

# MORPHOLOGY OF PROTOZOA

# Introduction to Parasitology

---

- Parasite is defined as an animal or plant that lives in or upon another organism (Host) and draws its nutrient directly from it.
- E.g include Bacteria, Viruses, Fungi, Protozoas and helminths.
- Study of parasite is known as Parasitology.
- Medical Parasitology is the study of animal parasite that infect and produce diseases in humans

# Classification of Parasites

---

## 1. Ectoparasite

- The parasites that live on the outer surface or in the superficial tissues of the host are called ectoparasites. Infection caused by these parasites is called infestation. E.g Lice

## 2. Endoparasite

- The parasites that live within the host are called endoparasites. Invasion by such parasites is called infection. Eg. Leishmania

# Types of Endoparasites

## a. Obligate Parasites

- The parasites that cannot exist without a host are called obligate parasites. Eg. *Toxoplasma gonodii*

## b. Facultative Parasites

- The parasites that live a parasitic or free-living existence when an opportunity arises are called facultative parasites. Eg *Naegleria fowleri*

## c. Accidental Parasites

- The parasites that attack an unusual host are called accidental parasites. Eg. *Echinococcus granulosus*

## d. Aberrant Parasites

- The parasites that during migration in the host, reach a site where they cannot live or develop further are called aberrant parasites. Eg *Toxocara* types

# Host

- A host is defined as an organism that harbours the parasites and provide nourishment and shelter.
- The hosts are relatively larger in size in comparison to their parasites.
  
- Types of Host
- i. Definitive Host
  - The host that harbours adult parasites (e.g. *Taenia saginata*) or highly developed forms of parasites (*Trypanosoma cruzi*) or where parasites replicate sexually (*Paragonimus westermani*).
  - Definitive host may be human or non-human living things.
- ii. Intermediate Host
  - The host that harbours the asexual forms of parasites are called intermediate host. They are needed for completion of life cycle.

### iii. Reservoir Host

- The animals that harbour parasites and serve as an important source of the infection to other susceptible hosts are known as reservoir host.
- ~~E.g. dogs are the reservoir host for cystic echinococcus.~~

### iv. Paratenic Host

- When the parasite lives in a host in which it cannot develop further, such a host is called paratenic host. E.g. freshwater prawn is the paratenic host for *Angiostrongylus cantonensis*.

### v. Natural Host

- The host that are naturally infected with certain species of parasites are called natural host. E.g. pig is natural host for *Balantidium coli*.

### vi. Accidental Host

- The hosts in which parasites is not usually found are called accidental hosts. E.g. human is an accidental host for *E. granulosus*

# Host-Parasite Relationship

- a. Symbiosis- parasites and host cannot live without each other.

---

- b. commensalism- it is an association in which only the parasite derives the benefit without causing any injury to the host. E.g. *Entamoeba coli* in the human intestine.
- c. Mutualism- both the parasite and the host are benefitted. E.g, the flagellates in the gut of termite digest woody materials consumed by termites. These are converted into glycogenous substances used by the host. In absence of each other both perish
- d. Parasitism- it is an association in which the parasites derives benefits from the host and always causes injury to the host e.g. *plasmodium spp.* Causing malaria

# Protozoa

- The word protozoa is come from Greek *protozoon* word meaning “First Animal”.
- Protozoa are unicellular (may be Multicellular) Eukaryotic microorganism.
- Protozoa constitute a large group of about 65,000 species. Most of which are harmless free living and inhabits water and soil
- A few species are pathogenic in nature parasitize human and other animals causing hundreds of million of infections in a year around the world



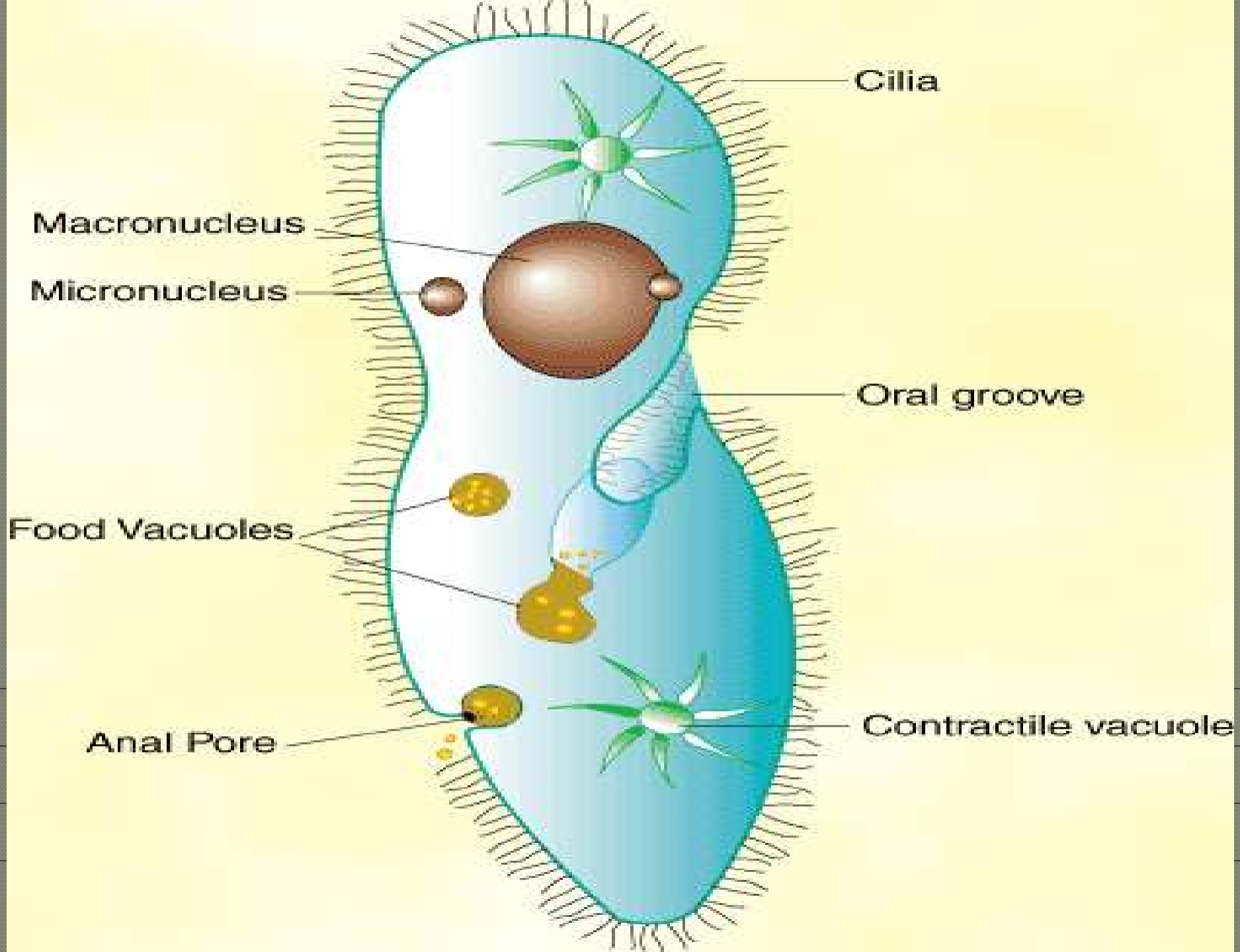
# CHARACTERISTICS

- Mostly Unicellular organism with fully functional cell
- Live freely, may be parasitic or symbiotic
- Protozoa are chemo-heterotrophs
- They are motile have locomotive organelles. E.g. Flagella and Cilia for movement

# MORPHOLOGY

- Protozoa are Eukaryotic resemble to animal cell, contain major cell organelles (including Nucleus, Mitochondria)
- They are microscopic in size less than 50  $\mu\text{m}$ .
- Their organelles are highly specialized for feeding, reproduction and movement
- The cytoplasm of protozoa are divided into an outer layer called *Ectoplasm* and an inner layer called *Endoplasm*

- Ectoplasm helps in movement, feeding and Protection
- Endoplasm houses Nucleus, mitochondria and food
- Some protozoa have special appendages **Flagella** and **cilia** that helps in their movements
- Freshwater protozoa have **contractile vacuoles** to pump out excess water
- Their shape may remain constant (specially in Ciliates) or change constantly (as seen in Amoeba)



# CLASSIFICATION OF PROTOZOA

- Protozoa are classified on the basis of their motility and method of reproduction
- They are classified into Four main types
  - Flagellates
  - Ciliates
  - Sarcodina
  - Sporozoates

# FLAGELLATES

- Flagellates move by help of Flagella (a tail-like structure ). The movement is whip like
- Example of Flagellates are
  - Trypanosoma, Leishmania (blood pathogen)
  - Giardia (intestinal parasite)
  - Trichomonas (reproductive tract pathogen)

# CILIATES

- Ciliates protozoa have movement through cilia (fine hair like structure attached with their body).
- Some protozoa have special kind of cilia for feeding and attachment.
- Most are harmless. Only one species *Balantidium Coli* is pathogenic for human causes a rare and server form of Dysentery.

## SARCODINA

- Major loco-motor organelles in Sarcodina is pseudopodia (Pseudo means false, *podia* means Foot)
- Common example of Sarcodina is Amoeba
- Most species are harmless
- Entamoeba is a parasitic for human causes intestinal disease



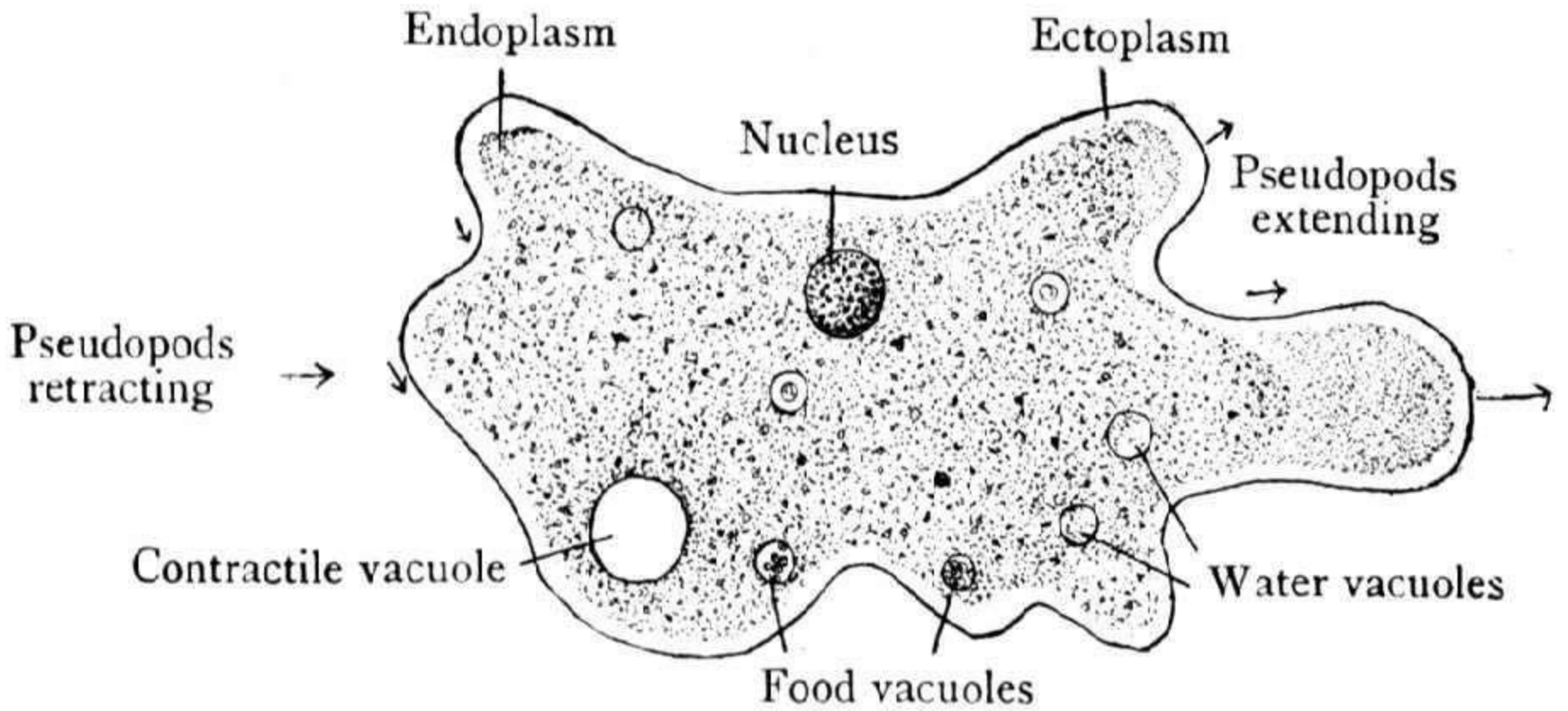
# SPOROZOITES

- Sporozoites are the only non-motile form of protozoa.
- Sporozoites have well developed sexual and asexual stages
- Entire group is parasitic in nature and are harmful
- Some common examples of Sporozoites and their infections are
- Plasmodium (causative agent of Malaria, causes 100 to 300 million infection world wide)
- Toxoplasma Gondii (causes Toxoplasmosis)

# Intracellular Structure

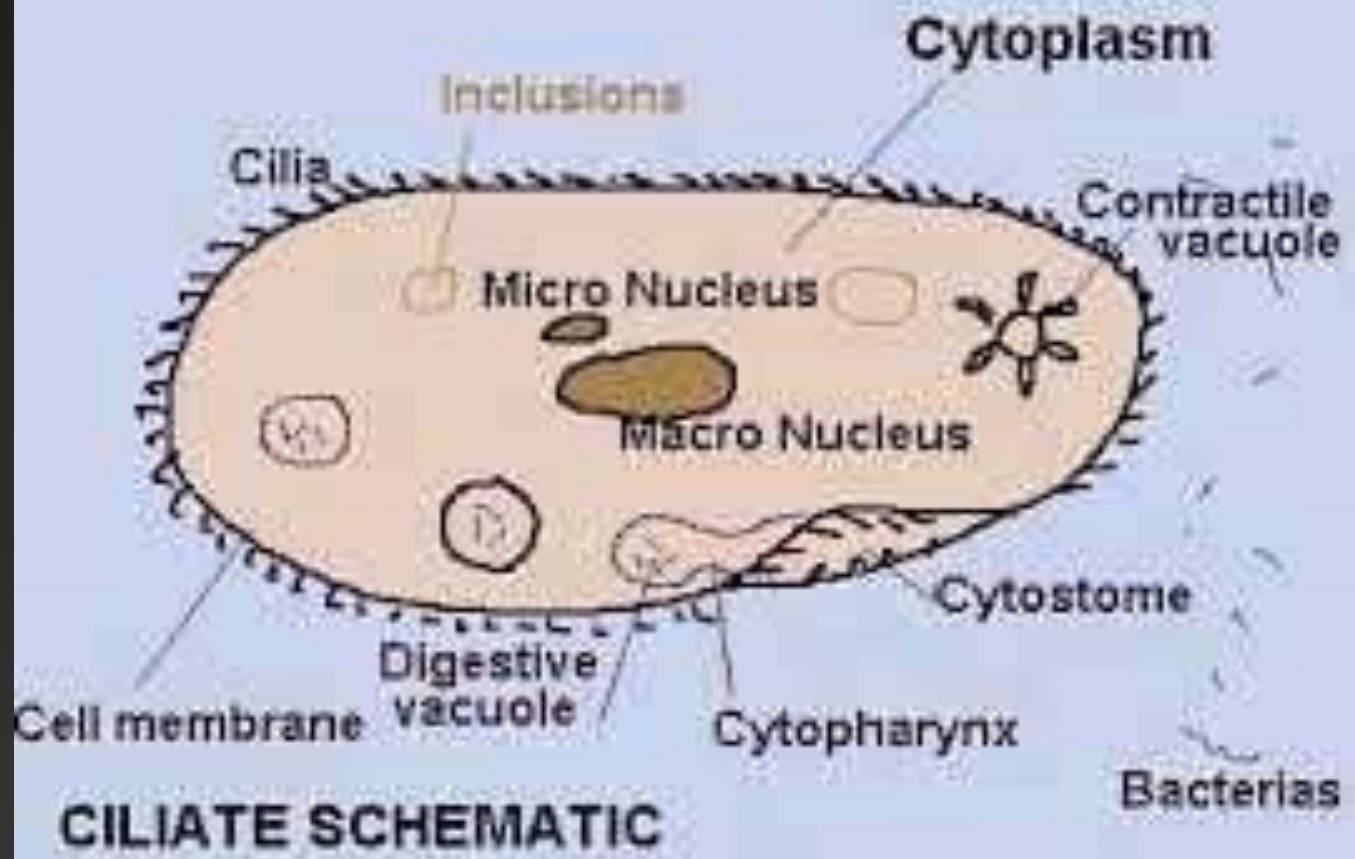
## Cytoplasm

- Homogeneous, show colours (green, brown, blue , purple due to pigment)
- Has submicroscopic protein fibrils (myonemes, microtubules)
- Arranged in parallel
- Divided in two portions- ectoplasm & endoplasm
- Ectoplasm- more gel like and endoplasm is voluminous and fluid
- Cell organelles are present (ER, ribosomes, golgi complex, mitochondria, food vacuole, contractile vacuole, kinetosome)



# NUCLEUS

- 
- Eucaryotic nucleus- has chromosomes, the nucleolar substance, the nuclear membrane, nucleoplasm
  - one or many
  - Some have two
    - a. Macronucleus- large in size, controls the metabolic activities and regeneration processes
    - b. Micronucleus- small in size concerned with reproductive activity



# PLASMALEMMA & OTHER COVERINGS

---

- **Cell membrane or plasmalemma**  
outermost layer, semi permeable
- **Functions**
  - a. protection**
  - b.site of perception of chemical and mechanical stimuli**
  - c. transport**

# Compound coverings

---

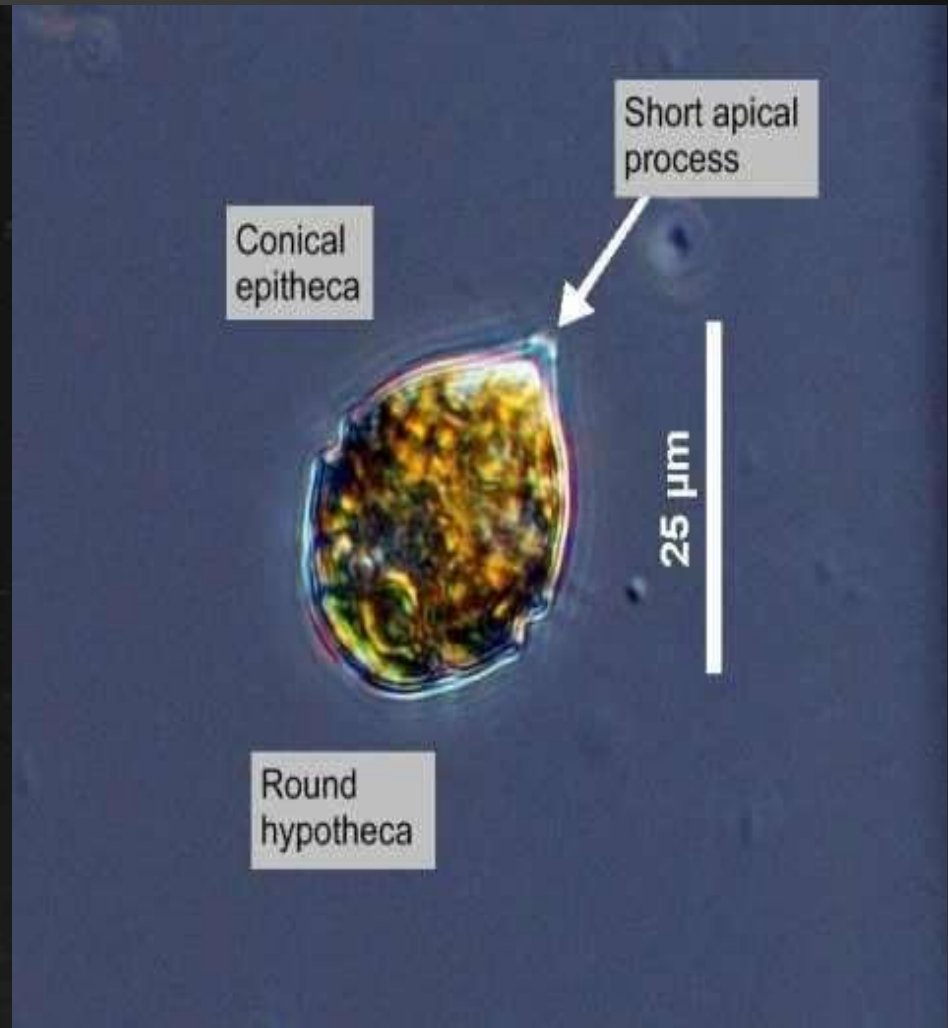
- **Combinations of membranes, also called pellicle**
- **Simplest is plasmalemma eg, Amoeba**
- **Some have mucopolysaccharide on plasmalemma plays an important role in pinocytosis and adhesion**
- **Can be thick, ridged and sculptured, nodular thickening,**

# ADDITIONAL COVERINGS

---

- **Diverse**
- **Egs. thecae, shells, tests or loricae**
- **Thecae- directly secreted by the organism**
- **Others are the loose coverings**
- **Made up of organic and inorganic materials (calcium carbonate and silica)**





# FEEDING STRUCTURES

- Pseudopodia- in Amoeba
- Tentacular feeding tubes- in suctorians
- Mouth (cytosome)- in ciliates
  - a. simple round opening
  - b. a slit like- remains open all the time in some and some have slit which can be opened and closed and always located anteriorly
- Oral groove- an indentation in the pellicle , guides food toward the cytosome and act as a concentrating device
- Peristome- this an oral groove with membranelles
- Cytopharynx- it is a region through which the food must pass and is enclosed in the food vacuole.

Pseudopodia

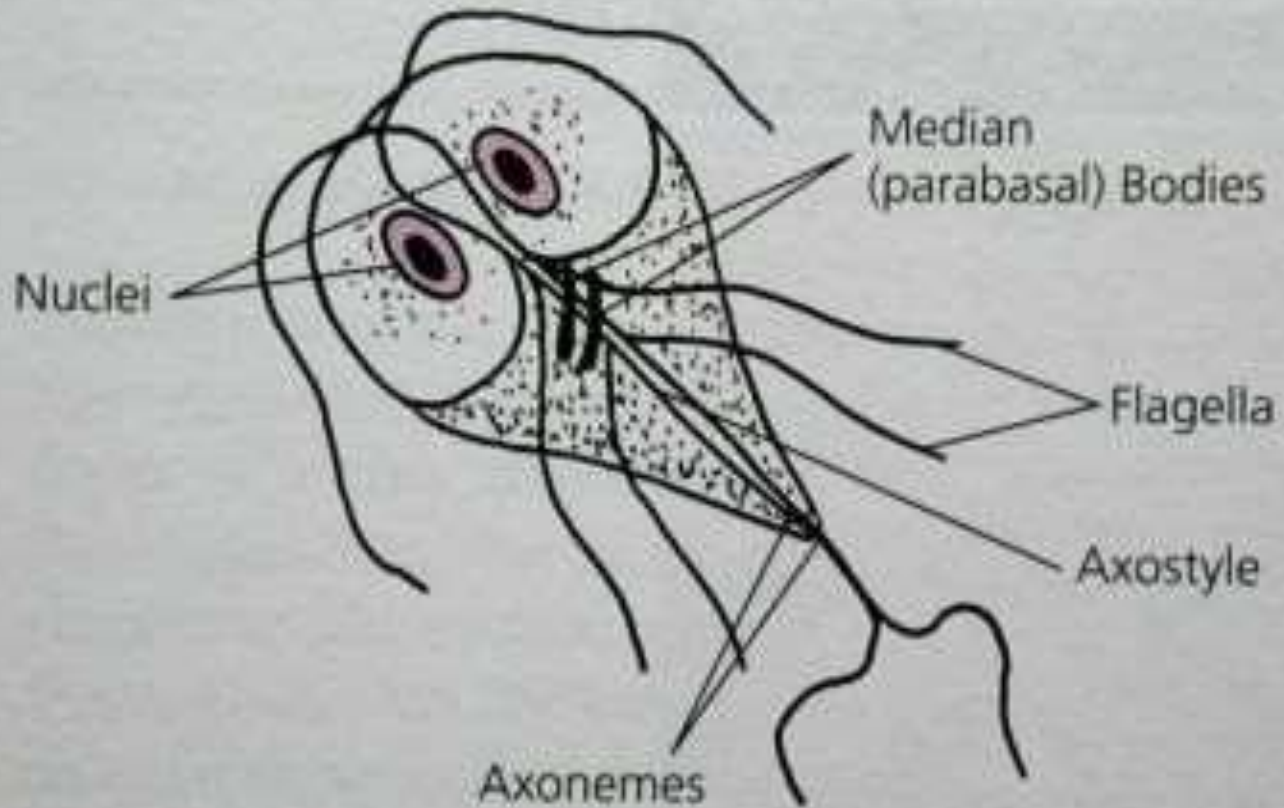
**TENTACULAR FEEDING  
TUBES**

# Stages of Protozoa

---

## Trophozoites

- It is the replicative stage of most of the protozoans
- It is the active feeding stage of the parasites and this stage is associated with the pathogenesis of the disease.

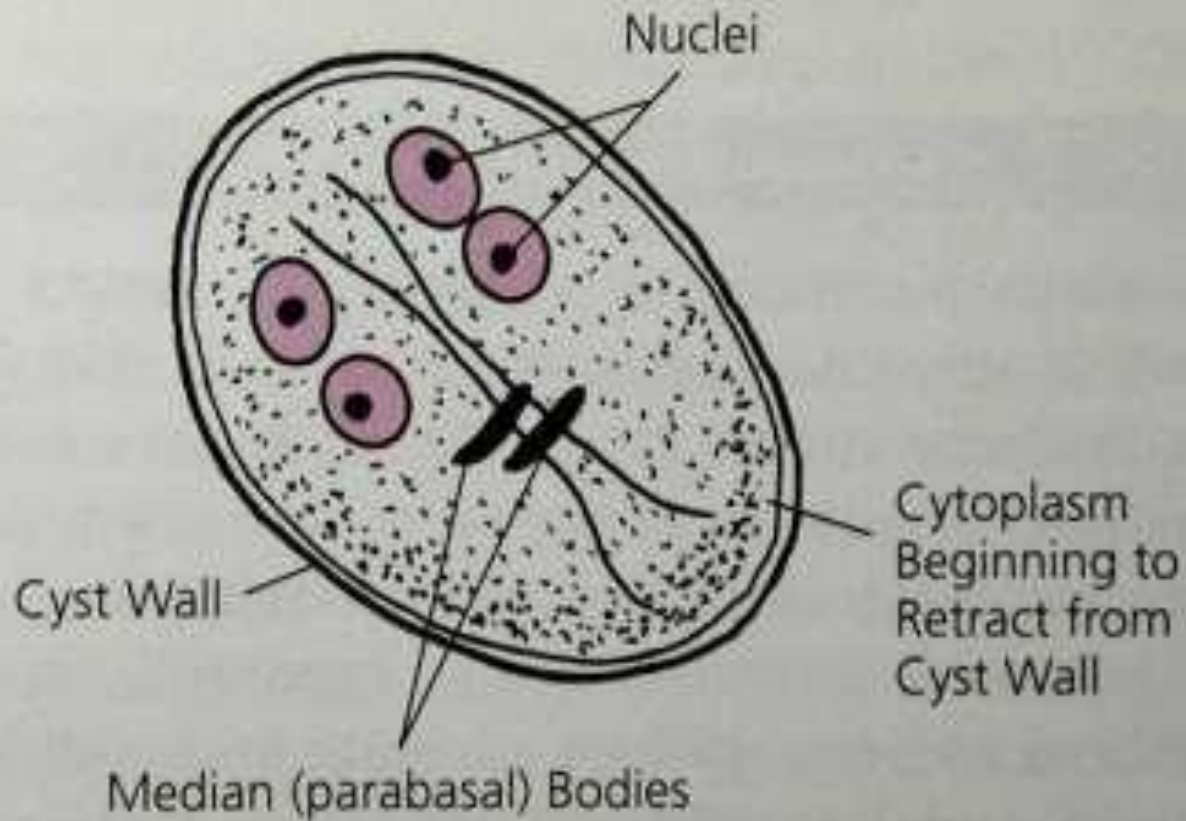


Size Range: 8 – 20  $\mu\text{m}$  by 5 – 16  $\mu\text{m}$   
Average Length: 10 – 15  $\mu\text{m}$

# CYS TS

---

- ❑ **Resistant structure**
- ❑ **Able to survive an adverse conditions like dessication, low nutrient supply, lack of oxygen etc.**
- ❑ **Surrounded by a protective membrane or thick wall called cyst wall**
- ❑ **Cyst stage is an infective stage for intestinal pathogens**
- ❑ **Cyst is important mean of asexual reproduction**



Size Range: 8 – 17  $\mu\text{m}$  by 6 – 10  $\mu\text{m}$   
Average Length: 10 – 12  $\mu\text{m}$

# Reproduction in Protozoa

---

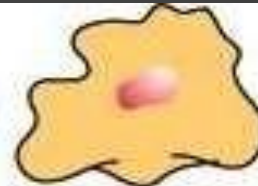
## □ PROTOZOA CAN REPRODUCE THEIR OFF SPRING BY BOTH SEXUAL AND ASEXUAL METHODS

- Asexual methods of reproduction are:
  - Budding
  - Binary Fission
  - Schizogony or Multiple Fission
- Sexual Methods
  - Conjugation
  - Gametogony

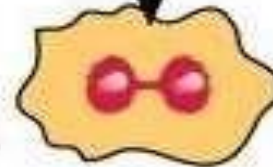


# Binary Fission

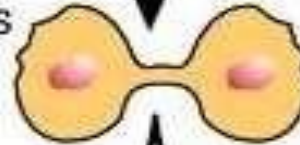
Amoeba divides after it has grown to a certain size.



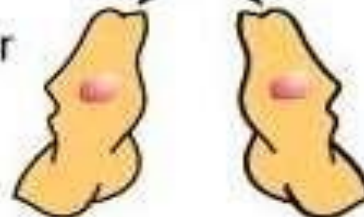
The pseudopodia are pulled in and the nucleus divides.



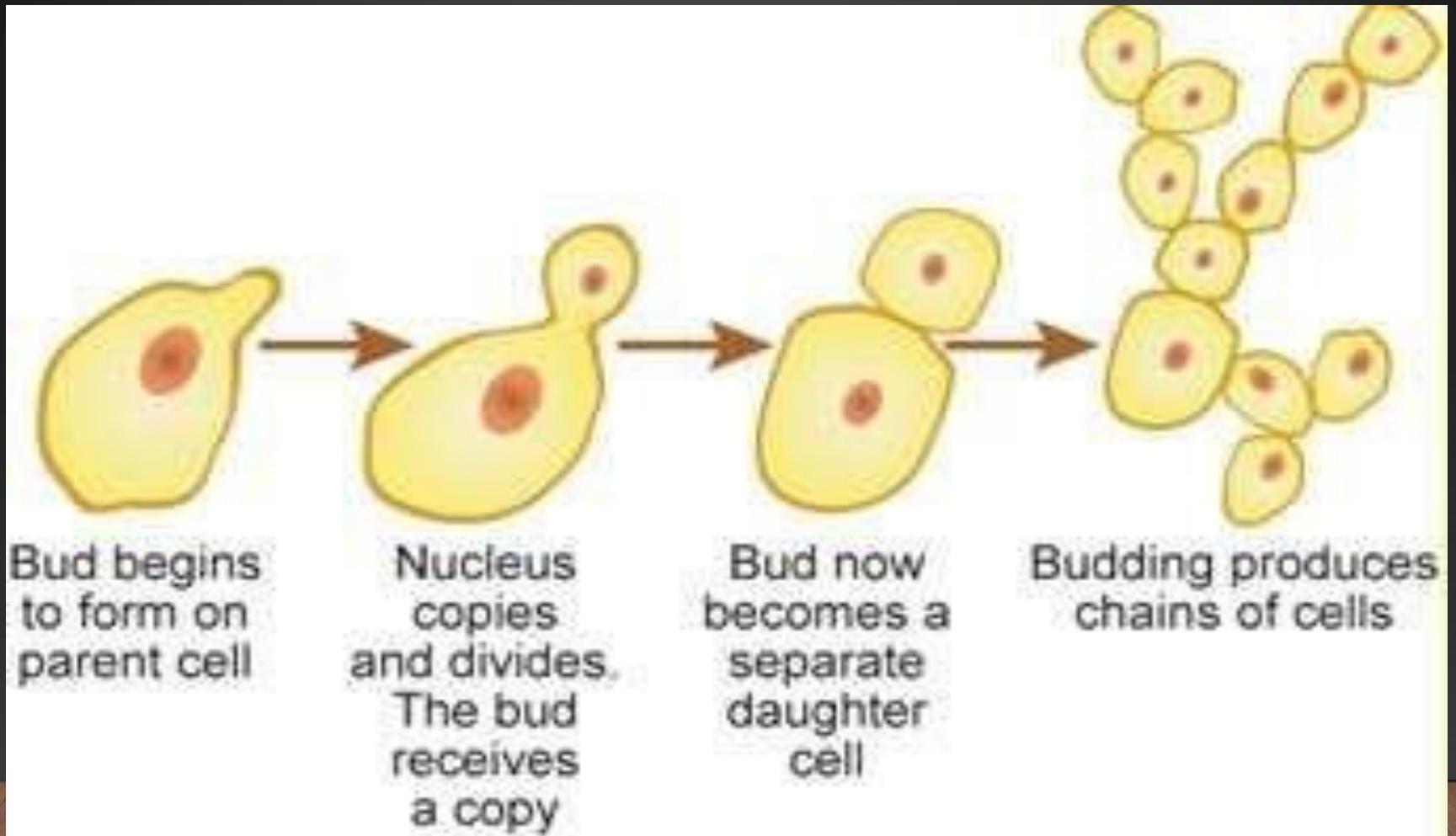
The cell body begins to divide when the nucleus has split.



Two daughter amoebae are formed.



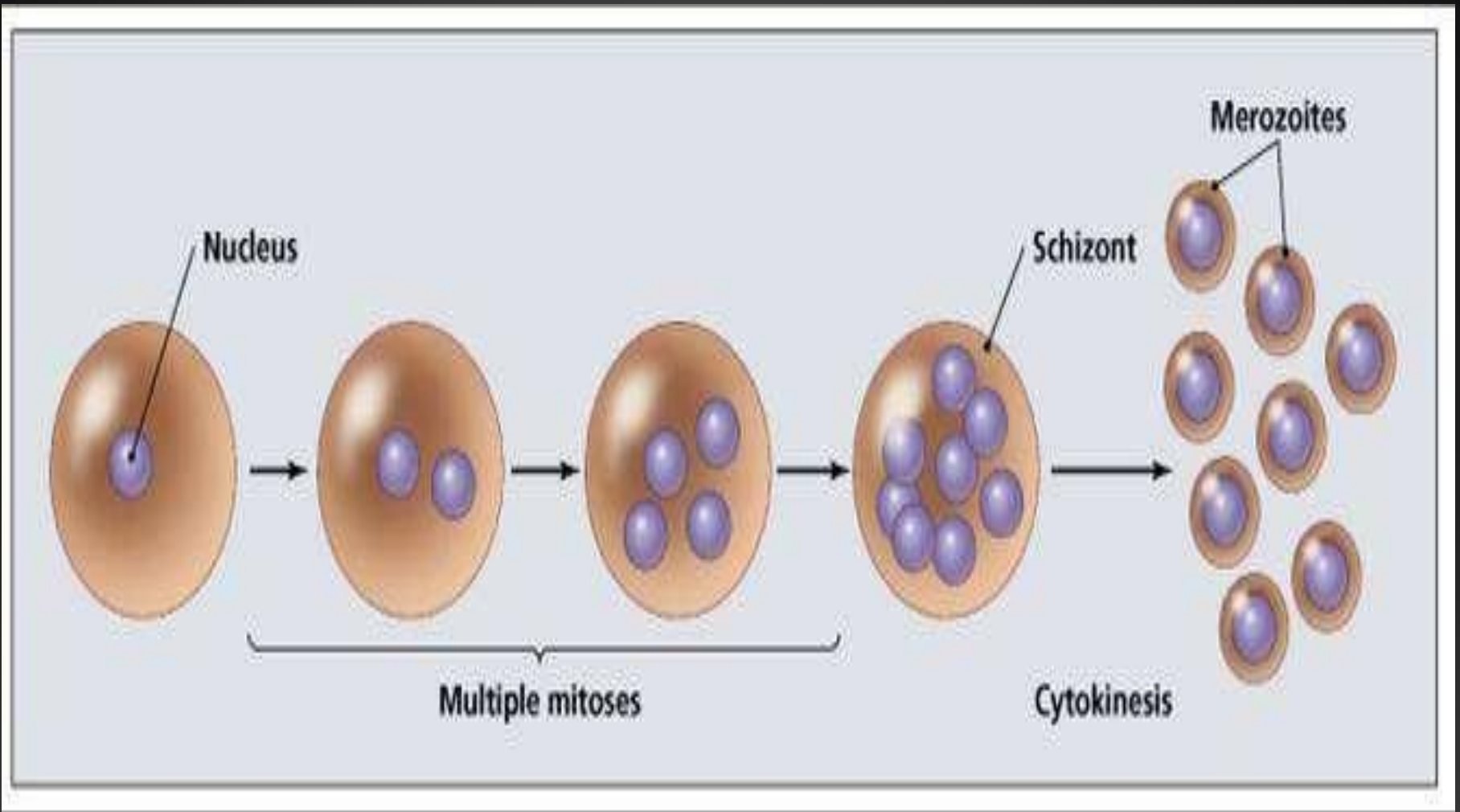
# Budding



# Schizogony

---

- It is the method of multiple fission in which first the nucleus undergoes multiple division, form many nuclei that a small portion of cytoplasm concentrate around each nucleus and than protozoan cell is divide into many daughter cells



# Sexual Reproduction

---

## □ **Conjugation:**

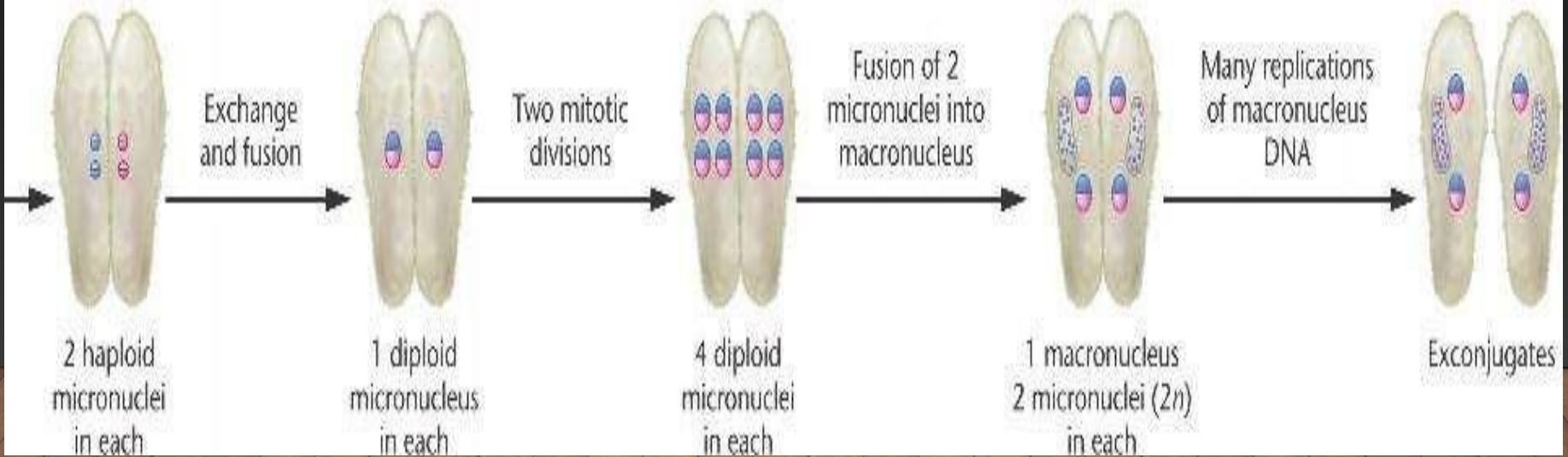
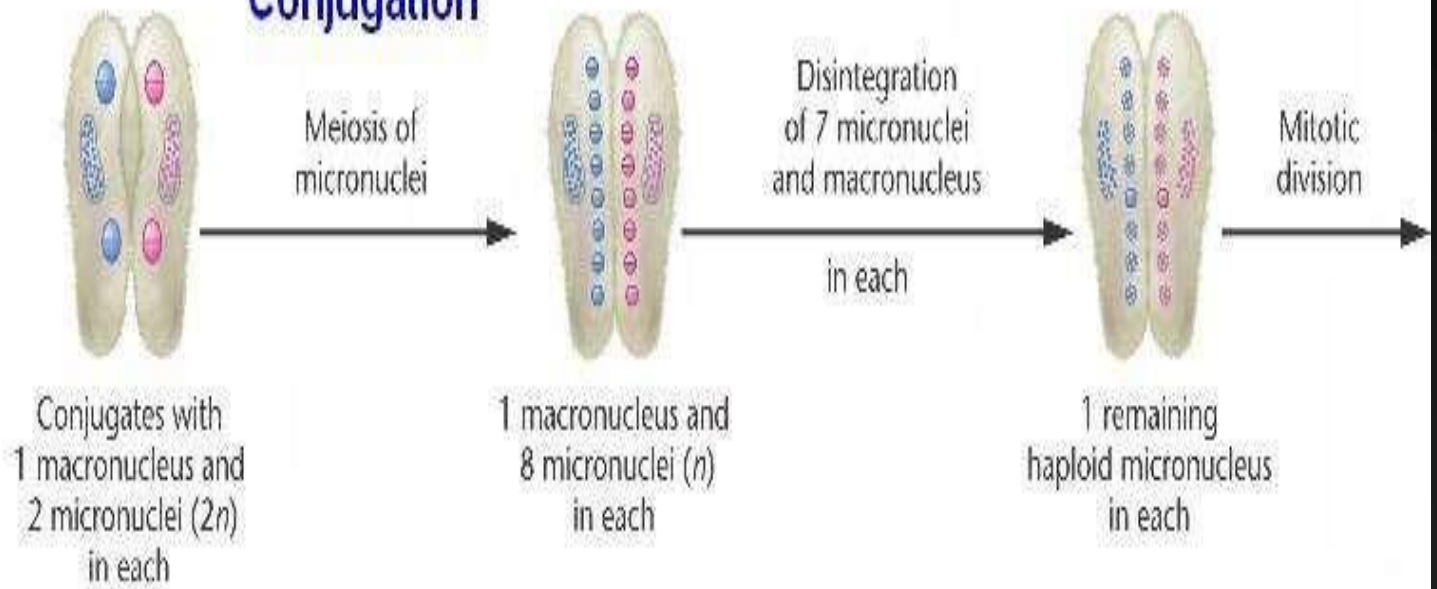
- Two protozoa meet together and exchange their genetic material

## □ **Gametogony:**

- Union of two sexually differentiated cells



## Conjugation



# Sporogony

