Ministry of Higher Education and Scientific Research
University of Baghdad
College of Science
Department of Biology

Practical Invertebrate Zoology
2022-2023

المرحلة الثانية ـ الدراستين الصباحية والمسائية

الفصل الدراسي الاول

تدريسي المادة :

أ.م.د.حارث سعيد جعفر الورد
أ.م. حسنين عبود حسون
م.د. زينب خضير

أ.م.د. أمجد قيس ابراهيم القيسي
م.بتول كاظم حبيب
م.م. غفران محمد حسان

Invertebrates

Lab 1

TAXONOMY

System for organizing, classifying, naming living things

- Kingdom
- Phylum or Division
- Class
- Order
- Family
- Genus
- Species
- *Amoeba proteus* or **Amoeba proteus**

قواعد كتابة الاسم العلمي

- **يتبع العلماء قواعد محددة عند كتابة الاسم العلمي على النحو التالي :**
- يكتب الحرف الأول من اسم الجنس كبيراً ، بينما تكتب بقية أحرفه وأحرف اسم النوع كلها صغيرة .
- يكتب الاسم العلمي في الكتب المطبوعة او المجلات بالخط المائل .
- إذا كتب الاسم العلمي بخط اليد يجب ان يوضع خط تحت اجزاءه كلها

Amoeba proteus or **Amoeba proteus**

Genus اسم الجنس | Species اسم النوع | Genus اسم الجنس | Species اسم النوع

Properties of Protozoa:

1- Unicellular – Eukaryotic microorganisms, do all cellular functions.

2- Size varies greatly between 2 TO 5,000 Micrometers (1cm = 10,000 µm)

3- No common basic structures, size or shape, no organs

4- Locomotion: Pseudopodia, flagella or cilia.

5- Distribution: Free living or Parasitic.

4- Nutrition: some are autotrophs = utilize light, some are hterotrophs = phagocytosis of particular matters, store products: glycogen, starch and lipids.

Properties of Protozoa:

5- Reproduction:
Asexual: Binary fission, multiple fission or budding.
Sexual: Syngamy or conjugation

6- Life stages:
Trophozoite = feeding & motile
Cyst = resting state.

7- Nucleus: vesicular حويصلي or compact مضغوط .

Protozoa **Class: Flagellata**

1- Order Cryptomonadina مستترات (*Chilomonas)*
Two flagella one of them longer than the other.

Protozoa **Class: Flagellata**

2- Order Phytomonadina نباتيات (*Volvox)*
Colonies in water

Protozoa **Class: Flagellata**

3- Order: Euglenoidina يوغلينيات (حنديراوات) (*Euglena)*

Protozoa **Class: Flagellata**

3- Order: Euglenoidina يوغلينيات (حنديراوات) (*Astasia)*

Protozoa **Class: Flagellata**

4- Order: Dinoflagellata سوطيات دوارة (*Ceratium*)
Has longitudinal and transverse grooves with a flagellum in each.

Protozoa Class: **Flagellata**

4- Order: Dinoflagellata (*Noctiluca*)

Protozoa Class: **Sarcodina**

1- Order: Amoebozoa (*Amoeba)*

Protozoa **Class: Sarcodina**

1- Order: Amoebozoa (*Pelomyxa)* multinuclear organism/ more and thin pseudopodia.

Protozoa **Class: Sarcodina**

2-Order: Testasea (*Arcella*)

Protozoa **Class: Sarcodina**

3- Order: Foraminifera مخرمات (*Globigerina)*
Multi-chambers shell, many pores with hooks.

Protozoa **Class: Sarcodina**

4- Order: Heliozoa شمسيات (*Actinospherium)*
Ectoplasm contains one or two lines of contractile vacuoles, Endoplasm contains food vacuoles and many nuclei, covered with spikes.

Protozoa **Class: Sarcodina**

5- Order: Radiolaria, different shells of Radiolaria
Produce mineral skeletons, has inner capsule divided into inner endoplasm and outer ectoplasm

Invertebrates

Lab 2

Classification:

1- Class: Flagellata سوطيات
Vesicular nucleus, Flagella, pellicle,
ectoplasm / endoplasm, Rep. fission

2- Sarcodina (جبانل) لحميات
Vesicular nucleus, pseudopodia,
no pellicle, ectoplasm / endoplasm
Rep. fission

3- Ciliata هدبيات
Compact nucleus, 2nuclei(macro & micro)
Cilia, pellicle

4- Sporozoa (parasitic) بوغيات

Protozoa **Class: Ciliata**

1- Order: Holotricha كاملة الاهداب , cilia are distributed equally.
- *Paramecium*

Protozoa **Class: Ciliata**

1- Order: Holotricha :Cilia distributed equally all over the body
- *Tetrahymena*

Protozoa **Class: Ciliata**

2- Order: Spirotricha ملفوفة الاهداب ; less cilia, usually as rings in different parts.
- *Stentor*

Protozoa **Class: Ciliata**

2- Order: Spirotricha; less cilia, usually as rings in different parts.
- *Stylonychia*

Protozoa **Class: Ciliata**

3- Order: Peritricha, cilia appear as a ring.
-*Voricella* , band nucleus شريطية

Protozoa **Class: Ciliata**

4- Order: Suctoria; has cilia only in the early life stages.
Ephelota, reticular nucleus شبكية , body and stalk, tentacles.

Phylum: Porifera

اسفنجيات (مساميات)

Lab. 3

Characteristics of Porifera:

1- Sponges are the simplest multi-cellular organisms include about 5000 species, most of which are marine except family Spongillidae.

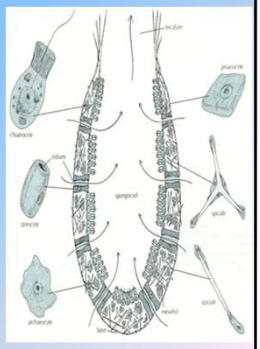
2- Size range from few mm to 2 meters, sessile (move by water flow)

3- Asymmetrical/ some have radial symmetry, lots of body pores, no true organs or tissues.

4- Body is a mass of cells imbedded in a gelatin matrix and supported by spicules ($CaCo_3$) , collagen and/or spongin fibers, some have special skeleton.

5- Water inters body cavity through many pores called **ostium** into the **spongocoel** and leave the body to the outside through an opening called **osculum**.

6- Body cavity usually lined up with flagellated cells called **choanocytes** خلايا قمعية , outer layer filled with **pinacocytes** (flattened), mesophyl contains **amebocytes**.



Characteristics of Porifera:

7- Most sponges are hermaphrodite, **asexual rep.** can occur by **budding** or **gemmule** formation to avoid hostile environment. **Sexual rep**. can occur by the formation of ova and sperms at different times to ensure cross-fertilization.

8- Economic importance:

1- Chemical substances secreted by some sponges have anti-inflammatory, antibiotic and anti-tumor activities.

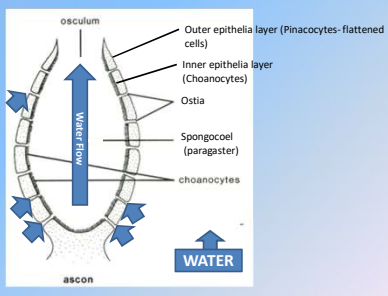
2- Washing and Cleaning.

Porifera body types :

- According to the complexity of the body and the flow through of water in and out of the body, Porifera can be divided into three body forms:
- 1- Asconoid type 2- Syconoid type 3- Leuconoid type

1. Asconoid type:

Simplest type

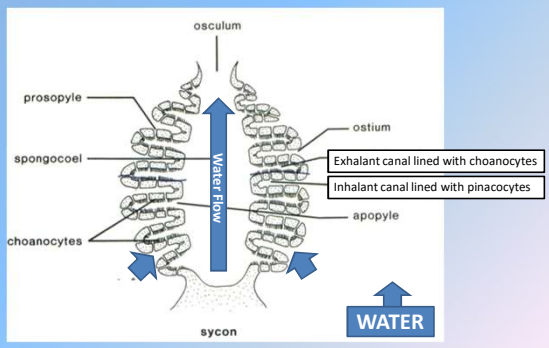


Water flow in Asconoid type

- Ostia ⇒ spongocoel ⇒ oscula

2. Syconoid type

Radial canals

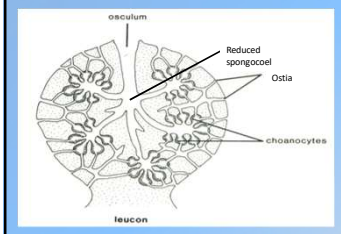


Water flow in syconoid type

Ostium ⇒ inhalant canal ⇒ prosopyle ⇒ exhalant canal ⇒ apopyle ⇒ spongocoel ⇒ osculum

3.Leuconoid type

Spongocoel is reduced



Classification of Porifera

1- Class: Calcarea كلسيات
- **Order**: Homocoela – ***Leucosolenia***
- **Order**: Heterocoela- ***Grantia***

2- Class: Hexactinelidae سداسية الاشواك
Euplectlla spicules

3- Class: Demospongia الاسفنجيات الشائعة (more than 90 % of sponges)
- **Order**: Monoxonida – ***Spongilla, Ephydatia, Chalina***
- **Order**: Keratosa – ***Euspongia***

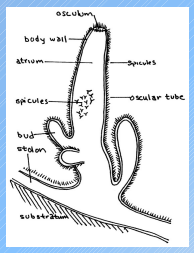
1. Class: Calcarea

1. Order: Homocoela مشتركة التجاويف

- Simplest body form sponges- asconoid
- Live in clusters or colonies as tubular shape
- Outer surface contains pinacocytes, mesophyl contains amebocytes, spongocoel lined up with choanocytes.
- Triaxon spicules.

Leucosolenia

1. Order: Homocoela



Leucosolenia **Whole mount and colony**

Class: Calcarea

2.Order: Heterocoela مختلفة التجاويف

- Syconoid and leuconoid body form.

  Ex. ***Grantia***
- Typical syconoid type, has spicules
- (Monaxon and triaxon).

2. Class: Hexactinellida سداسي الاشواك

- Sponges with three – dimensional , six – rayed siliceous spicules , spicules often united to form network, outer layer usually reduced.
- Body is often cylindrical or funnel shaped ; canal system syconoid or leuconoid ; all marine, mostly in deep water.

Ex- ***Euplectella***

3. Class: Demospongia

1. Order: Monoxonida وحيدة المحور:

- Monoaxon spicules (needle like).
- Composes 95% of sponges.
- Asexual rep. by gemmule

Ex: ***Spongilla*** (spicules and entire)
Ephydatia (gemmule)
Chalina **(entire)**

Class: Demospongia

1. Order: Monoxonida وحيدة المحور:

Class: Demospongia

2. Order: Keratosa قرنيات

- Includes commercial sponges, commercial importance.

Ex: ***Euspongia*** (common name: bath sponge)

Phylum: Cnidaria (Coelenterata)

اللاسعات (جوفية المعى)

Lab. 4

Characteristics :

- Radial symmetry.
- Diploblastic (body made of two cellular layers, outer epidermis and inner gastrodermis lines the body cavity- mesoglia in the middle)
- Generally possess tentacles around oral end.
- Body wall surrounds coelom which has one mouth opening for food and waste flow.
- More than one form during life cycle (polymorphism) larval form usually planula.
- Metagensis (ظاهرة تعاقب الاجيال) - Polyp asexual form and Medusa sexual form.
- Live solitary or colonial.
- Have nematocysts= specialized stinging capsules حويصلات لاسعة for attack and defense, located in cnidoblast cells within epidermis and gastrodermis.

CHARACTERISTICS :

- Hermaphrodite or diceous
- In life cycles in which both polyps and medusa are found , the juvenile polyp stage gives rise asexually to the medusa , which reproduce sexually.

Polyp & Medusa

(A) Polyp: Tubular body, with the mouth directed upward. Around the mouth are a whorl of feeding tentacles. Only have a small amount of mesoglea. Sessile

(B) Medusa: Bell-shaped or umbrella shaped body, with the mouth is directed downward. Small tentacles, directed downward. Possess a large amount of mesoglea. Motile, move by weak contractions of body

First Class: Hydrozoa (صنف المائيات)

- Most are marine, few are fresh water.
- Non-cellular Mesoglea.
- Forms are either Polyp, Medusa or both.
- Solitary or colonial.

- Class: Hydrozoa has 6 orders:
- 1- Calyptoblastea مغطاة البراعم
- 2- Gymnoblastea عارية البراعم
- 3- Hydrida هيدريات
- 4- Hydrocorallina مرجانيات هيدرية
- 5- Trachylina قاسيات
- 6- Siphonophora سيفونويات

FIRST CLASS: HYDROZOA

1- Order: Calyptoblastea مغطاة البراعم

- Polyp and Medusa are found in life cycle.
- Body is covered with perisac, extended to form hydrothecae around the hydranths and gonothecae around the blastostyles.

- e.g. *Obelia*
- Colonies, consist of polyps and medusa, gastrovascular cavity called coenosarc and covered with perisarc which is flexible.

- **Perisarc:** The horny or chitinous outer case or covering protecting the soft parts of hydrozoans.
- **Coenosarc (اللب المشترك) :** The tubular tissue connecting the polyps of a hydroid colony.
- **Polyp** has two forms:
  1. **Feeding polyp** (Hydranth) (الافراد الخضرية)
  2. **Reproductive polyp** (Gonangium) (الافراد التكاثرية)
- **Hydranth:** The terminal part of a hydroid polyp that bears the mouth and tentacles and contains the stomach region.
- **Hydrotheca:** The part of the perisarc covering a hydranth.
- **Gonangium:** A reproductive polyp of a colonial hydroid, giving rise asexually to medusa buds.
- **Gonotheca:** The part of the perisarc covering a gonangium.
- **Medusa bud:** One of the buds of a hydroid destined to develop into a gonophore or medusa

First Class: Hydrozoa

- **1- Order: Calyptoblastea مغطاة البراعم**

Sertularia

- **Hydranths are:**
  - **Opposite to each other**
  - **No balstyostyle (جالسة)**
  - **Small medusa**

First Class: Hydrozoa

- **1- Order: Calyptoblastea مغطاة البراعم**

Plumularia

- Hydranths present on one-side of stalk.
- Have nematophores حاملات الخيوط covered with nematotheca, used for attacking and defense.

First Class: Hydrozoa

2- Order: Gymnoblastea عارية البراعم

- **Have either polyp or medusa in life cycle.**
- **Coenosarc does not covered with perisarc.**

- ***Tubularia***

- **Colonies with hydranths stand on stalks.**
- **Two tentacles types, short oral and long aboral**
- **Gonophores shaped in clusters below oral tentacles.**

- **1- Short oral tentacles**
- **2- Long ab-oral tentacles**
- **3- Gonophores**
- **4- Perisarc (only covers the stalk).**

First Class: Hydrozoa

- **2- Order: Gymnoblastea عارية البراعم**

Pennaria

- **Feather-like shaped colonies**
- **Short oral capitate tentacles, long aboral tentacles.**
- **No-blastostyles.**

First Class: Hydrozoa

- **2- Order: Gymnoblastea عارية البراعم**

Hydractinia

- **Colonies live on dead shells, polymorphism.**
- Gastrozooid (tubular with oral tentacles), gonozooid (for rep.) and dactylozooid (thread-like shape, contractile, have nematocycts for attack and defense).

First Class: Hydrozoa

- 3- Order: Hydrida الهيدريات
- Solitary, only polyp found in life cycle.

Hydra

- Has basil disk, hypostome
- surrounded by hollow tentacles
- Reproduction - asexual by budding
- sexual: *Hydra* either male or female
- or hermaphrodite (20-30 testes on
- top, ovary on bottom)

First Class: Hydrozoa

- 5- Order: Hydrocorallina
- Calcareous skeleton secreated by epidermis.
- Fixed colonies.

Millepora

- Gastrozooids surrounded by smaller dactylzooids.

First Class: Hydrozoa

- 6- Order: Siphonophora سيفونيات
- Polyps lack oral tentacles, floating on water surface or move by wind.
- Colonies based on basal disk.
- Great polymorphism.

Physalia (قبعة المحارب البرتغالي)

- Colony with big float on water surface.
- Gastrozooid, gonozooid and dactylozooid.

First Class: Hydrozoa

- 6- Order: Siphonophora سيفونيات

Velella (الشراع الارجواني)

- Flat float.
- Gastrozooid surrounded by gonozooid, dactylozooid.

Phylum: Cnidaria (Coelenterata)

اللاسعات (جوفية المعي)

Lab. 5

Second Class: : Scyphozoa الكأسيات

- Mesoglea is cellular.
- Medusa is the main stage in life cycle, polyp (if found) is developed directly into larva which then developed into medusa.
  - *(Aurelia)* common name: Jelly fish

SECOND CLASS: : SCYPHOZOA الكأسيات

- **Subclass: Discomedusa** القرصيات

Order: Semaeostomeae لوائية الافواه

(***Aurelia***) common name: **Jelly fish**

- Medusa are less convex, no velum, contains gastric pouches جيوب معدية, each contains gonads (horseshoe) and gastric filaments.
- Medusa has 16 radial canals, 8 non-branched called Ad-radial canals and 8 branched: 4 between the gastric pouches called Per-radial canals, 4 between the gastric pouch and the ring canal called Inter-radial canals.

SECOND CLASS: : SCYPHOZOA الكأسيات

- Medusa are developed into gametes, either male or female, mating leads to zygote formation then life cycle continues as the following.

- **Planula larva**: free-swimming, ciliated, ovoid, elongated, radially symmetrical larva.

- **Scyphistoma:** Upon settling on an appropriate substratum, the planula develops into the characteristic scyphozoan **polyp**, the scyphistoma.
- Trumpet-shaped , tiny, asexual, sessile, **mouth** surrounded by a ring of **16** long **tentacles**

- **Strobila**: scyphistoma undergoes an asexual process of transverse fission called strobilation to produce a stack of tiny disks.

- **Ephyra larva**: The young medusae are ephyrae which accumulate in a stack at the oral end of the strobila, star-shaped.

THIRD CLASS: : ANTHOZOA الزهريات

- **Polyp is the main life stage, solitary or colonial.**
- **Rich-cellular mesoglea**
- **Gastrovascular cavity is divided by mesentries or septa (to increase digestive surface/ support)**
- **Gonads are gastro-dermal.**
- **Compose all coral reefs**

(الشعاب المرجانية).

THIRD CLASS: : ANTHOZOA الزهريات

- **1-Order: Alcyonaria (السماكيات او الثمانيات)**
- **Polyp with 8 pinnate tentacles (feather-like), 8 mesentries (septa) and 1 gutter (ميزاب).**
- **Internal skeleton secreted by mesoglea.**
- **Life cycle includes motile phase and sessile phase.**

THIRD CLASS: : ANTHOZOA الزهريات

- ***Alcyonium*** : colony of polyps, each polyp has 8 pinnate tentacles and 8 mesenteries, endoskeleton of separate spicules.
  - **Colony and spicules.**

THIRD CLASS: : ANTHOZOA الزهريات

- **1-Order: Alcyonaria**
- ***Tubipora***

Colony of fused spicules (skeleton)

THIRD CLASS: : ANTHOZOA الزهريات

- **2- Order: Zoantharia ….. *Metridium***
- **The septa that partition the coelenteron are in multiples of six and usually occur in pairs (ستة حواجز او مضاعفاتها)**
- **Tentacles are of many lines and small.**
- **Gonads are in septa.**
- **2 ciliated-gutters, one for the entrance and one for exit of water.**

Metridium

- Cylinder shape, fixed on basal disk.
- Oral disk, mouth in the middle, surrounded by small tentacles and leads to gullet.
- 3 types of mesentries:
- **1- Primary mes.** Longest and reach the gullet.
- **2- Secondary mes.** Shorter than primary and found between primary.
- **3- Teriary mes.** Shortest found between the primary and secondary.

- **Sexual reproduction by male and female gametes.**
- **Asexual by: 1- Budding**
  2- Binary fission
  3- Fragmentation (التشظي)

Phylum: Platyhelminthes
Flat Worms
Platy= flat
Helminth= worm

Lab- 6

General Characteristics

1.Bilateral symmetry - dorso-ventrally flattened.

2. Body has three germ layers (triploblastic).

3. No internal cavity (acoelomates).

4. Blind gut (mouth opening-no anus)

5.Excretion by passive diffusion or flam cells (protonephredia)

6. Cephalization (nerve fiber net), one cerebral ganglion – primitive brain- and 1 to 3 pairs of longitudinal nerve cords

7. Reproduction mostly sexual as hermaphrodites.

8. Locomotion: most are aquatic, do not swim but move by gliding or crawling.

Classification:

1- Class: Turbellaria- free living worms.

2- Trematoda (flukes) – parasitic.

3- Cestodes (tapeworms) – parasitic.

Class: Turbellaria

- The high surface-area-to-volume ratio of turbellarians makes them prone to dehydration in air, that's why most of turbellarians live in aquatic environment.
- Have ocelli (small eyes).
- Skin has single layer of cells.
- Aquatic worms.
- Hermaphrodite.

Order Tricladida: *Planaria*

- Has 3 branched intestine.
- Has retractable pharynx.
- Has 2 ocelli, 2 auricles.

Super-Phylum: Aschelminthes

1. Triploblastic, pseudocoelomate, bilateral symmetrical, un-segmented worm.

3. Sex separate (dioecious).

4. Mostly aquatic, free-living or parasitic.

5. Complete digestive tract (mouth and anus).

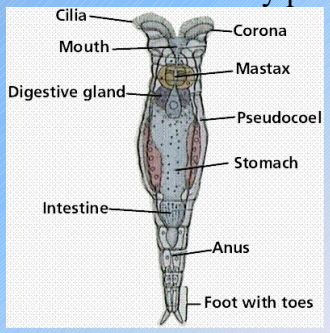
6. Respiratory and circulatory systems absent.

7. Excretory system of protonephridia and two protonephridial tubes which empty into a bladder.

8. Nervous system of three major ganglia and nerves.

1.Phylum :Rotifera

Wheel animals body parts



Asplanchna

- **Corona** – cilia for movement, capturing food
- **Mastax** – grinding organ made of chitin
- **Carapace** present in most species

2-Phylum: Nematodes

- Body is covered with cuticle.
- Nervous system with pharyngeal nerve ring.

Nematodes classification:

- 1- Class: Phasmidia
  Have phasmids.
- 2- Class: Aphasmidia
  Have no phasmids.

- **Class: Phasmidia**
- **Order: Rhabditata**
- **Ex. *Turbatrix aceti* (vinegar eel ثعابين الخل)**
- free-living nematods that feed on the microbial culture, called mother of vinegar used to create vinegar, and may be found in unfiltered vinegar.

Phylum: Annelida

Lab- 7

Characteristics

- **Annelids are to be found in marine , fresh water and terrestrial habitates.**
- **The larva is the trochophore.**
- **The body is vermiform , and segmented. Each segment is separated from contiguous ones by a transverse septum , although this basic feature may be modified in some forms.**
- **Coelomate.**
- **Possess nephridia and coelomoducts typically , for excretory and reproductive purpose.**

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- Coelomate.
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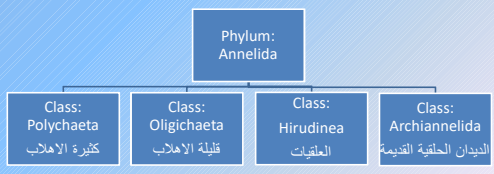
- May have chaetae , hard , bristle – like structures projecting from the body wall. (chaetae also named setae).
- The group is triploblastic , and has a body wall musculature of two layers (external circular and internal longitudinal muscle) , the animal being bouneded by a thin flexible cuticle.
- There is a well – developed closed circulatory system with pumping vessels.
- Annelids have a complete mouth – to anus digestive system.
- Reproduction may involve copulation.

Classification

Annelida are classified according to the the presence or absence of a clitellum , parapodia , setae , annuli , and other features



Classification

1- Class : Polychaeta

1. Segmented inside and out.
2. Parapodia with many setae
3. Distinct head with eyes , palps , and tentacles
4. No clitellum
5. Dioecious
6. Mostly marine

Order : Errantia الجوالات

Aphrodite , Perinereis

1.Free swimming

2.Pharynx with jaws

3.Parapodia with acicula

Order : Errantia الجوالات

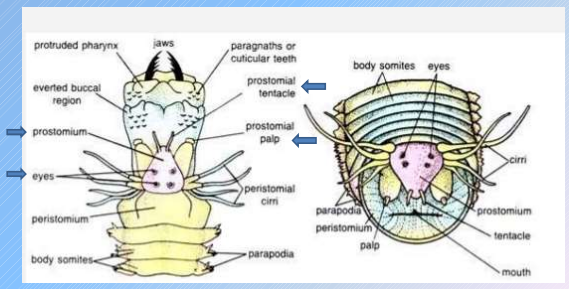
Aphrodite , Perinereis

1.Free swimming

2.Pharynx with jaws

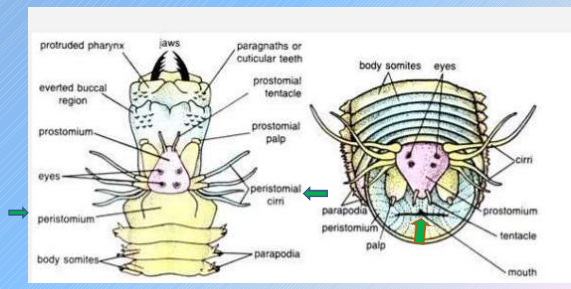
3.Parapodia with acicula

Perinereis external features



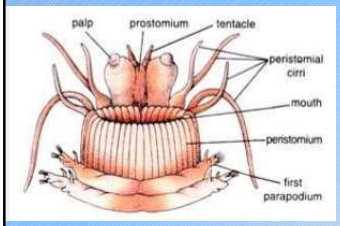
Head in dorsal view Head in frontal view

Perinereis external features



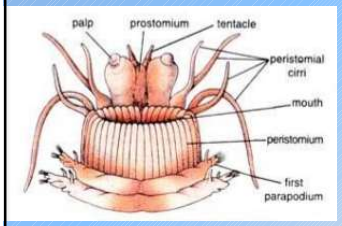
Head in dorsal view Head in frontal view

Perinereis external features



Head in ventral view

Perinereis external features



Head in ventral view

Order : Sedentaria الجالسات

Arenicola

1. Live inside different shape tubes
2. Small head
3. Simple parapodia without acicula

Order : Sedentaria الجالسات

Arenicola

1. Live inside different shape tubes
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Arenicola (Lug worm or Lobe worm)

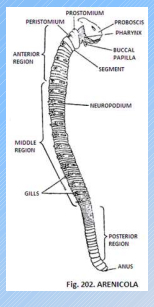

Fig. 202. ARENICOLA

2- Class: Oligochaeta

1. Body segmented inside and out.
2. Number of segment variable
3. No parapodia
4. Few setae
5. Haed is Poorly developed without tentacles
6. Clitellum present
7. Hermaphrodite
8. Mostly marine

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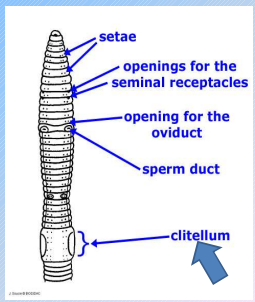
Order : Opisthopora

Lumbricus



3- Class: Hirudinea

1. Have fixed number of segments 33 , but the segmentation is un-noticed by the development of superficial annuli that give the appearance of greater number.
2. No parapodia or setae
3. Some segments are modified to form anterior (prostomium + first 2 segments) and posterior (last 7 segments) suckers.
4. hermophrodite
5. Terrestial , freshwater and marine
6. Leeches are intermittent ectoparasites.

Order : Gnathobdellidda

العلقيات الفكية

Hirudo

Lab 8: Phylum : Arthropoda

Characteristics

- Marine, fresh-water and terrestrial species.
- Triploblastic, coelomate, bilaterally symmetrical metazoans.
- Possess a chitinous exoskeleton (the cuticle).
- A tubular gut proceeds from mouth to anus.
- Organ systems are well developed.
- The coelom is generally reduced, the major body space is a hemocoel, it is filled with hemolymph, which circulates through the arthropod's "open" circulatroy system.
- Arthropods have jointed appendages, as fact that has given them their name, with at least one pair of functional jaws.
- The arthropod body is constructed of an extended series of repeated segments.
- The sexes are typically separated.

Classification

1- Subphylum: Onychophora

Characteristics:

- All are terrestrial in damp places, in tropical or south temperate areas.
- A thin, flexible cuticle is present.
- Body wall has circular and longitudinal muscle layers.
- There are numerous stumpy, unjointed, clawed, paired appendages.

Ex. : *Peripatus*

- Indistinctly segmented.
- Short antennae
- Stumpy legs
- The body is divided into:

1. Head (pairs of simple and dorsal eyes, pair of antenna 1st pair of appendages, pair of jaws (2nd pair of appendages, pair of oral papillae (3rd pair of appendages.
2. Trunk (posses legs from 14 – 43 pairs depending on the species and sexes).

Classification

2- Subphylum: Mandibulata

A- Class: Crustacea

- Primarily aquatic, most species marine, but with some fresh-water and terrestrial forms.
- With gills.
- Body covered with carapace.
- Appendages biramous and variously modified for different functions.
- Head with two pairs of antennae

Subclass: Branchiopoda

- Free living with compound eyes.
- Flattened thoracic appendages used for respiration mainly.

Order: Cladocera:

- All of the body except for the head is covered by carapace.
- Large biramous antennae.

- Ex: *Daphnia* (Water flea)

Daphnia (Water flea)

- A genus of small planktonic crustaceans living in freshwater
- Body are enclosed by carapace except the head.
- The head of the organism contains both a darkly colored compound eye and numerous antennae used for feeling and swimming
- The trunk appendages (five or six pairs) are flattened, leaf-like structures that serve for suspension feeding (filter feeders) and for locomotion.
- *Daphnia* males are generally smaller than females but have longer antennules.
- *Daphnia* females posses a brood chamber located between the body wall and dorsal surface of the carapace used to carry their eggs
- The heart is located dorsally.

Subclass: Copepoda

- Found everywhere in fresh and brackish water.
- Free living or parasitic
- The body divided into three regions : head , thorax and abdomen.

Order: Cyclopoida

- It's have pyriform body divided into three regions:
  1. Cephalothorax (head + 2 thoracic segments)
  2. Thorax (5 thoracic segments)
  3. Abdomen (3 abdominal segments)

Ex: *Cyclops*

Subclass: Malacostraca

- It is a large group. Relatively large members
- The body regions are : head (5 segments) , thorax (8 segments) and abdomen (6 segments and telson)
- Every segments bears a pair of appendages.

Order: Decapoda

Have five pairs of walking legs, the first pair modified to cheliped mostly and have three pairs of maxillipeds.

Ex: *Astacus* (Cray fish)

Astacus

The body of Crayfish consist of two well defined regions: the anterior cephalothorax and posterior abdomen ,

Cephalothorax segments consists of (5 cephalic segments + 8 thoracic segments) and covered by a hardened carapace, and it has a projection to the front of the head called rostrum, this structure have eye stalks on both sides of it, these stalks bears a compound eye. The portion of carapace covering the head region is separated from that covering the thoracic region by the dorsal cervical groove. On the lateral side of the carapace, the branchiostegite (dorsal and lateral branchial region of carapace), covers the gills.

Abdomen: The abdomen is composed of six segments and modified posterior extension, the telson which may or may not be considered a true segment.

2- Subphylum: Mandibulata

B- Class: Chilopoda

1. centipedes. Elongated with dorsoventrally flattened body.
2. Head with a pair each of antennae, mandibles, first and second maxillae.
3. Variable number of somites. each with pair of legs.
4. 1st trunk segment with modified appendages , the poison claws
5. Terminal segment without legs.

Ex: *Scolopndra*

2- Subphylum: Mandibulata

C- Class: Diplopoda

- Millipedes
- Subcylindrical body elongated and wormlike.
- Head with a pair each of antennae and mandibles, and with the fused 1st maxillae
- Variable number of segments (mostly diplo segments with two pairs of legs), then a number of apodous segments without legs and telson.

Ex: *Julus*

3- Subphylum: Chelicerata

- Horse shoe crabs, Spiders and Ticks.
- First pair of appendages is modified to form chelicera with pair of pedipalps and 4 pairs of legs.
- The body regions consist of prosoma (cephalothorax) and opisthosoma (abdomen).

3- Subphylum: Chelicerata
1- Class:Merostomata

- Abdominal appendages are modified to gills

Ex. *Limulus* Hours shoe crab or king crab

3- Subphylum: Chelicerata
2- Class: Arachnida

- Scorpions,spiders,ticks and mites.
- Head with chelicerae, pedipalps and 4 pairs of legs.
- Abdomen segmented or unsegmented with or without appendages.
- Respiration by gills, trachae or book lungs.

Order: Scorpionida

- **The body,** is divided into an anterior **prosoma or cephalothorax** and posterior **opisthosoma or abdomen,** the last one is subdivided into broad **mesosoma (7 segments)** and slender **metasoma (5 segments)** that end with terminal sting which have venome of different toxicity which is used to defend themselves, and to seize the prey, the pedipals are large, pincer like with sensory hairs on them which used to sense vibrations.
- **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

Ex. *Buthus* (Scorpion)

Phylum : Mollusca

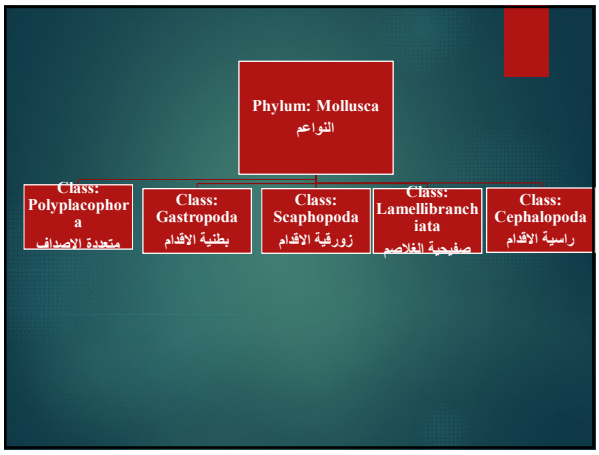
Lab 9

Characteristics

1. Mollusca are marine, fresh-water and terrestrial animals.
2. Mollusca have a specialized muscular foot, generally used for locomotion.
3. There are ctenidia or gills, originally used as respiratory organs, but in some groups adapted as feeding devices.
4. A fold of the dorsal wall, called the mantle, or pallium, encloses a mantle cavity, which usually contains the gills and secrets the exoskeleton, or shell.
5. There is an open circulatory system with pumping heart and complete mouth to anus digestive system.

Characteristics

6. Mollusca are coelomate but the coelom is often greatly reduced in extent. It is always present as the pericardium, the cavity of kidneys and the gonodal cavity.
7. Most Mollusca, with the bivalves being a conspicuous exception, have within the mouth a unique rasping organ, the radula, used for scraping off food materials.
8. Most Mollusca have a well-developed head – again, a feature absent in the bivalves.



Classification

Class: Polyplacophora متعدده الاصداف

1. Elongated, dorsally flattened body.
2. Possess a head of primitive type but without tentacles and eyes.
3. Bilaterally symmetrical.
4. Radula present.
5. Shell of eight dorsal plates.
6. Foot broad and flat.
7. The mouth and anus lie at opposite ends of the body.
8. Gills multiple.
9. Sexes usually separate.

e.g. : Chiton

Class: Gastropoda بطنية الاقدام

1. Snails, slugs, conchs and others.
2. Body symmetrical usually in a coiled shell (shell uncoiled or absent in some).
3. Head well developed with tentacles, eyes and radula.
4. Foot large and flat.
5. One or two gills. Or with mantle modified into secondary gills or lung.
6. Dioecious or monoecious.

Class: Scaphopoda زورقية الاقدام

1. Tooth shells.
2. Elephant tusk shells.
3. Body enclosed in a one-piece.
4. Tubular shell open at both ends.
5. Conical foot.
6. Mouth with radula and tentacles.
7. Head absent.
8. Mantle for respiration
9. Sexes separate.

e.g Dentalium

Class: Lamellibranchiata صفيحية الغلاصم

1. Also called bivalvia.
2. Body enclosed in a two-lobed mantle.
3. Shell of two lateral valves of variable size and form.
4. With dorsal hinge.
5. The head is reduced or absent.
6. No tentacles
7. No radula.
8. Foot usually wedge-shaped.
9. The gills platelike and large.
10. Greatly ciliated and involved in feeding processes.
11. Sexes usually separate.

Class: Cephalopoda راسية الاقدام

1. Squids, nautlioids, and octopuses.
2. Shell often reduced or absent.
3. Some cephalopods have chambered external shell.
4. Head well developed with eyes and radula.
5. Foot modified into arms or tentacles.
6. Siphon or funnel present.
7. Sexes separate.

Order: Dibranchiata

1. **Have a pair of kidneys and pair of gills (ctenidia).**
2. **Internal shell or there is no shell.**
3. **8 or 10 suckered tentacles (2 of which are always long in 10-armed forms).**
4. **Eyes with lenses , and an ink sac**

e.g. : Octopus , Sepia

Order: Tetrabranchiata

1. **Have 2 pairs of kidneys and 2 pairs of gills .**
2. **An external chambered shell.**
3. **Numerous unsuckered and retractile tentacles.**

e.g. : Nautilus

Phylum : Echinodermata

Lab 10

Characteristics

1. Exclusively marine.
2. Coelomate.
3. Symmetry pentaradial (radial symmetry) , the larva is bilaterally symmetrical.
4. They have a water vascular system that powers a multitude of tiny tube feet(podia) used for locomotion and food gathering.
5. The echinoderms lack a definite head , their nervous system and sense organs are primitive , locomotion is slow , and they lack segmentation.
6. The skeleton is internal and dermal "dermal endoskeleton" of calcareous plates(ossicle) and spines.
7. Sexes are separate and fertilization is external.

Classification

Class: Asteroidea

1. Sea stars. Star shaped
2. Arms not sharply marked off ,central disc contain extension of the alimentary canal (gut).
3. Ambulacral grooves open with tube feet on oral side.
4. Tube feet often with suckers.
5. Anus and madreporite aboral.
6. Pedicellariae present

Order: Forcipulata

e.g. : Asterias

Class: Ophiuroidea

1. Brittle stars (so called because of their great fragility).
2. They are star-shaped , with well – defined arms sharply marked off from the central disc which do not contain branches of the gut.
3. The madreporite lies on the oral surface.
4. Ambulacral grooves closed.
5. Tube feet without suckers.
6. Pedicellaria absent.

Order: Ophiurae

e.g.: Ophiura

Class: Echinoidea

1. Globular , oval or disc shaped without arms.
2. Ambulacral grooves(plates) closed.
3. Tube feet with suckers.
4. Aboral madreporite.
5. The whole animal is covered with numerous spines.
6. Knobes and pedicellariae

Order: Camarodonta

e.g. Echinus

Class: Crinoidea

1. Sea lilies and feather stars.
2. Primitively possess a stalk which they are attached to the substrate.
3. Anus on oral surface.
4. Five branching arms with pinnules.
5. Ciliated ambulcral groove on oral surface with tentacle – like tube feet for food collecting.
6. Tube feet without suckers.
7. Spines , madreporite , and pedicellariae absent.

e.g. : Antedon