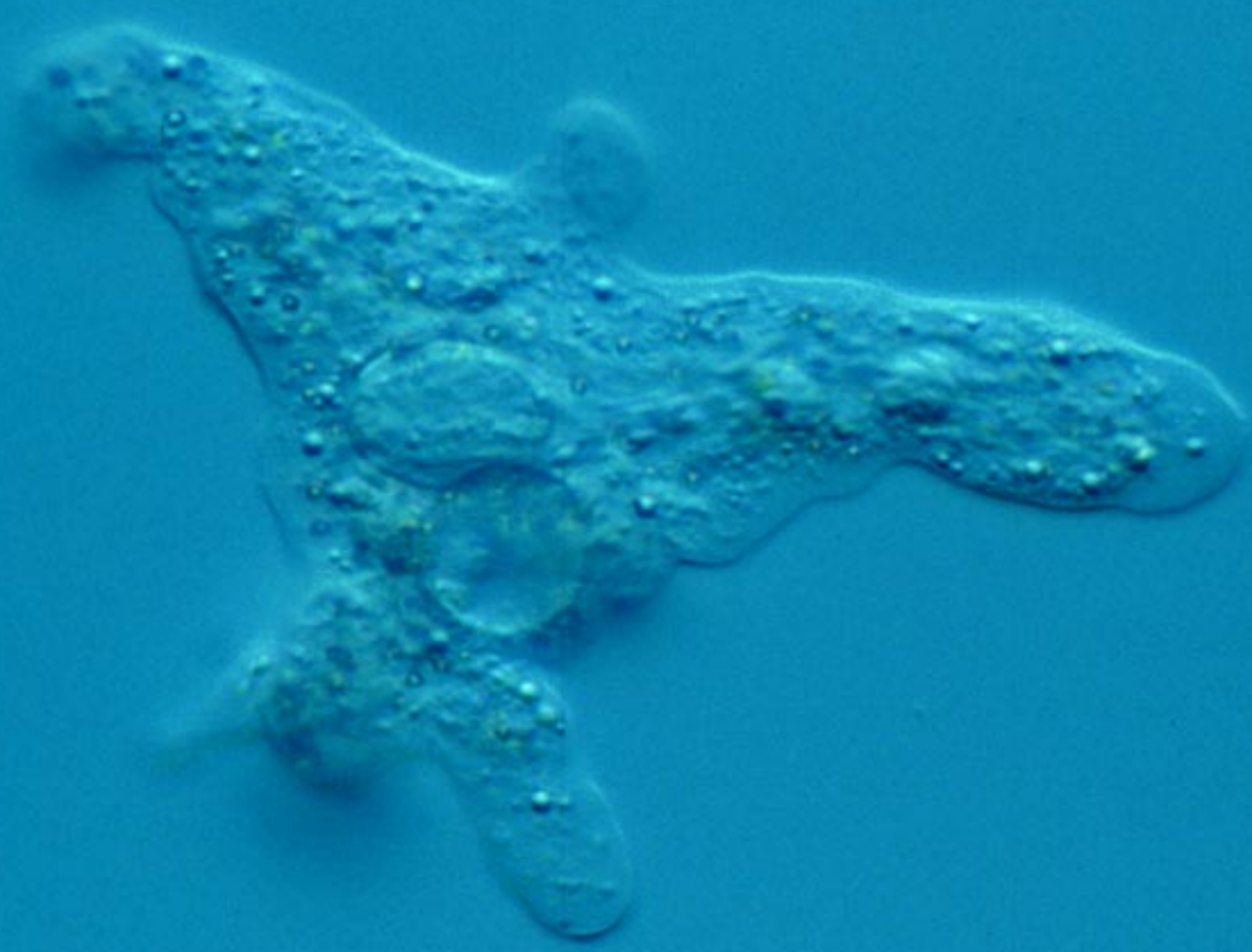


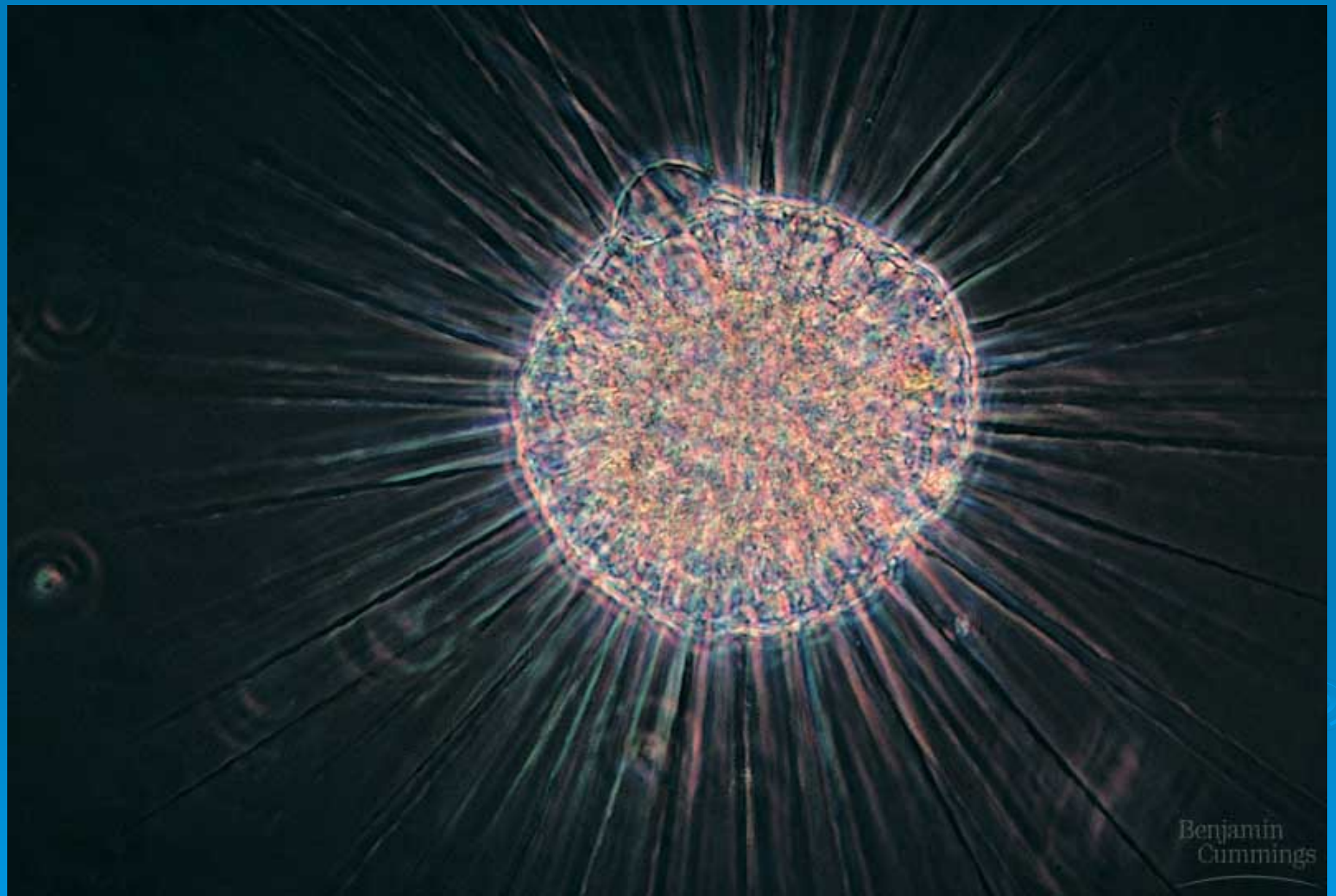
Kingdom Protista

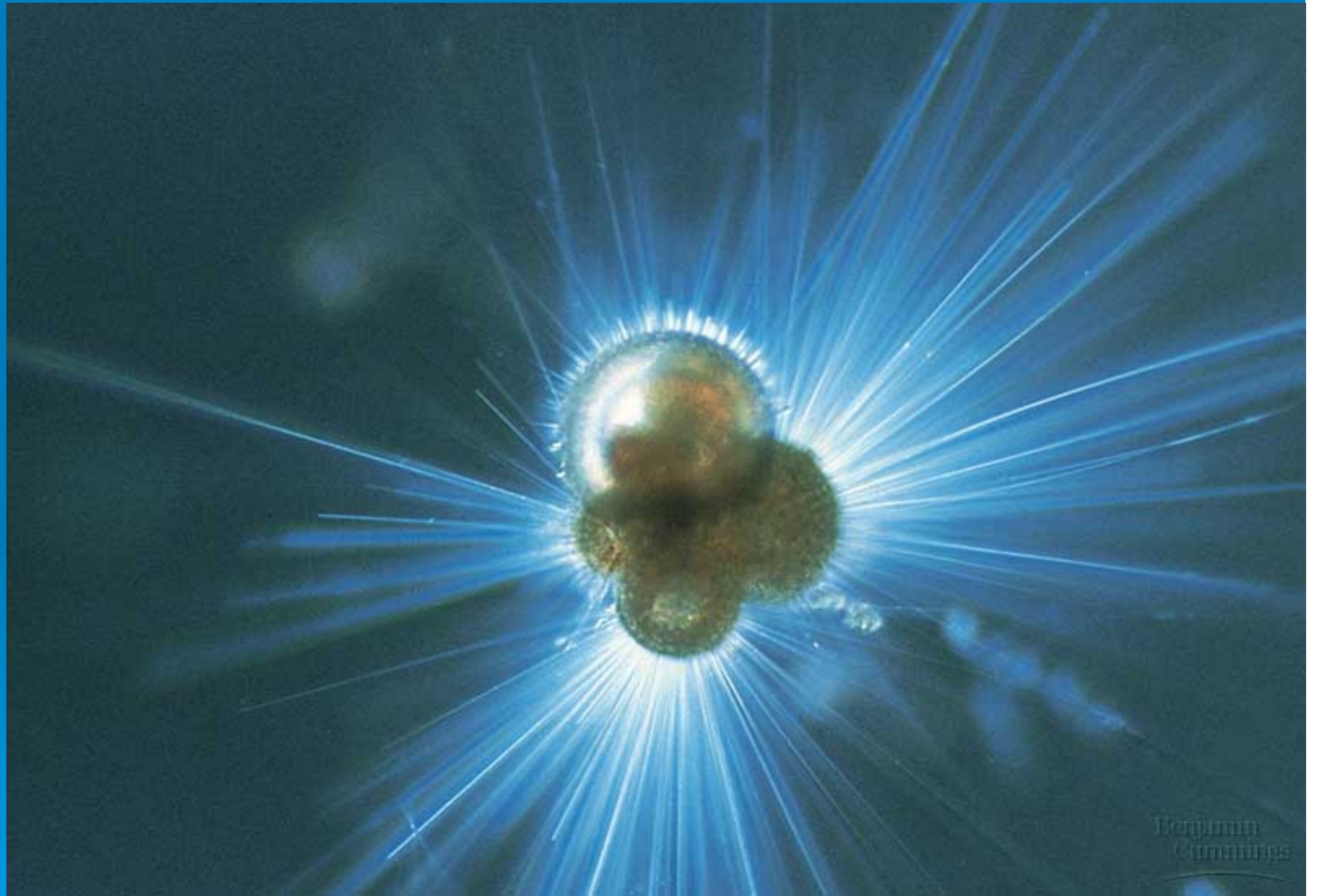
“The Catch All Kingdom”

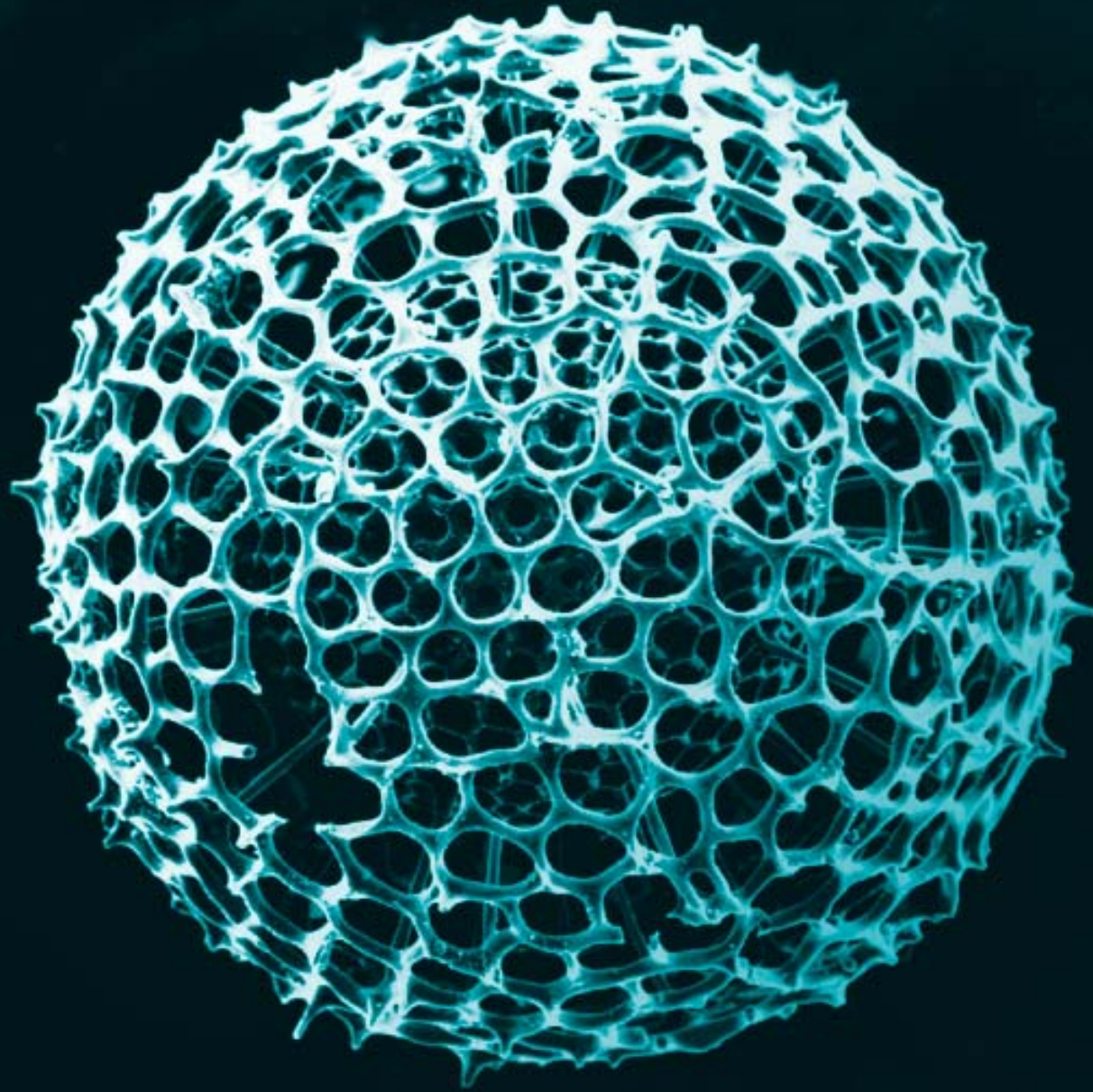


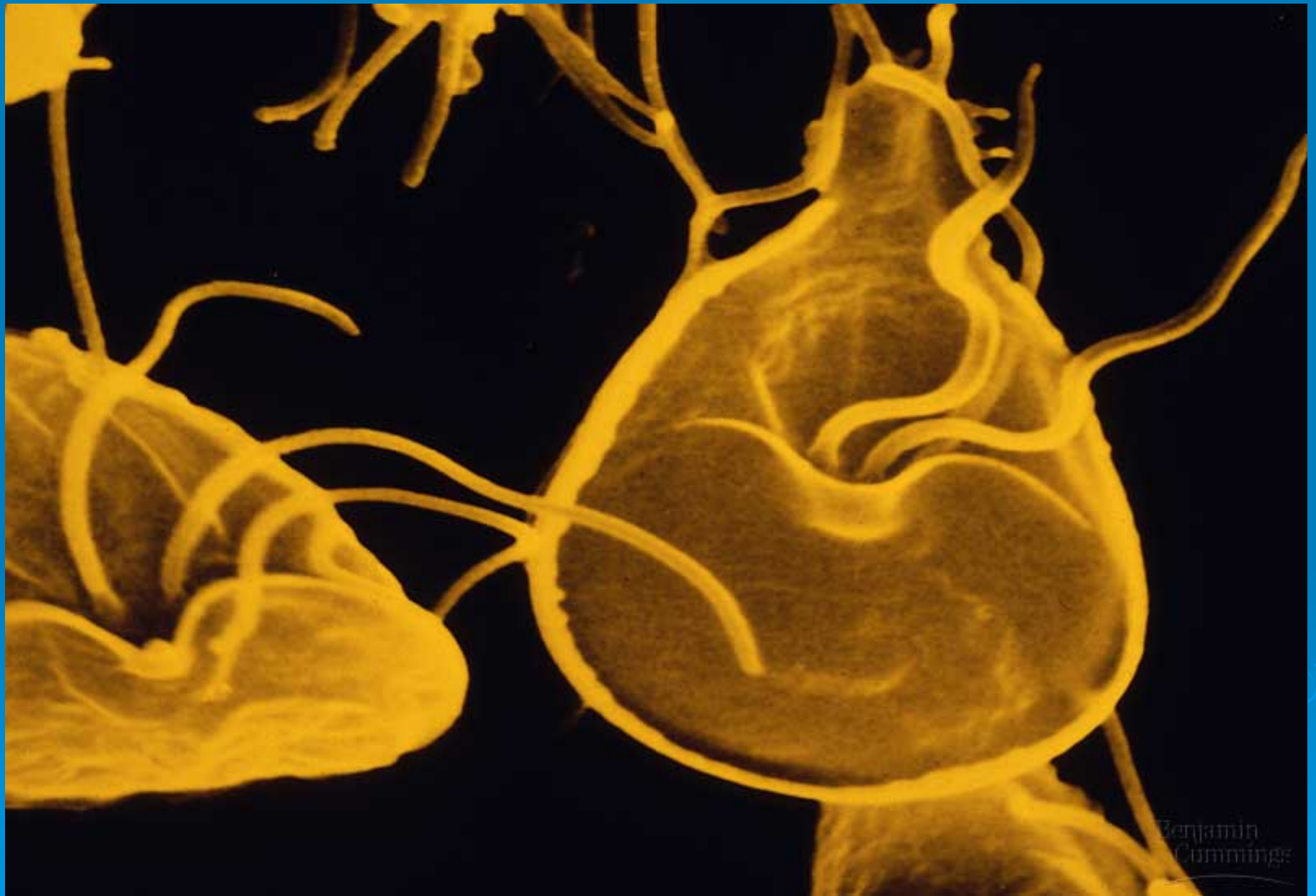


Benjamin
Cummings









Protist Diversity

- 200,000 species come in different shapes, sizes, and colors
- All are **eukaryotes** - have a nucleus and membrane-bound organelles

Evolution of Protista

- Prokaryotes – 3.5 billion years ago
- Eukaryotes – 1.5 billion years ago
- Protozoan thought to be descendents of first eukaryotes
- Endosymbiotic Theory

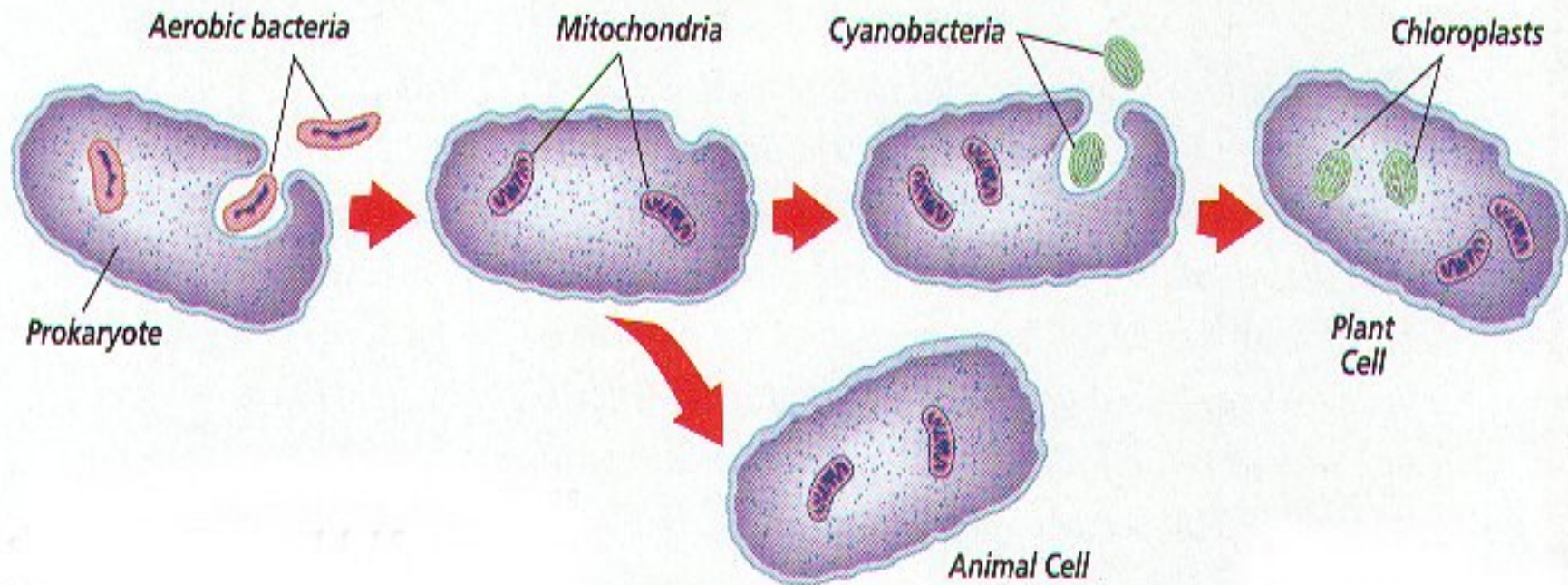
Endosymbiotic Theory

A A prokaryote ingested some aerobic bacteria. The aerobes were protected and produced energy for the prokaryote.

B Over a long time, the aerobes become mitochondria, no longer able to live on their own.

C Some primitive prokaryotes also ingested cyanobacteria, which contain photosynthetic pigments.

D The cyanobacteria become chloroplasts, no longer able to live on their own.



- The **endosymbiotic theory** concerns the origins of mitochondria and plastids (e.g. chloroplasts), which are organelles of eukaryotic cells.
- According to this theory, these organelles originated as separate prokaryotic organisms that were taken inside the cell as endosymbionts.
- Mitochondria developed from proteobacteria (in particular, Rickettsiales or close relatives) and chloroplasts from cyanobacteria.

Protists

The world of Protists:

Animal-like Protists (Protozoans)

Plant-like Protists

Fungus-like Protists

Protists

The world of Protists:

Animal-like Protists (Protozoans)

Plant-like Protists (Algae)

Fungus-like Protists

Protozoans

Animal-like Protists



Characteristics of Protozoans

- Single celled
- Microscopic
- Move independently – named for mechanism of movement
- 65,000 species
- Most heterotrophic
- Free-living or parasitic
- All capable of asexual reproduction through binary or multiple fission
- Some reproduce sexually through conjugation

Protozoans

- **Unicellular** - made up of one cell
- **Heterotrophs** - they eat other organisms or dead organic matter
- Classified by how they move

Phyla of Protozoans

Amoebas

Flagellates

Ciliates

Sporozoans

Classification

- Currently based on HOW they MOVE
- Reviewing this by looking at phylogeny

4 Phyla of Protozoans

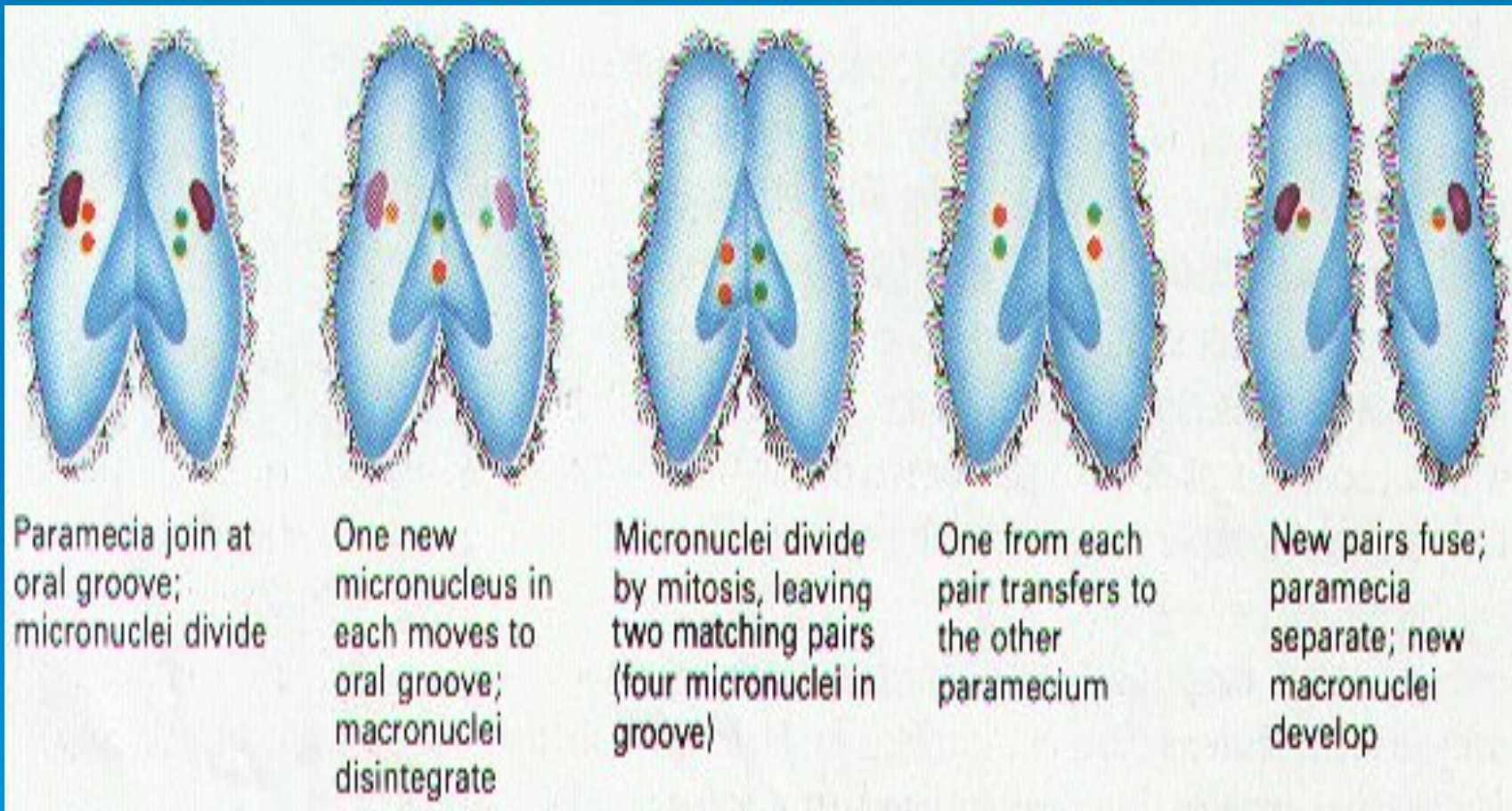
- Sarcodina (Amoebas)
- Ciliophora (Paramecium)
- Zoomastigina (*Trypanosoma*)
- Sporozoa ()



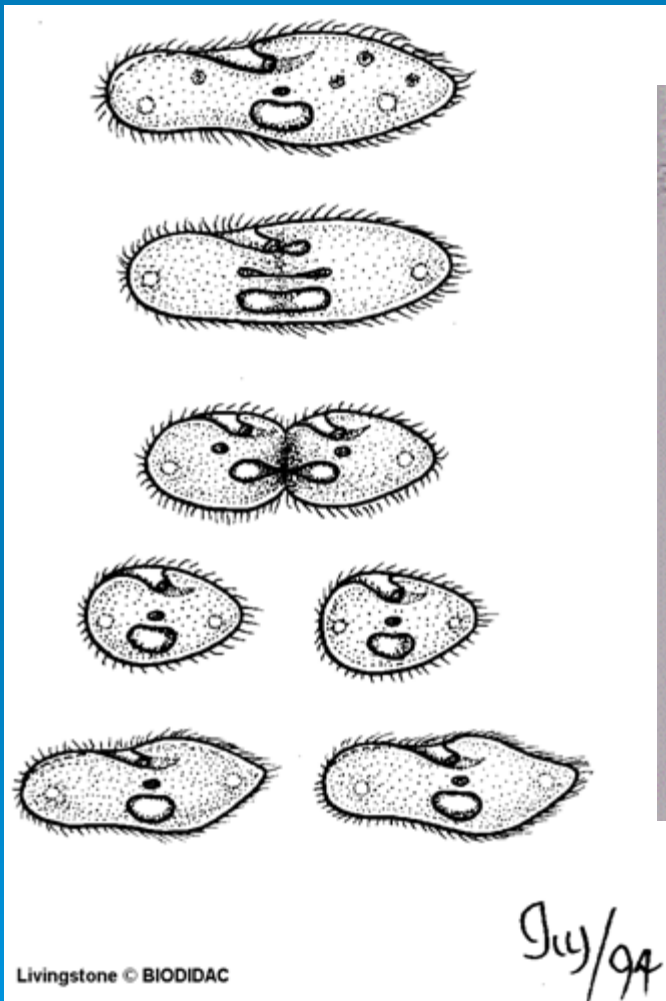
Adaptations

- Physiological mechanisms, like eyespots
- Form cysts
- Multiple nuclei

Sexual reproduction



Asexual reproduction



Schizogony

- Asexual reproduction in multiple fission, as in Malaria

Phylums...



Sarcodina

- 40,000 species
- Amoebas
- Pseudopodia – most move
- Cytoplasmic streaming
- Eat other protists
- Ecological roles:

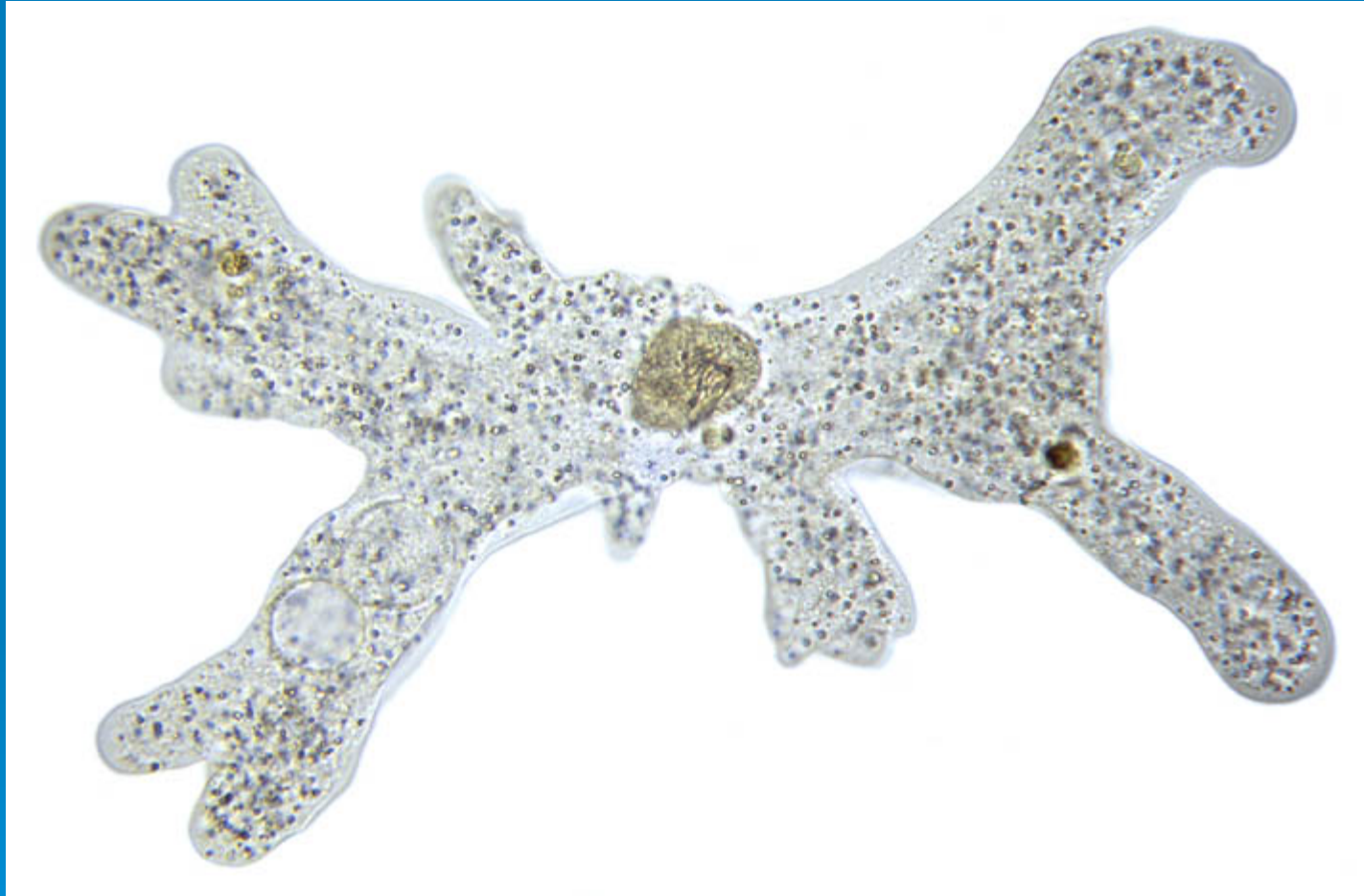
forams – tests made from CaCO_3 – sink to bottom and make limestone and chalk deposits

Radiolaria – tests made from SiO_2

- Cause diseases like amoebic dysentery

Amoebas: the blobs

- No cell wall
- Move using **pseudopods** - plasma extensions
- Engulf bits of food by flowing around and over them



Phylum Ciliophora

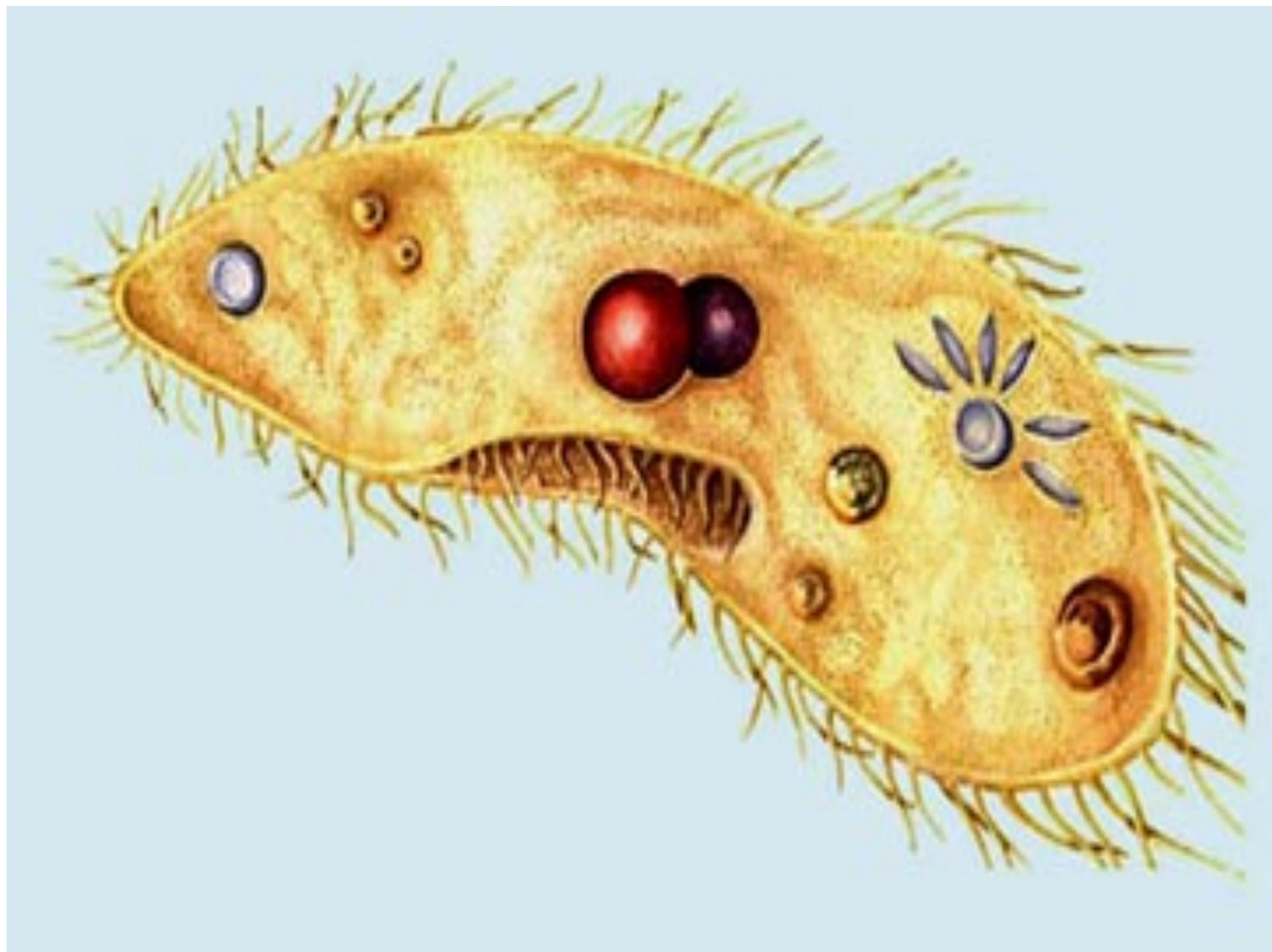
- 8,000 species
- Move using cilia
- Pellicle, oral groove, gullet, macronucleus, micronucleus
- Paramecium



Ciliates: the hairy ones

- Move beating tiny hairs called **cilia**









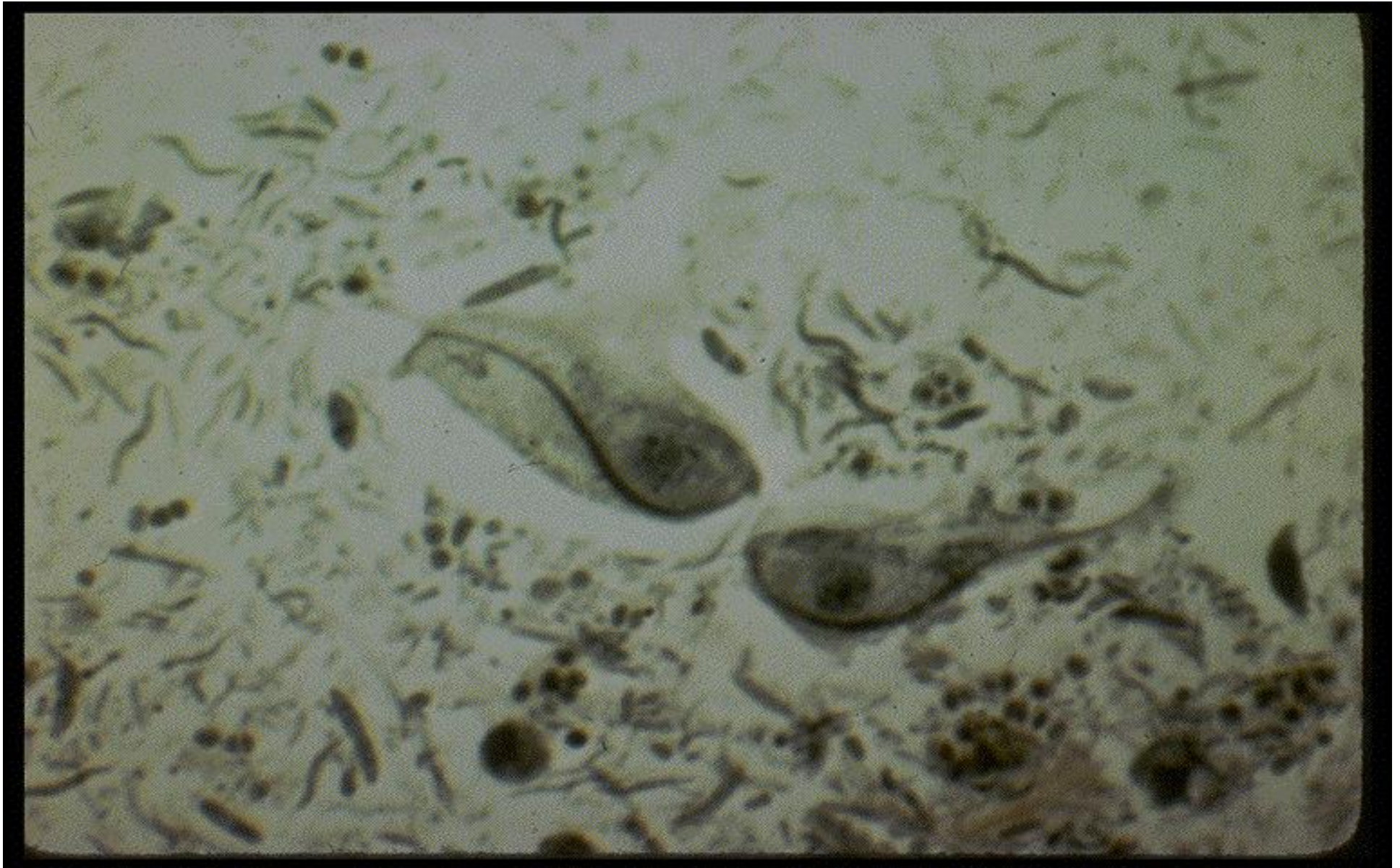
Phylum Zoomastigina

- 2,500 species
- Move using flagella
- Most free-living
- Cause disease – zooflagellates
- African trypanosomiasis – sleeping sickness – tsetse fly
- Chagas Disease – kissing bug
- Leishmaniasis – sand fly
- giardiasis

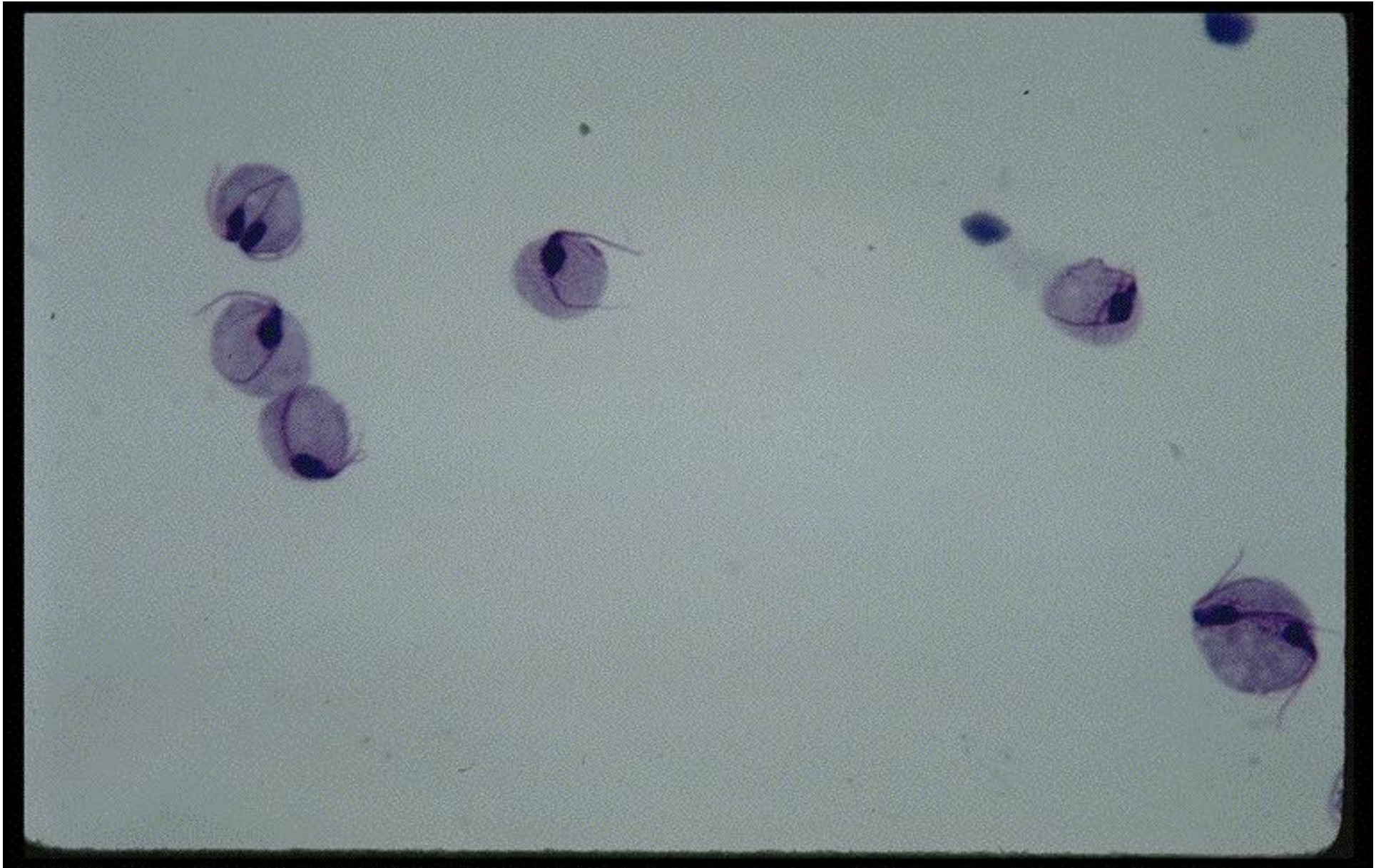
Flagellates: the motorboats

- Use a whip-like extension called a **flagella** to move
- Some cause diseases





➤ *Trichomonas foetus* : cow disease



➤ *Trichomonas vaginalis*: an STD

Giardia is contracted from
contaminated water



The tsetse fly – sleeping sickness vector



The Kissing Bug



Leishmaniasis



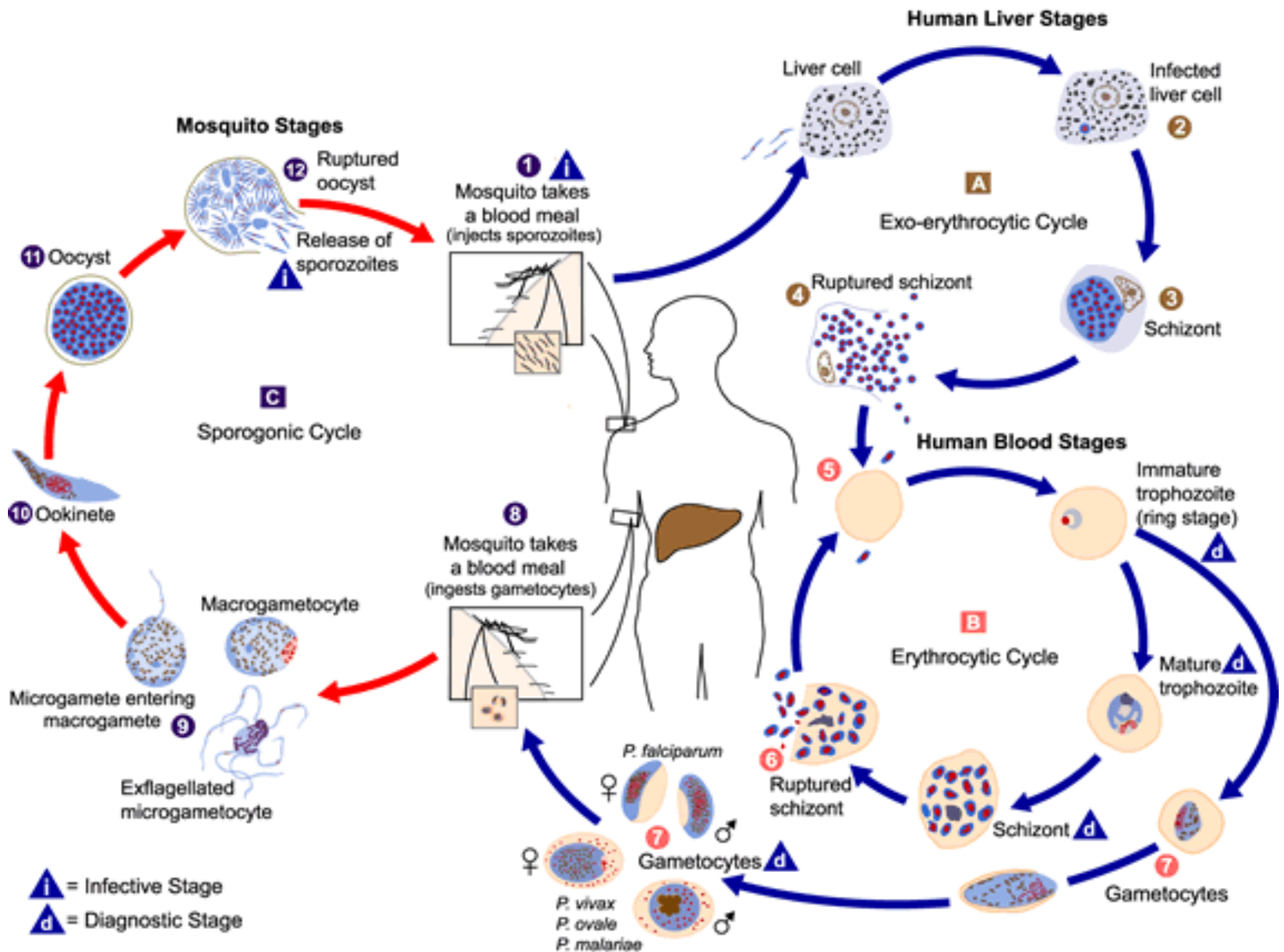
Phylum Sporozoa

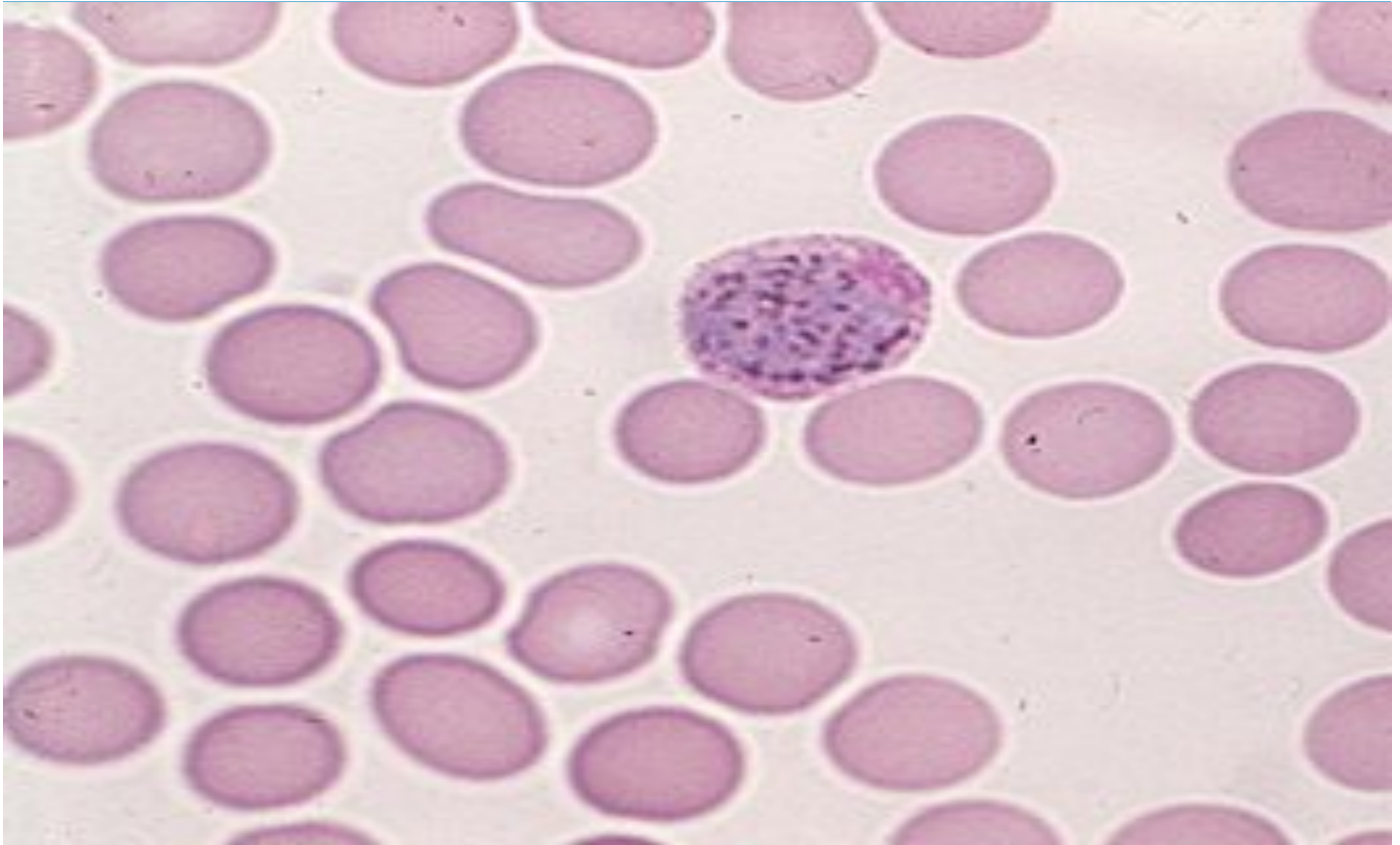
- 6,000 species
- Carried in blood
- Cause disease like toxoplasmosis and malaria
- Know malaria cycle!!!!



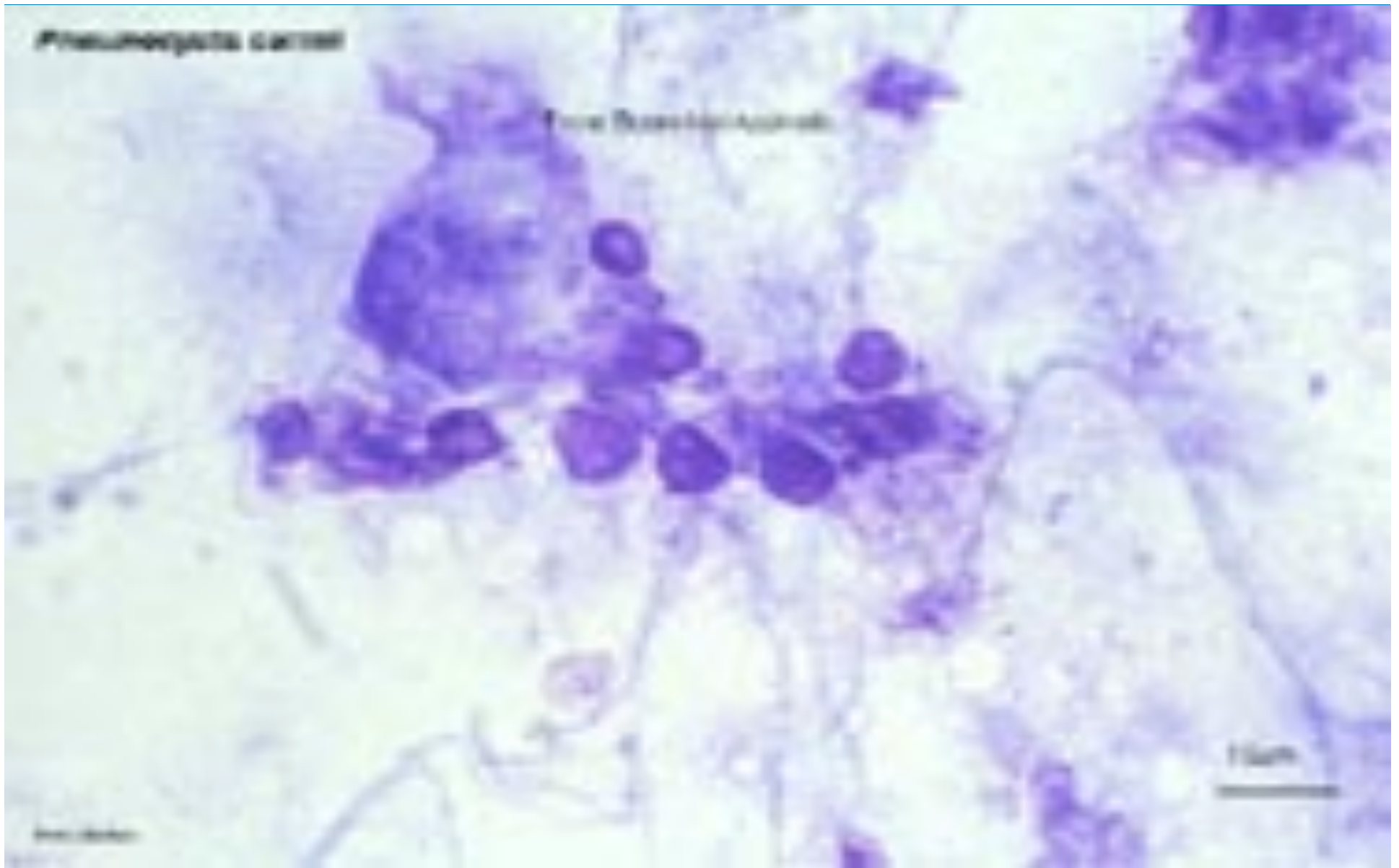
Sporozoans: the parasite

- Non-motile - Do not move
- Live inside a host
- One type causes malaria





➤ Malaria in red blood cells



➤ Pneumonia in aids patients

Trypanosoma causes African sleeping sickness



Algae

Plantlike Protists



What are Algae?

- **Multicellular** - made of more than one cell
- **Photosynthetic** - make their own food
- No roots, stems, or leaves
- Each has **chlorophyll** and other **photosynthetic pigments**

Characteristics of Algae

- Autotrophic
- Not plants – why?
- Often contain pyrenoids

centers of carbon dioxide fixation
within the chloroplasts of algae and
hornworts.

Pyrenoids are not membrane-bound

Structure of Algae

- Thallus or body
- Unicellular or multicellular
- Colonial: Volvox
- Filamentous: Spirogyra
- Multicellular: Ulva
- Asexual and sexual reproduction

Phyla of Algae

Euglenoids (Phylum Euglenophyta)

Diatoms (Phylum Bacillariophyta)

Dinoflagellates (Phylum Dinoflagellata)

Red Algae (Phylum Rhodophyta)

Brown Algae (Phylum Phaeophyta)

Green Algae (Phylum Chlorophyta)

Golden Algae (Phylum Chrysophyta)

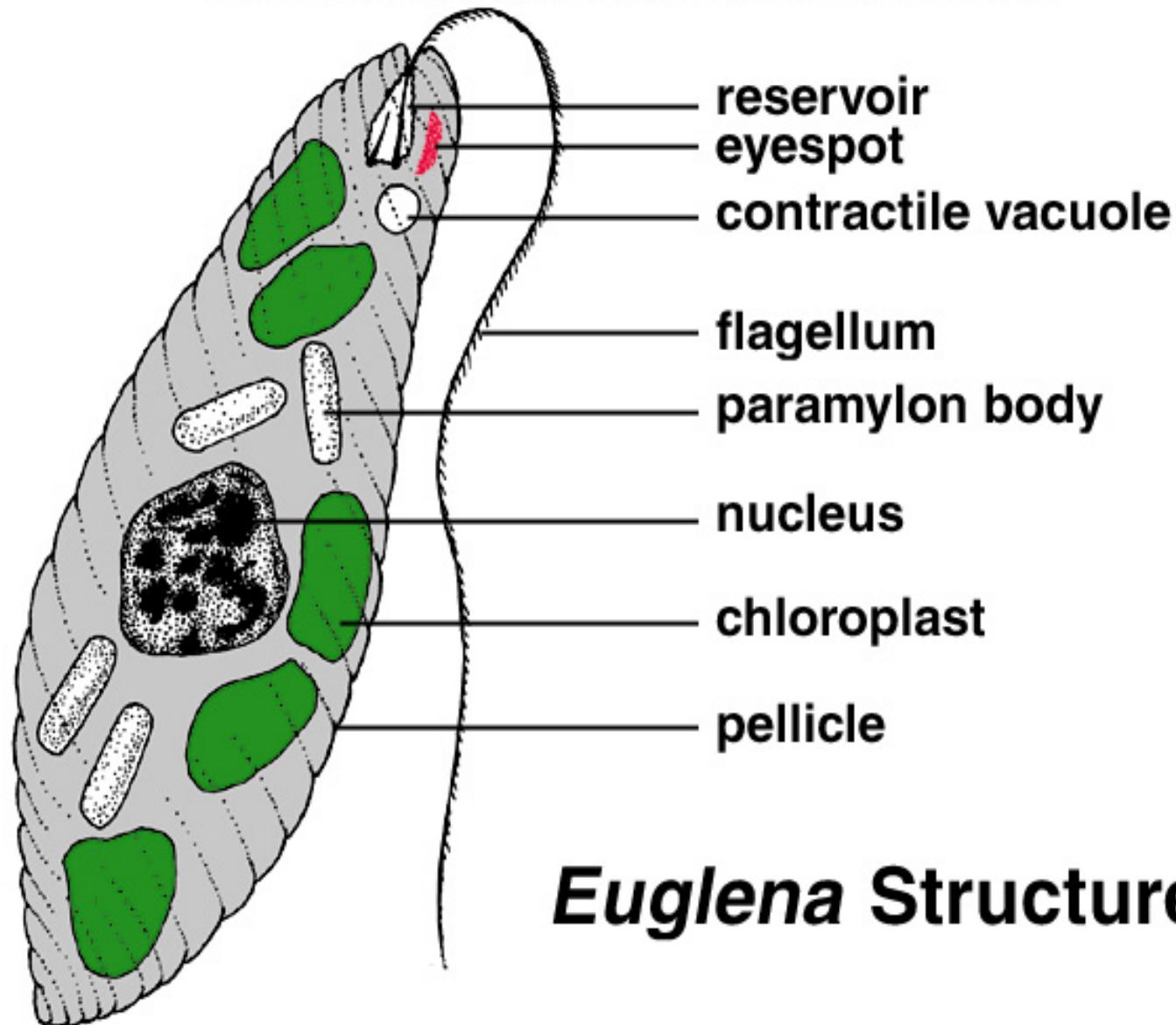
Euglenoids: The Survivors

- Aquatic
- Move around like animals
- Can ingest food from surroundings when light is not available
- Mixotrophic

Phylum Euglenophyta

- Euglenoids
- Plant-like and animal-like characteristics
- Many have chlorophyll and are photosynthetic
- No cell wall, motile
- Most live in fresh water





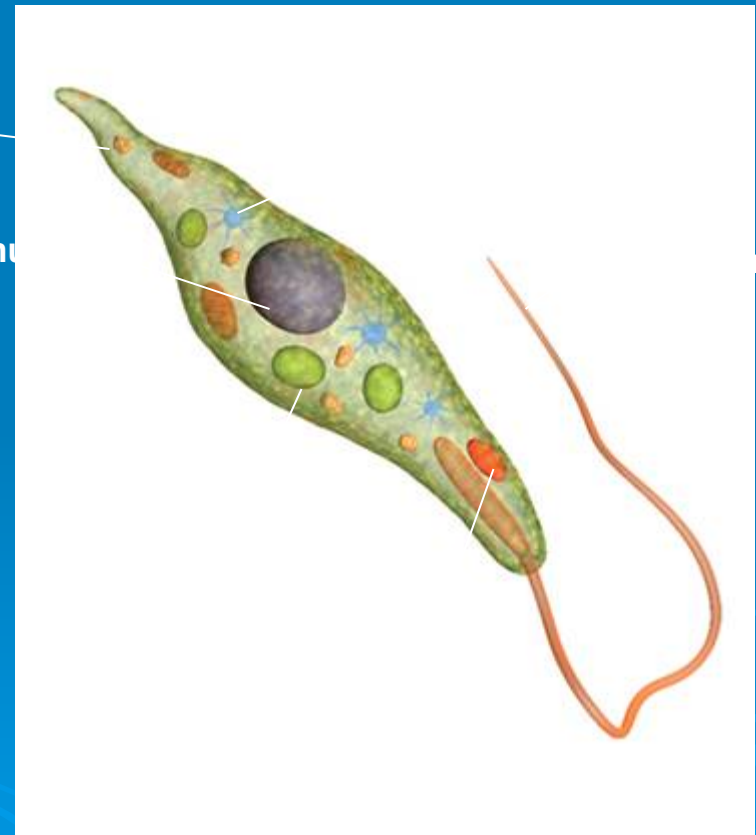
***Euglena* Structure**

A. Euglenoids are a large group of plantlike protists.
mostly photosynthetic, have one or two flagella

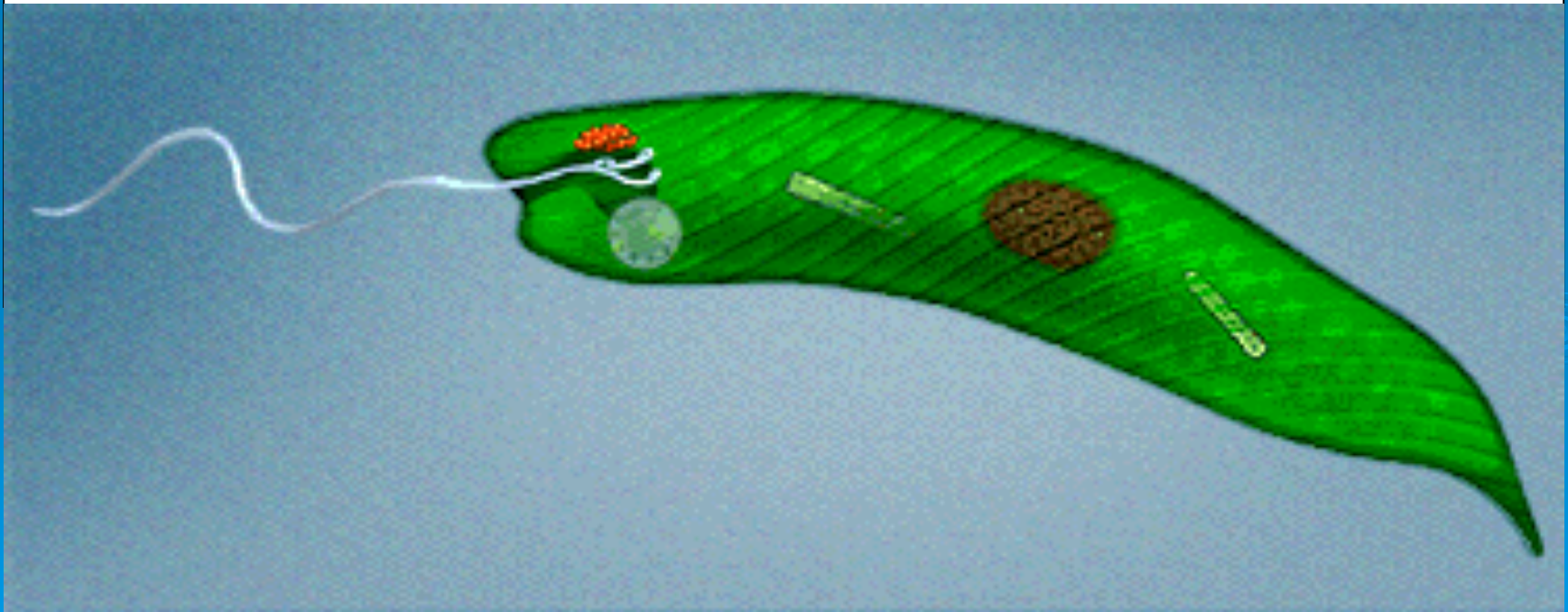


pellicle

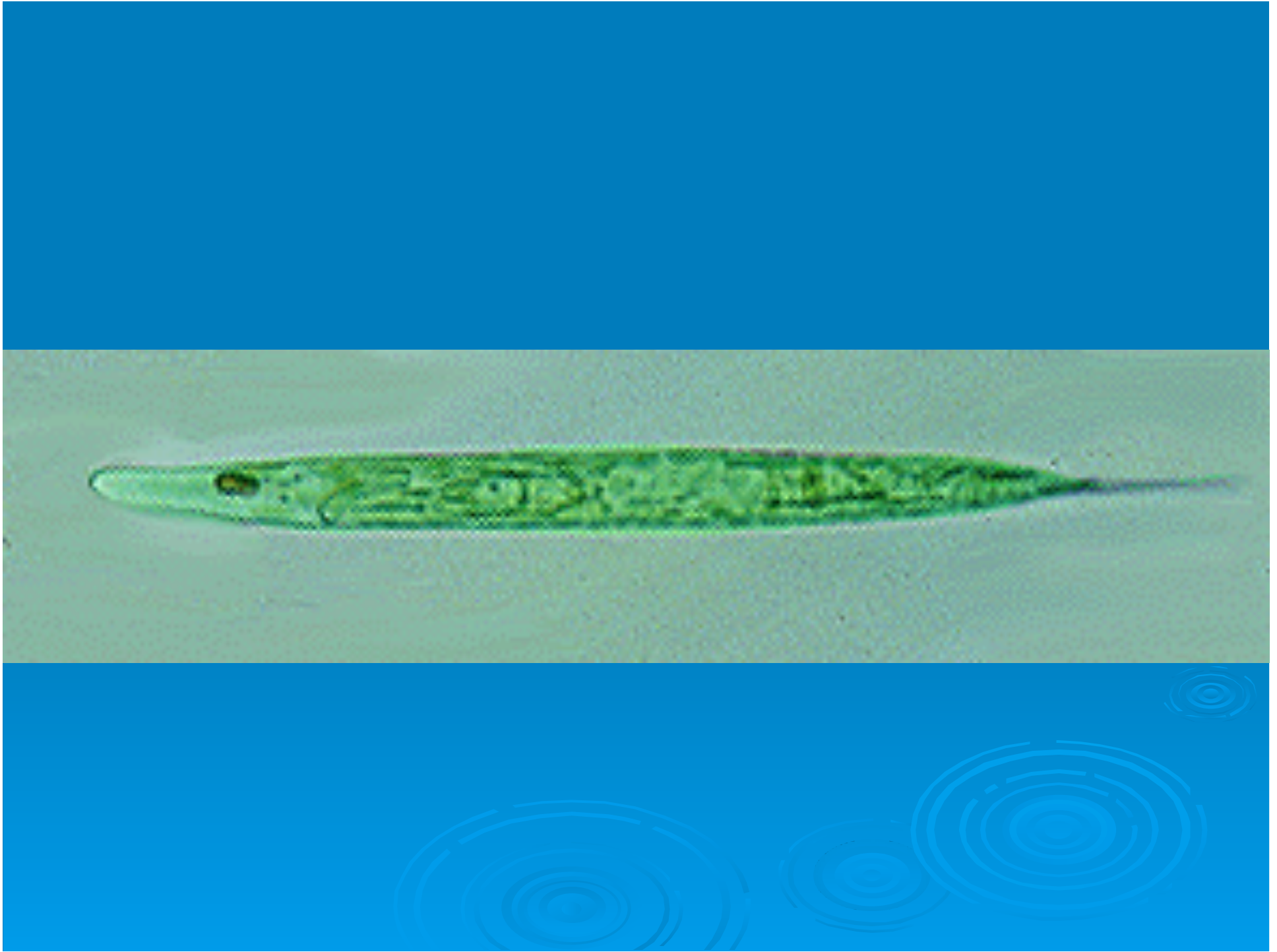
nu



- *Euglena* moves toward the light, which is known as a positive phototropism.
- Has a red eyespot, which is light sensitive







Diatoms: The Golden Ones

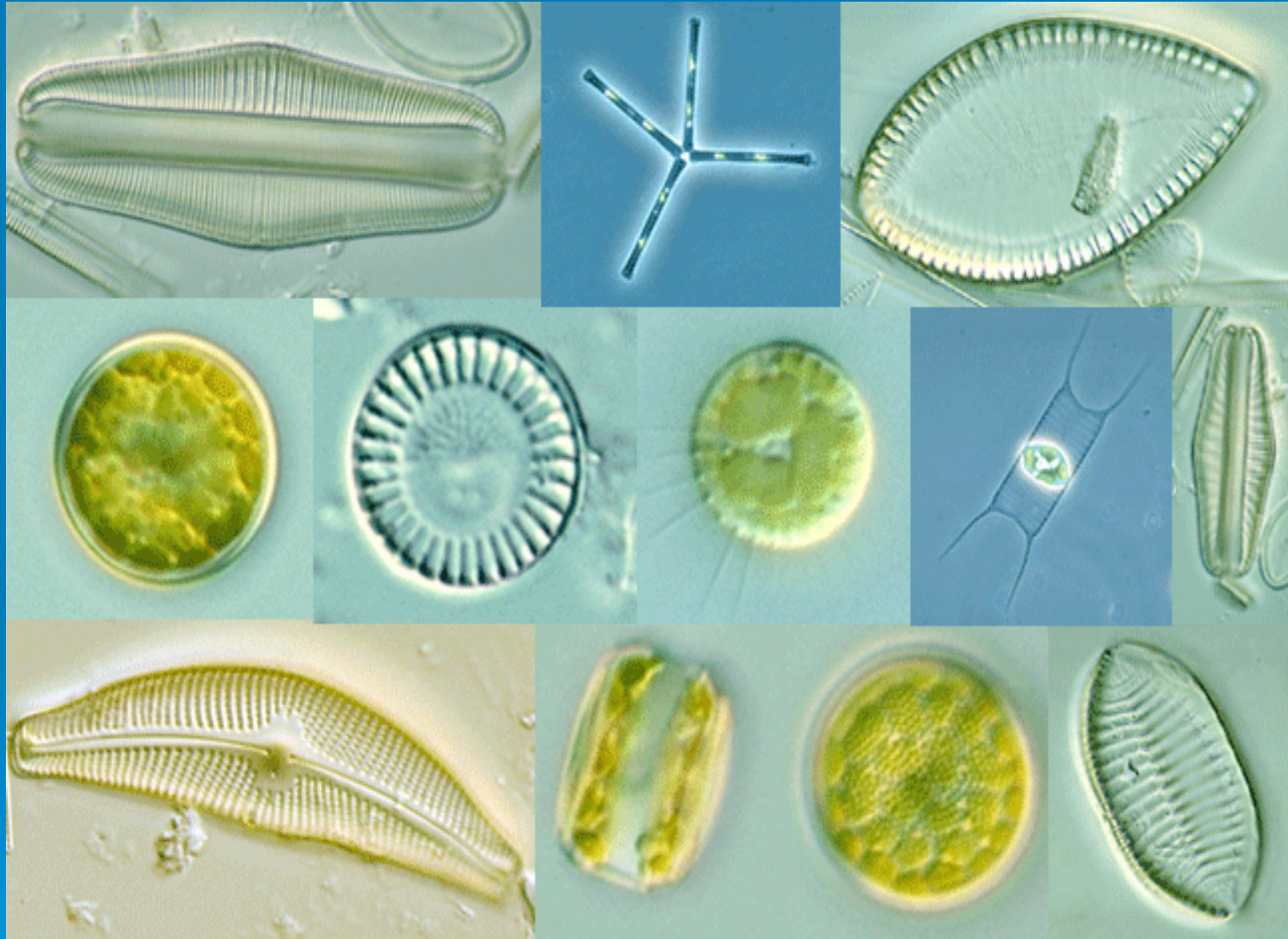
- Have shells made of silica (glass)
- Photosynthetic pigment called **carotenoids** - give them a golden color

Phylum Bacillariophyta

- Diatoms
- Shells fit together like a box with a lid
- Centric and pennate
- Main component of phytoplankton
- Diatomaceous earth
- Paints, reflective thingies

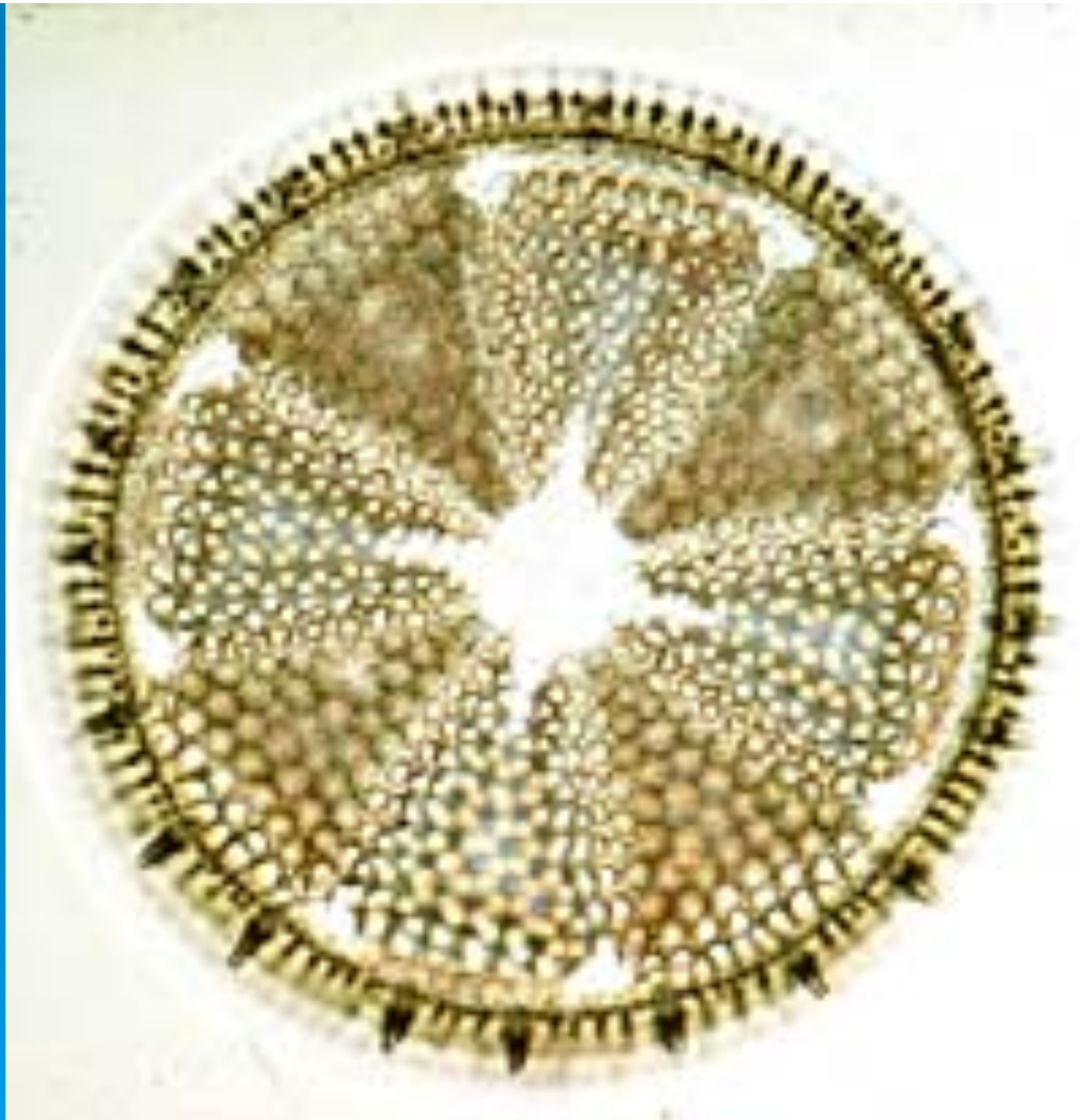


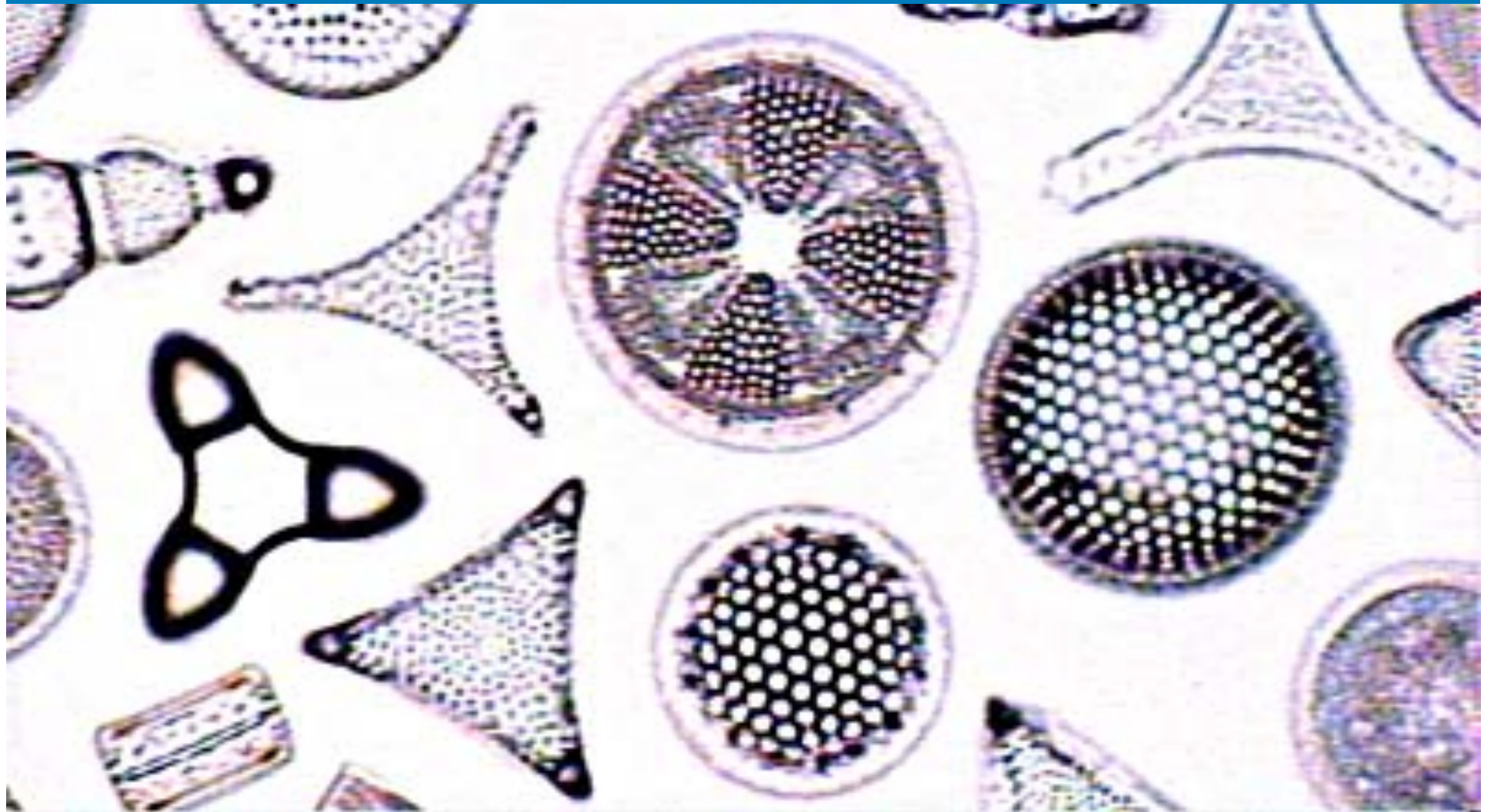
Dams



All after Entwisle et al. (1997)

Plate 1/2





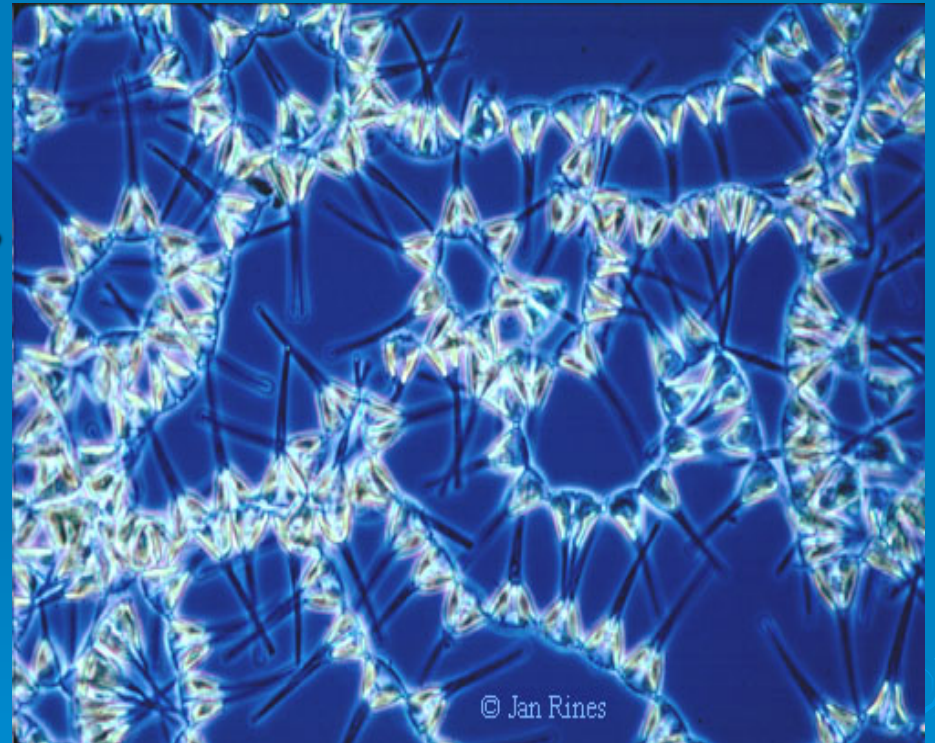
Diatoms are
dominant
members of the
phytoplankton
that can be
caught in a net.



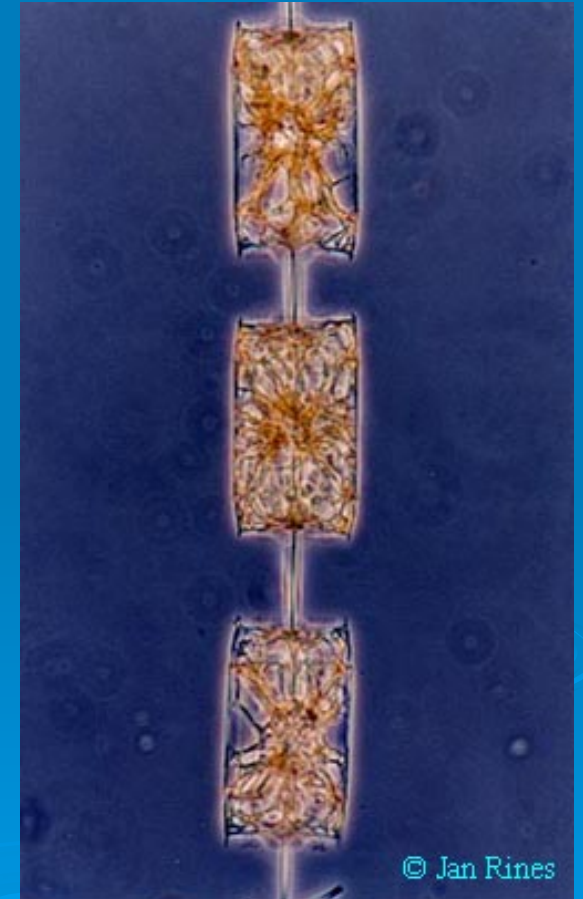
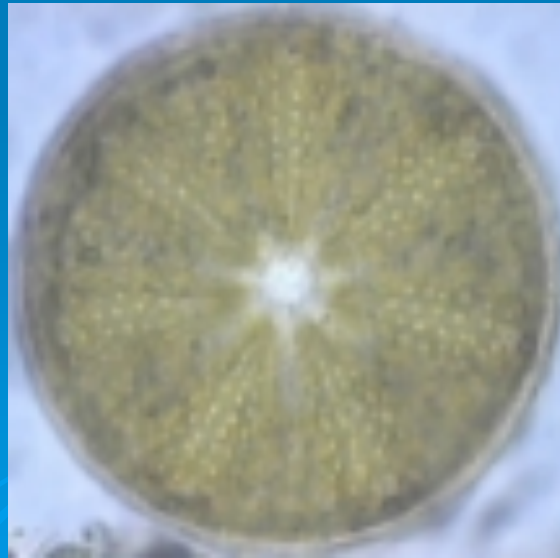
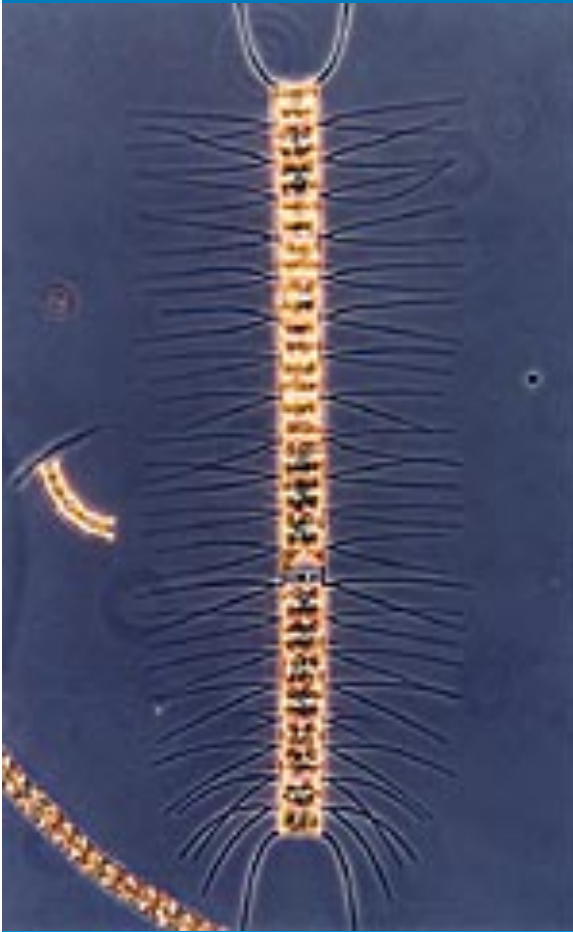
They are
especially
common in
temperate ,
coastal and
polar regions.



They have
sculptured
shells, or
frustules, made
of silica.
Diatoms can
come in a
variety of
shapes.

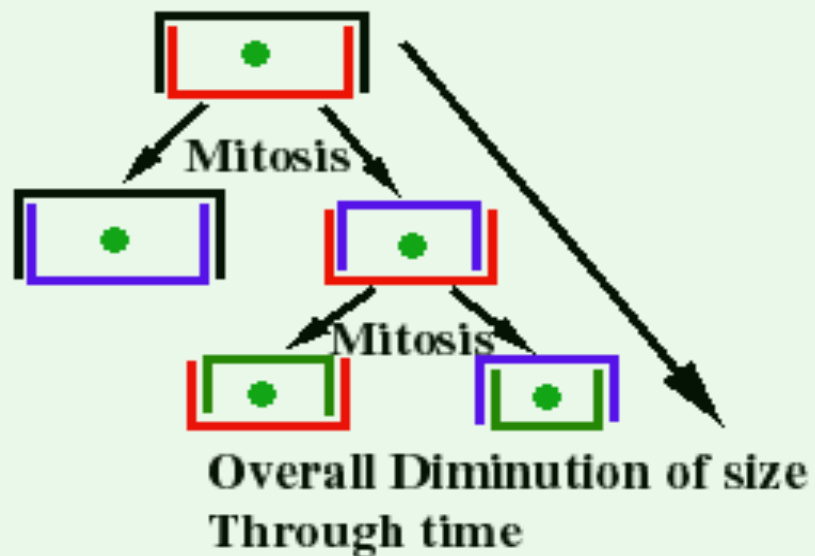


More Diatom Shapes

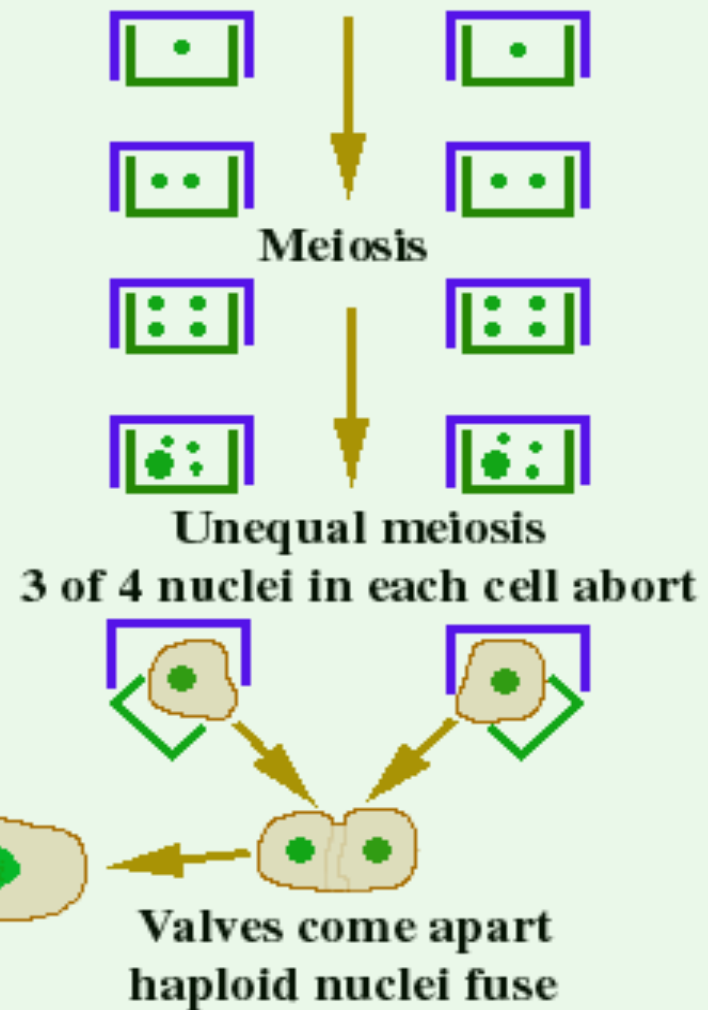


Life Cycle of a Diatom

Asexual Reproduction



Sexual Reproduction



Fish Killer

Some diatoms,
like this one
can kill fish
when found in
large numbers



The glasslike
projections
cause mucus
to build up in
the fish's gill
which can lead
to the fish's
death.



photo by Jan Rines

Dinoflagellates: The Spinning Ones

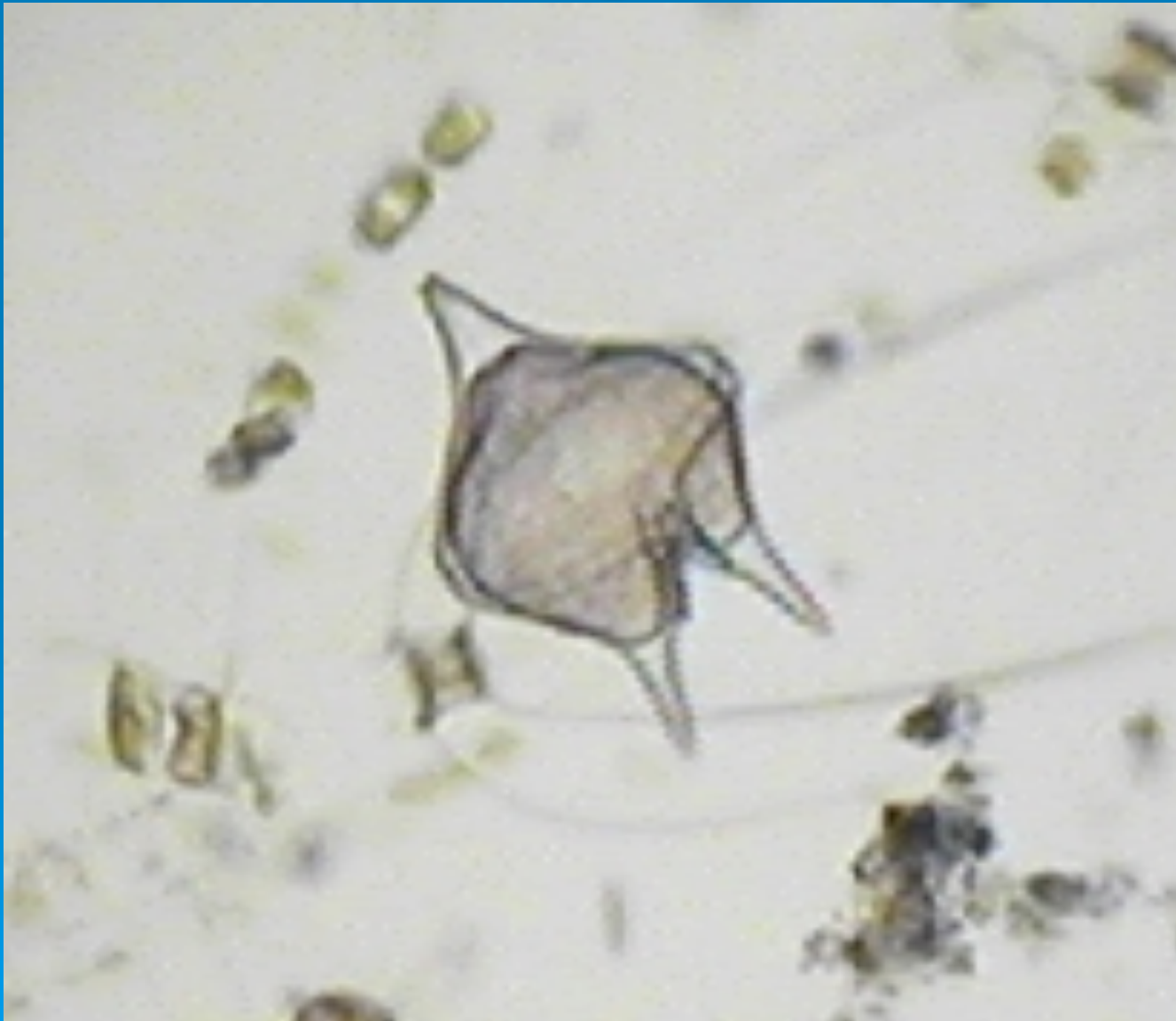
- Spin around using two flagella
- Responsible for Red Tides
- Create toxins that can kill animals and sometimes people

Phylum Dinoflagellata

- Dinoflagellates
- Small, unicellular
- Most photosynthetic
- Some bioluminescent
- Red tide a problem

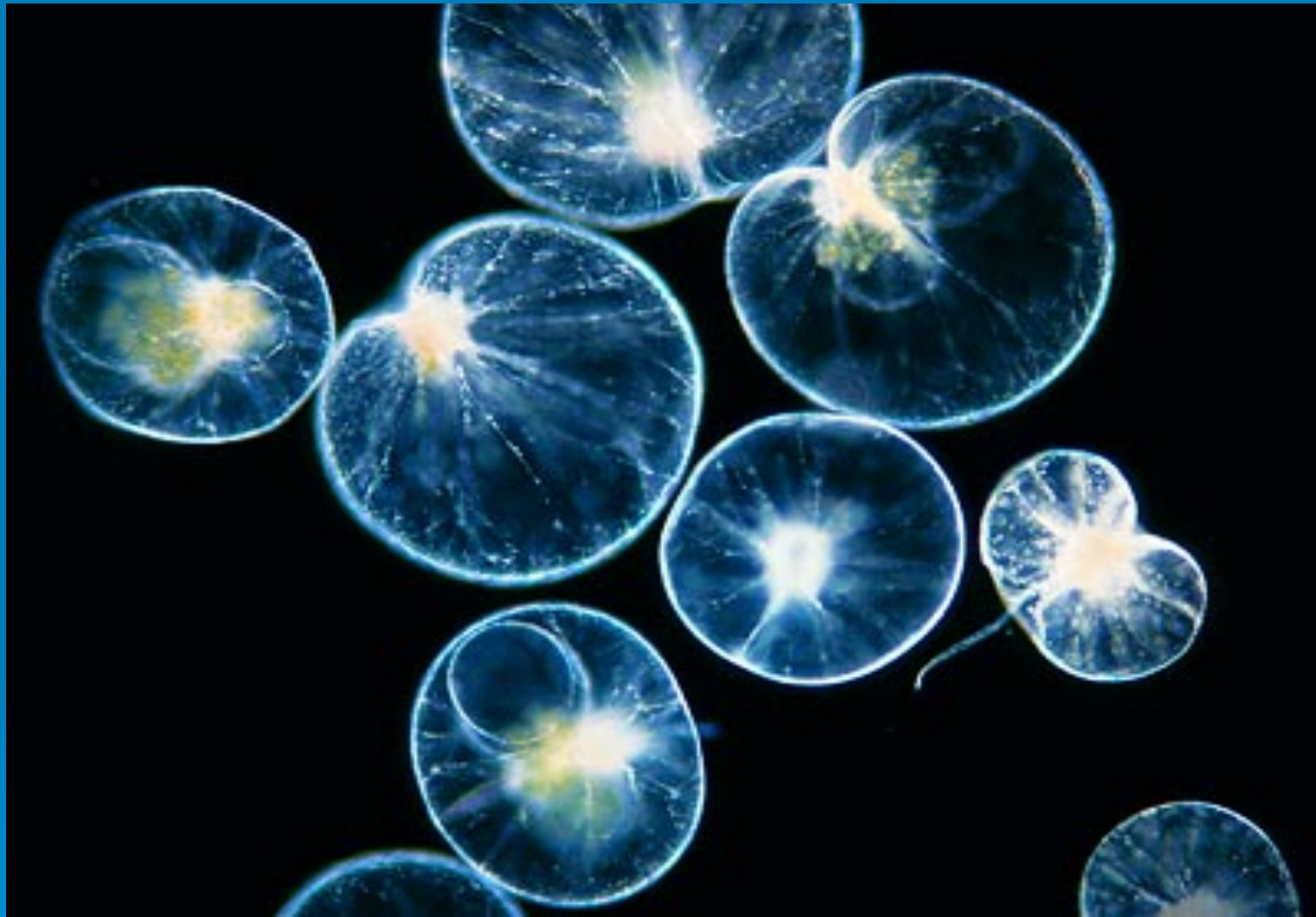


Dinoflagellates





@ PJS Franks

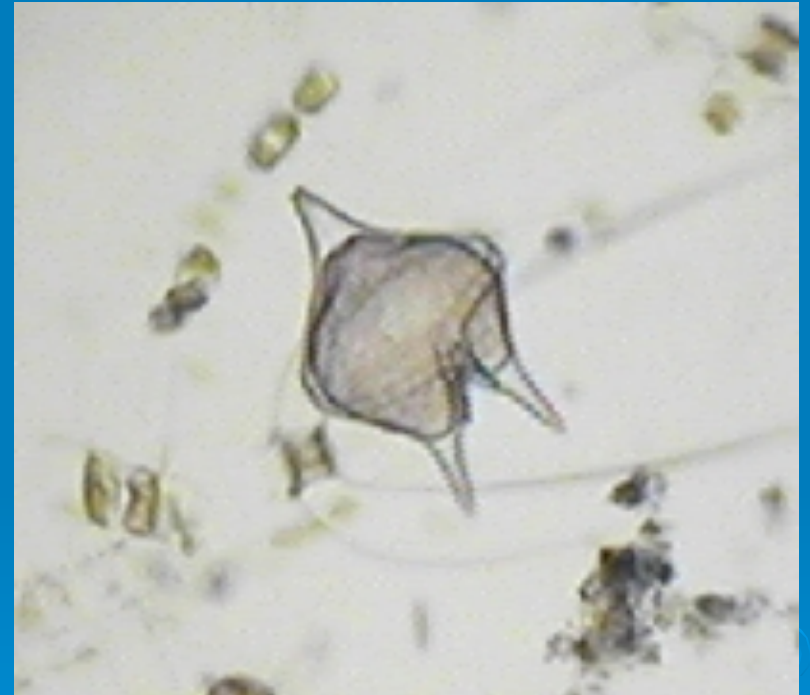






Dinoflagellates are found throughout the world's oceans, but tend to prefer warmer areas.

Given nutrients, dinoflagellates can bloom or explosively grow to huge numbers sometimes causing RED TIDES



Dinoflagellates: red tides



Florida red tide organism:
Gymnodinium breve



Around 60
species of
Dinoflagellates
are known to
cause red tides.
A few species
produce poisons
that are among
the most
powerful natural
toxins known.



During a red tide,
dinoflagellates
may poison the
waters, turning
the surface into
a sea of dead
fish.



Red tides can also
threaten human
health.

Mussels, clams
and other
bivalves store
the toxins as
they filter feed.

People who eat
the shellfish can

get Paralytic

Shellfish

Poisoning.

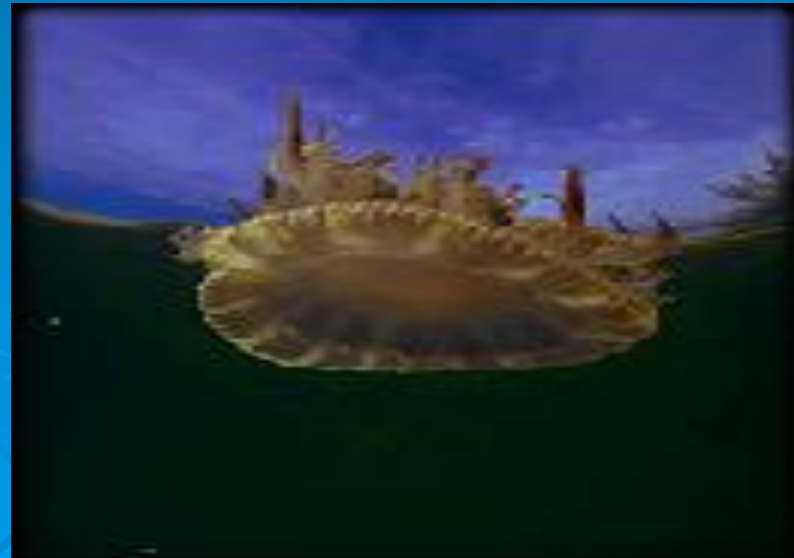


Victims suffer
numbness and
tingling, loss of
balance, slurred
speech, and in
extreme cases,
paralysis and
death!



Symbiotic Dinoflagellates

Some
dinoflagellates
like
Zooxanthellae,
are symbiotic
with corals or
jellyfish.



Red Algae:

The...uh...Red Ones (duh)

- Seaweeds
- Multicellular, marine organisms
- Have red and blue pigments

Phylum Rhodophyta

- Red algae but colors vary
- Marine seaweeds
- Smaller than brown algae and live in deeper waters
- Phycobilins – pigment for absorbing light
- Some coated with polysaccharide carageenan – cosmetics, gel capsules, cheeses
- Agar – extracted from cell walls of red algae





Rhodophyta



Porphyra



Gigarina



Filamentous Red Alga



Corraline Red Alga



Brown Algae: The Brown Ones (You think?)

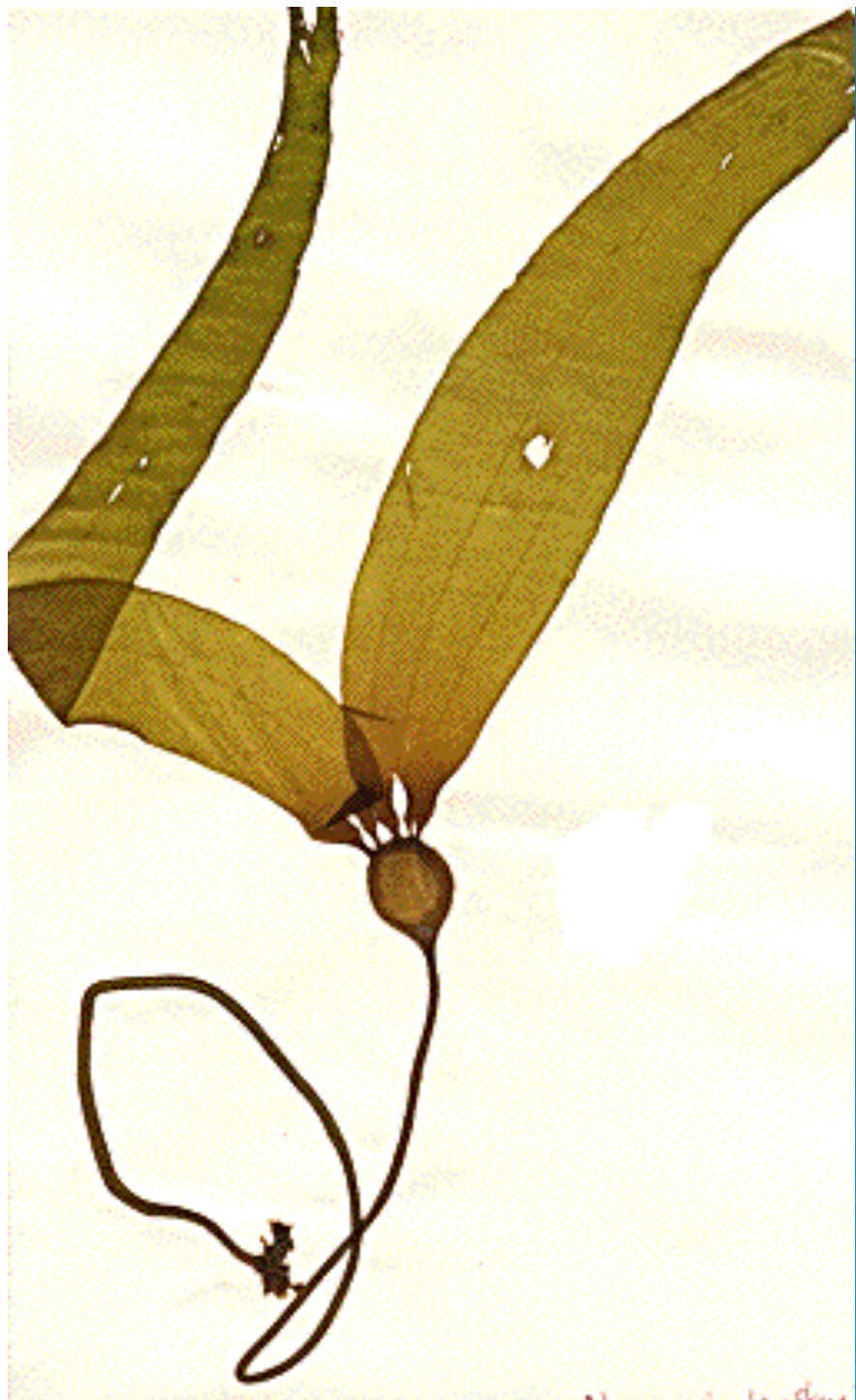
- They have **air bladders** to help them float at the surface - where the light is.

Brown algae

Phylum Phaeophyta

- Marine
- Seaweed and kelps
- Cooler areas of ocean
- Fucoxanthin pigment
- Store food as laminarin
- ALL multicellular
- Stemlike stipe
- Leaflike region called blade







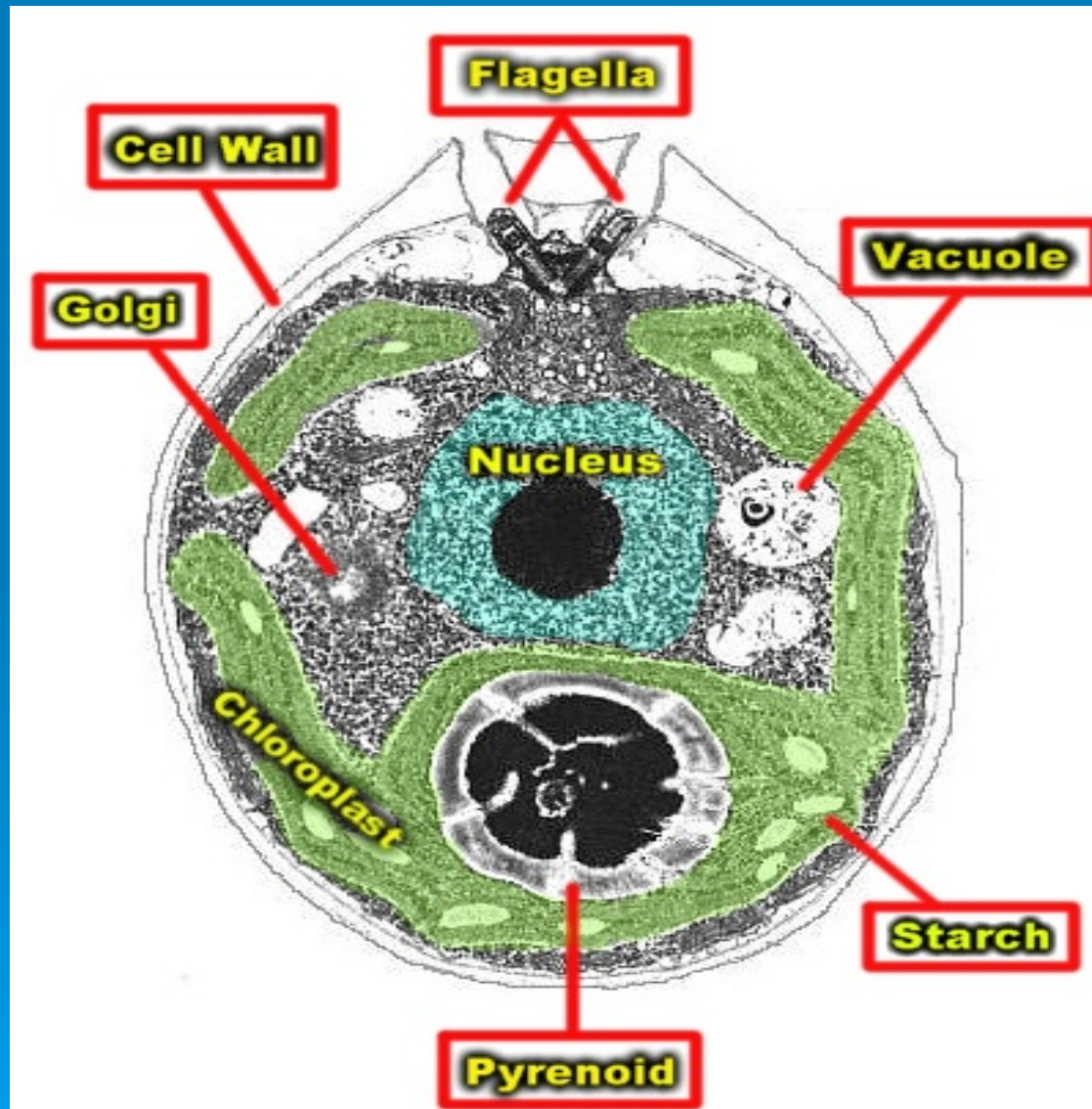
Green Algae:

Yeah, You Guessed it,
The Green Ones

- Most live in **fresh water**
- Can be unicellular or multicellular
- Live alone or in groups called **colonies**

Phylum Chlorophyta

- Look
- familiar?



Continued...

- Green algae
- Many different forms
- Gave rise to land plants – why?
- Chloroplasts that contain a and b chlorophyll
- Have carotenoids
- Cell walls of cellulose
- Many used for food and thickeners.

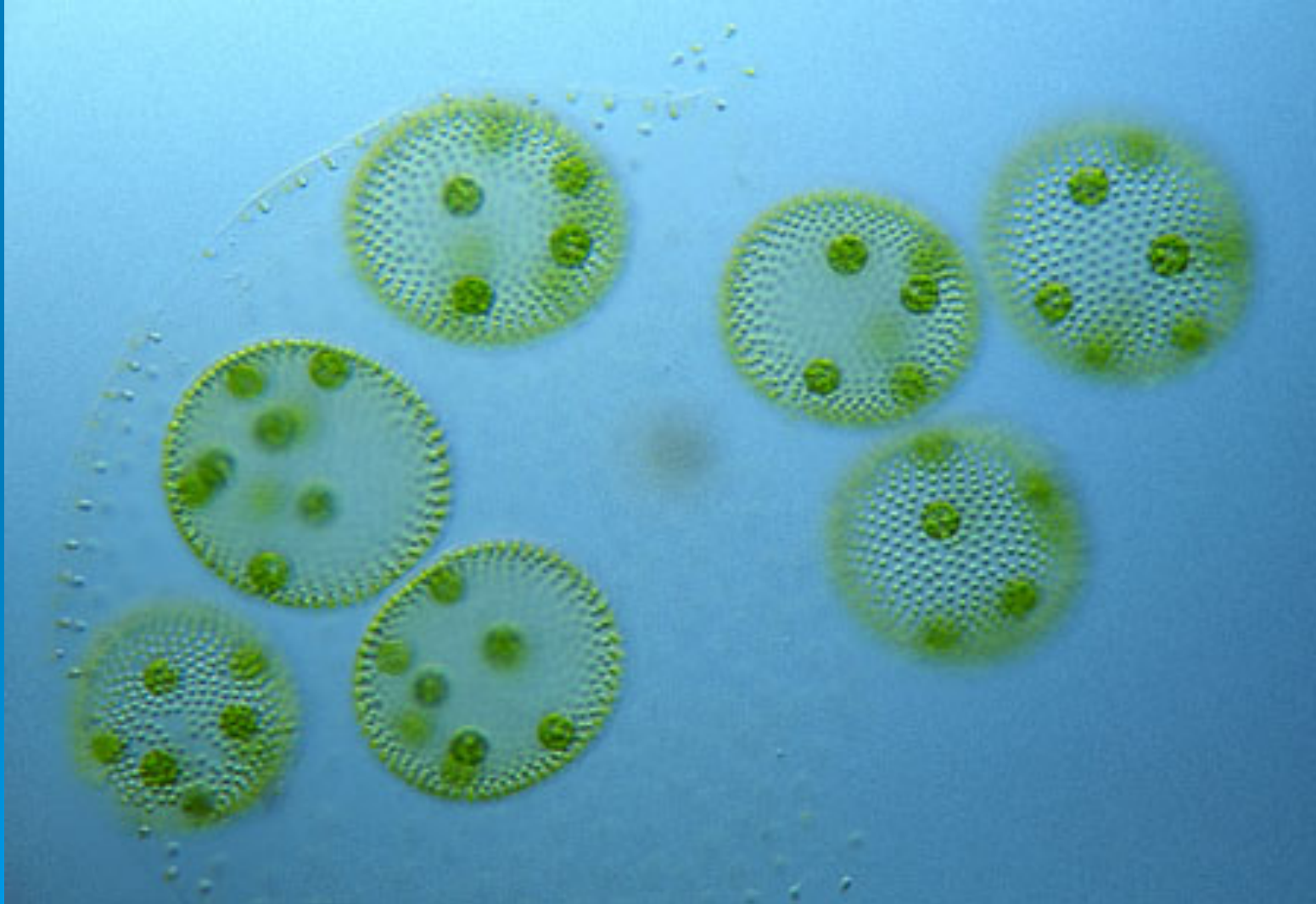
Ulva

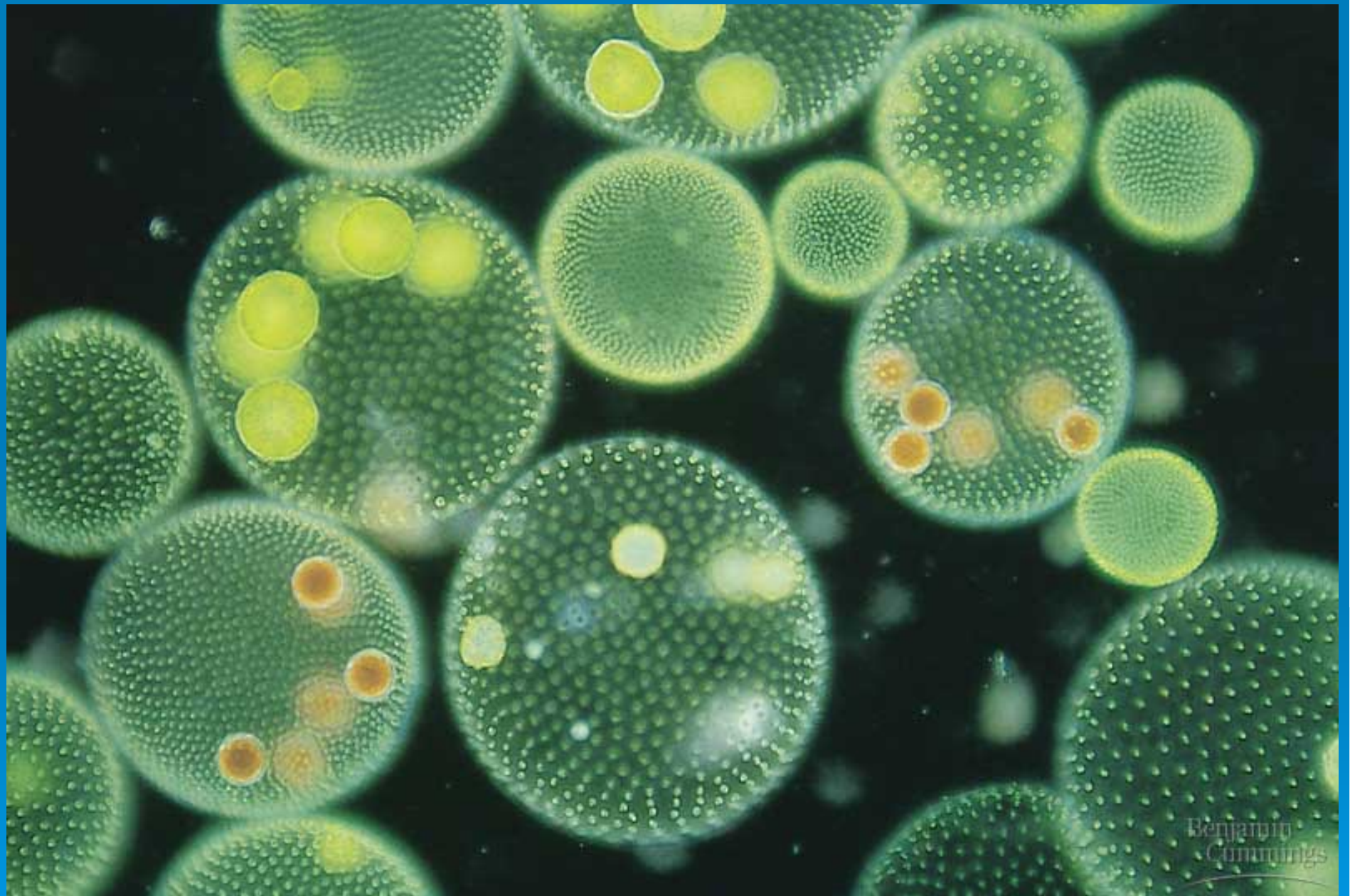


Colonial Chlorophyta

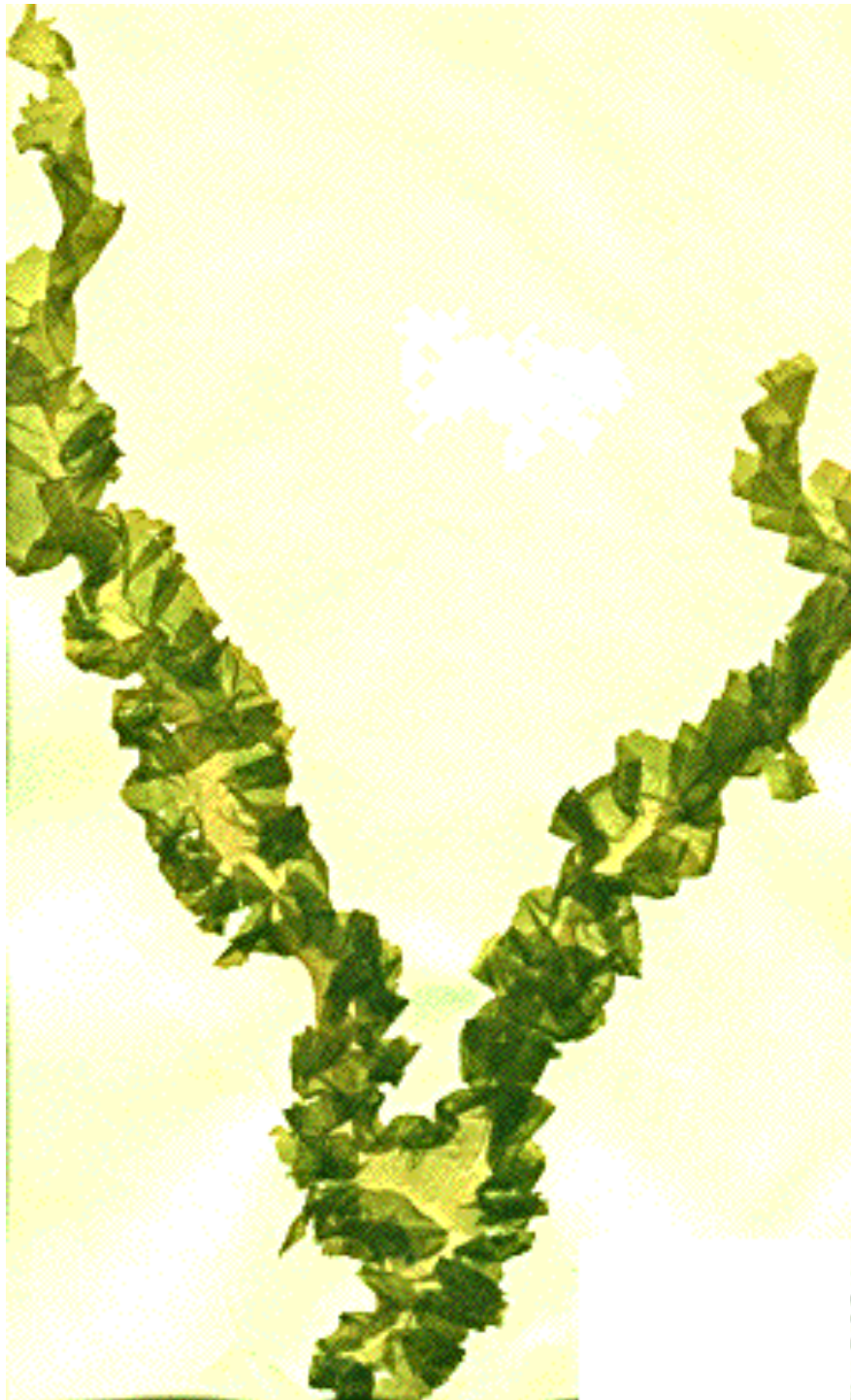


Daughter colonies leaving the mother colony.





Benjamin
Cummings

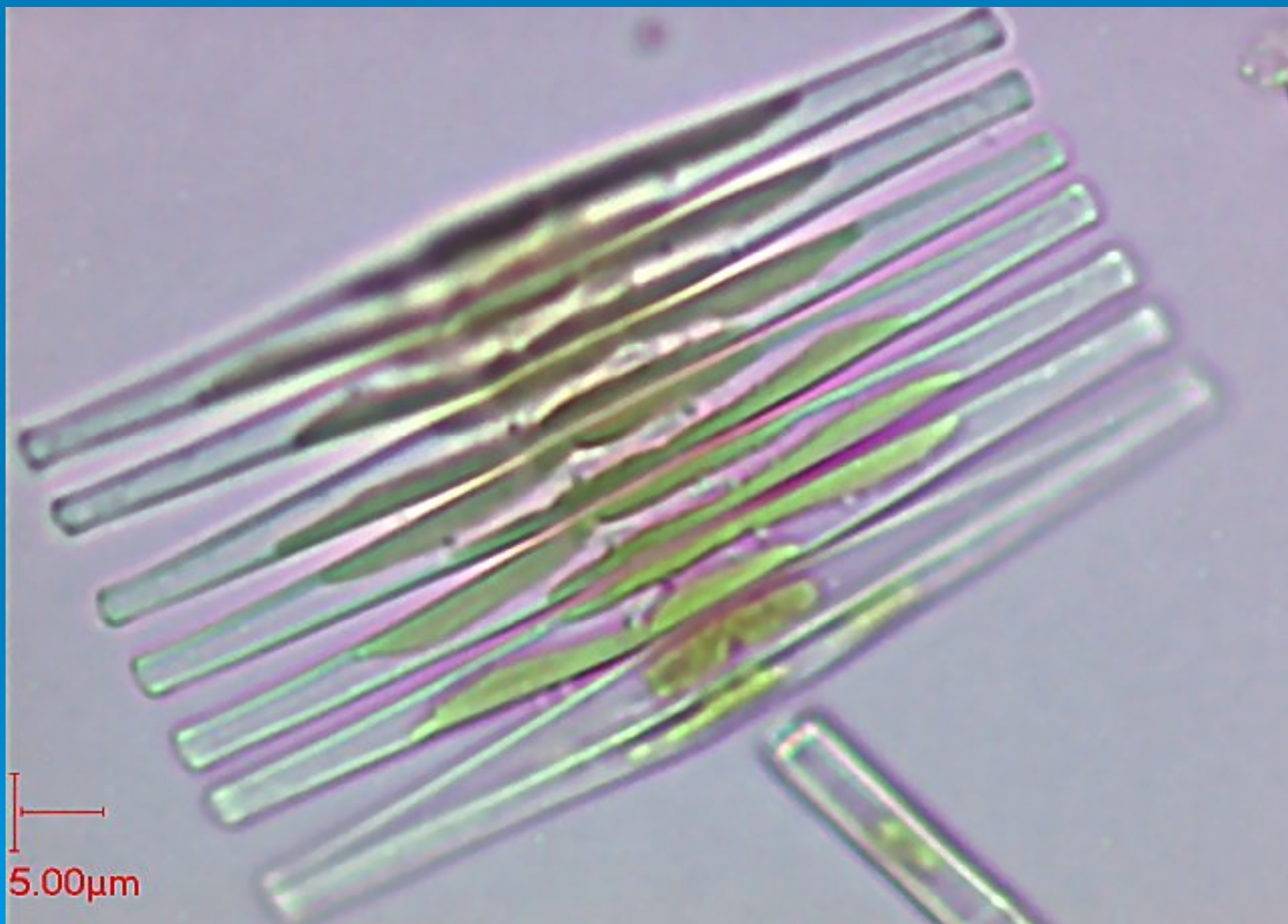




Golden Algae

Phylum Chrysophyta

- Most fresh water
- Form cysts
- 2 flagella
- Carotenoids give color
- Important for formation of petroleum deposits



Division Chrysophyta
Sub-Phylum Bacillariophyceae
Order Pennales
Family Naviculaceae
Genus Navicula





Fungus-like Protists



Characteristics in Common

- All form delicate, netlike structures on the surface of their food source
- Obtain energy by decomposing organic material
- No Chitin??

Fungus-like protists

- Slime molds:

Phylum acrasiomycota

- Cellular slime molds
- Amoeboid movement

Phylum Myxomycota

- Plasmodial slime molds
- Mass of plasmodium

- Water molds

Phylum Oomycota

- Blight

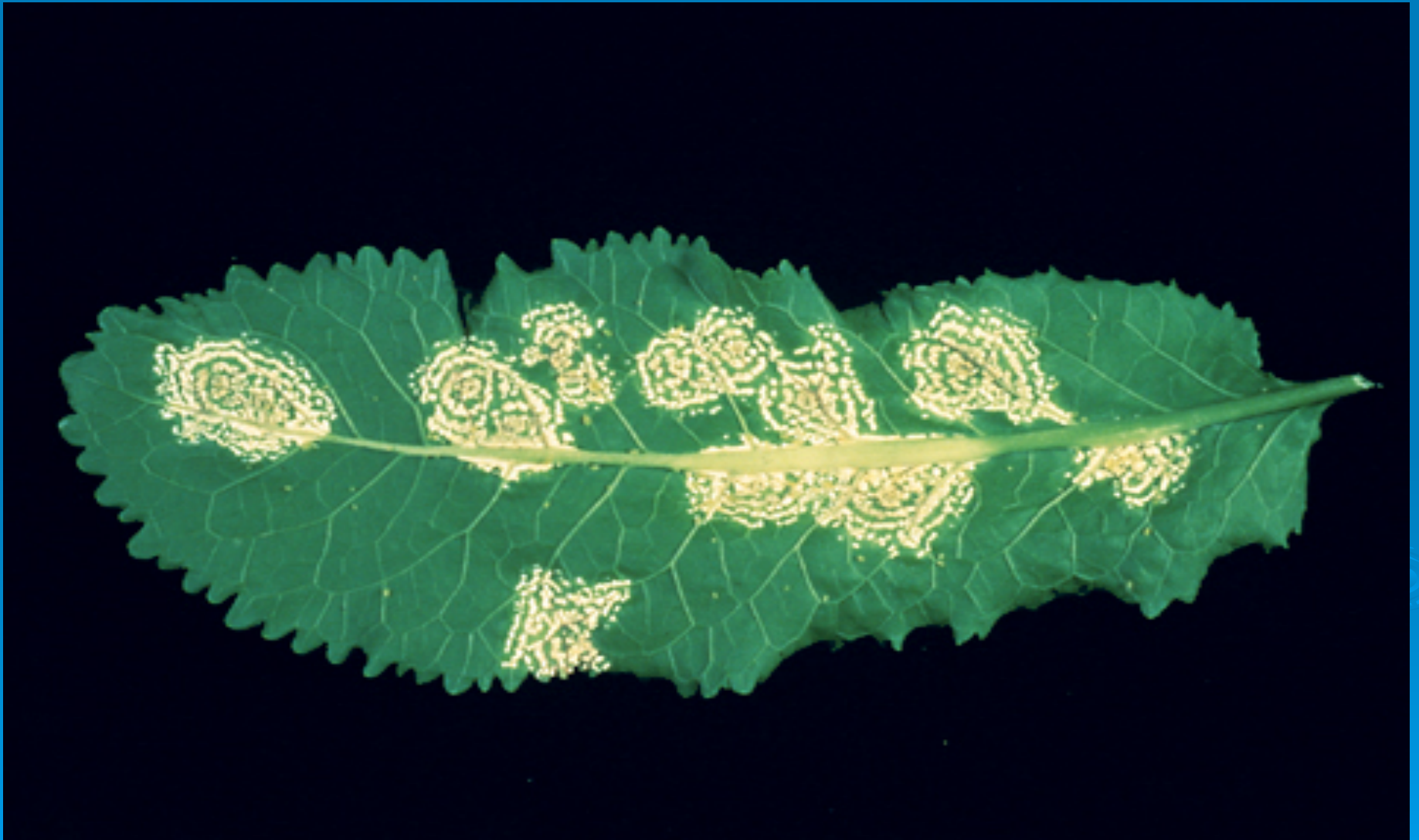
Phylum Chytridiomycota

- Chytrids
- Zoospores with one flagellum
- Maybe fungi?

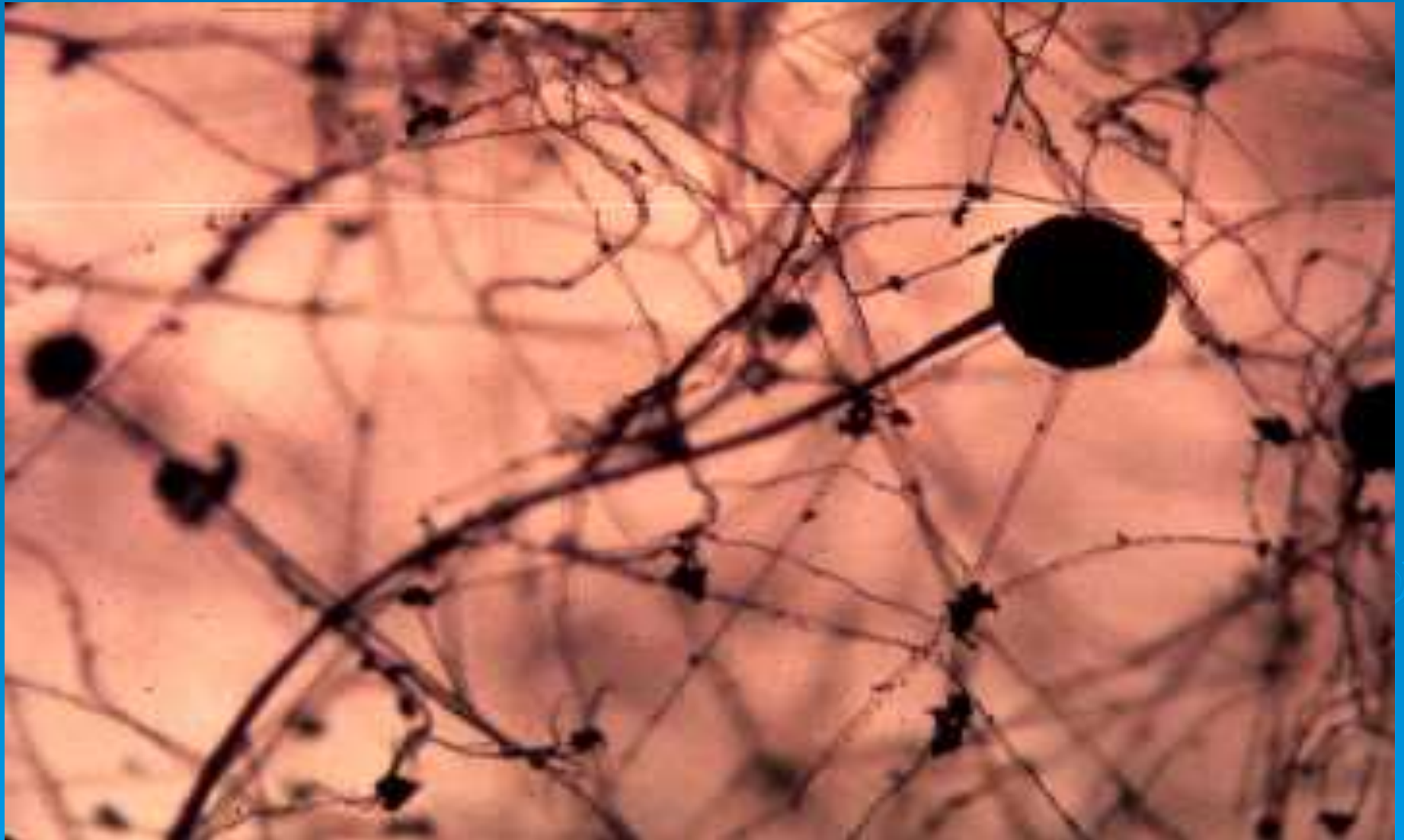
Slime molds



Water molds



Chytrids





©Mark Carroll

Phyla of Fungus-like Protists

Plasmodium Slime Molds

Cellular Slime Molds

Water Molds & Downy
Mildews

Slime Molds

- Live in cool moist, shady places where they grow on damp, organic matter

Plasmodium Slime Molds

- Form **plasmodium**: a mass of cytoplasm that contains many diploid nuclei but no cell walls or membranes - **its feeding stage**
- Creeps by amoeboid movement - 2.5 cm/hour

Plasmodium continued...

- May reach more than a meter in diameter
- Form reproductive structures when surroundings dry up
- **Spores** are dispersed by the wind and grow into new plasmodium





Cellular Slime Molds

- In feeding mode, they exist as individual amoebic cells
- When food becomes scarce, they come together with thousands of their own kind to reproduce
- May look like a plasmodium



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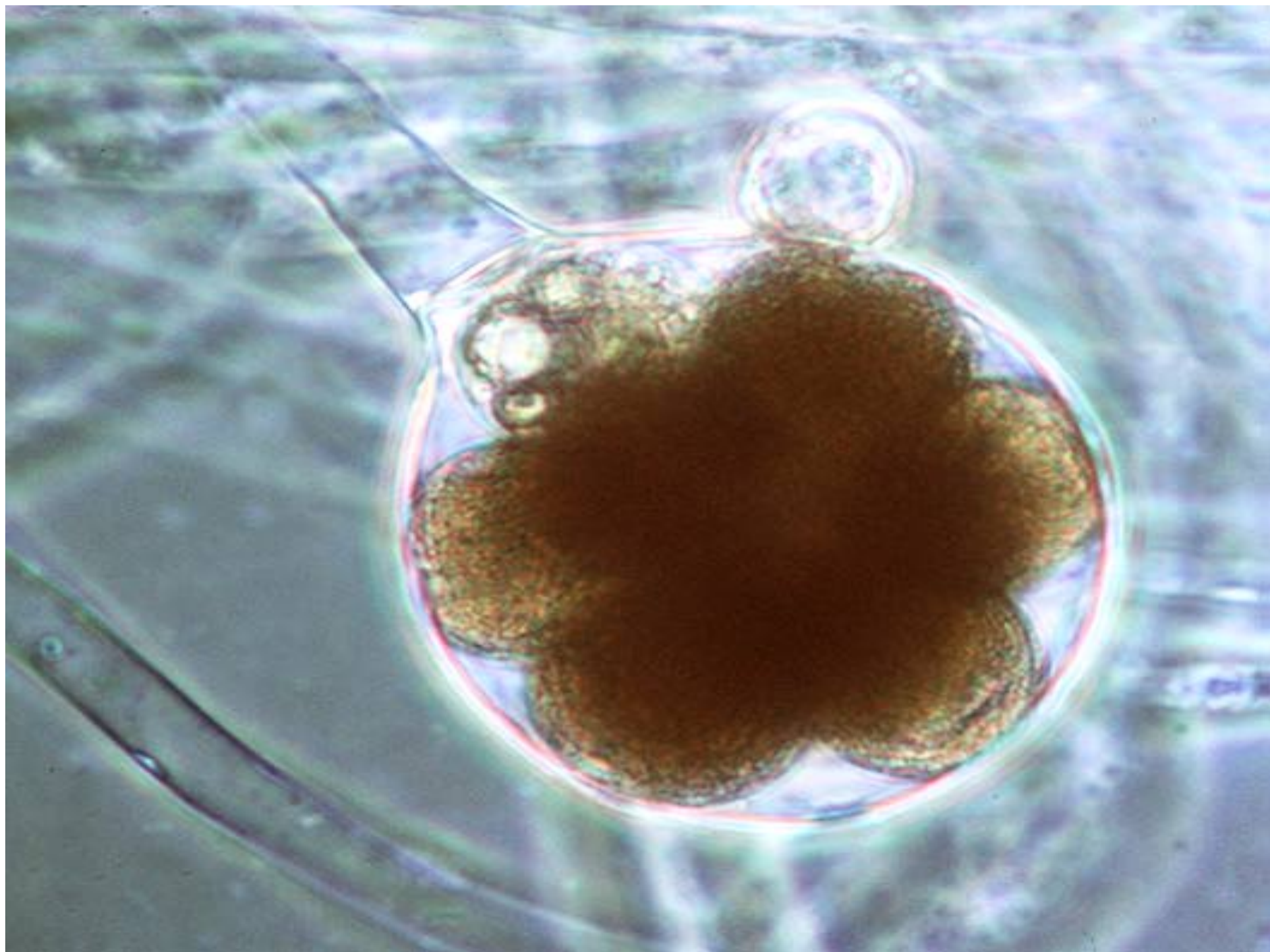


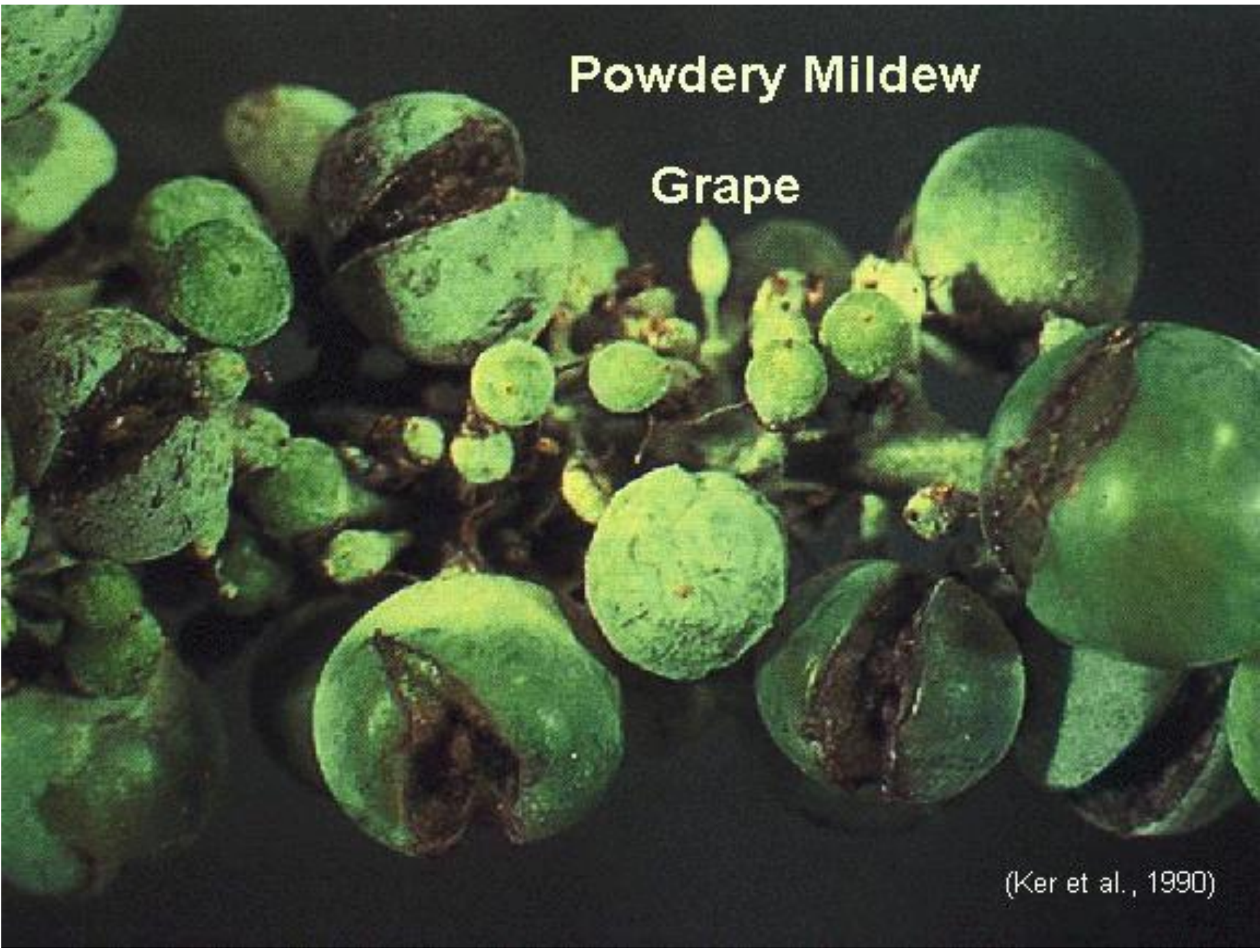


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Water Molds and Downy Mildews

- Live in water or moist places
- Feed on dead organisms or parasitize plants
- Fuzzy white growths





Powdery Mildew

Grape

(Ker et al., 1990)



Protozoa can be beneficial

