


Protozoans



Protozoans

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Things that animals do

- Obtain food
- Be able to move
- Obtain oxygen
- Remove metabolic wastes
- Maintain water and salt balance
- Sense and react to the environment
- Reproduce and perpetuate the species

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Things animals do – gas and nitrogenous waste
Advantages of small size
Protozoans are 0.005–0.3 mm in size.


Size	Surface	Volume	Surface/volume
0.5 mm	0.00007854	0000000001636	480,000
0.6 mm	0.1256	0.0004189	299
2.0 mm	12.57	4.189	3
5.0 mm	78.53	163.6	0.5

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Protozoans

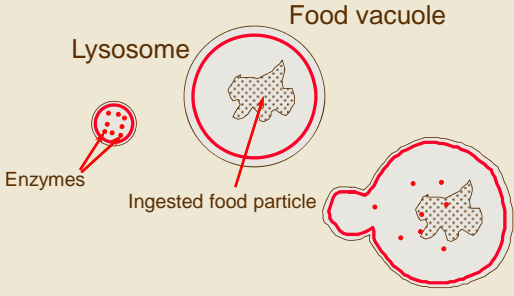
Things animals do – Obtain food
Phagocytosis and pinocytosis



The slide features a micrograph on the left showing a large, curved, translucent protozoan with a small green particle inside. To the right are four sequential diagrams illustrating the process of phagocytosis: 1) a protozoan with pseudopodia extending towards a small particle; 2) the pseudopodia engulfing the particle; 3) the particle fully enclosed within a vacuole; 4) the vacuole moving through the cytoplasm.

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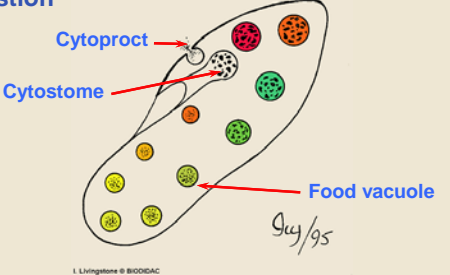
Things animals do – Obtain food
Digestion



The diagram illustrates the digestion process. On the left, a cluster of red dots is labeled 'Enzymes'. In the center, a large red circle labeled 'Food vacuole' contains a grey, irregularly shaped 'Ingested food particle'. On the right, a smaller red circle labeled 'Lysosome' is shown with red dots inside. Below the lysosome, a diagram shows the lysosome merging with the food vacuole, with red dots (enzymes) being released into the vacuole to digest the food particle.

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Things animals do – obtain food
Digestion



The diagram shows a large, bean-shaped protozoan with various internal structures. A red arrow points to a small opening at the top labeled 'Cytostome'. Another red arrow points to a small, circular structure labeled 'Cytoproct'. A third red arrow points to a large, oval structure containing several smaller, colored circles (red, green, yellow), labeled 'Food vacuole'. The signature 'Guy/95' is written in the bottom right of the diagram.

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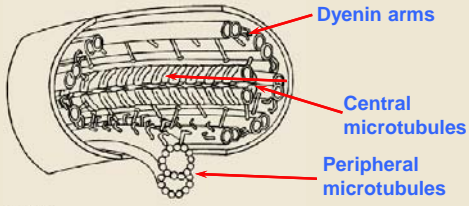
Protozoans

Things animals do - locomotion
Types of protozoan movement

- Pseudopods
- Undulipods
 - Cilia
 - Flagella
- No movement
 - Parasitic forms

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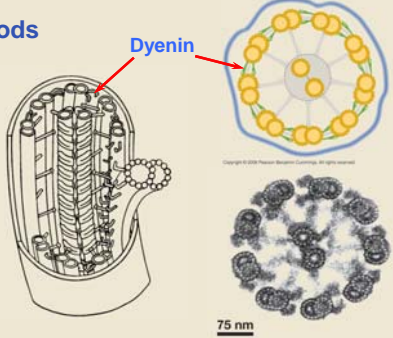
Things animals do - locomotion
Undulipodia: 9 + 2 Organization
(Sliding microtubule hypothesis)



Dyenine arms
Central microtubules
Peripheral microtubules

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Undulipods



Dyenin

75 nm

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Things animals do – salt and water balance
Water expulsion vesicle
(Contractile vacuoles)

Full

Endoplasmic reticulum
Excretory pore
Ampulla
Feeder canal

Empty

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Things that animals do -
Reproduction

- **Sexual reproduction**
 - Syngamy
 - Conjugation
- **Asexual**
 - Binary fission
 - Multiple fission

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Origin of the nuclear envelope

Cytoplasm
Nuclear region (Nucleoid)
Endoplasmic reticulum
Nuclear envelope

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Endosymbiosis

Nuclear material (Nucleoid)

Aerobic bacteria

Developing endomembranes

Mitochondria

Nuclear envelope

Endoplasmic retic.

Photosynthetic bacteria

Chloroplast

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Protist origins: Endosymbiont theory

- Endosymbiont theory accounts for
 - Nuclear membranes
 - Intracellular membranes and spaces
 - Mitochondria (chloroplasts)

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Centriole (Centrosomes or basal bodies)

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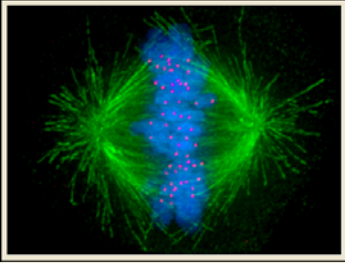
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Spindle fibers and chromosomes


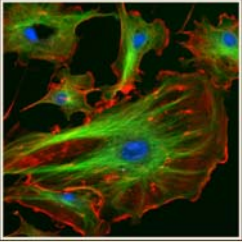


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Microtubules and cytoskeleton




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Origin of cellular motility – Cellular creeping



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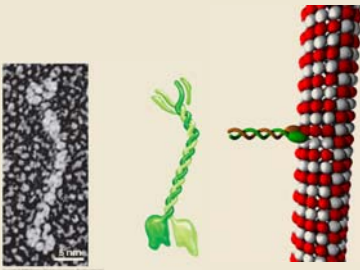
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Molecular motors

- Dyenin
- Kinesin
- Myosin



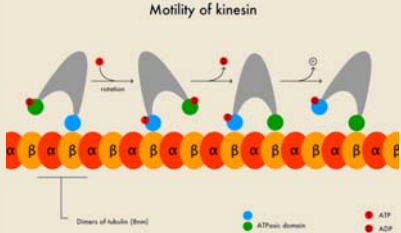
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Kinesin/Dyenin motors

Motility of kinesin

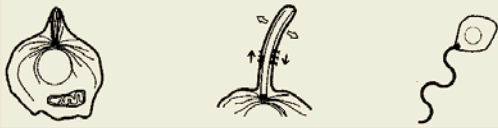


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Origin of cellular motility

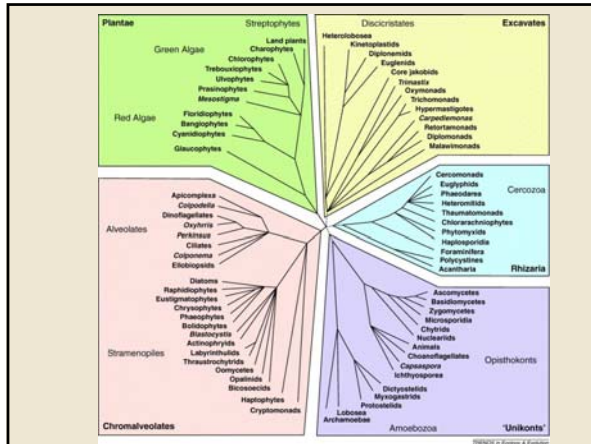


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Protozoans



Protist Supergroups

- **Unikonts**
 - **Opisthokonta (Animalia and Fungi)**
 - Amoebozoa
- **Bikonts**
 - Chromalveolata (Ciliophora and Apicomplexa)
 - Archaeplastida (Plantae)
 - Excavata (Euglenozoa)
 - Rhizaria

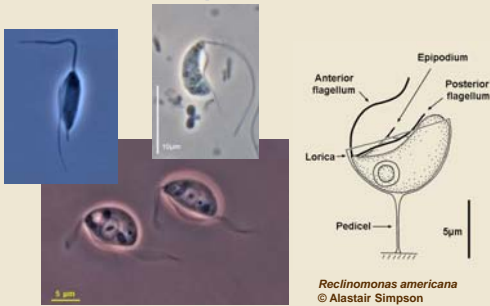
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Unikont and bikont protists



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Protozoans

Bikonts

Reclinomonas americana
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Choanozoa
(Unikont: Opisthokonta)

Flagella

Collar

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Colonial choanoflagellates
Unikont: Opisthokonta

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Things animals do - locomotion
Flagellar beat

Planar beat
Helicoid beat



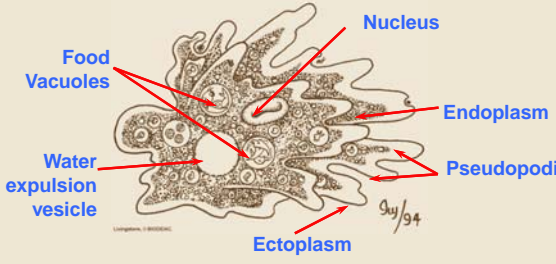
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Protist Supergroups

- **Unikonts**
 - Opisthokonta (Animalia and Fungi)
 - **Amoebozoa**
- **Bikonts**
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 - Excavata (Euglenozoa)
 - Rhizaria

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Things animals do - locomotion
Amoeba (Sarcomastigota: Amebozoa)

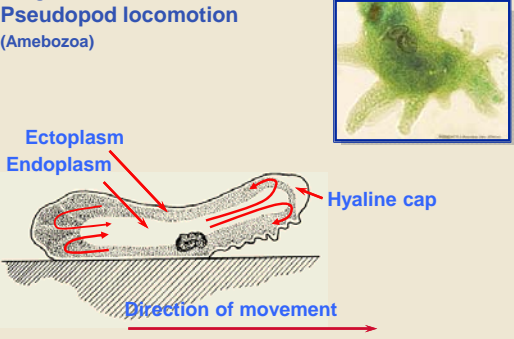


Nucleus
Food Vacuoles
Water expulsion vesicle
Endoplasm
Pseudopodia
Ectoplasm

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Things animals do – locomotion
Pseudopod locomotion
(Amoebozoa)

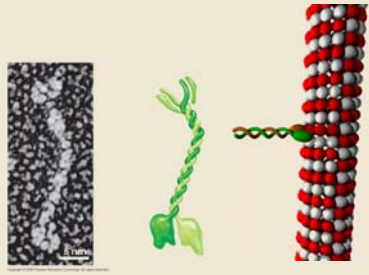


Ectoplasm
Endoplasm
Hyaline cap
Direction of movement

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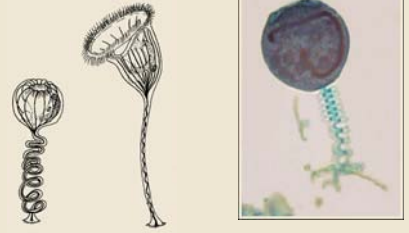
Molecular motors

- Dyenin
- Kinesin
- Myosin



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Vorticella: Myonemes
Alveolate: Ciliophora



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Protist Supergroups

- Unikonts
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 - Excavata (Euglenozoa)
 - Rhizaria

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Things animals do – Obtain food
Paramecium (Alveolate: Ciliophora)

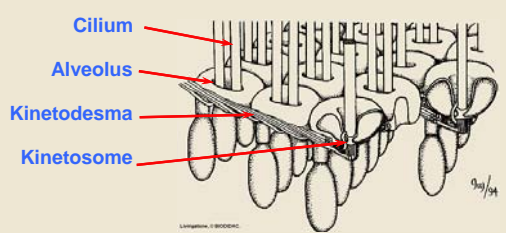
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Things animals do - locomotion
Ciliar movement:
Metachronal wave

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Things animals do - locomotion
Pellicle structure (Alveolate: Ciliophora)



Cilium
Alveolus
Kinetodesma
Kinetosome

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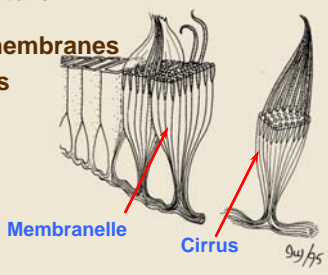
Things animals do - locomotion
Pellicle structure



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Things animals do - locomotion
Compound ciliature

- Undulating membranes
- Membranelles
- Cirrus




Membranelle
Cirrus

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Protozoans

Things animals do - locomotion
Euplotes
Alveolate: Ciliophora



The diagram on the left shows a cross-section of Euplotes with its internal organelles and cilia. The micrograph on the right shows a whole Euplotes cell with its characteristic alveoli and cilia.

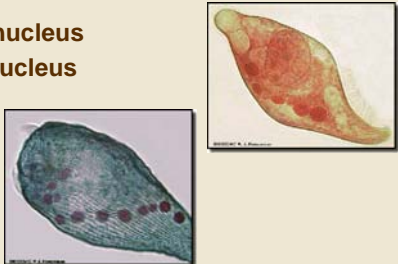
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Things animals do - reproduction
Nuclear organization
Alveolate: Ciliophora

- **Macronucleus**
- **Micronucleus**



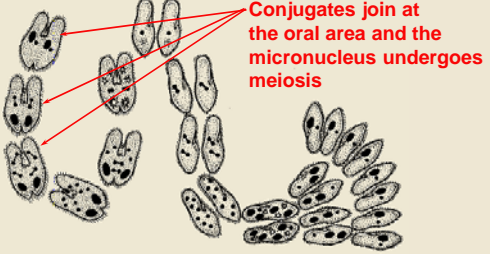
The top micrograph shows a single Euplotes cell with a large macronucleus and a smaller micronucleus. The bottom micrograph shows a cell with multiple micronuclei.

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Things animals do - reproduction
Conjugation - Alveolata: Ciliophora



The diagram illustrates the process of conjugation between two Euplotes cells. Red lines indicate the connection between the oral groove and the micronucleus of both cells. A red text box states: "Conjugates join at the oral area and the micronucleus undergoes meiosis".

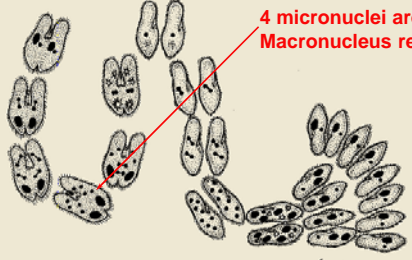
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Things animals do - reproduction
Conjugation (Alveolata: Ciliophora)

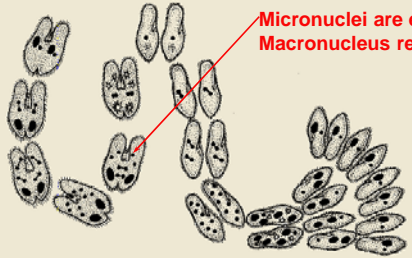


4 micronuclei are formed,
Macronucleus remains

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Things animals do - reproduction
Conjugation (Alveolata: Ciliophora)




Micronuclei are exchanged
Macronucleus remains

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Things animals do - reproduction
Conjugation (Alveolata: Ciliophora)



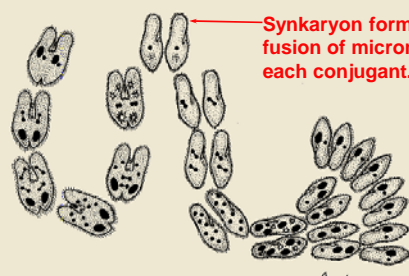
Two micronuclei and
macronucleus disappear

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Things animals do - reproduction
Conjugation Alveolata: Ciliophora




Synkaryon forms from the fusion of micronuclei in each conjugant.

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Things that animals do - reproduction
Conjugation (Alveolata: Ciliophora)

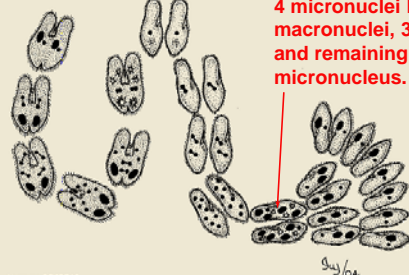


Three mitotic divisions produce 8 nuclei

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Things that animals do - reproduction
Conjugation (Alveolata: Ciliophora)



4 micronuclei become macronuclei, 3 disappear, and remaining become micronucleus.

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Things animals do - reproduction
Conjugation (Alveolata: Ciliophora)

Mitotic divisions of micronuclei and macronucleus

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Things animals do - reproduction
Malaria – human
 (Alveolata: Apicomplexa)

Sporogony

Gametogony RBCs Liver Schizogony

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Things animals do - reproduction
Malaria – human
 Alveolata: Apicomplexa

Oocysts beneath stomach lining Sporozoites migrate to the salivary glands

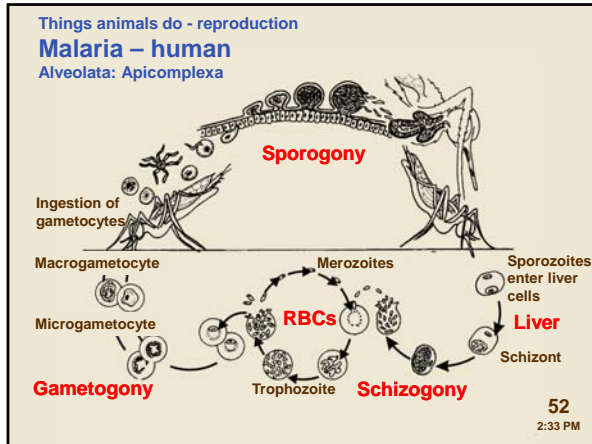
Female gamete Male gamete Sporogony

Ingestion of gametocytes Mosquito's saliva infects human

Gametogony RBCs Liver Schizogony

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Protozoans



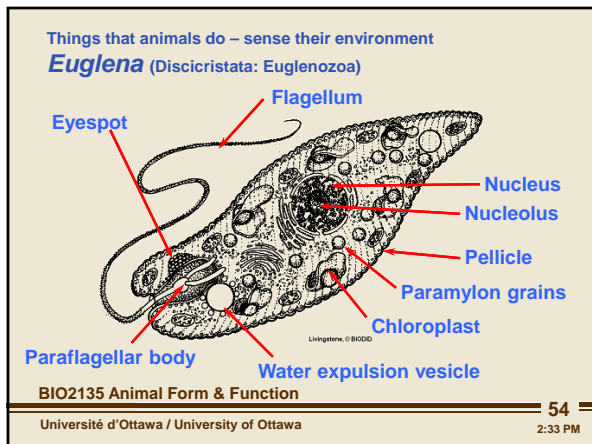
Protist Supergroups

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- **Bikonts**
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 - **Excavata (Euglenozoa)**
 - Rhizaria

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Protist Supergroups

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 - **Rhizaria**

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Protozoan skeletons: Tests

- **Calcium Carbonate**
 - Granuloreticulosae
- **Silica**
 - Rhizopods



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Protozoan skeletons
(Granuloreticulosea)



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