

Eukaryotic Nutrition

Eukaryote Nutrition

Nutrition Mode

Energy Source

Carbon Source

Photoautotroph	Light	CO ₂
Chemoautotroph	Inorganic chem	CO₂
Photoheterotroph	Light	Organic chem
Chemoheterotroph	Organic chem	Organic chem

Eukaryotic Nutrition

Eukaryotes can obtain nutrients through

1. Photosynthesis
2. Absorption of nutrients
3. Direct feeding*

*unique to eukaryotes

Eukaryotic Nutrition

Absorption of nutrients

Eukaryotes are not as versatile as prokaryotes.

Eukaryotes cannot use as wide of a variety of electron donors and acceptors.

TABLE 28.5 Some Electron Donors and Acceptors Used by Bacteria and Archaea

Electron Donor	Electron Acceptor	By-Products		Category*
		From Electron Donor	From Electron Acceptor	
Sugars	O ₂	CO ₂	H ₂ O	Organotrophs
H ₂ or organic compounds	SO ₄ ²⁻	H ₂ O or CO	H ₂ S	Sulfate reducers
H ₂	CO ₂	H ₂ O	CH ₄	Methanogens
CH ₄	O ₂	CO ₂	H ₂ O	Methanotrophs
S ²⁻ or H ₂ S	O ₂	SO ₄ ²⁻	H ₂ O	Sulfur bacteria
Organic compounds	Fe ³⁺	CO ₂	Fe ²⁺	Iron reducers
NH ₃	O ₂	NO ₂ ⁻	H ₂ O	Nitrifiers
Organic compounds	NO ₃ ⁻	CO ₂	N ₂ O, NO, or N ₂	Denitrifiers (or nitrate reducers)
NO ₂ ⁻	O ₂	NO ₃ ⁻	H ₂ O	Nitrosifiers

*The name biologists use to identify species that use a particular metabolic strategy.

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Eukaryotic Nutrition

Absorption of nutrients

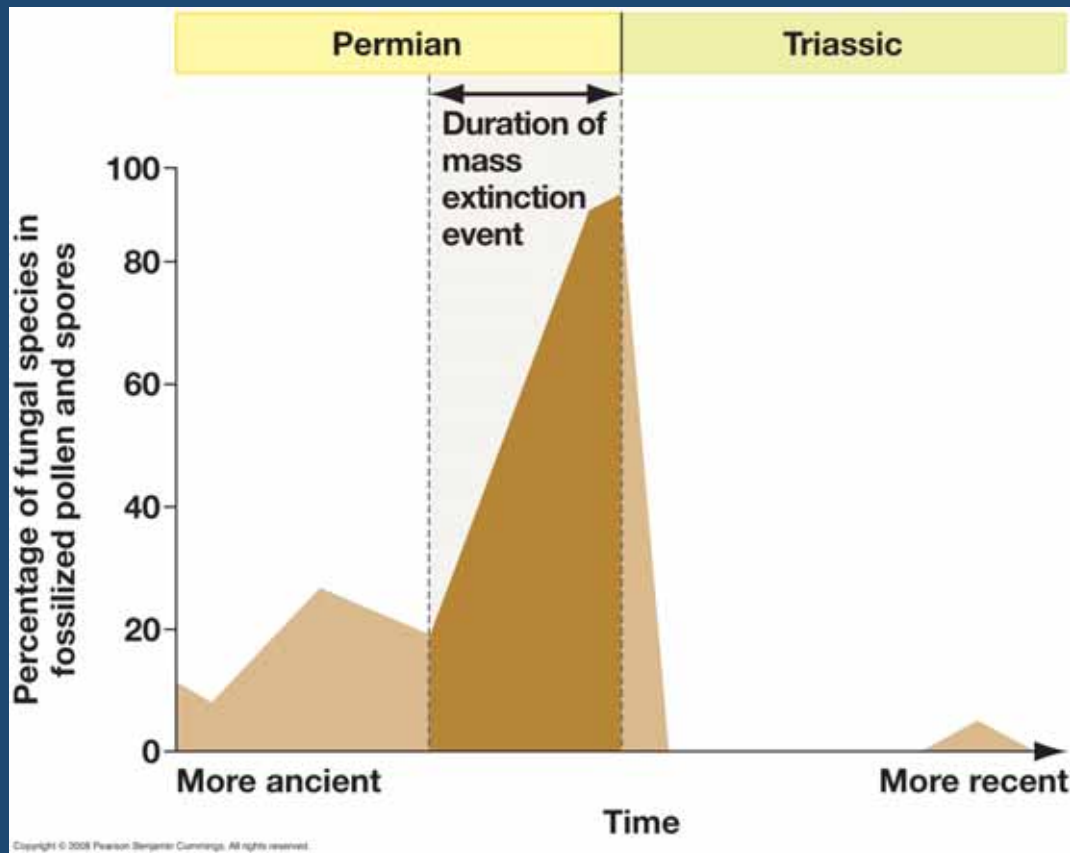
- Most eukaryotes use glucose as an electron donor (energy) and oxygen as the electron acceptor
- What lifestyle strategies allow for absorptive feeding?
 - Decomposers
 - Parasites

Decomposers

- Fungi are the most important decomposers on the planet.
- Obtain all their nutrients from absorption from other organisms
 - Dead (decomposers)
 - Alive (parasites)



Ancient Fungi



250 MYA

Largest extinction event on Earth (90% loss)

Followed by a massive pulse in the abundance of fungi

Provided evidence that this extinction was not limited to marine ecosystems

Fig 31.2

Decomposers

- Along with certain bacteria, the fungi are the only group that can metabolize the lignin and cellulose that make up wood.



Lignin

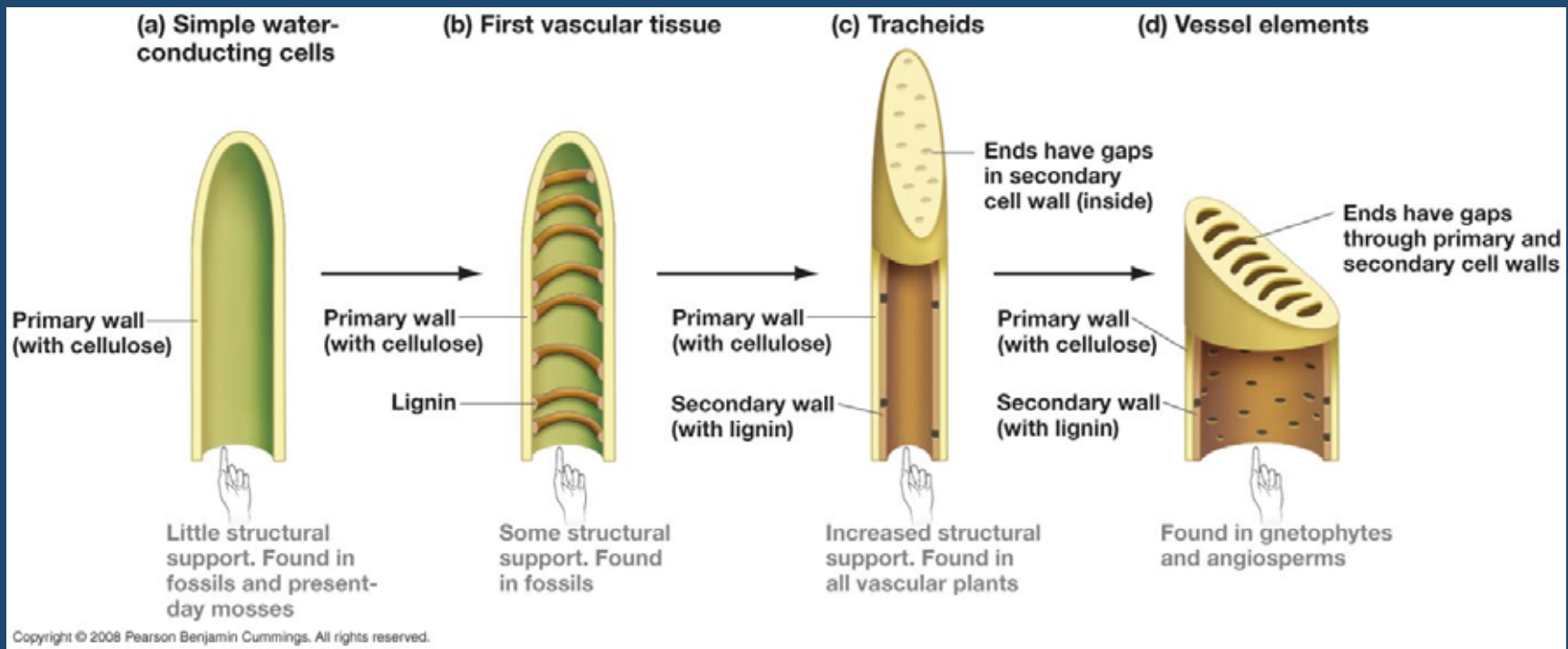
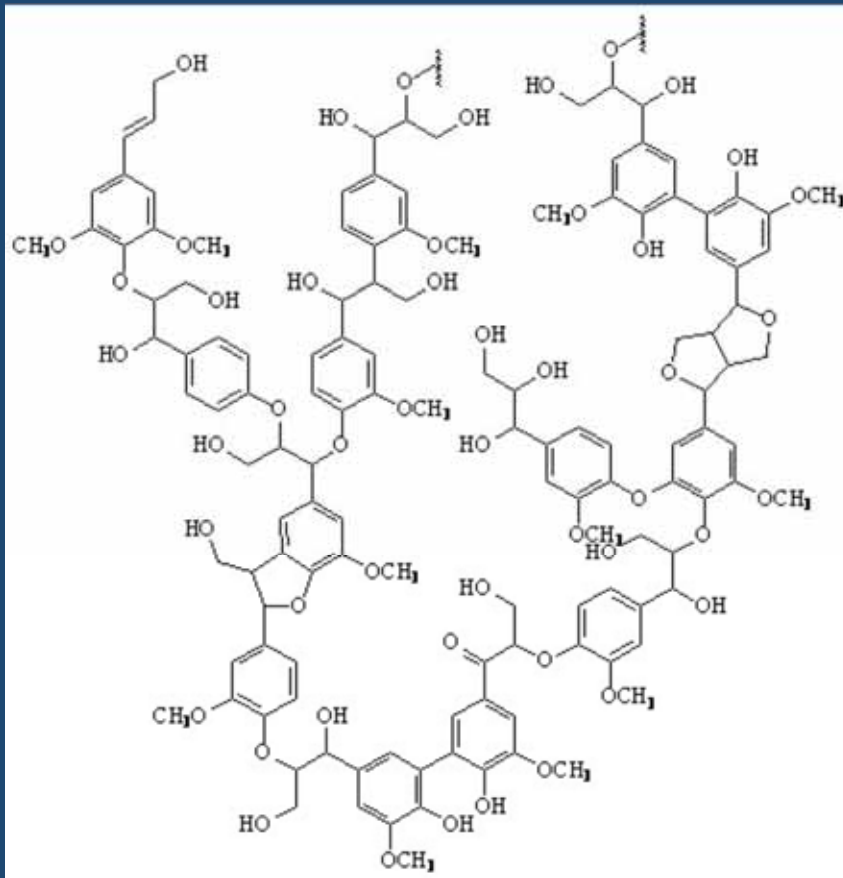


Fig 30.11

Lignin *for biochemists*



- 6-carbon rings make lignin extremely rigid
- Helped plants 'defy' gravity and develop a vascular system



Bryophyte

Lignin

The Reckoning

- Fungi “blast” lignin by removing a single electron from one 6-carbon ring
 - This creates a free radical and violent chain reaction



And the fungus doesn't even eat it!

The Real Feast

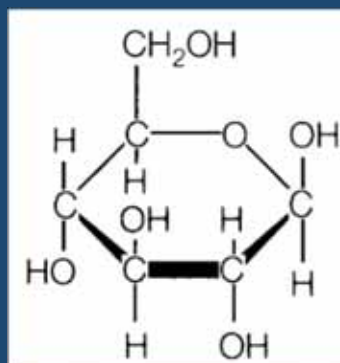


Once the lignin peroxidase softens the wood, the fungus can begin to decompose the cellulose

Trichoderma

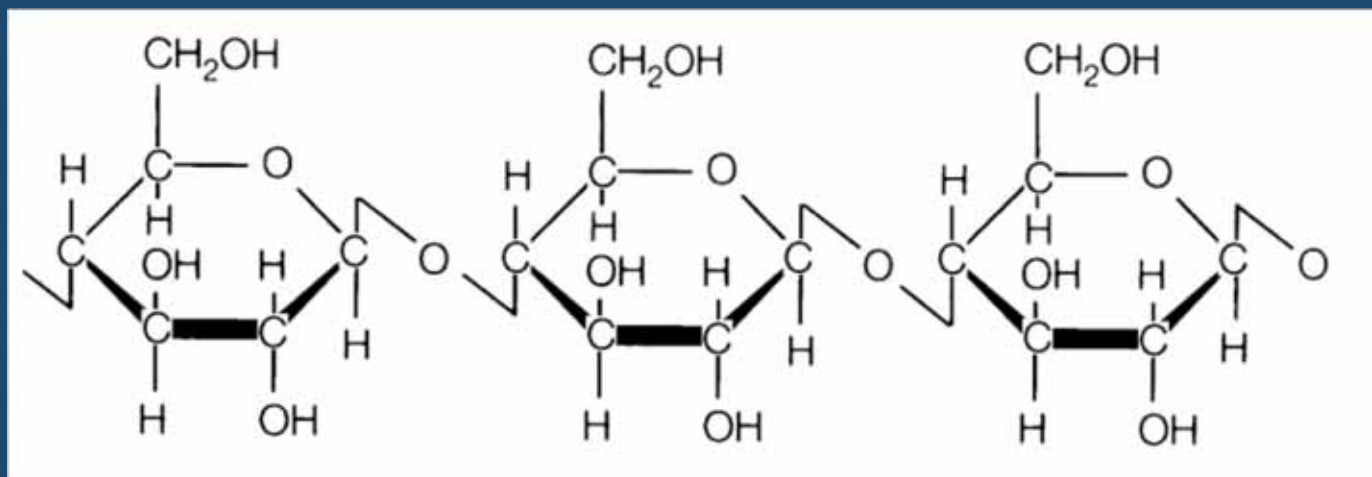
Uses 7 different kinds of cellulase enzymes

Glucose

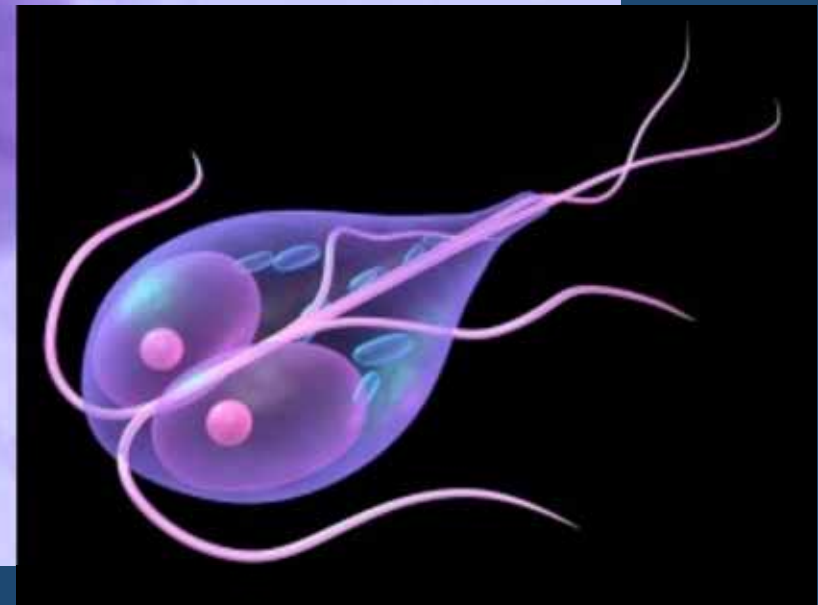


What else uses absorptive feeding?

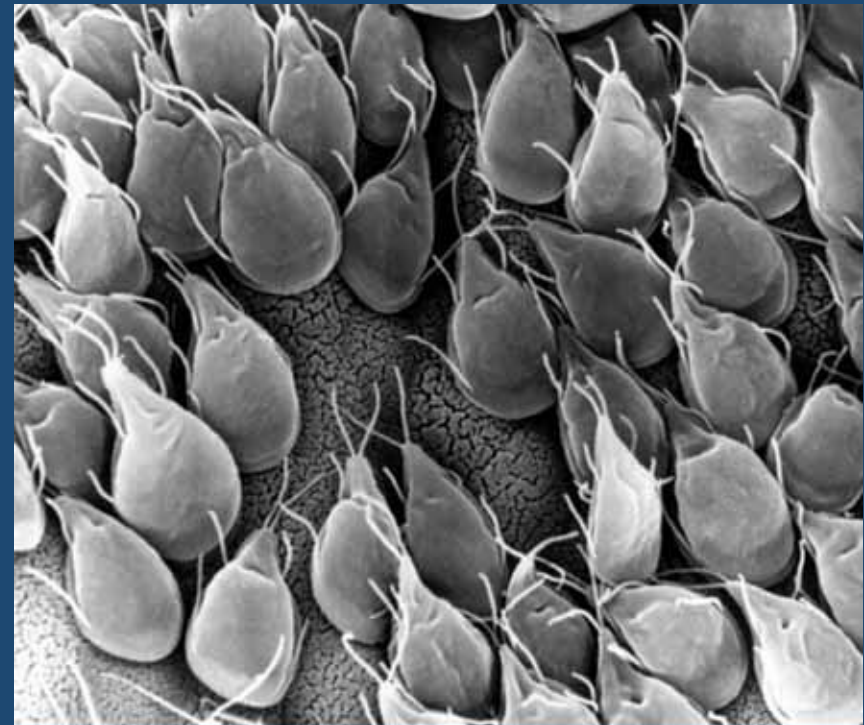
Cellulose



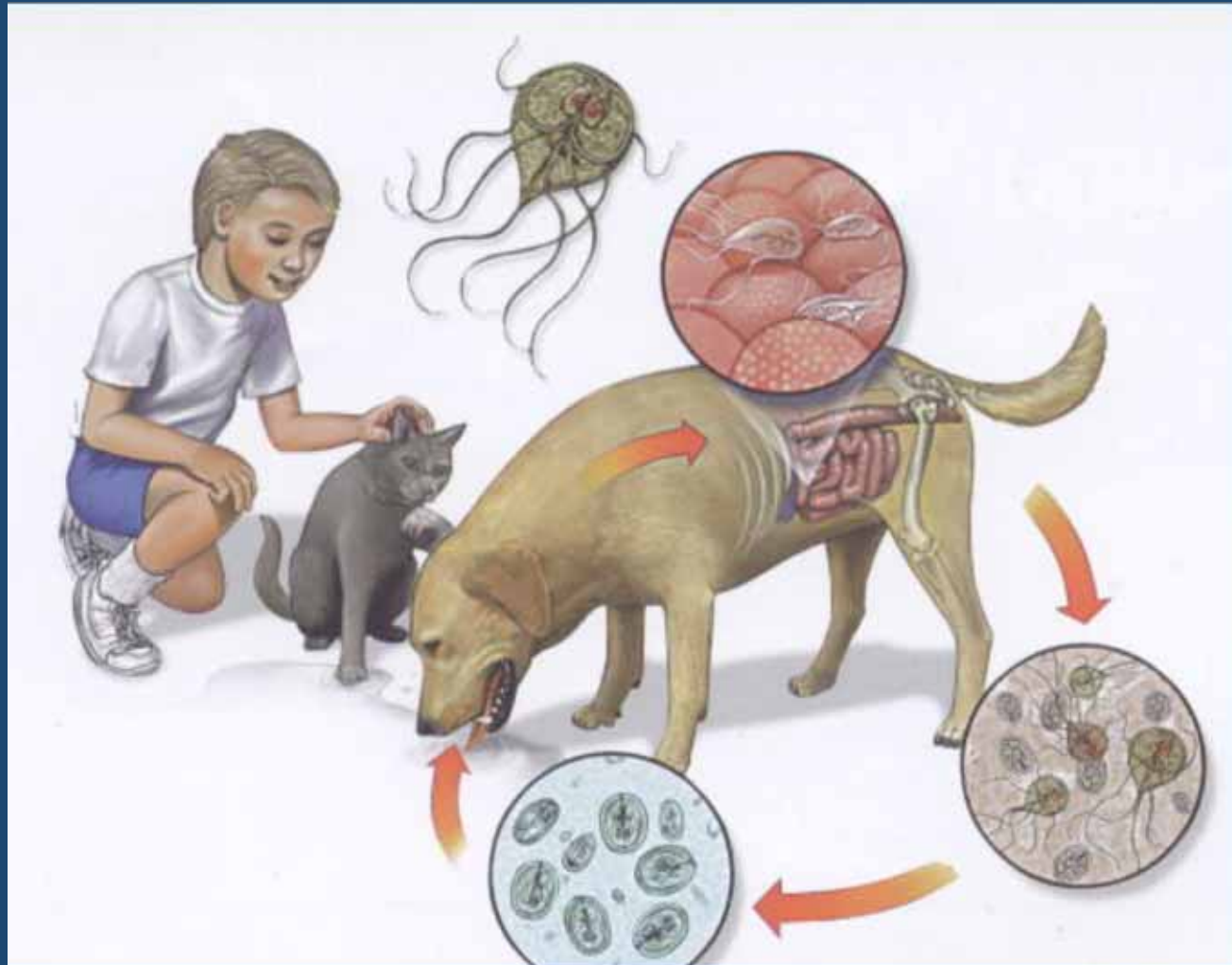
Giardia



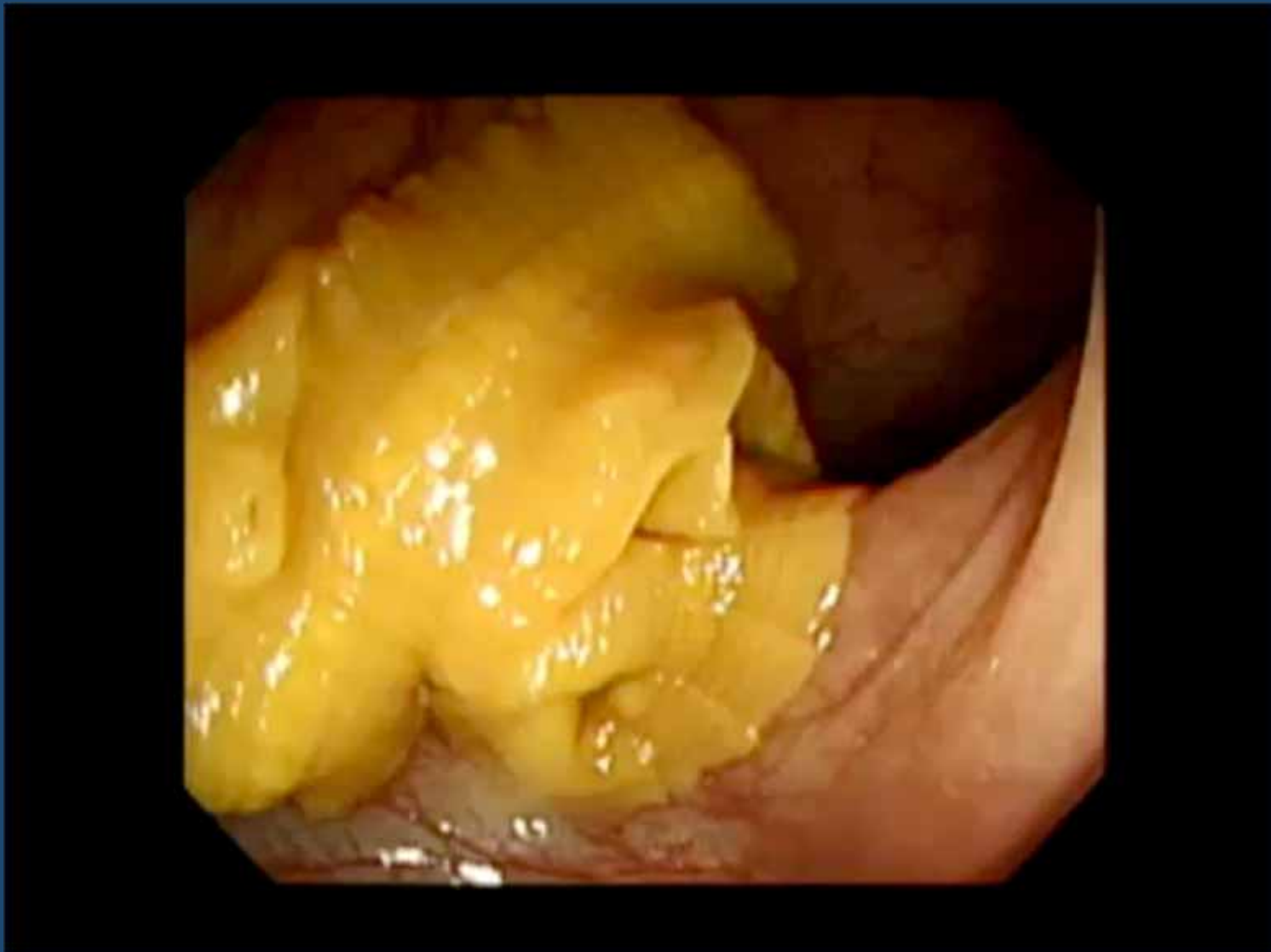
Giarida



Giardia



Diphyllobothrium



Diphyllobothrium

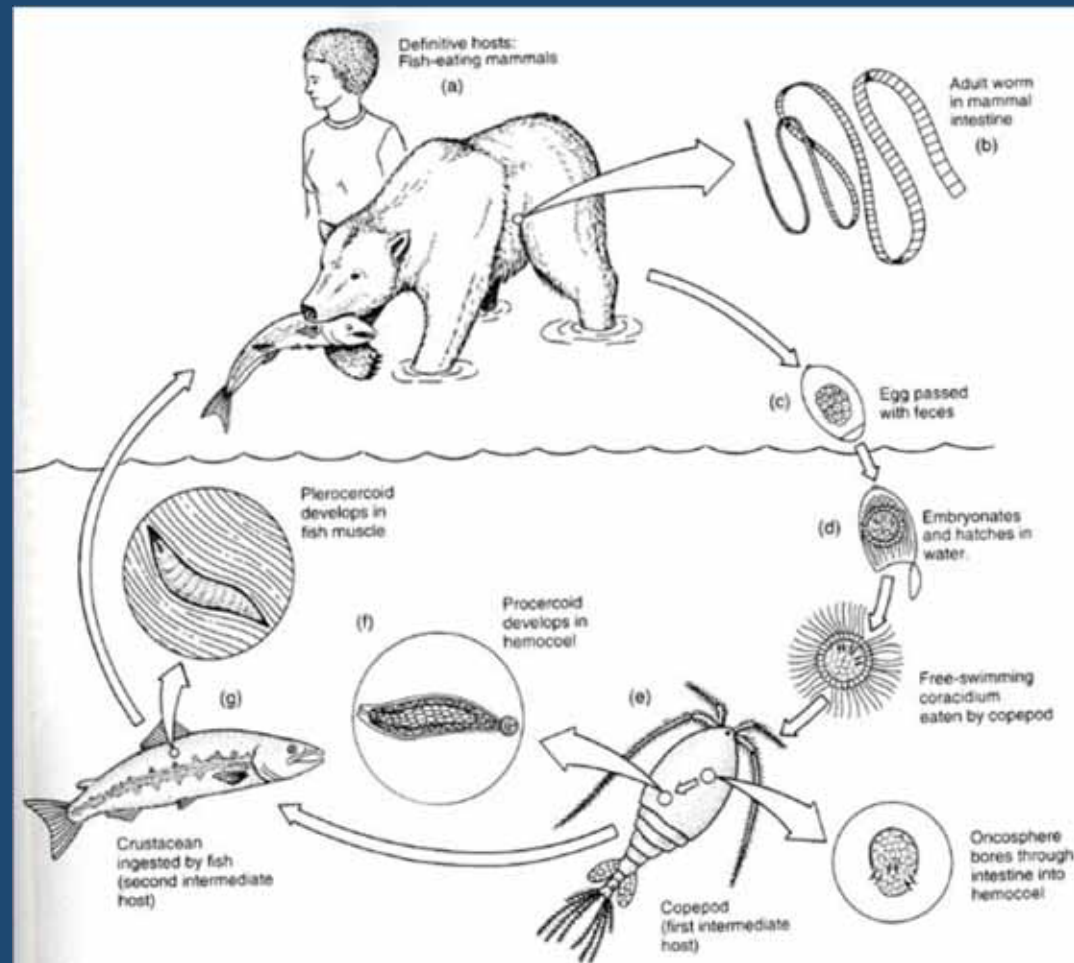


Figure 21.4

Life cycle of *Diphyllobothrium latum*. (a) Definitive hosts are any of a number of fish-eating mammals. (b) Adult worm is in mammal small intestine. (c) Shelled embryo passes in feces at an early stage of development. (d) Embryogenesis continues in water, and free-swimming coracidium hatches. (e) Coracidium eaten by copepod, and oncosphere penetrates intestine into hemocoel. (f) Proceroid develops in hemocoel. (g) Copepod eaten by fish, where proceroid penetrates into muscle and develops into plerocercoid.

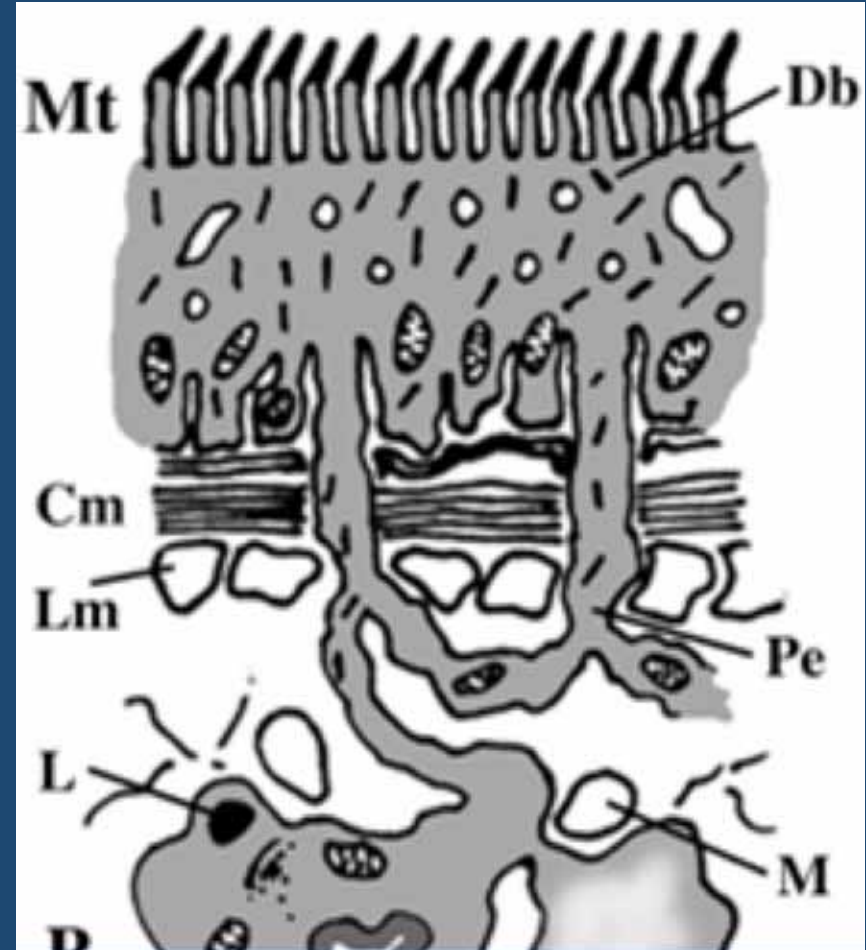
Drawing by William Ober and Clair Garrison.

Diphyllobothrium

- No digestive tract!
 - All absorptive feeding
- *D. latum* outcompetes the body for absorption of vitamin B₁₂
 - *Causes pernicious anemia in humans*



Microtriches



Direct Feeding by Eukaryotes

Direct Feeding by Eukaryotes

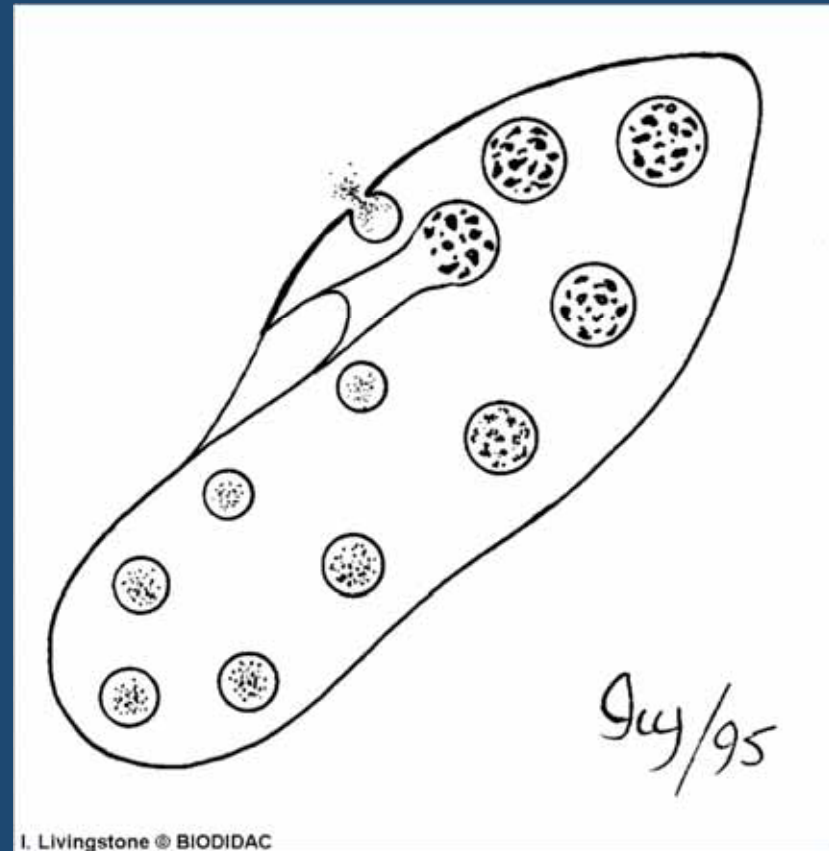
- Bacteria cannot ingest particles from the environment. WHY?
- Protists have no cell wall, now capable of ingesting large food particles

Feeding in a Ciliate

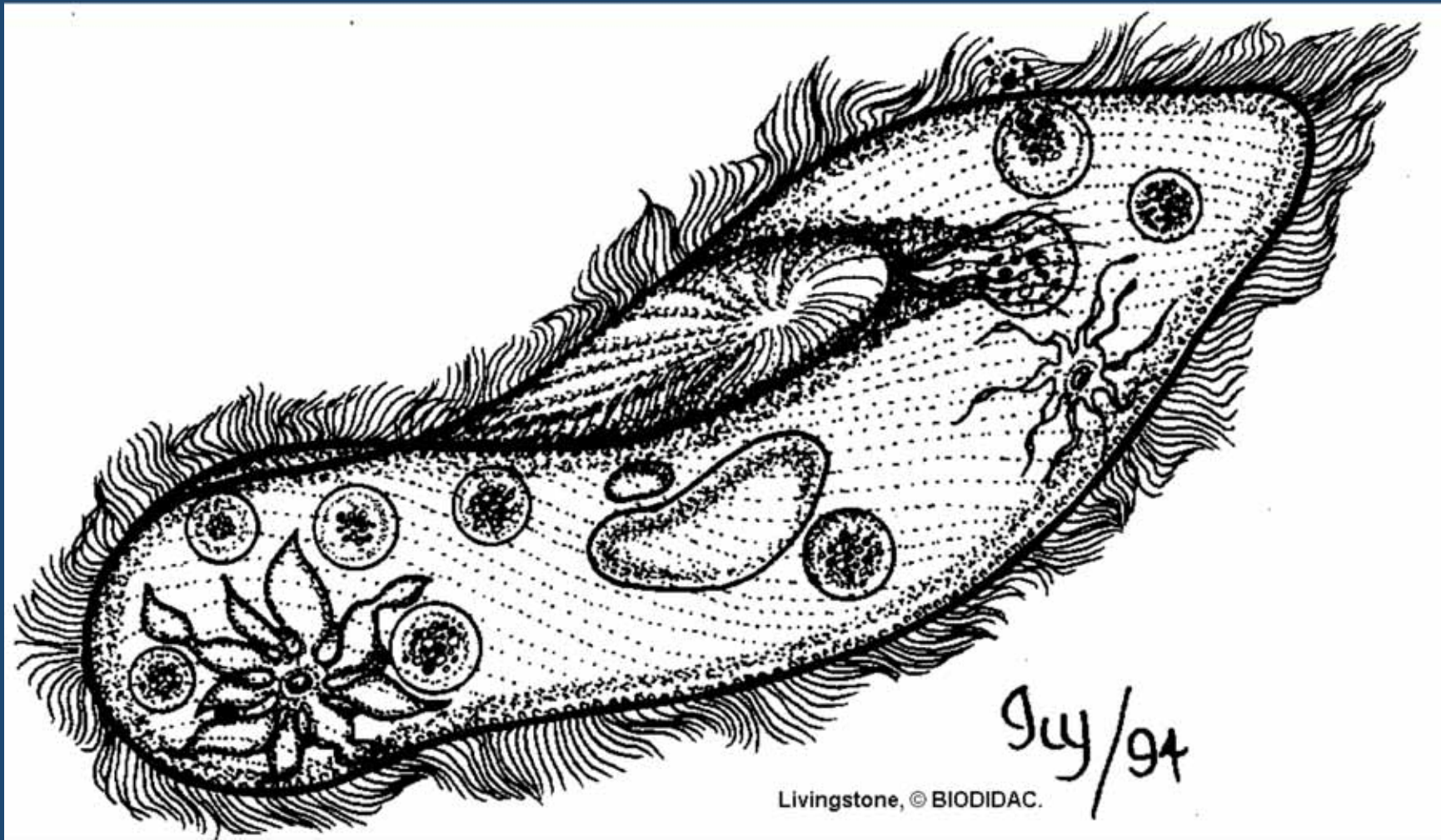
Cytostome
Oral groove
Gullet } ~ Mouth

Food vacuole formed at
terminus of oral groove

Lysosome fuses with food
vacuole, material digested



Feeding in a Ciliate



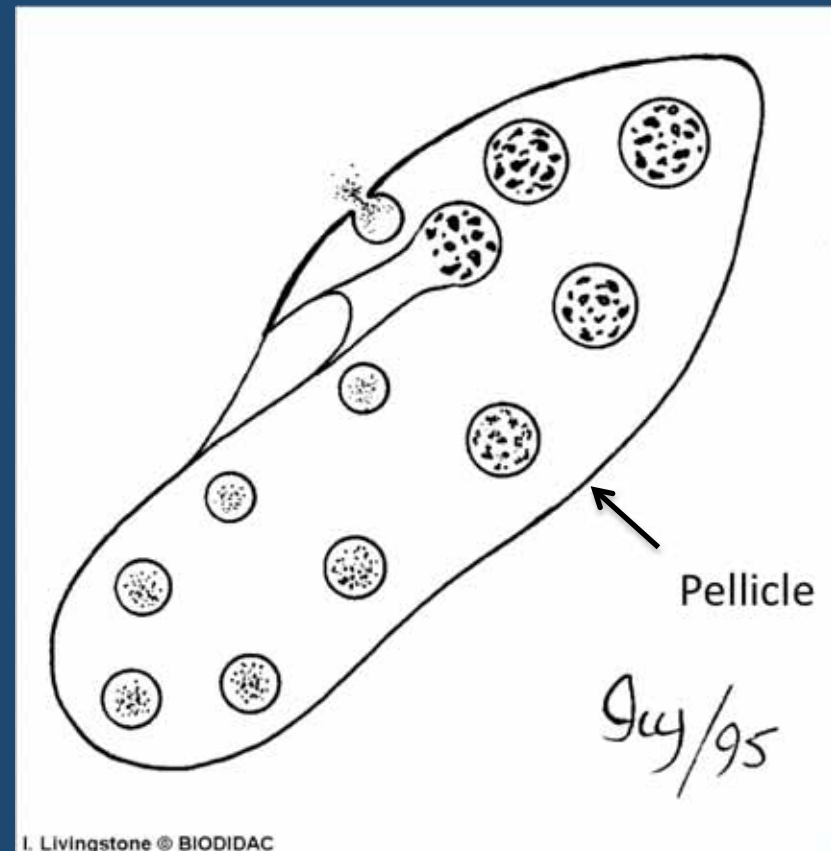
Livingstone, © BIODIDAC.



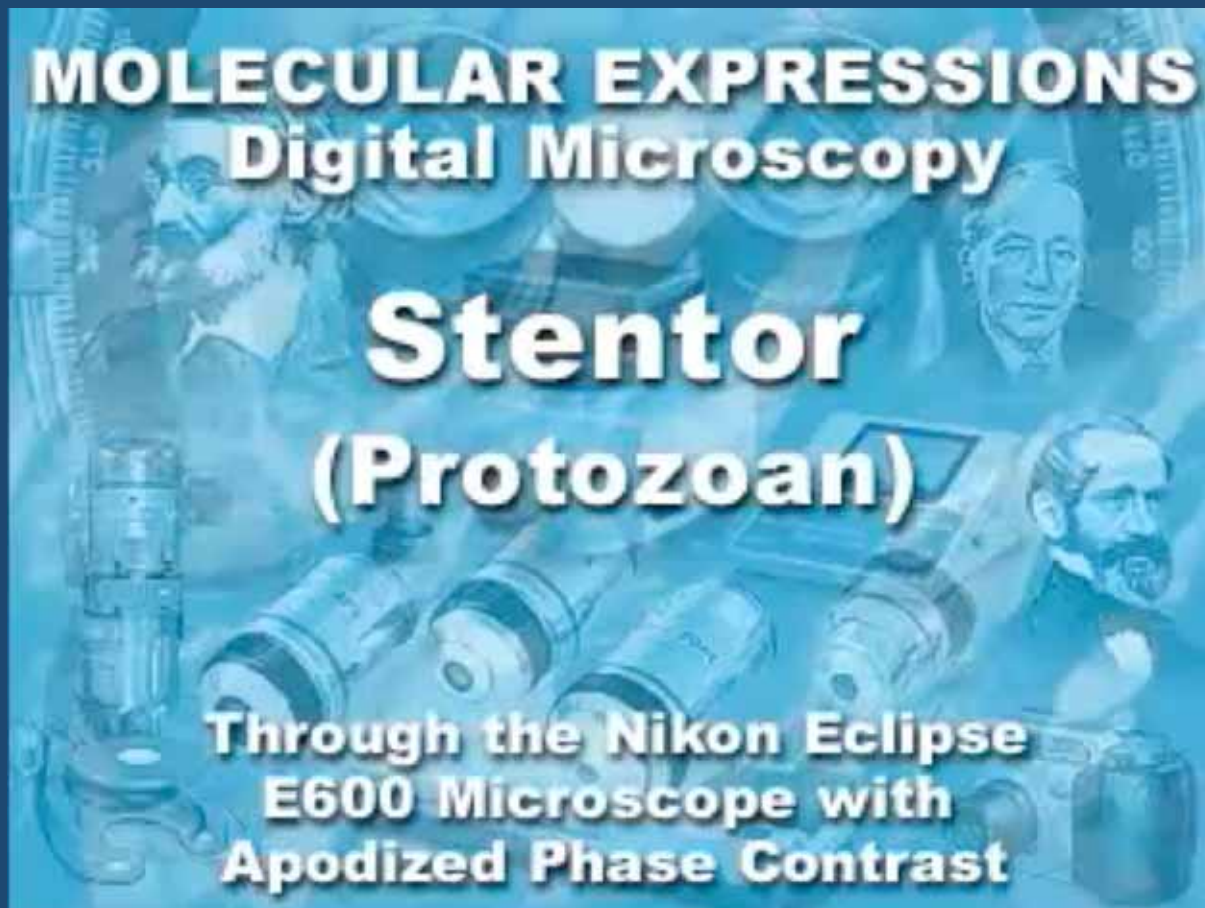
Feeding in a Ciliate

Pellicle: complex series of membranes that helps maintain rigid structure

Food vacuoles first become highly acidic, then basic. Remains are expelled.

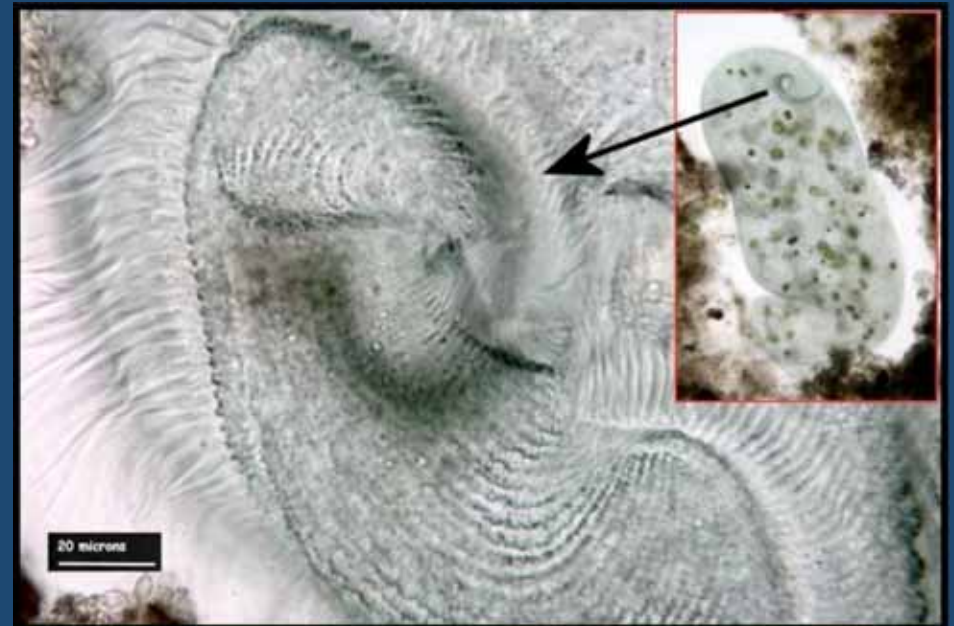


Stentor Feeding

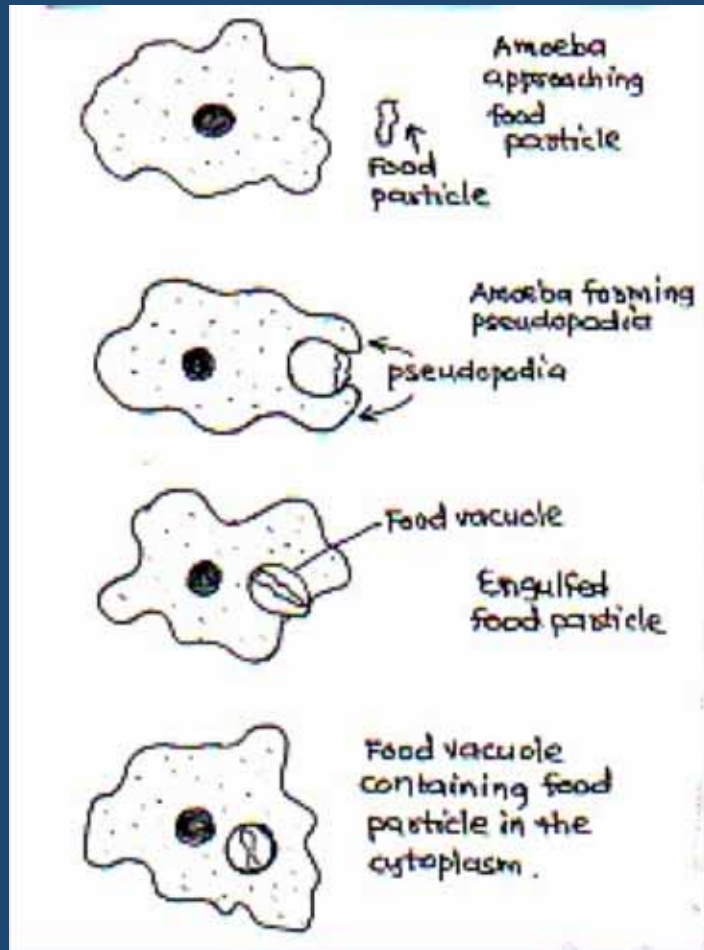


Stentor Feeding

- Sessile feeder
- Cilia creates current
- Food is funneled into cytostome

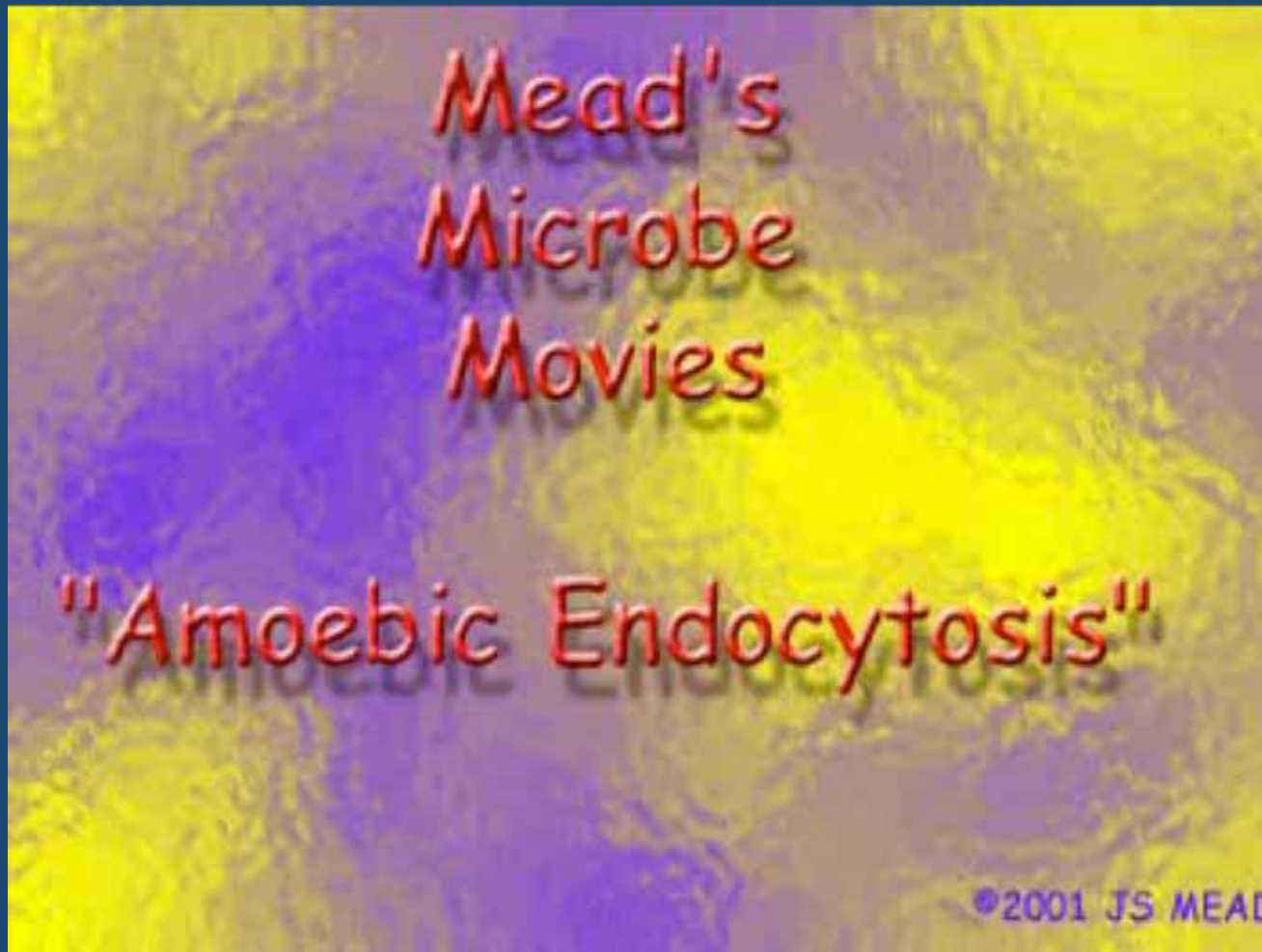


Feeding in Amoeboids



- Pseudopodia used for locomotion and feeding
- Phagocytosis
- Amoeboids have flexible membrane, no distinct form

Amoeba Feeding



Amoeboid feeding and movement



- Amoeboids move and feed via cytoplasmic streaming
- Cytoskeleton supported via actin proteins
- Notice endoplasm vs. ectoplasm

Big step!

- With the development of active feeding, eukaryotes climbed up the food chain
- Instead of competing with bacteria for food, eukaryotes were beginning to feed on bacteria