

Lab 1: Parasite Diversity

(Plus a review of not breaking microscopes)

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!

TAXONOMY CLASSIFICATIONS



DEAR

domain

KING

kingdom

PHILIP

phylum

CAME

class

OVER

order

FOR

family

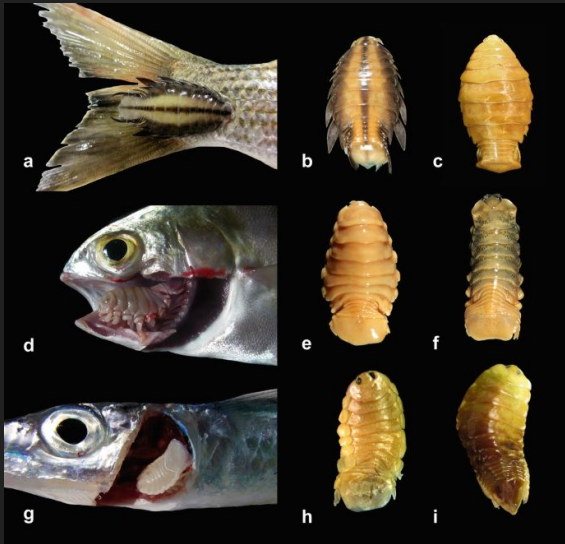
GOOD

genus

SOUP

species

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)

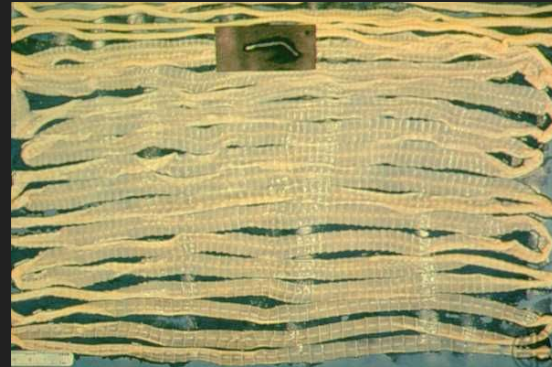
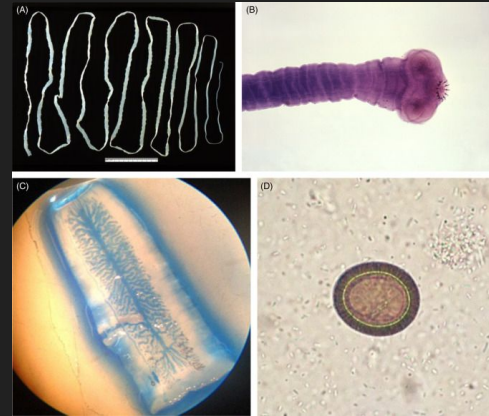


Class: Trematoda (flukes)



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



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

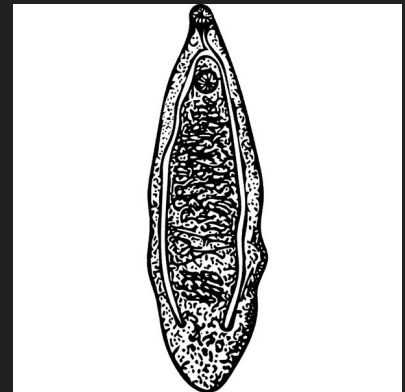
Domain Eukarya, Kingdom Animalia, Phylum Platyhelminthes, Class Trematoda

Class Trematoda (Flukes)

Monogeneans: One Oral sucker, simply life cycle
Digenean 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

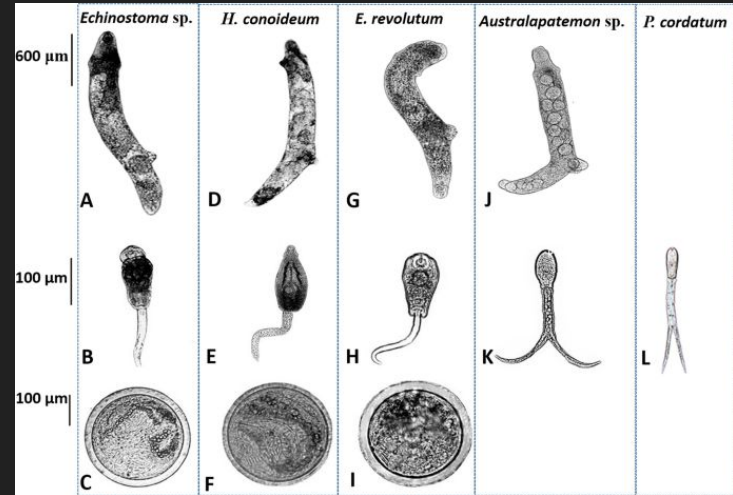
Often leaf-like in shape

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



Domain Eukarya, Kingdom Animalia, Phylum Nematoda

Phylum Nematoda (roundworms)

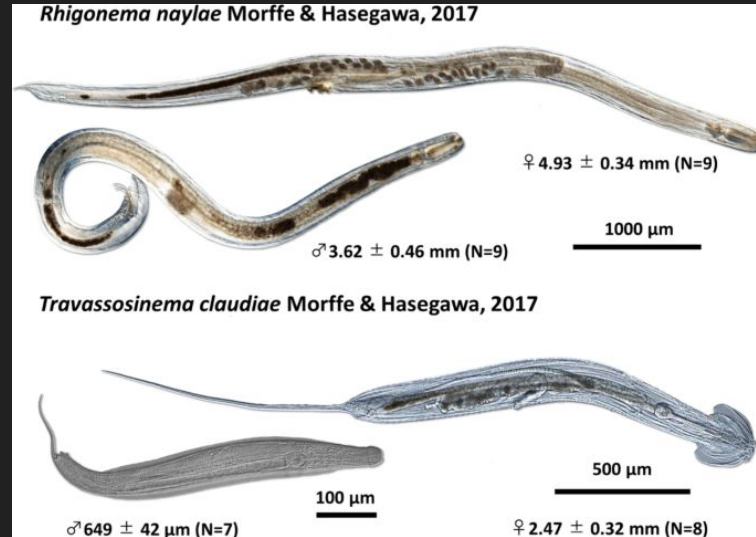
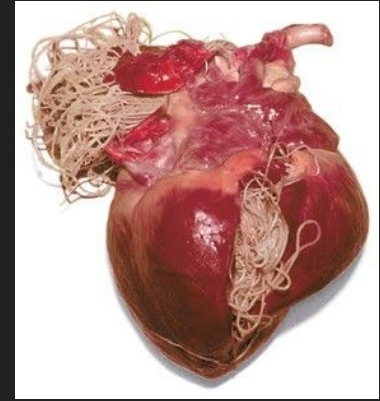
Many free living and parasitic species! - Most diverse group of helminths

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



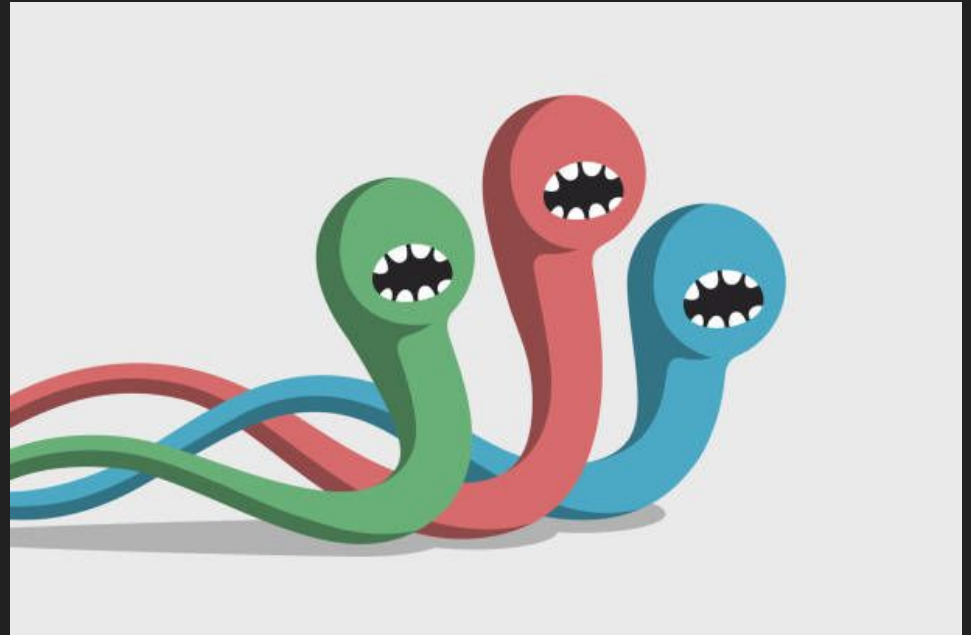
What is a “helminth”?

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

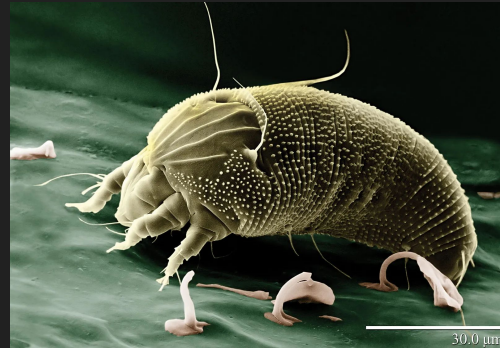
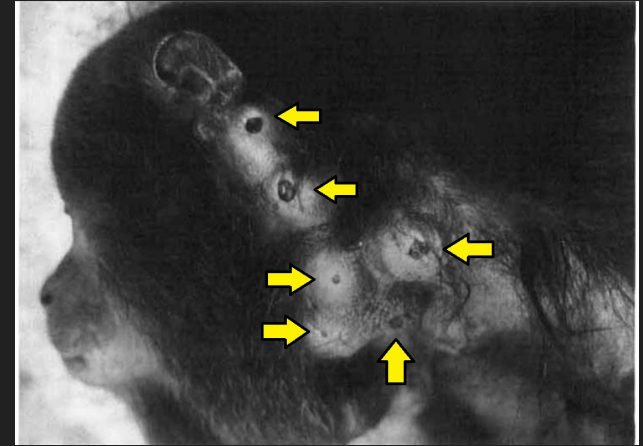


Class Arachnida

Superorder Acariformes

Order Ixodida

Class Insecta



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Crustacea

Class Crustacea

Most in 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



Domain Eukarya, Kingdom Animalia, Phylum Arthropoda, Class Arachnida

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

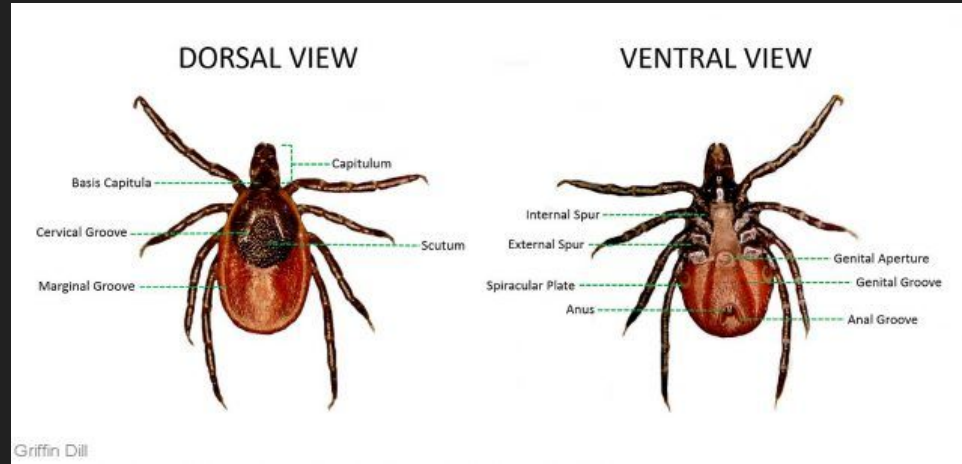
Hematophagous, 8 legged with hard outer exoskeleton

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

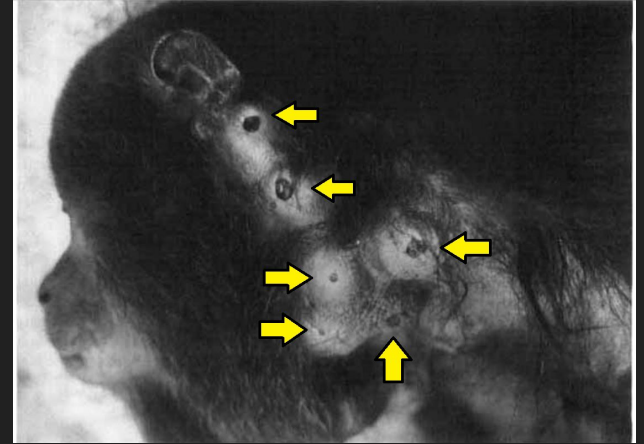
Many are in Order: Diptera (flies)

6 Legged, winged, hard outer exoskeleton

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

Others are hematophagous

In addition to being parasites themselves, often important microparasite vectors



Domain Eukarya, Kingdom Animalia, Phylum Chordata

Chordates can be parasites too!

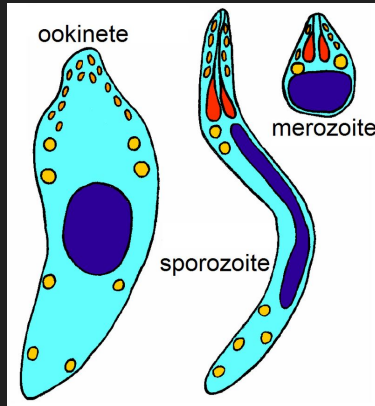


Clade Alveolata (Alveolates) : Phylum Apicomplexa

Intracellular parasitic protists

Includes the parasites causing...

- Toxoplasmosis
- Malaria
- Babesia
- Cryptosporidiosis

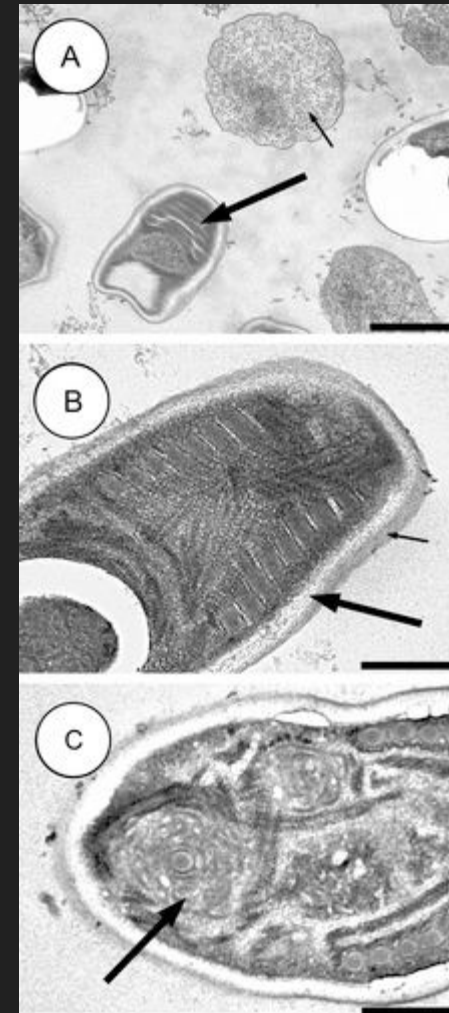
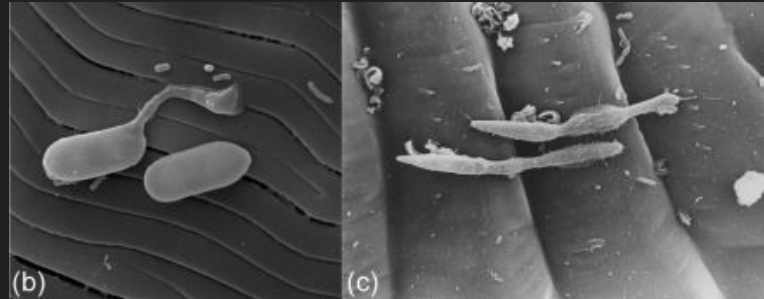


| Human Malaria | | | | | |
|----------------------|------|-------------|----------|------------|---|
| Stages Species | Ring | Trophozoite | Schizont | Gametocyte | |
| <i>P. falciparum</i> | | | | | <ul style="list-style-type: none"> • Parasitised red cells (pRBCs) not enlarged. • RBCs containing mature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

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, Clade Discoba/Excavata

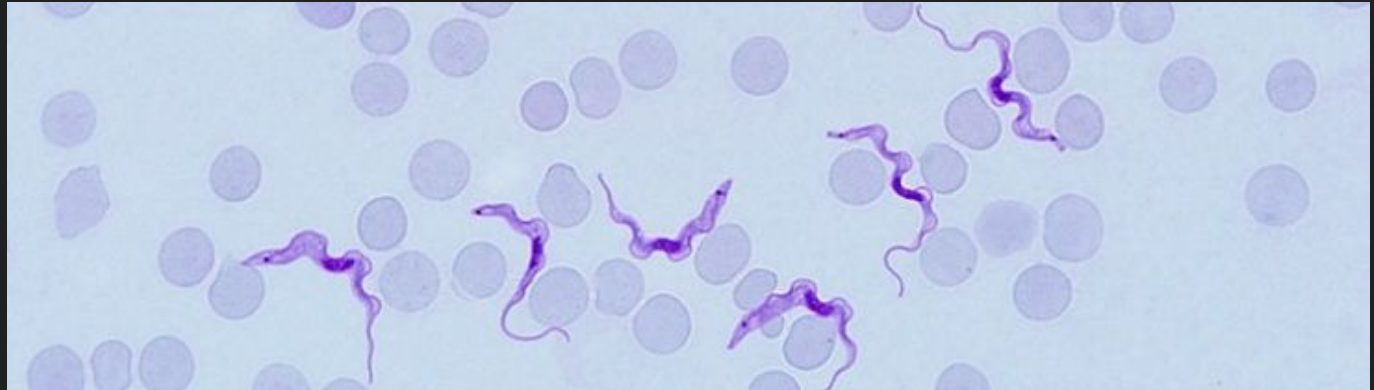
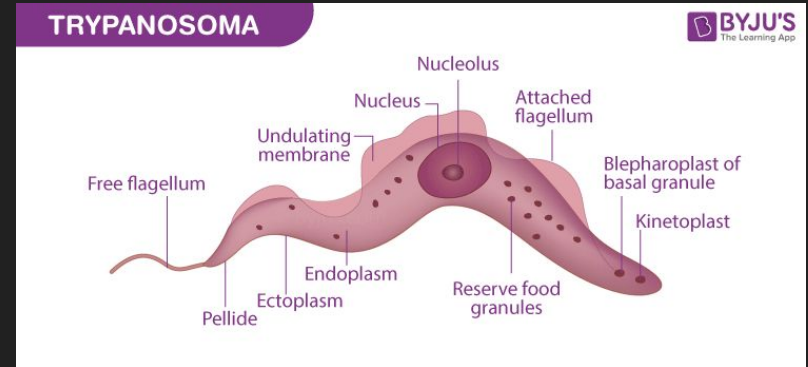
Protozoans (trypanosomes)

Unicellular, parasitic and flagellated

Dark nucleus visible under microscope
with many stains

Undulating membrane for locomotion

Malaria
Sleeping sickness



Domain Eukarya, Kingdom Plantae (Clade Viridiplantae)

Plants can also be parasites!

