PROTOZOA

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Invertebrate- 205

Semester 1

Week 2

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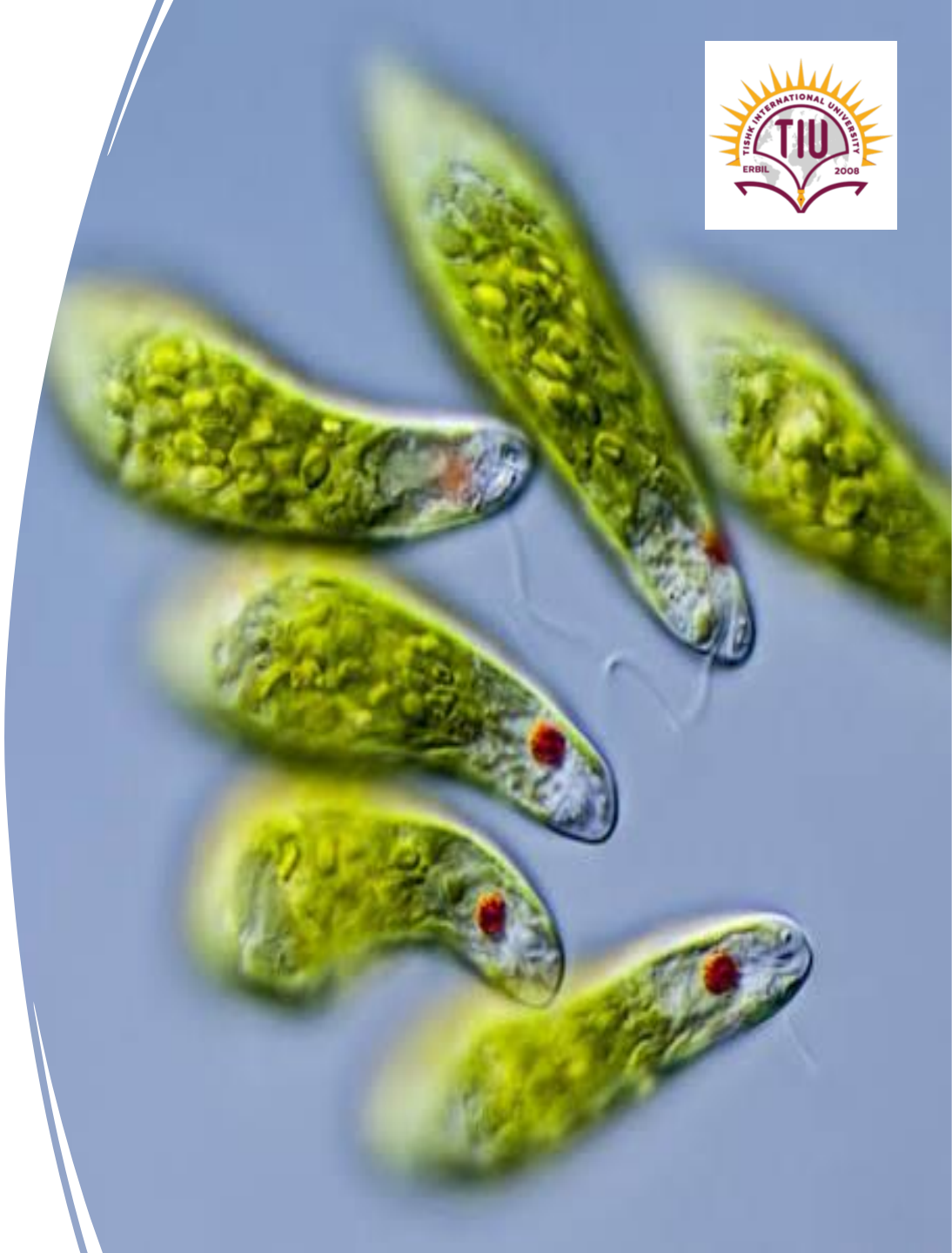
Outline

- Locomotion of Protozoa
- Flagella and cilia structure
- Excretion and osmoregulation in protozoa
- Reproduction
- Impact on health

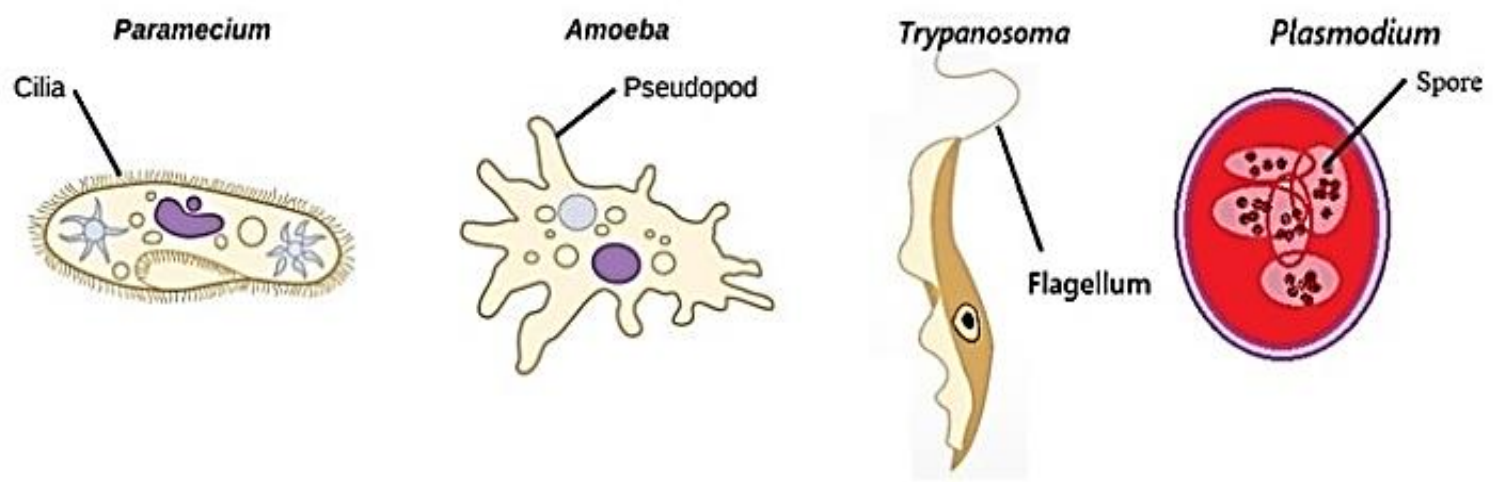


Objectives

- To understand Invertebrate life process including:
- Locomotion of Protozoa
- Excretion and osmoregulation in protozoa
- Reproduction
- Impact on health

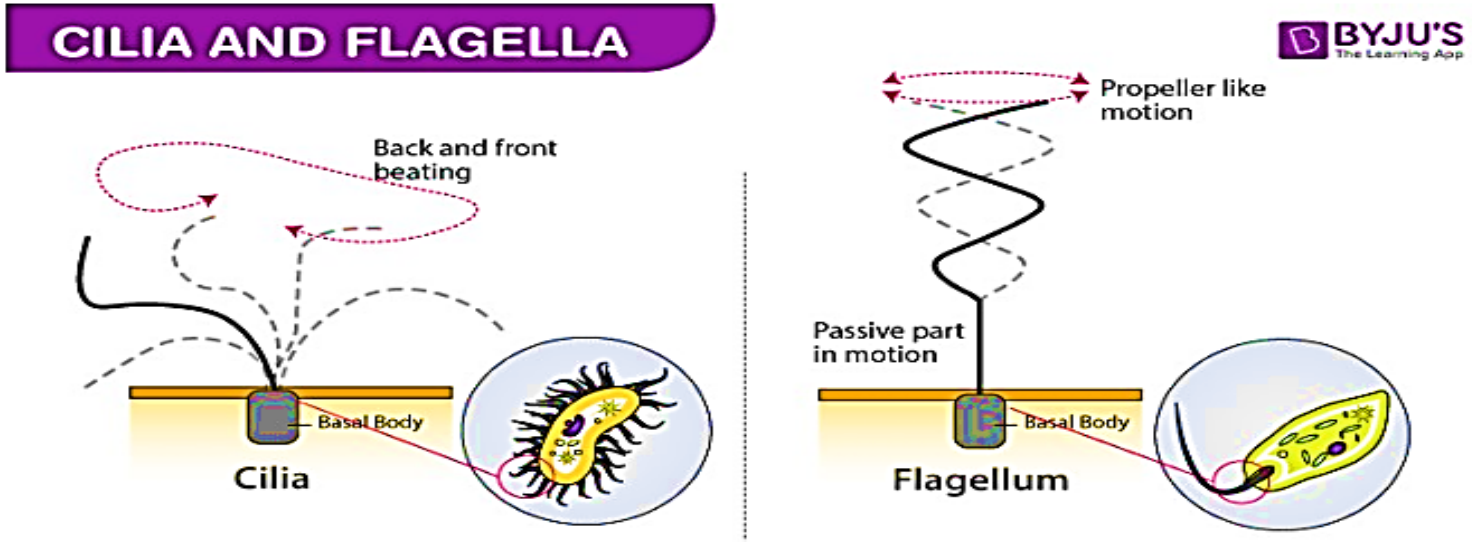
Locomotion of Protozoa

Originally, the means of locomotion was used to distinguish three of the four classes in the traditional phylum Protozoa. Members of a parasitic class, once called Sporozoa, lack a distinct locomotory structure. Members of the other three traditional protozoan classes differ in means of locomotion: **flagellates** use flagella, **amebas** extend their pseudopodia to move, and a **ciliate** has many short cilia for movement.



Locomotion of Protozoa

a- Cilia and Flagella: There are no real morphological distinction exists between cilia and flagella except cilia are relatively shorter in length than the flagella and more numerous in number than the flagella.



https://www.youtube.com/watch?v=fI7nEWUjk3A

https://www.youtube.com/watch?v=RyQfvxH425Q

- Many small metazoans use cilia not only for locomotion but also to create water currents for their feeding and respiration.
- Ciliary movement is vital to many species in osmoregulation (as in flame cells).

The structure of Flagella and cilia

Each flagellum or cilium contains nine pairs of longitudinal microtubules arranged in a circle around a central pair, and this is true for all motile flagella and cilia in the animal kingdom, with a few notable exceptions.

- This tube of microtubules in a flagellum or cilium is its axoneme

- The tube consists of nine pairs of microtubules and is interring the cell at a point called kinetosome (or basal body).

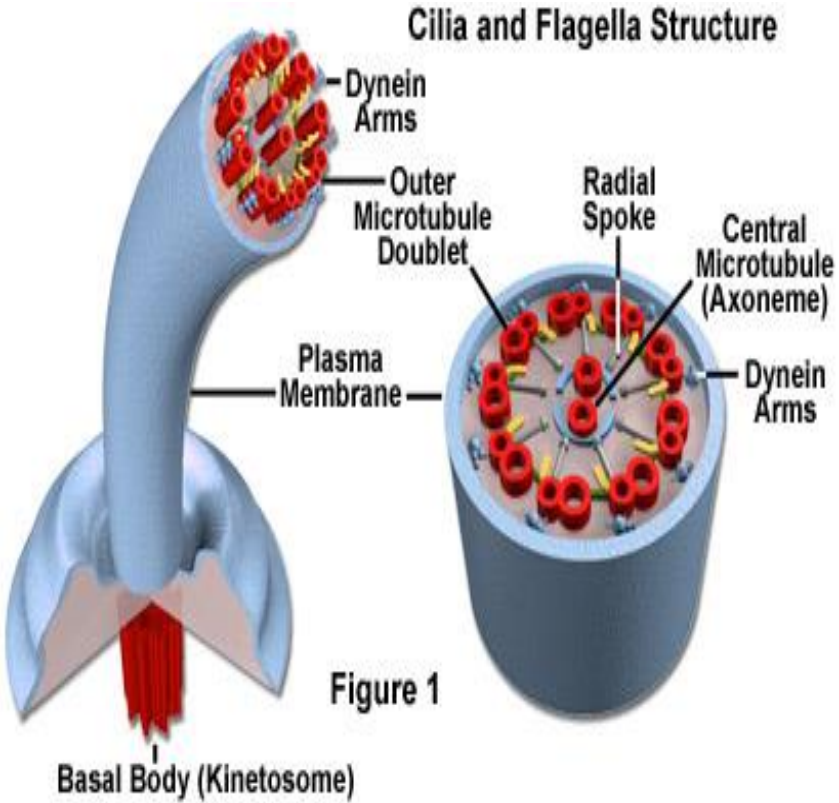


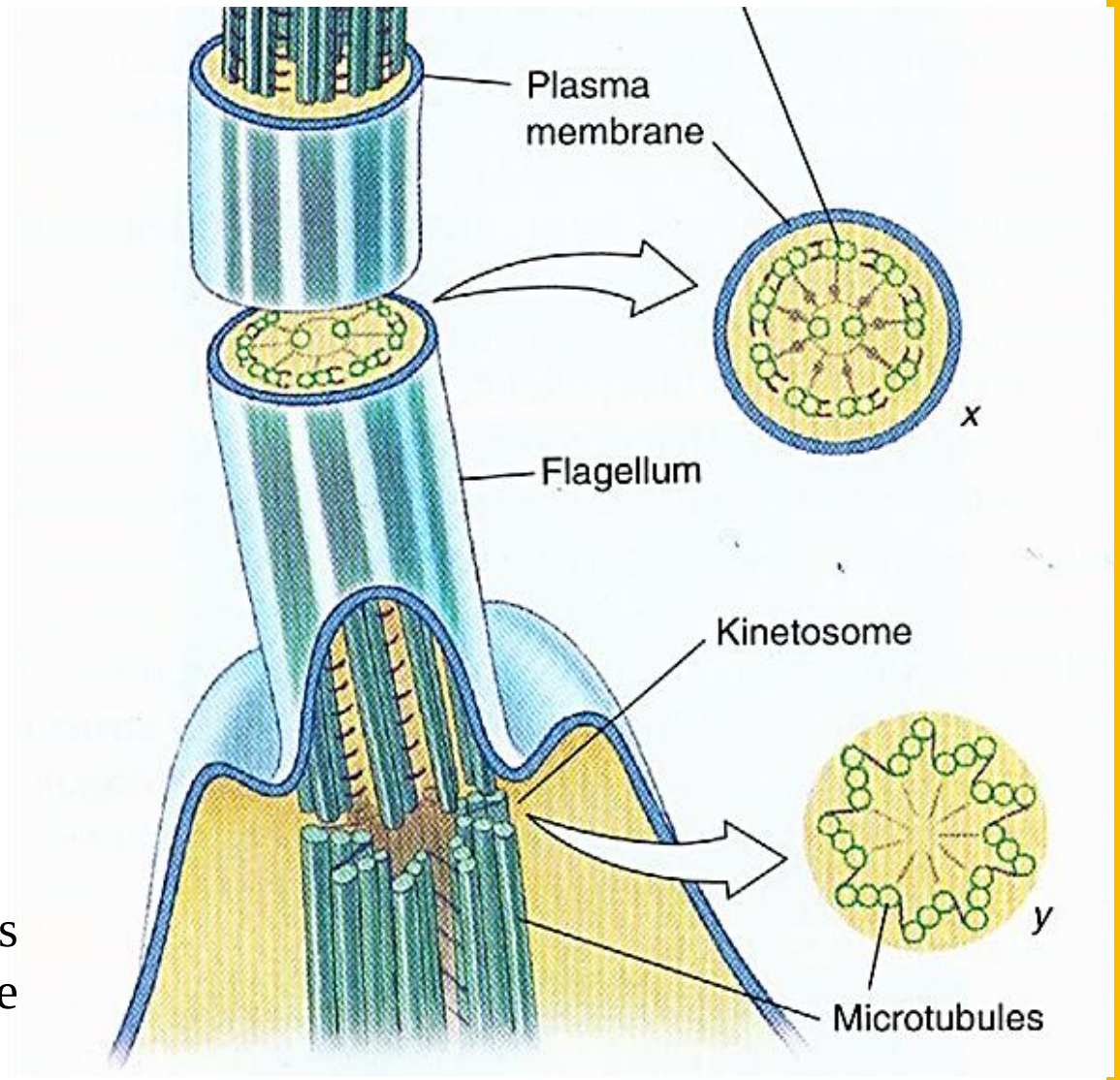
Figure 1

- At the basal body, another microtubule joins each of the nine pairs, so that these form a short tube extending from the base of the flagellum into the cell.

- The tube inside the cell consists of nine triplet of microtubules and is interring cell.

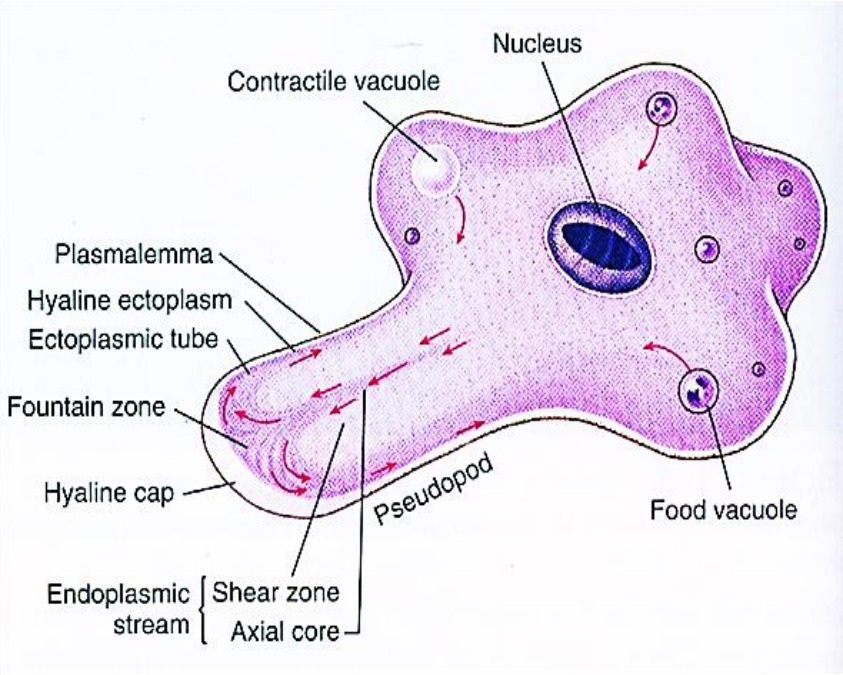
- The kinetosome is located at the base of the flagella and is the microtubule organizing center for flagellar microtubules

- An axoneme is covered by a membrane continuous with the cell membrane covering the rest of the organism.



b. Pseudopodia

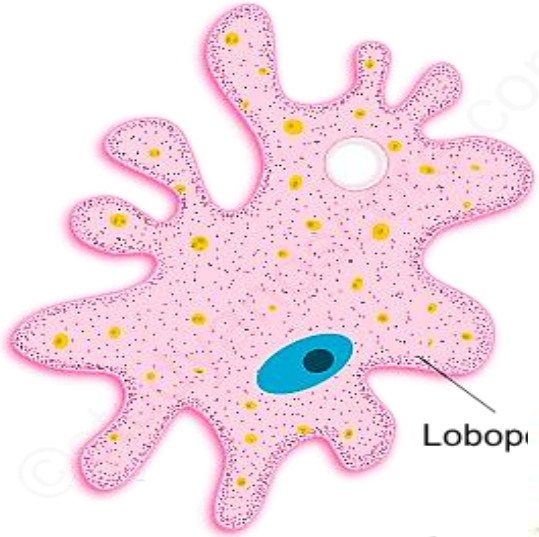
- Pseudopodia are extension of the cell cytoplasm used in locomotion
- Some amebas characteristically do not extend individual pseudopodia but move the whole body with pseudopodial motion.

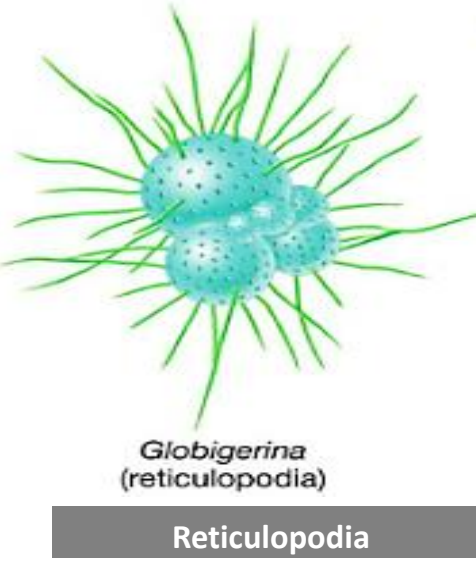


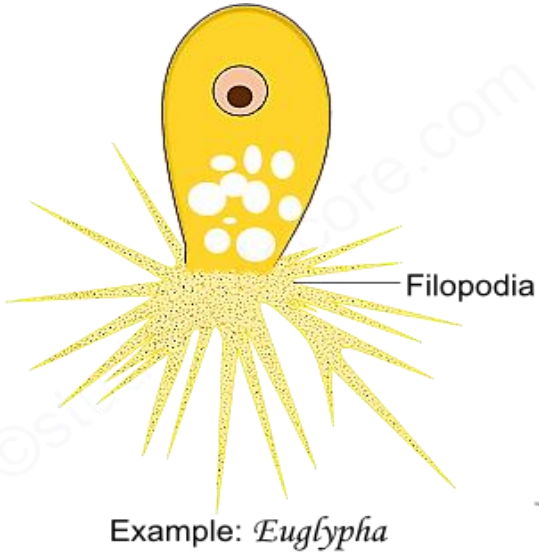
The cytoplasm is not homogeneous; sometimes peripheral and central areas of cytoplasm can be distinguished as **ectoplasm** and **endoplasm**. Endoplasm appears more granular and contains the nucleus and cytoplasmic organelles. Ectoplasm appears more transparent (hyaline). Ectoplasm is often more rigid and is in the gel state of a colloid, whereas the more fluid endoplasm is in the sol state.

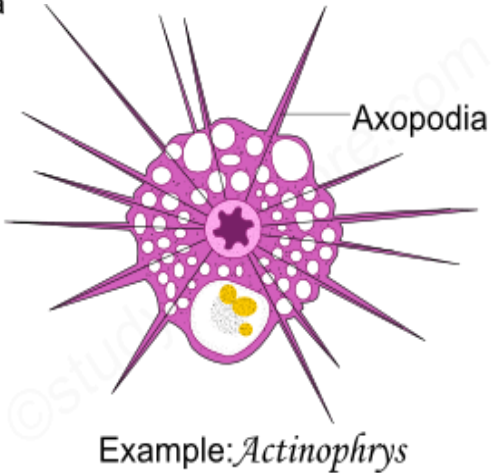
Pseudopodia Types

- Pseudopodia vary in composition and are of several types.
- **lobopodia**, The most familiar are which are large, blunt extensions of the cell body containing both endoplasm and ectoplasm.
- **Filopodia** are thin extensions, usually branching, and containing only ectoplasm.
- **Reticulopodia** are distinguished from filopodia in that reticulopodia repeatedly rejoin to form a net like mesh.
- **Axopodia**, which are long, thin pseudopodia supported by axial rods of microtubules.
- Axopodia can be extended or withdrawn by addition or removal of microtubular material.

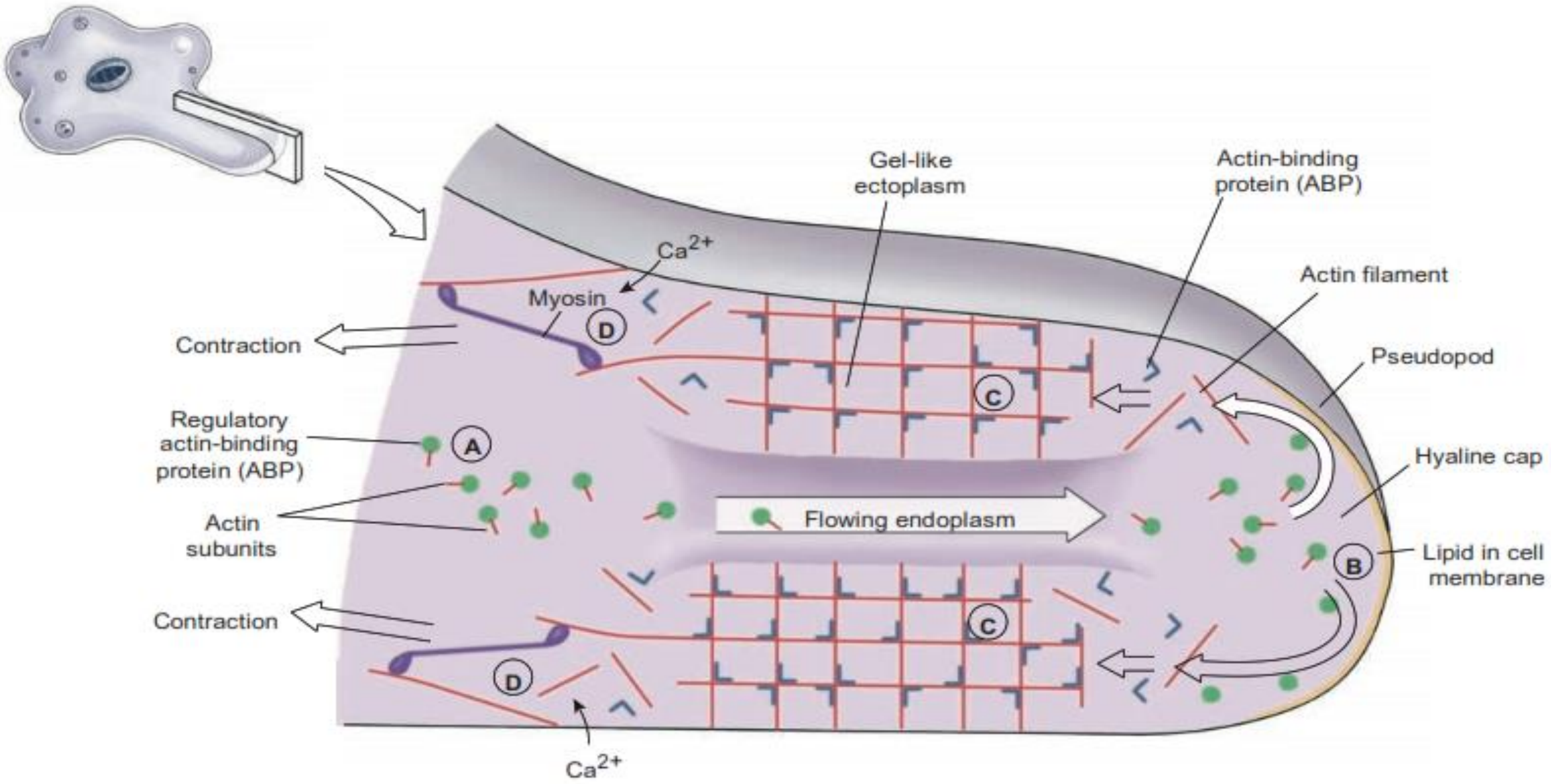








Mechanism of pseudopod movement : When a typical lobopodium begins to form, an extension of ectoplasm called a hyaline cap appears, and endoplasm begins to flow toward and into the hyaline cap. The flowing endoplasm contains actin subunits attached to regulatory, actin-binding proteins (ABPs) that prevent actin from polymerizing. As endoplasm flows into the hyaline cap, it spreads to the periphery. Interaction with phospholipids in the cell membrane releases the actin subunits from their regulatory binding proteins and allows them to polymerize into actin filaments. The actin filaments become cross-linked to each other by another ABP to form a semisolid gel, transforming the ectoplasm into a tube through which the fluid endoplasm flows as the pseudopodium extends. Near the trailing edge of the gel, calcium ions activate an ABP that releases actin filaments from the gel and permits myosin to associate with and to pull these actin filaments. The contraction at the trailing edge creates a pressure that forces the fluid endoplasm, along with its nowdissociated actin subunits, back toward the hyaline cap.



https://www.youtube.com/watch?v=7pR7TNzJ_pA

3. Excretion and osmoregulation in protozoa

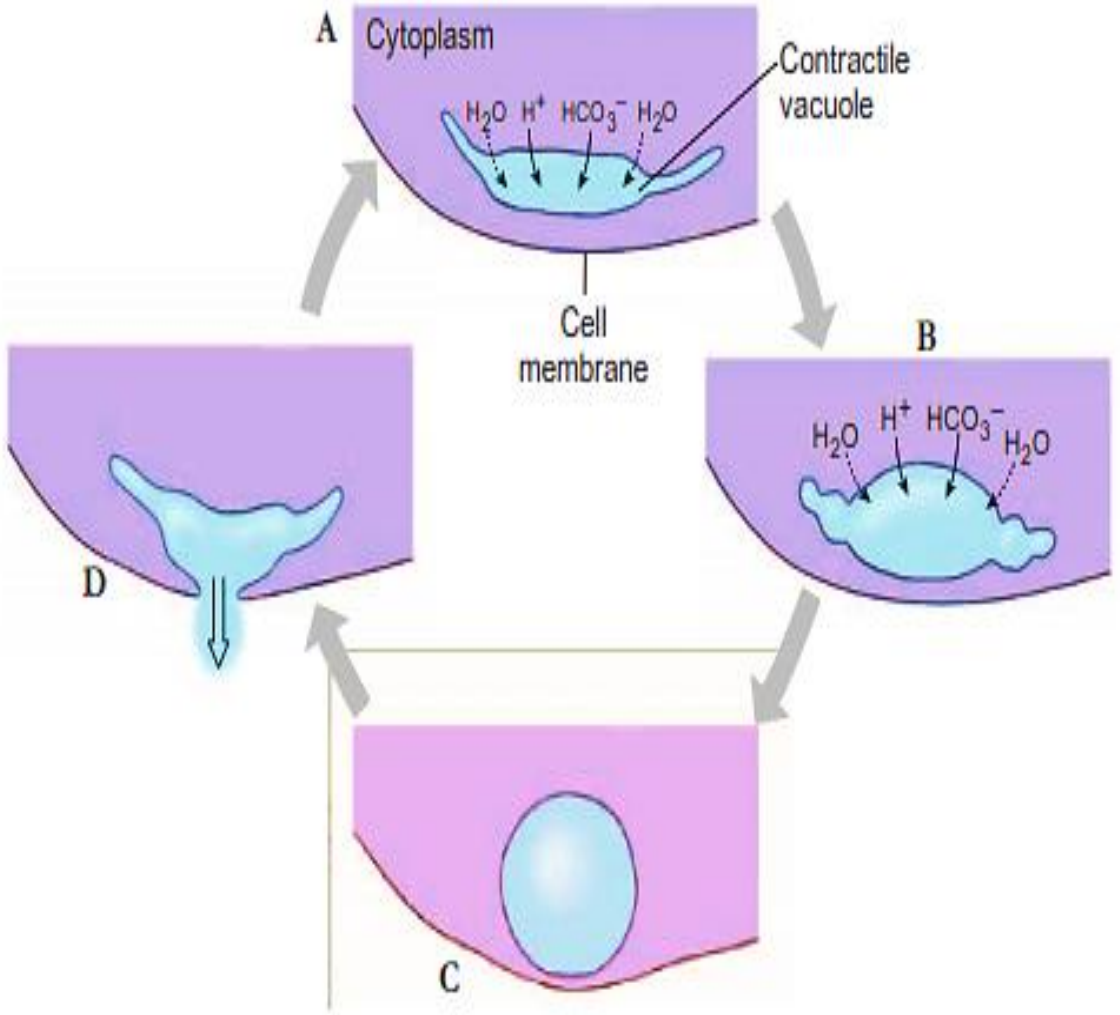
3- Excretion and Osmoregulation in Protozoa

Vacuoles can be seen by light microscopy in the cytoplasm of many protozoa. Some of these vacuoles periodically fill with a fluid substance that is then expelled. Evidence is strong that these contractile vacuoles function principally in osmoregulation. They are more prevalent and fill and empty more frequently in freshwater protozoa than in marine and endosymbiotic species, where their surrounding medium would be more nearly isosmotic (having the same osmotic pressure) to their cytoplasm.

Excretion of metabolic wastes, on the other hand, is almost entirely by diffusion. The main end product of nitrogen metabolism is ammonia, which readily diffuses from the small bodies of protozoa. Although it seems clear that contractile vacuoles function to remove excess water that has entered cytoplasm by osmosis, a reasonable mechanism for such removal has been elusive.

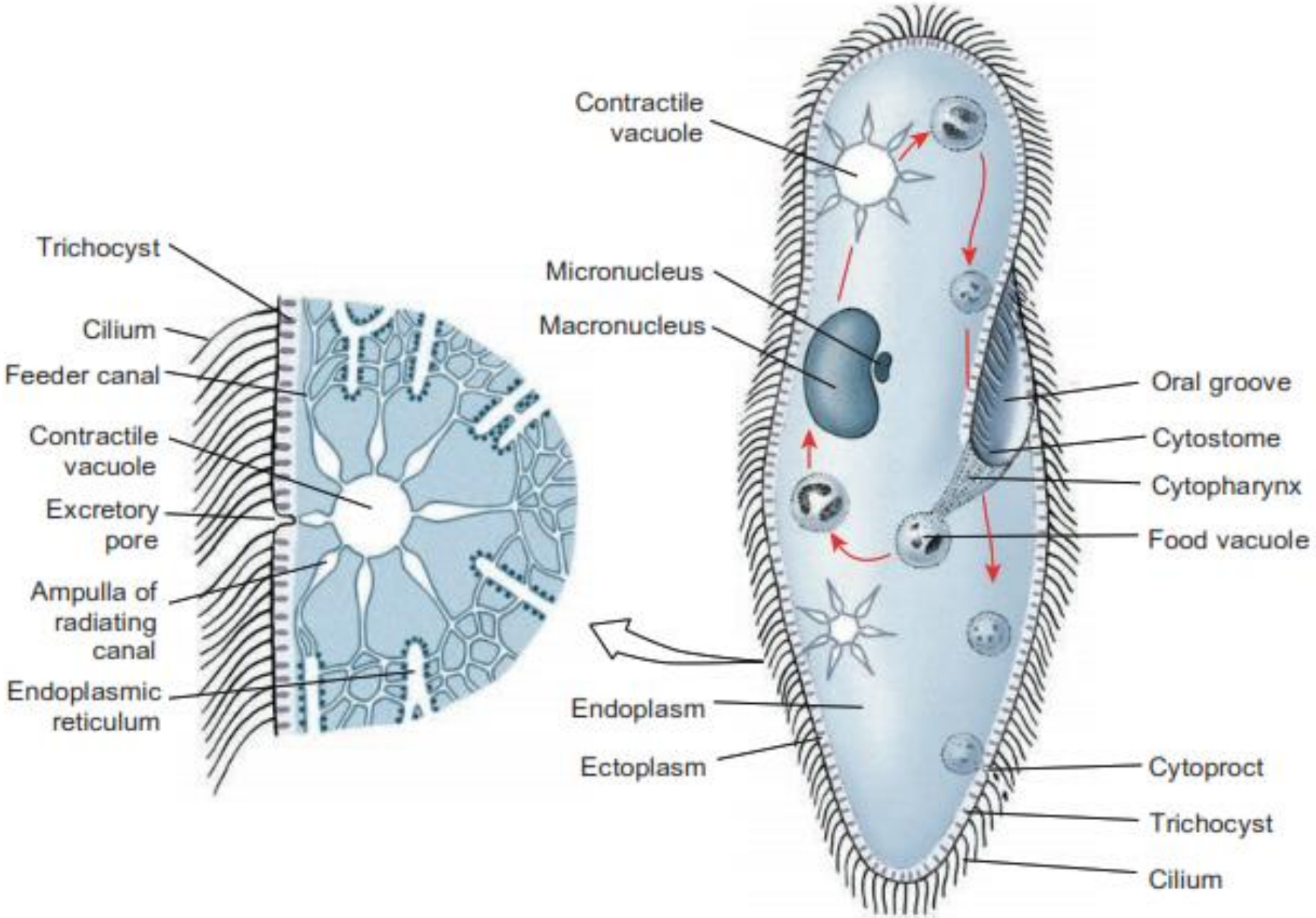
Excretion and osmoregulation in protozoa

- The proton pumps on the vacuolar surface and on tubules radiating from it actively transport H and cotransport bicarbonate (HCO3), which are osmotically active particles.
- As these particles accumulate within a vacuole, water would be drawn into the vacuole.
- Fluid within the vacuole would remain isosmotic to the cytoplasm.
- Then as the vacuole finally joins its membrane to the surface membrane and empties its contents to the outside, it would expel water, H, and HCO3.
- These ions can be replaced readily by action of carbonic anhydrase on CO2 and H2O



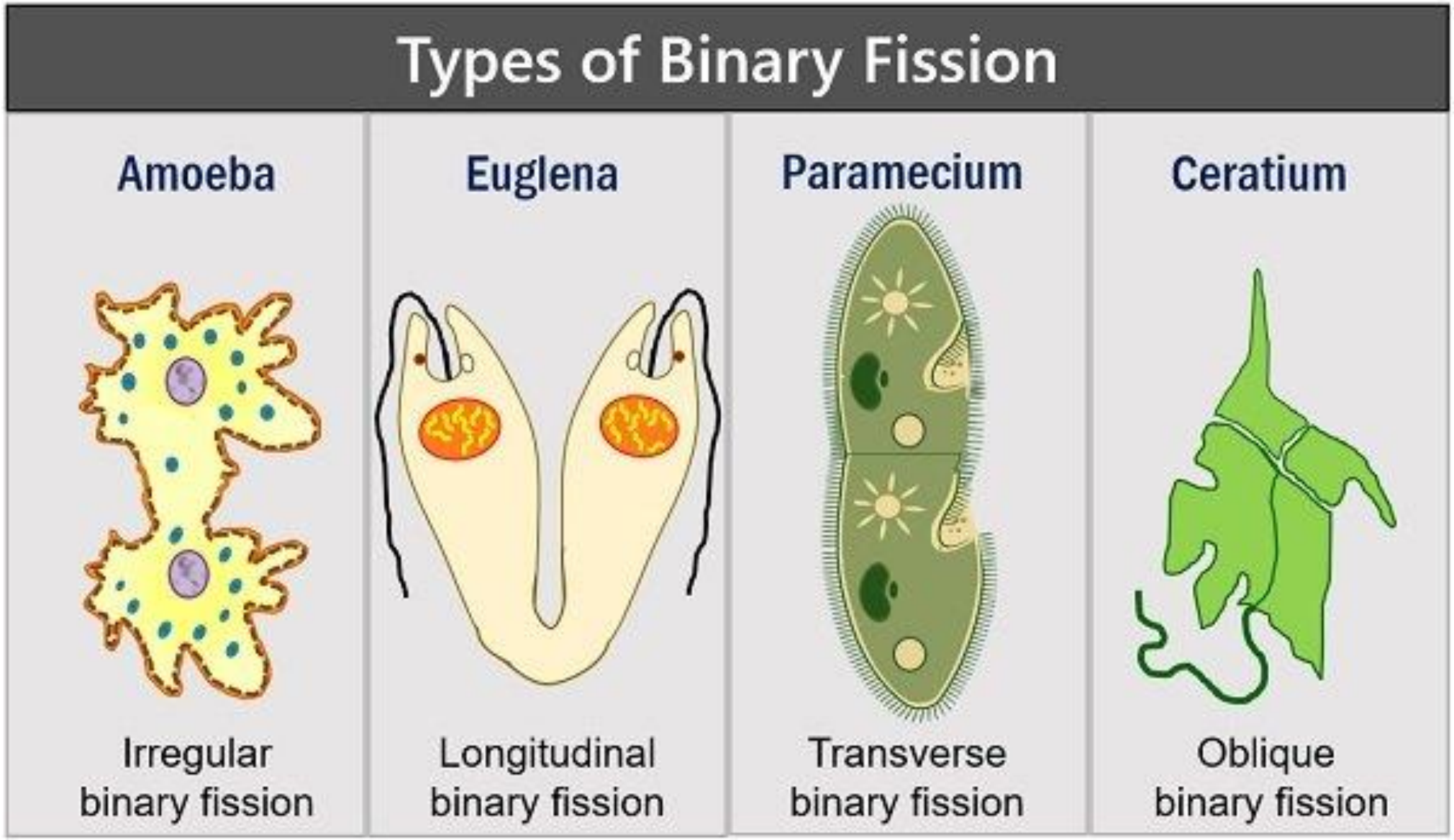
Excretion and osmoregulation in Paramecium

Others, such as Paramecium, have more complex contractile vacuoles. Such vacuoles are located in a specific position beneath the cell membrane, with an excretory" pore leading to the outside, and surrounded by ampullae of about six feeder canals. Feeder canals, in turn, are surrounded by fine tubules, which connect with the canals during filling of ampullae and at their lower ends connect with the tubular system of endoplasmic reticulum. Ampullae and contractile vacuoles are surrounded by bundles of fibrils, which may function in contraction of these structures. Contraction of ampullae fills the vacuole. When vacuole contracts to discharge its contents to the outside, the ampullae become disconnected from the vacuole, so that backflow is prevented. Tubules, ampullae, or vacuoles may be supplied with proton pumps to draw water into their lumens by the mechanism already described.


Trichocyst
Cilium
Feeder canal
Contractile vacuole
Excretory pore
Ampulla of radiating canal
Endoplasmic reticulum
Contractile vacuole
Micronucleus
Macronucleus
Oral groove
Cytostome
Cytopharynx
Food vacuole
Endoplasm
Ectoplasm
Cytoproct
Trichocyst
Cilium

4. Reproduction in protozoa

Asexual Reproduction



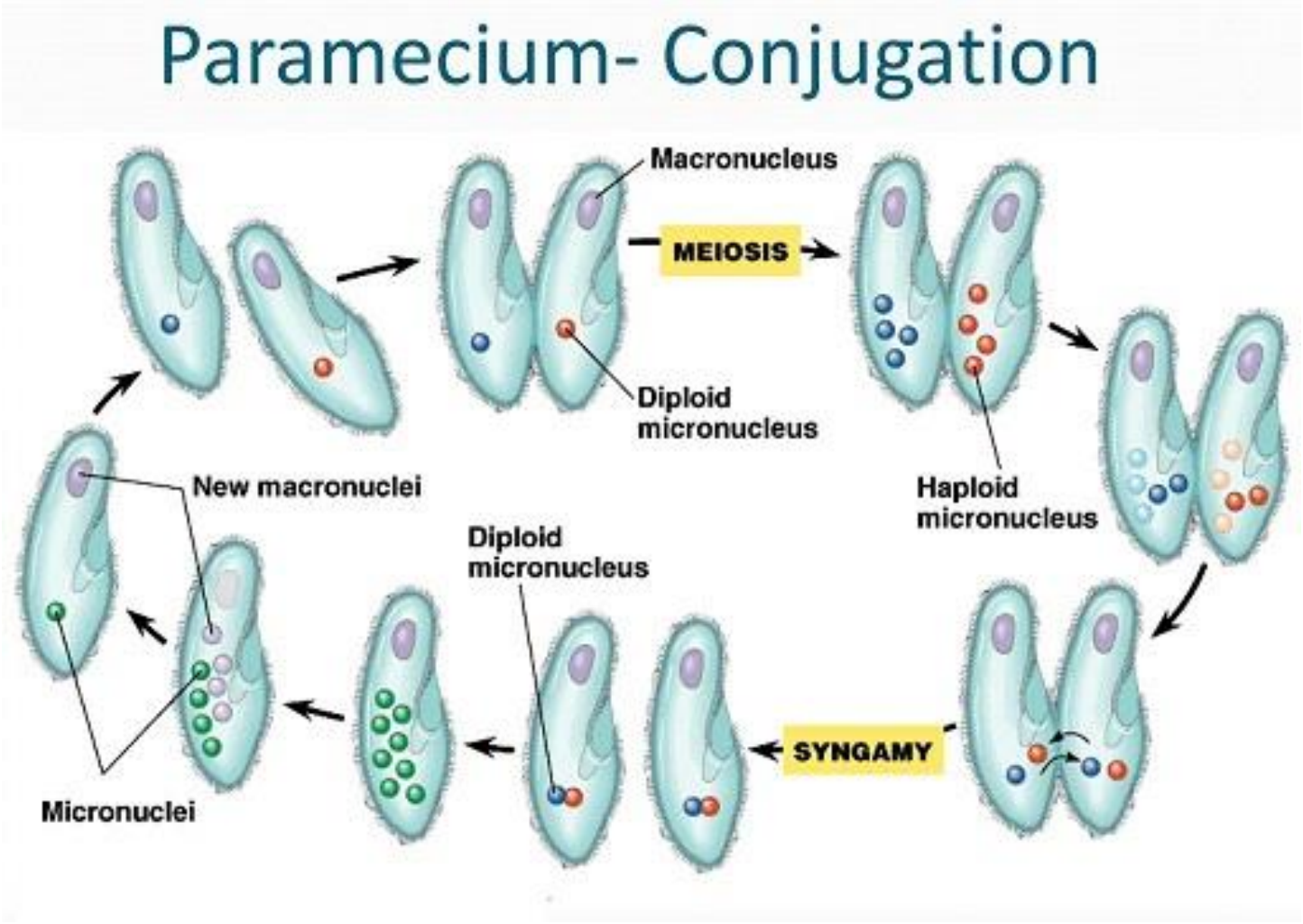
Sexual reproduction in paramecium

Replacement of the imbalanced macronucleus thus is very important. The new macronucleus has rejuvenating effect on the clone. A new macronucleus is produced by the following processes:

1. Conjugation
2. Autogamy
3. Endomixis
4. Cytogamy

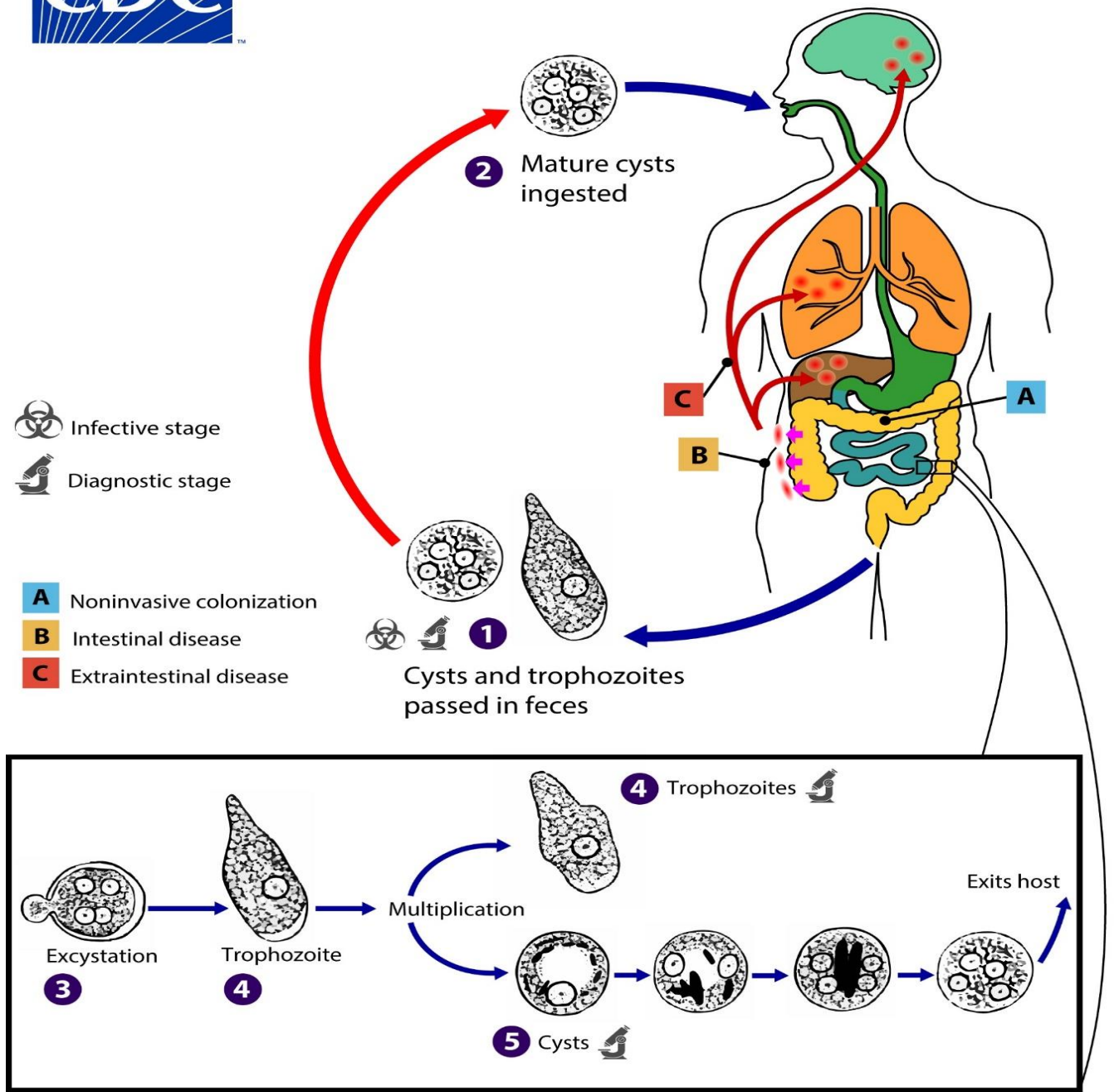
Conjugation is a form of sexual reproduction. It is a temporary union of two individuals of same species for mutual exchange of genetic materials

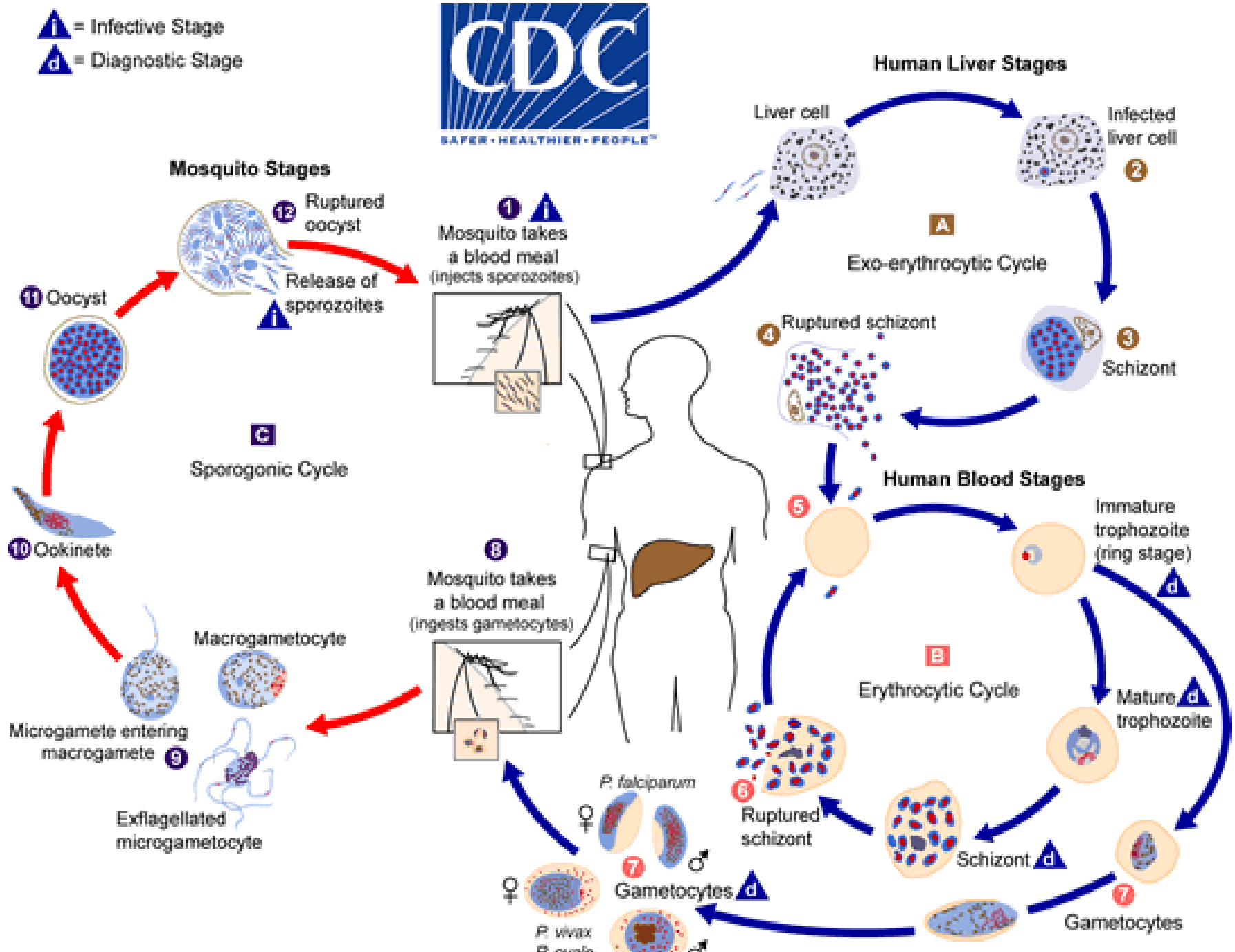
Continuous multiplication by binary fission is interrupted by conjugation as it is necessary for the survival and rejuvenation of the race.



4. Protozoa and Health

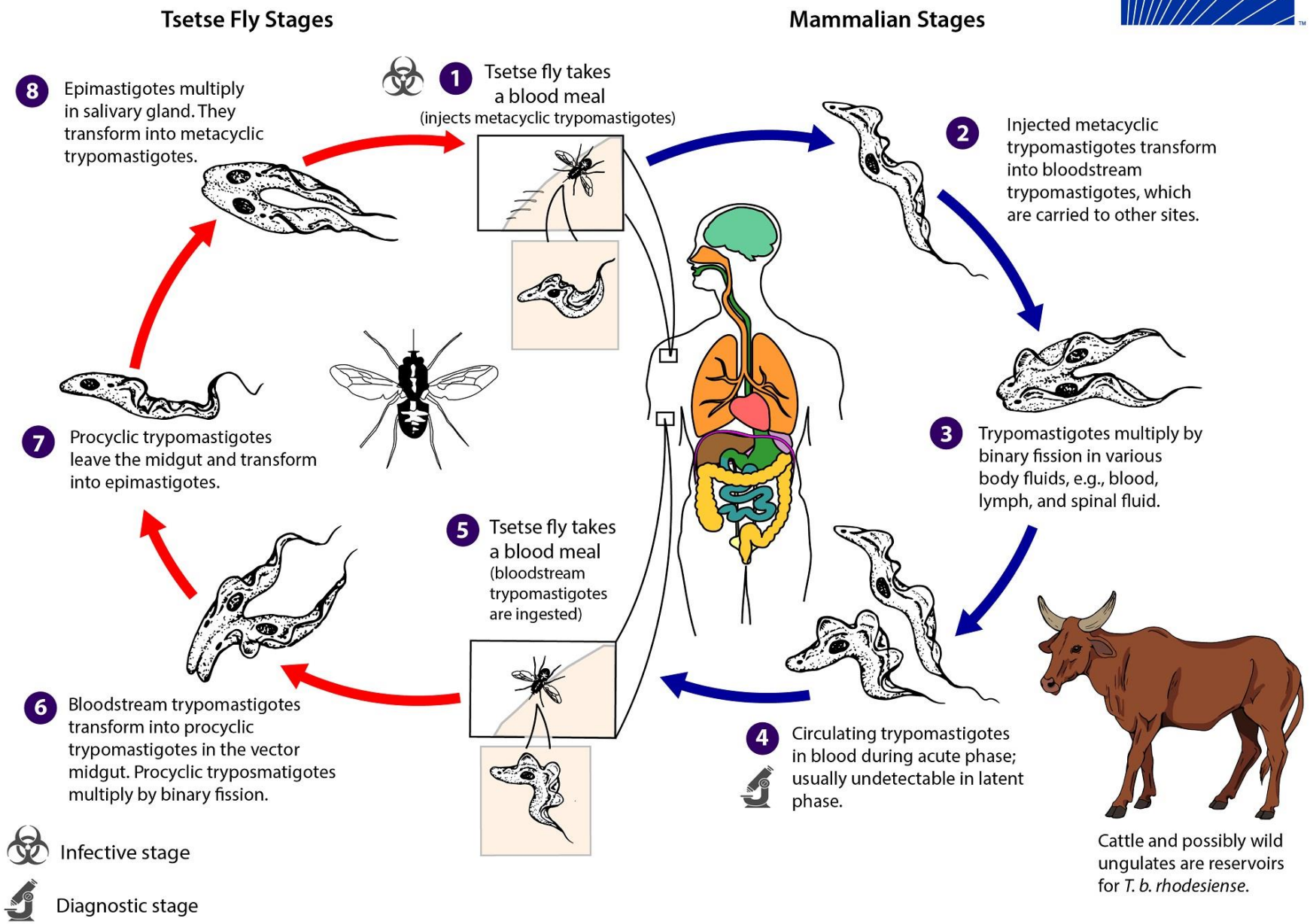
Amebiasis

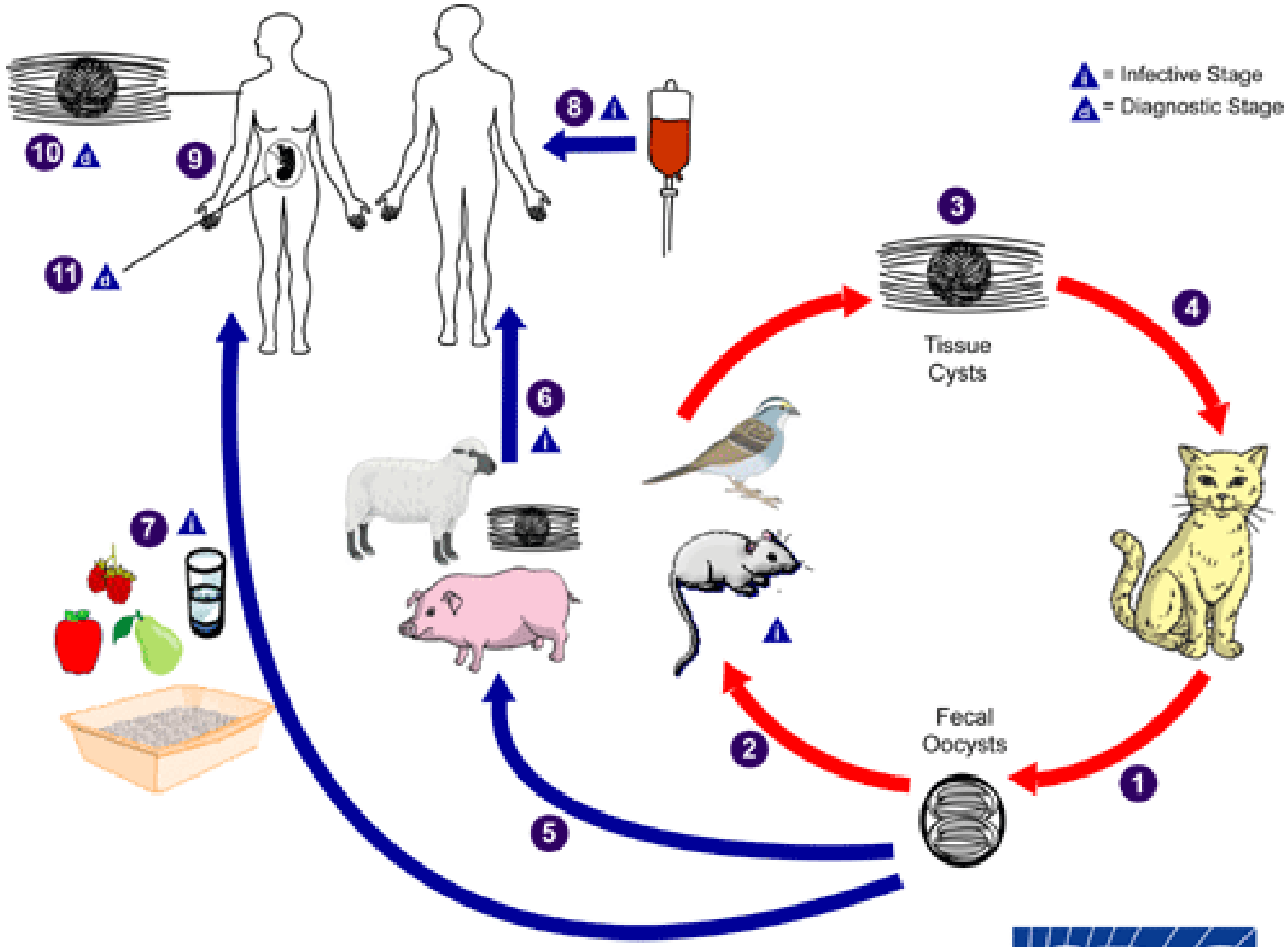

2 Mature cysts ingested
Infective stage
Diagnostic stage
A Noninvasive colonization
B Intestinal disease
C Extraintestinal disease
1
Cysts and trophozoites passed in feces
C
A
B
4 Trophozoites
Exits host
Multiplication
Excystation
3
Trophozoite
4
5 Cysts


= Infective Stage
= Diagnostic Stage
CDC
SAFER · HEALTHIER · PEOPLE™
Human Liver Stages
Liver cell
Infected liver cell
2
A
Exo-erythrocytic Cycle
Ruptured schizont
4
3
Schizont
Mosquito Stages
12 Ruptured oocyst
Release of sporozoites
1
Mosquito takes a blood meal
(injects sporozoites)
11 Oocyst
C
Sporogonic Cycle
10 Ookinete
Human Blood Stages
5
Immature trophozoite (ring stage)
d
8
Mosquito takes a blood meal
(ingests gametocytes)
B
Erythrocytic Cycle
Mature trophozoite
Macrogametocyte
Microgamete entering macrogamete
9
Exflagellated microgametocyte
P. falciparum
6
Ruptured schizont
Schizont
7
Gametocytes
Gametocytes
P. vivax

African Trypanosomiasis

Trypanosoma brucei gambiense & Trypanosoma brucei rhodesiense




= Infective Stage
= Diagnostic Stage
Tissue Cysts
Fecal Oocysts
1
2
3
4
5
6
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8
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11

References

- **For further reading please see:**
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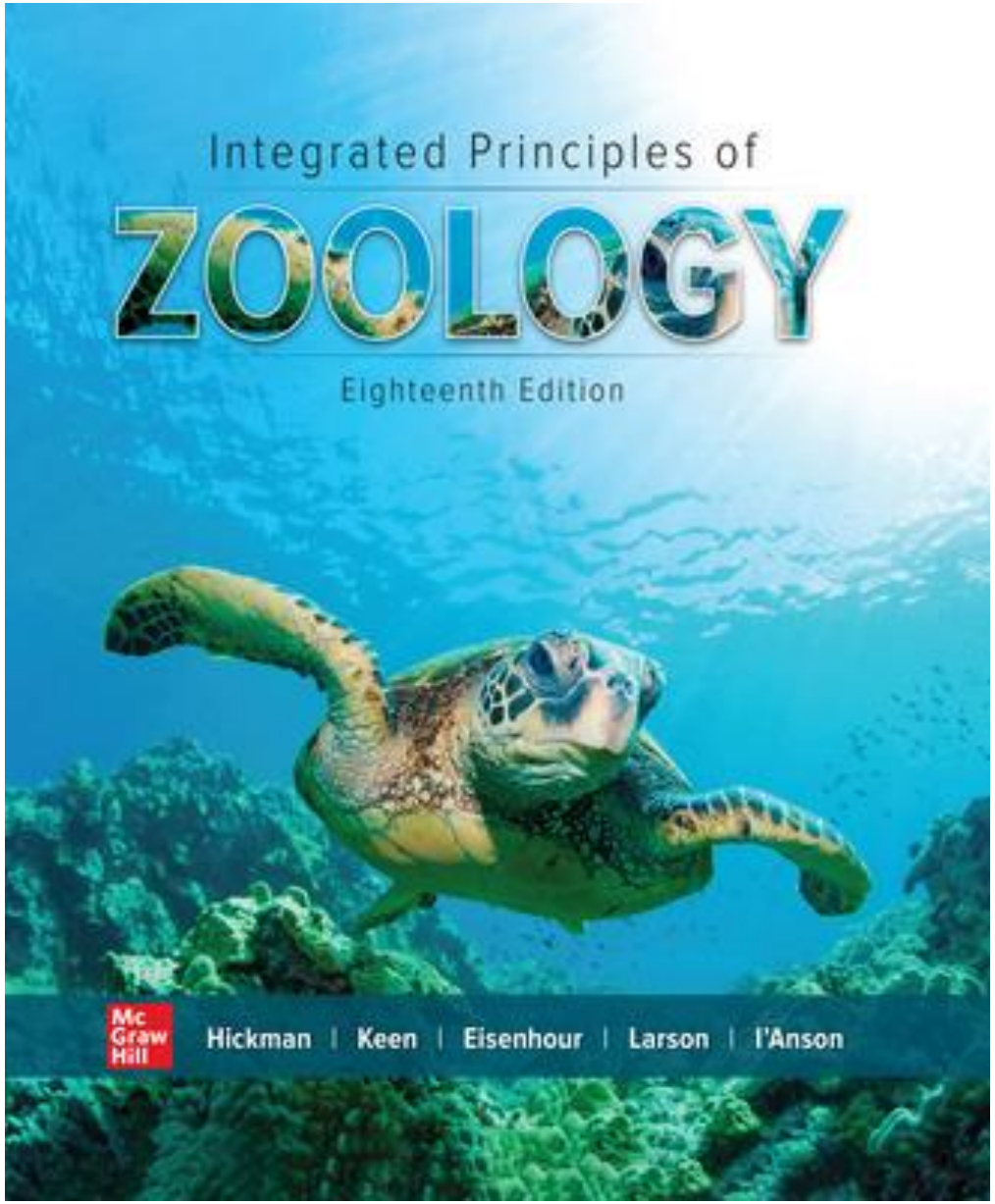
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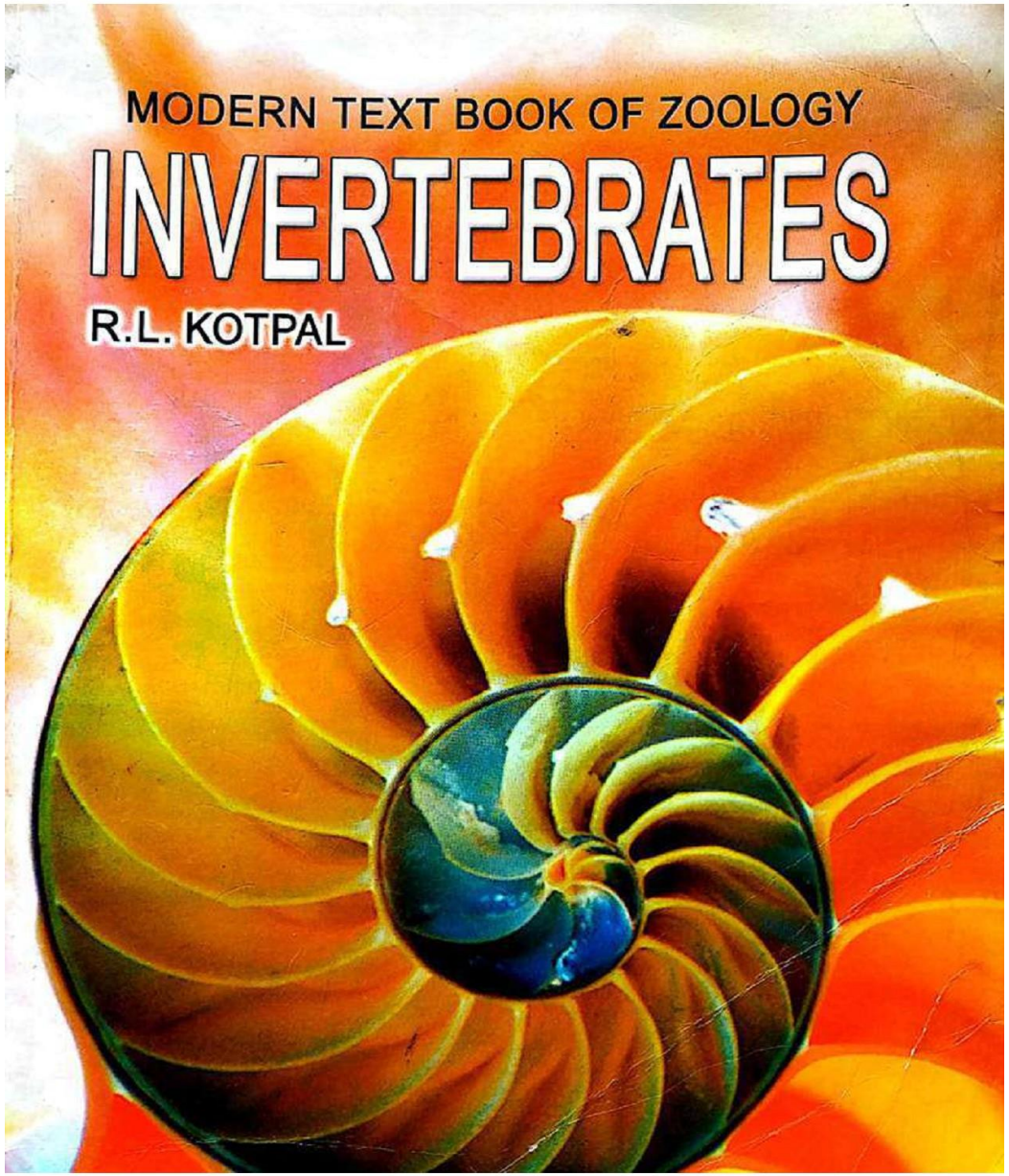
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