

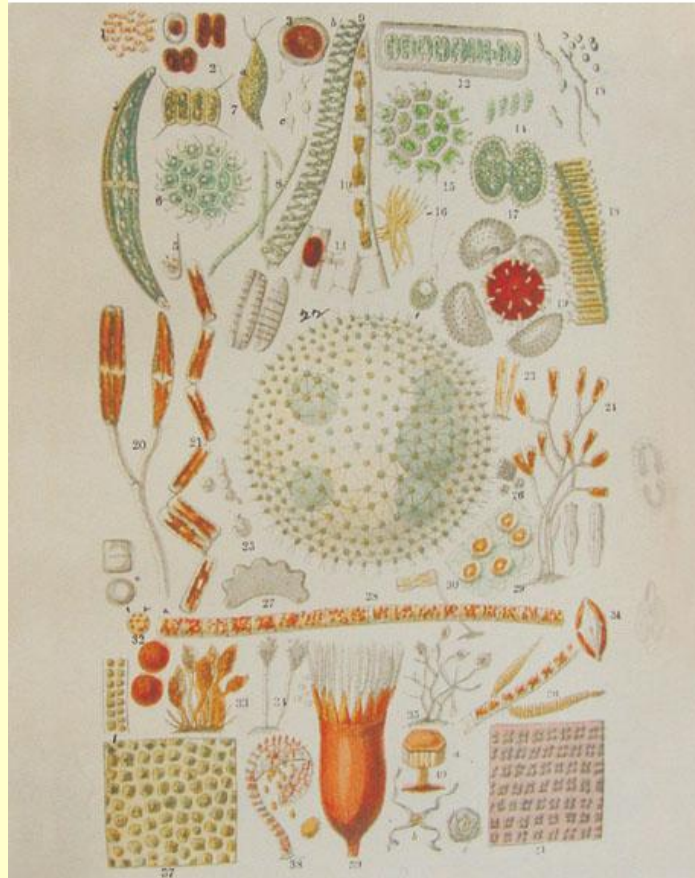
# Microbiology: A Systems Approach

First Edition

Cowan & Talaro

Chapter

5

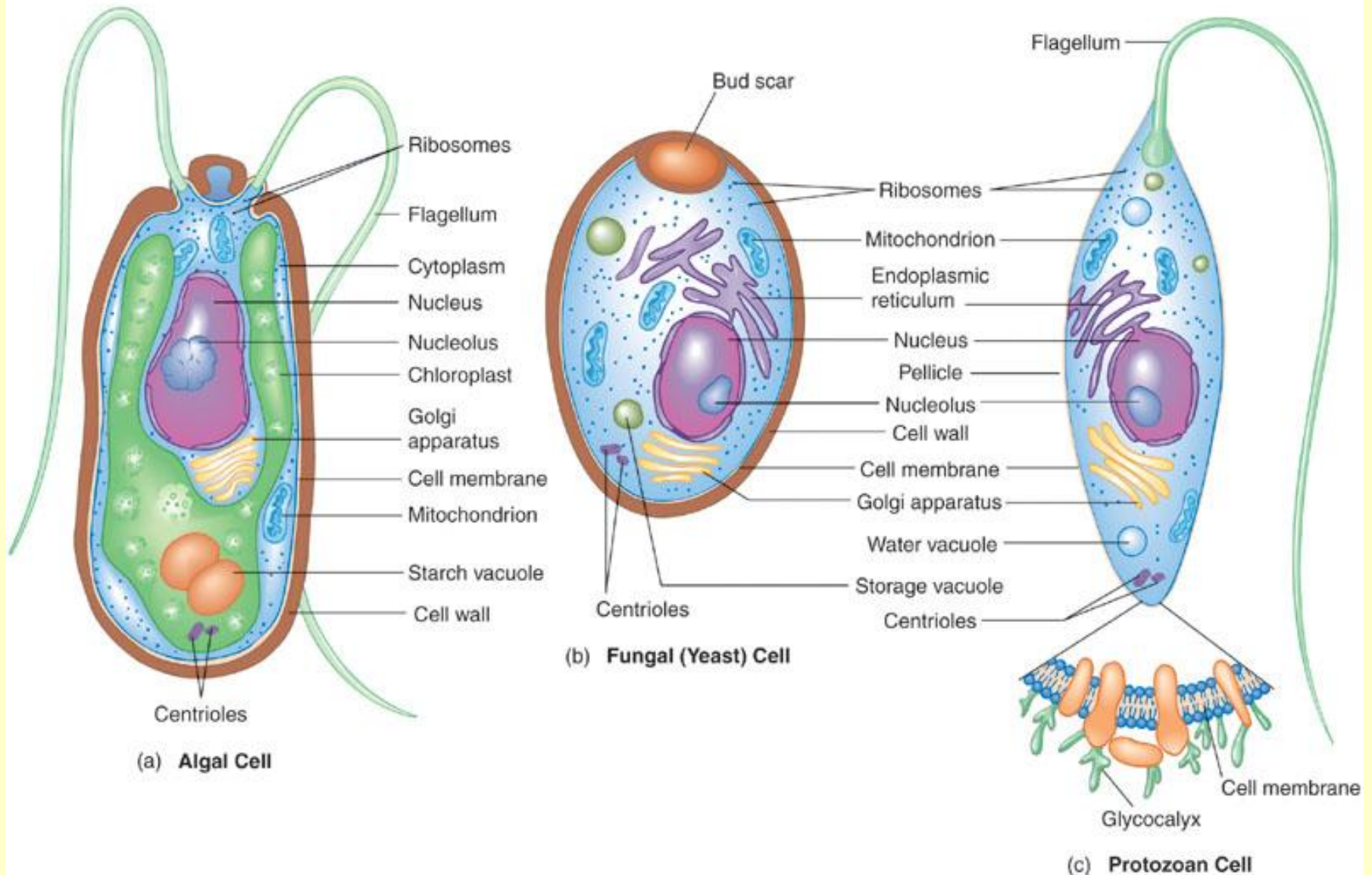


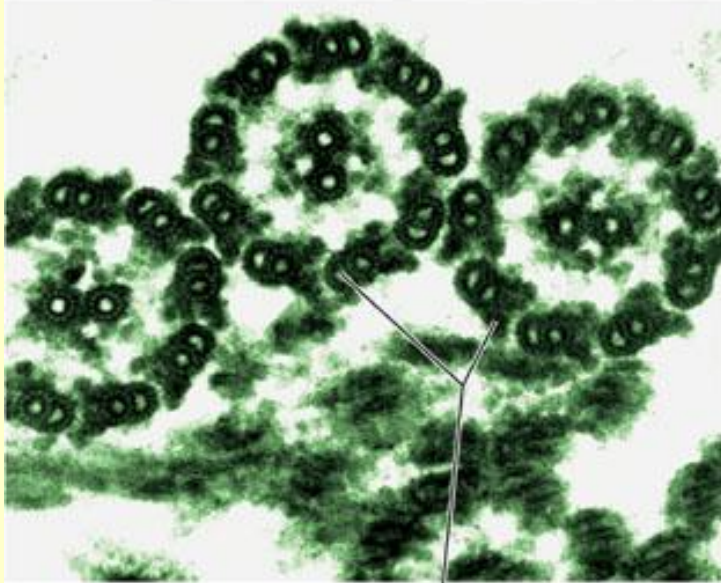
# Eucaryotic cells and microorganisms

## Chapter 5

# 3 Eucaryotic cells

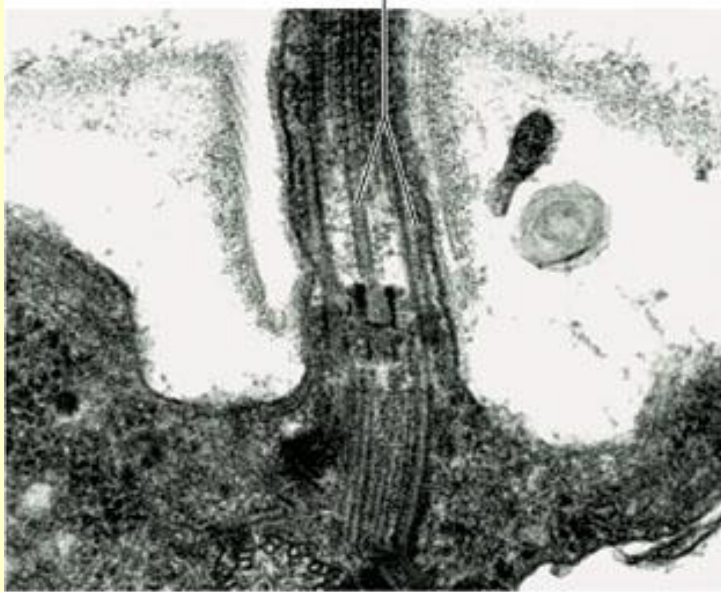
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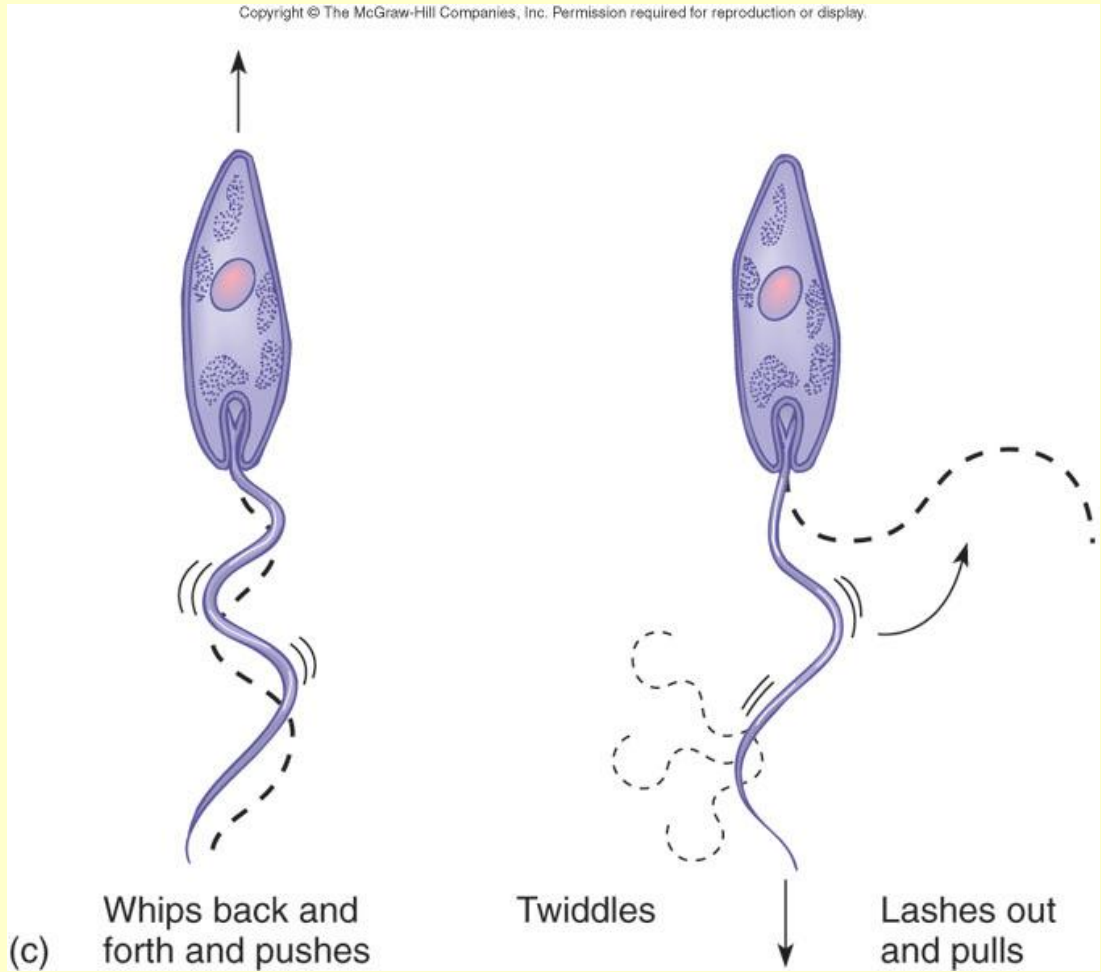
(a)

Microtubules



(b)

# Flagella



(c)

Whips back and forth and pushes

Twiddles

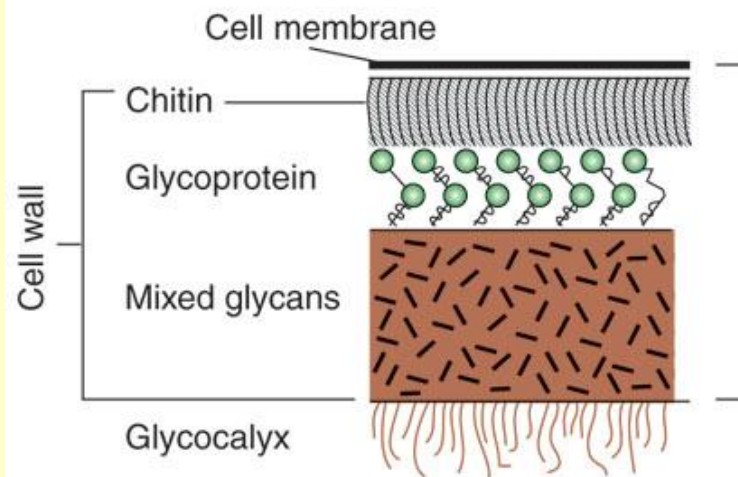
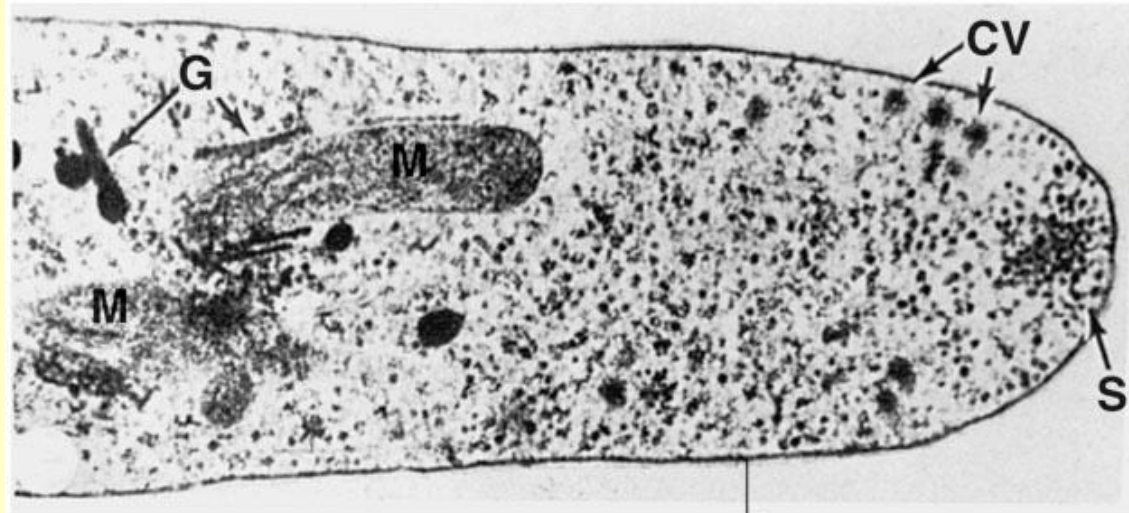
Lashes out and pulls

# Cilia

- similar in overall structure to flagella, but shorter and more numerous
- found only on a single group of protozoa and certain animal cells
- function in motility, feeding & filtering

# Glycocalyx structure

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# Cell wall

- rigid & provide structural support & shape
- fungi have thick inner layer of polysaccharide fibers composed of **chitin** or **cellulose** & a thin layer of mixed glycans
- Algae – varies in chemical composition; substances commonly found include **cellulose**, pectin, mannans, silicon dioxide, & calcium carbonate

# Cell membrane

- typical bilayer of phospholipids and proteins
- sterols confer stability
- serve as selectively permeable barriers in transport
- eucaryotic cells also contain membrane-bound organelles that account for 60-80% of their volume



# nucleus

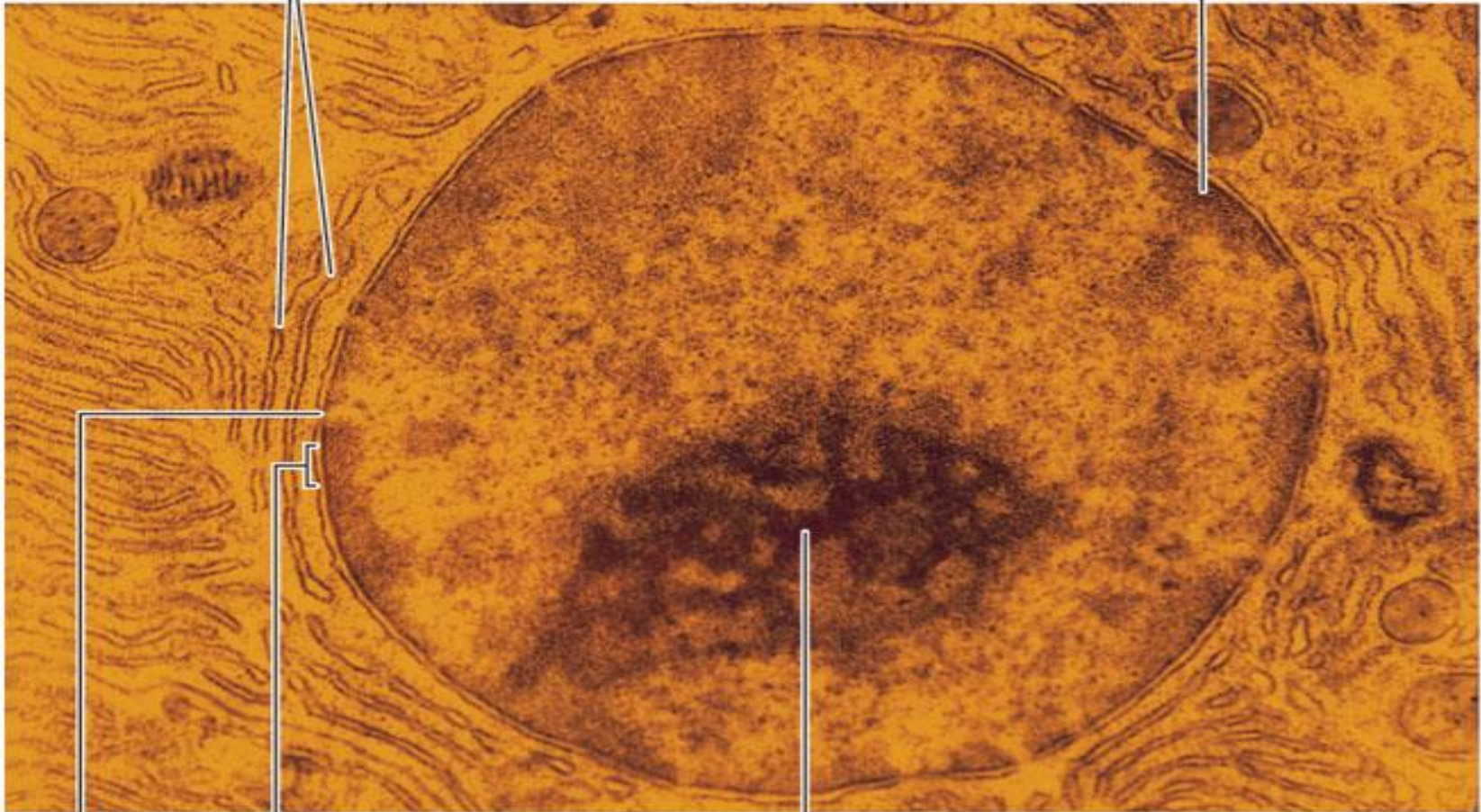
- **compact sphere, most prominent organelle of eucaryotic cell**
- nuclear envelope is composed of two parallel membranes separated by a narrow space & is perforated with pores
- contains chromosomes
- nucleolus – dark area for rRNA synthesis & ribosome assembly

# nucleus

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Endoplasmic reticulum

Chromatin



Nuclear  
pore

Nuclear  
envelope

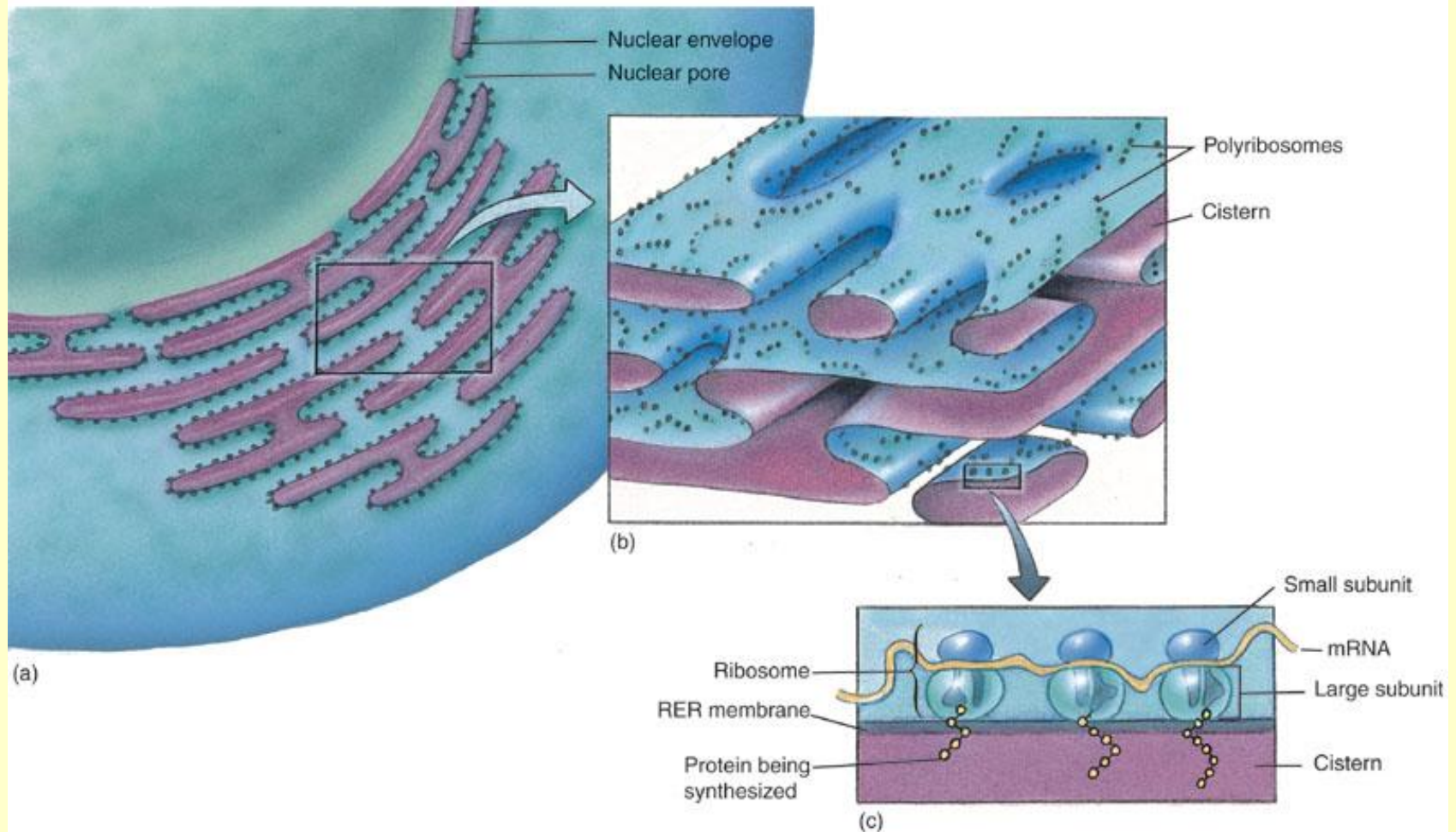
Nucleolus

# Endoplasmic reticulum

- **Rough** endoplasmic reticulum (RER)– originates from the outer membrane of the nuclear envelope & extends in a continuous network through cytoplasm; rough due to ribosomes, proteins are synthesized & shunted into the ER for packaging & transport. First step in secretory pathway.
- **Smooth** endoplasmic reticulum (SER)– closed tubular network without ribosomes, functions in nutrient processing, synthesis & storage of lipids, etc.

# rough endoplasmic reticulum (RER)

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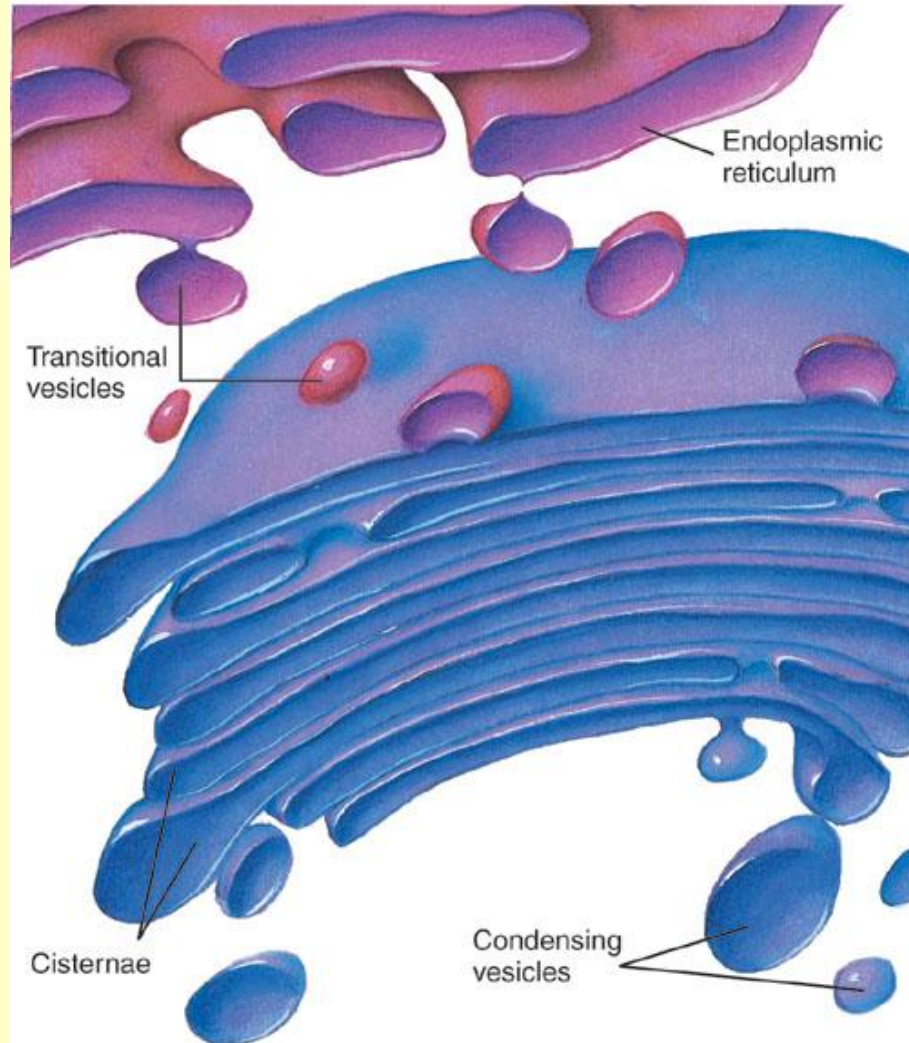


# Golgi apparatus

- consists of a stack of flattened sacs called cisternae
- closely associated with ER
- Transitional vesicles from the ER containing proteins go to the Golgi apparatus for modification and maturation
- Condensing vesicles transport proteins to organelles or secretory proteins to the outside

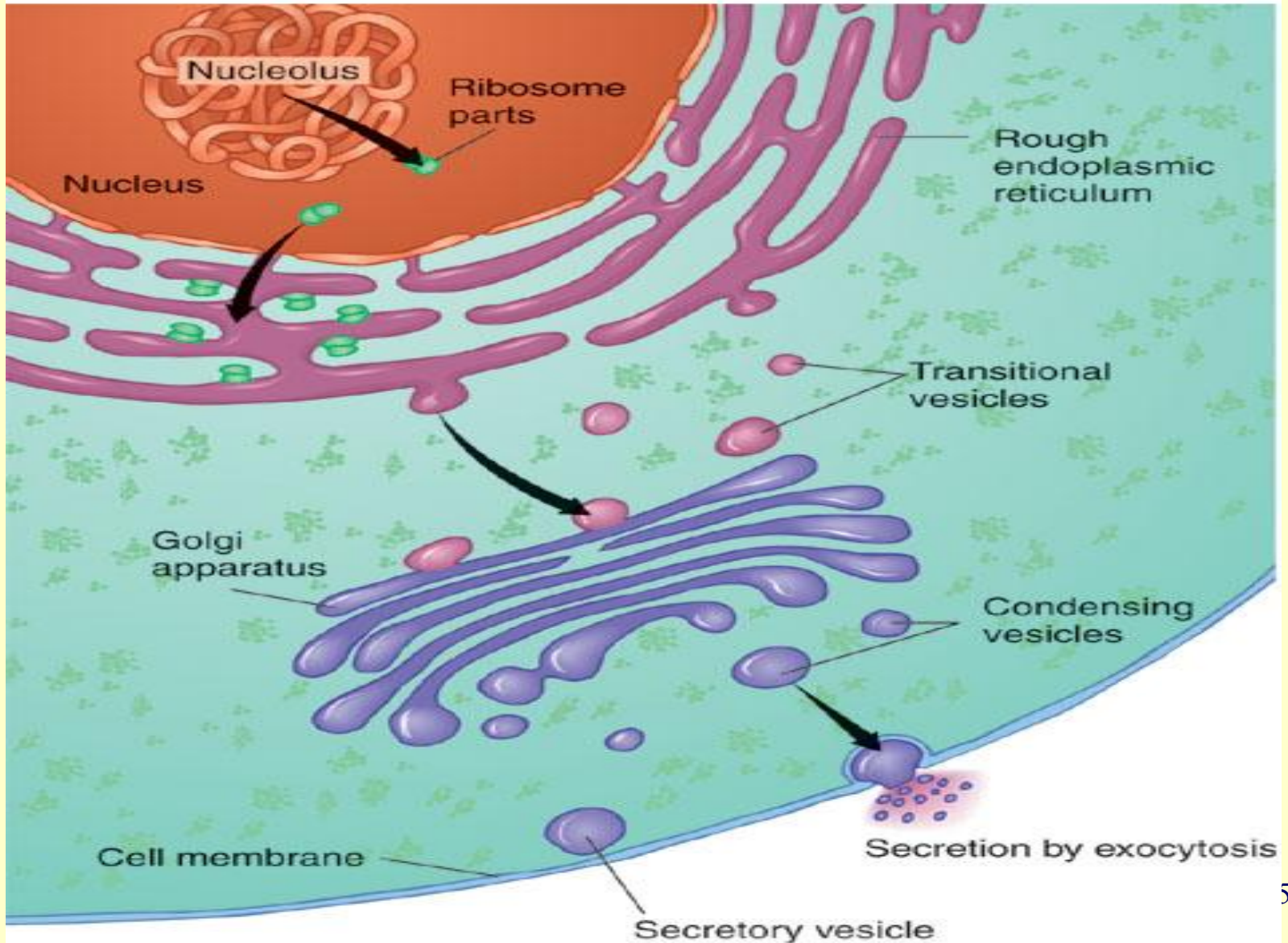
# Golgi apparatus

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# Transport process

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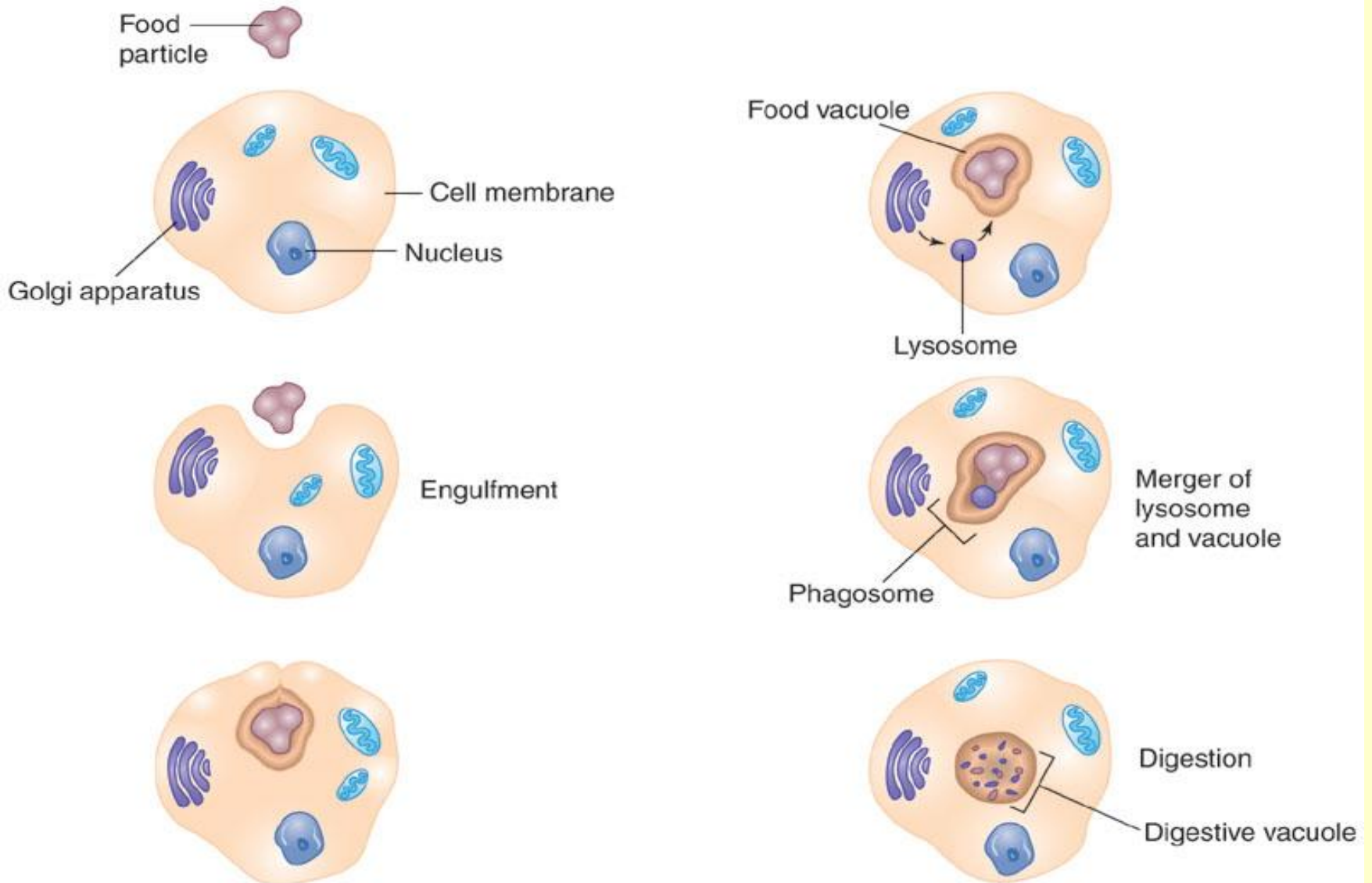
# lysosomes

- vesicles containing enzymes
- involved in intracellular digestion of food particles & in protection against invading microbes



# lysosomes

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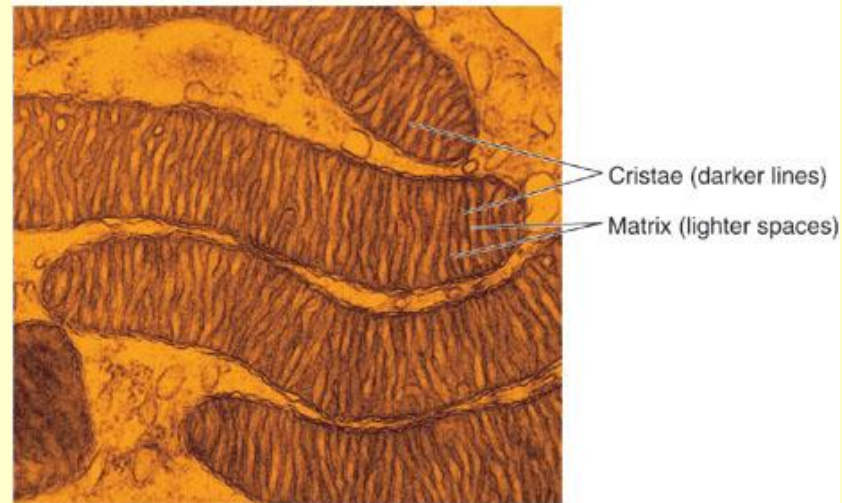
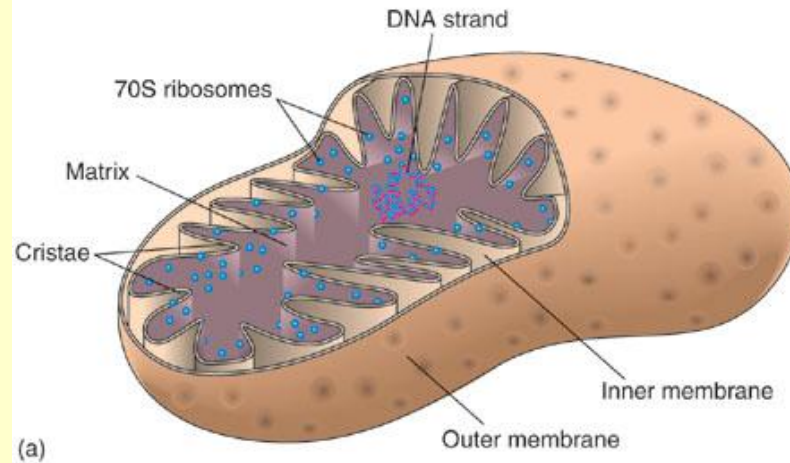


# mitochondria

- consists of an outer membrane & an inner membrane with folds called **cristae**
- cristae hold the enzymes & electron carriers of aerobic respiration
- divide independently of cell
- contain DNA and **procaryotic ribosomes**
- function in energy production

# mitochondria

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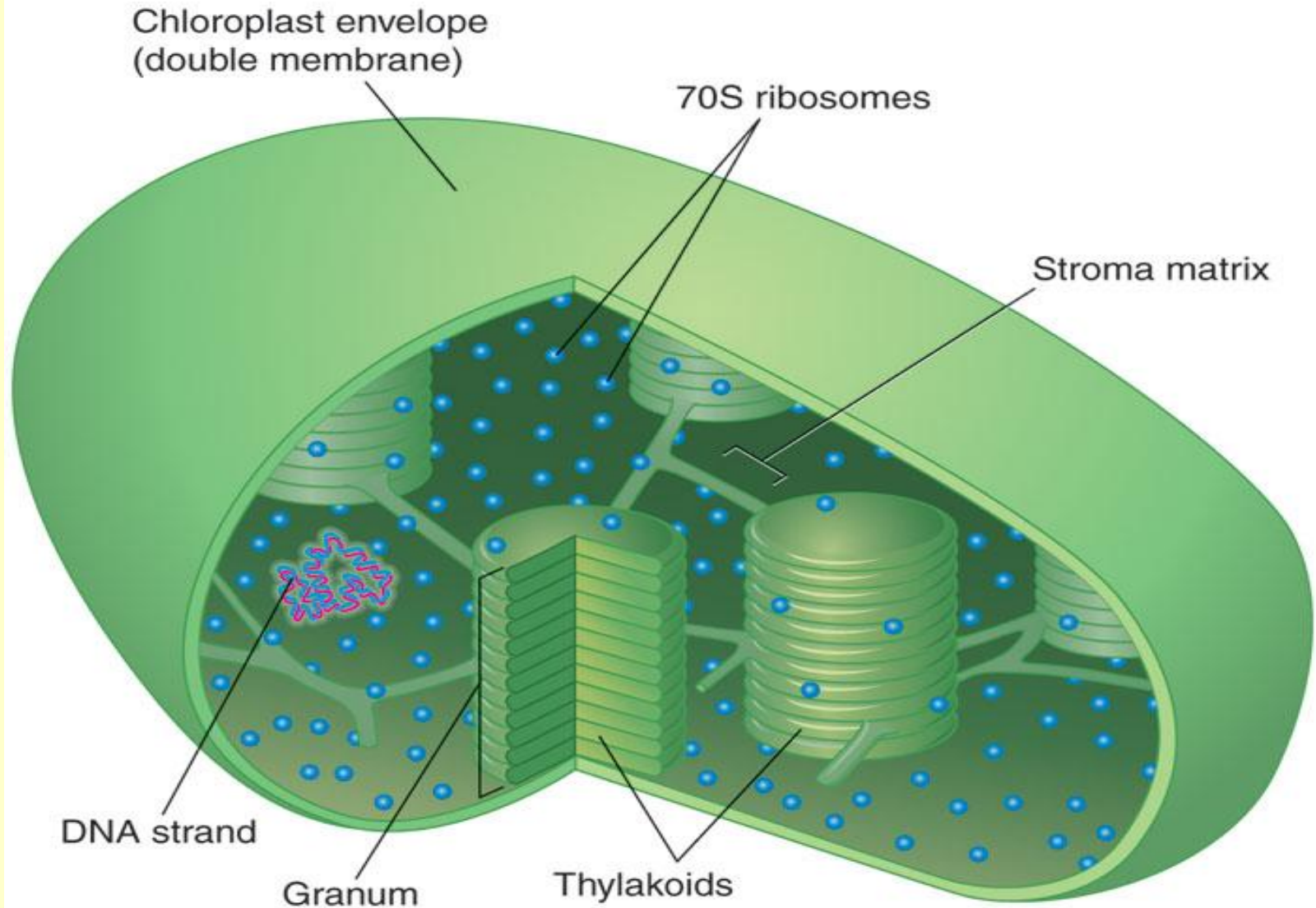
(b)

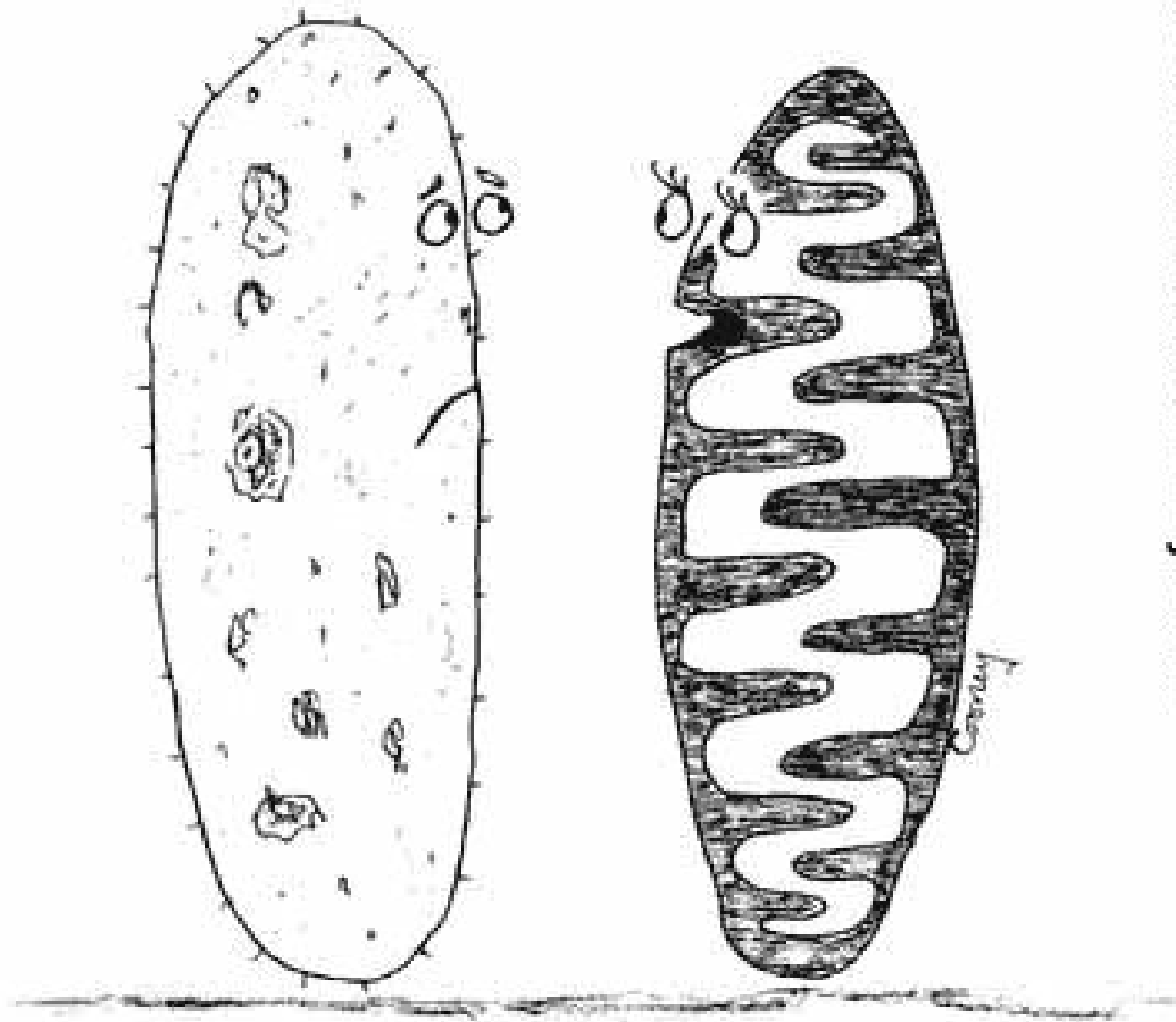
# chloroplast

- found in algae & plant cells
- outer membrane covers inner membrane folded into sacs, **thylakoids**, stacked into grana
- larger than mitochondria
- contain photosynthetic pigments
- convert the energy of sunlight into chemical energy through photosynthesis
- primary producers of organic nutrients for other organisms

# chloroplast

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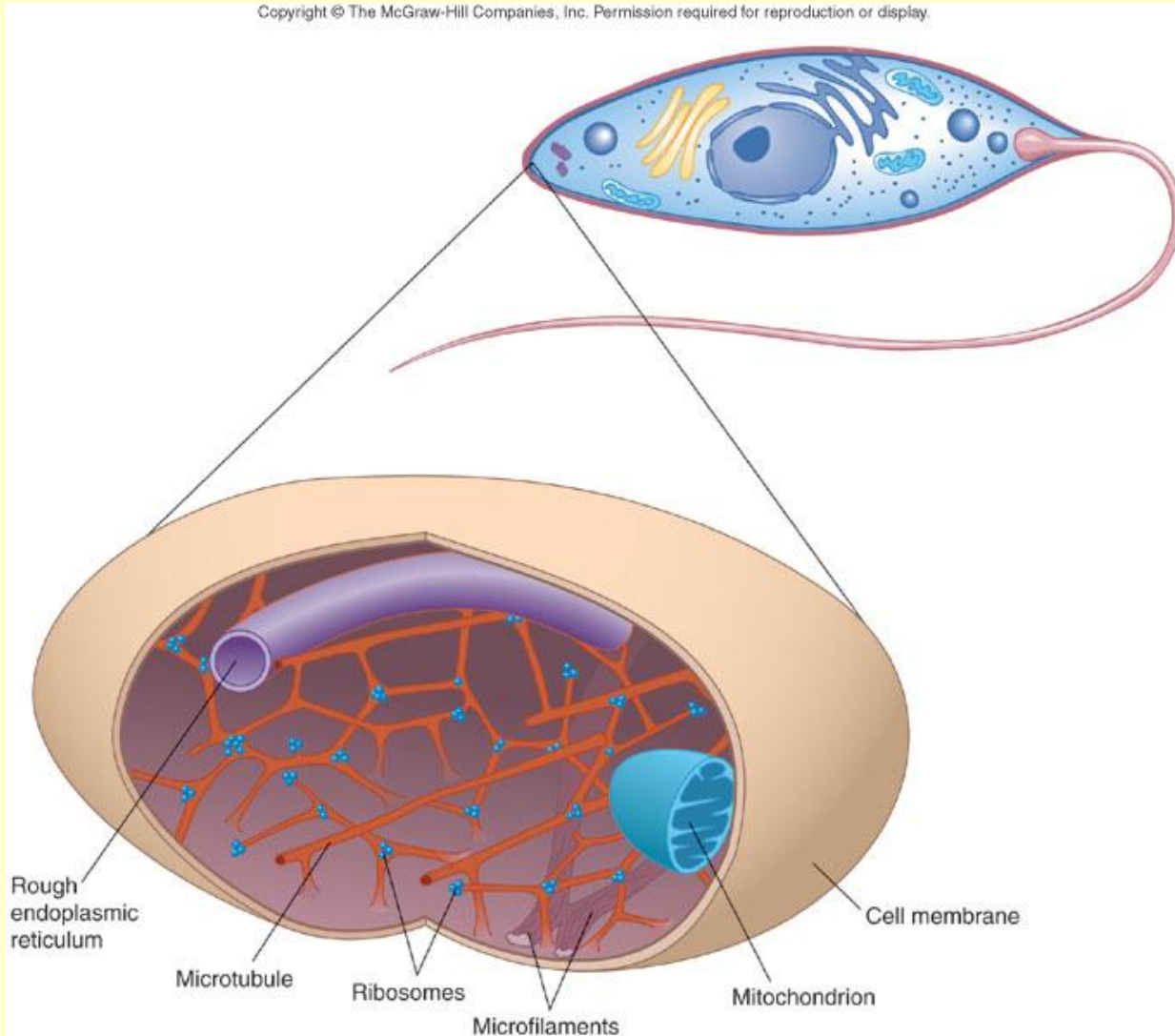




"Let's face it, this just isn't going to work out.  
You're a bacterium and I'm a mitochondrion."

# cytoskeleton

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# ribosomes

- composed of rRNA and proteins
- **40S** and **60S** subunits form **80S** ribosomes
- larger than procaryotic ribosomes
- function in protein synthesis



# Survey of eucaryotic microbes

- Fungi
- Algae
- Protozoa
- Parasitic helminths

# Kingdom Fungi

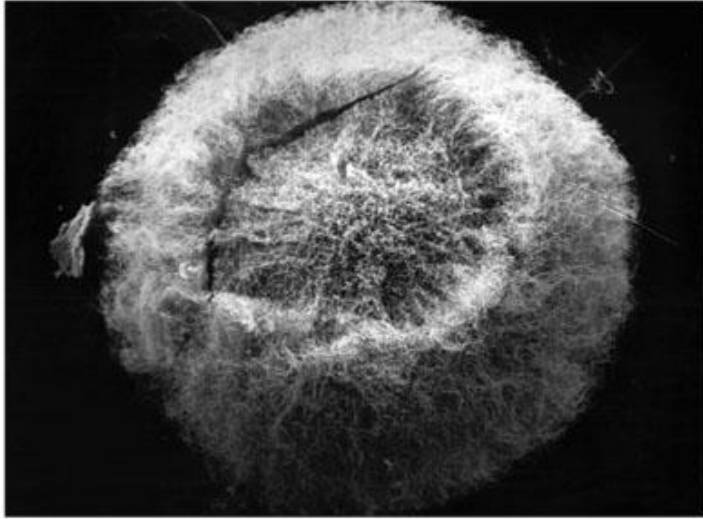
- 100,000 species divided into 2 groups:
  - macroscopic fungi ( mushrooms, puffballs, gill fungi)
  - microscopic fungi (molds, yeasts)
- majority are unicellular or colonial, a few have cellular specialization

# microscopic fungi

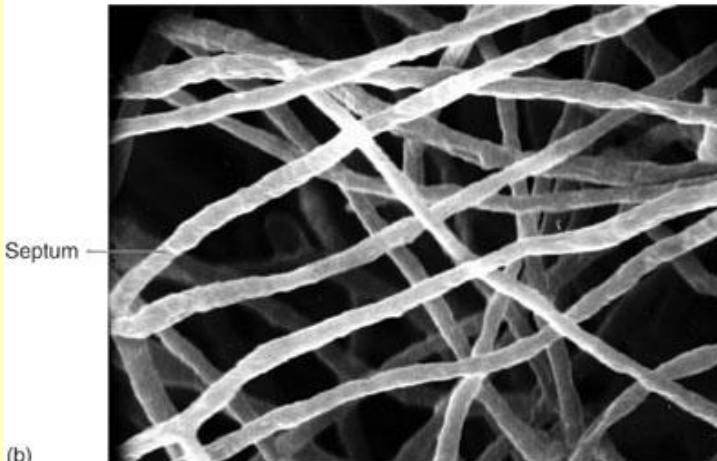
- exist in 2 morphologies
  - yeast – round ovoid shape, asexual reproduction
  - hyphae – long filamentous fungi or molds
- some exist in either form – **dimorphic** – characteristic of pathogens

# Morphology of yeasts

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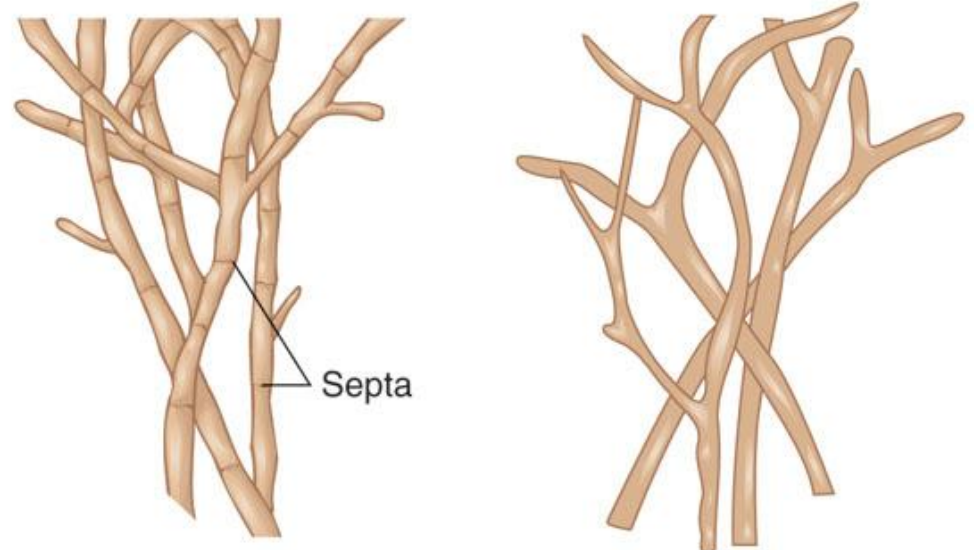


(a)



(b)

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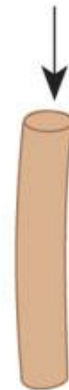


Septate hyphae

Nonseptate hyphae

as in *Penicillium*

as in *Rhizopus*



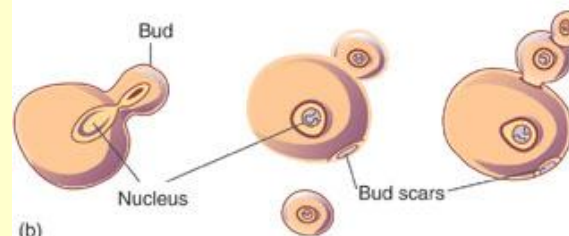
(c)

# Hyphae or mold

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(a)



(b)



(c)

Pseudohypha

# Fungal nutrition

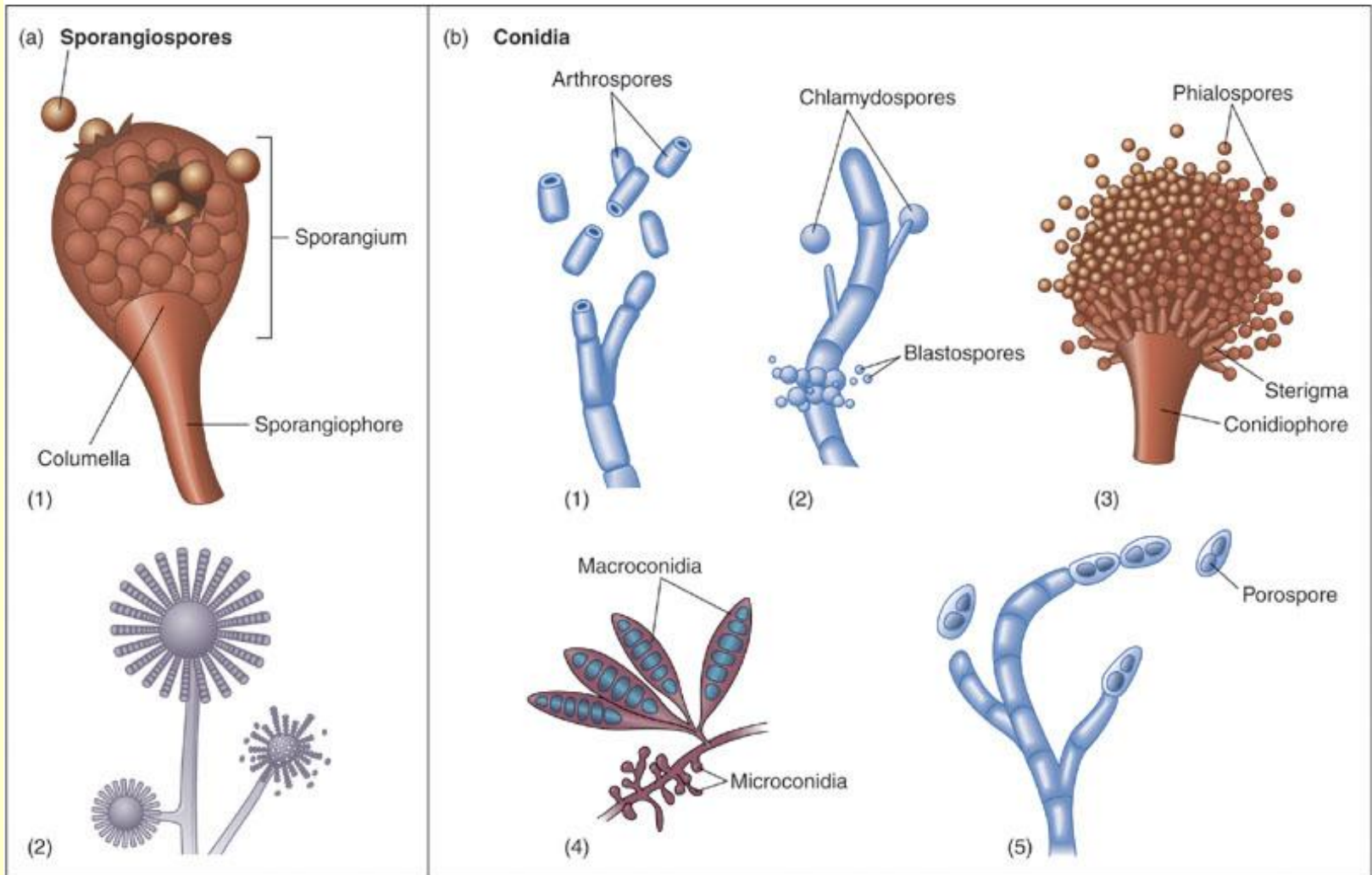
- all are heterotrophic
- majority are harmless **saprobies** living off dead plants & animals
- some are **parasites**, living on the tissues of other organisms, but none are obligate; **mycoses** – fungal infections
- growth temperature 20°-40°C
- extremely widespread distribution in many habitats

# Fungal Reproduction

- primarily through spores formed on special reproductive **hyphae**
  - asexual reproduction – spores are formed through budding or in conidia or sporangiospores
  - sexual reproduction – spores are formed following fusion of male & female strains & formation of sexual structure
- sexual spores are one basis for classification

# Asexual mold spores

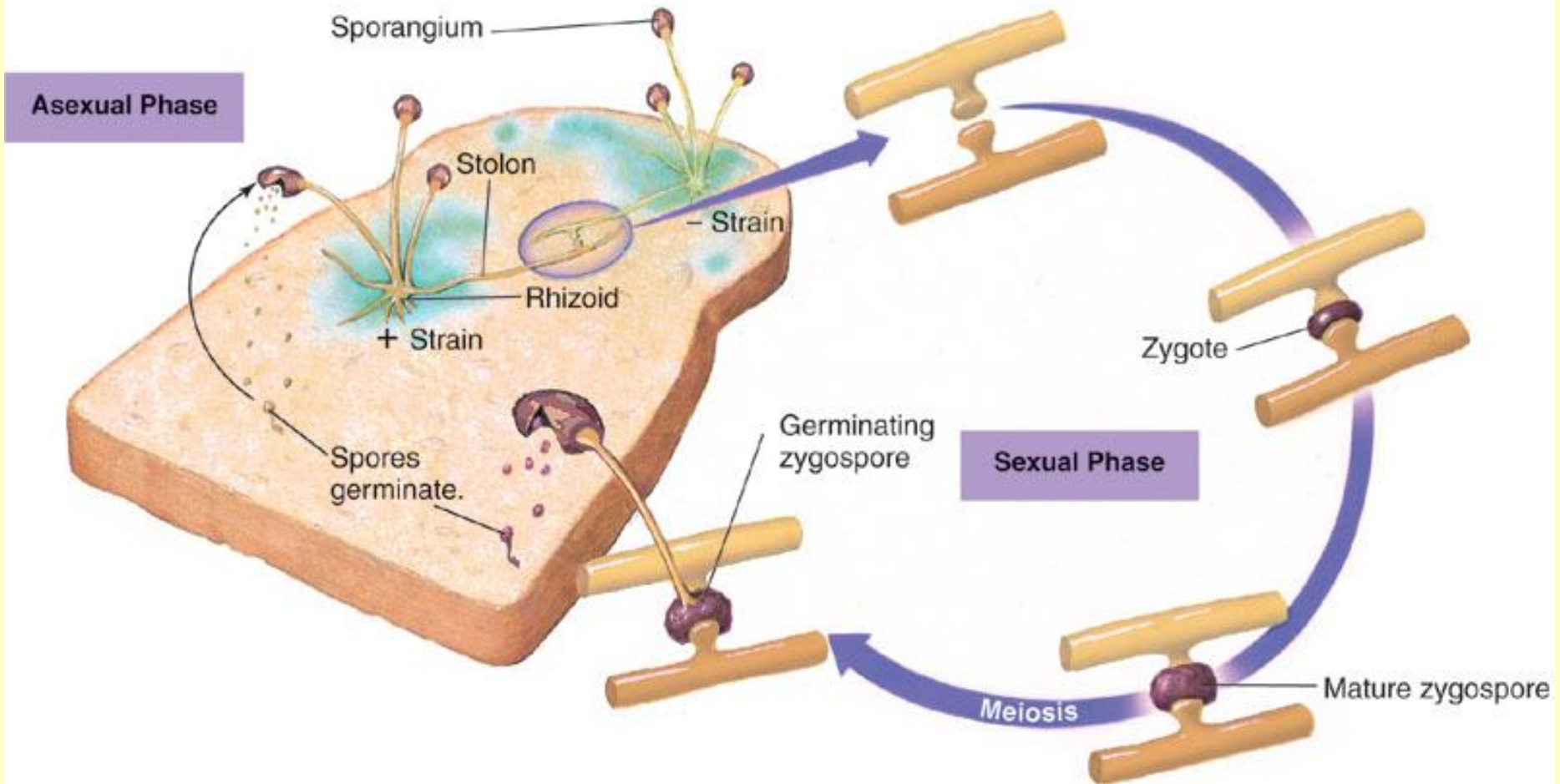
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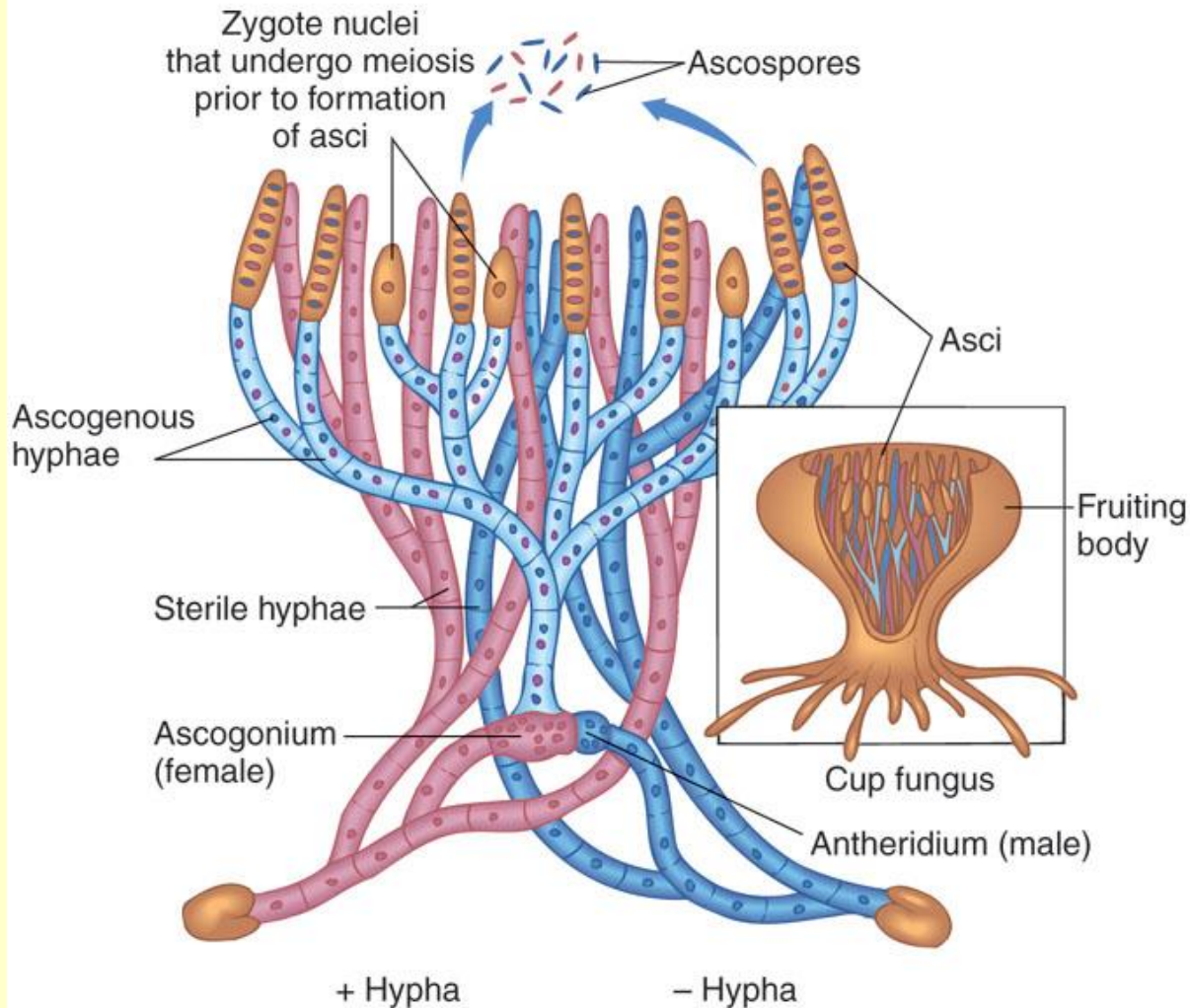
# I. Zygosporangia

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# II. Ascospores

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# Roles of fungi

- decomposers of dead plants and animals
- sources of antibiotics
- used in making foods & in genetic studies
- adverse impact – food spoilage, mycoses, toxin production

# Kingdom Protista

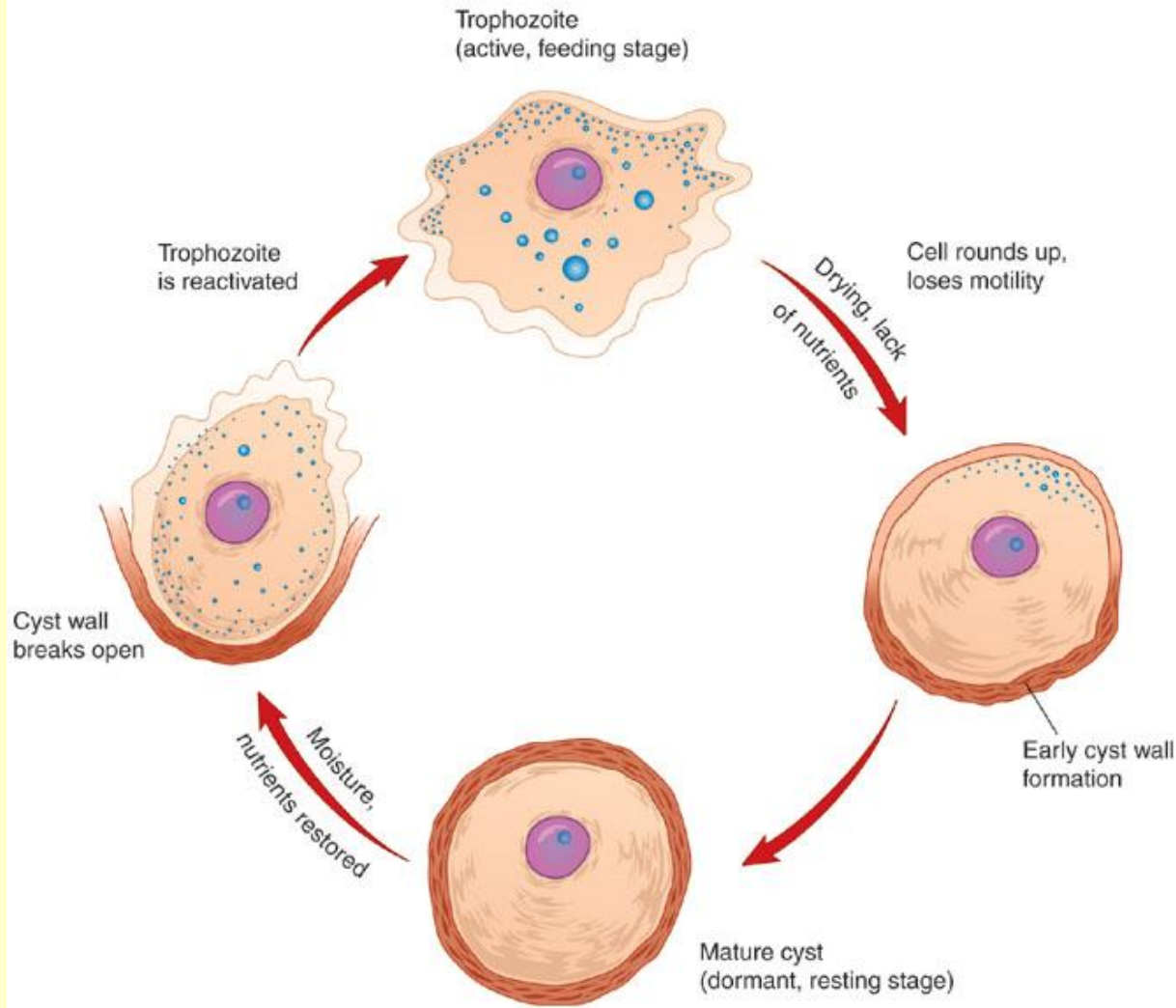
- algae
- protozoa

# Protozoa

- 65,000 species
- most are unicellular, colonies are rare
- most have locomoter structures – **flagella, cilia, or pseudopods**
- vary in shape
- lack a cell wall & chloroplasts
- can exist in **trophozoite**- motile feeding stage or **cyst** – a dormant resistant stage

# Protozoa

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# Protozoa

- all are heterotrophic,
- most are free-living in a moist habitat
- feed by engulfing other microbes & organic matter
- some are animal parasites & can be spread by insect vectors
- asexual and sexual reproduction

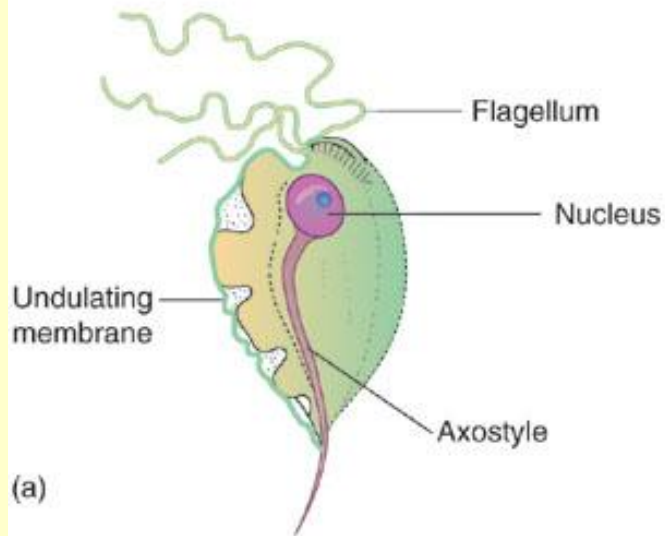


# Groups based on locomotion & reproduction

- Mastigophora – flagellates
- Sarcodina – amebas
- Ciliophora – ciliates

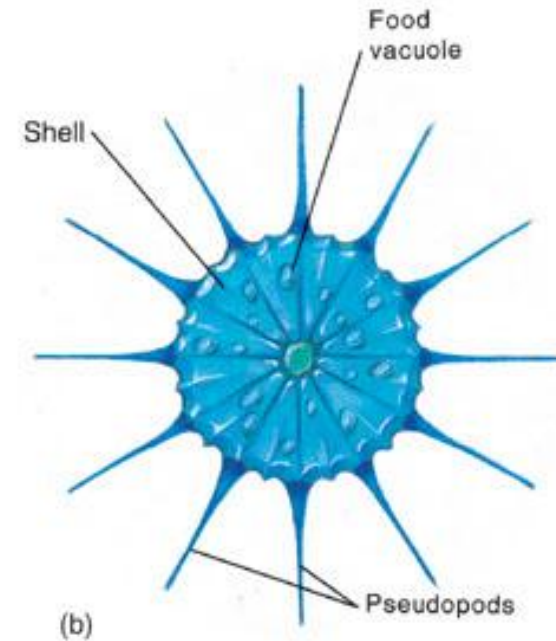
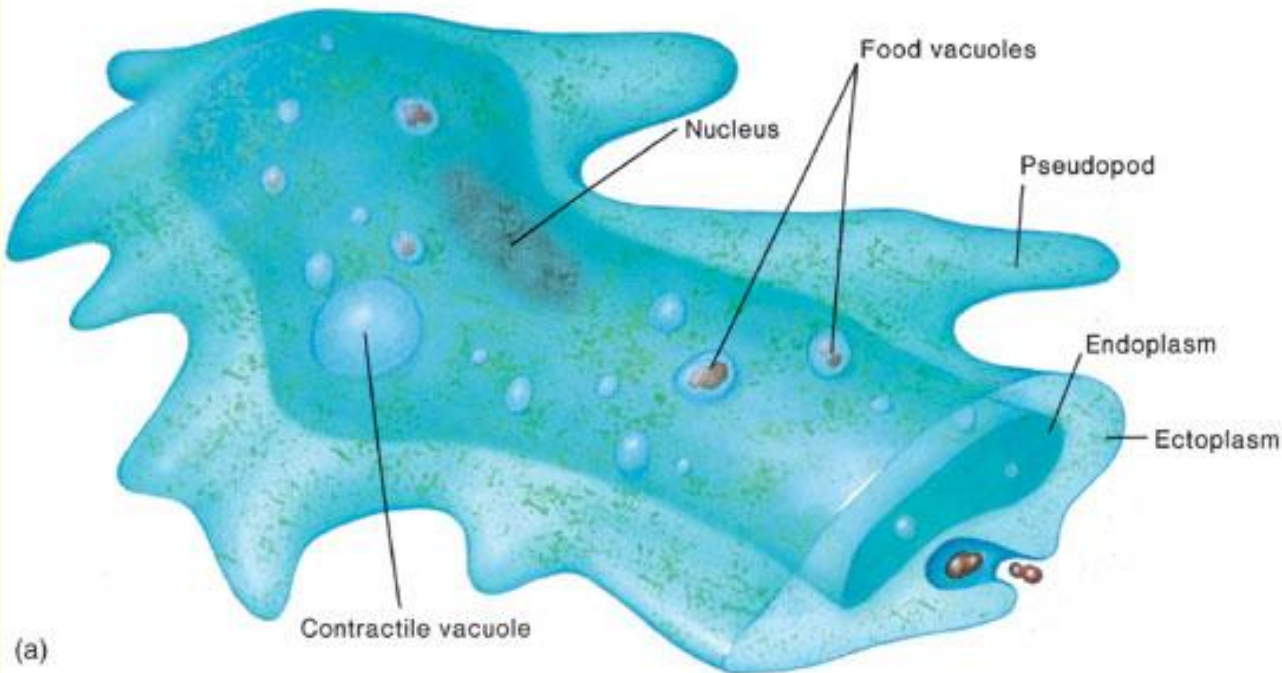
# Mastigophora – flagellates

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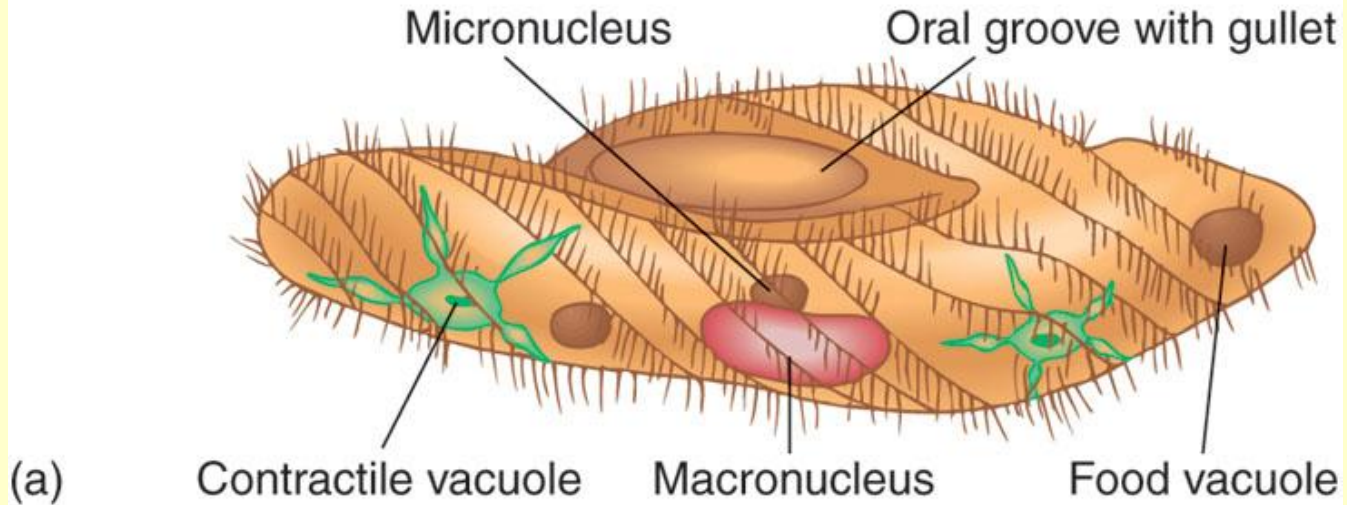
# Sarcodina – amebas

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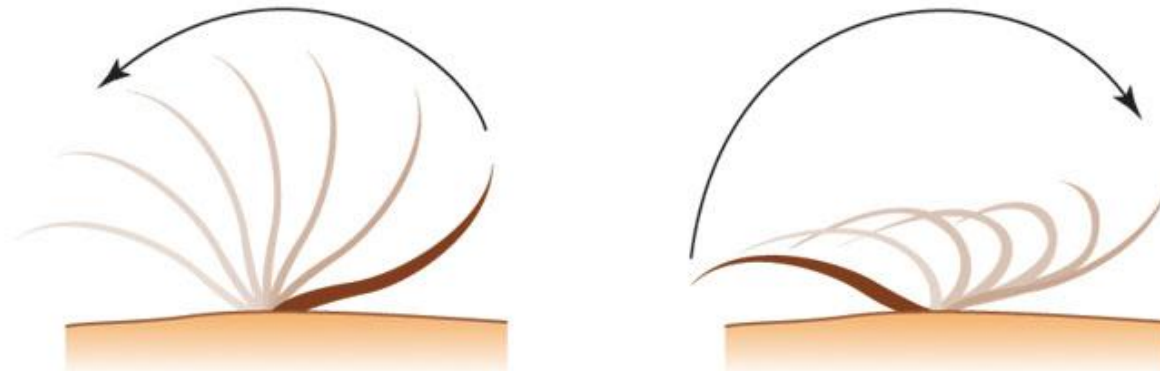


# Ciliophora – ciliates

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(a)



(b)

Power stroke

Recovery stroke

# Parasitic Helminths

- multicellular animals, organs for reproduction, digestion, movement, protection
- parasitize host tissues
- have mouthparts for attachment to or digestion of host tissues
- most have well-developed sex organs that produce eggs and sperm.
- fertilized eggs go through larval period in or out of host body

# Major groups of helminths

1. flatworms – flat, no definite body cavity; digestive tract a blind pouch; simple excretory & nervous systems
  - **cestodes** (tapeworms)
  - **trematodes** or flukes, are flattened , nonsegmented worms with sucking mouthparts
2. roundworms (**nematodes**)- round, a complete digestive tract, a protective surface cuticle, spines & hooks on mouth; excretory & nervous systems poorly developed

# Helminths

- 50 species parasitize humans
- acquired through ingestion of larvae or eggs in food; from soil or water; some are carried by insect vectors
- afflict billions of humans

