



**EDO UNIVERSITY IYAMHO**



**Department of Biological Science**

## **AEB 214: Invertebrates Animals and Environment**

**Instructor:** *Dr. Osikemekha Anthony Anani*, email: osikemekha.anani@edouniversity.edu.ng

Lectures: Wednesdays, 1-3pm ML1, Phone: (+234) 8036134216

Office hours: Mondays and Thursdays, 12.30 to 4 pm, Office: Faculty of Law Building Rm B3

NUMBER OF UNITS: 3 Units

COURSE DURATION: Two (2) hours per week

### INTENDED LEARNING OUTCOMES

At the end of this course, the students are expected to:

- i. understand the various classification groups of invertebrates
- ii. know the phylogenetic relationship across all the invertebrata classes
- iii. relate and distinguish each structure and function of each class of invertebrates
- iv. explain the basic biology, ecology and adaptation of their existence.

### LECTURE RULES

Every student is expected to abide by the following rules while classes are on- going:

- ✓ Punctuality is very essential.
- ✓ Lateness to class will not be condoned.
- ✓ Listen attentively and be actively involved in class activities
- ✓ Use of cell phones while lecture is on, is prohibited.
- ✓ Indecent dressing is not allowed in the lecture room and environs.

## Others

- ✓ 70% attendance is what make a student eligible to write the exam.
- ✓ Submission of assignment as at when due is highly encouraged!
- ✓ 30% CA (continuous Assessment); collectively test, term paper, assignment and 70% examination form your total assessment.

**Grading:** I will assign 10% of this class grade to home works, 10% for term paper presentation, 10% for the mid-term test and 70% for the final exam. The Final exam is comprehensive.

## COURSE CONTENTS:

The systematic inter-relationships and basic organization of the invertebrates, Identification, phylogeny, biology and economic importance of major phyla, adaptations.

## INTRODUCTION:

Invertebrates are animals that neither possess nor develop a vertebral column (commonly known as a backbone or spine), derived from the notochord. This includes all animals apart from the subphylum Vertebrata. Familiar examples of invertebrates include insects; crabs, lobsters and their kin; snails, clams, octopuses and their kin; starfish, sea-urchins and their kin; jellyfish, and worms.

The majority of animal species are invertebrates; one estimate puts the figure at 97%. Many invertebrate taxa have a greater number and variety of species than the entire subphylum of Vertebrata.

Some of the so-called invertebrates, such as the Tunicata and Cephalochordata are more closely related to the vertebrates than to other invertebrates. This makes the invertebrates paraphyletic, so the term has little meaning in taxonomy.

Animal Taxonomy.

Taxonomy is the grouping or categorizing of things into an outline or tree structure. In the scientific classification system, biologists group and categorize every organism, living or extinct, into:

Kingdom

Phylum

Class

Order

Family

Genus

Species

## GENERAL SINVERTEBERATA CLASSIFICATION

### **Kingdom Protista**

Subkingdom protozoa

Phylum Sacromastigophora

Class Phytomastigophora

Class Zoomastigophora

Subphylum Opalinata

Subphylum Sacordina

Phylum Labyrithomorpha

Phylum Apicomplexa

Phylum Myxozoa

Phylum Microspora

Phylum Ascetospora

Phylum Ciliophora

## **Kingdom Animalia**

Phylum Porifera

Class Calcarea

Class Demospongiae

Class Sclerospongiae

Class Hexactinellida

Phylum Coelenterata (Cnidaria)

Class Hydrozoa

Class Scyphozoa

Class Cubozoa

Class Anthozoa

Phylum Platyhelminthes

Class Turbellaria

Class Monogenea

Class Trematoda

Class Cestoda

Phylum Nematoda

Class Aphasmda

Class Phasmida

Phylum Annelida

Class Polychaeta

Class Oligochaeta

Class Archiannelida

Class Hirudinea

Phylum Mollusca

Class Polyplacophora

Class Aplacophora

Class Monoplacophora

Class Gastropoda

Class Bivalvia

Class Scaphopoda

Class Cephalopoda

Phylum Arthropoda

Subphylum Trilobittomorpha

Class Trilobita

Subphylum Chelicerata

Class Merostomata

Class Arachnida

Class Pycnogonida

Subphylum Uniramia

Class Chilopoda

Class Diplopoda

Class Insecta

Subphylum Crustacea

Class Ostracoda

Class Copepoda

Class Pentastomida

Class Cirripedia

Class Malacostraca

Phylum Echinodermata

Class Crinoidea

Class Ophiuroidea

Class Asteroidea

Class Echinoidea

Class Holothuroidea

## **Kingdom Protista**

### *Classification Subkingdom protozoa*

The four main groups of protozoa traditionally recognized were the flagellates, amoebas, spore formers and ciliates. The system that follows reflects a much more phylogenetic arrangement, including the recognition that amoeba and flagellates are more closely related to each other than they are to other groups and that the 'spore formers' represent several completely unrelated forms. This taxonomy continues to follow the principles of evolutionary taxonomy rather than cladistics taxonomy.

Kingdom Protista (pro teesta): This is single-celled eukaryotes and their immediate descendant (for example, multicellular algae).

Subkingdom Protozoa (pro-to-zo'a): first animal and zoon animal like protists.

Phylum Sarcomastigophora: It uses flagella, pseudopodia or both types of locomotory organelles; usually with only one type of nucleus; typically no spore formation; sexuality, when present, essentially syngamy. Example amoeba.

Subphylum Mastigophora: It is a large and varied group. It includes all protozoans which possess one or more FLAGELLA as adult locomotory organelles. A thin pellicle gives flagellates a definitive shape. Nuclei, if more than one, are of one type.

Flagellates reproduce asexually by longitudinal binary fission while sexual reproduction involves the fusion of gametes or two adults and is not followed by abundant spore formation.

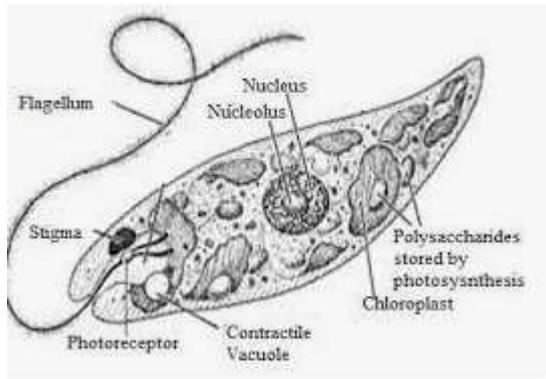
Most flagellates are solitary and free-living. An example is *Euglena*, with two unequal flagella. *Chlamydomonas* with two equal flagella. Many are sessile; others are colonial. Parasitic flagellates are the cause of some of the deadliest diseases of man and his domestic animals. Examples include sleeping sickness; *Trypanosoma* which causes African sleeping sickness; *Trichonympha*- aids digestion of wood materials in the gut of termites and wood roaches.

Flagellates consist of two groups/classes:

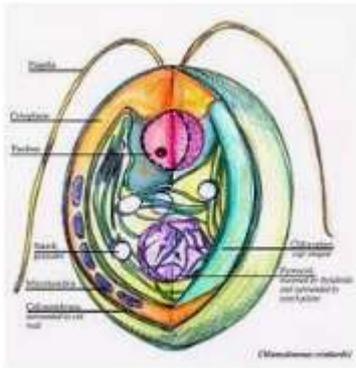
- a. Phytomastigophorea (phytoflagellates) which are plant like and have chloroplasts so are autotrophic.
- b. Zoomastigophorea (Zooflagellates) which are animal like and lack chloroplasts, so are heterotrophic (holozoic or saprozoic).

Class Phytomastigophorea

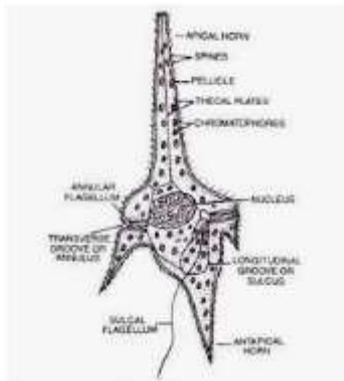
These are the plantlike flagellates, usually bearing chromoplasts (pigment-bearing bodies; chromoplasts with chlorophyll are chloroplasts), which contain chlorophyll. Examples are volvox, *Chilomonas*, *Euglena*, *Ceratium*, *Peranema* and *Noctiluca*.



## Euglena



## Chlamydomonas



## Ceratium

## Some Phytoflagellate protozoan

## A REPRESENTATIVE OF PHYTOMASTIGOPHOREA

### EUGLENA

Euglena is a representative phytomastigophorea which is easily found in stagnant water, especially pond containing high percentage of nitrogenous matter derived from organic sources.

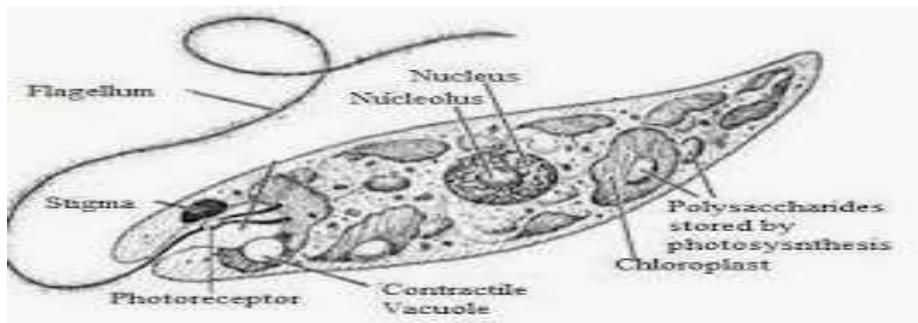


Diagram of *Euglena viridis*

Structure: The endoplasm contains the following:

1. Nucleus
2. Chloroplast, containing the chlorophyll
3. Paramylum granules (starch-like food)
4. Eyespot stigma
5. Contractile vacuole and accessory vacuoles

Functions:

Locomotion: This is done by the contraction and relaxation (lashing) of the flagellum, which acts like the propeller of a ship or plane.

Nutrition: The mode of nutrition is holophytic which involves photosynthesis by means of the chloroplast. If the surrounding water or fluid is rich in dissolved organic material or in a dark

environment where chloroplast cannot function, food substance in solution is absorbed in a saprophytic manner.

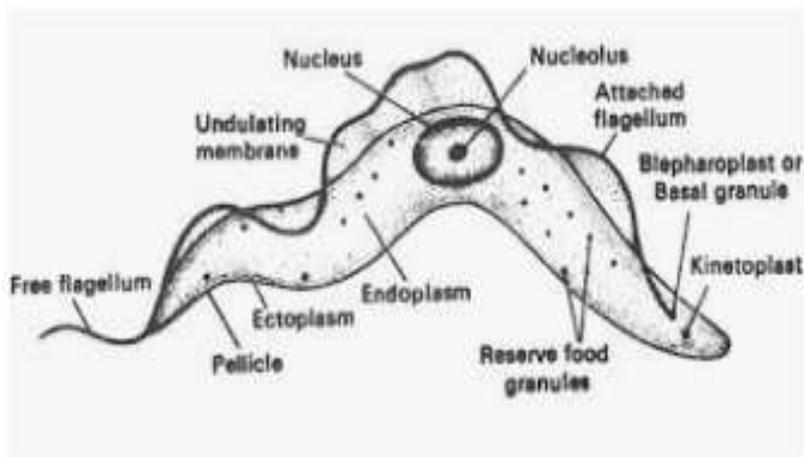
Respiration and Excretion: Gaseous exchange for respiration takes place by diffusion through the general body surface. Excretory products also diffuse outwards from the body surface.

Osmoregulation: Water content is regulated by the accessory vacuoles and the contractile vacuole. Excess water is eliminated thus excess water in the endoplasm is passed into the accessory vacuoles which in turn empty contractile vacuole enlarges to its maximum size. It contracts to pass the water into the gullet which then sends it out to the exterior.

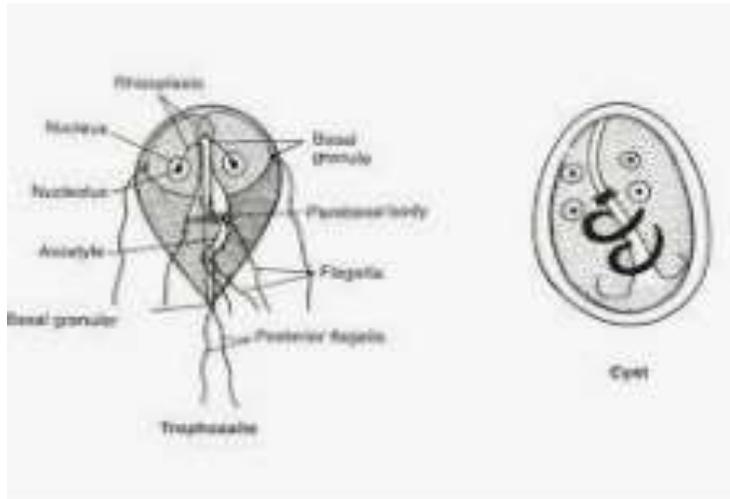
Reproduction: This involves simple longitudinal binary fission, commencing at the anterior ends after the loss of flagellum and terminating at the posterior end. No sexual fusion had been observed in Euglena.

#### Class Zoomastigophorea

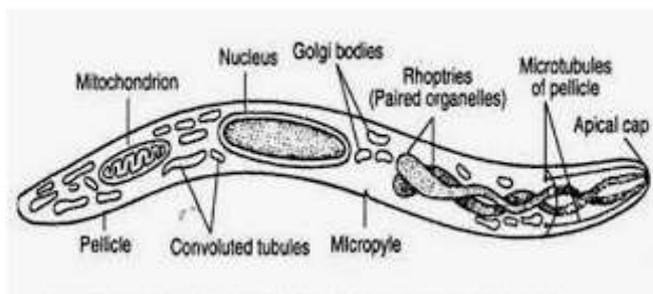
These are flagellates without chromoplast; one to many flagella, ameboid forms with or without flagella in some groups; species predominantly symbiotic E.G Trichomonas, Tichonympha, Trypanosoma, Leishmania.



## Trypanosoma sp



## Giardia lamblia



## Ultra structure of a plasmodium

### Subphyllum Oplanata

Its body is covered with longitudinal rows of cilium-like organelles; parasitic; cytostome (cell mouth) lacking; two to many nuclei of one type. Examples: Opalina, Protoopalina.

### Subphyllum Sarcodina

The pseudopodia typically present; flagella present in developmental stages of some free living or parasitic.

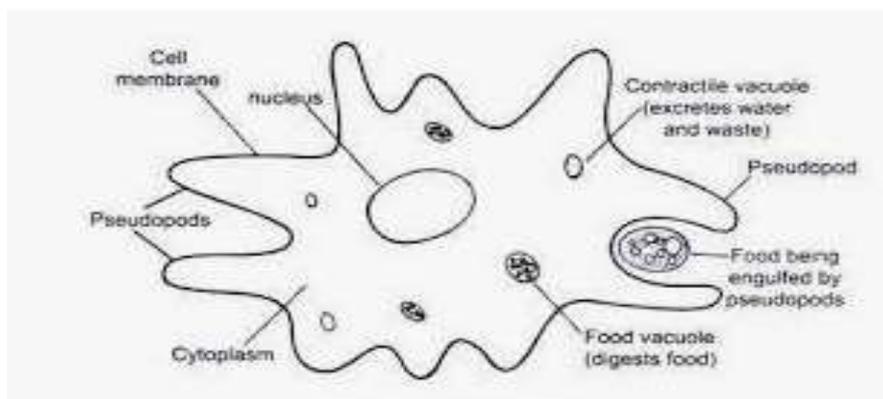
This group includes all protozoans which possess pseudopodia (flowing extensions of cytoplasm) of one type or the other (e.g. lobopodia and filopodia) as adult locomotory organelles. The body form is unstable owing to the absence of a rigid pellicle. Pseudopodia can be formed in any position on the periphery and can be withdrawn into the main mass of the cell. Many have complex skeletons (shells or tests) e.g. *Arcella* and *Amoeba proteus* with lobopodia; *Actinoshaerium* with needle-like axopodia or filopodia.

Most members are free-living and occur in freshwater, the seas and the soil e.g. *Amoeba*. Some sarcodines e.g. *Entamoeba* are parasitic. There is only one nucleus but if more than one, they are alike. Sarcodines possess fewer organelles than flagellates, and they are therefore often regarded as the simplest protozoans.

#### A REPRESENTATIVE SARCODINA: *Amoeba proteus*

*Amoeba proteus* is found creeping on mud surfaces in freshwater ponds and stagnant pools of water.

Structure: The protoplasm consists of two layers; (1) ectoplasm (outer layer), (ii) endoplasm (inner layer) in which granules are continuously moving. Inside the endoplasm are found; the contractile vacuole, the nucleus and one or more food vacuoles.



*Amoeba proteus*

Functions:

**Locomotion:** It moves by means of the pseudopodia which is a temporary protrusion of the cytoplasm. It is generally known as the amoeboid movement.

**Nutrition:** The free living Amoeba is holozoic. Its food consist of bacteria, algae, protozoans, diatoms, nematodes and rotifers. The pseudopodia engulf the prey along with drop of water to form a food vacuole. Digestion takes place within the food vacuoles. Digested food is absorbed into the cytoplasm and the vacuole becomes smaller. The undigested food remnants are removed through a temporary anus at the posterior end as the animal moves away.

**Respiration:** Gaseous exchange for respiration is through the body surface by diffusion across the ectoplasm.

**Osmoregulation:** The contractile vacuole collects excess water entering the protoplasm and periodically collapses to expel its contents through any part of the body surface.

**Excretion:** Nitrogenous waste materials pass into solution and diffuse outwards through the ectoplasm.

**Reproduction:** Amoeba reproduces entirely by asexual methods. There are two possible modes of division:

- a. **Binary fission:** This takes place under favorable conditions. The nuclear membrane divides by mitotic division, after which the nucleus elongates and separates followed by division of the cytoplasm to produce two daughter amoebae.
- b. **Multiple fission (spore formation):** This occurs under adverse conditions such as starvation and unfavorable environmental condition due to seasonal changes. The

amoeba produces an outer cyst wall around its body. Within the cyst the nucleus divides several times to produce several spores. Each spore forms a protective cyst wall from which a small amoeba will emerge when conditions become favourable.

There is basically no sexual reproduction, but at times, several individuals may flow together to give a single mass of cytoplasm with several nuclei, a process known as *plastogamy*.

Parasitic forms: Members of the genus *Entamoeba* are examples of the parasitic forms of Amoeba. Other examples include *Entamoeba gingivalis* , living in human mouth, *E coli*, inhabiting the colon of man, *Entamoeba histolytica*, found in human intestine causing amoebic dysentery.