NC STATE UNIVERSITY

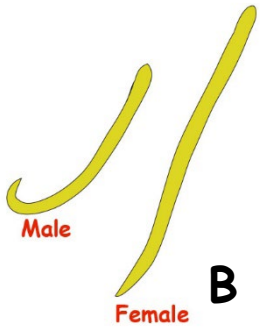
AHD2: VET 921

Parasitology Section

Platyhelminthes

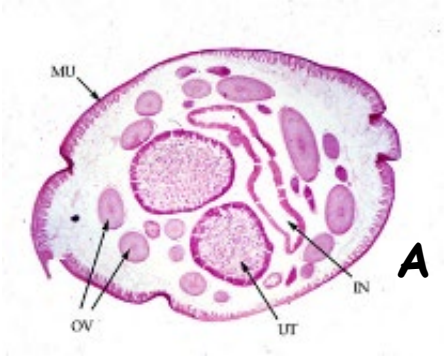
Flatworms

Nematoda v/s Platyhelminthes



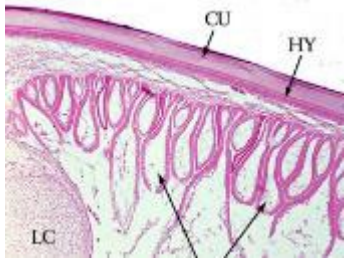
B

Dioecious



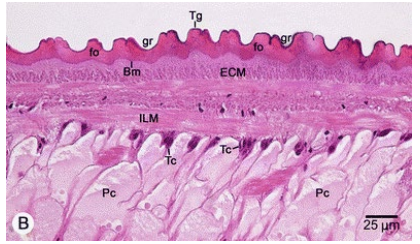
A

D

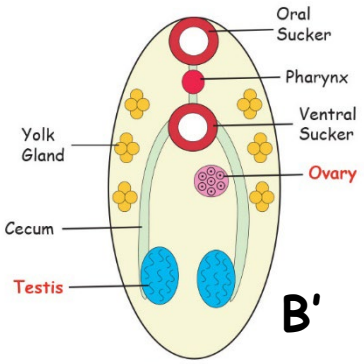


C

A'



C'



B'

Monoecious

D'

Roundworm (N) ?

OR

Flatworm (P) ?

Platyhelminthes Groups

- Class Turbellaria = Planarians
- Class Monogenea = Monogeneans
- **Class Trematoda = Flukes**
  - Subclass Aspidogastrea
  - **Subclass Digenea**
- **Class Cestoda = Tapeworms**

Class Turbellaria
Planarians
Free-living Flatworms

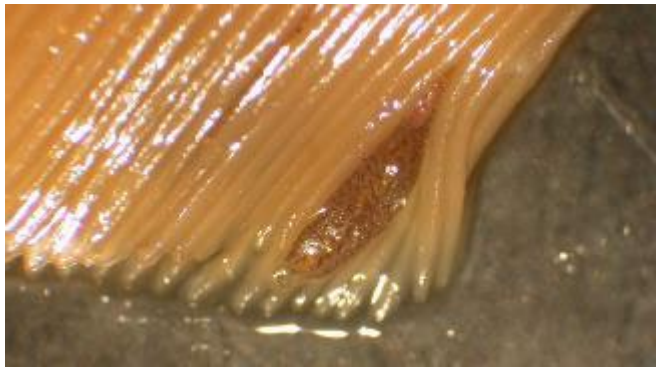
Freshwater Flatworms

Bipalium (Hammerhead worm)
a pseudoparasite

Land Flatworms

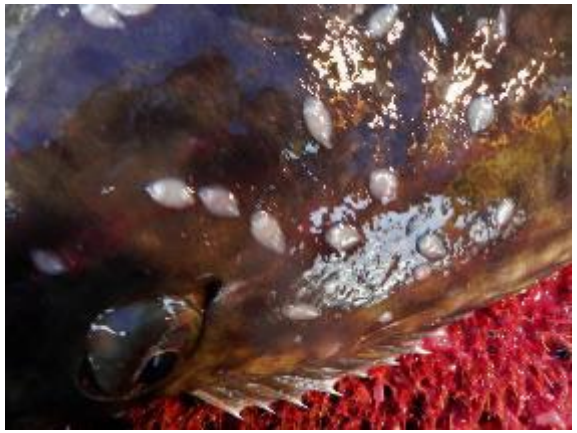
Marine Flatworms

Veterinary Importance



Class Monogenea

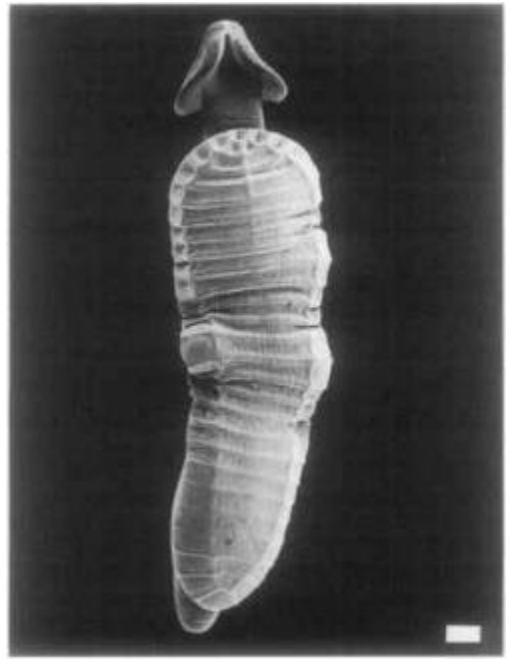
Gyrodactylus sp.
Polystomum sp.
Benedinia sp.



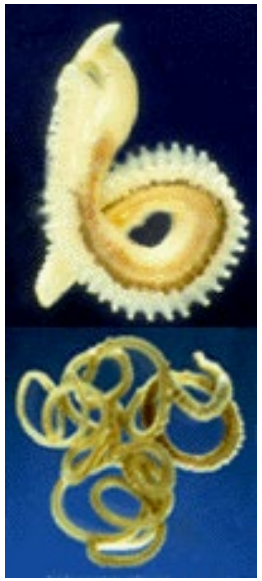
Monogenetic flukes

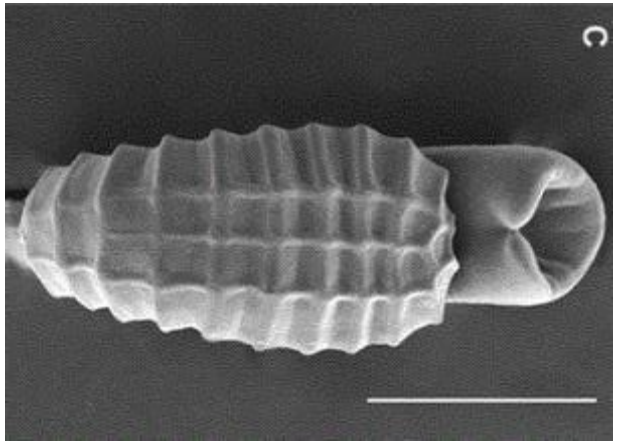
Ecto-Parasites of Fish

Aspidogaster sp.
Cotylogaster sp.
Lobatostoma sp.



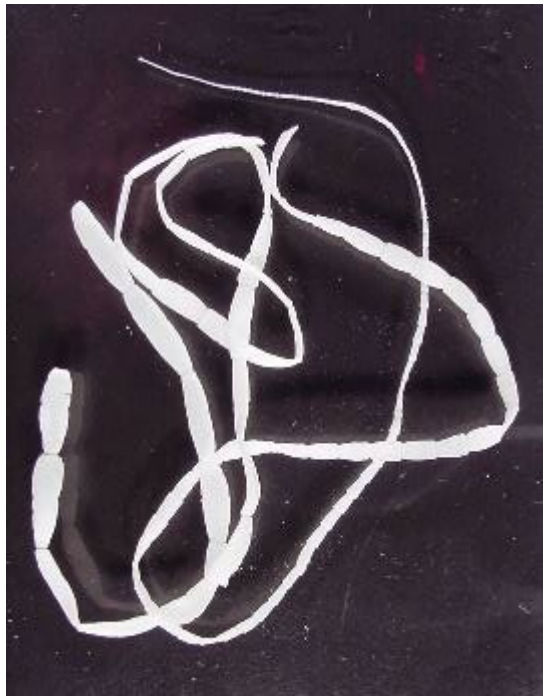
Ecto-Parasites of
Mollusks, Fish, Reptiles





Class Trematoda
Subclass Aspidogastrea

Taenia sp.
Dipylidium sp.
Anoplocephala sp.



Veterinary Importance

Class Cestoda

Tapeworms

Class Trematoda
Subclass Digenea

Digenetic flukes

Fasciola sp.
Paragonimus sp.
Heterobilharzia sp.

Endo-Parasites of Vertebrates

Veterinary Importance

Cestodes 1

Some Tapeworms

Tapeworms in General

Take Homes

- Cestodes are Tapeworms
- Understand the basic anatomy of an adult tapeworm.
  - Scolex, Strobila made of Proglottids
  - Immature, Mature, Gravid Proglottids
  - No digestive system, absorbs food across tegument
- Understand the basic lifecycle of most tapeworms.
  - Adult tapeworm in Definitive Host. Most often in the small intestine
  - Larval tapeworm in an Intermediate Host. IH is infected when it ingests the tapeworm egg.
  - DH is infected when it ingests the IH that is infected with the larval tapeworm.

Cestodes

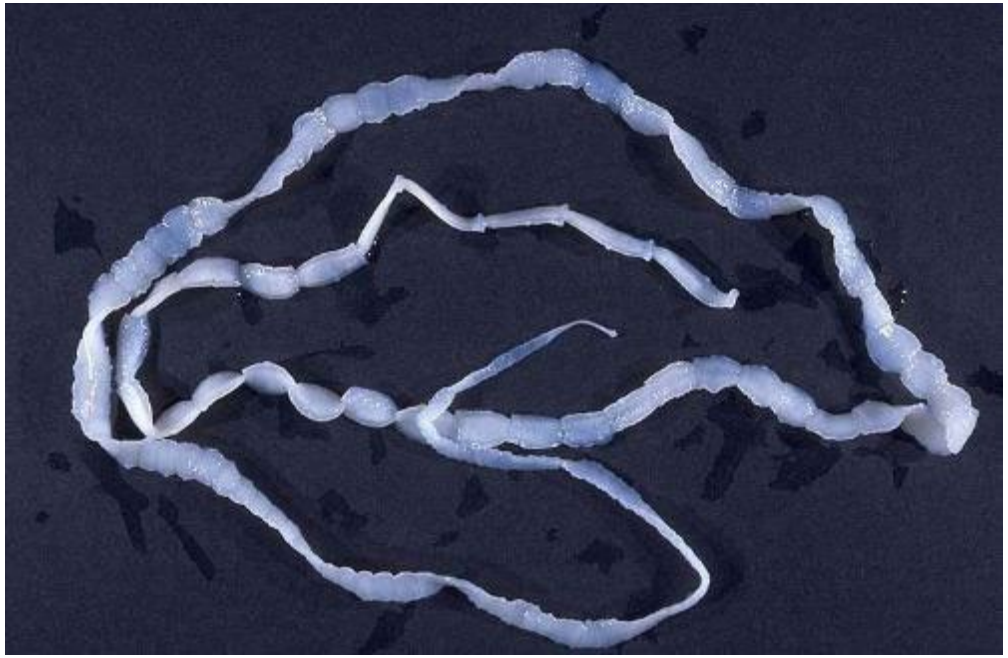
Tapeworms

General Flatworm Characteristics

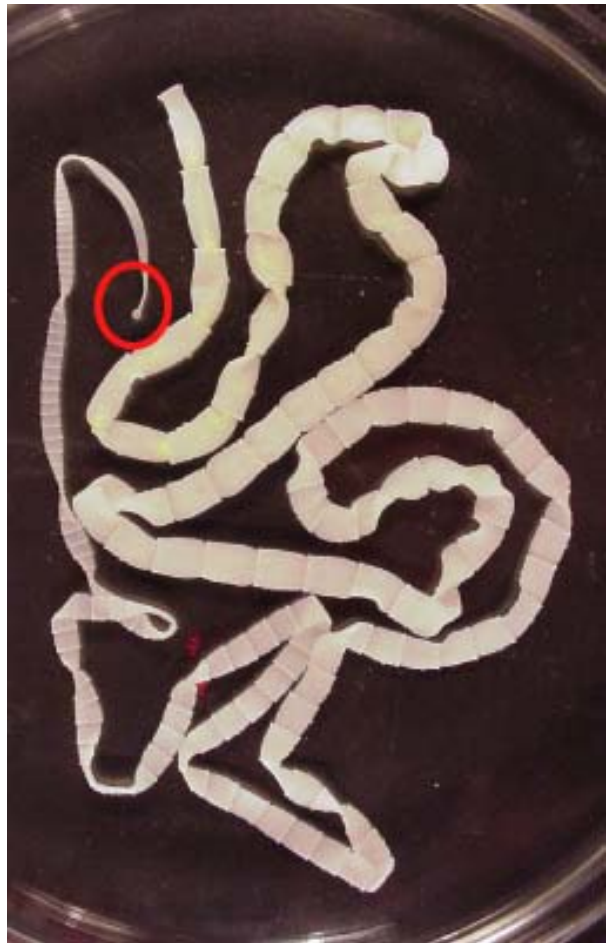
- Except lacks Digestive Tract
- Absorbs food directly across Tegument

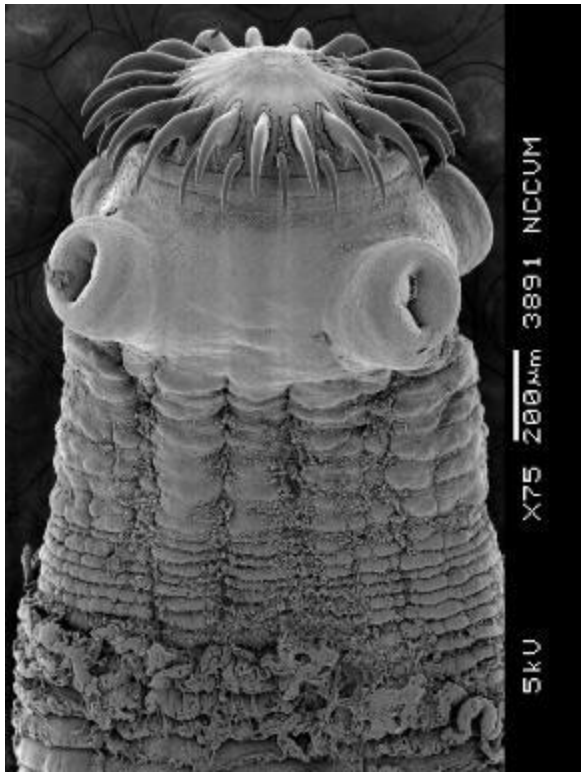
Adult Body

- Scolex => Holdfast organ
  - Usually has suckers, retractable or non-retractable rostellum of hooks
- Neck
  - Germinative region produces "segments", asexually
- Strobila
  - Series of Maturing "Segments" or Proglottids
  - Immature, mature, gravid proglottids in series
  - Each Proglottid is an individual reproductive unit



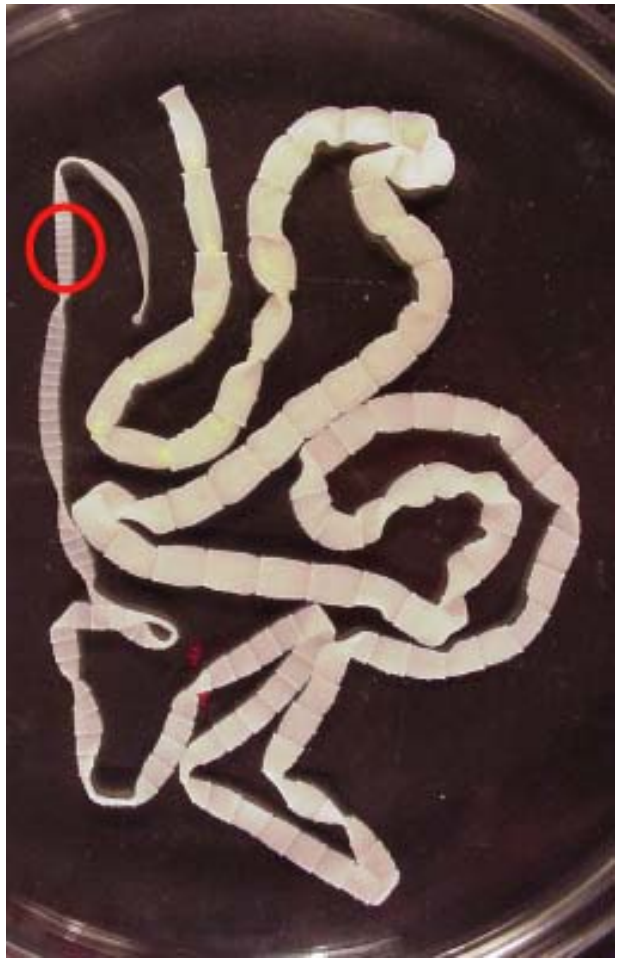
Scolex & Neck

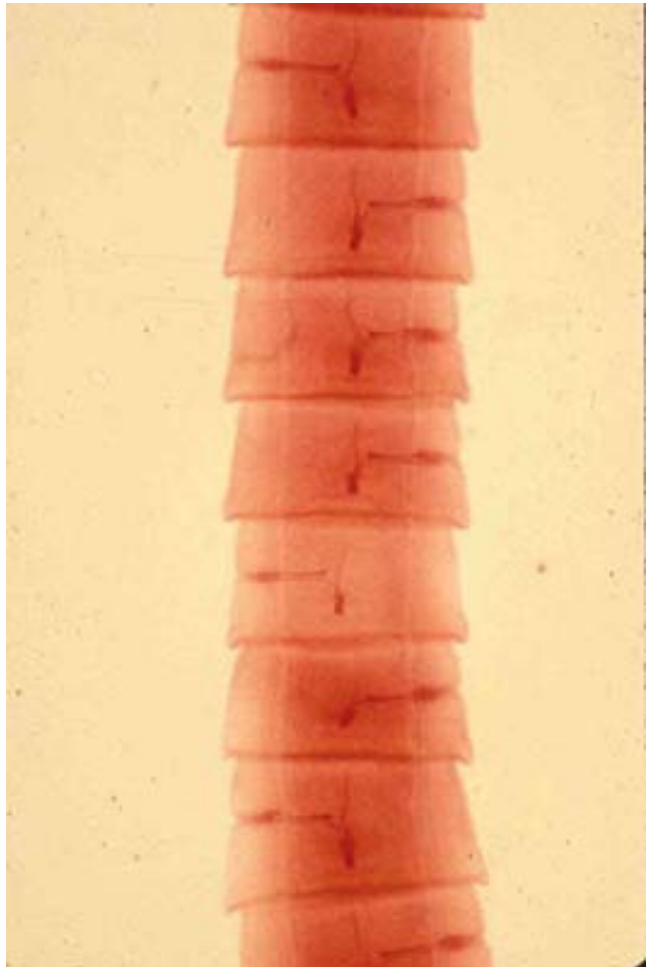




Taenia sp.

Immature Proglottids

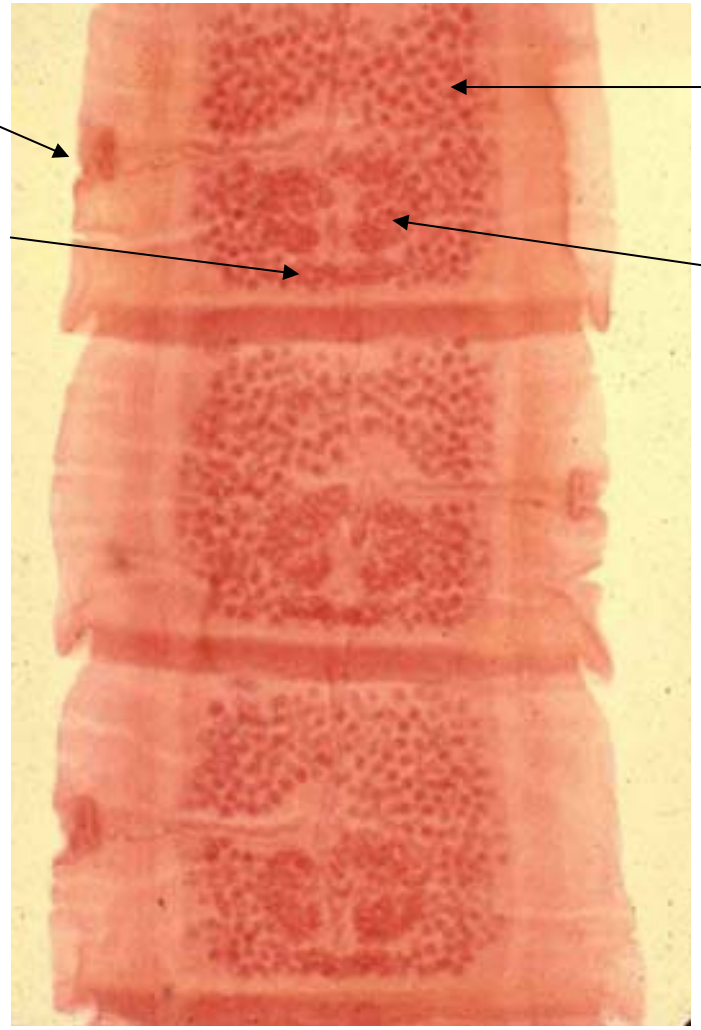




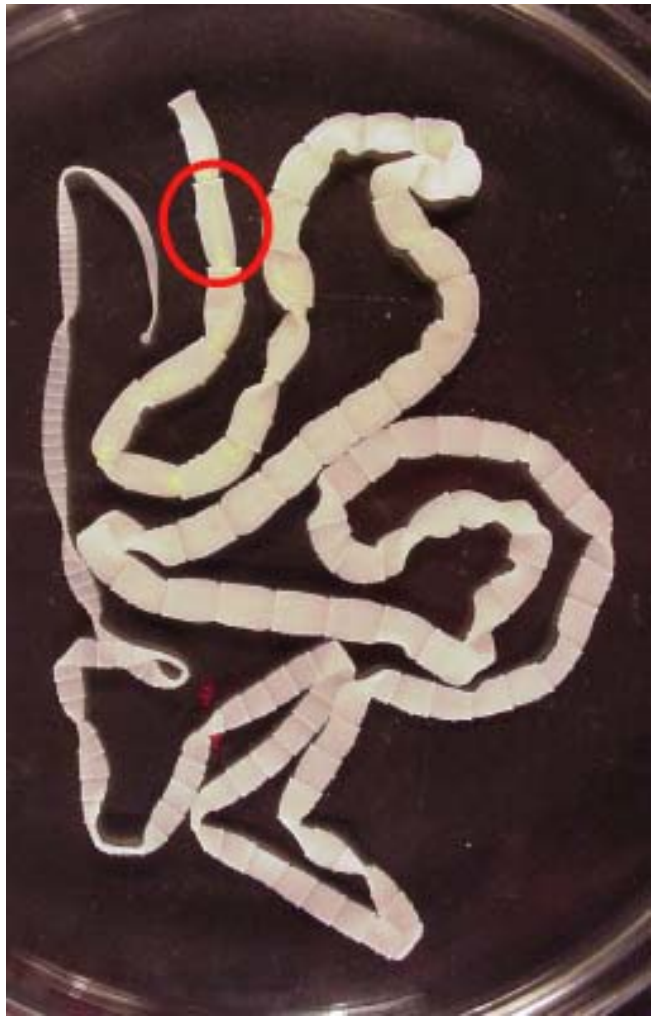
Taenia sp.

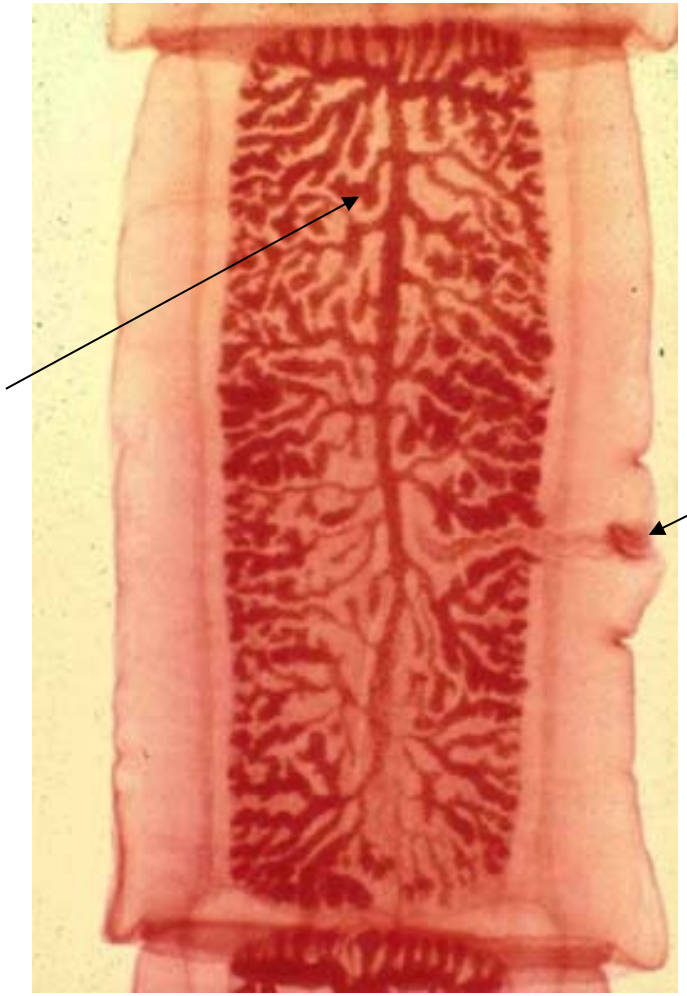
Mature Proglottids

Taenia sp.



Gravid Proglottid





Taenia sp.

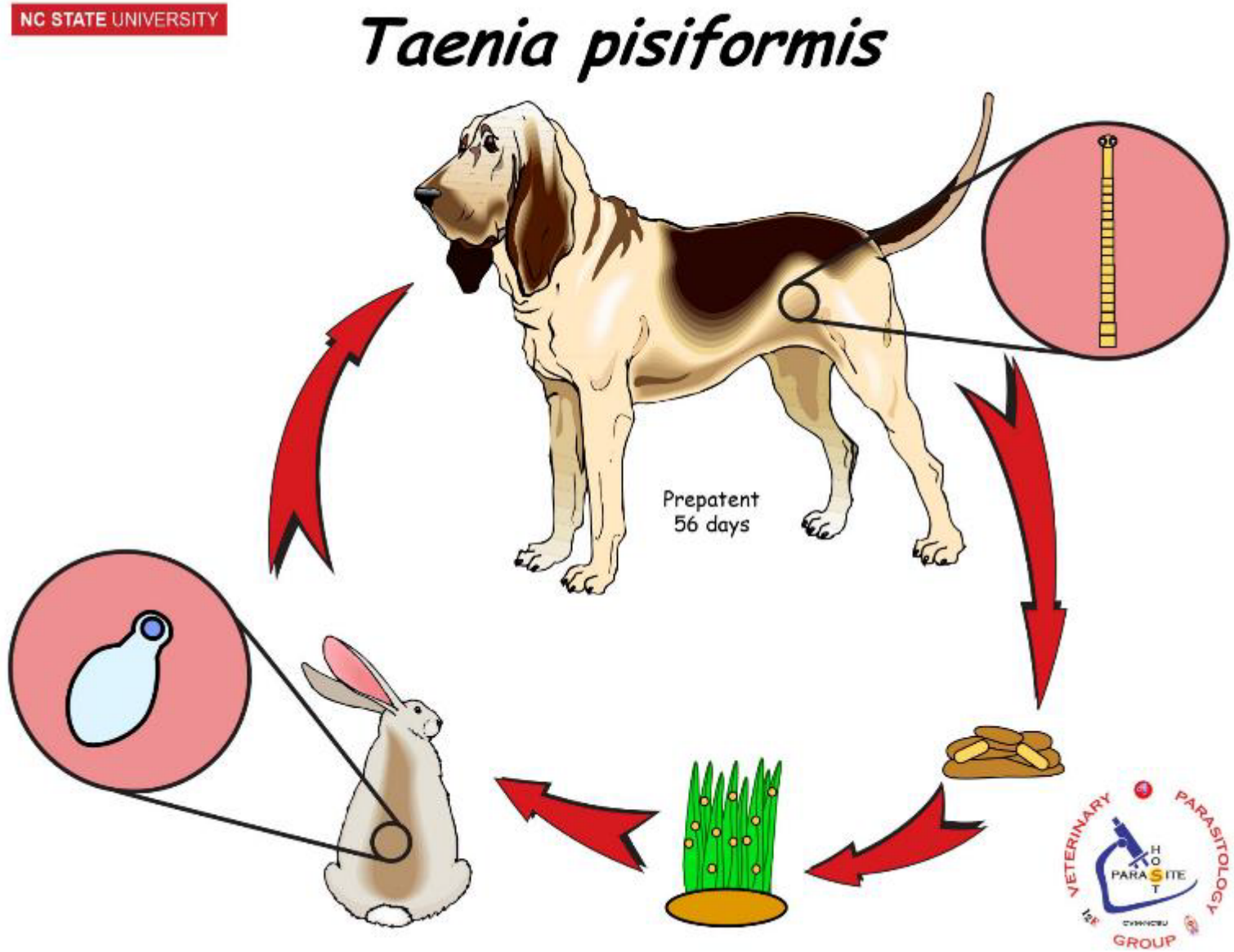
Cestodes

Complex Life Cycle

- Definitive Host
  - Adult Worms
  - Sexual Reproduction
- Ova
- 1 or 2 Intermediate Hosts
  - Larval tapeworms
    - "Metacestodes"
    - various types depending on species
    - Some show Asexual Reproduction

Cysticercus – bladder worm

Basic Tapeworm Life Cycle



Cestode Groups

Large Animals

- Adult Tapeworms
  - *Anoplocephala* (equine)
  - *Moniezia* (ruminants)
- Larval Tapes (condemnations)
  - *Taenia saginata* (cattle)
  - *Taenia solium* (swine)

Small Animals

- Adult Tapeworms
  - *Taenia pisiformis* (dogs)
  - *Taenia taeniaformis* (cats)
  - *Echinococcus granulosus* (dogs)
  - *Dipylidium caninum* (dogs, cats)
  - *Spirometra sp.* (dogs, cats)

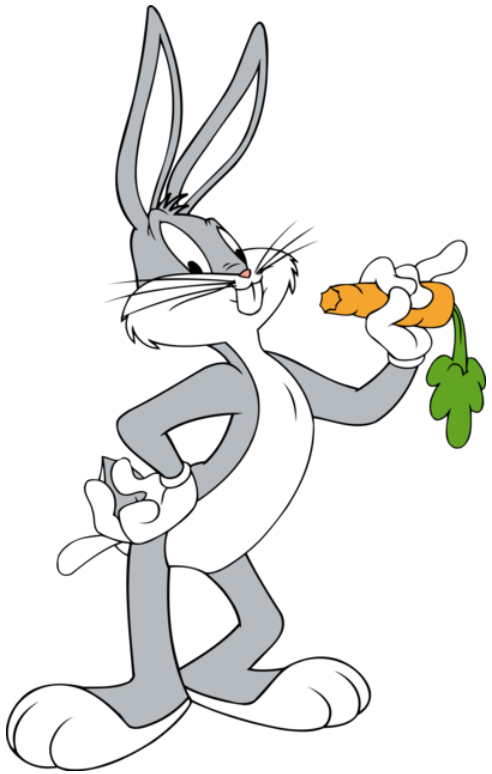
Human "Zoonosis"

- Adult Tapeworms
  - *Taenia saginata*
  - *Taenia solium*
  - *Dipylidium caninum*

Human Zoonosis

- Larval Tapeworms
  - *Echinococcus sp.*
  - *Taenia solium*
  - *Spirometra sp.*

Taenia spp. of Pets



Taenia spp. of Pets

Take Homes

- *Taenia pisiformis.*
  - DH: Dog small intestine. Segments passed in feces. IH: Rabbit mesenteries.
  - Pathology: Aesthetics for owner – proglottids on dog poop or butt. Diagnosis: segment squash
  - Control: No rabbits. Zoonosis: No

- *Taenia taeniaformis.*
  - DH: Cat small intestine. Segments passed in feces. IH: Rodent mesenteries.
  - Pathology: Aesthetics for owner – proglottids on cat poop or butt. Diagnosis: segment squash
  - Control: No rodents. Zoonosis: No

Taenia pisiformis

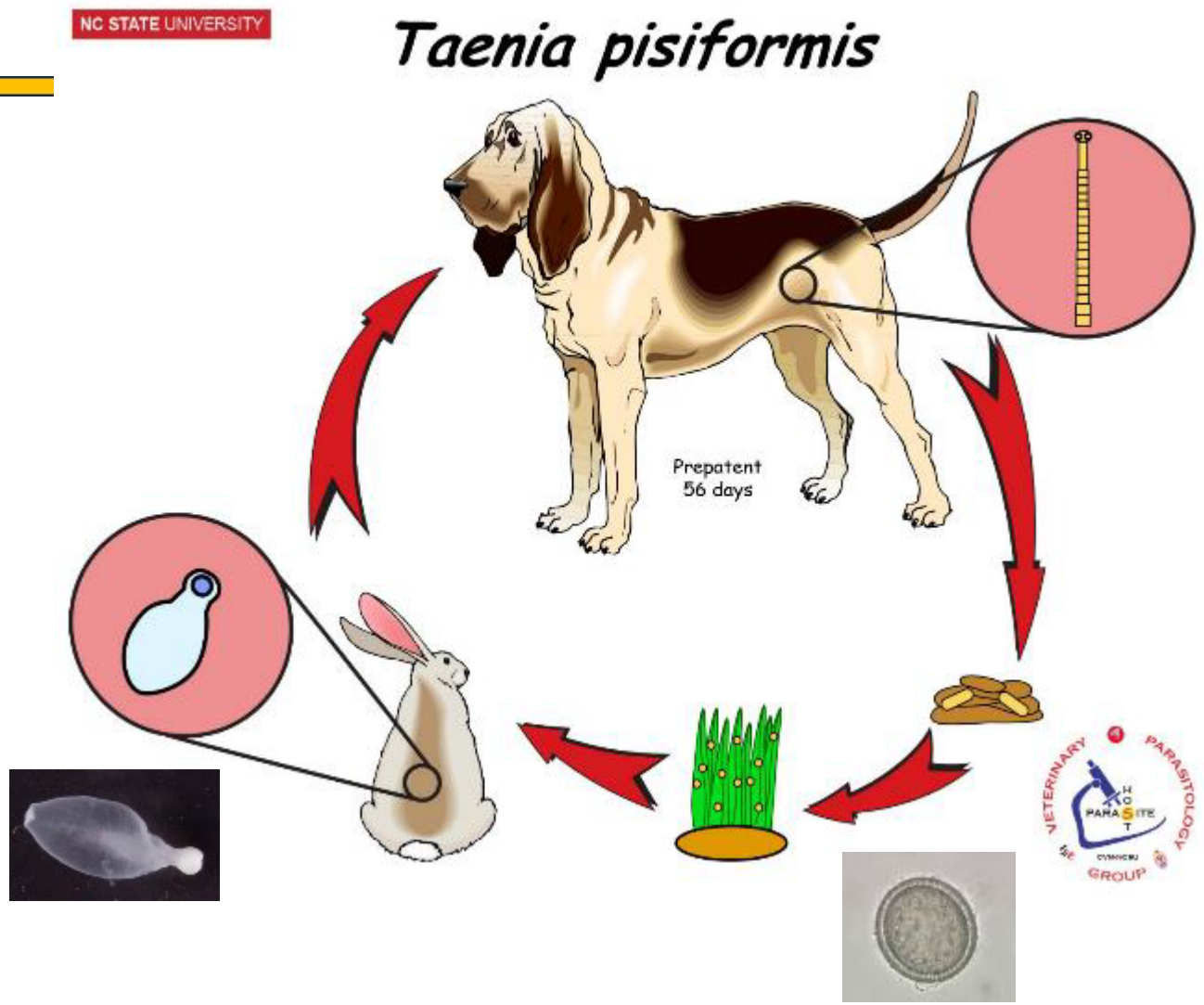
Large tapeworm of dogs

- Scolex with non-retractable armed rostellum and 4 suckers
- Strobila (up to 6 ft long) made of rectangular proglottids with single irregularly alternating unilateral genital pores

Life Cycle

- DH: Dogs, fox, coyote, wolf (small intestine)
- Gravid proglottids passed in feces
- Ova disseminated in environment
- IH: Rabbits or Squirrels
  - Cysticercus larvae (bladder worm) in liver and mesenteries.
  - Ingested by the Definitive host

- Worldwide
- Not Zoonotic

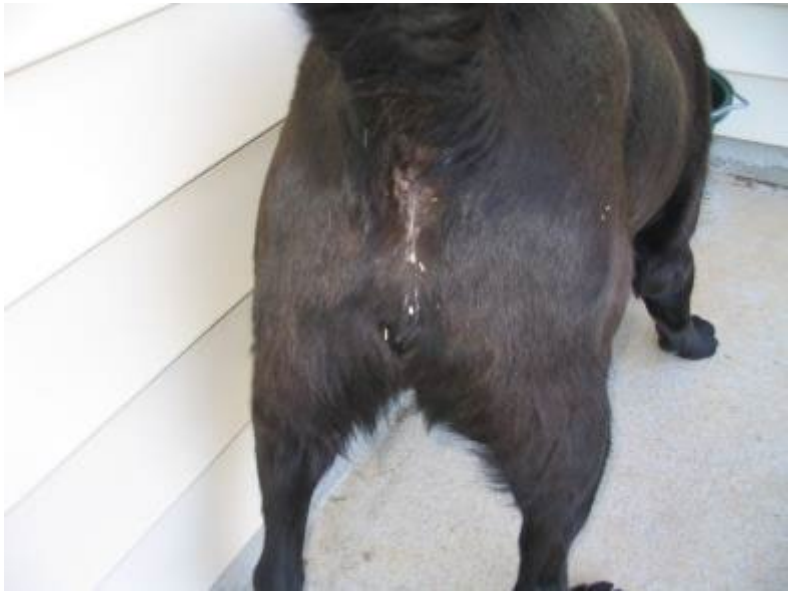


Taenia pisiformis

Pathology, Diagnosis

Active Segments on Poop or Pet

- No Pathology
  (maybe nutrient competition in malnourished hosts)
- "Client Worry" (proglottid aesthetics)



Clinical Signs

- Segments presented by Client
- Pet usually shows no signs
  - Occasionally dog drags tail
- Dietary History -- possibility of rabbit diet

Diagnosis

- Segment Squash
  - Rectangular segment
  - Single Spherical eggs with striated shell.

Taenia pisiformis

Treatment, Control

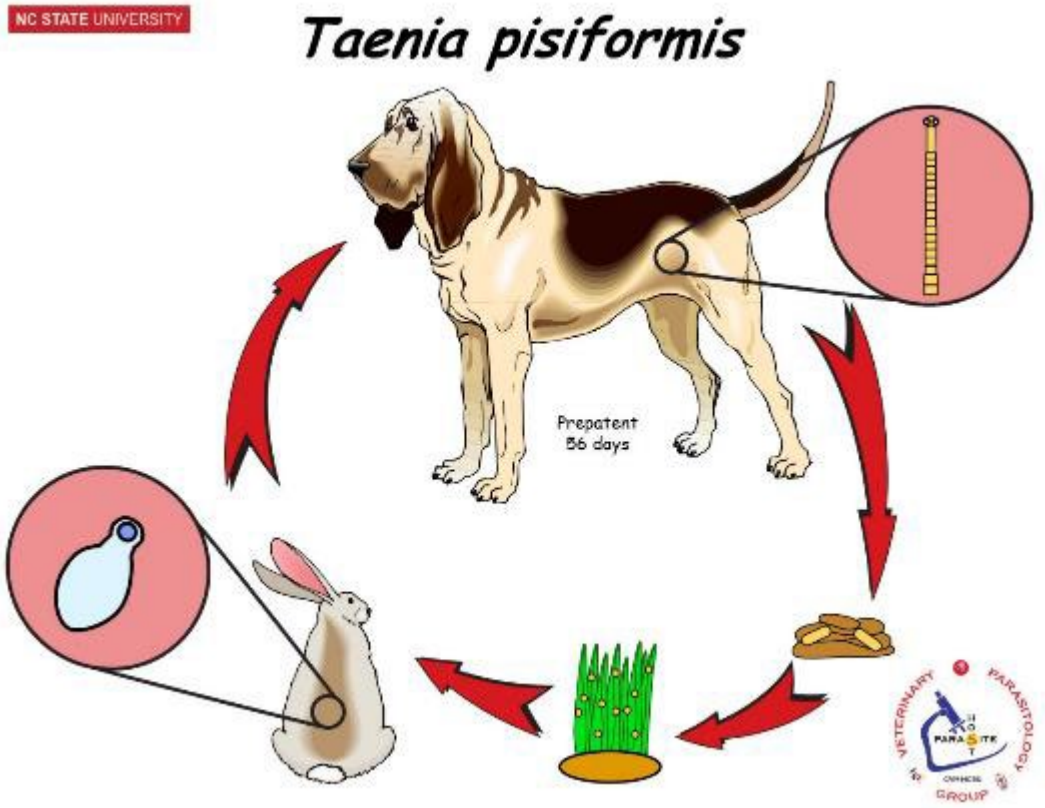
- **Praziquantel** (*Droncit*) (5mg/kg)
- Pyrantel+**Praziquantel**+Febantel (*Drontal Plus Tablets*)
- Pyrantel+**Praziquantel** (*Virbantel Flavored Chewables*)
- Ivermectin+Pyrantel+**Praziquantel** (*Iverhart Max Chewable Tablets*)

- **Epsiprantel** (*Cestex*) (5.5 mg/kg)

- Fenbendazole (*Panacur*) (50 mg/kg SID for 3 days)

(Praziquantel & epsiprantel are the drugs of choice for tapeworms.)

How would you prevent re-infection?



Taenia taeniaformis

Large tapeworm of cats

- Scolex with non-retractable armed rostellum and 4 suckers
- Strobila (up to 2 ft long) made of rectangular proglottids with single irregularly alternating unilateral genital pores

- Worldwide
- Not Zoonotic

Life Cycle

- DH: Cats, Lynx (small intestine)
- Gravid proglottids passed in feces
- Ova disseminated in environment
- IH: Rodents
  - Strobilocercus larvae in liver.
  - Ingested by the Definitive host

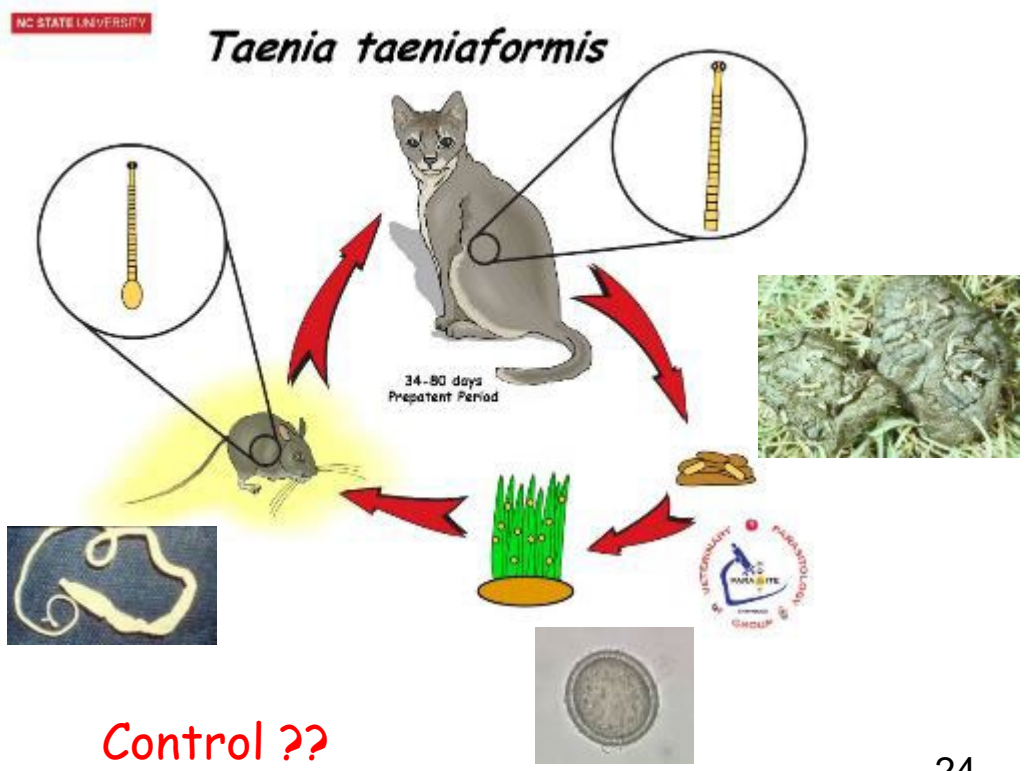
Pathology

- No Pathology
  (maybe nutrient competition in malnourished hosts)
- "Client Worry" (proglottid aesthetics)

Treatment

- **Praziquantel** (*Droncit*)
- **Pyrantel+Praziquantel** (*Drontal tablets*)
- **Emodepside+Praziquantel** (*Profender*)

- **Epsiprantel** (*Cestex*)
- **Fenbendazole** (*Panacur*) [extra-label]



Clinical Signs

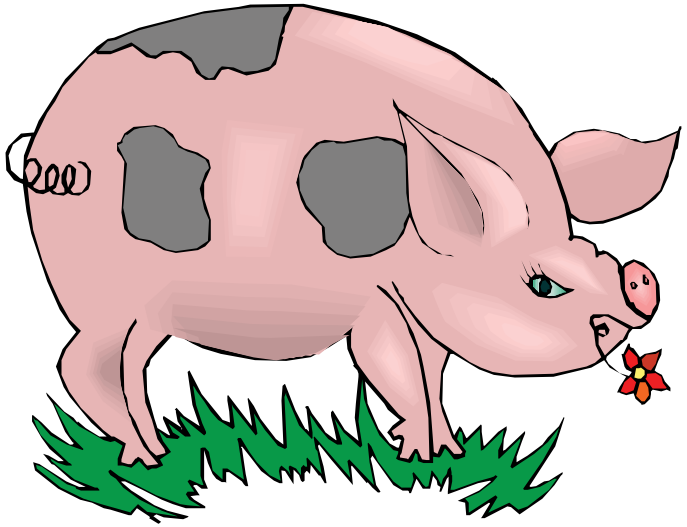
- Segments presented by Client
- Pet usually shows no signs
  - Occasionally cat drags tail
- Dietary History -- possibility of rodent diet

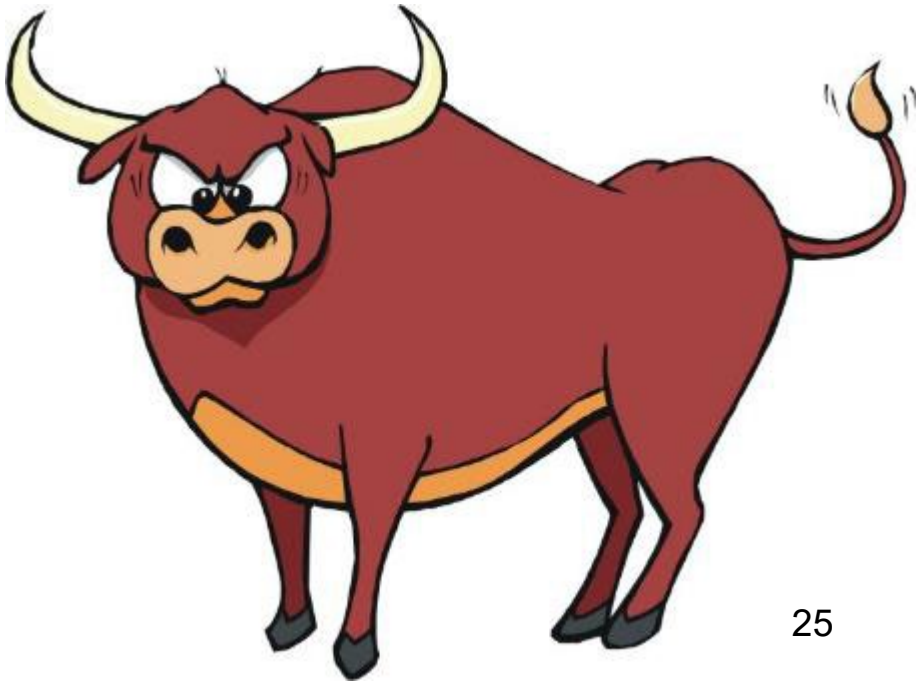
Diagnosis

- Segment Squash
  - Rectangular segment
  - Single Spherical eggs with striated shell.

Control ??

Taenia spp. of Humans





Taenia spp. of Humans

Take Homes

- *Taenia saginata.*
  - DH: Human small intestine. Segments passed in feces. IH: cattle muscles.
  - DH Pathology: Aesthetics, gross – proglottids in toilet / undies. Diagnosis: segment squash
  - IH Pathology: Measly Beef, Beer condemnation at slaughterhouse – economic loss for rancher
  - Control: No raw beef. Don't poop in pasture. Zoonosis: Human tapeworm

- *Taenia solium.*
  - DH: Human small intestine. Segments passed in feces. IH: swine muscles.
  - DH Pathology: Aesthetics, gross – proglottids in toilet / undies. Diagnosis: segment squash
  - IH Pathology: Measly Pork, Pork condemnation at slaughterhouse – economic loss for farmer
  - Control: No raw pork. Don't poop in pasture. Zoonosis: Human tapeworm.
  - Important Human DZ: If human ingests tapeworm eggs from human poop, then human gets tapeworm larval stages in muscles, liver, lungs, brain. Cysticercosis is a very important Human DZ.

Taenia saginata

Beef tapeworm of humans

- Worldwide
- 24 to 75 ft long, survives "many years"
- Larval tapeworms in cattle

Life Cycle

- DH: Humans (small intestine)
- Gravid proglottids passed in feces
- IH: Cattle
  - *Cysticercus bovis* (bladder worm) in muscles.
  - Ingested by the Definitive host

Pathology

Human (DH)

- Proglottid aesthetics
- Nutrient competition in malnourished hosts

Cattle (IH)

- *Cysticercus bovis*: Muscle & Heart damage
- Beef Condemnation ("Measly Beef") **[economic loss]**

Diagnosis

Human (DH) – Tapeworm in feces

Cattle (IH) - *Cysticercus bovis* @ slaughter

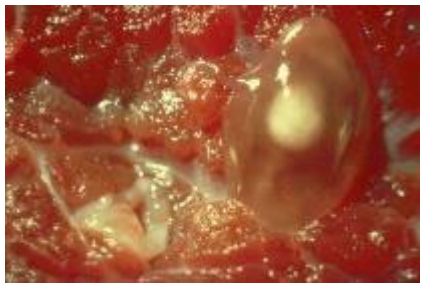
Treatment

Human (DH) – Niclosamide

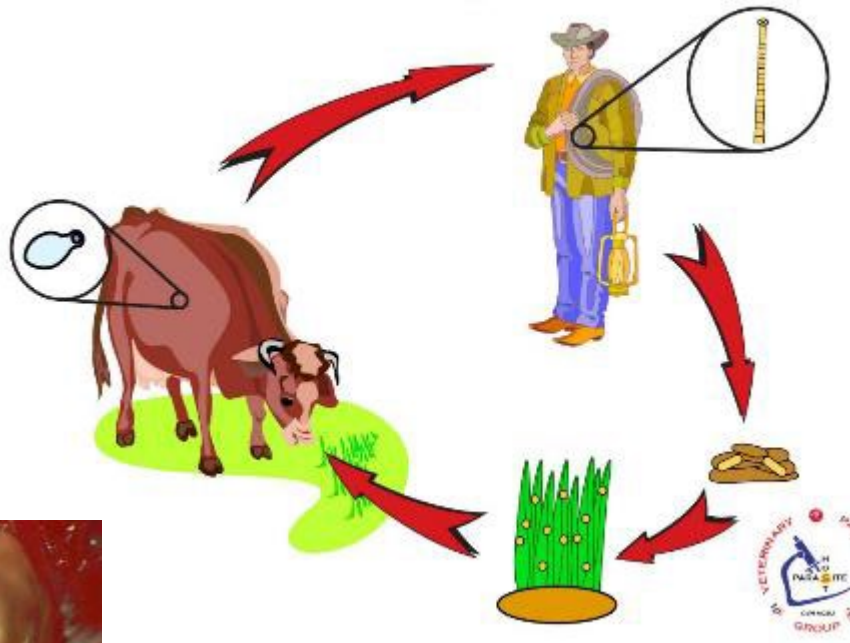
Cattle (IH) - *Cysticercus bovis* → control measures

Control ?

- **Restrict human defecation in cattle pastures.**
- **Restrict human from eating raw beef.**
- **USDA condemnation of "Measly beef".**
- **USDA guidelines for cooking beef.**



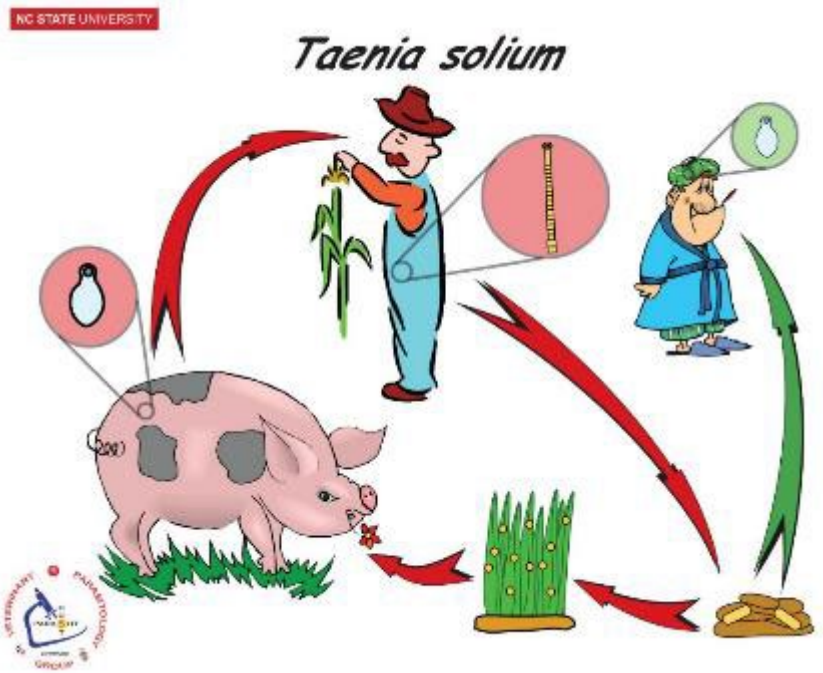
Measly Beef



18 ft from raw-beef eater

Taenia solium

Pork tapeworm of humans



- Worldwide
- 15 to 24 ft long, survives 25 years
- Larval tapeworms in swine

Treatment

Human (DH) – Niclosamide

Cattle (IH) - *Cysticercus cellulosae* → control measures

Life Cycle

- DH: Humans (small intestine)
- Gravid proglottids passed in feces
- IH: Swine [humans]
  - *Cysticercus cellulosae* (bladder worm) in muscles.
  - Ingested by the Definitive host

Pathology

Human (DH) (adult tapeworm)

- Proglottid aesthetics
- Nutrient competition in malnourished hosts

Swine (IH) & [humans]

- *Cysticercus cellulosae*: Muscle damage
- Pork Condemnation ("Measly pork") **[economic loss]**

Diagnosis

Human (DH) – Tapeworm in feces

Swine (IH) - *Cysticercus celulosae* @ slaughter

Control ?

- **Restrict human defecation in swine pastures.**
- **Restrict human from eating raw pork.**
- **USDA condemnation of "Measly pork".**
- **USDA guidelines for cooking pork.**

Measly Pork

Taenia solium -- Cysticercosis

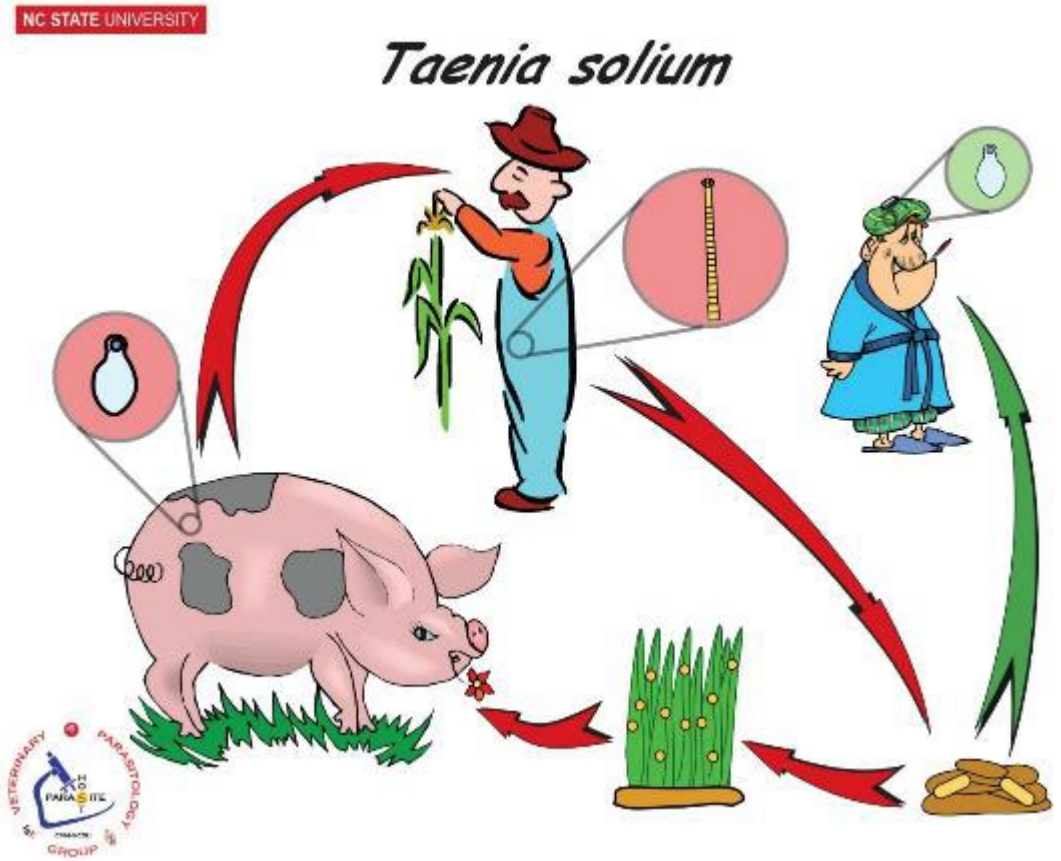
Larval pork tapeworm in humans

- Very Important Pathogenic Human DZ
- Most important cause of neurologic DZ in Latin America

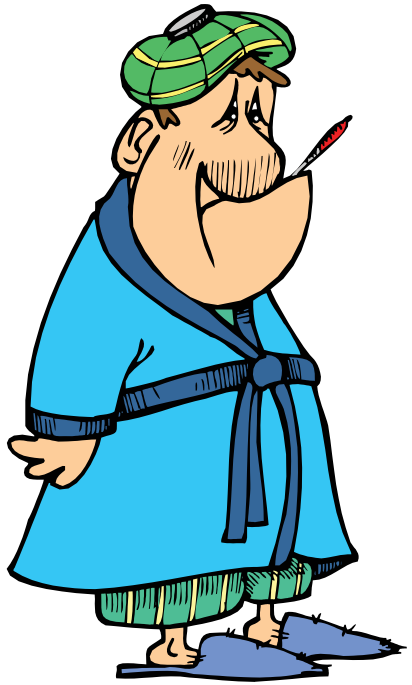
Humans as intermediate hosts. HOW ?

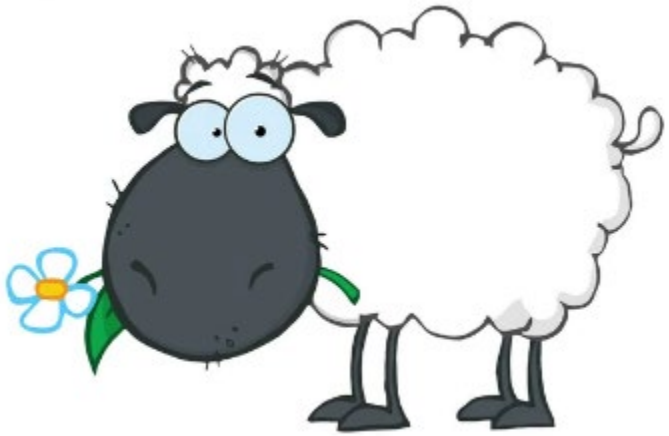
- cysticerci in muscles, eyes, brain.

Neural Cysticercosis



Echinococcus spp.





Echinococcus sp.

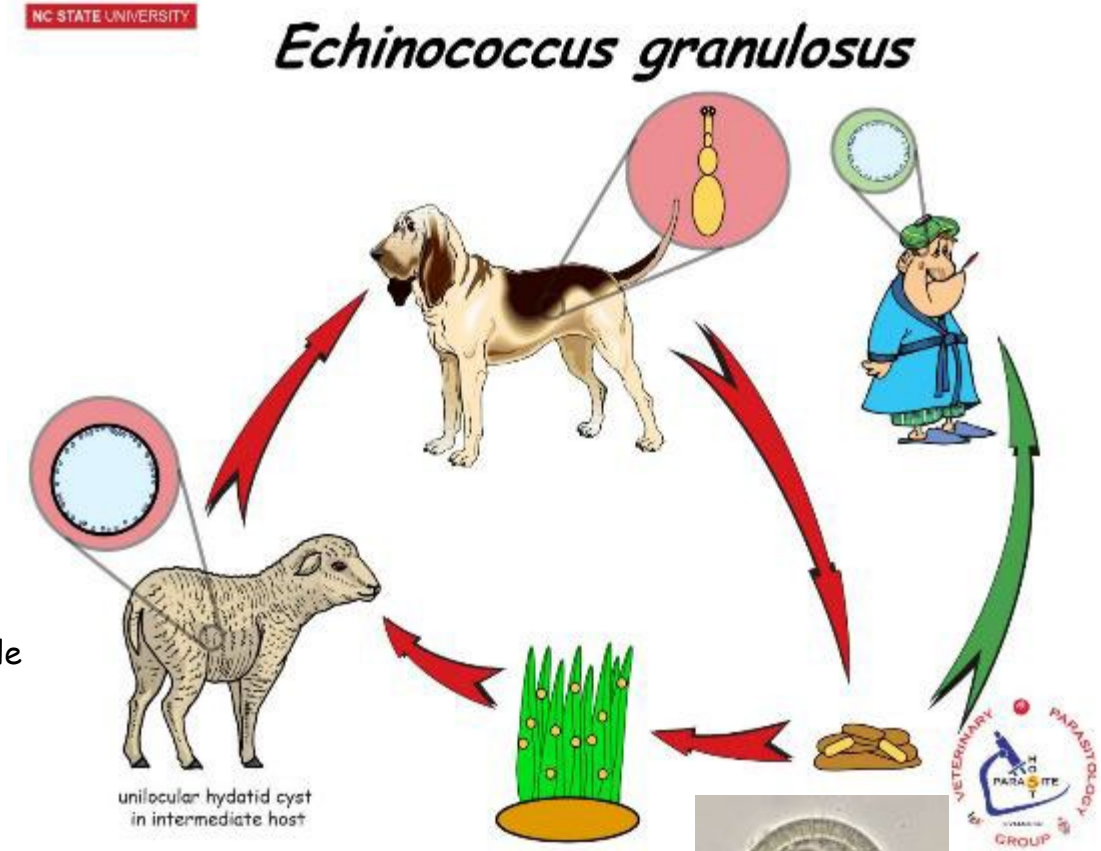
Take Homes

- *Echinococcus granulosus.*
  - DH: Canid small intestine. Segments passed in feces. IH: ruminant mesenteries.
  - DH Pathology: Minor Aesthetics. Diagnosis: segment squash
  - IH Pathology: Hydatid cysts in various organs
  - Control: Don't feed offal to dogs / wild canids. Keep canids from pooping in pasture.
  - Zoonosis: Very serious human DZ
  - Important Human DZ: If human ingests tapeworm eggs from canid poop, then human gets tapeworm larval stages in liver, lungs, brain. Hydatid Cyst DZ is a very important Human DZ.

Echinococcus granulosus

Minute tapeworm of Canids

- Sporadic distribution
- Larval tapeworms in various animals & humans
- Major Zoonotic concern



Life Cycle

- DH: Dogs, Wild Canids (small intestine)
- Gravid proglottids passed in feces
- IH: various ruminants & swine [humans]
  - Hydatid Cyst in various organs
  - Ingested by the Definitive host

Diagnosis

Dog (DH) – Tapeworm or Ova in feces

Various IH – Hydatid Cyst @ slaughter

- Serology, Radiographs
- Humans : CDC has ELISA to distinguish between the two species found in humans.

Treatment

Canid (DH) – Praziquantel, Epsiprantel

Various (IH) - Aggressive Mebendazole or Albendazole

Pathology

Canids (DH)

- No Pathology

Various (IH) & [humans]

- Hydatid Cyst DZ
  - Organ damage – Pressure atrophy
  - Risk of anaphylaxis if cyst ruptures

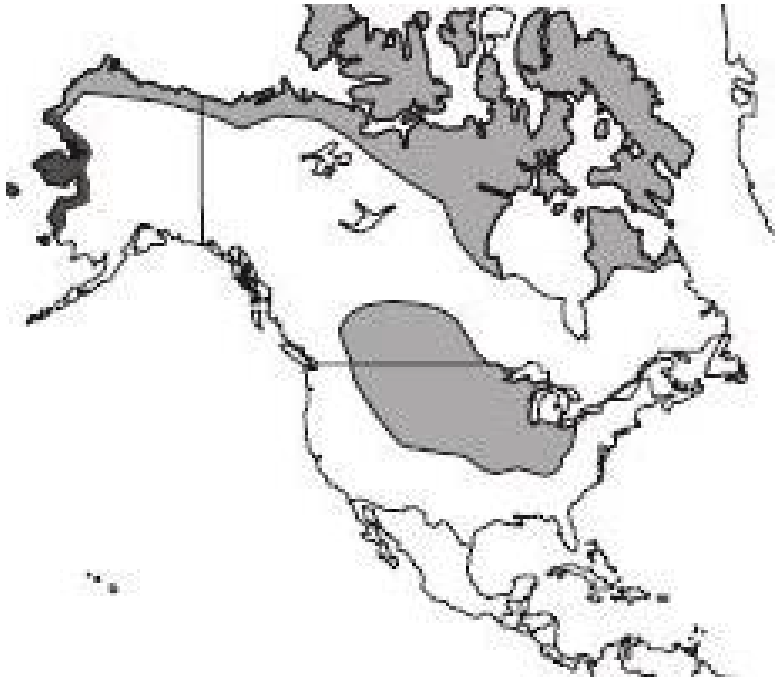
Control

- Restrict canine access to ruminant pastures.
- Do not feed canids uncooked offal
- Regular deworming of dog
- Eliminate stray or wild canids

Geographic Distribution

Sporadic Global Distribution

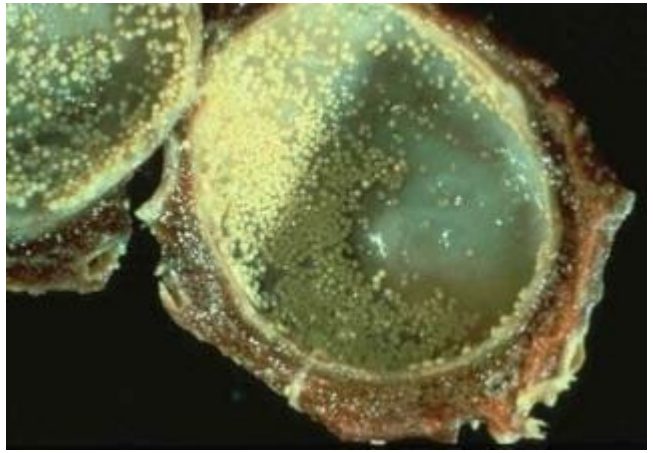
E. granulosus



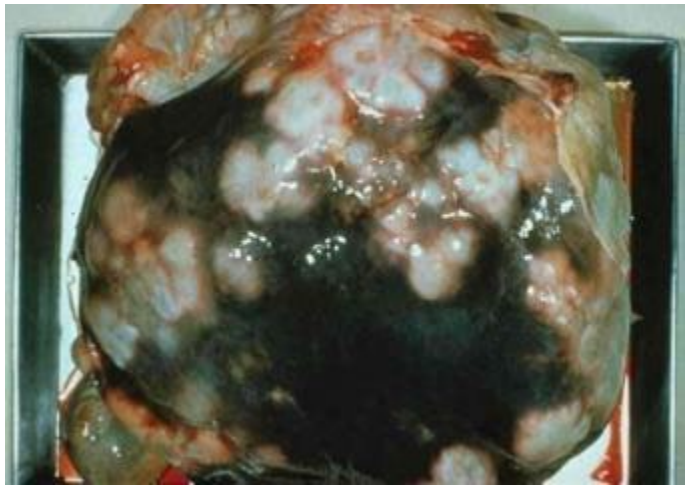
E. multilocularis

Echinococcus spp. – Hydatid Cyst DZ

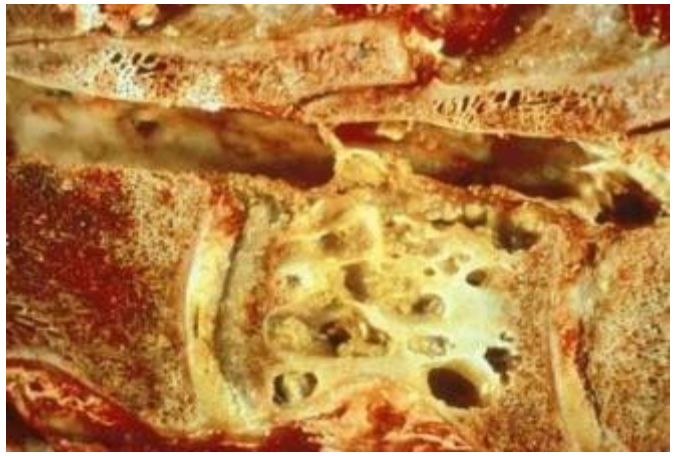
Larval tapeworm in various animals



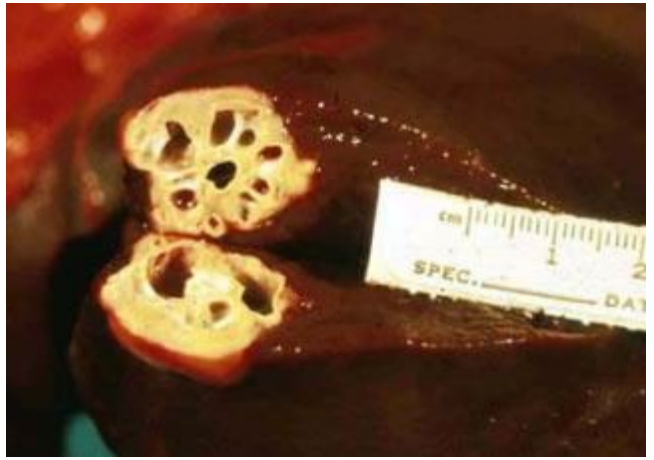
Unilocular Hydatid Cyst



Multilocular Cyst in Cow Liver



Multilocular Cyst in Vertebra



Multilocular Cyst in Horse Liver

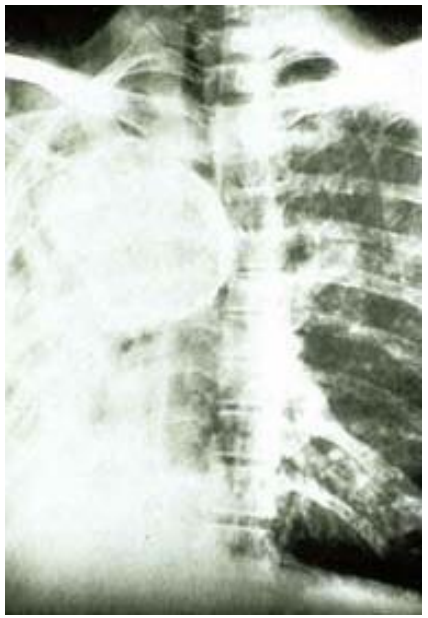
Echinococcus spp. – Hydatid Cyst DZ

Larval tapeworm in Humans

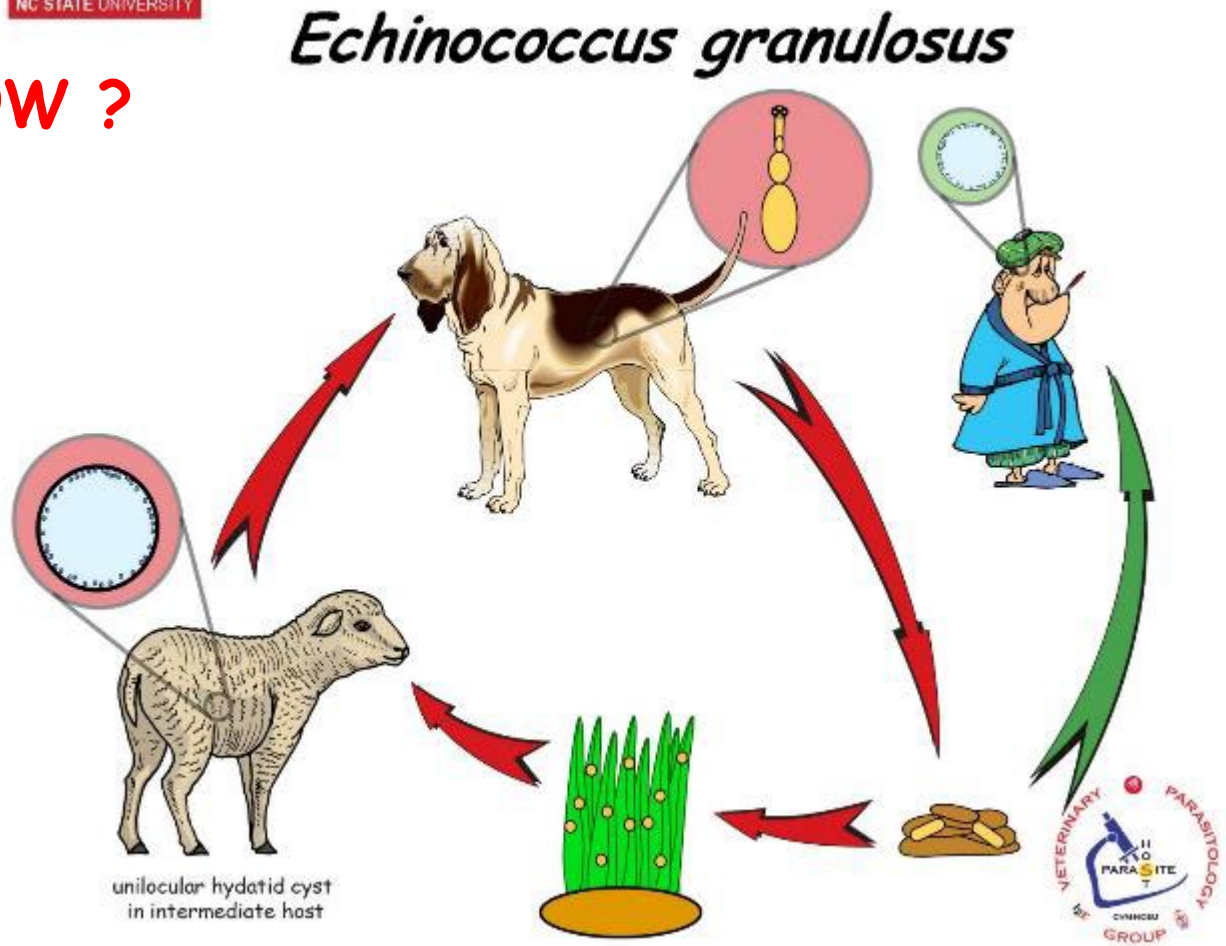
- **Very Important Zoonotic DZ**

Humans act as intermediate hosts. **HOW ?**

- Hydatid Cyst in Liver, Lungs, Brain.



Hydatid Cyst DZ



Cestode Table 1

Parasite	Definitive Host	Intermediate Host	Pathology	Diagnostics	Control	Zoonotic ?
Taenia pisiformis	Dog Small intestine	Rabbit	DH: aesthetics IH: Organ Damage	DH: Segment squash	Dx access to rabbits	No
Taenia taeniaformis	Cat Small intestine	Rodent	DH: aesthetics IH: Organ Damage	DH: Segment squash	Dx access to rodents	No
Taenia saginata	Human Small Intestine	Cow	DH: aesthetics IH: Muscle cysts Condemnation	DH: Segment squash IH: Necropsy Measly Beef	Don't poop in Pasture Cook Beef well	Minor: Adult tapeworm in intestine
Taenia solium	Human Small intestine	Pig	DH: aesthetics IH: Muscle cysts Condemnation	DH: Segment squash IH: Necropsy Measly Pork	Don't poop in Pasture Cook Pork well	Minor: Adult tapeworm in intestine MAJOR: Cysticercosis Larvae in muscles
Echinococcus spp.	Dog Small intestine	Ruminants, swine (asexual reproduction of Larval stage)	DH: aesthetics IH: Liver cysts Condemnation	DH: Segment squash IH: Necropsy	Don't let dogs poop in pasture Don't feed offal to dogs	MAJOR: Hydatid Cyst DZ Large Cysts in various organs


VETERINARY
PARASITOLOGY
HOST
PARASITE
IgE
CVM-NCSU
GROUP