. Predators, parasites and parasitiods may be used as biological control agents.

Predators eat other insects or animals. They may capture by speed in pursuit (e.g. robber fly, dragonfly), trapping (antlion larva) or by use of modified appendages (e.g. raptorial legs of mantid, extendable labium of dragonfly nymph).

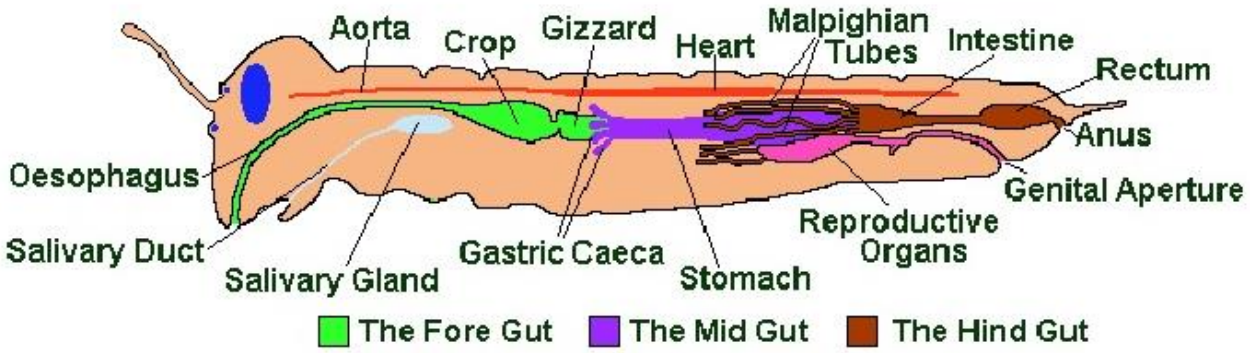
Parasites live off a host but do not kill it. Ectoparasites live externally on the host; endoparasites live inside the host.

Blood sucking insects may be ectoparasitic for a long period, (e.g. fleas, lice) or is with the host only while feeding (e.g. mosquitoes, bed bugs).

Parasitoids kill the host.

The alimentary canal or gut of insects can be divided into 3 sections

- Foregut (stomodeam)
- Midgut (mesenteron)
- Hindgut (proctodeam)



http://www.earthlife.net/insects/images/anatomy/guts.gif

The **foregut** consists of the

- Mouth (oral cavity) The salivary glands provide fluids and enzymes to the mouth for lubrication and to begin food breakdown.
- Throat (pharynx)
- Oesophagus
- Crop, for storage of food
- Proventriculus (or gizzard), where present, sometimes armed with teeth for grinding

The **midgut** consists of the

- ventriculus, where most digestion is carried out
- gastric caeca (sing. caecum) which, if present provide greater area for digestion

The **hindgut** consists of the

- anterior hindgut
- rectum

Both these areas reabsorb water and salts.
Valves are present to prevent back-flow of material within the gut

- cardiac (stomodeal) valve between fore and midgut
- pyloric valve between mid and hindgut

Your Turn

1. Draw up a table that shows the similarities and differences between the mammalian and the insect respiratory system.
   Make sure you list the structural parts of the system and their function.
2. Compare the insect and mammalian eye. Draw a diagram of both, label the diagrams, then discuss the differences.
3. Using the examples given above, choose one insect and describe its feeding habits. What does it feed on and how is it structurally and behaviourally adapted to do this.
4. Compare the parts of the human digestive system to the insect digestive system. How do they differ? What are the different functionsof the different parts?