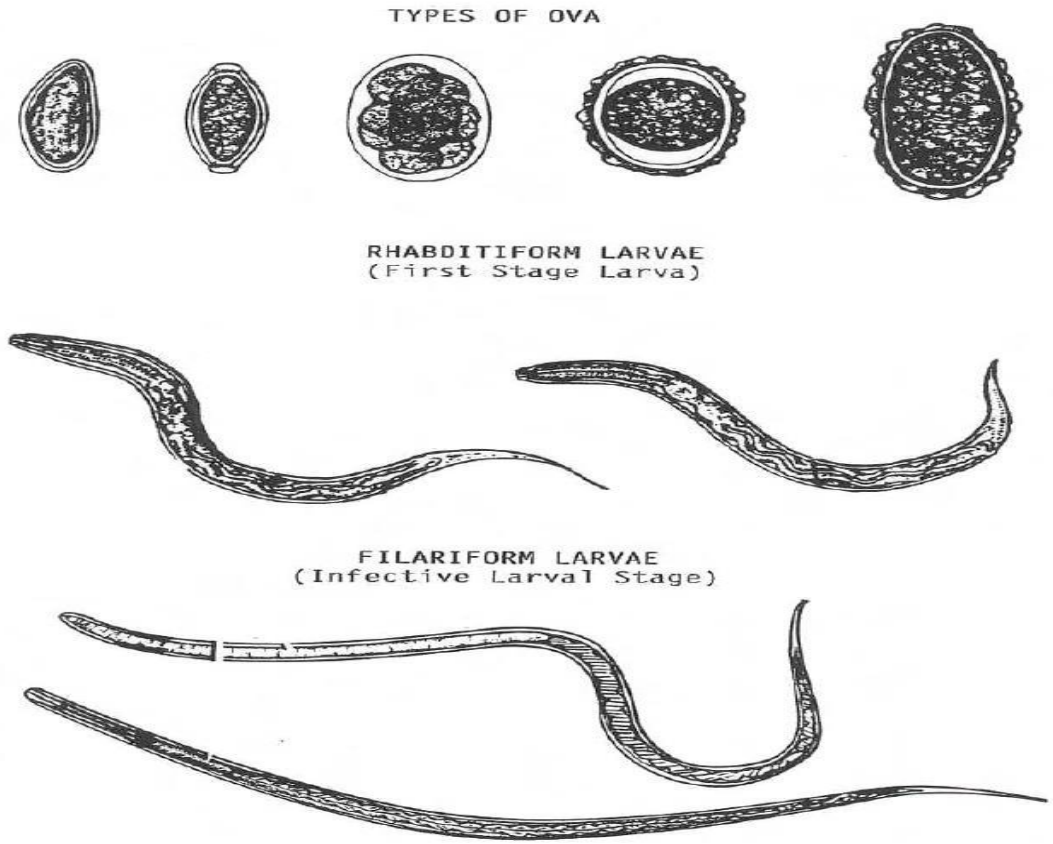
Lecture 7: Nematodes



Leaning objectives

- By the end of lecture students should be able to recall, Phylum Nematoda.
- Its characteristics, classification of nematodes, their lifecycles, epidemiology and pathogenesis.
- Laboritory diagnosis, treatment and prevention.
- Should also be able to diagnose their clinical casses.

Nematodes/ Nemahelminthes

- Roundworms with cylindrical body & complete digestive tract, a mouth & an anus.
- Body covered with non-cellular, highly resistant coating, cuticle.
- Have separate sexes: female usually larger than male.
- Male: coiled tail.

Nematodes
Divided according to location in body

1. **Intestinal** nematodes:

- *Enterobius* (Pinworm)
- *Trichuris* (Whipworm)
- *Ascaris* (Giant roundworm)
- *Necator* and *Ancylostoma* (Hookworms)
- *Strongyloides* (Small roundworm)

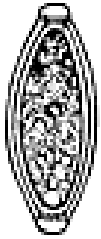
2. Tissue nematodes:

- *Wuchereria*
- *Onchocerca*

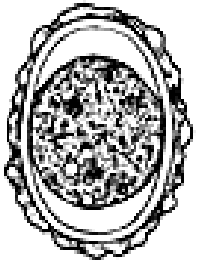
NEMATODES

Scale:
0 24 48 μm

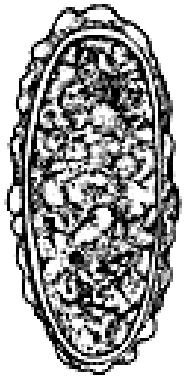
Enterobius vermicularis



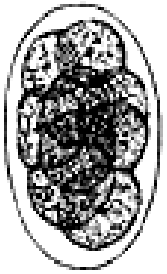
Trichuris trichiura



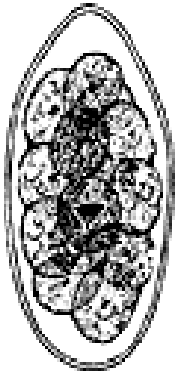
Ascaris lumbricoides fertile



Ascaris lumbricoides infertile



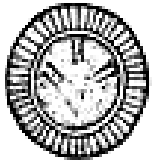
Hookworm



Trichostrongylus

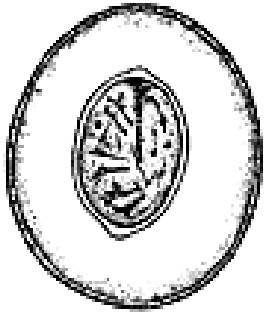
CESTODES

Scale:
0 24 48 μm

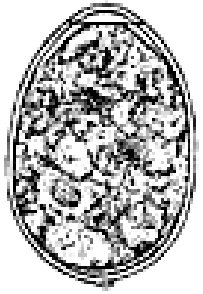


Taenia

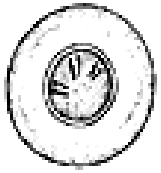
Hymenolepis nana



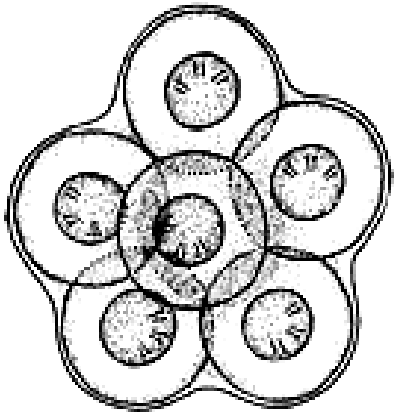
Hymenolepis diminuta



Diphyllobothrium latum



Dipylidium caninum

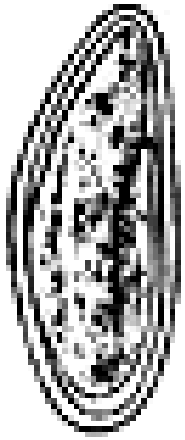


Dipylidium caninum egg packet

Transmission

- *Enterobius*, *Trichuris* & *Ascaris* transmitted by ingestion of eggs.
- Others transmitted as larvae.
- **Two larval forms:**
- **First & second-stage** (**rhabditiform**) **larvae:** Non-infectious, feeding forms.
- **Third-stage (filariform) larvae:** Infectious, non-feeding forms.
- **Tissue Nematodes:** Organisms transmitted from person to person by bloodsucking mosquitoes or flies (vectors).

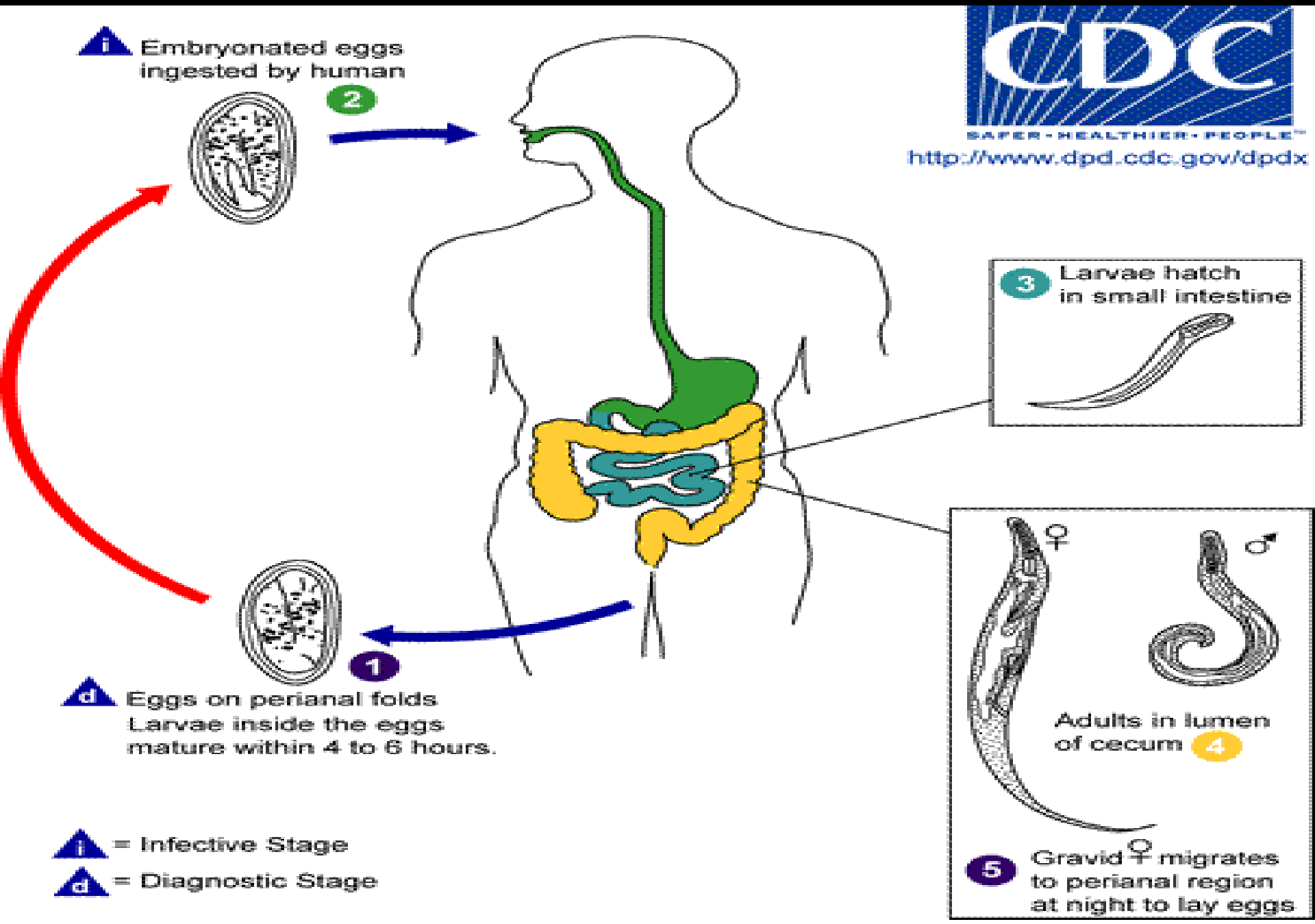
1. Enterobius vermicularis/pinworm



Enterobius vermicularis

Enterobius vermicularis/pinworm (Enterobiasis)

- Direct Life Cycle
- Life cycle **confined to humans.**
- **Transmission:** Acquired by ingesting worm eggs.


i
Embryonated eggs ingested by human
2
CDC
SAFER · HEALTHIER · PEOPLE™
http://www.dpd.cdc.gov/dpdx
3
Larvae hatch in small intestine
♀
♂
Adults in lumen of cecum
4
5
Gravid ♀ migrates to perianal region at night to lay eggs
1
d
Eggs on perianal folds
Larvae inside the eggs mature within 4 to 6 hours.
i = Infective Stage
d = Diagnostic Stage

Life Cycle

- Eggs hatch in small intestine, where larvae differentiate into adults & migrate to colon.
- Adult male & female worms live in colon, mating occurs.
- At night, female migrates from anus & releases thousands of fertilized eggs on perianal skin & into environment.
- Within 6 hours, eggs develop into embryonated eggs & become infectious.
- Re-infection can occur if carried to mouth by fingers after scratching itching skin.

Epidemiology & Pathogenesis

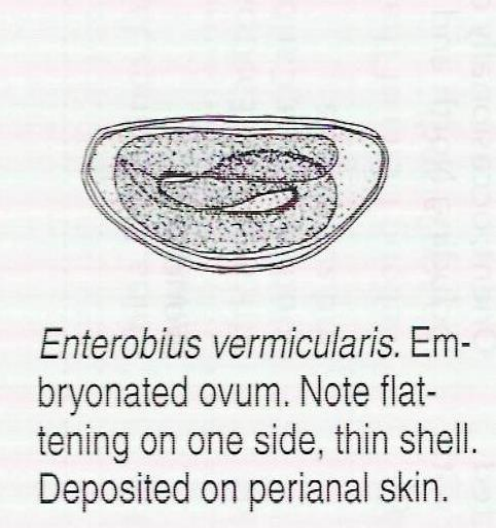
- Found worldwide & most common helminth in United States.
- Most commonly affected group: Children younger than 12 years of age.
- **Perianal pruritus:** most prominent symptom.
- **Pruritus:** An allergic reaction to presence of either adult female or eggs.
- Scratching predisposes to secondary bacterial infection.

Laboratory Diagnosis

- **Microscopy:**
- **Scotch tape technique**: Eggs recovered from perianal skin & observed microscopically.
- **Stool Examination:**
- Eggs not found in stools.
- Small, whitish adult worms found in stools or near anus of diapered children.
- **Serology:** No serologic tests available.

Ova of *Entrobius vermicularis*

- Color less
- Oval, flattened at one side.
- 50x30 um in diameter
- Contains a larva



Enterobius vermicularis. Embryonated ovum. Note flattening on one side, thin shell. Deposited on perianal skin.

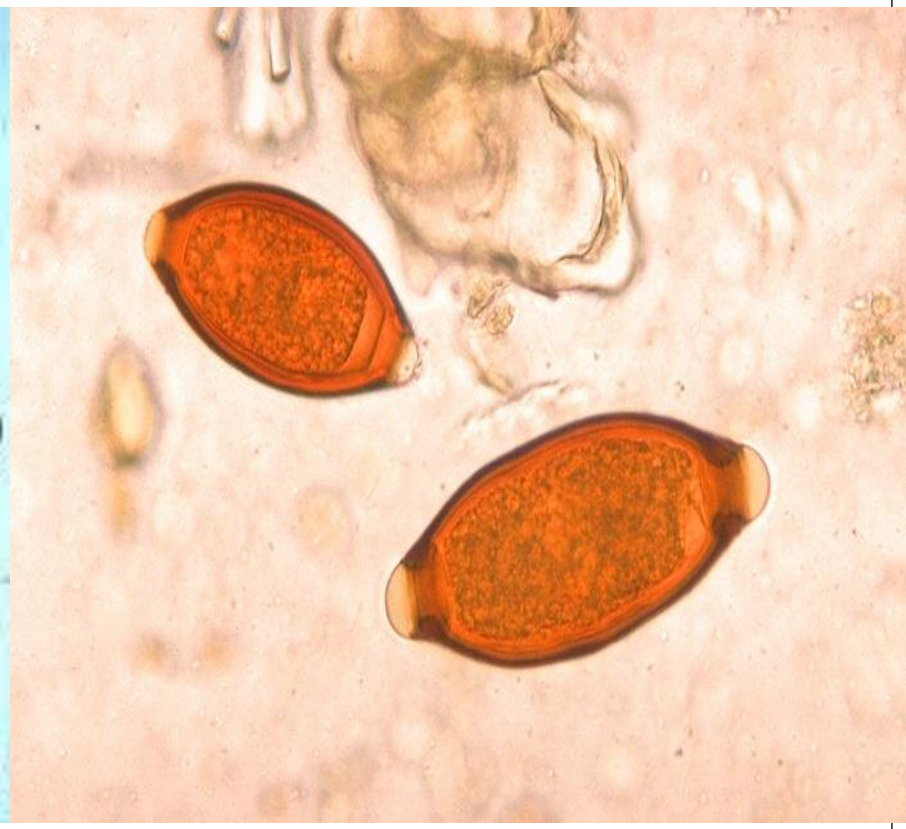
Treatment & Prevention

- Mebendazole or pyrantel pamoate: kill adult worms in colon.
- Retreatment in 2 weeks.
- Re-infection very common.
- No means of prevention.

2. Trichuris trichiura

Trichuris trichiura

has no intermediate host



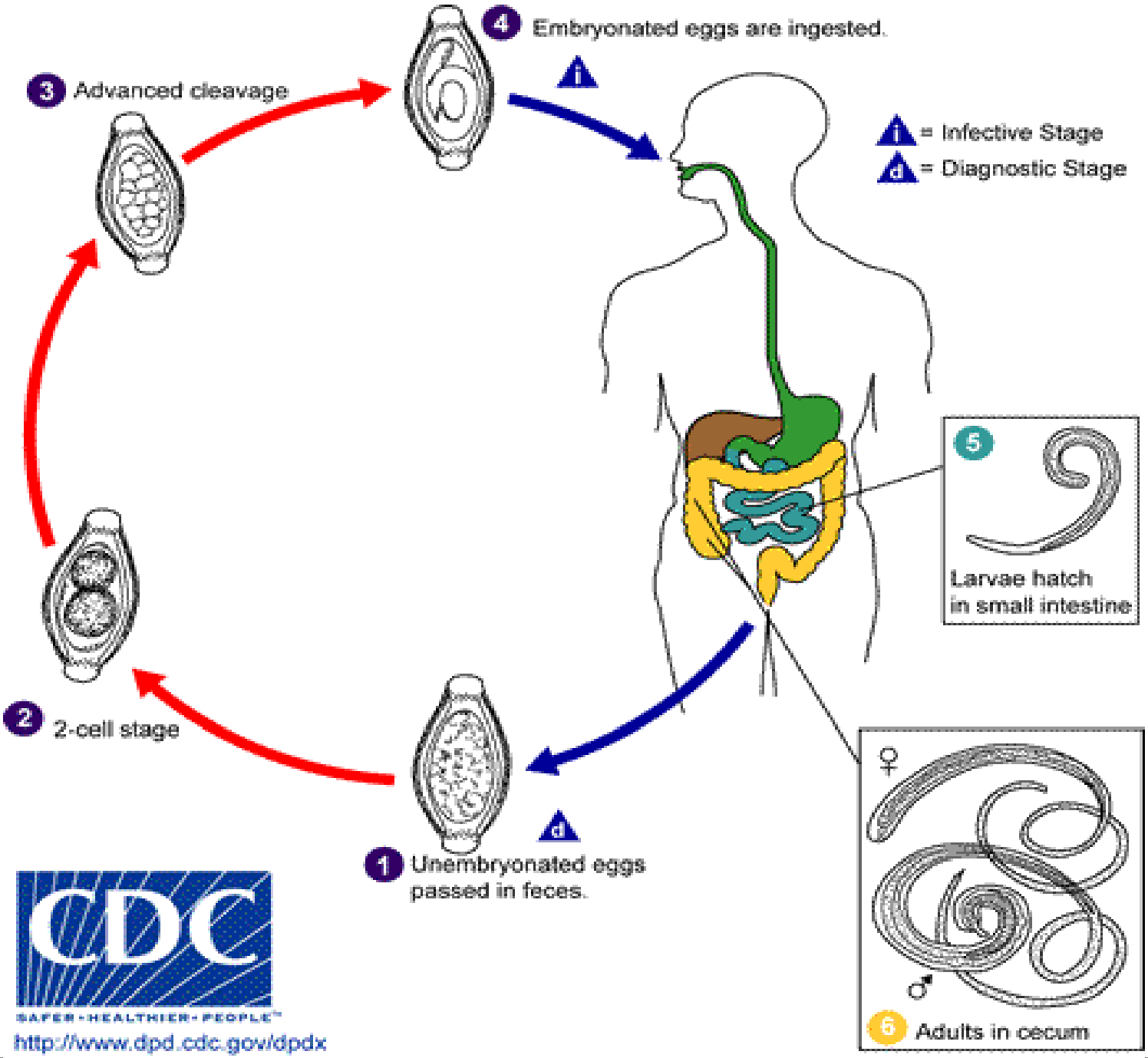
Trichuris trichiura/whipworm: Causes Trichuriasis

- “Whip-like" appearance of adult worm.

- **Transmission:**
- Due to ingestion of worm eggs in food or water contaminated with human feces.

Life Cycle

- Eggs hatch in small intestine, forms larvae.
- Larvae differentiate into immature adults.
- Migrate to colon, mature, mate & produce thousands of fertilized eggs daily, passed in feces.
- Eggs deposited in warm, moist soil and form embryos.
- When embryonated eggs ingested, cycle completed.


4 Embryonated eggs are ingested.
i
i = Infective Stage
d = Diagnostic Stage
3 Advanced cleavage
5
Larvae hatch
in small intestine
2 2-cell stage
d
1 Unembryonated eggs
passed in feces.
♀
♂
6 Adults in cecum
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx

Epidemiology

- Infection occurs worldwide, especially in tropics.
- More than 500 million people affected.
- In United States, mainly in southern states.

Pathogenesis

- Trichuris worms burrow their hair like anterior ends into intestinal mucosa.
- Do not cause significant anemia.
- May cause diarrhea.
- Most infections asymptomatic.

Clinical Findings

- **Rectal prolapse** in children with heavy infection.
- Prolapse results from increased peristalsis that occurs in an effort to expel worms.
- Whitish worms seen on prolapsed mucosa.

Laboratory Diagnosis

- **Stool Examination:**
- Barrel-shaped (lemon-shaped) eggs with a plug at each end.
- 50x25um in size.
- Yellowish brown.
- Central granular mass with un-segmented ovum.

Treatment & Prevention

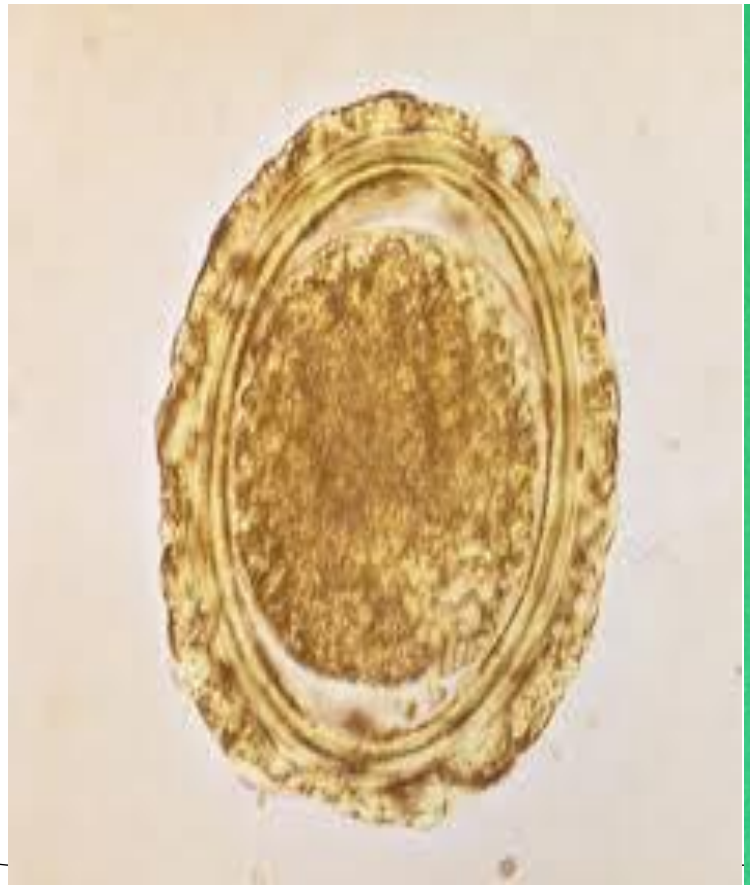
- Mebendazole.

- Proper disposal of feces.

3. Ascaris lumbricoides

Ascaris lumbricoides: Giant roundworm

Largest intestinal nematodes: 25 cm or more.

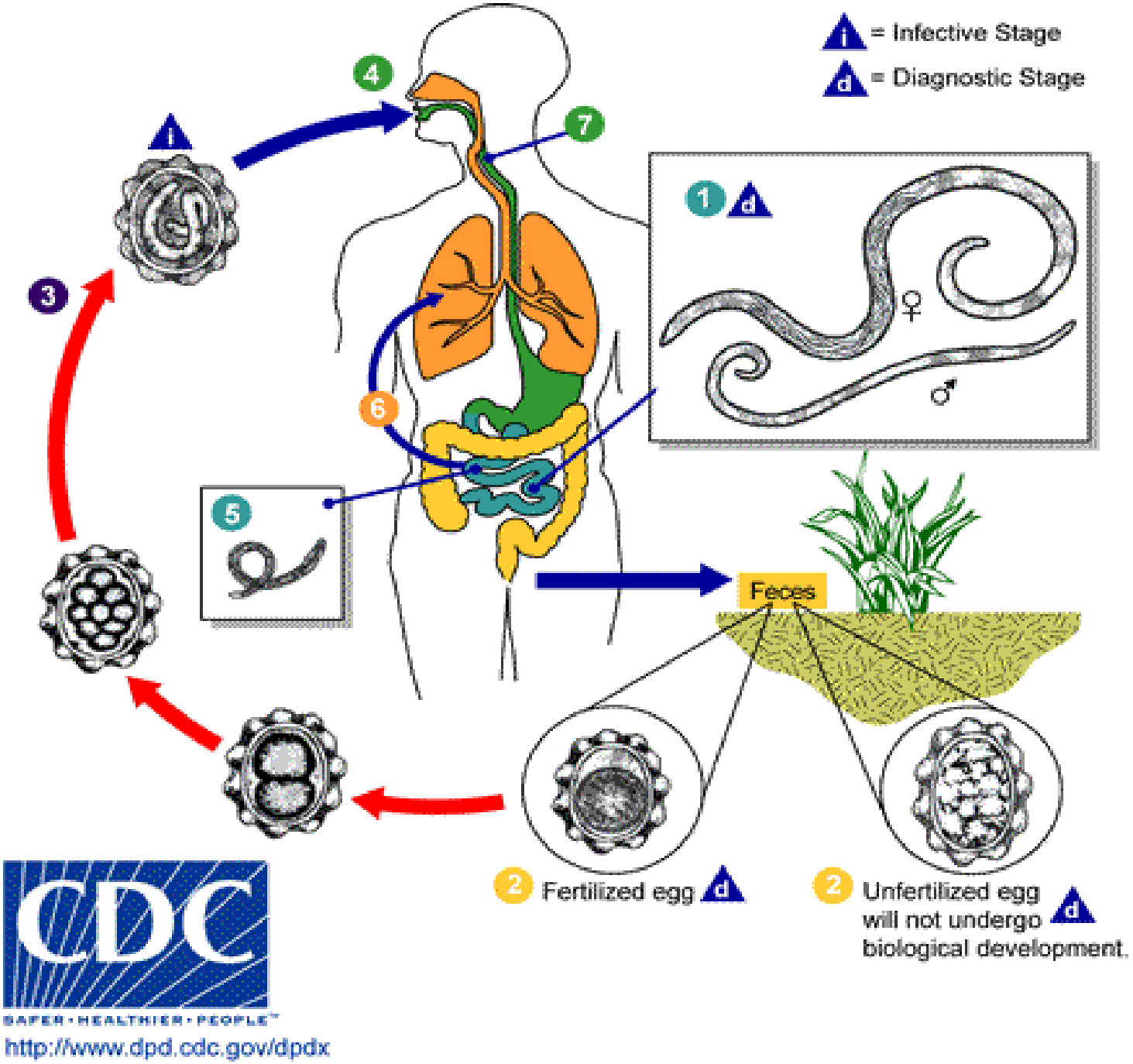


Ascaris lumbricoides
No intermediate host required

- **Transmission:** Humans **infected by** ingesting worm eggs in food or water contaminated with human feces.
- **Stage 1**: **Eggs in feces:** Unsegmented ovum passed in feces.
- **Stage 2: Development in soil:** Rhabditiform larva develops in soil.
- **Stage 3: Infection by ingestion of ova & liberation of larvae:** Through contaminated food & water, eggs ingested, passed down duodenum. Digestive juices break egg shell. Larva released & reach upper part of small intestine.

Ascaris lumbricoides causes ascariasis

- **Stage 4: Migration through lungs:** Larva do not form adult worm. It migrate through mucous membrane of small intestine , carried by portal circulation to liver. Finally pass out of liver, via right heart enter the pulmonary circulation.
- **Stage 5**: Re-entry in stomach and small intestine: From lung alveoli larvae crawl up the bronchi and trachea, and swallowed in esophagus. Reach stomach and upper part of small intestine.
- **Stage 6: Sexual maturity & egg liberation:** In intestine grow into adult worm. Eggs released in stool and cycle completed.


= Infective Stage
= Diagnostic Stage
1
4
7
3
6
5
Feces
2 Fertilized egg
2 Unfertilized egg will not undergo biological development.
CDC
SAFER · HEALTHIER · PEOPLE™
http://www.dpd.cdc.gov/dpdx

Epidemiology

- Infection very common, especially in tropics.
- Hundreds of millions of people infected.
- In United States, most cases occur in southern states.

Pathogenesis

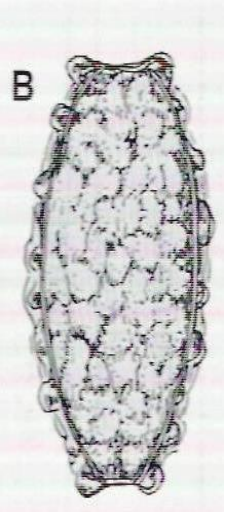
- Major damage occurs during larval migration rather than from presence of adult worm in intestine.
- **Principal sites of tissue reaction: lungs,** inflammation with **eosinophilic exudate** in response to larval antigens.
- A heavy worm burden may contribute to malnutrition, especially in children in developing countries.

Clinical Findings

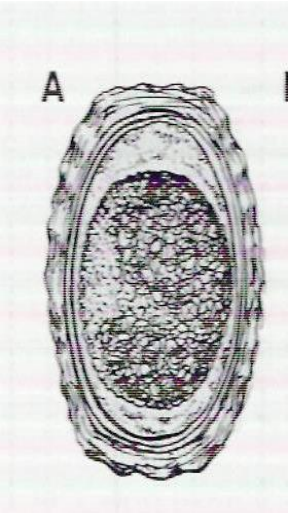
- Most infections asymptomatic.
- ***Ascaris* pneumonia**: (loefflers syndrome) fever, cough & eosinophilia with heavy larval burden.
- Abdominal pain and even obstruction result from presence of adult worms in intestine.

Laboratory Diagnosis

- Stool Examination: detects eggs in stools.
- Occasionally, adult worms in stools.



- **INFERTILE EGG:**
- Darker in color, thinner wall,
  more granular albuminous covering.
- More elongated measuring 90x45um.
- Contains a central mass of large granules.



- **FERTILIZED EGG**
- Yellow-brown, oval or round.
- 50–70um long & 30–50um wide.
- Shell covered by uneven albuminous coat.
- Central granular mass which is un-segmented
  fertilized ovum.

Treatment & Prevention

- Both mebendazole & pyrantel pamoate.
- Proper disposal of feces prevent ascariasis.

MCQ # 1

- **An eight year old presented with perianal pruritis associated with itching for the last few days. The boy had history of not properly washing his hands before meals. His scotch tape preparation was positive. Which one of the following is the most likely causative agent?**

A. *Echinococcus granulosus*

B. *Necatar americanans*

C. *Ankylostoma duodenale*

D. *Entrobius vermicularis*

E. *Diphylobothrium latum*

MCQ # 2

- **Which of the following nematode is also known as whip worm?**

A. *Ascaris lumbricoides*

B. *Ankylostoma duodenale*

C. *Trichuris trichiura*

D. *Enterobius vermiculoaris*

E. *Necatar americanas*

MCQ # 3

- Which one of the following parasite causes lofflers syndrome?

A. Ascaris lumbricoides

B. Necatar americanans

C. Ankylostoma duodenale

D. Entrobius vermicularis

E. Diphylobothrium latum

SEQ #1

- a)Enumerate 2 nematodes which infect human beings through oro-fecal route of transmission.
- b)Draw and label the life cycle of ascaris lumbricoides.
- c) Name the parasite causing iron deficieny anemia.

SEQ # 2

- A 4 years old boy is presented to pediatric OPD with anal itching. His mother says that he is unable to sleep at night because of scratching of perianal area for past few days. On local examination, perianal area reveals erythema and excoriation.

- Name the parasite responsible for this infection.
- Which test is used in the laboratory for diagnosis and what will be the findings?
- Draw its life cycle.