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اللافقریات	اسم المادة باللغة العربية
Invertebrates	اسم المادة باللغة الانكليزية
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كليسيراتا	عنوان المحاضرة باللغة العربية
Chelicerata	عنوان المحاضرة باللغة الإنكليزية
9	رقم المحاضرة

1-Sub phylum Chelicerata

Characteristic features of Chelicerata:

- They have **no head**.
- Only **one pair** of mouth parts.
- **Unlike** all other groups of arthropods, **no antennae**.
- The body is divided into an anterior **prosoma** and a posterior **opisthosoma**. The prosoma usually consists of **eight** segments. The first segment **never bears appendages**, the second **bears paired chelicerae (feeding and grasping structures)** and the third bears **paired pedipalpi (sensory, prehensile or reproductive appendages)**. The **fourth to seventh segments bear walking legs** (i.e. four pairs) which have small pincers (chelae) at their ends.

A- Class: Merostomata

- All are marine
- Appendages on the opisthosoma are flattened and **modified for gas exchanges as "book gills"**.
- Terminal portion of the body (telson) drawn out into an elongated spike. Example: *Limulus* (horseshoe crab)

External features

Prosoma (Cephalothorax): the body is covered by an exoskeleton consist of two tagmata **prosoma, opisthosoma**, in addition to the **tail spine**. The prosoma is a convex carapace horseshoe, the opisthosoma is a middle portion, and thin elongated tail called telson. The prosoma bears a pair of lateral compound eyes and pair of median simple eyes on dorsal side. Also it contains a six pairs of appendages located On the ventral side around the mouth which are:

Chelicera	Are small and are used for feeding.
Pedipalps (1 st walking leg)	In females they are morphologically and functionally similar to other walking legs. In male it is modified for grasping the female during mating.
2 nd , 3 rd , 4 th walking legs (bear claws)	In both sexes , the first 4 pairs of walking legs, including pedipalps , are each modified near the base to form a toothed food-grinding surface called gnathobase.
5 th walking legs(not bear claws)	Is slightly modified for cleaning the gills, and for removing mud during burrowing.

Opisthosoma (Abdomen): the abdomen bears six pairs of spines along the sides, and its ventral side, six pair of flat , plate-like appendages.

- The first of these forms the genital operculum, on the underside of which are two genital pore.
- The other five abdominal appendages are modified as gills. the underside of each gill flap bears approximately 150 leaf-like fold called lamellae.

Telson:the long slender telson or tail spine, is used for anchoring when the animal is burrowing or plowing through the sand , the anus located under the proximal end of the telson (Figure 19).

Reproduction: after several weeks of mating the egg hatch as free-swimming **trilobite** larvae, so named because their resemblance to trilobite, the larvae looks much like the adult except that it lacks the tail spine and have only two of the five pairs of book gills.

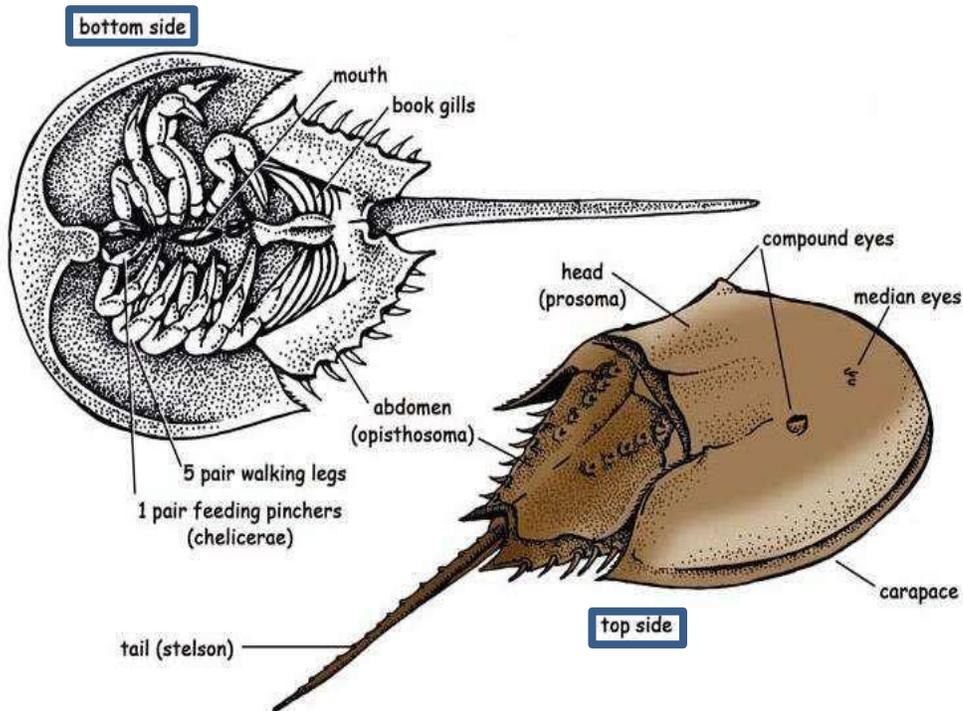


Figure (19): *Limulus* top and bottom side

B- Class: Arachnida

- The adult has six pairs of appendages: pair of chelicerae, pair of palps and four pair of walking legs.
- Segmented or unsegmented abdomen with or without appendages and generally distinct from cephalothorax.

- Respiration by **gills, tracheae, or book lungs**.
- Excretion by **malpighian tubules** or **coxal glands**.
- Dorsal bilobed brain connected to the ventral ganglionic mass with nerves, simple eyes.
- Chiefly oviparous.

Order Scorpionida

- Elongated and distinguished from the other arachnids by their large size.
- Prosoma is short and unsegmented , **broadly joined to abdomen**.
- Carapace bear 2 median and 6-10 lateral eyes.
- Opisthosoma differentiated into two portion : **mesosoma** and **metasoma**.
- Small chelicerae.
- Large and powerful pedipalps
- Respiratory by 4 pairs of **book lungs**.

Example : *Buthus* (Scorpion)

The Scorpion is a **dangerous** arthropod, widely spread in tropical and temperate region. It is nocturnal hiding away in the day time and become active during the night.

External Features:

The body, is divided into an anterior **prosoma or cephalothorax** and posterior **opisthosoma or abdomen**, the last one is subdivided into broad **mesosoma** and slender **metasoma** that end with terminal sting which have venome of different toxicity which is used to defend themselves, and to seize the prey, the pedipalps are large, pincer like with sensory hairs on them which used to sense vibrations (figure 20).

The Prosoma, is covered by a dorsal **carapace** which carries dorsally a pair of large median eyes and two groups of five smaller lateral eyes; all the eyes are simple. The mouth is small and ventral. The prosoma carries **6 pairs** of appendages:

1 st appendages	Chelicerae	Consist of 3 joints the distal two of which form a chela.
2 nd appendages	Pedipalps	Each pedipalps consist 6 jointes, the distal two of which form large toothed pincers (offensive).
3 rd , 4 th , 5 th & 6 th appendages	Walking legs	Each consist of 7 segments: coxa, trochanter, femur, patella, libia, basitarsus and tarsus which usually bears two dorsal claws.

The mesosoma , is consist of **7 segments** in the adult, the exoskeleton of each is formed of a dorsal tergum , a ventral sternum and two lateral pleural membranes.

The 1 st segment	carries on its ventral surface a genital operculum which covers the single genital operator.
The 2 nd segment	carries a pair of camb-like structures known as pectens (modified appendages , tactile in function) with teeth like processes on their posterior edge.
3 rd ,4 th , 5 th & 6 th segments	There are 4 paired stigmata or spiracle , they led into lung-books.
7 th segment	Has no appendages

The metasoma, consist of **5 short cylindrical segments with no appendages**, each has its tergum fused with its sternum, thus forming narrow cylindrical segments. Metasoma end with **stinging apparatus** which is bulbous at the base and curved to form a sharp spine or hook, **two poison glands** that contains a neurotoxin produce by the glands and transfer via ducts to be discharge through a pore at the end of the sharp spine.

Scorpion poison is used for defense and assassinating the prey, in addition it is a lethal to human (figure 20)

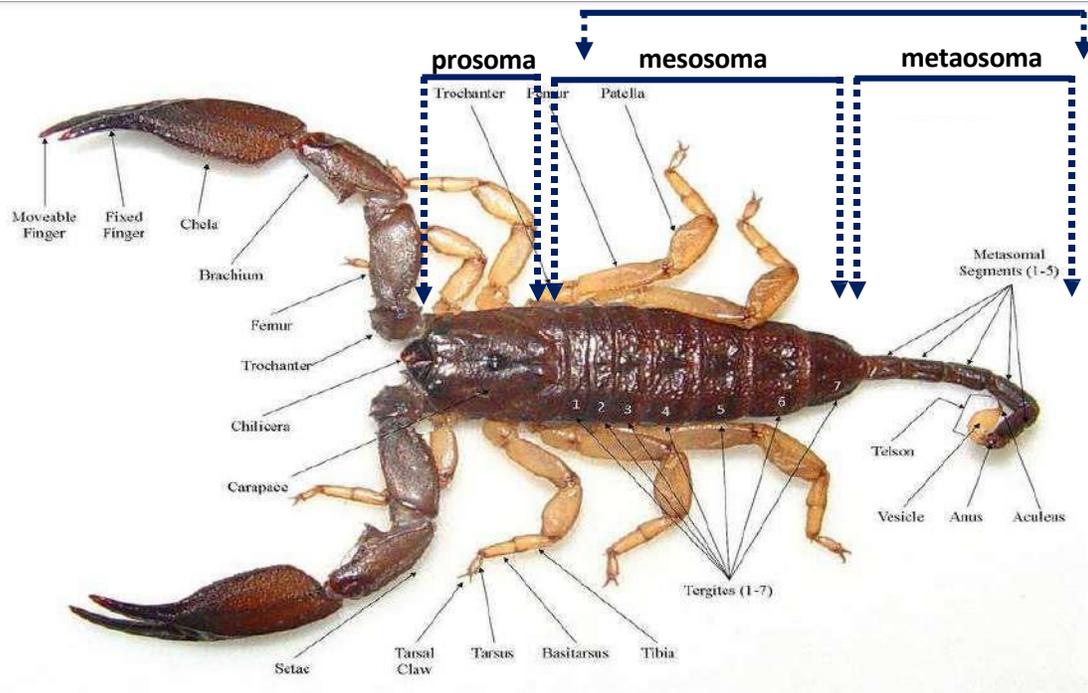


Figure (20): External morphology of *Buthus*.

Anatomy:

The heart: It is dorsal, tubular and extends within mesostoma, and has 7 pairs of ostia located in the heart wall through which the blood enters the heart. Blood leaves the heart into anterior and posterior aortae and paired lateral arteries (figure 21).

Digestive system : alimentary canal is a straight tube differentiated into:

- Mouth and pharynx
- The Mesentron : stomach and intestine
- The proctodaeum it is extremely short, and ends by the anus (figure 21) .

The Excretory System: Excretion in the scorpion is carried out by:

- **The coxal glands:** which are two small oval glands, that lie in the posterior part of the prosoma, and each opens to the exterior by short duct on coxa of the 3rd walking legs (figure 21).
- **The Malpighian tubules:** are 2 pairs of branching tubules open in the **intestine** (figure 21).

The reproductive system: the sexes are separated, the gonads lie in the mesosoma, in the male there are 2 testes, in the female , there is a single ovary (figure 21).

Nervous system: like other artropoda.

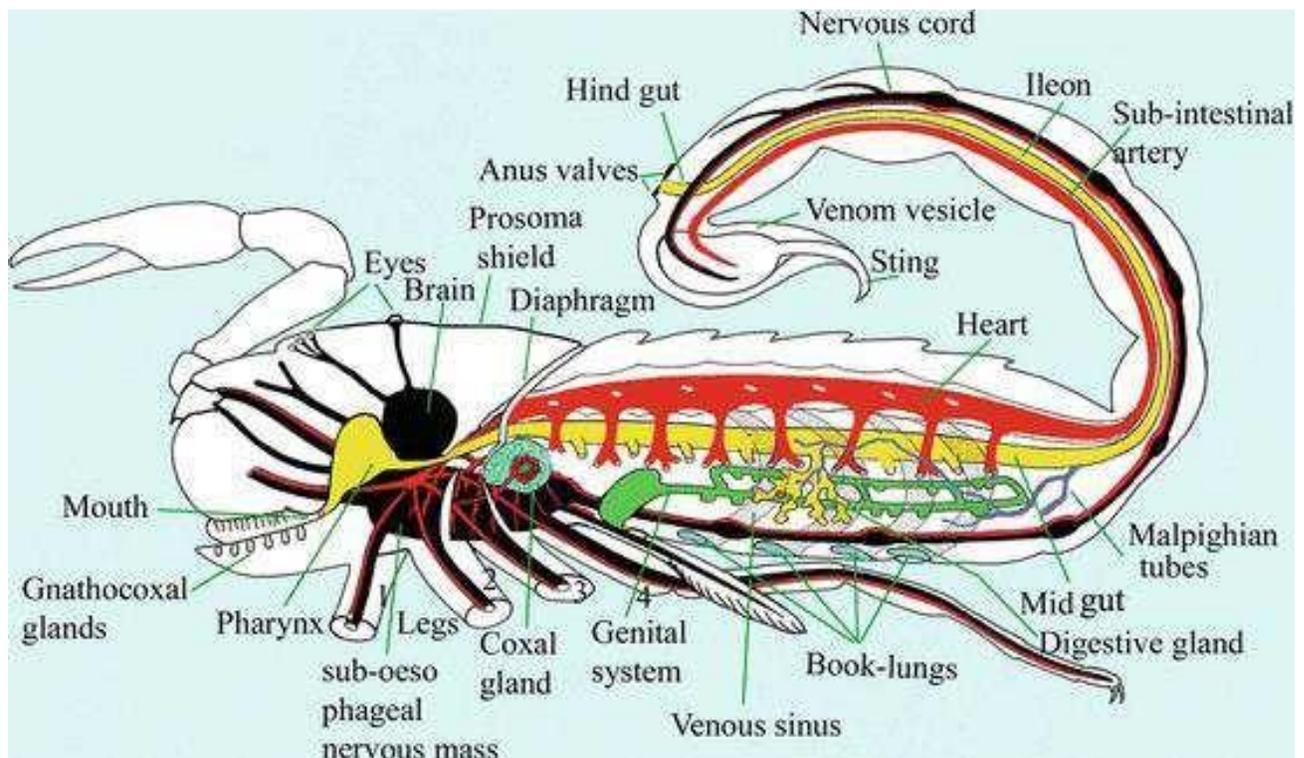


Figure (21): Internal anatomy of scorpion.

Order Araeneae (True spiders)

- Prosoma and opisthosoma both unsegmented and jointed **by slender pedicel**.
- Prosoma covered by a uniform carapace bearing not more than 8 simple eyes anteriorly.
- Opisthosoma soft, rounded, **without a telson** , **bearing 2-4 pairs of spinnerets which extrude silk**. The protein that forms silk is emitted as a liquid, but hardens as it is drawn out.
- Chelicerae, **contain poison gland**
- Pedipalps, **simple** form copulatory organ in male
- Respiratory organs 2-4 **book lungs or trachea or both**.

Example: *Argiope*

The body, is divided into anterior **prosoma** and posterior **opisthosoma**, connected to each other by narrow soft pedicel.

The prosoma (the fusion of head and thorax), is covered by a dorsal carapace, it carry 4 simple eye.

The prosoma carries 6 pairs of appendages:

1 st pair	Chelicerae	Each formed only of 2 joints, a large conical joint which contains a poison gland, and hook like terminal joint which bears the orifice of the poison gland.
2 nd pair	Pedipalps	Are short leg-like feeler. In male the terminal segment of each pedipalp is enlarged and modified into sexual organ , in which the sperms are sucked up and transferred to the female.
3 rd ,4 th ,5 th and 6 th pairs	Walking legs	The 4 pairs of walking leg are long and each composed of 7 segments covered with hairs , and end with 2 or 3 claws

The opisthosoma is oval, with no trace of segmentation and its skin is uniformly soft, covered with hairs, the opisthosoma carry the following:

- 1- **Stigmata:** there are 2 lateral stigmata which lead into a pair of book lungs.
- 2- *Genital opening,*
- 3- **Spinnerets:** there are three pairs of jointed movable processes known as the spinnerets (2 superior , 2 inferior and 2 middle) the tip of which are perforated by numerous opening of silk gland which secreted the protein that formed silk.
- 4- *The anus. (Check figure 22)*

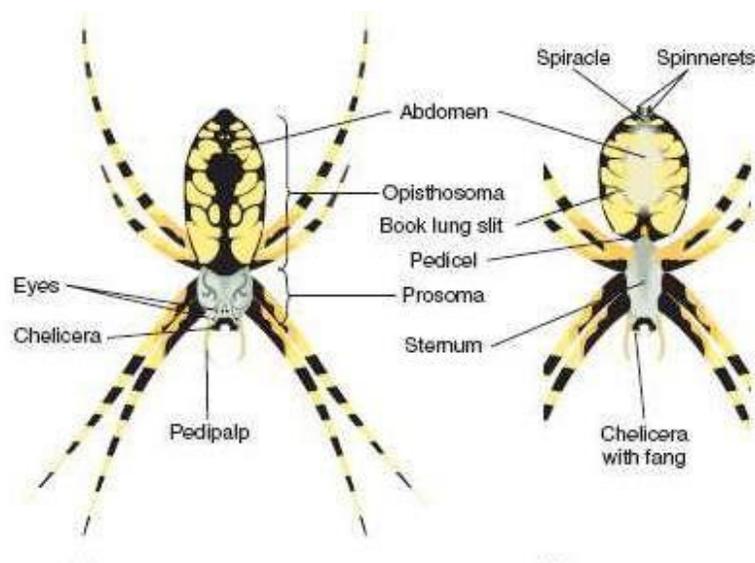


Figure 22: External morphology of *Argiope*

Respiratory System: compose of one or two pairs of book lungs and trachea, each lung compose of 15-20 thin lamellae (figure 23) .

Digestive System

All spiders are predaceous, feeding largely on insects. After a spider seizes prey with its chelicerae and injects venom, it liquefies the tissues with a digestive fluid and sucks the resulting broth into the stomach. Spiders with teeth at the bases of chelicerae crush or chew prey, aiding digestion by enzymes from their mouth.

Mouth, Esophagus, Sucking stomach, True stomach, Two caeca branched into 5 caeca, Intestine associated with Liver, Rectum, (check figure 23).

Excretory System

Spiders and insects have a unique **excretory system of Malpighian tubules**, which work in conjunction with specialized rectal glands. Potassium and other solutes and waste materials are secreted into the tubules, which drain the fluid, or “urine,” into the intestine. Rectal glands reabsorb most potassium and water, leaving behind such wastes as uric acid (figure 23).

Reproduction

Before mating, a male spins a small web, deposits a drop of sperm on it, and then picks the sperm up and stores it in special cavities of his pedipalps. When he mates, he inserts his pedipalps into the female genital opening to store the sperm in his mate’s seminal receptacles. A female lays her eggs in a silken net, which she may carry about or attach to a web or plant. A cocoon may contain hundreds of eggs, which hatch in approximately two weeks. Young usually remain in the egg sac for a few weeks and molt once before leaving it. Several molts occur before adulthood.

Circulatory System

Circulatory System in spider compose of : Blood , Blood sinuses , heart and blood vessel , the tube like heart lie in the dorsal region and it is surrounded with pericardium , the heart connected with 2 blood vessel :

Posterior aorta: provide the posterior region

Anterior aorta: provide the cephalothorax region

From the blood sinuses the blood transported to the book lung where it oxygenated then it returns back to the heart (figure 23).

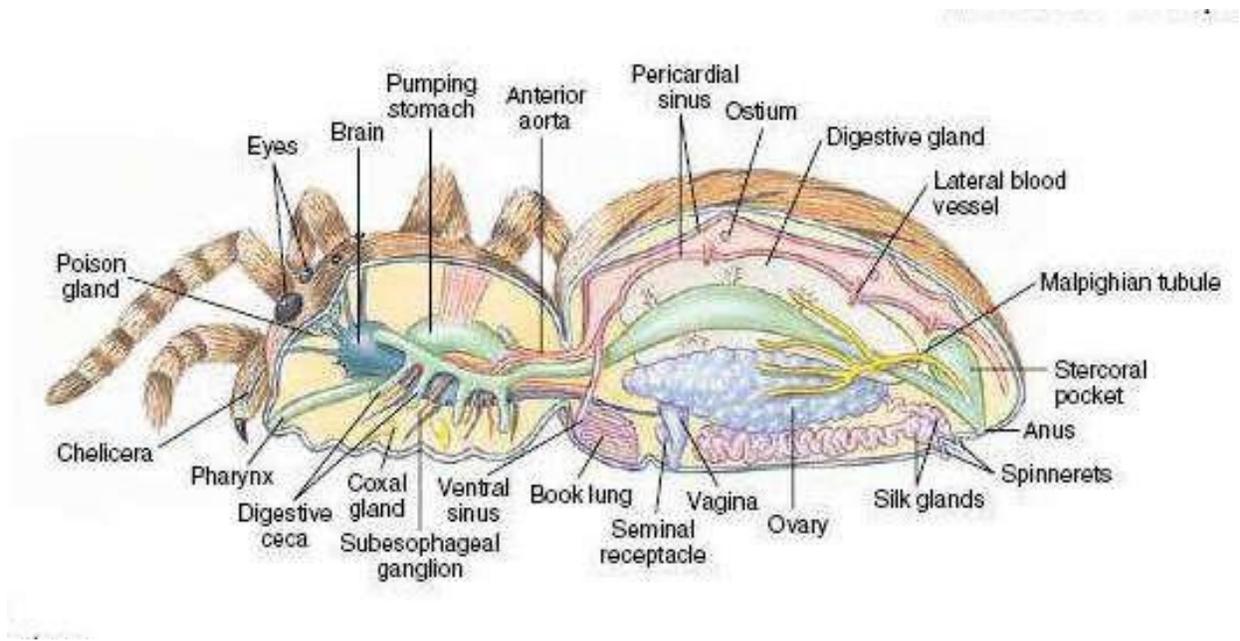


Figure (23): Internal anatomy of *Argiopo*

C-Class Pycnogonida

(pik_no-gon_ida) (Gr. *pyknos*, compact, *_gony*, knee, angle): **sea spiders.**

- Small (3 to 4 mm), but some reach 500 mm;
- Body chiefly cephalothorax; tiny abdomen;
- Usually four pairs of long walking legs (some with five or six pairs);
- Mouth on long proboscis;
- Four simple eyes;
- No respiratory or excretory system.

Example: *Pycnogonum*. (Figure 24)

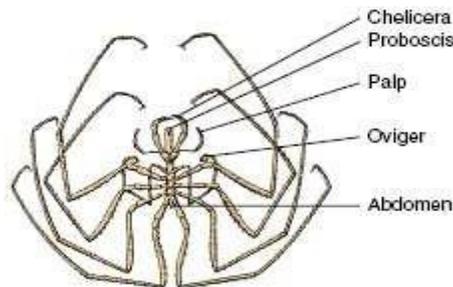


Figure (24): External morphology of *Pycnogonum*

D- Class: Tardigrada

(tar-di-gray_da) (L. *tardus*, slow, *_gradus*, step), or “water bears,” are minute organisms usually less than a millimeter in length.

- They have an elongated, cylindrical, or a long oval body that is unsegmented.
- The head is merely the anterior part of the trunk. The trunk bears four pairs of short, stubby, unjointed legs, each armed with four to eight claws .
- The body is covered by a nonchitinous cuticle that is molted along with the claws and buccal apparatus four or more times in the life history.
- Cilia are absent (figure 25).

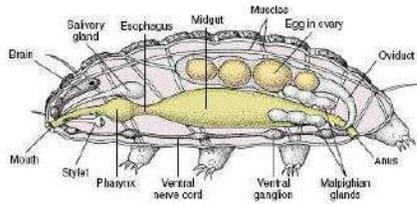


Figure (25): External morphology of water bears.

E- Class: Pentastomida

Pentastomida (pen-ta-stom_i-da) (Gr. *pente*, five, *_stoma*, mouth),

- Adults range from 1 to 13 cm in length.
- Transverse rings give their bodies a segmented appearance
- The body is covered with a chitinous cuticle that is molted periodically during larval stages.
- The anterior end may bear five short protuberances (hence the name Pentastomida). Four of these bear claws. The fifth bears the mouth and two pairs of hooks for attachment to the host tissues.
- There is a simple straight digestive system, adapted for sucking. The nervous system, similar to that of annelids and arthropods
- There are no circulatory, excretory, or respiratory organs.
- Sexes are separate, and females are usually larger than males (figure 26).

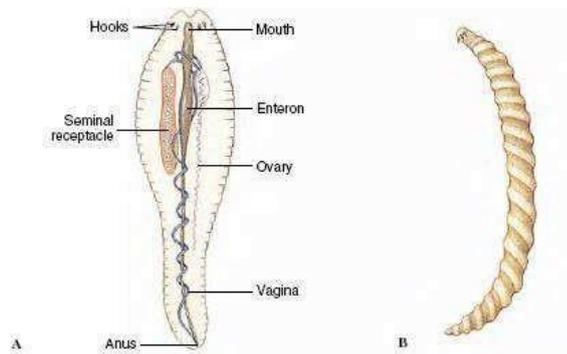


Figure (26): External morphology of Pentastomida.

The Importance of Arthropoda

Advantages

- Food for human: The larger crustaceans—shrimps, lobsters, and crabs—are used as food throughout the world.
- Small planktonic crustaceans, such as copepods, and other , are a major link in the food chain between the photosynthetic phytoplankton and the larger carnivores, such as many fish and whales.
- Approximately two-thirds of all flowering plants are pollinated by insects. Some are used in biological control.
- Recently insects have also gained attention as potential sources of drugs and other medicinal substances.

Disadvantages

- Diseases carried by blood-sucking insects may infect human and livestock animals.
- Many species of arthropods, principally insects but also mites, are agricultural and forest pests.
- Some arthropods, may act as intermediate host of some parasites.