Strongyloides spp.

Intestinal Threadworms

Strongyloides spp.

Take Homes

Strongyloides spp.

- Threadworms
- Very Complex life cycle including: Heterogonic Life Cycle, Homogonic Life Cycle, Parthenogenesis, Transmammary transmission, Somatic Migration, Tracheal Migration. Free-living Stages.
- Parasitic Females in the small intestine cause enteritis. Infective larvae cause dermatitis. Migrating larvae cause respiratory issues (Thumps).
- Only the young hosts have clinical signs (diarrhea) and pass eggs or larvae in feces. Adult hosts do not pass eggs or larvae in feces.
- Treat young to decrease environmental contamination. Treat dam to decrease lactogenic transmission to offspring.
- Sanitation control.

Strongyloides ransomi

- Piglets. Skin Penetration, Ingestion, Transmammary. Ova on Float or McMasters, Diarrhea, Scours, Thumps, Dermatitis

Strongyloides westeri

- Foals. Skin Penetration, Ingestion, Transmammary. Ova on Float or McMasters, Diarrhea, Scours, Thumps, Dermatitis

Strongyloides papillosus

- Calves, kids, lambs. Skin Penetration, Ingestion, Transmammary. Ova on Float or McMasters, non-pathogenic, potential Foot-Rot

Strongyloides stercoralis

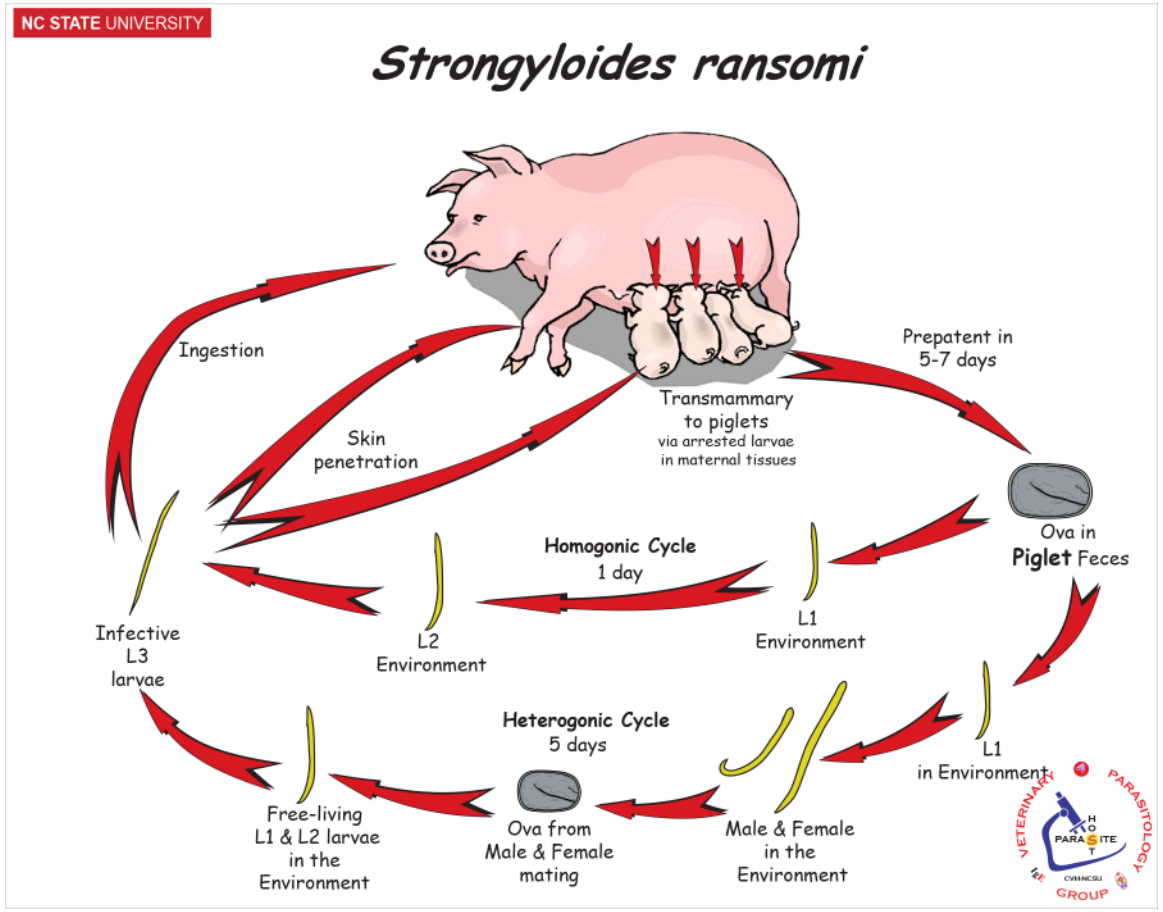
- Dogs & Humans. Skin Penetration, Ingestion, (Not transmammary). L1 larvae on Baermann, Diarrhea, Pododermatitis, Verminous Pneumonia.
- Special DZ manifestations: Autoinfection, Hyperinfection, Disseminated DZ. Important Zoonosis for the Immunocompromised.

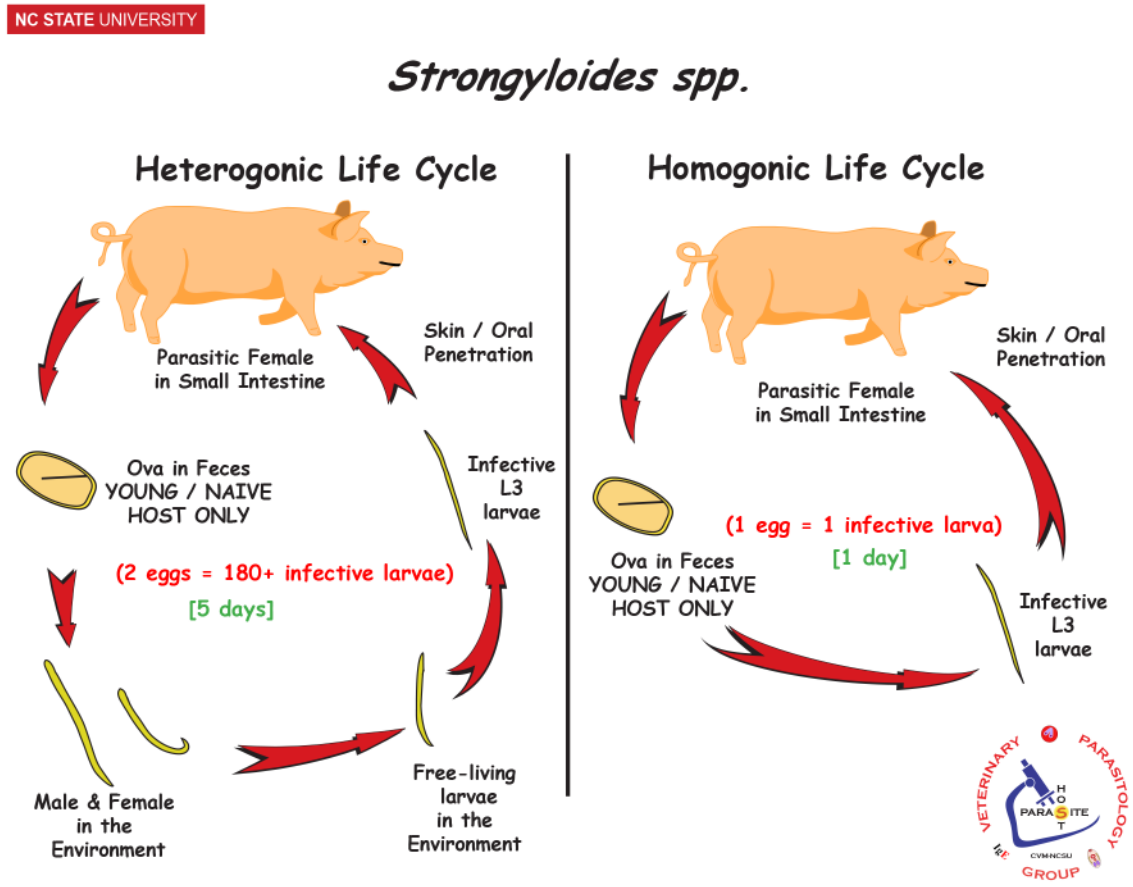
Strongyloides spp.

- Threadworm
- Several worm species showing host specificity
- Larval routes of infection
  - Skin penetration
  - Ingestion (= mucosal penetration)
  - Transmammary (Lactogenic) transmission
- Complex Life Cycle
  - Parthenogenesis
  - Homogonic Cycle
  - Heterogonic Cycle
- <u>Very young hosts</u> → Clinical Disease
  - Skin Penetration → Dermatitis
  - Tracheal migration → Respiratory DZ (verminous pneumonia)
  - Adult female worm → Small Intestine DZ (enteritis, diarrhea, malabsorption)
  - Source of Infection for Dam → → and future offspring
- Female hosts → Source of Infection for Neonates
  - Skin Penetration → Somatic Migration → Arrests
  - Arrested Larvae Reactivates → Transmammary transmission

Only the Female worm is Parasitic

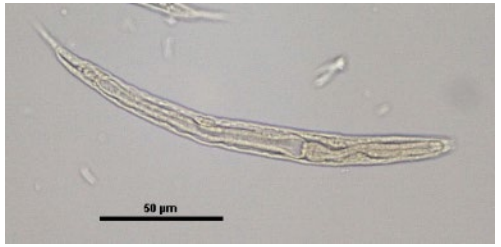
Strongyloides spp.





Strongyloides spp.

Egg
(diagnostic stage for ruminants, horses, swine)



L1 larvae
(rhabditiform larvae)
(diagnostic stage for dogs, humans)

Parasitic Female
(Parthenogenetic: doesn't mate to produce eggs)

Infective L3 larvae
(filariform larvae)

Free-living Male

Free-living Female

Strongyloides spp.

Genetics

FYI

Parthenogenetic Female
Triploid (3x chromosomes)

↓

Offspring
Triploid (3x chromosomes)

↓

Parthenogenetic Female
Triploid (3x chromosomes)

Homogonic

Parthenogenetic Female
Triploid (3x chromosomes)

↓

Free-living Female
Diploid (2x chromosomes)

↔

Free-living Male
Haploid (1x chromosomes)

↓

Offspring
Triploid (3x chromosomes)

↓

Parthenogenetic Female
Triploid (3x chromosomes)

Heterogonic

Strongyloides spp.

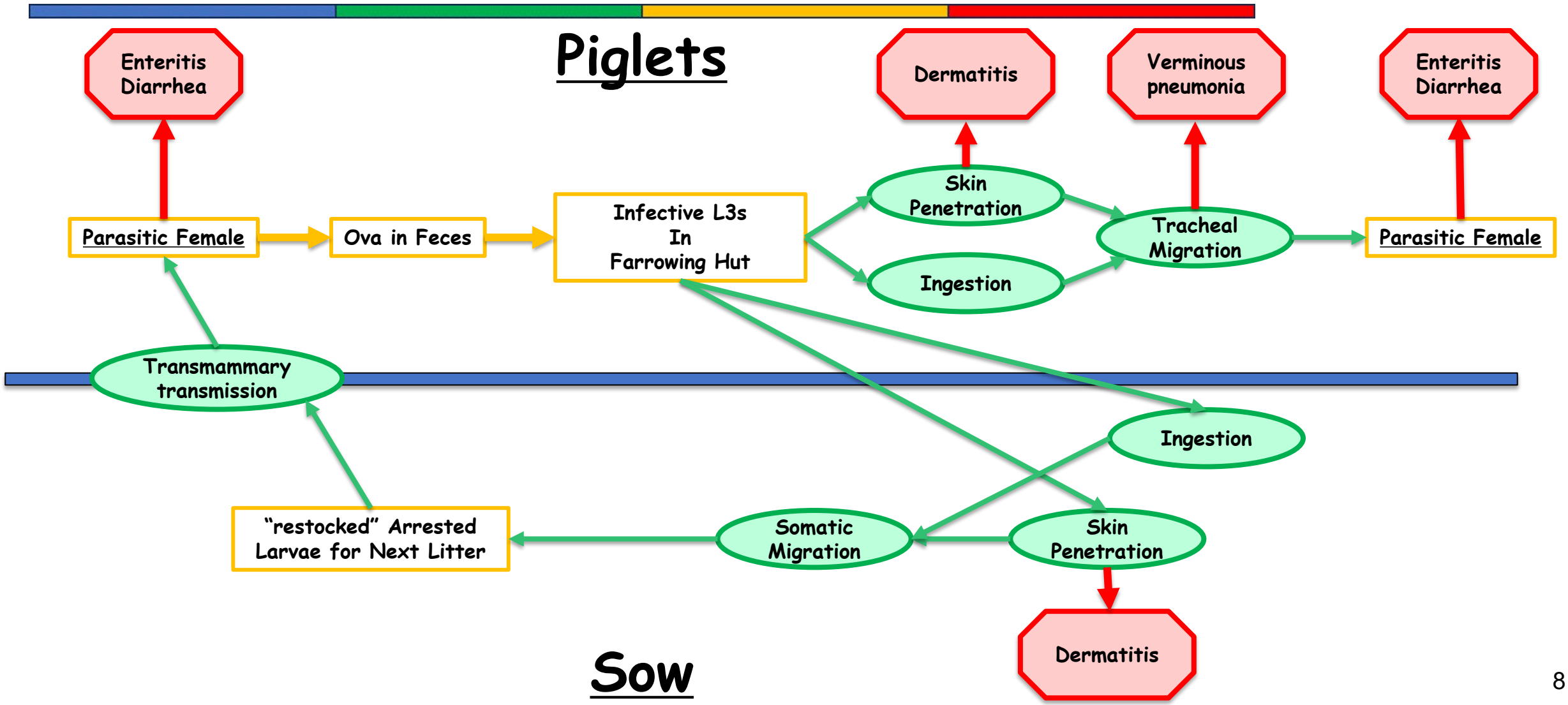
- **Transmission**
  - Transmammary (major) [aka Lactogenic]
    - Neonate → to intestine → initial infection / DZ
  - Penetration (major)
    - Skin Penetration & Ingestion [aka Mucosal penetration]
      - Neonate → tracheal migration → exasperates initial infection / DZ
      - Dam → somatic migration → restock larval stores for next set of offspring

- **Pathology**
  - Larval Skin Penetration → Dermatitis
  - Larval Tracheal Migration → Respiratory DZ
    - Bronchopneumonia, Verminous pneumonia
  - Adult Female in SI Mucosa → Intestinal DZ
    - Enteritis, Diarrhea, Watery (+/- mucus); Anorexia

Note: Variations for *Strongyloides stercoralis* will be addressed later.

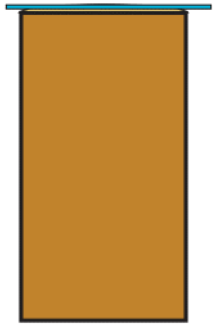
Strongyloides ransomi

Transmission & Pathology (same for *S. westeri*)

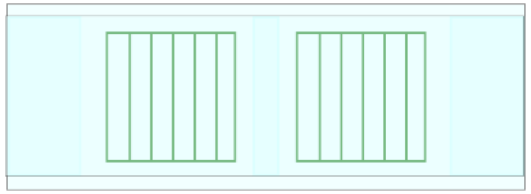


Strongyloides spp.

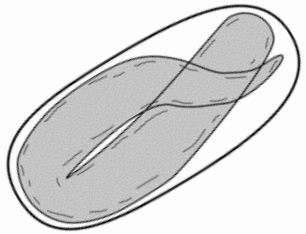
- **Diagnosis**
  - Signalment
    - neonate w/ diarrhea +/- cough
    - Also +/- pedal dermatitis
  - Fecal Float or McMasters
    - Larvated Ova in feces
      - **In neonate's feces; NOT mother's feces**



Passive Fecal Float



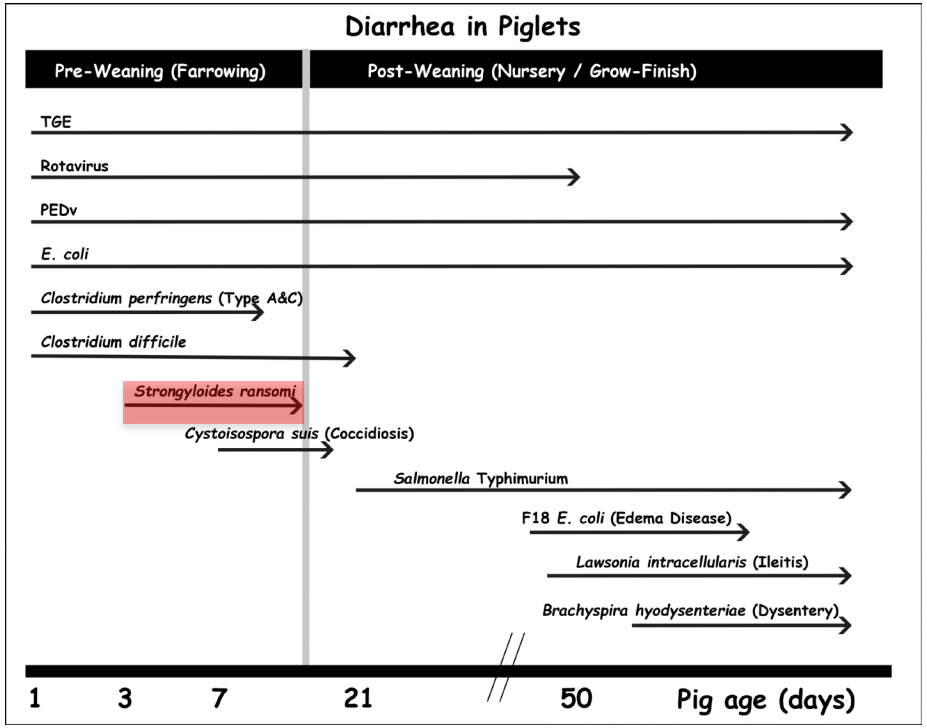
McMasters Counting Chamber



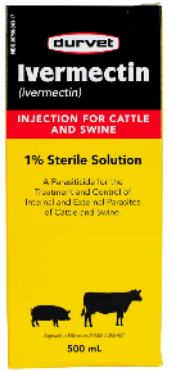
- **Treatment**
  - Various Anthelminthics may be used to treat *Strongyloides* infections.
  - Check withdrawal times for production animals.

- **Control**
  - Treat Neonates to decrease environmental contamination
    - Reinfection of self & dam
  - Treat dam near parturition to decrease lactogenic transmission
  - Sanitation / feces removal
    - Foaling stalls
    - Farrowing huts
    - Kennels

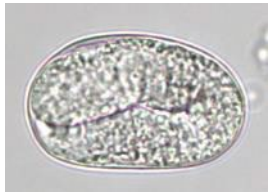
Strongyloides ransomi

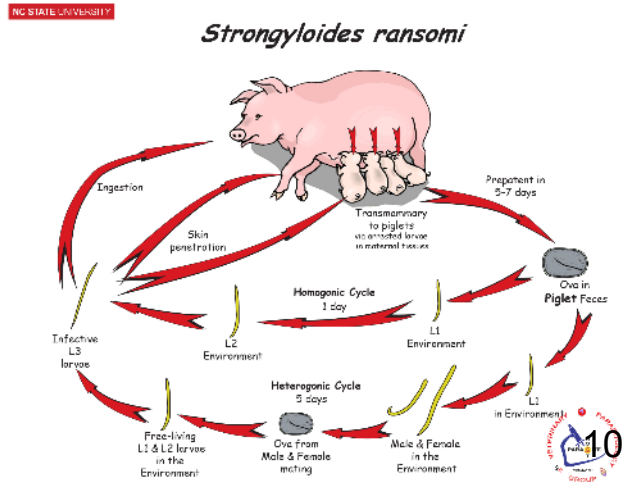


- **Piglets** (Pre-weaning)
  - Clinical Signs begin 1st week of life
  - Respiratory DZ : "Thumps"
  - Intestinal DZ : Diarrhea, "scours"
  - PPT: 2-4 days (lactogenic), 6-7 days (skin)

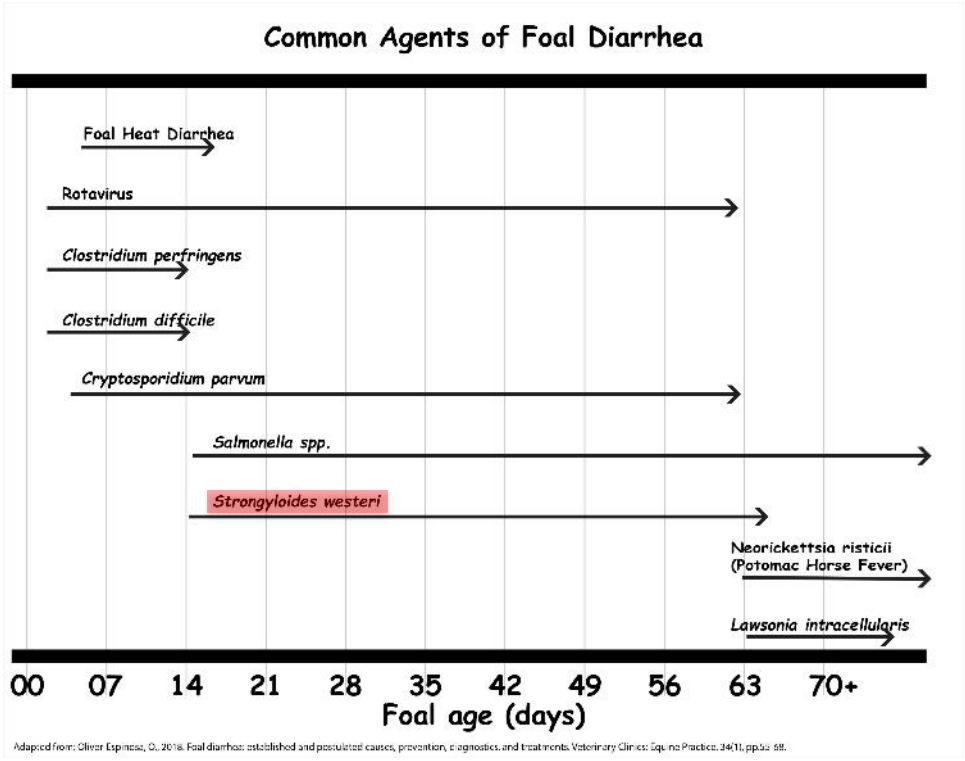


- **Treatments**
  - Adult worms
    - Fenbendazole, Ivermectin, Levamisole, Doramectin
  - Deworming sow around farrowing targets arrested larvae to decrease lactogenic transmission.
  - Check withdrawal times



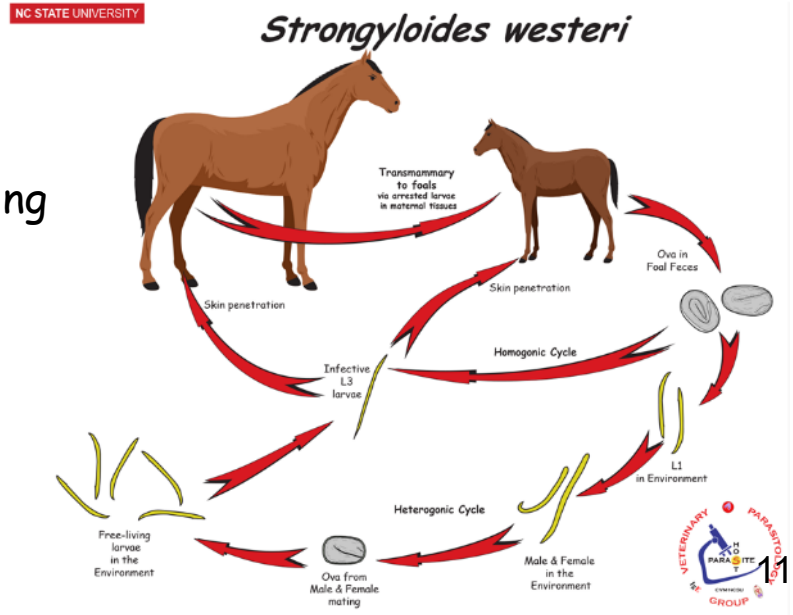


Strongyloides westeri



- **Foals**
  - Intestinal DZ : Enteritis → Diarrhea
    - Usually asymptomatic
    - Diarrhea @ +2,000 epg
  - Skin Penetration: Dermatitis
    - Hyperactive "frenzied" behavior
  - PPT: 5 days

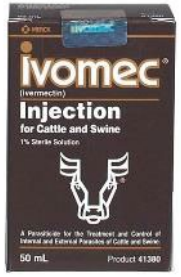
- **Treatments**
  - Adult worms
    - Ivermectin, Oxibendazole
  - Deworming mares around foaling is often practiced, but no evidence that it decreases lactogenic transmission.

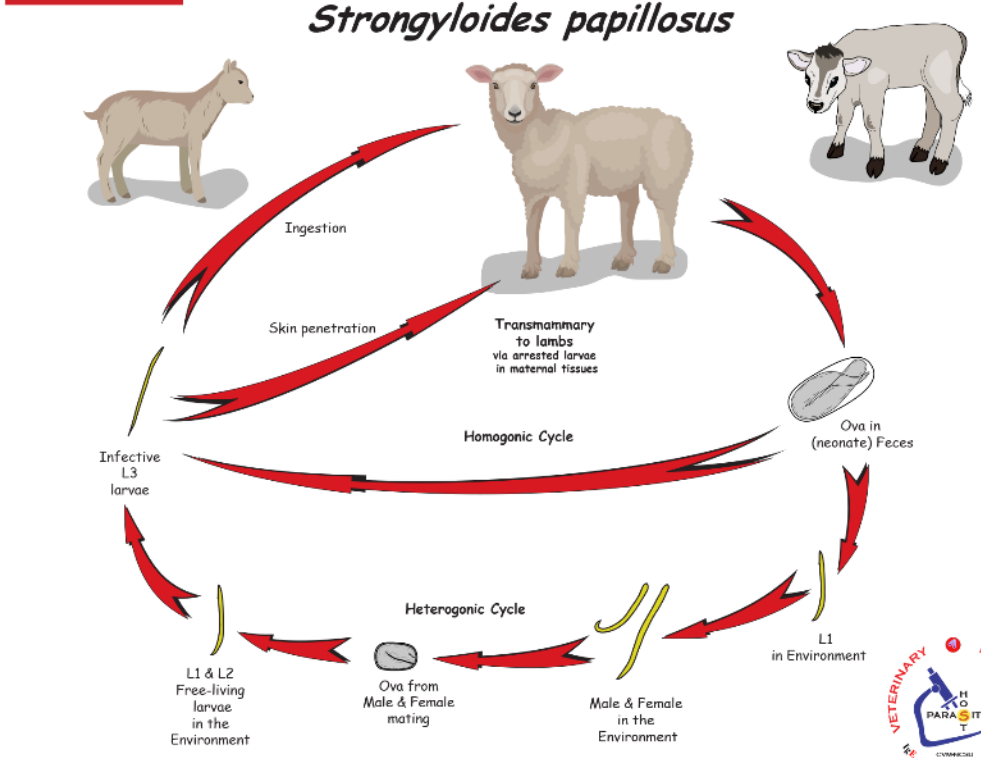


Strongyloides papillosus

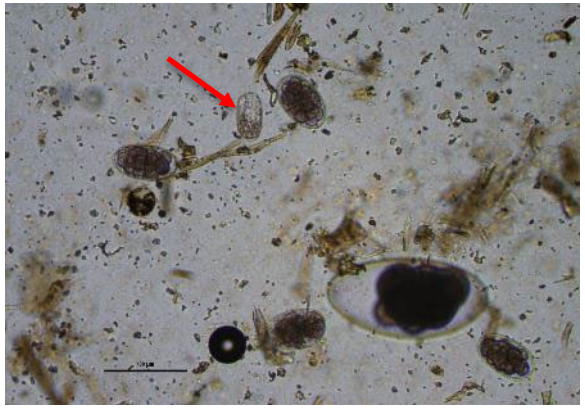
- **Lambs, Kids, Calves**
  - Pathology controversial
    - Generally considered a non-pathogenic commensal.

    But
    - Some studies show cases of pathology in kid goats.
  - Skin penetration may predispose for bacterial foot-rot





- **Treatments**
  - Adult worms
    - Ivermectin
  - Check withdrawal times

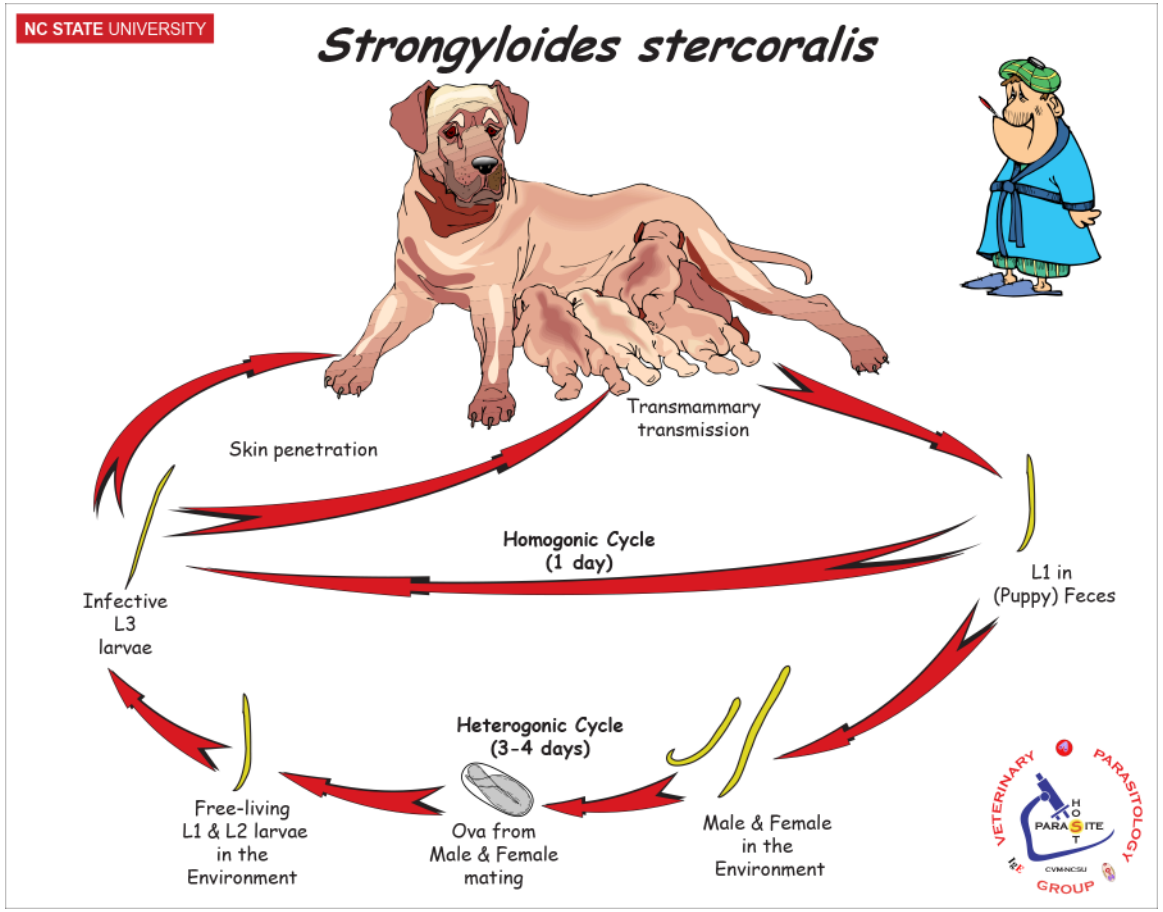


Strongyloides stercoralis

Differences v/s other *Strongyloides spp.*

- Transmission
  - Penetration (major)
    - skin & mucosa (ingestion)
  - Transmammary (very minor)
    - Only if dam is infected in late gestation or during lactation.
    - **No arrested larvae in dam's tissues**
- Life cycle
  - Ova hatches <u>in the host</u>
  - L1 passed in feces

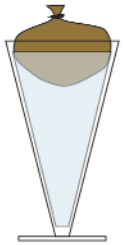
- **<u>Autoinfection</u>**
  - L1 develops to L3 <u>in the host</u>
  - Infective L3 penetrates the intestinal wall → tracheal migration back to SI
  - Maintains chronic infection in adult dogs.

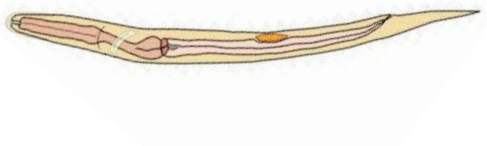


Strongyloides stercoralis

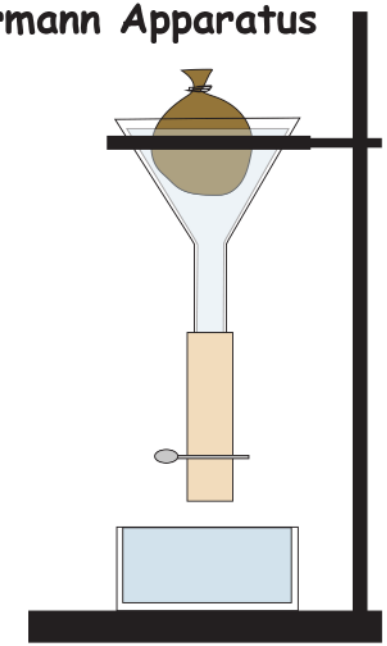
- **Pathology**
  - Larval Skin Penetration → Dermatitis
    - Often Pododermatitis
  - Larval Tracheal Migration → Respiratory DZ
    - Bronchopneumonia (verminous pneumonia)
  - Adult Female in SI Mucosa → Intestinal DZ
    - Diarrhea, Watery (+/- mucus); Anorexia
    - PPT = 5-7 days

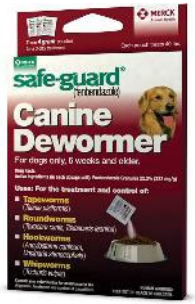
- **Diagnosis**
  - Signalment
    - Kennel
    - Neonate puppy w/ diarrhea +/- cough
  - Baermann Apparatus
    - L1 larvae in feces





Baermann Apparatus

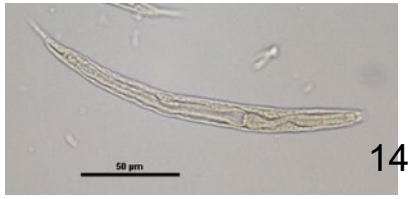




- **Treatment**
  - Ivermectin
    - 02.mg/kg PO SID X 2
  - Fenbendazole
    - 50 mg/kg PO SID X 5; RPT in 4 weeks

- **Zoonosis (??)**
  - Maybe strain dependent
  - Assume zoonotic
    - Immunodeficiency DZ, Immunosuppressive therapy, Transplant therapy

- **Control**
  - Sanitation / feces removal
    - Especially kennels



Strongyloides stercoralis

Special notes for *Strongyloides stercoralis*

Clinical Presentation (Canine & Human)

- Acute strongyloidiasis
  - Skin Penetration: localized pruritic, erythematous rash (Pododermatitis)
  - Tracheal Migration: dry cough, verminous pneumonia
  - Enteric Infestation: Diarrhea, constipation, abdominal pain, and anorexia.
- Chronic strongyloidiasis
  - Via autoinfection, generally asymptomatic, but may have minor lung & GI signs
- Hyperinfection Syndrome
  - Results from accelerated autoinfection due to impaired immunity
    - host is immunocompromised (neoplasia, immunosuppressive DZ, iatrogenic [ex. corticosteroid therapy])
  - Overwhelming Larval migration (via normal tracheal migration) → lung (verminous pneumonia) & GI pathology
- Disseminated Strongyloidiasis
  - Also due to accelerated autoinfection from immunosuppression
  - Overwhelming Larval migration (via abnormal somatic migration) to various organs (visceral larval migrans)
  - A variety of systemic, gastrointestinal, pulmonary, and neurologic signs/symptoms
  - High mortality if not treated

Strongyloides spp.

Strongyloides spp.	Host	Transmission Sp –skin penetration In – ingestion Tm - transmammary	Diagnostics (Young only)	Pathology
S. ransomi	piglets	Sp, In, Tm	Ova (Float)	Diarrhea (scours), Thumps
S. westeri	foals	Sp, In, Tm	Ova (Float)	Diarrhea (high parasite load)
S. papillosus	young ruminants (kids, lambs, calves)	Sp, In, Tm	Ova (Float)	Non-pathogenic (except rare cases in kid goats) (Contribute to foot-rot)
S. stercoralis	puppies, humans	Sp, In (no arrested larvae, but maintained in mother by **autoinfection**)	L1 (Baermann)	Pododermatitis, Verminous Pneumonia, Diarrhea, Hyperinfection, Disseminated DZ

In General
Life Cycle: Homogonic, Heterogonic, Parthenogeneis
Treat → Young to ↓ environmental contamination; Dam to ↓ lactogenic transmission.
Control → Sanitation. Young contaminate the environment. (the dams don't)

Trichuris spp.

Whipworms

Trichuris spp.

Take Homes

Trichuris spp.

- Whipworms
- Direct life cycle. Only Fecal-oral Transmission. Ingestion of infective eggs.
- Male & Female worms in the mucosa of the large intestine and cecum
- Long development & Long PPP, so usually DZ of older juvenile & adult hosts.
- Use Fecal Float Centrifugation: eggs heavier than most, so centrifugation is required.
- Many dewormers effective against adult worms but not juvenile worms. Deworm every month for 3 months.
- Eggs long lived & very hardy v/s desiccation. Sanitation control important but difficult. Remove host from contaminated lot or yard.

Trichuris suis

- Swine (post-weaned & adult). Intermittent Blood Diarrhea.
- Treat: many dewormers. Control: Use In-Feed dewormers to kill entering / hatching L3s.

Trichuris vulpis

- Swine (post-weaned & adult). Intermittent Blood Diarrhea. Pseudo-Addison's.
- Treat: many dewormers. Control: Use monthly HW preventative with effective GIN dewormer.

Trichuris discolor

- Cattle. Non-Pathogenic.

Trichuris ovis

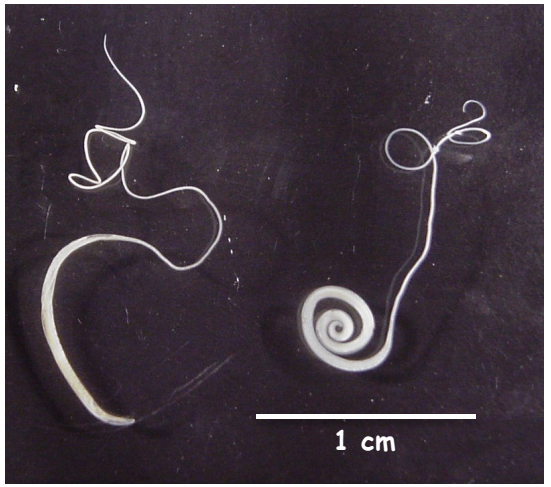
- Sheep & Goats. Non-Pathogenic.

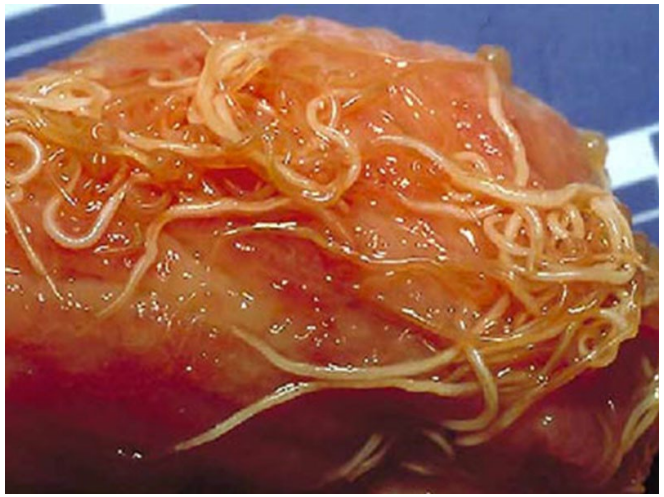
Trichuris spp.

(*Parasite Trivia*: Worm Misnamed
Trich = thin; *uris* = posterior)

Whipworms in General

- Occur in Cecum & Large Intestine
- Worms: Anterior thin, Posterior thick
  - Anterior end embedded in epithelial cells of gut.
- Egg: bipolar plugs, smooth shell
  - Very hardy, can survive many years
    - Resistant to desiccation, high temps and UV light
    - ➔ very difficult to control.
- Species
  - *Trichuris ovis* – Sheep & Goats – asymptomatic
  - *Trichuris discolor* – Cattle – asymptomatic
  - *Trichuris vulpis* – Canids – Pathogenic
  - *Trichuris suis* – Swine – Pathogenic





Trichuris vulpis & T. suis

Life Cycle

- Transmission
  - Fecal/oral: ingestion of infective egg **only**
- In Host
  - Eggs hatch in Small intestine
  - Larvae penetrate the mucosa of the small intestine and develop for 8 to 10 days.
  - Juvenile worms return to the lumen of the gut and migrate down to the cecum and colon
    - Juvenile worms are resistant to most dewormers
  - Adults in the cecum & colon mature and produce ova
    - Adults are susceptible to most dewormers

Pathology & Clinical Signs

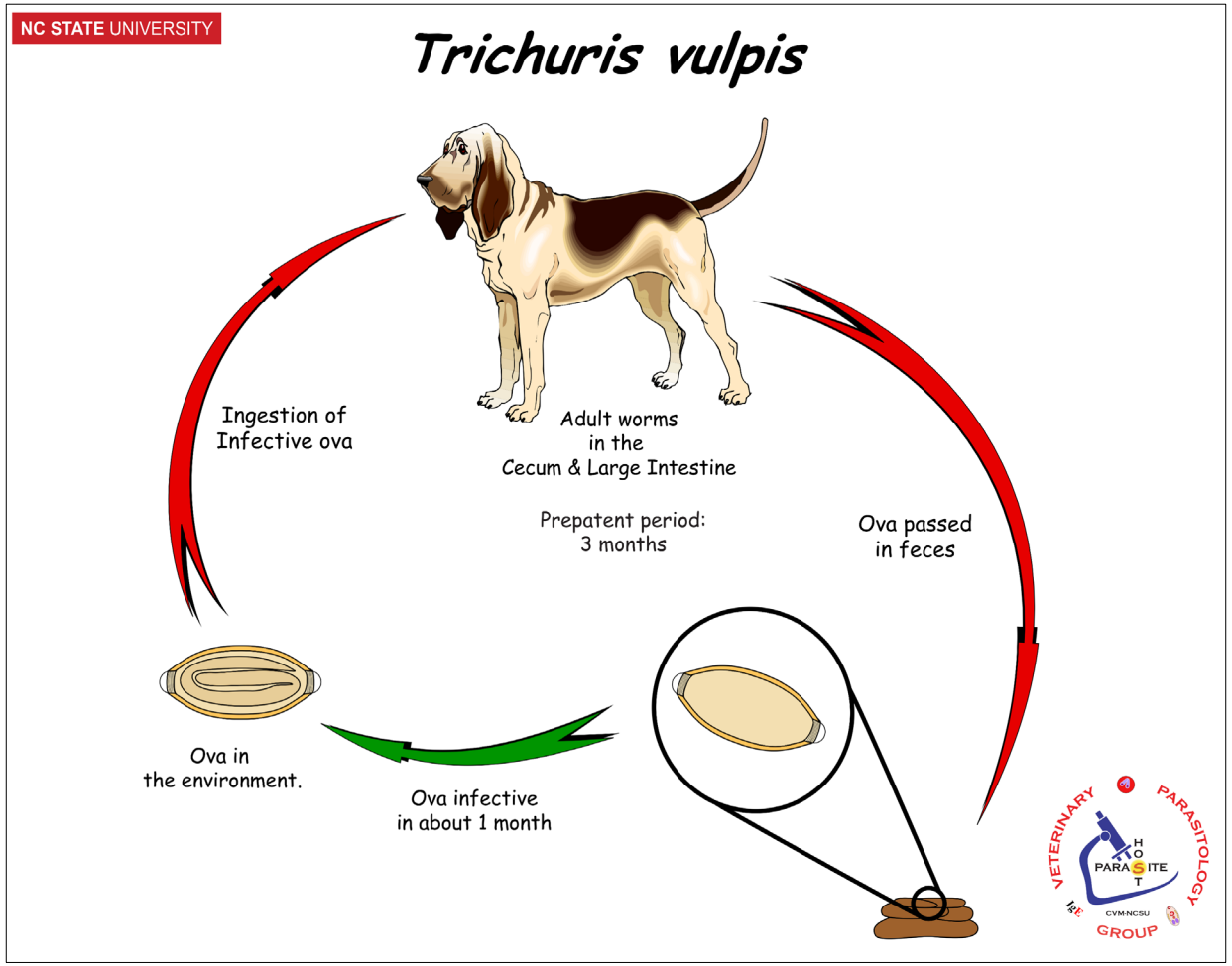
- Animals older than Neonates
- Lesions of the cecum & large intestine
  - Inflammation, hemorrhagic foci
  - Pathology by immature and mature adults.
- # of worms
  - Few worms -> Asymptomatic (most infections)
  - Many worms -> hemorrhagic cecum and colon
    - Intermittent diarrhea with mucus and blood
  - Severe infections -> much bloody diarrhea, dehydration, death (rare)

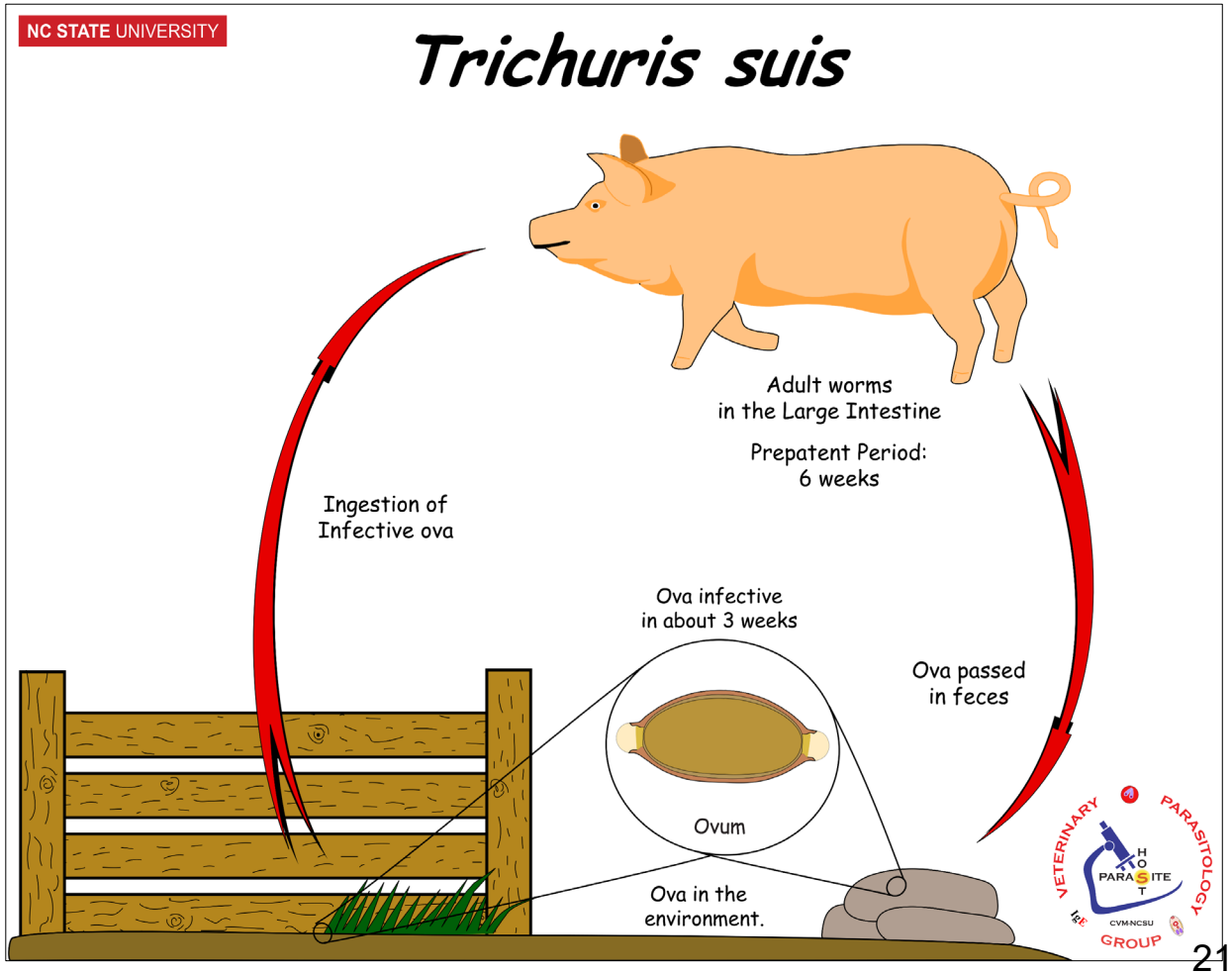
Diagnosis

- Fecal Float with Centrifugation
  - Eggs are heavy; slow to float w/ Passive Floatation

Trichuris vulpis & *T. suis*

Life Cycles





Trichuris suis

Diagnostic Clues

- Swine on Pasture or outdoor lots
- Unsanitary facilities
- Post-weaned piglets, and growing pigs
- Bloody diarrhea, ill thrift , depressed weight gain

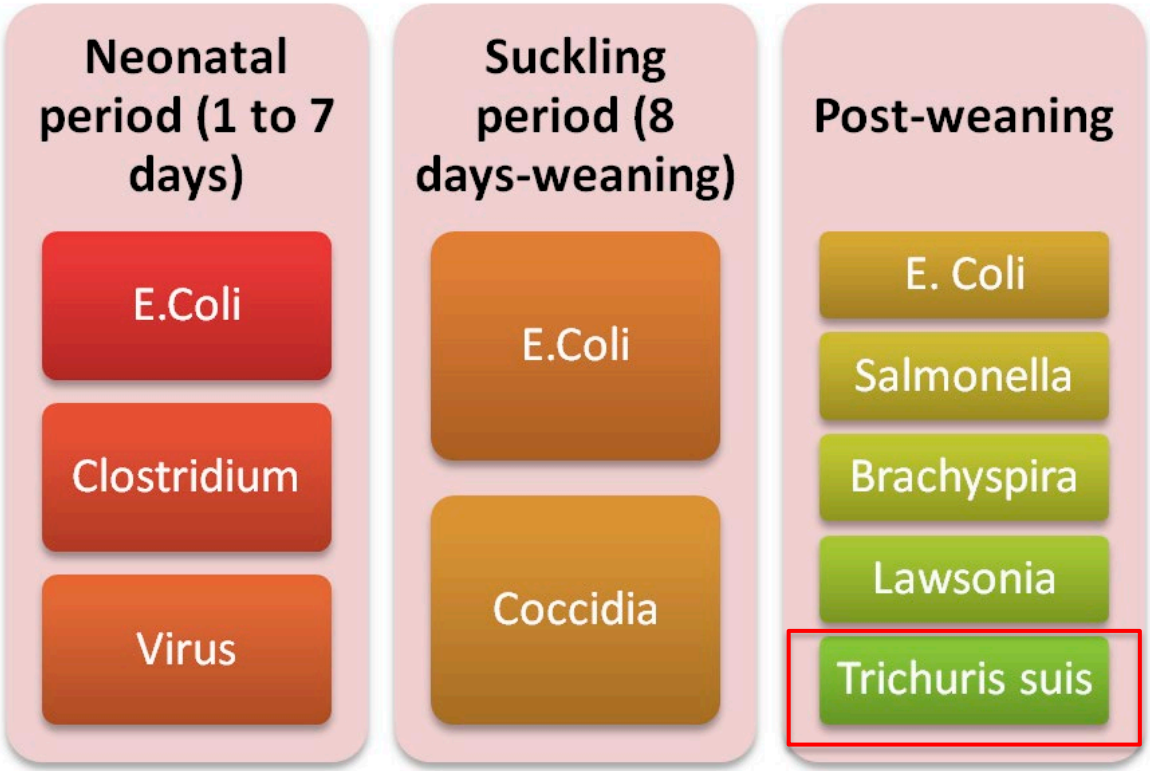
Treatment

- Deworm with effective dewormer and repeat treatments.
- Continuous in-feed dewormer that kills larvae as they hatch.

Control

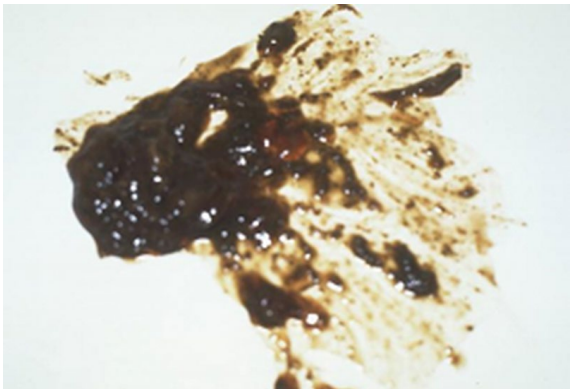
- Remove from contaminated lots
  - But eggs remain viable for years

Causes of Diarrhea in Piglets



Trichuris suis

Anorexia & Poor Growth



Bloody, mucoid diarrhea

Adult worms in cecum

Trichuris vulpis

Diagnostic Clues

- Dogs on dirt lots, runs, yards, unsanitary kennels
- Intermittent Bloody diarrhea

Basic Treatment

1. Remove from contaminated area
2. Deworm every month for 3 months
   (juvenile and immature adults are resistant for first 2 months)
3. Recheck fecal

Prophylactic control

- Utilize a monthly HW preventative that is also effective against Whipworms
- Especially, if owner can't remove dog from contaminated area.

Diagnostics

- Fecal Float centrifugation
  - False negatives
    - Prepatent infection (but showing clinical signs)
    - Intermittent shedders
    - Poor technique to find heavy eggs
- Commercial Fecal Antigen tests
  - Good for diagnosing poor egg shedders and prepatent infections
- CAPC advises using both diagnostics

Trichuris vulpis

Trichuris vulpis

Pseudo-Addisons DZ

- Canine Whipworm infections can mimic Addison's DZ
  - Symptoms mimic those of Addison's disease
    - waxing and waning weakness.
    - Severe electrolyte disturbance (hyponatremia and hyperkalemia), ultimately creates dehydration.
    - The syndrome mimics Addison's disease in every way except:
      - testing for Addison's disease is negative
      - and deworming yields a complete recovery.
  - Check fecal & Antigen test before proceeding with Addison's treatments.

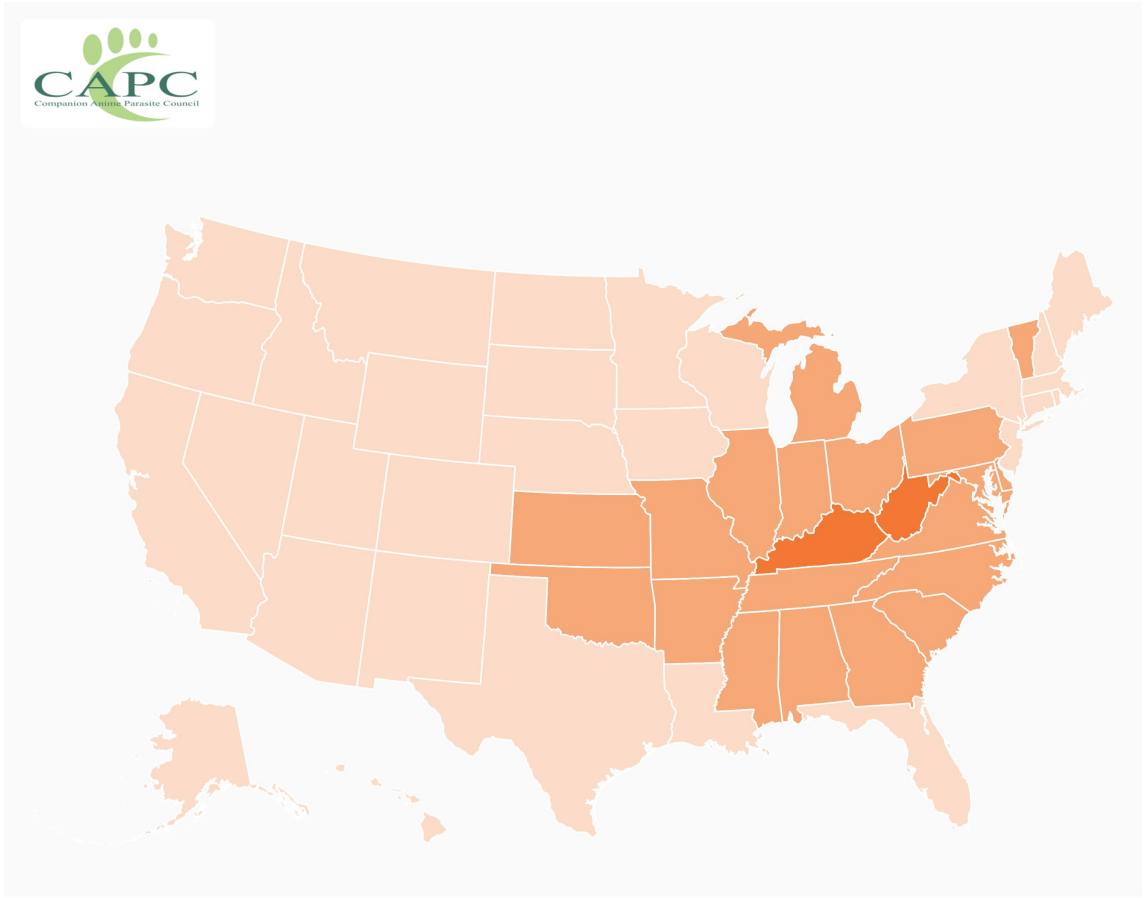
Addison's Diagnostics

CBC - $100
Chemistry Panel - $100
Urinalysis - $80
ACTH Stimulation Test - $220

Whipworm Diagnostics

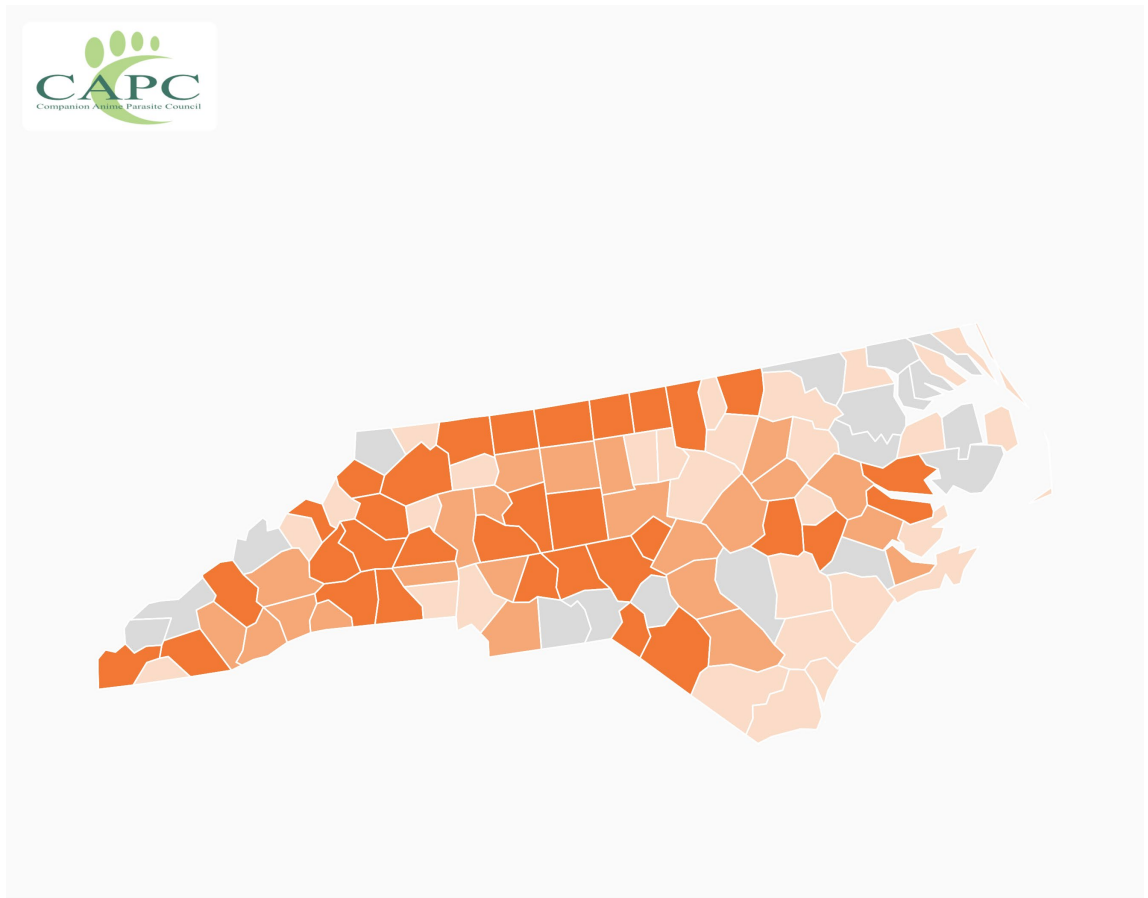
Fecal centrifugation - $50

Trichuris vulpis -- Prevalence Maps



Whipworm for Dogs
UNITED STATES
2023

TESTED POSITIVE	POSITIVE CASES	TOTAL TESTED
0.5%	56070	12317666



Whipworm for Dogs
UNITED STATES, NORTH CAROLINA
2023

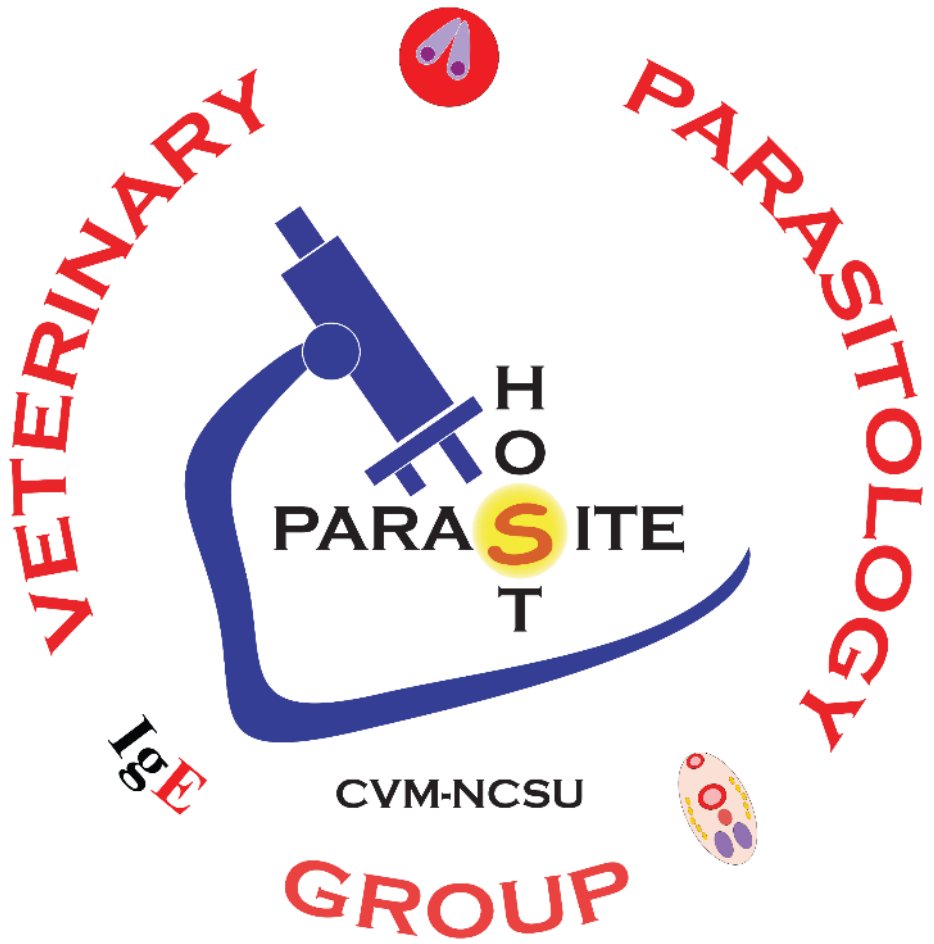
TESTED POSITIVE	POSITIVE CASES	TOTAL TESTED
0.7%	3591	511780

Trichuris spp.

Trichuris spp.	Host	Diagnostics	Pathology	Treatment
T. suis	Young & Adult Pigs (post-weaned)	Ova (Centrifugation Float)	Intermittent Bloody Diarrhea	Many dewormers kill adults; In-feed dewormer to kill entering L3s
T. vulpis	Adult Dogs (post-weaned)	Ova (Centrifugation Float); Fecal Antigen Tests	Intermittent Bloody Diarrhea; Pseudo-Addison's	Many Dewormers; Include effective dewormer in Monthly HW
T. discolor	Cattle	Ova (Centrifugation Float)	Non-pathogenic	n/a
T. ovis	Goats & Sheep	Ova (Centrifugation Float)	Non-pathogenic	n/a

In General

Ecology: Pastured Pigs, Kennel & Yard Dogs
Life Cycle: Fecal-Oral -- Ingestion of Infective Ova, Long PPP
Ova: Hardy, Long-lived, hard to clean environment
Treatment: Deworm monthly for 3 months. Juvenile & Young Adults resistant to dewormers
Control: Sanitation. Remove host from contaminated lot / yard


VETERINARY
PARASITOLOGY
HOST
PARASITE
IgE
CVM-NCSU
GROUP