# Zoology 3

## 2nd Grade Biology

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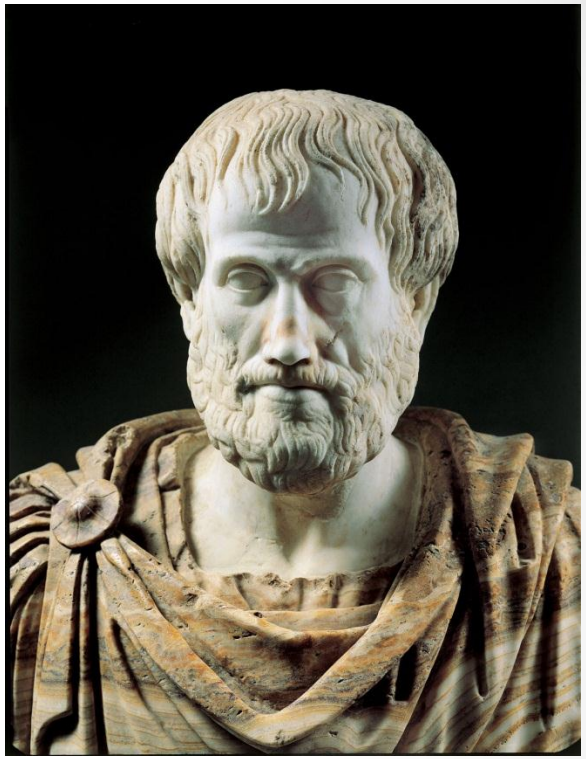
# First: Invertebrates

# Introduction

- Animal taxonomy is one of zoology branches that is concerned with identifying different types of animals, describing them, naming them and placing them in the appropriate classification position.
- More than million animal species are currently known to facilitate their study and to understand various relationships between their groups.

The Greek philosopher Aristotle (384-322 BC) was among the first scientists who were interested in classifying living organisms from animals and plants. He suggested that animals could be classified according to the presence or absence of red blood into two groups: Enaima and Anaima.



**Aristotle**

- Other attempts were performed to classify animals on other bases, such as:

1. Environment: accordingly, animals have been classified into terrestrial, aquatic and aerial.
2. Food type: consequently, animals were divided into two groups: carnivores and herbivores.

Gradually, however, emerged the idea of classifying animals according to the morphological similarities between them. This idea was formulated clearly by the English naturalist John Ray (1627-1705).

**John Ray**

- Ray's idea was taken up by the scientific community throughout the seventeenth century and considered the first attempt to classify animals on an accurate scientific basis.
- The scientist Ray was also the first to develop an accurate definition of species, which is the basic unit of classification for living organisms in general.

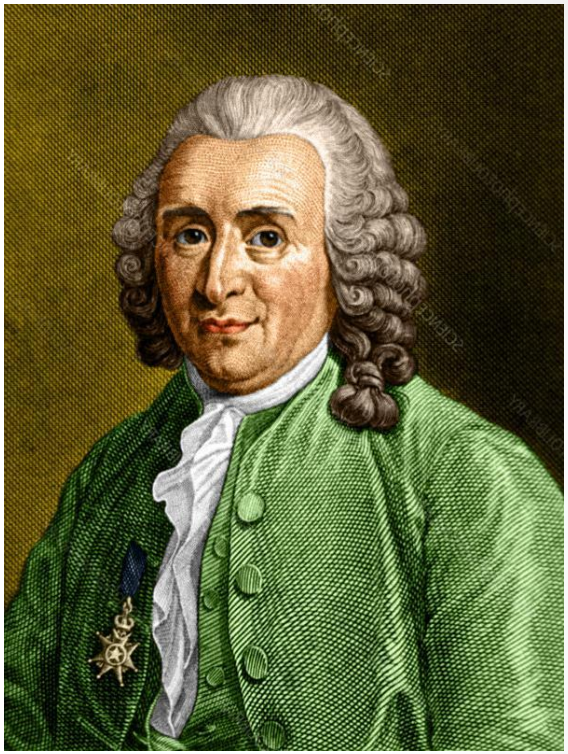
- The species was defined as: "A group of individuals with similar morphological characteristics, that can mate with each other, but do not mate with members of another species, and if this happens, sterile hybrids will result."

Later came the Swedish naturalist

Linnaeus (1707-1778) who laid down

the basis of the system of classification

we use nowadays.

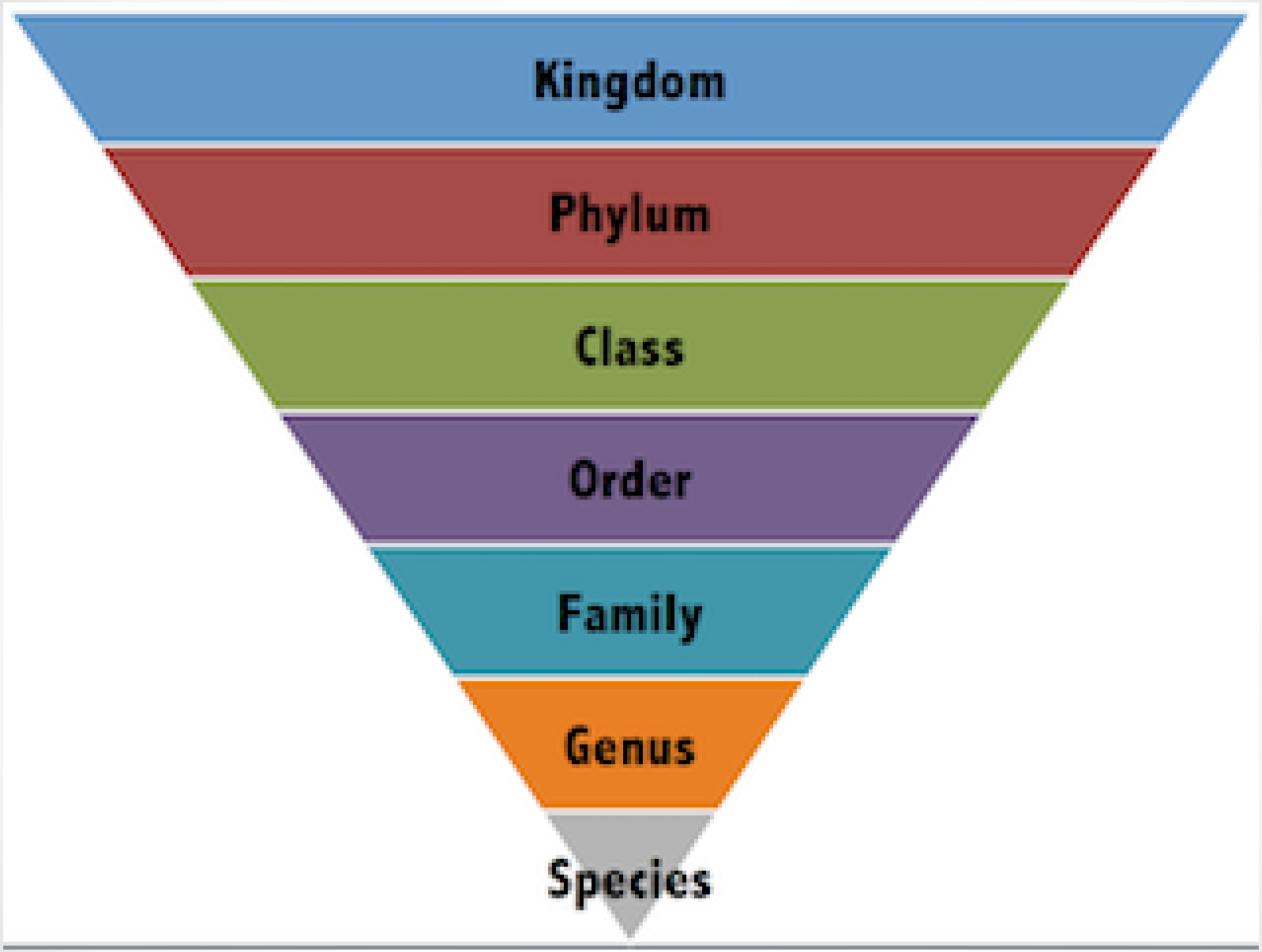


**Linnaeus**

- He classified living organisms according to the morphological and anatomical similarities between them.
- He also devised the system of “Binomial nomenclature” by which each type of organism is given a name composed of two words, the first is the name of the **genus**, and the second is the name of the **species**. Both are latin and are written underlined or typed in italics. The name of the genus starts with a capital letter and that of the species with a small letter.

- Nowadays, the classification of animals is not only based upon morphological and anatomical characteristics but also on biochemical, genetical, embryological and physiological features.

- Species having many features in common are placed in the same genus. Similarly, related genera are grouped in a family, and families with certain common characteristics constitute an order, and orders in turn are grouped into classes. From these classes, the higher taxonomic groupings known as phyla are formed.
- Although the relationships between the different phyla may not be obvious, it is always possible to arrange them according to the degree of complexity of structure and function into larger groups known as subkingdoms or branches.


Kingdom
Phylum
Class
Order
Family
Genus
Species

# Kingdom: Animalia

# General Characteristics of Kingdom Animalia

- **Nucleus:** Eukaryotes, have true nuclei in animal cells. Eukaryote cells are more complex than the simpler prokaryote cells found in bacteria.

- **Cellular Structure:**

✓ Multicellular, made up of more than one cell.

✓ No cell wall, plants, fungi, and prokaryote cells have a cell wall, which is a rigid outer layer that gives cells structure. Animal cells do not have this structure. As a result, animal cells are more flexible to change their shapes and movements.

- **Nutrition:** Heterotrophic, which means they can't produce their own food. Members of the Animalia Kingdom must ingest, or eat other organisms.

# Examples Of Kingdom Animalia Phyla

1- Phylum: Porifera

2- Phylum: Cnidaria

3- Phylum: Platyhelminthes

4- Phylum: Nematoda

5- Phylum: Annelida

6- Phylum: Arthropoda

7- Phylum: Mollusca

8- Phylum: Echinodermata

9- Phylum: Chordata

# Phylum: Arthropoda



# PHYLUM ARTHROPODA



# General Characteristics of Phylum Arthropoda

- **Phylum size:** The largest phylum in the Animal kingdom.
- **Habitats:** Arthropods are found in almost all of the habitats that cover the Earth's surface.

# General Characteristics of Phylum Arthropoda

- **Body:**

✓ Bilaterally symmetrical.

✓ Divided into several segments, some of which may merge to form distinct regions.

✓ Has jointed appendages which are modified to different structures to perform different functions.

✓ Covered with chitinous exoskeleton and has the ability to molt at intervals during growth.

# General Characteristics of Phylum Arthropoda

- **Digestive system:** Alimentary canal is well developed, begins with mouth and ends with anus.
- **Respiratory system:** Respiration takes place by general body surface or gills, trachea, book lungs or book gills.
- **Excretory system:** Excretion takes place through Malpighian tubules or nephridia.
- **Reproductive system:** Mostly unisexual, hermaphroditism is rare.

# General Characteristics of Phylum Arthropoda

- **Nervous system:** The central nervous system consists of a ganglion center above the esophagus known as the brain, connected to a ventral nerve cord carrying ganglia.
- **Muscular system:** Body muscles are often striated.

# General Characteristics of Phylum Arthropoda

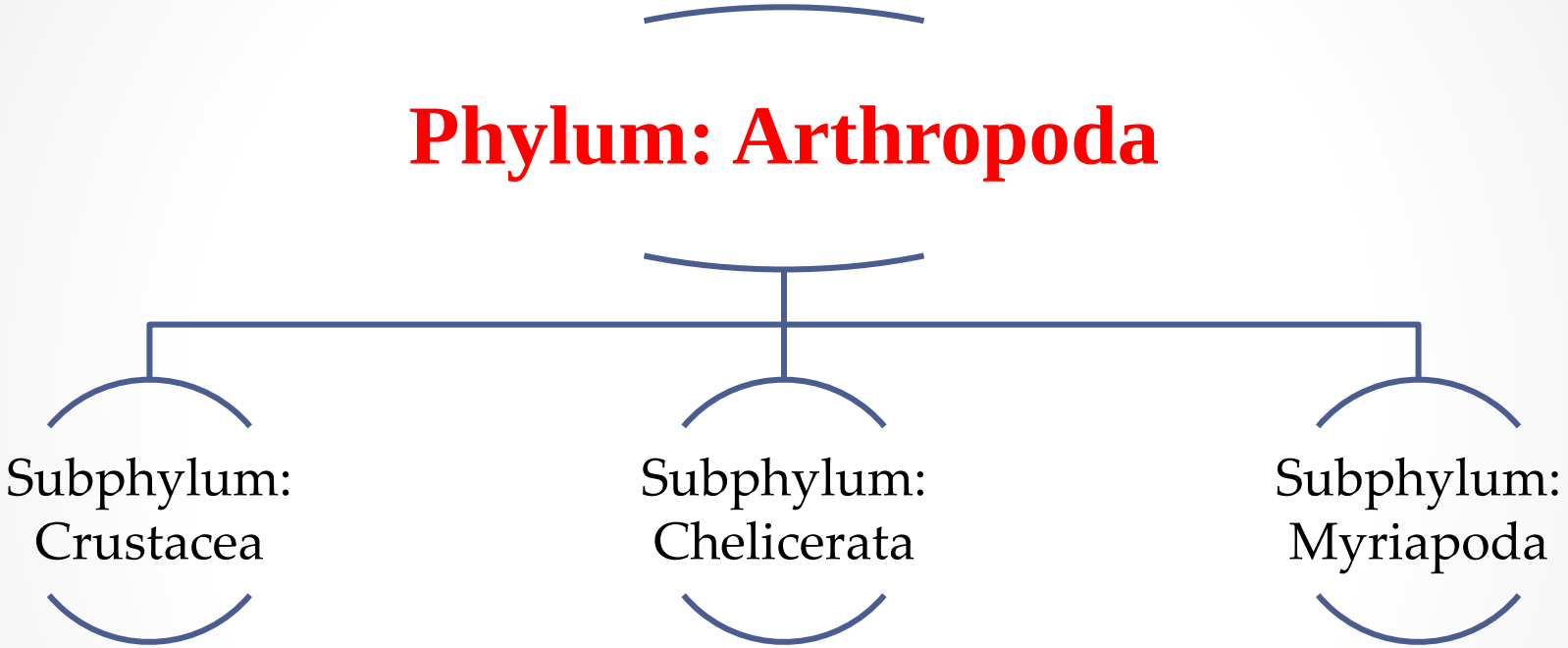
- **Circulatory system:**

✓ Opened type with no blood vessels.

✓ The heart is located dorsally with lateral openings.

✓ The blood enters directly into the body chambers or (hemocoel), and returns back to the heart through ostia.

# General Classification Of Phylum Arthropoda



# Examples of Arthropoda

# Prawn

Classification

Kingdom : Animalia

Phylum : Arthropoda

Subphylum : Crustacea

Class : Malacostraca

e.g. : *Penaeus japonicus*

# Habitat and living of prawn

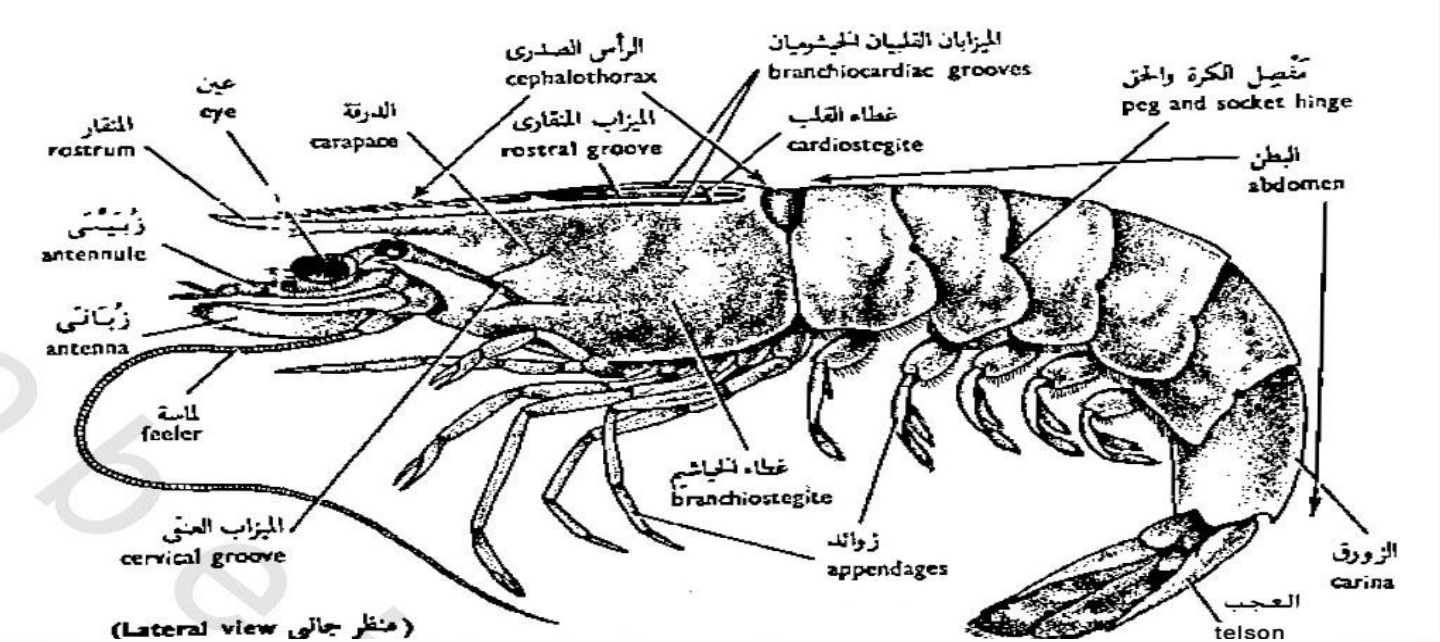
❑**Habitat:**

✓ The prawn is common in **marine fauna**.

❑**Living:**

✓Lives **free**.

# External features of prawn




## ❑Color:

✓ **Reddish grey** becomes **orange-pink** on boiling or preservation.

## ❑Body:

✓ Composed of: **Cephalothorax – Abdomen - Appendages**

- **Cephalothorax:**

✓ Consists of 6 cephalic segments + 8 thoracic segments.

✓ Is covered on all sides except ventrally by **carapace** which extended anteriorly into a long serrated pointed **rostrum**.

✓ **No** external signs of **segmentation** on head and thorax.

✓ **At lateral sides of carapace:** there is a V-shaped cervical groove that lies between head and thorax.

✓ **At dorsal side of carapace:** 3 dorsal grooves are present, 2 of these are branchiocardiac grooves and the 3rd is rostral groove.

✓ On both sides of rostrum two **compound eyes** are present carried on long stalks. Each eye made up of a large number of structural & functional units called ommatidia.

- **Abdomen:**

✓ 6 segments, easily distinguished dorsally and ventrally, ended with a small **telson,** where the **anus** opens on its ventral surface.

✓ Abdomen segments can move upon one another only in a vertical plane due to the presence of **peg and socket** hinges on each side.

# Phylum: Arthropoda

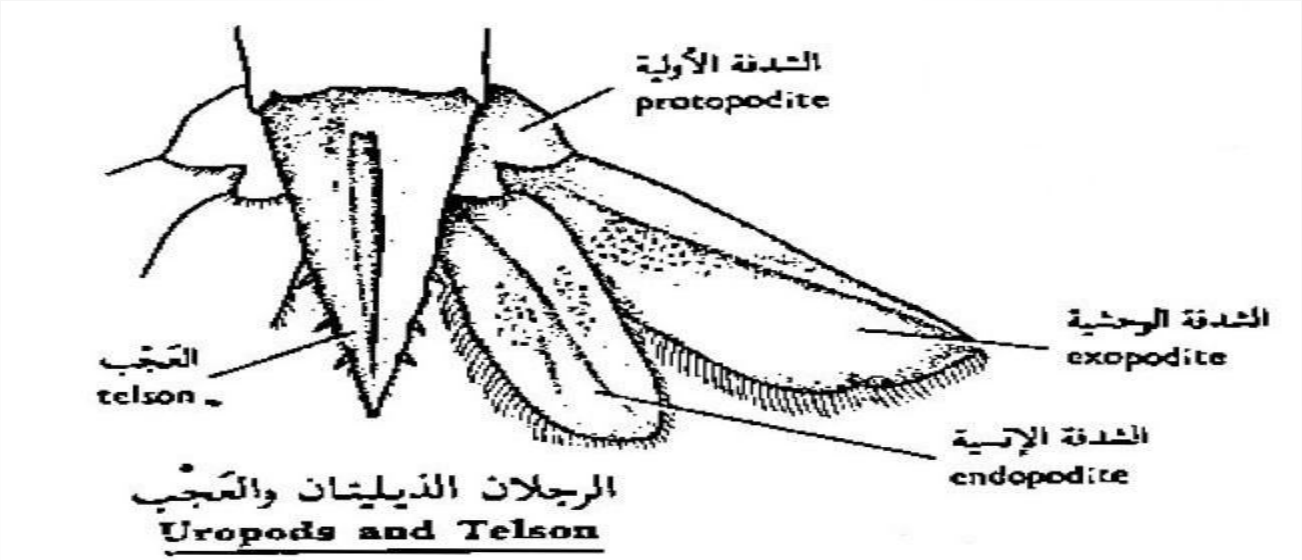
# External features of prawn

- **Appendages:**

✓ Body segments are **20** in number, the 1st disappears in the adult and is therefore not represented by any appendages.

✓ A pair of appendages is attached to each of the other 19 segments.

✓ Appendages consists of a number of sclerotized segments, that are movably articulating at joints, hence the phylum got its name **Arthropoda**.




- **Abdominal Appendages:**
- **Uropods (segment 20):**

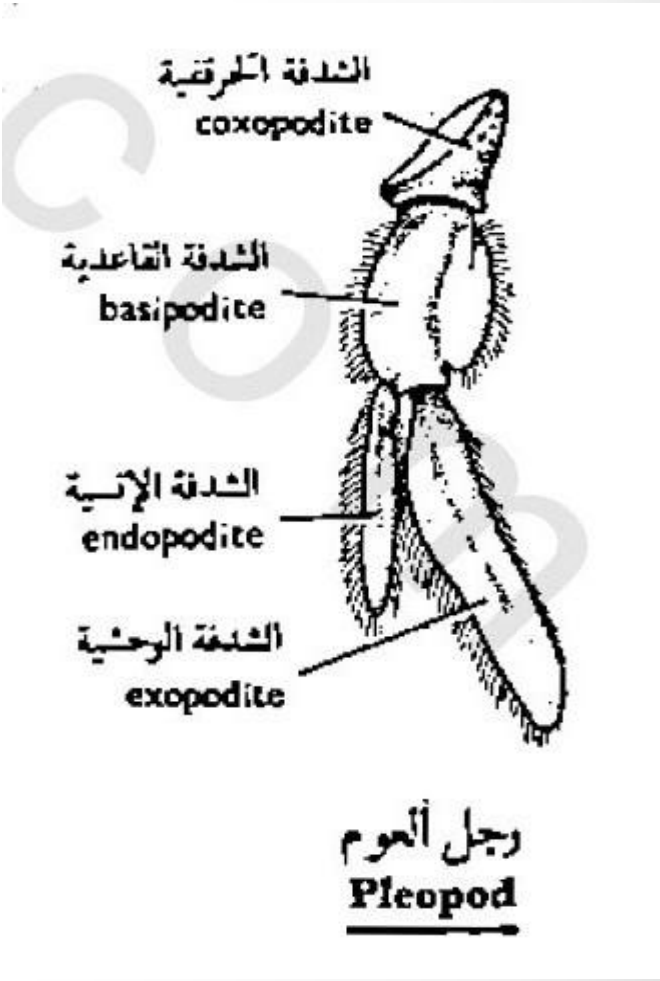
✓ **Structure:** Have undivided basal stem called protopodite, and carry 2 rami called exopodite and endopodite that are greatly flattened and fringed with bristles.

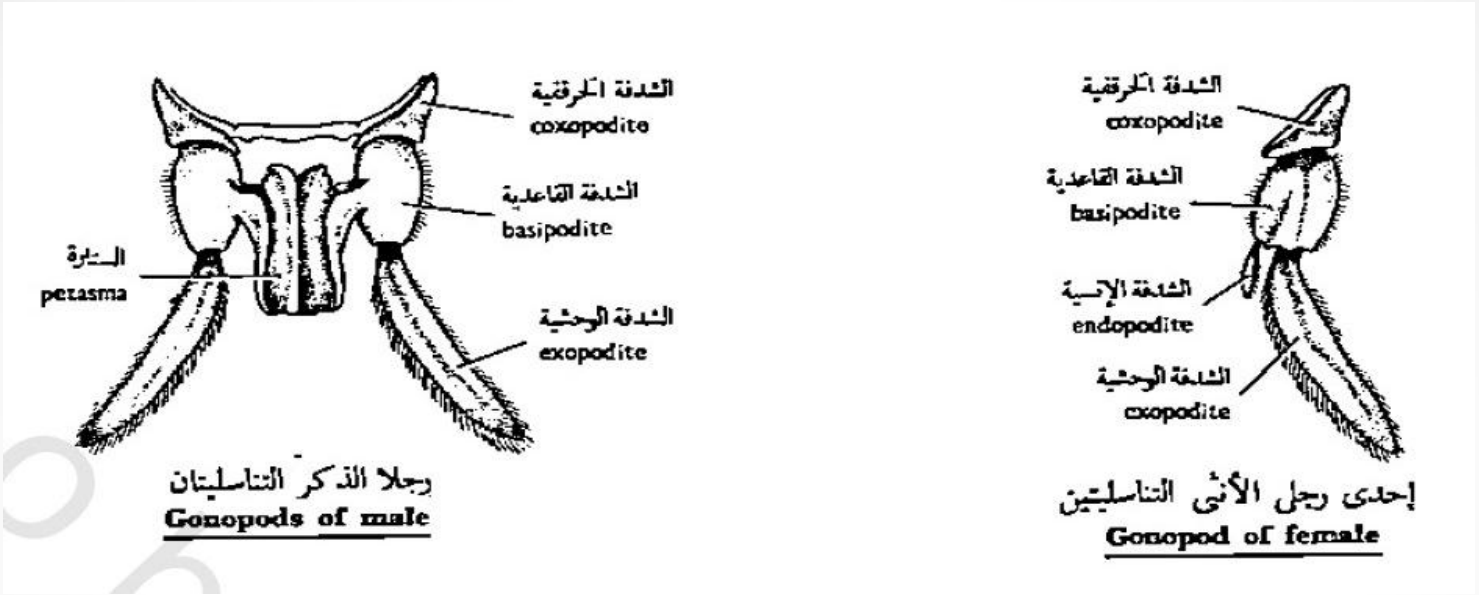
✓ **Function:** Backward swimming.

- **Abdominal Appendages:**
- **Pleopods (segments 16-19):**

✓ **Structure:** Have basal stem divided into coxopodite and basipodite, and carries 2 rami, exopodite and endopodite. Such appendages are typical biramus appendages.

✓ **Function:** Swimming.






- **Abdominal Appendages:**
- **Gonopods (segment 15):**

✓ **Structure:** Similar to pleopods, except endopodite, in female is very much reduced to a small filamentous structure, while in male is replaced by flap called petasma.

✓ **Function:** Sexual.

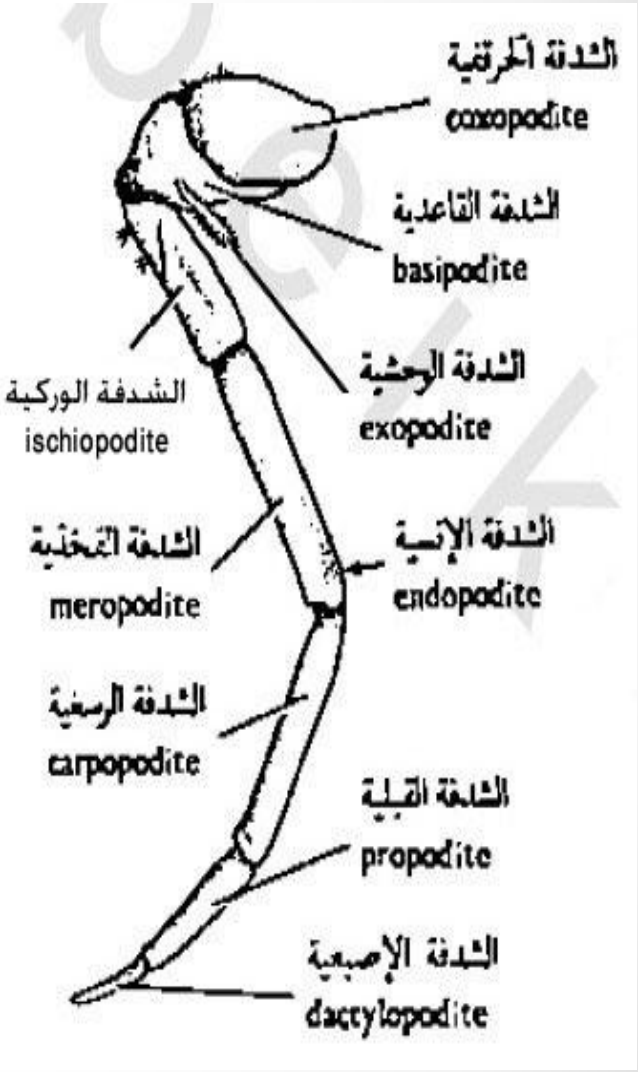
- **Thoracic Appendages 7th & 8th:**
- **Pereiopods (segments 13-14):**

✓ **Structure:** Protopodite: 2 segmented, male genital openings lie on coxopodites of 8th pair.

Exopodite: Very much reduced.

Endopodite: Much elongated and segmented.

✓ **Function:** Walking.



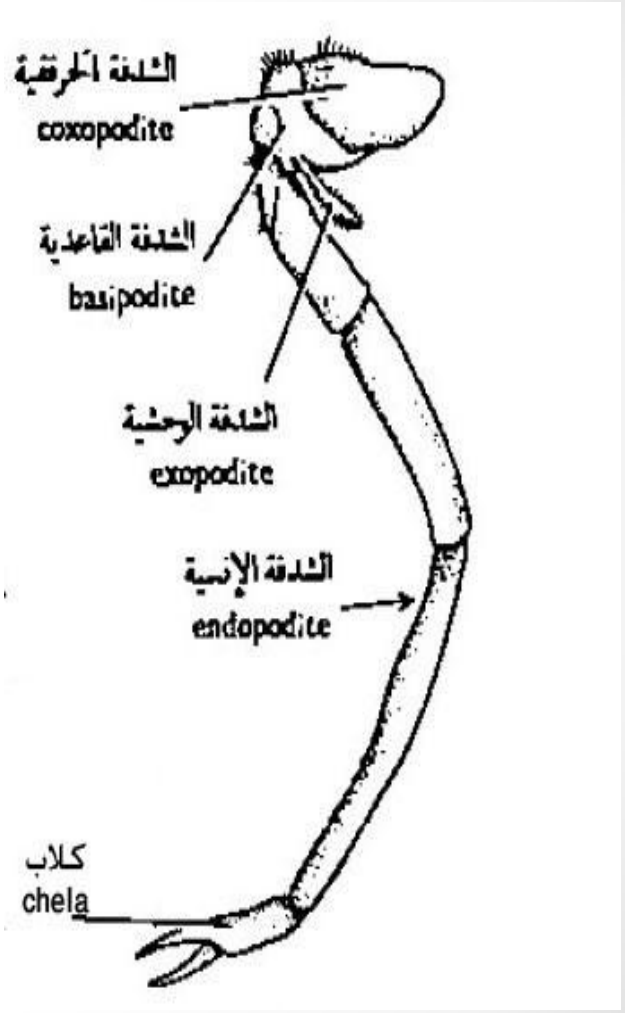
- **Thoracic Appendages 4th, 5th,6th:**
- **Chelipeds (segments 10-12):**

✓ **Structure:** Protopodite: 2 segmented, female genital openings lie on coxopodites of 6th pair.

Exopodite: Similar to preceding.

Endopodite: Similar to preceding except presence of chela.

✓ **Function:** Holding food, defence and walking.



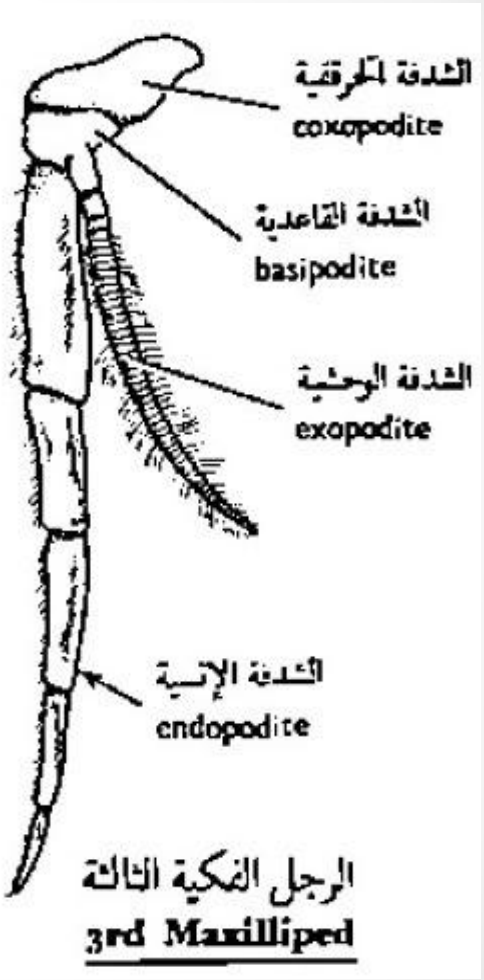
- **Thoracic Appendages:**
- **3rd Maxillipeds (segment 9):**

✓ **Structure:** Protopodite: 2 segmented.

Exopodite: Many segmented and filamentous supplied with bristles.

Endopodite: 5 segmented as preceding but without chela.

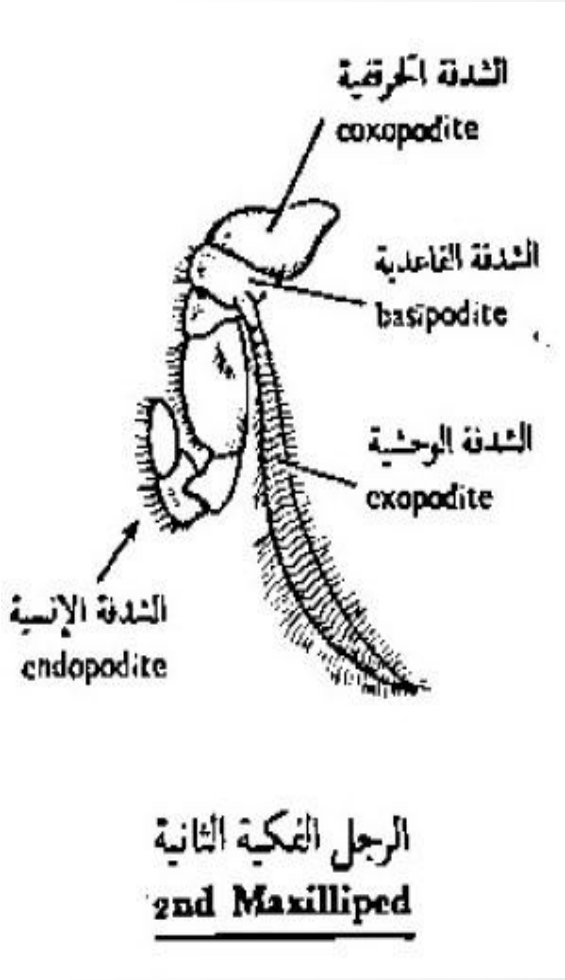
✓ **Function:** Holding food.



- **Thoracic Appendages:**
- **2nd Maxillipeds (segment 8):**

✓ **Structure:** Protopodite: Similar to preceding. Exopodite: Similar to preceding. Endopodite: Smaller than preceding and curved inwards, carry numerous bristles which intersect forming a sieve.

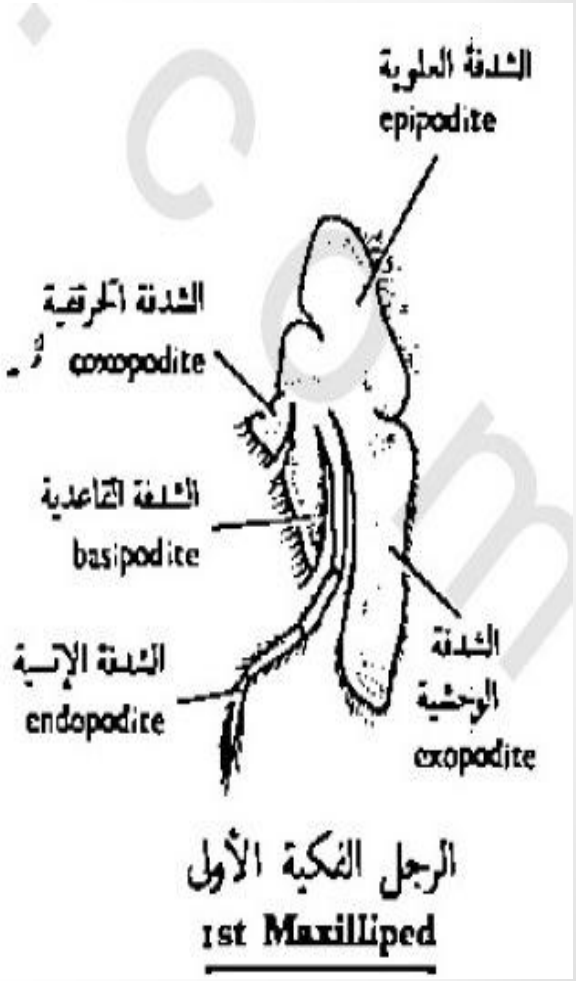
✓ **Function:** Shredding and straining food.



- **Thoracic Appendages:**
- **1st Maxillipeds (segment 7):**

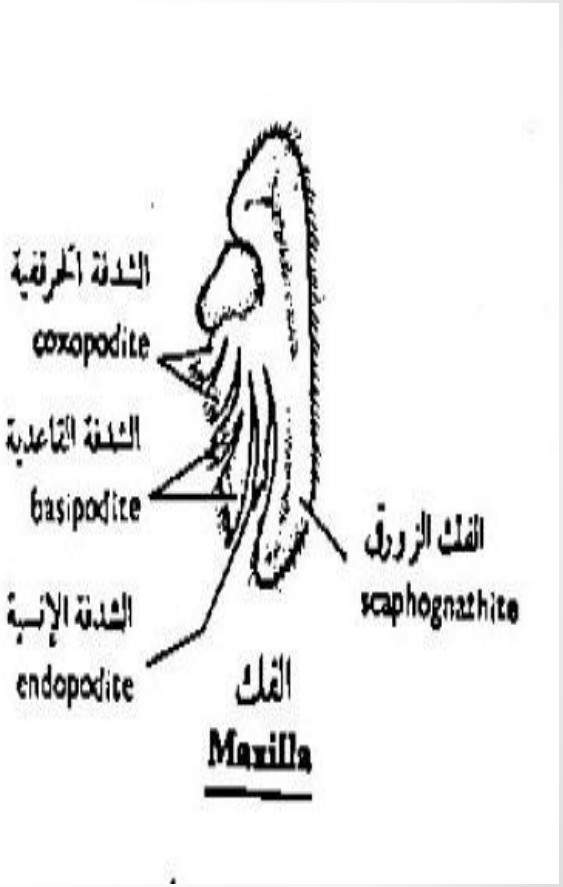
✓ **Structure:** Protopodite: 2 flattened segments which project into 2 endites bearing bristles and forming blade-like bipartite gnathobase, towards the outside it carries a broad epipodite. Exopodite: Flattened unjointed lamina. Endopodite: Filamentous and much reduced than preceding.

✓ **Function:** shredding food.



- **Cephalic Appendages:**
- **Maxillae (segment 6):**

✓ **Structure:** Protopodite: Similar to preceding, but develop 2 bilobed endites forming a gnathobase. Exopodite: forms with epipodite a large flattened plate known as scaphognathite, whose vibrations create a respiratory water current over the gills. Endopodite: Filamentous and very much reduced.

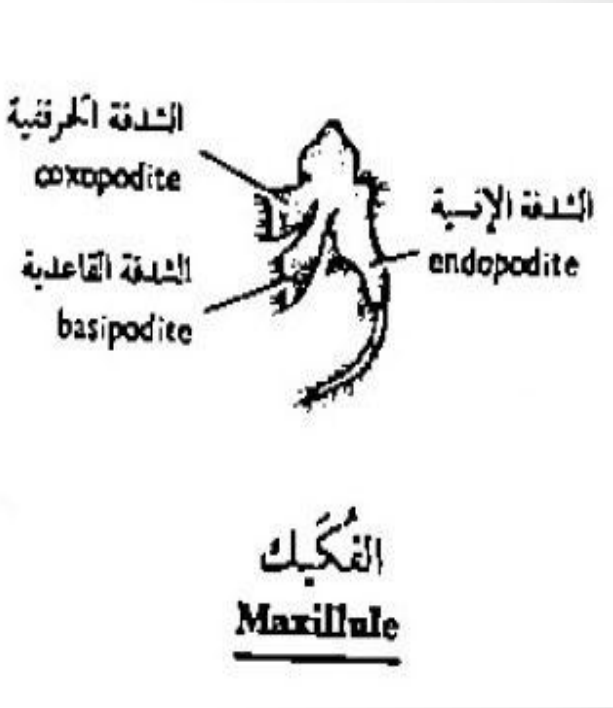



✓ **Function:** Holding food and respiration.

- **Cephalic Appendages:**
- **Maxillules (segment 5):**

✓ **Structure:** Protopodite: 2 flattened endites fringed with strong bristles. Exopodite: Absent. Endopodite: Very small and segmented.

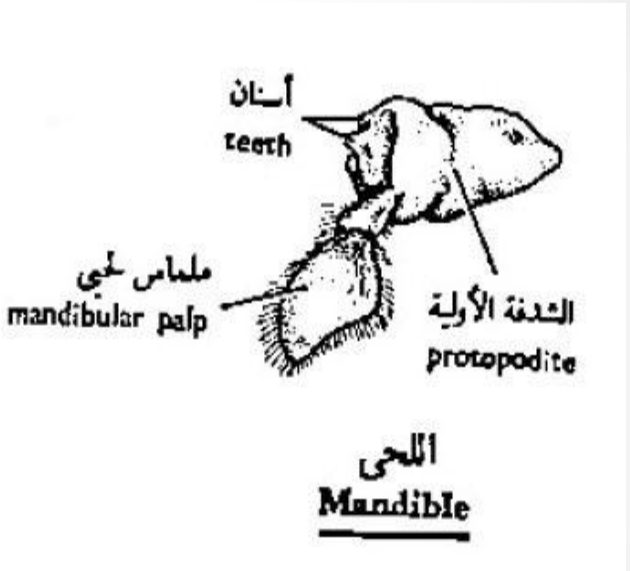
✓ **Function:** Holding food.



- **Cephalic Appendages:**
- **Mandibles (segment 4):**

✓ **Structure:** Protopodite: Forms a heavy unjointed jaw with strong internal teeth. Exopodite: Absent. Endopodite: Forms a 2 segmented mandibular palp.

✓ **Function:** Grinding food and forcing it into the mouth.

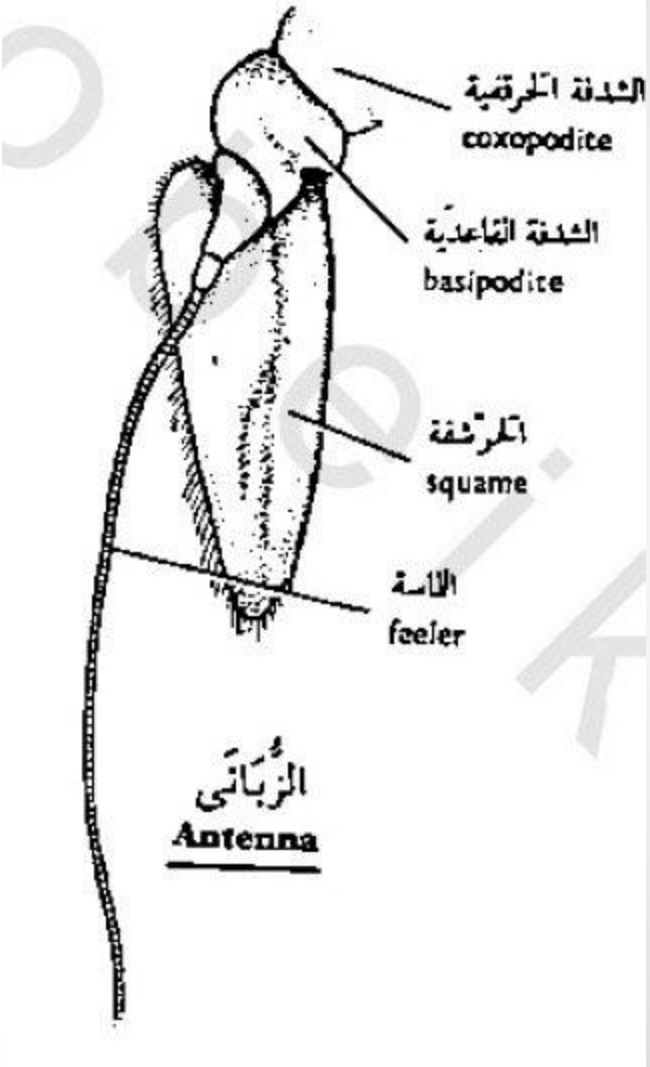


- **Cephalic Appendages:**
- **Antennae (segment 3):**

✓ **Structure:** Protopodite: 2 segmented, the coxopodites bear the opening of the excretory glands (green glands).

Exopodite: Forms a broad plate called squame. Endopodite: Forms a very long filamentous segmented feeler, bearing sensory bristles.

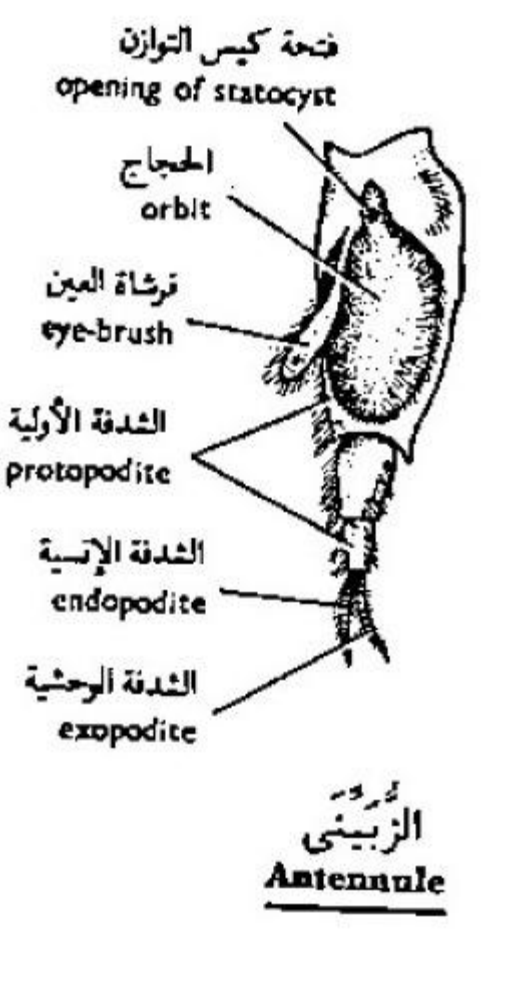
✓ **Function:** Tactile.



- **Cephalic Appendages:**
- **Antennules (segment 2):**

✓ **Structure:** Protopodite: 3 segmented, has an orbit where eyeball rests, and the balancing and auditory statocyst. A small process fringed with bristles called eye brush arises on its inner edge. Exopodite & Endopodite: 2 short slender rami of about equal length.

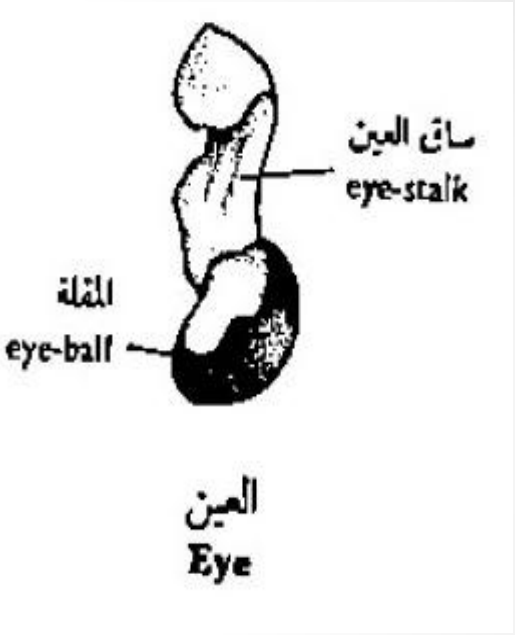
✓ **Function:** Sensation, balancing and auditory.



- **Eye stalks:**

✓ **Structure:** 2 segmented processes arise above antennules.

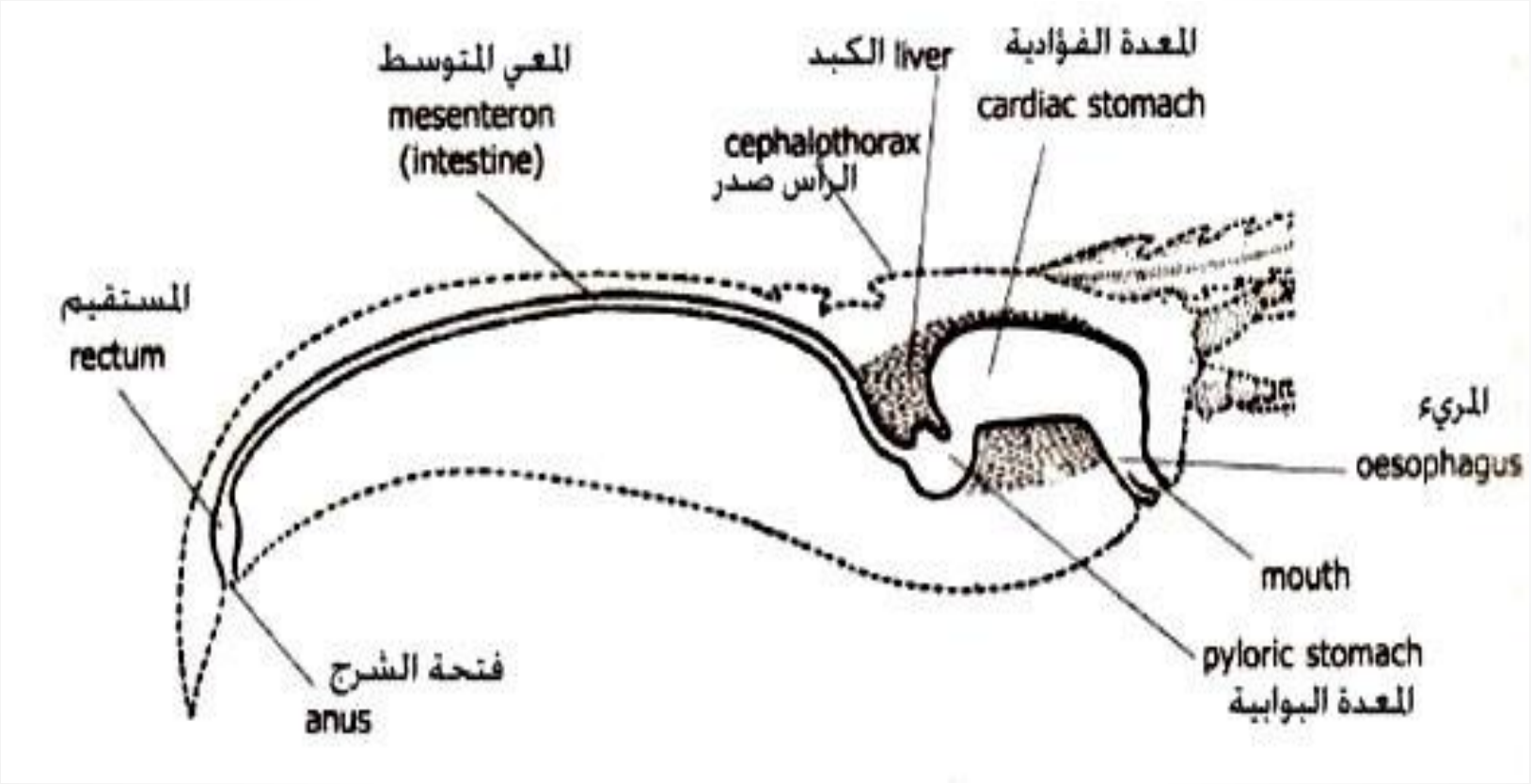
✓ **Function:** Carrying of eyes.



# Phylum: Arthropoda

# Internal anatomy of prawn

# Digestive system



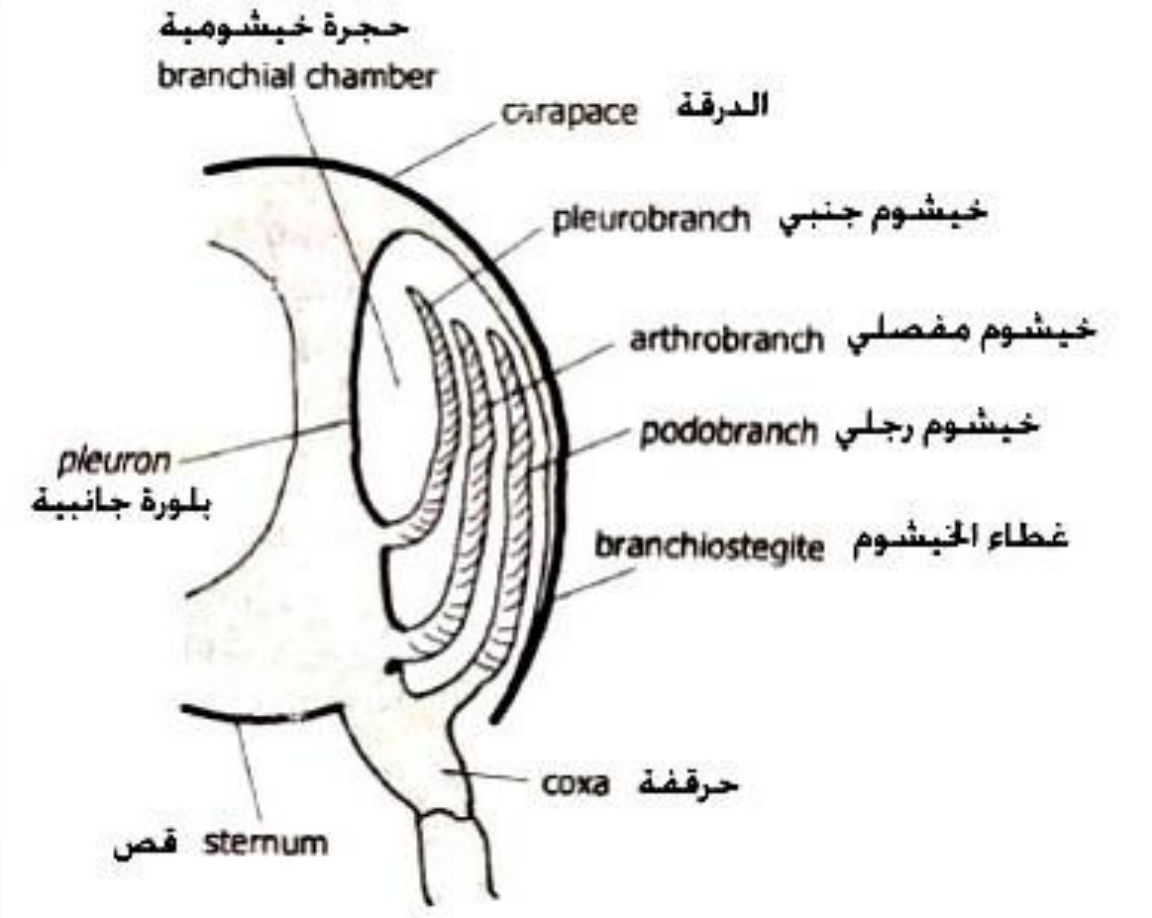
- Digestive system is composed of: **Foregut**, **Midgut** and **Hindgut**.

✓ **Foregut**: Starts with mouth, leads into short oesophagus and stomach. The later is divided into the cardiac or grinding stomach (with chitinous teeth) and the pyloric or sifting stomach (with chitinous sieve).

✓ **Midgut**: A short tube without chitin. Two large lobed masses called the digestive glands lie on each side of mid-gut. They are for secretion and absorption.

✓ **Hindgut:** A straight long tube extends along the abdomen, and ends with anus on the ventral side of telson.

# Respiratory system



- Respiration occurs mainly by **gills** which are branched filamentous outgrowths of the body surface through which blood circulates.
- They lie on either side of the thorax, enclosed in a narrow **branchial chamber** on each side, covered by branchiostegite.
- The gills are:

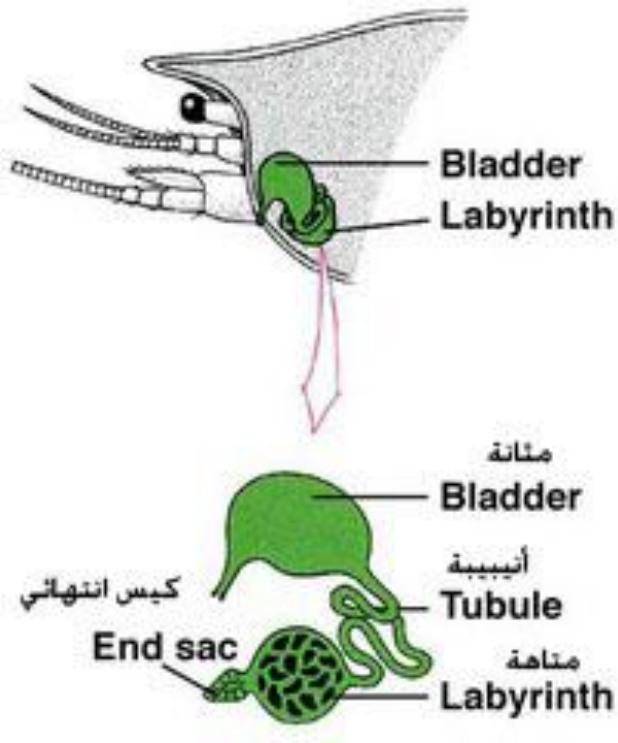
✓ **Pleurobranchiae:** Arise from thoracic segments.

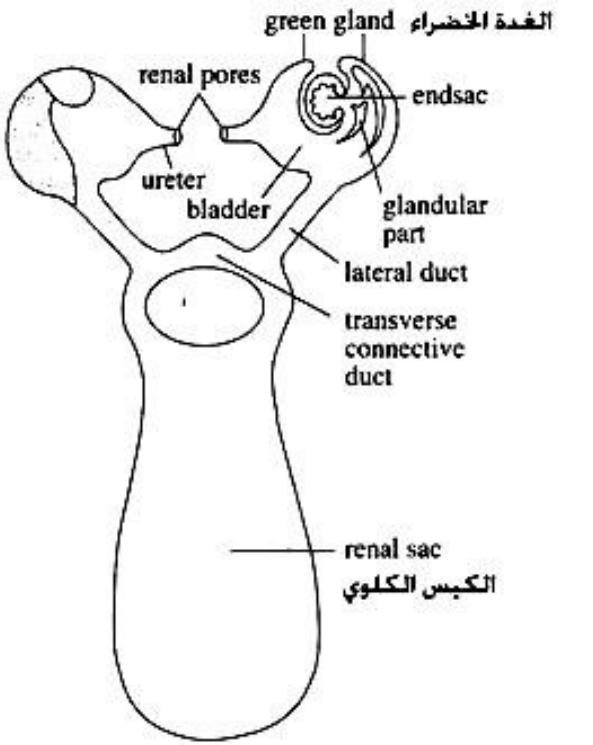
✓ **Arthrobranchiae:** Arise from bases of appendages.

✓ **Podobranchiae:** Arise from coxopodites of appendages.

✓ **Epipodites:** Arise from basipodites of appendages(not in chamber).

# Excretory system



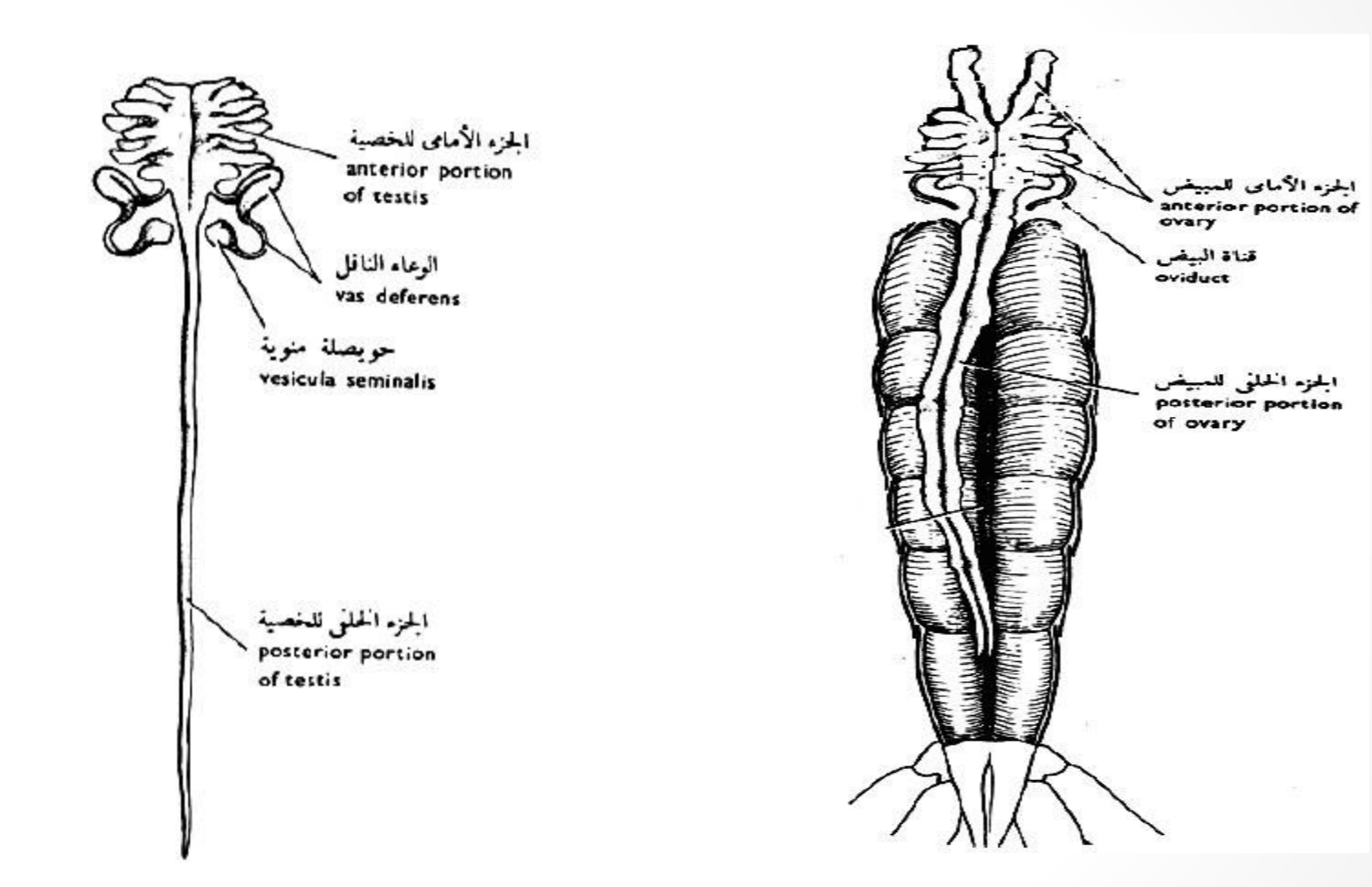



- Excretory system is composed of: **Green glands** and **Renal sac**.

✓ **Green glands:** A pair of glands lies in the coxae of antennae. It is composed of end sac, glandular labyrinth, coiled tubule and thin walled bladder which opens to the exterior by the excretory pore.

✓ **Renal sac:** Large blind sac. It covers the cardiac stomach and reaches the gonads. Anteriorly, it communicates with the green gland.

# Reproductive system




**Male** **Female**

- Male genital system is composed of: **Testes**, **Vasa deferentia** and **Vesicula seminalis**.

✓ **Testes:** There are two testes, each one consists of a broad lobed anterior portion and a long narrow posterior one. The two posterior portions are united together across the middle line.

✓ **Vasa deferentia:** Arises near the junction of the portions of each testis, each one has a narrow anterior region, a swollen and convoluted middle region and a narrow posterior region.

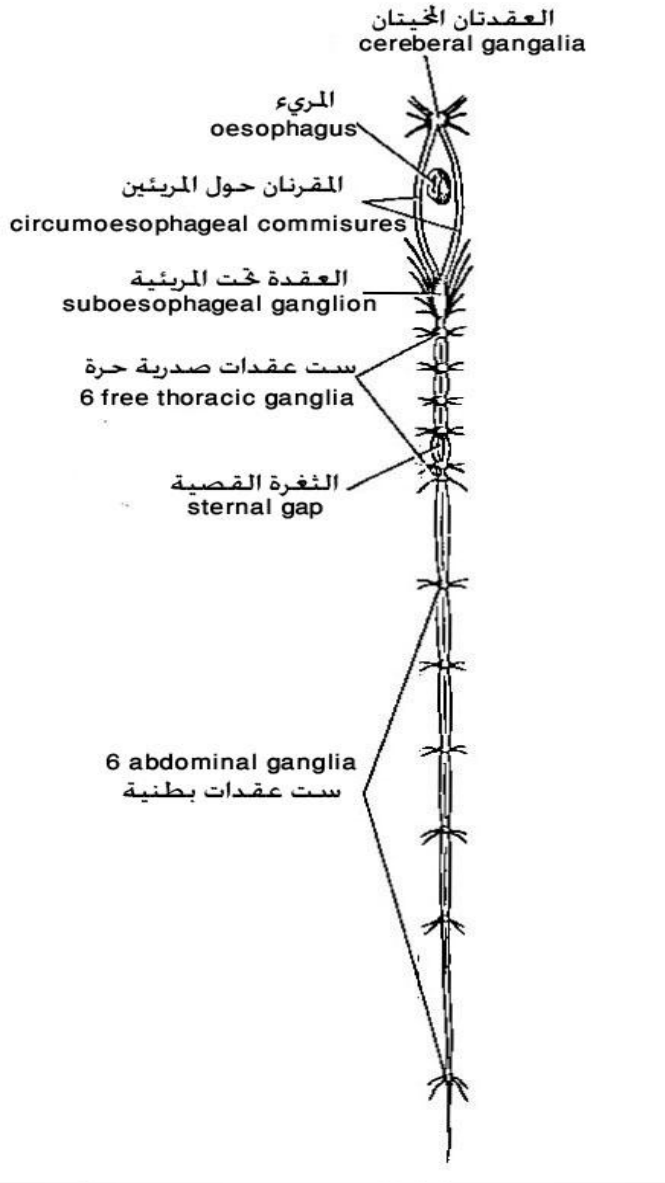
✓ **Vesicula seminalis:** These are club shaped posterior ends of the vasa deferentia. They store spermatozoa and opens with the **male genital openings**.

- Female genital system is composed of: **Ovaries**, **Oviducts**.

✓ **Ovaries:** There are two ovaries, each one generally resemble the testis in shape ( a broad lobe and a narrow lobe).

✓ **Oviducts:** These are slender curved tubes with wide proximal ends. From the middle region of each ovary arises an oviduct. They are simpler and thinner than vasa deferentia and open with the **female genital openings**.

# Nervous system



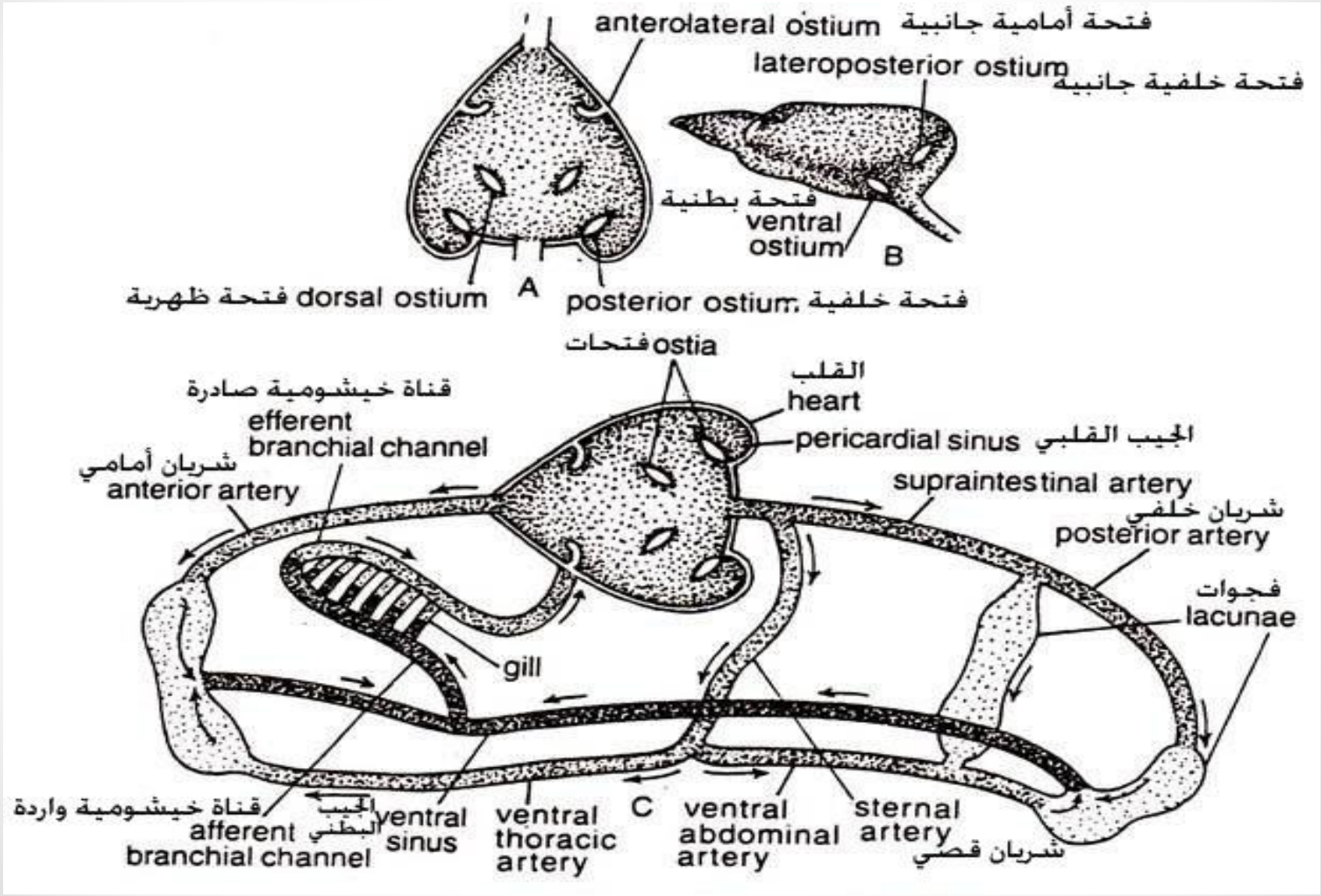
- The nervous system is composed of: **Cerebral ganglia**, **Suboesophageal ganglion** and **Nerve cord**.

✓ **Cerebral ganglia:** A large ganglionic mass found in front of the oesophagus. From this mass 3 pairs of nerves extends to eyes, antennules and antennae.

✓ **Suboesophageal ganglion**: Lies behind the oesophagus and connected to cerebral ganglia by 2 circumoesophageal commissures. From this 5 pairs of nerves extends to mandibles, maxillules, maxillae, 3rd and 2nd maxillipeds.

✓ **Nerve cord:** Has 12 pairs of nerves (6 for remain thoracic appendages and 6 for the abdominal ones ).

# Circulatory system



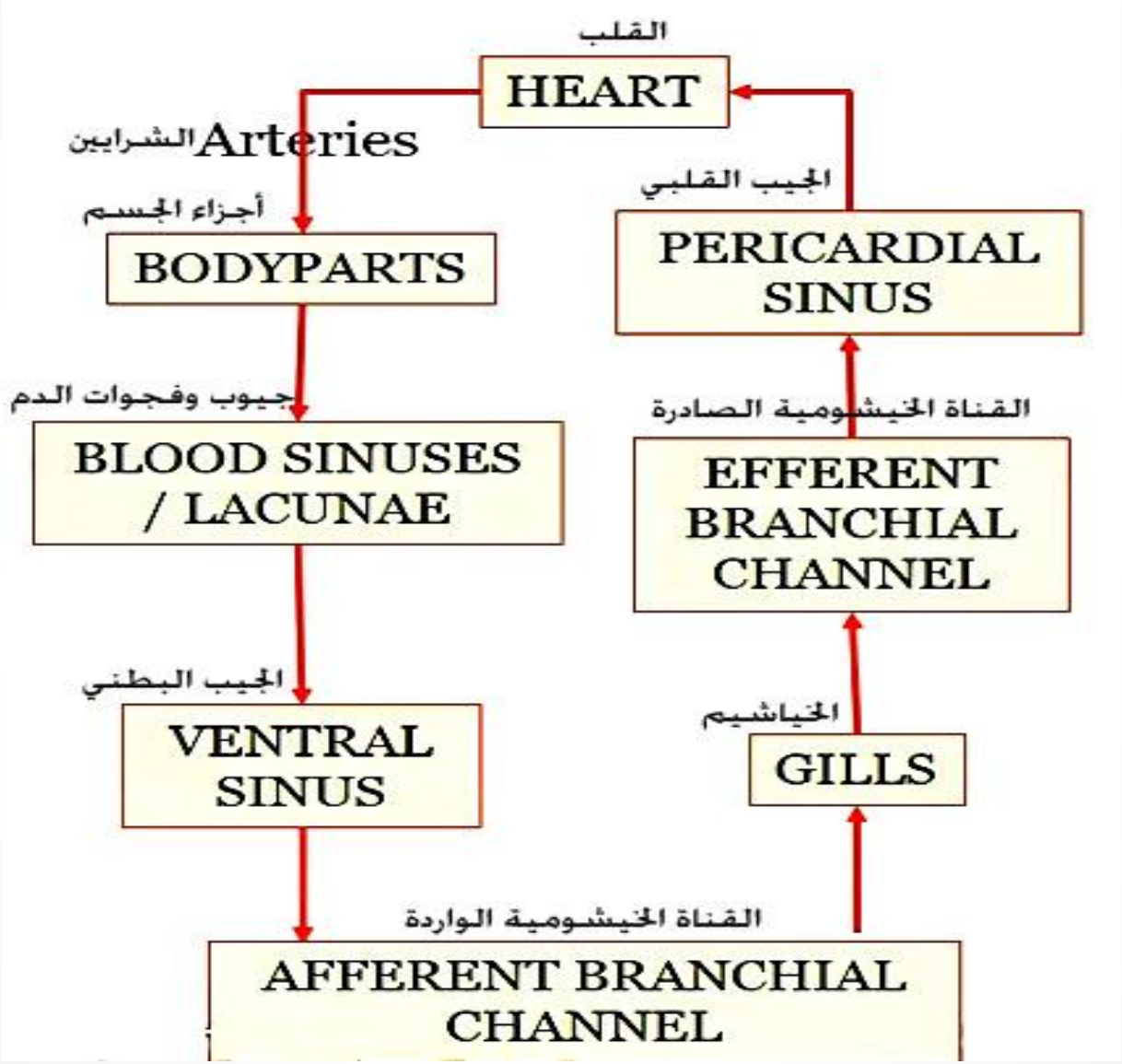
- The circulatory system is open and mainly composed of: **Heart**, **Arteries** and **Blood sinuses and lacunae.**

✓ **Heart:** A triangular chamber lies dorsally in pericardial sinus, provided with openings called **ostia** which are contractile structures work as valves to permit only flow of blood from pericardial sinus to the heart.

✓ **Arteries:** The main tubes which arise from the anterior and posterior regions of the heart.

✓ **Blood sinuses and lacunae:** Passage ways of blood (haemolymph).

# Circulation Mechanism



# Phylum: Arthropoda

# Examples of Arthropoda

# Scorpion

Classification

Kingdom : Animalia

Phylum : Arthropoda

Subphylum : Chelicerata

Class : Arachnida

e.g. : *Leiurus quinquestriatus*

# Habitat and living of Scorpion

## ❑Habitat:

✓ It is a dangerous animal, spread in **tropical** and **temperate** regions.

## ❑Living:

✓**Predator**, **nocturnal**, feeds on juice of insects and spiders .

# External features of Scorpion

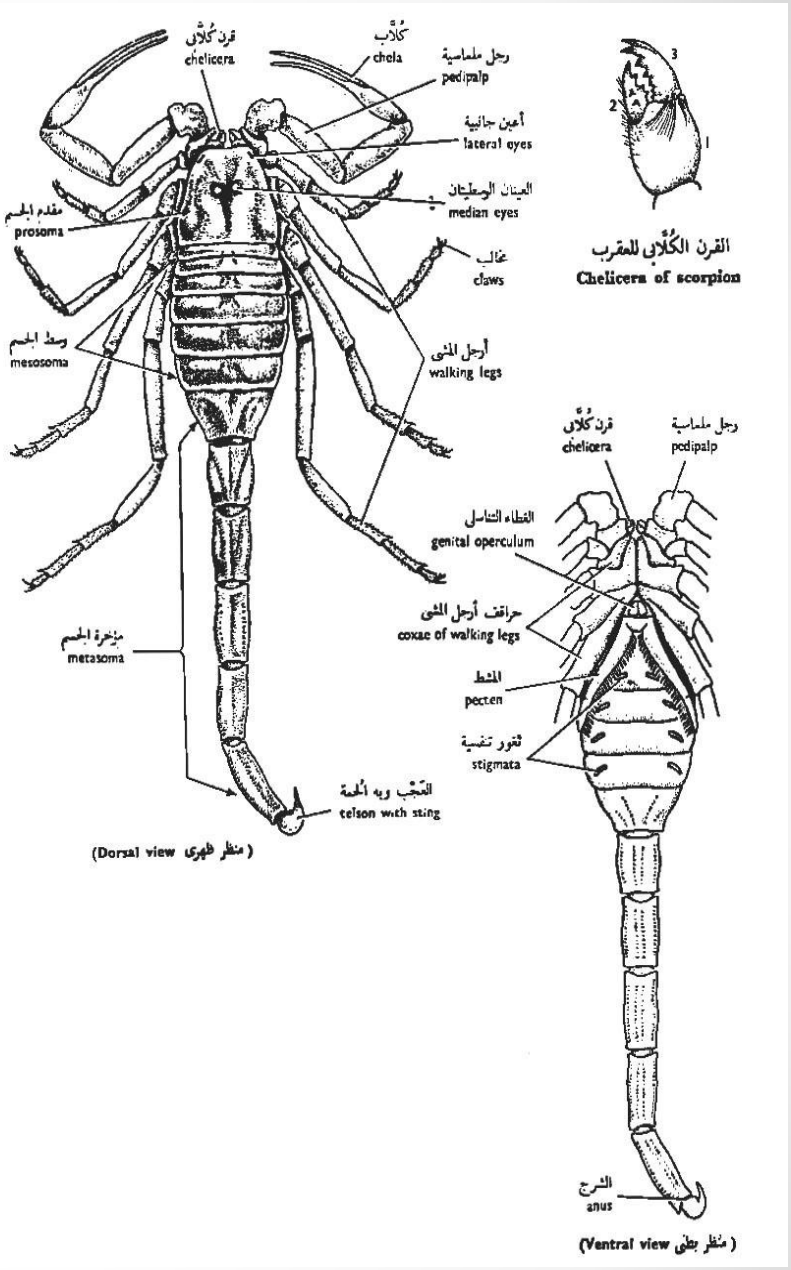
## ❑Color:

✓ **Pale yellow.**

## ❑Body:

✓ Composed of:

- **Prosoma**
- **Opisthosoma:** is subdivided to:
- Broad **mesosoma**.
- Slender **metasoma** ends in a sting.



- **Prosoma:**

✓ Covered by a dorsal shield (**carapace**) which carries dorsally a pair of median eyes and two groups each of 5 smaller lateral simple eyes.

✓ Carries **6 pairs of appendages**: the chelicerae, the pedipalps (as feelers and with toothed pincers for offensive action) and 4 pairs of walking legs.

- **Mesosoma:**

✓ 6 segments.

✓ The **first** segment carries on its ventral side a divided **genital operculum** covers the genital opening.

✓ The **second** segment carries a pair of comb-like structures (**the pectens**) act as tactile organs (longer in the male).

✓ The **4 other segments** with 4 pairs of **stigmata** on their ventral side, lead internally into the lung-books.

- **Metasoma:**

✓ **6** narrow cylindrical segments jointed to one another.

✓ The **last segment** terminates with the **telson** which forms the **sting**.

✓ **Two poison glands** are found within the sting and open near the spine.

# Internal anatomy of scorpion

# Digestive system

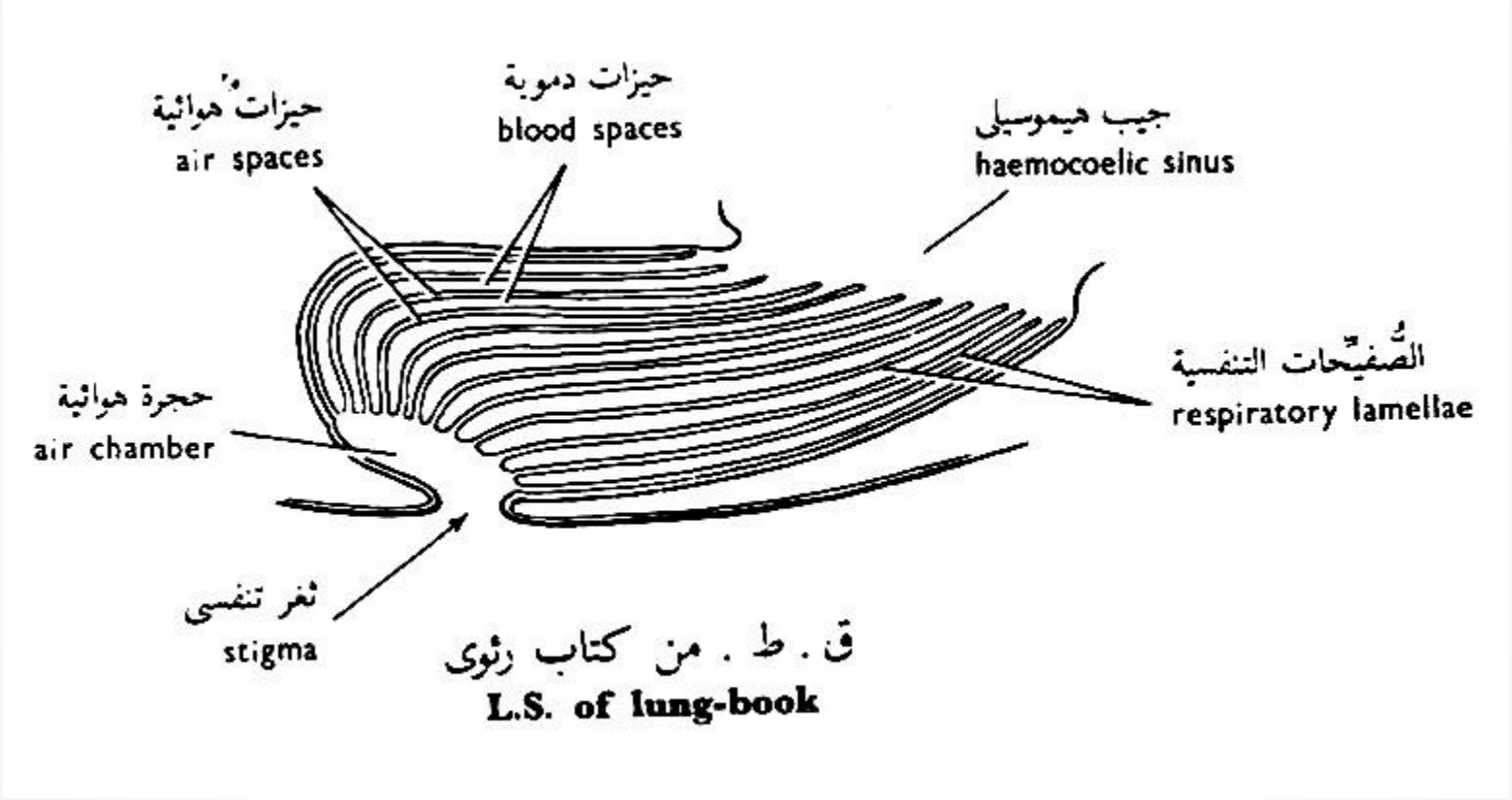
- Digestive system is composed of: **Foregut**, **Midgut** and **Hindgut.**

✓ **Foregut:** Starts with mouth that is located at the front of the body and followed by a muscular pharynx that absorbs prey juice and blood. The pharynx leads to an esophagus in which a pair of salivary glands opens and followed by the stomach then the midgut.

✓ **Midgut:** A long tube with glandular walls connected to the digestive gland or liver.

✓ **Hindgut:** A narrow tube opens with anus.

# Respiratory system




ق . ط . من كتاب رئوى

**L.S. of lung-book**

- ✓ Respiration in scorpion occurs through **four pairs of lung-book.**
- ✓ Each lung- book consists of **stigma** which leads into a wide **air chamber.**
- ✓ The **respiratory lamellae** are numerous hollow ingrowths of the body which are set up parallel to one another like the papers of a book. Each lamella encloses a narrow air space.
- ✓ The **haemocoelic sinus** is a spacious cavity filled with blood and all the lamellae project into it.
- ✓ The blood from this sinus circulates in the compressed blood spaces between the lamellae, and thus respiratory exchange take place through the thin walls of the lamellae.

# Excretory system

- Excretion in scorpion is carried out by: **Coxal glands** & **Malpighian tubules**.

✓ **Coxal glands:** A pair of glands found in the posterior part of prosoma and each opens externally on the coxopodite of the third walking leg.

✓ **Malpighian tubules:** Two pairs of tubules (or maybe one pair) open in the gut at the posterior end of mesosoma.

# Reproductive system

- Male genital system is mainly composed of: **Testes**, **Vasa deferentia** and **Vesicula seminalis**.

✓ **Testes:** There are 2 longitudinal tubular testes, each one is connected to the other with transverse branches.

✓ **Vasa deferentia:** Common median tubules connect to testes.

✓ **Vesicula seminalis:** 2 vesicles.

✓ There are 2 additional glands in addition to a double intromittent penis connected with the vas deferens.

- Female genital system is mainly composed of: **Ovary, Seminal receptacles**, **Oviducts**.

✓ **Ovary:** One ovary located in the posterior half of the mesosoma. The ovary consists of 3 longitudinal tubes that are connected to each other by transverse branches.

✓ **Seminal receptacles:** 2 seminal receptacles (each one is tubular in shape).

✓ **Oviducts:** connected to the seminal receptacles.

✓ The vagina is a short median tube that opens to the exterior through the genital opening on the genital operculum.

# Nervous system

- The nervous system is composed of: **Cerebral ganglia**, **Suboesophageal ganglion** and **Nerve cord**.

✓ **Cerebral ganglia:** 2 ganglia lie dorsal to the pharynx and give off nerves to the eyes.

✓ **Suboesophageal ganglion**: Large and connected to the cerebral ganglia by a pair of circumoesophageal commissures . It gives off nerves to all segments and appendages of the prosoma as well as the first 4 segments of the mesosoma.

✓ **Nerve cord:** Doubled and carries 8 ganglia, one in each of the last 2 mesosomatic and all metasomatic segments.

# Circulatory system

- The circulatory system is **open**.
- **Heart** is tubular and extends in the mid dorsal line along the whole length of the mesosoma.
- It consists of 7 chambers, each with a pair of dorsolateral ostia and a pair of lateral arteries.
- It leads anteriorly into an anterior aorta and posteriorly into a posterior aorta.

# Phylum: Arthropoda

# Examples of Arthropoda

# Centipede

Classification

Kingdom : Animalia

Phylum : Arthropoda

Subphylum : Myriapoda

Class : Chilopoda

e.g. : *Scolopendra morsitans*

Scolopendra morsitans

# Habitat and living of Centipede

## ❑Habitat:

✓ Areas of **high moisture**, such as in rotting logs, under stones, in trash or piles of leaves/grass.

## ❑Living:

✓**Predator**, **nocturnal**, feeds on of insects and earthworms.

# External features of Centipede

❑**Color:**

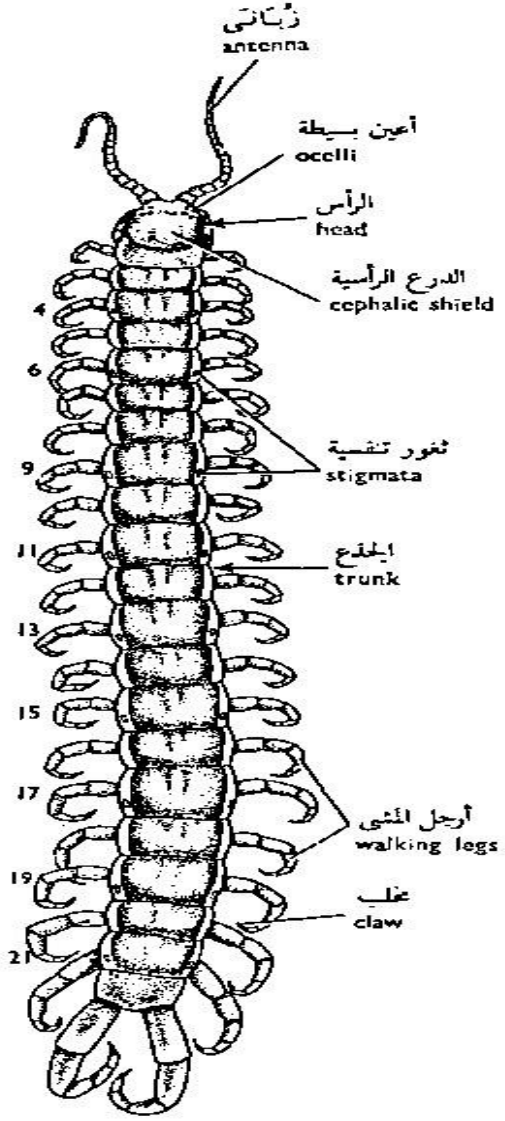
✓ **Reddish brown** with **yellow legs.**

❑**Body:**

✓ Elongated, dorsoventrally flattened.

✓ Composed of:

- **Head**
- **Trunk**.



(Dorsal view منظر ظهرى)

- **Head:**

✓ **6** segments.

✓ Covered by a **cephalic shield**.

✓ Dorsally, there are two lateral groups of simple eyes (**ocelli**), each group of 4 ocelli.

✓ The head bears two segmented **antennae** (the main sensory organs).

- **Trunk:**

✓ **22** segments.

✓ Each segment covered by a dorsal tergum, ventral sternum and 2 lateral pleura.

✓ The **first segment** has no separate tergum (maybe fused with the cephalic shield), this segment bears ventrally the **maxillipeds** or **two poison claws**, each ends in a sharp claw on which opens the poison gland.

- **Trunk:**

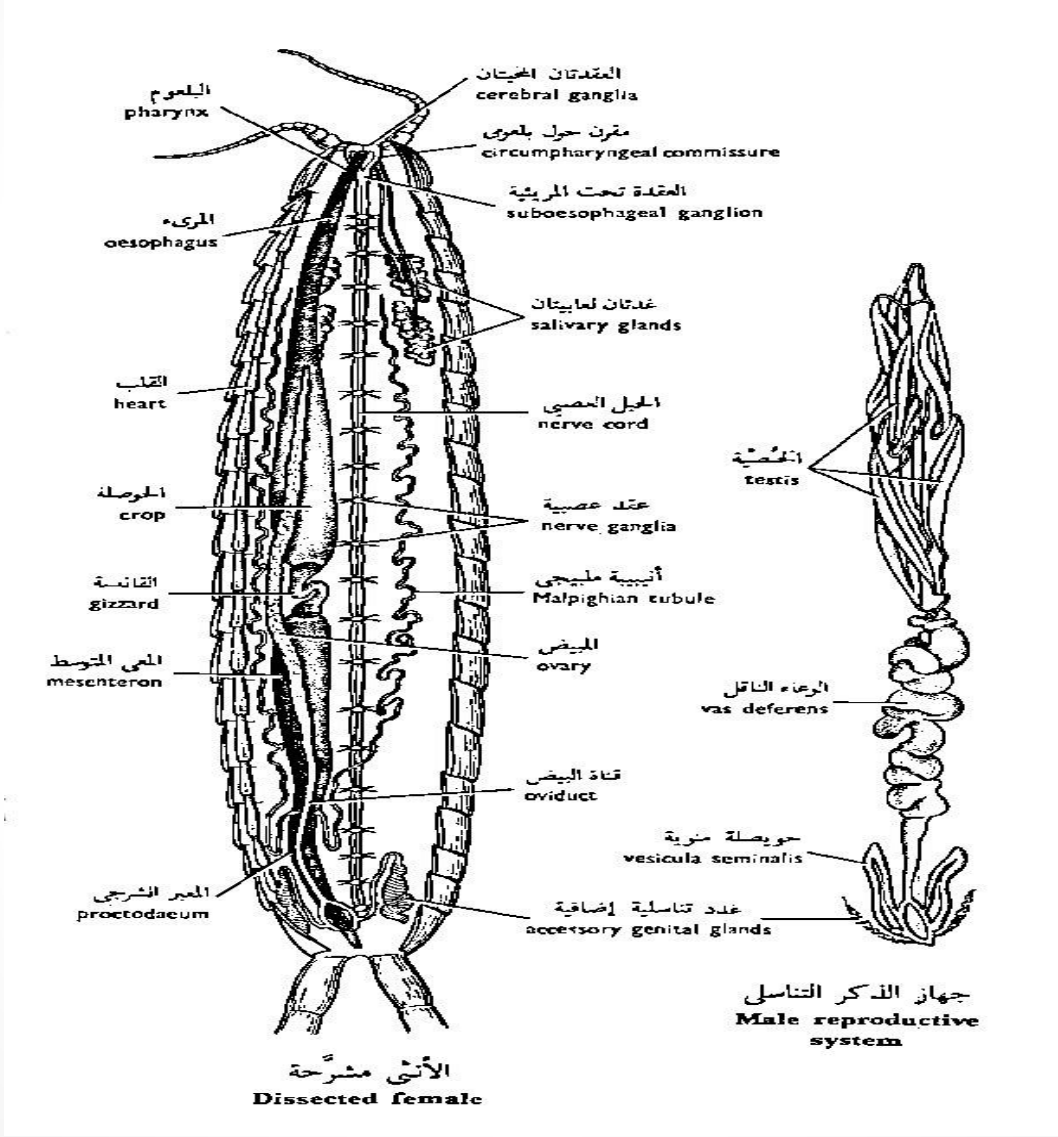
✓ Each segment from **2-22** carries one pair of **walking legs** (which together with the **2 antennae** make the **44** appendages).

✓ Each leg is built up of 7 segments named from the base: coxa, trochanter, femur, tibia and 3 tarsi ending in a claw.

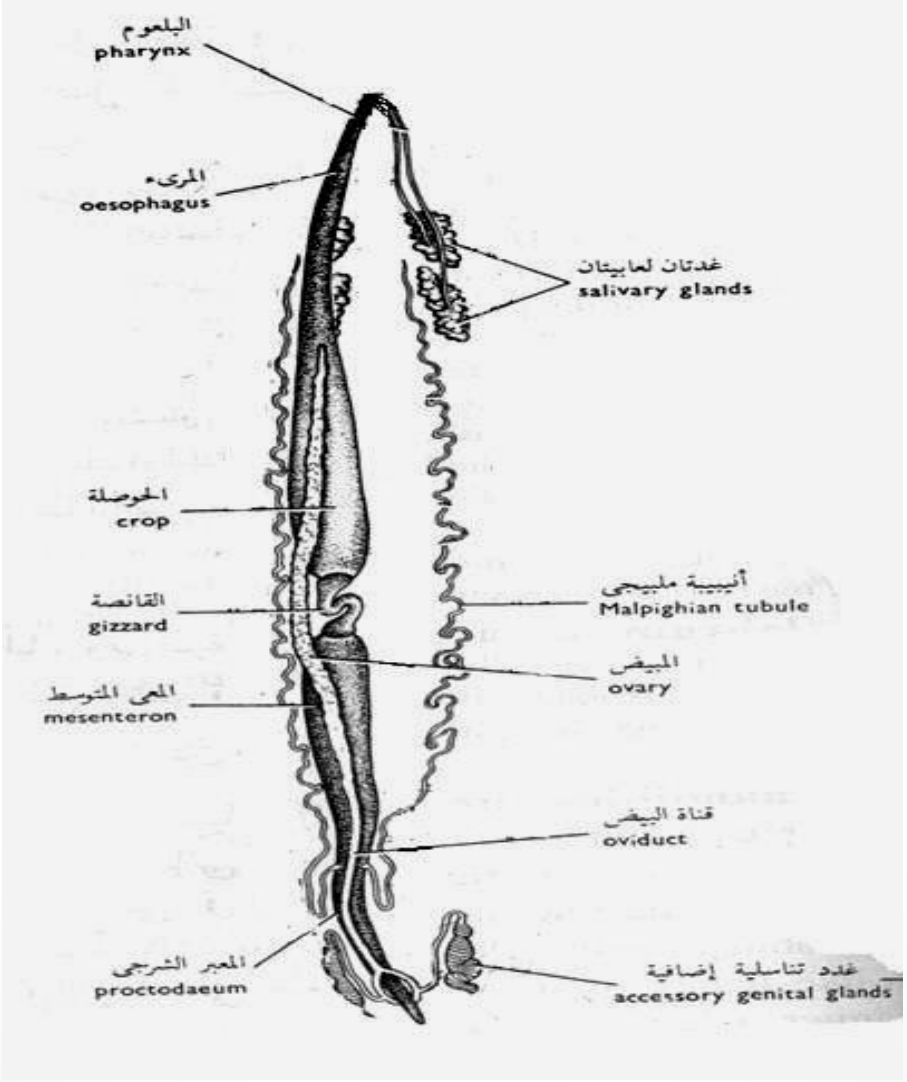
✓ Paired respiratory openings or **stigmata** lie on the pleural shields of the segments 4, 6, 9, 11, 13, 15, 17, 19 and 21.

✓ The **anus** opens ventrally on the last segment.

# Internal anatomy of Centipede



# Digestive system



- Digestive system is composed of: **Foregut**, **Midgut** and **Hindgut.**

✓ **Foregut:** Starts with mouth- pharynx, short oesophagus, thin-walled crop then gizzard. The gizzard is tubular and twisted like S. There are two salivary glands open anteriorly in the buccal cavity.

✓ **Midgut:** A dilated straight tube.

✓ **Hindgut:** Short and opens with anus.

# Respiratory system

- Respiration in centipedes occurs through **stigmata** which connected internally with the **tracheal system**.

# Excretory system

- A pair of long tubules (**Malpighian tubules**) open at the junction between mid-gut and hind-gut.

# Reproductive system

- Male genital system is mainly composed of: **Testis**, **Vas deferens, Vesicula seminalis.**
- **Testis:** Single extends on the dorsal side of the gut. It is formed of 8-10 paired, spindle-shaped, straight tubules which are connected by fine connections.

✓ **Vas deferens:** Wide and highly convoluted.

✓ **Vesicula seminalis:** The vas deferens tapers posteriorly and bifurcates into 2 ducts and receive on each side a long U-shaped vesicula seminalis and an accessory genital gland. The two ducts open on the last segment by a median genital opening.

- Female genital system is mainly composed of: **Ovary**, **Oviduct**.

✓ **Ovary:** Single extends on the dorsal side of the gut. It is a slender tube enclosing the eggs.

✓ **Oviduct:** Straight, biforked around the hind-gut into two tubes, receives some accessory genital glands and opens ventrally with the genital opening on the last segment.

# Nervous system

- The nervous system is composed of: **Cerebral ganglia**, **Suboesophageal ganglion** and **Nerve cord**.

✓ **Cerebral ganglia:** 2 ganglia, lie dorsal to the pharynx and give off nerves to the eyes and antennae.

✓ **Suboesophageal ganglion**: Large and connected to the cerebral ganglia by a pair of circumoesophageal commissures . It gives off nerves to the rest of the head segments and the first trunk segment carrying the maxillipeds.

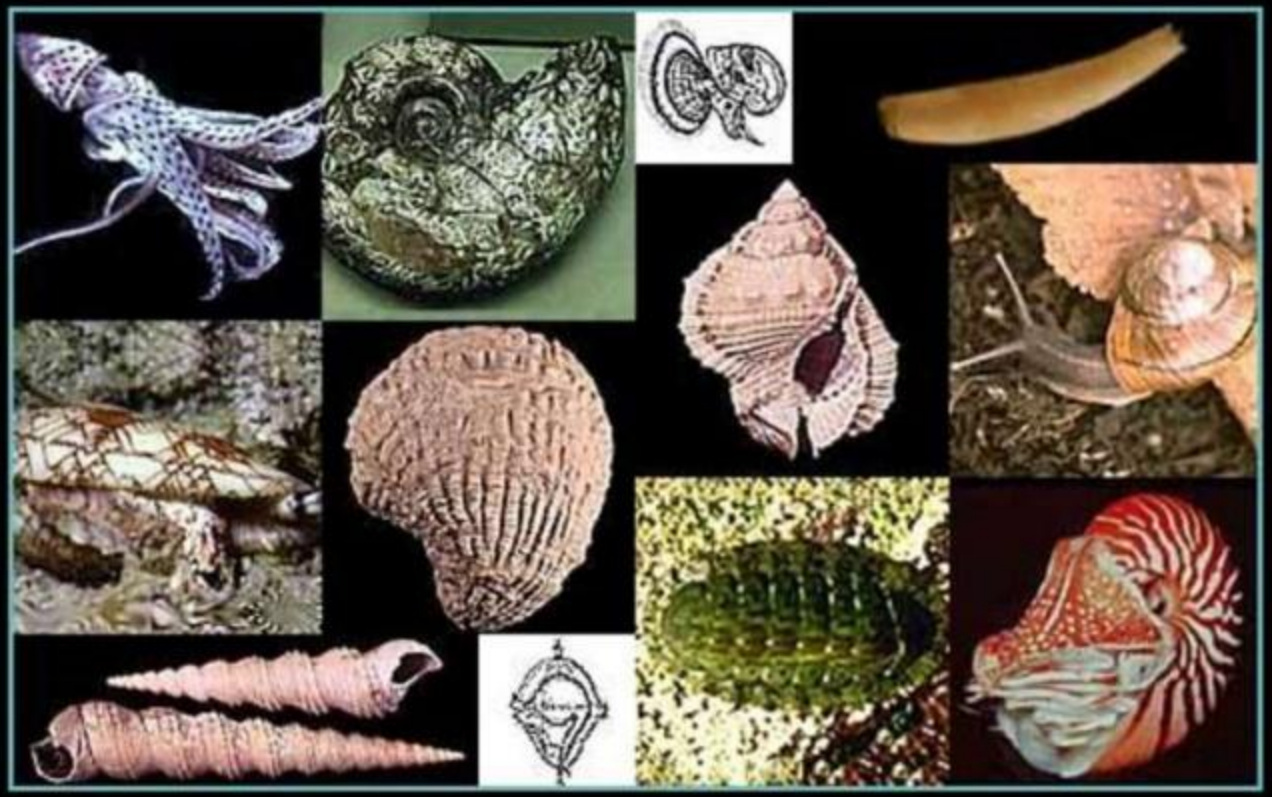
✓ **Nerve cord:** Double nerve cord extends from the subesophageal ganglion, along the mid-ventral line to the posterior end of the body. It carries 21 ganglia.

# Circulatory system

- The circulatory system is **open**.
- **Heart** is a long tube extending in the mid dorsal line along nearly the entire length of the body (as in insects).
- It consists of a segmental series of **chambers**, each with a pair of **ostia** and a pair of arteries, and leads anteriorly in an anterior aorta.
- The arteries branch and open in the **haemocoelic body cavity**.

# Phylum: Mollusca

# Phylum Mollusca



# General Characteristics of Phylum Mollusca

- **Phylum size:** Molluscs come in the second rank after arthropods according to the number of species.
- **Habitats:** Lives in water (freshwater or marine) and some forms are terrestrial.

# General Characteristics of Phylum Mollusca

- **Body:**

✓ Triploblastic, mostly bilaterally symmetrical.

✓ The body is soft, unsegmented without any appendages and divided into: head, a ventral foot and a dorsal visceral hump.

✓ The visceral hump is covered by a thin, fleshy fold called mantle. Mantle secretes a calcareous shell, which may be external or internal or not present at all.

✓ Mantle also encloses an opened mantle cavity, within lie a pair of gills, the anus and renal openings.

✓ Coelom is reduced represented by the pericardial cavity, cavities of gonads and kidneys.

# General Characteristics of Phylum Mollusca

- **Digestive system:** The digestive system with salivary and digestive glands. The mouth with a hard chitinous structure, called radula or odontophore.
- **Respiratory system:** Respiration by gills in aquatic forms and by lungs in terrestrial forms.

# General Characteristics of Phylum Mollusca

- **Reproductive system:** Sexes are usually separate and some are hermaphrodite. Development may be direct or indirect forming larvae.
- **Nervous system:** The nervous system contains 3 doubled ganglia: the cerebral, pedal and lateral ganglia and maybe visceral ganglion in some forms. Sense organs are eyes, tentacles and statocyst.

# General Characteristics of Phylum Mollusca

- **Muscular system:** Locomotion takes place by ventral muscular foot.
- **Circulatory system:**

✓ The circulatory system is mostly open.

✓ It consists of a heart enclosed in a pericardial cavity and extends into a haemocoel.

# Examples of Mollusca

# Chiton

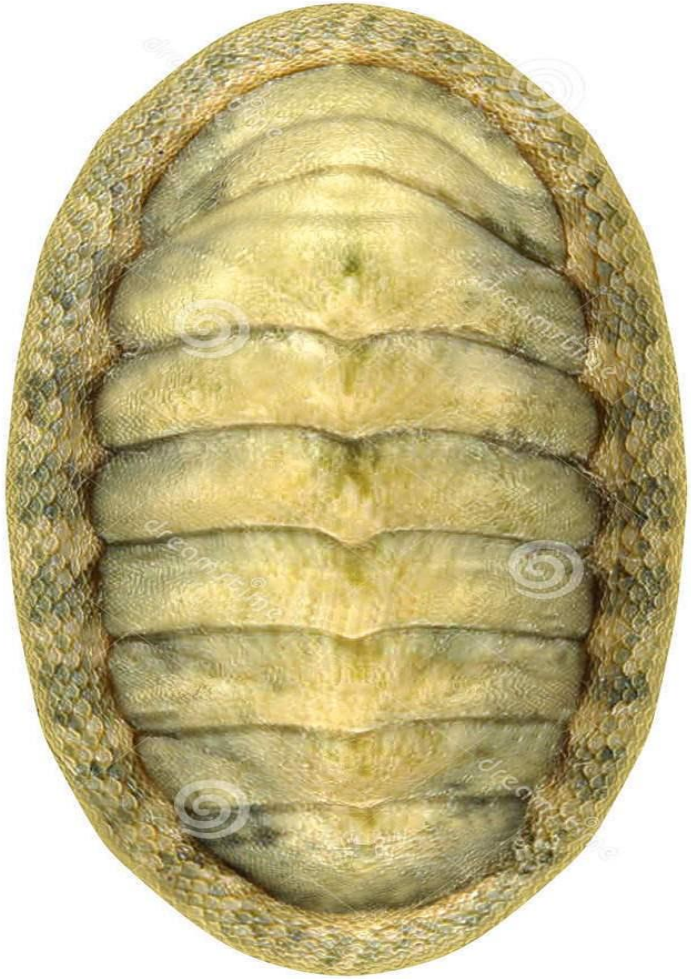
Classification

Kingdom : Animalia

Phylum : Mollusca

Class : Polyplacophora

e.g. : *Chiton* sp.

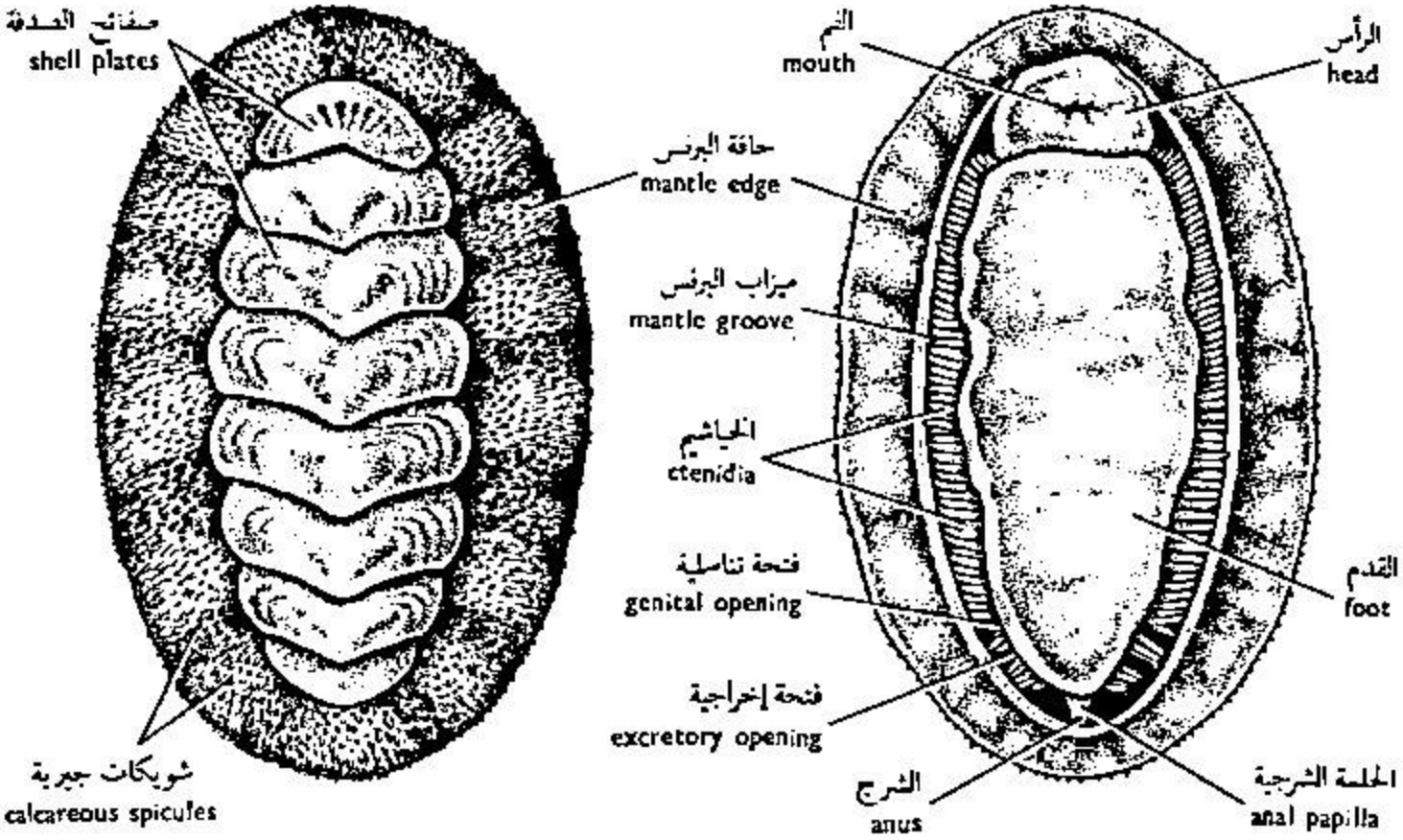


# Habitat of Chiton

## ❑ Habitat:

- ✓ It is common on our **sea coasts**, adhering to rocks, but when separated strongly from the rock, it rolls itself up to more or less spherical form like a ball.

# External features of Chiton


صفائح الصدفة
shell plates
شويكات جيرية
calcareous spicules
(منظر ظهري Dorsal view)
الفم
mouth
الرأس
head
حافة البرنس
mantle edge
ميزاب البرنس
mantle groove
الخياشيم
ctenidia
فتحة تناسلية
genital opening
فتحة إخراجية
excretory opening
الشرج
anus
القدم
foot
الحلمة الشرجية
anal papilla
(منظر بطني Ventral view)

## ❑ Body:

✓ Elongated and **oval** in shape.

✓ The mantle secrets in the dorsal side a **calcareous shell** formed of 8 overlapped plates, enabling the animal to roll into a ball.

The mantle edge with calcareous spicules.

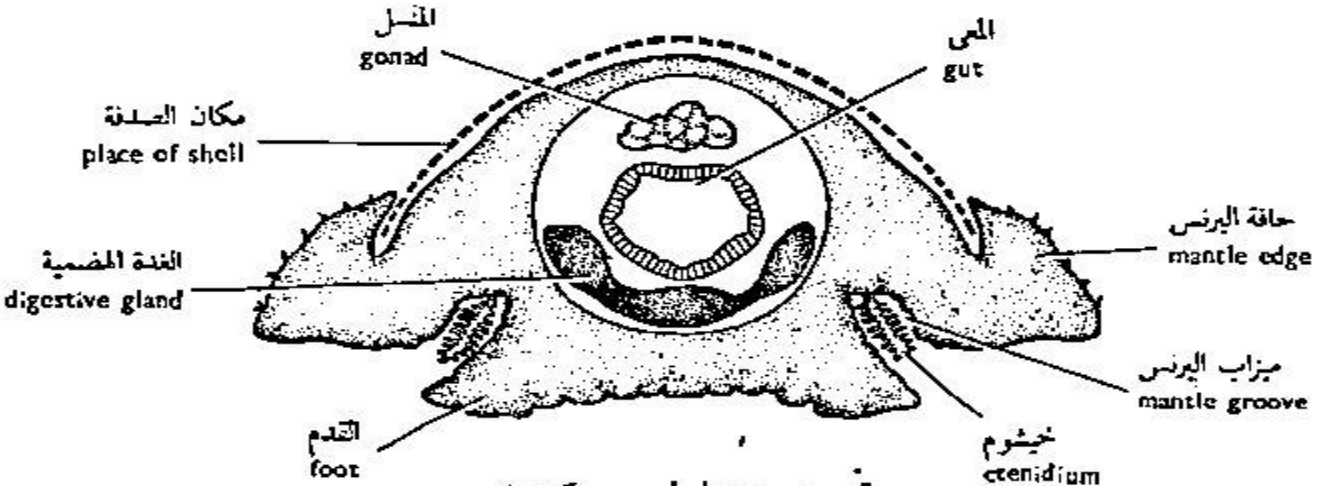
## ❑ Body:

✓ In the ventral side, the body is composed of:

- **Head:** Small with only a mouth.
- **Foot:** Large acts as a creeping organ and as a sucker.
- **Mantle cavity:** A groove between head-foot and the mantle edge, within found the gills on each side.

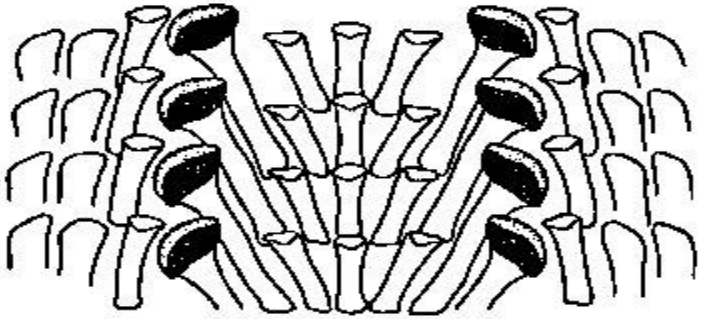
✓ The anus opens on a papilla projecting behind the foot. In front of anus on each side, an excretory pore and a genital opening.

# Internal anatomy of Chiton




ق.ع . تخطيطى من كيتون

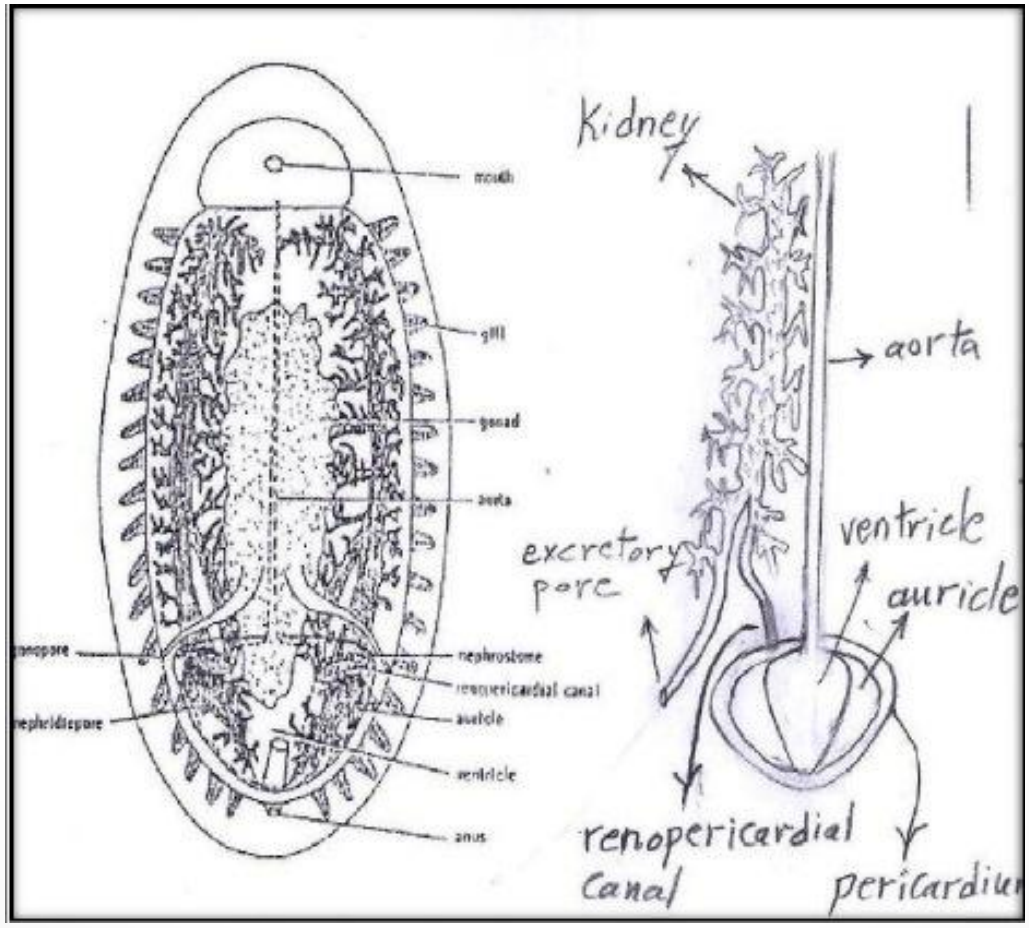
**Diagrammatic transverse section of a chiton**



المفتات

**Radula**

# Digestive system



- ✓ The **mouth** contains a muscular structure known as the odontophore. This consists of a chitinous ribbon carrying numerous rows of teeth and called the radula.
- ✓ The mouth leads to a short **pharynx** that opens into a somewhat rounded **stomach**.
- ✓ A large **digestive (liver) gland** opens in the stomach.
- ✓ The stomach leads to the **intestine**, which is a long, thin, coiled tube that ends with the **anus**.

# Excretory system

- ✓ There are two symmetrical **kidneys** located in the pericardium.
- ✓ Each kidney is a main, curved tube, in which many small, fine tubes open within it between the viscera.
- ✓ Each kidney opens internally into the pericardium with a funnel-shaped ciliated opening, the nephrostome, and opens into the exterior with the excretory opening.

# Reproductive system

- ✓ The sexes are **separated**.
- ✓ The testis and ovary are similar in shape, differing only in the color when they are mature.
- ✓ Each gonad is a **single bag** leads into two genital ducts that open through the genital openings in front of the excretory openings.

# Examples of Mollusca

# Desert Snail

Classification

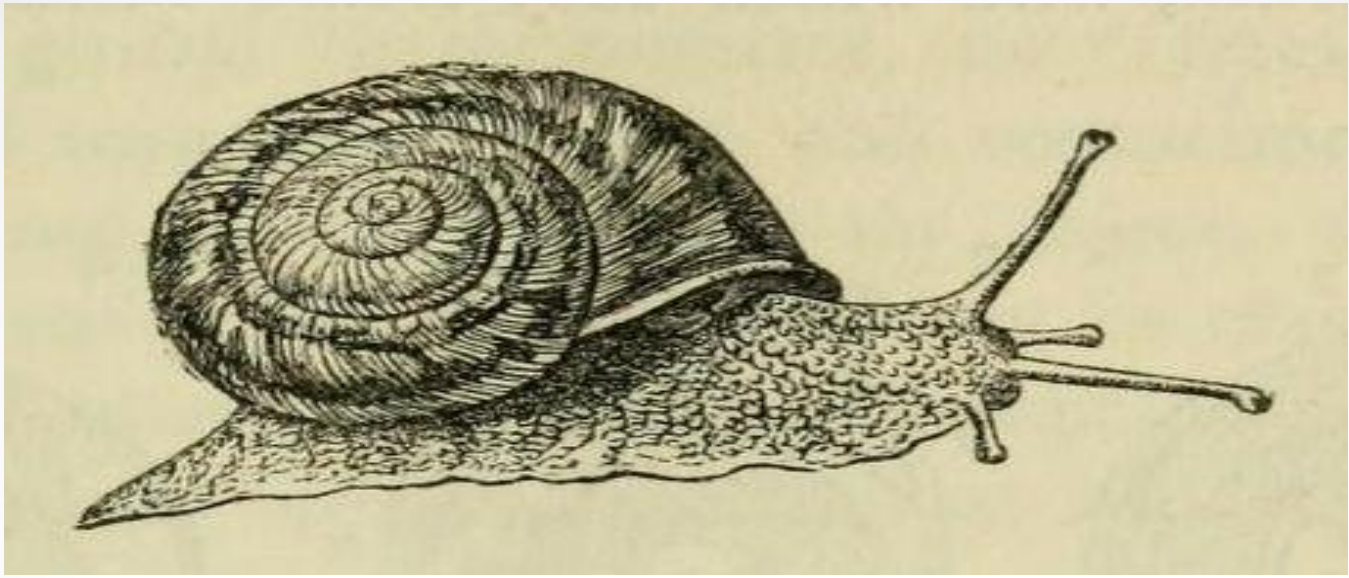
Kingdom : Animalia

Phylum : Mollusca

Class : Gastropoda

e.g. : *Eremina desertorum*

# Habitat And Living Of Desert Snail



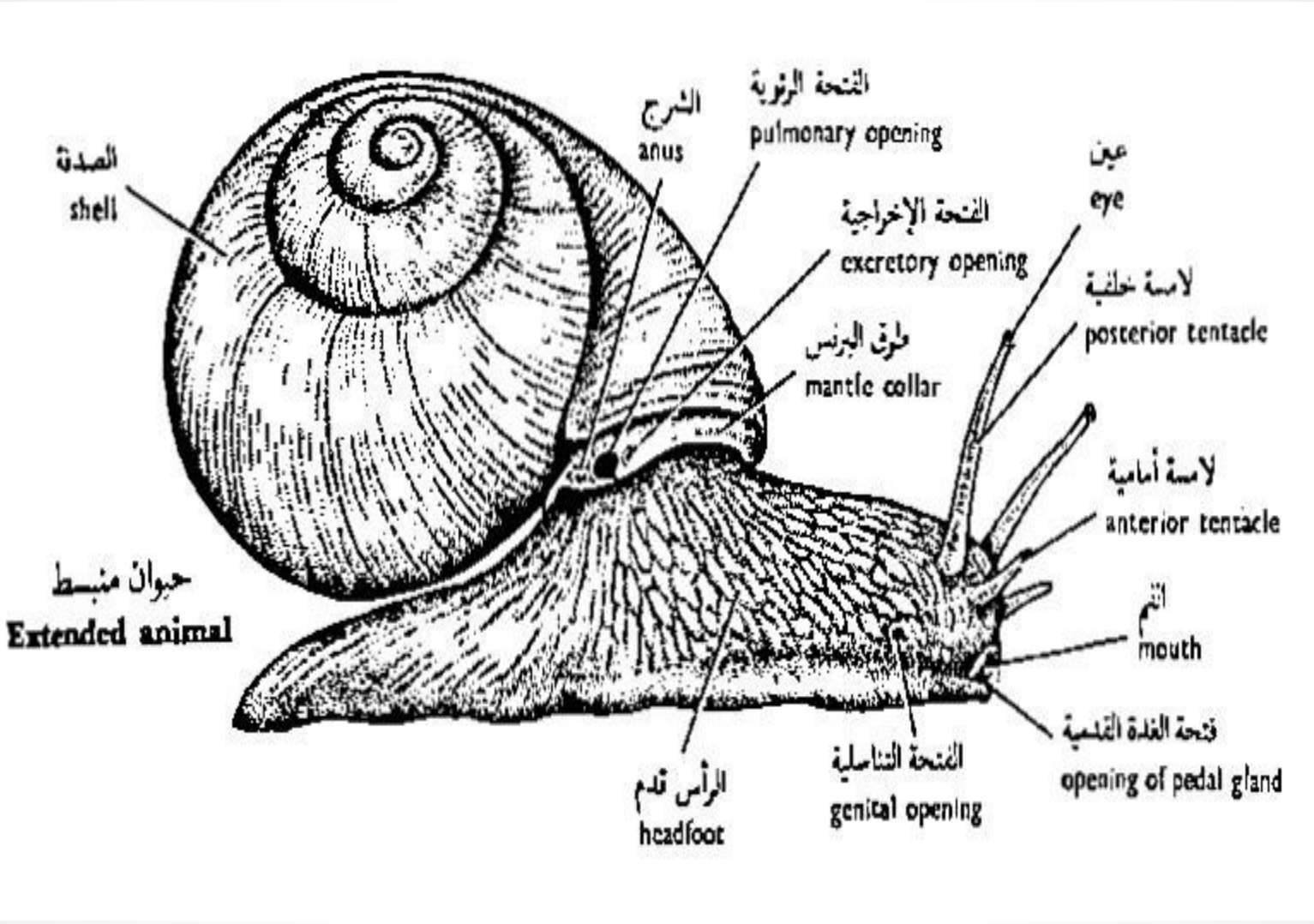
❑ **Habitat:**

✓ Common in the Egyptian **desert**.

❑ **Living:**

✓ **Nocturnal**, **phytophagous**, feeds on leaves and stems of desert plants. It is active in winter.

# External Features Of Desert Snail


الصدفة
shell
الشرج
anus
الفتحة الرئوية
pulmonary opening
عين
eye
الفتحة الإخراجية
excretory opening
لامسة خلفية
posterior tentacle
طوق البرنس
mantle collar
لامسة أمامية
anterior tentacle
حيوان منبسط
Extended animal
الفم
mouth
فتحة الغدة القدمية
opening of pedal gland
الرأس قدم
headfoot
الفتحة التناسلية
genital opening

## ❑ Body:

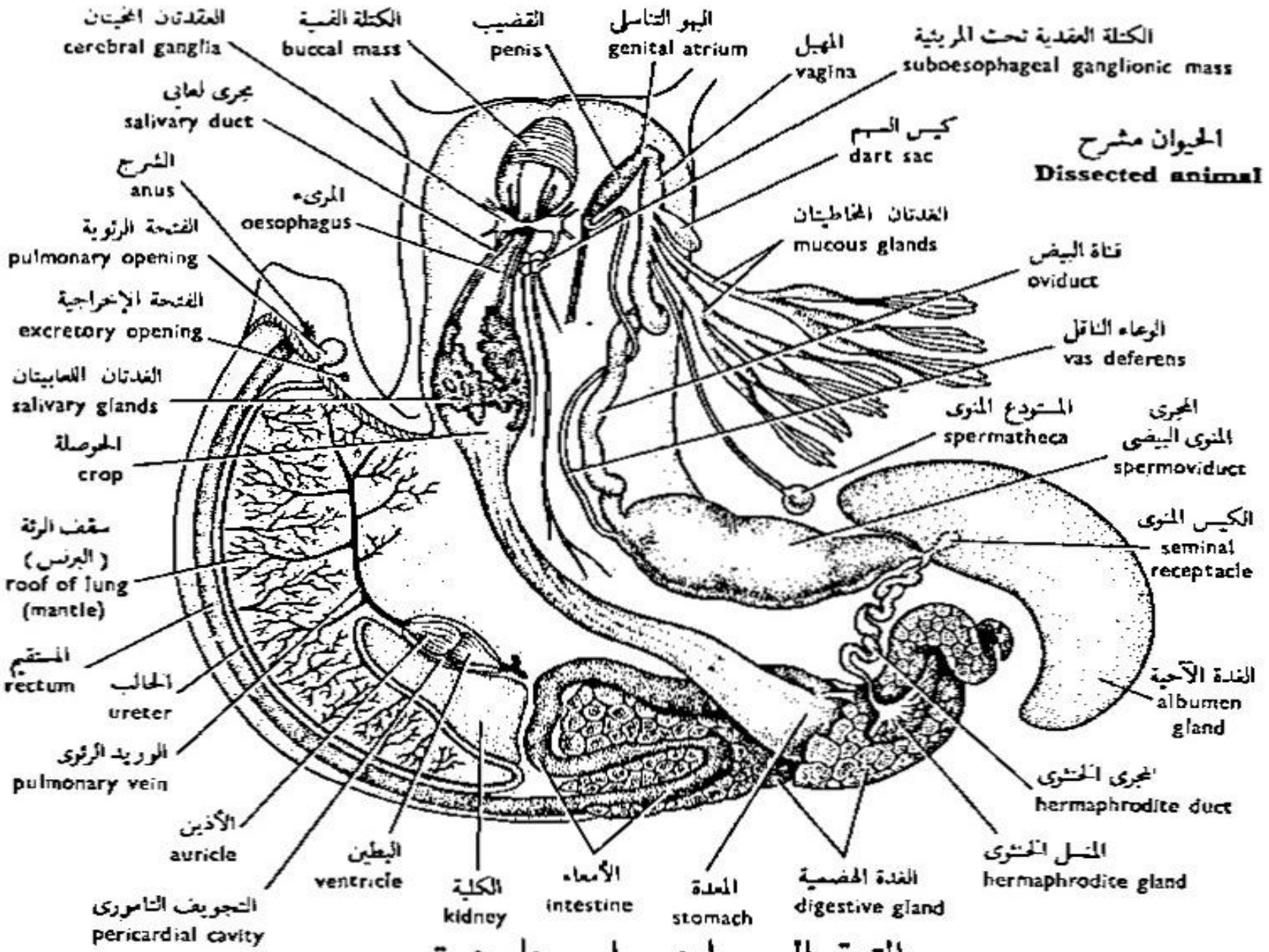
✓ Body is composed of: **Shell**, **head foot**, **visceral hump**.

- **Shell:** It is dextral. It has 4 whorls
- **Head foot:** A soft mass represent animal‘s head and foot. It bears anteriorly: the mouth, below it, an opening of a gland (the pedal gland) that produce a slimy secretion. There are 2 pairs of tentacles: the anterior pair is short, but the posterior one is long with two black eyes. A single genital opening found on the right side of head.

## ❑ Body:

- **Visceral hump:** It is spirally coiled and occupies the shell whorls. It is covered with mantle that form a thick ring called the mantle collar. This collar bears on the right side: the pulmonary opening which leads internally to a cavity rich with blood vessels and acts as a lung. Also the anus and the excretory opening on the mantle collar.

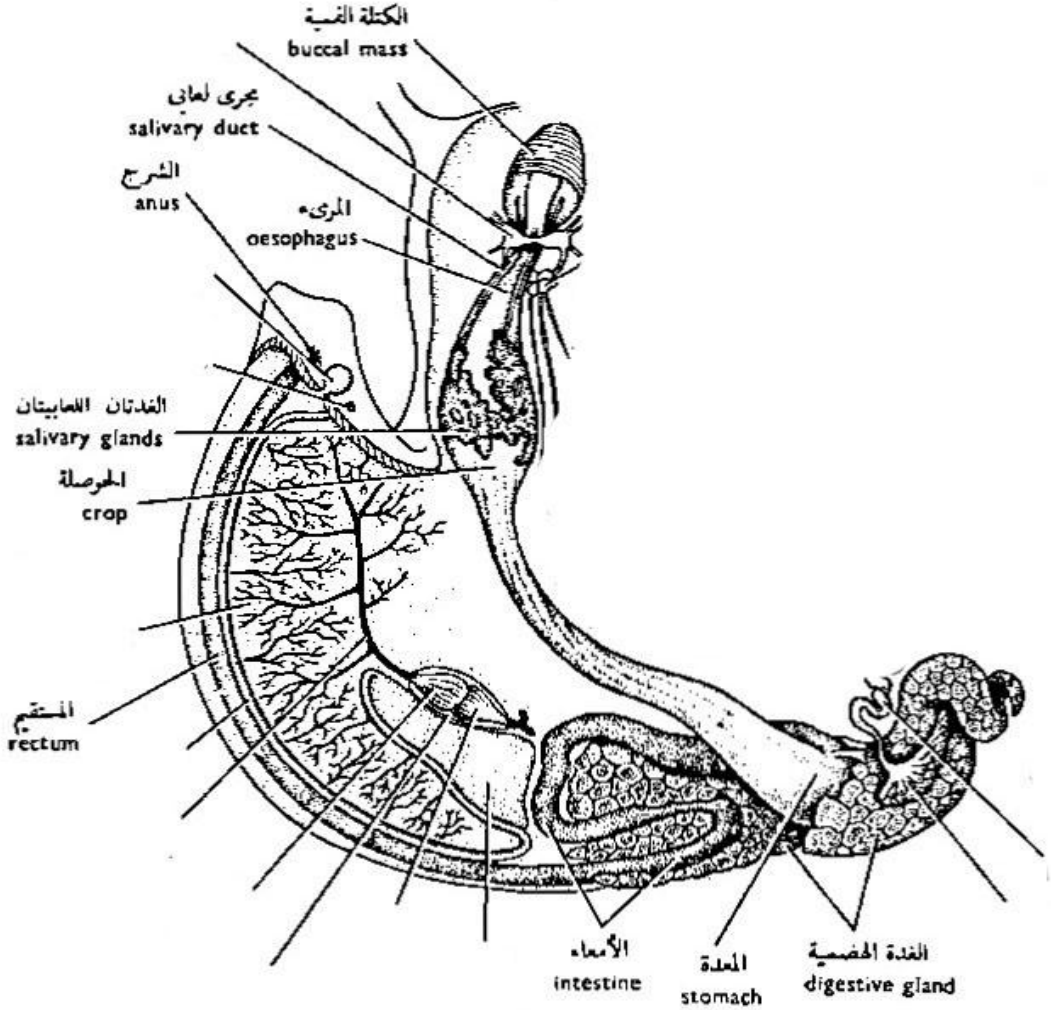
# Internal Anatomy Of Desert Snail




القوقع الصحراوي «إريمينا دزرتورم»

**EREMINA DESERTORUM**

# Digestive system



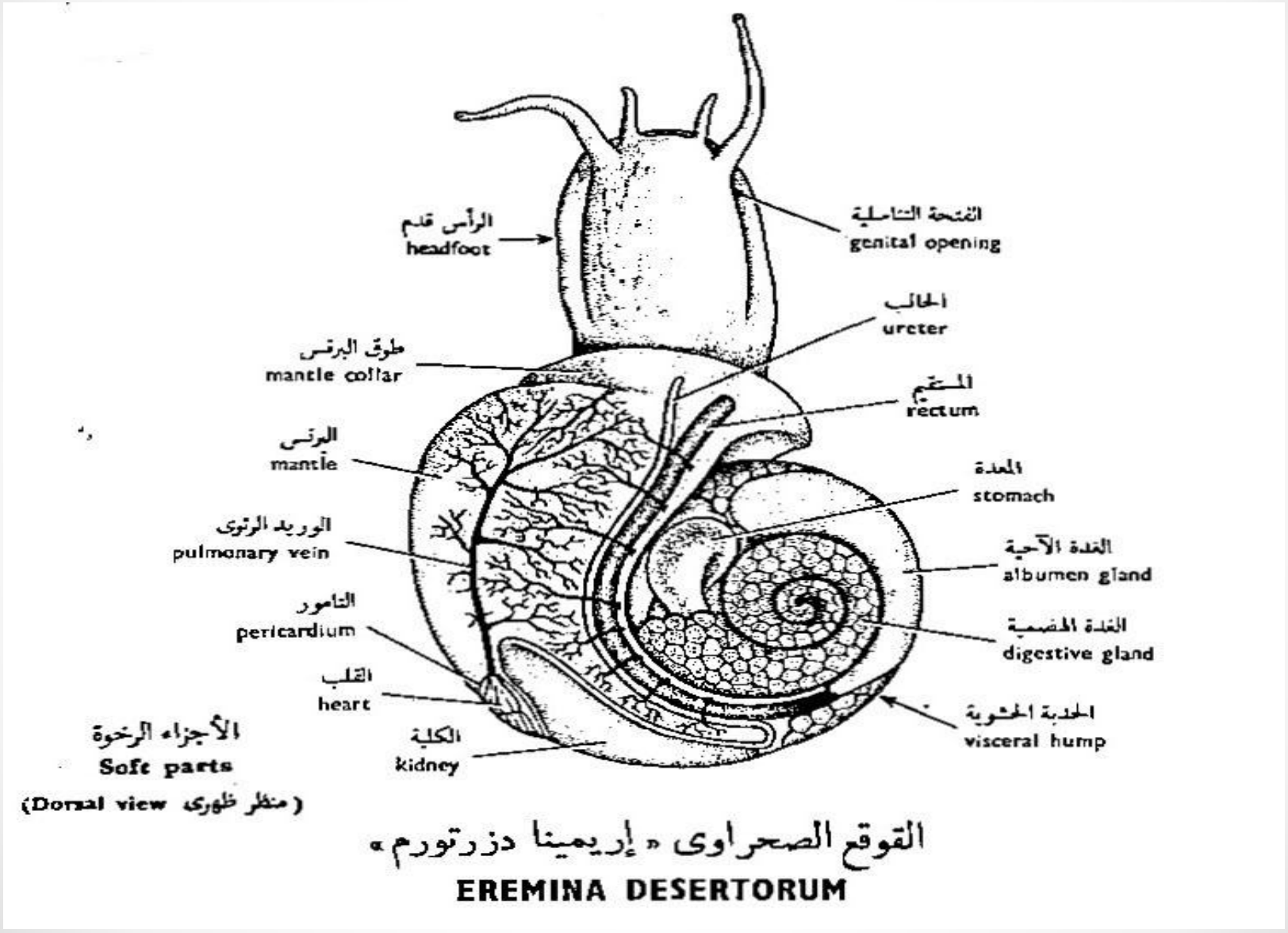

القوقع الصحراوى « إريمينا دزرتورم »

**EREMINA DESERTORUM**

- ✓ The **stomodaeum** starts with a pear-shaped **buccal mass** with highly muscular walls. The lumen of the mass is narrow and that a curved jaw projects on its roof and the odontophore with the radula project on its base.
- ✓ The buccal mass is followed by a narrow **oesophagus** and this dilates into a large thin walled **crop**. There are two **salivary glands** attached on the sides of the crop and open anteriorly into the buccal cavity. The crop leads into a small, thick walled and muscular **stomach** or **gizzard** which is embedded within the **digestive gland (liver).**

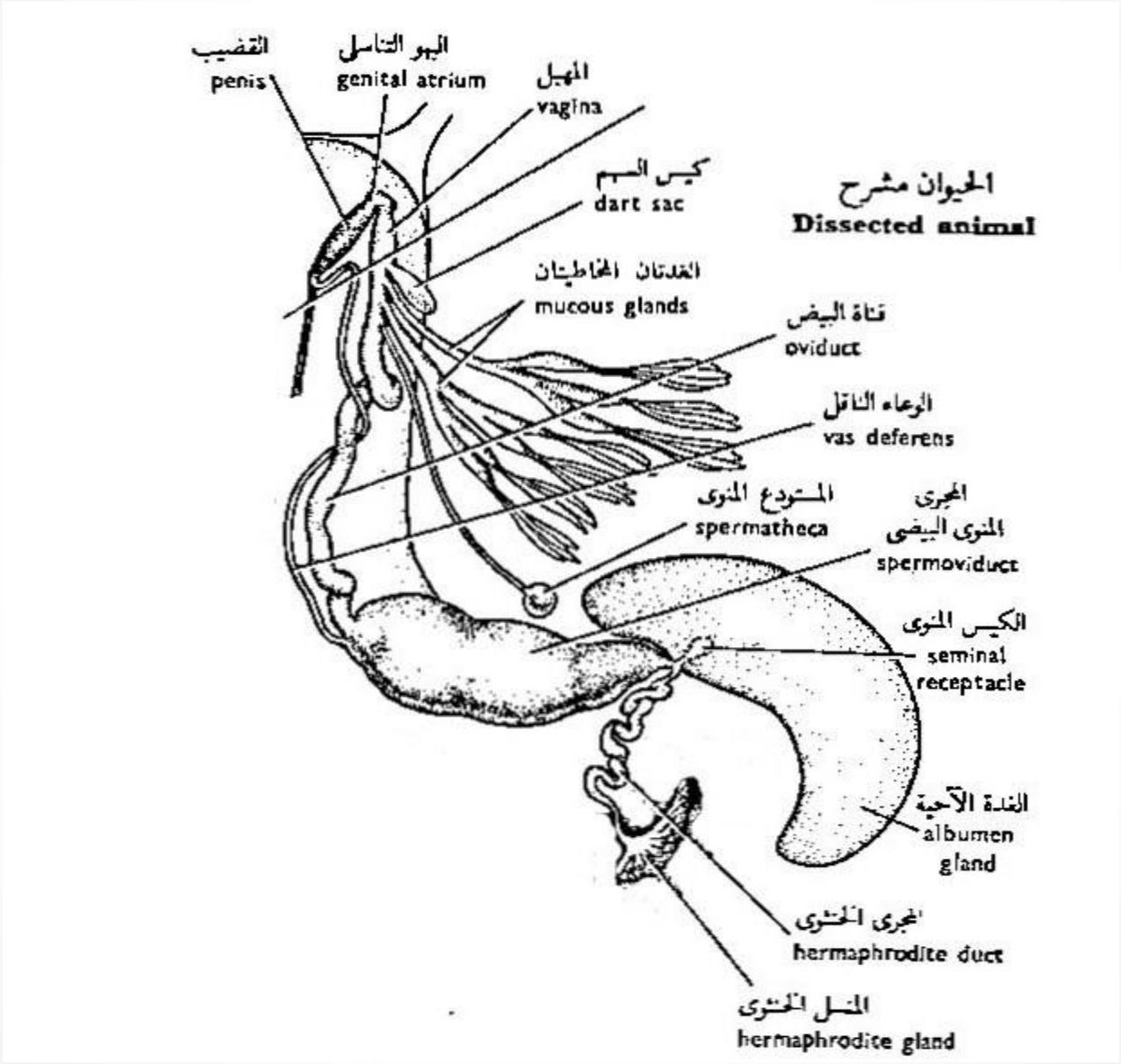
- ✓ The **midgut** or intestine is a long narrow tube which curves to form an S-shapes loop, and is partly lodged in the liver.
- ✓ The **proctodeum** or **rectum** extends and opens anteriorly by the anus.

# Excretory system



- ✓ The **kidney** is single and in the form of an elongated triangular spongy mass. The pericardial cavity and the cavity of kidney communicate through a narrow **reno-pericardial canal**.
- ✓ The **ureter** arises at the anterior end of the kidney, curves backwards then extends forwards again, parallel to the rectum, and opens externally by the excretory opening.

# Reproductive system



- ✓ The snail is **hermaphrodite**. There is a **single gonad**, which is called the **hermaphrodite gland**.
- ✓ The hermaphrodite gland leads to a single convoluted **hermaphrodite duct** which dilates into a small **seminal receptacle**, in which fertilization takes place, and the fertilized eggs receive albumen coat from the **albumen gland**.

- ✓ The seminal receptacle leads to a thick glandular tube, the **spermoviduct** which comprises internally 2 incompletely separated channels, one for the passage of sperms and another for the eggs. Anteriorly, the two channels separate as male (the **vas deferens**) and female ducts (the **oviduct**).
- ✓ The vas deferens is a long narrow tube leads forwards into a fusiform muscular **penis** provided with a retractor muscle.

- ✓ The oviduct is shorter and thicker than the vas deferens. It leads forwards into a thick walled tubular **vagina** that opens together with the penis in a common **genital atrium**, which opens to the exterior through the **genital opening**.
- ✓ There are **accessory organs** which open into the vagina, a small globular **spermatheca** (for storing sperms during the copulation) and has a long duct, a club-shaped muscular **dart sac** enclosing a pointed calcareous rod known as the dart, and a pair of tubular **mucous glands**.

# Phylum: Echinodermata


Phylum
Echinodermata

# General Characteristics Of Phylum Echinodermata

- **Habitats:** All are marine, found in the shores to the great depths. Includes forms quite different from the preceding invertebrates.
- **Body:**

✓ Adults are radially symmetrical while larvae are bilaterally symmetrical.

✓ Body is not divided, with different shapes (star, rounded or cylindrical).

# General Characteristics Of Phylum Echinodermata

- **Body:**

✓ Body possesses a dermal skeleton consists of calcareous ossicles which may develop into short or long spines pushes out on the surface, thus the name: Echinodermata.

✓ The coelom divided into several divisions (perivisceral coelom, perihaemal cavity and a water vascular system characterize this phylum).

✓ The water vascular system is connected to tube feet present on the outer body surface, these feet are the main locomotion organs but can also assist in sensation, respiration and food collecting.

# General Characteristics Of Phylum Echinodermata

- **Digestive system:** Usually complete but in some forms there is no anus.
- **Respiratory system:** Respiration occurs by dermal gills, tube feet.
- **Excretory system:** No special excretory organs.

# General Characteristics of Phylum Echinodermata

- **Reproductive system:**

✓ Usually separated and the development maybe direct or including larva formation.

✓ Show high power of regeneration.

- **Nervous system:** Has circumoral nerve ring and radial nerves in all body.
- **Circulatory system:** very reduced.

# Example of Echinodermata

# Starfish

Classification

Kingdom: Animalia

Phylum : Echinodermata

Class : Asteroidea

e.g. : *Astropecten* sp.

# Habitat And Living Of Starfish

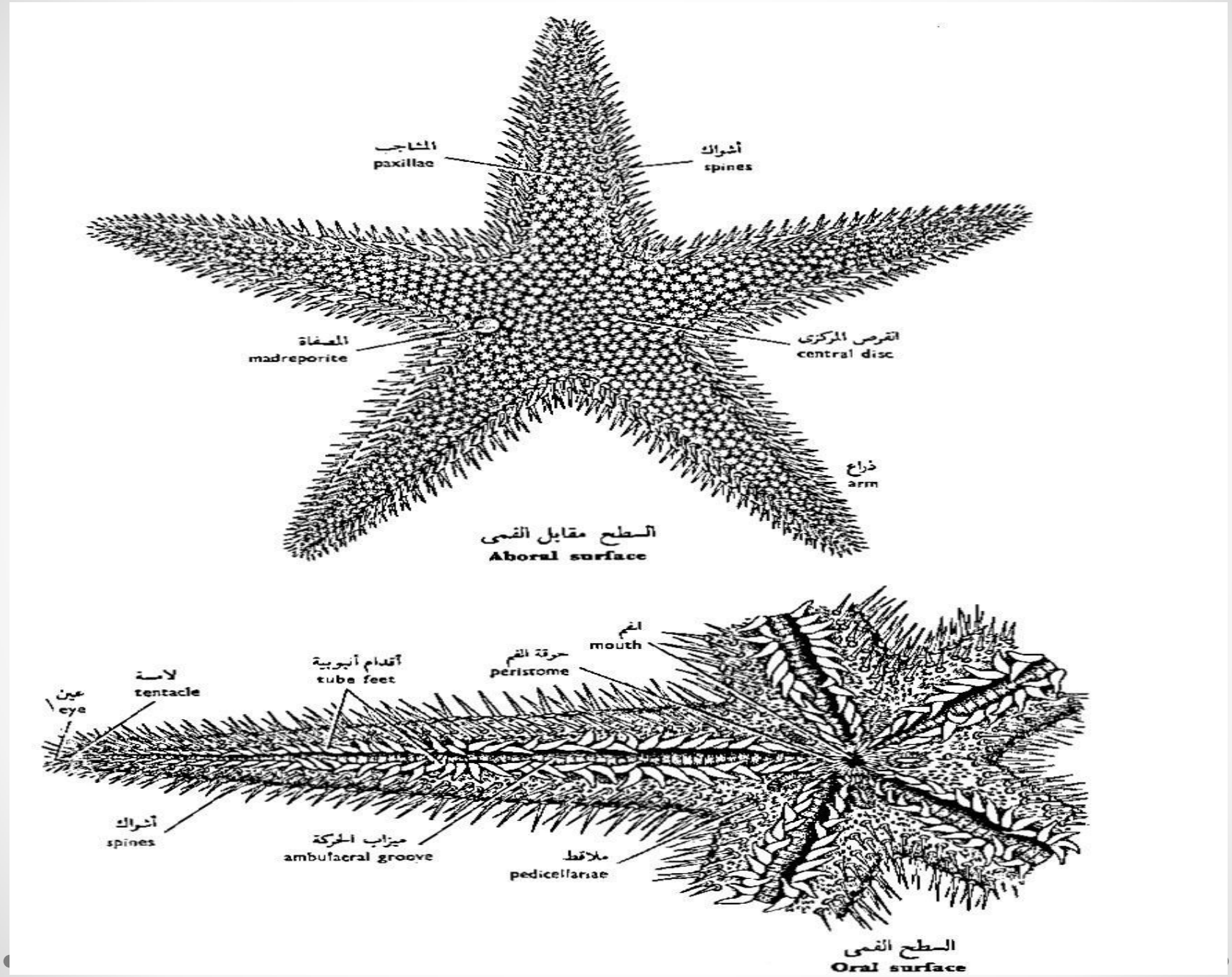
❑ **Habitat:**

✓ Common in our **seas**.

❑ **Living:**

✓ **Free,** creeps slowly on the bottom but in rest it lies buried in the sand except the central part.

# External Features Of Starfish


المشاجب
paxillae
أشواك
spines
المصفاة
madreporite
القرص المركزى
central disc
ذراع
arm
السطح مقابل الفمى
Aboral surface
فم
mouth
حرقة الفم
peristome
أقدام أنبوبية
tube feet
لامسة
tentacle
عين
eye
أشواك
spines
ميزاب الحركة
ambulacral groove
ملاقط
pedicellariae
السطح الفمى
Oral surface

## ❑ Body:

- ✓ Star-shaped, consisting of a central disc prolonged into 5 arms.
- ✓ Has two surfaces: a lower **oral surface** and an upper aboral **surface**.

## ❑ Body:

- **Aboral surface:**

✓ There are pointed spines on the edges of each arm and a blunt spines found in bundles called: the paxillae.

✓ Very minute dermal gills arise between the paxillae.

✓ There is a plate with pores in the central disc, opposite to the angle between two arms. This plate (the madreporite) lead into the water vascular system.

## ❑ Body:

- **Oral surface:**

✓ Mouth exists in the center, surrounded by a soft area (the peristome).

✓ Five ambulacral grooves extend out from the mouth along the entire length of each arm.

✓ Conical structures (tube feet) project in 2 rows along each ambulacral groove.

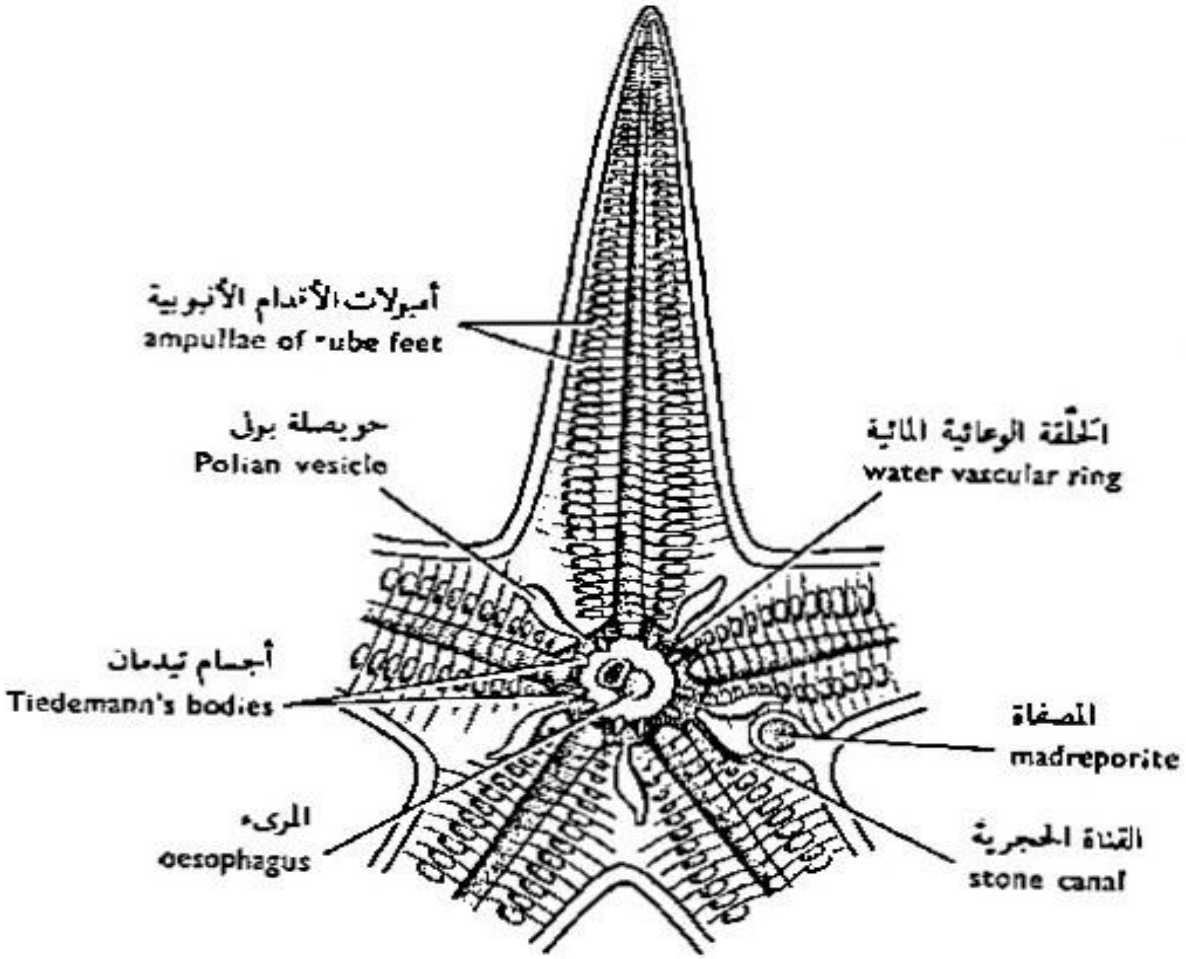
## ❑ Body:

- **Oral surface:**

✓ The terminal tube foot (called: the tentacle) has a pigmented spot (the eye) on its base.

✓ There are different types of spines and the very small modified spines which known as pedicellariae, these small spines clean the body surface and the ambulacral grooves.

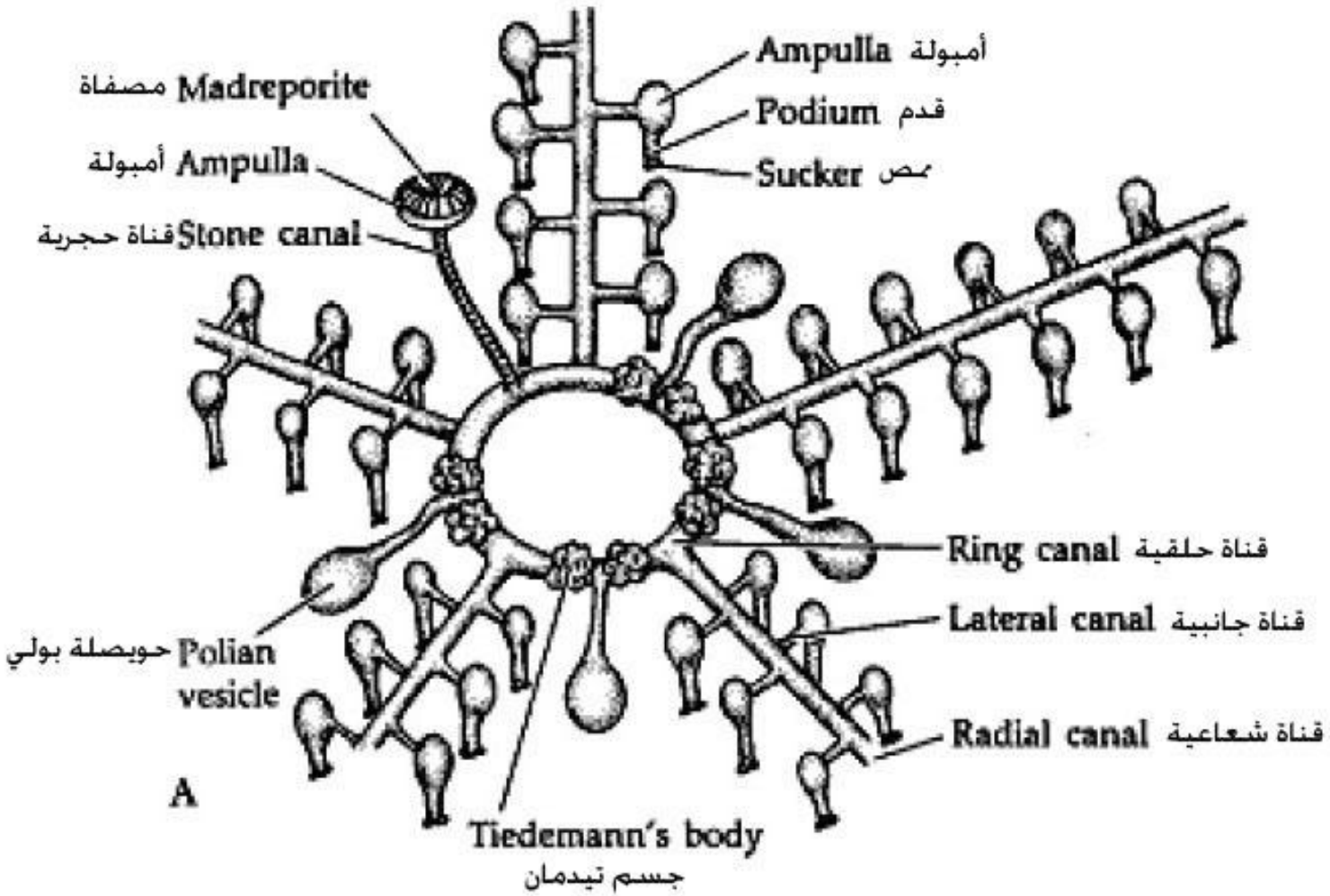
# The Water Vascular System Of Starfish




الجهاز الوعائى المائى

**Water vascular system**

# الجهاز الوعائي المائي The water vascular system



- ✓ The water vascular system or ambulacral system is filled with sea water.
- ✓ It consists of: **madreporite**, **stone canal**, **ring canal**, **Polian vesicles**, **Tiedemann's bodies**, 5 **radial canals**, **lateral canals** and **tube feet**.
- **Madreporite:** Present on the aboral surface of the central disc, and contains a number of pores lead into a stone canal.
- **Stone canal:** Its wall strengthened by calcareous rings keep it open and the inner surface is lined with ciliated cells. The movement of cilia will draw water currents into the stone canal.

- **Ring canal:** present around the mouth and contains Polian vesicles and Tiedemann's bodies.
- **Polian vesicles:** store water so they are considered as reservoirs.
- **Tiedemann's bodies:** Produce amoebocytes (excretory organs).
- **Radial canals:** arise from the ring canal and run throughout the entire length of the arm. Each radial canal lies below the ambulacral groove.
- **Lateral canals and tube feet:** From the radial canal of each arm, pairs of lateral canals will arise and they end with tube feet. The tube feet consists of an internal swollen ampulla and an external podium which ends in  a sucker.

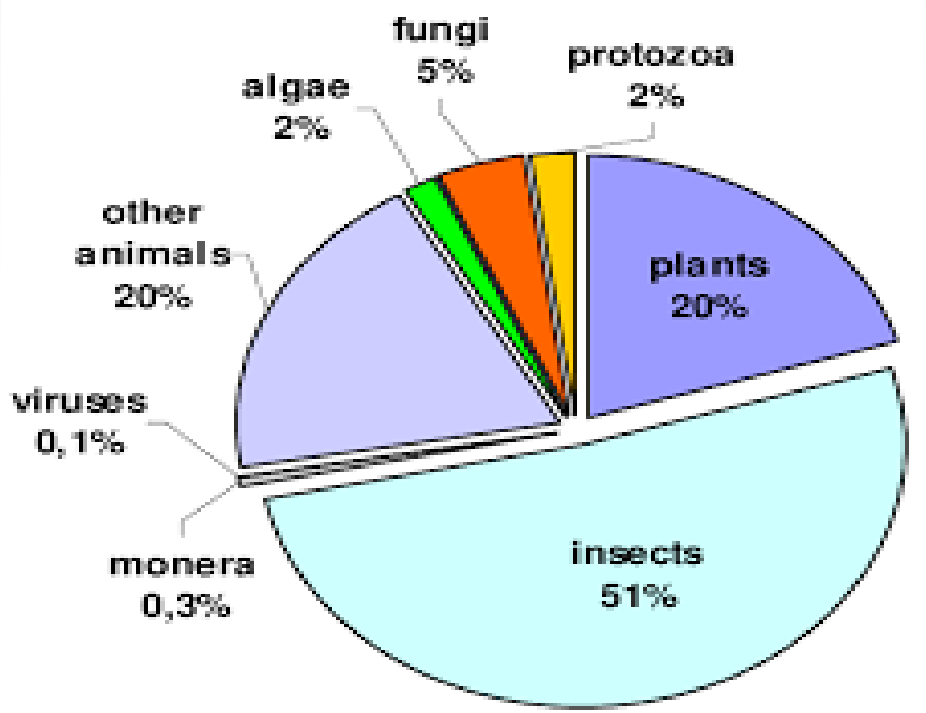
# Second: Insects

# Introduction

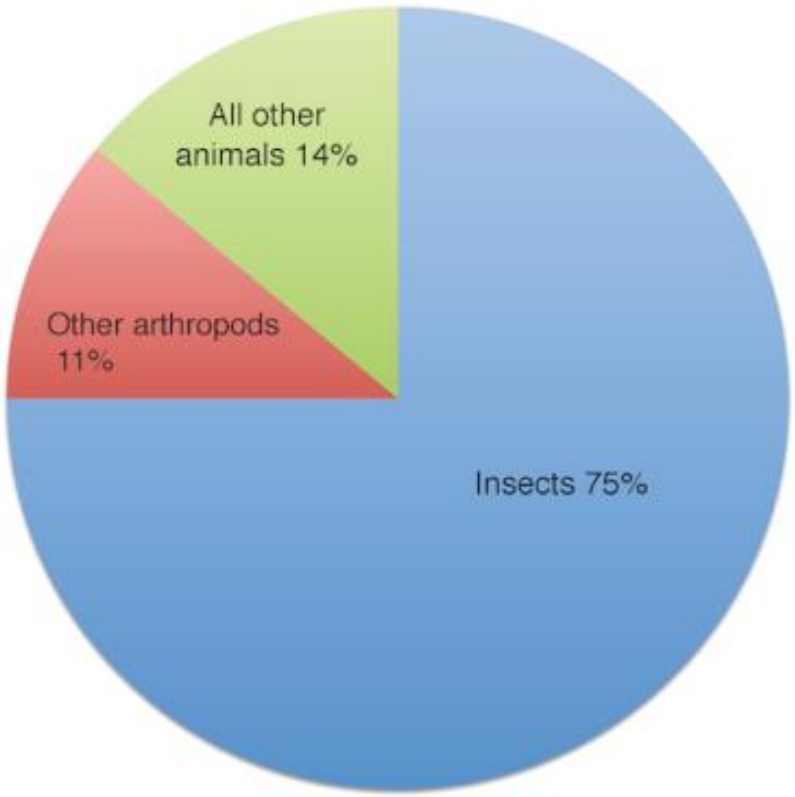
# STUDY OF INSECTS

- The study of insects is called **Entomology**.
- **Entomologists** are the people who study insects, and observe, collect, rear and experiment with insects.

# THE IMPORTANCE OF INSECTS




Did you know that insects represent almost half of all living organisms?




Did you know that insects represent almost 75% of all animals?

# THE IMPORTANCE OF INSECTS

- **There are many reasons why we should study insects:**

✓ Huge ecological diversity in water, on land or in soil.

✓ Tremendous ability to survive under a wide range of extreme conditions of heat or cold.

✓ Variation in lifestyles whether solitary, gregarious or social.

# THE IMPORTANCE OF INSECTS

- ✓ Enormous nutritional capabilities including herbivory, predation, parasitism, ingestion of detritus, rotting materials, wood and fungus.
- ✓ Domination of food web.

# THE IMPORTANCE OF INSECTS

✓ Crucial role in ecosystems represented in:

- **First:** Nutrient recycling, via leaf-litter and wood degradation, dispersal of fungi, disposal of carrion and dung, and soil turnover.
- **Second:** Plant propagation, including pollination and seed dispersal.

# THE IMPORTANCE OF INSECTS

- **Third:** Maintenance of environmental balance in plant community via phytophagy, including seed feeding.
- **Fourth:** Maintenance of environmental balance in animal community through transmission of diseases of large animals, and predation and parasitization of smaller ones.
- **Fifth:** Being food sources for insectivorous vertebrates.

# General Characteristics

# General Characteristics of Subclass Insecta

- **Subclass size:** The largest Subclass in the Animal kingdom.
- **Habitats:** Insects are found in almost all of the habitats that cover the Earth's surface.

# General Characteristics of Subclass Insecta

- **Body:**

✓ Covered with chitinous exoskeleton and has the ability to molt at intervals during growth.

✓ Divided into head, thorax and abdomen.

✓ The head consists of 6 fused segments, the 1st segment disappears.

✓ The thorax consists of 3 segments, and carries 3 pairs of legs.

✓ The Abdomen is typically 11 segmented.

# General Characteristics of Subclass Insecta

- **Respiratory system:** Respiration takes place through tracheal system.
- **Excretory system:** Excretion takes place through Malpighian tubules that open into the hind gut.
- **Reproductive system:** The sexes are separate.

# Head

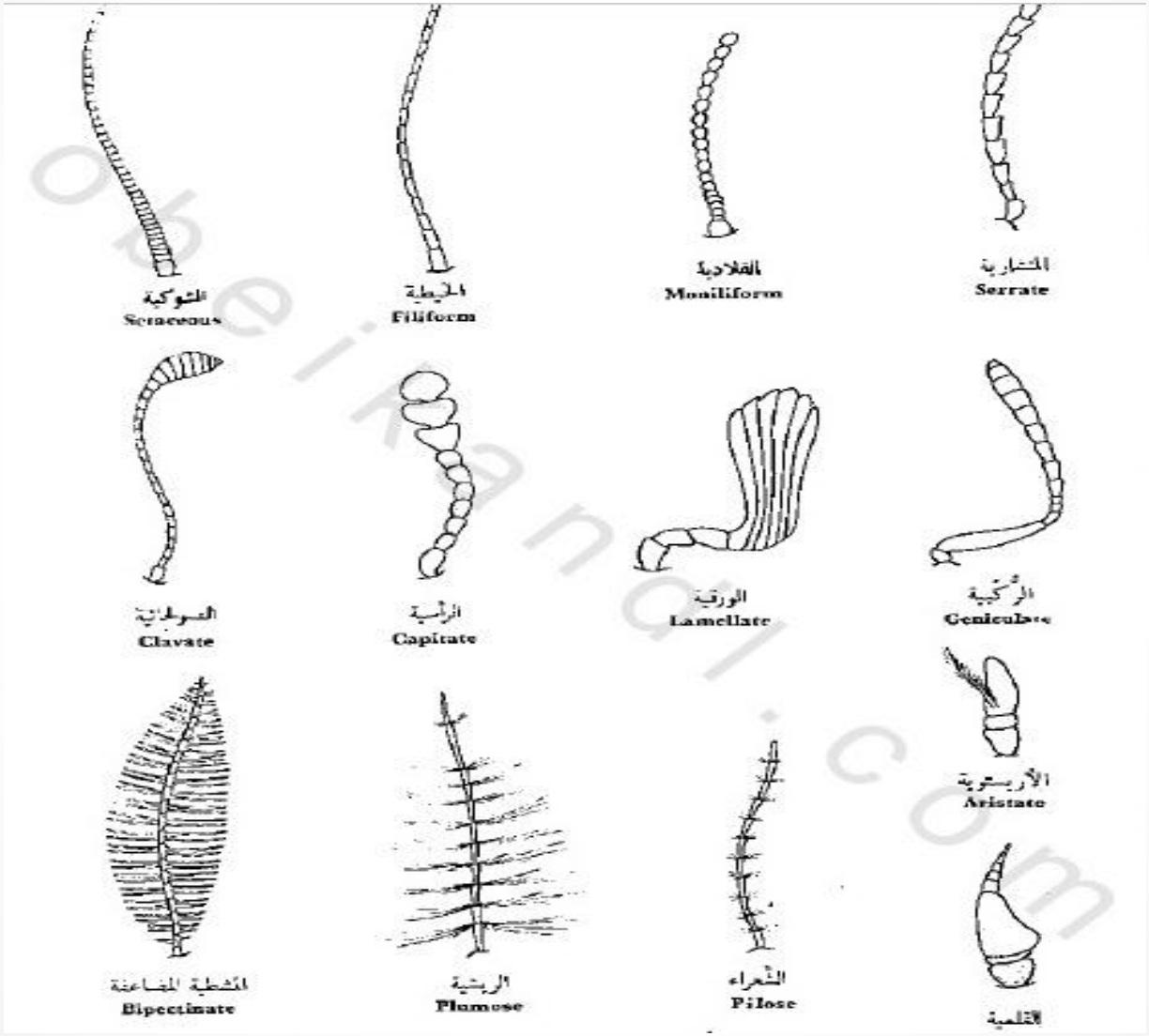
# Head

- ✓ The head is enclosed in a head capsule.
- ✓ Composed of number of fused sclerites marked off with sutures.
- ✓ It carries in most insects:
- A pair of compound eyes and ocelli.
- Antennae.
- Mouth parts.

# Antennae

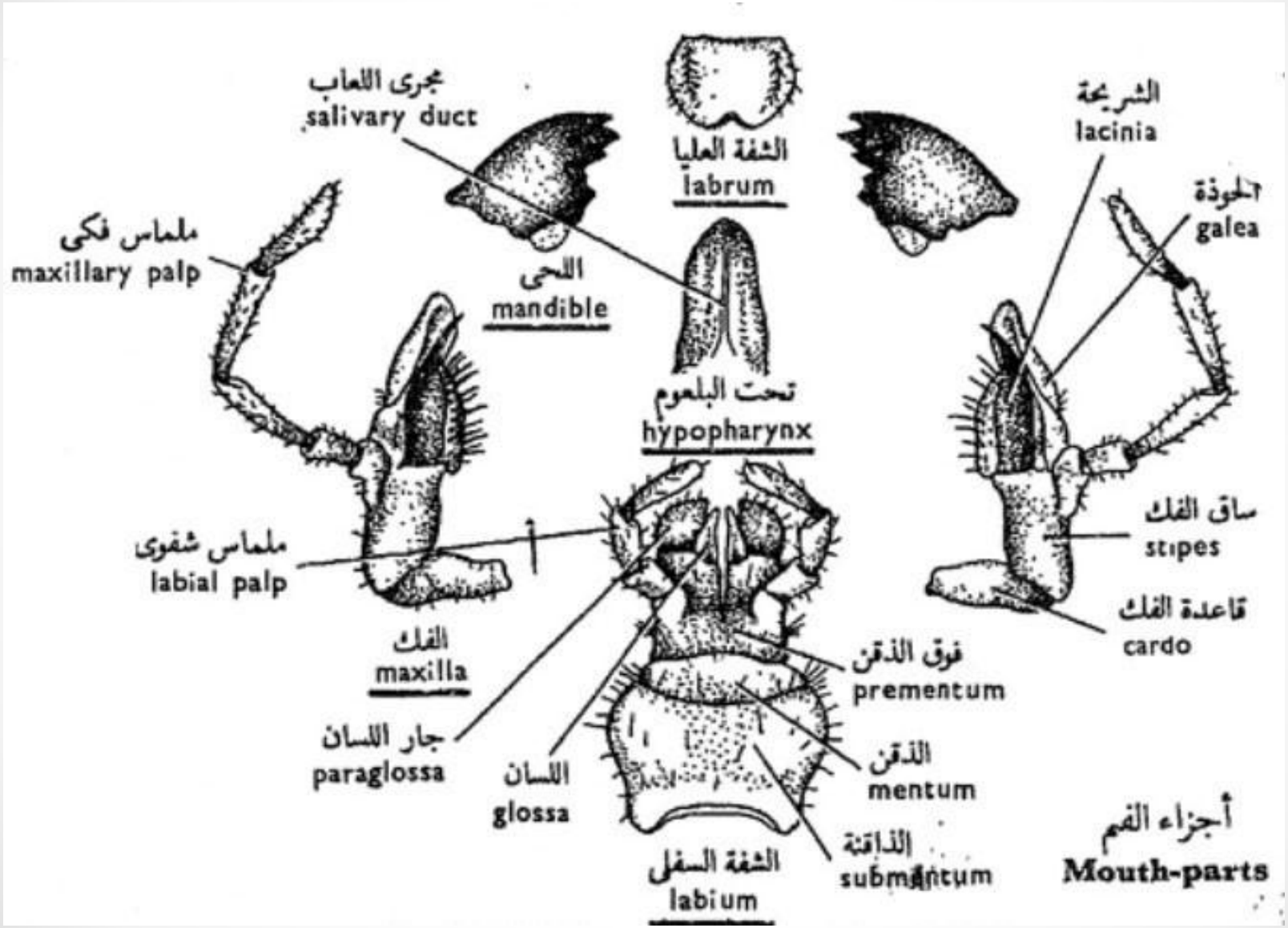
- ✓ Insect head carries 2 antennae.
- ✓ Antennae articulate with the head between eyes.
- ✓ They carry sensory hairs which may serve tactile, olfactory, gustatory or auditory functions.
- ✓ They vary greatly in form among insect species.

# Types of antennae



# Head: Mouth parts

# Biting mouth parts



✓**Example:** American cockroach.

✓**Food:** Solid.

✓ **Structure:** Typical mouth parts consists of **Labrum**, **Mandibles**, **Maxillae**, **Labium** and **Hypopharynx**.

- **Labrum:**

✓ **Structure:** Simple plate hinged to the exoskeleton of the head.

✓ **Function:** Upper covering of mouth opening.

- **Mandibles:**

✓**Structure:** Single segmented toothed appendages.

✓**Function:** Biting food by working together sideways.

- **Maxillae:**

✓ **Structure:** Segmented appendages, lie behind the mandibles.

✓ **Function:** Working as accessory jaws and sensation.

- **Labium:**

✓**Structure:** Basal segmented fused portion.

✓**Function:** Lower covering, holding food and sensation.

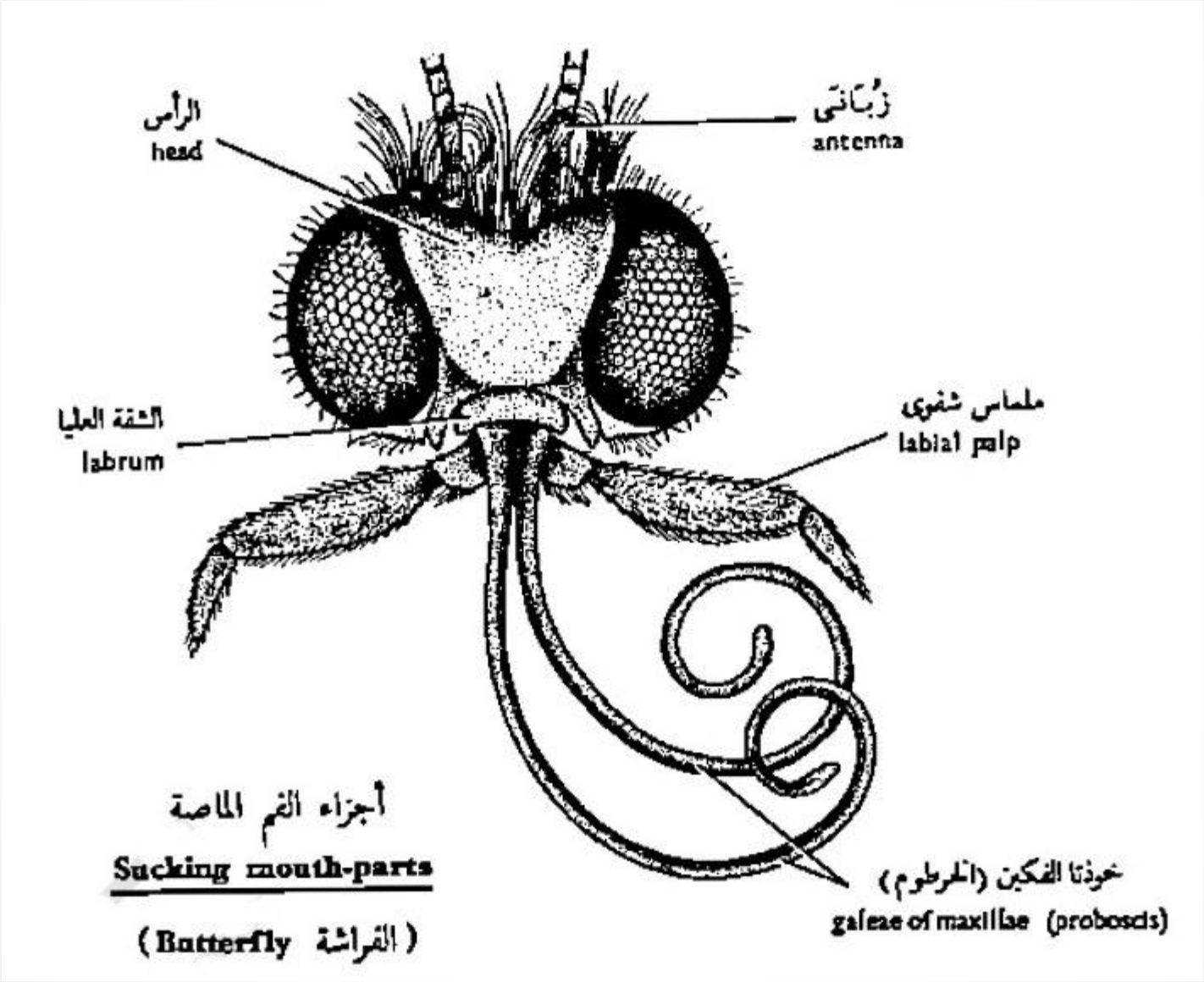
- **Hypopharynx:**

✓ **Structure:** A short median tongue-like structure lies above labium.

✓ **Function:** Salivary duct often opens on the ventral side of its base.

# Head: Mouth parts

# Sucking mouth parts



✓**Example:** Butterflies and moths.

✓**Food:** Liquid (flowers nectar).

✓ **Structure:** Elongated proboscis with food channel through which nectar is sucked up.

- **Labrum:**

✓ **Structure:** Reduced to a narrow transverse band.

- **Mandibles:**

✓**Structure:** Totally absent.

- **Maxillae:**

✓ **Structure:** Highly modified, being represented by elongated galeae which form proboscis. Each galea is longitudinally grooved on its inner surface forming food channel.

✓ **Function:** Sucking nectar.

- **Labium:**

✓**Structure:** Reduced to a small ventral plate and carries 2 well developed labial palps.

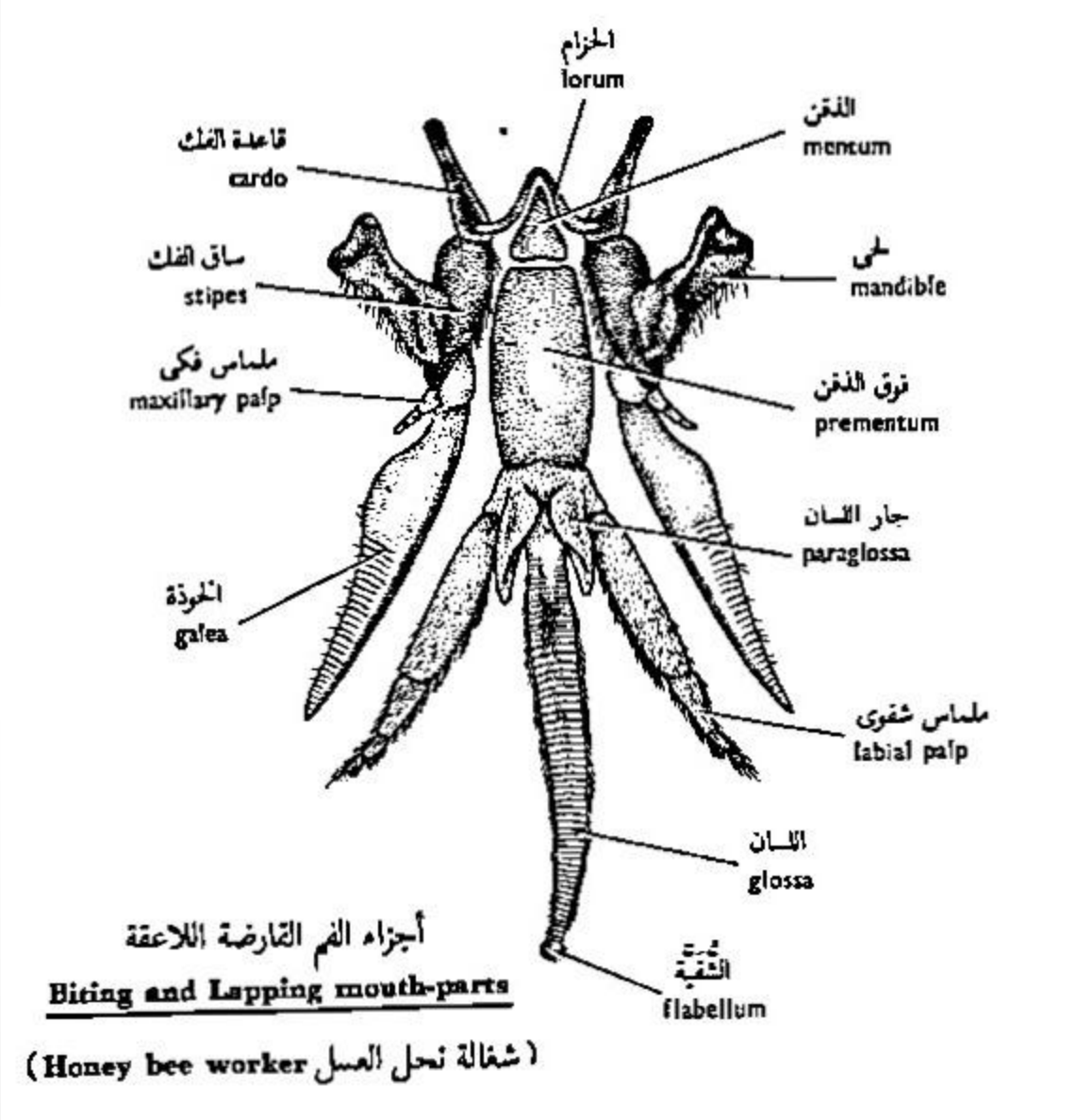
✓**Function:** Sensation.

- **Hypopharynx:**

✓ **Structure:** Totally absent.

# Head: Mouth parts

# Biting and lapping mouth parts




أجزاء الفم القارضة اللاعقة

**Biting and Lapping mouth-parts**

(Honey bee worker شغالة نحل العسل)

✓**Example:** Honey bees.

✓**Food:** Liquid (flowers nectar).

✓ **Structure:** Sucking proboscis to feed on nectar of flowers, in addition to strong mandibles used in wax molding.

- **Labrum:**

**Structure:** Totally absent.

- **Mandibles:**

✓ **Structure:** Well developed but have lost almost completely the teeth.

✓ **Function:** Wax molding

- **Maxillae:**

✓ **Structure:** Formed of cardo and stipes, the later carries a long blade like galea, a vestigial lacinia and a reduced maxillary palp.

✓ **Function:** Sucking nectar.

- **Labium:**

✓ **Structure:** Has 2 basal joints, mentum and prementum, supported by a transverse plate lorum. The labial palps are long and 4 segmented, the paraglossae are reduced while the 2 fused glossae are so much elongated forming a long glossa. Galea, labial palps and glossa form together the food channel.

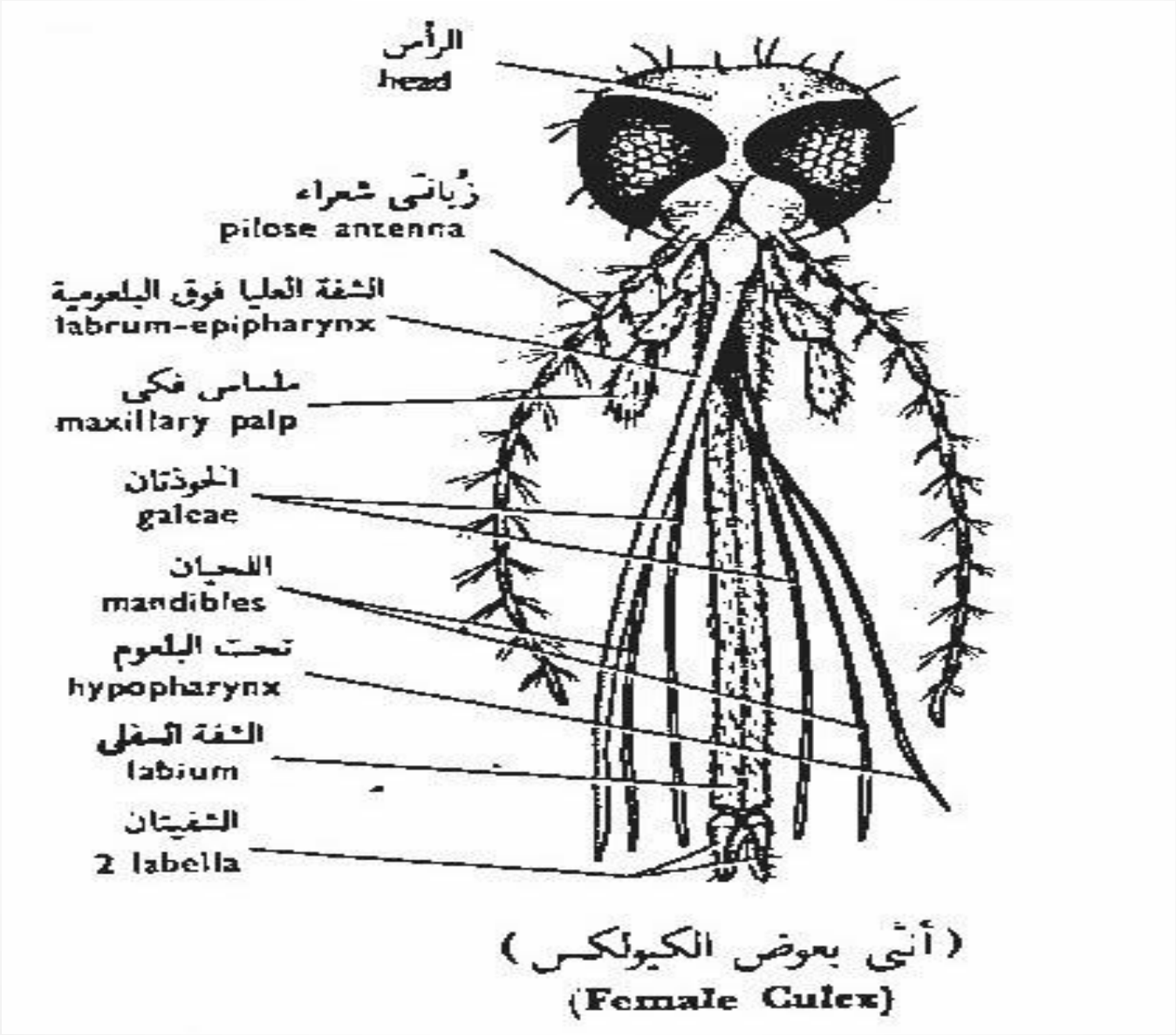
✓ **Function:** Sucking nectar and sensation.

- **Hypopharynx:**

✓ **Structure:** Totally absent.

# Head: Mouth parts

# Piercing and sucking mouthparts



✓**Example:** Mosquitoes.

✓**Food:** Liquid (blood).

✓ **Structure:** Needle-like stylets. The food channel is made between the labrum epipharynx and hypopharynx.

- **Labrum epipharynx:**

✓ **Structure:** Needle- -like stylet.

✓ **Function**: Sucking.

- **Mandibles:**

✓ **Structure:** Serrated needle- -like stylets.

✓ **Function:** Piercing.

- **Maxillae:**

✓ **Structure:** Represented by needle-like galea, and well developed maxillary palp.

✓ **Function:** Piercing and sensation.

- **Labium:**

✓ **Structure:** Forms a sort of elongated proboscis which is grooved dorsally and acts as a sheath for 6 stylets: the labrum epipharynx, the hypopharynx, the mandibles and the galea. The labium bears 2 terminal sensory labella.

✓ **Function:** Support and sensation.

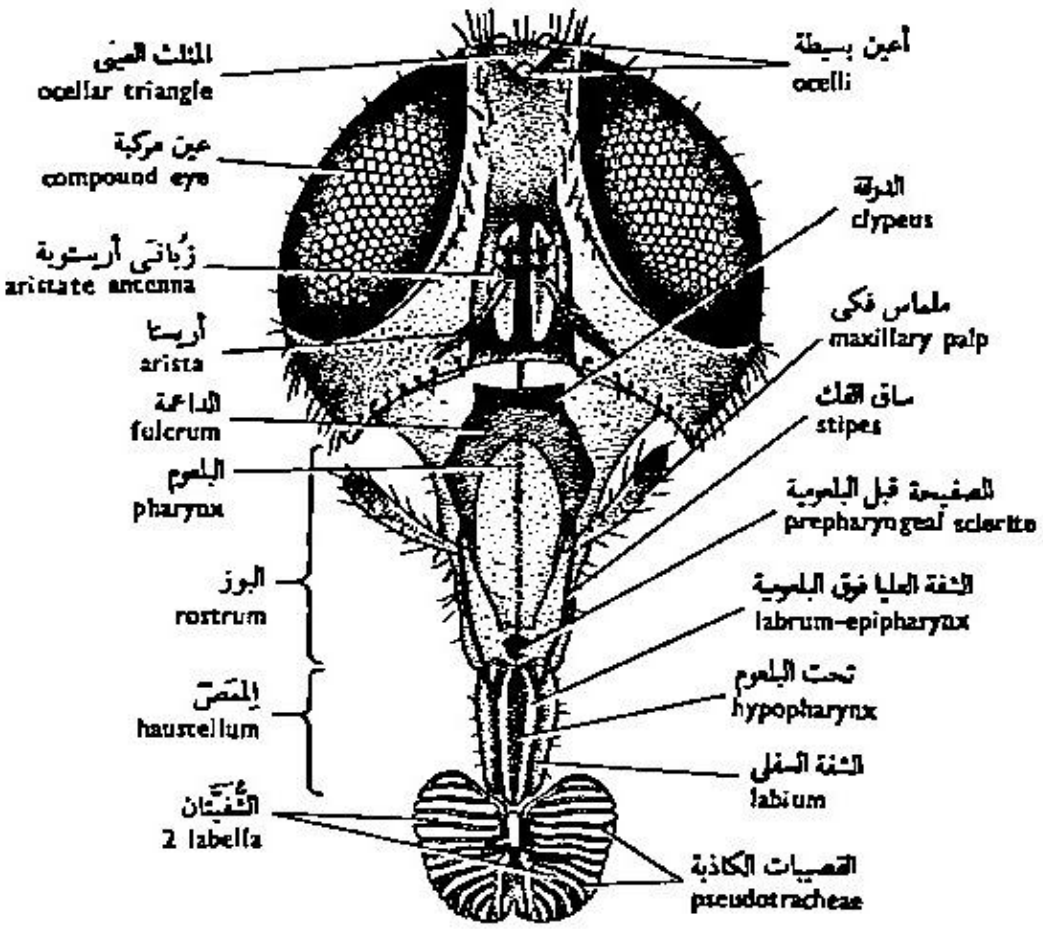
- **Hypopharynx:**

✓ **Structure:** Needle- -like stylet. The salivary channel extends inside the hypopharynx.

✓ **Function:** Sucking.

# Head: Mouth parts

# Sponging mouth parts




أجزاء الفم الماصة كالإسفنج

**Sponging mouth-parts**

( House-fly الذبابة المنزلية )

- ✓ **Example:** House flies.
- ✓ **Food:** Liquid or can be liquefied by the saliva or by the regurgitation of fluids from the gut.
- ✓ **Structure:** Elongated proboscis which hangs down vertically from the head and has terminal sponge-like labella. Three regions are distinguished in this proboscis: **rostrum**, **haustellum**, **2 labella.**

- **Rostrum:**

✓ **Structure:** It belongs morphologically to the head, is conical and covered anteriorly (dorsally) by 2 sclerites clypeus and fulcrum. Maxillae are represented by 2 rod-like stipes, and a pair of single- jointed maxillary palp.

✓ **Function:** Sensation.

- **Haustellum:**

✓ **Structure:** It consists of a large posterior (ventral) labium which has a deep anterior groove in which the labrum epipharynx and the hypopharynx lying behind it are lodged. The labrum epipharynx and the hypopharynx form together the food channel.

✓ **Function:** Sucking food.

- **2 Labella:**

✓ **Structure:** Greatly enlarged and traversed by numerous channels, the pseudotracheae. All these channels converge towards the oral opening.

✓ **Function:** Food sucking.

# Thorax & Abdomen

# Thorax

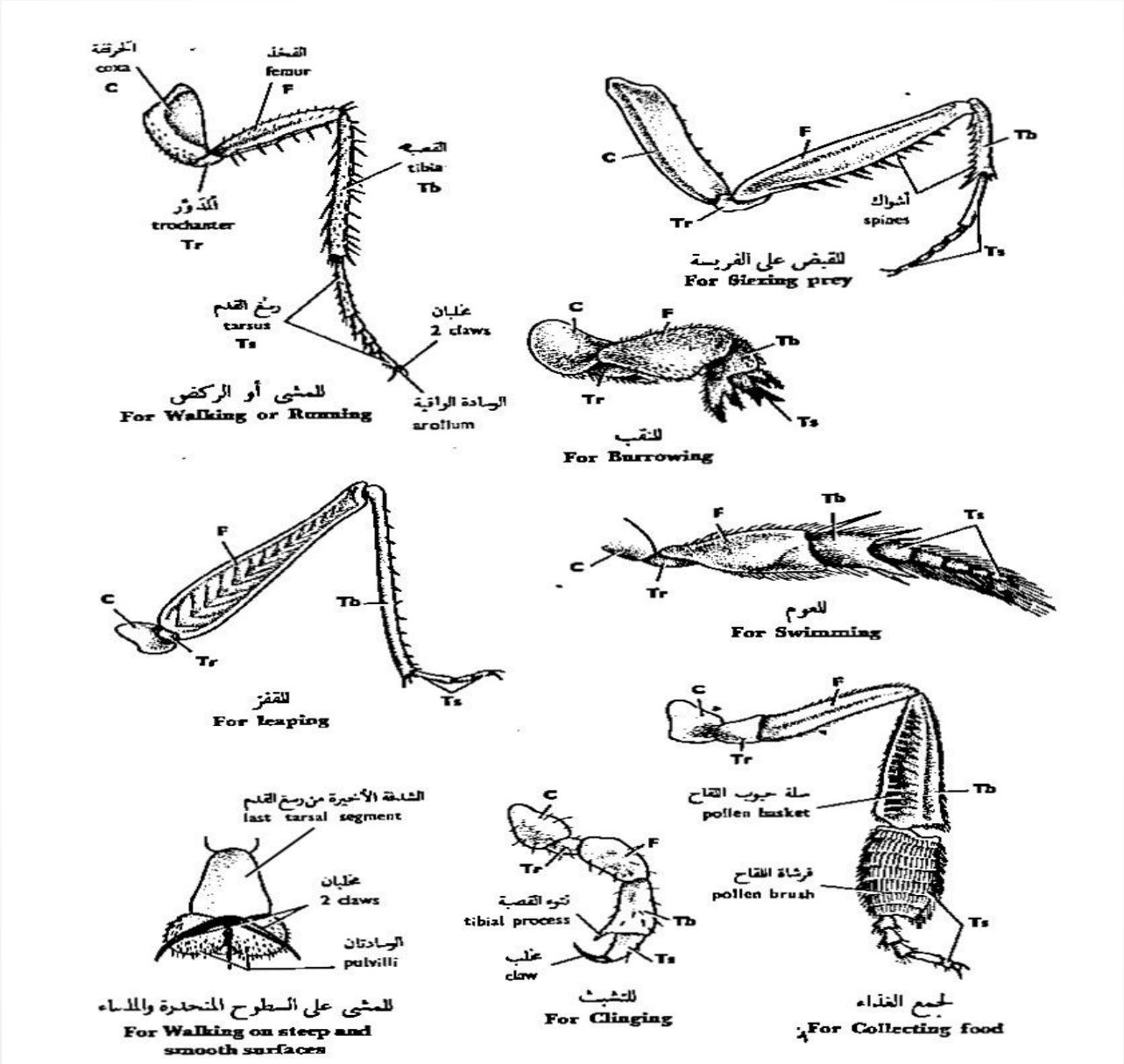
# Thorax

- ✓ The thorax consists of 3 segments: **prothorax**, **mesothorax** and **metathorax**.
- ✓ The skeleton of each is formed of a dorsal notum, a ventral sternum and 2 lateral pleura.
- ✓ Each thoracic segment carries a pair of walking **legs** and the **wings** when present are attached to meso- and metathorax.

# Legs

- ✓ Insect leg consists typically of 5 segments: coxa, trochanter, femur, tibia and tarsus.
- ✓ The tarsus is usually subdivided and ends in a pair of claws and one or more pad-like structures below them.
- ✓ The legs are primitively for walking and running, but may be modified to serve various other functions.

# Types of Legs



# Wings

- ✓ The majority of insects possess 2 pairs of wings: **forewings** and **hindwings**.
- ✓ They bear a framework of thickened ridges known as veins which contain air tubes, nerves and vessels.

# Types of Wings

(ب) حرشفی

Scaly

(أ) غمدی

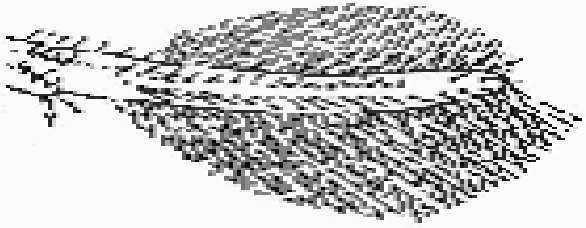
Elytra

(د) نصفی

Hemi-elytra

(ج) غشائی

Membranous



(و) هدبی

Fringed

(هـ) دبوس توازن

Halter

# Abdomen

# Abdomen

- ✓ The abdomen is typically composed of 11 segments.
- ✓ Each segment has a dorsal tergum, a ventral sternum and 2 lateral pleura on which the respiratory spiracles are usually located.
- ✓ The abdomen is limbless in adult insects but frequently bears some appendages at its posterior end as the genitalia (**aedeagus** in male and **ovipositor** or **sting apparatus** in female).

# Metamorphosis & Example Of Insects

# Metamorphosis

# Metamorphosis

- ✓ Growth of insects is accompanied by the shedding off of the skin, known as **moulting** or **ecdysis**.
- ✓ Usually it happens several times, in each of which the skin is renewed.
- ✓ The form of insect between 2 successive moults is called **instar**.
- ✓ The majority of insects change in form while passing from one instar to the other and this process is known as **metamorphosis**.

# Types Of Metamorphosis

- ✓ Metamorphosis is either simple or complex and accordingly two main groups of insects are known:
  - **Hemimetabola**
  - **Holometabola**

# Hemimetabola

- ✓ Includes insects with incomplete metamorphosis.
- ✓ Their young are called **nymphs.**
- ✓ Nymphs are usually similar to the adult in body form, mouth parts and usually live in the same habitat.
- ✓ Their wing buds develop as external outgrowths, hence also called **Exopterygota**.
- ✓ Examples: Locusts, cockroaches.

# Holometabola

- ✓ Includes insects with complete metamorphosis.
- ✓ Their early young stages are called **larvae**.
- ✓ Larvae differ markedly from the adult in body form, mouth parts, habits and often live in a different habitat.
- ✓ Their wing buds develop inside invaginated sacs of the body wall, hence also called **Endopterygota**.
- ✓ Examples: Moths and Mosquitoes.

# Example of Insects

# American Cockroach

Classification

Kingdom : Animalia

Phylum : Arthropoda

Subphylum : Crustacea

Class : Hexapoda

e.g. : *Periplaneta americana*

# Habitat and living of American Cockroach

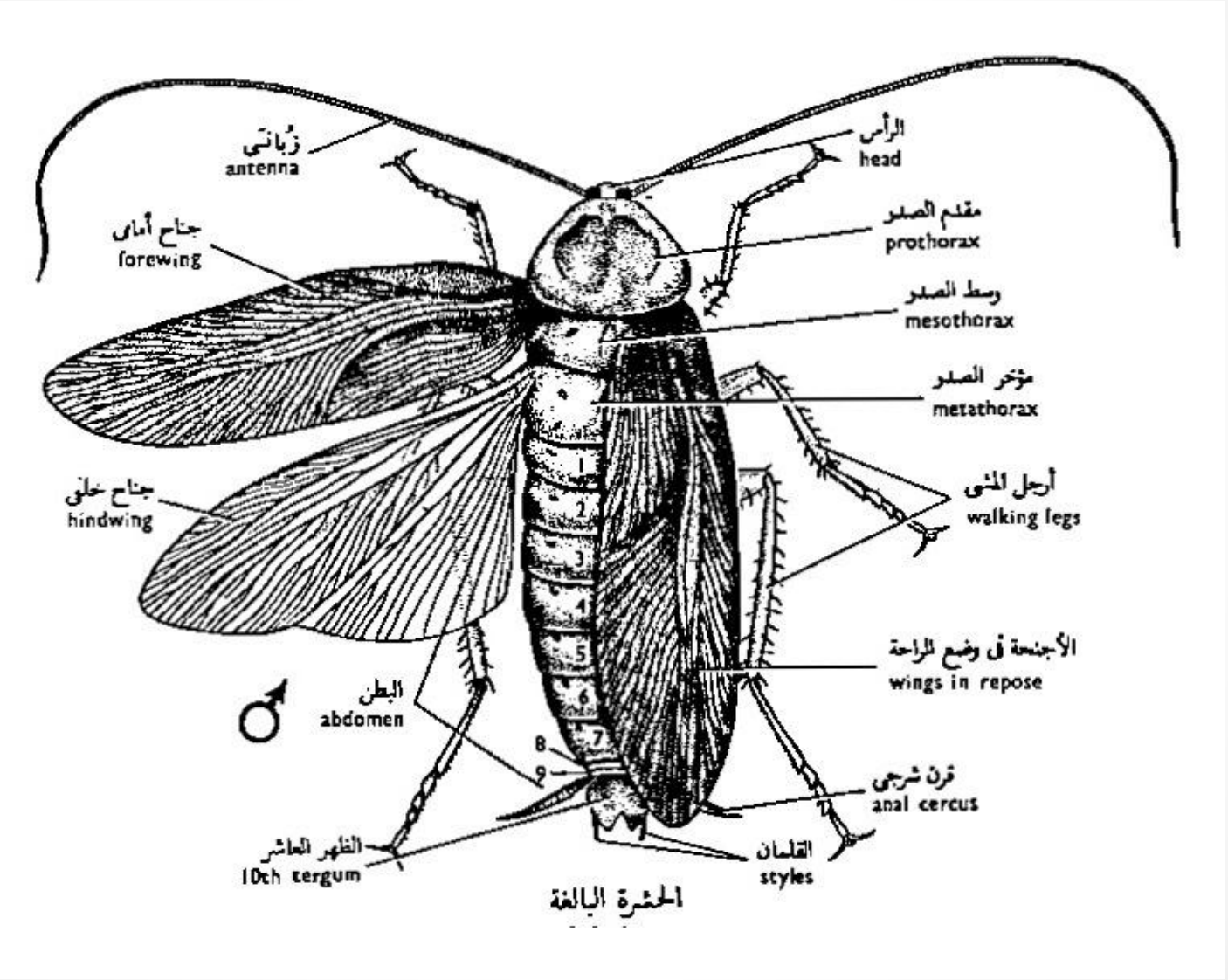
❑**Habitat:**

✓ Common in **drainage pipes**.

❑**Living:**

✓ **Free**, **nocturnal**, feed on organic matter both of animal and plant origin.

# External Features Of Cockroach



- ✓ Body is covered by a thick chitinous exoskeleton.
- ✓ Body is divided into: **head**, **thorax** and **abdomen**.
- ✓ The head appendages are a pair of **setaceous antennae** and **biting mouthparts**.
- ✓ There are three pairs of **walking legs** and two pairs of **wings** connected with the thorax.
- ✓ The abdomen consists of **10** distinct segments.