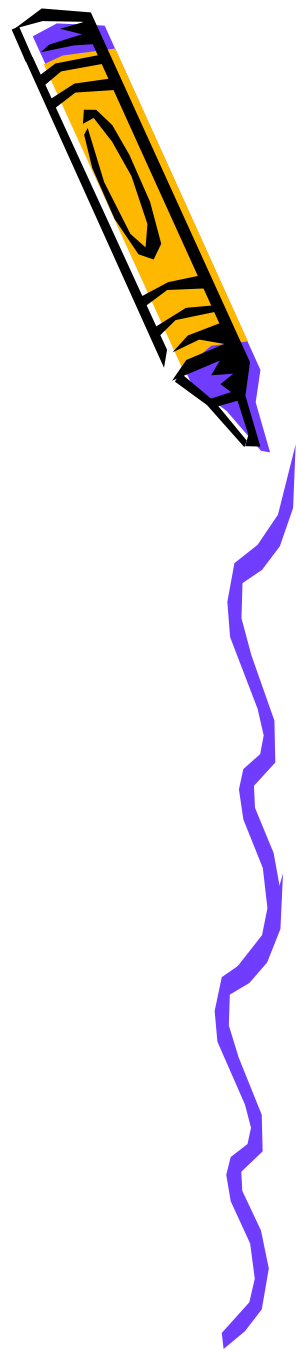


# NEMATODES (Round Worms)



- *Ascaris lumbricoides* (roundworm),
- *Trichinella spiralis* (trichinosis),
- *Trichuris trichiura* (whipworm),
- *Enterobius vermicularis* (pinworm),
- *Strongyloides stercoralis* (Cochin-china diarrhea),
- *Ancylostoma duodenale* and *Necator americanus* (hookworms)



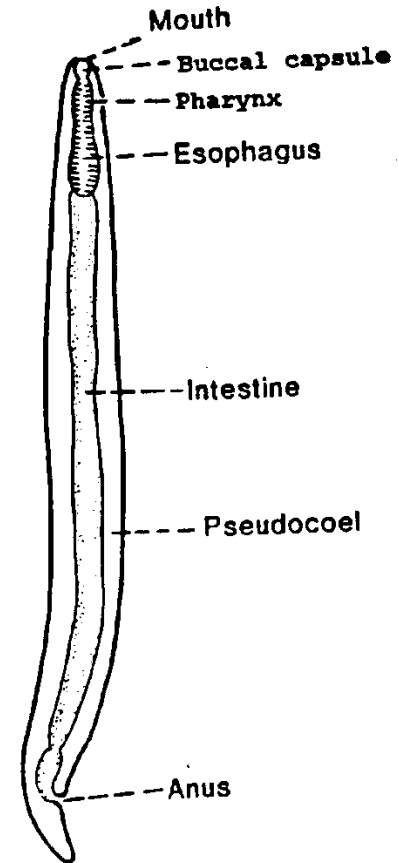
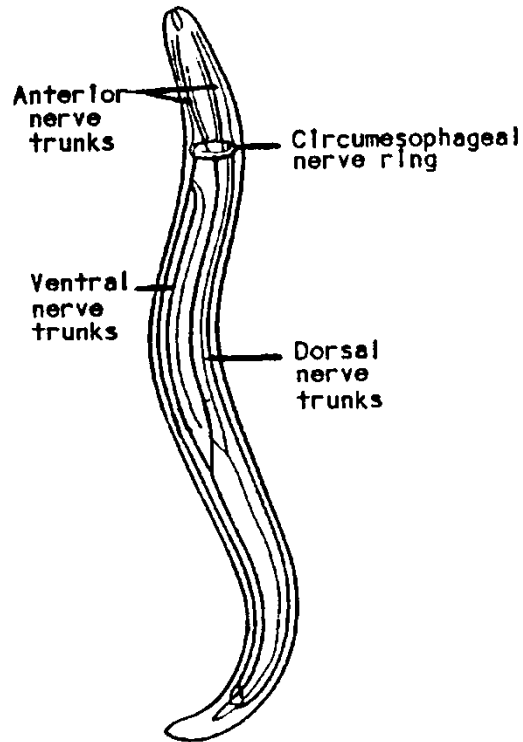
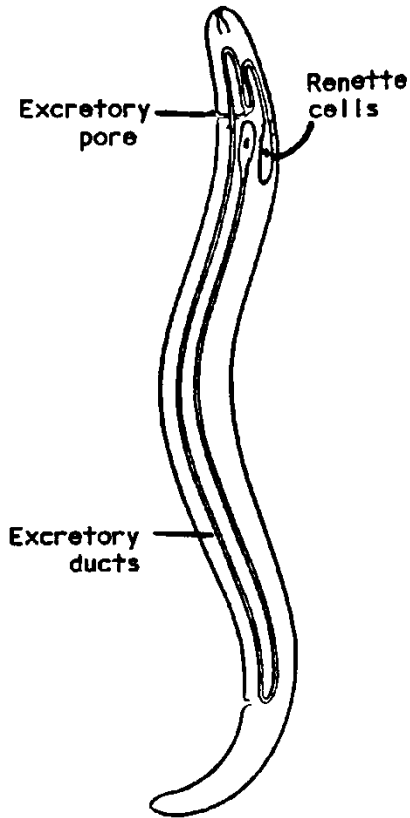
Phylum: Nemathelminthes (Aschelminthes)

Class: Nematoda

### **General features of nematodes**

- Nematodes (thread like) are non segmented, generally elongated, cylindrical, tapering at both ends, covered by a tough protective covering or cuticle.
- Human nematodes are dioecious worms. Generally males are much smaller than females worm, and males usually have a pair of copulatory spicules or posterior end is expanded in to copulatory bursa, supported by thick end rays.
- they have a complete digestive tract: the mouth part is called buccal cavity, which may contain teeth or cutting plates. Then muscular esophagus, intestine, rectum and anus.
- nematodes have reproductive system: male r. s. composed of a single convoluted tubule, while female r. s. composed of a single, double or multiple group of tubules.
- Nervous system: from the nerve trunks the nervous system consists of a nerve ring around oesophagus and sensory organs.
- Excretory system: is composed of a gland, excretory canals and excretory pore near the posterior end of oesophagus.
- Nematodes have several successive fundamental stages, zygote , embryo then 4 larval stages, then adult, in each larval stage there is growth, molt and cuticle. They are 2 types of larval stages.
  - 1-rhabditiform larva: has muscular bulb like esophagus, free in living, feeding, not infective, pass in 2 molt to form filariform.
  - 2- filariform larva: larger, not feeding , infective, found in host, pass in 2 molt to form adult ,
- Nematodes have 2 subclass 1- Phasimidia : has phasmids (structure in the caudal region, which are neuro-sensory) and lateral excretory canals. 2- Aphasimidia lacks both.

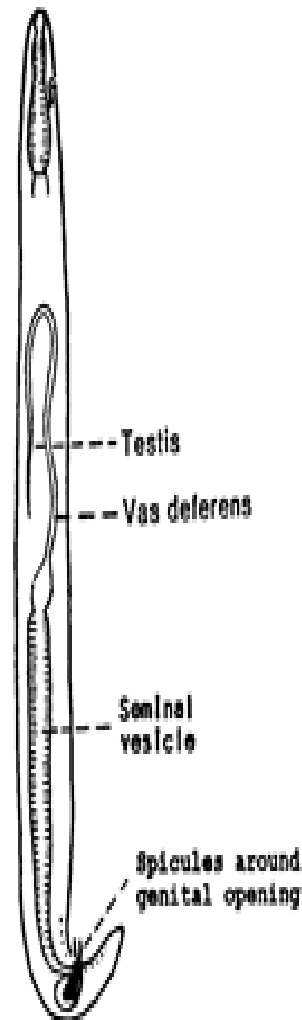
# Characteristics of the Phylum Nematoda



## Characteristics of the Phylum Nematoda

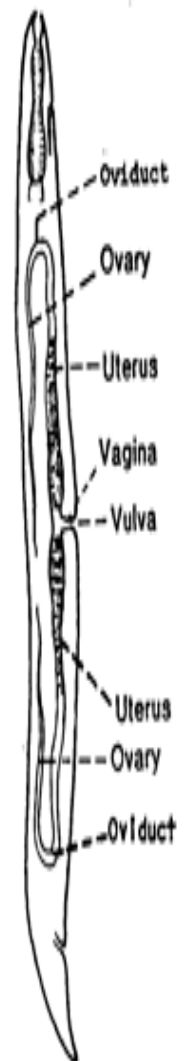
Reproductive system consists of tubular organs lying in the pseudocoelom.

MALE nematodes are generally smaller in size.



## Characteristics of the Phylum Nematoda

FEMALE nematodes are larger in size. The female reproductive organs are doubled.





**Phylum: Nemathelminthes**  
**Class: Nematode**  
**Subclass: Phasmidia**  
**order: Ascaridida**  
*Ascaris lumbricoids*

common name: round worm (large intestinal nematodes)

disease: Ascariasis, Ascariosis (commons human helminthic infection)

geographic distribution : cosmopolitan

habitat: the adult worms are found in the intestine of man mainly in the jejunum and upper part of ileum.

#### Morphology:

They are large, mouth possesses 3 toothed lips – one dorsal and 2 ventral each lip contains a pair of sensory papillae, the body filled with allergic fluid called ascarase or ascarone.

	Male	female
size	smaller	larger
Posterior end	coiled	tapering
Genital opening	at the posterior end, 2 spicules present	Vulva at the junction of anterior and middle, no spicule
Papillae	Pre and post anal-multiple	Post anal-one pair

#### Eggs:

A-fertilized eggs: oval to round, 45 to 75 by 35 to 50 um and have a thick shell, contain large un segmented ovum.

B- in fertilized eggs: larger and narrower have thinner shells.

## Family: ascarididae

### *Ascaris Lumbricoides*

- o *Ascaris lumbricoides* , common saying “round worm of man”, is the largest of the intestinal nematodes parasitizing humans.
- o It is the most common worm found in human.
- o It is worldwide in distribution and most prevalent through out the tropics, sub-tropics and more prevalent in the countryside than in the city.

### Morphology

1-Adult: The adults are cylindrical in shape, creamy-white or pinkish in color, filled with irritating fluid ascarase or ascaron.

2-The female averages 20-35cm in length, the largest 49cm, the male is smaller, averaging 15-31cm in length and distinctly more slender than the female, the typical curled tail with a pair sickle like copulatory spines.

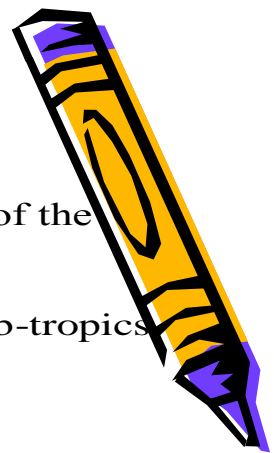
3- On the tip of the head there are three lips, arranged as a Chinese word , each lip possesses a pair of sensory papillae

4-type of eggs

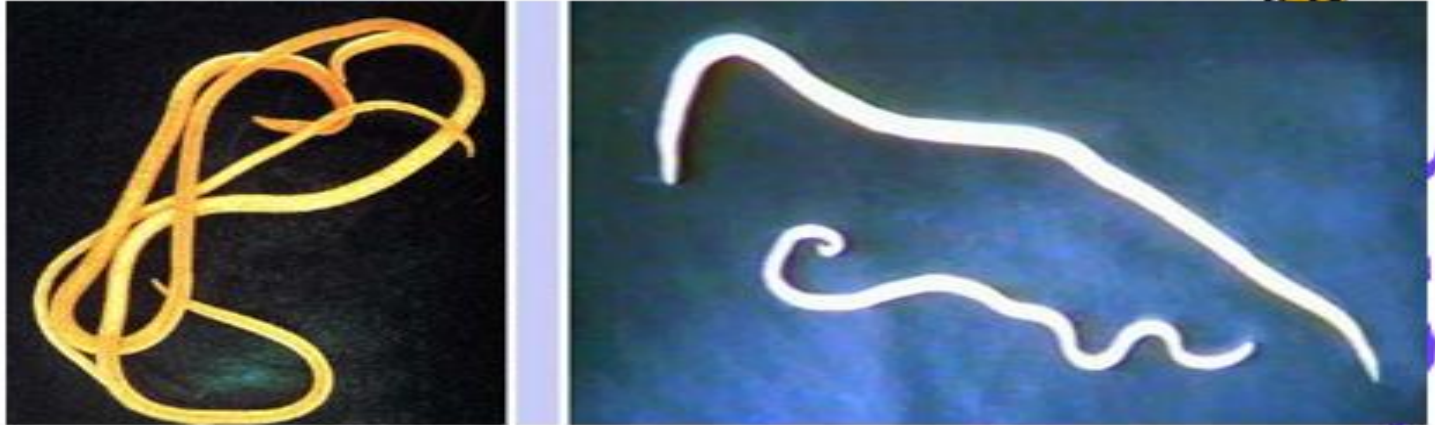
1. **Fertilized eggs**: broad oval in shape, brown in color, an average size  $60 \times 45 \mu\text{m}$ . The shell is thicker and consists of ascaroside, chitinous layer, fertilizing membrane and mammillated albuminous coat stained brown by bile. The content is a fertilized ovum. There is a new-moon(crescent) shaped clear space at the each end inside the shell.

2. **Unfertilized egg**: Longer and slender than a fertilized egg. The chitinous layer and albuminous coat are thinner than those of the fertilized eggs without ascaroside and fertilizing membrane. The content is made of many refractable granules various in size.

3. **Decorticated eggs**: Both fertilized and unfertilized eggs sometimes may lack their outer albuminous coats and are colorless



# *Ascaris lumbricoides*



Adult worm of *A. lumbricoides*

Female

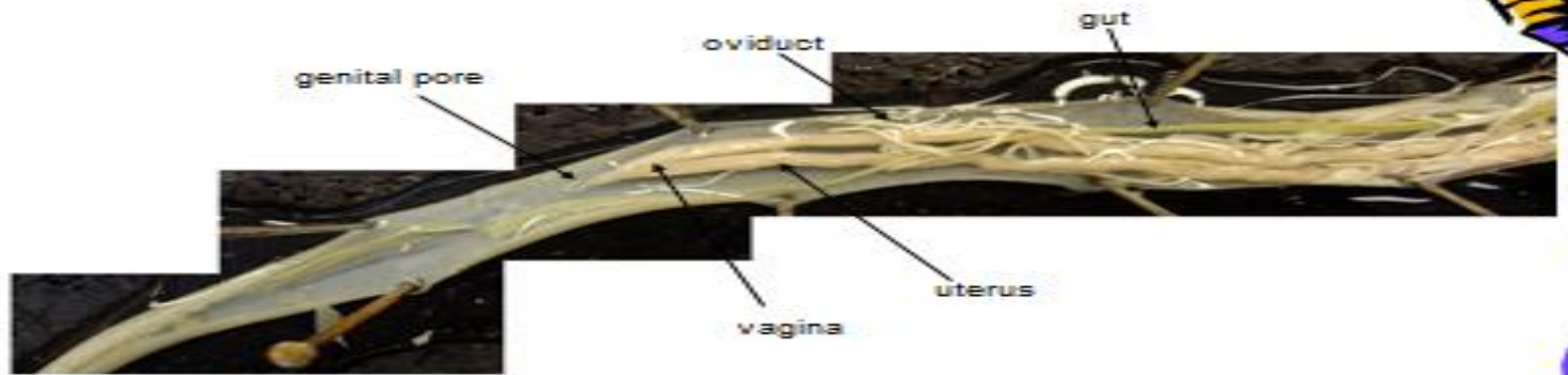


Male



## *Ascaris lumbricoides* cont.

Female



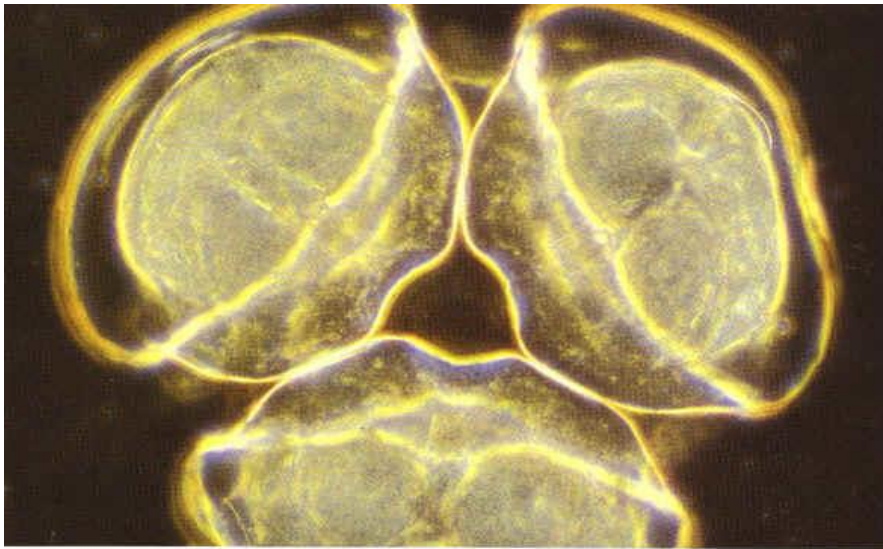
## *Ascaris lumbricoides* cont.

Male

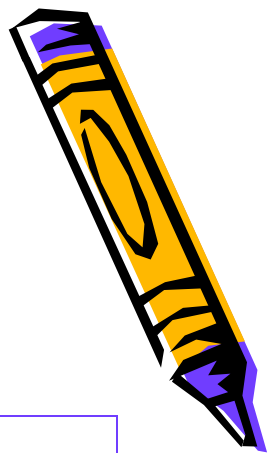




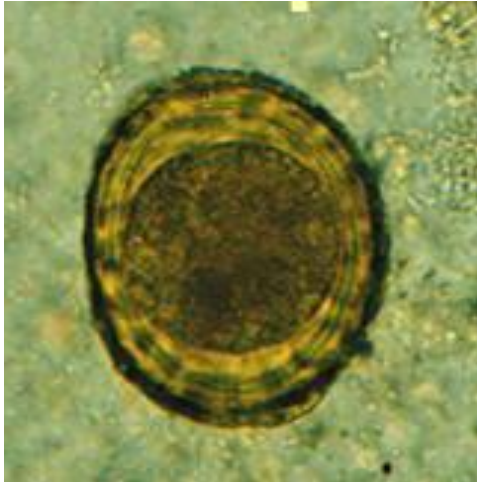
# The lips of *Ascaris lumbricoides*



The three lips are seen at the anterior end. The margin of each lip is lined with minute teeth which are not visible at this magnification.

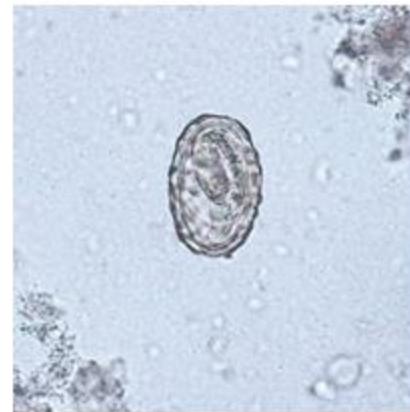
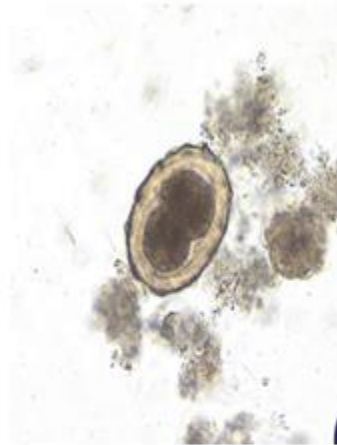
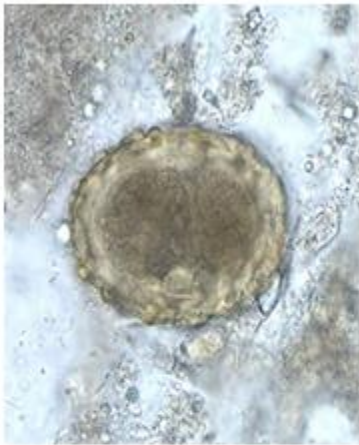


# Fertilized *Ascaris* Egg



A fertilized *Ascaris* egg, still at the unicellular stage, as they are when passed in stool.

Larvae of *Ascaris lumbricoides* hatching from eggs.



Fertilized egg of *A. lumbricoides* in unstained wet mounts of stool, with embryos in the early stage of development.

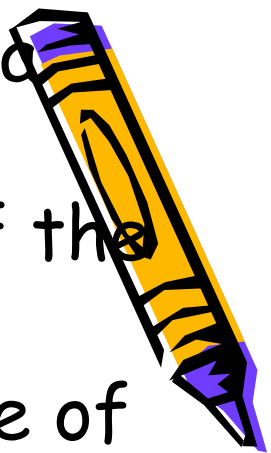
2. **Unfertilized egg**: Longer and slender than a fertilized egg. The chitinous layer and albuminous coat are thinner than those of the fertilized eggs without ascaroside and fertilizing membrane. The content is made of many refractile granules various in size.



Unfertilized egg of *A. lumbricoides* in an unstained wet mount of stool.



Unfertilized egg of *A. lumbricoides*. the prominent mammillations on the outer layer.

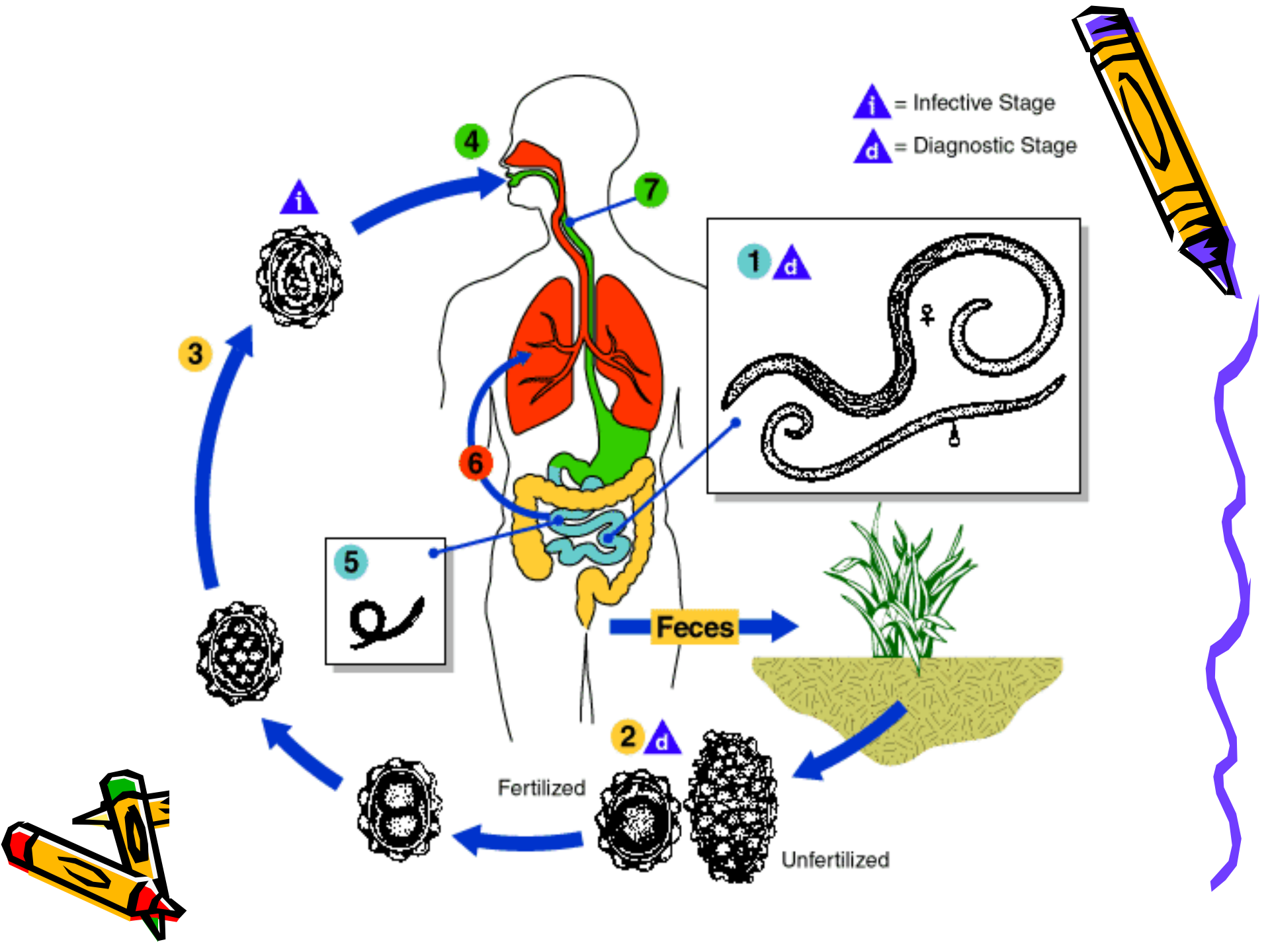


# Life cycle

Adult worms live in the lumen of the small intestine. A female may produce up to 240,000 eggs per day, which are passed with the feces . Fertilized eggs embryonate and become infective after 18 days to several weeks , depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed , the larvae hatch , invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs . The larvae mature further in the lungs (10-14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed . Upon reaching the small intestine, they develop into adult worms . Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.







# Ascaris



Massive Ascaris roundworms

1. A large bolus of anthelminthic



Cross section of a liver specimen contains many adult worms of *A.lumbricoides* obstructing the intrahepatic and extrahepatic bile ducts

## Ascaris Worms in Intestine



## Diagnosis

The symptoms and signs are for reference only. The confirmative diagnosis depends on the recovery and identification of the worm or its egg.

1. *Ascaris* pneumonitis: examination of sputum for *Ascaris* larvae is sometimes successful.

2. Intestinal ascariasis: feces are examined for the *ascaris* eggs.

**(1) direct fecal film: it is simple and effective.** The eggs are easily found using this way due to a large number of the female oviposition, approximately 240,000 eggs per worm per day. So this method is the first choice. floatation method

2- recovery of adult worms: when adults or adolescents are found in feces or vomit and tissues and organs from the human infected with ascarids , the diagnosis may be defined.

3- Indirect methods: a-eosinophilia in blood exam

B- sero-diagnosis : ELIZA, IHA

C- dermal allergic reaction using powdered of *ascaris* antigen



# Intestinal Nematodes

## *Enterobius vermicularis*

A pinworm ("threadworm") is a small, thin, white, called *Enterobius vermicularis* that sometimes lives in the colon and rectum of humans. While an infected person sleeps, female pinworms leave the intestine through the anus and deposit their eggs on the surrounding skin.

A second species, *Enterobius gregorii*, has been described and reported from Europe, Africa, and Asia. For all practical purposes, the morphology, life cycle, clinical presentation, and treatment of *E. gregorii* is identical to *E. vermicularis*.



Phylum : Nematoda Order : Oxyurida Family : Oxyuridae

Genus : *Enterobius* Species : *vermicularis*

Casual Agent:

The nematode (roundworm) *Enterobius vermicularis* (previously *Oxyuris vermicularis*) also called human pinworm. Humans are considered to be the only hosts of *E. vermicularis*. A second species, *Enterobius gregorii*, has been described and reported from Europe, Africa, and Asia. For all practical purposes, the morphology, life cycle, clinical presentation, and treatment of *E. gregorii* is identical to *E. vermicularis*.

**Common names:** Pin worm, Thread worm, Seat worm

**Distribution:** Cosmopolitan

More common in temperate and cold climate than warm climate

**Habitat:**

large intestine:Caecum , appendix and ascending colon

**Morphology:**

ADULT:

Short, white, fusiform

Pointed ends

Resemble white threads

Cervical Alae:

- At the anterior end, Three in number, Wing like cuticular expansions

Oesophagus- double bulb

**MALE WORM:**

Posterior end is curved ,Copulatory spicule

Length : 2-5 mm

Life span : 7 weeks

**FEMALE WORM:**

Thin, pointed, pin like tail, -Oviparous

Length : 8 - 13 mm

Life span : 5 - 13 weeks

**EGG:**

Colourless, non-bile stained,Shape: Planoconvex, Shell : Double layered, Transparent, Sticky  
outer albuminous layer,Contains 'tadpole shaped',coiled larva, Viable up to 2 weeks

- Phylum : Nematoda
- Order : Oxyurida
- Family : Oxyuridae
- Genus : *Enterobius*
- Species : *vermicularis*

## Casual Agent:

The nematode (roundworm) *Enterobius vermicularis* (previously *Oxyuris vermicularis*) also called human pinworm. Humans are considered to be the only hosts of *E. vermicularis*. A second species, *Enterobius gregorii*, has been described and reported from Europe, Africa, and Asia. For all practical purposes, the morphology, life cycle, clinical presentation, and treatment of *E. gregorii* is identical to *E. vermicularis*.

## Common names

- Pin worm, Thread worm, Seat worm

## Distribution:

- Cosmopolitan
- More common in temperate and cold climate than warm climate

## Habitat:

large intestine: Caecum , appendix and ascending colon

## Morphology:

### ADULT:

- Short, white, fusiform
- Pointed ends
- Resemble white threads

### Cervical Alae:

- At the anterior end, Three in number, Wing like cuticular expansions
- Oesophagus- double bulb

## MALE WORM:

- Posterior end is curved
- Copulatory spicule
- Length : 2-5 mm
- Life span : 7 weeks

## FEMALE WORM:

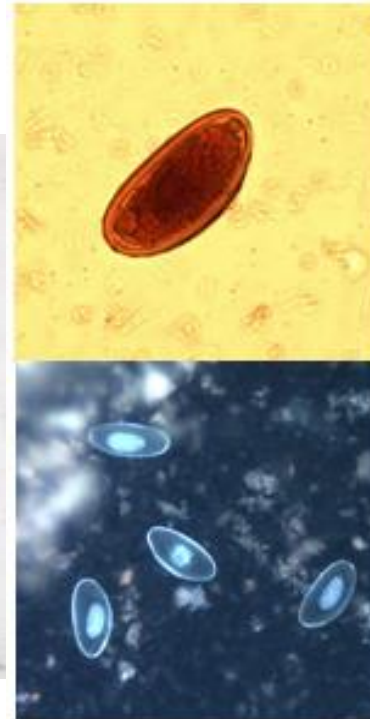
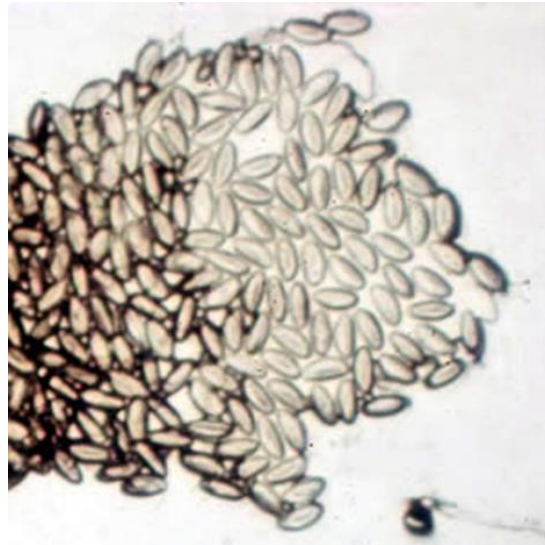
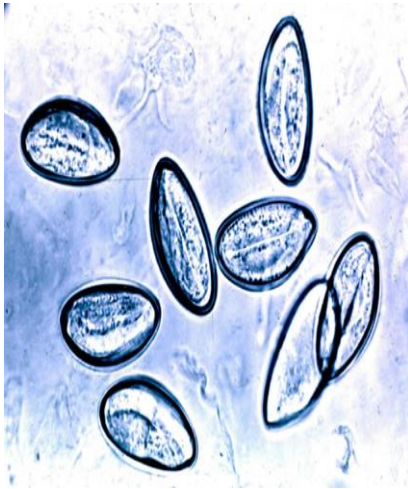
- Thin, pointed, pin like tail
- Oviparous
- Length : 8 - 13 mm
- Life span : 5 - 13 weeks

## EGG:

Colourless, non-bile stained, Shape: Planoconvex, Shell : Double layered, Transparent, Sticky outer albuminous layer, Contains 'tadpole shaped', coiled larva, Viable up to 2 weeks

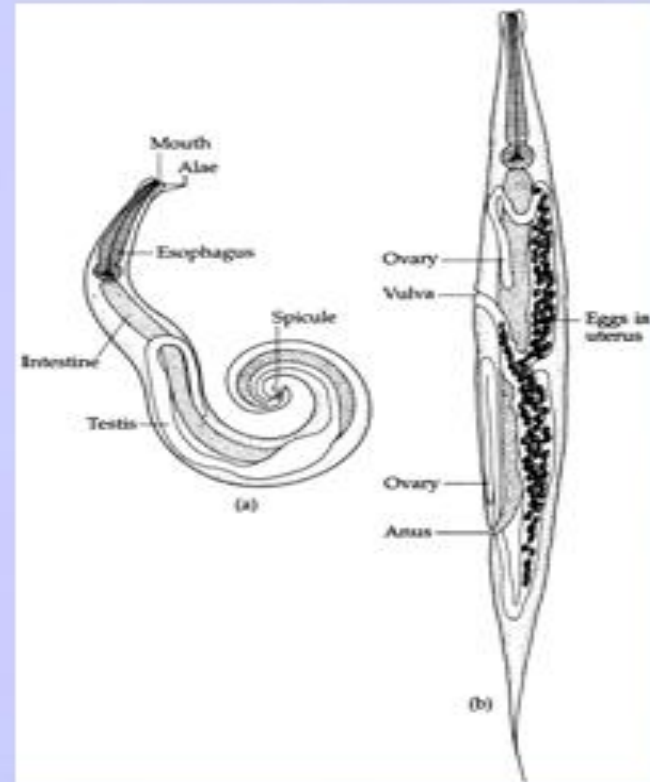
# Egg

The eggs of *Enterobius vermicularis* measure 50-60  $\mu\text{m}$  by 20-30  $\mu\text{m}$ , are elongate-oval and slightly flattened on one side. They are usually partially-embryonated when shed. Enterobiasis can be diagnosed by applying cellulose tape to the anus of a suspect patient, especially in the morning before the patient's first bowel movement. Eggs will adhere to the tape and can be seen microscopically.

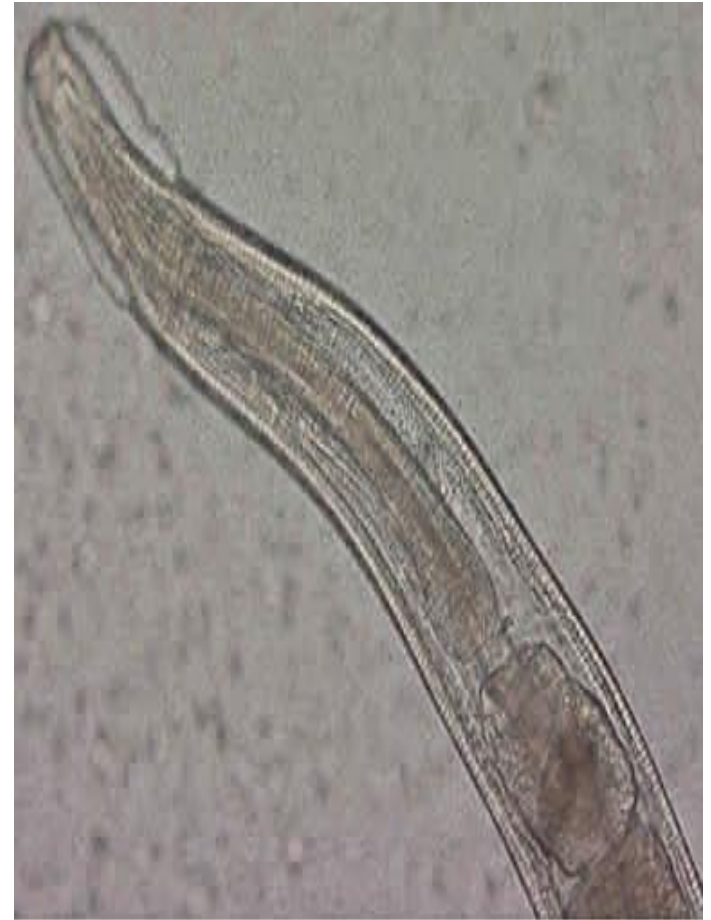


# Adult

Adult males of *Enterobius vermicularis* measure up to 2.5 mm long by 0.1-0.2 mm wide; adult females measure 8-13 mm long by 0.3-0.5 mm wide. Adult males have a blunt posterior end with a single spicule; females possess a long pointed tail. In both sexes, there are cephalic expansions.







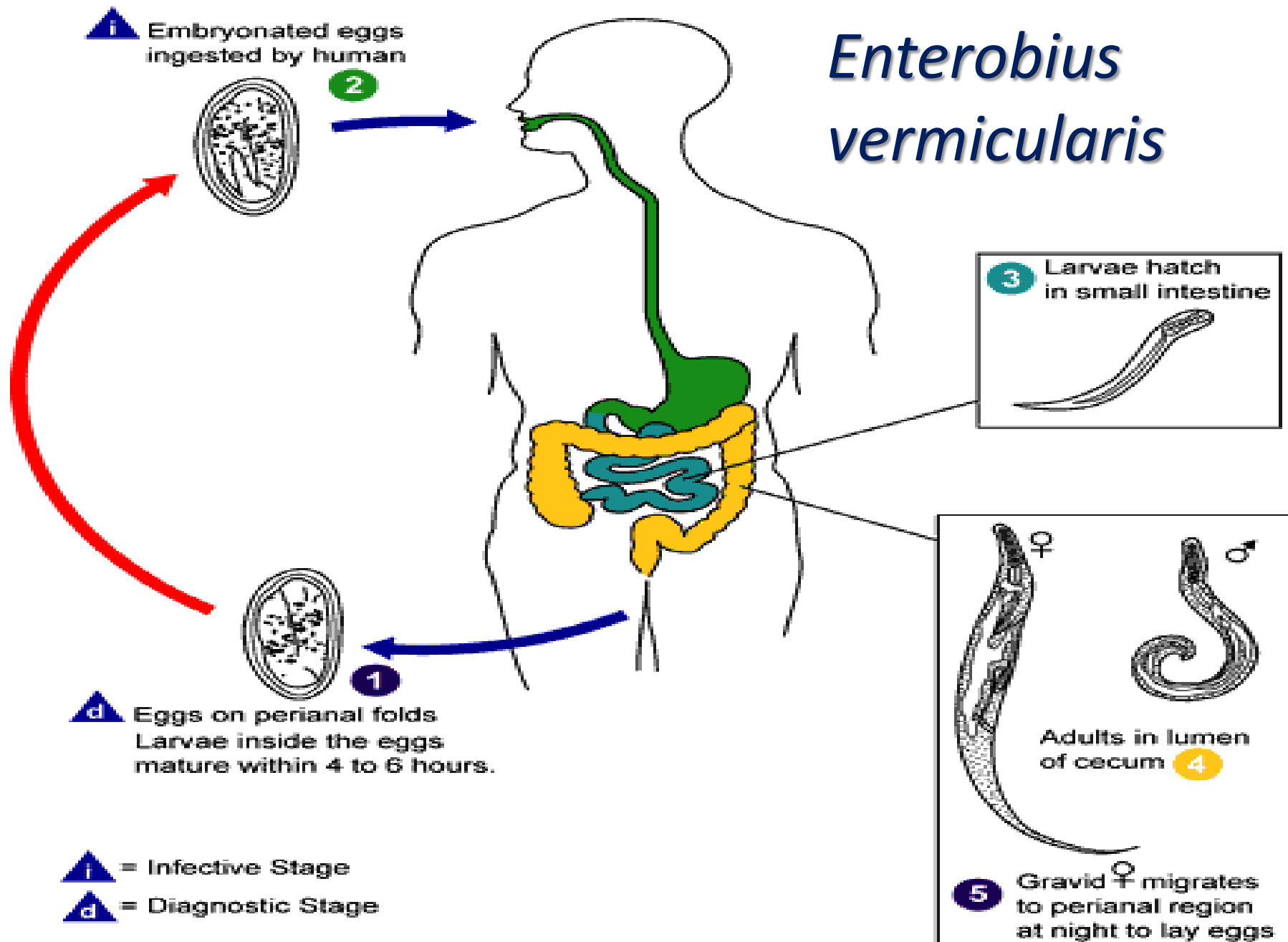
Adult male of *E. vermicularis* from a formalin-ethyl acetate (FEA) concentrated stool smear, Close-up of the posterior end of the worm

# Life cycle



Eggs are deposited on perianal folds **1**. Self-infection occurs by transferring infective eggs to the mouth with hands that have scratched the perianal area **2**. Person-to-person transmission can also occur through handling of contaminated clothes or bed linens. Enterobiasis may also be acquired through surfaces in the environment that are contaminated with pinworm eggs (e.g. , curtains, carpeting). Some small number of eggs may become airborne and inhaled. These would be swallowed and follow the same development as ingested eggs. Following ingestion of infective eggs, the larvae hatch in the small intestine **3** and the adults establish themselves in the colon **4**. The time interval from ingestion of infective eggs to oviposition by the adult females is about one month. The life span of the adults is about two months. Gravid females migrate nocturnally outside the anus and oviposit while crawling on the skin of the perianal area **5**. The larvae contained inside the eggs develop (the eggs become infective) in 4 to 6 hours under optimal conditions **1**. Retroinfection, or the migration of newly hatched larvae from the anal skin back into the rectum, may occur but the frequency with which this happens is unknown.

# *Enterobius vermicularis*



### Mode of infection:

1-external and internal autoinfection. 2-person to person infection. 3-egg become airborne and inhaled then swallowed. 4-ingested eggs with contaminated food and water.

### Pathogenesis:

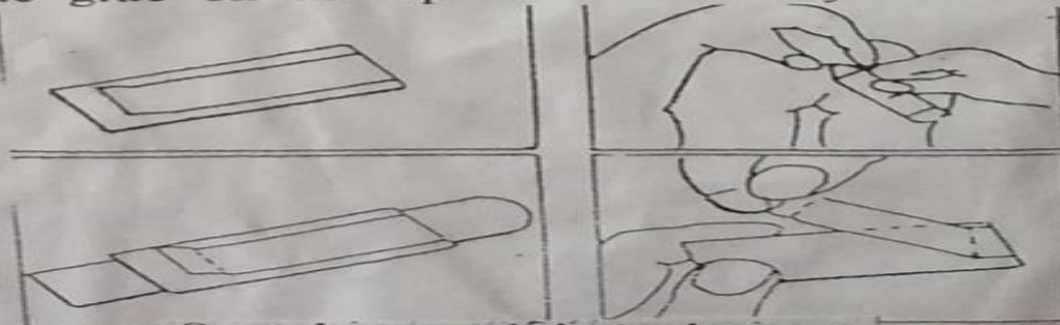
- Migration of the female worms from the anus produce pruritus, and the worms may invade vagina and producing local irritation and itching.
- The common symptoms in children pruritus ani, perianal excoriation, abdominal pain, anorexia, nail biting, insomnia and loss of weight.
- Ectopic enterobiasis may cause appendicitis, recurrent UTI and peritonitis.

### Lab. Diagnosis:

- finding adult worm on anal area.
- stool examination by direct smear and concentration techniques (stool exam. Is not recommended)
- perianal swabs reliable (cellulose tape collection procedure).

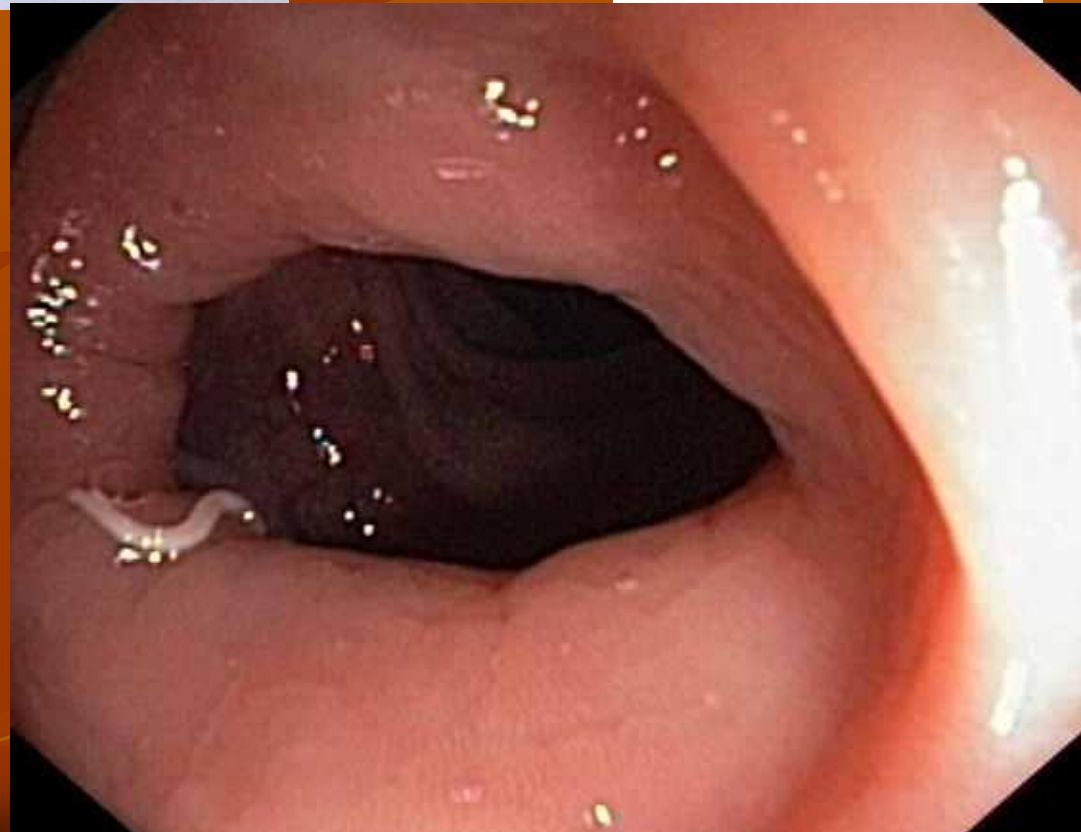
- A strip of cellophane tape was placed on a microscopic glass, starting 1.5 cm from one end and running towards the same end, continuing around this end across the slide. The strip was teared off even at the other end. Then, a strip of paper 1.5 cm was placed between the slide and the tape at the end.
- The tape was peeled back by gripping the label, and the slide was held with the tape looped adhesive side outward over a wooden tongue depressor and extended about 2.5 cm beyond it. The tape was pressed firmly against the right and left perianal folds.
- The tape was spreaded back on the slide, adhesive side down.
- The slide was then examined under low power for indication of the presence of the typical asymmetric pinworm eggs.

A drop of xyelene or toluene was placed on the slide before the tape. It will dissolve the glue on the tape and clear away bubbles (Schimdt and Roberts, 1996)

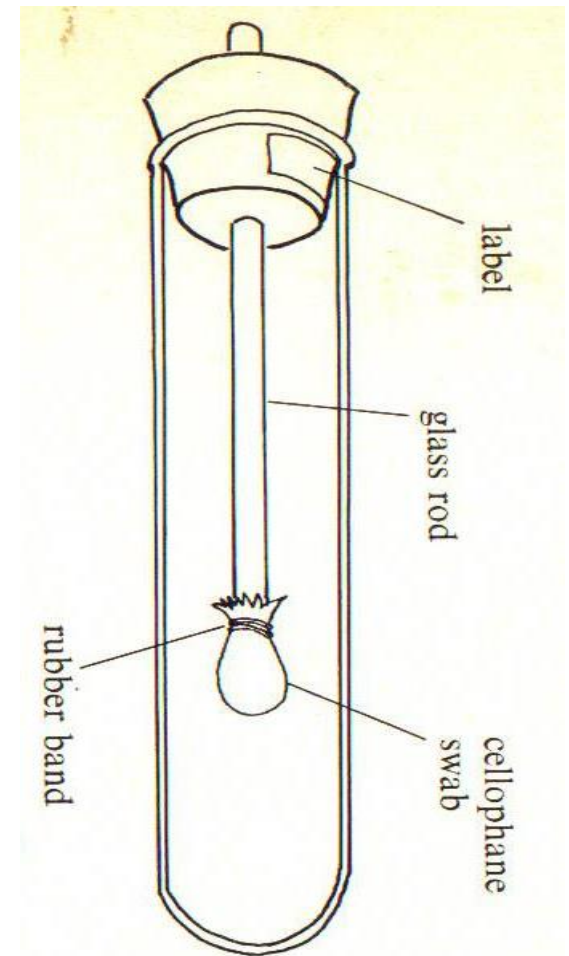
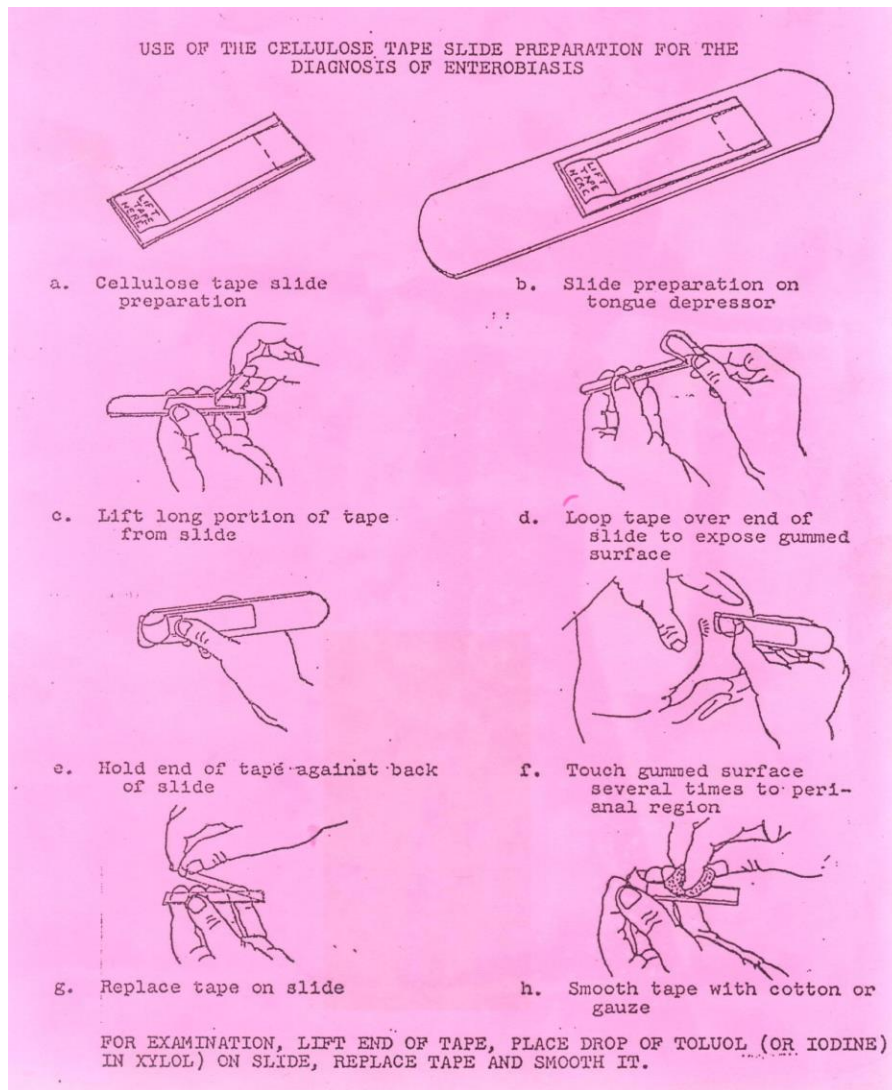




# *Entrobium vermicularis* eggs, larva & adult



## Scotch tape technique ( graham swab )



The NIH swab. The cellophane is now usually replaced with sticky tape

The techniques which used for detected the eggs of *E. vermicularis* from perianal skin,  
 Note : eggs can also be recovered from under the finger nails