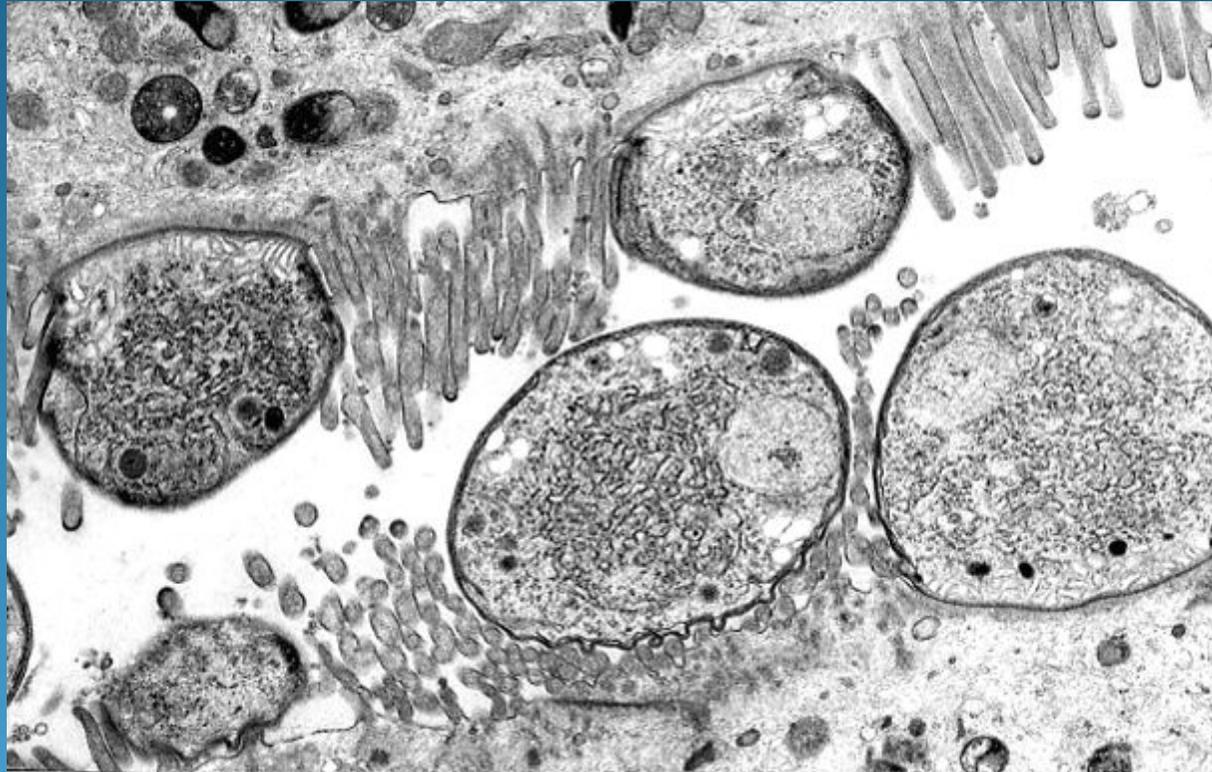


# *Cryptosporidium parvum*



# What is it?

- *Cryptosporidium* is a coccidian protozoan parasite
- It is associated with municipal water supplies which causes diarrhea
- *Cryptosporidium parvum* causes the disease Cryptosporidiosis.
- During the past two decades, *Cryptosporidium* has become recognized as one of the most common causes of waterborne illness in the United States.
- The pathogenic form of *C. parvum* is the oocyst which is 3 um in diameter (half the size of a red blood cell).

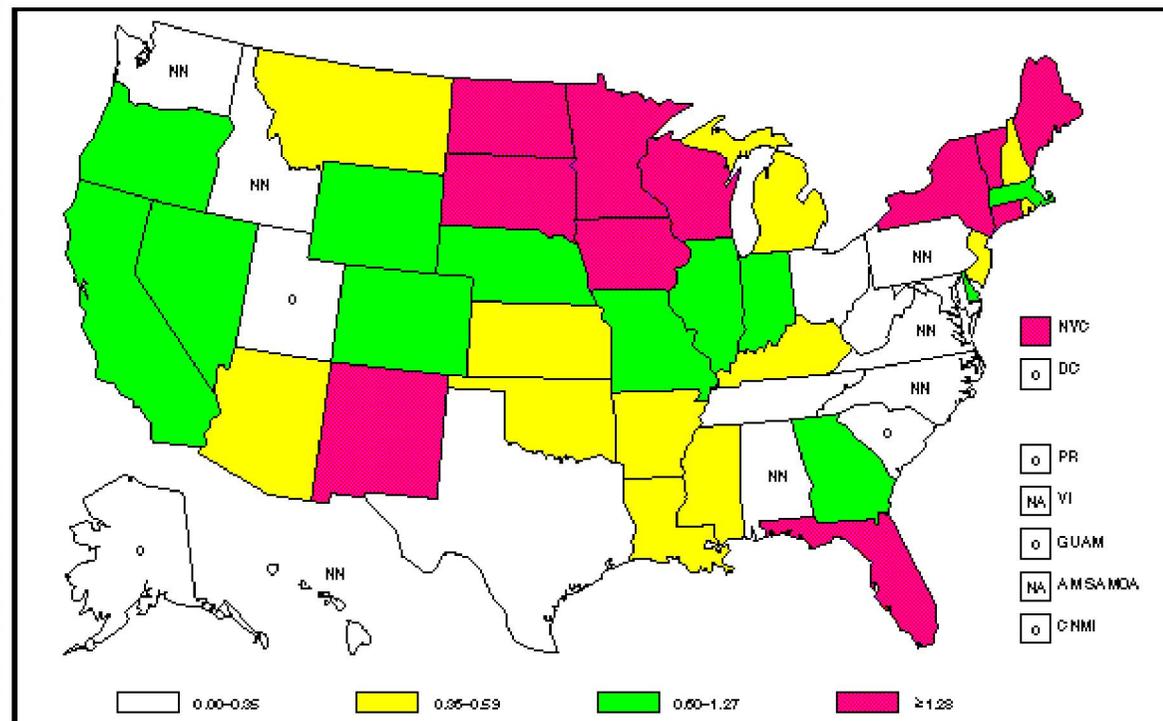
# Definitive Host / Intermediate Host:

- Definitive Host: Human
- Reservoir Hosts: kittens, puppies, goats, calves, mice
- It is a zoonotic disease and can travel from animals to humans.
- *Cryptosporidium parvum* has been recognized as a human pathogen since 1976.

# Geographical Distribution:

- Cosmopolitan

CRYPTOSPORIDIOSIS — reported cases per 100,000 population, United States and territories, 1997



Surveillance data from 1997 suggest that infection with cryptosporidium is geographically widespread. The highest reported rates were primarily in the north central and northeastern states. As in 1995 and 1996, cases primarily were reported in the late summer among children and adolescents aged <15 years.



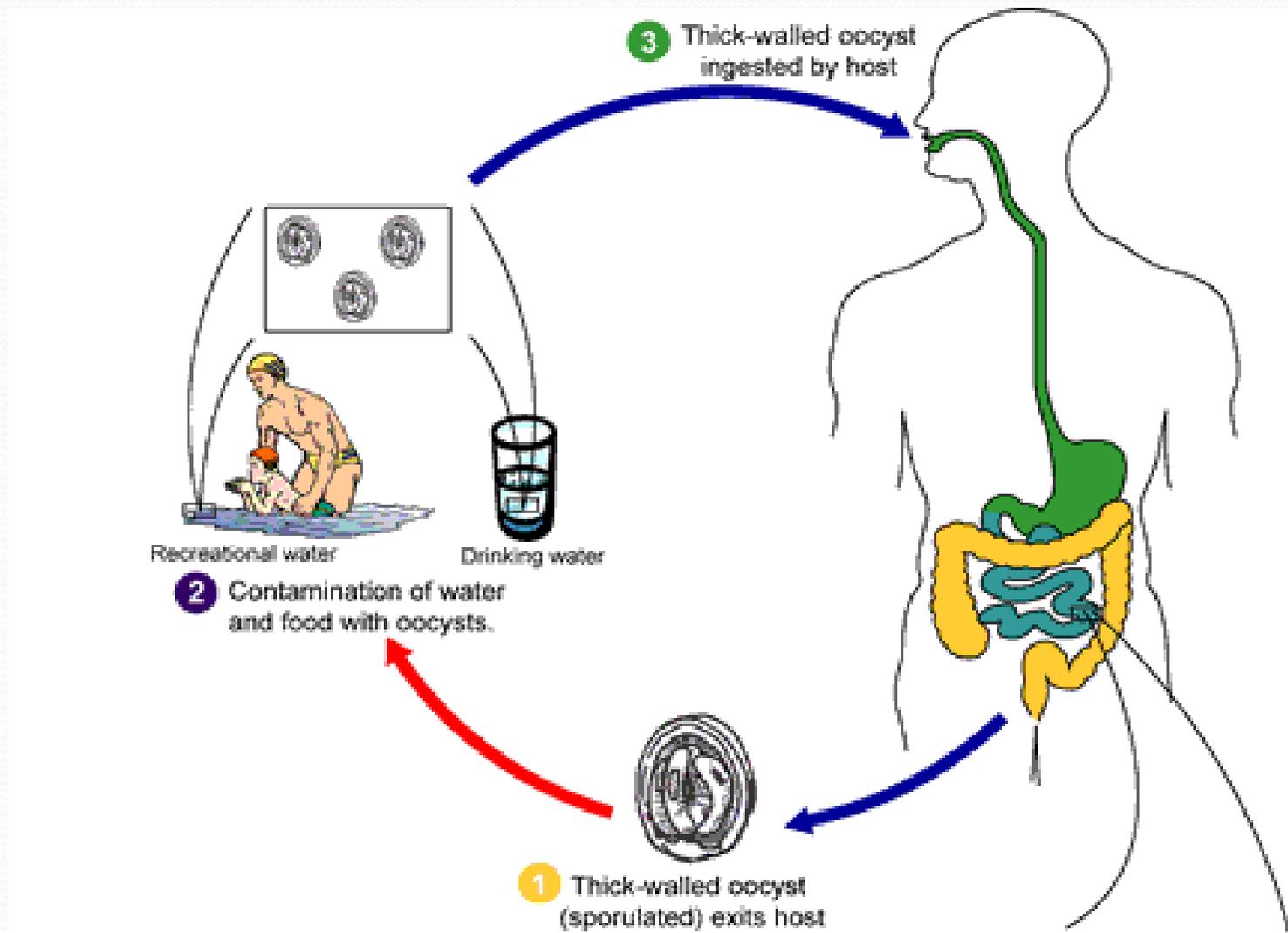
# Outbreaks:

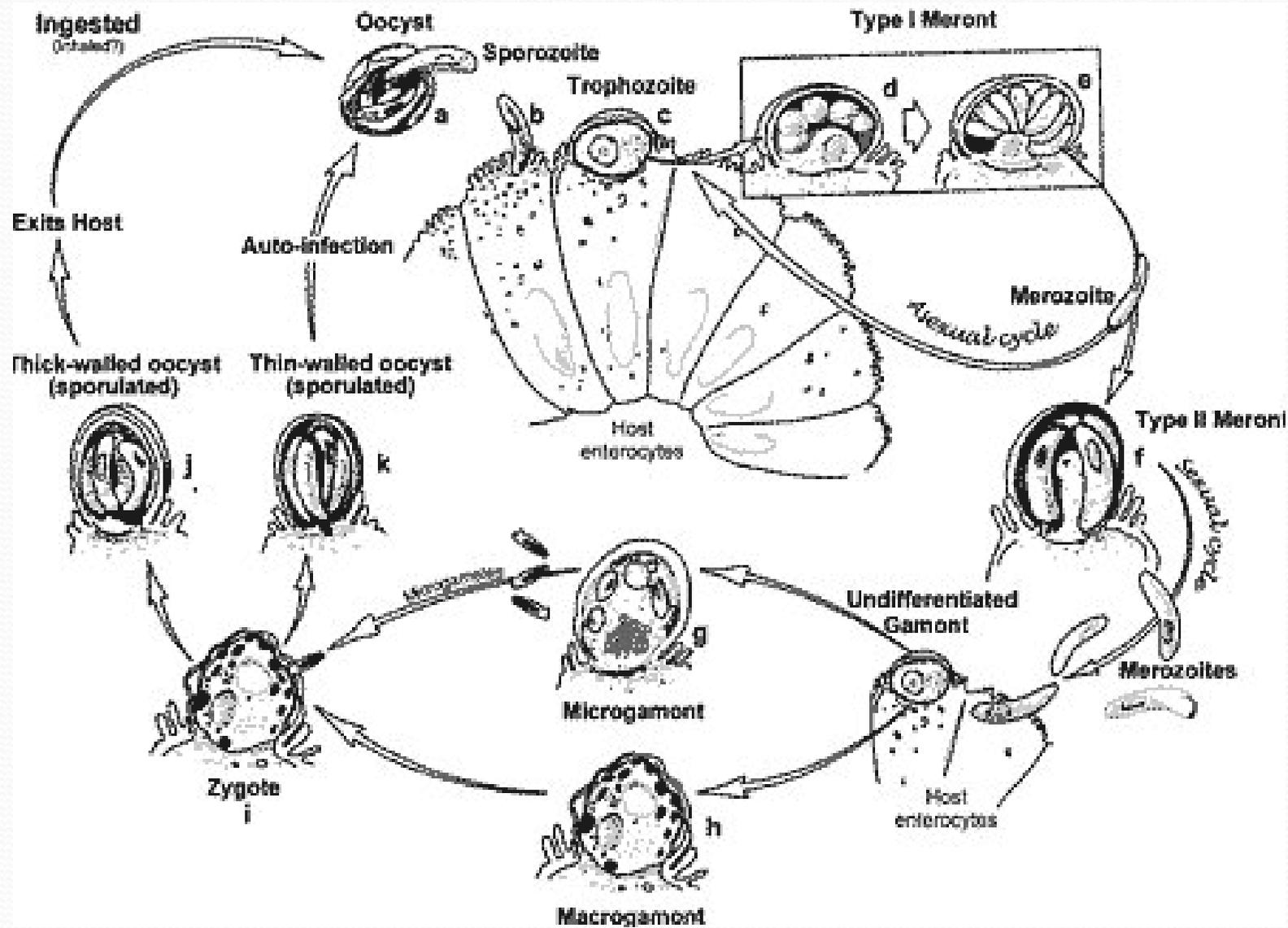
**Table 2:  
The largest confirmed outbreaks**

Year	Location	Population Exposed	Population Infected
1984	Bruan Station, Texas	5900	2006
1987	Carrollton, Georgia	12,960	12 960
1988	Ayrshire, UK	24,000	27
1989	Swindon/Oxfordshire, UK	741,092	516
1991	Pennsylvania, Pennsylvania	551	551
1991	Isle of Thanet, UK	177, 300	47
1992	Jackson County, Oregon	15,000	15,000
1993	Milwaukee, Wisconsin	403,000	403,000

**Lisle & Rose, 1995**

# Life cycle:





<http://www.dpd.cdc.gov/dpdx/HTML/Cryptosporidiosis.htm>

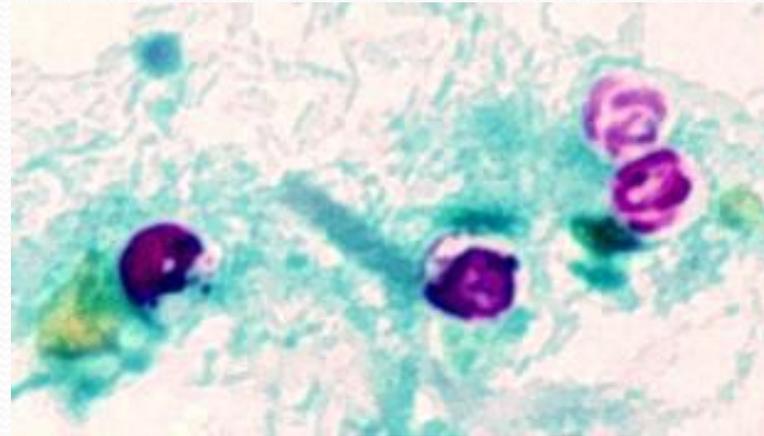
# Site of infection

- Epithelial cells of the gastrointestinal tract
- Has affected other tissues such as respiratory tract tissues and conjunctiva of the eye.
- Infectious dose: < 10 organisms (only 1 needed to initiate)
- Cell death is a direct result of parasite invasion, multiplication, and extrusion **or**
- Cell damage could occur through T cell-mediated inflammation, producing microvilli death and *Cryptosporidium* excess growth

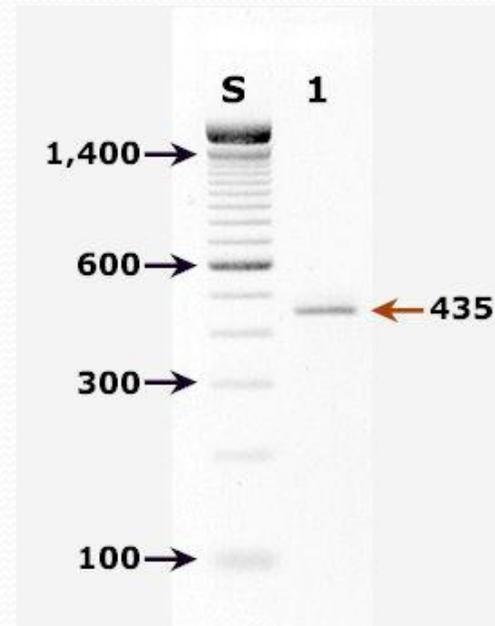
# Symptoms

- Some individuals can be asymptomatic
- Incubation period: 2-10 days
- Symptoms include:
  - Stomach cramps, pain, watery diarrhea, dehydration, weight loss, vomiting, fever.
  - Immuno-competent individuals: 1-2 weeks
  - Immuno-compromised individuals: longer (months, even years!)

# Diagnosis



- Microscopy with an acid fast stained stool smear
- Enzyme immunoassay for greatest sensitivity and specificity
- Molecular methods using PCR



# Treatment

- No effective therapy, currently researching for a suitable prophylactic drug.
- Immuno-competent individuals will recover with fluid and electrolyte replacement.
- Nitazoxande for treatment of diarrhea.
- For individuals with AIDS, anti-retroviral therapy will reduce oocyst excretion and decreases diarrhea.

# Control Methods:

- Water purification and filtration
  - Routine testing
  - Use of 1 micron filter to remove cysts
  - Boil water
- Drink bottled water when traveling abroad
- Educate public
- Wash hands frequently
- Avoid fecal matter during sexual activity

# Interesting Facts

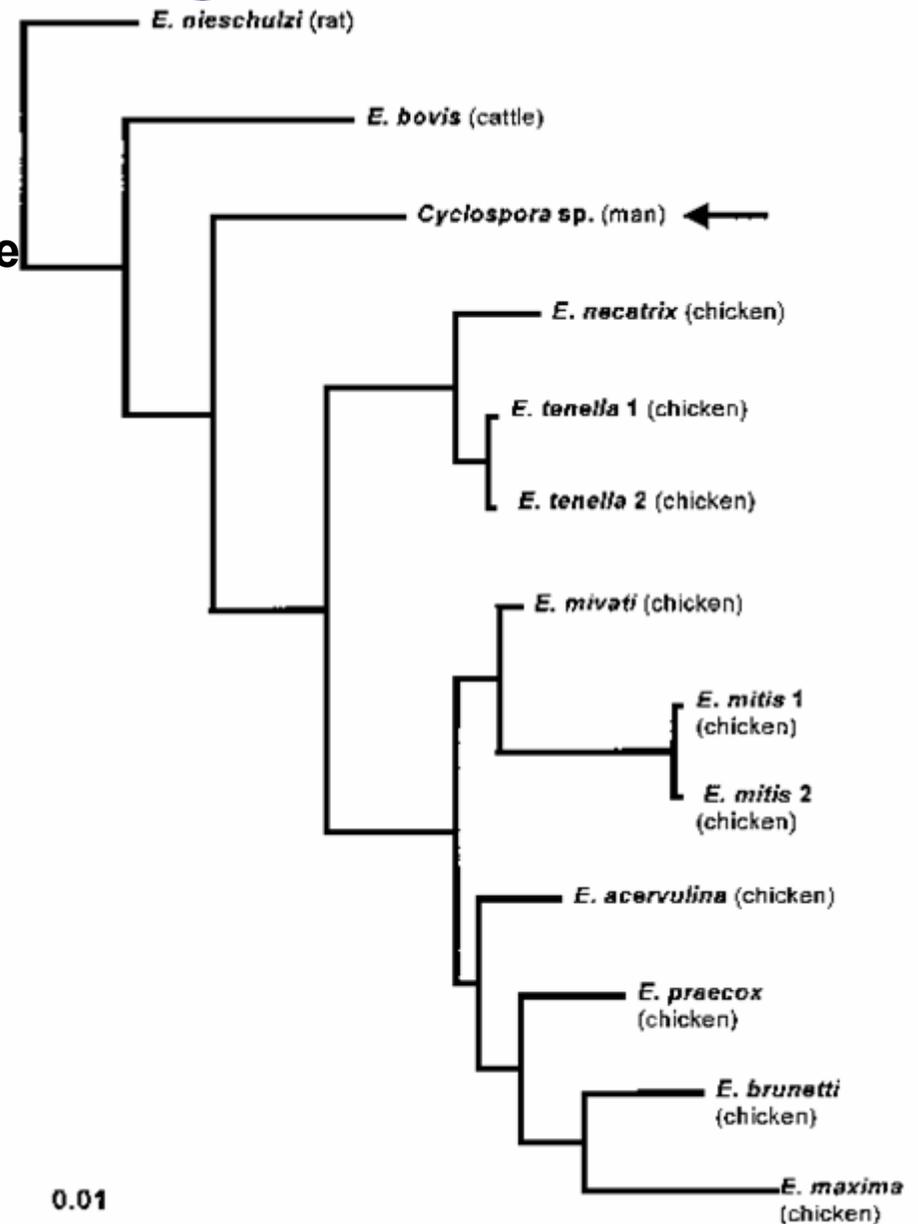
- *Cryptosporidium* is resistant to chlorine.
  - Not protected in chlorinated pool.
- Cannot be infected by blood exposure
- The sporocysts are resistant to most chemical disinfectants, but are susceptible to drying and the ultraviolet portion of sunlight



# Cyclospora

# Cyclospora cayetanensis

- first human case in 1979
- named in 1993
  - initially called 'cyano-bacteria like body' (CLB) or large Cryptosporidium
- related to Eimeria
- life cycle unknown
  - oocysts mature in environment
  - similar to Isospora?
  - zoonosis?



# Clinical Features

- **symptoms**

- watery diarrhea/frequent stools
- 1-2 week duration typical
- relapses over 1-2 months

- **associated with food-borne outbreaks**

- 37/64 attendees at luncheon near Charleston SC were positive for Cyclospora
  - raspberries from C. America was source?
- oocysts detected on market vegetables in Peru
  - presumed source: contaminated water or human waste as fertilizer

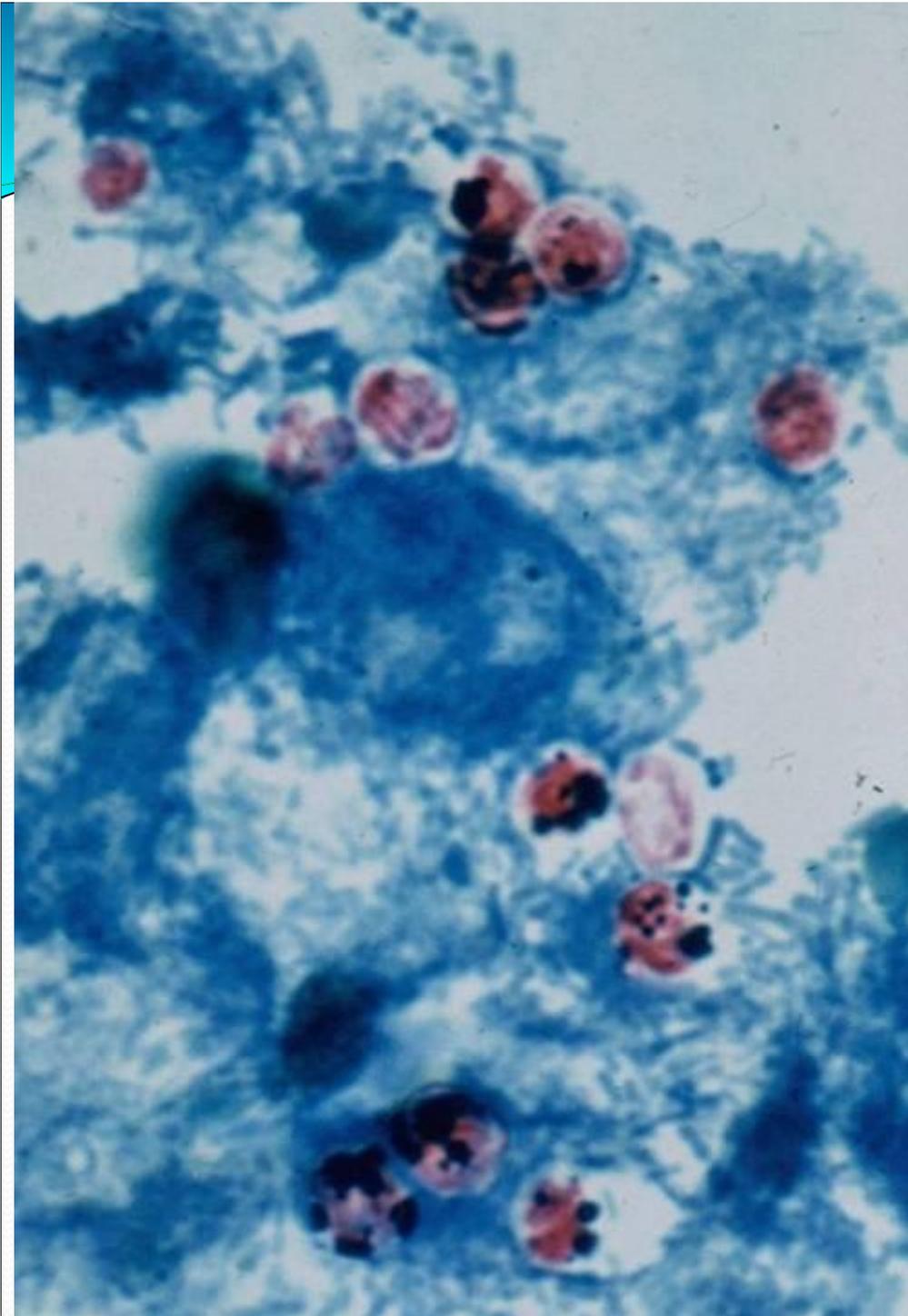
# Intestinal Coccidia

## Diagnosis

- demonstration of oocysts in feces
  - acid-fast stain (all three)
  - autofluorescence (Cyclospora)

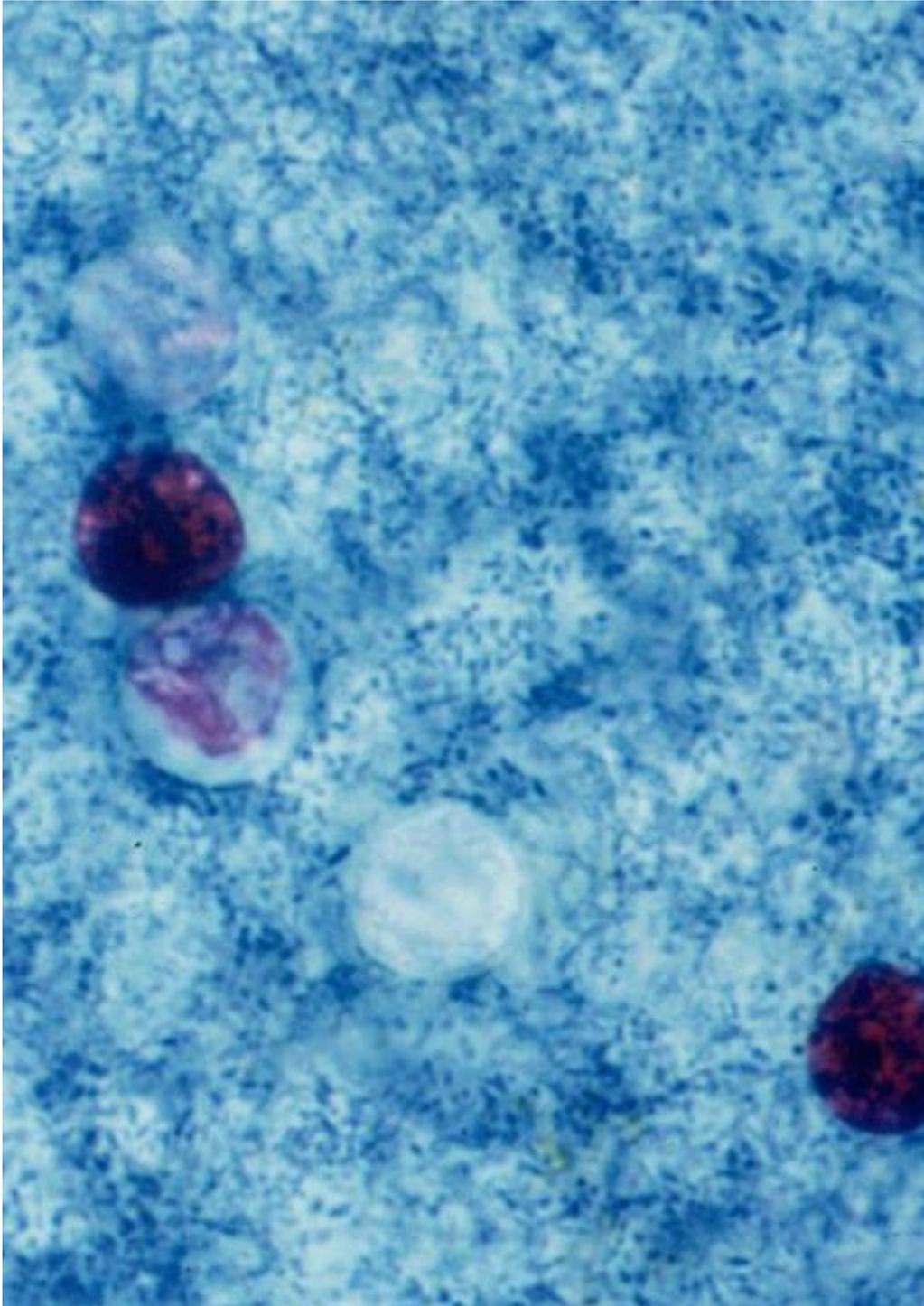
## Treatment

- trimethoprim-sulfamethoxazole for Cyclospora



## **Cyclospora**

- **8-10  $\mu\text{m}$  oocysts**
- **2 sporocysts**
- **2 sporozoites each**



## **Cryptosporidium**

- 4-5  $\mu\text{m}$  oocysts
- 4 sporozoites
- no sporocysts

## **Cyclospora**

- 8-10  $\mu\text{m}$  oocysts
- 2 sporocysts
- 2 sporozoites each

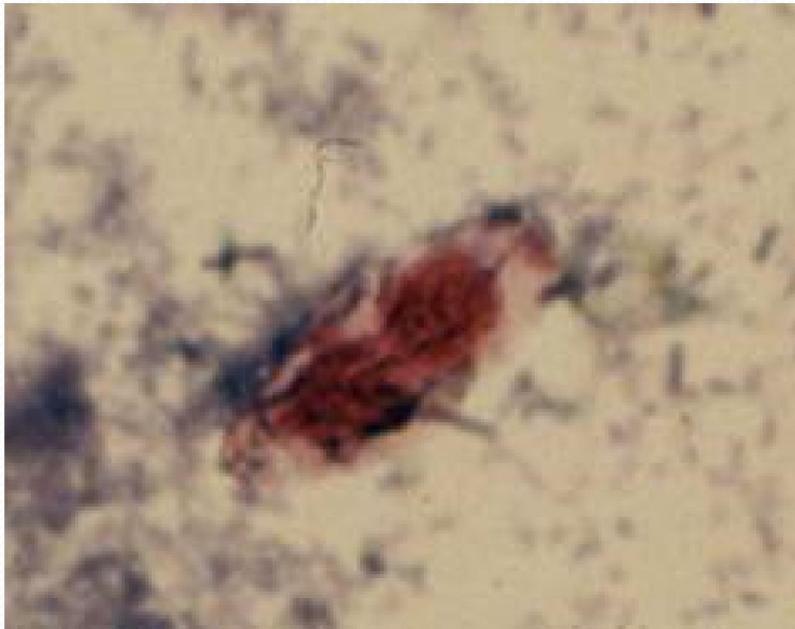
## **Isospora belli**

- 30 x 12  $\mu\text{m}$  oocysts
- 2 sporocysts
- 4 sporozoites each



## **Cyclospora**

- **8-10 mm oocysts**
- **2 sporocysts**
- **2 sporozoites each**



## What Causes the Disease Cyclosporiasis?

- *Cyclospora cayetanensis* is a coccidian parasite that affects the intestinal tract of humans.
- This parasite produces oocysts that once sporulated, produce two sporocysts.
- Each sporocyst contains two sporozoites.
- The release of the sporozoites is the cause of the infection in humans.

## Signs and Symptoms of Cyclosporiasis Infection

- Mild to severe nausea
- Anorexia
- Abdominal cramping
- Fatigue
- Weight loss
- Watery Diarrhea that can last up to nine weeks and/or may alternate disease and remission cycles.

Sterling & Ortega, 1999.

## Signs and Symptoms of Cyclosporiasis Infection

- May be asymptomatic in older children and adults due to a partial immunity effect in endemic areas.
- Young children are more likely to exhibit symptoms.
- Onset of symptoms may be between 1-14 days after exposure.
- In endemic areas, onset of symptoms may begin 5-8 days after exposure and may persist for a month or more.

## Modes of Cyclosporiasis Transmission

- *C. cayetanesis* can be found in the soil that has been contaminated with human feces.
- It has been found in the water supply.
- Raspberries have been implicated in Foodborne outbreaks due to farmers utilizing irrigated water supplies that had become contaminated.

## Other Links to Possible Risk of Cyclosporiasis Transmission

- People living in crowded homes.
- Not having indoor toilet facilities.
- Using or drinking untreated water.
- Contaminated recreational water sources.
- Children playing in soil that has been contaminated with human feces.

Bern et al, 1999.

## Statistics from a Few Select Cases and Studies

- In 1996, the US 1,465 cases of *Cyclospora cayetanensis* were reported from 20 states, including the District of Columbia, and two Canadian Provinces; 978 (67%) case were laboratory confirmed.
- Traceback of cases were attributable to Raspberries coming from Guatemala.

## Statistics from a Few Select Cases and Studies

- In Venezuela, *Cyclospora cayetanensis* has been linked to having no toilet in the home, the home being a hut, and having contact with feces soil.
- Children aged 6-15 had the highest risk rates for *Cyclospora cayetanensis*.

*Chacin-Bonilla; Barrios; & Sanchez, 2007.*



## Possible Solutions to the Problem

- Awareness Campaigns
- Health educational programs
- Housing and sanitation improvements
- Safe water treatment techniques for agriculture

Phylum \_\_\_\_\_

Class \_\_\_\_\_

Tissue Spp.

Nemathelminthes

Nematoda

*Trichinella spiralis*

*Dracunculus medinensis*

*Wuchereria bancrofti*

*Loa loa*

*Onchocerca volvulus*

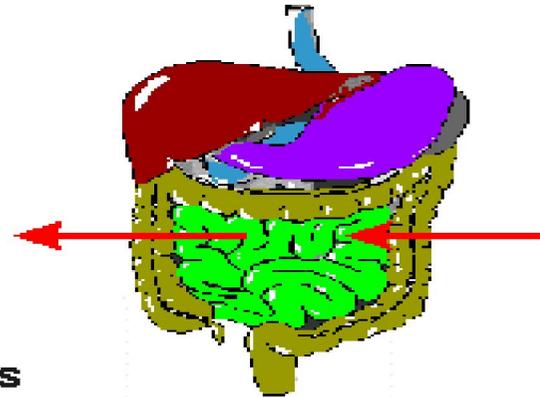
# The Life Cycle of *Trichinella spiralis* (causing trichinosis or trichinellosis in human)

Male and female worms mate, females produce living juveniles.

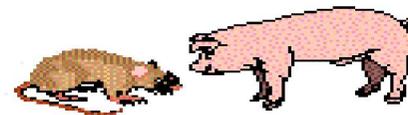
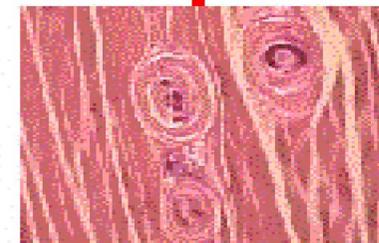
The juvenile worms migrate into muscles of the host and mature into the infective stage.

Humans are infected most often by eating improperly cooked meat products that contain infective juveniles.

Carnivores and omnivores are infected when they eat meat containing the infective juvenile stage.



Juveniles are digested from muscle, penetrate into tissues of small intestine and grow to sexual maturity.

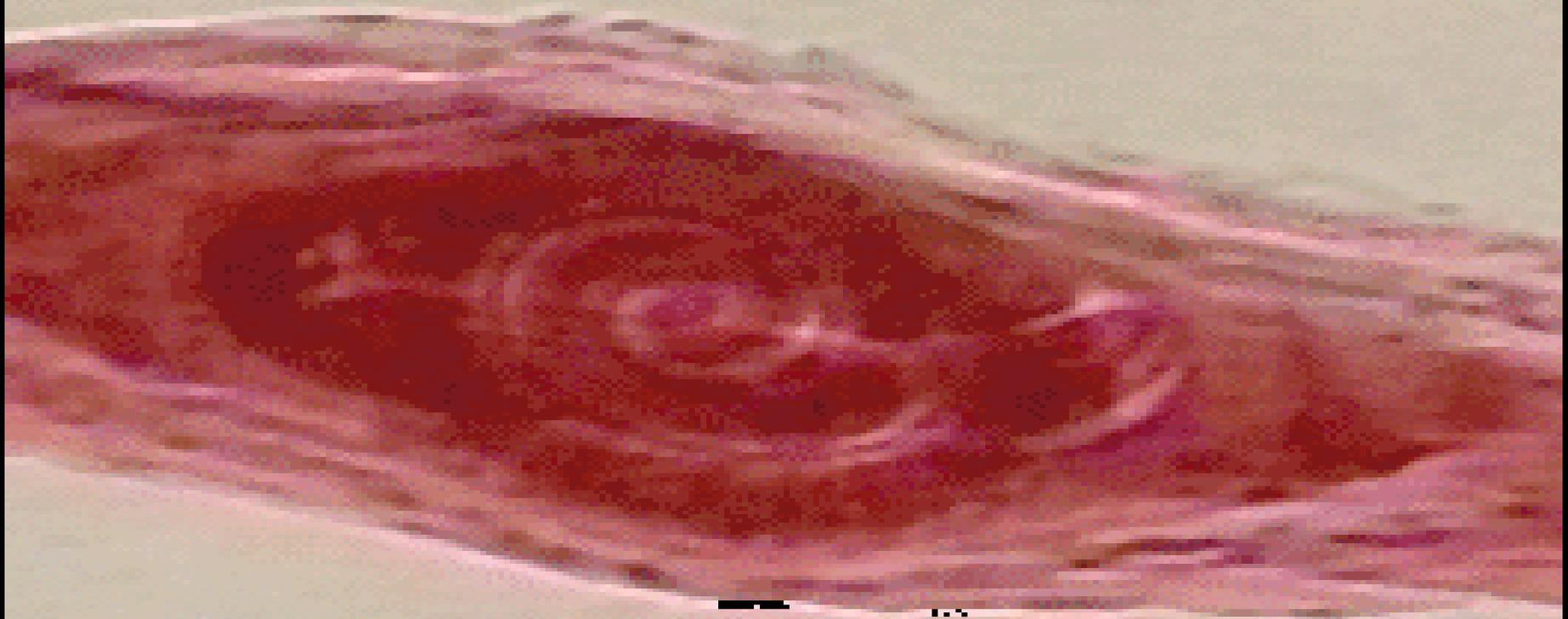


# *Trichinella spiralis*



(by P.W. Pappas and S.M. Wardrop)

# *Trichinella spiralis*



(by P.W. Pappas and S.M. Wardrop)

# *Trichinella spiralis*

## Encysted Larva

- Coiled in shape
- Usually encysted in Nurse cells of striated muscle
- Inflammatory infiltrates are present around the nurse cell

# *Trichinella spiralis*

## Larvae



# *Trichinella spiralis*

## Adult Features

Male: Curved posterior end with 2 rounded appendages

Female: Blunt round posterior end

Both: \* Thin anterior end

\* Small mouth

\* Long & slender digestive tract

# *Trichinella spiralis*

**Male**



**Female**

