

# Biodiversity

The classification of organisms into groups is known as **biological taxonomy**. The value of a classification system is that it allows biologists to discern relationships between different organisms. Classification of organisms is a pursuit that has preoccupied naturalists and biologists for millennia.

Today, biologists place organisms within a system of groupings, or **TAXA** (kingdom, phylum, class, order, family, genus and species), which reflect their perceived evolutionary (or **PHYLOGENETIC**) relationships.

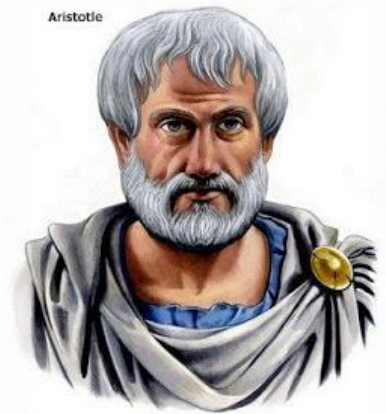
Taxonomy is the science of naming and classifying organisms. The term **taxonomy** is a Greek word. Its components are *taxis* and *nomos*. While *taxis* means arrangement, *nomos* means law. Thus taxonomy is defined as the “**theory and practice of classifying organisms**” (Mayr 1966).

The term **systematics** originates from the Greek word *systema*. It means ‘placing together’. Thus systematics means “**classification of living things in accordance with their natural relationships**”.

“**The grouping of information or objects based on similarities**”. The term **classification** in meaning partly overlaps with taxonomy. However it simply means the activity of classifying.

Since the world has a vast range of organisms, identifying the useful, as well as harmful living beings is a need. Differentiating, grouping and giving names to living things has been an ancient activity of every human culture. Without proper classification it would be impossible to deal with enormous diversity of life forms.

The initiation for evolving taxonomic systems was provided by **Aristotle (384-322 BC)**. He emphasized that animals can be classified according to their way of living, actions, habits and body parts. He observed insects, fishes, birds and whales. Due to his contributions, he is considered as the ‘**father of biological classification**’.

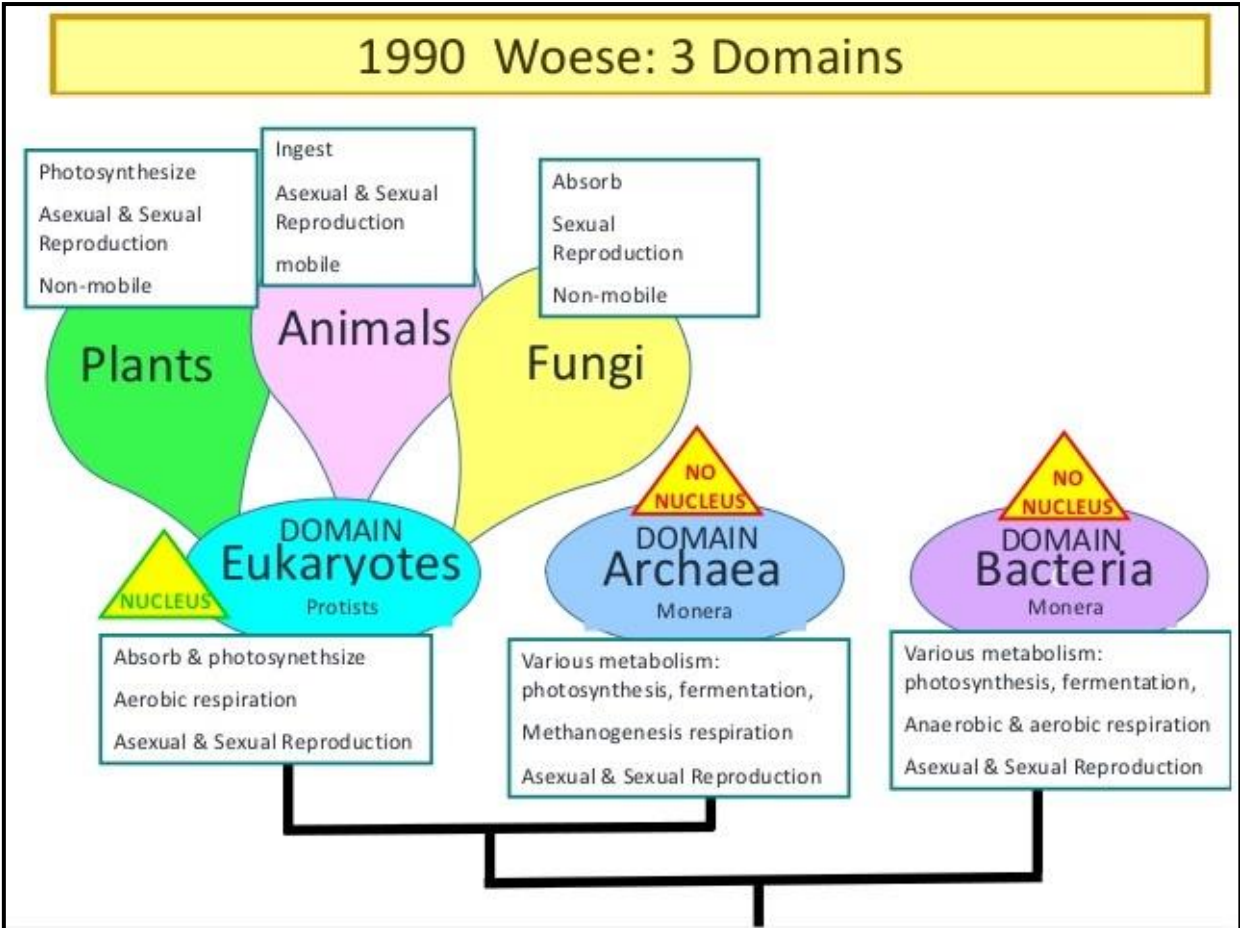


For modern taxonomy, the first work was carried out by **John Ray (1627 - 1705)** of England. He divided animals into those with blood and those without blood. He also classified animals based on gills, lungs, claws, teeth and other structures. He provided the first good definition of the species as ‘a reproducing unit’.



The great Swedish naturalist **Linnaeus (Carolus Linnaeus) (1707 - 1778)** exerted an important influence on further advancement in taxonomy. Hence he has been called the **father of taxonomy**. In 1758 he published his famous book, **systema naturae**. He first introduced the hierarchic system, both in animal and plant kingdoms. He followed four categories namely **class, order, genus, species** for the animal world. His greatest contribution to taxonomy was the use of **binomial nomenclature** for all species of animals and plants.





# Kingdoms and Domains

## The three-domain system

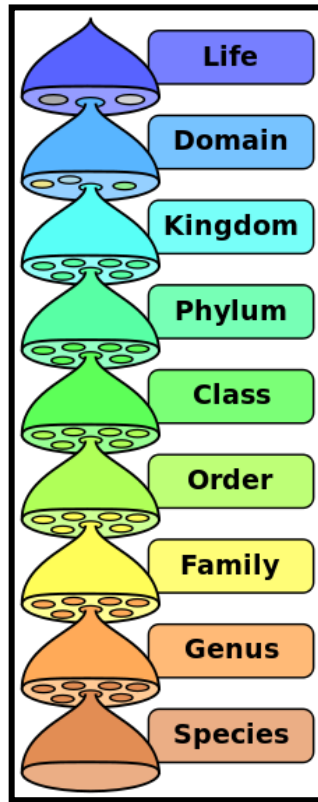


## The six-kingdom system



## The traditional five-kingdom system

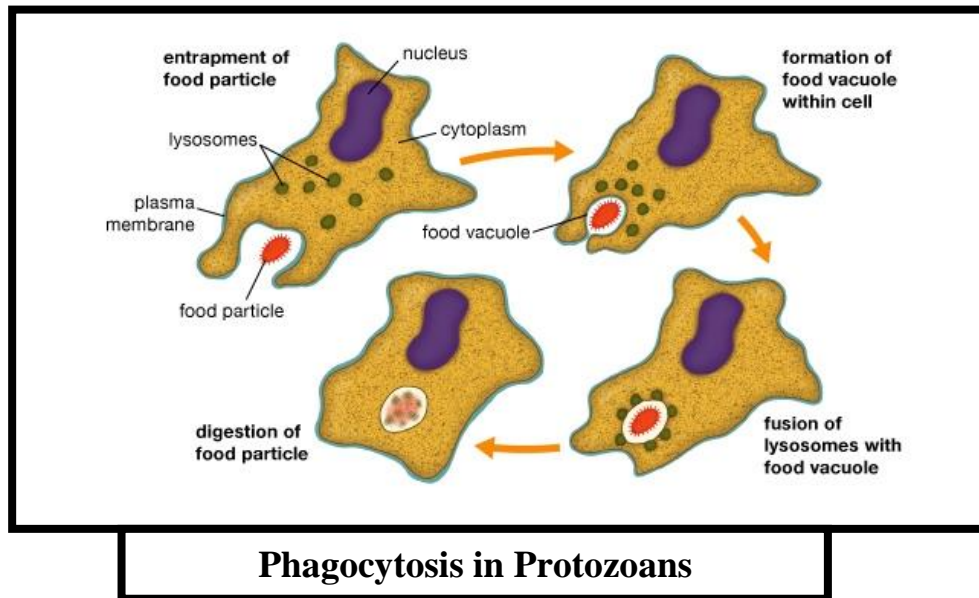




## Phylum: Protozoa

- 1- They are known as acellular or non-cellular organism. A protozoan body consists of only mass of protoplasm, so they are called acellular or non-cellular animals.
- 2- **Habitat:** mostly aquatic, either free living or parasitic or commensal. Over 64, 000 species have been described; about 50, 000 are free-living and protozoan parasites are responsible for some of the most important diseases of animals and humans.
- 3- **Size and shape.** Protozoa vary substantially in size and shape. Smaller species may be the size of fungal cells; larger species may be visible to the unaided eye. Body of protozoa is either naked or covered by a pellicle. Most protozoa have a single nucleus, but some have both a macronucleus and one or more micronuclei. Contractile vacuoles may be present in protozoa to remove excess water, and food vacuoles are often observed.
- 4- **Locomotion** is brought about by pseudopodia or flagella or cilia or myonemes.

5- **Nutrition:** Protozoa are **heterotrophic** microorganisms, and most species obtain large food particles by **phagocytosis (Fig. 14)**. The food particle is ingested into a food vacuole. Lysosomal enzymes then digest the nutrients in the particle, and the products of digestion are distributed throughout the cell. Some species have specialized structures called **cytostomes**, through which particles pass in phagocytosis. Nutrition are **holophytic** (like plant) or **holozoic** (like animal) or **saprophytic** or **parasitic**.



6- **Digestion:** digestion is **intracellular**, occurs in food vacuoles.

7- **Osmoregulation:** Contractile vacuoles help in osmoregulation.

8- **Exchange of respiratory gases** takes place by diffusion through the general body surface. Respiration is anaerobic in some parasitic forms.

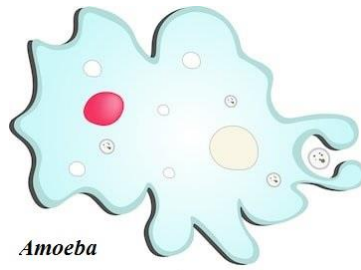
9- **Excretion** occurs by diffusion across general body surface or by contractile vacuoles. Contractile vacuoles serve mainly for osmoregulation and are common in freshwater forms.

10- **Reproduction:**

i- **Asexual reproduction** takes place by binary fission or multiple fission or plasmotomy or budding.

ii- **Sexual** reproduction takes place by syngamy or conjugation.

11- Many forms undergo **encystment** to tide over unfavorable conditions.



*Amoeba*



*Entamoeba*

**1- Class: Rhizopoda (Sarcodina)**



*Euglena*

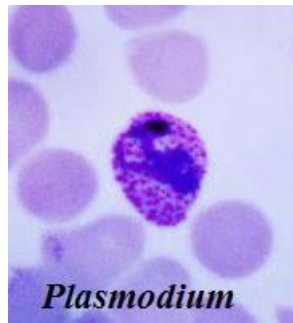


*Trypanosoma*



*Giardia*

**2- Class: Mastigophora (Flagellata)**

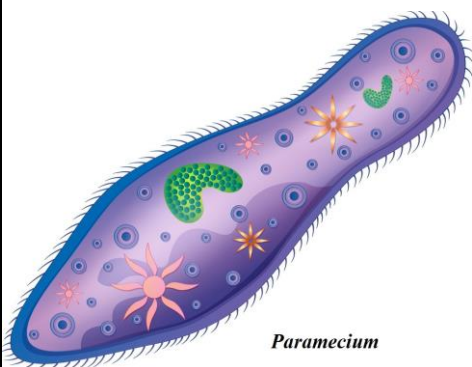


*Plasmodium*



*Monocystis*

**3- Class: Sporozoa**



*Paramecium*



*Vorticella*



*Balantidium*

**4- Class: Ciliata**

**Examples of Phylum Protozoa**

## Classification of Protozoa

Phylum	Class	Subclass	Examples
<b>Protozoa</b>	Rhizopoda (Sarcodina)	.....	<i>Amoeba,</i> <i>Entamoeba</i>
	Mastigophora (Flagellata)	<div style="display: inline-block; vertical-align: middle;"> <div style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></div> <div style="display: inline-block; width: 100px; height: 10px; border: 1px solid black; margin-right: 5px;"></div> </div>	<i>Euglena</i>
		Zoomastigophora	<i>Trypanosoma</i>
	Sporozoa	.....	<i>Plasmodium,</i> <i>Monocystis</i>
	Ciliata	.....	<i>Paramecium,</i> <i>Vorticella,</i> <i>Balantidium</i>

# Phylum: Porifera

**Porifera** (Gr.Porous-Pores, ferry- bearing). **Porifera** includes plant-like creatures with a large number of minute pores. So, commonly called **sponges**. **John Ellis** first recognized the sponges as an animal. **Robert Grant** coined the term "**Porifera**". The study of **sponges** or **poriferans** is called **parazoology**.

## General characteristics of Phylum Porifera

- 1- **Habitat:** Aquatic, mostly marine, few are terrestrial
- 2- **Habit:** They are solitary or colonial.
- 3- **Grade of organization:** cellular grade of body.
- 4- **Shape:** Body shape is variable, mostly cylinder shaped
- 5- **Symmetry:** Asymmetrical or radially symmetrical.
- 6- **Germ layer:** Diploblastic animals. The adult body wall contains two layers, outer **dermal** layer and inner **gastral** layer. In between these two layers, there is a gelatinous and non-cellular **mesogloea**. In **mesogloea**, there is supporting endoskeleton called **spicules** which are made up of  $\text{CaCO}_3$  (Calcareous),  $\text{SiO}_3$  (Siliceous) or protein (Spongin fibres).
- 7- The body surface is perforated with a large number of minute inhalant pores called **Ostia** (for the entry of water) and one largest exhalent pore called **osculum** (for the exit of water).
- 8- There is **water canal system** whose central cavity is called **paragastral cavity** or **spongocoel**. **Canal system** gets in food and oxygen and carries out carbon dioxide and wastes.
- 9- **Endoskeleton:** Either calcareous spicules (calcium carbonate) or siliceous spicules (silica) or sponging fibers (protein).
- 10- Nutrition is holozoic and digestion is intracellular.
- 11- Circulation absent, respiration, and excretion through diffusion.
- 12- Nervous system and sense organs completely absent.
- 13- **Reproduction:**
  - Asexual: by budding or gemmule or regeneration



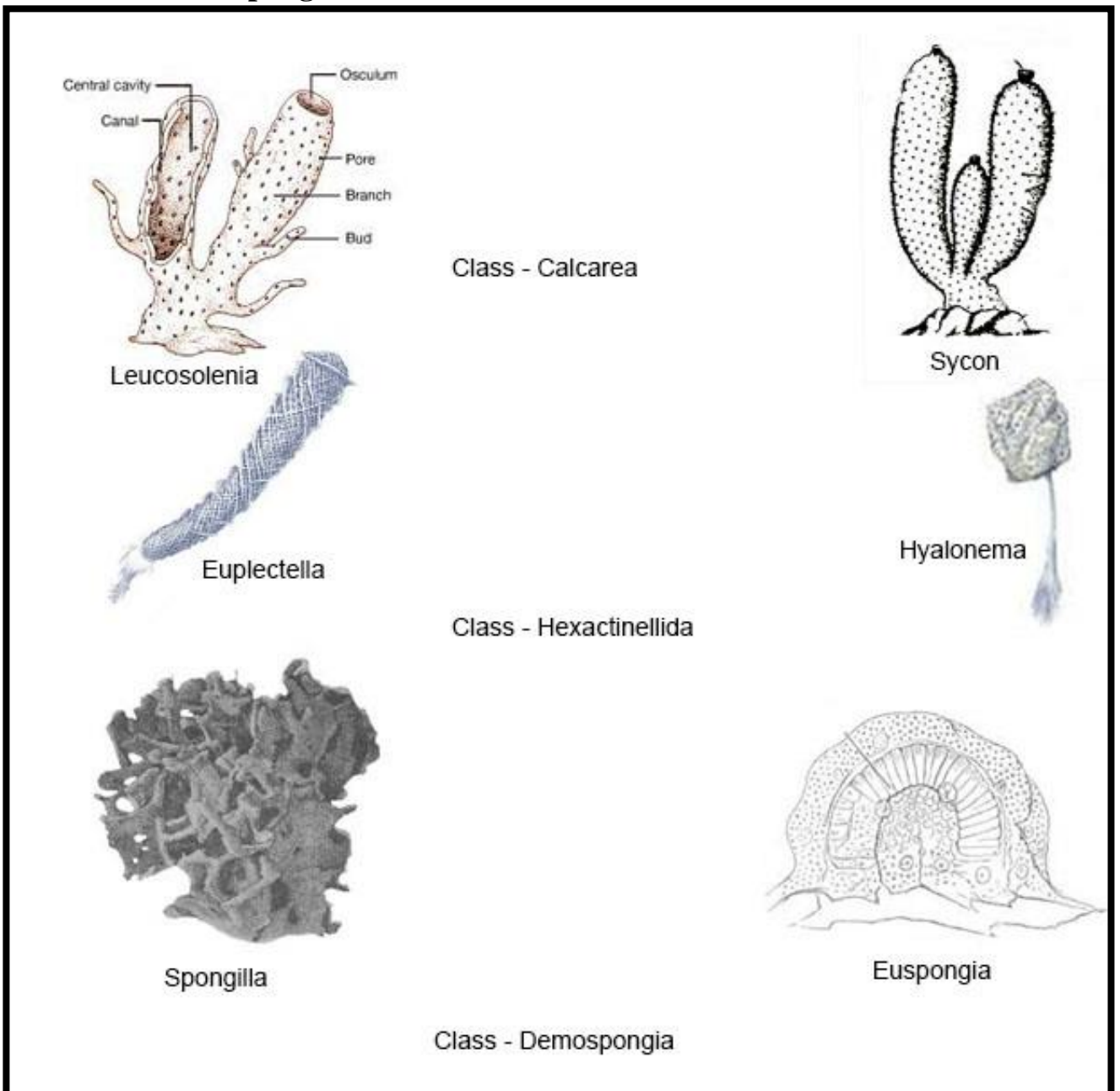
- Sexual: gamatic fusion

**15- Fertilization:** is internal and develop is indirect.

## Classification of Phylum Porifera

Porifera consists of almost 5000 living species. Based on the type of skeleton system. The phylum Porifera is divided into three classes.

- **Class 1: Calcarea**
- **Class 2: Hexactinellida**
- **Class 3: Demospongia**



Examples of phylum Porifera

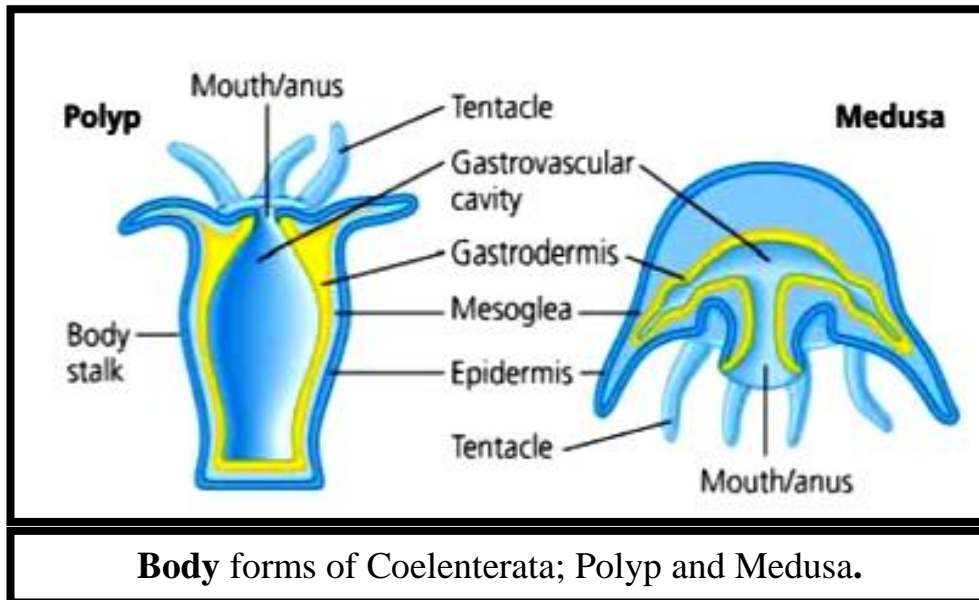
## **Phylum: Coelenterata**

These are typically invertebrate animals, which show a very simple level tissue organisation. They are aquatic animals and are mostly found in marine environments, attached to the rocks at the bottom of the ocean. A few species are also found in freshwater habitats. Coelenterates can be found solitarily or in colonies. They are sedentary or free swimming.

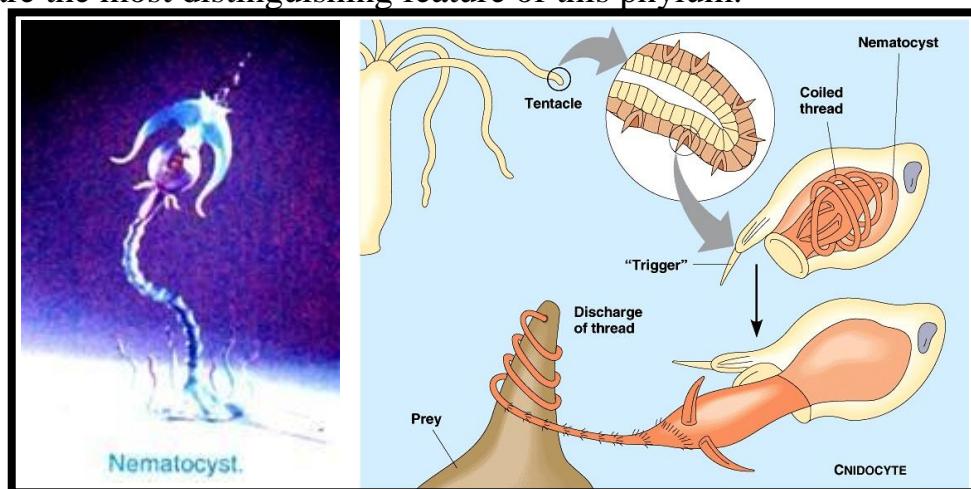
Coelenterates can be called as the simplest animal group that has true tissues and have the characteristic coelenteron or the gastrovascular cavity.

### **General characters of Coelenterata**

- 1- They are multicellular organisms, exhibiting tissue grade of the organization.
- 2- They are diploblastic, with two layers of cells, an outer layer called the (ectoderm) and the inner layer called the (endoderm). There is a non-cellular layer that is the (mesogloea) in between the ectoderm and the endoderm.
- 3- They show radial symmetry.
- 4- They have a single opening in the body through which food is taken in and also waste is expelled out.
- 5- The opening in the body is surrounded by tentacles.
- 6- Digestion takes place in the body cavity ( coelenteron).
- 7- They can live in marine or freshwater habitats.
- 8- They can be solitary or live in colonies. Each individual is called a zoid.
- 9- These organisms show two morphological forms – Polyps and Medusa



- 10- Polyps contain exoskeleton and endoskeleton.
- 11- The skeletons are composed of calcium carbonate.
- 12- Most of the coelenterates are carnivorous in nature with a few exceptions such as the sea corals. They get their food from other animals that live symbiotically within them.
- 13- Digestion is both intracellular and extracellular.
- 14- Tentacles have special structures known as the (nematocysts) (**Fig. 40**) which help in capturing and paralyzing prey. Coelenterates simply wave their tentacles and when a prey comes in contact, the nematocysts inject the toxin that paralyzes or kills the prey. Nematocysts are the most distinguishing feature of this phylum.



**Nematocyst**

- 15- Coelenterates do not have sensory organs.
- 16- Respiration and excretion occur through simple diffusion.
- 17- The circulatory system is absent.
- 18- Asexual reproduction is seen in polyps, through budding and sexual reproduction is seen in medusa form, through gametic.

## **Phylum: Platyhelminthes**

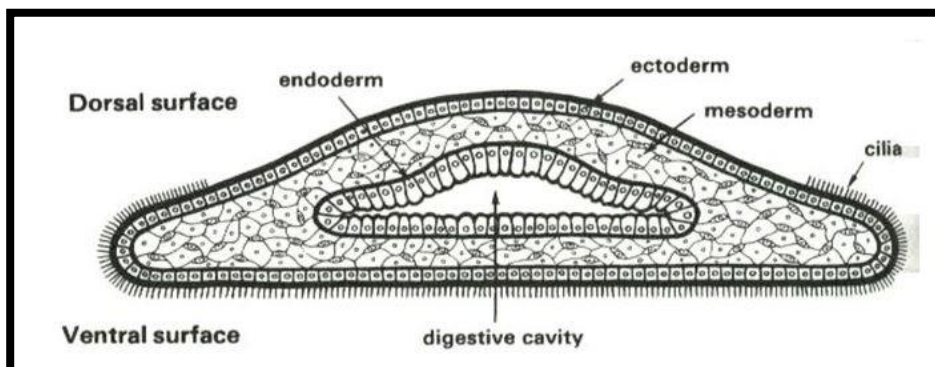
Platyhelminthes or flatworms are a diverse group comprising of 25000 living species that show evolutionary achievements over the diplo-blasts in having a structural body plan that is based on bilateral symmetry and in having definite organs or system of organs.

They, however, lack coelom (the space between the various organs being filled with a special connective tissue called parenchyma), the body being compact (acoelomate) and the absence of blood vascular system.

**Etymology: Greek: platy, (flat;) helminthes, (worms).**

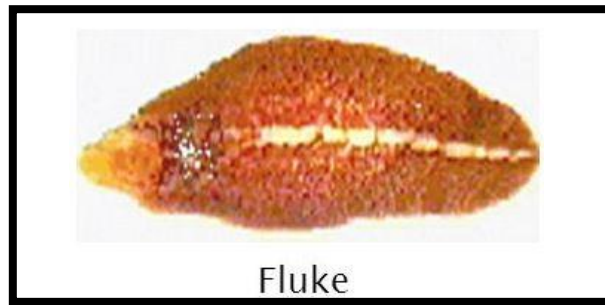
### **General characteristics of phylum Platyhelminthes**

1. Phylum Platyhelminthes are triploblastic, acoelomate (without a body cavity) and bilaterally symmetrical animals



**flatworm body plans.**

2. Body is soft, un-segmented and dorsoventrally flattened



**Platyhelminthes dorsoventrally flattened.**

3. Metameric segmentation and skeletal structures, in any form, are absent. Pseudometamerism is seen in some members (e.g., **Eucestoda**).

4. Anterior end of the body is differentiated into a head.

5. The body is covered by epidermis which is soft, syncytial and ciliated (e.g., *Turbellaria*) or in rest classes (e.g., **Trematoda, Monogenea and Cestoidea**) there are a syncytial, non-ciliated body covering, called tegument.

6. The parenchyma tissue, a mesenchymal layer which occupies the entire space between the outer body wall and the endoderm of the gut, develops from both ectodermal and entomesodermal layer of the embryo.

7. The mouth of Phylum Platyhelminthes is the single opening of the digestive tract and the anus is absent when the digestive canal is present. The digestive system is totally absent in **Cestoidea** and **Acoela**, and digestive canal is branched in **turbellarians**. So the digestive system is incomplete when present.

8. Locomotion of Phylum Platyhelminthes is effected by the use of cilia rather than muscles.

9. There are no respiratory and circulatory systems. Haemoglobin is present in a very few species (e.g., **Derostoma, Syndesmis, Telorchis, etc.**).

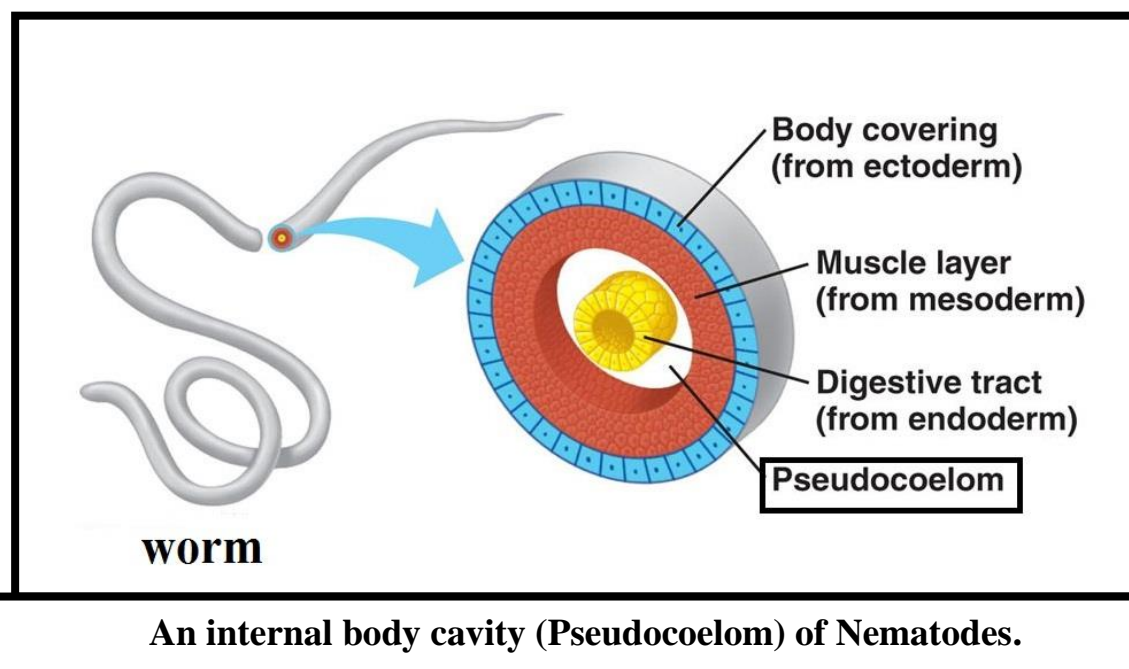
10. The nervous system is most primitive type and is formed by longitudinal nerve cords with a pair of cerebral ganglion or brain. Fertilization internal.

## Phylum: Nematoda

**Nematode**, also called **roundworm**. **Nematodes** are among the most abundant animals on Earth. They occur as parasites in animals and plants or as free-living forms in soil, fresh water, marine environments, and even such unusual places as vinegar, beer malts, and water-filled cracks deep within Earth's crust. The number of named species is about 20,000, but it is probable that only a small proportion of the free-living forms have been identified. A great deal of research has been conducted on the parasitic forms because most of them have some medical, veterinary, or economic importance.

**Nematode** is from the **Greek** (roots) *nemat-*, meaning (*thread*), and *-odes*, meaning *like* or (*resembling*). They have also been described as similar to a long, thin, round tube...hence, roundworms.

**Nematodes** were once classified with a **very large** and **heterogeneous cluster of animals** grouped together on the basis of their overall **worm-like appearance**, simple structure of an internal body cavity called a **pseudocoelom (Fig. 100)**, and the lack of features such as cilia and a well-defined head that are found in most animals. **This group**, variously known as **Aschelminths** or **Pseudocoelomata**, is today no longer recognized as a natural one.



**Phylum Nematoda** is un-segmented vermiform animals with anterior lateral chemosensory organs and with a persistent **blastocoel** or **pseudocoelom**; dorsal and ventral nerve cords in epidermis and excretory system of tubules.

### **General characteristics of phylum Nematoda**

- 1- Body of Phylum **Nematoda** is un-segmented, bilaterally symmetrical, elongated and tapering at both ends.
- 2- Triploblastic animals with perivisceral cavity is more extensive than that of Platyhelminthes.
- 3- Body of Phylum Nematoda is generally covered with thick, flexible multi-layered collagenous cuticle and often bears cuticular setae (hairs), spines or annulations.
- 4- Epidermis or hypodermis syncytial; i.e., the nuclei are not separated from each other by cell membranes.
- 5- Only longitudinal body-wall muscles; no circular body-wall muscles.
- 6- Body cavity of Phylum Nematoda is pseudocoel filled with parenchyma in most cases.
- 7- Mouth of Phylum Nematoda is surrounded by six lips. Alimentary canal provided with distinct mouth and anus (complete digestive tract). Muscular pharynx and the inner surface of the gut usually not lined by cilia. Extracellular digestion.
- 8- They are free-living or phytoparasitic or zooparasitic.
- 9- Blood vascular system and respiratory system are absent in of Phylum Nematoda.
- 10- Excretory system without nephridia and flame cells. In the class **Adenophorea** glandular renette cells with a duct or in the class **Secernentea** excretory canal system without flame cells act as excretory system.
- 11- Sexes of Phylum Nematoda are separate (gonochoristic). Fertilization is internal in of Phylum Nematoda.

## General classification of Phylum Nematoda

