

The background of the slide is a composite of various microscopic images of protists, primarily radiolarians and diatoms, which are single-celled organisms with intricate silica-based shells. These organisms appear in various shapes, including circular, oval, and elongated forms, with some showing radial symmetry and others showing more complex, patterned surfaces. The colors are predominantly blue, green, and brown, giving the background a scientific and textured appearance.

Chapter 21

Protists

BIOLOGY II

Section 1 – Characteristics of Protists

- **Diversity**
 - Most diverse of all organisms
 - ALL are eukaryotic
 - Are eukaryotic organisms that cannot be classified as fungi, plants, or animals

A few well-known Protozoa

0 50 μm



Trichonympha lives
in the gut of termites



Trypanosoma gambiense
(causes African sleeping
sickness)

Euglena viridis



A red blood cell

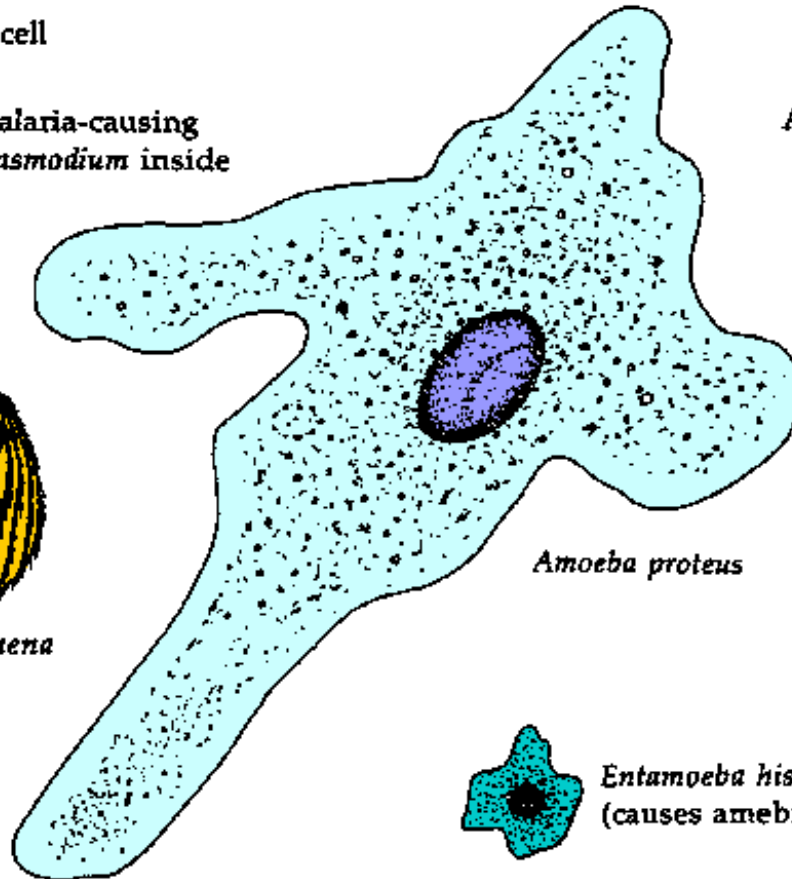


Malaria-causing
Plasmodium inside



Tetrahymena

A dinoflagellate



Amoeba proteus



Entamoeba histolytica
(causes amebic dysentery)

Characteristics

- Unusually diverse assortment of eukaryotes
- Membrane bound organelles
 - Mitochondria and chloroplasts
- Complex cilia and flagella
- Sexual reproduction with gametes
 - Allows for greater diversity than asexual reproduction
- Multicellularity
 - Allows cells to specialize

*The 1st Eukaryotes

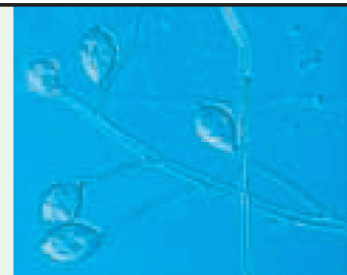
- Protists = 1st eukaryotes
- Thought to have evolved 1.5 billion years ago via endosymbiosis
- Kingdom Protista – contains life-forms similar to that of kingdoms fungi, plants, and animals
- 2 important features that evolved among protists
 - Sexual reproduction
 - Most mitosis (asexual), some meiosis (sexual)
 - Multicellularity
 - Involves significant coordination among specialized cells

***What Unites Protists**

- **Kingdom Protista includes all eukaryotes that cannot be classified as animals, plants, or fungi**
 - However, they lack the specialized features that characterize the three other multicellular kingdoms
- **Major phyla of protists are very different from one another, are only distantly related**
- **Historically, scientists have referred to protists this way:**
 - Heterotrophic protists = protozoa
 - Photosynthetic protists = algae
 - **NOT formal classification**

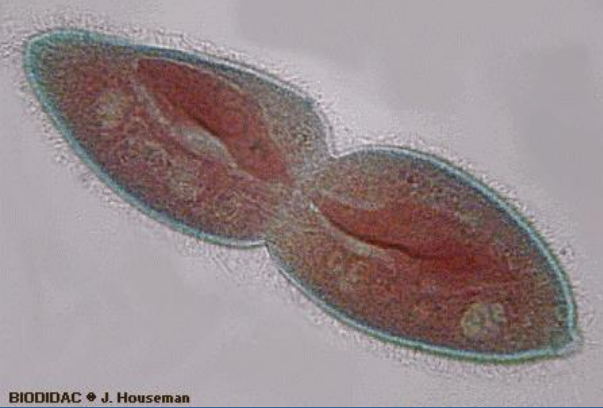
*Some Important Protozoa

Phylum	Distinguishing features	Mode of nutrition
Rhizopoda (amoebas) Foraminifera (forams)	Move using pseudopodia	Heterotrophic
Chlorophyta (green algae) Rhodophyta (red algae) Phaeophyta (brown algae)	Typically multicellular	Photosynthetic
Bacillariophyta (diatoms) Dinoflagellata Euglenophyta	Typically unicellular	Typically photosynthetic
Kinetoplastida Ciliophora (ciliates)	Move using flagella/cilia	Heterotrophic
Acrasiomycota (cellular slime molds) Myxomycota (plasmodial slime molds) Oomycota	Funguslike	Heterotrophic
Apicomplexa (sporozoans)	Form spores	Heterotrophic

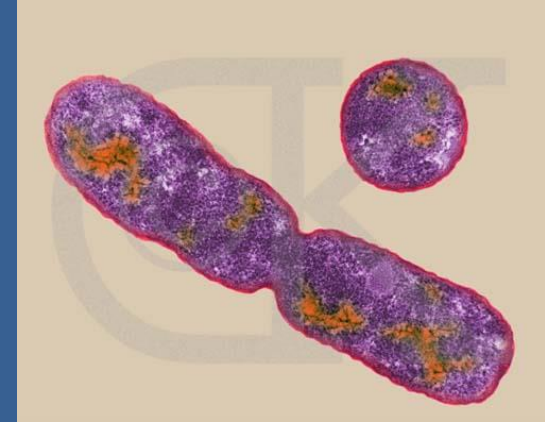


Reproduction

- Asexual – results in identical offspring
 - binary fission, budding, and fragmentation
- Sexual – results in offspring that are genetically different from each parents
 - Involves union of reproductive cells, usually called gametes(sex cells)
 - Gametes are haploid cells that join to form a diploid zygote



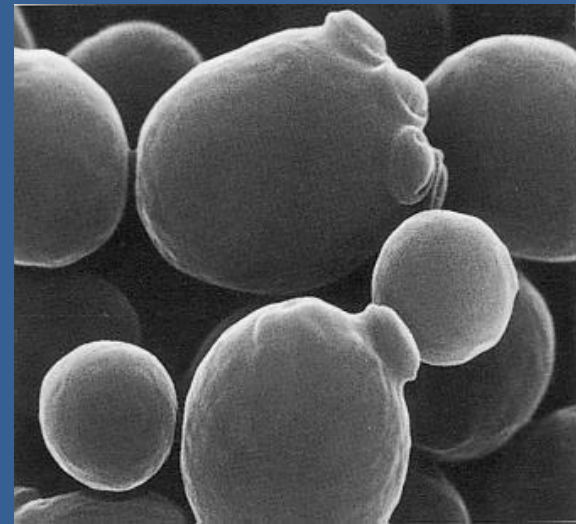
Binary Fission



- Occurs when unicellular organism reproduces by splitting in half after replicating DNA
- Sometimes called mitosis
 - NOT really mitosis – mitosis is division of nucleus
 - Prokaryotes do not have mitosis but reproduce by binary fission
- Multicellular organisms reproduce by mitosis with cytokinesis(cell division)
 - Multicellular organisms do not undergo binary fission

Budding

- Part of the parent organism pinches off and forms a new organism
- Can occur in unicellular and multicellular organisms
- Offspring is smaller than parent



Fragmentation

- Part of multicellular organism breaks off and starts a new organism
- Different from budding
 - Budding is performed by the organism
 - Fragmentation is the result of an accident or an action that is done to an organism



Reproduction

- *Chlamydomonas* (greenalga) - reproduction is typical of unicellular protists.
 - Reproduce sexually or asexually
- As a mature organism, the single-celled protist is haploid.
- When it reproduces asexually, *Chlamydomonas* first absorbs its tail and divides by mitosis
 - produces two to eight haploid cells called zoospores
 - Remain within the wall of the parent cell until they mature and break out

Sexual Reproduction

- Can occur as response to environmental stress or lack of nutrients
 - Zygosporangium – tough outer coating secreted by zygote
 - Can survive freezing, drying, and UV

Sexual Reproduction, cont.

- In Unicellular Protists

- Ex – chlamydomonas – mature organism is haploid

- Divides by binary fission to produce haploid gametes

- Two gametes fuse to form diploid zygote, which becomes zygospore

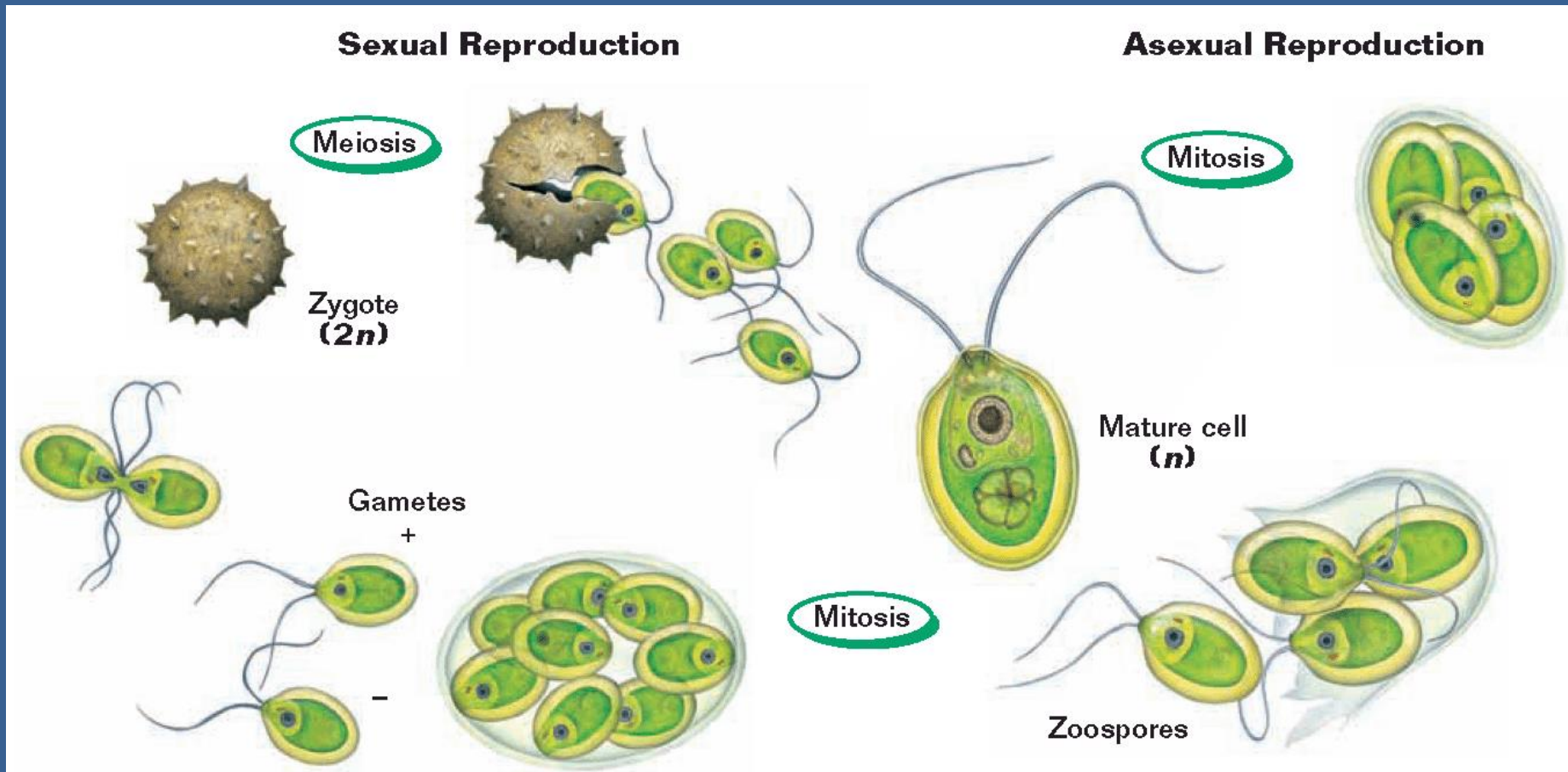
- » When environmental conditions improve, meiosis occurs within zygospore

- Haploid cells break out of the zygospore and grow into mature cells



Reproduction of Chlamydomonas

- *PREFER asexual, sexual only under certain conditions



Alternation of Generations

- In multicellular protists....
- The reproductive cycle of *Ulva*, characterized by two distinct multicellular phases.
- The diploid, spore-producing phase is called the sporophyte generation.
- The haploid, gamete-producing phase is called the gametophyte generation.
- The adult sporophyte alga has reproductive cells called sporangia
 - produce haploid spores by meiosis

Reproduction of Ulva

Diploid ($2n$)

Haploid (n)

Mature sporophyte

Meiosis

Mitosis

Zygote

Sporangia

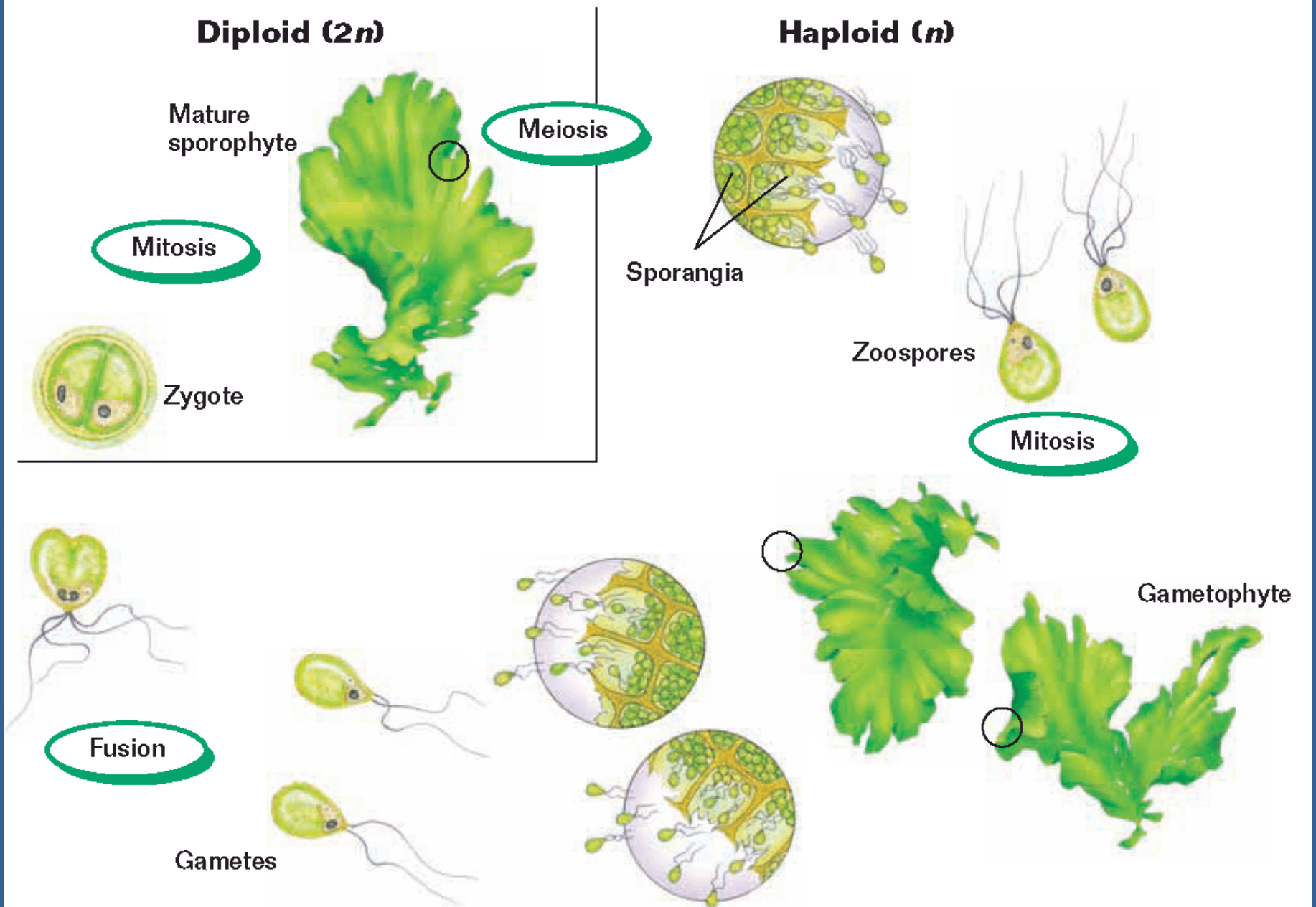
Zoospores

Mitosis

Fusion

Gametes

Gametophyte



Classifying Protists...

- **Ongoing challenge**
 - **Currently group in kingdom Protista**
 - **Likely to change as scientists learn more**
- **Characteristics protists share with plants, animals, and fungi provide information about the evolution of these organisms.**

21.2 Groups of Protists

- Grouping Protists..
 - By their source of nutrition
 - Helps us to understand their ecological roles
 - Can divide into 3 groups
 - Plant-like – get energy by photosynthesis
 - Animal-like – capture and eat other organisms
 - Fungi-like – absorb nutrients from their environment
- For every generalization about protists, there is an exception..

Animal-like Protists

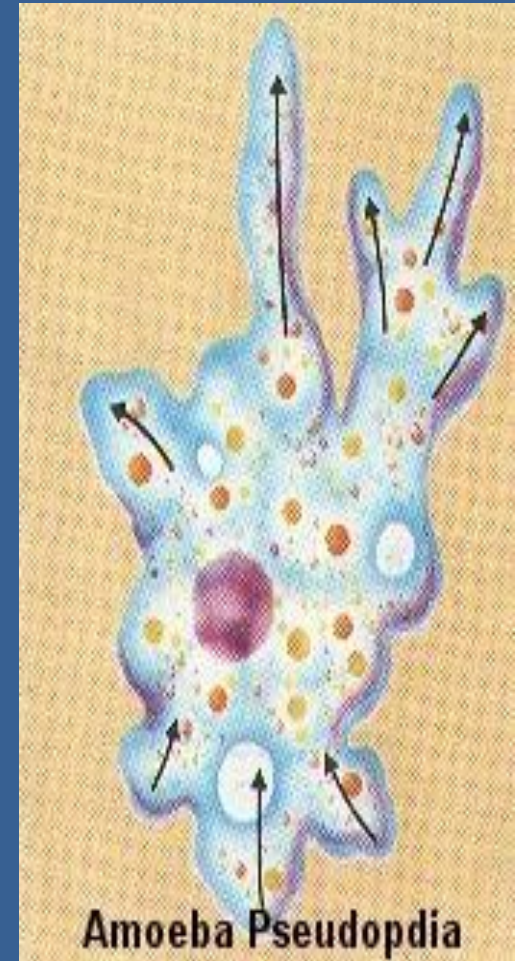
- Often called protozoa – means “first animals”
 - Heterotrophic
 - All are Unicellular
 - Most move
 - Most reproduce asexually by binary fission

Animal-like Protists Movement

- Sub classified by how they move
 - Amoeboid protists – use pseudopodia
 - Ciliates – example: paramecium
 - Flagellates
 - sporozoans

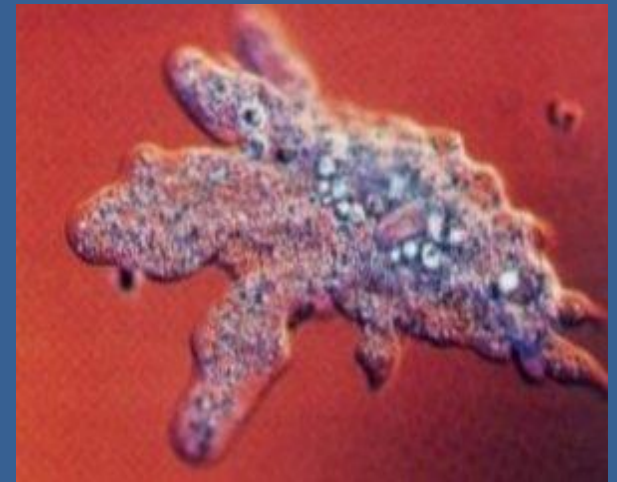
Protozoans with pseudopods

- Pseudopods - 'false feet'
- Used for movement and to collect food
- Cell membrane pushes in one direction & the cytoplasm flows into the bulge. This allows the protozoan to move, dragging the rest of the cell behind it.



Pseudopods, cont.

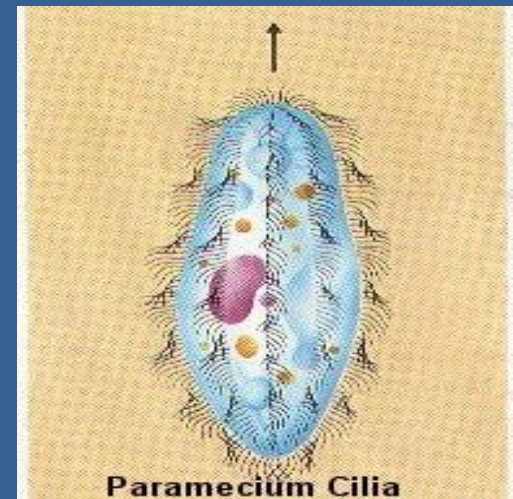
- Reproduce by binary fission
- Contractile vacuole - it collects extra H₂O & expels it from cell
- 2 pseudopods can surround & trap food. Then form a food vacuole to break down food in the cytoplasm.
- no definite shape.
- Example - Amoeba.



Protozoans with cilia



- Cilia - hairlike structures - help organisms move, get food and sense environment.
- Multicellular with 2 nuclei.
 - 1 nuclei controls everyday functions
 - 1 nuclei is for reproduction.
- Reproduce by binary
- fission or conjugation.



Cilia, cont.

- Oral groove lined with cilia - moves H₂O containing food into food vacuole at end of oral groove.
- Food vacuole breaks down food and sends through cell.
- Example : paramecium.

<http://www.youtube.com/watch?v=zIHHJzOsQho>



Protozoans with flagella

- Organisms called zooflagellates
- Use long whiplike part called flagella to move.
- These usually live inside other organisms.



Sporozoans

- Form sporelike cells called sporozoans
- Reproduce sexually and asexually
- Lack flagella, cilia, and pseudopodia, so stationary
- All are parasitic and cause disease

Plantlike Protists

- Better known as algae
- Autotrophs-photosynthesize
- Size: unicellular to very large
- Contain different pigments so they come in different colors.
- Euglena: special type of algae -when there is no sunlight they become heterotrophic.
 - Have special structure, eyespot, light sensing organ that helps them move toward light



<http://www.youtube.com/watch?v=jl0TzaWUQWk>

<http://www.youtube.com/watch?v=HwdZFAnHnpg>



Plantlike Protists Continued

- Euglenoids
- Dinoflagellates
 - Typically two flagella
 - Protective silica cellulose coats, gives shape
- Diatoms
 - Double shell make of silica or calcium carbonate
 - Offspring smaller than parents

Plantlike Algae

- Red Algae
 - Most multicellular, found in deep warm ocean water and play Important role in formation of coral reefs
- Brown Algae
 - Multicellular, found in cool ocean water, form more than one tissue type, example kelp
- Green Algae
 - Closely resemble plants, closest related evolutionarily
 - Photosynthetic pigment same as plants
 - Marine plankton, some found in damp soil

Funguslike Protists



- Like animals - they are heterotrophs
- Like plants - they have cell walls
- Reproduce by spores (tiny cells that can grow into a new organism)
- Not in fungi kingdom because they can move at one point in their lives.
- An examples: slime molds, water molds and mildew.

Section 3 – Protists and Health

- Effect humans by causing disease
 - Pain, death, and medical costs of preventing and treating diseases
- Also affect humans by diseases they cause in livestock

Diseases Caused by Protists

Disease	Description of illness	Protist	How the disease is transmitted
African sleeping sickness	Fever, weakness, lethargy	<i>Trypanosoma gambiense</i> , <i>Trypanosoma rhodesiense</i>	Bite from infected tsetse fly
Amebic dysentery	Bloody diarrhea, vomiting, extremely strong stomach cramps, fever	<i>Entamoeba histolytica</i>	Contaminated food or water
Giardiasis	Cramps, nausea, diarrhea, vomiting	<i>Giardia lamblia</i>	Contaminated food or water
Malaria	Fever, chills, sweats	<i>Plasmodium</i> sp.	Bite from infected mosquito
Toxoplasmosis	Primary danger is fetal infection; can cause convulsions, brain damage, blindness, and death in fetuses	<i>Toxoplasma gondii</i>	Contact with infected cats or improperly cooked meat

Trichomoniasis

- Most common sexually transmitted infections in US
- Caused by *trichomonas vaginalis*
 - Men don't usually have symptoms
 - Women experience discolored discharge, genital itching and urge to urinate
 - Treatable with medicine



Chagas Disease

- Aka American trypanosomiasis caused by protist *Trypanosoma cruzi*
- In South and Central America
- Spread by kissing bugs
- Advanced cases can lead to heart disease, heart failure, heart attack, or abnormal heartbeat, enlargement of esophagus and large intestine

Cryptosporidiosis

- Aka *crypto* caused by *Cryptosporidium*
- Spread by contaminated water, objects, or uncooked food
- Severe cramps and diarrhea

Malaria

- One of the most deadly diseases in humans
 - 100 million + people have malaria at any given time
 - Up to 3 million, mostly children, die from it every year
- Caused by sporozoans of genus *Plasmodium*, spread by mosquito
- Symptoms:
 - Severe chills
 - Fever
 - Sweating
 - Confusion
 - Great thirst
- Victims die from: anemia, kidney failure, or brain damage

Treating and Preventing Malaria

- Quinine – derived from bark of cinchona tree
 - Derivatives of Quinine, chloroquine and primaquine are now used to treat malaria
- Can be controlled by reducing mosquitos

- Red tide -describe the brownish or reddish coloration of waters that sometimes occurs in oceans, rivers, or lakes due to dinoflagellates.
 - Produce powerful toxins, can make you sick
- caused by algal blooms—the rapid increase of algae population
- When algal bloom dies bacteria consume and decompose algae, which depletes the oxygen levels in water



Beneficial Protists

- Commensal protists – live in the digestive tract of humans and in animals that humans eat
 - Help digest cellulose
 - Found in hay
- Plankton – help support food chains
- Single largest group of photosynthesizers on the planet
- Many are detritivores, help recycle important chemicals

Giardiasis

- Caused by *Giardia*
- Infects intestinal track
- Enters as a cyst, once inside host reproduces by binary fission
- Severe diarrhea and cramps, rarely fatal

Amebic Dysentery

- Caused by parasite *Entamoeba histolytica*
- Symptoms: pain, bloody diarrhea, fever
- In rare cases fatal
- Transmitted on food washed with contaminated water and eaten raw

Taxoplasmosis

- Caused by protist *Toxoplasma gondii*
- Spread by cats and eating undercooked meat with cysts
 - Cats release spores in feces