PARASITOLOGY: HELMINTHS

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These study guides are my personal notes & materials that I used to study for my veterinary school courses. Illustrations are not necessarily drawn to scale but rather more conceptually to better understand how everything connects and where they are. I do not claim to be an expert and can not guarantee the accuracy of all statements.

- Sydney Day
**Prepatent period (PPP)** - time between infection with a parasite and demonstration of its presence.

**Hypobiosis** - arrested development where metabolic activity of the parasite ceases within the host in response to resistance by the host or unfavorable environmental conditions.

**Periportorment relaxation of resistance (PPRR)** - lack of resistance to helminth infections and reproduction in a female host during late pregnancy and early lactation.
CESTODES a.k.a. TAPES segmented flatworms

- Indirect life cycles - need more than one host
- Monoecious - have both male & female reproductive systems
- Lack a complete digestive tract - use flat surface for nutrient & waste exchange

**Cyclophyllidea**

- Rostellum like cat claws
- Suckers set of 4 around scolex
- Nearest/most immature proglottids
- The rostellum & suckers help with attachment and movement
- Each proglottid is an independent reproductive system

- Mostly only ONE intermediate host
- Families:
  - Taeniidae
  - Monostomidae
  - Anoplocephalidae
  - Dipylidiidae
  - Hymenolepididae

**Pseudophyllidea**

- Bothria two long, thin, longitudinal grooves for attachment
  - Basically weak version of the suckers that cyclophyllidae have

- Has TWO intermediate hosts
- Involved in aquatic food chains
- Families:
  - Dipylidium
  - Spirometra
GENERAL CESTODE LIFE CYCLE

1. DEFINITIVE HOST consumes INTERMEDIATE HOST
2. Scolex anchors into intestine
3. Neck begins to bud off segments (proglottids)
4. As segments move away from the neck, they develop REPRODUCTIVE ORGANS
5. Self-fertilization
6. Segment gets passed and breaks open
7. Fertilized EGGS either
   - released thru uterine pore
   - accumulate in the segment
8. EGG is consumed by INTERMEDIATE HOST

In CYCLOPHYLLIDEA specifically,

1. EGG consumed by INTERMEDIATE HOST
2. EGG converted → EMBRYOSPHERE → ONCOSPHERE
3. ONCOSPHERE develops in INTERMEDIATE HOST tissues into a METACESTODE (larval stage)
4. DEFINITIVE HOST ingests all or part of INTERMEDIATE HOST containing the METACESTODE
5. ADULT Tapeworm develops in the DEFINITIVE HOST

Cysticercus - translucent, fluid-filled cyst with a single protoasclel in a MAMMALIAN intermediate host

Cysticercoid - solid bodied larval stage in an ARTHROPOD intermediate host
**TREMATODES** a.k.a. **FLUKES**

- **Monocious** - have both male + female reproductive systems
- Lack a complete digestive tract - use flat surface for nutrient + waste exchange

**GENERAL TREMATODE LIFE CYCLE**

- ** DEFINITIVE HOST** (Vertebrate)
- Consumed by Definitive Host
- Gets inside a SECOND INTERMEDIATE HOST (Invertebrate or Fish)
- EGG - Usually out into H2O
- Larvae, penetrate intermediate host
- CERCARIA - Looks like a tadpole
- Burst out of small + gets onto a leaf
- INTERMEDIATE HOST (Mollusc, usually a snail)
NEMATODES

- **Dioecious**: male or female reproductive organs; sexual reproduction
- **Sexual dimorphism**: males smaller than females
- **Many are free-living and feed on organic debris**
  - Others parasitize plants and animals
- **Direct or Indirect life cycles**
  - Majority = direct
- **Unsegmented, cylindrical worm**
  - **Pseudocoelom**: large body cavity containing fluid under pressure
  - So that pressure provides mechanism for movement

**Female**

- Ovary
- Uterus
- Vagina
- Vulva
- Eggs
- Intestine

**Male**

- Mouth opening
- Intestine
- Testis
- Capulatory bursa

Can be...

- **Oviparous**: one celled or segmented egg passed
- **Ooviviparous**: larvated egg passed
- **Viviparous**: living larvae passed
**General Nematode Life Cycle**

- **Egg** → **L1** → **L2** → **L3** → **L4** → Adult male/female → Adults molt → In most cases, leave the host as Eggs

*USUALLY!* **INFECTIVE STAGE**
Stage that infects the definitive host

**Common Migration Pathways Within the Host**

- **Local Migration** - localized to the same organ (usually gut)

- **Direct Migration** - direct penetration through organs towards a predilection site

- **Hepatotracheal Migration**

  - Coughed up + swallowed
  - Trachea → Bronchi → Lungs → **RIGHT HEART** → Vena cava → Hepatic veins → Liver → Mesenteric veins → Portal vein → Gut
## Nematode Superfamily Common Characteristics

### Rhabditioidea
- **Order:** Rhabditida
- Only females parasitic
- **Direct** life cycle
  - Larval eggs or larvae passed in feces
  - L3 infective
- **Transmission:**
  - Skin
  - Ingestion
  - Transmammary
- *ex*: Strongylidae

### Strongyoidea
- **Order:** Strongylida
- **Family:** Ancylostomidae
  - **Direct** life cycle
    - L3 pass in feces
    - Predilection for small intestine
    - *ex*: Hookworms
- **Family:** Strongylidae
  - **Direct** life cycle
    - Predilection for large intestine
    - *ex*: Cyathostomes

### Trichostrongyloidea
- **Order:** Strongylida
- Affects grazing animals
- **Direct** life cycle
  - Segmented eggs passed in feces
  - Predilection for stomach, SI, or trachea/bronchi
- *ex*: Haemonchus
  - Near impossible to dif. species by eggs

### Metastrongyloidea
- **Order:** Strongylida
- Mostly **Indirect** life cycles
  - L1 passed in feces
  - Predilection for respiratory tract
- *ex*: Meningeal worm

### Oxyuroidea
- **Order:** Oxyurida
- Very host-specific — no dogs/cats!
- L3 infective
- Predilection for colon, cecum, + rectum
- *ex*: Pinworms

### Filarioidea
- **Order:** Spirurida
- **Indirect** life cycle (via blood sucker)
- Extraintestinal, nothing passed via feces
- *ex*: Heartworm

### Trichuroidea
- **Order:** Enoploida
- Greatest diversity of all superfamilies
- **Direct** life cycle
- *ex*: Trichinella, Trichuris
HELMINTHS of SMALL ANIMALS

CARDIOVASCULAR
Dirofilaria immitis
Heartworm

INTEGUMENT
Dipetalonema reconditum
Dracunculus insignis
Canine Guinea Worm

SMALL INTESTINE
ROUND WORMS
Toxocara canis
Dog Roundworm
Toxocara cati
Cat Roundworm
Toxascaris leonina

HOOK WORMS
Ancylostoma caninum
Common Dog Hookworm
Ancylostoma tubaeformae
Common Cat Hookworm
Ancylostoma braziliense
Southern Hookworm
Uncinaria stenocephala
Northern Hookworm
Strongyloides stercoralis
Puppy Mill Worm

TAPE WORMS
Taenia spp.
Echinococcus spp.
Dipylidium caninum
Flea Tapeworm

EYE
Thelazia californiensis
Eyeworm

RESPIRATORY
Filaroides osteri
Capillaria aerophila
Aelurostrongylus abstrusus
Paragonimus kellicotti
Lung Fluke

URINARY
Pearsonema (Capillaria) plica
Dioctophyma renale
Giant Kidney Worm

LARGE INTESTINE
Trichuris vulpis
Dog Whipworm
Trichuris campedalis
Cat Whipworm
**Toxocara canis** "Dog Roundworm"

**DIRECT LIFE CYCLE**
- Dogs
  - Hepatotraheal migration + maturation

<table>
<thead>
<tr>
<th>Segmentated EGG</th>
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★ in older dogs, more larvae in somatic tissue

→ Transplacental infection
→ Transmammary infection

**CLINICAL SIGNS**
- Noisy breathing
- Cough
- V+/D+
- Stunted growth
- Distended abdomen + discomfort

Death = rare (usually G1 obstruction)

**TREATMENT / PREVENTION**
- We assume most puppies are + and treat empirically
  - 2 weeks old
  - 4 weeks old
  - 2 months old

**MORPHOLOGY**
- EGG ~ 75-80 µm

Adults have cervical alae - clear cuticular flanges - running along its anterior lateral margins

**Toxocara cat:** "Cat Roundworm"

**DIRECT LIFE CYCLE**
- Cats
  - Hepatotraheal migration + maturation

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**Zoonotic**
Humans can be u.v. visceral larvae, migrations

→ Transmammary infection

**DIAGNOSIS**
1D of EGGS in feces

**ANTHELMINTICS**
- Piperazine, Benzimidazoles, Nitroscanate

**MORPHOLOGY**
- EGG ~ 65-75 µm

Adults have broad cervical alae, giving it an "arrow head" appearance on EM

**PATHOLOGY + CLINICAL SIGNS**
- Same as for dogs + T. canis

**TREATMENT / PREVENTION**
- Regular deworming for hunters
- We assume most kittens infected and treat similarly to T. canis
**Toxascaris leonina**

**DIRECT LIFE CYCLE** DOGS + CATS

- or ingestion of PARATENIC HOSTS
- L2 → segmented egg → L3

**MORPHOLOGY** EGGs ~65-80 μm

**ADULTS** similar to *T. canis*

**PATHOLOGY + CLINICAL SIGNS**

- light infections not very serious
- heavy infections: D+ dehydration, poor doing, v. infrequently death

**DIAGNOSIS**

- ID of EGGS in feces

**ANTHELMINTICS**

- Fenbendazole, Mebendazole, Piperazine, Pyrantel + Dichlorvos

**Baylisascaris procyonis**

**DIRECT LIFE CYCLE** RACOONS

- fecal-oral route of infection only
- ingested eggs hatch + larvae develop in the small intestine

**DIAGNOSIS**

- ID of EGGS in feces

**PATHOLOGY**

- 90+ species have been found to be infected with *B. procyonis* larvae!

- NONPATHOGENIC in raccoons

- in other species, the larvae can’t mature into adults but they are still highly PATHOGENIC by causing **Neurotropic larval migrans** → has caused several fatal outbreaks in farms, zoos, & research settings

**NO effective treatment for incidental hosts** (anthelmintics MAY slow larval migration)

**PREVENTION IS PARAMOUNT**
**Nanophyetus salmincola** "Salmon Poisoning Fluke"

**PATHOLOGY**
- *transmits the bacteria Neorickettsia helminthoeca*
- The fluke itself is usually clinically inapparent

- Ly high fever
- weight loss
- vomiting/diarrhea
- lymphadenopathy
- DEATH in 7-10 days

**SALMON POISONING DISEASE**

**DIAGNOSIS**
- Identification of N. salmincola EGGS in feces
- History: - Pacific Northwest
  - raw salmon or trout ingestion

Diagnosis of Neorickettsia - confirmed with serology/PCR

**HOOKWORMS**

**Ancylostoma caninum** "Common Dog Hookworm"

**DIRECT LIFE CYCLE** DOGS + WILD DOGS

- Skin-blood migration
- L3
- + transmammary transmission

**DIAGNOSIS**
- ID of EGGS in feces

**ANTHELMINTICS**
- Fenbendazole, Pyrantel + more

**PATHOLOGY**
- Hookworms are all bloodsuckers!

**CLINICAL SIGNS**
- anemia
- black, tarry stool
- death
- dermatitis related to skin entry

**Ancylostoma tubaeformae** "Common Cat Hookworm"

**CATS, WILD CATS**

**ANSWELMINTICS**

**Ancylostoma braziliense** "Southern Hookworm"

**DOGS, CATS, WILD DOGS + CATS**

- Con cause cutaneous larval migrans in humans (a.k.a. "plumber's itch")
  - Usually A. braziliense
  - Self-limiting in 5-6 weeks

**Uncinaria stenocephala** "Northern Hookworm"

**DOGS, CATS, WILD DOGS + CATS**

**ANTHELMINTICS**
- Tetracyclines + Praziquantel, Albendazole or Fenbendazole
**Strongyloides stercoralis** "Puppy Mill Worm"

**PATHOLOGY**
ADULTS bury into mucosa of the anterior half of the small intestine

**MORPHOLOGY**
Small, slender worms ~2mm long

**DIRECT LIFE CYCLE**

1. Skin-blood migration
2. L3
t3. Female L3s inside Host = Female
4. Male L3
5. Free-living Females
6. Free-living Males

**CLINICAL SIGNS**
- asymptomatic
- Adult animals
  - Puppies:
    - D+ (sometimes bloody)
    - abdominal pain
    - weight loss
    - coughing, wheezing
    - pneumonia

**DIAGNOSIS**
Identification of L1s on fecal smear or via Baermann

**CONTROL**
- difficult to the free-living form
- larval stages susceptible to sunlight, ↑ temp. + desiccation
- proper sanitation/hygiene
- most dewormers work

**Taenia spp.** Various Tapeworm species

**INDIRECT LIFE CYCLE**

**Definitive Hosts**: DOGS + CATS

**CLINICAL SIGNS**
RARELY causes clinical signs in definitive hosts

**PATHOLOGY**
Orgon damage 2nd to larval migration + cyst development

**MORPHOLOGY**
1-9 feet long

**DIAGNOSIS**
ID of EGGS in feces or visualization of proglottids
**Echinococcus spp.**

** INDIRECT LIFE CYCLE **

**Definitive Hosts:**
- *E. granulosus*
  - DOGS *+ other CANIDS* (~7mm long)
- *E. multilocularis*
  - RED FOX (~3.5mm long)

**Intermediate Hosts:**
- *E. granulosus*
  - HERBIVORES, PIGS, HUMANS, etc.
- *E. multilocularis*
  - MICROTENE RODENTS, HUMANS

**CLINICAL SIGNS**
RARELY causes clinical signs in definitive hosts

**DIAGNOSIS**
Problematic - EGGS look the same as *Taenia* spp.

**ANTHELMINTICS**
Praziquantel

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**Dipylidium caninum** — *Flea Tapeworm*

** INDIRECT LIFE CYCLE. **

**Definitive Hosts:**
- DOGS, CATS + HUMANS

**Intermediate Hosts:**
- FLEAS, LICE

**MORPHOLOGY**
ADULTS 10-70 cm long

**CLINICAL SIGNS**
Humans can be infected by ingesting fleas

**DIAGNOSIS**
1D of EGGS in feces or visualization of proglottids

**ANTHELMINTICS**
Praziquantel + control fleas!
**PATHOLOGY**

- heavy worm burden → Typhilitis - inflammation of the cecum

**CLINICAL SIGNS**

- mucoid D+
- mushy stools
  (rarely blood involved)

**DIAGNOSIS**

1D of EGGS in feces

**CONTROL**

Routine milbemycin + moxidectin

**ANTHELMINTICS**

Fenbendazole x 3 days
**CARDIOVASCULAR**

**Dirofilaria immitis** "Heartworm"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** DOGS, CATS, FERRETS, HUMANS (RARE)

**INTERMEDIATE HOST:** MOSQUITOS Aedes sp., Culex sp., Anopheles sp.

1. **L1 → L3 in 2 weeks**
   - Mosquito ingests L1s
   - Mosquito deposits L3 subcutaneously

2. **L3 → L4 in 1-3 days (subcutaneously)**
   - L4 migrate through tissues, mature over 50-70 days to ADULTS (sexually immature)
   - L4 migrate to heart + lungs as early as 70 days post-infection
   - Circulating MICROFILARIA as early as 6 mo post-infection

3. **Sexual maturity in pulmonary artery producing larvae**

**PATHOLOGY**

Adult worms obstruct the PULMONARY ARTERIES

- Pulmonary endarteritis + fibrosis
  - Inflammation, thickening, scarring
- Turbulence + ↓ flow

**CLINICAL SIGNS**

- Chronic progressive cough
- Exercise intolerance / fatigue
- Weight loss
- Ascites

**VENA CAVA SYNDROME**

Large obstruction in vena cava of worms disrupts the venous return

**Chronic PULMONARY HYPERTENSION**

**R-sided HEART FAILURE**

**MORPHOLOGY**

- 15 cm
- 30 cm
- L1 - Microfilaria ~ 300 μm
**DIAGNOSIS**

- **ANTIGEN DETECTION**: 68-90 days post-infection
  - detects female worms

- **ID Microfilaria in a blood smear**: 6 months post-infection
  - not good in cats (transiently microfilaremic)
  - simple blood smear
    or
    modified Knott’s technique

- **Antibody Detection**: 60 days post-infection
  - Abs only present against female worms
  - cats may only have 2 adult worms, if both worms male, the test will be 🎁

- **Radiography looking for**:
  - enlarged RIGHT heart + enlarged pulmonary arterial trunk

- **Echocardiography**

- **Necropsy**

**TREATMENT**

- **PREVENTION IS THE NAME OF THE GAME!**

1) **Annual testing**

2) **Chemoprophylactic prevention** - start at 4-8 weeks old, then for life
   - **Ivermectin**: Heartguard, Heartguard Plus, Iverhart
   - **Milbemycin oxime**:Interceptor, Sentinel, Trifexis
   - **Selamectin**: Revolution
   - **Moxidectin**: Advantage Multi
If infected:

- ADULTICIDAL Tx - Melarsomine (I/miscide)
- MICROFILARIACIDAL Tx - Ivermectin
- Surgical removal of worms

**ADULTICIDAL TREATMENT PROTOCOL**

- **Day 0:**
  1) Exercise restriction
  2) Start on monthly HWP
  3) Start course of Doxycycline

- **Day 60:** 1st Melarsomine injection IM in epaxial muscle

- **Day 90:** 2nd Melarsomine injection

- **Day 91:** 3rd Melarsomine injection

- **Day 120:** Recheck Test

- **Day 150:** Recheck if + at Day 120 and retreated

- **Day 270:** Recheck Test

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**Wolbachia pipiens**

- Gram negative intracellular bacteria with a symbiotic relationship with *Dirofilaria immitis*

- When parasite dies, bacterial antigens are released and cause immune-mediated inflammation

  - This is why *Wolbachia* is a contributor to pathology and clinical signs of HWD

- Susceptible to tetracycline
**RESPIRATORY**

**Filaroides osleri**

**DIRECT LIFE CYCLE**

**DOGS**

1) LARVAE migrate from intestines to trachea  
2) ADULTS live in nodules in large airways

![Dog diagram](image)

Larvae produced in trachea, coughed up + swallowed  
Passed in feces

L1 INFECTIVE!

**PATHOLOGY**

- nodules in trachea + major bronchi  
- bronchitis  
- mechanical interference with breathing

**MORPHOLOGY**

ADULTS are small, slender roundworms

♂  
♀  

~6mm  
~13mm

**DIAGNOSIS**

Identification of LARVAE:  
→ in feces  
→ in sputum, transtracheal wash, or bronchoalveolar lavage  
→ via bronchoscopy

**CONTROL**

Treatment with albendazole or surgical excision of nodules

Isolate infected animals (highly transmissible in kennel situations)

**LOW Prevalence but it is distributed WORLDWIDE**

**CLINICAL SIGNS**

- coughing  
- dyspnea (labored breathing)  
- stridor (wheezing)  
- emaciation, anorexia

**ANTHELMINTICS**

Albendazole
**Capillaria aerophila** "Bronchial Capillarids"

**DIRECT LIFE CYCLE** DOGS, CATS (FOX + OTHER WILD ANIMALS)

1) LARVAE hatch from egg in intestines & migrate to lungs
2) ADULT females lay eggs in the lungs

EGGS get coughed up + swallowed, then passed in the host’s feces

PREPATENT PERIOD = 40 days

MORPHOLOGY

EGGS characteristically boxy + textured

ADULTS 2-3cm long

**PATHOLOGY**

irritation of the trachea + bronchi

**CLINICAL SIGNS**

usually just an incidental finding!

- chronic cough
- nasal discharge, sometimes, + not responsive to atox

**CONTROL** prevent with proper sanitation, treat with most dewormers

**ANTHELMINTICS**

Broad spectrum dewormers
**Aelurostrongylus abstrusus**

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** CATS  
**INTERMEDIATE HOST:** SNAILS, SLUGS  
**PARATENIC HOST:** BIRDS, RODENTS, AMPHIBIANS, REPTILES

1) LARVAE ingested by host, migrate to lungs  
2) ADULTS reside in alveolar ducts & terminal bronchioles  
   - females lay eggs here  
   - eggs hatch & LARVAE are coughed up & swallowed

**MORPHOLOGY**  
ADULTs are 0.7-1.0cm long in CATs lung parenchyma

**PATHOLOGY**  
EGGS deposited in subpleural nodules of the lung parenchyma

**CLINICAL SIGNS**  
usually NONE - may have chronic cough + dyspnea (labored breathing)

**DIAGNOSIS**  
Identification of LARVAE  
- Baermann: not ideal, poorly motile larvae in feces  
- fecal smear  
  ★→ transtracheal wash / bronchoalveolar lavage ★★ BEST

Possible radiographic evidence (calcification of nodules in lung parenchyma)

**CONTROL**  
avoiding PARATENIC HOSTS (snails + slugs) - primary source of infection for CATS

**ANTHELMINTICS**  
Fenbendazole or Ivermectin
**Paragonimus kellicotti** — "Lung Fluke"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** DOGS, CATs (+ HUMANS - v. rare)

- Eggs shed in feces, hatch in water

**INTERMEDIATE HOST:** 1) SNAIL

- Develops into Cercarial stage

2) CRAYFISH

- Develops into INFECTIVE Metacercarial

Ingestion of Raw or Undercooked CRAYFISH

**PATHOLOGY**

- Ingested young flukes penetrate intestines + enter peritoneal cavity (7-10 days)

- Then migrate into pleural cavity

- Penetrate the LUNGS (10-14 days post infection)

In the LUNGS, flukes are paired up + surrounded by

- Eosinophilic inflammation
- Necrotic tissue
- Cellular infiltrates

**CLINICAL SIGNS**

- Cough
- Fever
- Malaise
- ★ if cysts rupture (or in heavy infections) pulmonary hemorrhage can occur + cause severe disease

**DIAGNOSIS**

ID of EGGS in sputum or feces

**ANTHELMINTICS**

Praziquantel
Albendazole, Fenbendazole
**Pseudophyllid (Capillaria) plica**

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** DOGS, CATS (*many WILD ANIMALS*)

**INTERMEDIATE HOST:** EARTHWORM

Adults are 1-6 cm long in mucosa of the urinary bladder.

EGG'S released in urine:
- Larvate to L1 in 30-36 days
- L1 consumed by Earthworm
- Earthworm consumed
- L1 → L2 → L3 which migrate to bladder via blood into kidneys

**PATHOLOGY**

- Bladder irritation + inflammation

**CLINICAL SIGNS**

- Usually asymptomatic
- But can show signs of:
  - Cystitis
  - Pollakiuria

**DIAGNOSIS**

- 1D of EGG'S in urine sediment

**ANTHELMINTICS**

- Ivermectin

**TREATMENT/CONTROL**

- Ivermectin to treat
- Prevent consumption of Earthworms!

**Dioctophyma renale** "Giant Kidney Worm"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** DOGS + MINK

**INTERMEDIATE HOST:** EARTHWORMS

**PARATENIC HOST:** FISH, FROGS

- Usually infection due to consumption of a PARATENIC HOST
- Prepatent period: 5 months

**PATHOLOGY**

- Pressure → necrosis of kidney parenchyma
  (progressive to point of no kidney remaining)

**CLINICAL SIGNS**

- Usually none (alone)
- Since only one kidney normally infected
- Typically the RIGHT one peritonitis if renal capsule ruptures

**DIAGNOSIS**

- 1D of EGG'S in urine sediment
- Ultrasound

**TREATMENT/CONTROL**

- Prevent ingestion of untreated H2O, fish, frogs
- Treat with surgical removal
**INTEGUMENT**

*Dipetalonema reconditum*

**INDIRECT LIFE CYCLE**
- **DEFINITIVE HOST**: DOGS
- **INTERMEDIATE HOST**: Ctenocephalides felis (FLEA) + Heterodoxus spiniger (LICE)

**ANTHELMINTICS**: Ivermectin

NO pathology or clinical signs, but *Microfilaria* in blood, so need to differentiate from Heartworm with Modified Knott’s technique.

**Dracunculus insignis** "Canine Guinea Worm"

**INDIRECT LIFE CYCLE**
- **DEFINITIVE HOST**: DOGS, RACOONS, MINK, FOXES, SKUNKS
- **INTERMEDIATE HOST**: COPEPODS
- **PARATENIC HOST**: FROGS able to harbor L3 infective larvae

**PATHOLOGY**
- Migration from GI tract
- SubQ tissue
- Female to the skin
  - Localized inflammation + blistering enable female to exteriorize her posterior
  - Can release L1 larvae into water

**DIAGNOSIS**
- Visualization of the worm

**TREATMENT / PREVENTION**
- Most anthelmintics or surgical excision
- Routine deworming
- Avoiding ingestion of impure H2O

**EYE**

*Thelazia californiens* "Eye Worm"

**INDIRECT LIFE CYCLE**
- **DEFINITIVE HOST**: DOGS, CATS, DEER, SHEEP, HUMANS
- **INTERMEDIATE HOST**: FLIES (*Diptera*)

**PATHOLOGY + CUN SIGNS**
- eye irritation
  - Excess tears
  - Corneal ulceration
  - Cloudiness
- Consumes *L1* in tears or manure (hosts can swallow their tears)
- Matures to *L3* inside fly
- *L3* infects eye once fly lands on a host and develops there into an ADULT
HELMINTHS OF Ruminants

CNS
*Parastrongylus tenuis*
Meningeal Worm

Liver
*Fasciola hepatica*
*Fascioloides magna*

Eye
*Thelazia spp.*
Eye worm

Respiratory
*Dictyocaulus viviparous*
*Dictyocaulus filaria*
*Protostrongylus rupesae*
Lung Worm
*Muellerius capillaris*
Goat Lung Worm

Abomasum
*Haemonchus contortus*
*Haemonchus placoides*
*Ostertagia ostertagia*
*Teladorsagia (Ostertagia) circumcincta*
*Trichostrongylus axei*
*Trichostrongylus colubriformis*

Small Intestine
*Cooperia pectinata*
*Cooperia punctata*
*Cooperia onchophora*
*Cooperia curticei*
*Nematodirus*
*Buonostomum phlebotomum*
*Buonostomum trichocephalum*
*Strongyloides papillosus*
*Moniezia spp.*

Large Intestine
*Oesophagostomum radiatum*
*Oesophagostomum columbianum*
*Chabertia ovina*
*Trichuris ovis*
*Trichuris discolor*
*Trichuris globulosa*
*Trichuris tenuis*
**Abomasum**

*Haemonchus contortus* "Barber Pole Worm"

**Order:** Strongylida  **Superfamily:** Trichostrongyloidea

**Cattle:** *Haemonchus placei*  
Not as clinically relevant.

**Direct Life Cycle**

1. **L1** larvae are consumed and undergo a molt called "exsheathment" in the rumen.
2. Larvae go on to abomasum and penetrate gastric epithelial cells to mature into adults.

**Morphology**

**Adults** 2-3.5 cm  
Females have characteristic "barber pole" appearance.

**Pathology**

- Adult worms louse abomasal wall and suck blood (~50 μL/worm/day).
- Go through hypobiosis in winter months.
- Host PPR - periportalient relaxation of resistance (resistance of the host) to parasites.

**Clinical Signs** - *Haemonchosis*

- Anemia
- Ascites or bottle jaw (due to protein loss)
- Anorexia, emaciation
- Wool break
- Collapse, death

**Diagnosis**

1. 10 strongyle eggs in feces
2. Necropsy

**Anthelmintics**

Much resistance to dewormers; repeat fecals after deworming a must!

**Treatment/Prevention**

- Multimodal parasite control:
  - FAMACHA-guided deworming
  - Pasture management
  - Breeding for resistance

**High fecundity:** Females can lay 5,000 eggs/day.

**Prepatent Period:** ~3 weeks.
**Ostertagia ostertagia**  “Brown Stomach Worm”

**MOST IMPORTANT HELMINTH OF CATTLE**

Order: Strongylida  Superfamily: Trichostrongylidea

**SMALL RUMINANTS**

**DIRECT LIFE CYCLE**

- L1 to L3
- **Prepatent period:** ~3 weeks

**MORPHOLOGY**

- **Adults** are small, slender worms
  - 7-12 mm

**CLINICAL SIGNS**

- Hypoproteinemia
- Anemia
- Abomasal wall sloughing

**OSTERTAGIOSIS**

**TYPE 1:**
- North - summer + autumn
- South - autumn + winter
  - Parasites emerge from the gastric glands 2 weeks after ingestion
  - Failure to gain weight, diarrhea, dehydration

**TYPE 2:***
- North - winter + spring
- South - autumn
  - Simultaneous emergence from gastric glands after hypobiosis
  - Severe emaciation, diarrhea, edema, death

**DIAGNOSIS**

- 1D strongyle eggs in feces

**ANTHELMINTICS**

- Most effective → no resistance seen... yet

**PATHOLOGY**

- Ingested L3 penetrate the gastric glands to develop

- Emergence from the gastric glands causes damage + degeneration
  - ↓ HCl, ↓ pepsinogen
  - ↑ Abomasal pH

- Adults also blood suckers
  - Can ingest 10-20% of circulating blood volume in a single day!

**PPRR + Hypobiosis can occur**

- Avoid by treating the hypobiotic larvae
  - Winter in the North
  - Summer in the South

Necropsy → characteristic textured appearance to Abomasum like moroccan leather
**ABOMASUM + SMALL INTESTINE**

*Trichostrongylus spp.*

- **Order:** Strongylida
- **Superfamily:** Trichostrongyloidea

**Ruminants, Horses, Pigs**

*T. axei* "Hair Worm"  
*T. colubriformis* "Bankrupt Worm"

**Sheep, Goats, Camelids, Exotic Ruminants**

**DIRECT LIFE CYCLE**

- **L3**
- **L2**
- **Prepatent period:** 2-3 weeks

**MORPHOLOGY** 5.5-8 mm

**PATHOLOGY**

- Adults ingest **blood** in the Abomasum + Small Intestine

**CLINICAL SIGNS**

- Rarely causes clinical disease on its own
- Contributing factor to parasitic gastroenteritis
  - Emaciation, anorexia
  - Diarrhea
  - Anemia

**DIAGNOSIS**

- 10 strongyle EGGs in feces

**ANTHELMINTICS**

- Most effective → no resistance seen...yet

---

**H.O.T. COMPLEX**

*Haemonchus, Ostertagia, Trichostrongylus*

- **Usually affects young**  
  → Resistance improves with age

- **Some life cycles → DIRECT, L3 infective**
  
  - Hypobiosis
  - Periparturient rise

- **Clinical Signs**
  - Weight loss
  - Rough coat
  - Poor appetite
  - Diarrhea
  - Weakness
  - Bottle jaw
  - Dehydration
  - Anorexia
  - Collapse/recumbency

**ANTHELMINTICS**

- Must tailor to each form
**SMALL INTESTINE**

**Cooperia spp.**

*Order: Strongylida  
Superfamily: Trichostrongyloidea*

**CATTLE**  
*C. pectinata  
C. onchophora  
C. punctati*

**SHEEP**  
*C. curticei*

**ANTHELMINTICS**

*Most work  
Macrolides less effective*

**DIRECT LIFE CYCLE**

**EGG** passed in host feces  
L3 is the **INFECTIVE** larval stage

**PATHOLOGY + CLINICAL SIGNS**

*Takes hundreds of thousands to cause D+ and clinical disease  
but can contribute to parasitic gastroenteritis (with others)  
by interruption of nutrient absorption*

**DIAGNOSIS**

*ID strongyle EGGs in feces*

**MORPHOLOGY**

*Adults 5-11 mm*

---

**Nematodirus spp.**  
*"Twisted Wire Worm"*

*Order: Strongylida  
Superfamily: Trichostrongyloidea*

**DIRECT LIFE CYCLE**

*1° CAMELIDS, RUMINANTS also*

- Egg provides extra protection for larvae to survive on pasture indefinitely  
- Requires cold weather followed by warm weather  
  ➤ see surges in spring

**PATHOLOGY + CLINICAL SIGNS**

*Larvae penetrate + encyst win mucosa  
mucosa damaged when they re-emerge  
• mucosal + villous atrophy  
• malabsorption  
• D+  
• dehydration  
• anorexia*

**DIAGNOSIS**

*ID of EGGs in feces  
+very characteristic (HUGE) eggs*
**Bunostomum spp.** "Hookworm"

**Order:** Strongylida **Superfamily:** Ancylostomatoidea

**CATTLE** B. phlebotomum **SHEEP + GOATS** B. trigonocephalum

**DIRECT LIFE CYCLE**
Lympathic - Tracheal Migration

**PATHOLOGY**
- Lung damage 2º to migration
- Attach to S1 mucosa
  - L3 damage + hemorrhage

**MORPHOLOGY**
- Adults - 2.5 cm

**CLINICAL SIGNS**
- Black, tarry D+
- Anemia
- Anorexia

**DIAGNOSIS**
- 1D of EGGs in feces
- Necropsy

**Strongyloides papillosus** "Hair Worm"

**Order:** Rhabditida **Superfamily:** Rhabditoida

**DIRECT LIFE CYCLE**
Skin - Tracheal Migration

**PATHOLOGY**
- Lung damage ²º to migration
- Attach to S1 mucosa
  - L3 damage + hemorrhage

**MORPHOLOGY**
- Adults are slender, ~6 mm

**CLINICAL SIGNS**
- Loose manure
- Dermatitis
- Rapid death if millions of worms present

**DIAGNOSIS**
- 1D of EGGs in feces

**ANTHELMINTICS**
- Fenbendazole, Ivermectin

**ANTHELMINTICS**
- All effective
**Moniezia spp.** "Broad" or "Common Tapeworm"

**Order:** Cyclophyllidae  
**Superfamily:** Anoplocephalidae

**INDIRECT LIFE CYCLE**
- **DEFINITIVE HOST:** Ruminants
- **INTERMEDIATE HOST:** Forage mites

**MORPHOLOGY**
- Adults up to 2m long in definitive hosts!

**CLINICAL SIGNS**
- Usually asymptomatic
- But can cause D+ and obstruction in juveniles

**DIAGNOSIS**
- 1D of eggs in feces

**ANTHELMINTICS**
- Benzimidazoles - Fendazole + Albendazole  
  "White dewormers"

- + Sanitation
**LARGE INTESTINE**

*Oesophagostomum spp.* "Nodular Worm"

**Order:** Strongyliida  
**Superfamily:** Strongyloidea

**CATTLE**  
*O. radiatum*  
**SHEEP + GOATS**  
*O. colombianum*  
*O. venulosum*

**DIRECT LIFE CYCLE**

1. L1
2. L3

**Prepatent period:** 4-5 months

**PATHOLOGY**
- Nodule formation - purulent, can calcify
- Lymphocytic, eosinophilic infiltration of LI mucosa

**CLINICAL SIGNS**
- D+ and weight loss

**DIAGNOSIS**
- 1D strongyle EGGS in feces
- Necropsy - finding nodules + adult worms in large intestine
- Radiographs - can see calcified nodules

**ANTHELMINTICS**  
All are effective

---

*Chabertia ovina* "Large Mouthed Bowel Worm"

**Order:** Strongyliida  
**Superfamily:** Strongyloidea

**DIRECT LIFE CYCLE**

1. L1
2. L3

**Prepatent period:** 9 weeks

**MORPHOLOGY**
- Stout, white worms
- 8-21 mm long

**PATHOLOGY**
- Adult's feed on blood + mucous

**CLINICAL SIGNS**
- Bloody D+
- Weight loss
- Anemia

**DIAGNOSIS**
- 1D strongyle EGGS in feces
- Necropsy

**ANTHELMINTICS**
- Broad spectrum + strategic deworming
<table>
<thead>
<tr>
<th><strong>Trichuris spp.</strong></th>
<th>&quot;Whipworms&quot;</th>
</tr>
</thead>
</table>

**Order:** Enoplida  
**Superfamily:** Trichuroidea

- **T. ovis**  SHEEP, GOATS, CAMELIDS  
- **T. discolor**  CATTLE, SHEEP, GOATS  
- **T. globulosa**  CATTLE, SHEEP, CAMELIDS  
- **T. tenus**  CAMELIDS

**DIRECT LIFE CYCLE**  
CAMELIDS most adversely affected

- Prepature period: 7-9 weeks
- L1s can live in environment for several years

**MORPHOLOGY**  
3.5 - 8 cm long  
Posterior = short + stout  
Anterior = long + slender

**PATHOLOGY**  
CAMELIDS are adversely affected  
Usually not pathogenic to ruminants, even in large numbers

**CLINICAL SIGNS** in CAMELIDS
- Poor growth
- D+  
- Anemia

**DIAGNOSIS**  
ID of EGGS in feces  
Characteristic bipolar football EGGS

**ANTHelmintics**  
Fenbendazole

**Ruminant**
**RESPIRATORY**

*Dictyocaulus spp.* "Lung Worm"

**Order:** Strongylida  **Superfamily:** Trichostrongyloidea

**CATTLE** *D. viviparous*  **SHEEP+GOATS** *D. filaria* → seldom in the U.S.

**DIRECT LIFE CYCLE**

Lymphatic - Tracheal Migration

<table>
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<tr>
<th>L1</th>
<th>L3</th>
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→ ADULTs live in small bronchi
→ lay EGGS, get coughed up + swallowed
→ EGGS hatch in intestinal tract + L1 are passed in manure

**PREPATURE PERIOD:**
- 21-22 days in CATTLE
- 26-28 days in SMALL RUMINANTS

**PATHOLOGY**

- eosinophilic exudate forms during PPD
  → blocks bronchioles
- foreign body granulomas form in lungs
- emphysema

**CLINICAL SIGNS**

**ACUTE**
- Verminous pneumonias
  (T: 104-105.5°F)
  - tachycardia + tachypnea
  - nasal discharge
  - coughing
  - death

**CHRONIC**
- weight loss
- "hoose" or "husk" cough
- slow recovery with possible permanent damage

**DIAGNOSIS**

ID of LARVAE in feces
→ need a RECTAL sample

Necropsy
→ finding worms in bronchi + frothy exudate

**ANTHELMINTICS**

All effective, Levamisole preferred – treat at first sign!

**CONTROL:** rotate pastures
**Protostrongylus rufusans** "Lung Worm"

Order: Strongylida  Superfamily: Metastrongylidea

★ Important due to the threat to Bighorn Sheep population

**INDIRECT LIFE CYCLE**  one of the few nematodes with indirect life cycle

**DEFINITIVE HOST**: SHEEP + GOATS

**INTERMEDIATE HOST**: LAND SNAILS + SLUGS

Lymphatic-Tracheal Migration

![Diagram](image)

L3 ← L1 inside intermediate host

**PATHOLOGY**

Nonpathogenic in domestic small ruminants

Pathogenic in Bighorn Sheep

**CLINICAL SIGNS**

DEATH in Big Horn lambs

**DIAGNOSIS**

ID of LARVAE in feces  → need a RECTAL sample

Necropsy  → EGGS + LARVAE found in LUNGS

**ANTHELMINTICS**

ALL effective, Levamisole preferred - treat at first sign!
**Muellerius capillaris** "Goat Lung Worm"

**Order:** Strongylida  
**Superfamily:** Metastrongyloidea

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** GOATS (i) + SHEEP

**INTERMEDIATE HOST:** LAND SNAILS + SLUGS

**Lymphatic-Tracheal Migration**

L1 → L1 inside intermediate host

**Prepatent period:** 3-5 weeks

**PATHOLOGY**

**ADULTs** live in terminal bronchioles + alveoli

Host immune reaction causes worms to become enclosed in fibrous nodules

**CLINICAL SIGNS**

**SHEEP:** asymptomatic

**GOATS:**
- cough
- anorexia
- weight loss
- 2nd broncho pneumonia

**DIAGNOSIS**

ID of LARVAE in feces
→ need a RECTAL sample

Necropsy
→ palpable fibrous nodules that contain EGGS + LARVAE

**ANTHELMINTICS**

Macrolides
**Fasciola hepatica** "Common Liver Fluke"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** Ruminants + Humans

**INTERMEDIATE HOST:** Snails

Requires a warm & wet environment endemic to Western and some Southern Gulf states of the US

Prepatent period: 4.5 months

**PATHOLOGY**

- Ingested metacercaria encyst in the GI tract & releases immature flukes
- Penetrate GI and migrate thru the peritoneal cavity to liver
- By 7-8 wks, migrate to bile ducts
- Adults establish in bile ducts & release eggs from here

**CLINICAL SIGNS** FASCIOLIASIS

- Can be acute or chronic
- Hepatic insufficiency
  - Since immature flukes consume the liver
  - May also block bile ducts
- Anemia
- Anorexia
- Weakness
- ↓ Production & sudden death

**MORPHOLOGY**

Adults 1.5 cm wide + 3 cm long

**DIAGNOSIS**

- ID of EGGS in feces
  - Only can be found in chronic infestations
  - Appear 4.5-6 months post-infestation
- Necropsy

**ANTHELMINTICS**

- Clorsulon, Fenbendazole
  - Prophylactic treatment
  - Snail control
  - Avoiding pasture when wet
**Fascioloides magna** | “American” or “Deer Liver Fluke”

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST**: WHITE TAILED DEER

**ACCIDENTAL HOST**: CATTLE, SHEEP, GOATS, MOOSE, ELK

**INTERMEDIATE HOST**: SNAILS

Requires a warm + wet environment
endemic to Western and some Southern Gulf states of the US → some as common liver-fluke

Prepatent period: 4.5 months

**PATHOLOGY**

**DEER**: adult flukes live in thin-walled cysts in bile ducts, EGGS pass into GI

**CATTLE/MOOSE**: adult flukes live in thick-walled cysts in bile ducts

**SHEEP/GOATS**: metacercaria do not mature, instead they MIGRATE thru host + cause tons of damage + DEATH

**CLINICAL SIGNS**

**SHEEP/GOATS**: sudden death! usually d/t rupture of a major blood vessel

**CATTLE/MOOSE/ELK**: usually no clinical signs

→ livers get condemned at slaughter

**DIAGNOSIS**

Clinical History + Necropsy

**ANTHELMINTICS**

Clorsulon, Albendazole
- prophylactic treatment
- snail control
- deer control
- avoiding pasture when wet
**CNS**

*Parelaphostrongylus tenuis* "Meningeal Worm"

**Order:** Strongylida  **Superfamily:** Trichostrongyloidea

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** WHITE TAILED DEER + OTHER RUMINANTS

**INTERMEDIATE HOST:** LAND SNAILS + SLUGS

- EGGs pass from brain to lungs + hatches there
- L1 coughed up + swallowed

- L3 migrates from stomach to spinal cord
- migrates up spinal cord caudally → cranially

L3 ← L1 inside intermediate host

**MORPHOLOGY**

- ADULTs 39–91 mm
- Slender, white worms

**DIAGNOSIS**

- Usually only based on
  - Clinical signs + time of year
- CSF tap looking for eosinophilia
- Necropsy larvae in meninges
- Fecal only works on deer hosts

**PATHOLOGY**

- Larval migration + inflammation

**CLINICAL SIGNS**

- WHITE TAILED DEER: usually asymptomatic
- RUMINANTS: • ataxia
  - often fatal
  - paraplegia
  - tetraplegia

**PREPARENT PERIOD:** 3 months

**ANThelmIntICS**

- Fenbendazole + Ivermectin
- Anti-Inflammatories

**CONTROL**

- Keep white-tailed deer out of pastures
- prophylactic deworming
  - Ivermectin q21 days
  - or
  - Eprinomectin q3 months (long range)
**EYE**

*Thelazia sp.* “Eye Worm”

**Order:** Spirurida  
**Superfamily:** Spiruroidea

**INDIRECT LIFE CYCLE**

- **T. californiens**  
  **DEFINITIVE HOST:** SHEEP + DEER  
  (DOGS, CATS, + HUMANS)

- **T. gulosa**  
  **T. skrjabini**  
  **DEFINITIVE HOST:** CATTLE

**INTERMEDIATE HOST:** FLIES (Diptera)

↓ consume L1 in tears or manure  
  (hosts can swallow their tears)

↓ matures to L3 inside FLY

↓ L3 infects eye once FLY lands on a Host  
  + develops there into an ADULT

**Pre-patent period:** 3-6 weeks

**PATHOLOGY**

None Known  
but associated with pink eye

**CLINICAL SIGNS**

- excess lacrimation
- photophobia
- plugged lacrimal ducts
- 2° pinkeye

**DIAGNOSIS**

Visualization of the worm

**CONTROL**

→ surgical removal

→ irrigation with boric acid

→ fly control important
HELMINTHS of SWINE

Not many anthelmintics are officially approved for swine.

**MUSCULOSKELETAL**
- Trichinella spiralis
- Taenia spp.

**RESPIRATORY**
- Metastrongylus spp.

**URINARY**
- Stepheonorus dentatus

**SMALL INTESTINE**
- Ascaris suum
- Strongyloides ransomi

**STOMACH**
- Hypostrongylus rubidus

**LARGE INTESTINE**
- Trichuris suis
- Oesophagostomum spp.
**STOMACH**

**Hyostrongylus rubidus** "Red Stomach Worm"

**Order:** Strongylida  **Superfamily:** Trichostrongyloidea

**DIRECT LIFE CYCLE**

- L3
- L1
- Prepatent period: 21 days

**MOST common in pastured pigs**

**CLINICAL SIGNS**

- Anemia
- Onorexia
- D+/V+

**DIAGNOSIS**

ID of LARVAE with a Baermann

**ANTHELMINTICS**

Most approved swine dewormers will work

**MORPHOLOGY**

- 4-8mm

**PATHOLOGY**

- Larvae invade the gastric glands
  - Chronic wasting
  - Gastric ulceration
  - Degeneration of glands
  - $HCl$↓ $pepsinogen$ = $\uparrow$ pH

**stomach pH**

- 2-3: Normal
- 4-5: Activity ↓
- 6.0: Diarrhea
- 7.0: Mucosal sloughing, bacterial invasion
**SMALL INTESTINE**

*Ascaris suum* - "Pig Roundworm"

**Order:** Ascaridida | **Superfamily:** Ascaroidea

**DIRECT LIFE CYCLE**

Hepato-Tracheal Migration

L1 infective! prepatent period: 6-8 weeks

**PATHOLOGY**

- Larvae migrate through LIVER + LUNGS can obstruct:
  - small intestine
  - bile duct
  - pancreatic duct
- Antigenic excretory byproducts of molting + migration trigger the host immune response → 2º damage
- Causes these characteristic milky spots on LIVER
- Leads to condemnation at slaughter!

**MORPHOLOGY**

25-40cm identical to human ascarids

**CLINICAL SIGNS**

MILD:
- Cough
- Diarrhea
- Weight gain
- "poor-doers"
- Pendulous abdomen

SEVERE:
- Cough with hemorrhagic exudate
- "thump"
- Pneumonia
- Bronchitis

**DIAGNOSIS**

ID of EGGS in feces

Necropsy - characteristic lungs

**ANTHELMINTICS**

Treat constantly so that treatment is during the prepatent period in order to prevent migration

**CONTROL** by maintaining sanitation

*MOST economically important nematode of swine*
**Strongyloides ransomi** "Pig Threadworm"

**Order:** Rhabditoidea  **Superfamily:** Rhabditoidea

**DIRECT LIFE CYCLE**

1. **Prepatent period:**
   - Skin-Tracheal Migration - 9 days
   - Transmammary Transmission - 4-6 days

**PATHOLOGY**
- Blunting of intestinal villi
  - Inhibits nutrient absorb.
  - Pulmonary migration

**CLINICAL SIGNS**
- Most severe in suckling piglets
- D+ (hemorrhagic)
- Emaciation, anorexia
- Shunting
- VT
- Anemia

**DIAGNOSIS**
- ID of EGGS in feces
  - Need a RECTAL sample
- Baermann can help for differentiating LARVAE

**MORPHOLOGY**
- ADULTs are 6mm

**ANTHELMINTICS**
- Ivermectin for sows
- Benzimidazoles for piglets

**CONTROL** by
- Maintaining sanitation
- Keeping pens dry
- Deworm sows b/w litters
**LARGE INTESTINE**

*Trichuris suis*  "Whipworm"

**Order:** Enoplida  
**Superfamily:** Trichuroidea

**DIRECT LIFE CYCLE**

Prepatent period: 6-7 weeks

**MORPHOLOGY**

3.5 - 8 cm long  
Posterior: short + stout  
Anterior: long + slender

**PATHOLOGY**

Necrosis of mucosa in cecum + large intestine

**CLINICAL SIGNS**

Piglets @ 2-6 months  
→ D+  
→ anemia  
→ anorexia

**DIAGNOSIS**

ID of EGGs in feces  
Characteristic bipolar football EGG

**ANTHELMINTICS**

Fenbendazole
**Oesophagostomum spp.** "Nodular Worm"

**Order:** Strongylida  **Superfamily:** Strongyloidea

---

**DIRECT LIFE CYCLE**

- **L1/L2**
- **L3**
- Pre-patent period: 40-50 days

---

**MORPHOLOGY**

Stout, white worms 8-21 mm long

---

**PATHOLOGY**

Necrosis of mucosa in LI
2° to antigenic activity

Nodule formation - purulent, can calcify

---

**CLINICAL SIGNS**

Usually asymptomatic
Can cause ↓ growth rates

---

**DIAGNOSIS**

ID of EGGS in feces
- Can incubate to hatch to help identify by LARVAE

---

**ANTHELMINTICS**

All effective
**RESPIRATORY**

**Metastrongylius spp. “Lungworms”**

<table>
<thead>
<tr>
<th>Order: Strongylida</th>
<th>Superfamily: Metastrongyloidea</th>
</tr>
</thead>
</table>

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** Pigs

**INTERMEDIATE HOST:** Earthworms

![Larval EGG](image)

\[L_3 \leftarrow L_1 \text{ in earthworm}\]

**Prepatent period:** 4 weeks

**MORPHOLOGY**

Slender white worms up to 58mm

**PATHOLOGY**

- Larvae breaking into bronchioles
  - Inflammation
  - Pulmonary edema
- Lymphoid hyperplasia
- Vesicular emphysema

*Presence of lungworms enhances the pathogenicity of other respiratory agents*

**CLINICAL SIGNS**

- Young piglets initially cough
- Permanently lung consolidation leads to a worsening cough

**DIAGNOSIS**

- ID of larvated EGGS in feces
- Necropsy - exam of lungs

**ANTELLEMINTICS**

- Macrolides or Fenbendazole
**MUSCULOSKELETAL**

**Trichinella spiralis**

**Order:** Enoplida  
**Superfamily:** Trichuroidea

**DIRECT LIFE CYCLE**  
Can occur in MOST MAMMALS!

- L1 encysted in striated muscle

**prepatent period:** 20-24 days

**PATHOLOGY**

- Cysts can interfere with
  - Muscle function
  - Eosinophilia
  - Acute myositis

**CLINICAL SIGNS**

- In pigs – NONE

**HUMANS:**

- V+
  - Headache
  - Photophobia
  - Muscle pain
  - Meningoencephalitis
  - Death

**ANTHelmintics**

- Adult worms susceptible to most dewormers
- Anti-inflammatories can help

**ONCE INGESTED:**

1) Cyst digested and L1 released in GI tract
2) Adults develop and mate
3) Females penetrate GI mucosa and enter lymphatics to produce L1
4) L1 migrate to muscles and become encysted
   → Affected muscle cells are referred to as "nurse cells"
5) Encysted larvae remain viable for ~1 year before dying
   → L1 then the cyst calcifies

**DIAGNOSIS**

- Serology
- or
- Trichinoscope - thin piece of muscle between glass slides examined microscopically

**PREVENTION**

- Prevent cannibalism
- Cook meat/garbage at 58°C
**Taenia spp.** "Tapeworms"

**Order:** Cyclophyllidae  **Family:** Taeniidae

**INDIRECT LIFE CYCLE**
**DEFINITIVE HOST:** DOGS + CATS
**INTERMEDIATE HOST:** GRAZING ANIMALS (Ruminants + Pigs)

**PATHOLOGY**
- LIVER Damage in Pigs
- Cyst formation in LIVER or MUSCLE in Ruminants
  - partial or complete carcass condemnation

**CLINICAL SIGNS**
None really in the Definitive Hosts

**DIAGNOSIS**
- Id of EGGS in feces
- Visualization of proglottids in feces
**URINARY**

**Stephanurus dentatus** "Swine Kidney Worm"

**Order:** Strongylida  **Superfamily:** Strongyloidea

**DIRECT LIFE CYCLE**

- In URINE
- L1/L2
- L3
- Prepatent period: 9-16 months!

**PATHOLOGY**

- Damage 2° to migration
- Muscle abscessation

**CLINICAL SIGNS**

- Anorexia
- Emaciation
- Poor growth rate
- Posterior paralysis

**DIAGNOSIS**

- Based on clinical signs
- ID of EGGs in urine
- Necropsy
  - Can find extensive visceral damage d/t larval migration

**THEN:**

- Wander in LIVER for 3-9 mos
- Leaves LIVER and wanders in the peritoneal cavity until finding and entering the perirenal fat
- Molts to L5 in a cyst connected to the lumen of the ureter

**ANTHELMINTICS**

- Macrolides + Fenbendazole
HELMINTHS of EQUINES

**EYE**
- *Thelazia lacrymalis*
  - Eye worm

**RESPIRATORY**
- *Dictyocaulus arnfieldi*
  - Equine Lungworm

**INTEGUMENT**
- *Onchocerca cervicalis*
  - Neck Threadworms

**STOMACH**
- *Draschia megastoma*
- *Habronema muscae*
- *Habronema microstoma*

**SMALL INTESTINE**
- *Parascaris equorum*
  - Equine Roundworm
- *Strongyloides westeri*
  - Threadworm

**LARGE INTESTINE**
- *Anoplocephala perfoliata*
  - Ileocecal junction
- Large Strongyles
  - *Strongylus vulgaris*
  - *Strongylus edentatus*
  - *Strongylus equinus*

Small Strongyles (40 spp.)
- *Oxyurus equi*
  - Equine Pinworms
**Equine Stomach Worms**

- **Draschia megastoma**: 4x most severe, but rare now.
- **Habronema muscae**: 4x most prevalent.
- **Habronema microstoma**: 4x not reported in US (yet).

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST**: EQUINES

**INTERMEDIATE HOST**: MUSCID FLY

1. Flies deposit L3 LARVAE around horses’ mouth → get swallowed by horse
2. Flies deposit L3 LARVAE on moist skin, wounds, or eye → CUTANEOUS HABRONEMIASIS
   - a.k.a. Summer sores
   - granulomatous reaction
   - reddish brown, greasy skin lesion containing yellow, calcified material the size of rice grains
   - spontaneous healing can occur
   - sx removal or cautery may be needed

**PATHOLOGY**

- Usually asymptomatic
- Heavy infections can cause gastritis
- Draschia produces most severe lesions
  → nodules up to 10cm in diameter filled with necrotic material + a large number of worms
  → rarely, these nodules can cause mechanical obstruction or rupture & cause Fatal Peritonitis

**ANTHELMINTICS**

Moxidectin or Ivermectin

+ Fly control, esp. for wounds!

**DIAGNOSIS**

- EGGS not seen on routine fecals
- Molecular methods available but infrequently used
- May see on gastroscopy or necropsy

**Dx Summer Sores**: ID LARVAE on skin scraping
**Small Intestine** these are clinically relevant in foals

*Parascaris equorum* "Equine Roundworm"

**Direct Life Cycle**
- Eggs containing L2s hatch in the gut
- L2 migrate thru wall of SI to liver + molt from L2 to L3
- 7-14 days post infection, majority of larvae have made it to lungs
- L3s break out of alveolar capillaries into alveoli, migrate up trachea to be coughed up + swallowed
- Final maturation to adults occurs in SI

**Morphology**
- Females may be as large as 50 cm long + 8 mm in diameter
- Males may be 15-28 cm long

**Pathology + Clinical Signs**
- Damage from larval migration
  - Coughing
  - Nasal discharge
  - "Summer colds"
- Developing adult worms in SI
  - Heavy infestations can cause
    - Impaction
    - Rupture
    - Subsequent death

**Anthelmintics**
- Routine broad spectrum deworming
  - This parasite is one of the reasons foals are dewormed more regularly than adults

**Control**
- Eggs are hardy + long-lasting in the environment
- "Last year’s foals are the biggest source of eggs for this year’s babies

★ Top concern when you have a colicking foal, esp. if poor deworming hx
**Strongyloides westeri**; "Equine Threadworm"

**DIRECT LIFE CYCLE**

ADULT worms reside in SI of foals
- small intestinal enteritis and DI
- skin irritation
- "frenzied behavior" d/t percutaneous infection

**PATHOLOGY**

**CLINICAL SIGNS**

Affects foals
Adult horses rarely have clinical signs

**TRANSMAMMARY transmission**

- mares often have larval stages in their tissues
- parturition activates larval migration to mammary tissues

**ANTHELMINTICS**

Prevent infection of foals via mare's milk
- Ivermectin for mares routinely within 24 hrs of foaling
**LARGE INTESTINE**

*Anoplocephala perfoliata* “Equine Tapeworms”

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST**: EQUINES

**INTERMEDIATE HOST**: FORAGE MITE (Orbipodidae)

- Immature tapeworms are released from the ingested mite
- Attaches to intestinal lining
  - **ILEOCECAL JUNCTION**

**PATHOLOGY + CLINICAL SIGNS**

Many are asymptomatic

But can:
- Damage intestinal mucosa
- Be associated with ileal impaction, spasmodic colic, cecal intussusception, and rupture
- Large worm burden can obstruct the bowel

**DIAGNOSIS**

- ID of EGGS in feces – not very diagnostic/reliable

**ANTHELMINTICS**

Praziquantel or Pyrantel pamoate at a double dose

*Recommended to deworm with something effective against tapeworms at least once per year*
Large Strongyles, "Red Worms" or "Blood Worms"

DIRECT LIFE CYCLE

- EGG → L1 → L2 → L3

Internal migration patterns vary by species:

- **Strongylus vulgaris** - migrates to cranial mesenteric artery & branches
  - Prepatent period: 6 months

- **Strongylus edentatus** - migrates to LIVER via portal veins
  - Prepatent period: 11 months

- **Strongylus equinus** - migrates to LIVER and PANCREAS through the peritoneal cavity
  - Prepatent period: 9 months

PATHOLOGY

- Damage to GI mucosa
- **S. vulgaris**
  - Migration to artery damages vascular endothelium
  - → arteritis
  - → thrombosis
  - → embolism of artery
  - → possible fatal infarction of bowel wall
  - All can manifest as COLIC

- **S. edentatus**
  - Migration is confined to the LIVER, thus relatively harmless

- **S. equinus**
  - Migration is confined to the LIVER + PANCREAS, thus relatively harmless

CLINICAL SIGNS

- Unthriftness
- Lethargy
- Anemia
- Hypoproteinemia
- Dependent edema
- Diarrhea

DIAGNOSIS

Based on clinical signs

ID of strongyle EGGS in feces

ANTHELMINTICS

- All Equine dewormers effective
  - Ivermectin
  - Fenbendazole
  - Moxidectin + Praziquantel
**Small Strongyles**

**DIRECT LIFE CYCLE**

![Diagram of the life cycle of small strongyles](image)

**PATHOLOGY**

- NO migration outside of the GI tract
- Larvae encyst in small nodules within the submucosa
- Larvae ➔ Adults in the nodules
- Adults emerge from the nodules and feed on the mucosal surface (blood suckers)

**CLINICAL SIGNS**

- Usually harmless
- Heavy infections:
  - Emergence from nodules all at once can cause irritation + inflammation
  - Interference with nutrient absorption
  - L1: Unthriftness
  - L2: Lethargy
  - L3: Anemia
  - L4: Hypoproteinemia
  - L5: Dependent edema
  - L6: D+ (death)

**DIAGNOSIS**

- ID of strongyle EGGS in feces
- Recommended to deworm 2x/year regardless of FEC bc of this

**ANTHELMINTICS**

All Equine dewormers effective for Adults free in the LI
- Ivermectin
- Fenbendazole
- Moxidectin + Praziquantel

Encysted small strongyles need
- High dose Fenbendazole
- Moxidectin + Praziquantel
**Oxyuris equi** "Equine Pinworms"

**DIRECT LIFE CYCLE**

- L3s emerge from ingested EGGS
  - enter mucosa of cecum + colon to feed + molt
- ADULTs live in lumen and feed on gut contents
  - FEMALES migrate to end of intestine and out the anus
  - EGGS laid on perianal skin

**MORPHOLOGY**

♀

L ≈ 15 cm

♂

L ≈ 2 cm

**PATHOLOGY + CLINICAL SIGNS**

- Heavily infected horses may be nervous + lose their appetite
- Perianal irritation from rubbing and scratching the area
  - → dull coat + hair loss especially the tail
- 2nd bacterial infection of perianal skin d/t rubbing, scratching + irritation
- Can be some ulceration in intestine resulting from LARVAE feeding on the intestinal mucosa

**DIAGNOSIS**

"Scotch-tape test"

- collecting EGGS from perianal area for microscopic exam

**ANTHELMIINTICS**

ALL Equine dewormers effective

- Ivermectin
- Fenbendazole
- Moxidectin + Praziquantel

+ treat any secondary infections
**RESPIRATORY**

*Dictyocaulus arnfieldi*; "Equine Lungworm"

**DIRECT LIFE CYCLE** DONKEYS (♂) and HORSES

LYMPHATIC-TRACHEAL MIGRATION

![Diagram of life cycle]

ADULTS reside in the bronch + bronchioles
EGGS +/- L1s are coughed up + swallowed

**PATHOLOGY**

chronic, nonsuppurative, eosinophilic, granulomatous pneumonia
most common in the caudal lung lobes
severity dependent upon worm burden

**CLINICAL SIGNS**

**DONKEYS:**
- asymptomatic
- more mild than clinical disease
- can handle a HIGH worm burden

**HORSES:**
- coughing
- dyspnea
- unthriftness
- exercise intolerance
- Death in extreme cases

**DIAGNOSIS**

ID of LARVAE in feces, sputum, or saliva
via Baerman technique
or Tracheoalveolar wash / Bronchoalveolar lavage

**ANTHELMINTICS**

broad spectrum dewormers:
- Ivermectin
- Moxidectin

🌟 Take extra care when pasturing horses + donkeys together!

Since donkeys can be big shedders while being asymptomatic
**INTEGUMENT**

*Onchocerca cervicalis* "Neck Threadworms"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** EQUINES

**INTERMEDIATE HOST:** BLACK FLY

- L3 deposited into skin
- FLY picks up L1s when biting
- L3 in the FLY

L3 mature into adults in subQ tissues

**PATHOLOGY**

Some debate over the role of this parasite in the pathogenesis of a few diseases commonly associated with it

- dermatitis
- fistulous withers
- poll evil
- uveitis

Large numbers of these worms are common also in horses WITHOUT these diseases...

**CLINICAL SIGNS**

Intense pruritis + associated dermatitis with reaction to microfilaria

**DIAGNOSIS**

- Skin biopsy - full thickness, ≥6mm diameter
  - Tissue minced + macerated in isotonic saline for several hrs
  - Microfilaria concentrated + stained with new methylene blue

Highly suggestive if extremely itchy 48-72 hrs after deworming (as microfilaria die)

**ANTHELMINTICS**

- NO treatment effective against adults
- Ivermectin and Moxidectin are efficacious against microfilaria
Thelazia lacrymalis "Eye Worm"

**INDIRECT LIFE CYCLE**

**DEFINITIVE HOST:** HORSE

**INTERMEDIATE HOST:** MUSCOID FLIES (Face Fly + House Fly)

L1 consume L1 in tears or manure (hosts can swallow their tears)

↓ matures to L3 inside FLY

↓ L3 infects eye once FLY lands on a host + develops there into an ADULT

**Prepatent period:** 2-4 weeks

**PATHOLOGY**

None known but associated with pink eye

**CLINICAL SIGNS**

- Excess lacrimation
- Chronic conjunctivitis
- Corneal clouding

Clinical signs tend to be more severe in Europe + Asia compared to North America.

**CONTROL**

→ Fly control important

**DIAGNOSIS**

- Visualization of the worm (not reliable)
- Suspicion based on clinical signs
- Can attempt microscopic examination of lacrimal fluids for embryonated eggs or larvae

**ANTHELMINTICS**

Single anthelmintic dose not effective

Fenbendazole: multi-dose regimen

10mg/kg/day for 5 days

or mechanical removal of worm
TAPEWORMS  

**Cestodes**

**HOSTS + PREDILECTION SITES:**

- **DOGS + CATS - Taenia spp.**  
  *SI*
- **DOGS - Echinococcus spp.**
- **DOGS, CATS, HUMANS - Dipyldium caninum**
- **RUMINANTS - Moniezia spp.**

- **EQUINES - Anoplocephala perfoliata**  
  *LI + ileocecal junction*

- **PIGS + RUMINANTS - intermediate host for Taenia spp.**  
  *LIVER + MUSCLE*

**LIFE CYCLE:**  
Indirect lifecycle

- LA: Intermediate host: forage mites
- SA: Intermediate hosts also arthropods

**CLINICAL SIGNS:**  
All definitive host species usually asymptomatic

- At most causes issues with young animals
  1. Inhibit nutrient absorption
  2. Potential of blockage
  3. Intestinal upset

**Dx:** Visualization of proglottids in feces  
or fecal to 1D eggs

**HUMAN RISK:** Echinococcus species causes hydatid dz in humans
**FLUKES**

**Trematodes**

**HOSTS + PREDILECTION SITES:**

- **DOGS - *Fasciolopsis buski***
  - Internal hosts - snails + semi-aquatic birds

- **DOGS + CATS - *Fascioloides magna***
  - **RESPIRATORY**

- **RUMINANTS + HUMANS - *Fasciola hepatica***
  - **LIVER + BILE DUCTS**

- **WHITE-TAILED DEER - *Fascioloides magna***
  - **DOMESTIC RUMINANTS**

**LIFE CYCLE:**
- Indirect lifecycle
  - Internal hosts - snails + crayfish (all except *Fasciolopsis buski*)

**Dx:**
- Fecal to ID eggs

**HUMAN RISK:**
- *Fasciola hepatica*

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**INTEGUMENT**

**HOSTS + PREDILECTION SITES:**

- **DOGS - *Dipetalonema reconditum***
  - **SKIN**

- **DOGS - Dracunculus insignis***

- **EQUINES - Onchoerca cervicalis***

**LIFE CYCLE:**
- Indirect life cycles

**CLINICAL SIGNS:**
- Dracunculus + Onchoerca cause intense pruritis + associated dermatitis

**Dx:**
- *Dipetalonema -* only important to look for microfilaria in blood a R/O for HW

- Dracunculus - visualization of worm

- Onchoerca - skin bx
**EYE WORMS**  
*Thelazia spp.*

**HOSTS + PREDILECTION SITES:**
- **DOGS, CATS, HUMANS, SHEEP, DEER** - *T. californiensis*
- **CATTLE** - *T. gulosa + T. skrjabini*
- **EQUINE** - *T. lacrymalis*

**LIFE CYCLE:** Indirect lifecycle
- Intermediate hosts = flies
  (muscid - Equine, dipthro - others)

**CLINICAL SIGNS:** Eye irritation + may be associated with pink eye in LA’s

**Dx:** Visualization of worm or based on hx

**HUMAN RISK:** *T. californiensis*

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**WHIPWORMS**  
*Trichuris spp.*

**HOSTS + PREDILECTION SITES:**
- **DOGS** - *T. vulpis*
- **CATS** - *T. campauba*
- **RUMINANTS + CAMELIDS** - *T. ovis, T. discolor, T. globulosa, T. tenius*
- **SWINE** - *T. avium*

**LIFE CYCLE:** Direct life cycle
- Fecal-oral route

**CLINICAL SIGNS:**
- **Dogs + Cats:** D+/mushy stools
- **Swine + Camelids:** Most affected:
  - Camelids - poor growth, anemia, D+
  - Swine - necrosis of cecum + LI

**Dx:** Fecal to 10 eggs
HOOKWORMS

HOSTS + PREDILECTION SITES:

- DOGS - Ancylostoma caninum
- CATS - A. tubaeforme
- DOGS + CATS - A. braziliense
- DOGS + CATS - Uncinaria stenocephala
- RUMINANTS - Bunostomum spp.

LIFE CYCLE: Direct life cycle - skin transmission (or ingestion w/ ruminants)

CLINICAL SIGNS: Blood suckers!

- anemia
- black, tarry stool
- anorexia

- lung damage 2° to larval migration
- dermatitis 2° to skin transmission

Dx: Fecal to ID eggs

HUMAN RISK: A. braziliense can cause cutaneous larval migrans in humans
ASCARIDS

HOSTS + PREDILECTION SITES:

- DOGS - *Toxocara canis*
- CATS - *Toxocara cati*
- DOGS + CATS - *Toxascaris leonina*
- RACOONS - *Baylascaris procyonis*
- SWINE - *Ascaris suum*
- EQUINE - *Parascaris equorum*

LIFE CYCLE: Direct life cycle - fecal-oral route for all

CLINICAL SIGNS: damage to SI:

- V/D
- Stunted growth / poor doing
- Distended abdomen (LARGE worms) **some risk of impaction**
- Dehydration

Damage from larval migrans (thru lungs + liver):

- Cough
- Nasal discharge
- Bronchitis

*Characteristic white milky spots on LIVER of swine*

**DX:** Fecal to 10 eggs

HUMAN RISK: Visceral larval migrans caused by *T. canis* + *T. cati*

Neurotropic larval migrans caused by *Baylascaris sp.*
STRONGYLOIDES spp.

HOSTS + PREDILECTION SITES:

- DOGS + PRIMATES - S. stercoralis
- RUMINANTS - S. papillosus
- SWINE - S. ransomi
- EQUINE - S. westeri

LIFE CYCLE: Direct life cycle - Skin transmission +/- ingestion

CLINICAL SIGNS: adults not very affected, problematic for young

- Damage to SI:
  - D+
  - Abdominal pain
  - Weight loss
  - Blunting of intestinal villi
  - Enteritis
  - "Frenzied behavior" seen in foals

- Damage from skin transmission:
  - Dermatitis + skin irritation

Dx: Fecal to ID Larvae (S. stercoralis, westeri) or Eggs (S. papillosus, ransomi)

HUMAN RISK: S. stercoralis can infect humans
RESPIRATORY

HOSTS + PREDILECTION SITES:

**DOGS** - *Filaroides osleri*

**DOGS + CATS** - *Capillaria aerophila*

**DOGS + CATS** - *Paragonimus kellicotti*

**CATS** - *Aelurostrongylus abstrusus*

**RUMINANTS** - *Dictyocaulus spp.*

**SMALL RUMINANTS** - *Protostrongylus rufusens* → danger to Big Horn Sheep

**SMALL RUMINANTS** - *Muellerius capillaris*

**SWINE** - *Metastrongylus*

**EQUINES** - *Dictyocaulus arnfieldi*

**LIFE CYCLE:**

- Direct life cycle - *Filaroides, Capillaria, Dictyocaulus spp.*
- Indirect life cycle - *Paragonimus, Aelurostrongylus, Protostrongylus, Muellerius, Metastrongylus*

**CLINICAL SIGNS:**

- cough
- dyspnea
- wheezing
- anorexia, emaciation
- nasal discharge

**Dx:**

- Fecal to 1D Eggs *Filaroides, Dictyocaulus spp., Protostrongylus, Muellerius*

- Fecal to 1D Larvae *Capillaria, Metastrongylus*
PRACTICE CASES

Trying to answer practice cases (even without knowing all the right answers) helps to focus on the clinically relevant pieces of information and to present info in ways that makes sense to owners. If you think of all your practice cases as if you’re a mixed animal practitioner, it opens the door for having to explain lots of comparative medicine to clients who own or work with multiple species.

ALPACA PROBS:

Your client who already has a small flock of sheep has decided that they wanted to get a few alpacas as well. They have no prior experience with alpacas, but they say "how different from sheep can they be?"
Among other things you probably need to educate these clients on about their new alpaca friends, what parasite(s) are you particularly concerned about for them and what prevention and treatment strategies do you tell them to utilize?
You get a call from one of your equine clients *freaking out* because some girl at the barn insisted that you can get WORMS in your EYES from being around horses?! She wants to hear from you, since vets know best what we can catch from animals. What do you tell her about the zoonotic risks of eye worms? (Cover your bases and let her know about the risks from any domestic species affected by eye worms).
Working with a rescue organization, you're brought a litter of ~7 wk old puppies with their dam (rescued pregnant - whelping uneventful) for their first well check. You soon learn that this rescue has only worked with adult cats before but wanted to help out this dog, so they're looking for your guidance on this new venture! What do you talk to them about regarding parasite control (treatment & prevention) for these puppies? They say if this whole ordeal goes well, they'll feel comfortable enough to help out more rescue animals with litters, so they ask if this is all the same regarding kittens?
Becky told you yesterday when she brought a fecal sample in for Fido's annual that she didn't see why it needed to be checked, and felt like it might be a waste of time and money since he's always been negative before and he has "never" had any signs of GI upset. His fecal result comes back from the lab today as positive for hookworms!

What do you tell Becky about how Fido picked up this parasite?

Assuming you failed to address the topic of why fecals can be important to check yesterday at the appointment, what do you tell her today on the phone about why it is important to treat him for the hookworms even though they haven't noticed any symptoms in him?
Sweet old Betty & Bob recently adopted a meatball of a pitty from (insert any Southern state where all the New England rescue dogs come from). All they know about her is that she's the sweetest thing ever and she was "on the streets for a long time."

The lil' meatball of love's rescue records show they dewormed her one time (dewormer type not clear...) and they had her on Heartguard monthly while she was there. The last heartworm test with the rescue was negative, but that was 2 months ago and she was rescued from "the streets" in the South just 3 months ago.

What's your best & client-friendly spiel on heartworm in dogs, and what does that mean for this specific patient? When will you retest this dog next?

Would you recommend treating her for other parasites proactively, assuming she had some pre-existing infestation but you have no idea what they dewormed her with?

Would you wait for a fecal result first (pupperoni is asymptomatic)?
THE CLASSIC SOUTHERN RESCUE DOG:
SICK FEEDER PIGS GET CARE TOO:

A new client, Jack, calls your office bright and early Monday morning. He says he's raised a couple feeder pigs every year for himself and his family for over a decade, but this year he's noticed one of the gilts not doing right, and recently just got a lot worse. He tells you she's lost a ton of weight, has stopped eating, and is having diarrhea. You get to the property and see quite an emaciated pig laying in the cool dirt and its very well-muscled friend running to meet you at the gate. The ill gilt is dull, and on exam (which she's just laying down for) she is slightly hypothermic, pale, and seems to have a painful abdomen on palpation. You can see the dark diarrhea staining on her rear. These pigs get a nice big fenced-in dirt area at the back of the property, and the owner feeds largely food scraps with grain as well.

What parasite are you most suspicious about with how this pig looks (BCS: 1-2/5)? The client wants to give this pig care and see what can be done to help her comfortable and eating again.

What test would you like to check to rule in the parasite you're suspicious of?

If you chose to just treat on that assumption, what pathology can be caused by that parasite that you may want to help treat symptomatically (along with whatever dewormer you choose) to help give this gilt a chance to recover?
SICK FEEDER PIGS GET CARE TOO: