Introduction to the internal parasites

BVM&S Parasitology

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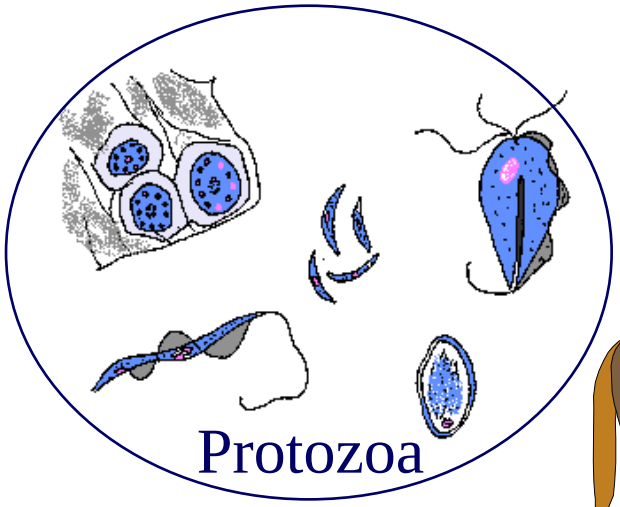
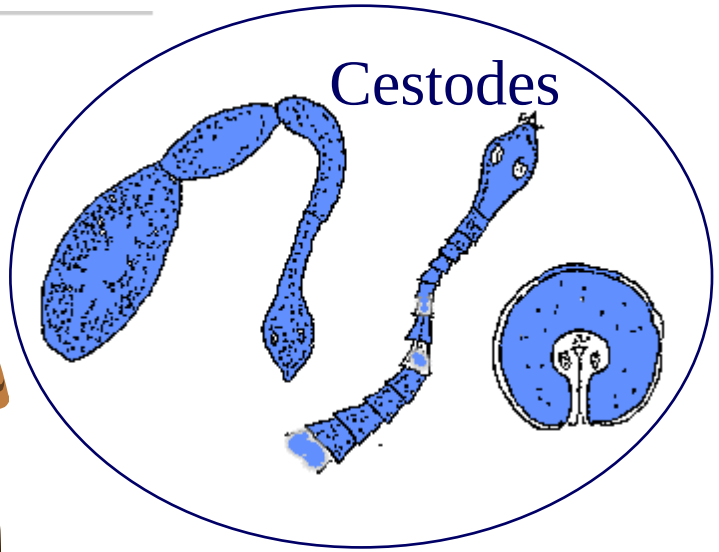
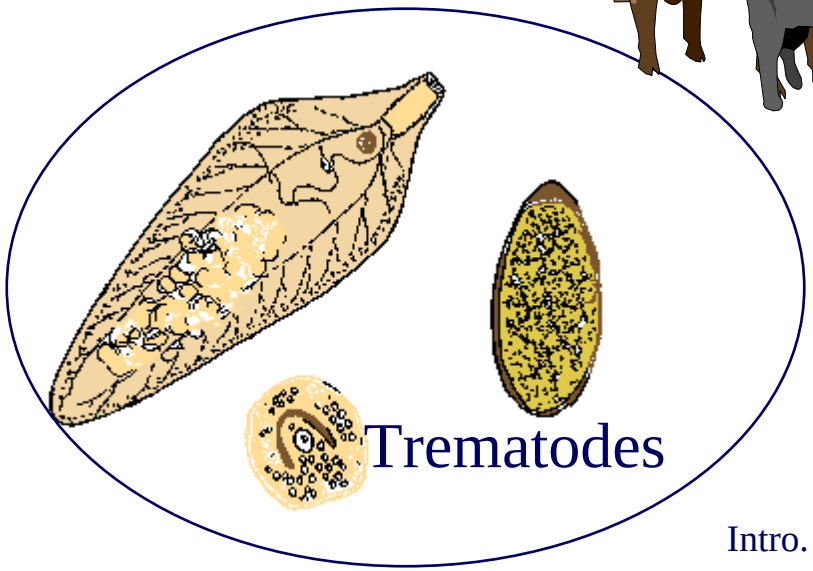
Learning Outcomes

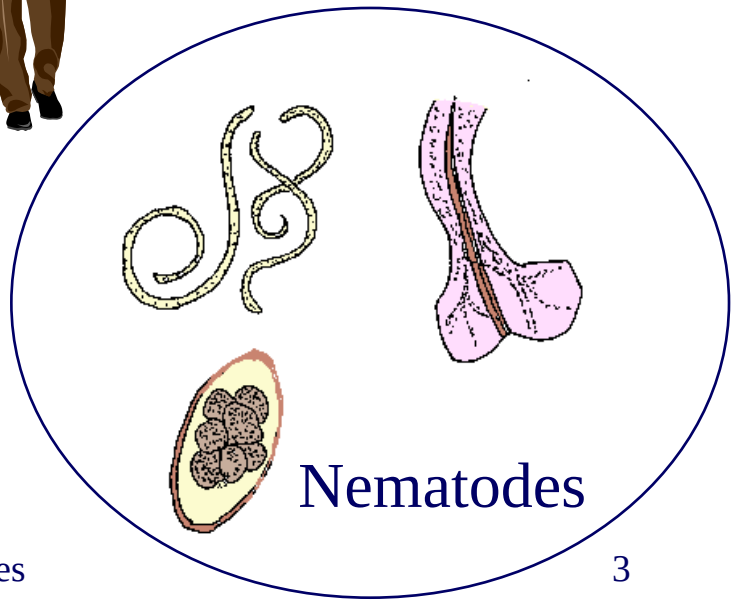
- Describe what is meant by internal parasites, where they can be found and why they are important to veterinarians.
- Describe the features of different types of life cycles in relation to epidemiology.
- Describe adaptations to internal parasitism by host and parasite in relation to epidemiology and disease.
- Use appropriate terminology to describe features of internal parasites.

What are the “internal parasites”?









Who lives where?

BRAIN
Toxoplasma
Tapeworm larvae

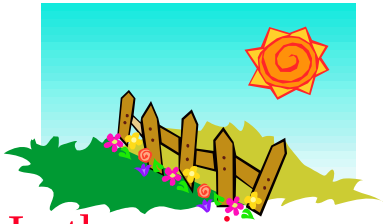
MUSCLE
Toxoplasma, Sarcocystis
Tapeworm larvae

Foetus
Toxoplasma

LUNGS
Lungworm
Tapeworm larvae

LARGE INTEST.
Nematodes
Coccidia

BLOOD
Babesia



In the environment

ABOMASUM
Nematodes

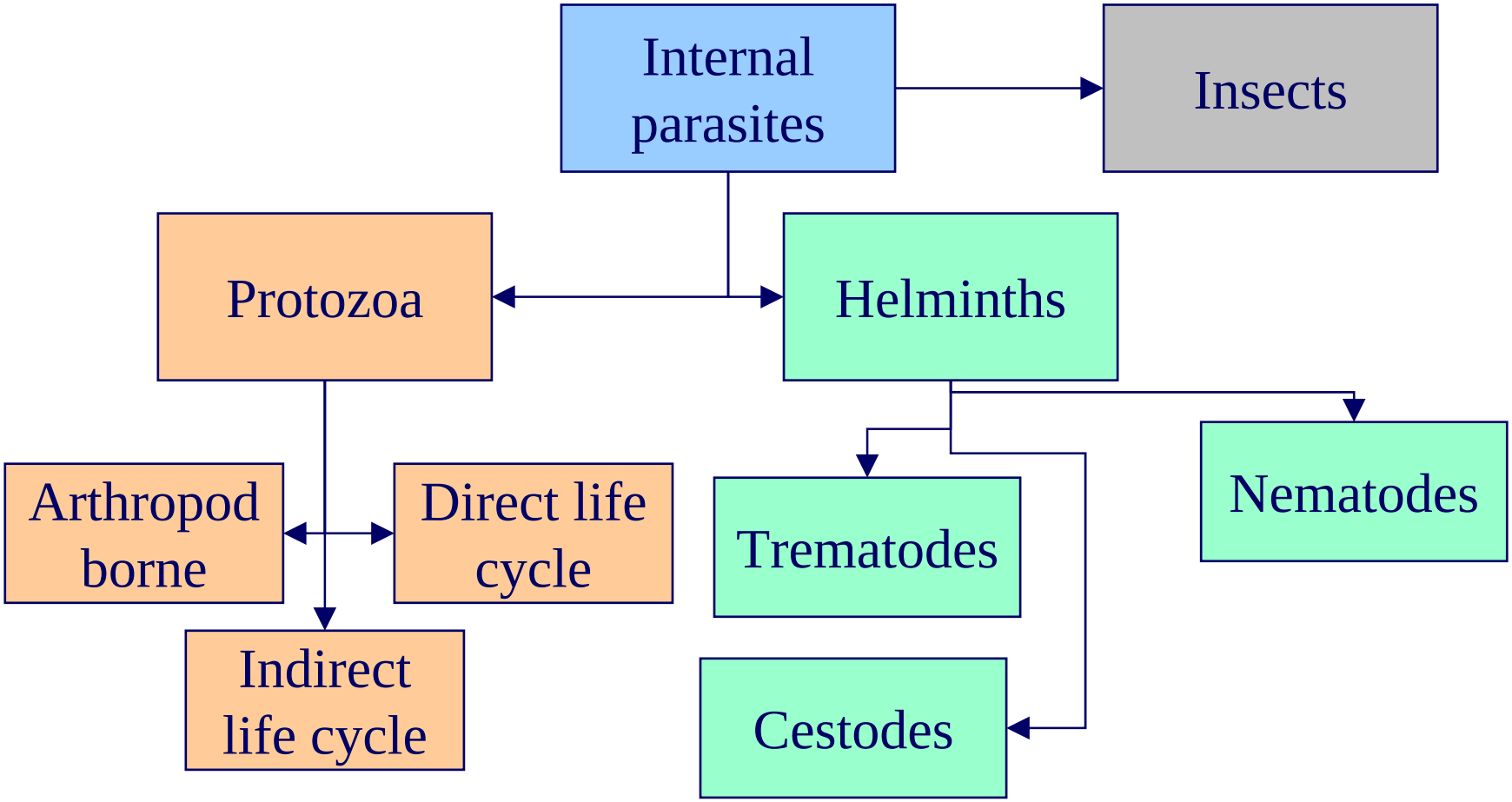
LIVER
Fluke

SMALL INTEST.
Nematodes
Adult tapeworms

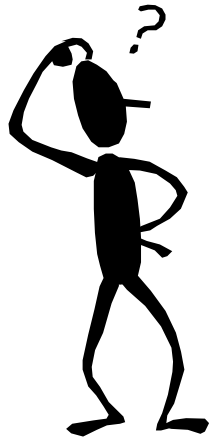
Why are internal parasites important?

- **Reduced productivity** due to:
  - subclinical conditions e.g. chronic helminth infections
  - due to clinical disease especially in young animals e.g. coccidiosis
- **Costs of treatment** or prevention e.g. poultry coccidiosis (31% of UK animal health sales are for anti-parasitics).
- **Death** of animals with loss of capital investment
- Cause of **disease in humans** (zoonoses)

Learning map for internal parasites



Same parasite; different look



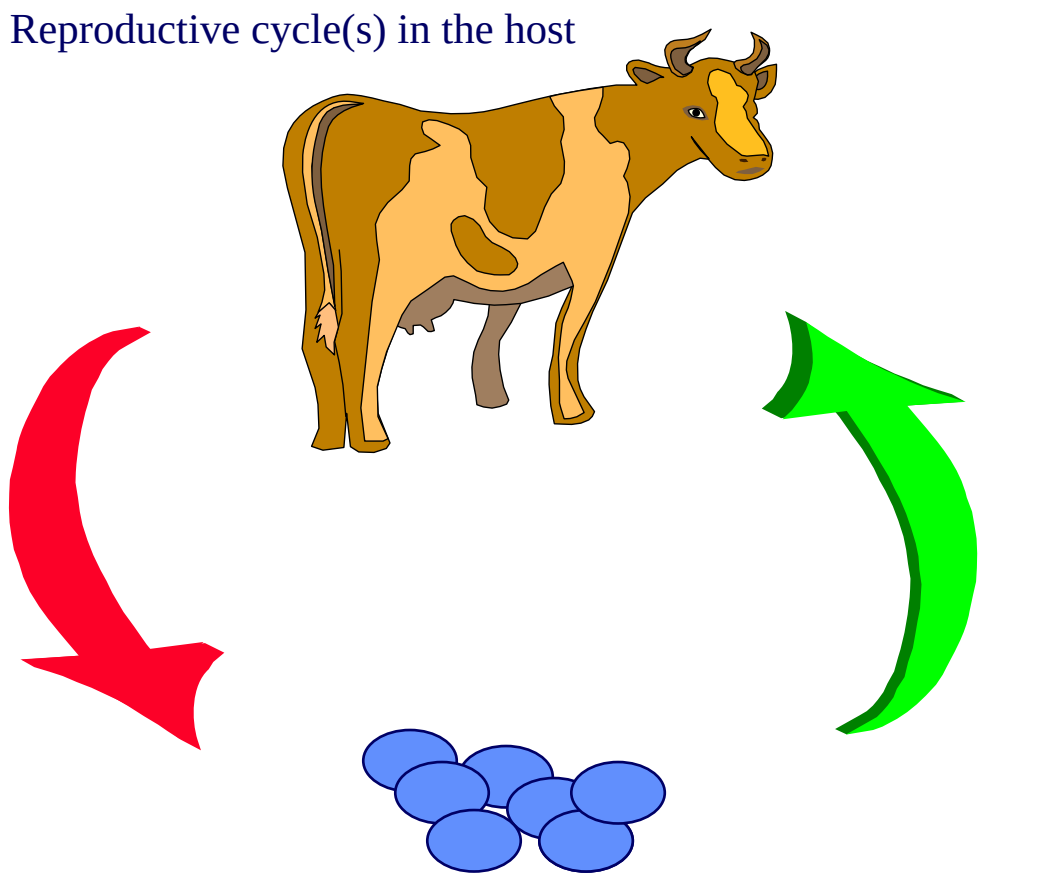
- Active.
  - Feeding and reproducing.
- Dormant or "resting" stages.
  - Cysts or oocysts (protozoa), eggs (helminths), nematode larvae.
- Free-living.
  - Larval stages of nematodes.

Host-parasite Relationships

- Most infect a **single host species** e.g. poultry coccidia, nematodes.
- Some infect **two or three host species**, often needing to cycle between them e.g. cestodes cycle between herbivores and carnivores.
- A few parasites can infect a **wide range of host species**.

Understanding Parasite Life Cycles

- **DIRECT** or MONOXENOUS.
  - Single host.
- **INDIRECT** or HETEROXENOUS.
  - Cycles between two or more hosts.
- **ARTHROPOD-BORNE** parasites.
  - Cycles between vertebrate and arthropod (aka the vector).



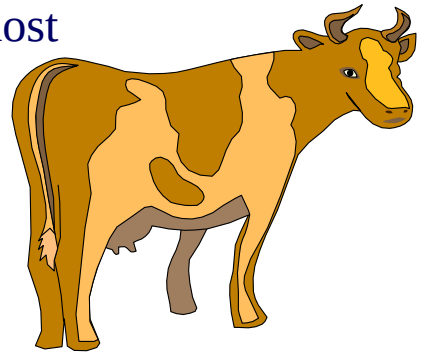
A direct life cycle

Features of indirect life-cycles

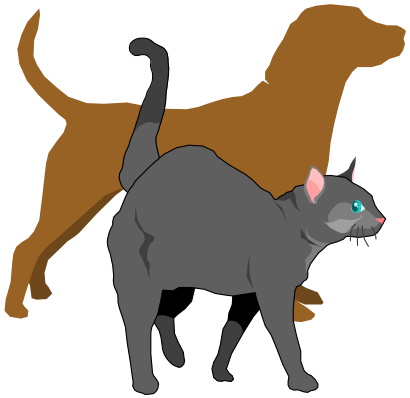
- At least **two** host types involved in the life cycle
  - **Definitive host** - sexual reproduction
  - **Intermediate host** - asexual reproduction or no reproduction
- Obligate vs. facultative

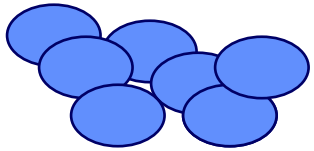
Herbivore: Carnivore cycle

Asexual reproduction cycles in **INTERMEDIATE** host



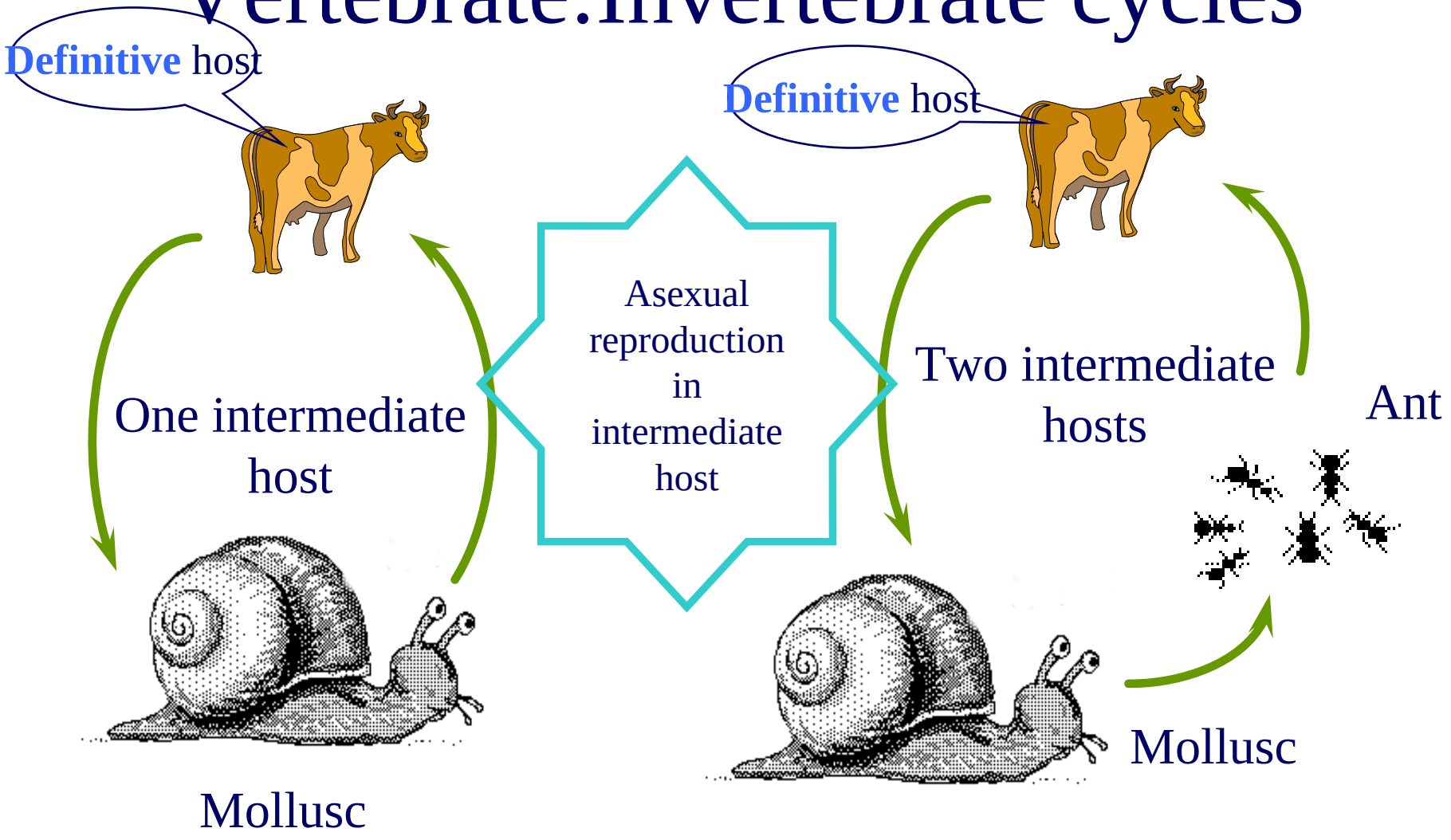
Sexual +/- asexual reproduction cycles in **DEFINITIVE** host





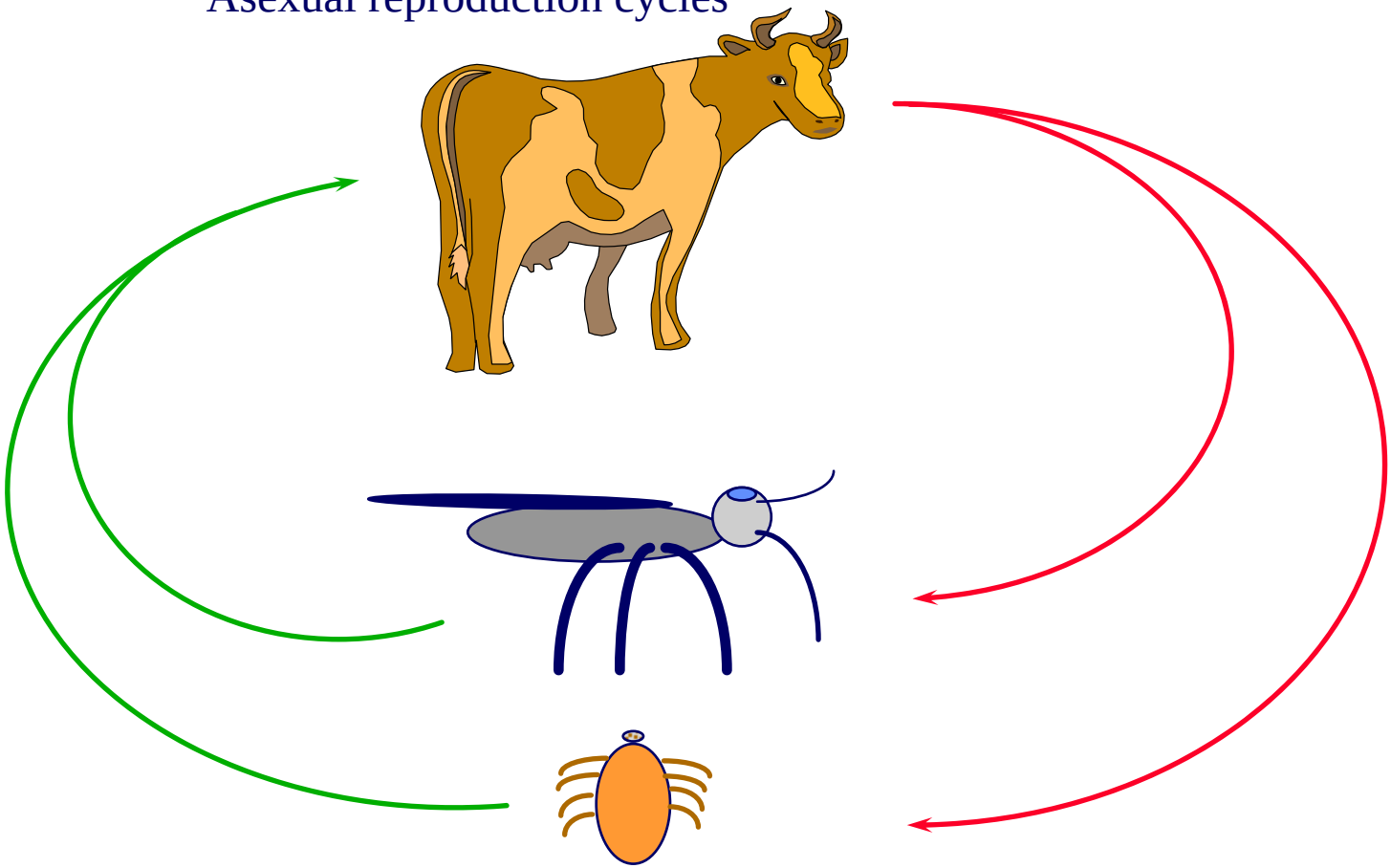
Non-replicating external form

Vertebrate:Invertebrate cycles



Arthropod-borne Parasites

Asexual reproduction cycles



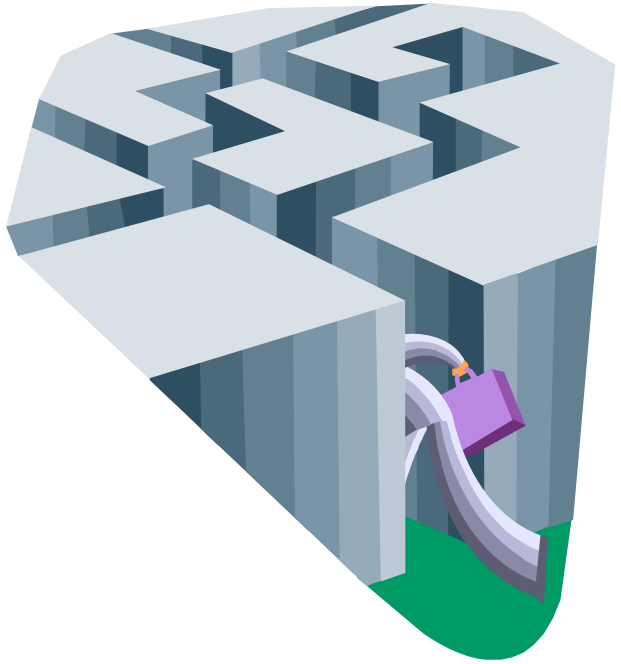
Sexual & asexual reproduction

Host Names

- **DEFINITIVE** or FINAL host. - Where sexual reproduction takes place.
- **INTERMEDIATE** host – only in indirect life cycles
- **TRANSPORT** host - no parasite development
- **PARATENIC** hosts - limited development
- DISEASE host - the host in which disease is seen
- FOMITES - inanimate objects e.g. water, boots.

How are parasites adapted to living inside a host?

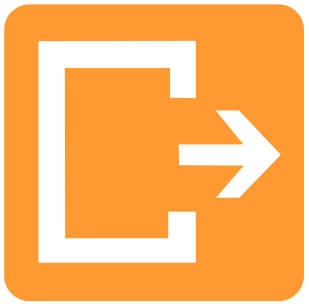
- Getting into the host
- Getting out again
- Surviving in the host
- Feeding
- Reproduction



How do they get in?

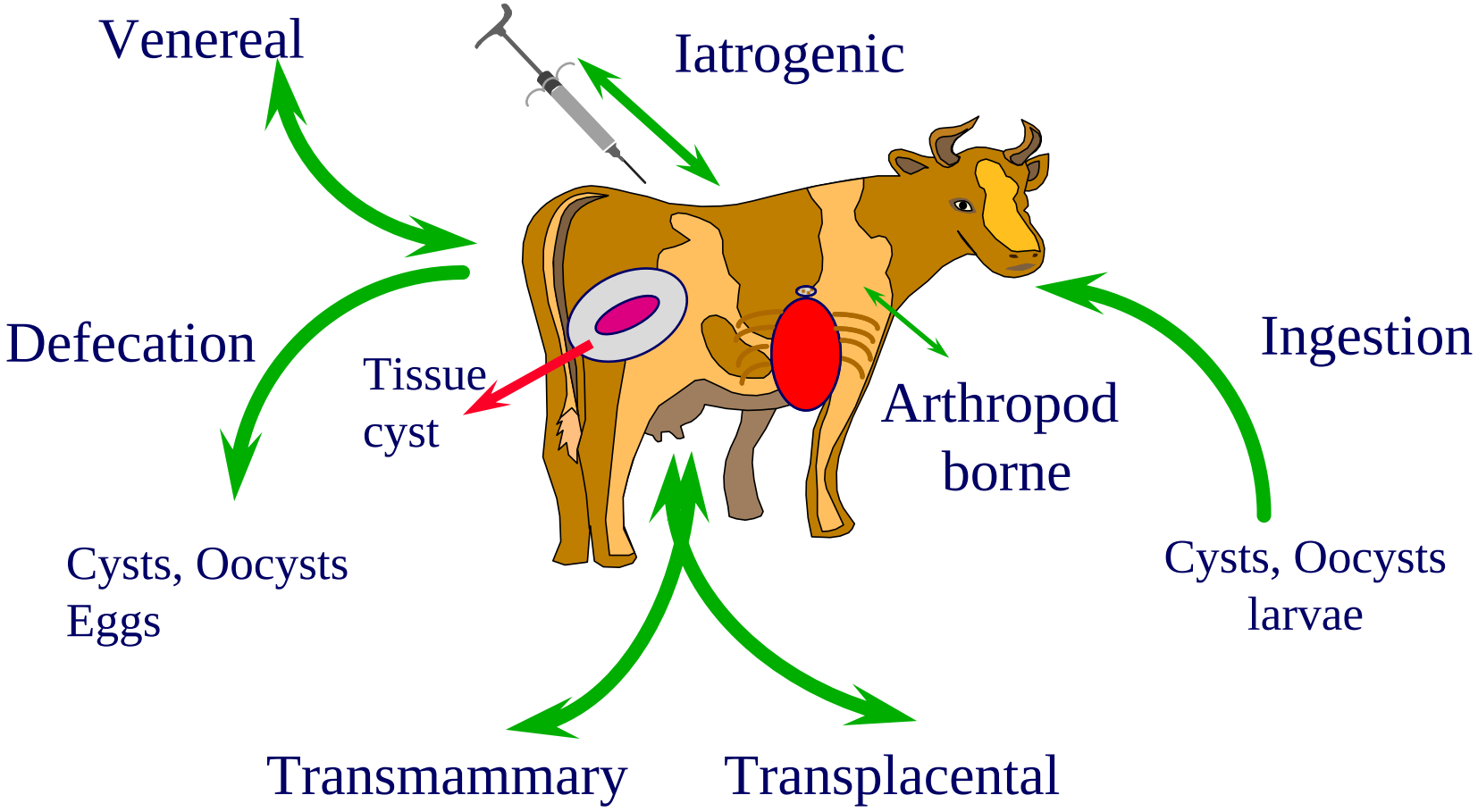
- MOUTH - in food or drink .
- SKIN - direct penetration or via blood sucking arthropod .
- IATROGENIC - via contaminated needles or blood transfusion.
- During COITUS.
- TRANSPLACENTAL - passed to foetus from mother before birth
- TRANSMAMMARY - passed to new-born from mother in milk after birth

How do they get out again?



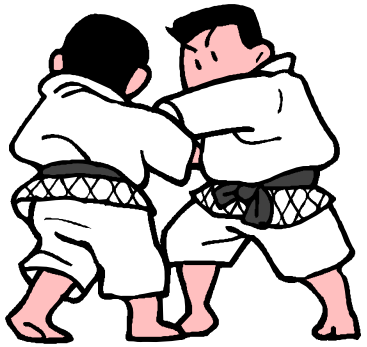
- Via host FAECES .
- Using stages that “rest” in muscles of the host until eaten by another host.
- Pass into a blood sucking arthropods (vector) during feeding.
- Passing out during coitus.
- Passing from the mother to the foetus.
- Passing from mother to the young via milk.

The ins and outs of life as an internal parasite



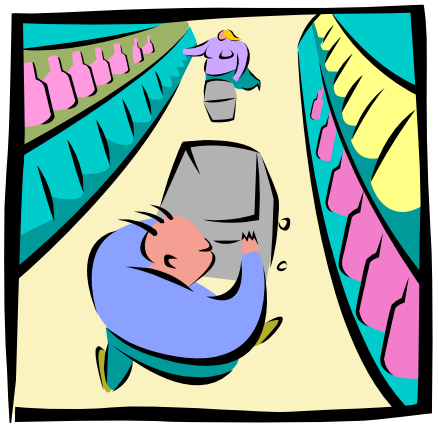
Countering Host Responses

- SPECIAL ATTACHMENTS e.g. hooks, suckers, adhesive plates to counter gut activity.
- Dealing with host IMMUNE RESPONSE
  - Inhabiting lumen of hollow organs.
  - Camouflage by mimicking host antigens
  - Changing their antigens
  - Inhibiting parts of the host immune system
  - Rapid multiplication

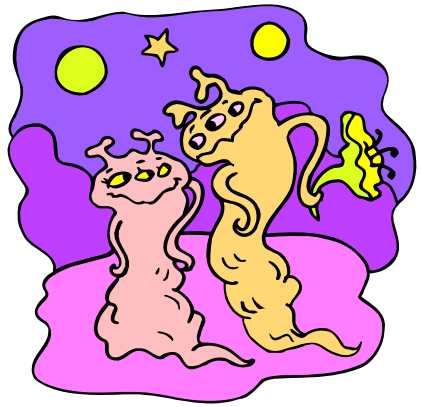


Feeding Mechanisms

- Passive absorption through the outer surface e.g. protozoa and cestodes
- Browsing on gut contents
- Tissue feeders
- Blood feeders



Reproductive Strategies



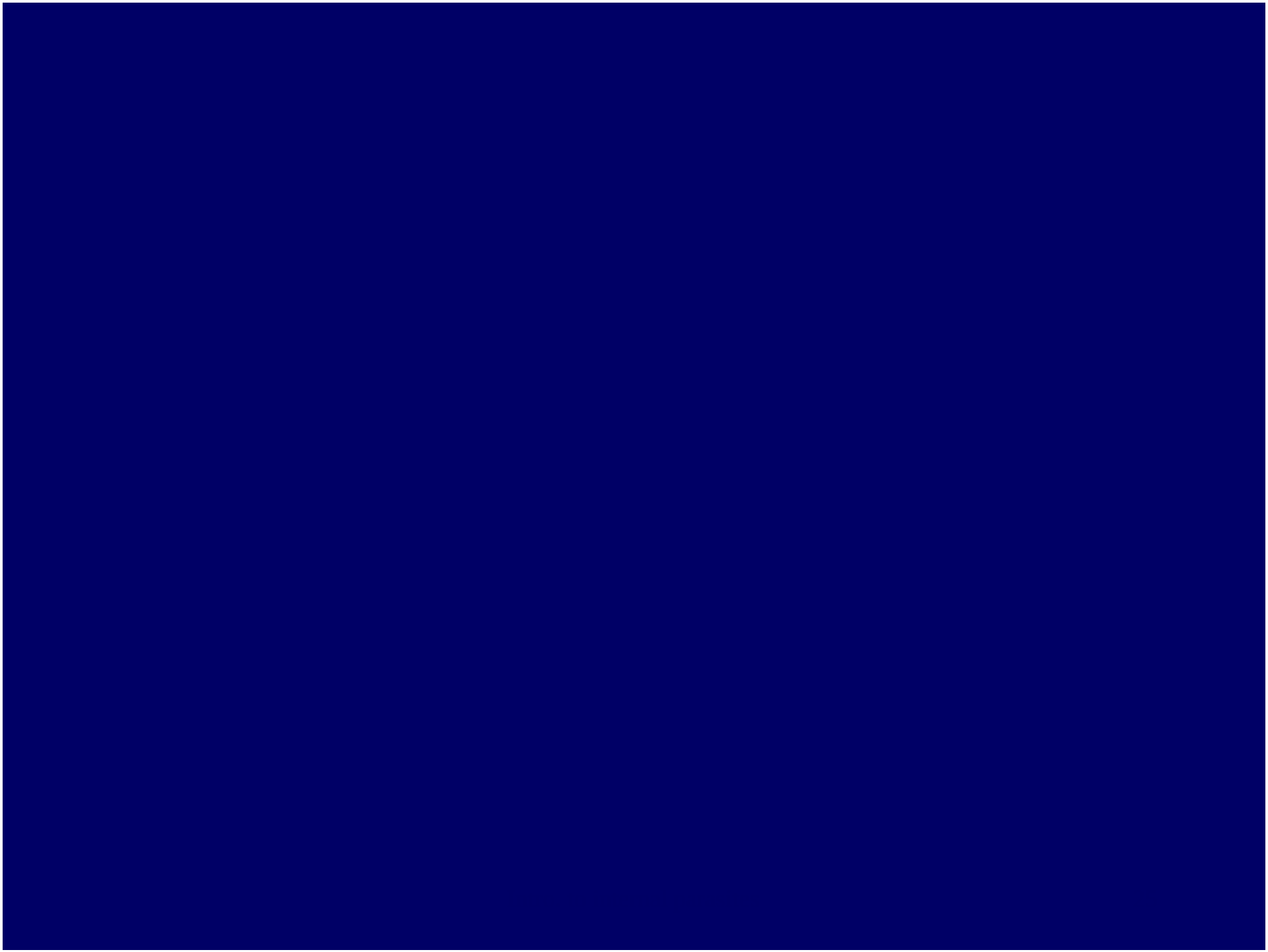
- Asexual
  - Binary fission
  - Multiple nuclear division- schizogony (protozoa)
- Sexual
  - Mating types
  - Gametes
  - Separate males and females
  - Male & female organs in same individual

Effects of Infection

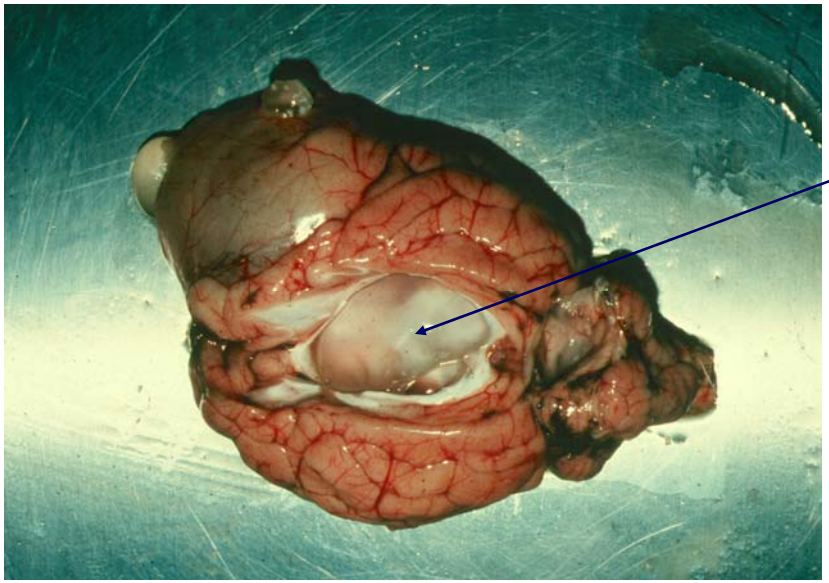
- *Direct* effects
  - Gut disorders caused by gut parasites - diarrhoea, obstruction, intersusception, colic;
  - Respiratory distress - lungworms
  - Anaemia due to blood-sucking gut nematodes
- *Indirect* effect
  - "Failure to thrive" - competition for nutrients, damage to gut wall

Reducing the Impact of Parasite Infections

- *Drug therapy* - lots to choose from (IVS lists over 100 anthelmintics for livestock!).
- *Vaccination* - very few available, are all live vaccines.
- *Environmental management* to reduce exposure to infective forms.
- *Genetic manipulation* using resistant breeds.

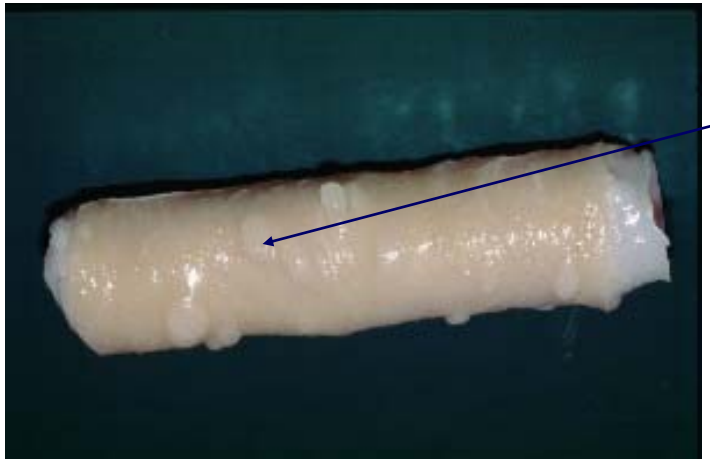


Parasites on the brain



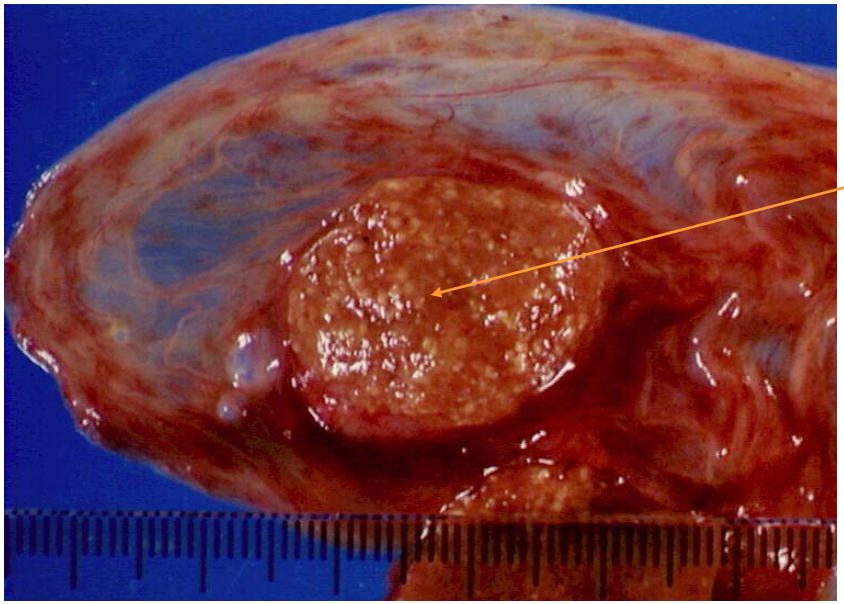
The larval stage of a tapeworm developing in the brain of a sheep

Parasites in the muscle



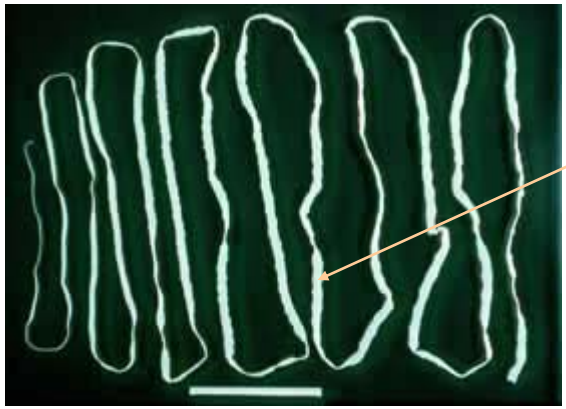
Protozoan tissue cysts in the muscle of a sheep's oesophagus

Parasites infecting the foetus



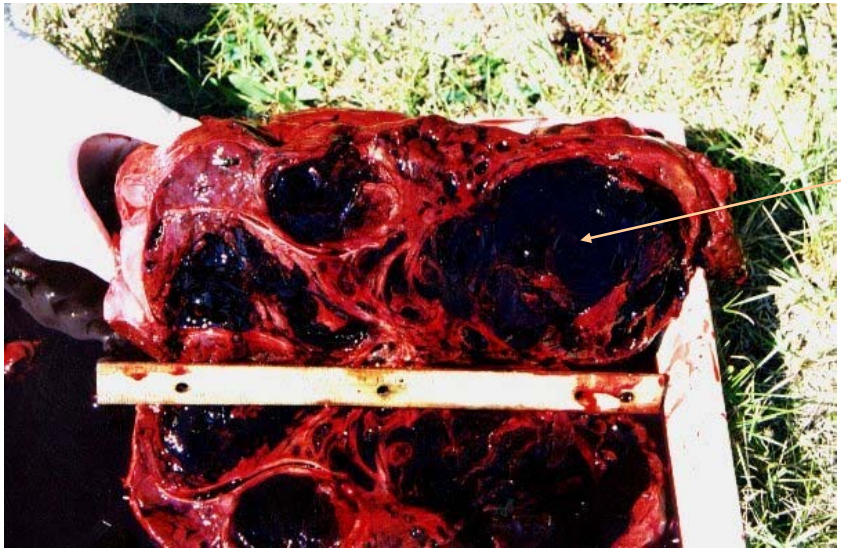
Toxoplasma infection of sheep placenta

In the intestines



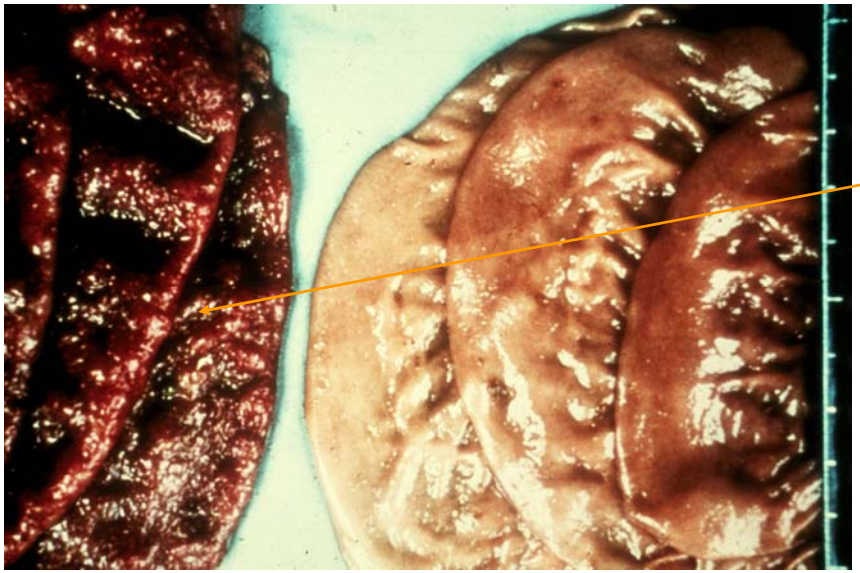
Adult tapeworm from the gut of a dog

Liver parasite



Liver damage caused by acute fluke infection in a moose

Abomasum

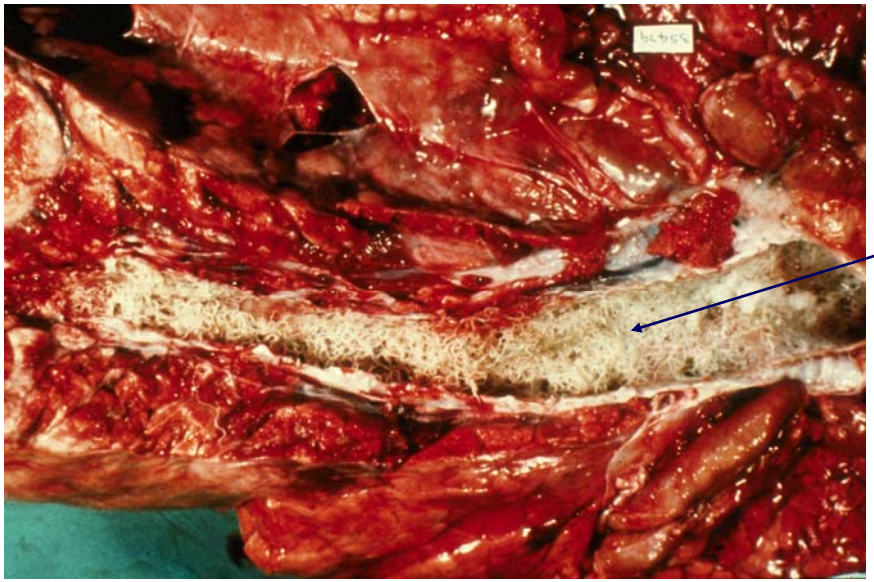


Destruction of abomasal mucosa by larval stages of *Ostertagia*

Blood parasites

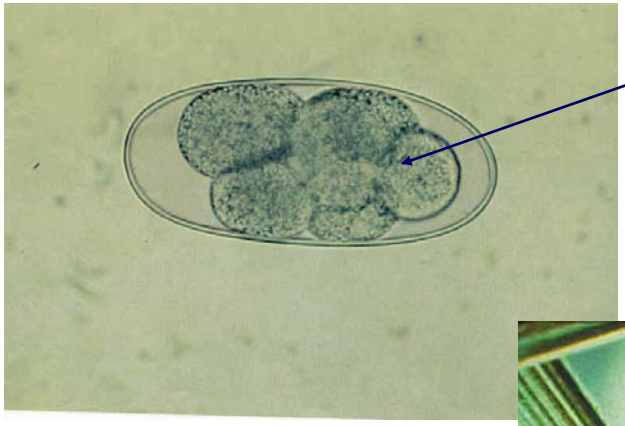
"Redwater" caused by acute *Babesia* infection

Parasites in the lungs

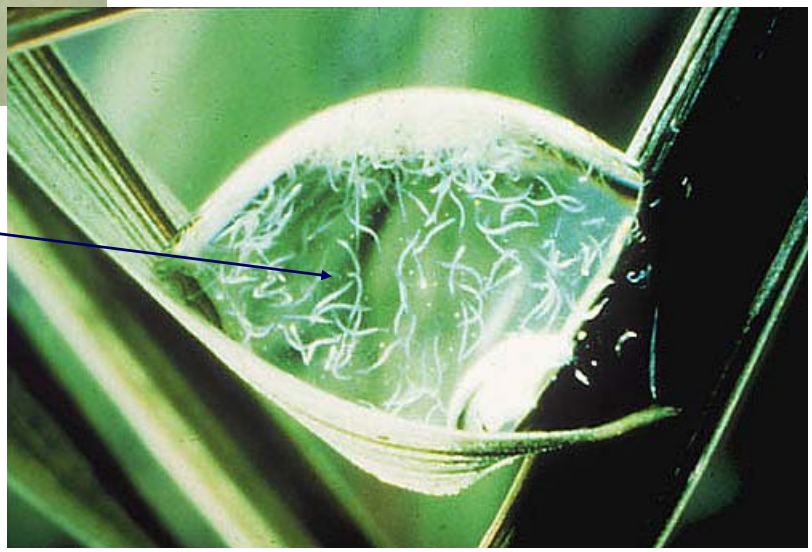


Adult lungworms in the lung of a cow

Parasites “in the field”

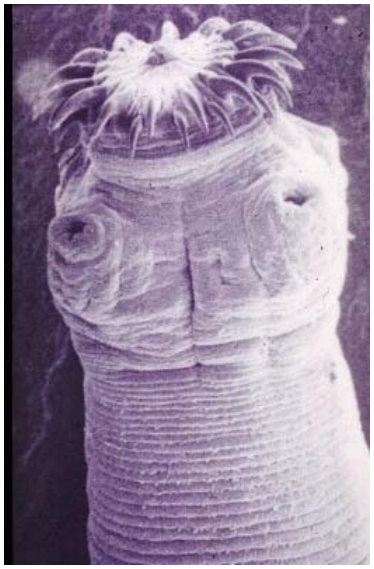


Egg stage of a nematode

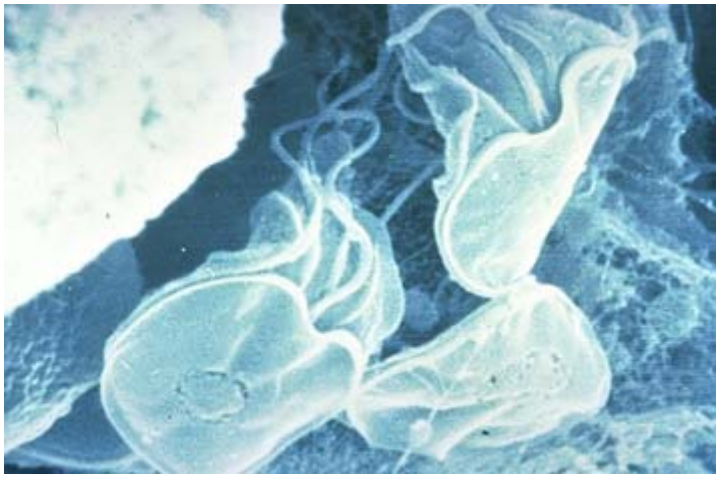


Free-living larval stages of a nematode

Attachment organs

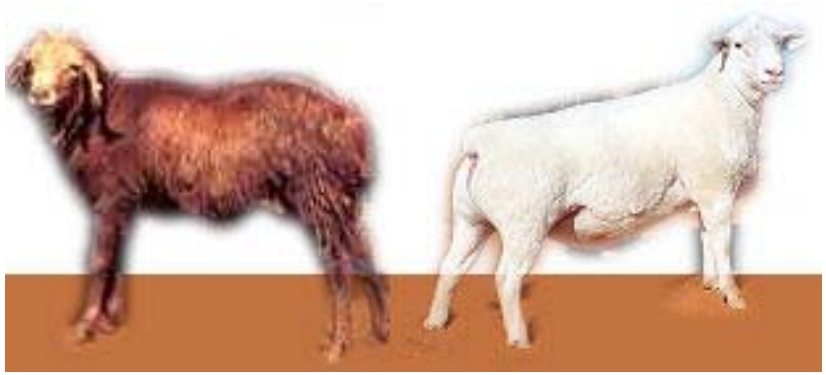


The adult tapeworm has hooks and suckers to keep it in position in the gut lumen.



Giardia has an adhesive plate which it uses to attach itself to the gut wall.

Parasite-resistant livestock

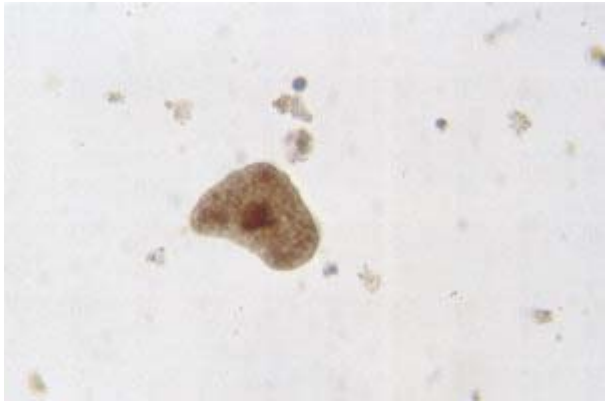


Kenyan Red Massai sheep are less susceptible to nematodes than the imported Dorper breed

West African N'dama cattle can survive in areas where other cattle breeds die of trypansosmiasis

Tissue feeders

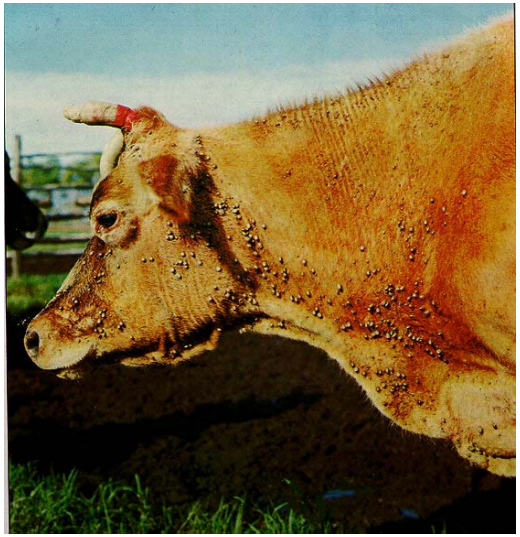
Tissue feeding nematodes digest the host's gut wall using powerful enzymes



The protozoan *Entamoeba* attacks host tissues in the gut, liver and brain

Blood feeders

1,000 adult *Haemonchus* worms can remove up to 50ml of blood per day from the host



Blood feeding by 30 female ticks can result in anaemia but they also transmit other parasites while they feed