

# Lab 1:Parasite Diversity

(Plus a review of not breaking microscopes)

# Introductions

1. Your Name
2. Your Degree Program
3. An answer to one of the following
  - a. A cool thing you did over winter break
  - b. Your favorite thing to do outside of class
  - c. Your favorite parasite and why
  - d. One thing you're proud of



# Course Basics!

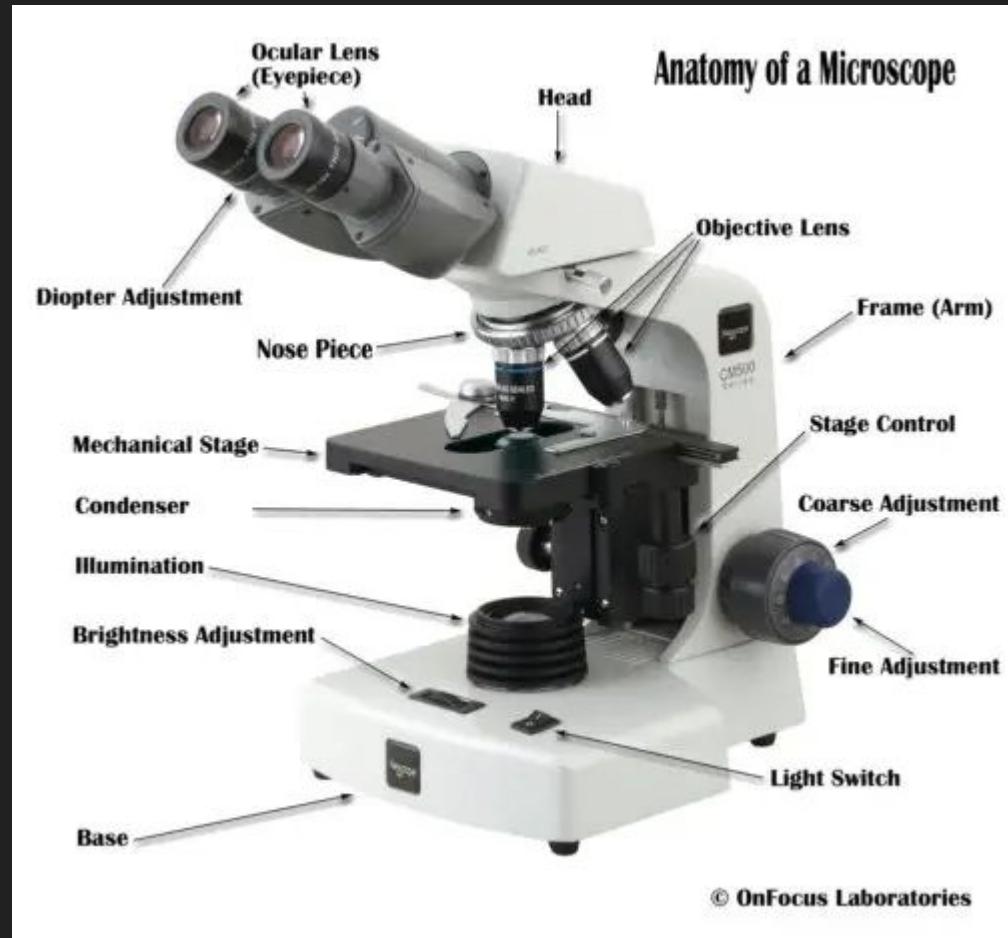
Syllabus walkthrough (lab portions)

Lab Safety

Projects



# Microscope Anatomy



# What's a Parasite?

*“If a definition is helpful in the understanding of a biological process, it is worthwhile, but it should never be allowed to channel or limit one’s idea”* - Poulin, Evolutionary Ecology of Parasites (2007)

# Parasite Diversity

*Great fleas have little fleas upon  
their backs to bite 'em,  
And little fleas have lesser fleas,  
and so ad infinitum.*

Augustus De Morgan—A  
Budget of Paradoxes (1915)



A small, male *Ixodes* tick feeding on an engorged female; an example of intraspecific hyperparasitism

# How do we classify parasites?

## Macroparasite

- Large!
- Longer generation times
- Persistent Infections
- Impact on host often dependent on # of parasites
- Study # per host and aggregation

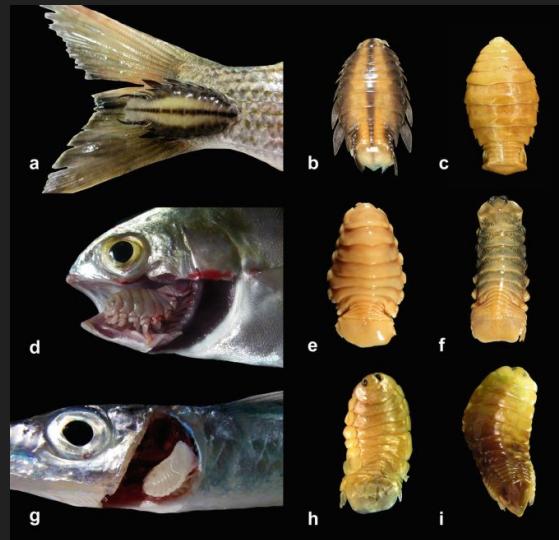
## Microparasite

- Small! (virus, bacteria, protozoa, fungi)
- Rapid multiplication
- Often leads to lasting immunity
- Transient infection

# Reminder about Taxonomy!



# Eukaryotic Parasites: Kingdom Animalia (clade Holozoa)



Domain Eukarya, Kingdom Animalia, Phylum Platyhelminthes

# Phylum: Platyhelminthes (flatworms)

- Many Free-living species
- Two major parasite classes:



Free-living  
marine flatworm

Class: Cestoda (tapeworms)



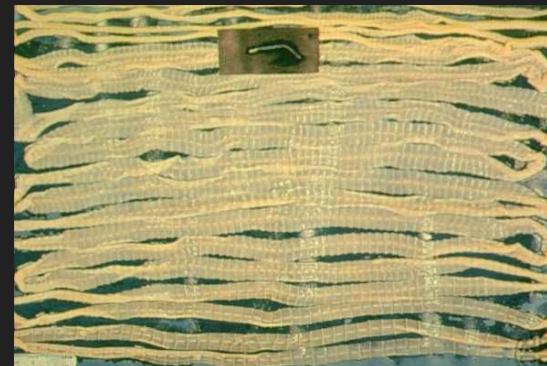
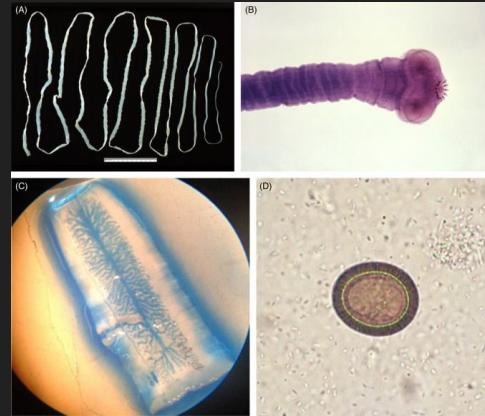
Class: Trematoda (flukes)



Univ. Ottawa © Biolabs

## Class Cestoda (tapeworms)

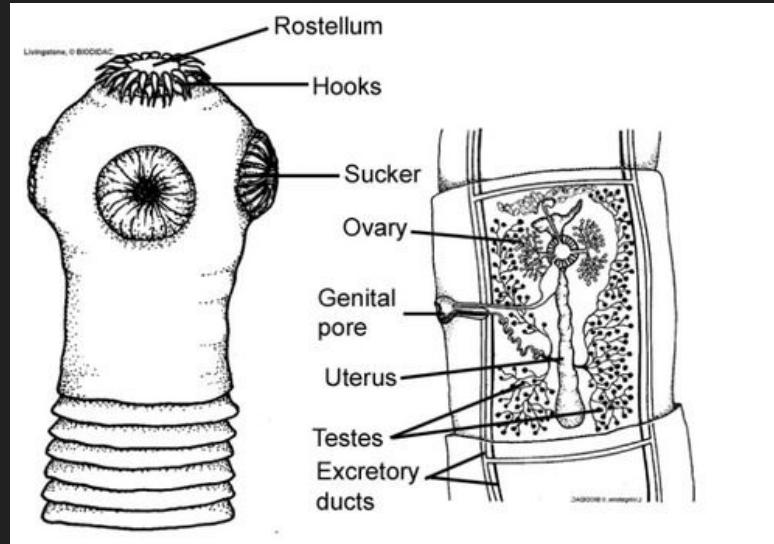
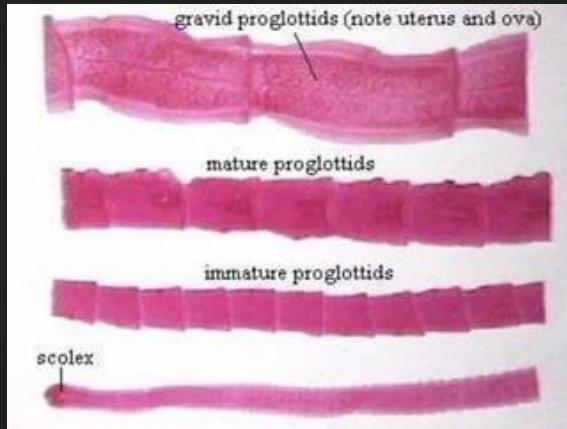
- Specialists of vertebrate guts
- Adults lack a true gut, absorbing nutrients through surfaces
- Reproductive organs (proglottids) + head
- Attach to host gut wall through head-like scolex (some suction-cup like, some hooked or grooved).
- Generally large; range from a few centimeters to meters



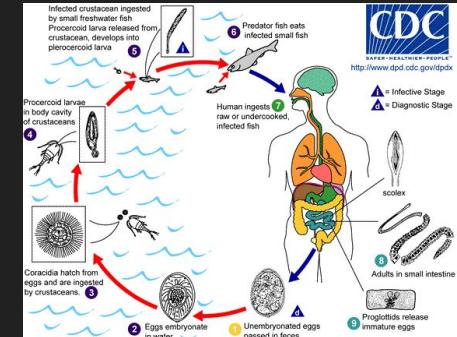
*Diphyllobothrium latum*, the broad fish tapeworm, can grow up to 15m

# Class Cestoda (tapeworms)

- Each proglottid has full hermaphroditic reproductive system
- Once mature, gravid proglottids filled with eggs detach, passing through stool



Many cestodes have complex life cycles, with transmission relying on ingestion of proglottids.



Domain Eukarya, Kingdom Animalia, Phylum Platyhelminthes, Class Trematoda

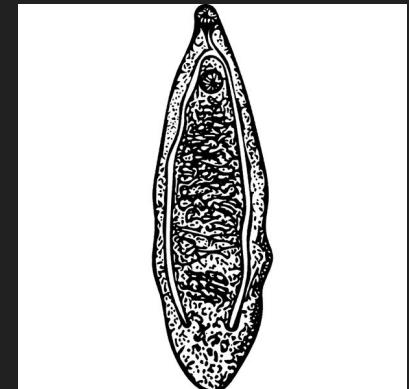
## Class Trematoda (Flukes)

Monogeneans: One Oral sucker, simply life cycle

Digenetic Trematode: Two suckers, complex life cycle

Adults parasitize organs (liver, lungs, blood intestinal tract, etc)

Have many, often very different life stages: eggs, miracidium, redia, cercaria, metacercaria, adults



Domain Eukarya, Kingdom Animalia, Phylum Platyhelminthes, Class Trematoda

# Class Trematoda (Flukes)

Adults

Dorsoventrally flattened

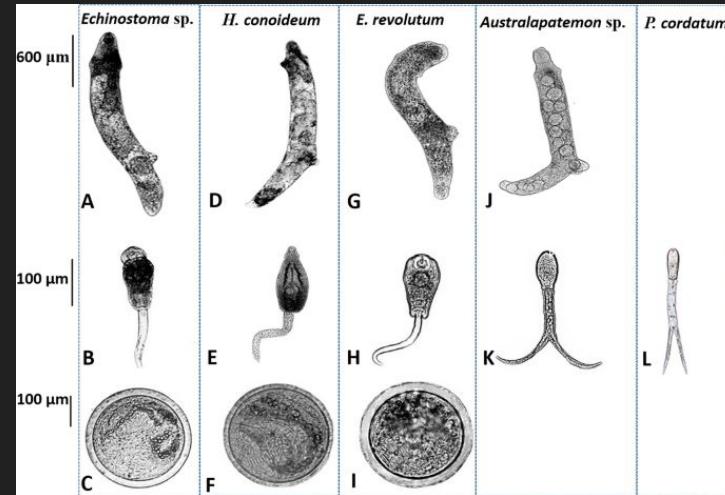
Often leaf-like in shape

Radially striated suckers

Cercariae one of the most recognizable larval stages:

Tapered head, often with “tail”

Body covered in integument,  
which can often be spined



# Phylum Nematoda (roundworms)

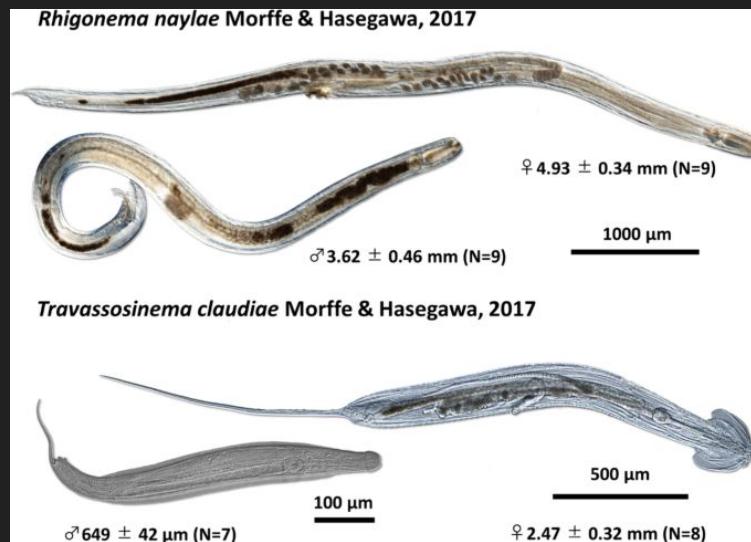
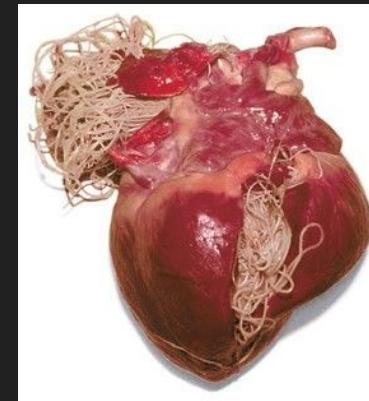
Many free living and parasitic species! - Most diverse group of helminths

Cylindrical or “eel” shaped  
Smooth and unsegmented.

Variety of infection pathways  
(penetrating skin,  
ingestion of eggs, vectorborne or  
trophic transmission)

Generally lack holdfasts (some exceptions-ex.hookworms)

Common parasite of vertebrates  
as well as plants

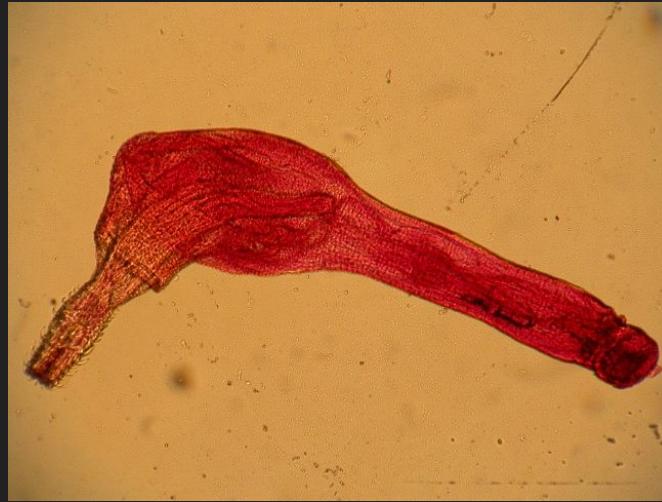
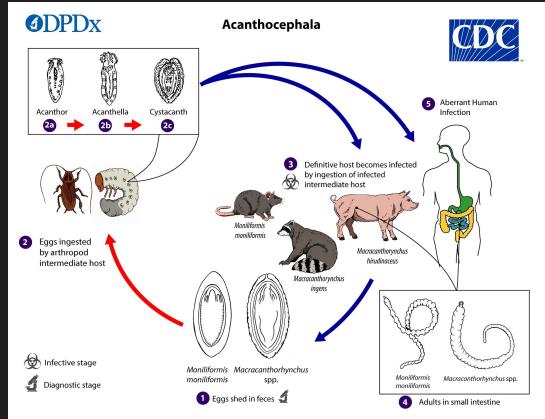


# Phylum Acanthocephala (thorny-headed worms)

Have a thorny proboscis,  
invaginated in many species

Attaches to gut wall by forcible  
everting proboscis

Often have complex life cycles



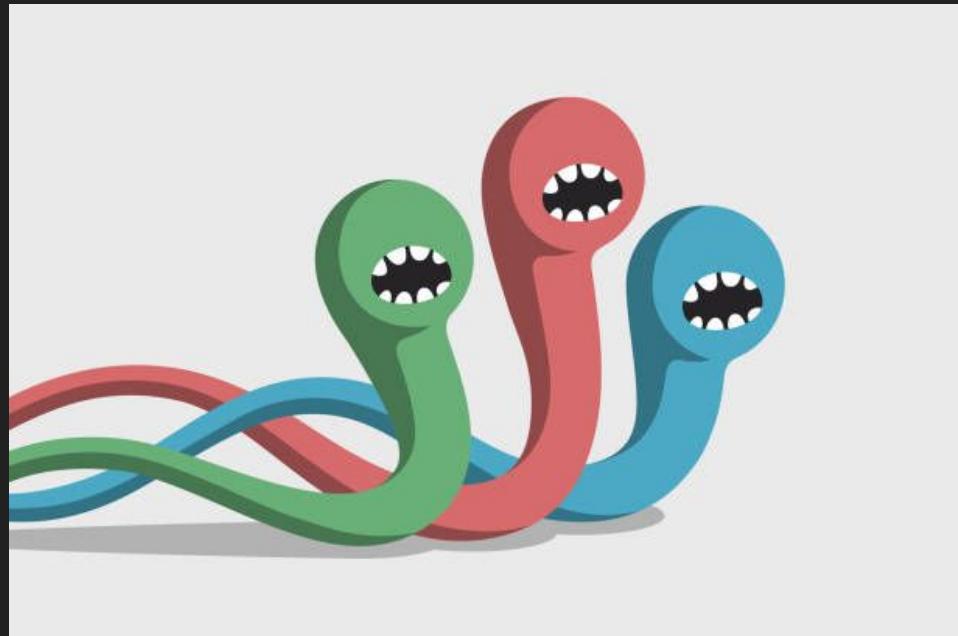
# What is a “helminth”?

From greek “*helmins*” = “worm”

Acanthocephalans, Cestodes, Nematodes,  
Trematodes

Descriptive term; not monophyletic, but all  
endoparasitic and “worm-like”

Many respond to similar classes of medication



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda

# Arthropods

Many of these you know! - Lots  
of Free living members!

Class Crustacea

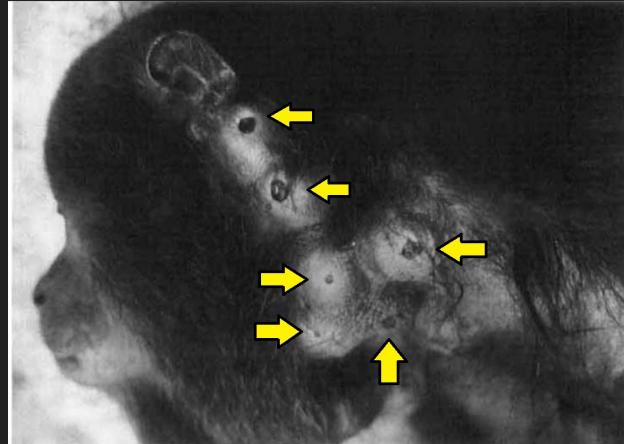


Class Arachnida

Superorder Acariformes

Order Ixodida

Class Insecta



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Crustacea

## Class Crustacea

Many belong to subclass  
Copepoda - “fish lice”

Often ectoparasites living on  
gills, scales, skin, or flesh of fish

Segmented body with chitinous  
exoskeleton

Large compared to most of our  
other parasite groups

Many have hook-like holdfasts



# Class Arachnida

Includes

- Mites (Superorder Acariformes)
- Ticks (Order Ixodida)

Many ectoparasites with special holdfast mechanisms



**Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Arachnida, Superorder Acariformes**

# Mites

Tiny ectoparasites, often feeding on blood, skin, or keratin

8 legged, jointed bodies, jointed legs, and an outer skeleton.

Extremely small; most less than 750 microns

Chelicerae (jaws) with pedipalps



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Arachnida, Order Ixodida

# Ticks

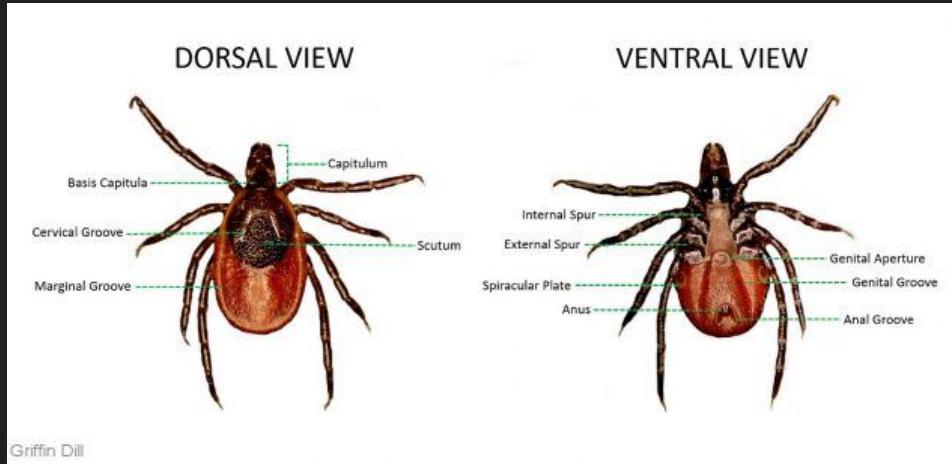
Hematophagous, 8 legged with hard outer exoskeleton

Small head (capitulum) with flattened, oval shape body (idiosoma)

“Hard bodied ticks” have dorsal plate called scutum

Many have multiple hosts throughout their lifecycle, vectors of many viral diseases

Insert a barbed hypostome into host to suck blood



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Insecta

## Class Insecta

6 Legged, winged (usually-fleas and lice are exceptions), hard outer exoskeleton

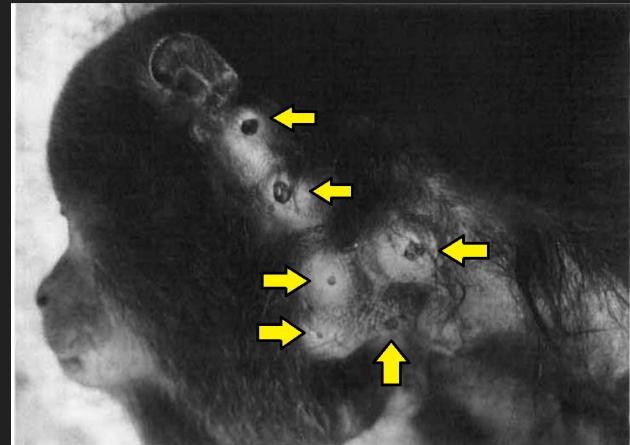


Some lay eggs inside their host to hatch out (ex. botflies)



Others are hematophagous

In addition to being parasites themselves, often importance microparasite vectors



Domain Eukarya, Kingdom Animalia, Phylum Chordata

Chordates can be parasites too!

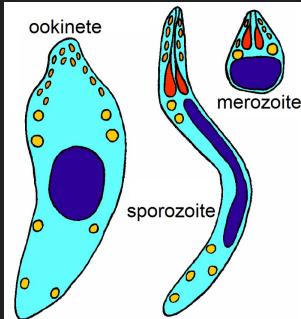


# Clade Alveolata (Alveolates) : Phylum Apicomplexa

Intracellular parasitic protists  
Unicellular, spore-forming

Includes the parasites causing...

- Toxoplasmosis
- Malaria
- Babesia
- Cryptosporidiosis

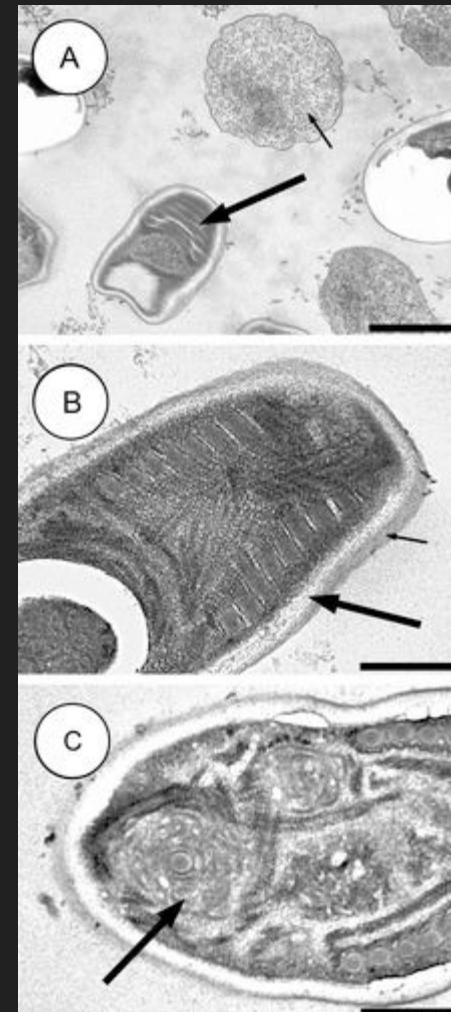
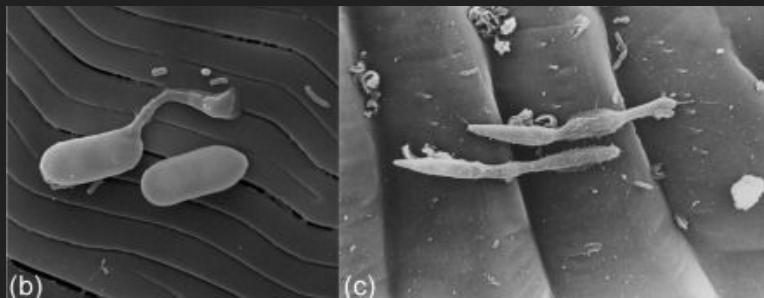


		Human Malaria				
Species \ Stages		Ring	Trophozoite	Schizont	Gametocyte	
<i>P. falciparum</i>						<ul style="list-style-type: none"> <li>Parasitised red cells (pRBCs) not enlarged.</li> <li>RBCs containing mature trophozoites sequestered in deep vessels.</li> <li>Total parasite biomass = circulating parasites + sequestered parasites.</li> </ul>
<i>P. vivax</i>						<ul style="list-style-type: none"> <li>Parasites prefer young red cells</li> <li>pRBCs enlarged.</li> <li>Trophozoites are amoeboid in shape.</li> <li>All stages present in peripheral blood.</li> </ul>
<i>P. malariae</i>						<ul style="list-style-type: none"> <li>Parasites prefer old red cells.</li> <li>pRBCs not enlarged.</li> <li>Trophozoites tend to have a band shape.</li> <li>All stages present in peripheral blood</li> </ul>
<i>P. ovale</i>						<ul style="list-style-type: none"> <li>pRBCs slightly enlarged and have an oval shape, with tufted ends.</li> <li>All stages present in peripheral blood.</li> </ul>
<i>P. knowlesi</i>						<ul style="list-style-type: none"> <li>pRBCs not enlarged.</li> <li>Trophozoites, pigment spreads inside cytoplasm, like <i>P. malariae</i>, band form may be seen</li> <li>Multiple invasion &amp; high parasitaemia can be seen like <i>P. falciparum</i></li> <li>All stages present in peripheral blood.</li> </ul>

Domain Eukarya, Kingdom Fungi, (Phylum Rozellomycota, Class Microsporidia)

# Kingdom Fungi (clade Holomycota)

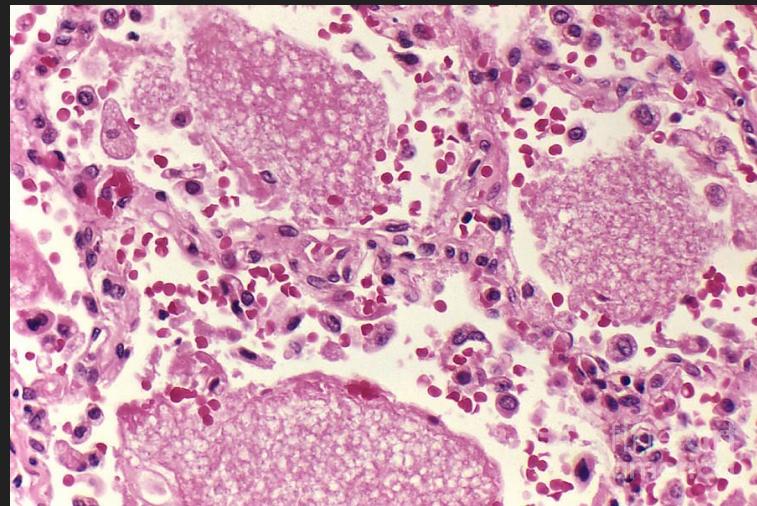
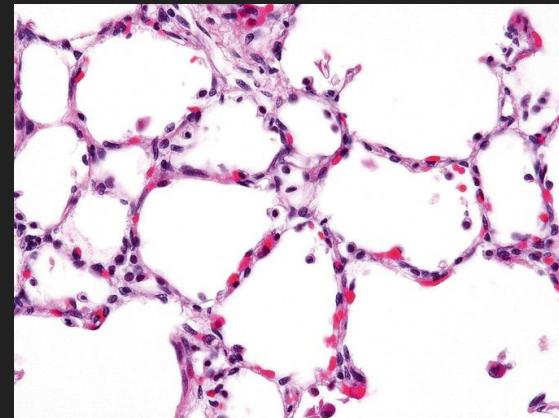
- Rigid cell wall made of chitin
- Vegetative growth via fungal mycelium or yeast-like budding
- Elongated hyphae can grow through host cells
- Produce sexual or asexual spores
- Many live as free-living saprophytes, feed on dead or decaying material.



Domain Eukarya, Kingdom Fungi, (Class Pneumocystidomycetes, Order Pneumocystidales)

## Class: Pneumocystidomycetes

- “Yeast-like” fungi that invade human lung tissue.
- Found in the lungs of many healthy humans, but in some circumstances (often associated with reduced immune function) can cause *Pneumocystis* pneumonia
- Extracellular
- Complicated life cycle; when mature, globular cysts form, visible in biopsy of host tissue



# Protozoans (trypanosomes)

Unicellular, parasitic and flagellated

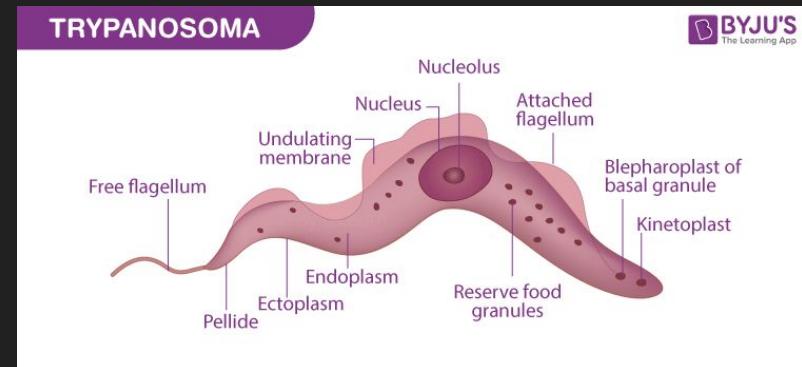


Dark nucleus visible under s  
with many stains

Undulating membrane for  
locomotion

African trypanosomiasis  
(Sleeping sickness)  
*Trypanosoma brucei*

Chagas Disease  
*Trypanosoma cruzi*



Domain Eukarya, Kingdom Plantae (Clade Viridiplantae)

Plants can also be parasites!



# Before next lab...

Submit Worksheet 1 through  
blackboard

Review Lab 2 presentation

Review Microscope basics +  
anatomy (on next week's pre-lab  
quiz)

