NC STATE UNIVERSITY

Animals in Health & Disease

Veterinary Parasitology

Introduction

Name 8 Parasites

1

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Parasites in Practice

- In a veterinary practice how much time & effort is spent on Parasite issues?
  - _____
- What parasites are often diagnosed in a veterinary practice?
  - _____
- What parasites are managed prophylactically?
  - _____
- What growing issue has made managing some parasites difficult?
  - _____
- Which parasites are currently showing _____(answer to previous question)_____?
  - _____

AHD: Parasitology

BRIEF OVERVIEW OF PARASITE GROUPS

Take Home's

- Define a parasite / parasitism.
- Be able to recognize Parasite groups and Genera that belong to those groups

Parasitism

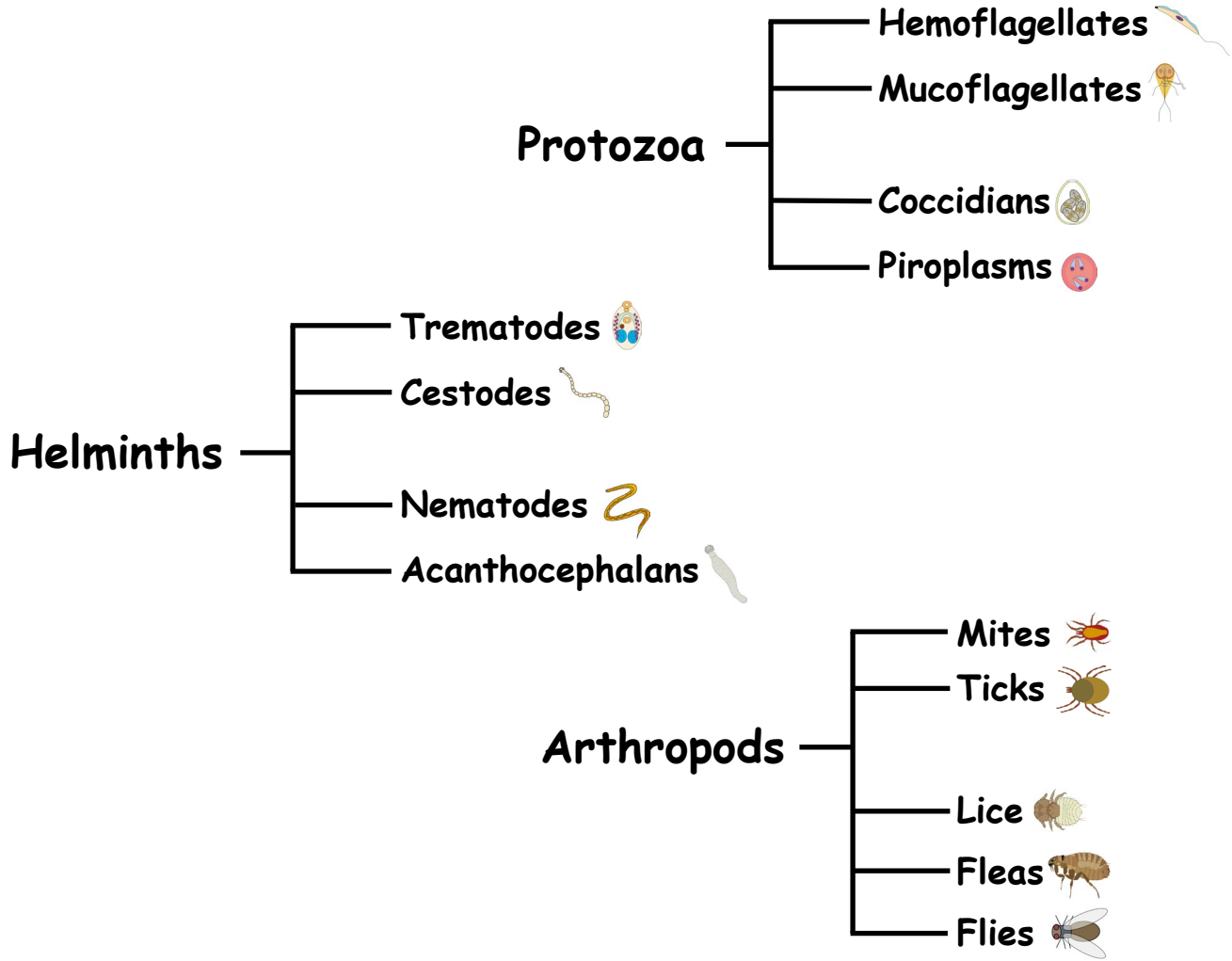
- Intimate relationship between two hetero-specific organisms, in which the parasite, usually the smaller symbiont, is metabolically dependent on the host.

- One symbiont (host) is harmed, while the other symbiont (parasite) benefits.

Parasite Groups

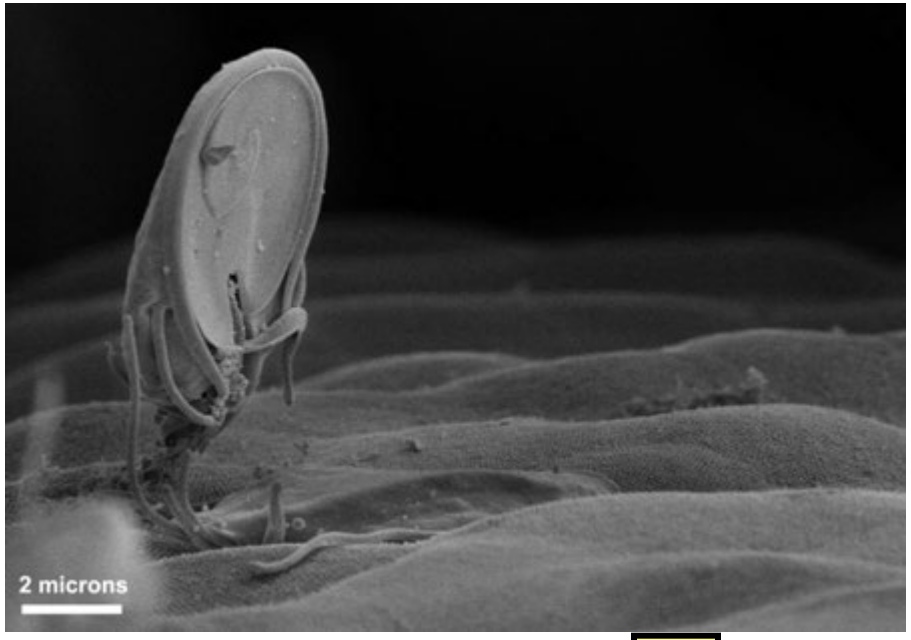
Infectious diseases

- Microbiology
  - Virology
  - Bacteriology
  - Mycology
- Parasitology
  - Protozoology
  - Helminthology
  - Entomology



Protozoa

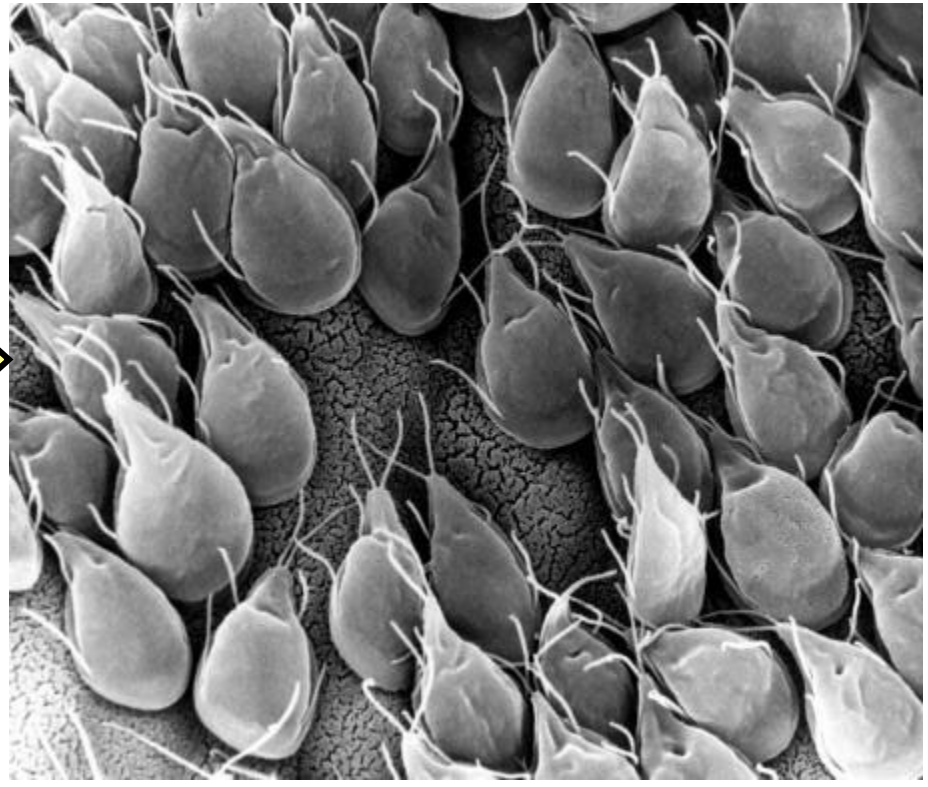
- Microparasites
  - Single-cell parasites
    - (Protozoa, [bacteria, viruses])
  - Intracellular & Extracellular
  - Individual organisms self-replicate in the host.
    - "mechanism" of protozoan induced pathology



Like viruses and bacteria, replication is necessary for pathology caused by protozoa.

Pathology:
Host organ dysfunction

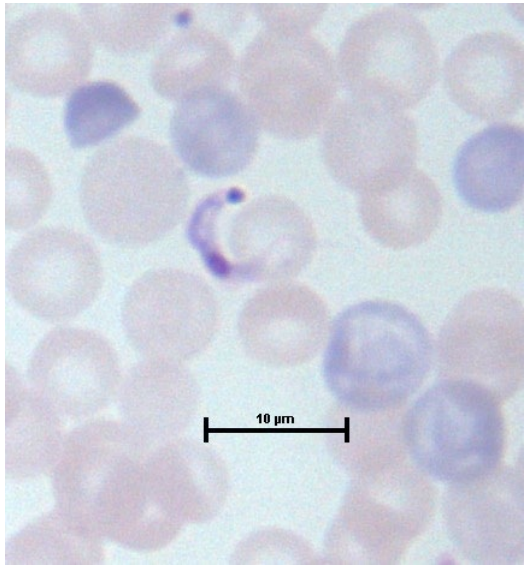
Replication
(binary fission)

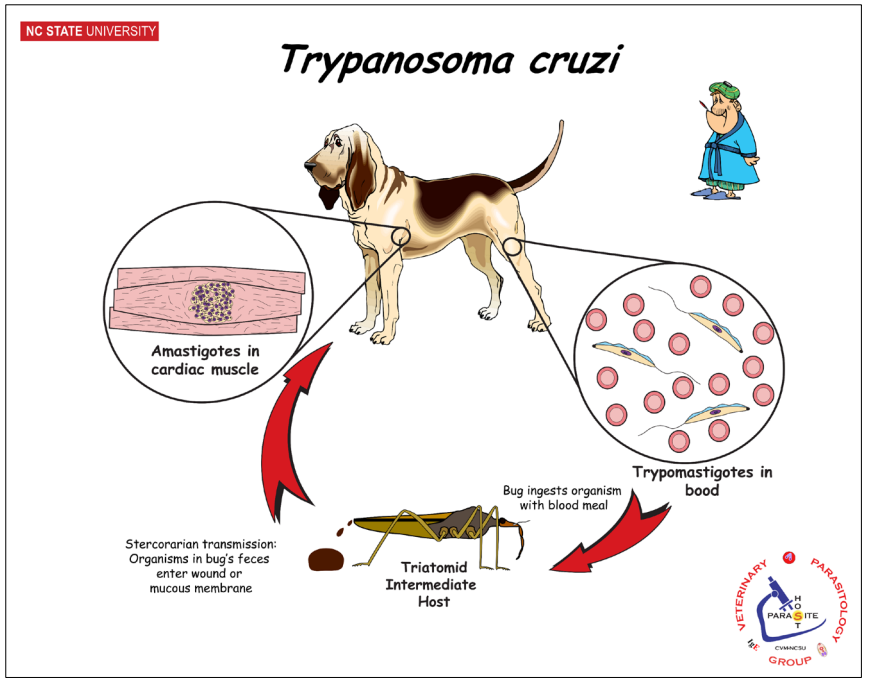


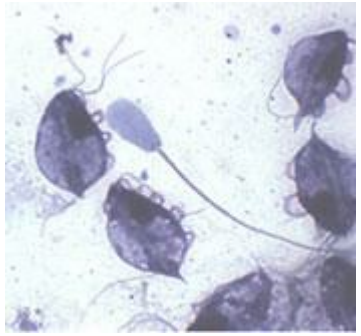
Giardia sp.

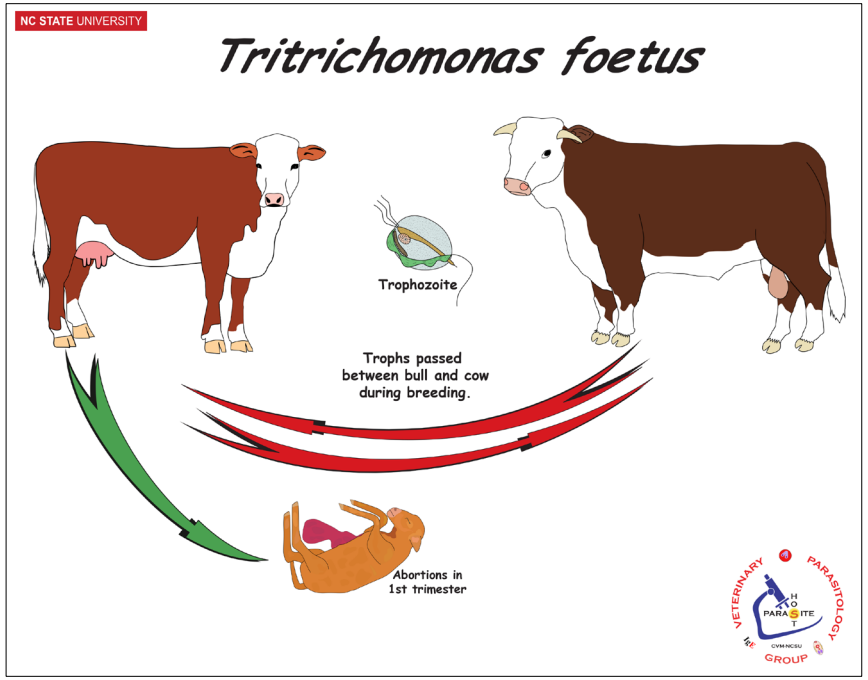
Protozoa

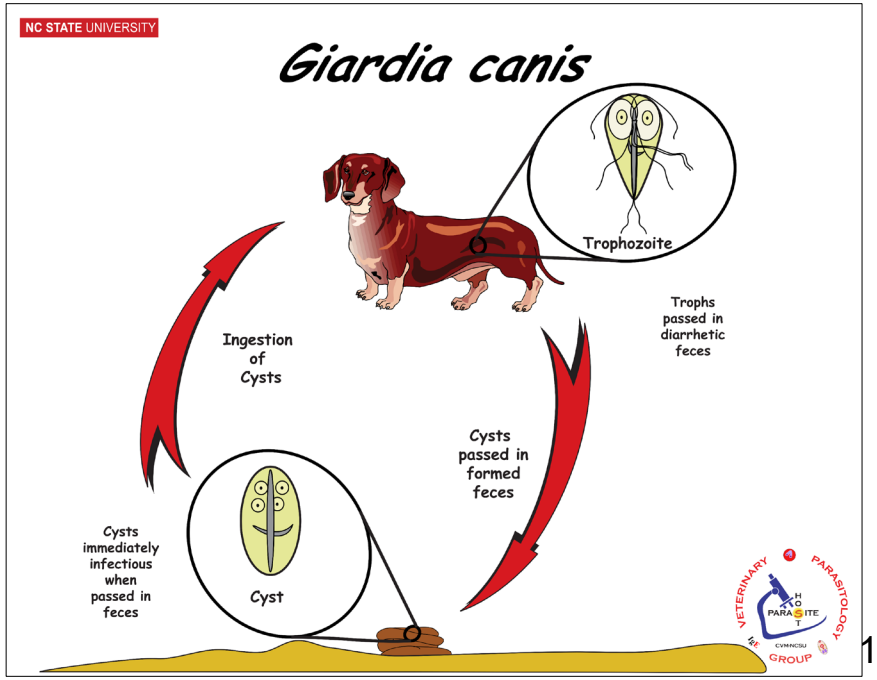
- Hemoflagellates
  - *Trypanosoma*
  - *Leishmania*
- Mucoflagellates
  - *Giardia*
  - *Tritrichomonas*





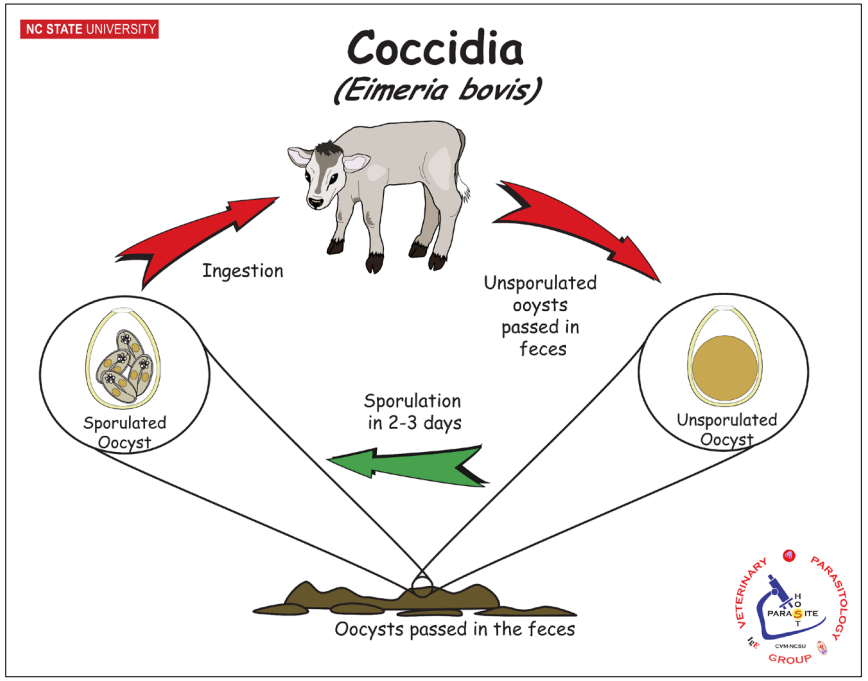


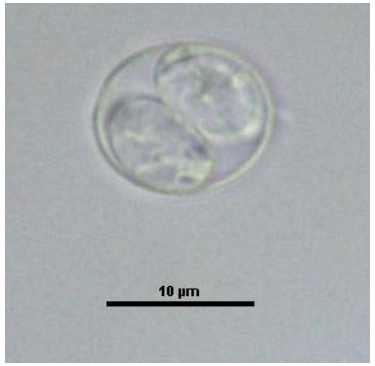


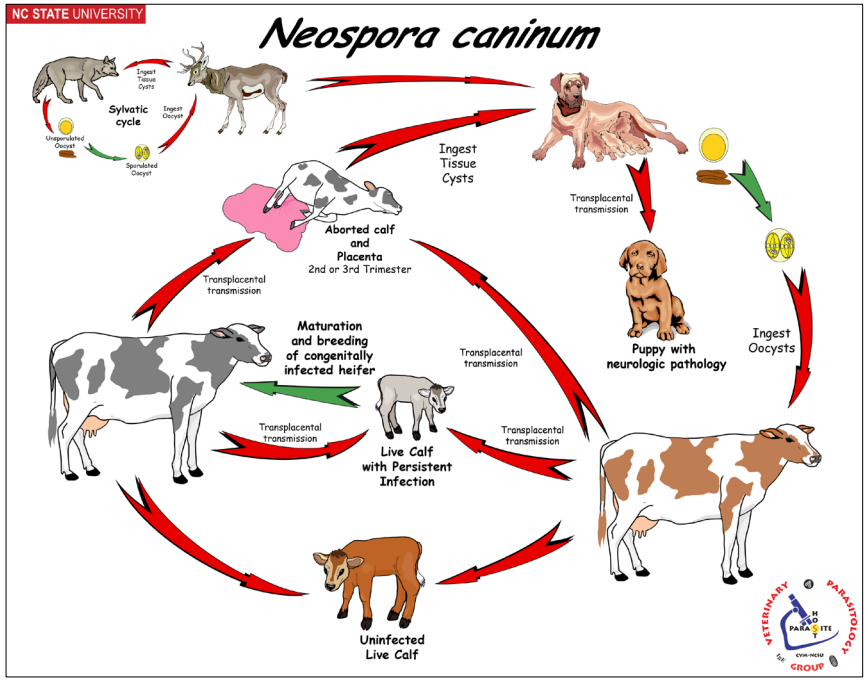


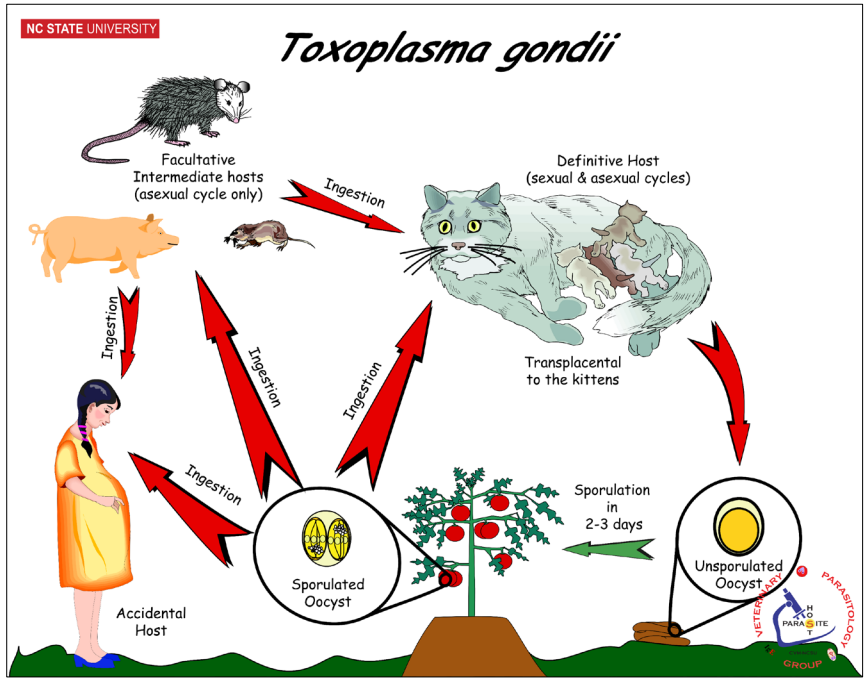
Protozoa

- Apicomplexans
  - Coccidians
    - *Eimeria*
    - *Cystoisospora*
    - *Cryptosporidium*
  - Systemic Sporozoa
    - *Neospora*
    - *Sarcocystis*
    - *Toxoplasma*
    - *Hepatozoon*



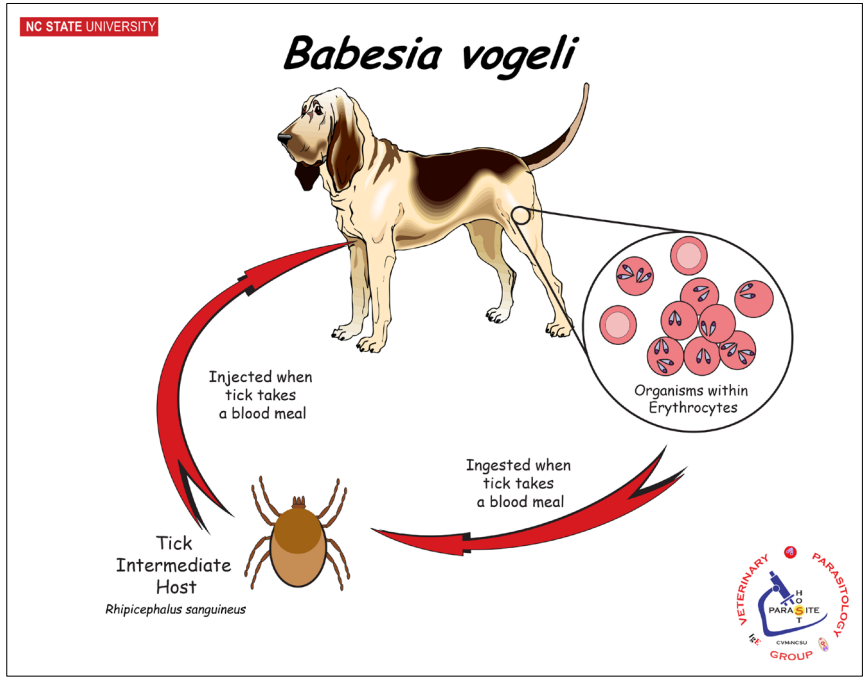


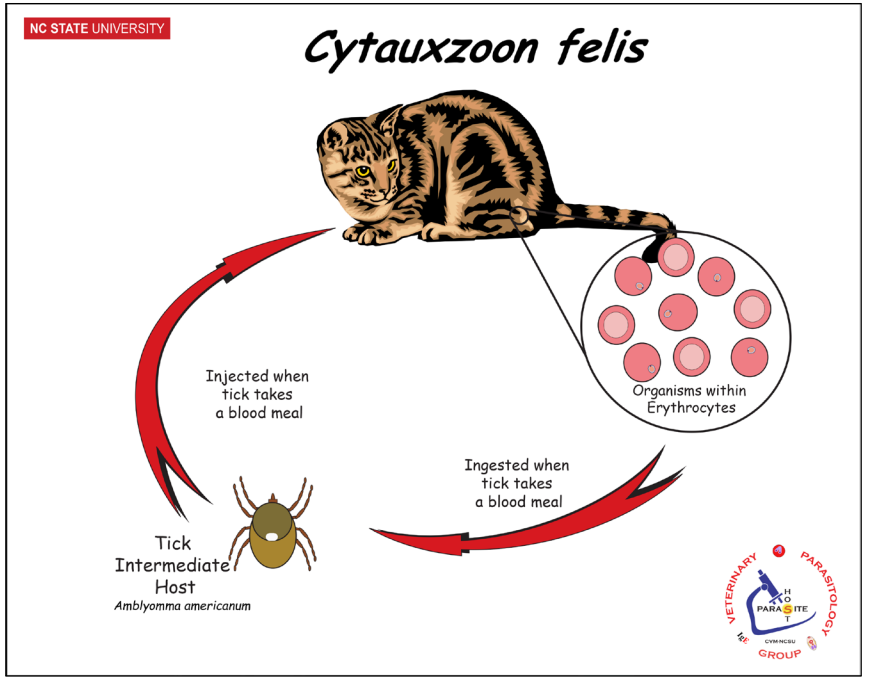


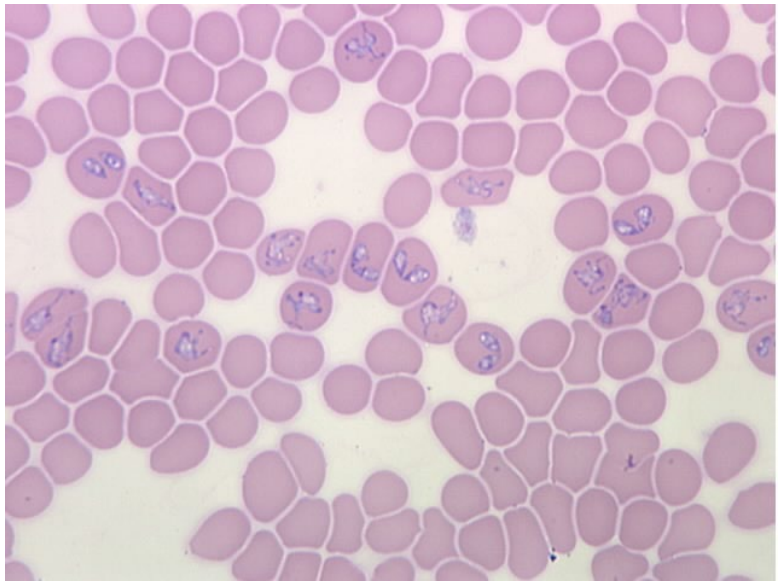


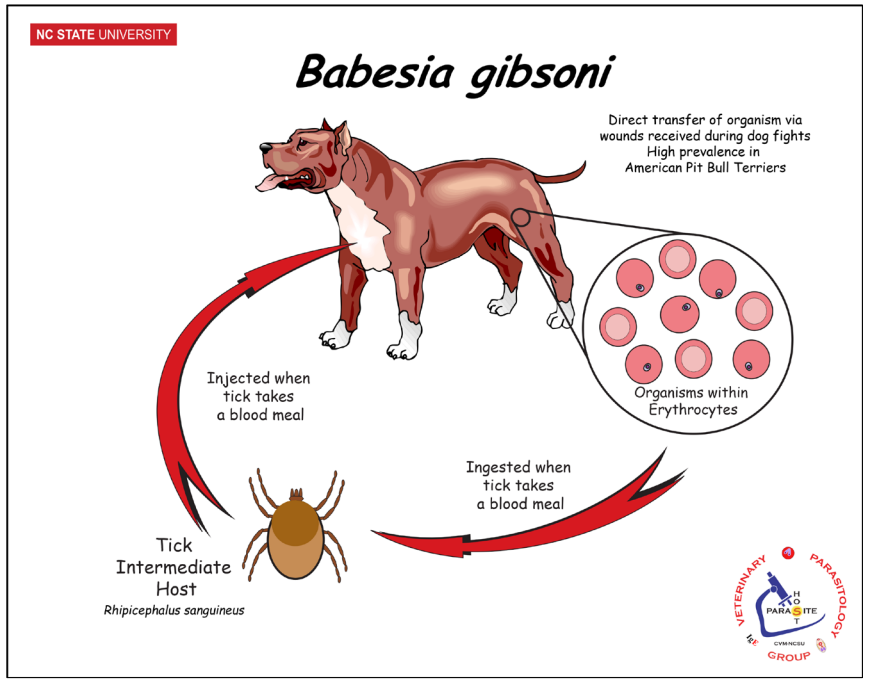
Protozoa

- Apicomplexans
  - Blood Sporozoa
    - *Babesia*
    - *Cytauxzoon*
    - *Theileria*







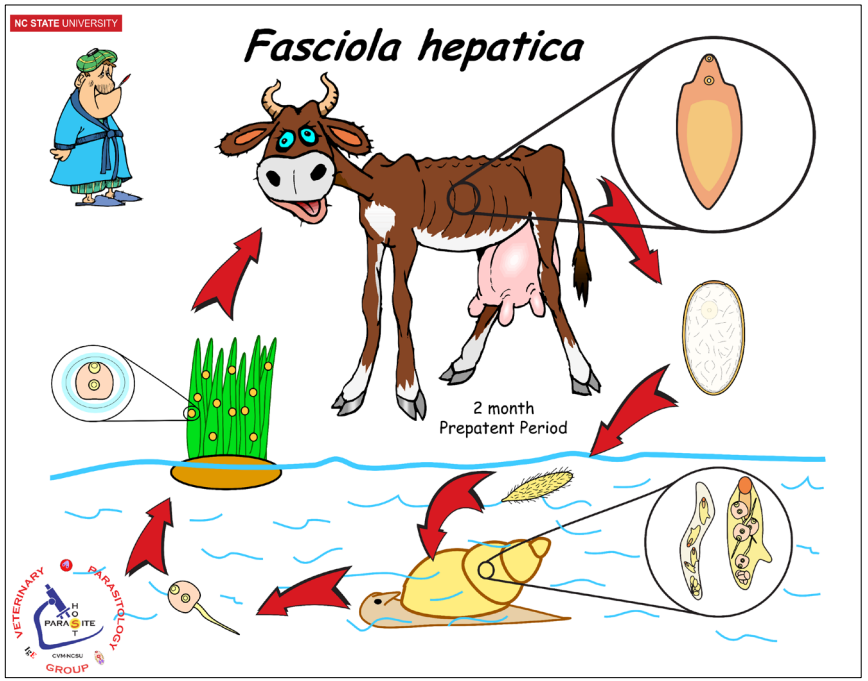


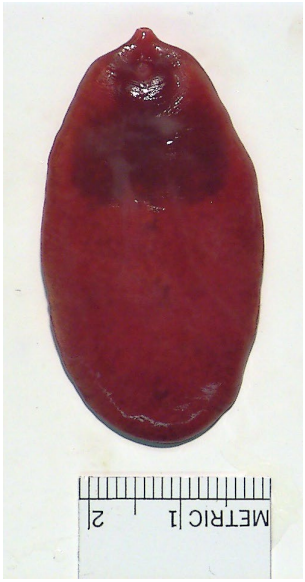
Trematodes

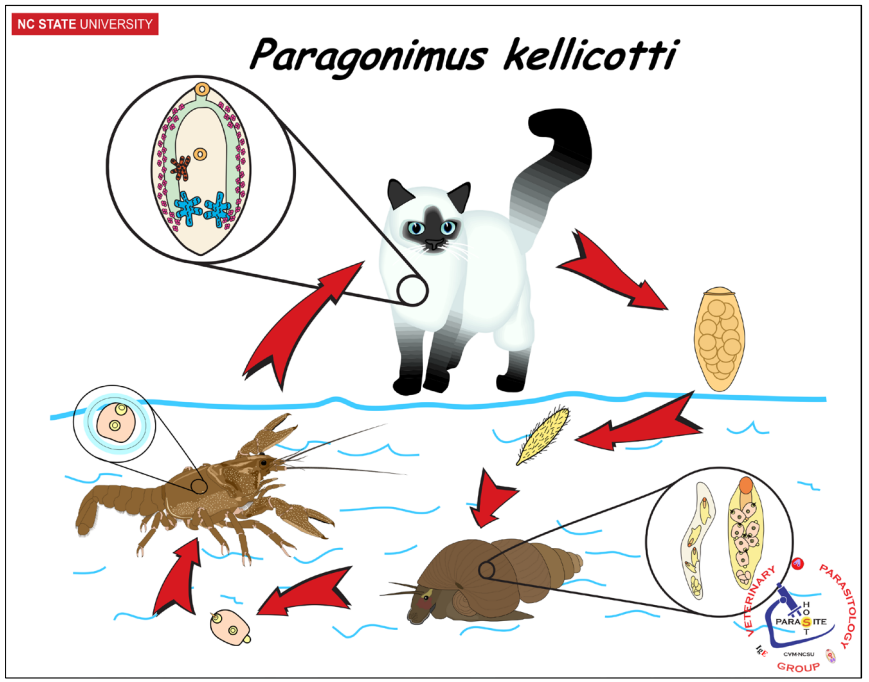
- Flukes
  - Multicellular parasites
  - Individual ADULT organisms do Not self-replicate in the host.

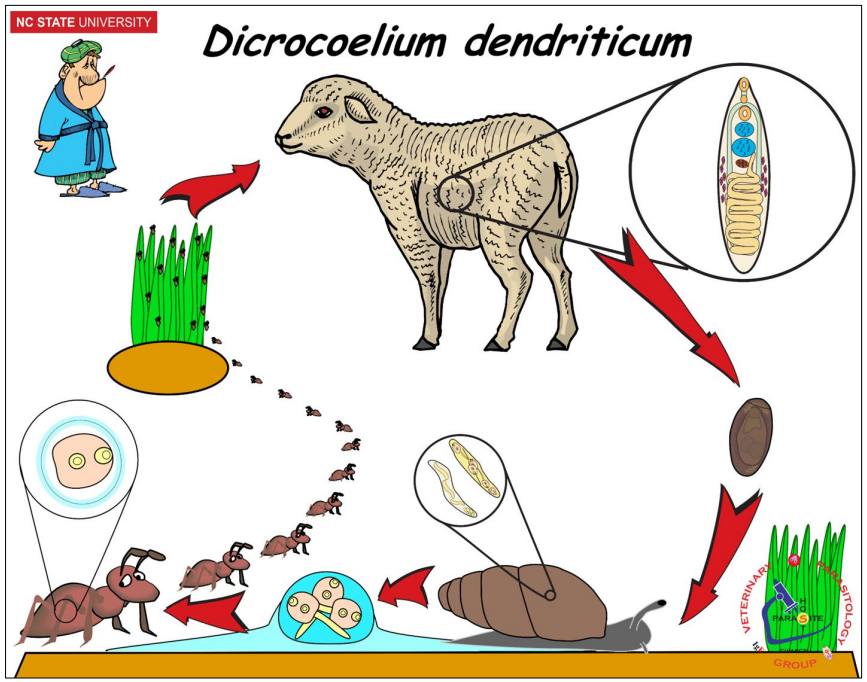
Trematodes

- Flukes
  - Liver Flukes
    - *Fasciola*
    - *Fascioloides*
    - *Dicrocoelium*
  - Lung Fluke
    - *Paragonimus*
  - Blood Fluke
    - *Heterobilharzia*







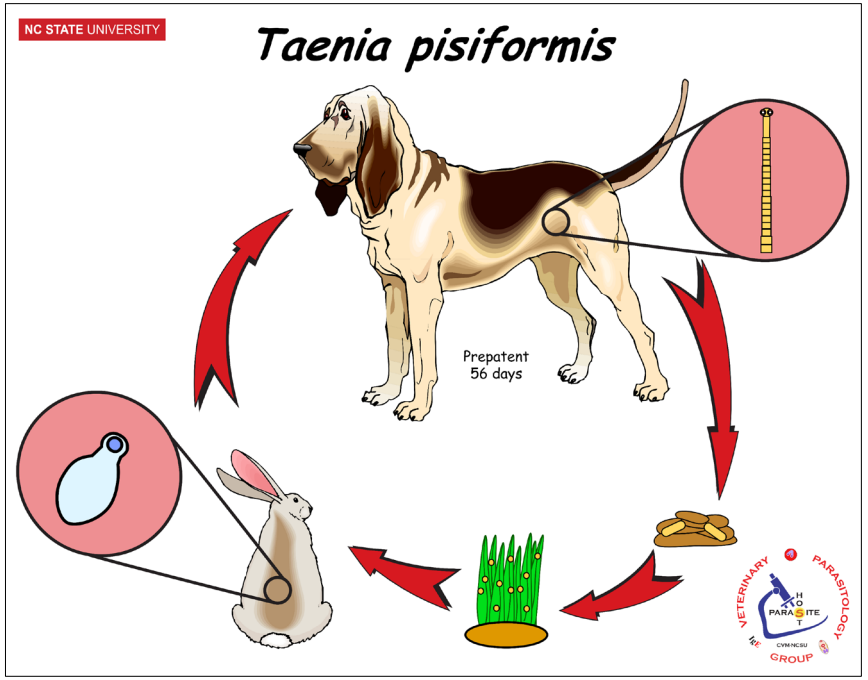


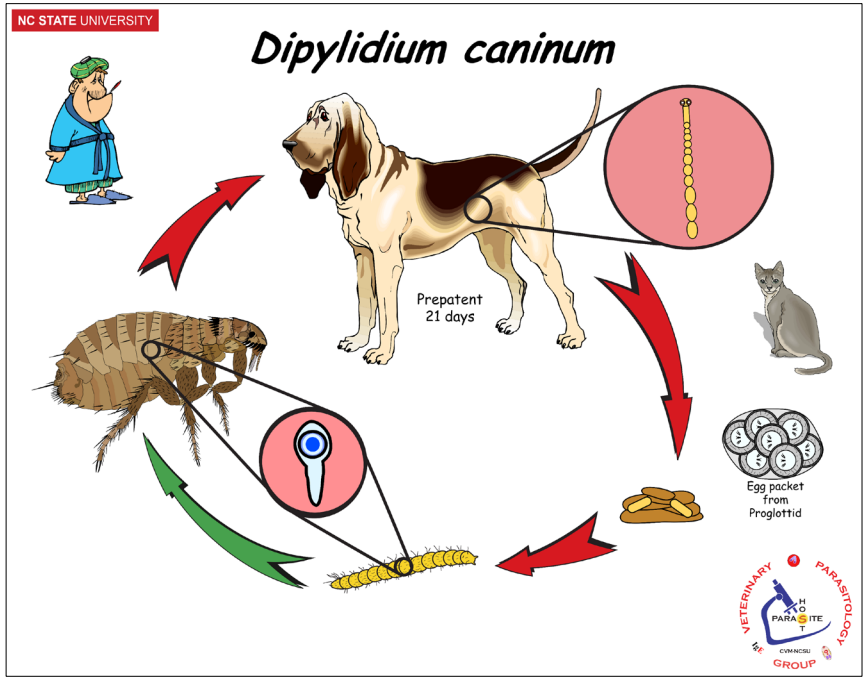
Cestodes

- Tapeworms
  - Multicellular parasites
  - Individual ADULT organisms do Not self-replicate in the host.

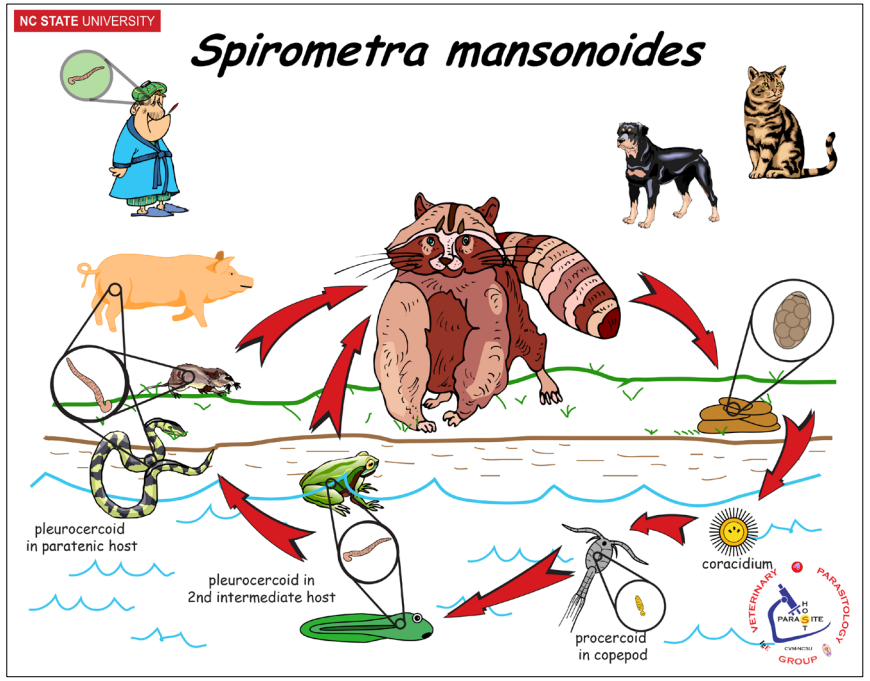
Cestodes

- Tapeworms
  - *Taenia*
  - *Echinococcus*
  - *Anoplocephala*
  - *Moniezia*
  - *Dipylidium*
  - *Spirometra*





https://www.troccap.com/feline-guidelines/gastrointestinal-parasites/cat-tapeworm-feline/

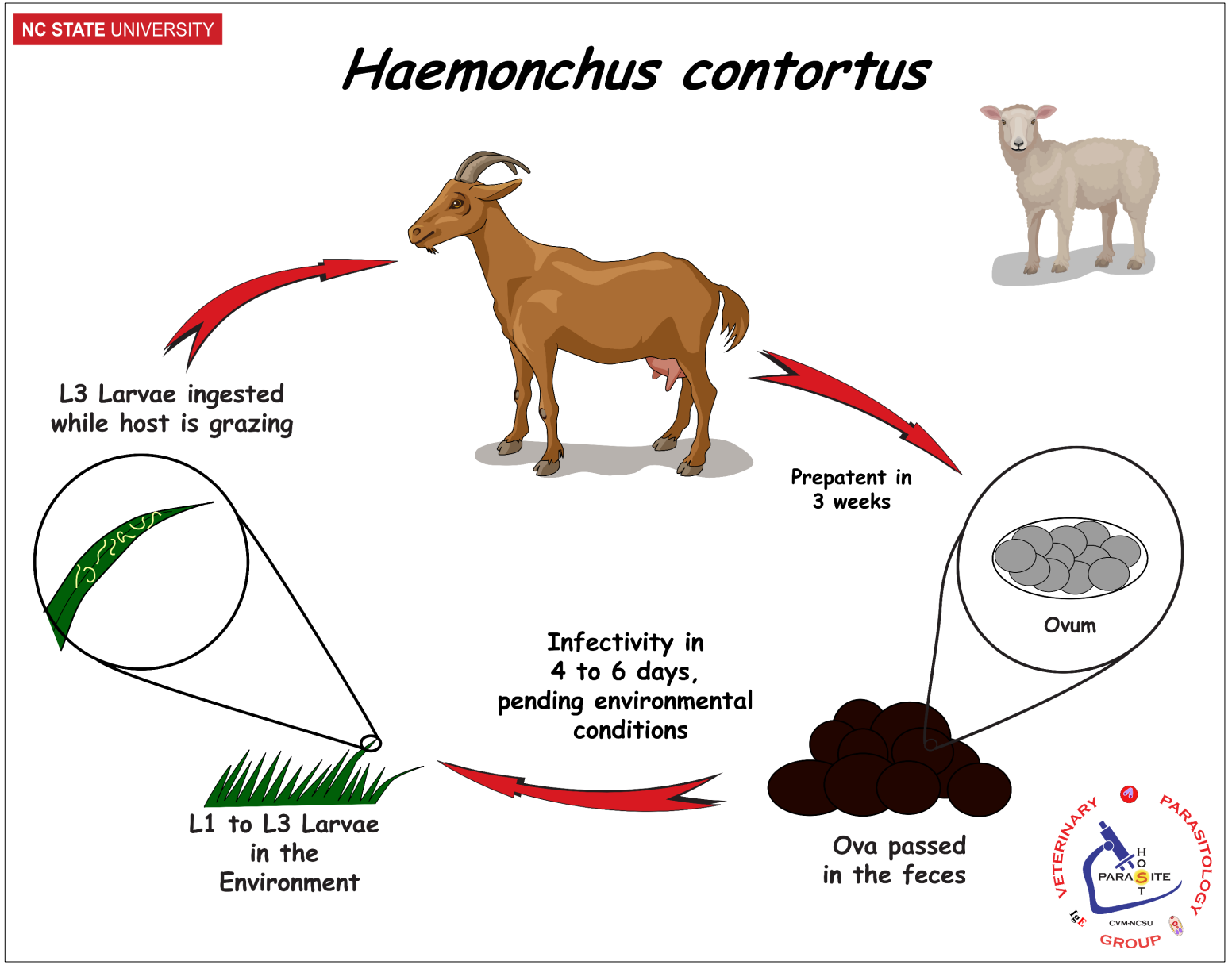


Nematodes

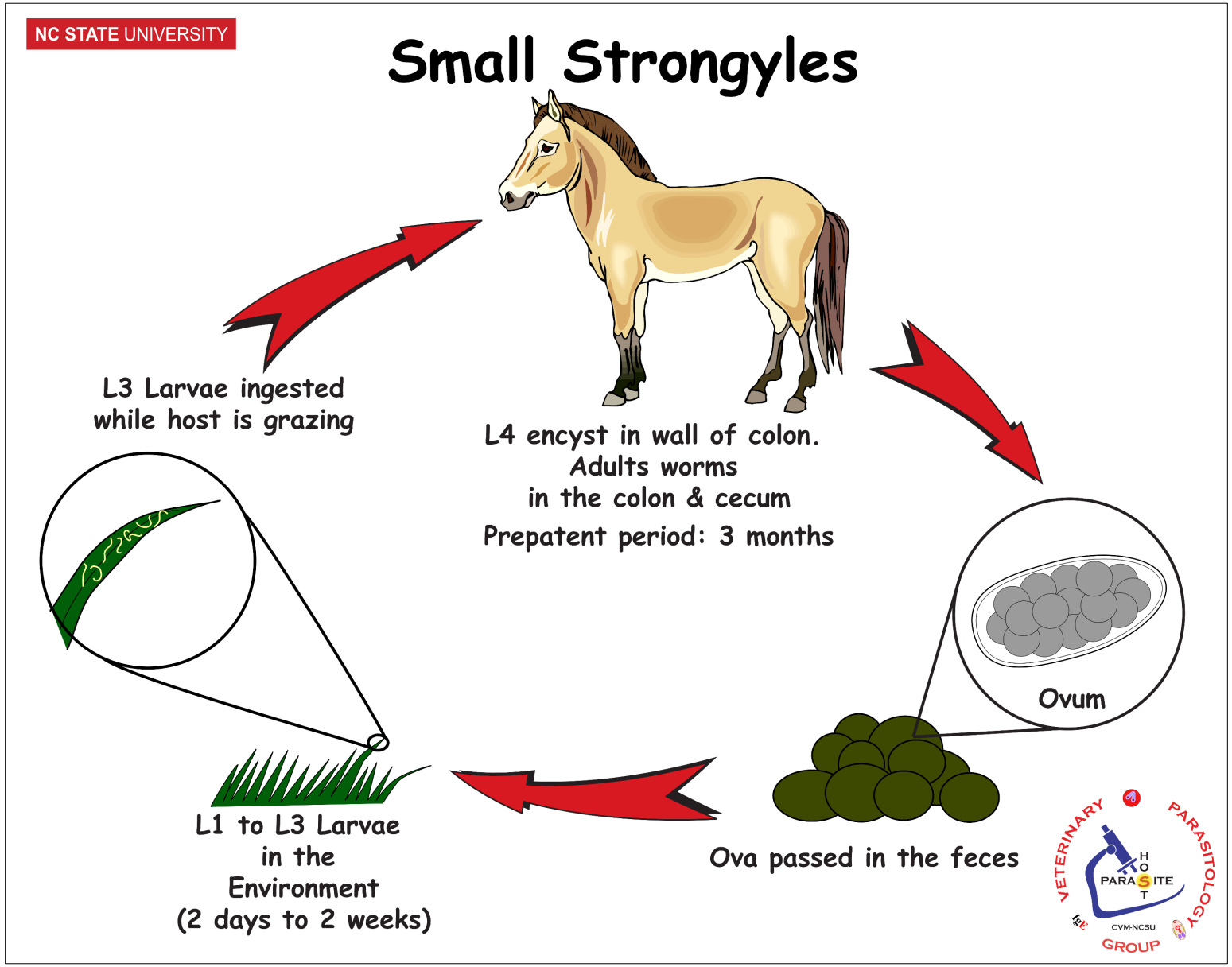
- Roundworms
  - Large (multicellular) parasites
  - Individuals do Not self-replicate in the host.

Nematodes

- Strongylids (bursate)
  - Trichostrongyles
    - *Haemonchus*
    - *Ostertagia*
    - *Trichostrongylus*
    - *Nematodirus*
    - *Dictyocaulus*

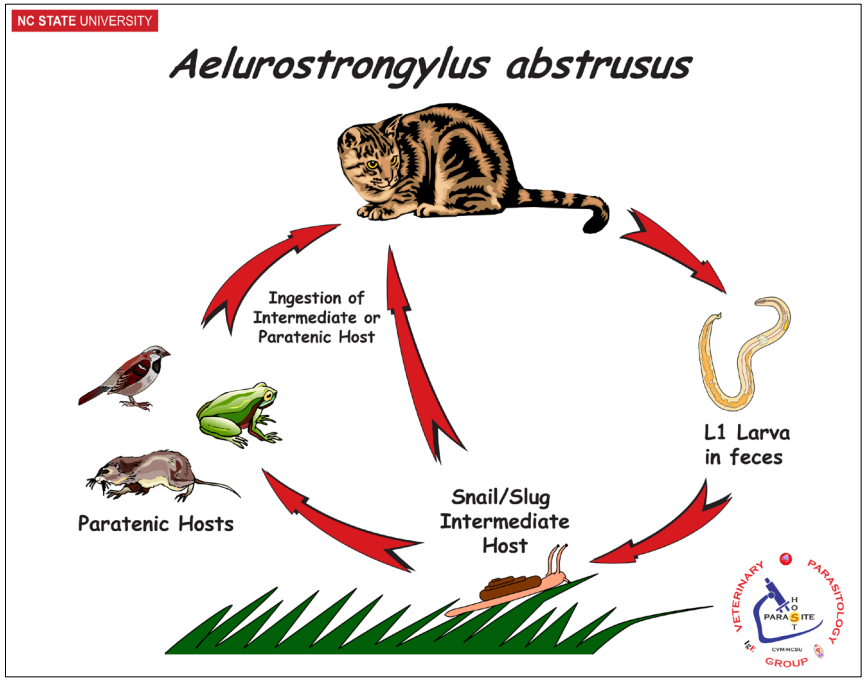


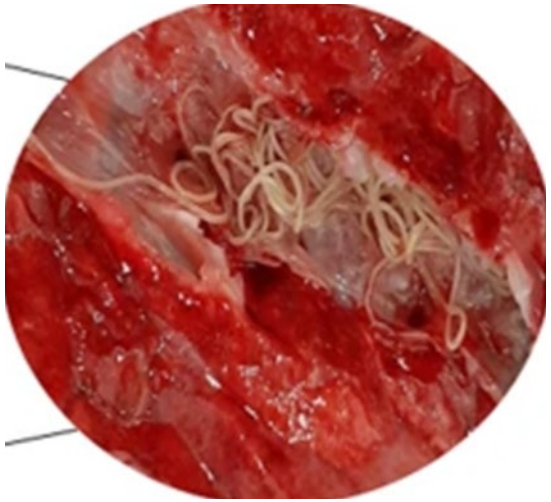
Nematodes
- Strongylids (bursate)
  - Strongyles
    - Small Strongyles
      - *Strongylus*
      - *Oesophagostomum*
      - *Syngamus*

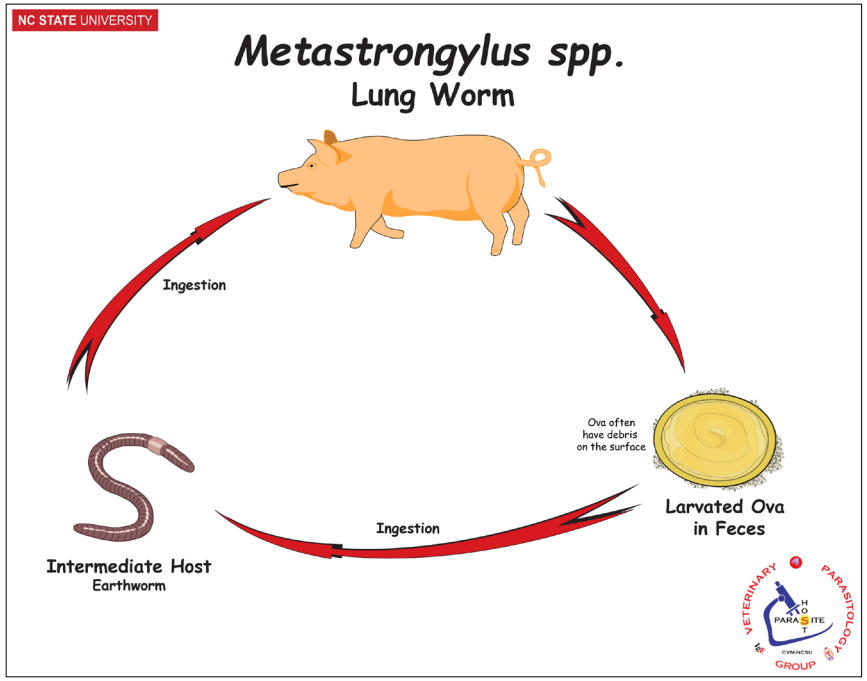


Nematodes

- Strongylids (bursate)
  - Metastrongyles
    - *Metastrongylus*
    - *Aelurostrongylus*

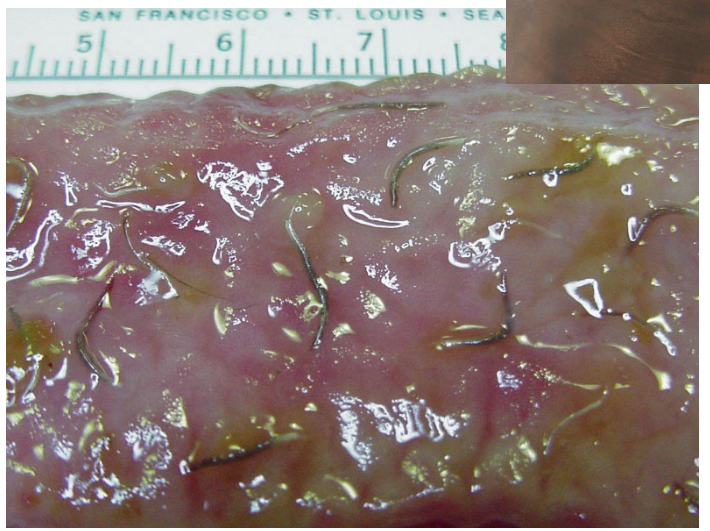


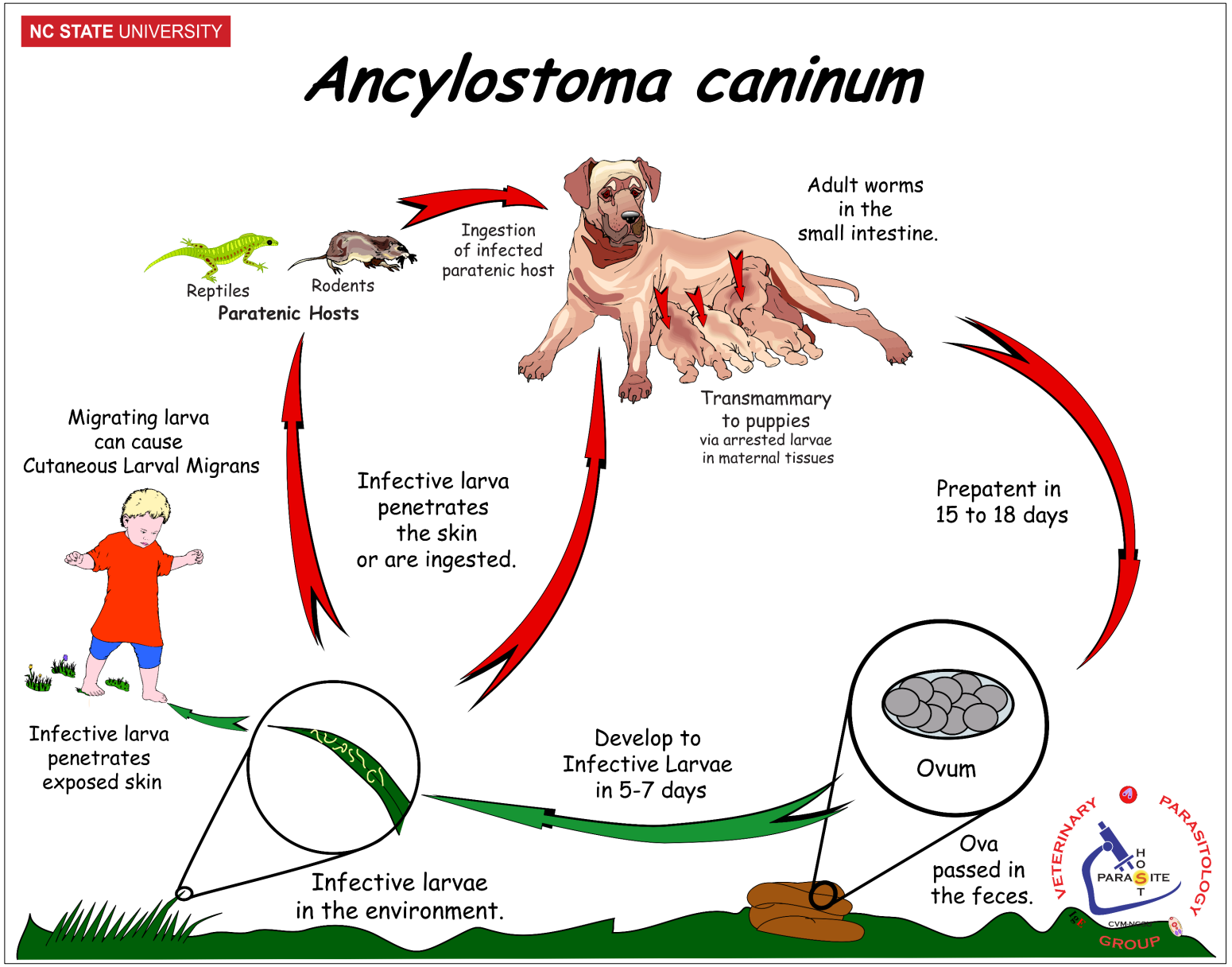




Nematodes

- Strongylids (bursate)
  - Ancylostomes (hookworms)
    - *Ancylostoma*
    - *Uncinaria*

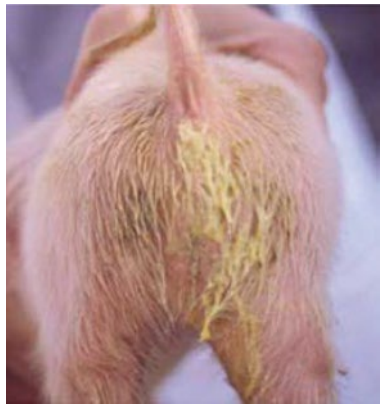


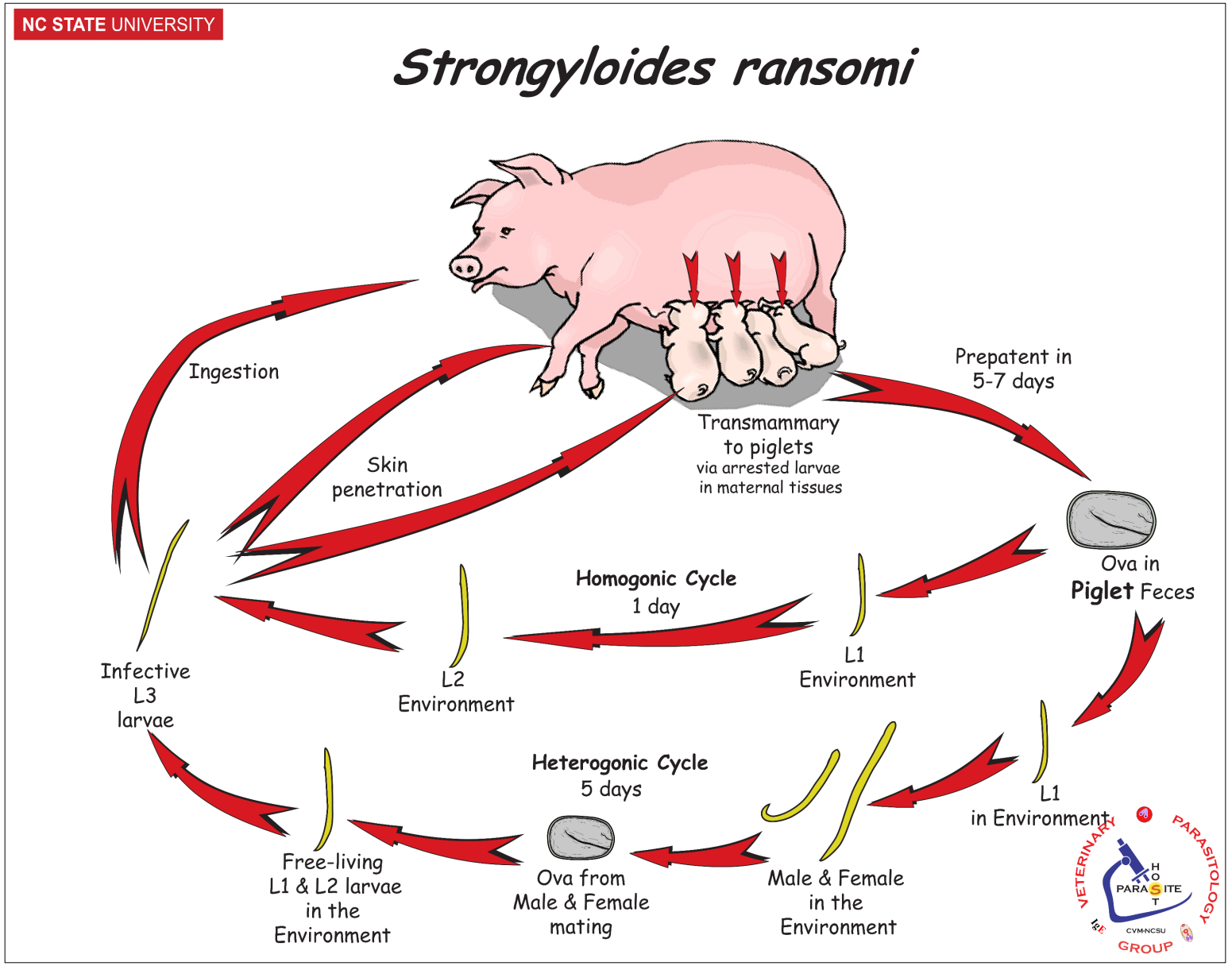


Nematodes

Rhabditids

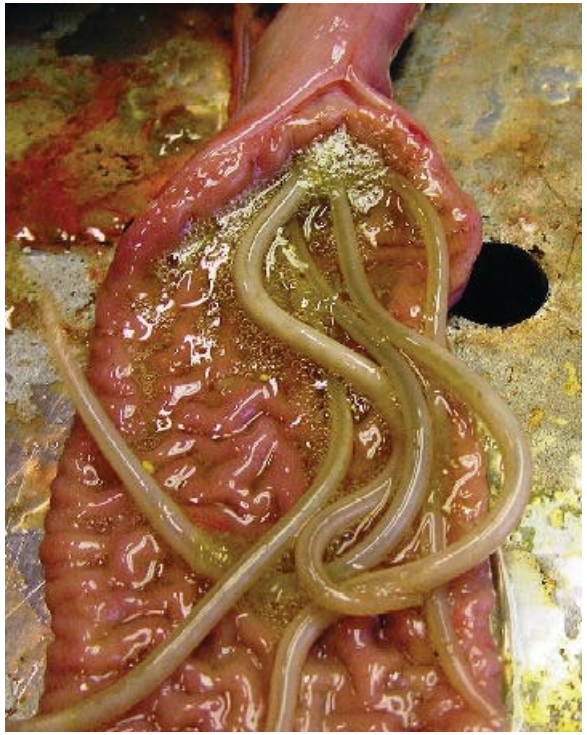
Strongyloides

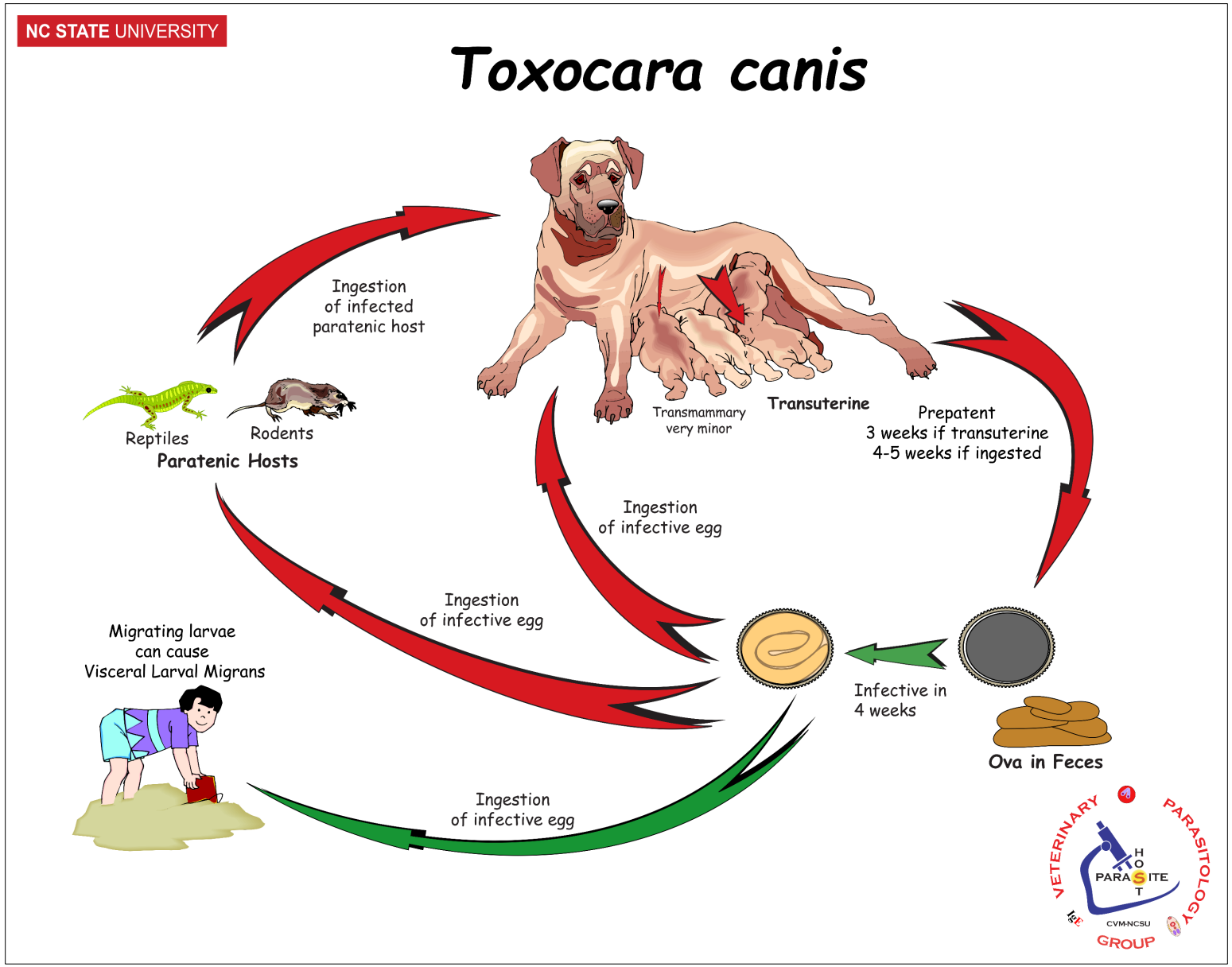




Nematodes

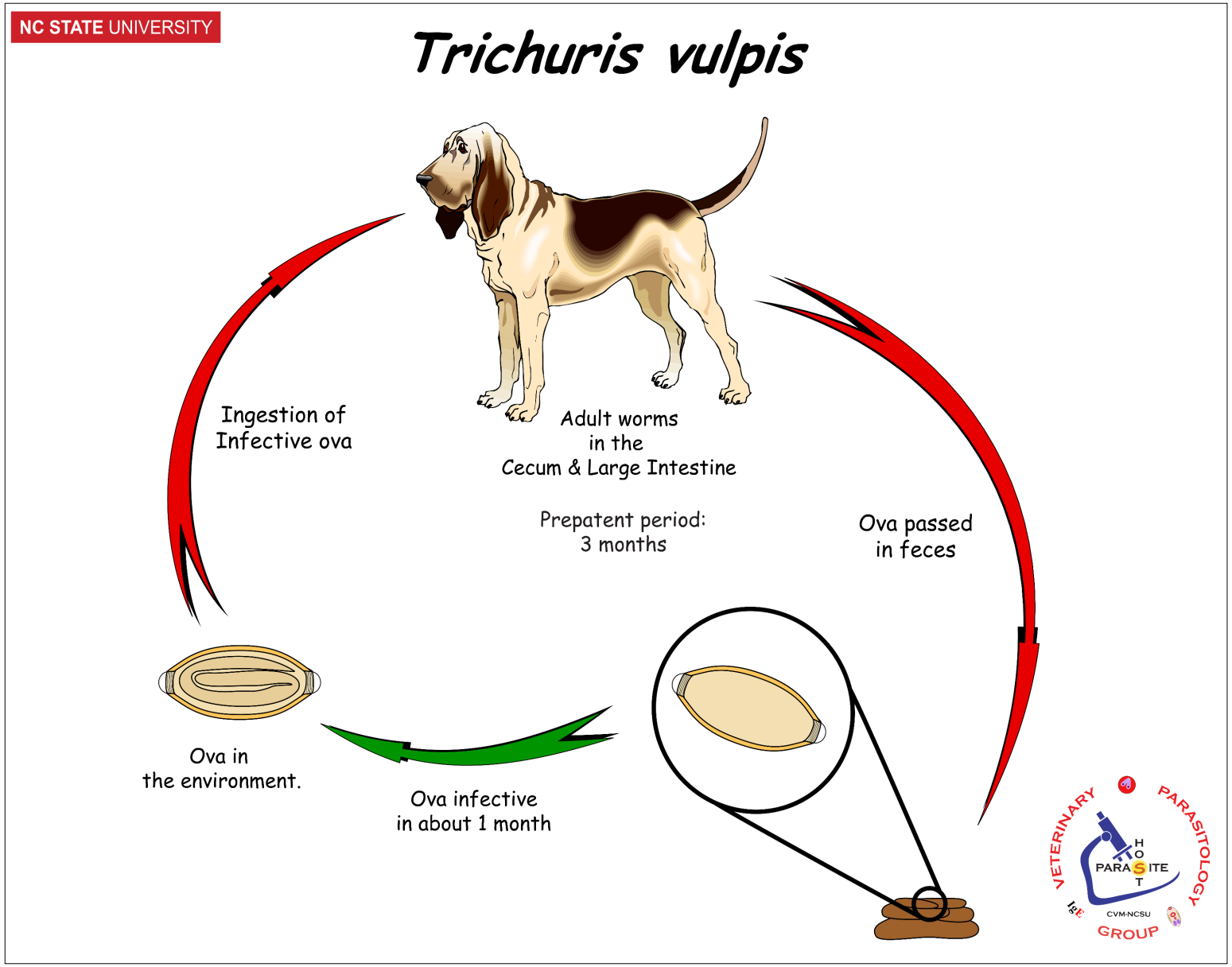
- Ascarids
  - *Toxocara*
  - *Ascaris*
  - *Parascaris*
  - *Baylisascaris*
  - *Ascaridia*



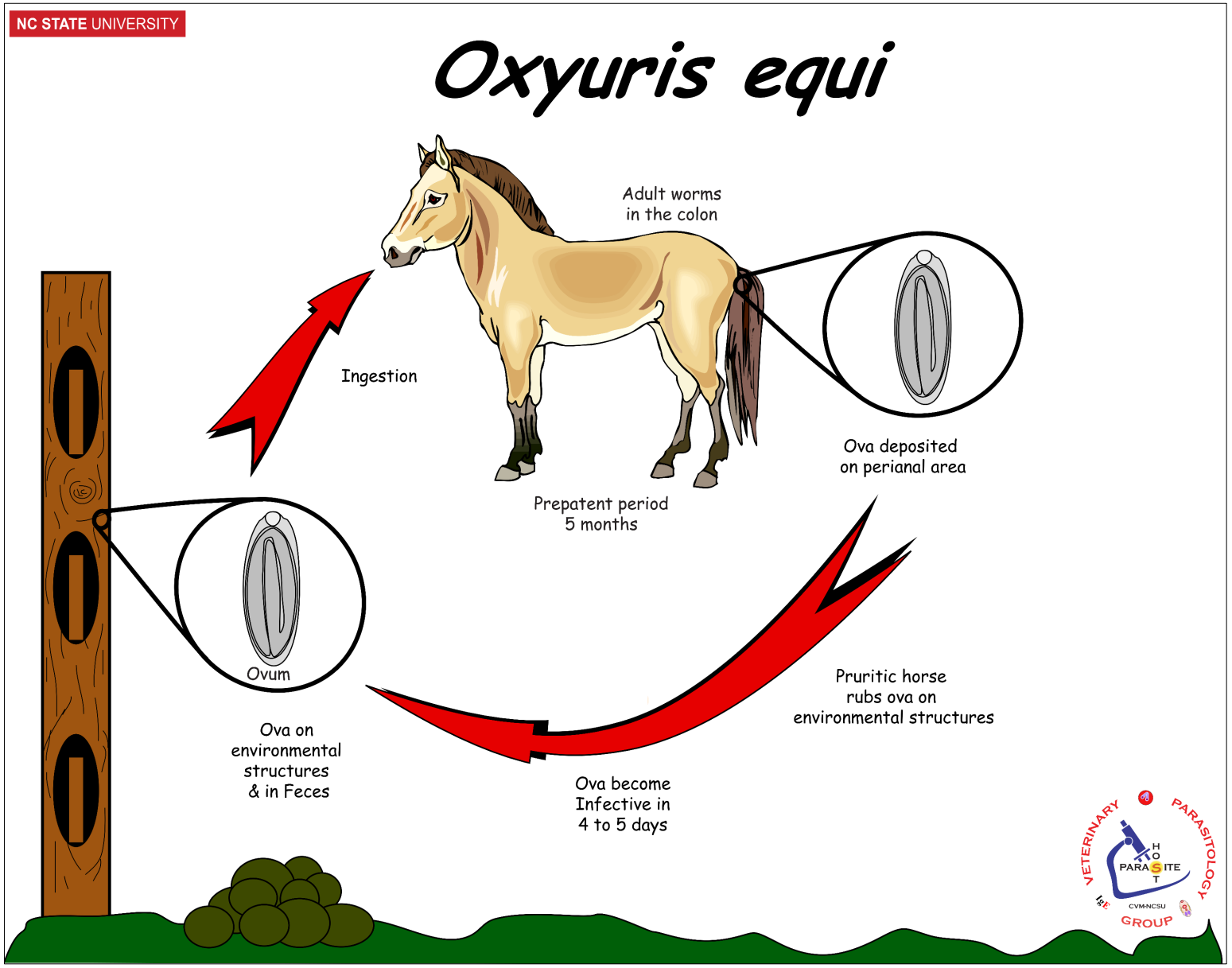


Nematodes

- Enoplids
  - *Dioctophyme*
  - *Trichinella*
  - *Trichuris*
  - *Eucoleus (Capillaria)*

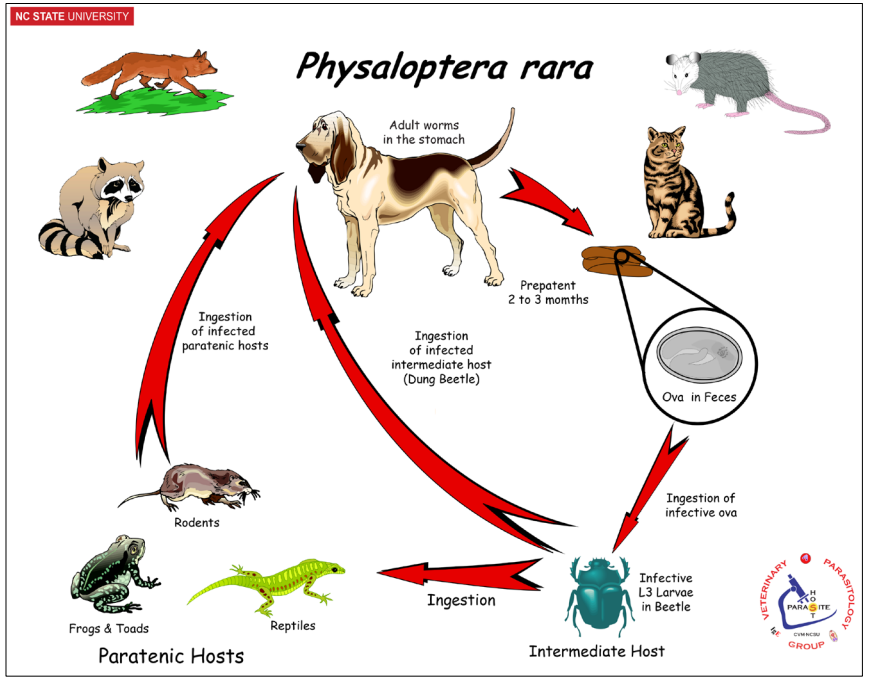


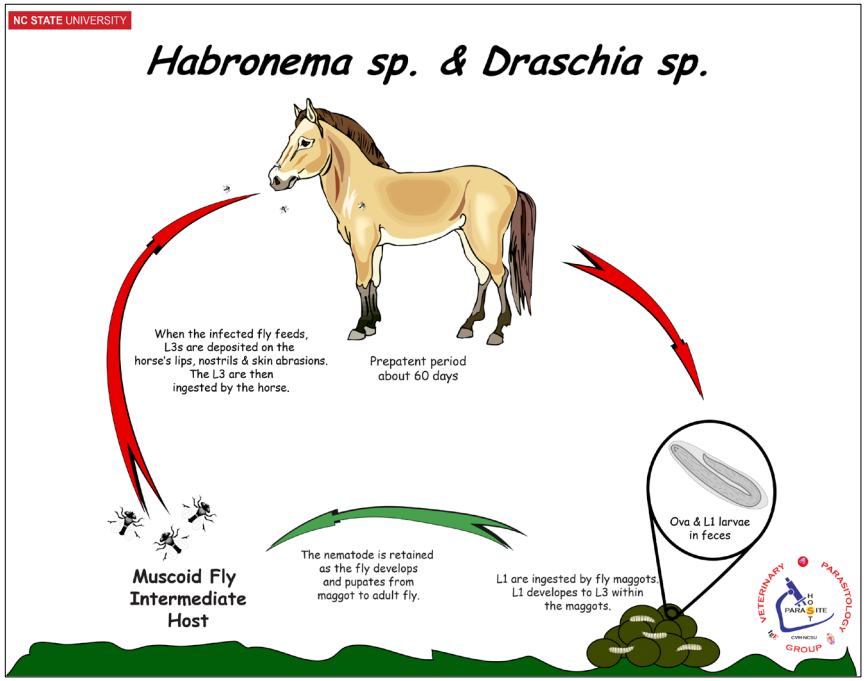
Nematodes
Oxyurids
(Pinworms)
Oxyuris

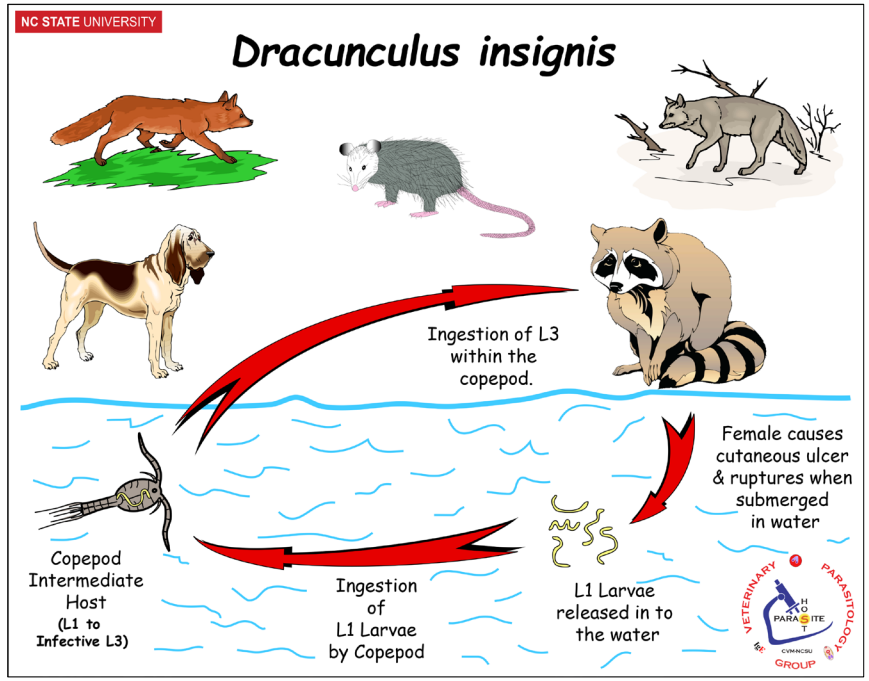


Nematodes

- Spirurids
  - Camallanid
    - *Dracunculus*
  - Physalopterid
    - *Physaloptera*
  - Habronematids
    - *Habronema*
    - *Draschia*

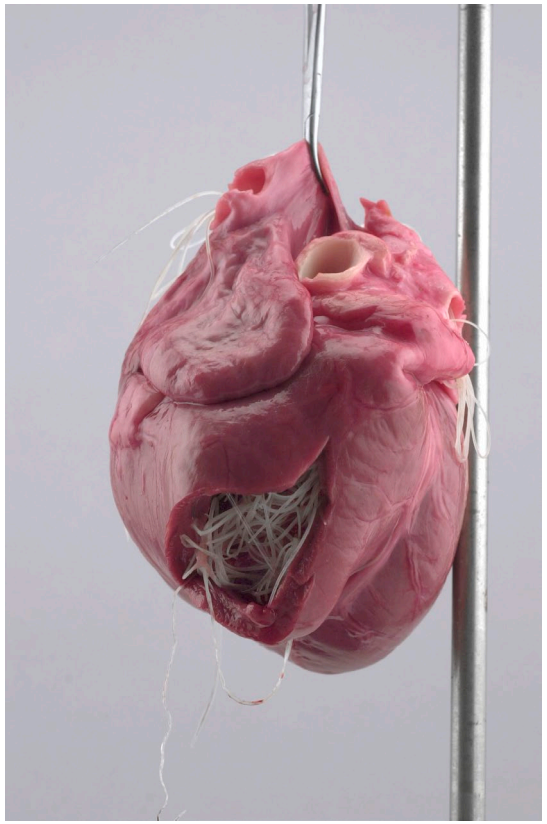


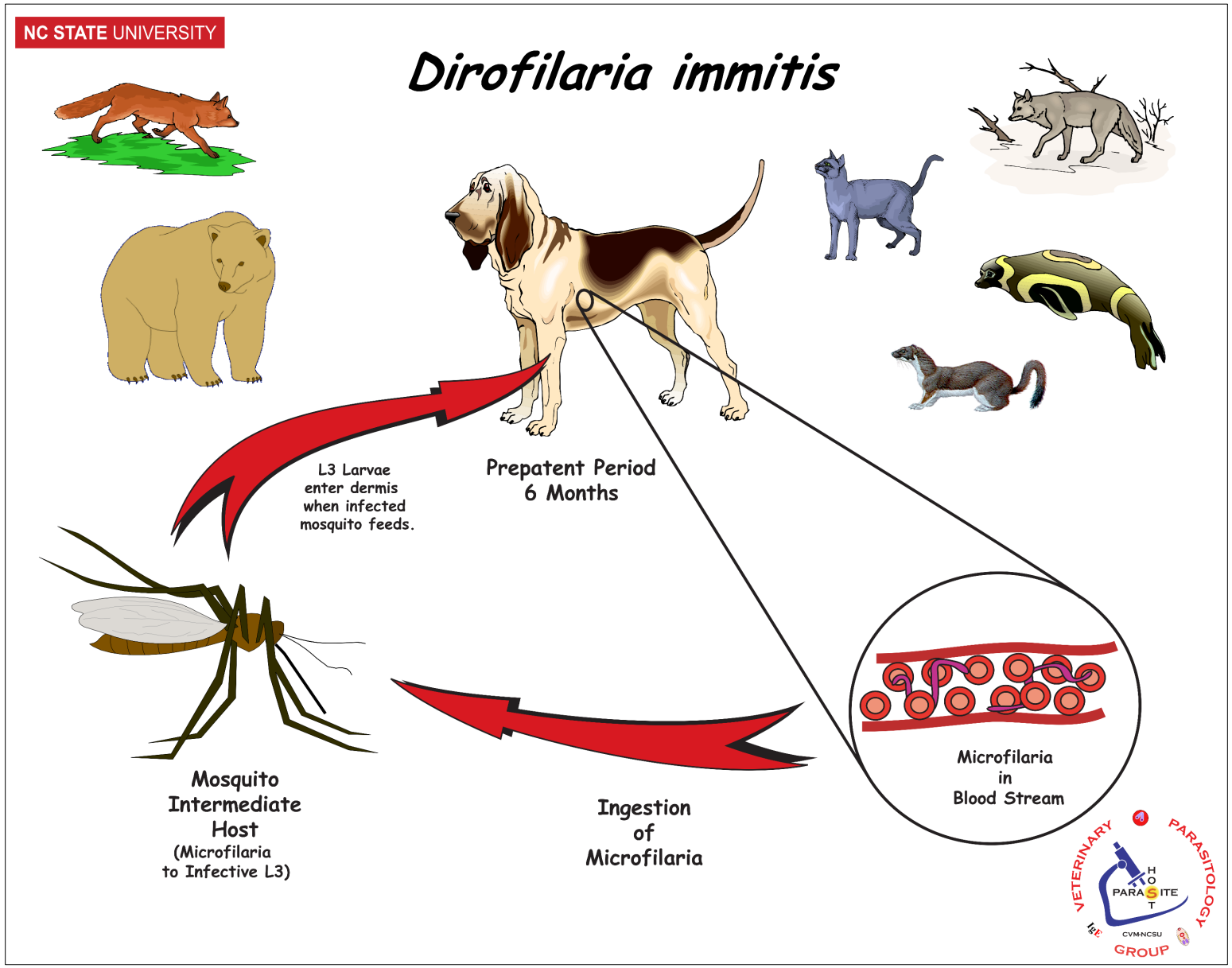




Nematodes

- Spirurids
  - Filarial
    - *Dirofilaria*
    - *Onchocerca*
    - *Acanthocheilonema*



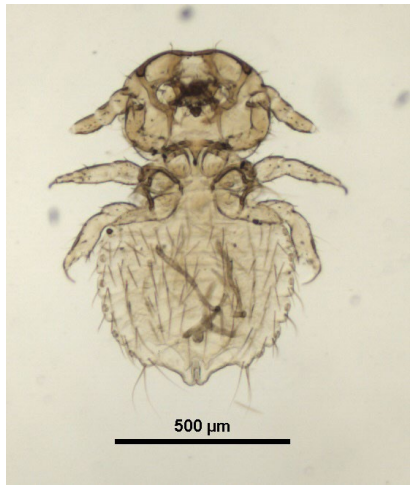


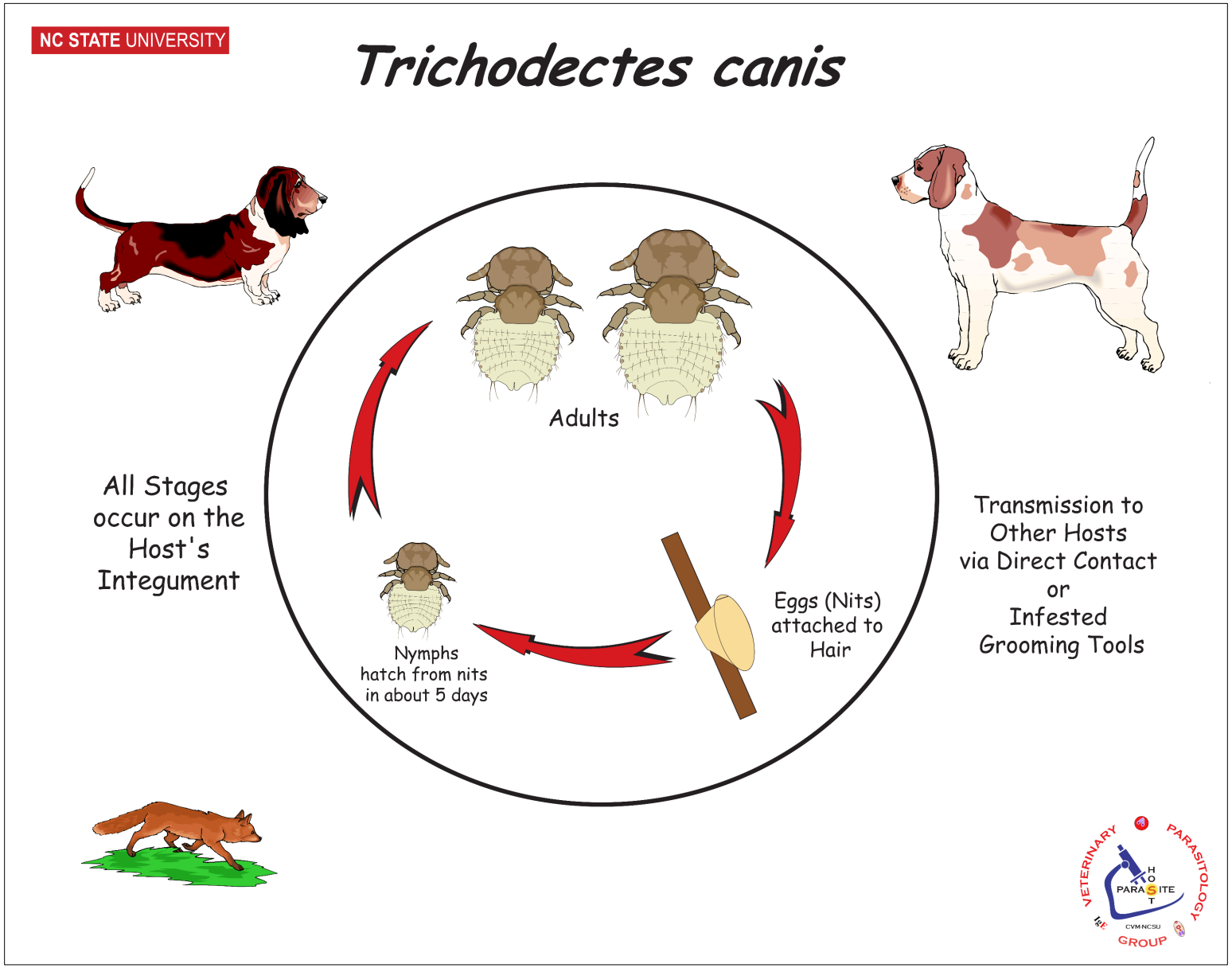
Arthropods

- "Bugs"
  - Multicellular parasites
  - Individual organisms do Not self-replicate in or on the host.
    - Although the pathology of some arthropods (mites & lice) is due to their reproduction of offspring on the host.
  - Many are Vectors for other disease agents

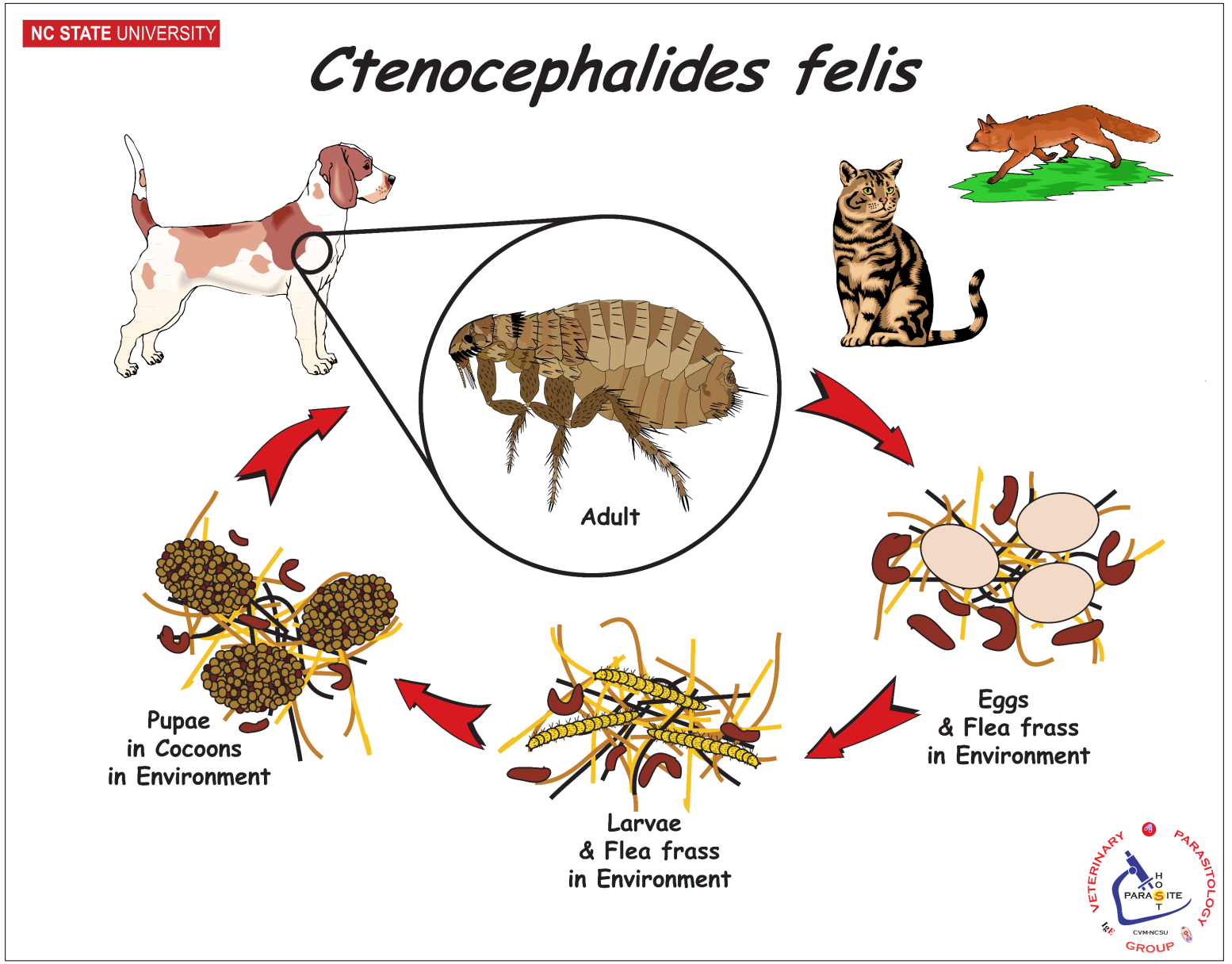
Arthropods

- Insects
  - Lice
    - Mallophagan (chewing)
      - *Bovicola*
      - *Trichodectes*
      - *Felicola*
      - *Menacanthus*
    - Anopluran (sucking)
      - *Haematopinus*
      - *Linognathus*



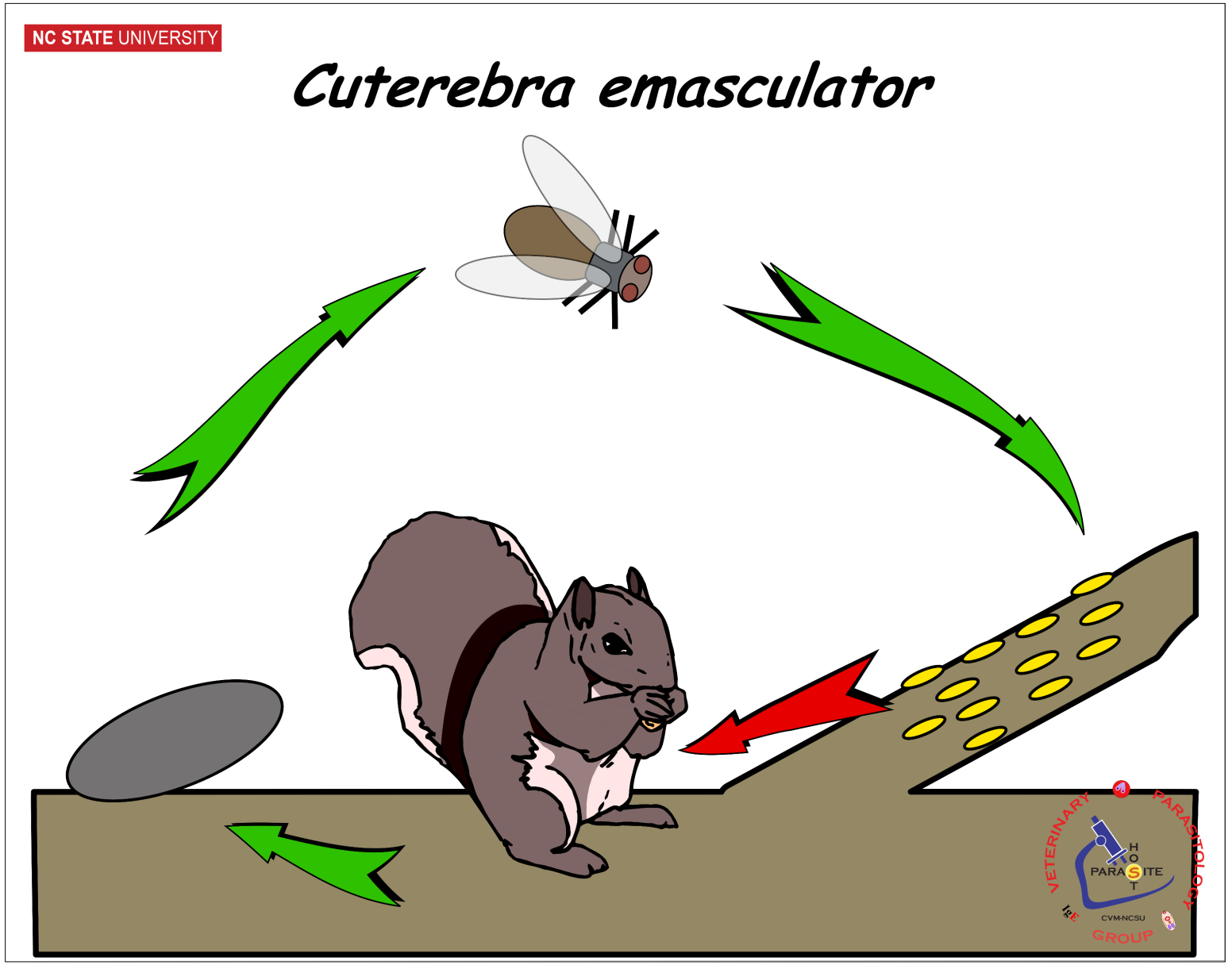


Arthropods
- Insects
  - Fleas
    - *Ctenocephalides*
    - *Pulex*



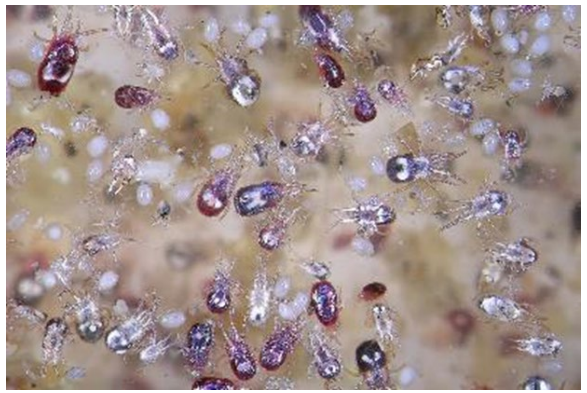
Arthropods

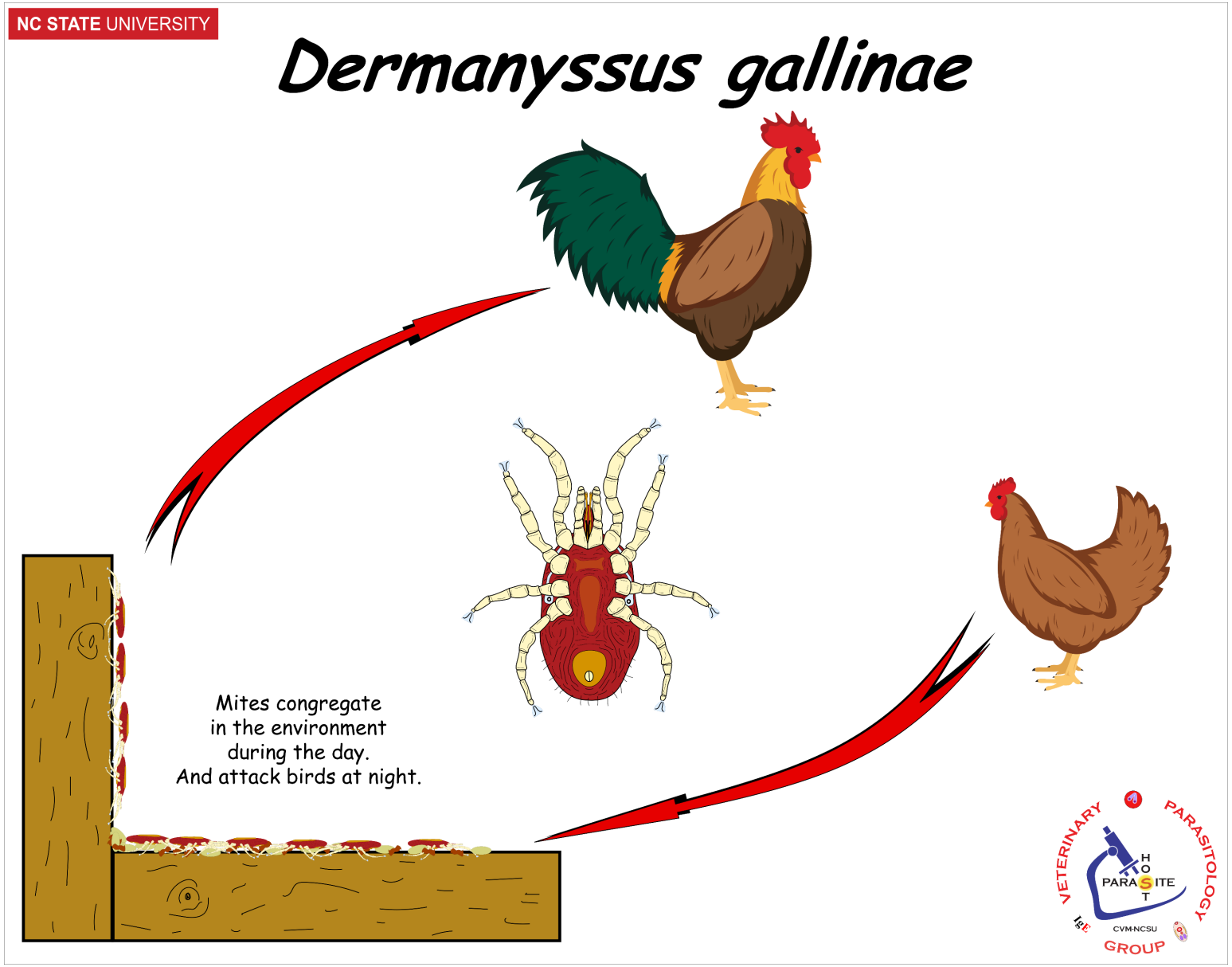
- Insects
  - Filth Flies
    - *Musca*
    - *Stomoxys*
    - *Haematobia*
  - Blow Flies
    - *Phormia*
    - *Cochlyomia*
  - Bot Flies
    - *Cuterebra*
    - *Hypoderma*
    - *Oestrus*
    - *Gasterophilus*



Arthropods

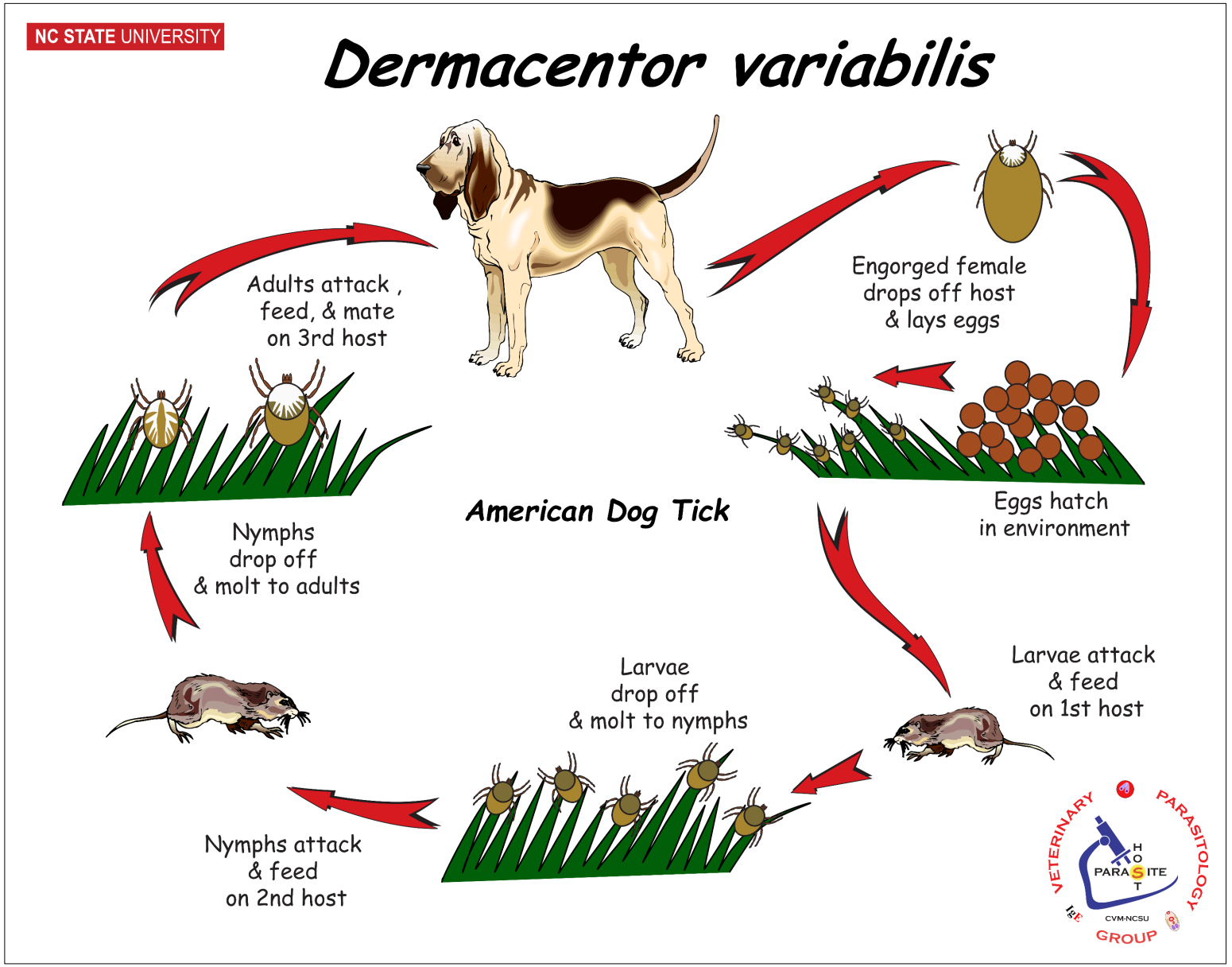
- Arachnids
  - Mites
    - Mesostigmatid
      - *Ornithonysus*
      - *Dermanysus*
    - Astigmatid
      - *Knemidocoptes*
      - *Otodectes*
      - *Sarcoptes*
      - *Notoedres*
    - Prostigmatid
      - *Demodex*





Arthropods

- Arachnids
  - Soft Ticks
    - *Argas*
    - *Otobius*
    - *Ornithodorus*
  - Hard Ticks
    - *Dermacentor*
    - *Rhipicephalus*
    - *Amblyomma*
    - *Ixodes*
    - *Haemaphysalis*



Parasite groups and members

Matching: Match each Parasite with its appropriate high-level group.

____ **1.** *Haemonchus contortus*

____ **2.** *Macracanthorhynchus insignis*

____ **3.** *Amblyomma americanum*

____ **4.** *Fasciola hepatica*

____ **5.** *Dipylidium caninum*

____ **6.** *Trypanosoma cruzi*

A. Arthropod

B. Acanthocephalan

C. Trematode

D. Protozoa

E. Cestode

F. Nematode

Parasite groups and members

Matching: Match each Parasite with its appropriate common name or group.

_____ **1.** *Paragonimus kellicotti*

_____ **2.** *Ostertagia ostertagi*

_____ **3.** *Toxocara cati*

_____ **4.** *Bovicola equi*

_____ **5.** *Anoplocephala perfoliata*

_____ **6.** *Tritrichomonas foetus*

A. Chewing louse

B. Mucoflagellate

C. Trichostrongyle

D. Tapeworm

E. Lung Fluke

F. Ascarid

LIFE CYCLE TERMINOLOGY

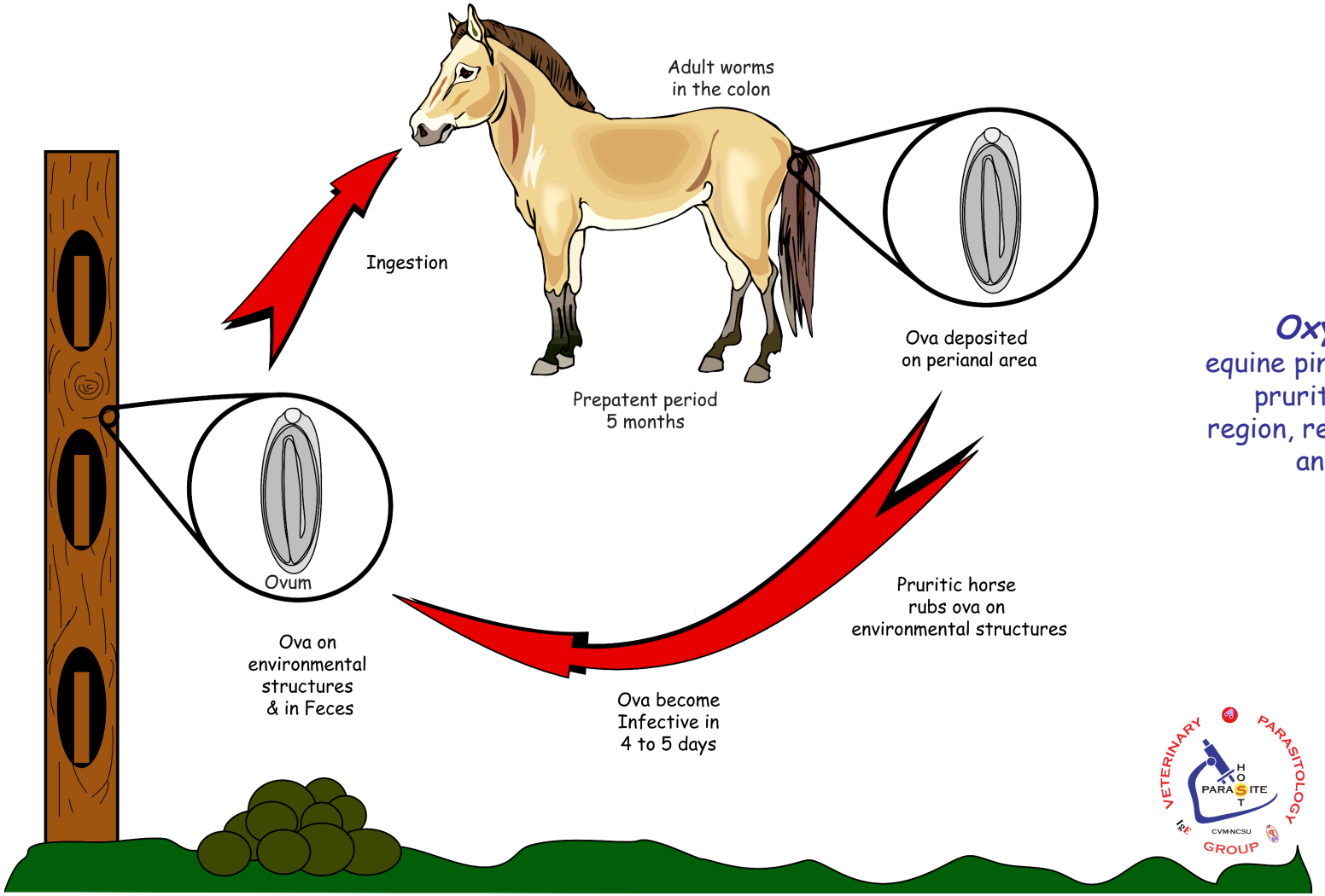
Take Home's

- Understand and be able to utilize various life cycle terms; including
  - Types of Life Cycles
  - Life Stages of Various Parasites
  - Types of Hosts.

Life Cycle Terms

- Types of Life Cycles
  - Direct life cycle - parasite does not require an intermediate host.
    - The infective stage (egg, cyst, or larva) is in the environment.
  - Indirect life cycle - parasite requires an intermediate host (vector).
  - Facultative Indirect life cycle – parasite **may** use a paratenic host
    - Paratenic host is not necessary (Facultative = "Optional")
- Parasite Stages
  - Various terms for stages depending on the parasite group (worms, protozoa, arthropods)
  - Ex. Worms
    - Larval stage - sexually immature form of the parasite
    - Adult stage - sexually mature form of the parasite
- Hosts
  - Definitive host (primary host) – required host that is infected with the sexually mature parasite.
  - Intermediate host – required host that is infected with larval stage(s) that continue development, but do not mature
    - Vector - transmits a pathogen from one host to another
      - Mechanical vector – not necessary for pathogen development (face fly proboscis)
      - Biological vector - necessary for pathogen development (tick)
  - Paratenic host (transport host) – optional host infected by a larval stage that does not develop further.
  - Aberrant host (dead-end host) – accidental host that is infected and does not transmit parasite further.

Oxyuris equi



Helminth Life Cycles

Life Cycle Type
Direct Life Cycle

Hosts
Definitive Host

Oxyuris equi is the equine pinworm that causes pruritus of the perianal region, resulting in alopecia and a bald tail-head.

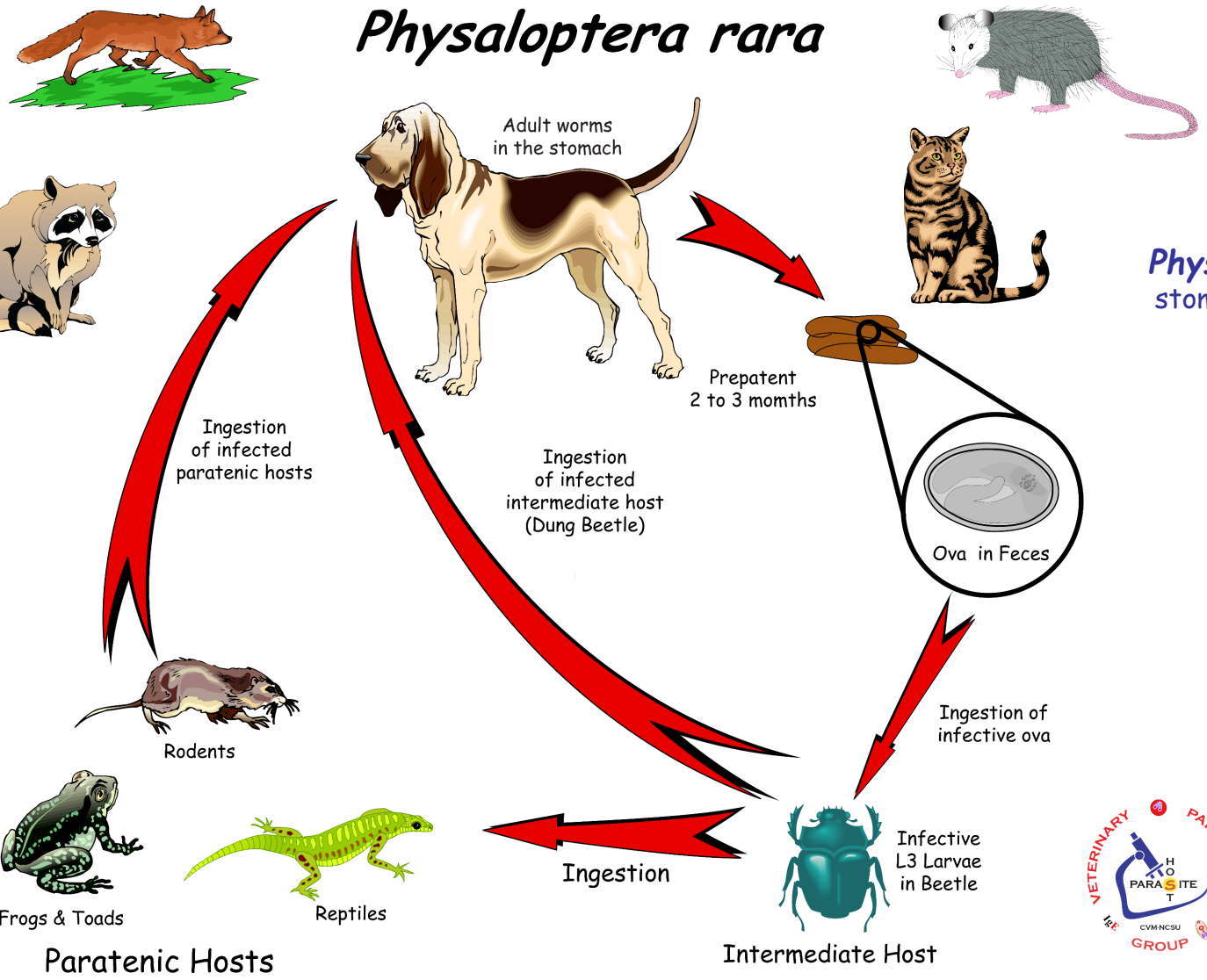
Parasite Stages
Adult
Ovum or Ova

Host Specificity
High

Zoonotic
No

- **Direct Life Cycles** have a single host (**Definitive Host**) and do not require an Intermediate Host to complete the parasite's life cycle.
- Many **Direct Life Cycles** involve fecal-oral transmission.
- The **Definitive Host** is the host in which the **Adult** or sexually mature parasite resides.
- For some parasitic worms, **Ova** (eggs) are produced by **Adult** worms and the **Ova** are passed in the feces.
- An **Ovum** provides a protective shell in which an **Infective Larvae** develops.
- The **Ova** are often the diagnostic stages for many parasites.

Physaloptera rara



Physaloptera rara is a stomachworm of pets and wildlife. It may cause gastritis with gastric ulcers.

Helminth Life Cycles

Life Cycle Type

Indirect Life Cycle

Hosts

Definitive Host
Intermediate Host
Paratenic Host
Sylvatic Host
Reservoir Host

Parasite Stages

Adult
Ovum or Ova
Infective larvae
Arrested larvae
(Hypobiotic larvae)

Host Specificity

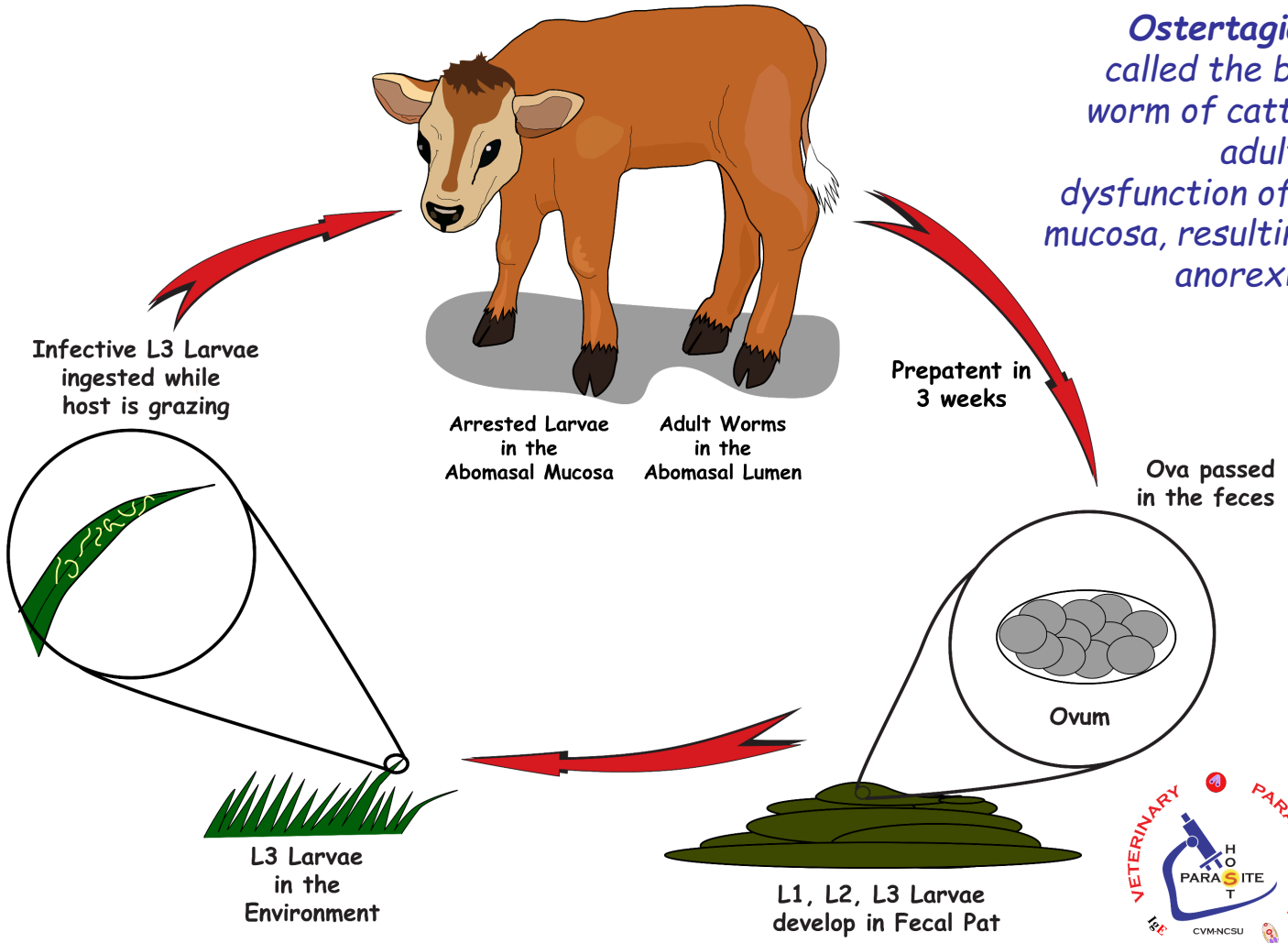
Low

Zoonotic

No

- An **Indirect Life Cycle** requires an **Intermediate Host** in which development of the parasite is necessary.
- Non-domestic **Definitive Hosts** are called **Reservoir Hosts** or **Sylvatic Hosts**.
- **Infective Larvae** may develop within the **Intermediate Host** to later infect the **Definitive Host**.
- A **Paratenic Host** is not required for the development of the parasite but may transport **Arrested Larvae** to the **Definitive Host**.

Ostertagia ostertagi



Ostertagia ostertagi *is called the brown stomach worm of cattle. Larvae and adult worms cause dysfunction of the abomasal mucosa, resulting in diarrhea, anorexia, and protein catabolism.*

Helminth Life Cycles

Life Cycle Type
Direct Life Cycle
Pasture-borne Parasite

Hosts
Definitive Host

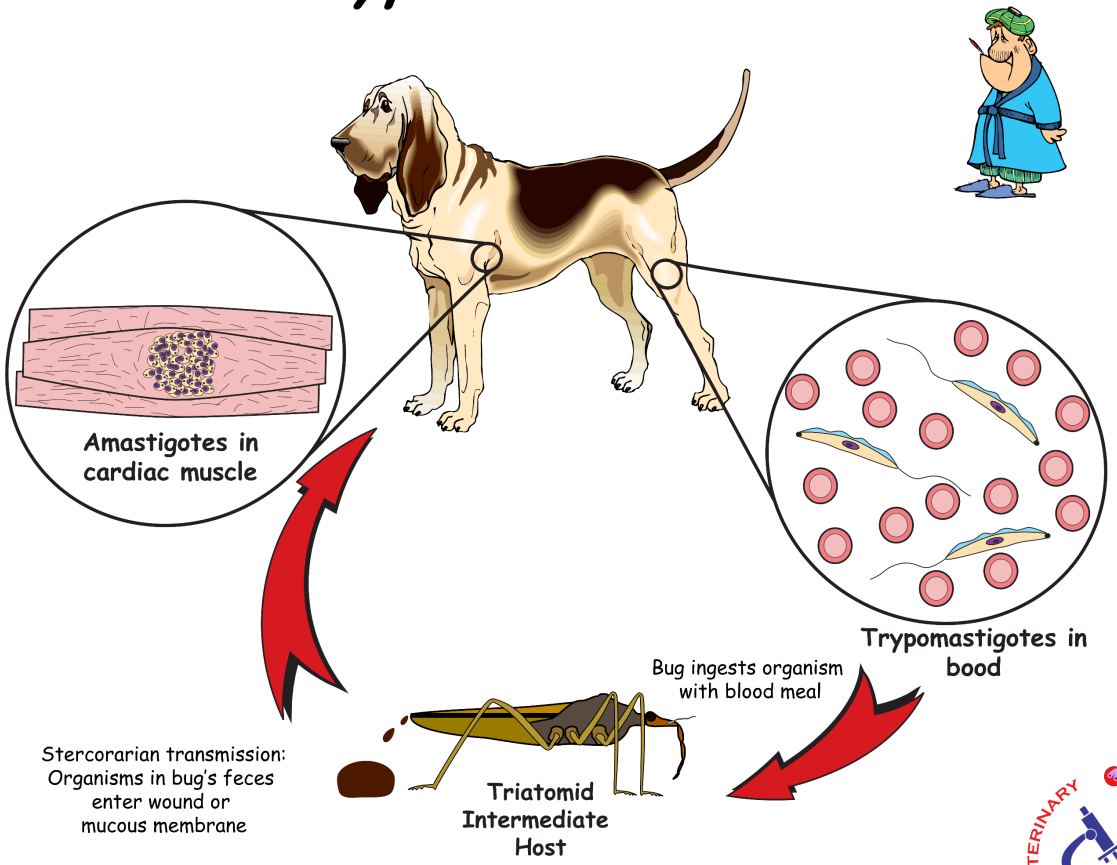
Parasite Stages
Adult
Ovum or Ova
Free-living larvae
Infective larvae
Arrested larvae
(Hypobiotic larvae)

Host Specificity
High

Zoonotic
No

- Many pasture-borne parasites, such as *Ostertagia spp.*, have **Direct Life Cycles**.
- When **Ova** are passed in the feces, **Free-living Larvae** hatch and develop on pasture.
- The **Free-living Larvae (L1 & L2)** eventually develop into **Infective Larvae (L3),** which are accidentally ingested by the **Definitive Host** while grazing.
- After ingestion, the **Infective Larvae** develop in the abomasal mucosa and become **Arrested Larvae**, also known as **Hypobiotic Larvae**.
- **Arrested Larvae** will re-activate & re-emerge into the lumen of the abomasum and become **Adult** worms.

Trypanosoma cruzi



Trypanosoma cruzi *is a vector-borne pathogen transmitted by triatomine bugs ("kissing bugs") that can cause Chagas disease. Its tropism for cardiac muscle often causes damage to the heart.*

- Hemoflagellates, such as *Trypanosoma cruzi*, have **Indirect Life Cycles**, which includes a mammalian **Definitive Host** and an insect **Intermediate Host**.
- The insect **Intermediate Host** is also called the **Vector** for the protozoan.
- The protozoa multiply asexually by **Binary Fission** or **Clonal Replication**, resulting in **Asexual Stages Only**.
- Without control by host immunity, some parasites, like *Trypanosoma cruzi*, will continue to multiply until they overwhelm the host. This is called a **Continuous Life Cycle**.
- Life Cycle forms, for Trypanosoma cruzi, include **Amastigotes** in the mammalian tissues, **Trypomastigotes** in the mammalian blood, and **Epimastigotes** in the insect gut.

Protozoan Life Cycles

Hemoflagellates

Life Cycle Type
Indirect Life Cycle
Continuous Life Cycle

Hosts
Definitive Host
Intermediate Host
Vector

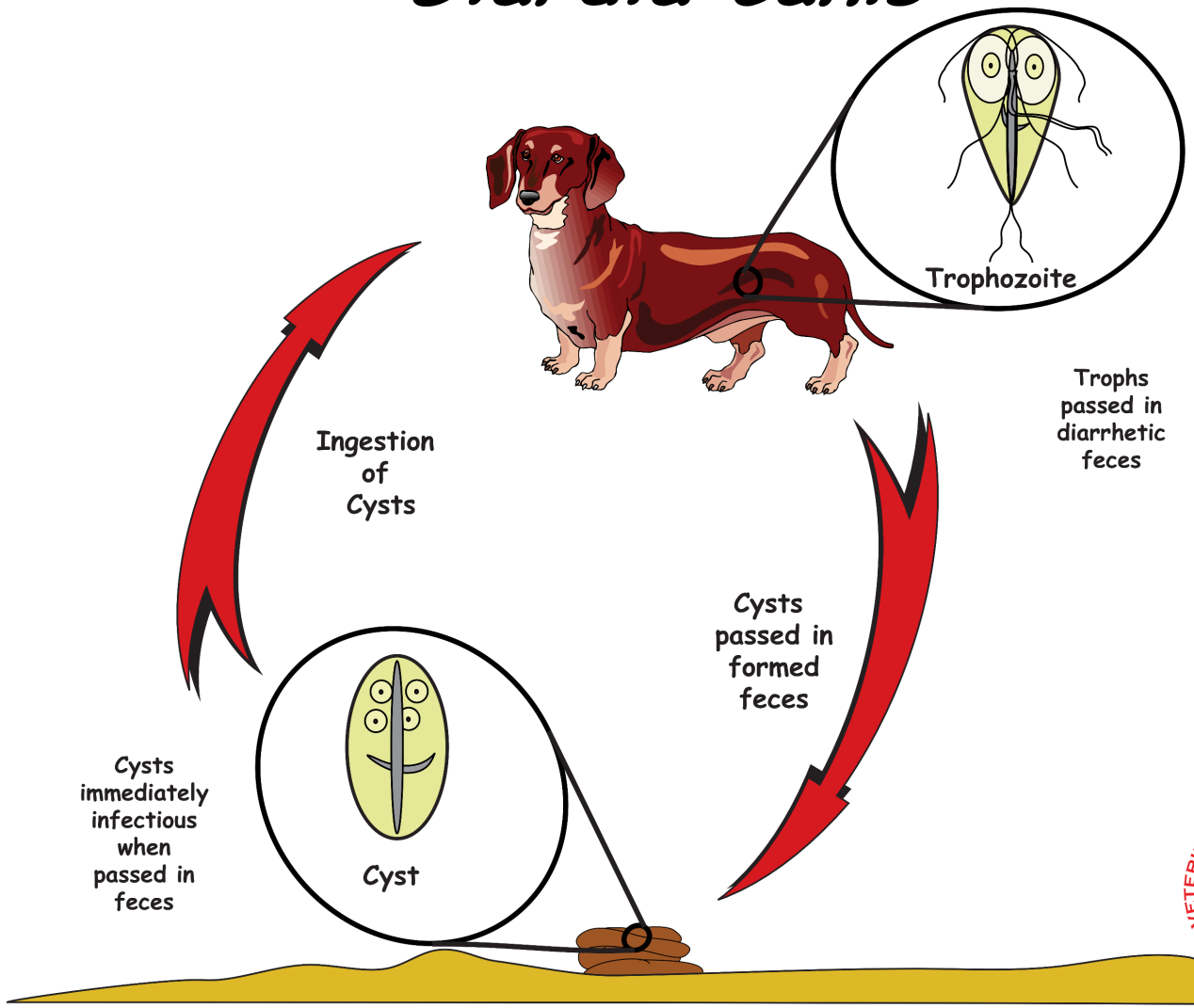
Life Cycle Processes
Binary Fission
Clonal Replication

Parasite Stages
Asexual Stages only
Amastigote
Trypomastigote
Epimastigote

Host Specificity
Low

Zoonotic
Yes

Giardia canis



Protozoan Life Cycles

Mucoflagellates

Life Cycle Type

Direct Life Cycle

Hosts

Definitive Host

Parasite Stages

Asexual Stages only

Trophozoite

Cyst

Giardia spp. *are protozoa parasites that infect the gastrointestinal tracts of animals and can cause diarrhea. Giardia cysts are transmitted via fecal-oral route.*

Life Cycle Processes

Binary Fission

Clonal Replication

Host Specificity

High

Zoonotic

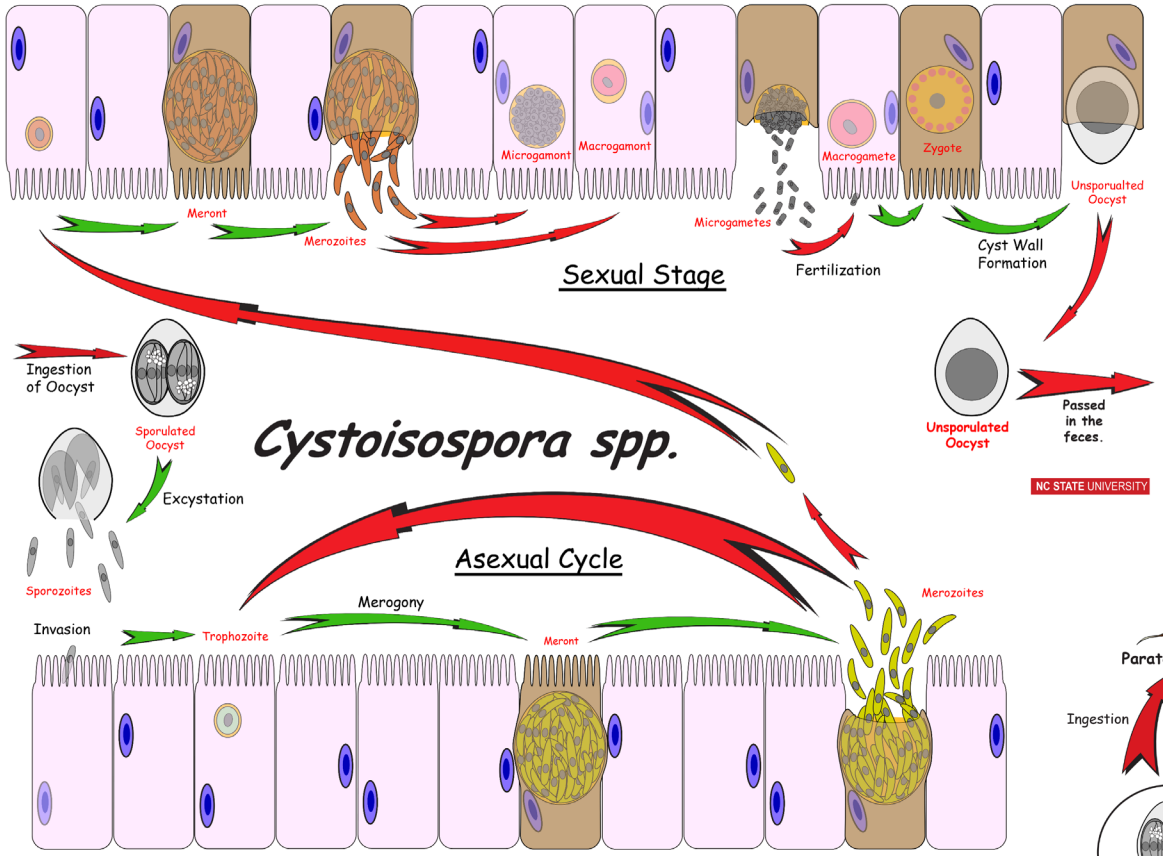
No

- Mucoflagellates, such as *Giardia canis*, have **Direct Life Cycles**, which only requires the **Definitive Host**.
- The protozoa multiply asexually by **Binary Fission** or **Clonal Replication**, resulting in **Asexual Stages Only**.
- Life Cycle forms include an active **Trophozoite** with in the **Definitive Host** and a **Cyst** that contaminates the environment.
- The **Definitive Host** is infected by ingesting the **Cyst** stage.

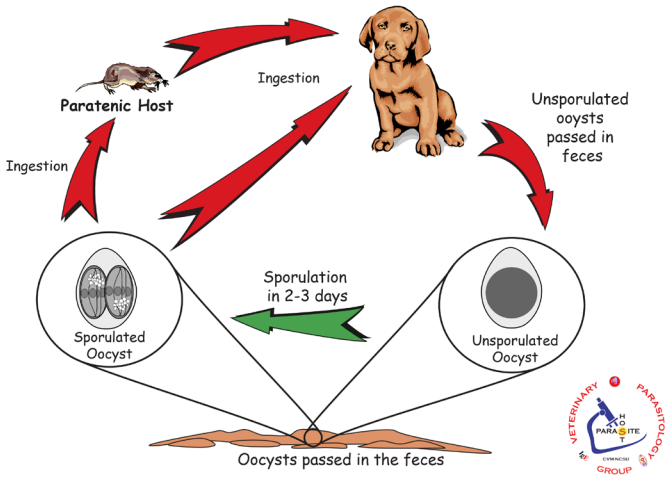
Protozoan Life Cycles

Coccidia

Cystoisospora spp. are protozoa parasites that infect the gastrointestinal tract of carnivores, causing diarrhea primarily in young or immunocompromised animals. It is transmitted via fecal-oral route and can be prevented with proper sanitation.



Cystoisospora canis



Life Cycle Type
- Direct Life Cycle
- Single Direction Life Cycle
- "All In – All Out"
- Facultative Indirect Life Cycle
- Asexual Cycle
- Sexual Cycle

Hosts
- Definitive Host
- Paratenic Host

Host Specificity
- High

Zoonotic
- No

Parasite Stages
- Unsporulated Oocyst
- Sporulates Oocyst
- Sporozoites
- Meront
- Merozoites
- Gametocytes
- Zygote

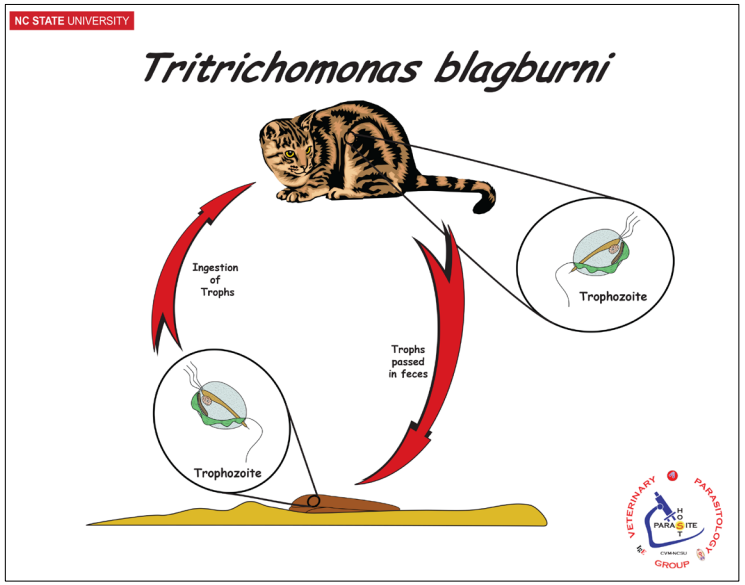
Life Cycle Processes
- Binary Fission
- Sporulation
- Merogony
- Gametogony
- Fertilization

- Most coccidians have **Direct Life Cycles**, which only requires the **Definitive Host** and fecal-oral transmission.
- However, some coccidia, like *Cystoisospora spp.*, have **Facultative Indirect Life Cycles**, which provides the use of unnecessary **Paratenic Hosts** to maintain the life cycle. **Paratenic Hosts** harbor **Cystozoites** which infect the **Definitive Host** upon ingestion.
- Coccidians utilize **Sexual & Asexual Cycles** within the **Definitive Host**.
- Some parasites have a **Single Direction Life Cycle**. Once the life cycle is completed then all organisms are gone ---**"all in – all out"**.
- **Unsporulated Oocysts** are passed in the host's feces. These go through **Sporulation**, resulting in an infective **Sporulated Oocysts**
- After being ingested, the **Sporulated Oocyst** releases **Sporozoites** which invade gut cells. This begins the **Asexual Cycle**: **Sporozoites** multiply by **Binary Fission** or **Merogony** producing a **Meront** full of **Merozoites**.
- The **Sexual Cycle** occurs when **Merozoites** differentiate into **Gametocytes** via **Gametogony**. After **Fertilization**, the resulting **Zygote** develops into an **Unsporulated Oocyst** to be passed out in the feces.

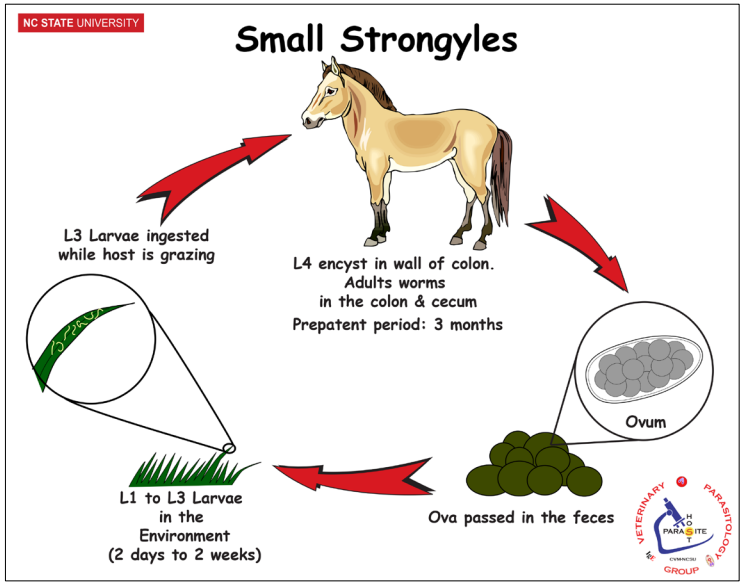
Direct Life Cycle Transmission Strategies

Reminder: Direct Life Cycles have a single host and do not require an Intermediate Host to complete the parasite's life cycle.

- Immediate Transmission: The Infective Stage is passed by the host.
  - Host is immediately infectious to another host.
- Delayed Transmission: Development in the environment is required before becoming infective.
  - Host is NOT immediately infectious to next host.

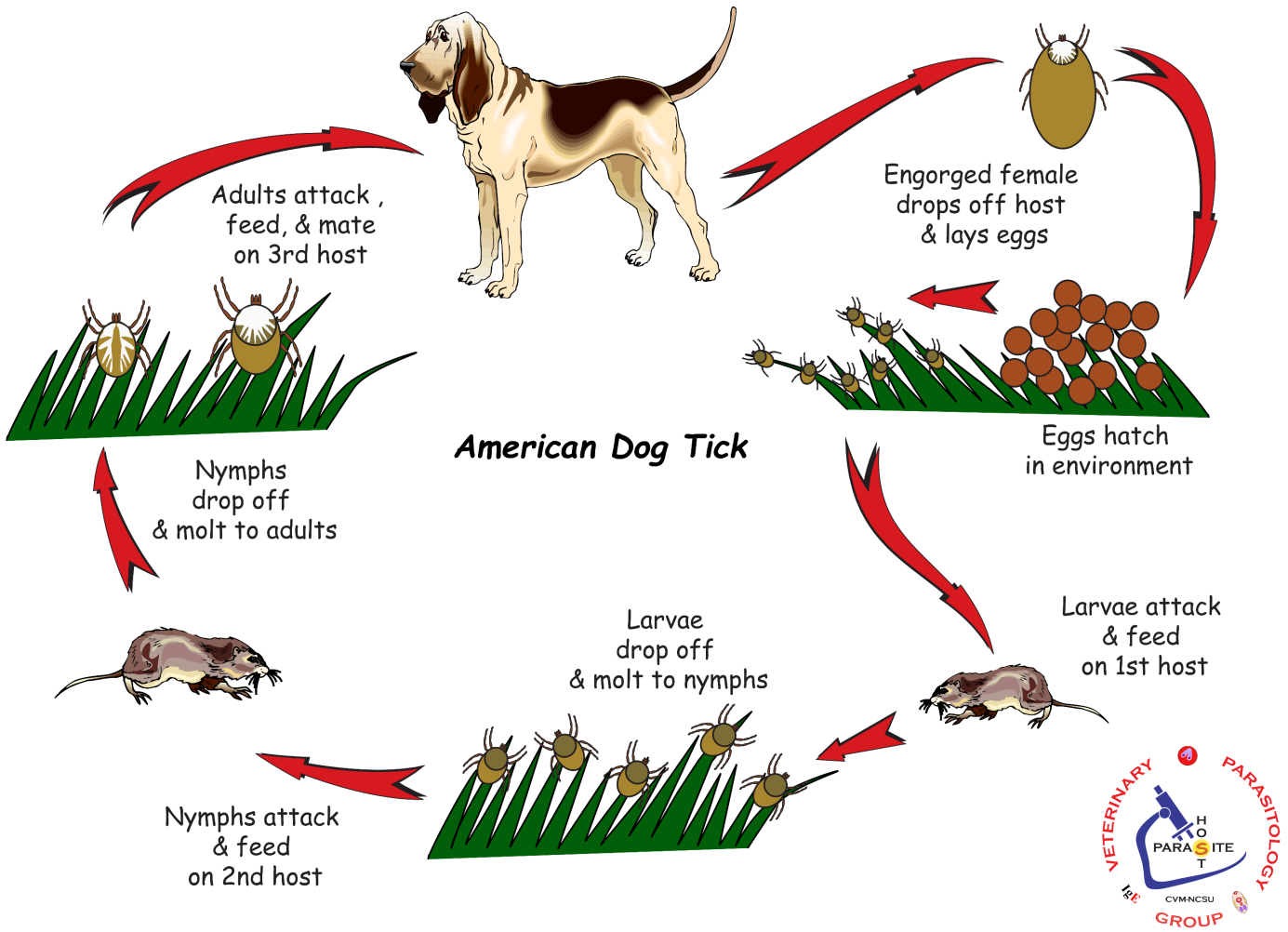


Immediate Transmission



Delayed Transmission

Dermacentor variabilis



Arthropod Life Cycles

Life Cycle Type

Simple Metamorphosis

1-Host Tick

2-Host Tick

3-Host Tick

Dermacentor variabilis *is called the American Dog Tick. Besides causing irritation, blood loss and Tick Paralysis, this tick is also a vector for Rickettsia rickettsia (Rocky Mountain Spotted Fever).*

Parasite Stages

Eggs

Larvae

Nymphs

Adults

Male

Female

Host Specificity

Low

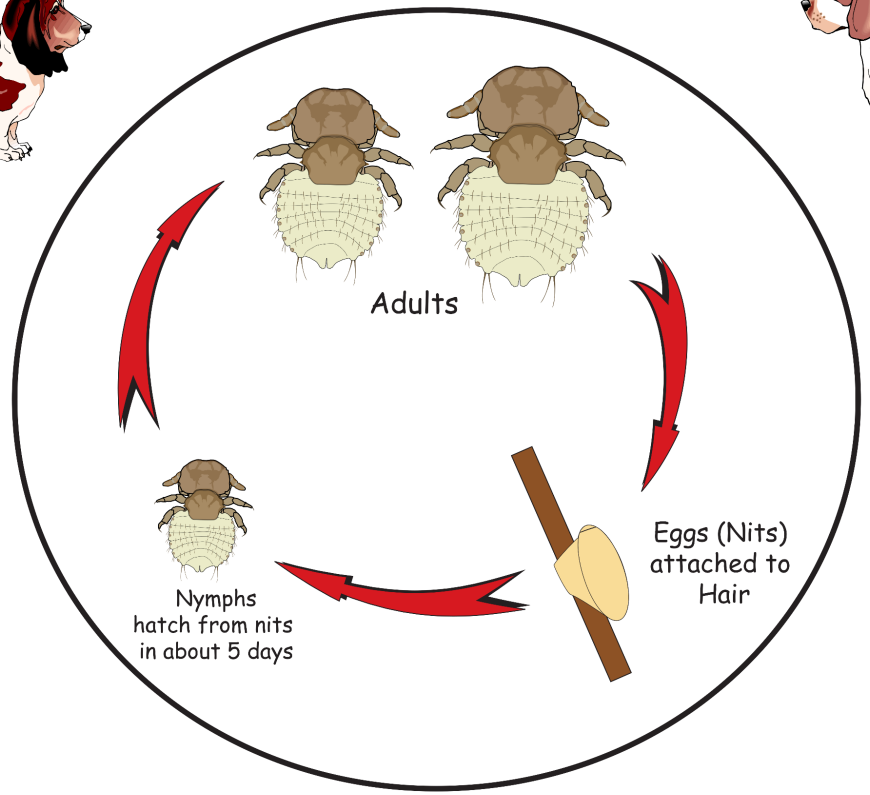
Zoonotic

Yes

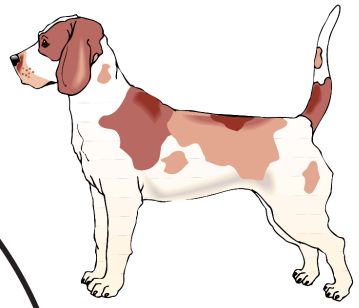
- Like other arachnids, ticks have eight legs, except for the six-legged **larvae**.
- Ticks develop from **Larvae** to **Adults** through a process of **Simple Metamorphosis.**
- **Simple Metamorphosis** is when all life stages of an arthropod look similar, except for size and minor differences.
- Engorged **Female** ticks drop off the host and deposit **Eggs** in the environment.
- Six-legged **Larvae** hatch from these **Eggs** and feed on a host. The larvae develop and molt to become eight-legged **1st Nymphs**, which also feed.
- After feeding, the **1st Nymph** develops and molts into the **2nd Nymph**. Like wise, the **2nd Nymphs** feed, develop, and molt into **Adult** ticks.
- **Male and Female Adult** ticks feed and mate on the host. The engorged **Female** then drops off the host to lay **Eggs** in the environment.
- *Dermacentor variabilis* is a **3-Host Tick** because it feeds on 3 different hosts. Other species of ticks are **1-Host** or **2-Host Ticks**.

Trichodectes canis

Arthropod Life Cycles



All Stages occur on the Host's Integument



Transmission to Other Hosts via Direct Contact or Infested Grooming Tools

Trichodectes canis is a chewing louse of dogs. *Chewing Lice feed on skin, fur, feathers, and debris; and cause general irritation, pruritus, and alopecia. Other lice are Sucking Lice, which feed on blood.*

Life Cycle Type
- Simple Metamorphosis
- Hemimetabolous

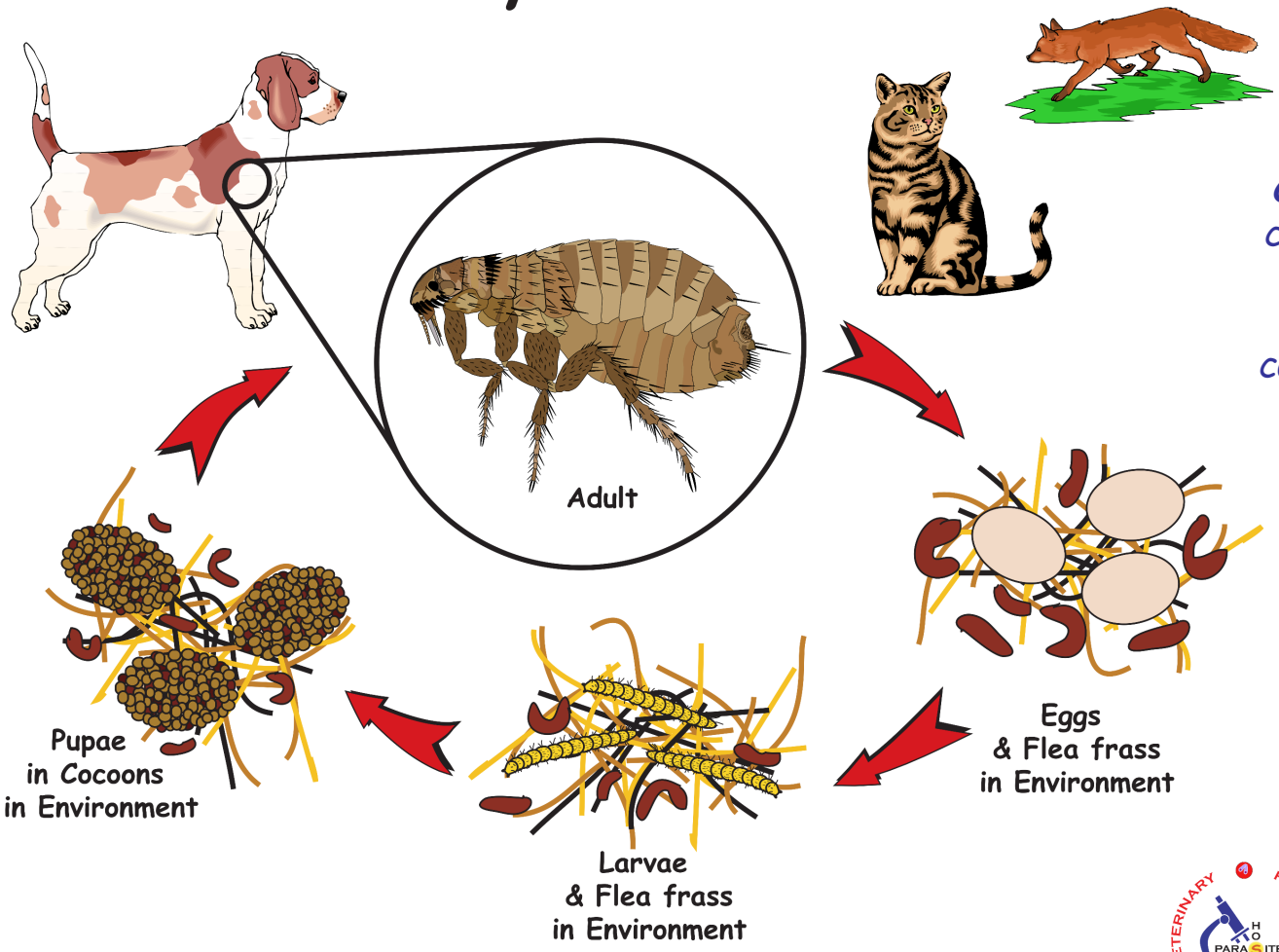
Parasite Stages
- Nits
- Nymphs
- Adults
- Male
- Female

Host Specificity
- High

Zoonotic
- No

- Lice develop from **Nymphs** to **Adults** through a process of **Simple Metamorphosis** or **Hemimetabolous** development.
- **Simple Metamorphosis** occurs when all life stages have a similar appearance, except for size.
- **Male & Female** Lice mate on the host and the **Female** louse cements **Eggs** (aka **Nits**) on the hair or feather shaft of the host.
- **Nymphs** hatch from the **Nits**, then feed and molt to the next stage. There are usually several molts before reaching the **Adult** stage.
- All stages, from **Nits** to **Nymphs** to **Adults**, remain on the host.

Ctenocephalides felis



Ctenocephalides felis *is called the Cat Flea but is found on dogs as well as many other hosts. Fleas cause irritation, pruritus, alopecia, blood loss, and Flea Allergy Dermatitis (FAD).*

Arthropod Life Cycles

Life Cycle Type
Complex Metamorphosis
Holometabolous

Parasite Stages
Eggs
Larvae
Pupae
Puparium
Adults
Male
Female

Host Specificity
Low

Zoonotic
Yes

- Fleas develop from **Eggs** to **Adults** through a process of **Complex Metamorphosis** or **Holometabolous development**.
- **Complex Metamorphosis** occurs when the life stages have a dissimilar appearance.
- **Male and Female** fleas feed and mate on the host. **Eggs** are deposited on the host; but fall off into the environment.
- In the environment, **Larvae** hatch from the **Eggs** and develop through 3 **Larval Stages** via 2 molts.
- The caterpillar-like **Larvae** feed on environmental debris.
- The 3rd **Larval Stage** builds a cocoon (aka **Puparium**) in which the **Pupa** develops into **Adult** fleas.
- When a host passes by, the **Adult** flea will emerge from the **Puparium** and attack the host.

Life Cycle Terms

Matching: Match each Life Cycle Term with its associated parasite, statement, or definition.

_____ **1.** A parasite that is transmitted to the next definitive host without development in an intermediate host.

_____ **2.** The host in which the sexually mature parasite resides.

_____ **3.** A form of asexual reproduction that many protozoa utilize.

_____ **4.** *Ostertagia ostertagi*

_____ **5.** An optional host, in which a parasite does not develop but utilizes as a transport host.

_____ **6.** An arthropod life cycle in which the nymphal stages look like the adult arthropod.

_____ **7.** *Ctenocephalides felis*

A. Pasture-borne Nematode

B. Simple Metamorphosis

C. Direct Life Cycle

D. Definitive Host

E. Holometabolous

F. Binary Fission

G. Paratenic Host

H. Indirect Life Cycle

AHD: Parasitology

BASIC CONCEPTS

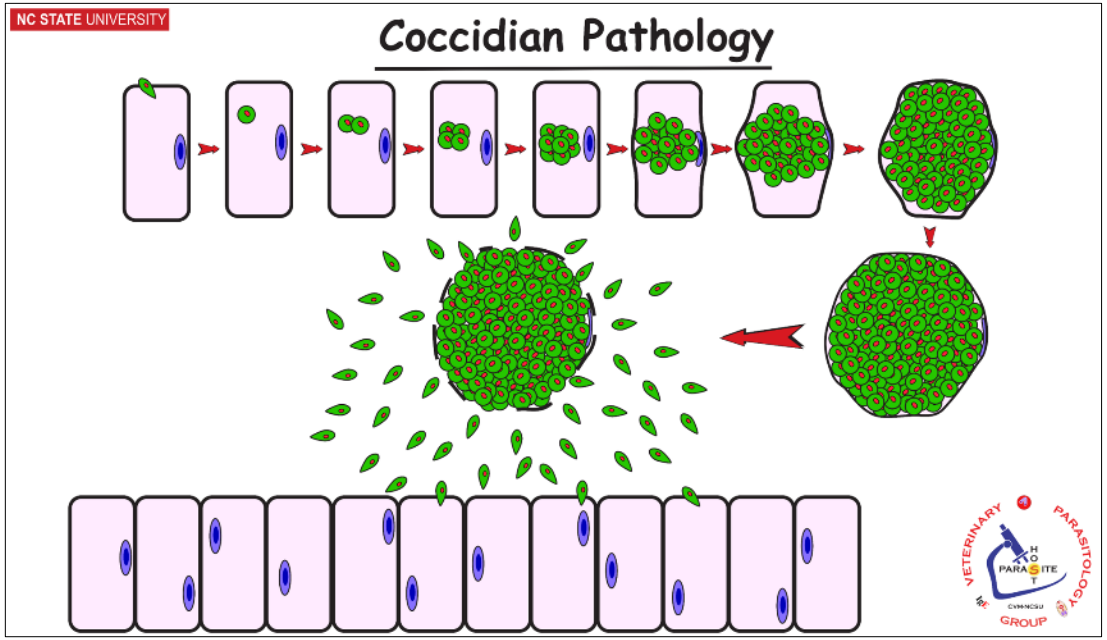
Take Home's

- Appreciate the variety of pathologies caused by parasites. (but throughout the course learn the pathologies caused by specific parasites).
- Differentiate the terms: Disease, Infection, and Infectious.
- Understand and utilize often used parasitological terms: including Prepatent Period, Zoonosis, and Host Specificity.
- Understand and utilize the forms of Host Specificity: High Host specificity, Low Host Specificity.

Parasite Pathogenesis

- Pathogenesis (how the pathogen causes disease)
  - Production or Development of Disease

- Forms of Pathogenesis
  - Trauma
    - Direct destruction of the host cells or tissues
      - *Eimeria, Babesia, Sarcoptes, Haemonchus*, Small Strongyles
    - Indirect destruction of host cells or tissues
      - *Tritrichomonas, Giardia, Ascaris*
    - Organ occlusion
      - *Parascaris, Dirofilaria, Heterobilharzia, Babesia*
  - Nutrient Robbing
    - Tapeworms, *Ascaris*
  - Excretion of Toxins or Other Pathogens
    - *Tritrichomonas, Fasciola, Nanophyetus*
  - Interactions with host immune / inflammatory responses
    - *Demodex, Dirofilaria, Leishmania*, Fleas



Traumatic destruction of epithelial cells

Parasite Impact on Host

- Parasite effects on hosts are a continuum
  - Parasite number and pathogenicity determine disease state
    - No effect on host
    - Subclinical
      - no obvious signs; subtle performance losses
    - Clinical
      - disease manifestation

Clinical judgement: "Is the parasite's effect on the patient important enough to justify treatment?"

Infection ≠ Disease ≠ Infectious

- Infection = presence of an agent that has the potential to cause disease
- Disease = the occurrence of dysfunction / pathology
- Infectious = infected host capable of transmitting infection to another host
  - ("Contagious" in virology)
  - v/s Infective = parasite stage capable of invading the next host.
- Infection ≠ Infectious ≠ Disease

Infection, Disease, and/or Infectious?

A. The dog showed no adverse symptoms to the 2 female *Dirofilaria immitis* in its pulmonary arteries.

Infection

B. A lamb with 1,000 juvenile *Haemonchus contortus* in its abomasum suffers from severe anemia.

Infection + Disease

C. A cat, suffering small bowel diarrhea, passes *Giardia cati* cysts in its stool.

Infection + Disease + Infectious

D. After using the bathroom, she was horrified to see that she had passed several active segments of the beef tapeworm, *Taenia saginata*.

Infection, +/- Infectious

E. *Eimeria sp.* oocysts are found on a dog's annual wellness visit.

None (pass-through)

Other Concepts

- Host Specificity
  - Degree of Host-Parasite compatibility
  - An inverse relationship of compatibility (↑ Specificity = ↓ Host species)

  - High Host specificity
    - Parasite can infect only one or a few host species
    - (*Oxyuris*, Lice, *Eimeria*, sexual stages of *Toxoplasma*)
  - Low Host Specificity
    - Parasite can infect several or many host species
    - (*Physaloptera*, Fleas, asexual stages of *Toxoplasma*)

- Prepatent v/s Patent
  - Prepatent Period (PPP) – developmental / maturation time needed between time of infection to the production of offspring. Determines the timing of treatment for control measures.
  - Patent - an infection in which sexually mature parasites are generating offspring.

- Zoonosis - an animal disease transmitted to humans

Parasitology Concepts

Matching: Match each Parasitological Concept with its associated parasite, statement, or definition.

____ **1.** Within the definitive host, the period of parasite development from host infection to production of parasite offspring.

____ **2.** *Oxyuris equi*

____ **3.** A parasite that can infect a human.

____ **4.** Degree of Host-Parasite Compatibility

____ **5.** An infection in which the parasite is producing offspring.

A. Low Host Specificity

B. PrePatent Period

C. Host Specificity

D. Zoonotic

E. High Host Specificity

F. Patent

AHD: Parasitology

CLINICAL THOUGHT EXERCISE

Controlling Parasites

Assume you are working at a Wildlife Rehab facility.

1. Regarding the concern for re-infection & build-up of the parasite population; Rank the following 3 parasites on basis of concern? (low, moderate, high)

2. What would you generally do to control reinfection?
   Sanitation or Pest Control

Concern for reinfection, build up of large parasite population in the host ?

+ low concern
++ moderate concern
+++ high concern

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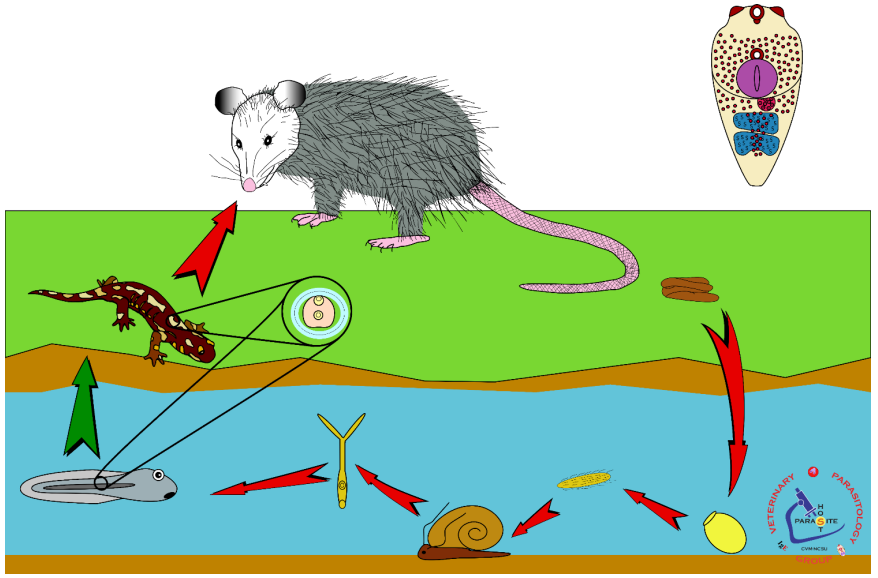
Didelphodiplostomum variable



1

Primary Control Effort?

Sanitation
Pest Control

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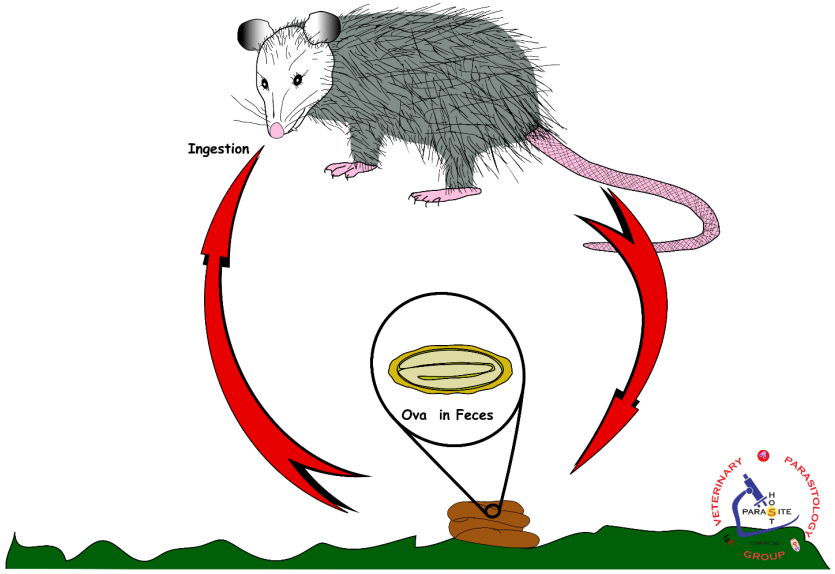
Cruzia americana



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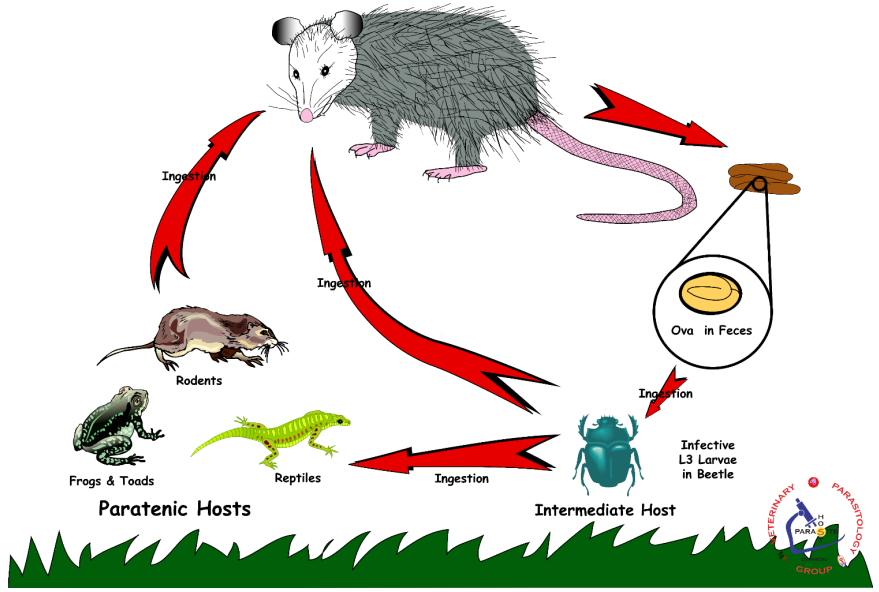
Physaloptera turgida



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AHD: Parasitology

TAKE-HOME SUMMARY

Take Home

- Common and Genus names of Parasites and the groups of which they belong.
- Concepts that should become "second nature":
  - Infection v/s Infectious v/s Disease
  - Host Specificity: Low v/s High
  - Life Cycles: Direct v/s Indirect
  - Prepatent v/s Patent
  - Parasite Stages: (EX. Worm: Larva, Infective Larva, Adult) (also stages for Arthropods & Protozoa)
  - Hosts: Definitive v/s Intermediate v/s Paratenic
  - Zoonosis
- Importance of knowing life cycles for successful clinical cases and disease control.


VETERINARY
PARASITOLOGY
HOST
PARASITE
IgE
CVM-NCSU
GROUP