Biomedical parasitology

Parasite sex

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Politically incorrect

Must address 'taboo' topics:

- Politics
- Religion
- Health
- Education
- Gender
- Sex

Social sciences dominated by gender issues

So too, the biological sciences!

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Parasitic life style

Parasite requires host for:

- home (shelter)
- sustenance (food)
- reproduction (growth)
- mobility (transmission)

Detrimental effect on host:
- mortality (death)
- morbidity (disease)

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Biodiversity

Species richness
- species evolve to fill habitats/niches

Evolution
- survival of the fittest

How to adapt to changing circumstances?
- cells not immortal (need to propagate)
- need more than 'cloning' process (mitosis)
- progeny must be better adapted (inheritance)
- change genome during reproduction by:
  - recombination, through sex (meiosis)

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Need to study sex!

Sexual reproduction involves:

- gender differentiation
  - female + male gametes
- fertilization
  - recombination in zygote
- gestation/parturition
  - embryo/neonatal care

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Gender of HOST

Distribution/abundance
- females 'more prevalent' on Earth (consider herd/flock structures)
- females longer-lived

Gender differences
- genotypic (DNA)
- phenotypic (appearance)
- invest in reproduction (gestation, rearing)
- but females 'more susceptible' to disease!?

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Host susceptibility

- age (young/old)
- physiological state (malnourished/stressed)
- immunodeficiencies (congenital/acquired)
- gender (pregnancy/lactation)

Infections more severe during pregnancy:
- malaria, viral hepatitis, influenza, polio, etc

Infections can reactivate during pregnancy:
- cytomegalovirus, herpes, Epstein-Barr virus

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Host preferences

Many parasites prefer female hosts:

- behavioural characteristics
  - head lice in girls (long clean hair)
- tissue tropism
  - *Trichomonas* urogenital tract
- vertical transmission
  - *Toxoplasma* crossing placenta

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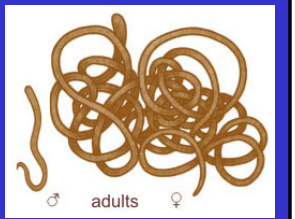
Gender of PARASITE

Variable equity issues

- some gender-less
- a few with gender equity
- most with gender inequity



(females bigger, stronger, hungrier, live longer)

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PARASITOLOGY

Protozoa (amoeba, flagellates, ciliates, sporozoa) | Helminths (roundworms, tapeworms, flukes) | Arthropods (ticks, mites; fleas, flies, lice)

Micro-parasites
- multiplicative
- reproduce quickly
- cause acute diseases

Macro-parasites
- cumulative
- reproduce slowly
- cause chronic diseases

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PARASITOLOGY

Protozoa | Helminths | Arthropods

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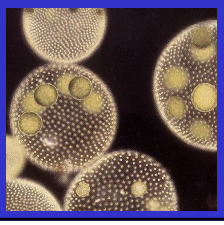
PARASITOLOGY

Protozoa (amoeba, flagellates)

cloning

- cell fission (splitting)
- some form colonies
- some form 'embryos'



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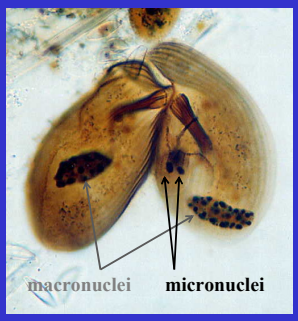
PARASITOLOGY

Protozoa

ciliates

conjugation

- pairing
- swap genetic material



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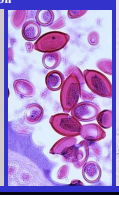
PARASITOLOGY

Helminths

roundworms

- dimorphism (F ≥ M)
- rough sex
- lusty appetites
- egg factories

sexual differentiation



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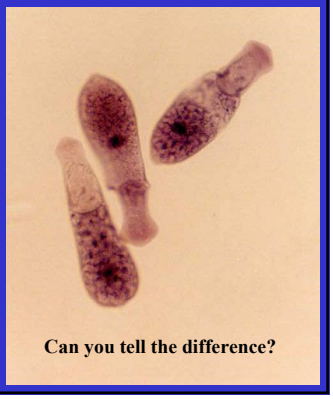
PARASITOLOGY

Protozoa

sporozoa

gamogony

Gregarines
- form pairs
- = gametes (m, f)
- isogamy (equal numbers)



Can you tell the difference?

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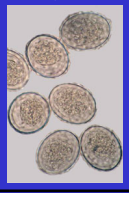
PARASITOLOGY

Helminths

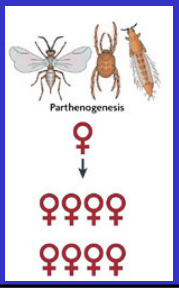
roundworms

- do without males
- females support development of unfertilized eggs (= parthenogenesis)

sexual differentiation, BUT . .



Found in:
- worms
- insects
- lizards



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PARASITOLOGY

Protozoa

sporozoa

gamogony

Coccidia, malaria
- form gametes
- anisogamy (F > M)

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PARASITOLOGY

Helminths

tapeworms

- body segments with both M + F organs
- hermaphrodites

sexual differentiation, BUT ..

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PARASITOLOGY

Helminths

- body with both M + F organs
- hermaphrodites

flukes

- single exception

sexual differentiation, BUT ..

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PARASITOLOGY

Protozoa amoeba flagellates ciliates sporozoa

Helminths roundworms tapeworms flukes

Arthropods ticks, mites fleas, flies, lice

cloning pairing gamogony

sexual dimorphism

but:

hermaphroditism
parthenogenesis

shift from asexual cloning to sexual differentiation
(with a bit of gender blending)

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PARASITOLOGY

females with lusty appetites
(blood meals)
(protein for progeny)

Arthropods

fleas, flies, lice

sexual differentiation

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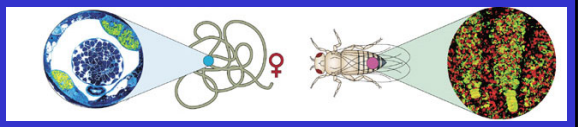
Enigmatic interactions

Wohlbachia bacteria

-found in insects, helminths

- strange effects on male hosts



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PARASITOLOGY

females with lusty appetites
(engorge with blood)

female fecundity high
progeny survival low

Is parasitism a wasteful process?

Arthropods

ticks, mites

sexual differentiation

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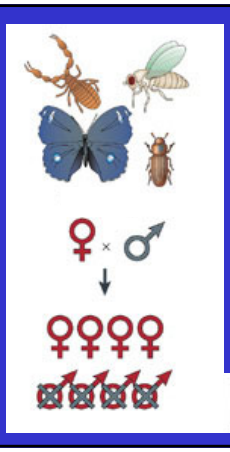

Male killing

- infections selectively kill males

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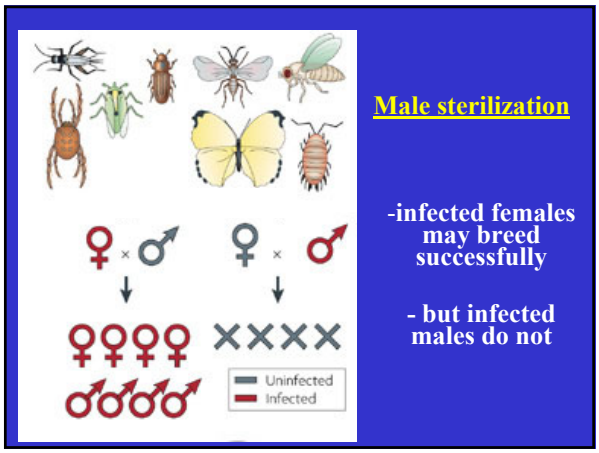
Male sterilization
-infected females may breed successfully
- but infected males do not
Uninfected
Infected

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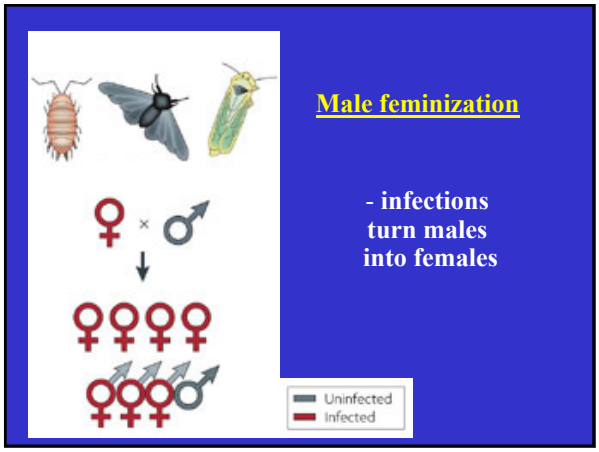
Male feminization
- infections turn males into females
Uninfected
Infected

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CONCLUSION
In the microbial world,
good to be a female,
not so good to be a male!

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