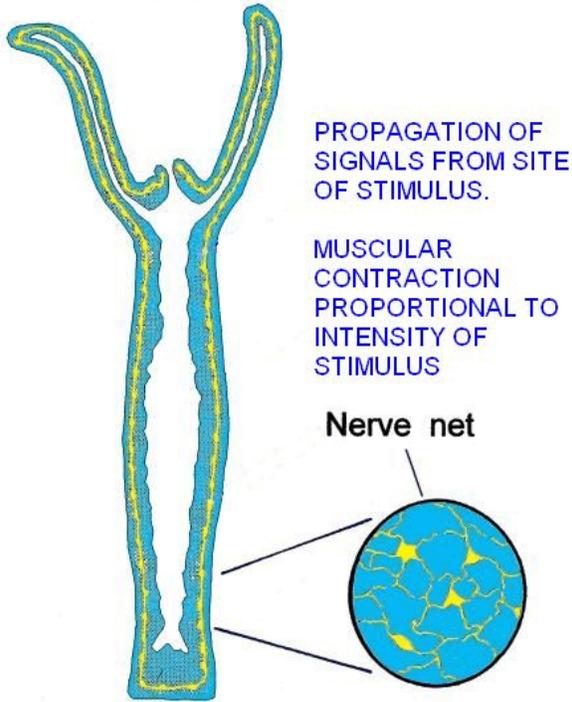


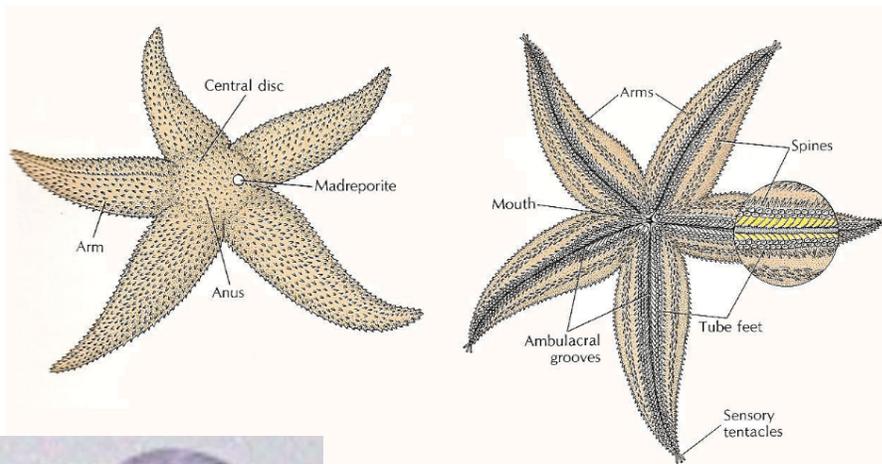
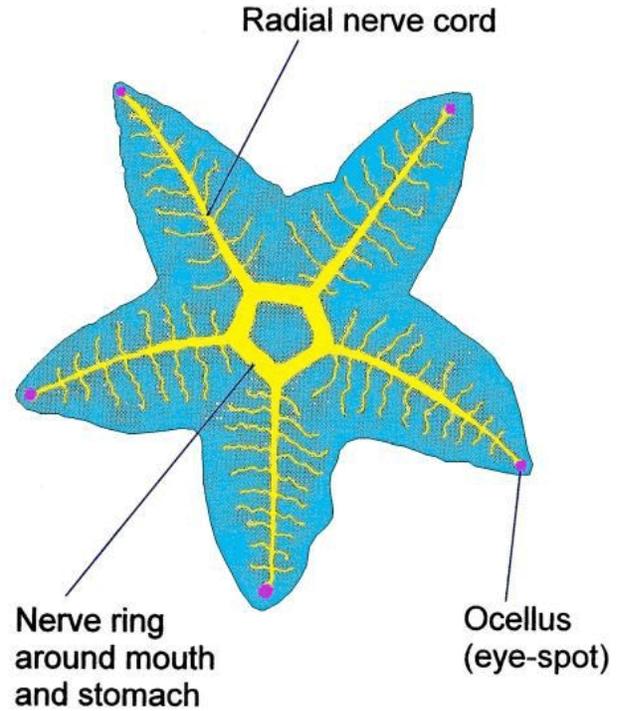
# INVERTEBRATE NERVOUS SYSTEMS

A simple cnidarian  
(= coelenterate), *Hydra*

CNIDARIA - Hydra

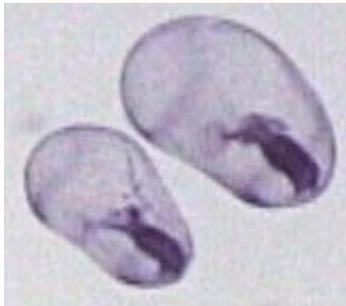


An echinoderm (starfish). Not really radially symmetrical.



ALSO SENSORY CELLS IN THE EPIDERMIS, CONNECTED BY A NERVE NET WITH RADIAL NERVE NERVES AND NERVE RING.

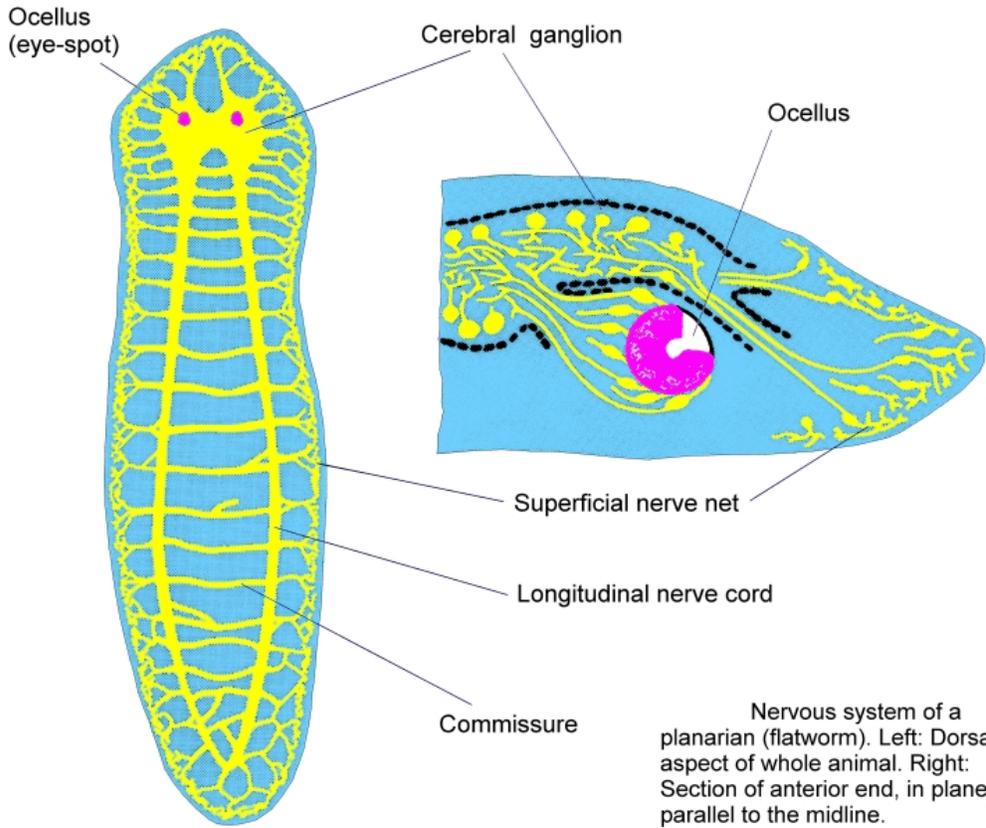
NO BRAIN BUT COMPLEX COORDINATED BEHAVIOUR PATTERNS.



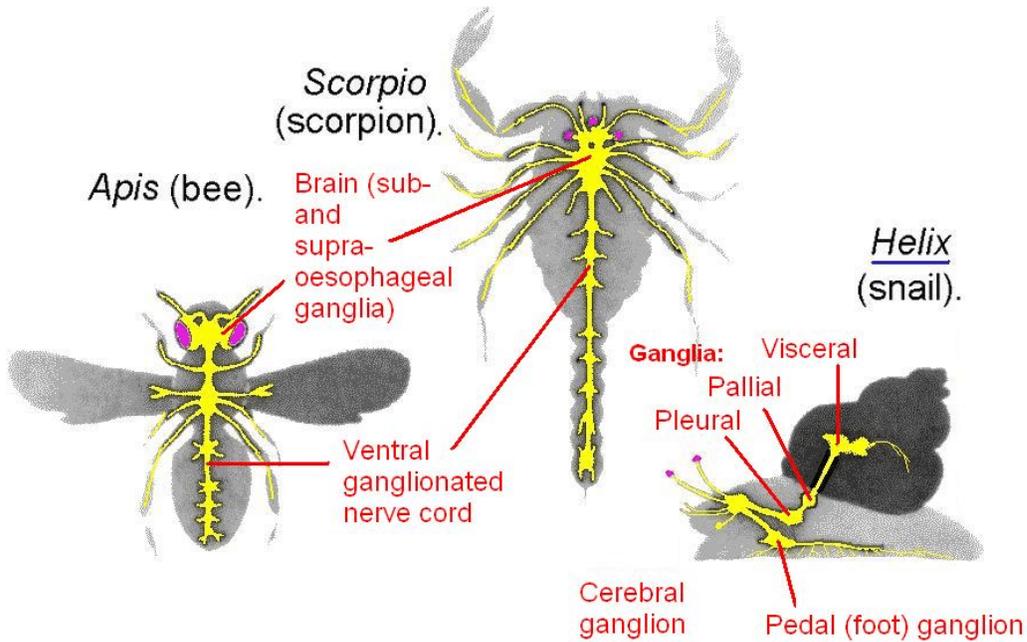
Starfish larvae are bilaterally symmetrical.

Image from <http://www1.fccj.cc.fl.us/dbyres/images/bipinn40.jpg>

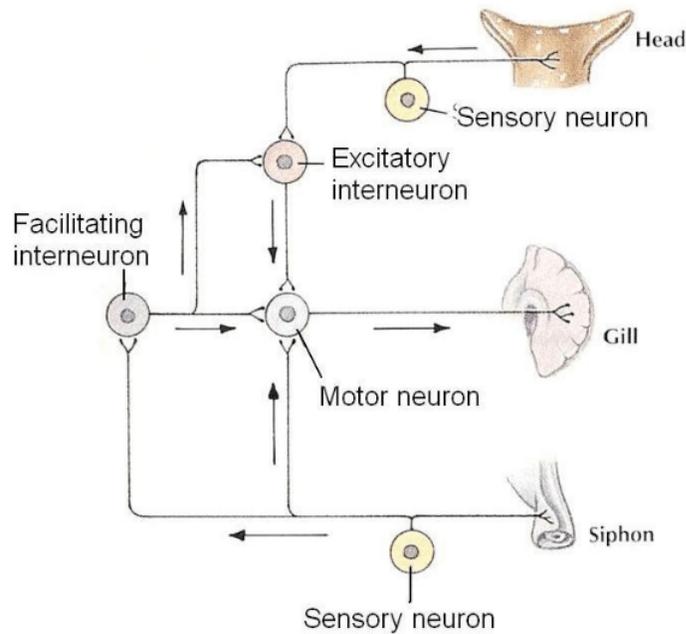
**PLATYHELMINTHS - flatworms.**



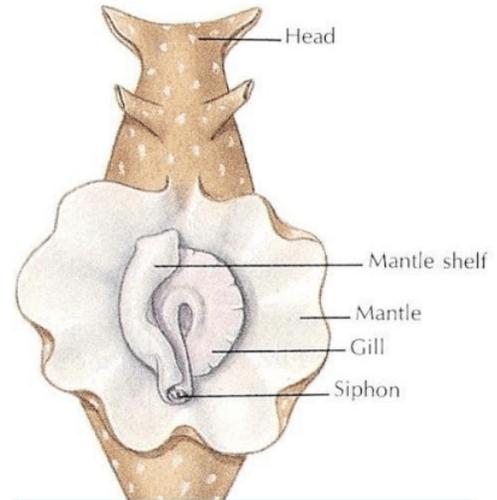
**ARTHROPODS and MOLLUSCS.**



## APLYSIA (a sea-slug).



C P Hickman & L S Roberts (1994) *Biology of Animals*.  
6th ed. Dubuque, IA: Wm C Brown. p. 335



### Gill withdrawal reflex

Poke the siphon.

Gill pulled back into mantle cavity.

( 2 neurons; 1 synapse )

### Habituation

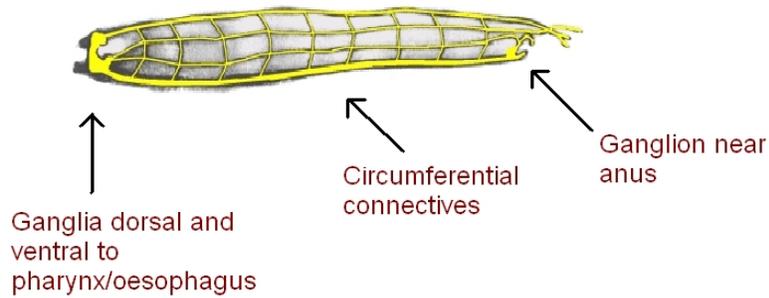
With repeated stimulation of siphon, the gill withdrawal stops, because of depletion of neurotransmitter of the sensory neurons.

### Conditioned learning (sensitization)

After noxious stimuli to siphon and head, gill is withdrawn after stimulation of only the head. This happens even after siphon-gill reflex habituation.

Eric Richard Kandel. Nobel prize, 2000

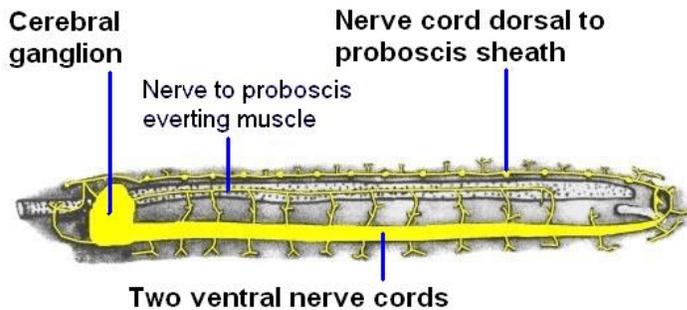
Nematode (*Ascaris*). Unsegmented. Ventral and smaller dorsal and lateral nerve cords.



*Ascaris* (roundworm) is an intestinal parasite of mammals, including man. Its is similar in size to an earthworm.

*Caenorhabditis elegans* is a soil-dwelling nematode about 0.1 mm long. Its development from 1 to about 1000 cells is well documented.

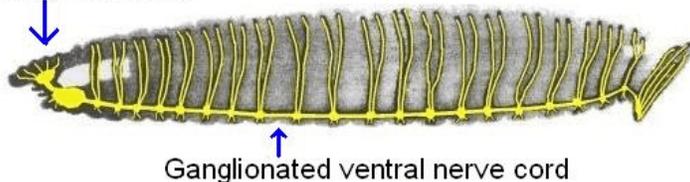
Ribbon worms (Nermerteia): *Neuronemertes*



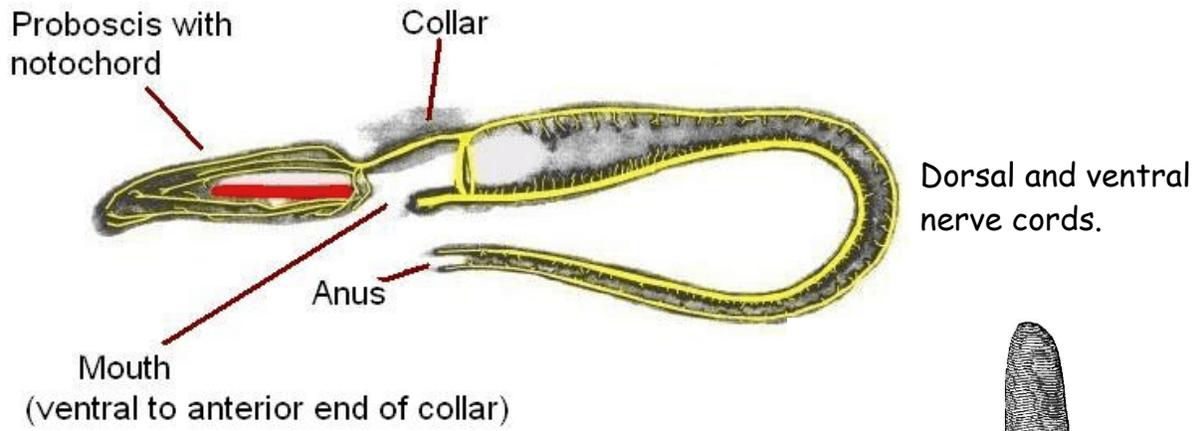
Annelids: *Hirudo* (Leech)

Metameric segmentation

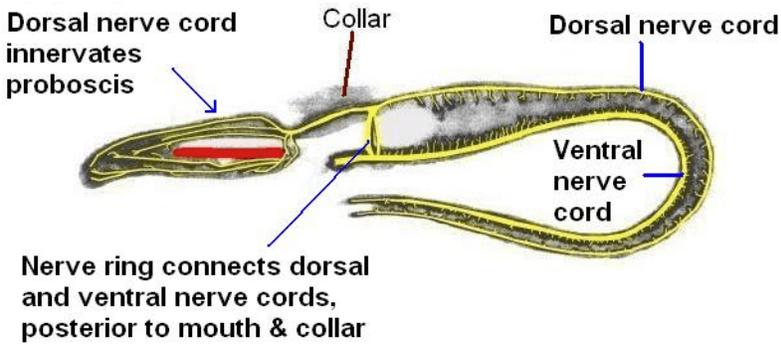
Cerebral ganglion around oesophagus



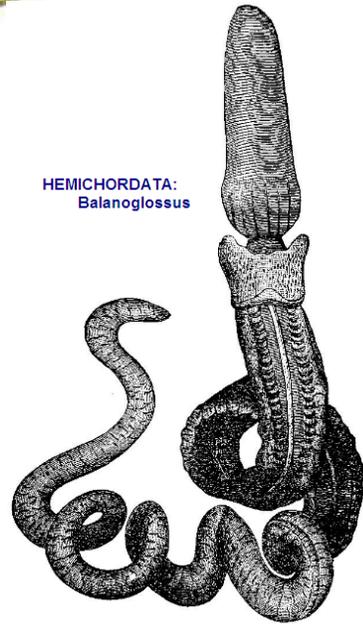
Hemichordates: *Balanoglossus* (Acorn worm)



Hemichordates: *Balanoglossus* (Acorn worm)



HEMICHORDATA:  
*Balanoglossus*



J R Ainsworth Davis (1905) The Natural History of Animals. Vol 1 p. 301. London: Gresham Publishing Co.

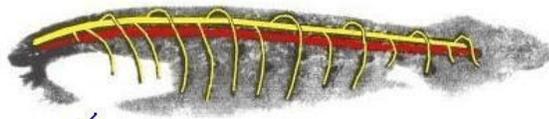
The phylum *Chordata* also includes all the vertebrates.

Chordata; subphylum Cephalochordata:

*Branchiostoma* (Amphioxus; Lancelet)

An almost headless animal

Hollow nerve cord dorsal to notochord



Mouth is ventral to anterior ends of nerve cord and notochord

Alternating dorsal (sensory) and ventral (motor) nerves. Bipolar sensory neurons on dorsal surface of nerve cord.

