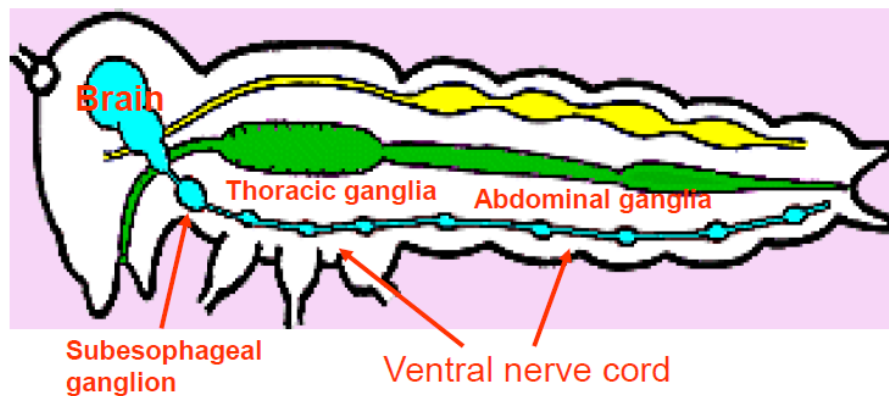


Lec. 6

Nervous System

Insects have a complex nervous system which includes a variety of internal physiological information as well as external sensory information. Like other animals the nervous system in insects **serves to coordinate the activities of its various systems.** The units of this system are elongated cells or **neurons** which carry information in the form of electrical impulses ((ليدانی کاره بايی)) from external and internal sensilla (sensory cells) to appropriate effectors (e.g., glands, muscles) and special cells called glial cells which protect, support, and provide nutrition for the neurons.fig.1

Insect nerve system (NS)



Signal transducer, transmitter, processor (integrator)

Fig.1 Central Insect nervous system.

Insect Nerve system: anatomy

- **Central nerve system (CNS)** - most ganglia included: brain+ventral nerve cord
- **Stomatogastric nerve system (SNS)** - Frontal ganalion + hypocerebral ganglion + ventricular ganglion; innervate muscles of the mouth cavity, foregut, midgut; and regulate food uptake and food transport
- **Peripheral Nerve system (PNS)**- all sensory neurons; not bundled in ganglia; located in integument

The Central Nervous System

Is composed of the **Brain** as major coordinating organ located in the head plus **paired nerve centers called Ganglia**. Brain and ganglia consist of masses of nervous tissue joined together by **Nerve Cords**. The ganglia are fused in some insects as shown in **fig. 2**

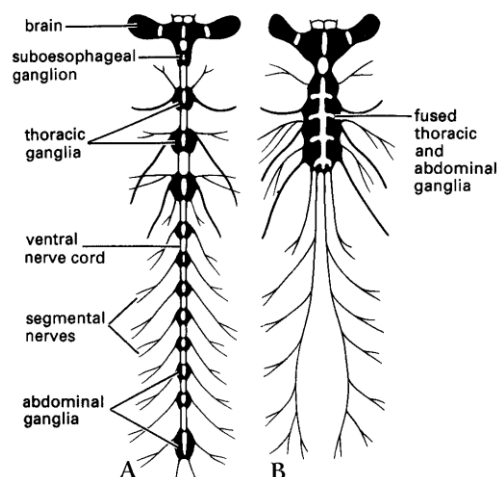


Fig. 2 The central nervous system of insects with brain and several ganglia (A) and fused ganglia (B).

The types of the Cells of Nervous system

1. Nerve cells (=Neurons): Conducting (organize and carry out) cells that transduce, transmit or process nerve impulses.
2. Ganglia cells: non-conducting supporting cells that surround neurons and help to protect neurons and maintain stable ionic environment.

Nerve cell Structures

1. The nerve cell (neuron)

Neuron: Is the basic functional unit of the nervous system also called the nerve cell.

The neuron consists of a cell body (**Soma**), one or more **axons**, and **dendrites** as shown in **fig.3**

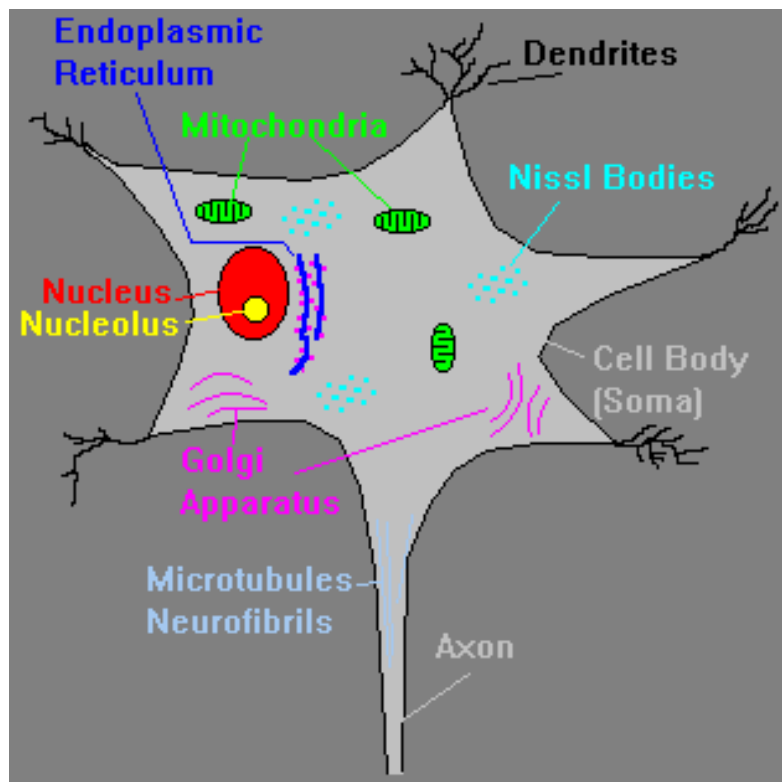


Fig.3/A The structure of the nerve cell.

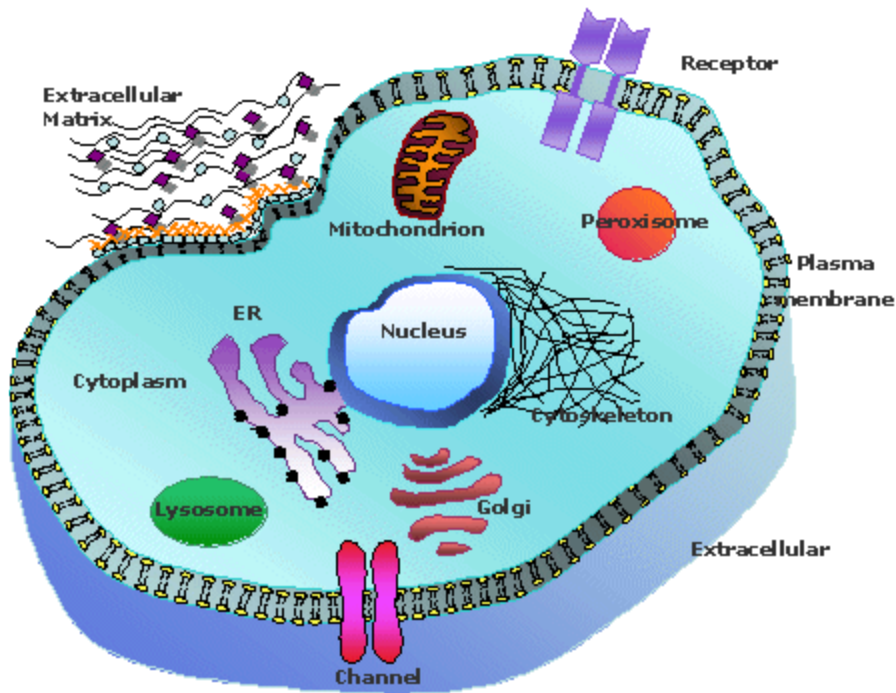


Fig.3/B The structure of the nerve cell

Neurons similar to other cells, but have some differences: -

- 1- Have specialized extensions called **dendrites** and **axons**. **Dendrites** bring information **to the soma** and **axons** take information **away from the soma**.
- 2- Neurons communicate with each other through specialized structures called synapses and chemicals (e.g., neurotransmitters).

Types of neuron: two ways of classification

By the number of extensions

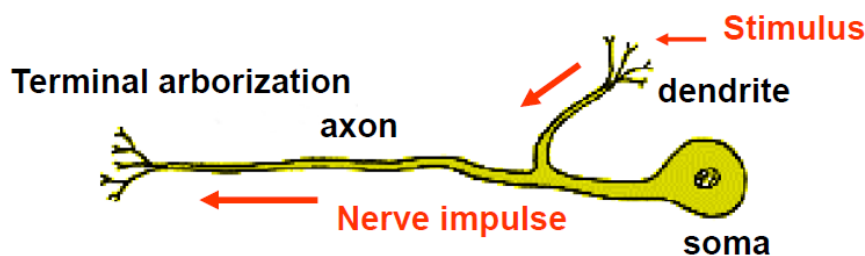
- **unipolar neurons** have one projection extending from the soma.
- **Bipolar neurons** have two projection extending from the soma
- **Multipolar neurons** have many projections extending from the soma. However, each has only one axon

By the direction of information that they send (function)

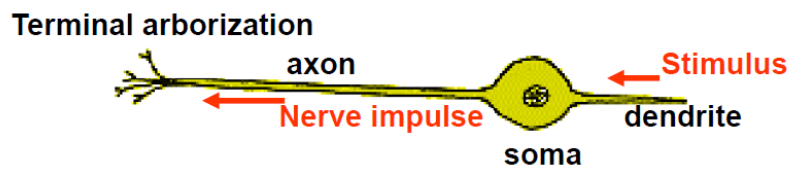
- **Afferent (sensory) neurons** --bipolar or multipolar cells have dendrites that are associated with sense organs. They carry information **TOWARD** the central nervous system (CNS).
- **Efferent (motor) neurons** -- unipolar cells that conduct signals **AWAY** from CNS and stimulate responses in muscles and glands.
- **Interneuron (association neuron)** -- unipolar cells that form connections between afferent and efferent neurons and conduct signals **WITHIN** CNS.

Types of neuron: unipolar

one projection extending from the soma

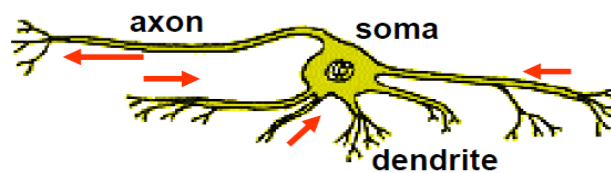


Types of neuron: bipolar



- Two projections extending from the cell body
- Typical of sensory neuron

Types of neuron: multipolar



Many projections extending from the soma
But only one axon

1. Central nervous system

Like most other arthropods, insects have a relatively simple central nervous system with a dorsal **brain** linked to a ventral **nerve cord** that consists of **a paired segmental ganglia** running along the ventral midline of the thorax and abdomen. Ganglia within each segment are linked to one another by a short **medial nerve**.

An insect's brain is a complex of **six fused ganglia (three pairs)** located dorsally within the head capsule. Each part of the brain controls a limited spectrum of activities in the insect's body: what are these activities?

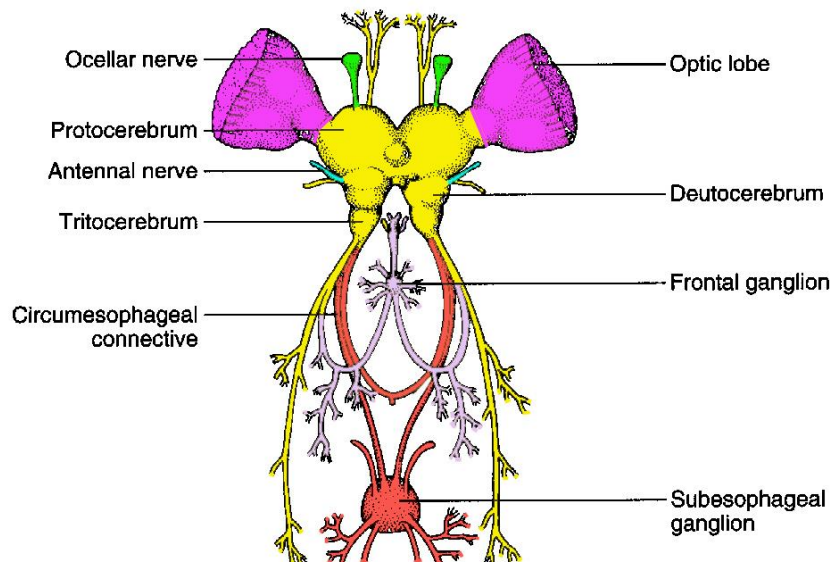
1-Protocerebrum: The first pair of ganglia is largely associated with vision; they innervate (Supply) the compound eyes and ocelli.

2-Deutocerebrum:

The second pair of ganglia process sensory information collected by the antennae. The deutocerebrum contains the antennal or olfactory lobes. The antennal lobes are important as they are the centers for receiving and processing several kind of information related with host selection, mate location, food finding, locating oviposition sites etc.

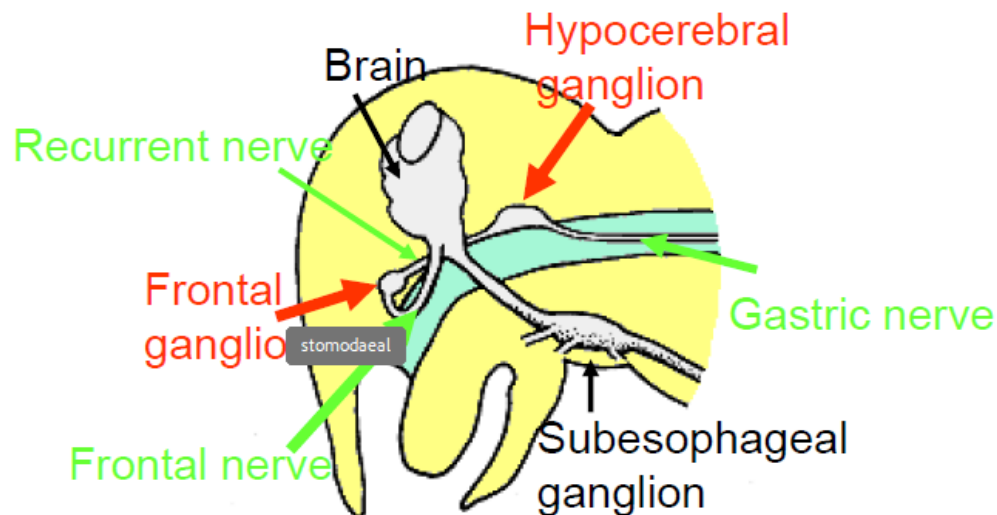
3-Tritocerebrum: The third pair of ganglia innervates the labrum.

In the thorax, three pairs of thoracic ganglia (sometime fused) control locomotion by innervating the **legs and wings.**



2. Stomodaeal Nervous System (Visceral nervous system)

The stomatogastric subsystem: Nerves associated with the brain, salivary glands, and the foregut are these include the frontal ganglion (FG), the hypocerebral ganglion (HG) and Ventricular ganglion or cluster (VG).



3. Peripheral Nervous system

All sensory neurons; not bundled in ganglia; located in integument, these nerves are associated with sensory structures. Cell bodies of the sense organs, called sensory neurons, lie at the periphery of the body just below the cuticle. The sensilla are usually small hairs modified for perception of specific stimuli (e.g., touch, smell, taste, heat, cold); each sensillum consists of one **sense cell** and one **nerve fibre**. Although these small sense organs occur all over the body.

LIST OF SENSE ORGANS

1. Antennae
2. Compound eyes
3. Ocelli
4. Cerci
5. Palps.
6. Tympanum
7. Oviposition

PNS: all sensory neurons

- In epidermis
- Sensory neurons
- Outside ganglion

