Taxonomy

Taxonomy is the branch of science that deals with the study of nomenclature, classification, and principles of classification. Taxonomy word was given by **"Candolle"**
(**Taxis** - arrangements. **Nomia**-distribution).

Aristotle

Aristotle:- He is known as the **"father of zoology"**. (Book **Historia Animalium**).
He is also known as the father of ancient taxonomy. He classified animals into two groups on the basis of the color of blood.
(1) **Anaima** - Those animals which don't have red blood or in which RBC are absent. e.g. Invertebrates like Sponges, Cnidaria, Mollusca, Arthropoda, Echinodermata.
(2) **Enaima** :- These animals have **red blood**. This group includes all vertebrates and it has been further divided into two subgroups.
(a) **Vivipara**:- It includes animals that give birth to young ones. e.g. Mammals.
(b) **Ovipara**:- It includes animals that lay eggs. e.g. Pisces, Amphibians, Reptiles, Aves, etc.

Symmetry

Asymmetry	When any plane that passes through the centre does not divide the body of animals into two equal halves. e.g : most of the sponges are asymmetrical.
Radial symmetry	When any plane passing through the central axis of the body divide the animal into two identical halves. e.g : Coelenterates, Ctenophores and Echinoderms (adult)
Bilateral symmetry	When the body can be divided into identical left & right halves in only one plane. e.g : Platyhelminthes to Chordates.

Body plan

Cell-aggregate type	e.g. Sponges
Blind Sac type	Animals in which digestive system is incomplete, it has only single opening to the outside of the body that serves as both mouth and anus. e.g. Coelenterates to Platyhelminthes
Tube-within-tube type	Found in those animals having complete digestive tract i.e. with separate openings mouth and anus. e.g. Nemathelminthes to Chordates

Germinal layers

Diplob-lastic	Animals in which the cells are arranged in two embryonic layers ectoderm and endoderm with an intervening undifferentiated mesoglea e.g. Coelenterates and Ctenophores.

Germinal layers (cont)

Triploblastic	Those animals in which the developing embryo has a third germinal layer–Mesoderm in between the ectoderm and endoderm e.g. Platyhelminthes to Chordates.

Level of body organisation

Protoplasmic level	In protozoans, unicellular body performs all biological activities
Cellular level	In sponges, cells are arranged as loose cell aggregates and division of labour occurs among cells (Tissues absent)
Tissue level	In coelenterates and ctenophores, cells performing the same function are arranged into tissues
Organ level	In Platyhelminthes tissues are grouped together to form organs.
Organ system level	In higher animals, organs further organise to form organ systems e.g. Aschelminthes, Annelida, Arthropoda, Echinodermata and Chordata

Segmentation

Pseudo-metameric	e.g. Tapeworms
Metameric	In Annelids, Arthropods and Chordates. In these animals, the body is externally and internally divided into segments with a serial repetition of atleast some organs, this is called metameric segmentation and the phenomenon is known as Metamerism.

Notochord

Non-chordates	Animals without notochord e.g. Porifera to Hemichordata
Chordates	Animals with notochord. eg. Chordata

The notochord is a mesodermally derived rod-like structure formed on the dorsal side during embryonic development in some animals.

Circulatory system

Open type	In which the blood is pumped out of heart and the cells & tissues are directly bathed in it. e.g. Arthropods, Molluscs, Echinoderms, Hemichordates and some lower Chordates like tunicates

Circulatory system (cont)

Closed type	In which the blood is circulated through a series of vessels of varying diameters i.e. arteries, veins and blood capillaries e.g. Annelids, Cephalopod molluscs, Vertebrates etc.

Embryonic development

Protostomiates	Animals in which mouth is formed first (Blastopore→Mouth) e.g. Platyhelminthes to Mollusca
Deuterostomiate	Animals in which anus is formed earlier than mouth (Blastopore → Anus) e.g. Echinoderms, Hemichordates and Chordates.

On the basis of the fate of blastopore, animals can be divided into two categories :
(i) Protostomiates
(ii) Deuterostomiate

Body Cavity or Coelom

Acoelo-mates	Animals in which the body cavity is absent e.g. Porifera, Coelenterata, Ctennophora, Platyhelminthes
Pseudocoe-lomates	In same animals body cavity is not lined by mesoderm, instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom. e.g. Aschelminthes.
Coelomates	Animals possessing coelom i.e. the body cavity which is lined by mesoderm on all sides On the basis of embryonic development, the coelom is of two types: (i) **Schizocoel** – Coelom formed by splitting of a mesodermal mass e.g. Annelida, Arthropoda, Mollusca. (ii) **Enterocoel** – Coelom formed by fusion of gut pouches during embryonic stage e.g. Echinodermata, Hemichordata and Chordata.

The presence or absence of a cavity between the body wall and gut wall is very important in classification.

Important Phyla

1.	**Protozoa (Included in kingdom - Protista)**	Amoeba , Paramoecium etc
2.	**Porifera (Kingdom - Animalia)**	Sponges (Leucosolenia, Sycon)
3.	**Coelenterata/Cnidaria**	Hydra, Jellyfish, etc
4.	**Ctenophora (minor phylum)**	Pleurobrachia, Ctenoplana
5.	**Platyhelminthes**	Flatworms (eg: Tapeworm)
6.	**Nemathelminthes/Aschelminthes**	Roundworm (eg: Ascaris)
7.	**Annelida**	Earthworm, Leech, etc

Important Phyla (cont)

8.	**Arthropoda**	Insects, Scorpion, Fly, etc.
9.	**Mollusca**	Snail, Pila, Octopus, etc.
10.	**Echinodermata**	Starfishes
11.	**Hemichordata**	Balanoglossus
12.	**Chordata**	Fish, Snake, Birds, Monkey, etc

Test Your Knowledge 01

1. Which of the following phylum have radially symmetrical organisms ?

(1) Coelenterata

(2) Platyhelminthes

(3) Aschelminthes

(4) Annelida

> (1) Coelenterata

2. Which of the following phylum possess true coelom ?

(1) Aschelminthes

(2) Annelida

(3) Ctenophora

(4) Platyhelminthes

> (2) Annelida

3. Loose cell aggregate type body plan is found in _____.

(1) Protozoa

(2) Porifera

(3) Coelenterata

(4) Platyhelminthes

> (2) Porifera

4. Which of the following phylum is pseudocoelomate ?

(1) Aschelminthes

(2) Arthropoda

(3) Annelida

(4) Platyhelminthes

> (1) Aschelminthes

5. When any plane passing through the central axis of body and divides the animal into two identical halves. It is called as _____.

(1) Asymmetry

(2) Radial symmetry

(3) Bilateral symmetry

(4) Biradial symmetry

> (2) Radial symmetry

6. Which of the following phylum have "Tube within tube" body plan ?

(1) Platyhelminthes

(2) Coelenterata

(3) Porifera

(4) Nemathelminthes

> (4) Nemathelminthes

7. Which of the following phylum has closed circulatory system ?
(1) Arthropoda
(2) Annelida
(3) Mollusca
(4) Echinodermata

> (2) Annelida

8. Segmentation is found in :-
(1) Annelida, Arthropoda, Mollusca
(2) Arthropoda, Mollusca, Echinoderms
(3) Annelida, Arthropoda, Chordata
(4) Arthropoda, Echinoderms, Chordata

> (3) Annelida, Arthropoda, Chordata

9. Which of the following group is Deuterostome–
(1) Annelida, Arthropoda, Mollusca
(2) Echinodermata, Hemichordata, Chordata
(3) Annelida, Mollusca, Chordata
(4) Arthropoda, Mollusca, Echinodermata

> (2) Echinodermata, Hemichordata, Chordata

10. Incomplete digestive tract found in -
(1) Platyhelminthes and Aschelminthes
(2) Platyhelminthes and Ctenophora
(3) Aschelminthes and Annelida
(4) Coelenterates and Aschelminthes

> (2) Platyhelminthes and Ctenophora

Animal Kingdom Cheat Sheet

by Mudassir Khan (mvdassir_) via cheatography.com/160173/cs/33771/

PHYLUM - PORIFERA (Sponges)

1. Members of this phylum are commonly known as **"Sponges"**. The study of sponges is known as **Parazoology.**

2. All are **aquatic and Sessile**, mostly **marine** but few are found in **fresh water** also. They are solitary or colonial. The entire body with pores i.e. numerous small **Ostia** for entry and one large opening **Osculum** for the exit of water.

3. Sponges have various body forms and shapes with **irregular** shapes mostly **Asymmetrical**. (Radial symmetry in Sycon and Leucosolenia)

4. Sponges are primitive multicellular acoelomate animals and have a **cellular level** of organization.
5. Body wall encloses a large central cavity the **spongocoel** or **paragastric cavity** with small hollow canals.

6. **Canal system or water transport system**: It is a unique feature of sponges, water enters through Ostia in the body wall into the spongocoel and goes out through the osculum. This pathway of water transport is helpful in food gathering (Nutrition), respiratory exchange, and removal of Wastes (excretion).

7. **Choanocytes** form the lining of Spongocoel and canals. The ceaseless beating of flagella helps in maintaining the flow of water current.

8. Nutrition is holozoic. Digestion is **intracellular** and occurs in food vacuoles of choanocytes.

9. Skeleton is internal, and consists of tiny **calcareous spicules** or **siliceous spicules** or fine **spongin fiber** located in the mesenchyme. **Scleroblast** secretes spicules and **spongioblast** secretes spongin fibers.

10. **Respiration** and **Excretion** take place by diffusion of gases through the body surface. The excretory matter is **Ammonia.**

11. **Reproduction** takes place by means of-
(A) **Asexual** - By Budding or Fragmentation or by Special cell mass **Gemmules** containing **Archaeocytes.**
• Endogenous buds of asexual reproduction in sponges are known as **Gemmules** (In unfavorable conditions).
(B) **Sexual** - Sponges are **Hermaphrodite**, fertilization is **internal** and **cross** due to **Protogynous** condition and development is **indirect** having a larval stage which is morphologically distinct from adult.

PHYLUM - CNIDARIA

• Coelenterates are also known as **Cnidarians** due to the presence of stinging cells called **Cnidoblast** or **Cnidocytes**.

1. Mostly **marine**, **few fresh-water** (Hydra) Carnivorous, sessile or free swimming.

2. **Radial symmetry**.

3. **Tissue level of organization, acoelomate animals.**

4. They develop from two germinal layers **(1) Ectoderm (2) Endoderm** i.e. they are **Diploblastic** (mesogloea between two layers) Interstitial cells are totipotent cells found in both layers of the body wall.

5. Coelenterates have two basic body forms (**Dimorphic**) -

(A) **Polyp**-

-Cylindrical and sessile form

- May be solitary or Colonial

- Mouth directed upwards

e.g.- Hydra, Adamsia

(B)**Medusa**-

- Umbrella-shaped and free swimming

- Always solitary

- Mouth directed downwards

e.g. - Aurelia

• Either or both zooids may occur in a species.

• If both are found in a species, two forms alternate in life cycle, Polyps produce medusae asexually and medusae form the polyps sexually, this alternation of generation is called **Metagenesis** eg:- **Obelia**

• Group of different types of zooids in polyp or medusa shows **polymorphism**.

6.**Cnidoblast** or **Cnidocyte** (contains stinging capsule as Nematocyst) present on the tentacles and body, which are used for **anchorage** (Attachment), **defense** and for the capture of Prey (Offence).

PHYLUM - CNIDARIA (cont)

• Body of some coelenterates may be covered by the exoskeleton of calcium carbonate. eg. :- **Corals**

7. A large central cavity called **Coelenteron** is having a single aperture on **hypostome** i.e. **Incomplete digestive tract (Blind sac)**.

8. **Digestion** is **extracellular** as well as **Intracellular** i.e. takes place in Coelenteron as well as in food vacuole. The mouth serves both purposes.

• Coelenteron is also responsible for the distribution of food besides partly digesting it. Due to this dual role, it is named coelenteron or **Gastro-vascular cavity**.

9. **Respiration** and **Excretion** take place by diffusion of gases through **body surface**. The excretory matter is **Ammonia**.

10. **Nervous system** diffused type and consists of **non-polar neurons** (Nerve net).

11. Reproduction

– Asexual by budding

– Sexual by the production of gametes

– Development is indirect with larval stages

– Larva of **Obelia - Planula** (free living).

– Larva of **Aurelia - Ephyra.**

PHYLUM - CTENOPHORA

1. Ctenophores are known for their **beauty** and **delicate** nature. In sunlight, their comb-plates give the effect of a rainbow. They are commonly known as **"Sea-gooseberries"** or **"Comb-jellies"** or **"Sea-walnuts".**

2. Nematoblasts are absent, so they are also called **"acnidarians".**

3. They are **exclusively marine.**

4. **Bioluminescence** (The property of a living organism to emit light) is well marked.

5. Body is soft **transparent** jelly-like. They are **radially symmetrical**, **Diploblastic** organisms with **tissue grade** body organization.

6. Locomotion takes place by the presence of **8 ciliary comb plates** on the body surface.

7. Digestion is both extracellular and intracellular.

8. Skeletal, Excretory and Respiratory systems are absent.

9. They are **carnivorous**. A pair of long solid tentacles are present. In place of nematoblasts, special types of cells are present on tentacles, called **Lasso cells (Colloblasts)** which help in catching the prey.

10. Sexes are not separate. Reproduction takes place only by sexual means. Fertilization is external.

11. Development is of the **indirect** type. The life cycle involves a free-living **Cydippid** larval stage.

e.g.

1. Pleurobrachia
2. Ctenoplana
3. Beroe - Swimming eye of Cat.
4. Cestum -

PHYLUM - PLATYHELMINTHES

1. They have dorsoventrally flattened bodies and hence are called **flatworms.**

2. These are **mostly endoparasites** found in animals including human beings but some are Free-living (aquatic).

3. Study of worms causing a parasitic infestation in humans is called **Helminthology.**

4. Body is **Bilaterally symmetrical** and the body organization is of **organ /organ system grade.**

5. Body is **Triploblastic** i.e. body is formed from three germinal layers i.e. **Ectoderm, Endoderm & Mesoderm.**

PHYLUM - PLATYHELMINTHES (cont)

6. Locomotary organs are absent in these animals but **adhesive organs** like **suckers, hooks**, etc are present in the parasitic form.
7. Epidermis is sometimes ciliated. On the body wall of parasitic animals, a thick cuticle is present i.e. **Tegument.** A thick cuticle protects the parasite from the digestive enzymes of the host.
– Muscles in the body wall are **mesodermal**. Below the epidermis, **longitudinal, circular, and oblique** muscles are present.
8. These are **acoelomate.** In between various organs a solid, loose mesodermal tissue called **Mesenchyma** or **Parenchyma** is present.
9. Digestive system is **incomplete** (Blind sac body plan) and without an anus but in Tapeworm digestive system is completely absent. They absorb nutrients from the host directly through their body surface.
10. **Skeleton, respiratory and circulatory systems** are **absent.**
11. They **respire** through the **body surface. Anaerobic** respiration is found in internal parasites like Taenia.
12. **Excretion** occurs through specialized cells called **flame cells or Solenocytes (Protonephridia)**. They also help in **osmoregulation.**
13. **Nervous system** is **ladder-like** and consists of a nerve ring and longitudinal nerve cords.
14. They are **Bisexual.** The **reproductive system** is **complex** and well developed. Fertilization is **internal.** Development **indirect** through many larva stages.
15. Some members like **Planaria** possess a **high regeneration capacity.**
16. Examples-

(A) Planaria -

Found in freshwater, nocturnal, cannibalic, slow creeping, omnivorous. Reproduce sexually as well as asexually (Transverse binary fission), with good power of regeneration. The pharynx can be everted.

(B) Fasciola hepatica (Liver fluke)

• Life history involves two hosts (Digenetic parasite)
(1) Primary host - Sheep & Goat
(2) Secondary host - Garden snail (Planorbis, Lymnea)
• Adult fluke is found in the bile ducts and liver of Sheep and causes **Liver-rot** or **Cirrhosis disease.**
• Shows many larval stages namely **Miracidium** (enters into snails body) →Sporocyst → Redia →Cercaria → Metacercaria →Eaten by sheep and develops into adult fluke.
• Infective stage for Primary host (Sheep) - Metacercaria
• Infective stage for Secondary host (Snail) - Miracidium (Free swimming)

(C) Schistosoma (Blood fluke):

Found in veins of human bladder and intestine. Unisexual, Large male carries female in a groove **gynaecophoric canal** on the ventral side. It shows sexual dimorphism.

• Life history involves two hosts (Digenetic parasite)
(1) Primary host - Man
(2) Secondary host - Garden snail (Planorbis, Lymnea)
• **Miracidium** → **Sporocyst** → **Cercaria** larvae are found.
• Larva enters the human body by boring in the skin while bathing in ponds.
It damages the liver & causes intestinal disorder - **Schistosomiasis** or **Bilharzia disease.**

(D) Taenia solium (Pork tapeworm):

Flat, white ribbon-like.
• Body divided into (1) head or scolex with hooks & suckers (2) Neck-for forming new proglottides

PHYLUM - PLATYHELMINTHES (cont)

(3) long strobila approx 850 proglottides. T. solium is a human gut parasite, Attached to the intestinal wall by hooks & suckers. Anaerobic respiration. Hermaphrodite, Self-fertilization.

• Life history involves two hosts (Digenetic)

(1) Primary host - Man

(2) Secondary host - Pig

• Development through many larval stages namely: Onchosphere, Hexacanth, Bladder worm and Cysticercus

• Man gets an infection from undercooked pork containing encysted larvae cysticerci.

• Infective stage for the primary host (Man) - Cysticercus.

• Infective stage for the secondary host (Pig) - Onchosphere

• It causes the disease Taeniasis and Cysticercosis

PHYLUM - NEMATHELMINTHES (ASCHELMINTHES)

1. Phylum includes **roundworms** that appear circular in cross-section.

2. **Nematodes** are found everywhere, they may be free-living (aquatic and terrestrial) or parasites in plants and animals.

3. They have long, **cylindrical bodies** with tapering ends and **without segmentation.**

4. Symmetry - **Bilateral**,
Germ layer - **Triploblastic**,
Level of organization - **Organ-system level** and having **tube within tube body plan.**

5. Anterior end does not show a distinct head (Cephalisation absent).

6. **Body wall** consists of
(i) **Cuticle** - Nonliving, thick, and resistant to the digestive enzymes of the host.
(ii) **Epidermis** - Syncytial i.e. a continuous layer of cytoplasm having scattered nuclei.
(iii) **Muscle layer** - Only Longitudinal muscle fibers present

7. They are **Pseudocoelomate** animals, the body cavity is there between the body wall and digestive tract which is not lined by a mesodermal epithelium i.e. **Pseudocoel** (developed from embryonic blastocoel)

8. **Skeleton** is absent but fluid pressure in the pseudocoelom maintains body shape. It is called **Hydroskeleton.**

9. **Digestive tract** is **complete** and differentiated into mouth, pharynx, intestine, and anus.
The **pharynx** is **muscular** and well developed. It is used to suck liquid food. The intestine is non-muscular.

10. **Respiration** is through the **body surface** by diffusion.

11. **Excretory system** is H-shaped and consists of **excretory canals (Protonephridia)** which remove body wastes from the body cavity through excretory pores. They develop from an embryonic **"Renette cell".** The excretory matter is **ammonia.**

12. **Nervous system** comprises a **nerve ring (Brain)** and longitudinal **nerve cords.** Sense organs like **Papillae** (tangoreceptors), and **Amphids** (chemoreceptors) are present on lips while **Phasmids** (chemoreceptors) are found on the tail.

13. **Reproduction system** is developed and the sexes are separate **(Dioecious)**. Fertilization is **internal** and development may be **direct or indirect.**

14. **Sexual dimorphism** is present.
In Ascaris male is smaller than the female and curved from its caudal end. Male has Pineal setae for copulation. The genital tract joins with the digestive tract to form the cloaca. Female is larger than male and straight at both ends. Genital and digestive tract open independently (Cloaca absent).

PHYLUM - NEMATHELMINTHES (ASCHELMINTHES) (cont)

15. Eg.
(1) **Ascaris** - Roundworm (in the small intestine), larva - **Rhabditiform/Rhabditoid**
(2) **Ancylostoma** - Hookworm (in the small intestine)
(3) **Wuchereria** - Filarial worm (Viviparous)
• Digenetic parasite that causes **Filariasis/Elephantiasis** disease.
• Carrier host is a female **Culex** mosquito.
• Adult mainly infects lymph vessels and lymph nodes in humans.
(4) Dracunculus - Guinea worm (Madina worm) or Fiery serpent (Digenetic - Cyclops as intermediate host)
(5) Enterobius - Pinworm or seat worm (in the large intestine)
(6) Trichuris - Whipworm (in the intestine)
(7) Rhabditis - Free-living nematode
(8) Trichinella - Infection in intestines and striated muscles (viviparous)

PHYLUM - ANNELIDA

1. Free-living is found in moist soil (Terrestrial), freshwater or marine but few are parasites.
2. Body is soft elongated, cylindrical, and divided into **segments** or **metameres** by ring-like grooves called Annuli.
3. They are **bilaterally symmetrical**, **triploblastic**, and have an **organ system level** of organization with the **tube within the tube** body plan.
• They are **metamerically segmented** and **coelomate** animals.
• Anterior end has a distinct head with sense organs in a few annelids. (eg: Nereis)
4. They have **Chitinous Setae** and lateral muscular appendages called **Parapodia** for **locomotion.**
5. **Body wall** consists of
(i) **Cuticle** - Moist and elastic
(ii) **Epidermis** - Living layer that secretes dead cuticle outside
(iii) **Muscle layer** - Contains circular and longitudinal muscles which help in Locomotion
6. **Body cavity** is a **true coelom** lined by mesodermal coelomic epithelium. **(Schizocoel/First Eucoelomate).** It is filled with **coelomic fluid** that serves as a **hydrostatic skeleton.**
7. **Digestive tract** is **complete**, straight, and extends through the entire body. Digestive glands are developed for the first time in Annelida.
8. **Respiration** is through **moist skin (Cutaneous respiration)**, Some have **gills (branchial respiration).**
9. **Circulatory system** is the **closed** type and a **pulsatile heart** is present.
• The blood is red with **hemoglobin-like** pigment which remains dissolved **in plasma (Erythrocruorin).** It has amoeboid corpuscles only. (RBCs absent)
10. **Excretory organ** is **Nephridia** (sing. nephridium). They also help in **osmoregulation.** Excretory matter (1) **Ammonia** in aquatic form (2) **Urea** in landform
11. **Nervous system** consists of a **nerve ring (Brain)** and a solid, double, and ventral **nerve cord** with ganglia.
12. **Reproduction** is **sexual**, **Nereis** is **dioecious** but **earthworms** and **leeches** are **monoecious.**
• Development is **direct or indirect** with free swimming ciliated **trochophore** larva.
13. Examples:
1. **Nereis** - Sandwarm/ Ringworm
(a) Cephalisation is present.
(b) Parapodia helps in locomotion.

PHYLUM - ANNELIDA (cont)

(c) Unisexual
(d) Larva is trochophore
2. **Pheretima** - Earthworm
(a) Cephalisation absent
(b) Setae for locomotion
(c) Bisexual or hermaphrodite
3. **Hirudinaria** - Freshwater leech (Bloodsucking leech)
(a) Cephalisation and setae absent
(b) Parapodia and setae absent
(c) Bisexual
(d) Hirudin (anticoagulant) present
4. **Aphrodite** - Sea mouse

PHYLUM - ARTHROPODA

1. Arthropoda is the largest phylum of Animalia which includes insects. Over two-thirds of named species on earth are arthropods.
2. They may be aquatic (marine and freshwater) or terrestrial, free-living, and sometimes parasitic.
3. Body is Bilaterally symmetrical, Triploblastic with organ system level of organization
4. They are metamerically segmented and coelomate animals.
5. Body is divided into three regions Head, thorax & abdomen, but in some head and thorax are fused to form cephalothorax (Prosoma)
6. Unique features
(i) They have jointed appendages for different functions. (arthro - jointed, poda - foot/appendages).
(ii) The body of Arthropods is covered by a Chitinous exoskeleton.
7. Body cavity around the viscera contains blood and the coelom filled with blood is called the haemocoel.
8. Digestive Tract is complete and they can feed upon all kinds of food substances.
9. Respiration by gills (e.g. Prawn), Book-gills (e.g. King crabs). The tracheal system (e.g Insects), Book-lungs (e.g. Scorpion), The trachea carries oxygen directly to the body cells.
10. Circulatory system is Open type i.e. blood flows in open tissue spaces and haemocoel instead of blood vessels. Blood is colourless and called Haemolymph (e.g. Insect). Respiratory pigment absent. Copper-containing pigment haemocyanin is found in some arthropods (e.g. Prawn).
11. Excretory organs are - Antennary or green glands (e.g. Prawn), Coxal gland (e.g. Scorpion), Malpighian tubules (e.g. Insects) opening into the gut.
12. Excretory matter is Ammonia in aquatic animals and Uric acid in land animals.
13. Nervous system comprises a nerve ring and a double, solid, and ventral nerve cord bearing ganglia.
14. Head is distinct [High degree of cephalization]
15. Sensory organs like simple eyes, compound eyes or both, antennae, statocyst, and anal cerci are found.
16. They are mostly dioecious. Fertilization is usually internal but few aquatic forms have external fertilization. Gonads have ducts. Sexual dimorphism may be present. They are mostly oviparous.
17. Development may be direct or indirect.
18. Animals of Arthropoda are the most successful invaders of terrestrial environments among invertebrates due to the presence of (i) Cuticle (ii) Appendages (iii) Wings
19. Examples:-
• Economically important insect - Apis (Honey bee), Bombyx (Silkworm), Laccifer (Lac insect)
• Vectors - Anopheles, Culex, and Aedes (mosquitoes)

PHYLUM - ARTHROPODA (cont)

• Gregarious pest - Locusta (Locust)
• Living Fossil - Limulus (King crab)
• Others - Butterfly, Scorpion, Prawn, Spider, Cyclops, Centipede, Millipede, Peripatus, etc.
20. MOUTH PARTS IN INSECTS
(i) Biting and chewing - Grasshopper, Cockroach, Termites, Caterpillars.
(ii) Piercing- sucking - Mosquitoes, Bugs, Tse-tse fly
(iii) Chewing- lapping type - Honey Bee
(iv) Sponging type - Housefly.
(v) Siphoning type - Butterflies, moths
21. Muscles are stripped/striated/voluntary (first time developed in Arthropods)
22. Due to the presence of joints, muscles are separate or arranged in bundles in them.
23. Class Arachnida (Octapoda)
- Cephalothorax bears 1 pair of Chelicerae, 1 pair of Pedipalps for feeding & 4 pairs of walking legs
– Antennae absent
- Respiration - Trachea or book lungs
- Excretion - Coxal gland or Malpighian Tubules or both
- Development- Direct
-e.g.
1. Palamnaeus - Scorpion (viviparous and last segment modified into poison sting)
2. Lycosa/Agelena– Spider
3. Ticks and Mites