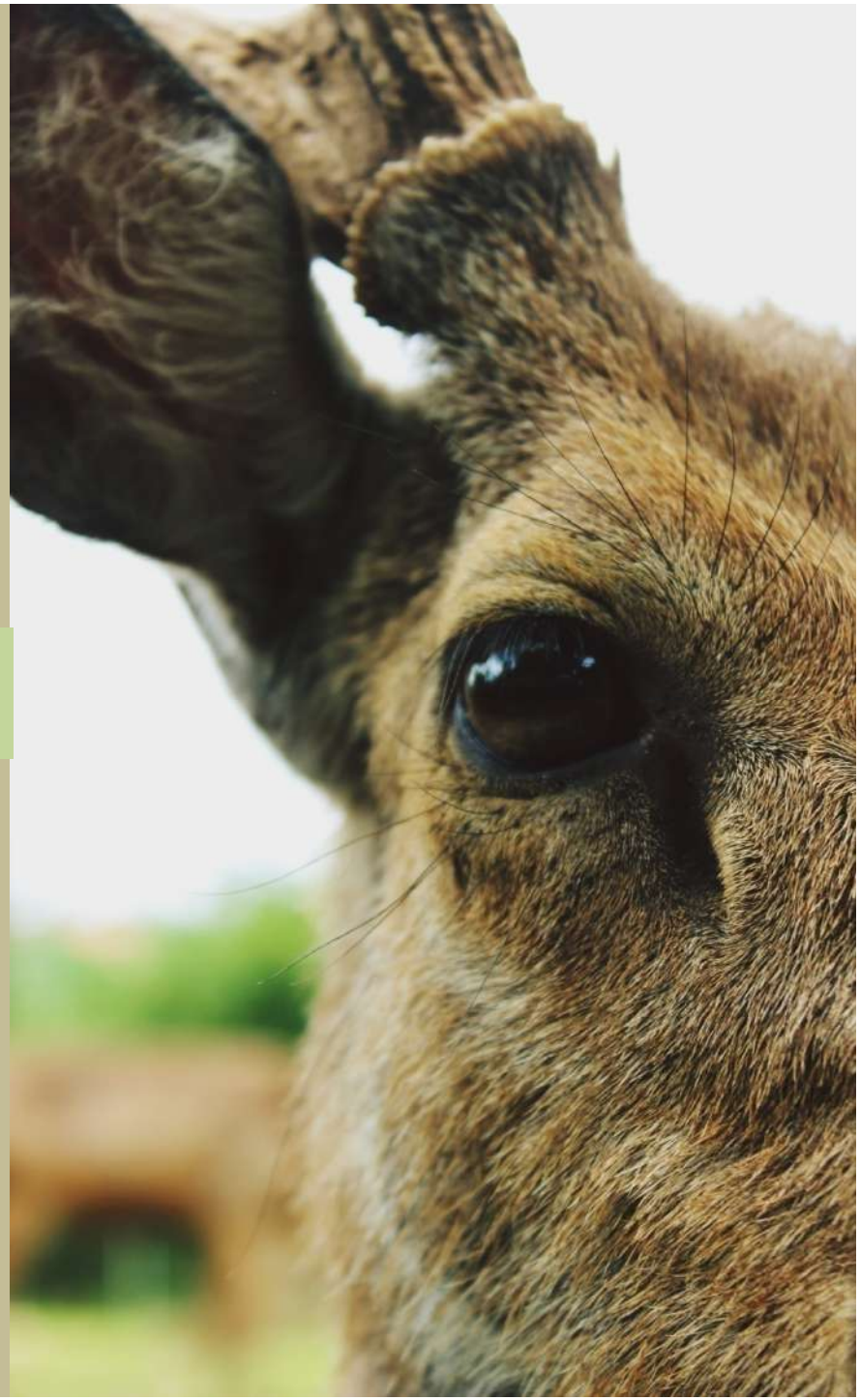
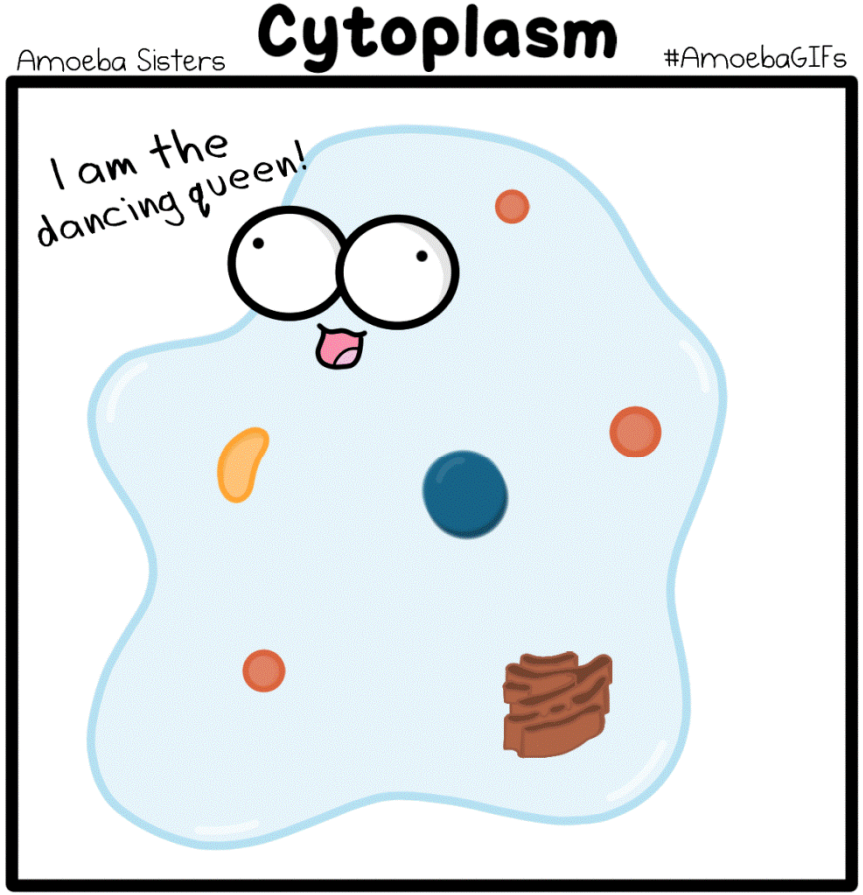
TAKSONOMI HEWAN

CHAPTER 2: PROTOZOA



Husni Mubarok, S.Pd., M.Si.
Tadris Biologi
IAIN Jember

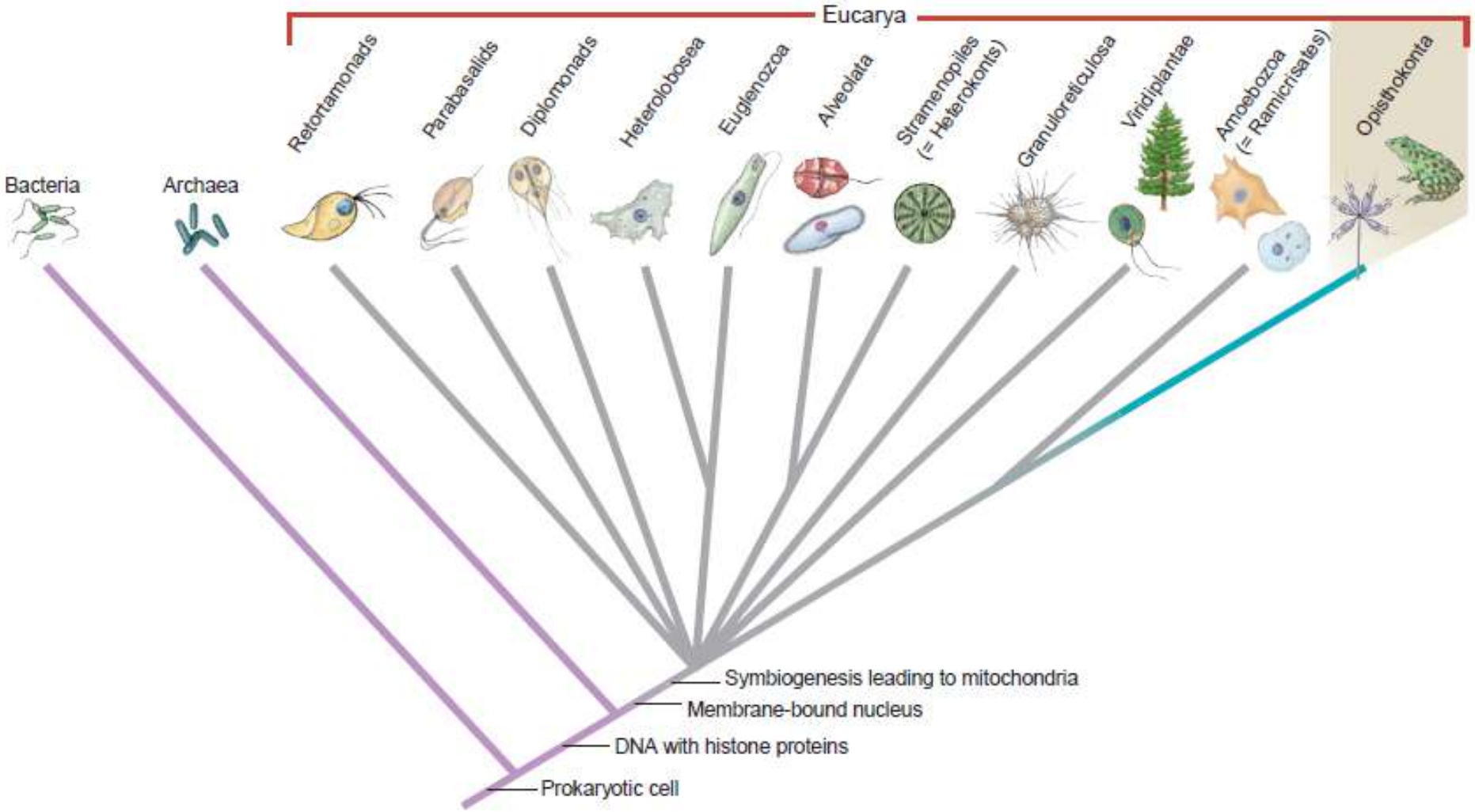
SIAPAKAH AKU...??



SISTEM KLASIFIKASI

Linnaeus 1735[29]	Haeckel 1866[30]	Chatton 1925[31][32]	Copeland 1938[33][34]	Whittaker 1969[35]	Woese *et al.* 1977[36][37]	Woese *et al.* 1990[38]	Cavalier-Smith 1993[39][40][41]	Cavalier-Smith 1998[42][43][44]	Ruggiero *et al.* 2015[45]
2 kingdoms	3 kingdoms	2 empires	4 kingdoms	5 kingdoms	6 kingdoms	3 domains	8 kingdoms	6 kingdoms	7 kingdoms
(not treated)	Protista	Prokaryota	Monera	Monera	Eubacteria	Bacteria	Eubacteria	Bacteria	Bacteria
					Archaebacteria	Archaea	Archaebacteria		Archaea
		Eukaryota	Protista	Protista	Protista	Eucarya	Archezoa	Protozoa	Protozoa
							Protozoa		
							Chromista	Chromista	Chromista
Vegetabilia	Plantae		Plantae	Plantae	Plantae		Plantae	Plantae	Plantae
				Fungi	Fungi		Fungi	Fungi	Fungi
Animalia	Animalia		Animalia	Animalia	Animalia		Animalia	Animalia	Animalia

KLADOGRAM DIVERSIFIKASI EUKARIOT

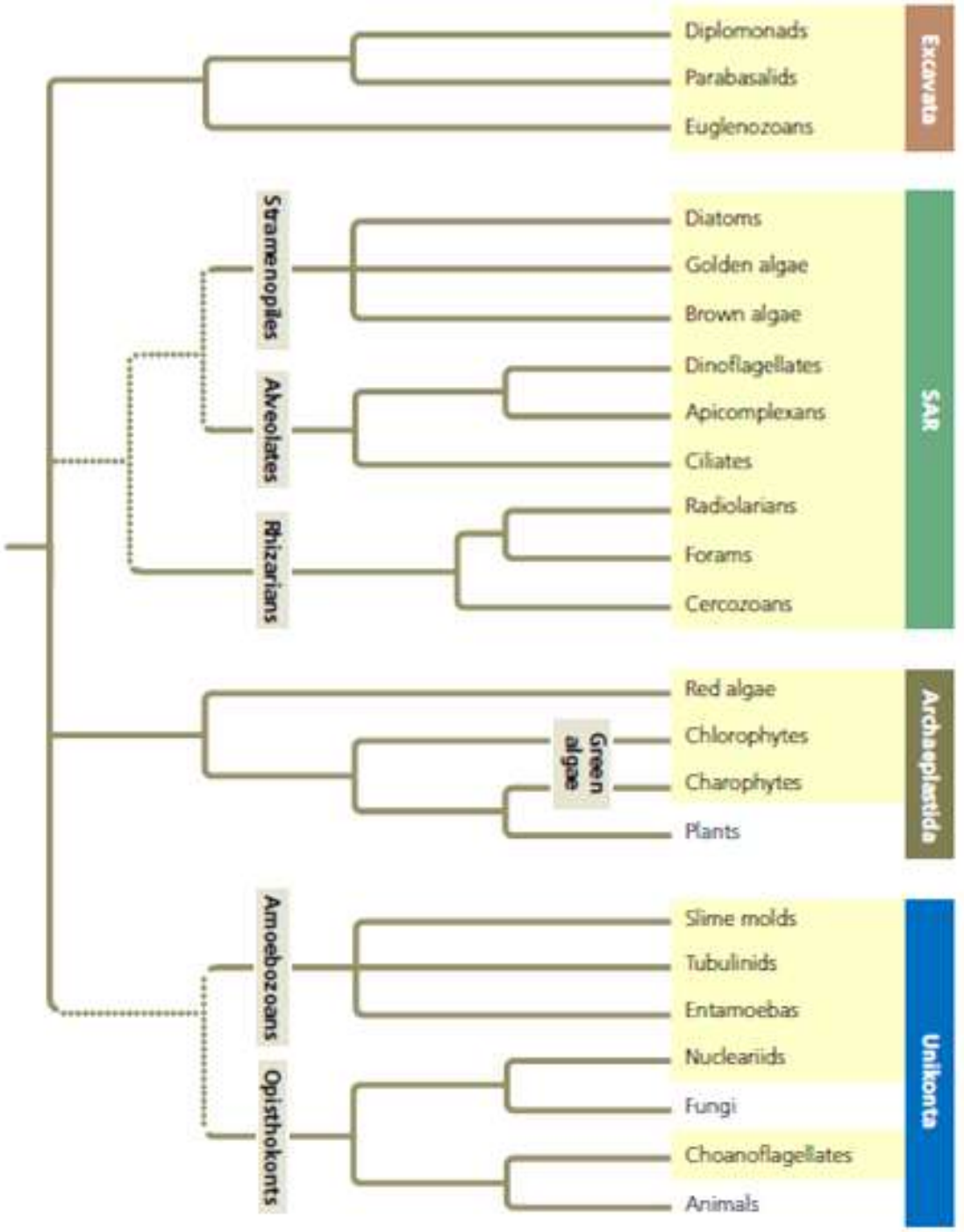


Hipotesis Pohon Filogenetik Eukariot yg ada sekarang

4 Super Group

1. **EXCAVATA**
2. **SAR** (Stramenopila, Alveolata, Rhizaria)
3. **ARCHEOPLASTIDA**
4. **UNIKOTA**

Garis putus-putus = Belum Pasti/ Masih diperdebatkan



Apa Itu Protozoa

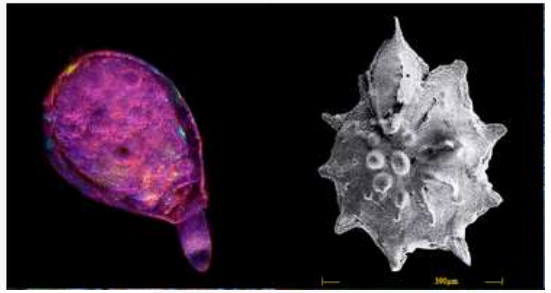
- ***Protos:*** Pertama & ***Zoon:*** Hewan
- Uniseluler
- 10-50 µm, dpt tumbuh 1 mm, & mudah dilihat di mikroskop
- Eukariotik (memiliki membran nukleus)
- Hidup soliter (sendiri)/ berkoloni (kelompok)
- Umumnya Heterotrof
- Bentuk vegetatif (**Trophozoite**), atau bentuk istirahat (**Kista)** utk bertahan hidup
- Hidup bebas, saprofit atau parasit pd inang
- Alat gerak **Pseudopodia, Silia,** atau **Flagela**

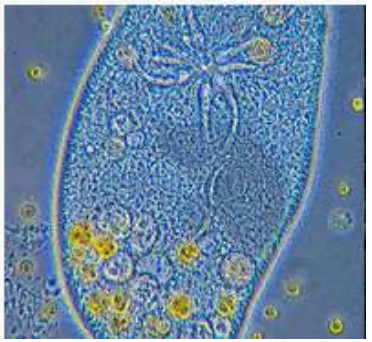
Characteristics of Unicellular Eukaryotes

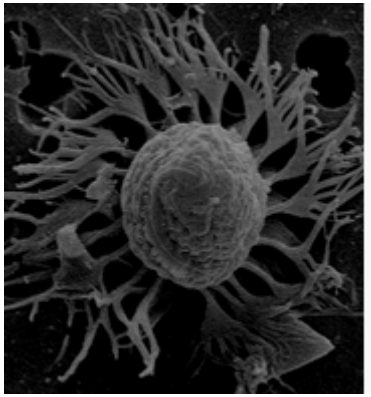
1. **Unicellular;** some colonial, and some with multicellular stages in their life cycles
2. **Mostly microscopic,** although some are large enough to be seen with the unaided eye
3. All symmetries represented in the group; shape variable or constant (oval, spherical, or other)
4. **No germ layer present**
5. No organs or tissues, but **specialized organelles** are found; nucleus single or multiple
6. Free-living, mutualism, commensalism, parasitism all represented in the groups
7. Locomotion by **pseudopodia, flagella, cilia,** and direct cell movements; some sessile
8. Some provided with a **simple endoskeleton** or **exoskeleton,** but most are naked
9. **Nutrition of all types:** autotrophic (manufacturing own nutrients by photosynthesis), heterotrophic (depending on other plants or animals for food), saprozoic (using nutrients dissolved in the surrounding medium)
10. Aquatic or terrestrial habitat; free-living or symbiotic mode of life
11. Reproduction **asexually** by fission, budding, and cysts and **sexually** by conjugation or by syngamy (union of male and female gametes to form a zygote)
12. The simplest example of **division of labor between cells** is seen in certain colonial protozoa that have both somatic and reproductive zooids (individuals) in the colony.

Apa Itu Protozoa

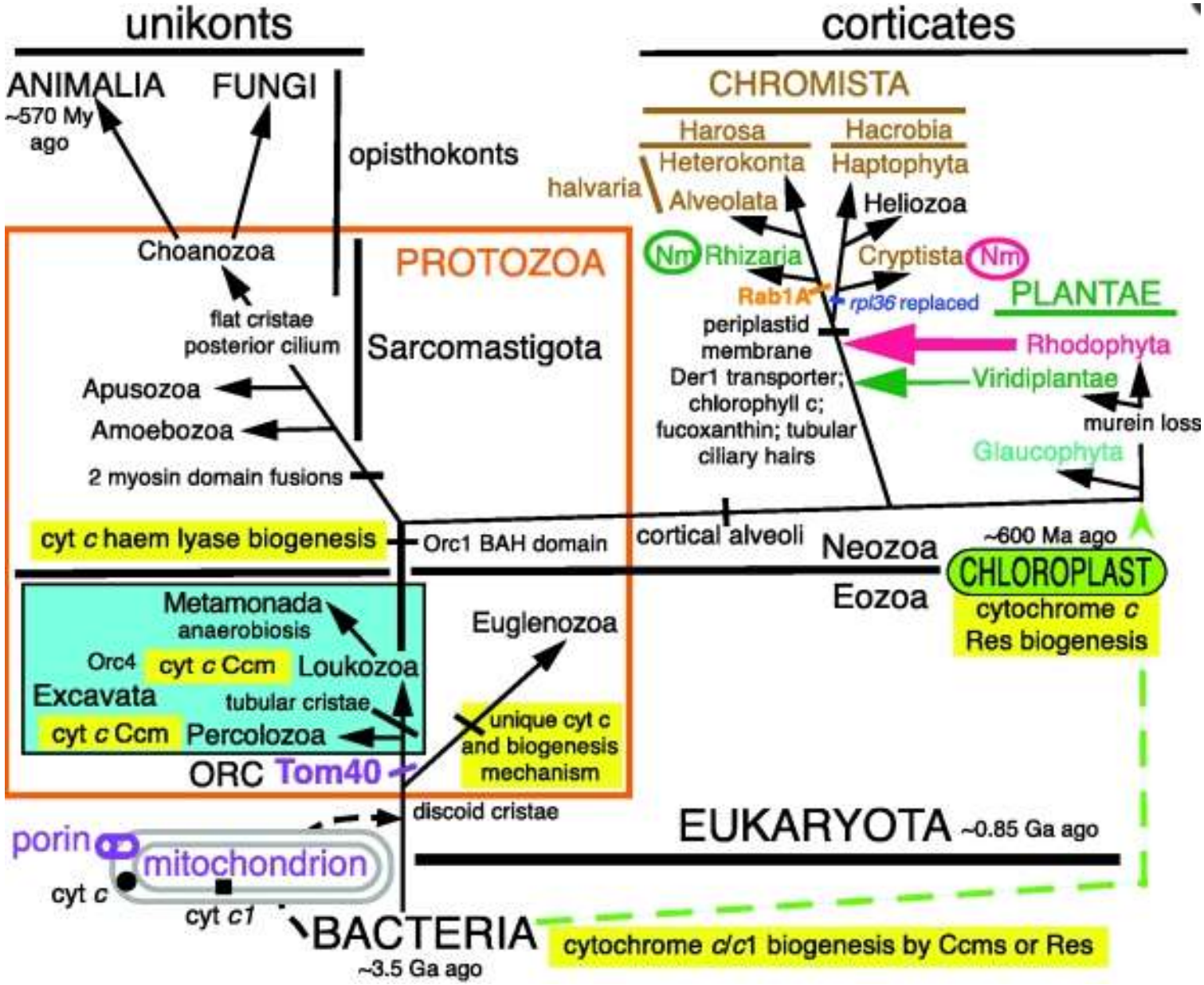
- Bentuk beragam (Bola, memanjang, tak beraturan)
- Umumnya hidup di tempat lembab, lautan, air tawar / daratan.
- **Aerobik nonfotosintetik**, tetapi beberapa protozoa dpt hidup pd **lingkungan ananaerobik** ex: saluran pencernaan manusia/ hewan
- Predator (memangsa uniseluler / berserabut ganggang, bakteri, & microfungi)
- Protozoa → sbg herbivora & konsumen di *decomposer link* rantai makanan
- Mengendalikan populasi bakteri dan biomas

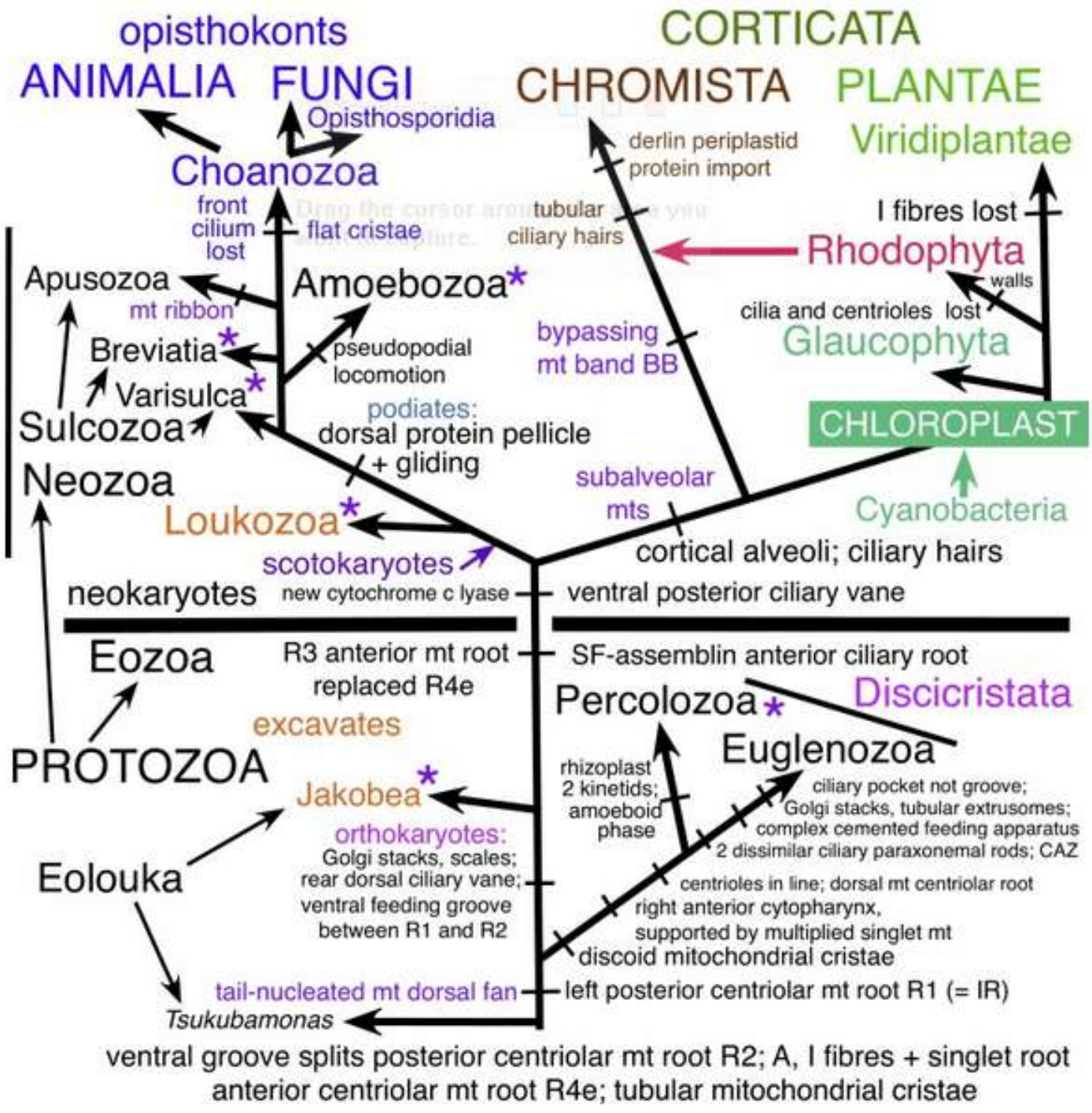






Evolutionary Relationships of The Six Kingdoms (Cavalier-Smith 1995)





Schematic eukaryote phylogeny consistent with 187-protein trees (Cavalier-Smith et al. 2015)

PLOS | ONE

CORRECTION

Correction: A Higher Level Classification of All Living Organisms

Michael A. Ruggiero, Dennis P. Gordon, Thomas M. Orrell, Nicolas Bailly, Thierry Bourgoin, Richard C. Brusca, Thomas Cavalier-Smith, Michael D. Guiry, Paul M. Kirk

OPEN ACCESS

Citation: Ruggiero MA, Gordon DP, Orrell TM, Bailly N, Bourgoin T, Brusca RC, et al. (2015) Correction: A Higher Level Classification of All Living Organisms. PLoS ONE 10(6): e0130114. doi:10.1371/journal.pone.0130114

Published: June 11, 2015

Rank
Superkingdom
Kingdom
Subkingdom
Infrakingdom
Superphylum
Phylum
Subphylum
Infraphylum
Superclass
Class
Subclass
Infraclass
Superorder
Order

Main ranks are in bold type; unnamed taxa are not counted.

doi:10.1371/journal.pone.0130114.t001

KLASIFIKASI PROTOZOA

SUPERKINGDOM EUKARYOTA			
KINGDOM PROTOZOA			
SUBKINGDOM EOZOA			
INFRAKINGDOM EUGLENOZOA			
	Phylum Euglenozoa		
	Subphylum N.N.		
		Class Diplonemea	
			Order Diplonemida
		Class Kinetoplastea	
			Order Bodonida
			Order Prokinetoplastida
			Order Trypanosomatida
	Subphylum Euglenoida		
		Class N. N.	
			Order Petalomonadida
			Order Ploeotiida
		Class Euglenophyceae	
			Order Euglenida
			Order Eutreptiida
		Class Peranemea	
			Order Heteronemida
			Order Peranemida
			Order Rhabdomonadida
	Subphylum Symbiontida		
		Class Postgaardea	
			Order Postgaardida

Included in Supergroup Excavata

INFRAKINGDOM EXCAVATA	*Supergroup*	
Phylum Loukozoa		
Subphylum Eolouka		
	Class Jakobea	
		Order Jakobida
	Class Tsukubea	
		Order Tsukubamonadida
Subphylum Neolouka		
	Class Malawimonadea	
		Order Malawimonadida
Phylum Metamonada		
	Class Anaeromonadea	
		Order Oxymonadida
		Order Trimastigida
	Class Carpomonadea	
		Order Carpediemonadida
		Order Chilomastigida
		Order Dysnectida
	Class Eopharyngea	
		Order Diplomonadida
		Order Retortamonadida
	Class Trichomonadea	
		Order Cristamonadida
		Order Spirotrichonymphida
		Order Trichomonadida

		Order Tritrichomonadida
	Class Trichonymphea	
		Order Lophomonadida
		Order Trichonymphida
Phylum Percolozoa		
Subphylum Pharyngomonada		
	Class Pharyngomonadea	
		Order Pharyngomonadida
Subphylum Tetramitia		
	Class Heterolobosea	
		Order Acrasida
		Order Schizopyrenida
	Class Lyromonadea	
		Order Lyromonadida
	Class Percolatea	
		Order Percolomonadida
		Order Pseudociliatida
SUBKINGDOM SARCOMASTIGOTA		
Phylum Amoebozoa		
Subphylum Conosa		
	Class Archamoebea	
		Order Mastigamoebida
		Order Pelobiontida
		Order Rhizomastigida

Class Dictyostelea

Order Dictyostelida

Class Myxogastrea [= Myxomycetes]

Subclass Exosporeae

Order Ceratiomyxida

Subclass Myxogastria

Superorder Collumelidia

Order Echinosteliida

Order Fuscisporida

Superorder Lucisporidia

Order Liceida

Order Trichiida

Class Protostelea

Order Protostelida

Class Variosea

Order Artodiscida

Order Holomastigida

Order Phalansteriida

Order Varipodida

Subphylum Lobosa

Class Discosea

Subclass Flabellinia

Order Dactylopodida

Order Himatismenida

Order Pellitida

Order Stygamoebida

Order Trichosida

Order Vanellida

Subclass Longamoebia

Order Dermamoebida

Order Centramoebida

Order Thecamoebida

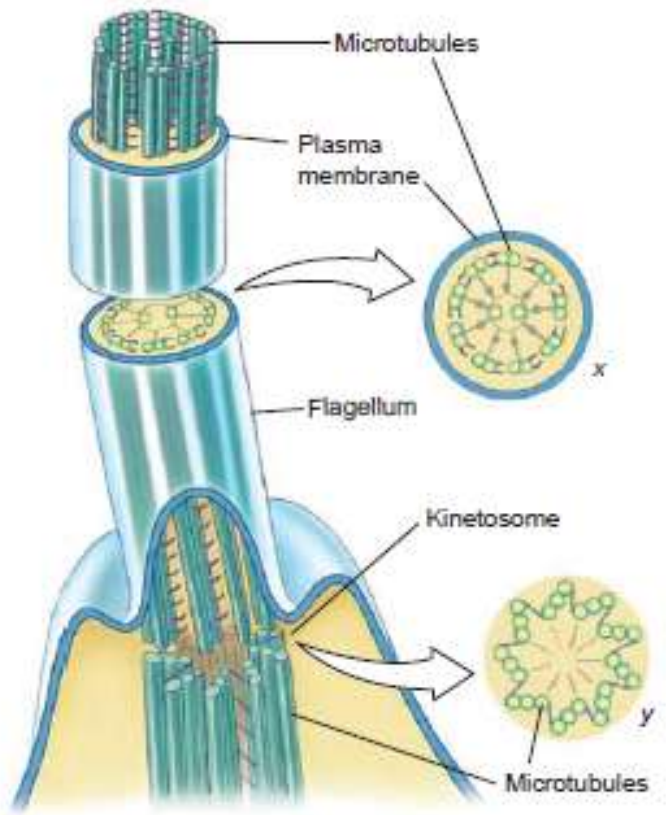
	Class Tubulinea [= Lobosea]	
		Order Arcellinida
		Order Echinamoebida
		Order Euamoebida
		Order Leptomyxida
		Order Nolandida
Phylum Choanozoa [with Microsporidia, Animalia, and Fungi constitutes "Supergroup Opisthokonta"]		
Subphylum Choanofila		
	Class Choanoflagellatea	
		Order Acanthoecida
		Order Craspedida
	Class Corallochytrea	
		Order Corallochytrida
	Class Filasterea	
		Order Ministeriida
	Class Ichthyosporea	
		Order Dermocystida
		Order Eccrinida
Subphylum Paramycia		
	Class Aphelidea	
		Order Aphelidida
	Class Cristidiscoidea	
		Order Fonticulida
		Order Nucleariida
	Class Rozellidea	
		Order Rozellida
Phylum Microsporidia [with Choanozoa, Animalia, and Fungi constitutes "Supergroup Opisthokonta"]		
	Class Disporea	
		Order N.N. (e.g., *Nosema*)
	Class Metchnikovellea	
		Order Metchnikovellida

		Class Minisporea [= Microsporea]
		Order Minisporida [= Minisporea]
	Class Pleistophorea	
		Order Pleistophorida
Phylum Sulcozoa		
Subphylum Apusozoa		
	Class Breviatea	
		Order Breviatida
	Class Thecomonadea	
		Order Apusomonadida
Subphylum Varisulca		
	Class Diphyllatea	
		Order Diphylleida
	Class Glissodiscea	
		Order Mantamonadida
		Order Planomonadida
	Class Hilomonadea	
		Order Rigifilida

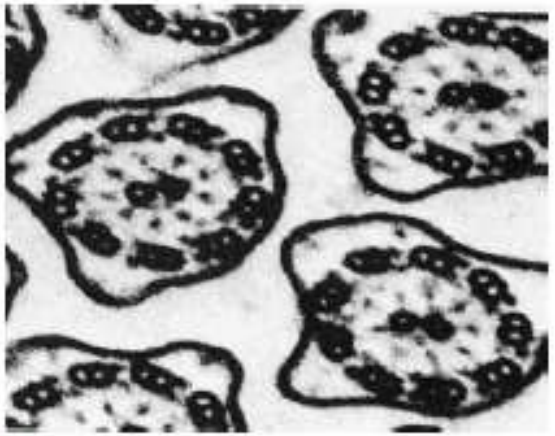
LOCOMOTION

Cilia dan *Flagella*

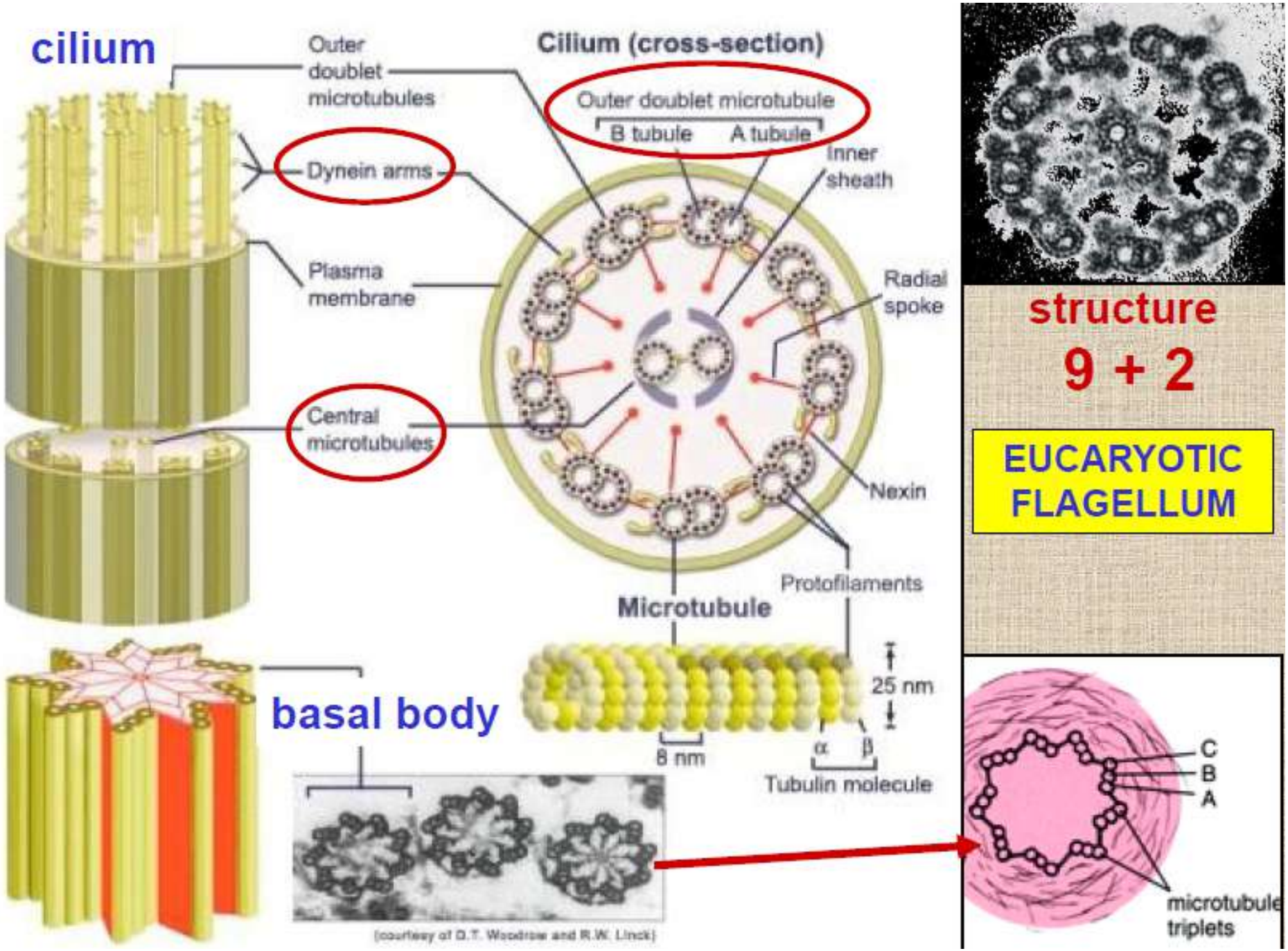
- 9 pasang mikrotubul longitudinal
- 9 triplets microtubules disebut **Kinetosome (*basal body*)**
- Komplex “9 + 2” tube of microtubules → **Axoneme**
- **Axoneme** ditutup oleh membran kontinus dgn membran sel yg menyelimuti organisme



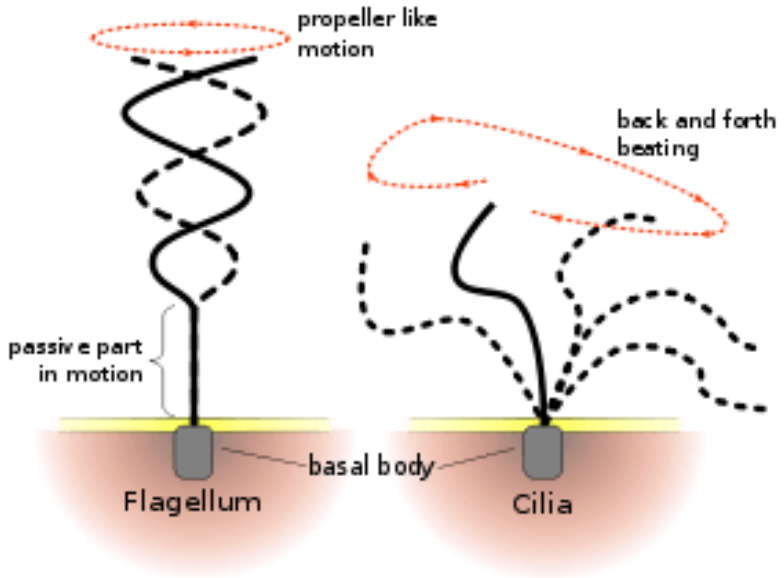
A



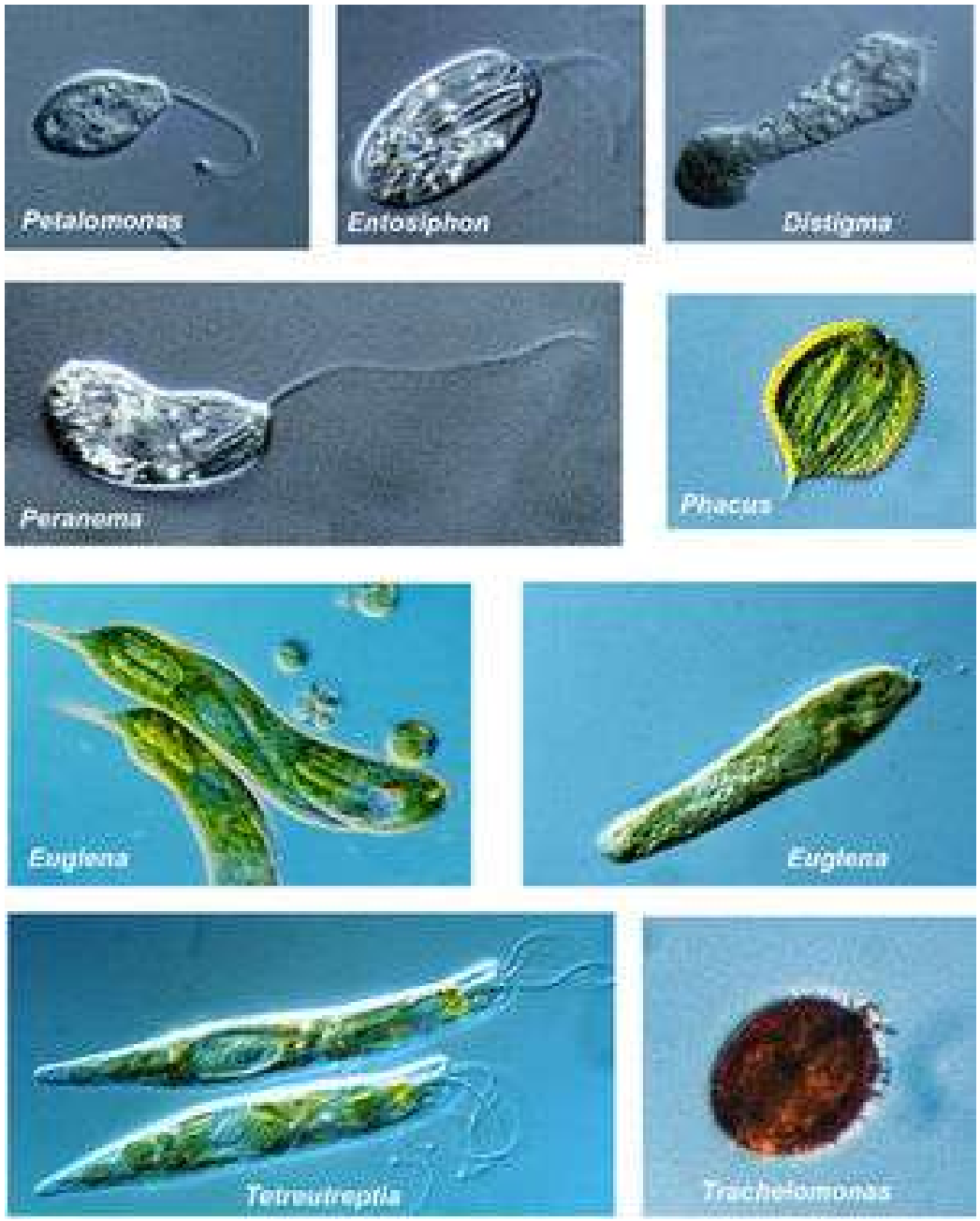
B


cilium
Outer doublet microtubules
Dynein arms
Plasma membrane
Central microtubules
basal body
Cilium (cross-section)
Outer doublet microtubule
B tubule
A tubule
Inner sheath
Radial spoke
Nexin
Protofilaments
Microtubule
25 nm
8 nm
α
β
Tubulin molecule
(courtesy of D.T. Woodrow and R.W. Linck)
C
B
A
microtubule triplets
structure
9 + 2
EUCARYOTIC FLAGELLUM

	Silia	Flagela
Definisi	Silia adalah pelengkap pendek, seperti rambut yang membentang dari permukaan sel hidup.	Flagela adalah pelengkap panjang, seperti benang di permukaan sel hidup.
Potongan Melintang	Ada lengan nexin	Ada lengan nexin
Panjang	Relatif Pendek	Lebih panjang silia, bisa bervariasi
Pergerakan	Berputar, seperti motor, bergerak sangat cepat	Gerakan seperti gelombang, bergelombang, sinusoidal, lambat dibanding silia
Kepadatan	Banyak (ratusan) per sel	Sedikit (kurang dari 10) per sel
Ditemukan di	Sel eukariotik	Sel eukariotik dan prokariotik

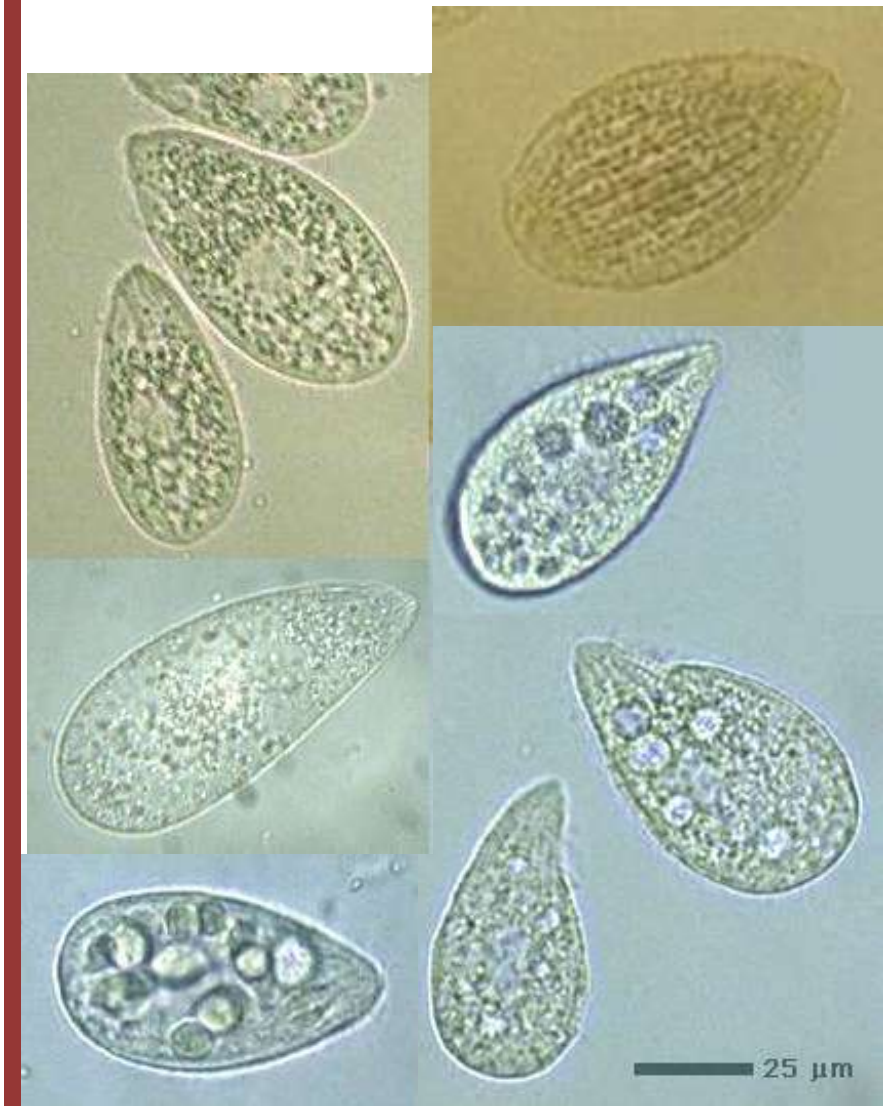


Phylum Euglenozoa



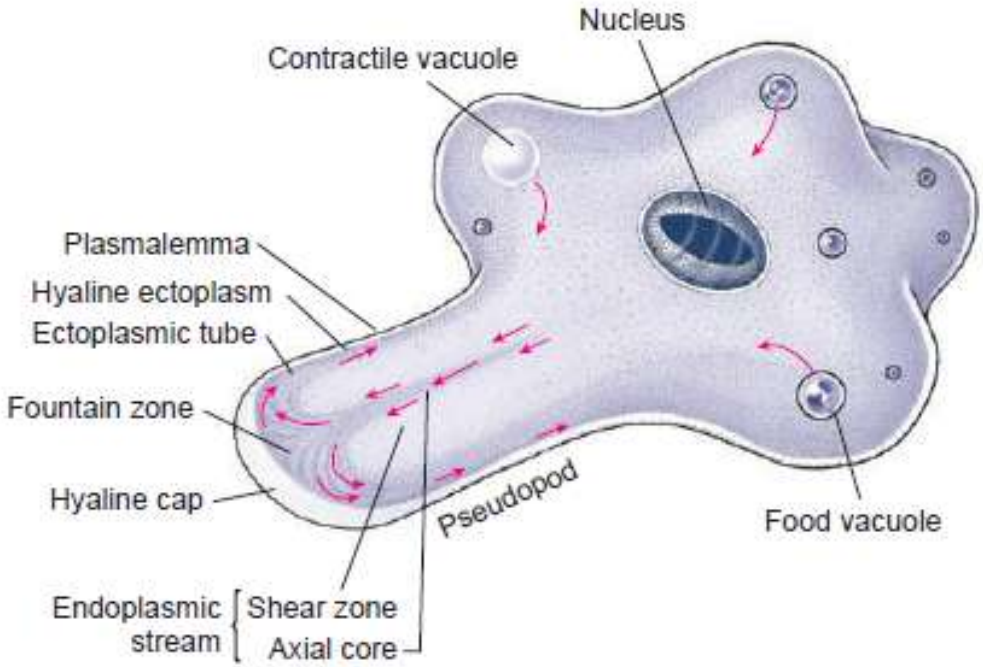
Kingdom : Chromista
Phylum : Ciliophora
Class : Oligohymenophorea

Tetrahymena thermophila



Pseudopodia

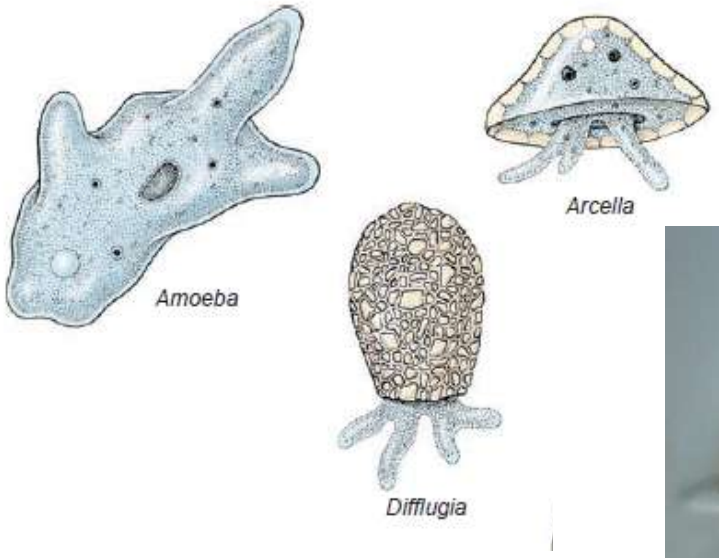
- **PSEUDOPODIA**: perpanjangan sitoplasma yg digunakan utk bergerak
- **Sitoplasma** = ***Not Homogeneous***



- **Ektoplasma (*ectoplasm*)**: Bagian Tepi, lebih granular, mengandung inti & organel
- **Endoplasama (*endoplasm*)** : Bagian Tengah, lebih transparan, berbentuk koloid gel

Type of Pseudopodia

1. **LOBOPODIA**
   - Bentuk paling umum
   - Besar (large), perpanjangan sel tubuh
   - Mengandung ekto & endoplasma
   - Beberapa ameba brgerak dgn seluruh tbuh → bentuk **limax**
   - **Ex: Amoeba, Difflugia, Arcella**



Phylum Amoebozoa
Class Tubulinea
Order Arcellinida

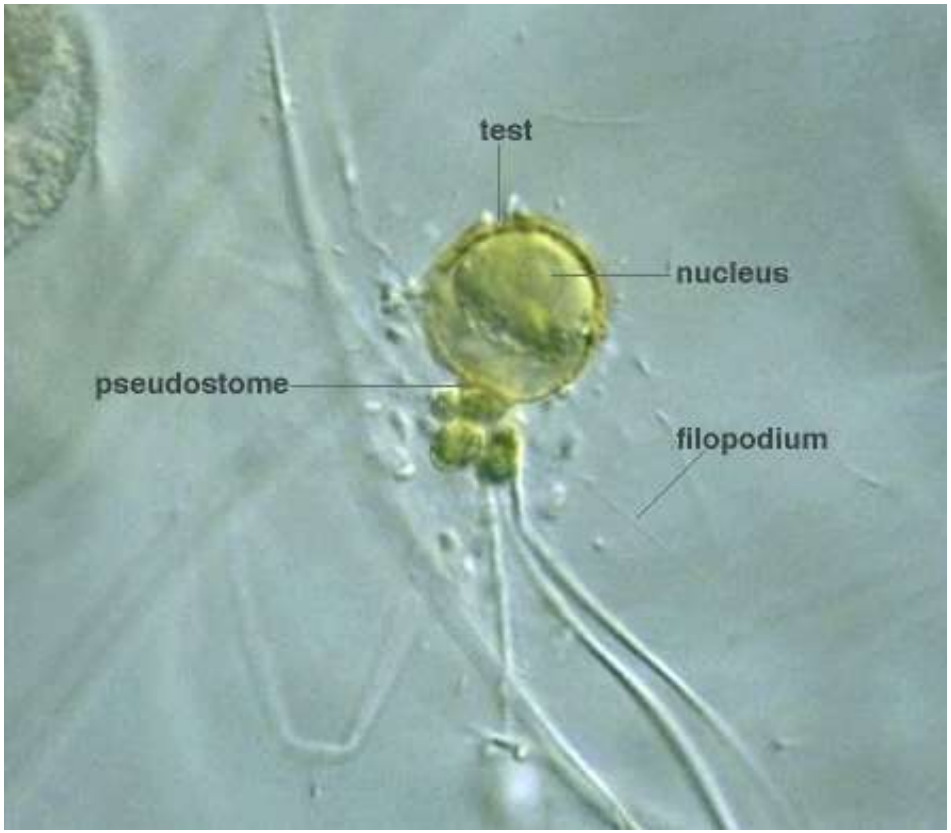
Type of Pseudopodia

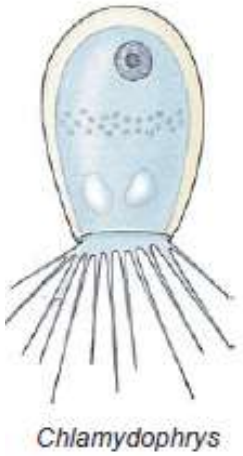
2. FILOPODIA

- Perpanjangan tipis (biasanya berbentuk cabang & mengandung ektoplasma)
- Ex: *Euglypha, Chlamydophrys*

Euglypha

Kingdom Chromista
Infrakingdom Rhizaria
Phylum Cercozoa
Order Euglyphida

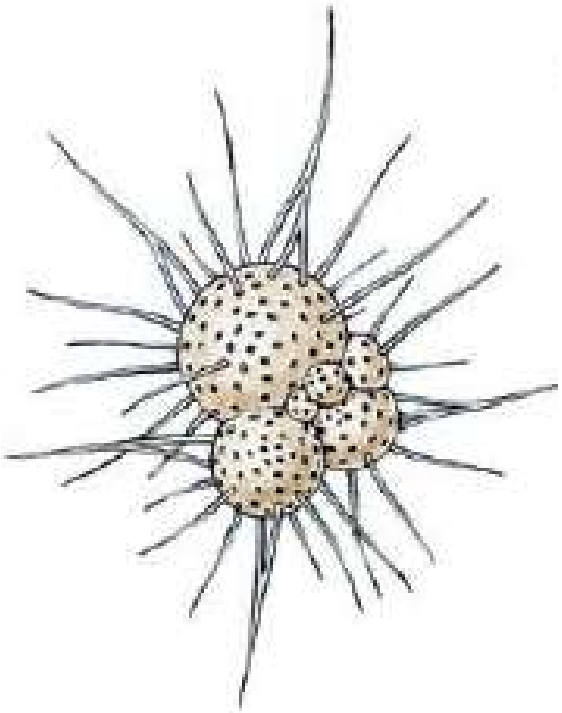




Chlamydophrys

Kingdom Chromista
Infrakingdom Rhizaria
Phylum Cercozoa
Order Tectofilosida

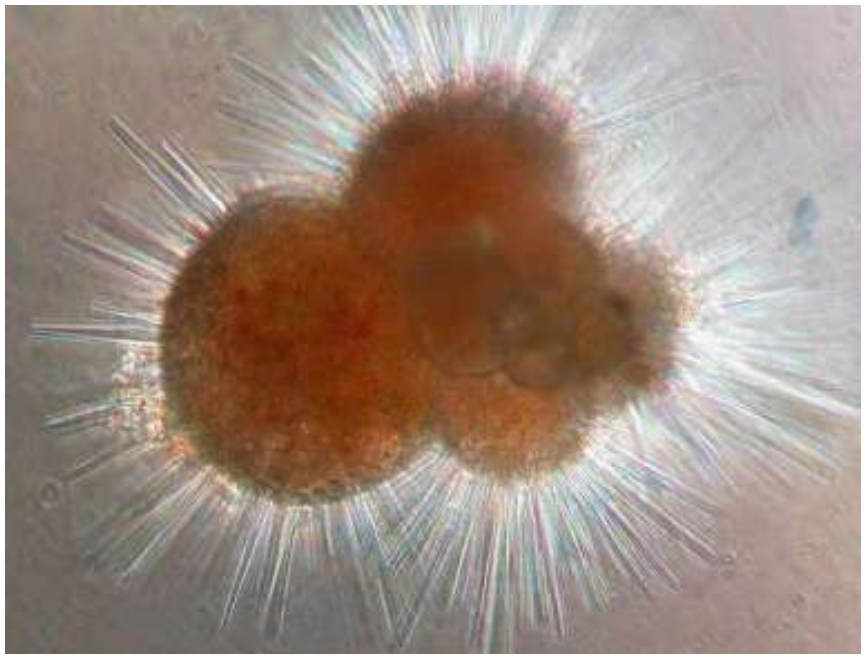
Type of Pseudopodia



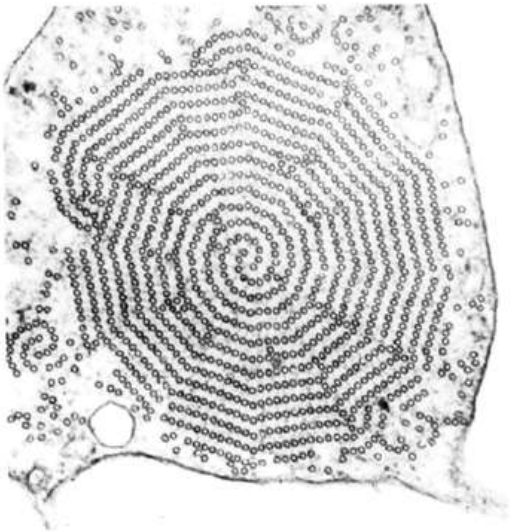
Kingdom Chromista
Phylum Retaria
Subphylum Foraminifera
Order Globeriginida

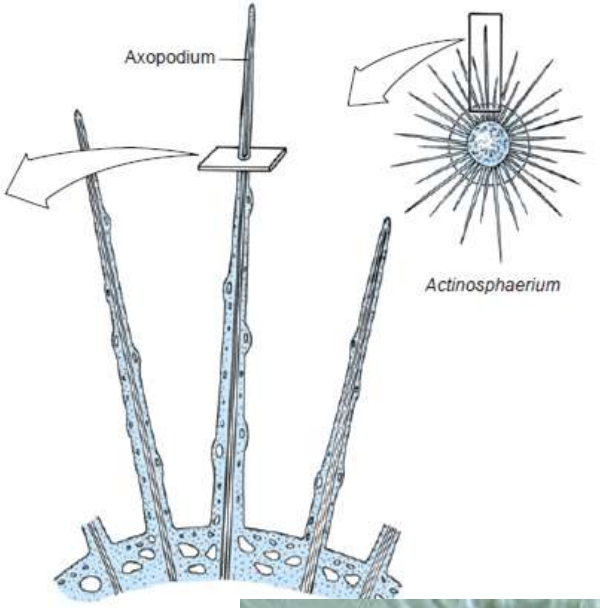
3. RETIKULOPODIA

- Spt filopodia tetapi berbentuk spt jaring
- Ex: Globigerina



Type of Pseudopodia

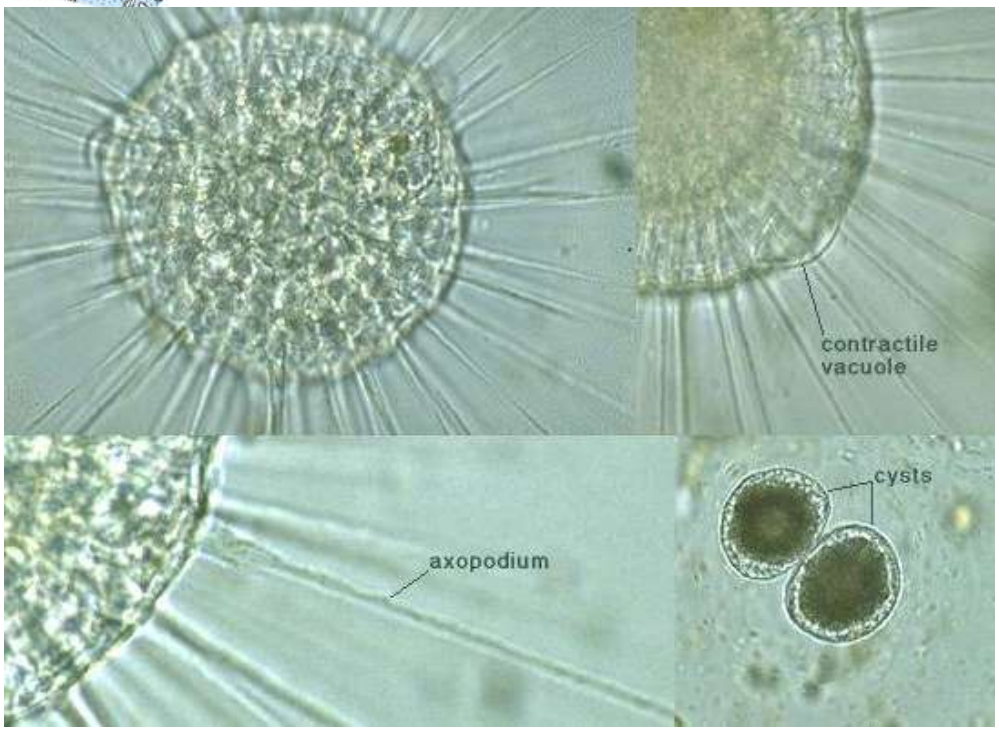




Kingdom Chromista
Phylum Ochrophyta
Class Raphidophyceae
Order Actinophryida

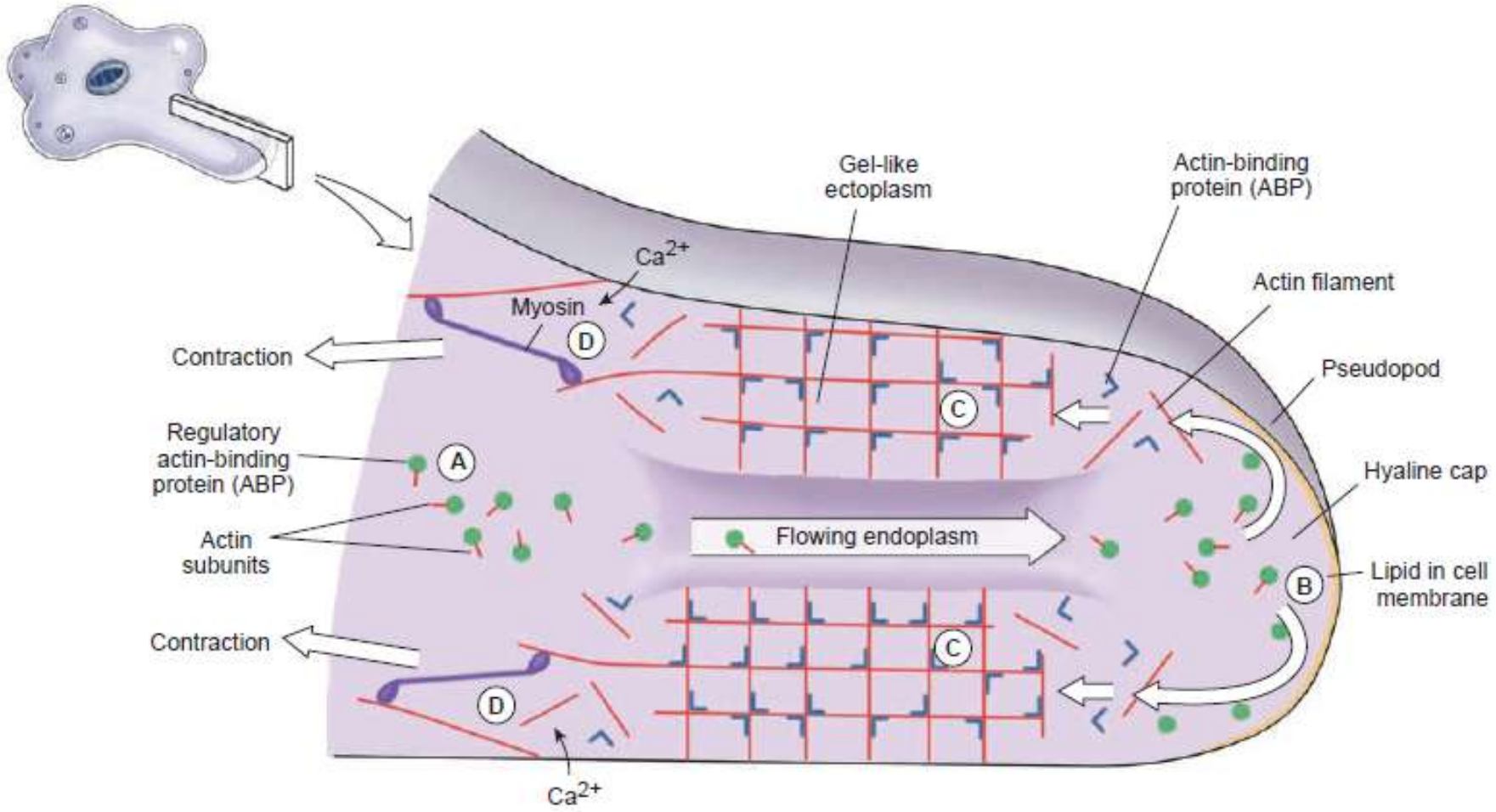
4. AXOPODIA

Semipermanen pseudopodia yg terdiri dari batang aksial yg dikelilingi selubung ektoplasmik




50 µm
Dr. R. Wagner

Mechanism of Pseudopodial Movement



NUTRITION

Chemoheterotrophic = need organic compounds (carbs, fats, proteins) from environment

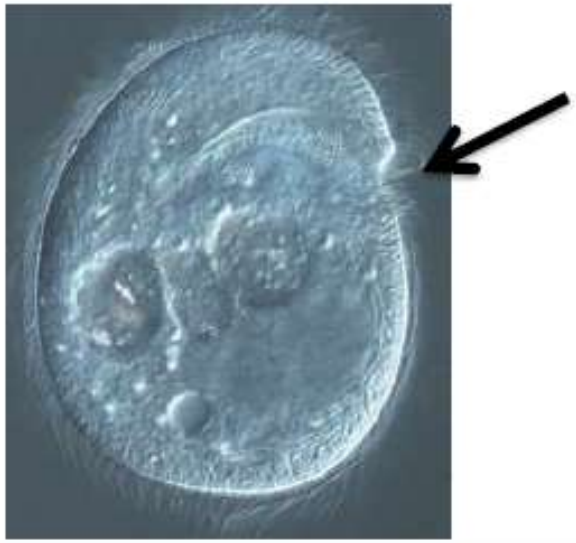
- instead of producing it themselves from sunlight or inorganic compounds

- Some transport food across the plasma membrane

Pellicle = protective coating on some protozoa

- Requires special structures to take in food

Cytostome = mouth-like opening used by ciliates; wave their cilia to move food toward it

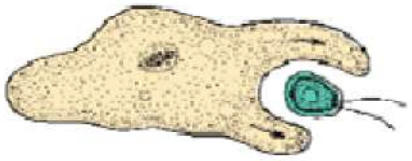


Vacuoles = membrane-enclosed compartments where digestion takes place

CARA MAKAN (*FEEDING METHODS*) PROTOZOA

Kingdom Protozoa
Sub Kingdom Sarcomastigota
Phylum Amoebozoa
Ruggiero,*et al*. 2015

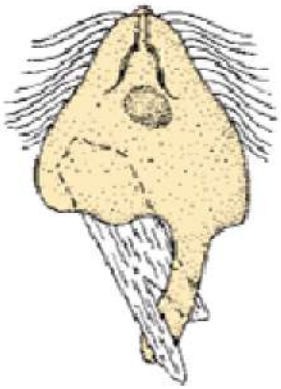
Pseudopodia



Amoeba

Cistosom Sementara → hanya me
Paramec
dikunyah
ujung ant

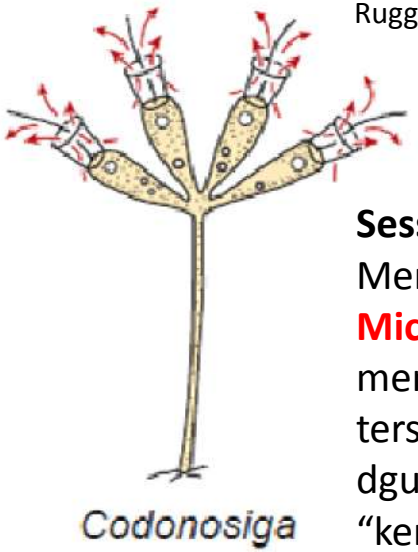
Tentakel → menangkap mangsa & menyedot sitoplasma mangsa ke dlm tubuh yg mmbentuk vakuola makanan



Leidyopsis

Pseudopodia
(*ingests wood chips*)

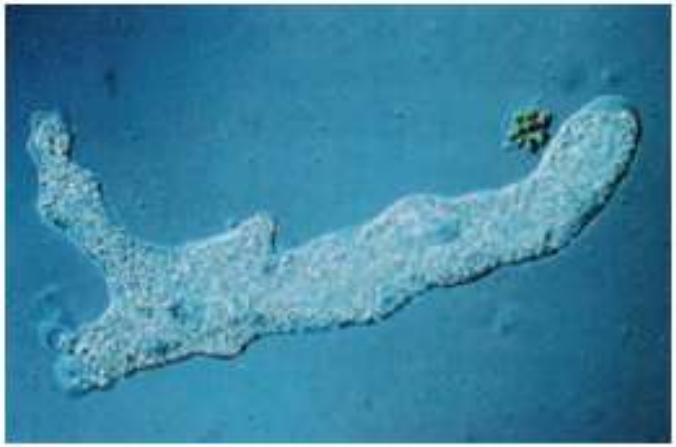
Kingdom Protozoa
Phylum Choanozoa
Class Choanoflagellatea
Ruggiero,*et al*. 2015



Codonosiga

Sessile Protozoa
Memiliki **"kerah"**
Microvilli → memakan partikel tersuspensi yg dgulung melalui "kerah" krn dorongan flagel
Secara teknis → Tipe **Fagositosis**

Amoeba Feeding



Codonosiga/ Codosiga Feeding

Podophyra Feeding

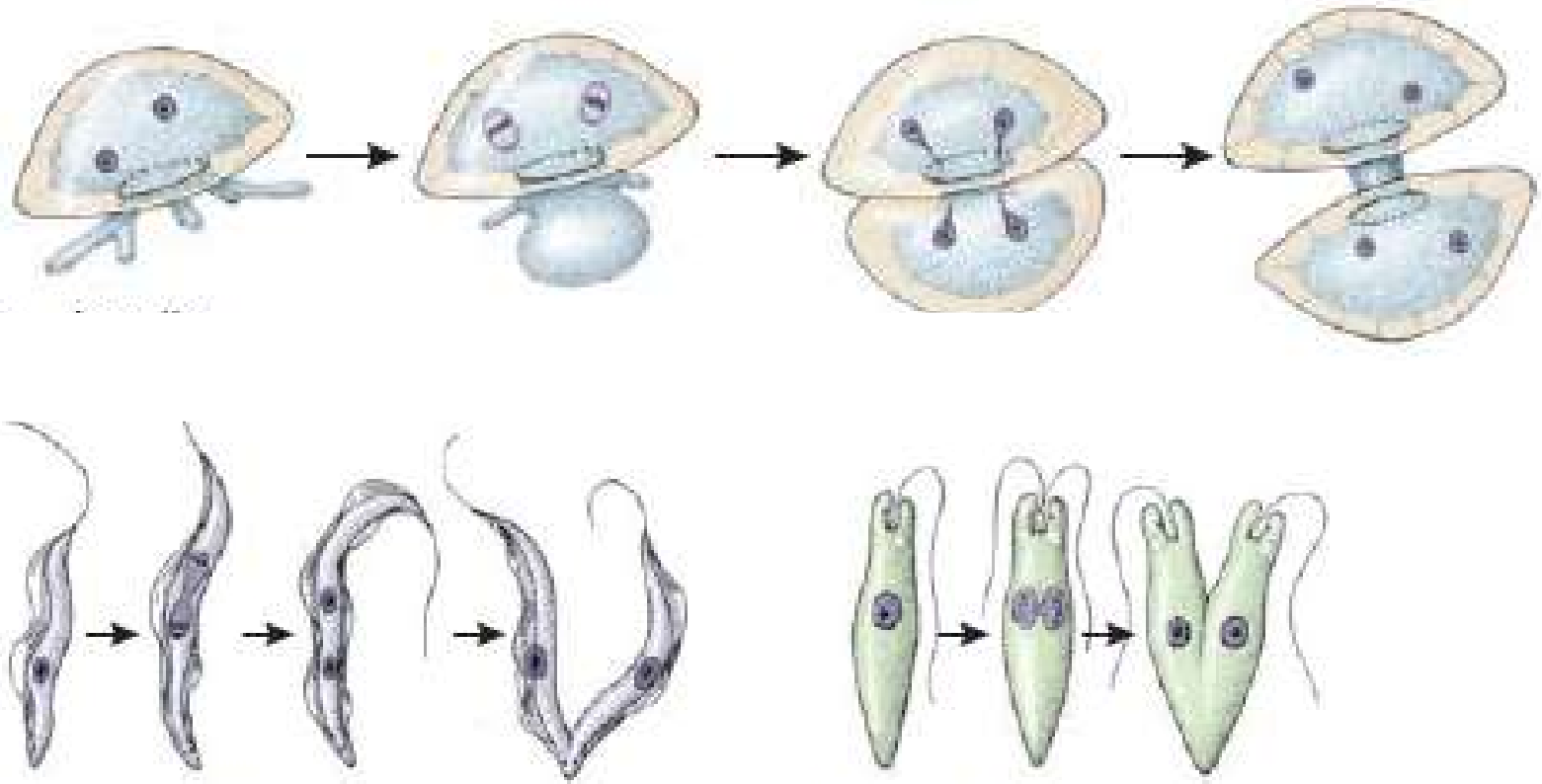
Didinium Feeding

REPRODUCTION

- All protozoa reproduce **asexually,** but sexual features is occur
- Protozoa do not have embryos
- Essential features of **sexual processes** include: (1) a reduction division of the chromosome number to half (diploid number to haploid number), (2) the development of sex cells (gametes) or at least gamete nuclei, and usually a fusion of gamete nuclei
- The cell multiplication process that produces more individuals in protozoa is called **fission**
- The most common type of fission is **binary**

The two nuclei of ***Arcella*** divide as some of its cytoplasm is extruded and begins **to secrete a new test** for the daughter cell.

Trypanosoma **has a kinetoplast** (part of the mitochondrion) near the kinetosome of its fl agellum close to its posterior end in the stage shown. All of these parts must be replicated before the cell divides.

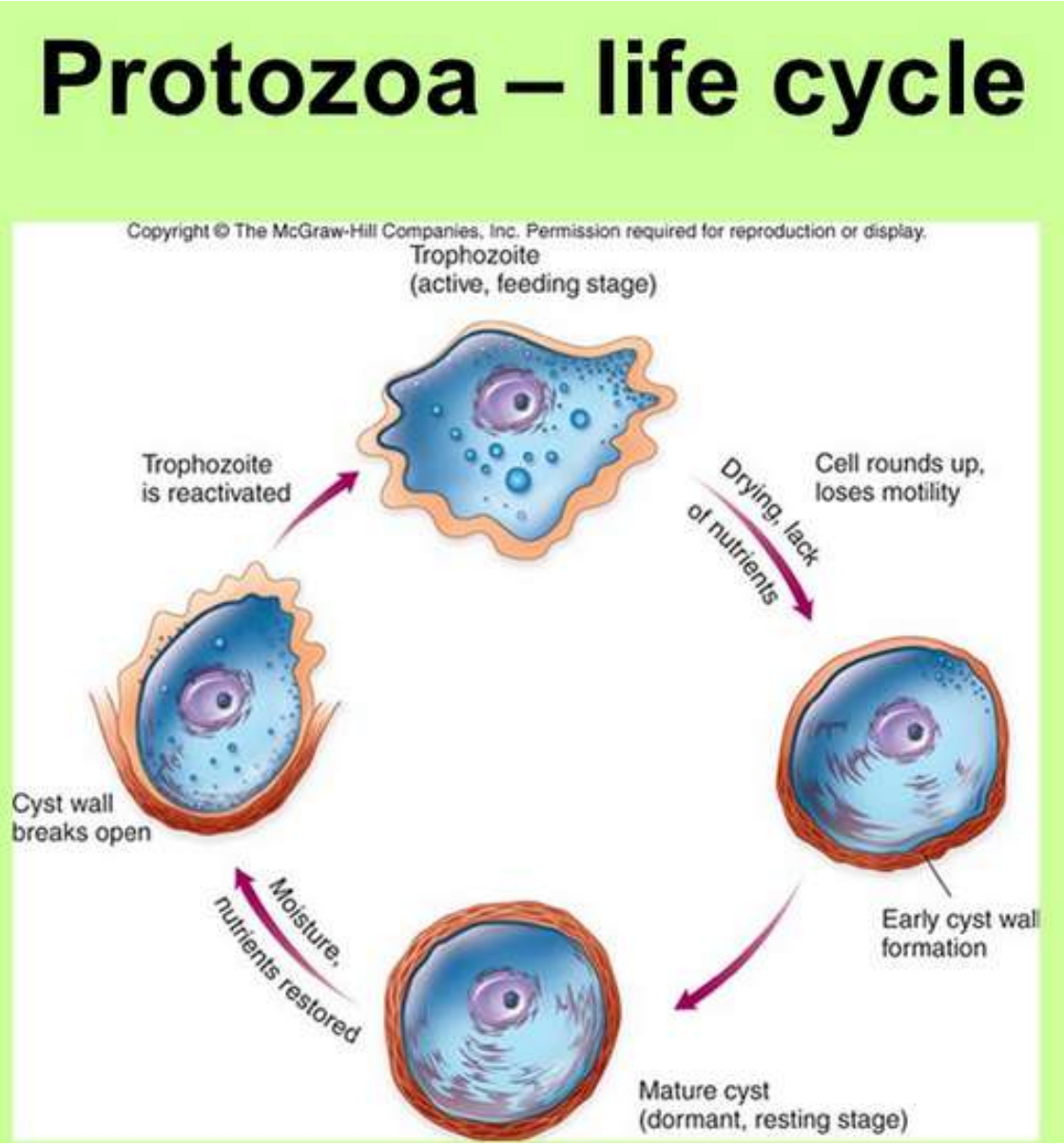


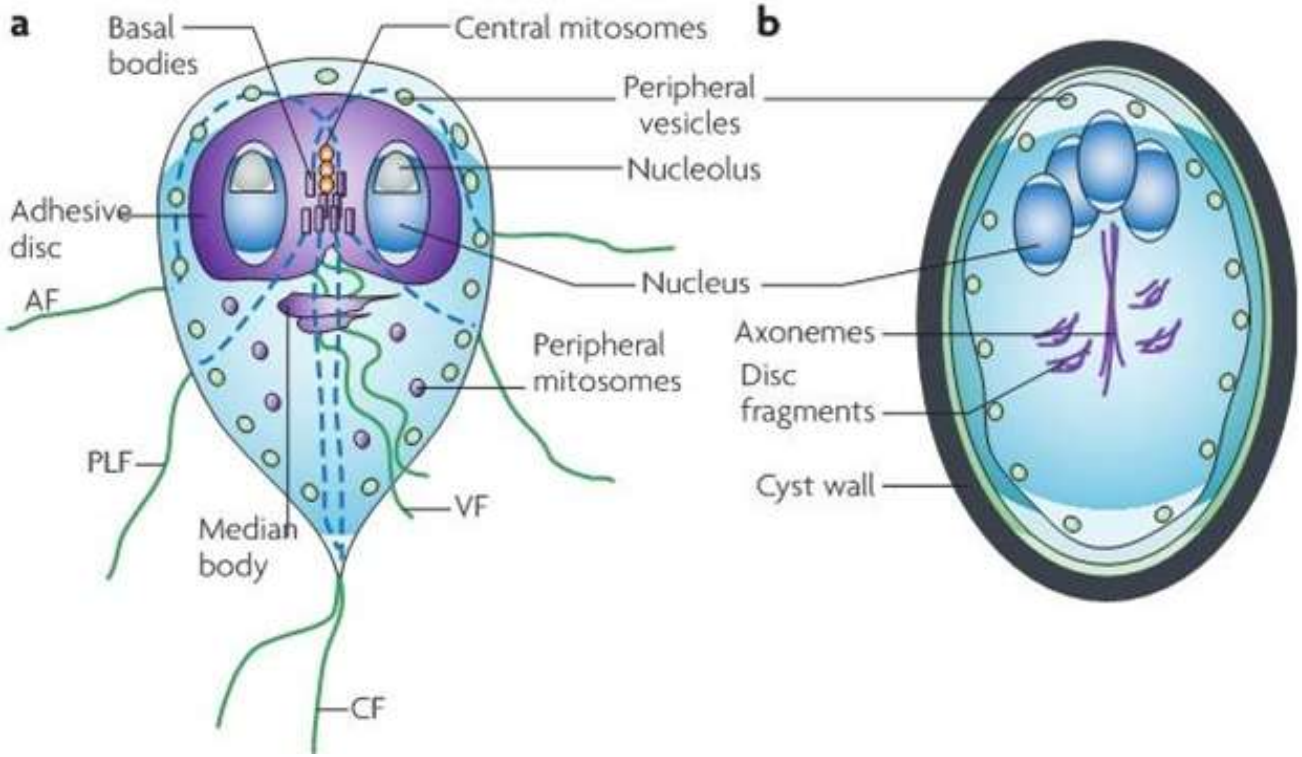
Two-stage life cycle:

Trophozite = feeding and growing stage; eats bacteria and small particulate nutrients

Cyst = a protective capsule that permits the protozoa to survive under unfavorable conditions

- Can live outside a host
- Must be excreted from a host to get into a new host





G.lamblia trophozoite

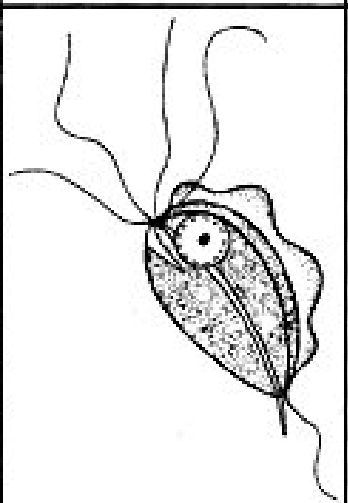
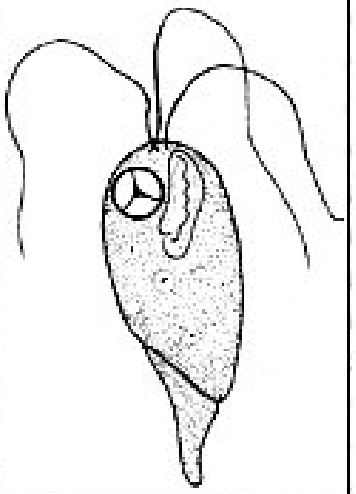
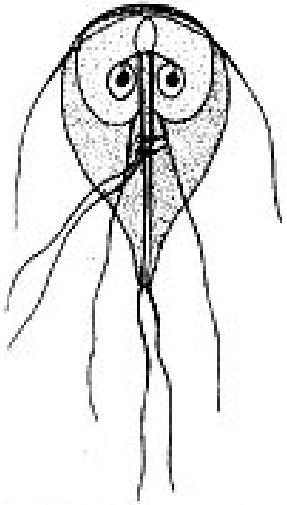
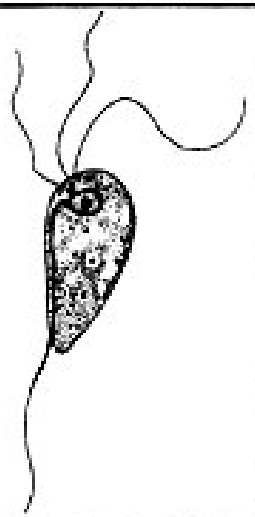
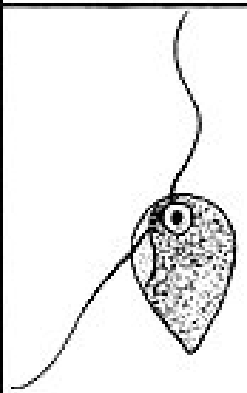
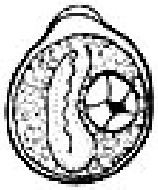
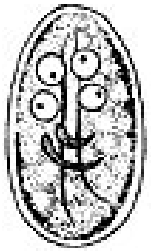
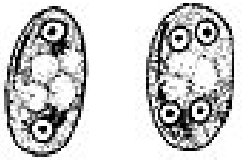
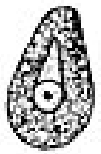
CLOSE

G.lamblia cyst

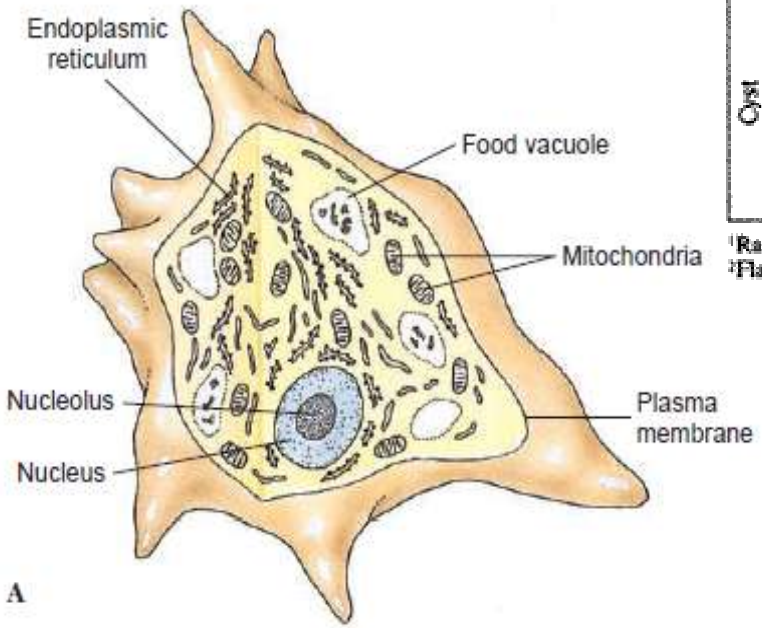
CLOSE

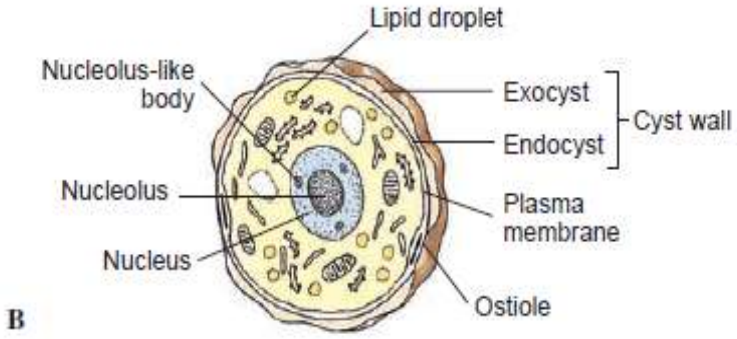
Trophozoite : Typical Characteristics	
Size range	8 to 20 µm long 5 to 16 µm wide
Shape	Pear / teardrop
Motility	"Falling leaf"
Appearance	Bilaterally symmetrical
Nuclei	Two ovoid-shape, each with a large karyosome No peripheral chromatin
Flagella	Four pair, origination of each : • One pair anterior end • One pair posterior end • Two pair central laterally
Other structures	Two median bodies Two axonemes Sucking disc

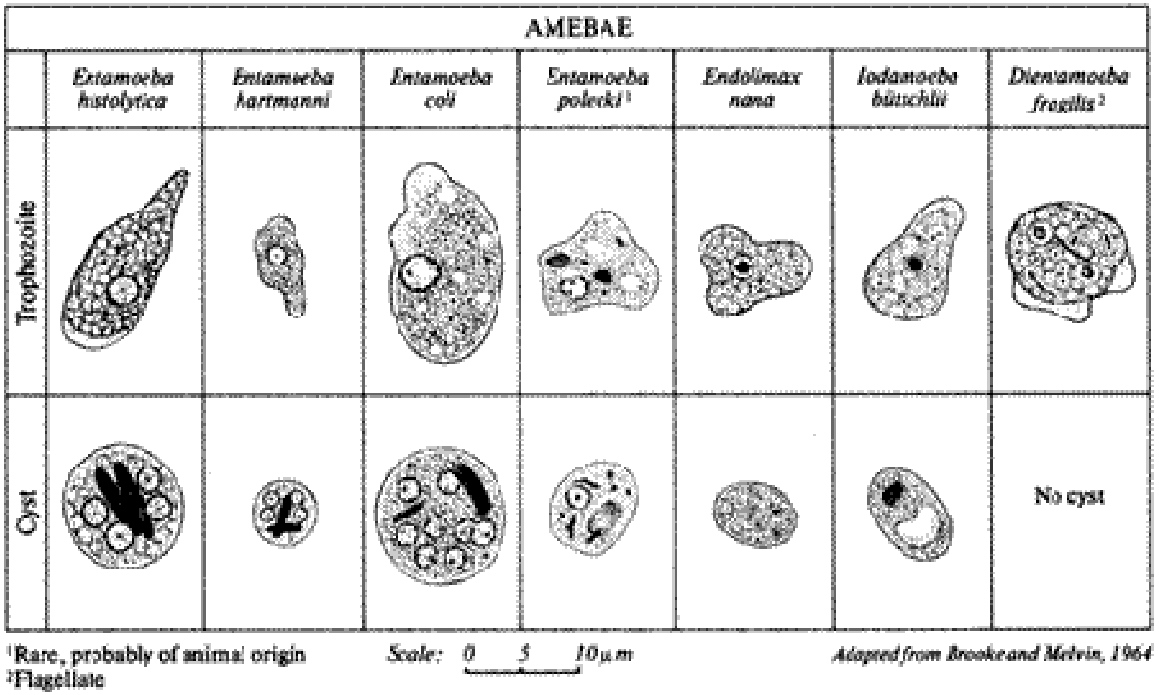
Cyst : Typical Characteristics	
Size range	8 to 17 µm long 6 to 10 µm wide
Shape	Ovoid
Nuclei	Immature cyst – 2 Mature cyst – 4 Central karyosomes No peripheral chromatin
Cytoplasm	Retracted from the cell wall
Other structures	Two to four median bodies Interior flagella structures

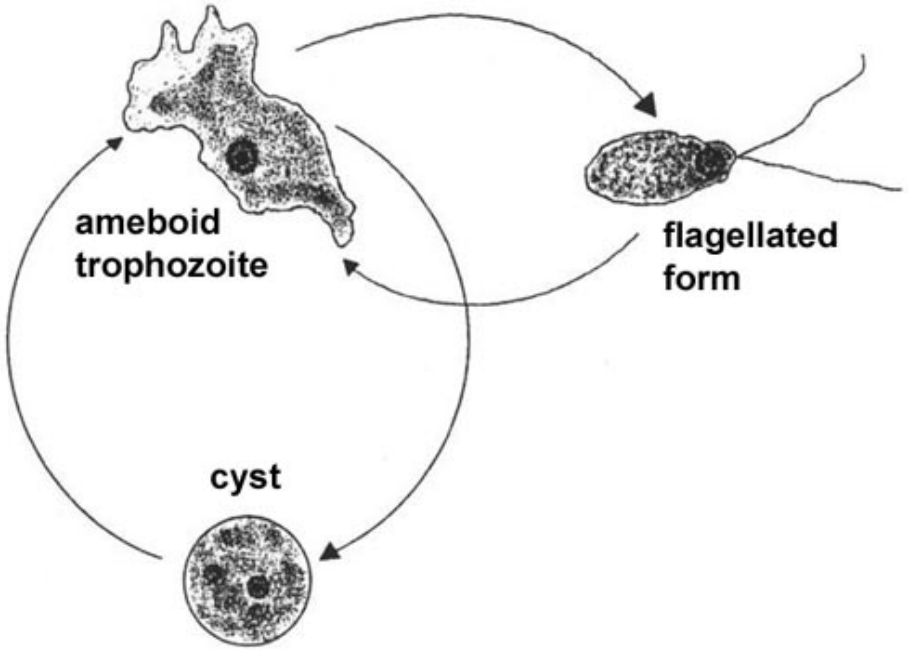
FLAGELLATES					
	Trichomonas hominis	*Chilomastix mesnili*	*Giardia lamblia*	*Enteromonas hominis*	*Retortamonas intestinalis*
Trophozoite					
Cyst	*No cyst* *Scale:* *0 5 10* *μm*				

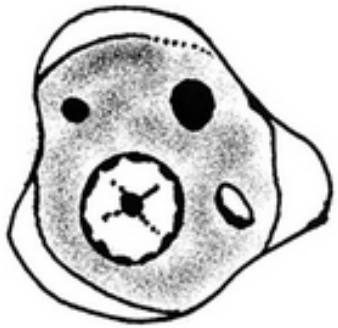
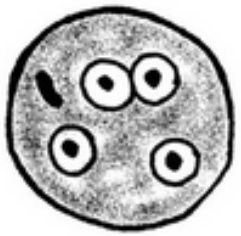
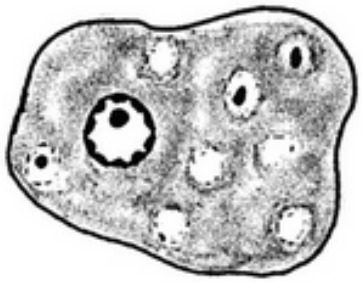
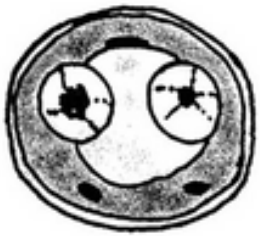
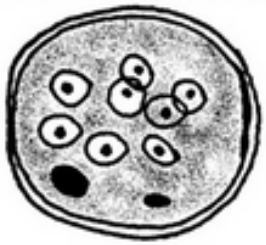
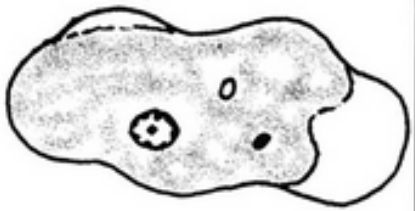
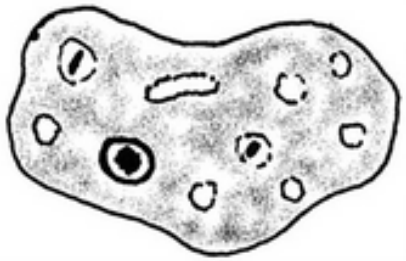
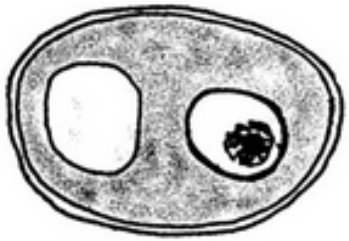
Structure of *Acanthamoeba palestinensis*. ***A, Active, feeding form. B, Cyst.***





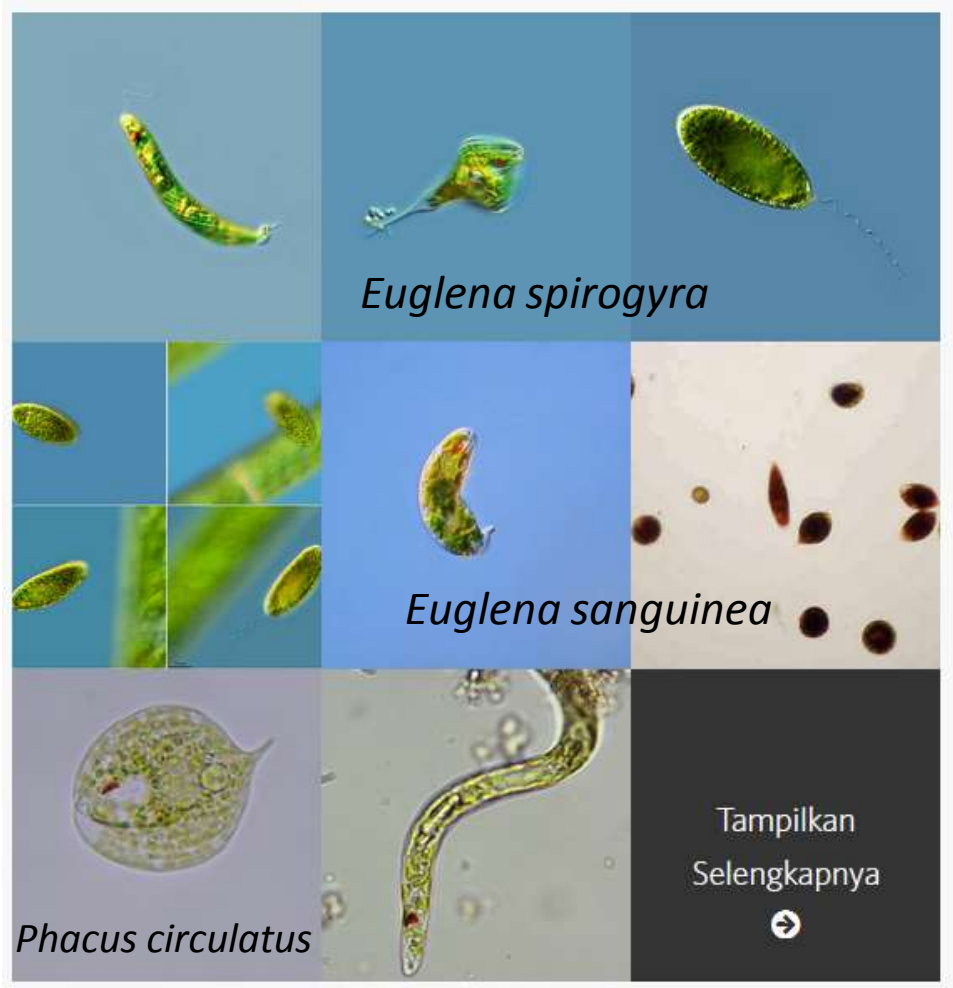




Organism	Trophozoite	Precyst	Cyst
E. histolytica *E. dispar* *E. moshkovskii*			
E. coli			
E. hartmanni			
I. bütschlii			

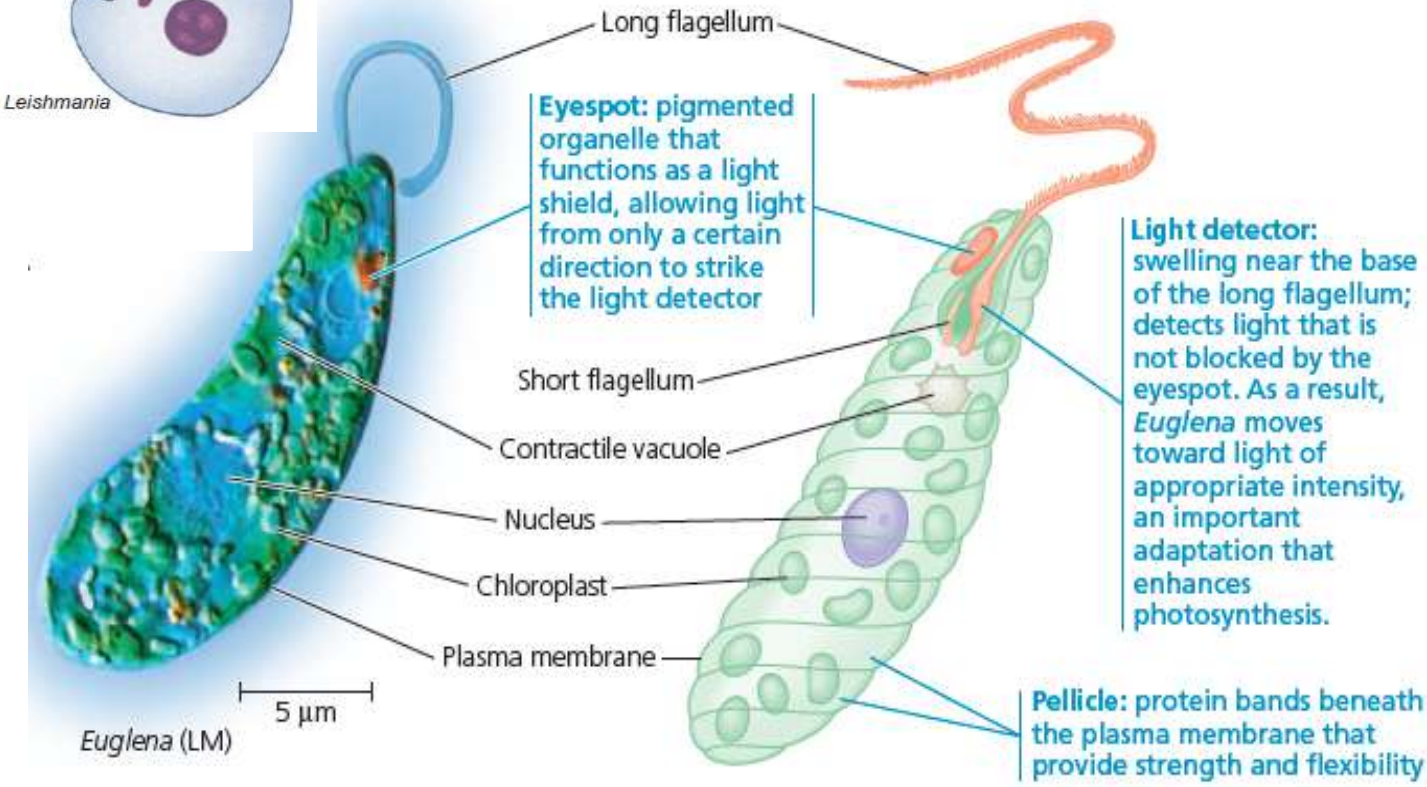
Phylum Euglenozoa

- Uniseluler
- Besar 15-40 µm, Panjang 500 µm
- Bentuknya beragam
- Kebanyakan Heterotrof (ada yg Autrotrof)
- Vakuola makanan → mjd ATP
- **Spiral or Crystalline rod inside flagella**
- **Memiliki Flagel berpasangan** → *Locomotion*
- DNA (mtDNA) mengumpul di ujung mitokondria dlm kantong **Kinetoplas**
- **Kinetoplas jg dsebut *base of the flagellum* & perpanjangan mt**
- Habitat: Kebanyakan di Air Tawar (Danau/ Kolam)
- Tidak bsa survive di habibat yg intensitas cahaya rendah
- Reproduksi Aseksual (mitosis)
- Bbrapa ada yg parasit pd manusia ex: **Class Kinetoplastea**



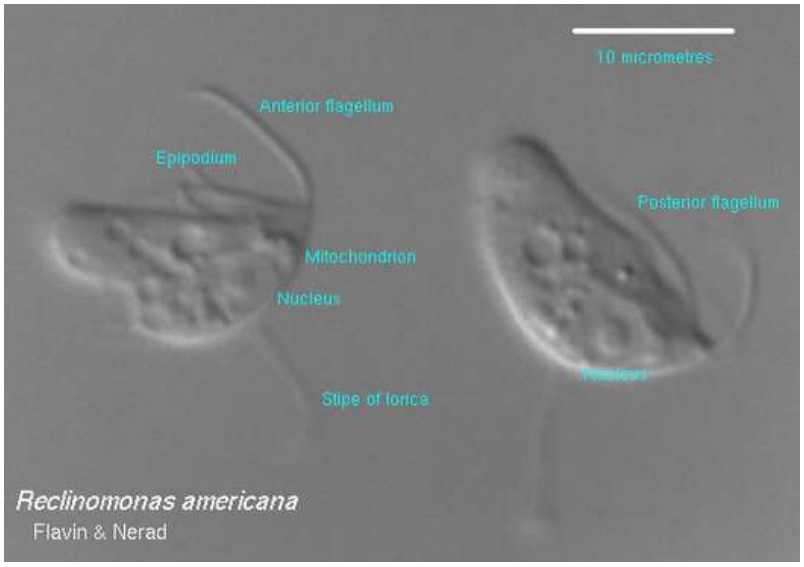
https://www.inaturalist.org/taxa/142256-Euglenozoa

Figure 28.6 Euglenozoan flagellum. Most euglenozoans have a crystalline rod inside one of their flagella (the TEM is a flagellum shown in cross section). The rod lies alongside the 9 + 2 ring of microtubules

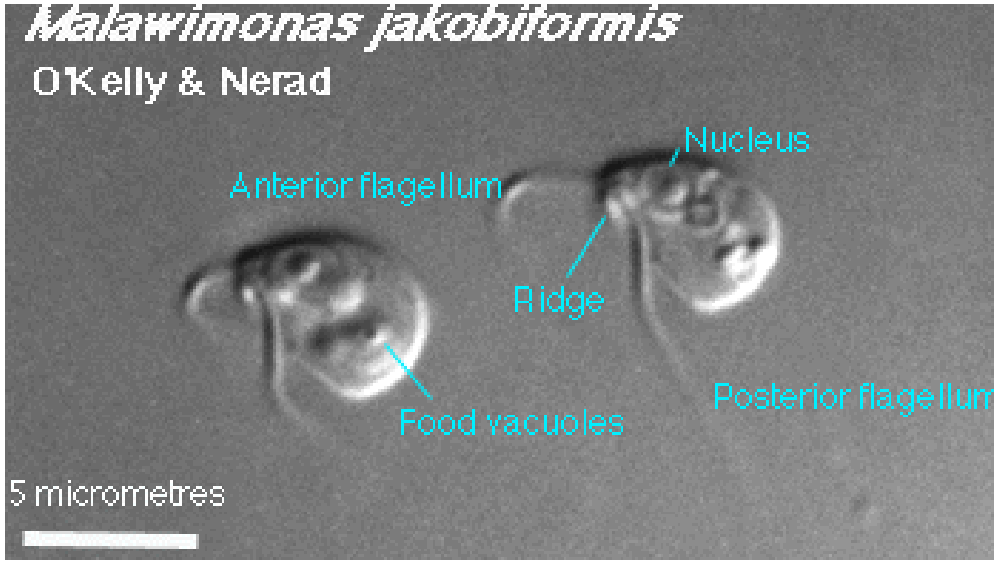


Phylum Loukozoa

- **Loukozoa** (latin l*oukos*: lekuk) adl takson parafiletik Excavata
- Kelompok terbesar Loukozoa adl "Jakobid“ dan Malawimonas.
- **Jakobids & Malawimonas** terlihat sama
- Bukti filogenetik molekular → Jakobids lebih dekat kekerabatnya dgn Heterolobosea & Euglenozoa



Jakobids

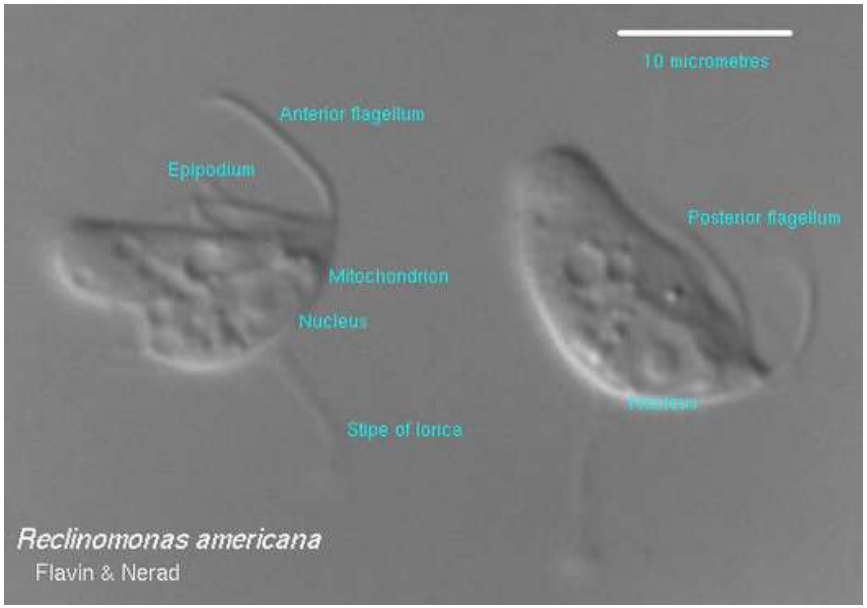


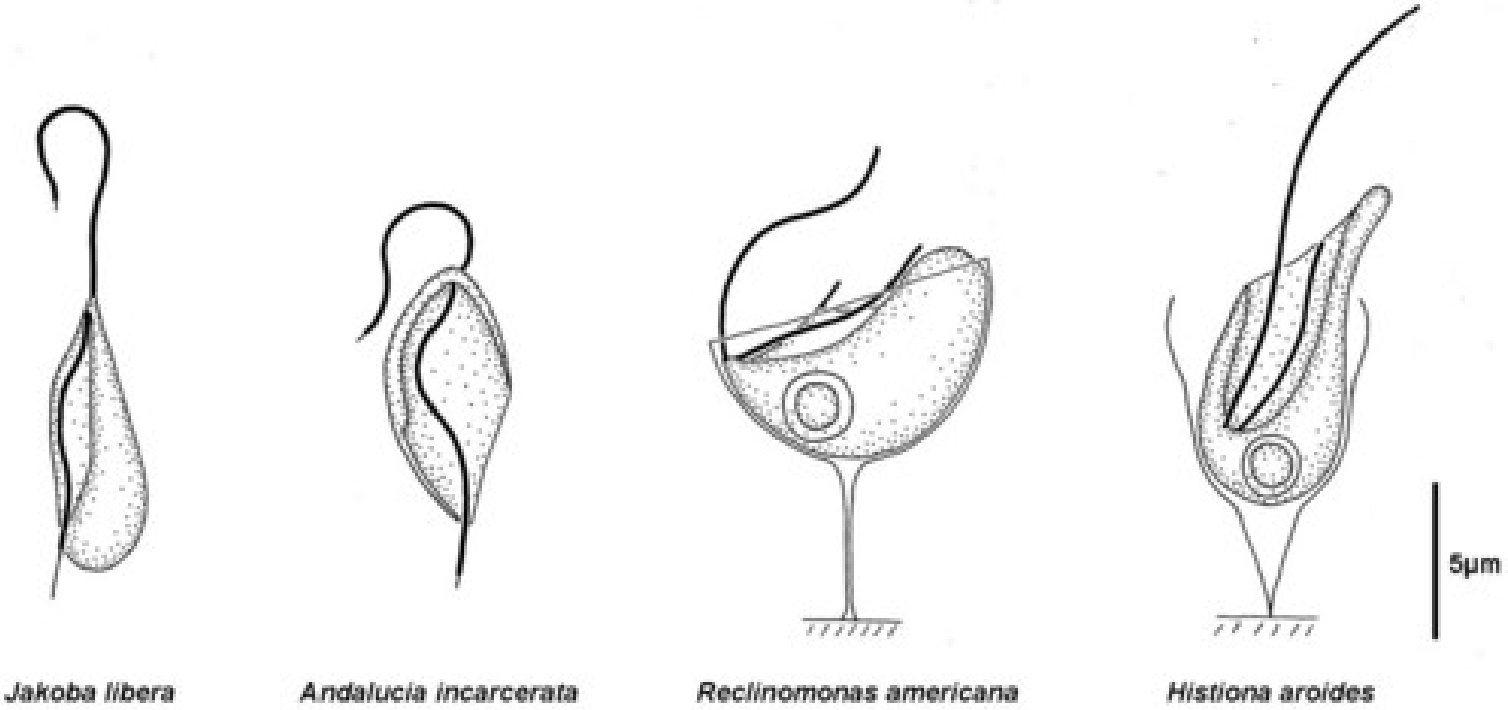
Malawimonas

Jakobids (Jakobida or Jakobea)

- Small group of **free-living**
- **Heterotrophic flagellates**
- Only a dozen described species
- Uniquely bacterial-like mitochondrial genomes
- Generally less than **15 micrometres in length** (mostly <10 micrometres)
- Have two flagella, which insert near one end of the cell (the anterior end in swimming cells)
- One of the two flagella can be difficult to see by light microscopy in some loricate species
- One flagellum is directed posteriorly and bears a **single vane (baling2**)
- The vane can be seen readily by electron microscopy
- The **vaned flagellum** is associated with a groove that occupies most of one side of the cell (ventral side)
- This groove is a feeding structure – the beating action of the posterior flagellum generates a feeding current that moves suspended particles into the groove
- Prokaryotes are trapped at the posterior end of the groove → **phagocytosed**

- There are four formally described genera : ***Jakoba*, *Andalucia*, *Reclinomonas* and *Histiona*.**
- *Jakoba* and *Andalucia* are **free-swimming**, *Reclinomonas* and *Histiona* are **sessile**, and reside within an extracellular **organic lorica** (shell-like protective outer covering)
- The lorica is usually shaped like a stemmed glass, with the stem (pedicel) attaching the structure to the substrate
- During cell division the lorica is inherited by one daughter cell, while the other swims away as a **zoospore**, presumably subsequently settling and constructing a new lorica
- **Cysts** have been observed in several species, both loricate and aloricate
- Free-swimming jakobids have been recorded in a wide variety of environments, including **marine, freshwater, soil** and even very **hypersaline** habitats
- *Andalucia incarcerata* (formerly known as *Jakoba incarcerata*), is a microaerophile or **anaerobe**, mitochondrial organelle **lacks cristae**





Jakoba libera *Andalucia incarcerata* *Reclinomonas americana* *Histiona aroides*

Phylum Metamonada

- A number of **oxymonads** are found in **termite guts**
- Play an important role in **breaking down the cellulose** found in wood
- Some other metamonads are **parasites** ex : *Giardia*
- These flagellates are unusual in lacking mitochondria, retain both organelles and nuclear genes derived from them. Mitochondrial relics include **hydrogenosomes**, which produce hydrogen, and small structures called **mitosomes**.
- All of these groups are united by having **flagella or basal bodies ,** which are often **associated with the nucleus**, forming a structure called a **karyomastigont**

Genus *Giardia*

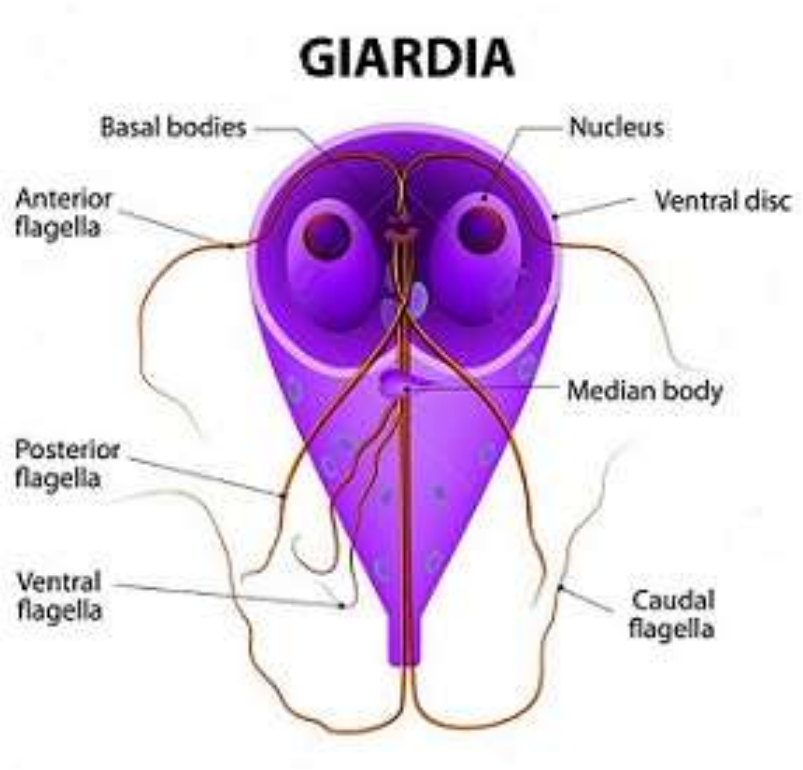
- *G. lamblia* has two morphological stages: the **trophozoite** and the **cyst**.

- The trophozoite is pear shaped, with a broad anterior and much attenuated posterior .

  10-12µm long and 5-7µm wide, bilaterally symmetrical, and has **two nuclei**

  It is also relatively flattened, with a large sucking disk on the anterior ventral side, which serves as the parasite's method of attachment to the mucosa of the host. The trophozoite also has two median bodies and four pairs of flagella (anterior, caudal, posterior and ventral)

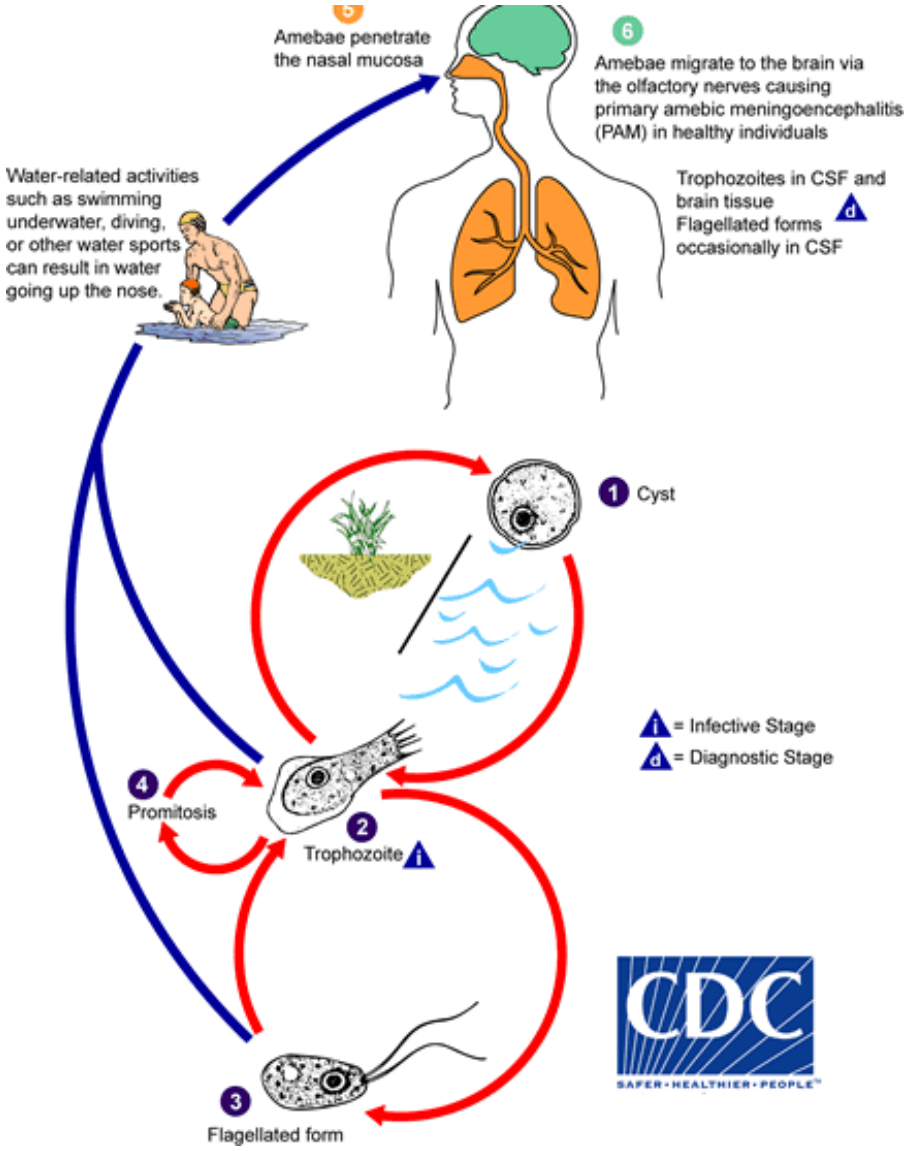
- The *G. lamblia* cyst **is egg-shaped**, and **measures 8-14µm by 7-10µm**. After encystation, each organelle duplicates, so each cyst contains four nuclei, four median bodies, eight pairs of flagella--although these organelles are not arraigned in any clear pattern. Upon excystation, each cyst produces two trophozoites

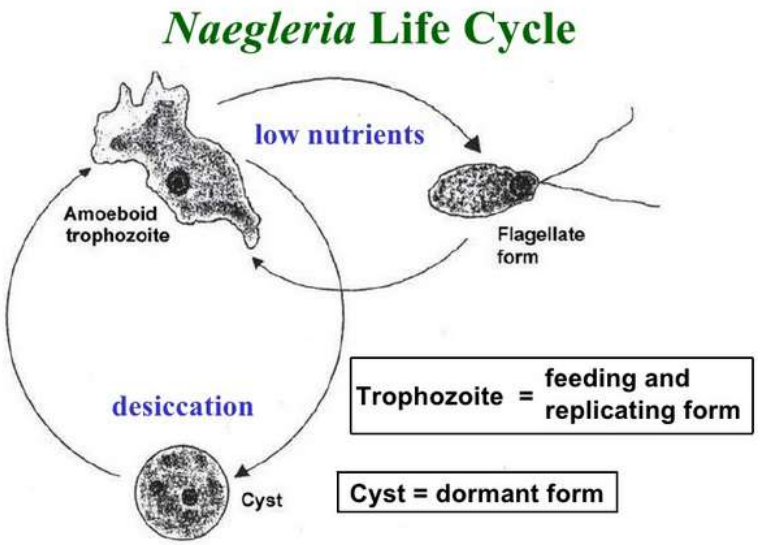


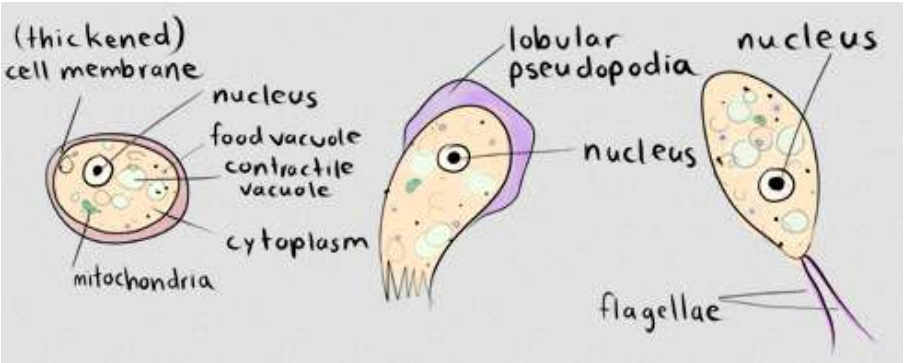
Phylum Percolozoa

- **Colourless**, **non-photosynthetic**, including many that can transform between amoeboid, flagellate, and cyst stages.
- Most Percolozoa are found as bacterivores in soil, fresh water and occasionally in the ocean
- The only member of this group that is infectious to humans is ***Naegleria fowleri***
- Unusual characteristic of having mitochondria with discoid cristae
- The presence of a ventral feeding groove in the flagellate stage
- The amoeboid stage is roughly cylindrical, typically around 20-40 µm in length. The flagellate stage is slightly smaller, with two or four anterior flagella anterior to the feeding groove.
- Flagellate form is used for rapid locomotion. However, not all members are able to assume both forms

Subphylum Tetramitia
Class Heterolobosea







Naegleria fowleri

Phylum Amoebozoa

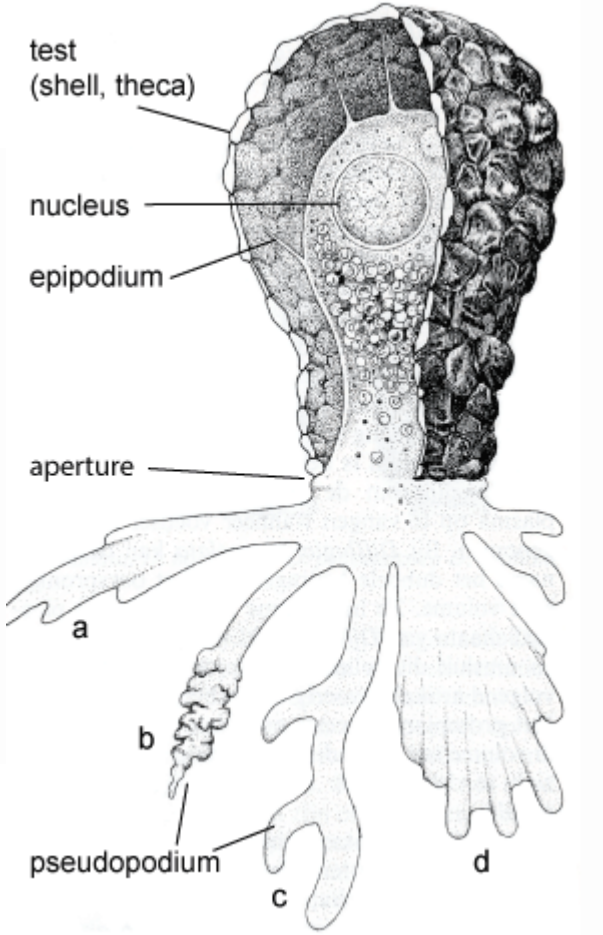
- Amoebozoan cell is typically divided into a granular central mass, called **endoplasm**, and a clear outer layer, called **ectoplasm**.
- The entire cell functioning as a single **pseudopod** also multiple **indeterminate pseudopodia**
- Most amoebozoans are **"naked"** like familiar Amoeba or **covered with a loose coat** (mantel longgar), like members of the **order Arcellinida**
- In all amoebozoa, the primary mode of nutrition is **phagocytosis**
- When food is scarce, **most species can form cysts**, which may be carried aerially and introduce them to new environments.
- The majority of Amoebozoa **lack flagella** and more generally do not form microtubule-supported structures **except during mitosis**
- Amoebozoan protozoa pathogenic to humans : *Entamoeba histolytica, Acanthamoeba, Balamuthia mandrillaris, Endolimax*

Order Arcellinida (*Difflugia*)

From left to right: *D. acuminata, D. pyriformis, D. labiosa, D. nodosa, D. urceolata, D. scalpellum, D. varians* (all on scale)

Difflugia is the oldest and most species-rich genus of testate amoebae (more than 300 species and a lot of subspecies and varieties)

The test or shell is composed of mineral particles, **like quartz fragments, or diatom frustules**, collectively called **xenosomes**, that are assembled on structured or **sheet-like organic cement**.

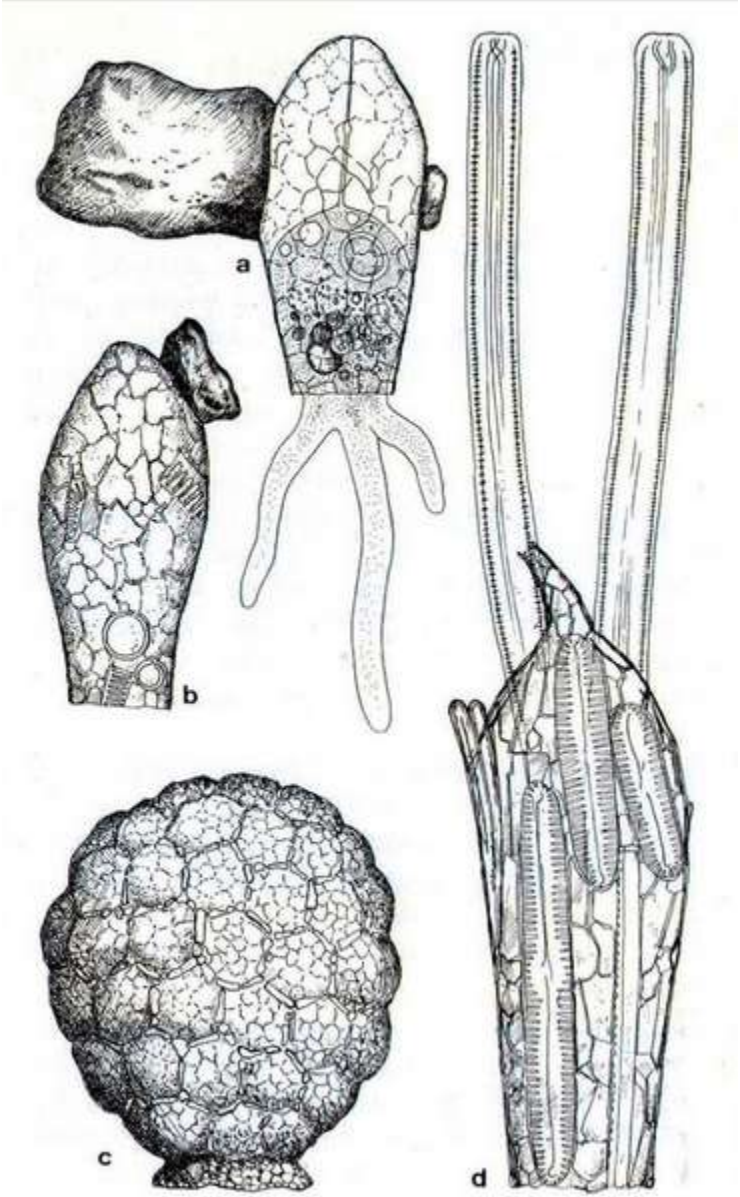


a *stretching pseudopodium,*
b *retracting,* ***c*** *branching and*
d *broad so-called lamellipodium.*

Common in freshwater sediments or between water plants; others are planktonic with a benthic phase during winter; some live in dry mosses and soil. Lakes of different trophic status (eutrophic, dystrophic or oligotrophic)

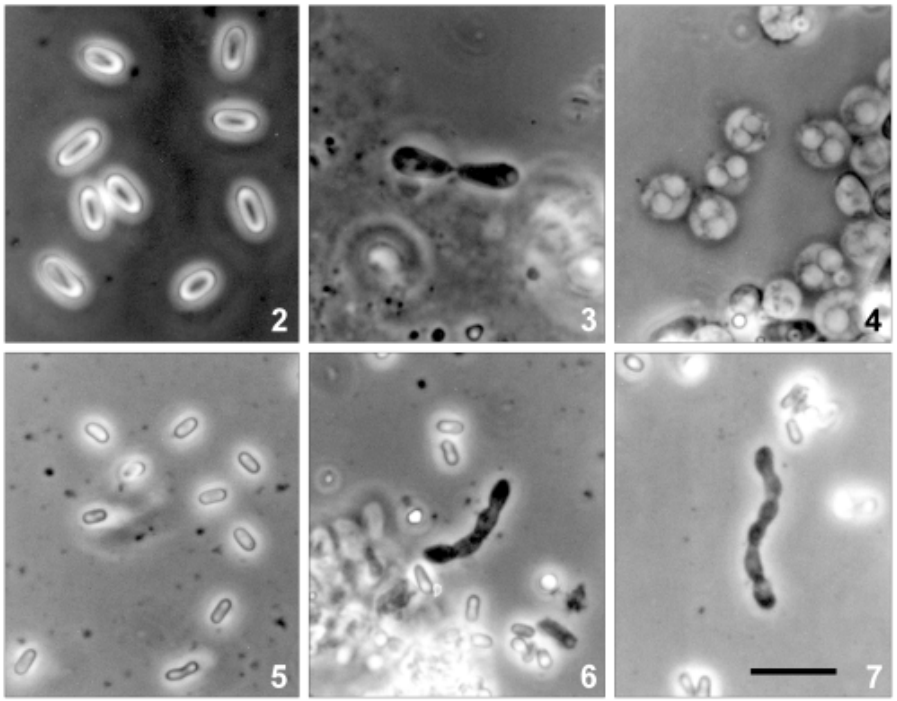
Feeding: mainly algae and fungi. Small species like *D. minuta* or *D. pulex* can use bacteria too.

Play an important role in shell morphology
a clear decrease of shell size moving from wet to dry conditions in three different species groups



Specimen a and b have relatively large sand grains attached to their shell; c now recognized as *Netzelia tuberculata*. shows a berry like structure and d has two long diatoms attached.

PERAN PROTOZOA DALAM KEHIDUPAN MANUSIA



Figs 2-7. Developmental stages and spores of Nosema locustae and Perezia dichroplusae as fresh preparations under phase contrast microscopy. 2 -mature spores of N. locustae, 3 -disporoblastic sporogony of N. locustae, 4 -diplokaryotic stages (meronts) of N. locustae; 5 -mature spores of P. dichroplusae, 6, 7 -moniliform plasmodia and polysporoblastic sporogony of P. dichroplusae. Scale bar 10 µm.

Bioinsecticide to Kill Grasshoppers or Crickets

Kingdom	: Protozoa
Subkingdom	: Sarcomastigota
Phylum	: Microsporidia
Class	: Disporea
Genus	: *Nosema*
Spesies	: ***Nosema locustae***

- Infect over 80 species of grasshoppers
- To infect a grasshopper, it must be **ingested**
- Spores germinate in the gut and a polar filament is extruded that injects the sporoplasm directly into gut cells
- The sporoplasm enters fat body tissue and effectively starves the host of energy reserves
- Will not affect humans or animals; only pathogenic to certain insects

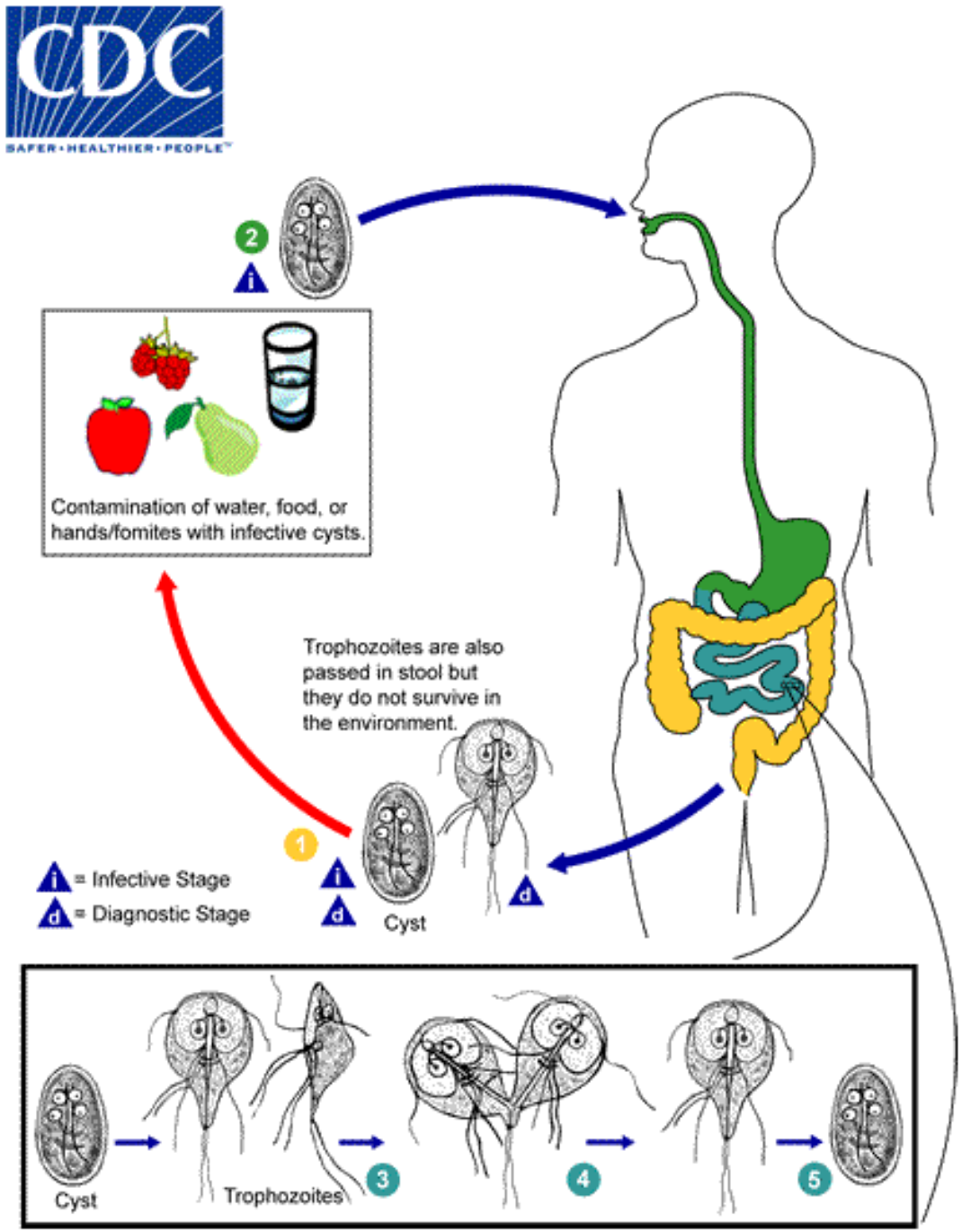
PERAN PROTOZOA DALAM KEHIDUPAN MANUSIA

Klasifikasi

Kingdom	: Protozoa
Infrakingdom	: Excavata
Phylum	: Metamonada
Class	: Eopharyngea
Order	: Diplomonadida
Family	: Hexamitidae
Genus	: *Giardia*
Spesies	: *Giardia intestinalis* *Giardia lamblia* *Giardia duodenalis*

Diarrheal Illness/ Giardiasis

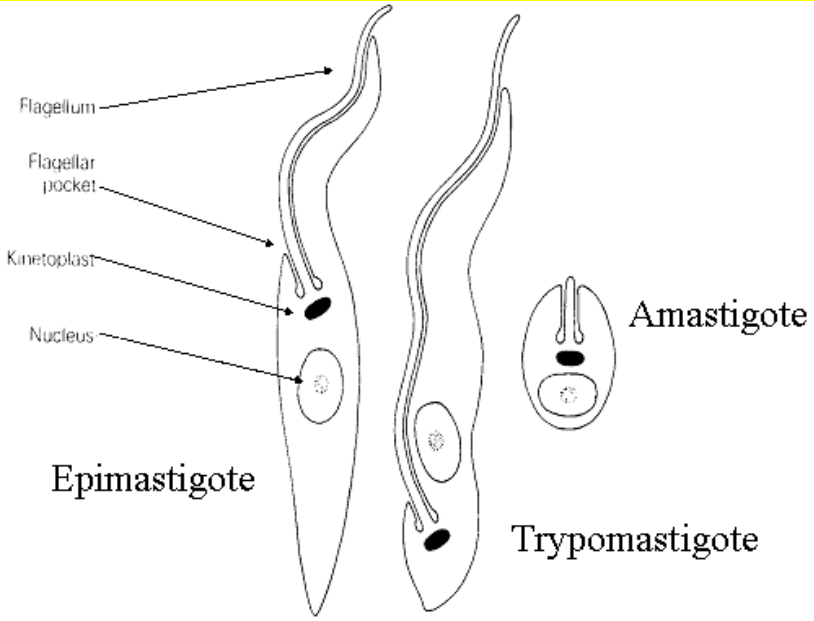
- *Giardia* is a microscopic parasite
- Found on surfaces or in **soil, food, or water that has been contaminated with feces (poop)** from infected humans or animals.
- *Giardia* is protected by an outer shell that allows it to survive outside the body for long periods of time and makes it **tolerant to chlorine disinfection**
- While the parasite can be spread in different ways, water (drinking water and recreational water) is the most common mode of transmission.



Giardia duodenalis

Cysts are resistant forms and are responsible for transmission of giardiasis. Both cysts and trophozoites can be found in the feces (diagnostic stages) (**1**). The cysts are hardy and can survive several months in cold water. Infection occurs by the ingestion of cysts in contaminated water, food, or by the fecal-oral route (hands or fomites) (**2**). In the small intestine, excystation releases trophozoites (each cyst produces two trophozoites) (**3**). Trophozoites multiply by longitudinal binary fission, remaining in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disk (**4**). Encystation occurs as the parasites transit toward the colon. The cyst is the stage found most commonly in nondiarrheal feces (**5**). Because the cysts are infectious when passed in the stool or shortly afterward, person-to-person transmission is possible. While animals are infected with *Giardia*, their importance as a reservoir is unclear.

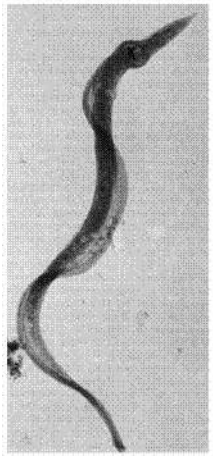
PERAN PROTOZOA DALAM KEHIDUPAN MANUSIA



Kingdom: Protozoa
Infrakingdom: Euglenozoa
Phylum: Euglenozoa
Class: Kinetoplastea
Order: Trypanosomatida
Family: Trypanosomatidae
Genus: ***Trypanosoma***
Spesies: ***T. cruzi***

Chagas disease (*T. cruzi* infection)/ American Trypanosomiasis

- Nucleus, microtubules (cytoskeleton and flagellar), endoplasmic reticulum, Golgi apparatus and a single mitochondrion.
- In addition, they have another body, the **kinetoplast**
- Have several morphologic forms: **amastigote, epimastigote, trypomastigote and promastigote.**

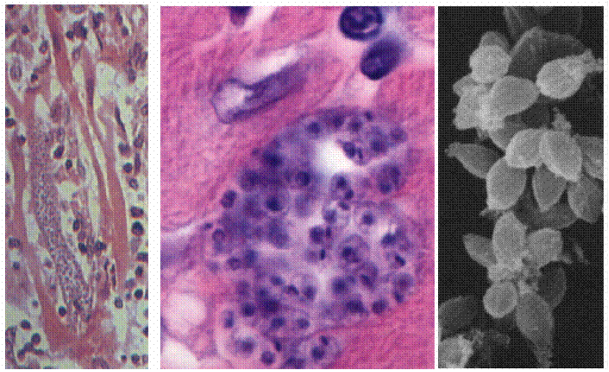


Scanning Electron Microscope

Giemsa Stain

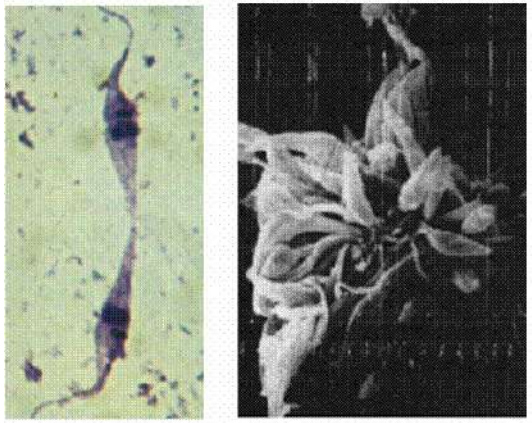
Blood (right) and Metacyclic (left) trypomastigotes

TRYPOMASTIGOTE : found in the bloodstream of infected vertebrates (C shaped in Giemsa Staining)



AMASTIGOTE : intracellular dividing form in the cytoplasm of vertebrate cells. It is a round/oval-shaped cell with no protruding flagellum.

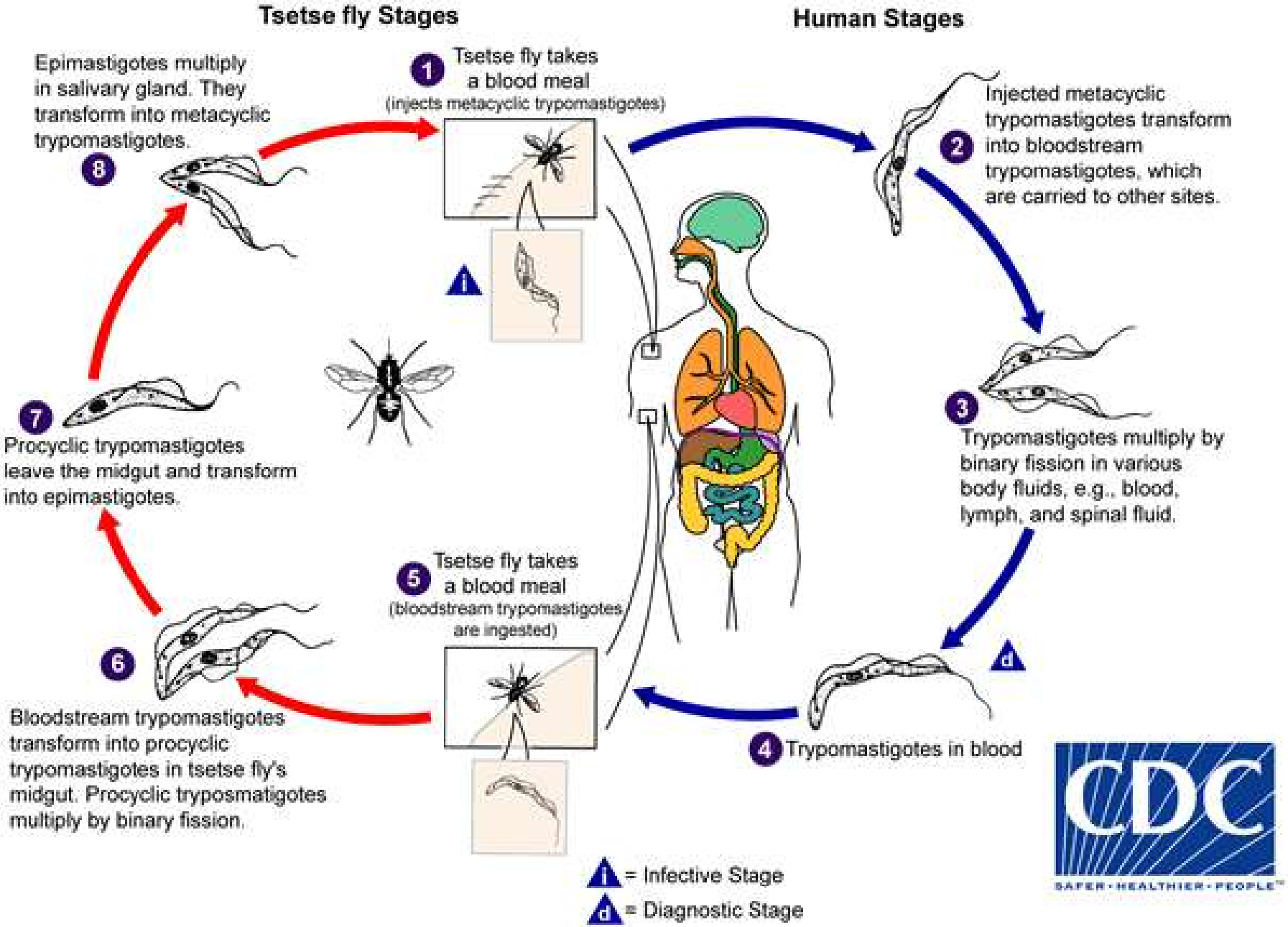
T. cruzi Epimastigote



Trypanosoma cruzi
Epimastigote & Trypomastigote

EPIMASTIGOTE : Found in the intestinal tract of the insect vector. In this form, the kinetoplast is found anterior and adjacent to the nucleus .The flagellum emerges in the middle of the cell. Below are an epimastiogote (left) and a metacyclic trypomastigote (right) in bug feces.

Life Cycle:


Tsetse fly Stages
Human Stages
Epimastigotes multiply in salivary gland. They transform into metacyclic trypomastigotes.
8
1 Tsetse fly takes a blood meal
(injects metacyclic trypomastigotes)
i
2 Injected metacyclic trypomastigotes transform into bloodstream trypomastigotes, which are carried to other sites.
3 Trypomastigotes multiply by binary fission in various body fluids, e.g., blood, lymph, and spinal fluid.
d
4 Trypomastigotes in blood
5 Tsetse fly takes a blood meal
(bloodstream trypomastigotes are ingested)
6 Bloodstream trypomastigotes transform into procyclic trypomastigotes in tsetse fly's midgut. Procyclic tryposmatigotes multiply by binary fission.
7 Procyclic trypomastigotes leave the midgut and transform into epimastigotes.
i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™

“Jangan meremehkan sesuatu yang kecil, bukankah sesuatu yg besar tidak akan pernah dianggap besar kalau tidak ada yg kecil??”

TUGAS

TULIS DI BUKU TUGAS

1. Perbedaan antara **Protozoa**, **Chromista**, dan **Animalia**
2. Karakteristik **Phylum Choanozoa**
3. Karakteristik **Phylum Microsporidia**
4. Karakteristik **Phylum Sulcozoa**