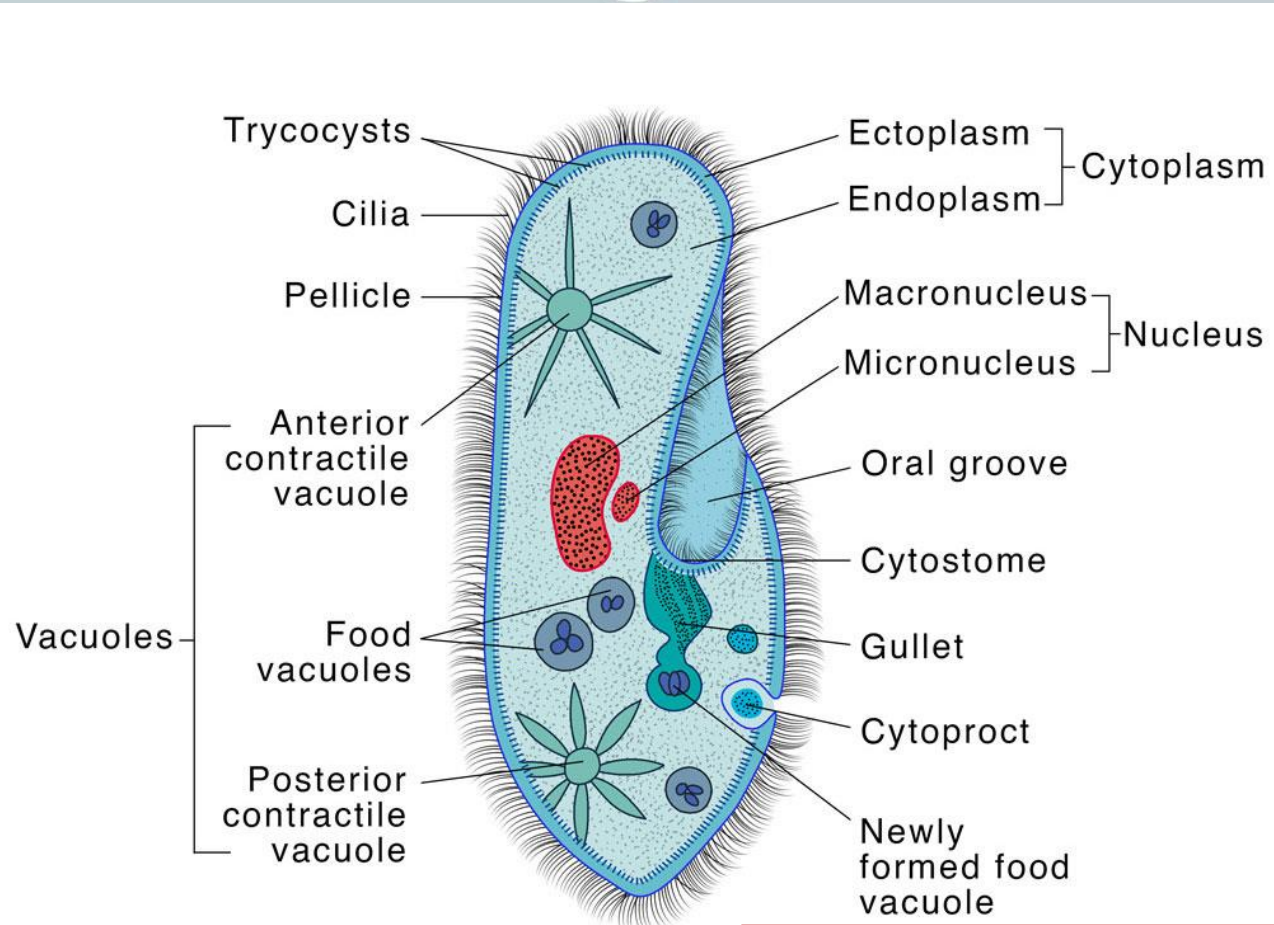


Type study: Paramecium

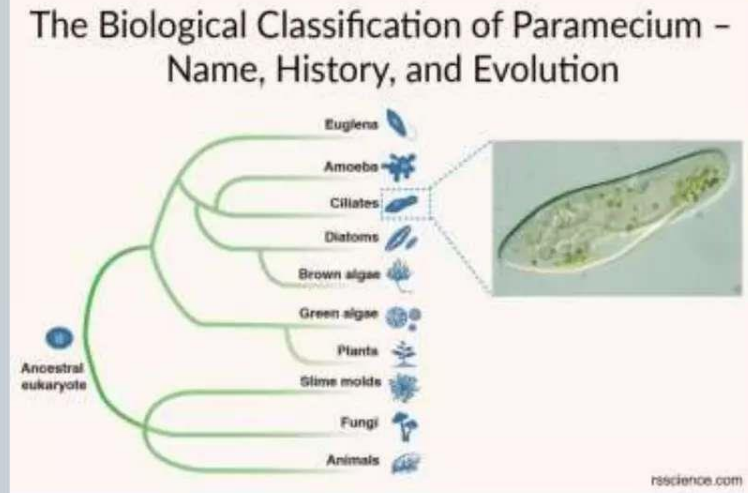


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Taxonomical Position



- Phylum - Protozoa
- Sub-Phylum- Ciliophora
- Class- Ciliates
- Order- Hymenostomatida
- Genus - Paramecium
- Species- caudatum



Habit and Habitat

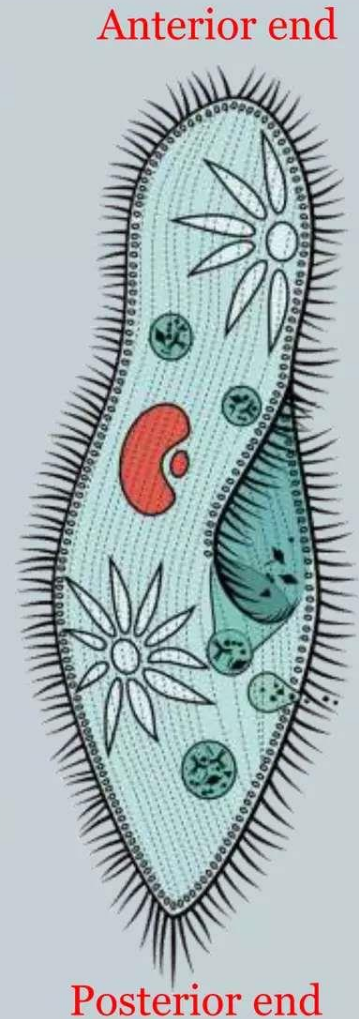


- Paramecium lives on small micro-organisms like bacteria, diatoms, small algae & other protozoa
- They lives in various freshwater ecosystem viz., (pond, pools, ditches, rivers, lakes and so on)
- They abundant in stagnant water with rich organic materials
- It thrives well in ponds or slow running water containing aquatic plants.
- It swims freely in the water bodies
- Worldwide in distribution.
- They are omnivorous & holozoic nutrition

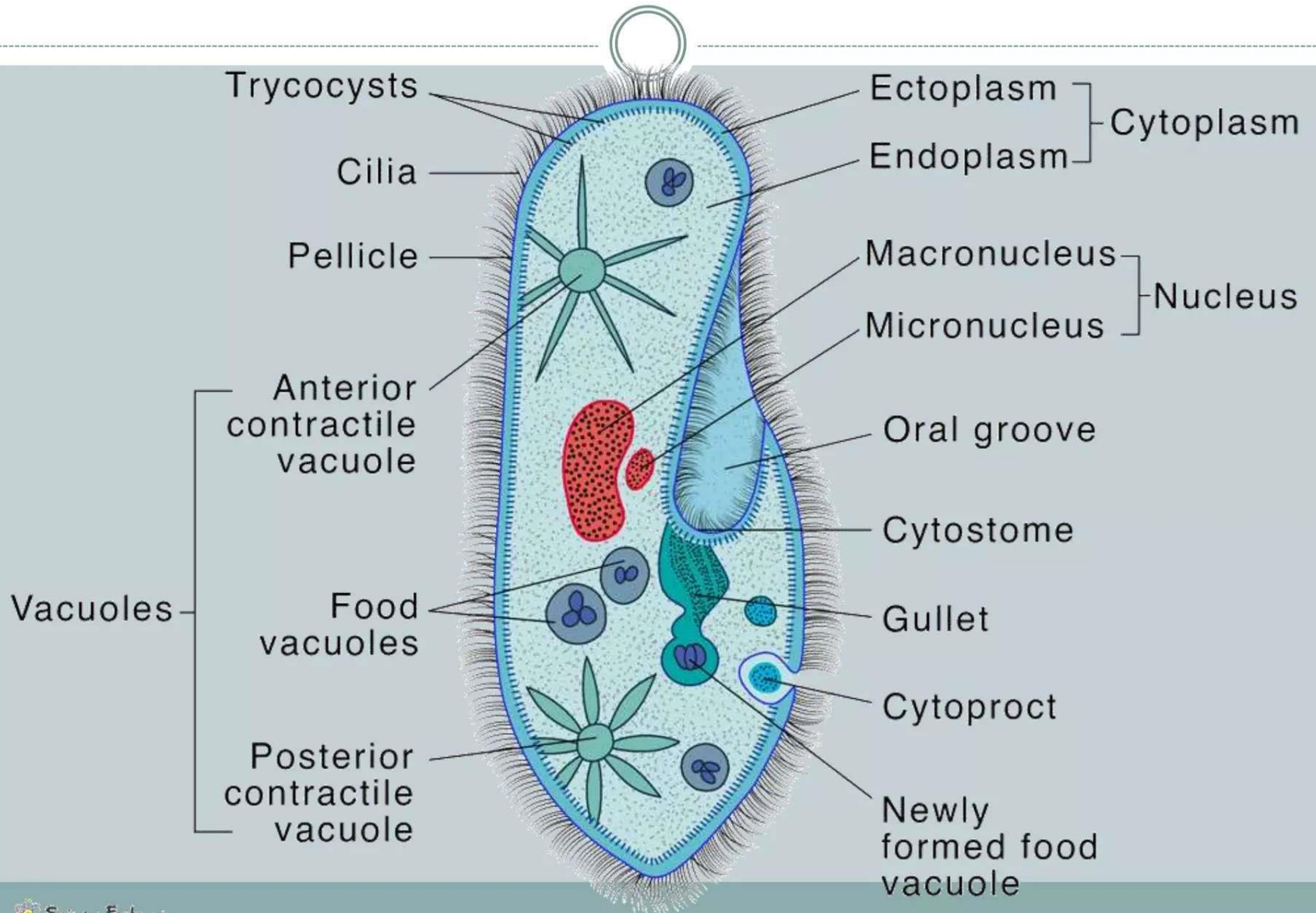
Shape and Size



- It is a microscopic, elongated organism cylindrical
- It is **light gray or white** in color
- Size range between - **170µm and 330 µm** long
- Shape is like **a slipper** – **slipper animalcule**
- It has distinct **anterior & posterior end**
- **Dorsal & a ventral side**
- Anterior end of the animal is **blunt** & posterior side is **pointed**



Paramecium



Structure of Paramecium

Pellicle

It is the covering of paramecium.

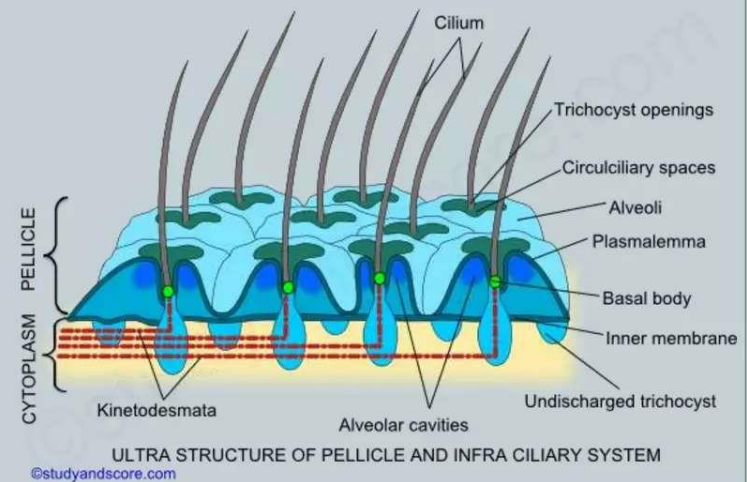
It is a **thin, double-layered, tough, elastic,** and colourless membrane.

It holds the **shape of the animal** but elastic enough to permit contractions.

It has a **double membrane**; the outer membrane is continuous with **cilia** and the inner membrane with the **ectoplasm**

It shows **rectangular or hexagonal depression** on its surface under the high magnification of the microscope.

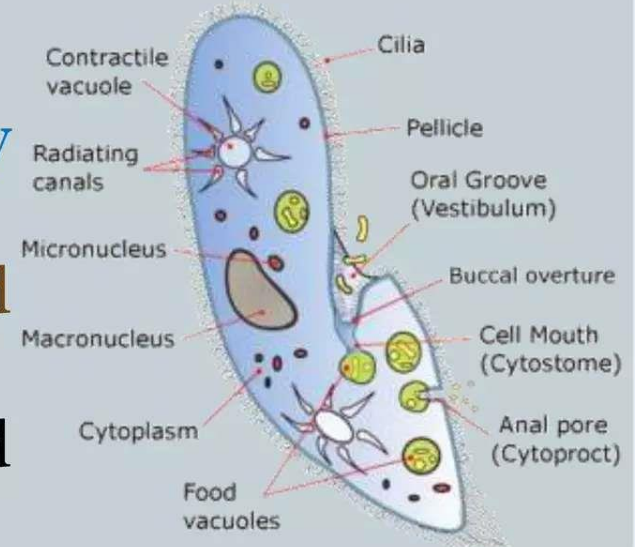
It helps to **protects the internal organelles** from mechanical injuries.



Oral groove



- Situated at the **ventral surface of the body**.
- It originates from the **middle of the body**.
- It drives **food materials** in to the body.
- Oral groove leads into a **v-shaped cavity** called a vestibule.
- The vestibule leads into an **oval-shaped opening** called **cytostome**.
- Cytostome leads into funnel-shaped **cytopharynx**.
- Cytopharynx ends in the cytoplasm



Cytoplasm of Paramecium



- It is filled with **colloidal substance** & **Formed region (Ectoderm & Endoderm)**
- **Ectoderm-** Outer layer of cytoplasm, just below the pellicle, denser fluid, consists basal granule & Trichocysts.
- **Endoderm-** Central part of Cytoplasm, less dense, it contains Nucleus, Contractile vacuoles, & food vacuoles.

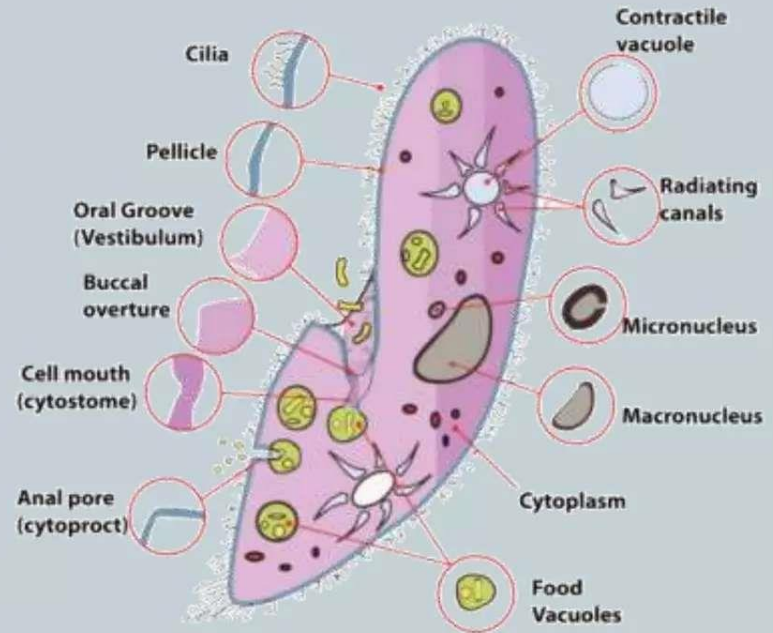
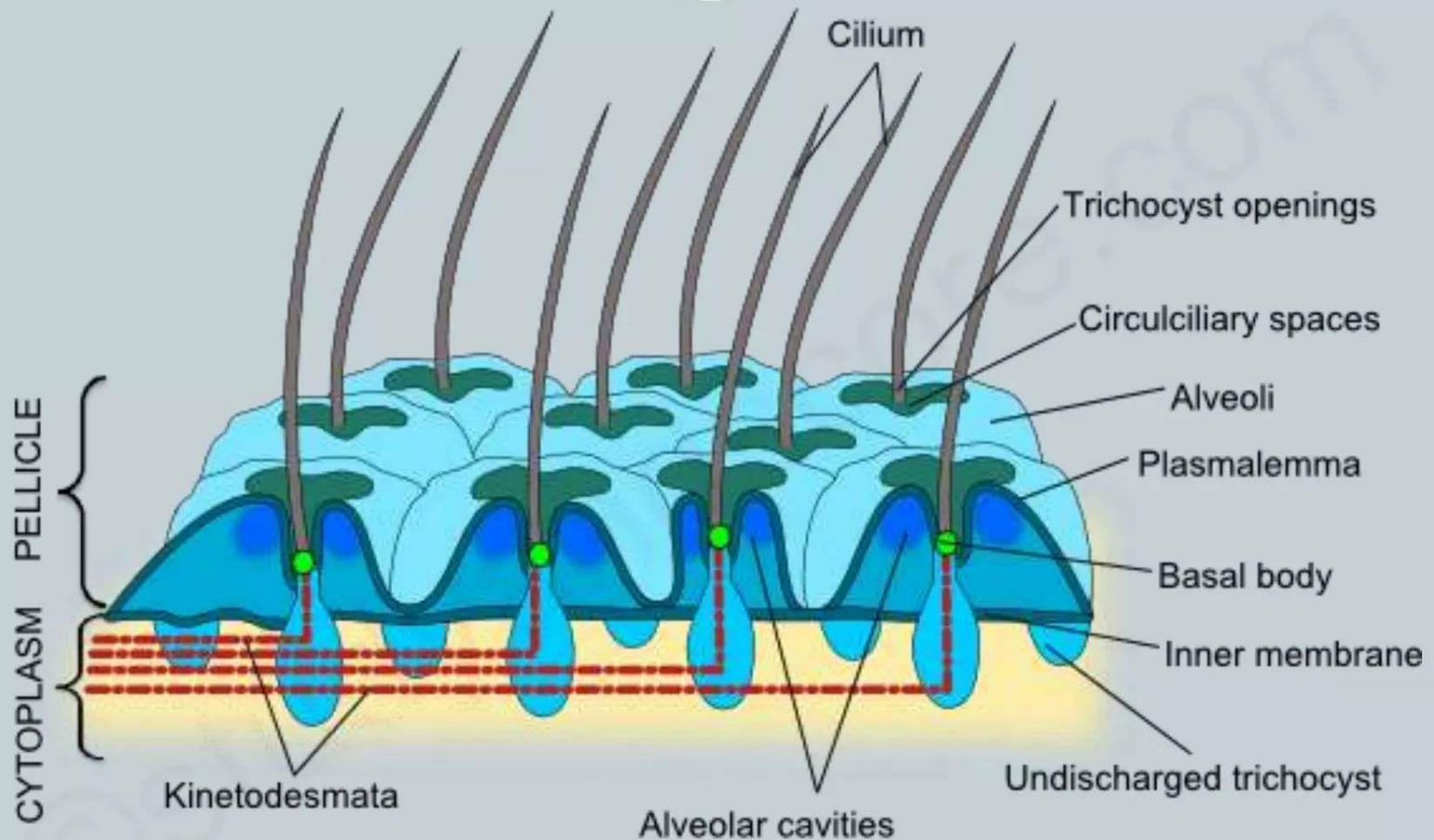


Figure: Ultra structure of Paramecium

Ectoderm layer of Paramecium

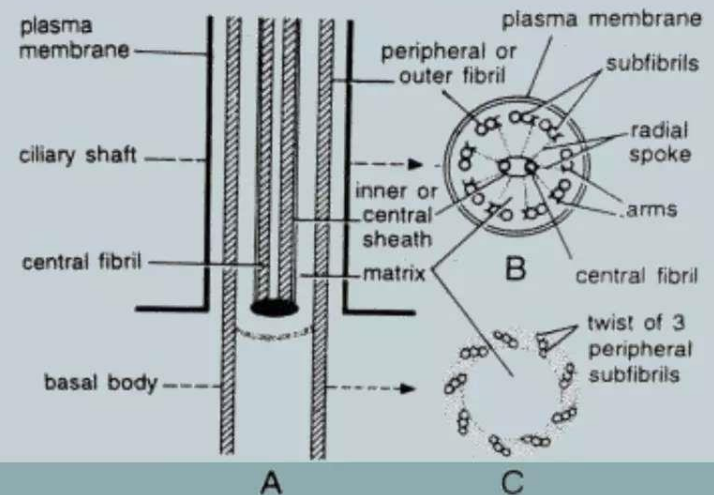
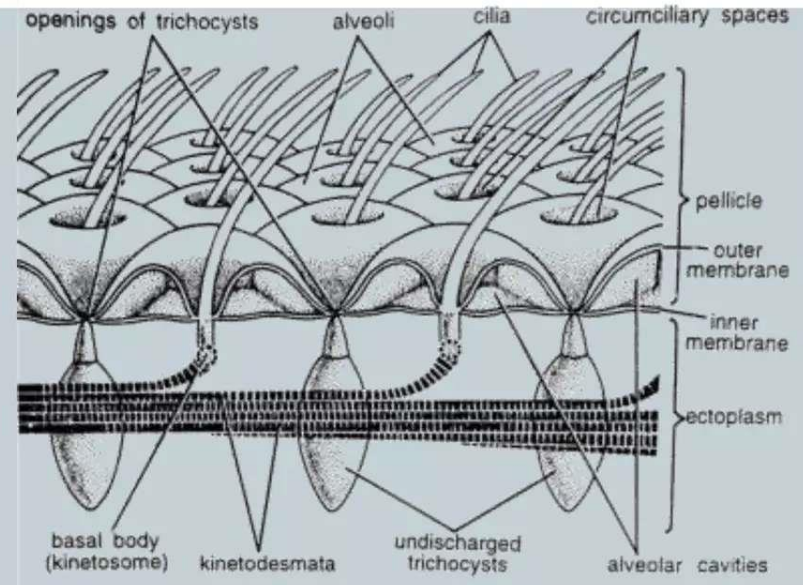


ULTRA STRUCTURE OF PELLICLE AND INFRA CILIARY SYSTEM

Cilia



- Short hair like structures, arising from **basal granule of ectoplasm**, covered all over the body
- It helps in **locomotion** as well as in **food collection**
- **Holotrichous**- Longitudinally & Uniform
- Outer cilia covered with a membrane **cytoplasmic sheath** and consists of cilium substance is called- **Matrix**
- **Matrix has double longitudinal fibres**
- **Also has outer peripheral fibres**



Trichocyst

Trichocyst are **conical bag** like structure

Located at the ectoderm & formed from **basal granule of ectoderm**

Matrix - filled with **gelatinous refraction substances & swelling fluid**.

The outer end of trichocyst spine like structure is called **spike**.

Spike covered with a **cap**.

Function- Offence and defence

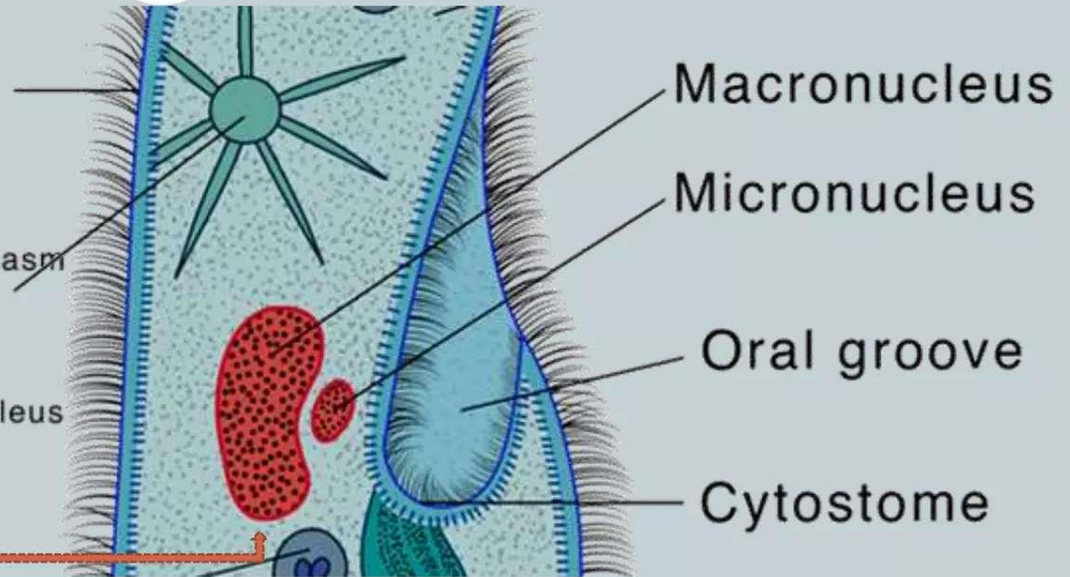
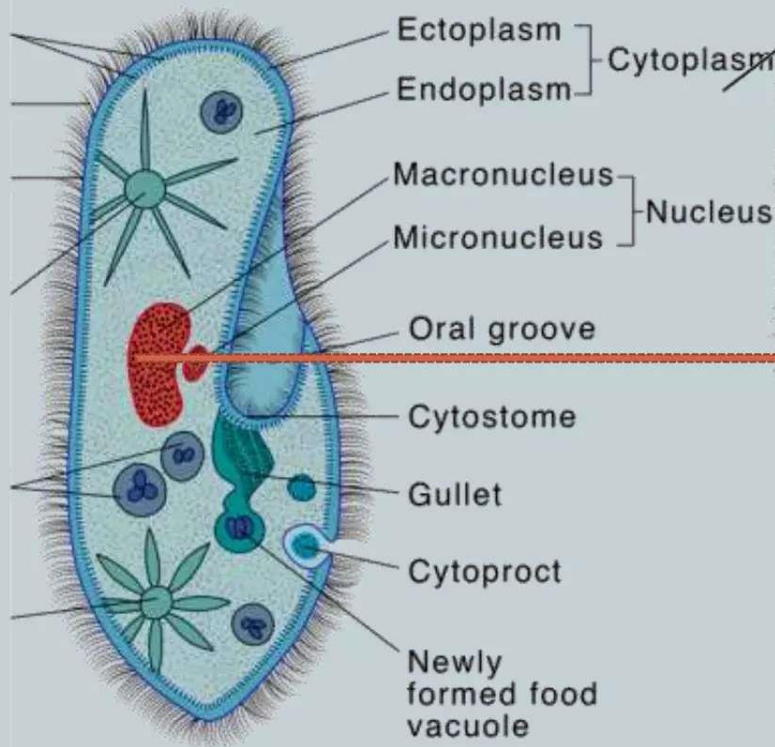
The diagram illustrates the structure of a trichocyst in three stages:

- A:** A cross-section of a cell showing internal organelles: a large contractile vacuole, a micronucleus, and a macronucleus. The cell is covered by a pellicle. Discharged trichocysts are shown as fine spines extending from the surface.
- B:** A cross-section of a trichocyst showing a cap at the top, a spike or tip extending from the cap, a matrix filling the body, and a shaft at the base.
- C:** A longitudinal section of a trichocyst showing the spike or tip at the top, the matrix in the middle, and the shaft at the bottom. The shaft is covered with horizontal striae.

Nucleus

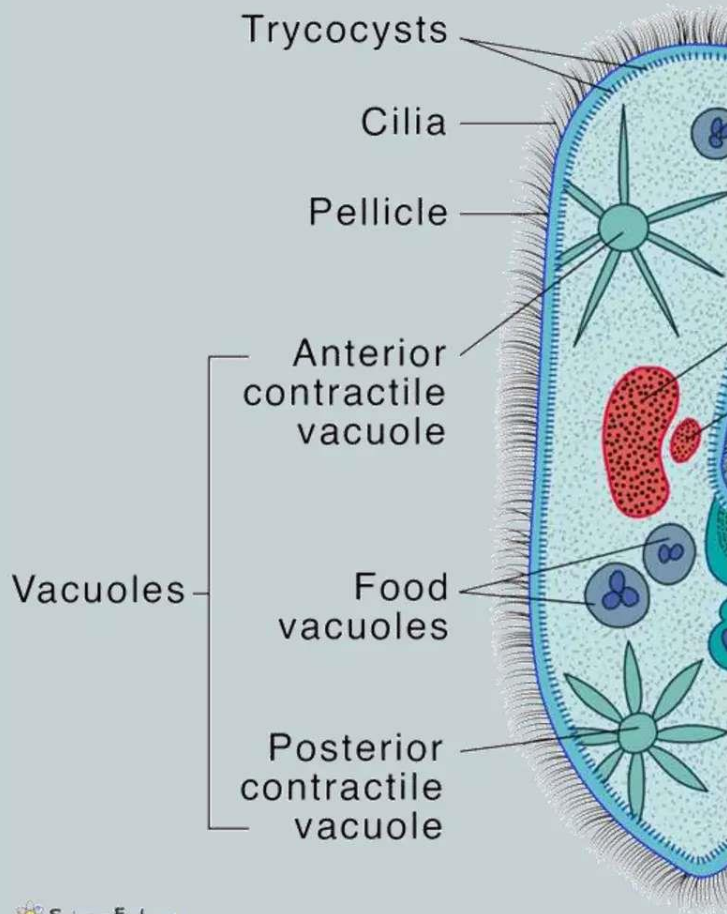


Paramecium



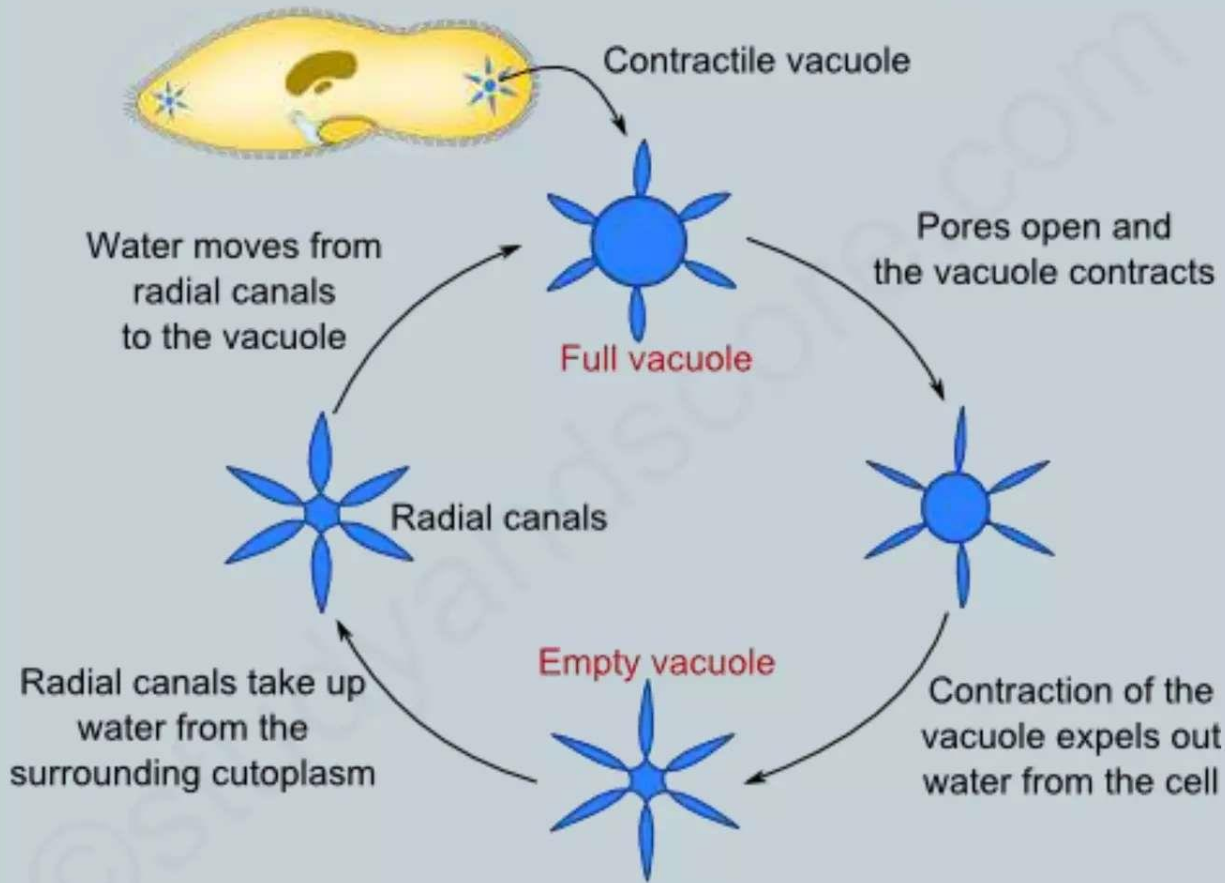
- Two nucleus (**Macro & Micro**)
- **Macro**- Bean or Kidney Shaped, densely packed with DNA, control the **vegetative function**
- **Micro**- located nearer to macro nucleus control the **reproductive function**.

Contractile vacuoles



- There are **two vacuoles** located **one at each end of the body**.
- It covered by **thin elastic, semi permeable layers**
- It exhibits the contraction (**systole**) & relaxation (**diastole**)
- Vacuoles surrounded by six or seven canal- **Radial Canal**
- Key function is it **collects fluids** from the entire cell (Osmoregulation) and **expels them out of the cell** (Excretion).

Osmoregulation in Paramecium



Parts of Radial Canal

- Collecting tubule
- Ampulla
- Injector canal

STEPS IN THE PROCESS OF OSMOREGULATION IN PARAMECIUM

Nutrition & Food



- It includes oral apparatus, food , mode of feeding, digestion, absorption, and digestion.
- It engulfs the solid food materials- **Holozoic**
- It feeds bacteria, diatoms, algae, protozoan, small plant and animal and its materials- **Omnivorous**

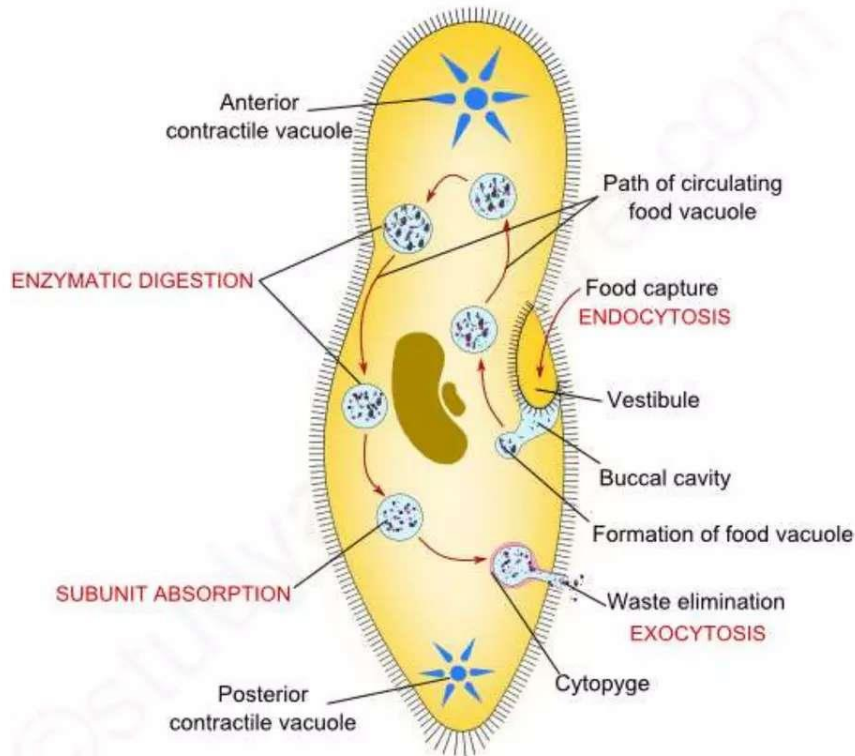


Oral apparatus



- It helps to feed
- Located at the ventral side of paramecium
- It is formed of oral groove, vestibule. Buccal cavity, cytostome, cytopharynx, the cytopharynx opens into the endoplasm and finally formed a temporary opening is called cytopyge or anal spot.

Feeding Mechanism



FORMATION OF FOOD VACUOLE AND PROCESS OF CYCLOSIS IN PARAMECIUM

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The cylindrical movement of food vacuoles is called **cyclosis**

- It feeds when **it is rest**
- It moves with **cilia** where the **food** are plenty in water.
- Cilia of oral apparatus beat vigorously and **cause the water current**.
- Water current along the food materials **pass through the oral groove and vestibule**.
- The cilia of vestibule direct the food into **cytopharynx**.
- Tip of the cytopharynx in a membrane is called **vesicle**.
- When the sufficient food particles is collected it is separated from cytopharnx.
- It is called **food vacuole- 1 – 5min**

Digestion

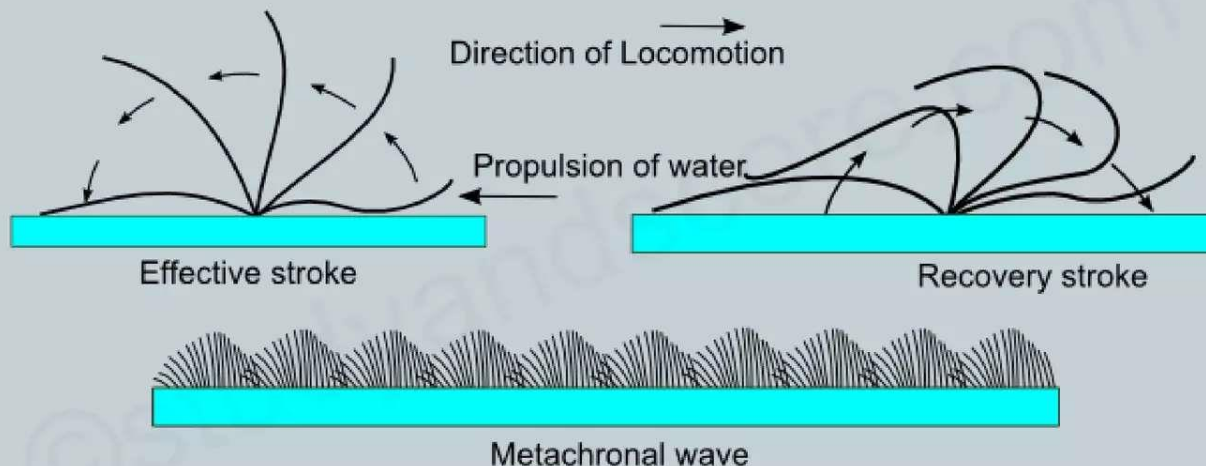


- Both acidic and alkaline digestion in general
- Carbohydrates → Glucose
- Proteins → Amino acids
- Fats → Fatty acids + Glycerol

Locomotion



- It moves with the help of cilia
- It called ciliary locomotion (forward and backward)
- Moves beating of the cilia



CILIARY MOVEMENT-TYPES OF STROKES

Reproduction



- It is process by which offspring produce by the parents
- Types (Asexual and Sexual)
- Asexual Reproduction

The process is without involvement of gametes

Paramecium exhibited- Binary Fission

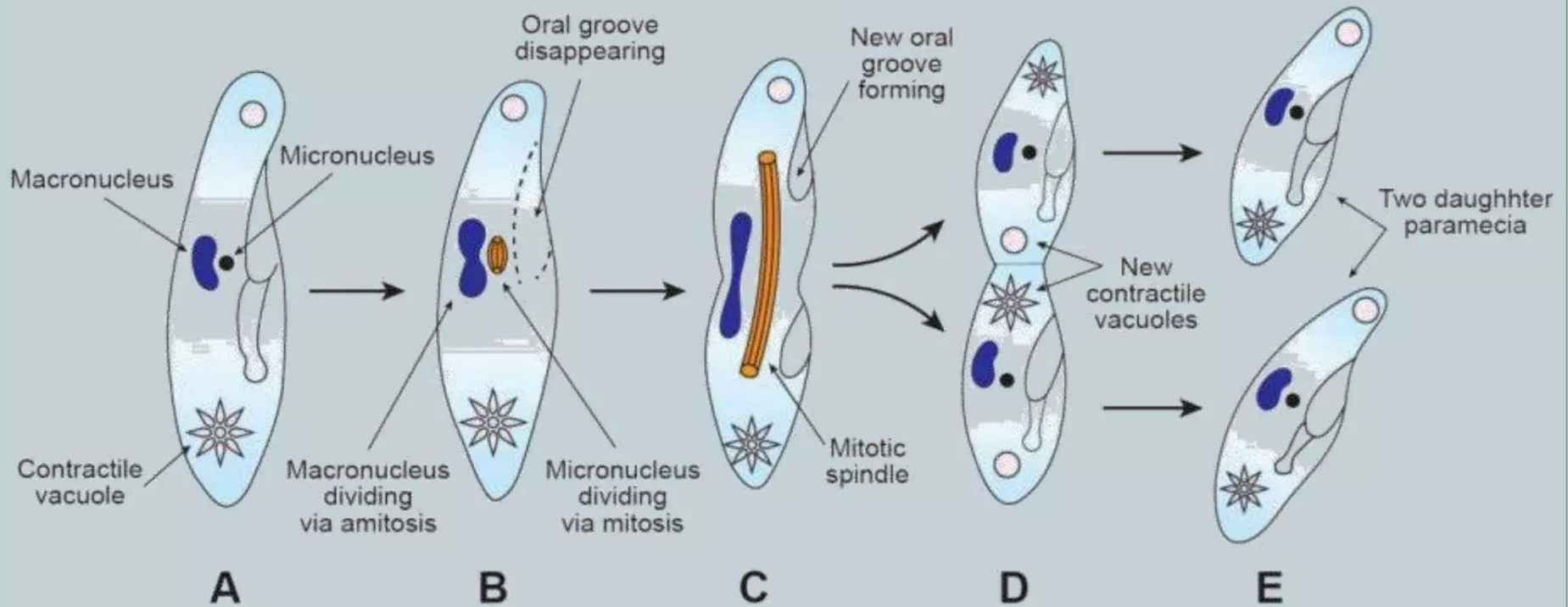
Binary Fission



- **Asexual Reproduction**
- It is a common method of reproduction (favourable condition)
- Fully grown paramecium equally divided into two **daughter individuals**
- It occurs transversely- **Transverse binary fission-**
- Completed the whole process **within 30 min.**
- **Process Steps:**
- 1- Stop feeding
- 2- Disappearance of oral apparatus
- 3- Micronucleus is elongated and becomes divided into two daughter micronuclei-**Mitosis**
- 4- Macronucleus is elongated and becomes divided into two daughter micronuclei-**Amitosis**
- 5. The constriction appears in the middle of the body and becomes it divided in two daughter cells.

Binary Fission

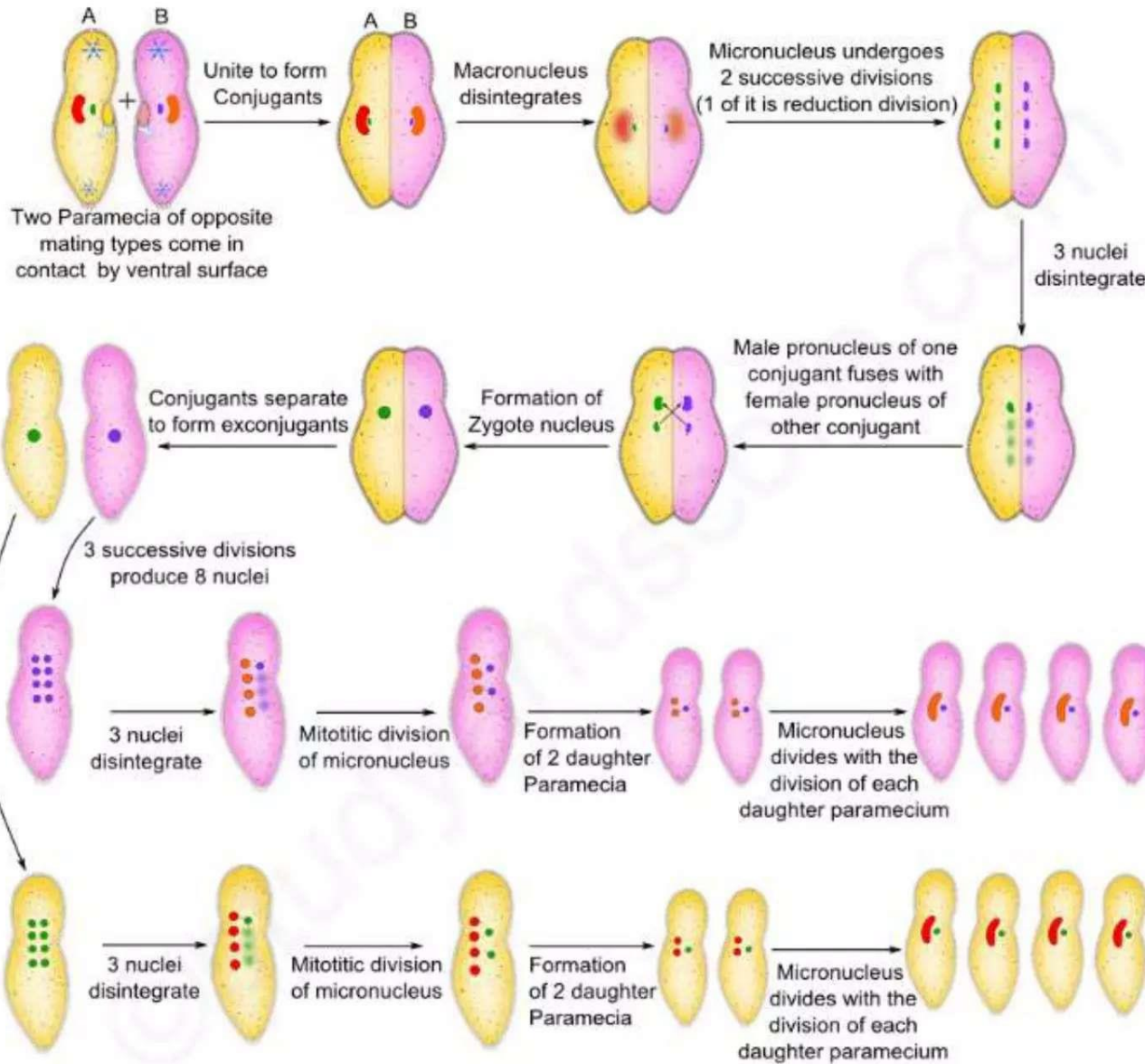
Binary fission of Paramecium



Conjugation (sexual reproduction)



- Frequently referred to as sexual reproduction.
- Temporary union of two individuals of same species for mutual exchange of genetic materials- Conjugants
- Stick together through their oral groove region
- The following apparatus cilia, Trichocysts, feeding degenerate
- Pellicle & ectoplasm degenerate- **Cytoplasmic bridge/Conjugation canal**
- Macronucleus has no role in conjugation, but micronucleus divides twice
- As a result of meiotic division four haploid daughter micronuclei are produced. Three are degenerate and disappear.
- Remaining one micronucleus divides by mitosis to form two unequal pronuclei.(Larger is called stationary or female pronucleus and smaller on migratory or male pronucleus) .



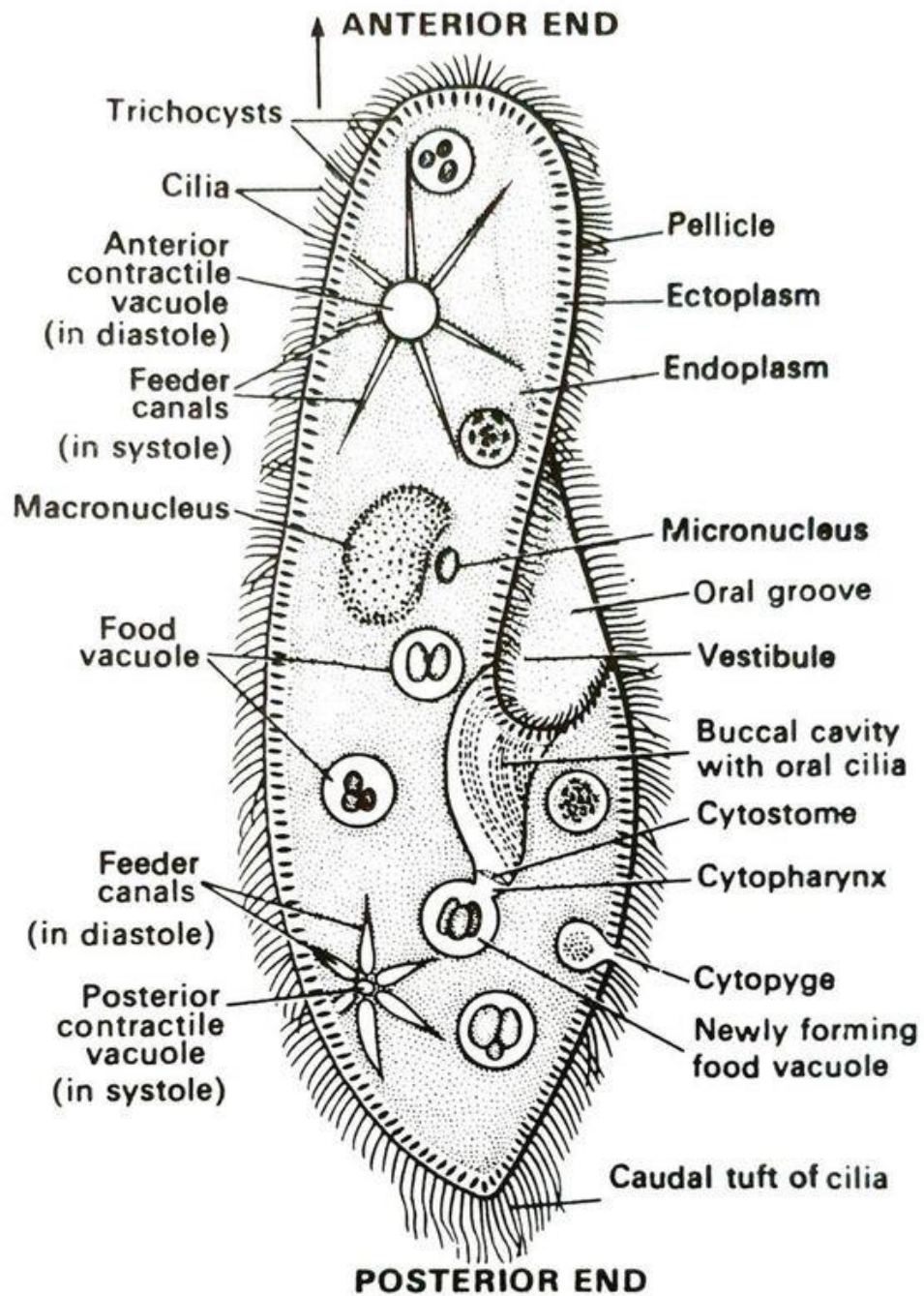
- Zygote formation
- Exconjugants
- Zygote nucleus divided thrice & produce 8 nuclei
- 4+4 Micro/Macro
- 3 micronuclei disappear
- 2 exconjugants undergoes binary fission each daughter cells which carries two macro and one micro nucleus
- Micronucleus undergoes further division
- Finally each exconjugants produce 4 daughter cells

STEP WISE REPRESENTATION OF CONJUGATION PROCESS IN PARAMECIUM

Significance of conjugation



- Maintain the **vigour**
- Old macronucleus is replaced by **new macronucleus**
- Two **different mating types** are exchanged hence it brings **recombination of genetic materials**
- Possibly origin of **genetic variation**.
- Conjugation occurs after **about 300 asexual generations** of binary fission, or it alternates with binary fission
- Starts early **morning and continued till afternoon**. It **does not during dark condition of light**
- Conjugation brings about the formation of the **correct number of chromosome**



पैरामीशियम कांडेटम (*P. caudatum*)