

الجامعة المستنصرية

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فرع علوم الأنتسان

# الديدان الطفيلية النظرية

## Medical Helminthology

مدرسي المادة

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للطباعة والأستنساخ

السعر:

# **Medical Helminthology**

## **Introduction to Medical Helminthology**

***Medical Helminthology:*** studies biological features and geographic distribution of parasitic worms (helminthes), the course of helminthic invasions, diagnosis, prophylaxis and control of helminthic diseases.

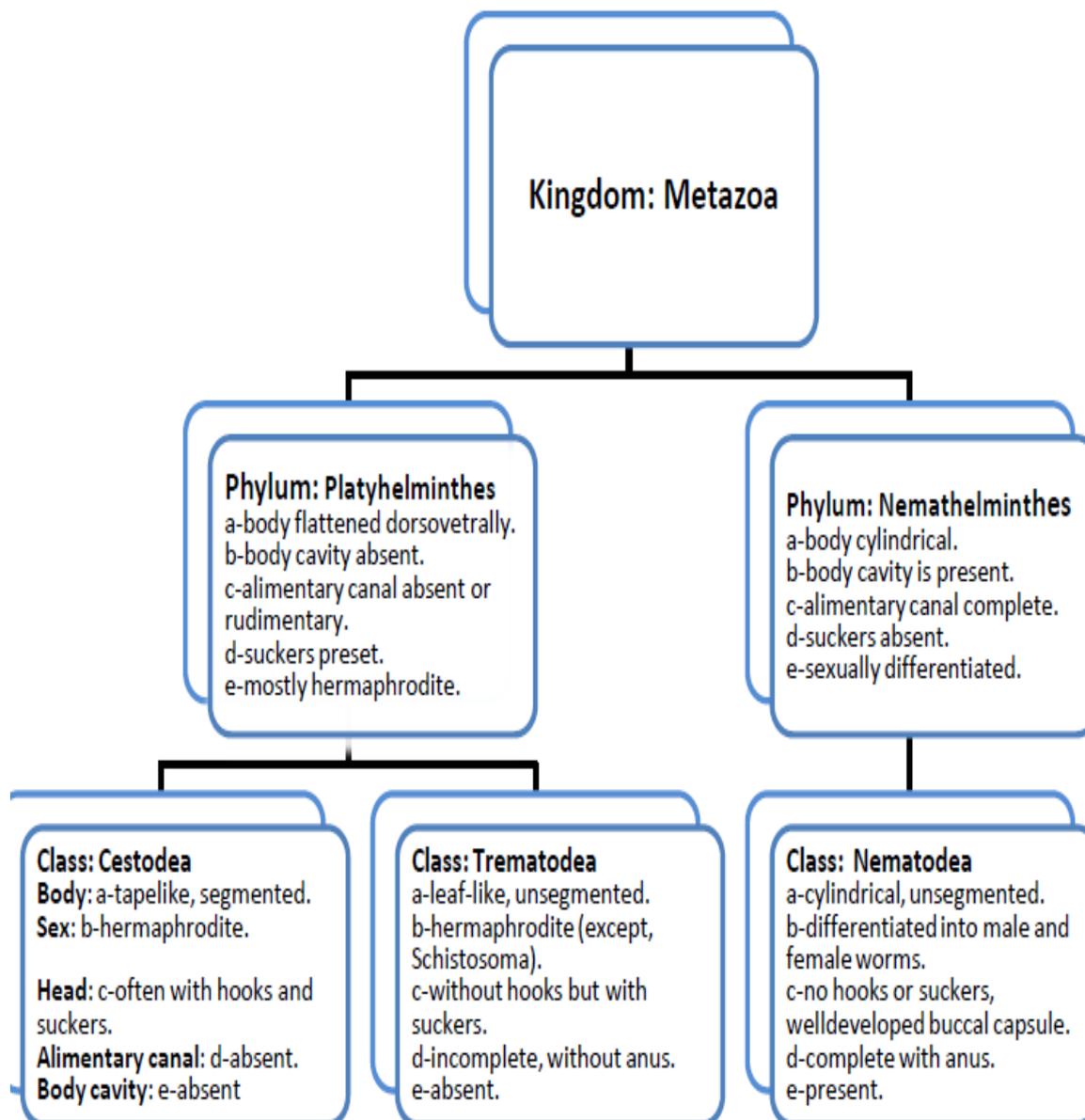
**Helminths:** are invertebrates that develop through egg, larval (juvenile), and adult stages.

The definitive classification is based on : **the external and internal morphology of egg, larval, and adult stages.**

**The main phyla which contain:**

**1- vermiform parasites are Platyhelminthes (flatworms)**

**2-Nemathelminthes (roundworms). Flatworms include: Tapeworms (Cestodes) and Flukes (Trematodes).**



The most characteristic feature of parasitic worms is that they may reside in humans for years, in many instances for decades, actively producing eggs or larvae. Almost all species **can not complete their life cycles in human host and require one or two obligatory intermediate hosts or specific conditions of environment.** A common name of a disease caused by helminths is helminthosis.

**Depending on the features of their life cycle, the helminthic parasites can be classified into three groups:**

**1- biohelminths** :which develop with alternation of hosts. As a rule, in this case the factors of pathogen transmission include animate entities (such as crustaceans, insects) of food products of animal origin.

Examples of biohelminthes are liver fuke *Fasciola hepatica*, beef tapeworm *Taeniarhynchus saginata*, round worm *Trichinella spiralis*.

**2-geohelminths**: which develop without alternation of hosts and part of their life cycle passes *in soil*. In geohelminthiasis, factors of transmission are objects of inanimate nature, such as water or soil, but also fruit and vegetables raised in soil and contaminated with invasive eggs. Examples are maw worm *Ascaris lumbricoides*, dog heart worms *Toxocara spp*.

**Helmintic parasites can enter into human body** by different modes.

**A-In active penetration:** of helminths into human body, larvae penetrate host skin in soil contact (i.e., acquired by walking barefoot on contaminated soil).

**B- In passive penetration:** parasitic invasion is acquired by ingestion of poorly cooked meat, which contains encysted larvae, or egg-contaminated water or food supplies. The particular parasites in certain regions of world are transmitted to human by insect vector, e.g., filarial worms by mosquitoes of genera *Culex*, *Aedes*, *Anopheles* (vector transmission).

### **Types of Host**

**1- Definitive host (DH):** that harbors the adult or sexually mature stages of the parasite(or in whom sexual reproduction occurs) e.g. man is DH for *Schistosomahaematobium*,

- 2- **Intermediate host (IH):** that harbours larval or sexually immature stages of the parasite (or in whom asexual reproduction occurs) e.g. man is IH of malaria parasites.
- 3- **Reservoir host (RH)** harbours the life cycle of the parasite in nature and is therefore, a reservoir source of infection for man. e.g. sheep are RH for *Fasciola hepatica*.
- 4- **Paratenic or transport host** in whom the parasite does not undergo any development but remains alive and infective to another host. Paratenic hosts bridge gap between the intermediate and definitive hosts. For example, dogs and pigs may carry hookworm eggs from one place to another.
- 5- **Vector** is an arthropod that transmits parasites from one host to another, e.g. female sand fly transmits *Leishmania* parasites .

### **Why are helminths important ?**

- **Production losses due to**

- Competition for nutrients
- Damage to body systems e.g. gut, liver
- Death

- **Animal welfare**

- Companion animals
- Food animals

- **Public health (zoonotic infections)**

- **Feeding:**

- 1- **Passive feeders**

- 2- **Tissue feeders:**– Solid tissues – Blood

## -Reproduction

1- **Asexual:** A– Multiplication B– Parthenogenesis

2- **Sexual:** A– Monoecius B– Dioecius

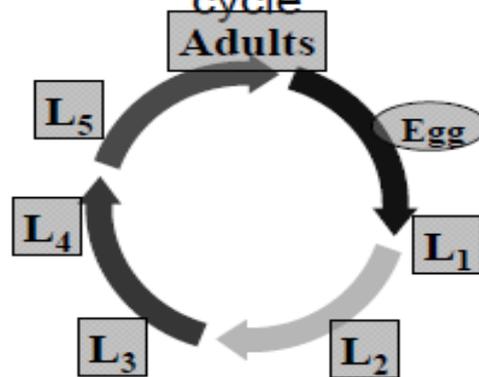
## -Life cycles

1- **Direct**

2- **Indirect:**– Definitive Host – Intermediate host – Arthropod (vector)

Born

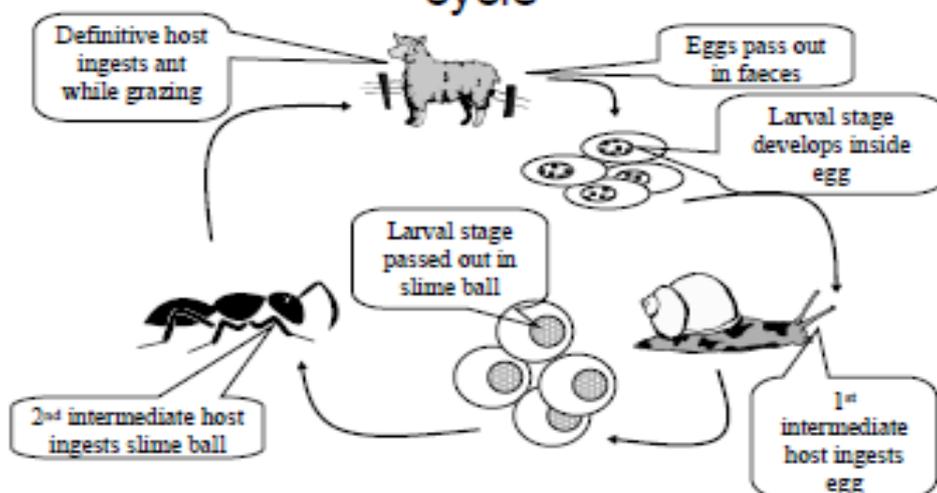
### Example of a simple, direct life cycle



Introduction to the helminths

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### Example of a complex, indirect life cycle



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# Characteristics of helminths

	Trematode	Cestode	Nematode
<b>Appearance</b>	<b>Leaf-like</b>	<b>Tape-like</b>	<b>Worm-like</b>
<b>Cross-section</b>	<b>Flattened</b>	<b>Flattened</b>	<b>Cylindrical</b>
<b>Body cavity</b>	<b>Absent</b>	<b>Absent</b>	<b>Fluid-filled</b>
<b>Gut</b>	<b>Blind sack</b>	<b>Absent</b>	<b>True gut</b>
<b>Life cycle</b>	<b>Indirect</b>	<b>Indirect</b>	<b>Direct &amp; indirect</b>
<b>Reproduction</b>	<b>Monoecious</b>	<b>Monoecious</b>	<b>Dioecious</b>

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## General characteristics of helminthes

1. They do not possess organs of locomotion, so locomotion is by muscular contraction & relaxation.
2. The outer covering, known as cuticle or integument. It is situated on its outer surface & may be armed with spines or hooks. It is resistant to intestinal digestion.
3. Nervous system and excretory system are primitive.
4. Digestive system is complete, partially lost (rudimentary) or absent. The alimentary tract has entirely disappeared from all stages of the tapeworms (cestodes);
5. Reproductive system is very well developed.
6. They may be monocious or diecious. Both self-fertilization and cross-fertilization may take place.

## **Lec(2): Phylum Nematoda(roundworms)**

### **Characteristics of Nematoda:-**

- 1) Bilaterally symmetrical, and vermiform.
- 2) Body has more than two cell layers, tissues and organs.
- 3) Body cavity is a pseudocoel, body fluid under high pressure.
- 4) Body possesses a through gut with a subterminal anus.
- 5) Body covered in a complex cuticle.
- 6) Has a nervous system with pharyngeal nerve ring.
- 7) Has no circulatory system (no blood system)
- 8) Reproduction normally sexual and gonochoristic.
- 9) Feed on just about everything.
- 10) Live just about everywhere, many species are endoparasites.

### **1-Intestinal nematodes**

#### ***1-Enterobius vermicularis* - Pinworm, Threadworm**

The pin worms are one of the most common intestinal nematodes .The adult worms inhabit the cecum and colon. Right after mating, the male dies. Therefore ,the male worms are rarely seen. The male worms migrate out the anus depositing eggs on the perianal skin.Humans get this infection by mouth and by autoinfection.

## Morphology

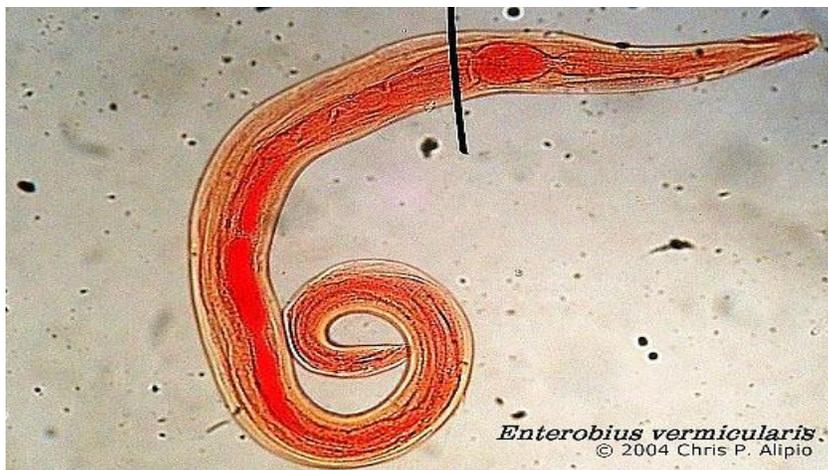
1. **Adults:** The adults look like a pin and are white in color. The female worm measures about 8 to 13 mm in size and is fusiform in shape. The male adult is only 2-5 mm. The tail of a male is curved. The anterior end tapers and is flanked on each side by cuticular extensions called “cephalic alae”.

The esophagus is slender, terminating in a prominent posterior bulb, which is called the esophageal bulb. The cephalic alae and esophageal bulb are important in identification of the species.

2. **Egg:** 50 to 60  $\mu$ m by 25  $\mu$ m, colorless and transparent, thick and asymmetric shell, content is a larva.

### MALE WORM:

Posterior end is curved. Copulatory spicule. Length: 2-5 mm

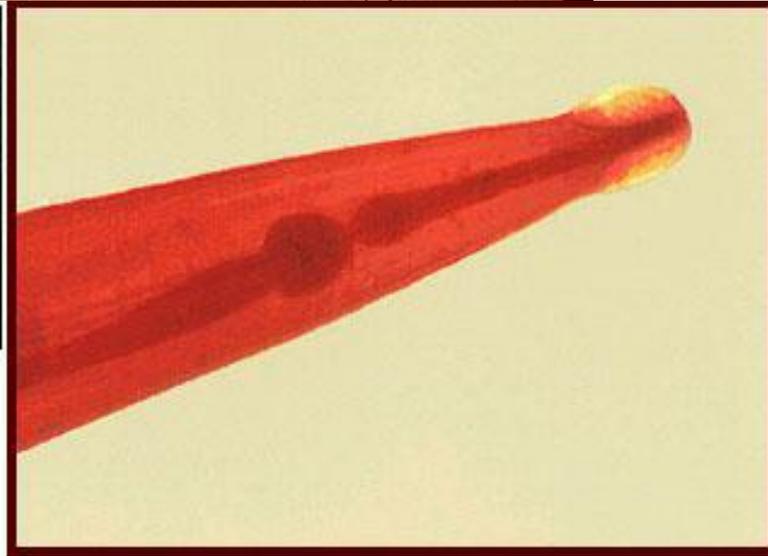
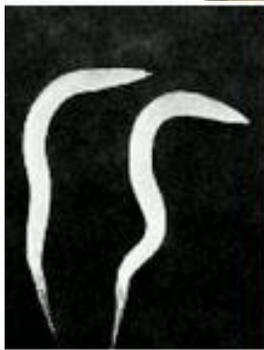


### FEMALE WORM

Thin, pointed, pin like tail. Reproductive organs

-T shaped and -paired

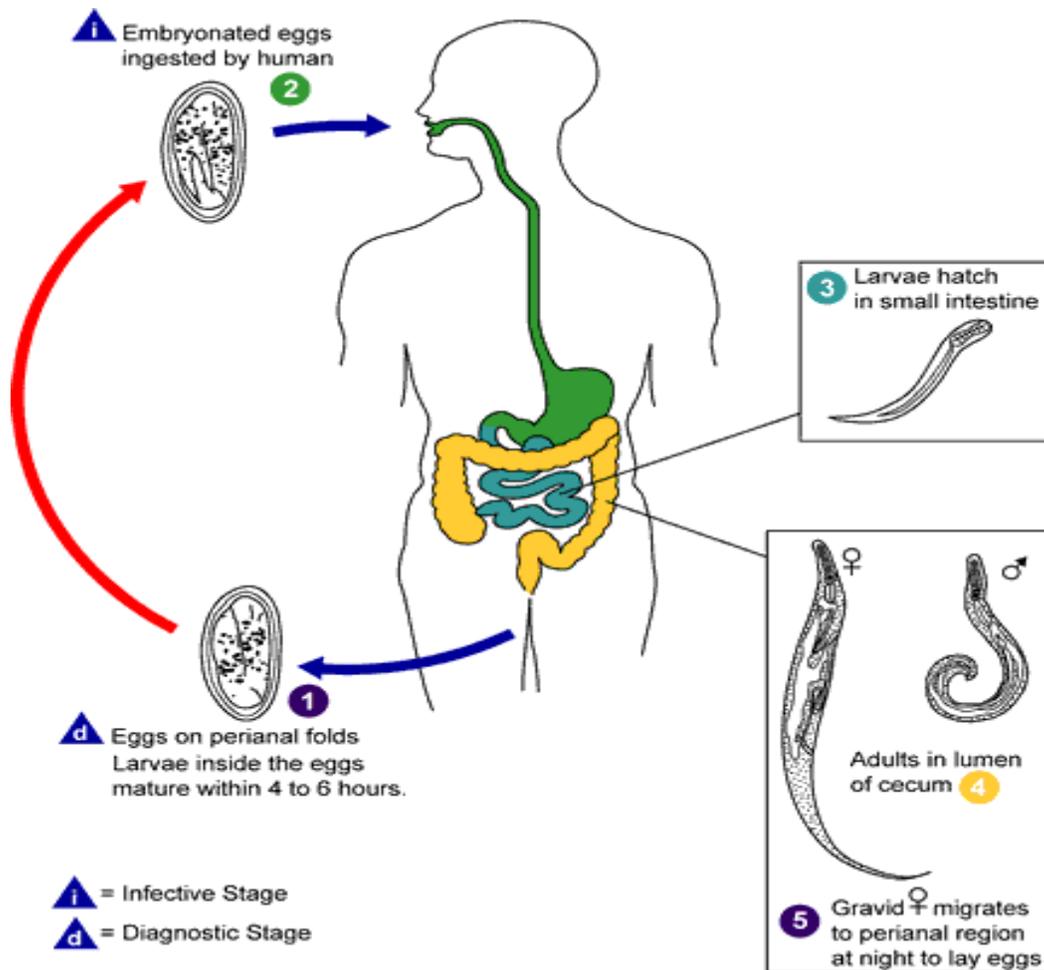
Length: 8 - 13 mm



Anterior part of *E. vermicularis*. Note cephalic alae and esophageal bulb

### Life Cycle

1. site of inhabitation: cecum and colon
2. infective stage: embryonated egg
3. infective route :by mouth
4. without intermediate host and reservoir host
5. life span of female adults: 1-2 months



## Symptomatology

About one-third of pinworm-infected persons are **asymptomatic**, the adult worms may cause **slight irritation** of the intestinal mucosa.

Major symptom is **anal pruritus**, which associates with the nocturnal migration of the gravid females from the anus and deposition of eggs in the perianal folds of the skin. **Restlessness, nervousness, and irritability**, probably resulting from poor sleep associated with anal pruritus,.

## Diagnosis

Diagnosis depends on recovery of the characteristic eggs. The eggs and the female adults can be removed from the folds of the skin in the

perianal regions by the use of the cellophane tape method. The examination should be made in the morning, before the patient has washed or defecated

### **Prevention:**

1. treat the patients and carriers 2. individual health 3. public health 4. health education and hygienic habits

### **Epidemiology**

Geographical distribution—cosmopolitan in temperate zones with about 30 to 50% of the population infected. It is more common in white than colored people and more prevalent in children than adults. Enterobiasis is most common where people live under crowded conditions such as kindergartens, and large families.

### ***2-Ascaris lumbricoides* - The Large Human Roundworm.**

*Ascaris lumbricoides* is one of **the largest and most common**

parasites found in humans. It is estimated that 25% of the world's population is infected with this nematode.

### **Habitat:**

The adult worm lives in the small intestine of man

### **Morphology :**

#### **Adult;**

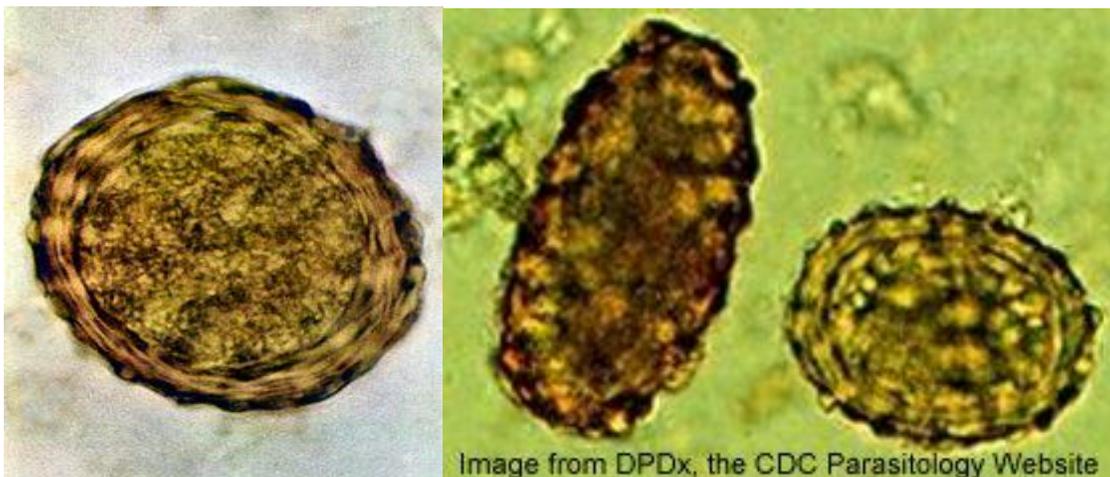
*As. Lumbricoides* is characterized by its great size. Males are 2-4mm in diameter and 10-30 cm long. The male posterior end **is curved**

**ventrally with two spicules, but no copulatory bursa.** Females are 3-6mm wide and 20-35cm long. The **vulva is located in the anterior end and accounts for about a third of its body length.** Uteri may contain up to 27 million eggs at a time with 200,000 being laid per day. The posterior end is straight and conical. The mouth at the anterior end of both male and female has three finely denticulate lips, one dorsal and two ventro-lateral.

### **Eggs:**

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

**2-Unfertilized egg:** The chitinous layer and albuminous coat are thinner than those of the fertilized eggs without ascaroside and fertilizing membrane.



### **Life cycle,:**

\_Life cycle stages : Adult, larva, ova

\_Host : Single host, man (definitive)

\_Infective form : *Embryonated* egg

\_Pathogenic form : Adults & larva

\_Route of infection : Fecal oral

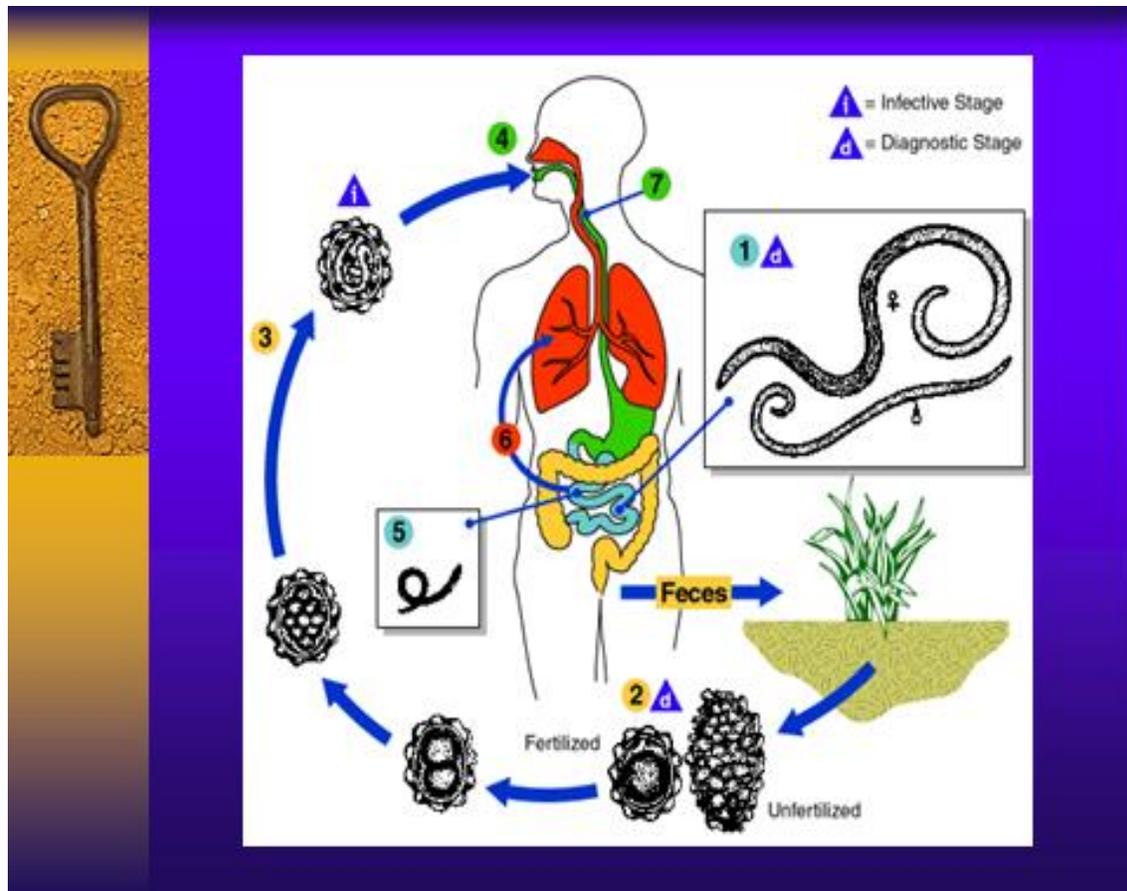
\_Site of localization : Small intestine

\_Time required for completion of life cycle :

2-3 months

The humans are infected when they ingest such infective eggs. The eggs hatch in the small intestine, the juvenile penetrates the small intestine and enters the circulatory system, and eventually the juvenile worm enters the lungs.

In the lungs the juvenile worm leaves the circulatory system and enters the air passages of the lungs. The juvenile worm then migrates up the air passages into the pharynx where it is swallowed, and once in the small intestine the juvenile grows into an adult worm.



## Pathogenesis

There are two phase in ascariasis:

**1. The blood-lung migration phase of the larvae:** During the migration through the lungs, the larvae may cause a pneumonia. The symptoms of the pneumonia are low fever, cough, blood-tinged sputum, asthma. Large numbers of worms may give rise to allergic symptoms. Eosionophilia is generally present. These clinical manifestation is also called **Loeffler's syndrome**.

**2-The intestinal phase of the adults.** The presence of a few adult worms in the lumen of the small intestine usually produces no symptoms, but may give rise to vague abdominal pains or intermittent colic, especially in children. A heavy worm burden can result in

malnutrition ,in which **biliary ascariasis is the most common complication**

## **Diagnosis**

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

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

## **Epidemiology**

- ◆ World wide distribution, very common in China, especially in the countryside.

## **Factors favoring the spread of the transmission:**

1. Simple life cycle.
2. Enormous egg production ( 240,000 eggs/ day/ female ).
3. These eggs are highly resistant to ordinary disinfectants( due to the ascroside). The eggs may remain viable for several years.
4. Social customs and living habits.
5. Disposal of feces is unsuitable

## **Prevention**

- 1-Sanitary disposal of feces.
- 2-Hygienic habits such as cleaning of hands before meals.
- 3.Health education

**3-Hookworms are the voracious blood feeders of the nematode world**

### 3- *Necator americanus* and *Ancylostoma duodenale*

*Necator americanus* known as the american killer also known **the new world hookworm.**

*Ancylostoma duodenale* known as **the old world hookworm**

✦ Definitive host: Human No Intermediate host

✦ *Necator americanus*: is the most common species in humans in most of the world. About 95% of the hookworms in the southern United States are this species .It has a pair of dorsal and a pair of ventral cutting plates surrounding the anterior margin of the bucal capsule

Males have bursa diagnostic for the genus. The needle like spicules have minute barbs at their tips and are fused distally.



✦ ***Ancylostoma duodenale***: Associated with miners because mines offer an ideal habitat for egg and juvenile development due to constancy in temperature and humidity.

It was known to cause a serious anemia in miners.

Has two ventral plates, each with large teeth that are fused at their bases. A pair of small teeth is found in the depths of the capsule. The needlelike specules have simple tips and are never fused distally.

### **Morphology**

**The eggs** :are bluntly rounded, thin shelled, and are almost indistinguishable between the different species



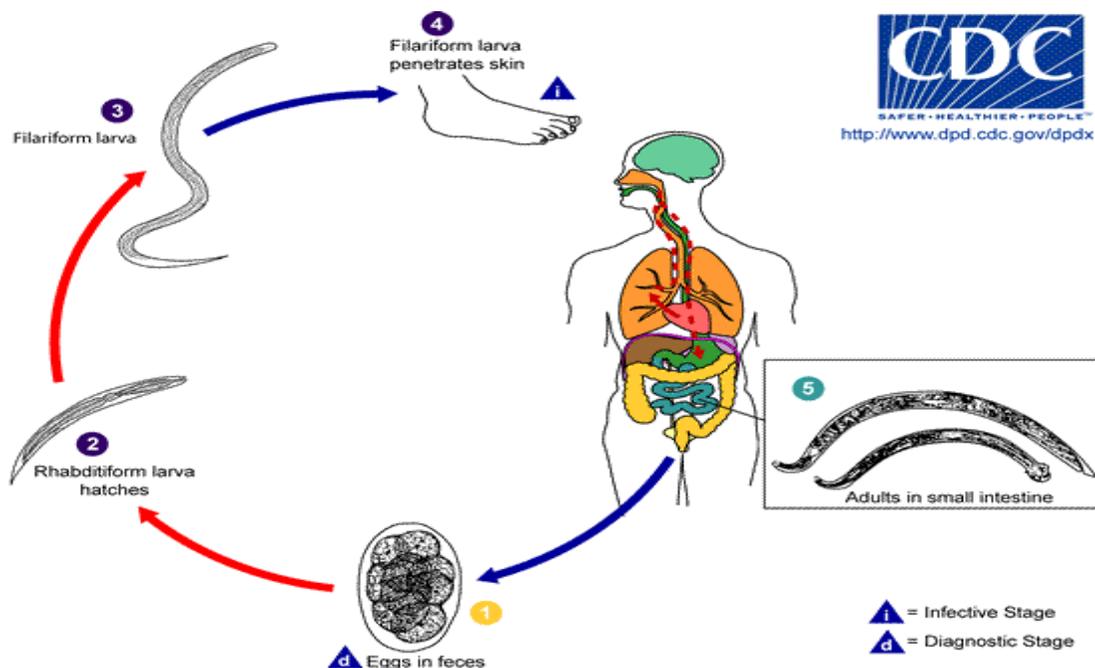
**The adult parasites:** are small cylindrical worms, (*Ancylostoma duodenale* being slightly larger than *Necator americanus*)

The male worm is equipped with a characteristic copulatory bursa, used to catch and hold the female during mating.



## Life cycle

- ✦ Eggs are passed with feces. Eggs hatch in about 48 hours under favorable conditions such as (moist soil, protection from direct sun rays and temperature about 25°C).
- ✦ The **first-stage larva** feed upon bacteria in the feces about three days and then molt to **second-stage larva**. First and second stage larva have a **rhabditiform esophagus**. After 5-10 days they molt and become **filariform third-stage larva** that are infective.
- ✦ These infective larva can survive 3-4 weeks in favorable environmental conditions. 25 -15°C at 0°C death occurs rapidly. They move to the surface of the soil and wave back and forth which increases the chance to contact host. When they contact with the human host, the larva penetrate the skin and are carried through the veins to **the heart and then to the lungs**, break through into air sacs, to the **trachea and are swallowed**. The larva reach the small intestine, where they reside and mature in to adults.



**Note:** Hookworms have evolved strategies to evade the host's defense system, and several of these has been discovered.

*Ancylostoma* spp. Secrete a **neutrophil inhibition factor** that interferes with activation of neutrophils.

*N. americanus* secretes **acetyl cholinesterase**, which inhibits gut peristalsis and possibly is an anti-inflammatory factor.



### **Symptoms/pathogenesis**

- ✦ Itching of skin as a result of penetration by the larvae.
- ✦ Congestion in lungs in heavy infections.
- ✦ Anemia due to loss of blood, particularly if diet is deficient.
- ✦ Diarrhea
- ✦ Persons with chronic hookworm disease are debilitated.
- ✦ Chronic heavy hookworm infection can damage the growth and development of children.

Hookworm infection has been known to be fatal, particularly in infants

### **Diagnosis**

- ✦ Recovery of the eggs in stool samples.

## Prevention

- ✦ Proper sanitation practices.
- ✦ Appropriate fecal disposal.
- ✦ Do not walk barefoot or contact with bare hands in areas where hookworms is common or there are likely to be feces in the soil or sand.

**Comparison of hookworms**

	<i>Necator americanus</i>	<i>Ancylostoma duodenale</i>
Buccal cavity	Dorsal and ventral cutting plates	2 ventral plates and two large teeth
Size of female	9-11mm	10-13
Size of male	7-9mm	8-11mm
Position of vulva	Mid-body	1/3 from posterior
Egg production	9000/ day	25000/ day
Penetration through skin	Yes	Yes
Longevity	15 years	5 years

### 4- *Strongyloides stercoralis*

Habitat: females live in the superficial tissues of the small intestine (duodenum and jejunum)

- Definitive host: Human, dogs and cats
- Route of infection: Filariform larvae penetrate the skin of human.
- Infective stage: Third stage larvae (filariform).

- Diagnostic stage: First stage larvae(Rhabditiform) in feces

## **Morphology**

### **Egg:**

oval . Clear, thin shelled Similar to hookworm but are smaller.

Eggs are laid in the mucosa, hatch into rhabditiform larvae that penetrate the glandular epithelium and pass into the lumen of the intestine and out the feces (Eggs are seldom seen in stools).



### **Adult:Male (parasitic or free-living):**

- 0.7 mm in length,- Rhabditiform oesophagus- Posterior end curved ventrally with Spicules

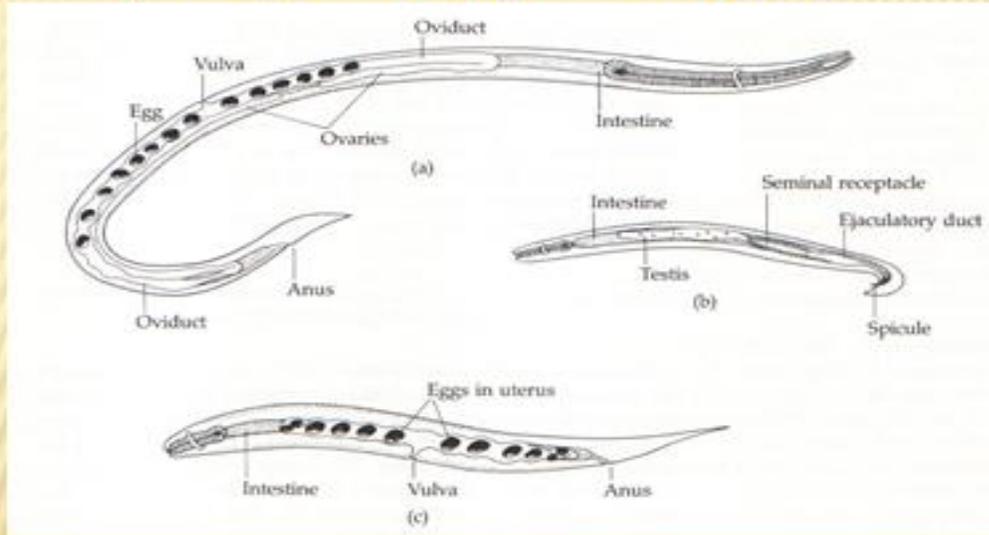
### **Parasitic female:**

- 2.2 mm in length
- Cylindrical oesophagus (1/3 body length)
- Posterior end straight

### **Free living female:**

- 1 mm in length
- rhabditiform oesophagus
- posterior end straight

## Morphology of *Strongyloides stercoralis*



- a) parasitic female
- b) free-living male
- c) free-living female

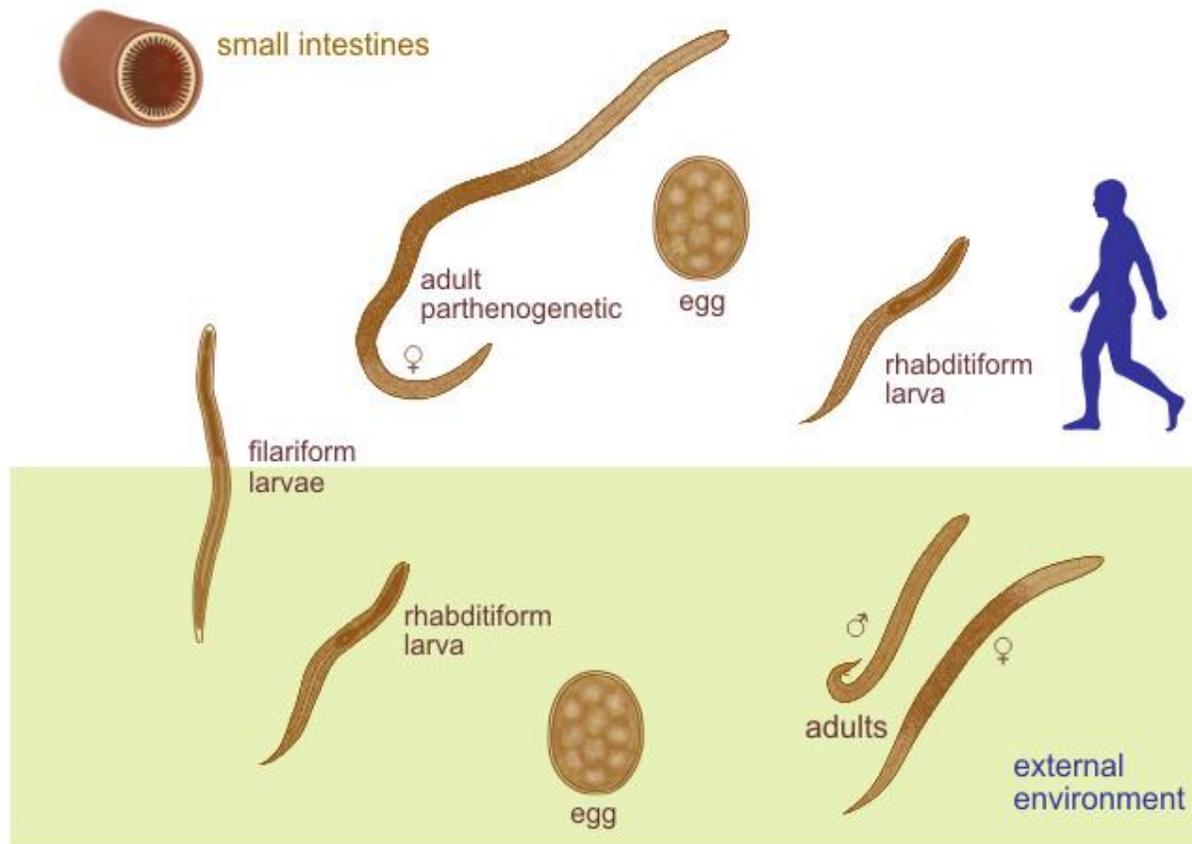
### *Rhabditiform larvae*

✘ Short buccal cavity. **Diagnostic stage** Appear in stools within 4 weeks of infection.



### *Filariform larvae posterior part*

Filariform larva with,notched tail. Infective stage



## Life Cycle:

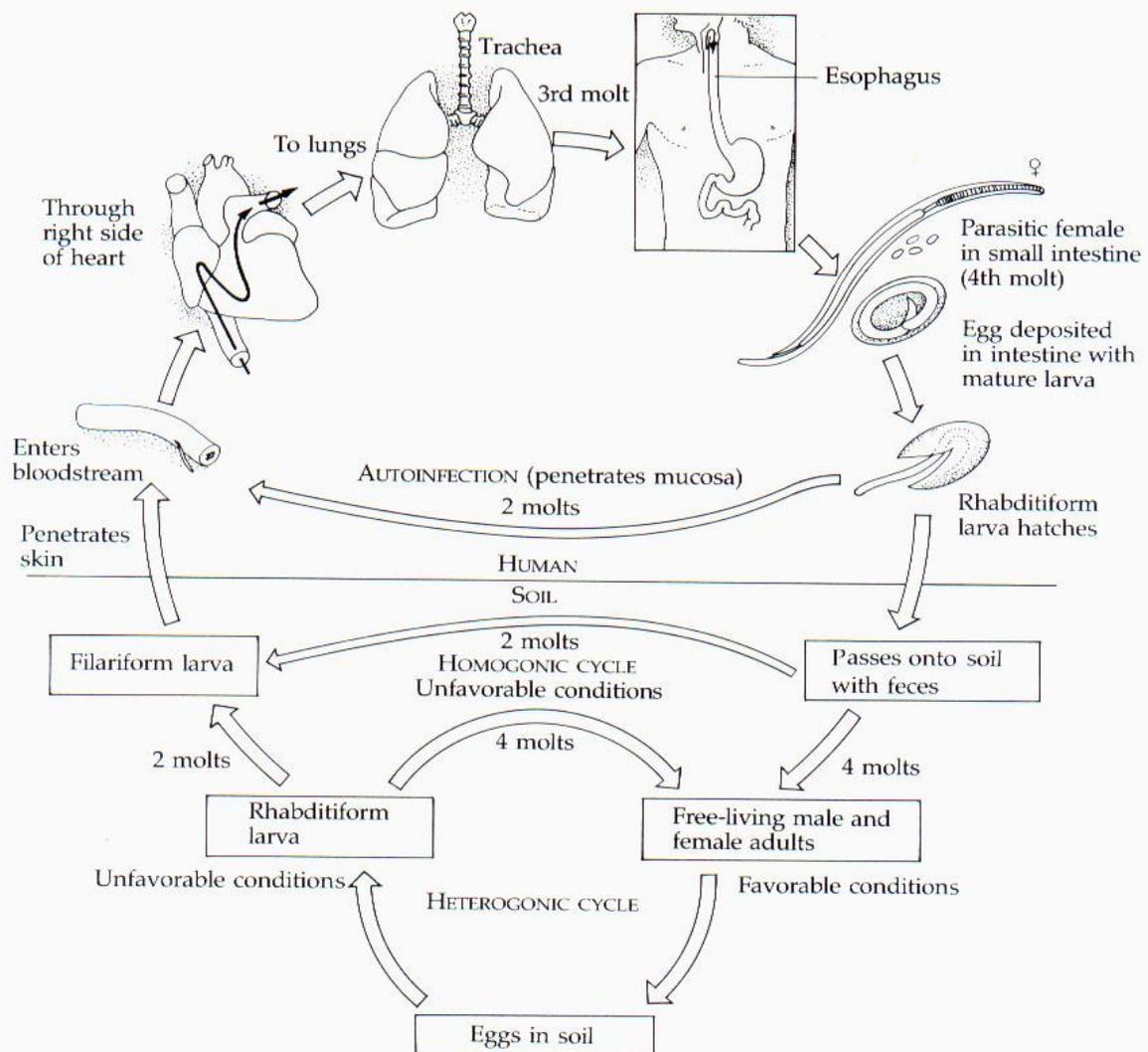
### Free-living cycle

**Parasitic cycle:** In the parasitic stage, no male form of this organism has been reliably identified, and the female reproduce in a parthenogenetic manner.

### 1. Free-living Phase

- Free living *S. stercoralis* dwell in moist soil in warm climates
- Copulation occurs in soil; sperm penetration merely activates the oocyte to develop parthenogenetically with no contribution to the genetic material of the developing embryo

- Following oviposition, eggs hatch in the soil and give rise to 1st stage rhabditiform larvae
- These feed on organic debris, go through several molts and become sexually mature adults
  - This free-living heterogonic life cycle may continue indefinitely
- However, if the environment becomes inhospitable, the rhabditiform larvae molts to become a nonfeeding filariform larva - the form infective to humans



## **Parasitic Phase**

When filariform larvae encounter a human or another suitable host (e.g. cats and dogs), they penetrate the skin and are carried by cutaneous veins to the vena cava

They enter the right side of the heart and are carried to the lungs via the pulmonary artery

In the lungs, following a 3rd molt, the larvae rupture from the pulmonary capillaries and enter the alveoli

From the alveoli, the larvae move up the respiratory tree to the epiglottis

- Abetted by coughing and subsequent swallowing by the host, they migrate over the epiglottis to the esophagus and down into the small intestine, where they undergo a final molt and become sexually mature females
- Females produce embryonated eggs parthenogenetically
- These eggs hatch in the mucosa into 1st stage rhabditiform larvae
- These exit the intestine with the feces, feeding down the length of the intestine
- Larvae become established in the soil, undergo several molts and become free-living adults
- Under adverse conditions they can revert to being filariform larvae

## **Autoinfection**

During passage through the host digestive system, rhabditiform larvae may undergo 2 molts to filariform larvae and by penetrating the intestinal mucosa, enter the circulatory system and continue their parasitic lives without leaving the host

- Autoinfection can also occur when larvae remain on and penetrate the perianal skin.
- Autoinfection often leads to very high worm burdens in humans

## **Clinical manifestations**

Cutaneous reaction due to skin penetration “ **ground itch**”

- Pulmonary symptoms (**including Loeffler’s syndrome**) can occur during pulmonary migration of the filariform larvae.
- Gastrointestinal symptoms include abdominal pain, vomiting, diarrhea, weight loss, malabsorption,.
- Dermatologic manifestations include urticarial rashes in the buttocks and waist areas (larva migrans).

## **Laboratory Diagnosis**

- ✘ Direct stool smears (larvae)
- ✘ Cultivation of stool. (Damp charcoal or Harada-Mori mediums).
- ✘ Histological examination of duodenal or jejunal biopsy specimens obtained by endoscopy can demonstrate adult worms embedded in the mucosa.
- ✘ Eosinophilia, is present in uncomplicated strongyloidiasis, but is lost in hyper infection
- ✘ For population screening in endemic areas, an ELISA for IgG *anti-Strongyloides antibodies* is effective.

## **Prevention**

- ❖ wearing shoes

❖ improved sanitation

## 5- *Trichostrongylus*

It is parasitic nematodes, has at least 32 species, most of which are found predominately in animals (in sheep & cattle) like *T.orientalis* & *T.culoliformus* . However, at least 8 *spp.* have been reported in humans. □ *Trichostrongylus* is similar to Hookworm but requires a different treatment

**Disease caused by *Trichostrongylus spp.***

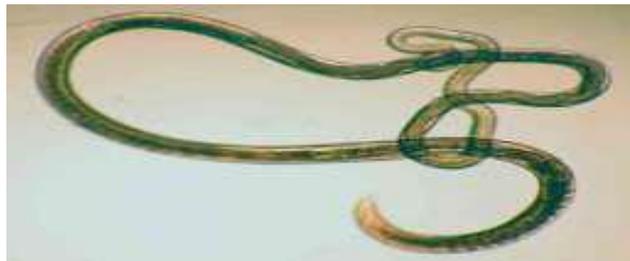
**Called: Trichostrongyliases**

- **Habitat:** in small intestine
- **Mode of Transmission:** Ingestion of infective third stage from feces contaminated food or soil; contact with herbivore feces.

### **Morphology:**

**The egg :**They measure between 80 and 90 mm long. They are already segmented when laid and develop into infective larvae.

**Adult worms :**The worms are slim, with small anterior ends and no buccalcavity. Male worms can be recognized by their asymmetrical dorsal ray and two short nearly equal spicules. The female has a vulva of about 1 mm near the tip of the tail.



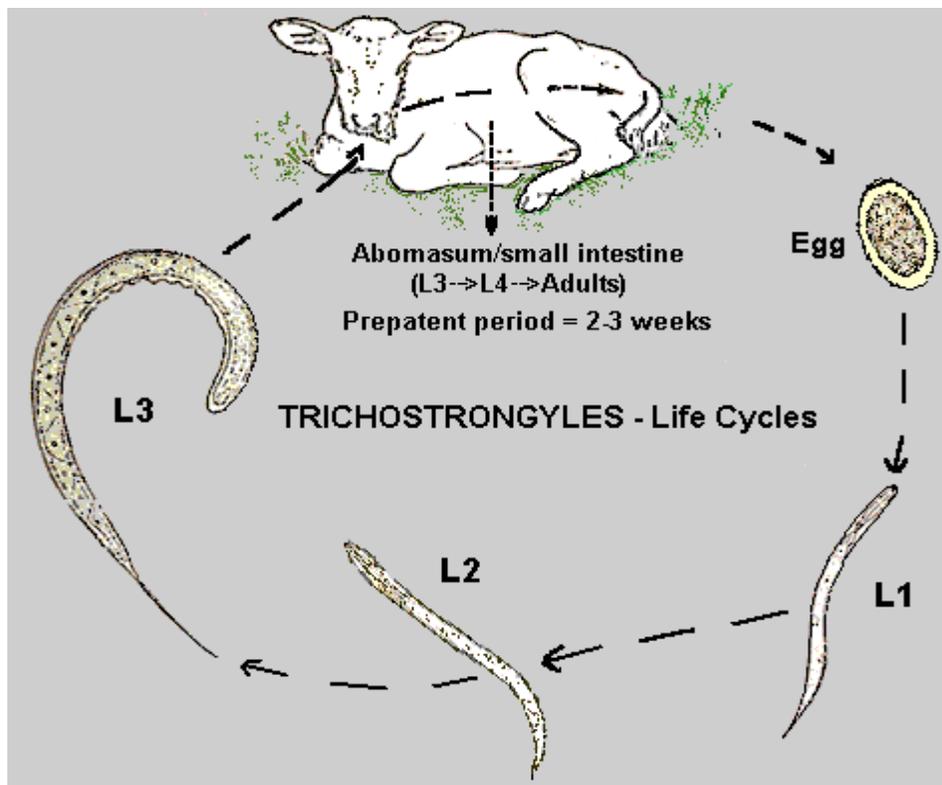
## Life cycle:

□ The eggs produced by the female will pass in the feces and hatch outside the host. They are already segmented when laid and develop into infective larvae within 6 days. The L1 and L2 stages of the larvae are microbivorous. The L3 stage, reached after 16-18 days, is non-feeding and infective by ingestion. L3, L4 and L5 are immature adults that develop into mature forms in the digestive tract of the host. The life cycle is direct, with no intermediate hosts.

### □ Infection in man :

□ It is very rare infection in man, the infection occurs by swallowing or eating vegetables containing the filariform larva ,which pass unharmed through the stomach and resides in the small intestine where it becomes an adult (directinfection).

□ **Symptoms:** It cause abdominal pain associated with diarrhea .



## Laboratory Diagnosis:

□ Diagnosis is made by finding eggs (or sometimes larva) in stool examination.

## 6- *Capillaria philippinensis*

### MORPHOLOGY :

Adult Male 2.3-3.2 mm long Small caudal alae ,Spineless spicule sheath

Adult Female :2.5-4.3 mm long,Esophagus is half as long as body

Produce Capillaria-type eggs that lack pits

Egg:Peanut shaped ,Striated shell



### LIFE CYCLE

- DEFINITIVE HOST: fish-eating birds
- INTERMEDIATE HOST: Fish
- VECTOR: None
- ACCIDENTAL HOSTS: Human

- Acquire by eating small species of raw infected fish
- Direct and Indirect Life Cycles

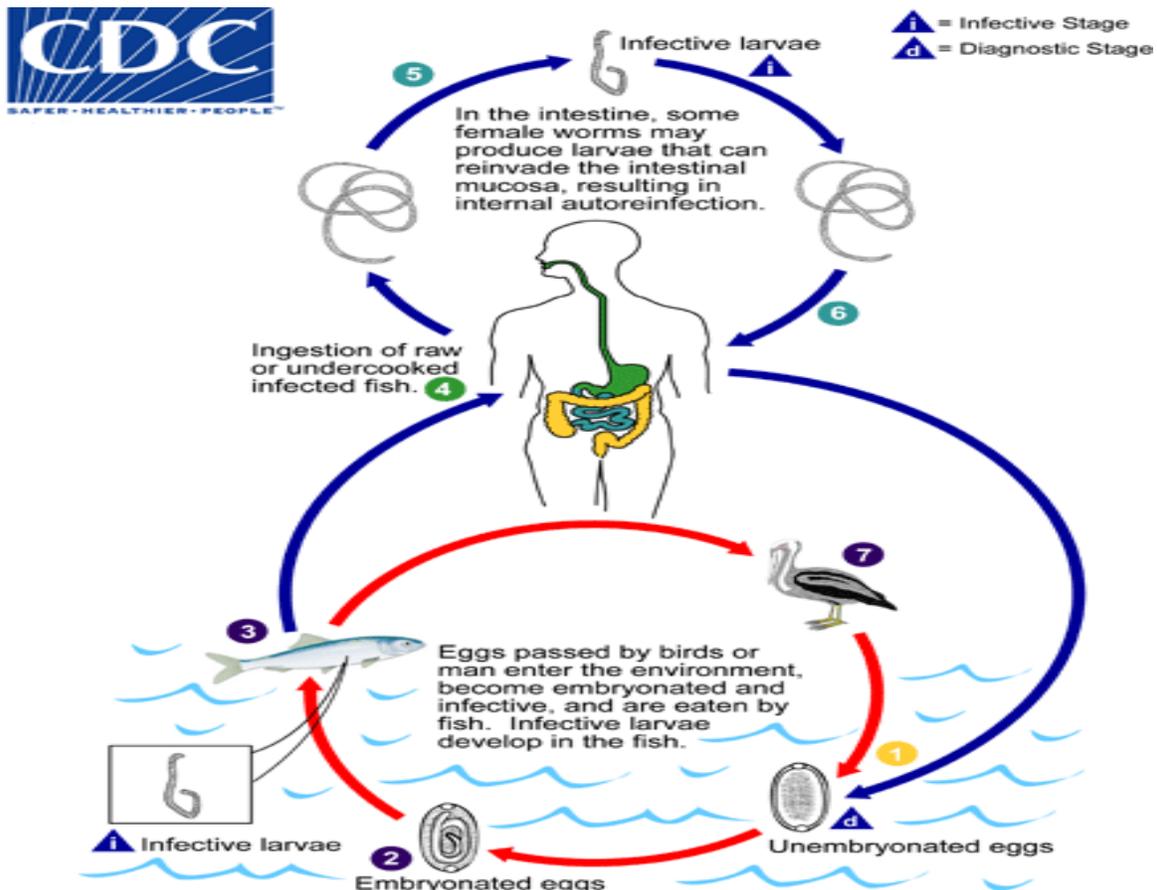
## LIFE CYCLE

Unembryonated eggs are passed in human/bird stool.

Unembryonated eggs become embryonated in the external environment.

Fresh water fish ingest embryonated eggs, larvae hatch, penetrate the intestine, migrate to tissues. Ingestion of raw or undercooked fish results in infection of human host. Adult worms reside in human small intestine, burrow in mucosa. Female adult worms deposit unembryonated eggs.

- Some eggs become embryonated in intestine, release larvae, cause autoinfection, leading to hyperinfection, Parasite of fish-eating birds.



## **PATHOGENESIS In Humans**

- Causes intestinal capillariasis
- Damages cells of intestinal wall
- Worms repeatedly penetrate mucosa of small intestine and reenter lumen (jejunum)
- Leads to progressive degeneration of mucosa and submucosa

Depressed levels of potassium and albumin in blood

- Watery diarrhea, Abdominal pain, Edema, Weight loss
- Weakness, Malaise

- **DIAGNOSIS In Humans**

- Finding eggs, larvae, and/or adults in:
  - Stool samples
  - Unembryonated eggs
  - Severe infections have eggs, larvae, and adults
  - Intestinal biopsies

### ***7-Trichuris trichiura (whip worm)***

Morphology:

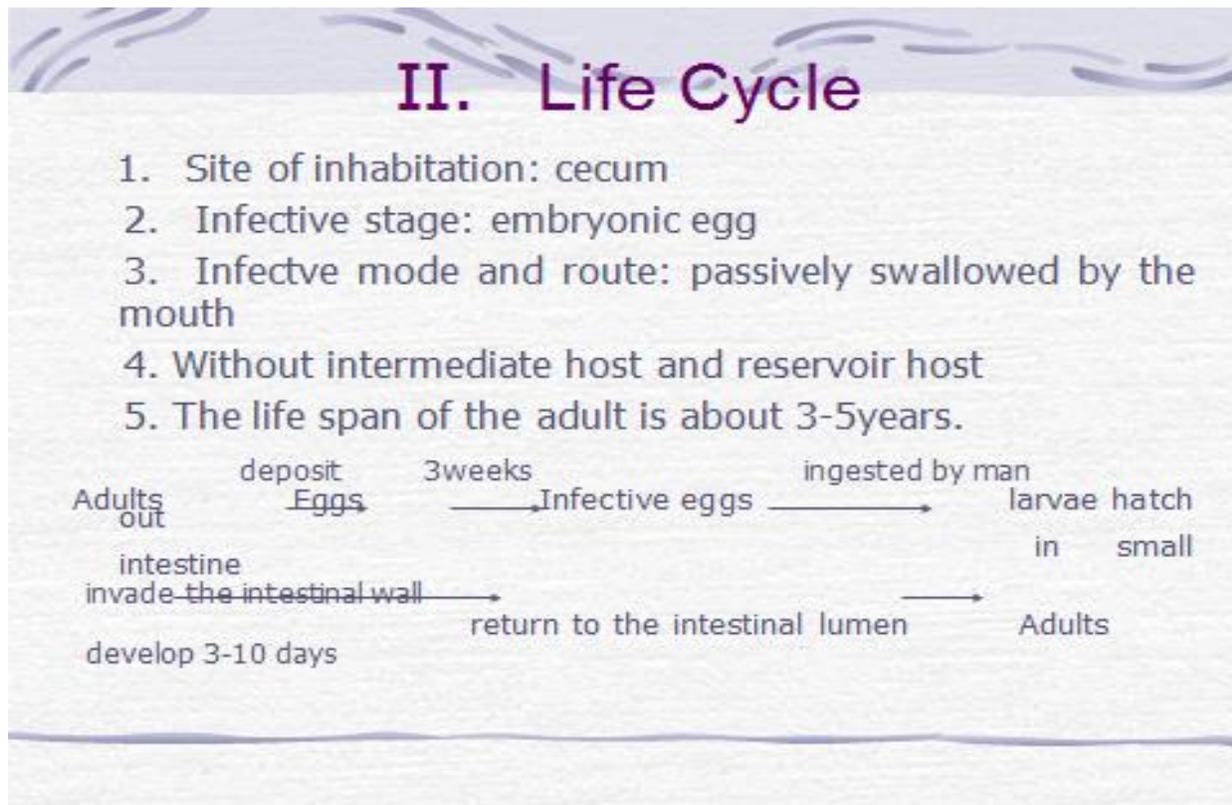
- ☞ Adult: the worm looks like a buggy whip, the anterior 3/5 is slender and the posterior 2/5 is thick. It is pinkish gray in color. The female worm is 3-5 cm in length and has a long slender esophageal region. The male is smaller than the

female and has a curved tail. The reproductive organs of male and female are all double tubule.

- ☞ Egg: it is barrel or spindle in shape and  $50 \times 20\mu\text{m}$  in size. It is brownish and has a translucent polar plug at either ends. The content of the egg is an undeveloped cell



## Life Cycle



### Pathogenesis:

1. Light infection: Asymptomatic

2. Middle infection: Clinical manifestations are usually abdominal pain, anorexia, diarrhea, constipation .

3. Heavy infection: Bloody diarrhea, emaciation, prolapse of the anus may occur.

### IV. Diagnosis:

Discover the eggs in feces by saturated brine flotation method or direct fecal smear.

**V. prevention: Same as those of ascariasis**

## **2- Nematodes Tissue:**

### **1-*Trichinella spiralis*:**

- Intestinal infection ,in which adult worms are found in the mucosa of the intestine and encystment of larvae are found in the muscle.. Parasite of carnivorous mammals, especially common in rats and in swine fed uncooked.

ONE SPECIES, *Trichinella spiralis*, IS A PARASITE OF MAN

### **Morphology**

- THE CAUDAL END OF THE FEMALE IS BLUNTLY ROUNDED, WHILE THE MALE IS CURVED AND HAS A SINGLE SPICULE.
- THE FEMALE SINGLE OVARY AND THE VULVA IS NEAR THE LEVEL OF THE BASE OF THE ESOPHAGUS.

. THE FEMALES ARE VIVIPAROUS

THE ADULT INHABIT IN THE INTESTINE AND THE LARVAE IN THE MUSCLE OF MAMMALS.

The adult is a small worm with a slender anterior end.

### **THE MALE**

- From 1.4 to 1.5 mm long and 0.04 mm broad.

The cloaca is at the ventrally curved posterior end between two lobular caudal appendages which serve during copulation

### **THE LARVA**

The mature larva has a digestive tract similar to that of the adult, and while the reproductive organs are not fully developed, it is often possible to differentiate the sexes

## **HOSTS**

*Trichinella spiralis* is found chiefly in :Man,Hogs,Rats,Bears,

Foxes,Dogs,Cats, but any carnivorous or omnivorous animal may be infected

## **DISEASES :**

TRICHINOSIS; TRICHINIASIS; TRICHINELLIASIS

## **LIFE CYCLE**

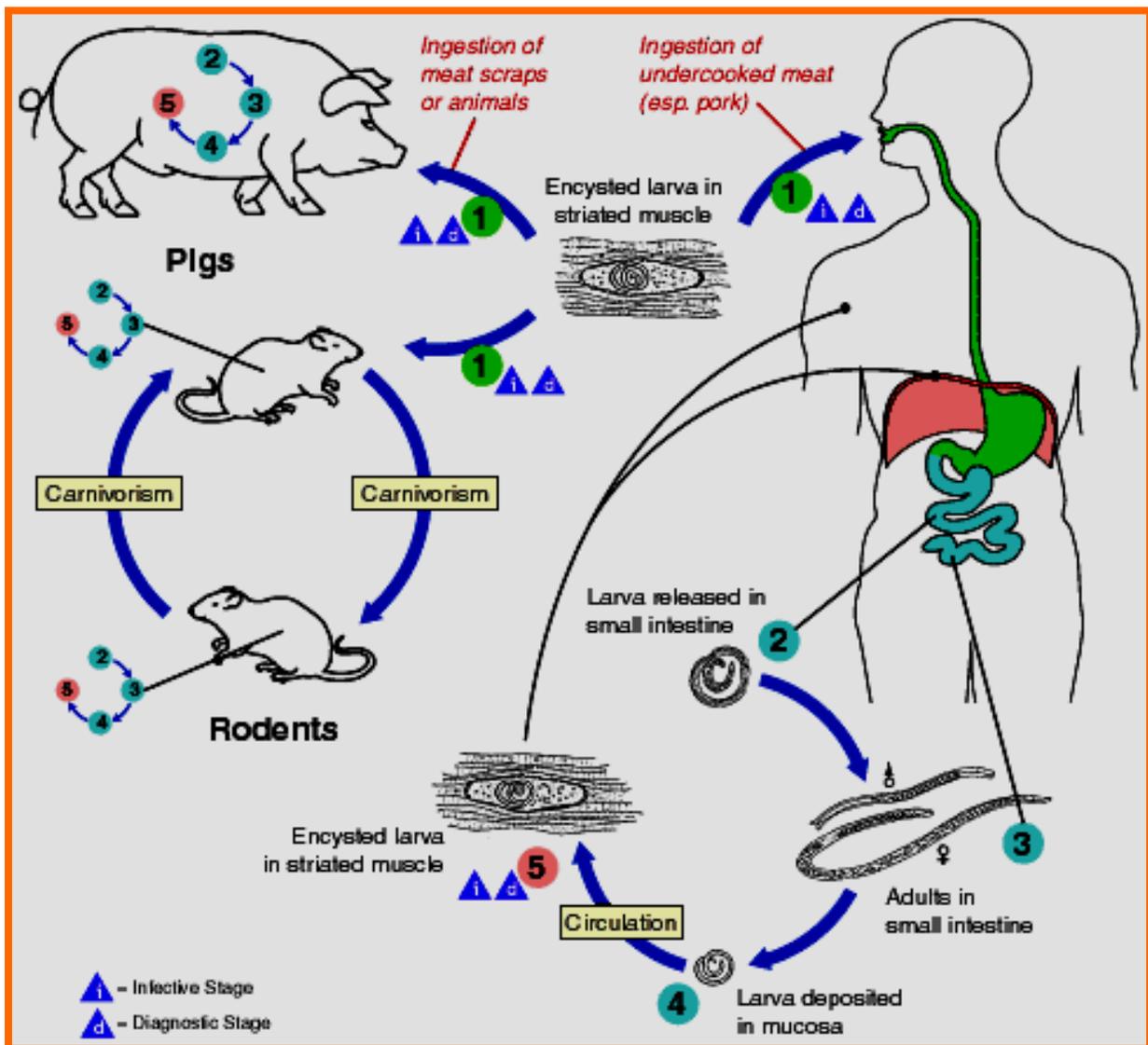
- The adult worms are attached or hidden in the intestinal mucosa.
- Found in the small intestine from the duodenum to the ileocecal valve and sometimes in the cecum and first portions of the colon.
- When infective stage are ingested by humans, usually in raw or poorly cooked pork ,they pass to the upper small intestine, where the capsules are digested and the larvae released in a few hours by the action of digestive juice. The liberated larvae immediately invade the intestinal mucosa.
- They rapidly penetrate into the epithelium of the duodenal and jejunal mucosa
- The amount of damage to the intestinal lining is depend on the number of invading organisms and the time and number of previous exposures.
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- Found in the small intestine from the duodenum to the ileocecal valve and sometimes in the cecum and first portions of the colon.

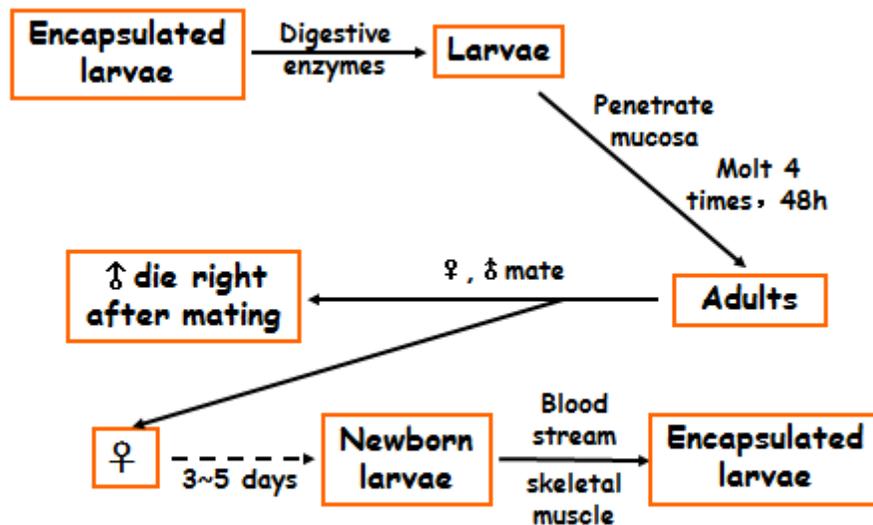
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- The amount of damage to the intestinal lining is depend on the number of invading organisms and the time and number of previous exposures.

In 18 to 24 hours may be differentiated in male and female

- \* Within two days the worm reach sexual maturity and mate in the small intestine

- \* After copulation gravid female increases in size and in about 48 hours, burrows deeply into the mucosa of the intestinal villi from the duodenum to the caecum and even in the large intestine in heavy infections
- \* About the fifth day female worm begins to deposit larvae into the mucosa and sometimes directly into the lymphatics from which they reach the thoracic duct and enter the blood stream and the larvae are carried to all parts of the body.

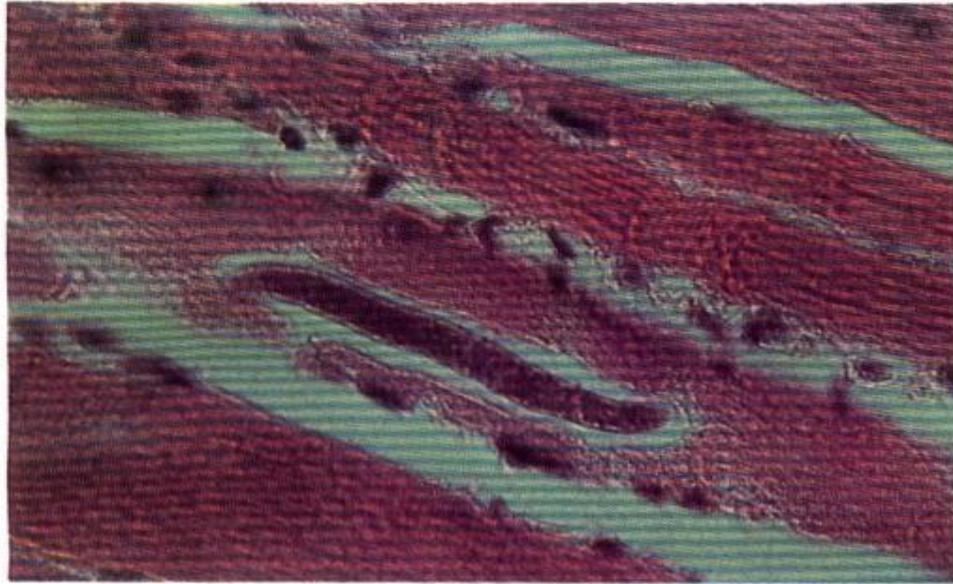




## **PATHOLOGY**

The pathologic changes in man involve many organs :

- \* Gastrointestinal tract: hemorrhages, edema and occasionally slight ulceration of the mucosa
- \* Lungs: bronchitis, bronchopneumonia,:
- \* Skeletal muscles: increase in size, become edematous
- \* Heart: Macroscopically the heart is soft, and reddish brown, and sometimes the pericardium is injected and contains increased fluid.
- \* Central Nervous System: serious focal cerebral damage.
- \* Miscellaneous organs: The larvae may invade the lungs, pleura, pancreas, gallbladder, kidney, and other organs, producing local inflammation and edema



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## **LABORATORY EXAMINATION**

Based on the detection of the larval worms in the muscle by biopsy and serologic and intra cutaneous test

## **Prevention**

- **Development of industrialized pig farms**
- **Improvement of pig feeding**
- **Inspection of meat**
- **Health education**

***2-Toxocara Canis (Dog Round Worm)and Toxocara cati (cat Round Worm)***

- **Geographic Range: Worldwide**
- **Definitive Host: Dogs,**

- Intermediate Host: None
- Accidental Host: Humans and other mammals

- Children more susceptible than adults

- **Infection:**

- Dogs: Found in Intestines, by: Ingest Egg

Transplacenta, Transmammary, Puppies Born Infected with *T. canis*, Puppies less than 5 weeks

- Humans: Can be found in liver, lung, brain, heart, muscle, or eye

- **Morphology**

- Eggs: 85µm x 75µm, Have thick brown shell

- *T. cati* eggs look identical

Adult Female: 5 to 18 cm long

Adult Male: 4 to 10 cm long

**Life Cycle:**

- Eggs must be present in external environment for 2 weeks to be infective
- Ingestion by dog
- Eggs hatch and larvae penetrate the gut wall
- Migrate into various tissues; encyst if dog older than 5 weeks
- Younger dogs larvae migrate through lungs, bronchial tree, esophagus, and move back into the small intestine

## ■ Older Dogs

- Encysted Stages reactivate during pregnancy
- Infection spread by transplacental and transmammary routes
- Infective eggs spread through lactating bitches

## Accidental Host

- Infected by ingestion of infective eggs
- Eggs hatch and larvae penetrate the intestinal wall
- Carried by Circulatory System to various tissues
- Larvae don't undergo further development but can cause reactions in tissue (toxocariasis)

## Symptoms

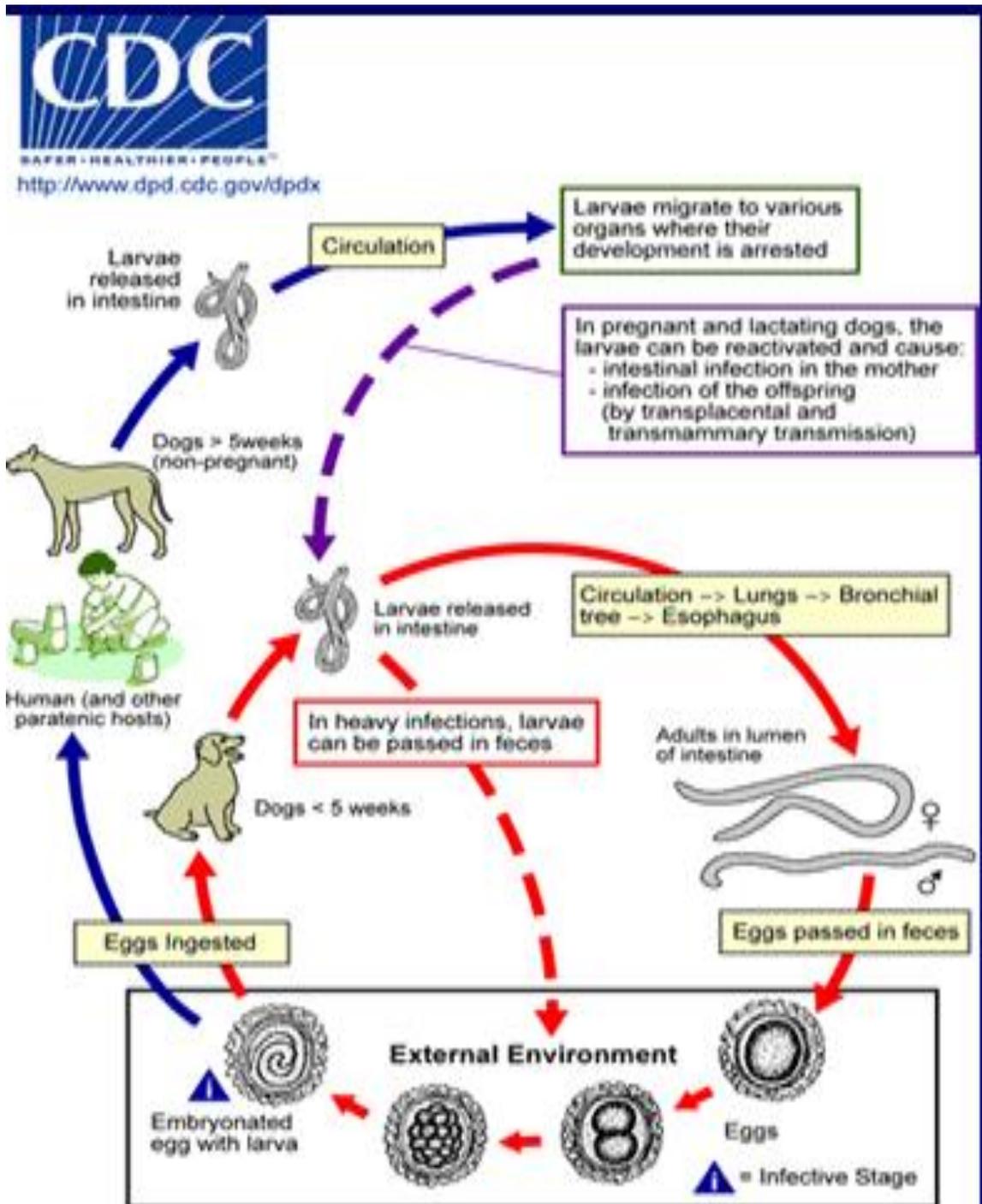
In dogs usually asymptomatic, Heavy infections can result in death

**In Humans:** Abdominal Pain, Decreased Appetite, Restlessness  
Fever, Other symptoms vary with site larvae infection.

## Diagnosis

- Dogs: Fecal Float
- Humans: Monitor for symptoms
- ELISA, Anti-Toxocara antigen IgE Level
- CT scans or Ultrasound can allow for visualization
- **Control Methods**
- Treat dogs, especially puppies, regularly for worms
- Good hygiene practices when handling animals

- Don't let children play in areas dogs are allowed to defecate
- Teach children not to eat dirt or soil



## **larva migrans**

Larva migrans describes a parasitic disease involving migration of immature (larval) worms in various parts of the body. Several different worm species can be involved and migration occurs in one of three forms.

### **- Cutaneous Larva Migrans**

Larval migration in the skin of the host causes cutaneous larva migrans. These infections are often acquired by skin contact with environmental sources of larvae, such as the soil. The larvae cause a pruritic, migrating dermatitis as they travel through the skin. Many of these infections are self-limiting.

Animal hookworms are the most common cause of cutaneous larva migrans in humans. *Ancylostoma braziliense* is the most important species. Less often, cutaneous larva migrans is caused by *A. caninum*

### **-Visceral Larvae Migrations (VLM)**

Caused by movement of worm larvae throughout various organs of the body  
Dependent on organ infected: Fever, Coughing, Asthma, Pneumonia, Wheezing, Hepato-splenomegaly.

### **-Ocular Larvae Migrations (OLM)**

Caused by larva migration to the retina, Inflammation

Scar formation, Retinal Detachment, Partial to Full Vision Loss

10,000 Infections per year, 700 permanent vision loss.

### How Can get larva migrans.

Humans can get infested by various worm species after (accidentally) **ingesting** the parasite eggs or by eating tissues from an infested animal and by penetration (**direct contact**) of the worm larvae through the skin.



### How can I protect myself from larva migrans?

Good hygiene and regular deworming of pets will reduce the chance of human exposure. Children should not play in areas possibly contaminated with animal feces

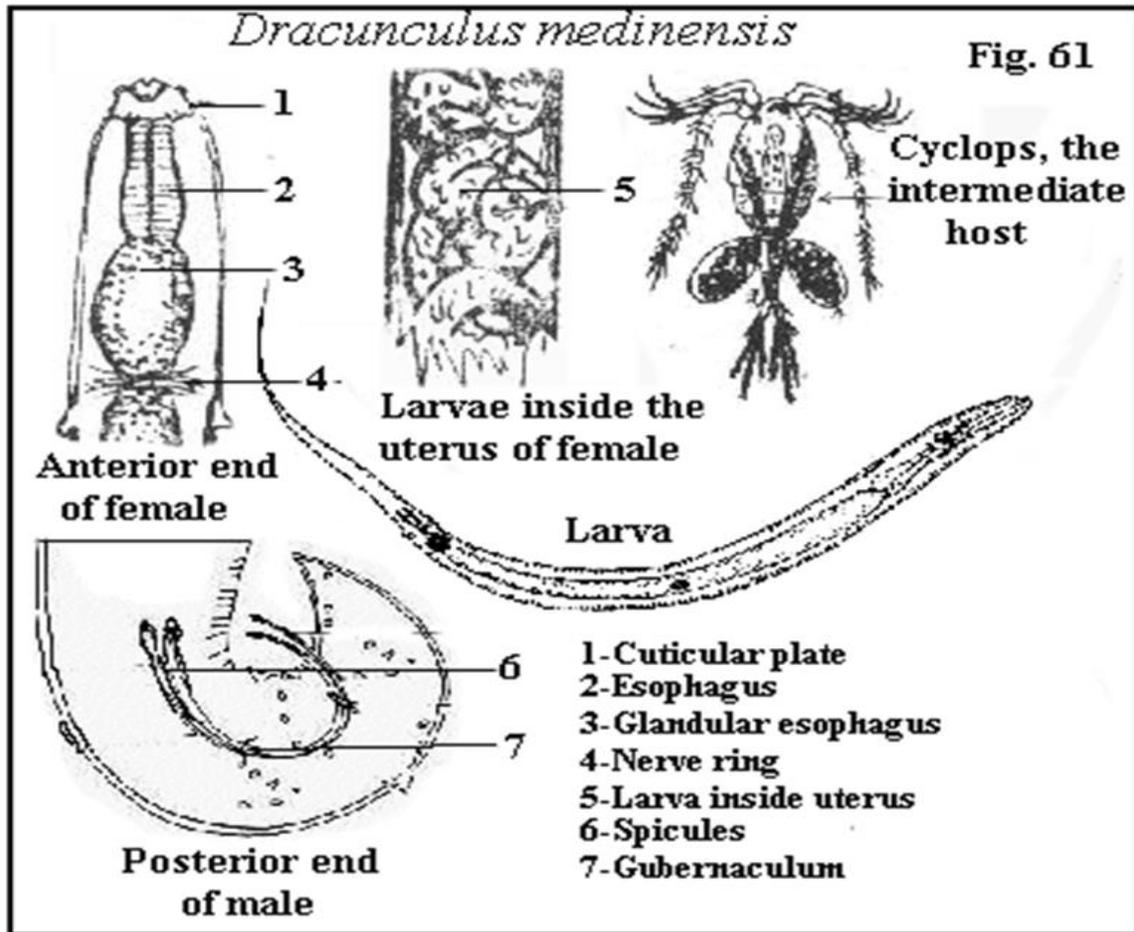
### *3-Dracunculus medinensis*

- **Common names-** Guinea Worm, Dragon Worm
- **Definitive:** Humans
- **Intermediate:** Copepod

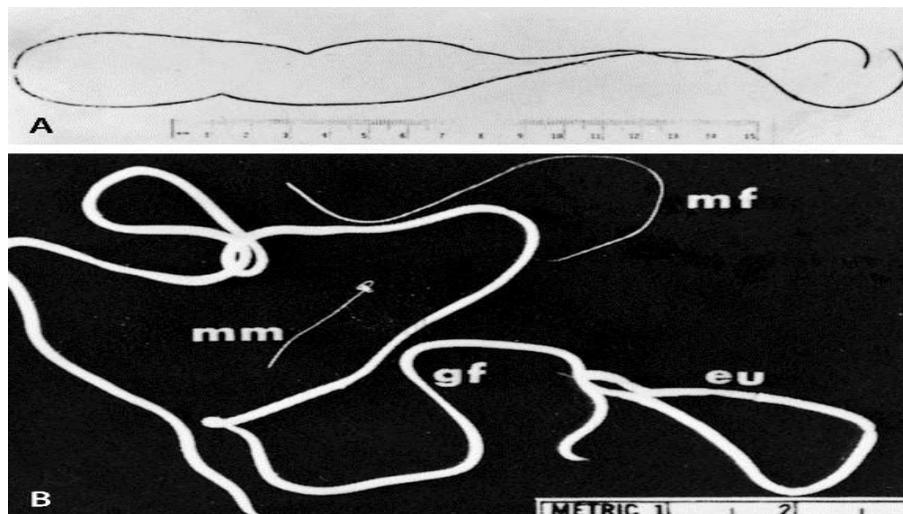


## Morphology

- One of the largest nematodes known.
- Adult females have been recorded up to 800 mm long
- Few males known do not exceed 40 mm.
- The mouth is small and triangular and is surrounded by a quadrangular, sclerotized plate.
- Lips are absent.
- The esophagus has a large glandular portion
- Spicules of the male are unequal and 490 to 730  $\mu\text{m}$  long. The gubernaculum ranges from 115 to 130  $\mu\text{m}$  long.

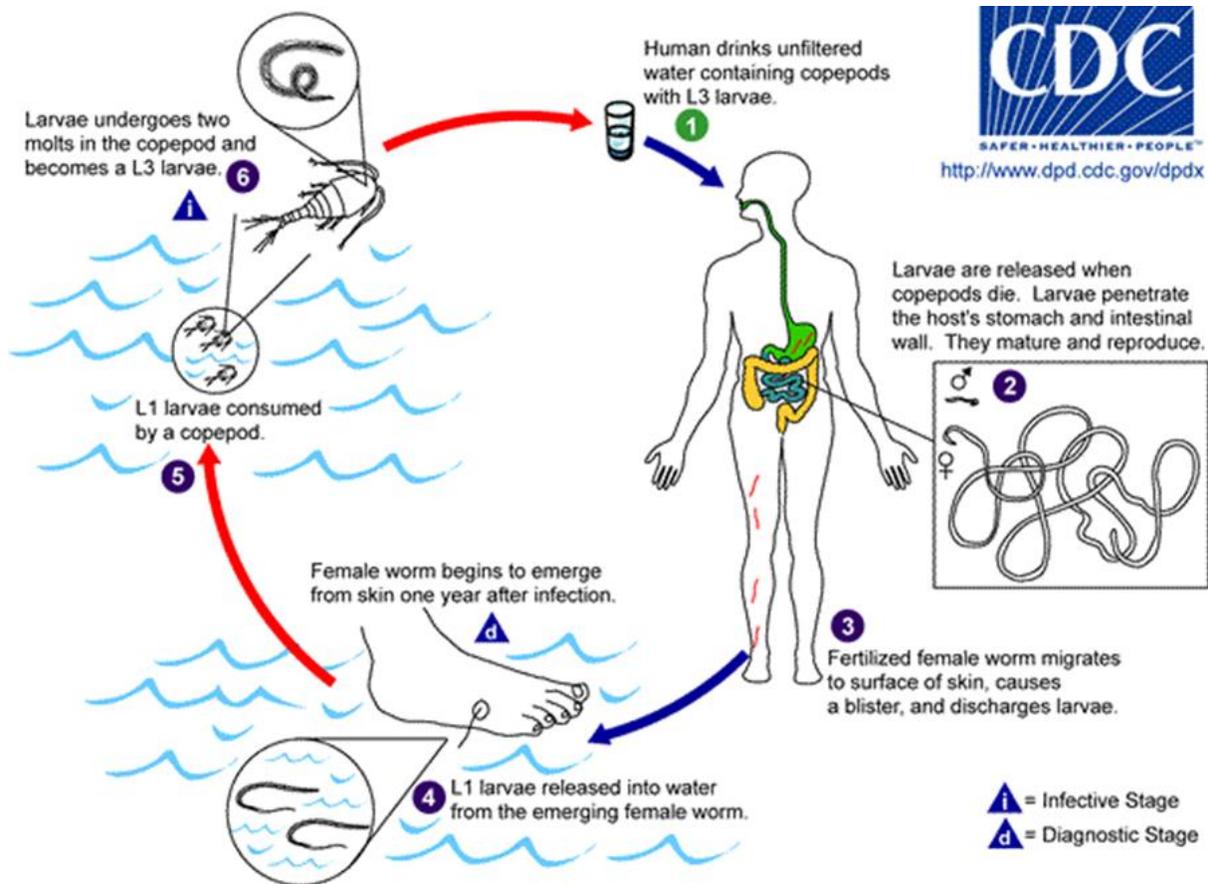


- **Adult *D. medinensis* worms.** The adult female guinea worm is a long, slender worm ranging from 30 to 120 cm in length and from 0.09 to 0.17 cm in width.



## Life Cycle

- **Humans become infected by drinking unfiltered water containing copepods (small crustaceans) which are infected with larvae of *D. medinensis***
- Following ingestion, the copepods die and release the larvae, which penetrate the host stomach and intestinal wall and enter the abdominal cavity and retroperitoneal space.
- The worm molts again 20 days and 43 days post infection
- Females are fertilized by the third month.
- After maturation into adults and copulation, the male worms die and the females (length: 70 to 120 cm) migrate in the subcutaneous tissues towards the skin surface
- Approximately one year after infection, the female worm induces a blister on the skin, generally on the distal lower extremity, which ruptures.
- When this lesion comes into contact with water, which the patient seeks to relieve the local discomfort, the female worm emerges and releases larvae
- The larvae are ingested by a copepod and after two weeks (and two molts) have developed into infective larvae



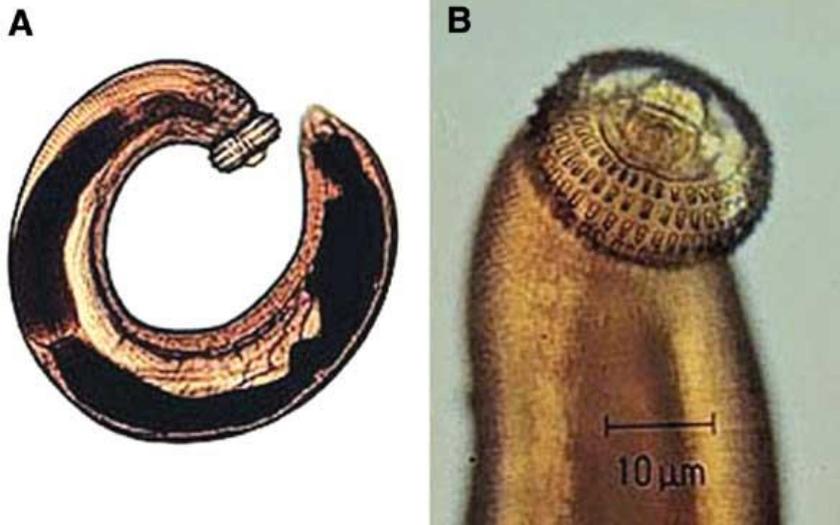
## Diagnosis

- Diagnosis is made from the local blister, worm or larvae.
- The outline of the worm under the skin.
- Some people claim to be able to feel the worm moving towards the surface of the skin.
- Finding Calcified worms.
- **Pathology**
- **None until the female worms cause an allergic reaction** by releasing metabolic wastes into host. This occurs at the onset of migration to the skin.
- a rash accompanied by severe itching

- nausea ,vomiting ,diarrhea ,dizziness,edema
- Reddish papule-blister (local itching and intense burning).
- Blister ruptures, becomes abscessed-very painful.
- Secondary bacterial infections of opening possible.
- **Control**
- Filter, boil, or treat water with chlorine to kill intermediate host.
- Finely-meshed cloth or, better still, a filter made from a 0.15 mm nylon mesh, is all that is needed to filter out the copepods from the drinking water.
- Avoid bathing or wading in drinking water.

#### 4-*Gnathostoma spinigerum*

- Caused by the third stage larvae of several species of the nematode genus *Gnathostoma*, most commonly *G. spinigerum* in humanscauses [gnathostomiasis](#)The larval nematode is acquired by eating raw or undercooked fish and meat.

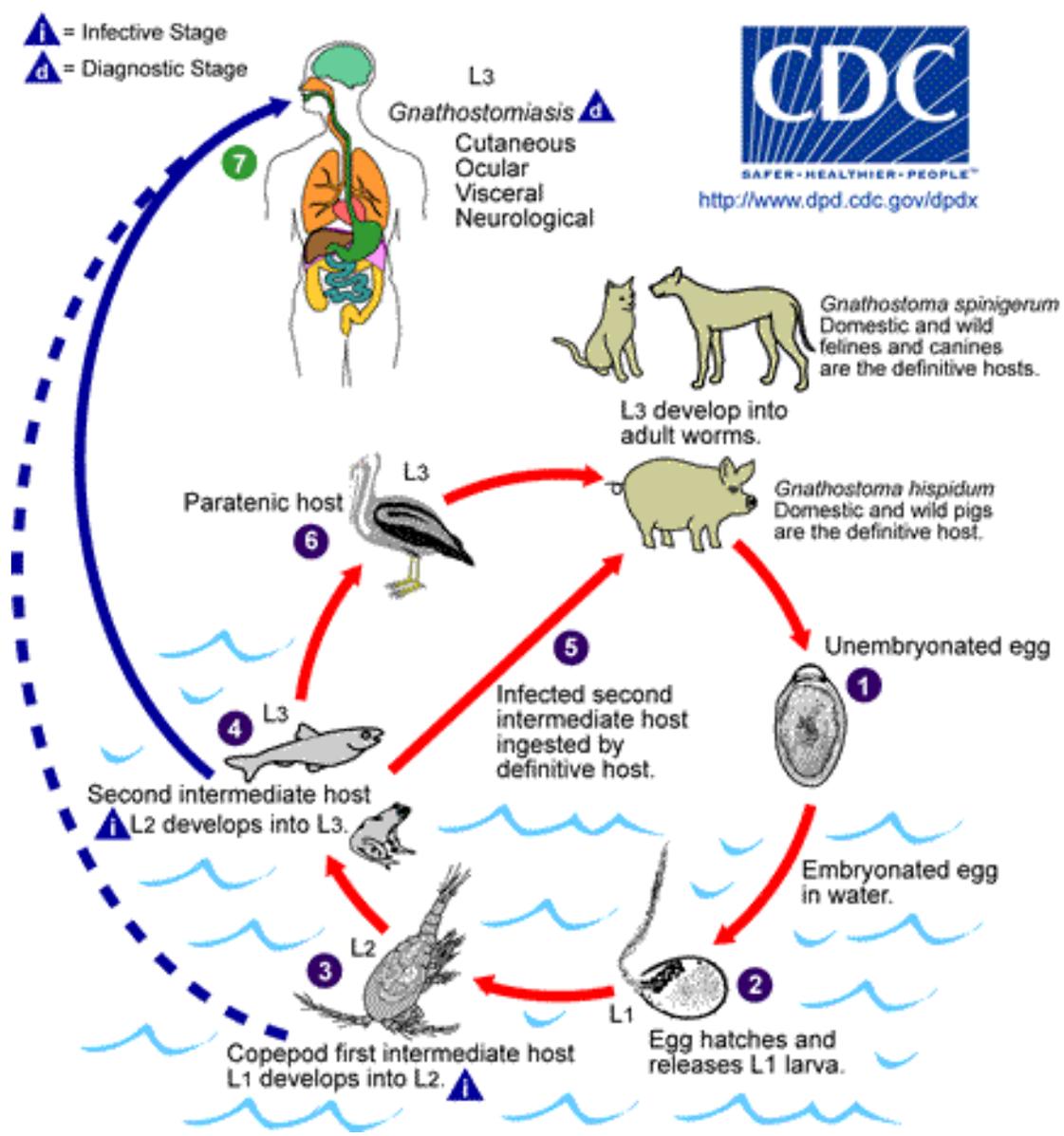


## Morphology

**This species grows to a length of 11 to 54 mm (0.43 to 2.13 in).**

Species within the genus *Gnathostoma* are recognized by a bulbous head with a pair of lateral lips surrounding a mouth on the longitudinal axis. The cephalic region is covered by transverse rows of cuticular spines. Internally, the head is divided into four glandular cervical sacs that attach near the esophagus, The body is typically pink and is also covered anteriorly with circles of flat spines,





## Symptoms

- Worms leave stomach after 24-48 hours → epigastric pain, nausea, vomiting, fever, malaise, anorexia
- Begin random migrations after 3-4 weeks or several years → symptoms specific to area of migration

- Mortality of 8-25% if central nervous system involved due to eosinophilic meningitis

- **Diagnosis**

- **Serologic Tests:** ELISA (for IgG antibodies)

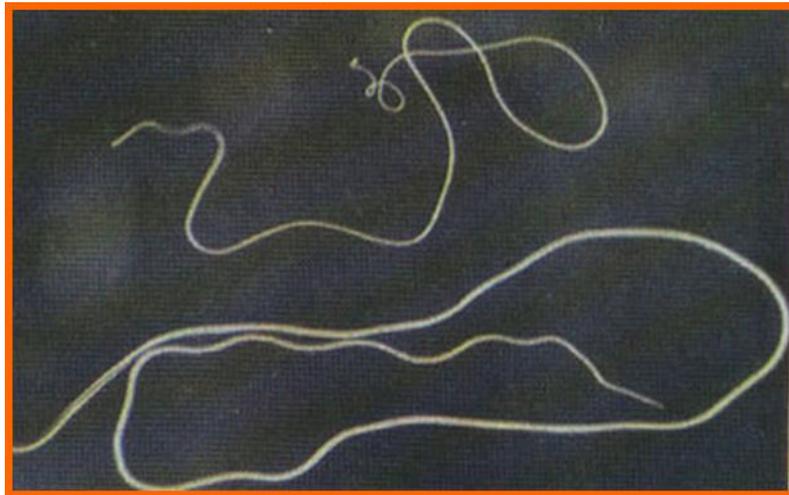
- **Prevention:** Avoid undercooked meat

### **3-Nematodes :Blood and other body fluids and skin**

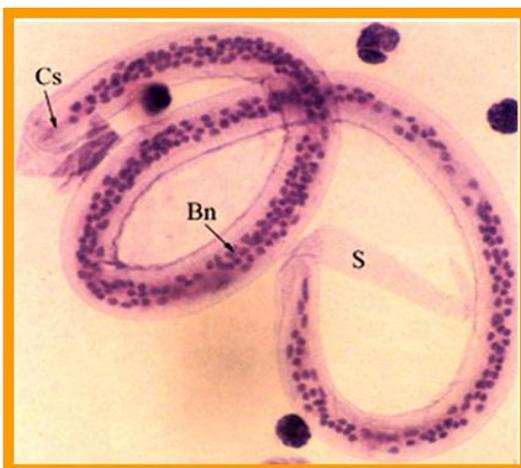
#### **1-Filaria**

- Filariasis is a widely spread disease caused by different species of filariae .The adults of filariae inhabit the lymphatics, subcutaneous tissue, deep connective tissue, peritoneal or thoracic cavity
- There are eight species of filariae, namely, *Wuchereria bancrofti*, *Brugia malayi*, *Brugia timori*, *Loa loa*, *Onchocerca volvulus*, *Mansonella ozzardi*, *Dipetalonema perstans* and *Dipetalonema streptocerca* in humans
- Larvae known as microfilariae appear in the circulating blood or tissue fluids
- *W. bancrofti* and *B. malayi* which lie coiled in **the lymphatic vessels** are most commonly responsible for lymphatic filariasis and of more medical importance
- Microfilariae circulate in peripheral blood once each day. **Mosquito is essential** vector and intermediate host

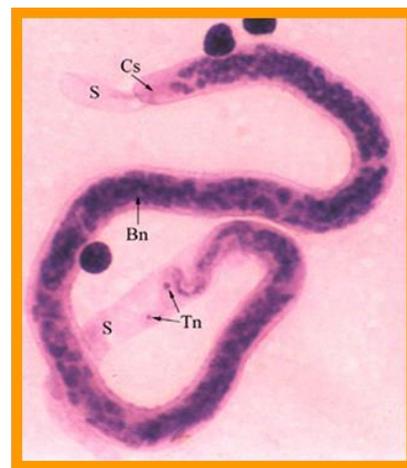
- *Wuchereria bancrofti* and *Brugia malayi*
- **Morphology** – Adult, Slender, thread-like, White in color
- Male -- 2.5-4 cm long and has a curved tail, female -- 5-10 cm in length



- **Microfilaria**--177~296  $\mu\text{m}$  in length, encased in a sheath with free endings. Bluntly rounded anteriorly and tapers to a point posteriorly. A large number of nuclei seen in the body are arranged in a column from head to the posterior



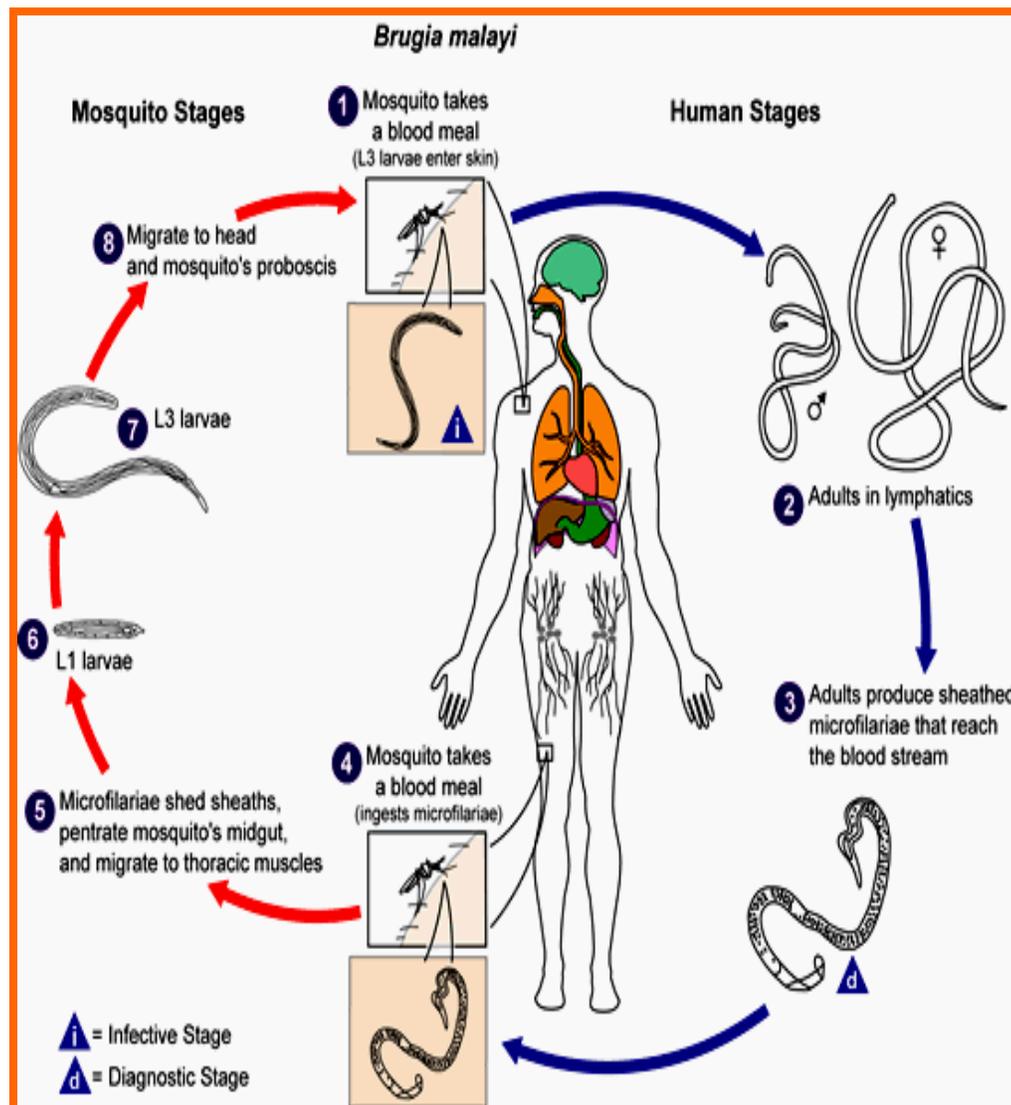
*Wuchereria bancrofti*



*Brugia malayi*

## The morphological differentiation of bancroftian and malayan microfilariae

	<i>W. bancrofti</i>	<i>Brugia malayi</i>
Size	Larger, 244~296 by 5.3~7 $\mu\text{m}$	Smaller, 177~230 by 5~6 $\mu\text{m}$
Shape	Curves of body are natural, smooth	Curves of body are rigid, the small in larger curve
Cephalic space	Shorter (length is equal to or less than width)	Longer (length is two times as long as width)
Body nuclei	Equal sized, clearly defined, countable	Unequal sized, coalescing, uncountable
Terminal nuclei	No	Two



- **Host:** mosquitoes as intermediate host, human as final host
- **Location:** lymphatic vessels and lymph nodes
- **Infective stage:** infective larvae
- **Transmission stage:** microfilariae
- **Diagnostic stage:** microfilariae
- Ovoviviparity
- **Different parasitic site between the two species of lymphatic filariae:** *W. bancrofti* parasitizes in the superficial and deep lymphatic systems, including in the genitourinary lymphatic system; *B. malayi* parasitizes in the shallow lymphatic system only, especially in the lymphatics of limbs
- **Nocturnal periodicity:** the numbers of microfilariae present in the peripheral blood **during day time is very low** in density, usually undetectable, but gradually increase from evening to **midnight and reach the greatest density at 10 p.m. to 2 a.m.**
- The mechanism for this phenomenon is still not clear. It may be related to the change of oxygen tension in cerebral and the pulmonary vessels
- **Pathogenesis**
- **Acute diseases**--dilatation of the lymphatics / hyperplastic changes in the vessel endothelium / infiltration by lymphocytes, plasma cells and eosinophils

- **Chronic lesion**--the changes include granuloma formation, fibrosis, and permanent lymphatic obstruction Dilated vessels may rupture, spilling lymph into the tissue to cause **lymphedema and elephantiasis**



### **Diagnosis**

- **Microfilariae:** demonstration of microfilarae in the peripheral blood
- **Adult:** biopsy of the nodes or lymphatic vessels
- **Immunological tests:** antibody or circulating filarial antigen (CFA)
- **Prevention:** Elimination of vectors and protection of the people from mosquito bites are important to control filariasis

## 2- *Onchocerca Volvulus*

## Onchocerciasis

“River Blindness: Blackfly lives and breeds near fast flowing streams and rivers

Blackfly (genus *Simulium*)= intermediate host

- Humans = definitive host
- 5-stage life cycle
- Microfilariae persist in human host for 3-5 years
- Adult females live for 10-15 years

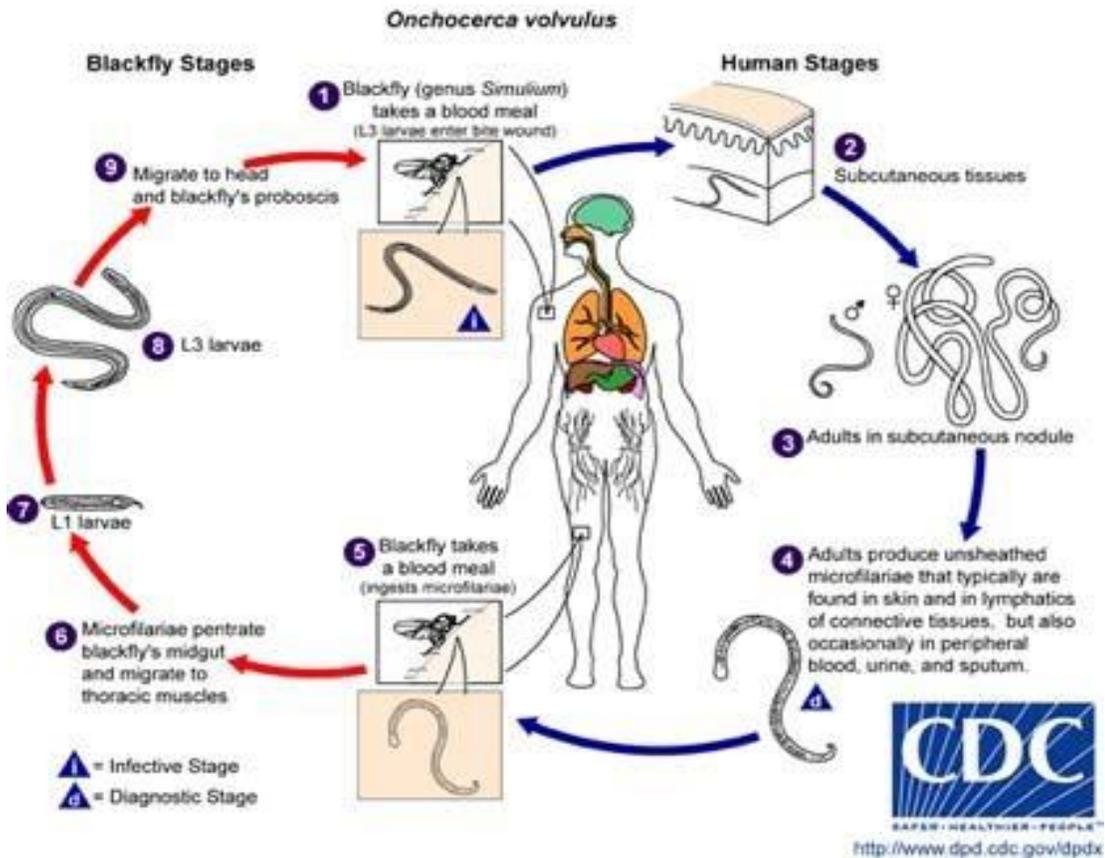
### **Morphology-**

- **Adult worm-**Microscopically the cuticula is seen to be raised in well marked annular and oblique thickenings
- The male measures 3 cm in length by about 0.13 mm in breadth, it has a coiled tail.
- The female is very long, measuring up to 50 cm in length by 0.4 mm in its greatest diameter• The gravid females may live as long as 15 years.

### **Microfilariae:**

- These are found in the skin.,• They are unsheathed and non-periodic.,• The column of nuclei does not extend to the tail tip.

## Life cycle:



Larva drop from proboscis • human subcutaneous tissues • grow to adults (3-12months) • female nematode makes fibrous capsule, males migrate • female sheds 100,000s microfilariae which migrate • microfilariae taken up by blackfly during meal • fly's gut • muscles • grow to larva • proboscis

## Clinical Findings

### SKIN

- Papular dermatitis, intensely pruritic

- Chronic disease can develop asymptomatic depigmentation • Hypo vs Hyperpigmentation, “Leopard skin



**Skin Nodules:** “Onchocercomata”: • Subdermal nodules usually over bony prominences, “Robles Disease” in South America, • Raised, round, firm, 2-3 cm, contain at least 1 adult

Lymphatic blockage may cause extremity edema, ie “equatorial arm”

**Ocular findings**

- Anterior Disease: punctate or sclerosing keratitis, uveitis
- Chorioretinitis, optic atrophy • As microfilariae die, they release Wolbachia antigens as well • Immune reaction to antigens • corneal inflammation



## **Diagnosis**

### **Skin-snip**

- Small snip of skin (only dermis), place on slide with saline, microfilariae crawl out overnight into saline, ELISA PCR tissue, Rapid serum antibody, Rapid urine antigen,

### **Prevention**

Blackflies bite during the day, best prevention is to prevent getting bitten! • , long pants and long shirts

**3-Loa Loa Common name -The African eye worm**

### **Morphology-**

- Adult worm- Microscopically, the cuticula is found to have

numerous rounded protuberances ( cuticular bosses) which vary in number and arrangement in the two sexes.

- Exists in three forms: Adult, • Microfilarial, • Larval
- Adult male 30-34mmx0.4mm
- Adult female 50-77mmx0.5mm

Transmitted by Tabanid fly , Genus Chrysops

- Deerfly/Mango fly/Mangrove fly

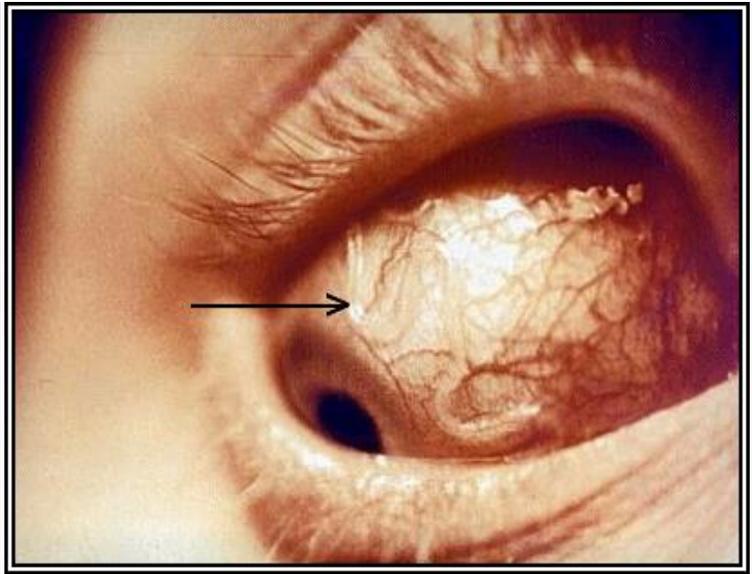
The worm produces the disease in man called loiasis

Microfilariae climb into dermis through hole cut in skin by fly

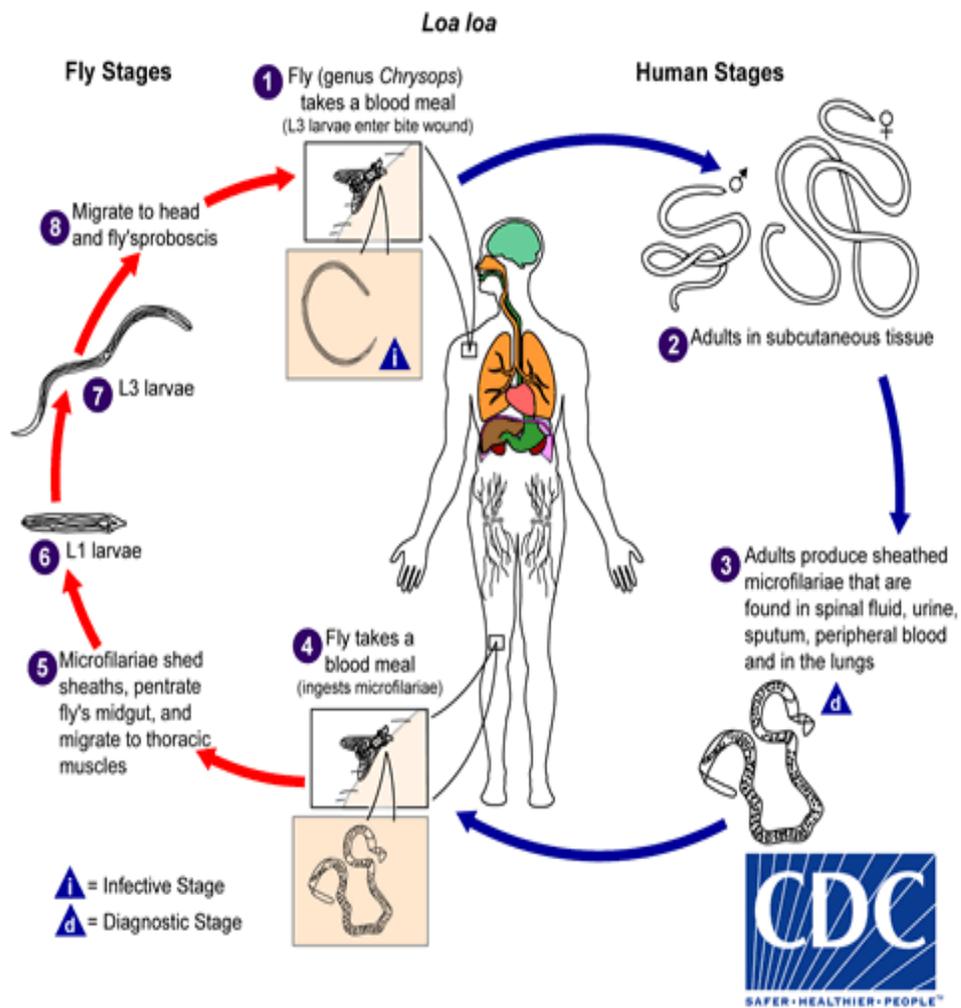
- Move on to lymphatics
- Adult worms set up shop in the tissue between the fascial layers of muscle and the skin
- Adult life span up to 17 years
- Once fertilized, females start releasing 10-20K microfilariae per day
- Microfilariae pass into the lymphatics • move to lung blood
- Some percentage continue on to peripheral blood
- 17 months from penetration into skin to found blood

Diurnal periodicity: Densities of microfilariae peak by noon, and decrease to low levels at night

- Chrysops flies active in **daytime**



**Life Cycle:**



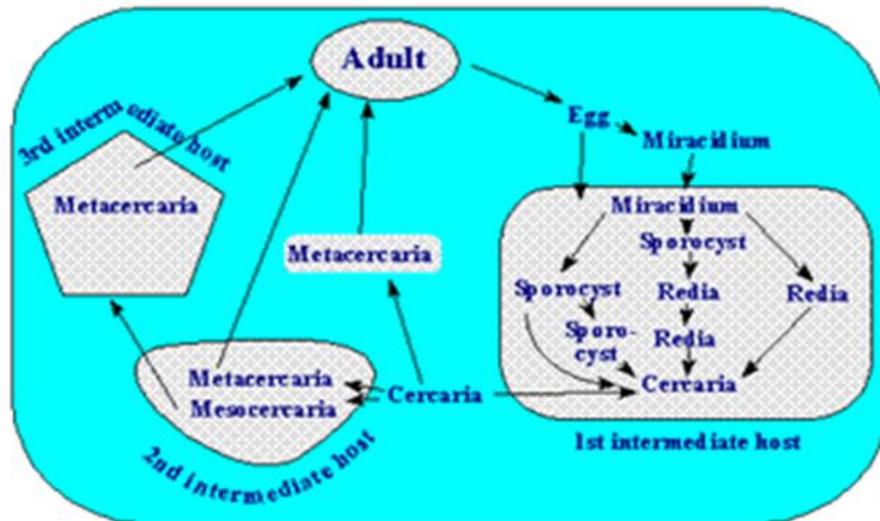
## Phylum Platyhelminthes.

- All flatworms are acoelomate, triploblastic, and bilaterally symmetrical.
- flattened dorsoventrally
- they have a definite head at the anterior end.
- The most of flatworm species, in all three classes, are hermaphrodites. A single individual generally cannot fertilize itself,.

### Class Trematoda

Flattened dorsoventrally (leaf-like).

- Unsegmented.
- Body is covered by cuticle.
- Organs of fixation: oral sucker, ventral sucker.
- Genital system: Trematodes are hermaphrodites except genus *Schistosoma*.
- The life cycle is passed in two hosts (alternation of hosts)



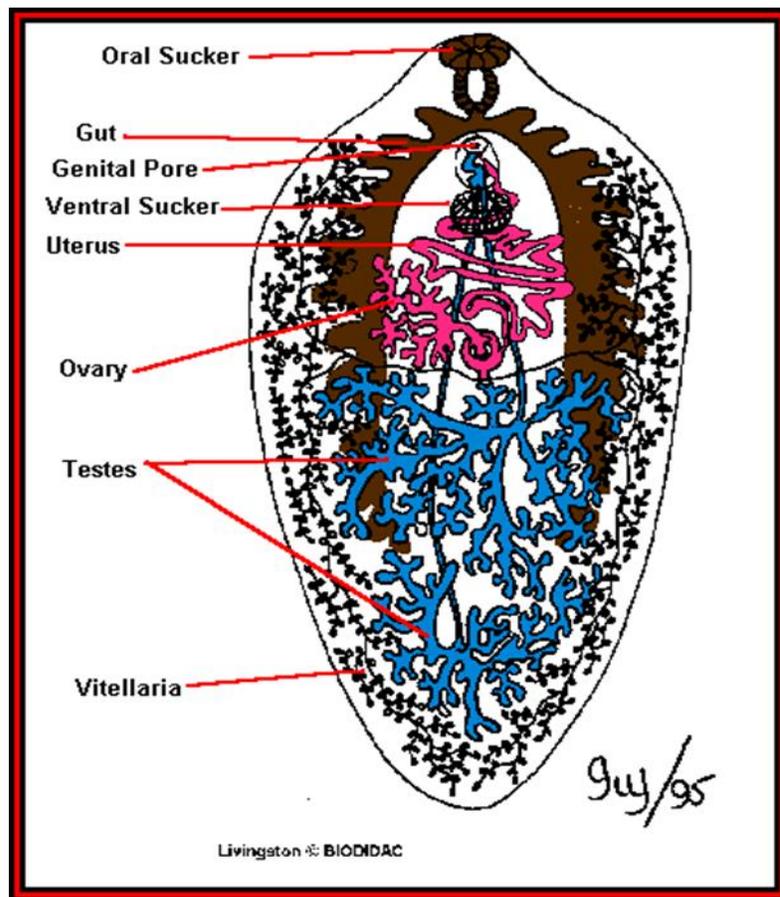
Egg—miracidium—sporocyst or redia—daughter sporocysts—cercariae—

Metacercariae/mesocariae—adults

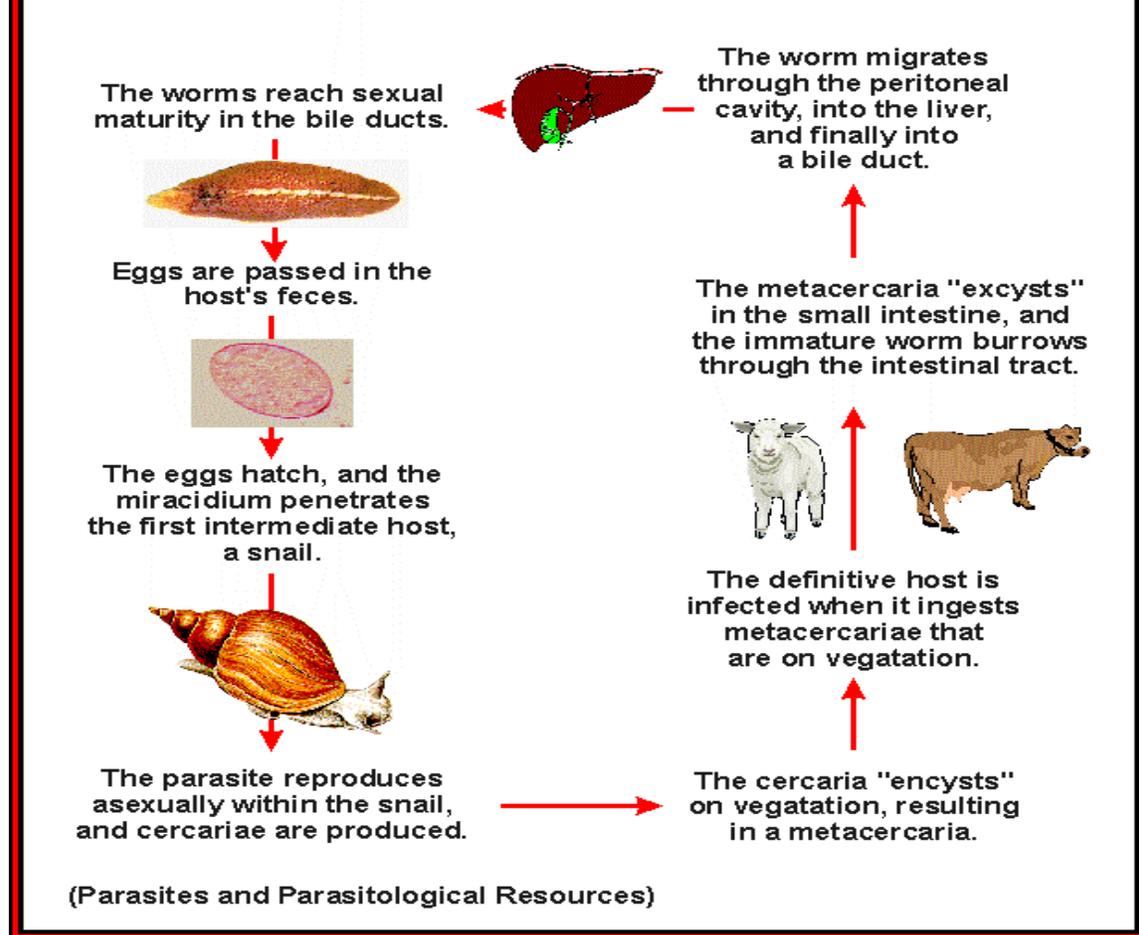
## A-BILIARY (LIVER) FLUKES

### *1-Fasciola hepatica* an agent of fascioliasis

- **Distribution:** endemic in Far East.
- **Localization:** bile ducts, gallbladder, and pancreas.
- **Morphology:** large size (3-5 cm) and conical form of the body sucking disks (oral and abdominal)
- Multi branched uterus is situated under the abdominal sucking disk.
- Testis are branched too and located in the middle part of the body.
- **Life-cycle:**
- **Final host** - herbivorous mammals (horses) and humans.
- **Intermediate host** — the snail *Limnea truncatula*.
- **Transmission:** fecal-oral



## THE LIFE CYCLE OF *FASCIOLA HEPATICA* (THE SHEEP LIVER FLUKE)



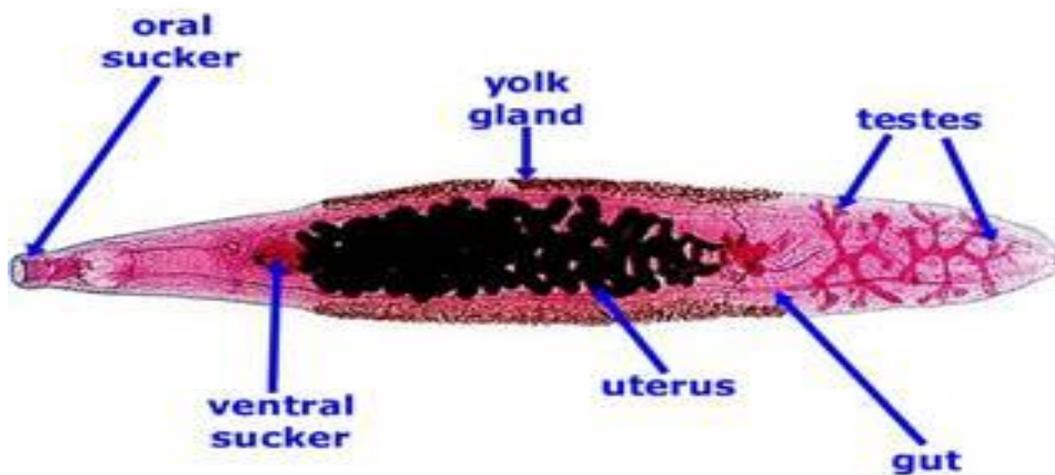
- **Clinical disease:** Parasites obstruct bile ducts and lay eggs within them, leading to cholelithiasis (gallstones).
- Biliary obstruction can occur, sometimes causing biliary cirrhosis.
- **Diagnosis:** immature eggs in feces.
- **Prevention:** involves not eating wild aquatic vegetables.

### 2- *Clonorchis (Opisthorchis) sinensis, Opisthorchis felines, viverrini*

- **Opisthorchiasis.**

■ **Morphology:**

- flat, the length of the body 4-13 mm.
- In the middle part of the body there is a branched uterus.
- Behind it there is a round ovary.
- roseolla-like testis in the back of the uterus - a diagnostic sign of this worm.



■ **Life-cycle:**

- **Final host** - carnivorous mammals and humans.
- **Intermediate host**
  - 1) - snail
  - 2) - fish.
- **Transmission:** ingestion of fish, which contains metacercariae.
- **Invasive stage:** metacercariae cysts in fish muscles.
- **Localization:** bile ducts, gallbladder, liver.



■ **Clinical disease:**

- cholecystitis and cholelithiasis,
- hepatic colic, cirrhosis.
- Infection can lay dormant for several years before presenting clinically.
- **Diagnosis:** immature eggs in feces, in fluid from biliary drainage, or duodenal aspirate.
- **Prevention** involves not eating undercooked or contaminated raw, frozen, dried, pickled, and salted fish; eradication of snail hosts when possible.

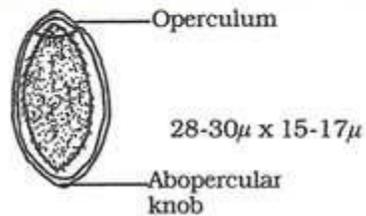
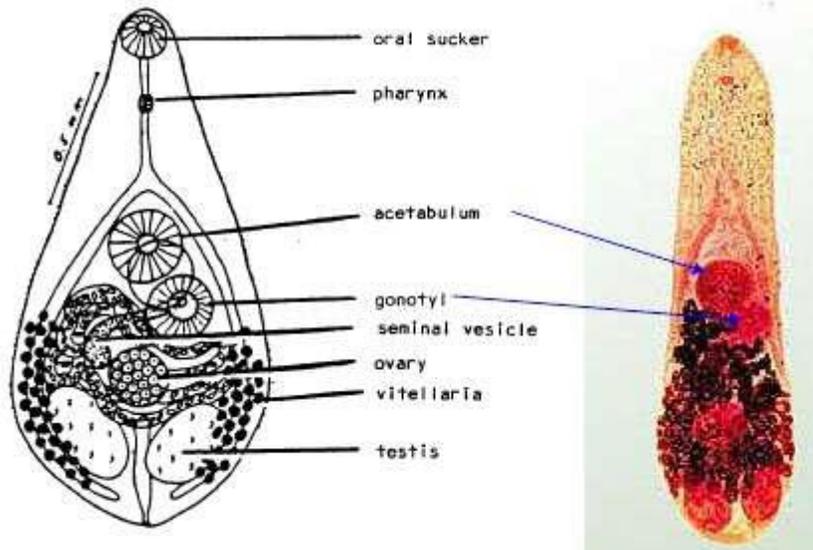
**B-Intestinal fluke**

**1-*Heterophyes heterophyes***

It is a minute intestinal fluke, with different shapes. • It infects small intestine of various fish eating mammals including humans. • The disease caused by the fluke is called heterophyiasis.

**Adult morphology:**

- 1) Size: 1.5-3mmx 0.5 mm.
  - 2) Shape: pyriform or pear shape, spines cover the cuticle anterior.
  - 3) Suckers: three suckers.
    - Oral sucker: small.
    - Ventral sucker: large.
    - Genital sucker (gonotyle): postero-lateral to ventral sucker.
- Genital system:-Testes: two, oval, opposite each other.
- Ovary: single, globular, in front and between the testes.



**Egg:**

Shell: thick. Special character: operculum at one pole and a small knob at the other. Colour: golden yellow. Content: mature (miracidium).

**Life cycle:**

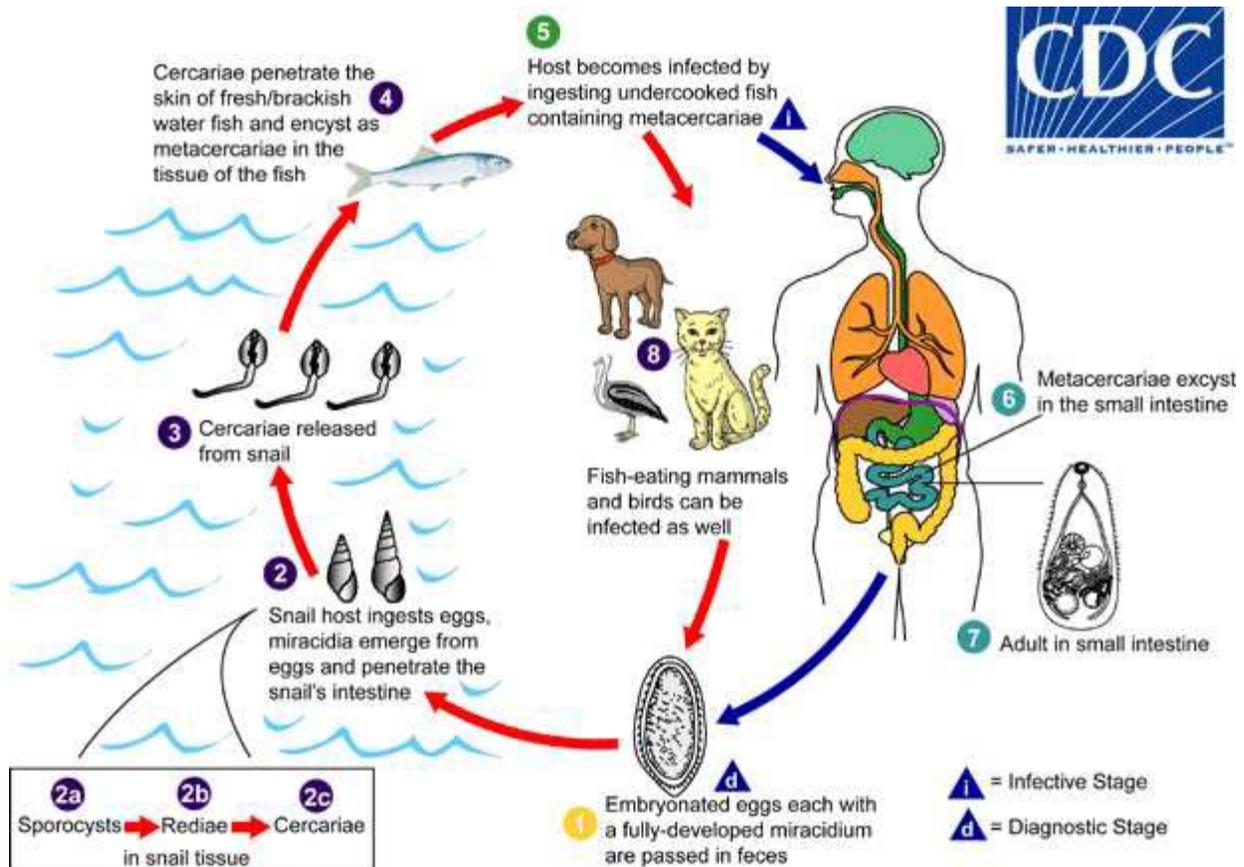
**Habitat:** embeded between villi of small intestine.

**Definitive host:** man.

**1st I.H.:** snail, **2nd I.H.:** fish

**Reservoir hosts:** cats, dogs and any fish eating

mammals. **Infective stage:** encysted metacercaria in the muscles of the 2nd I.H. and their fins, gills and scales. **Stages in life cycle:** egg → miracidium → sporocyst → redia → cercaria → encysted metacercaria → adult.



Eggs appear in stool 2-5 weeks after infection.

-In water, egg is ingested by the snail I.H.; brackish water and bottom feeding. -Miracidium hatches □ sporocyst □ rediae □ cercariae, which escape in 30 days. -Cercariae penetrate tissue of fish encysted metacercariae, infective within 20 days.

## **Pathogenicity**

**Mild infection with no symptoms.**

**-Heavy infections cause:**

- Abdominal colic.
- Abdominal discomfort.
- Chronic intermittent diarrhea, sometimes with blood.

## **Diagnosis:**

1. Clinical. 2. Laboratory: by detection of the characteristic mature eggs in stool. 3. Eosinophilia.

## **Prevention and control:**

- Avoid defecation in water.
- Avoid eating raw, insufficiently cooked fish or salted less than 10 days.
- Proper grilling of fish.

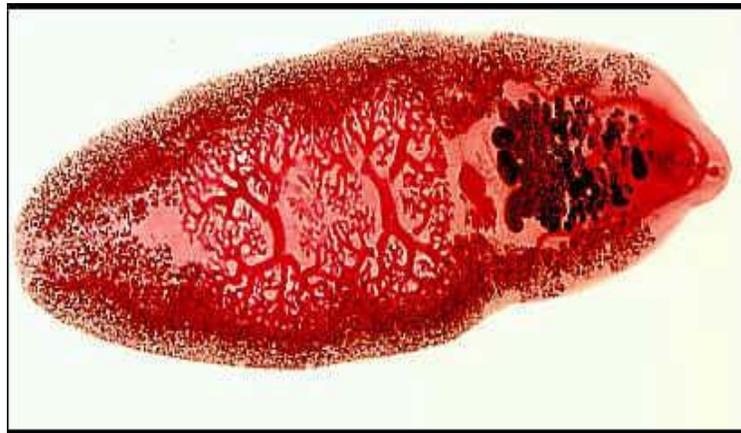
## ***2-Fasciolopsis buski*(giant intestinal fluke)**

The prevalence of fasciolopiasis is related to growing water plants and feeding pigs on water plants.

## **Morphology**

Adult: the body is long elliptic, flesh-colored, looks like a slice of raw meat. The size is about 20-75 × 8-20 × 1-3mm, the largest one of human trematodes. The ventral sucker is near by the much smaller oral sucker.

Two coral-like testes are located in the posterior half of the body egg is oval in shape, slight yellow in color

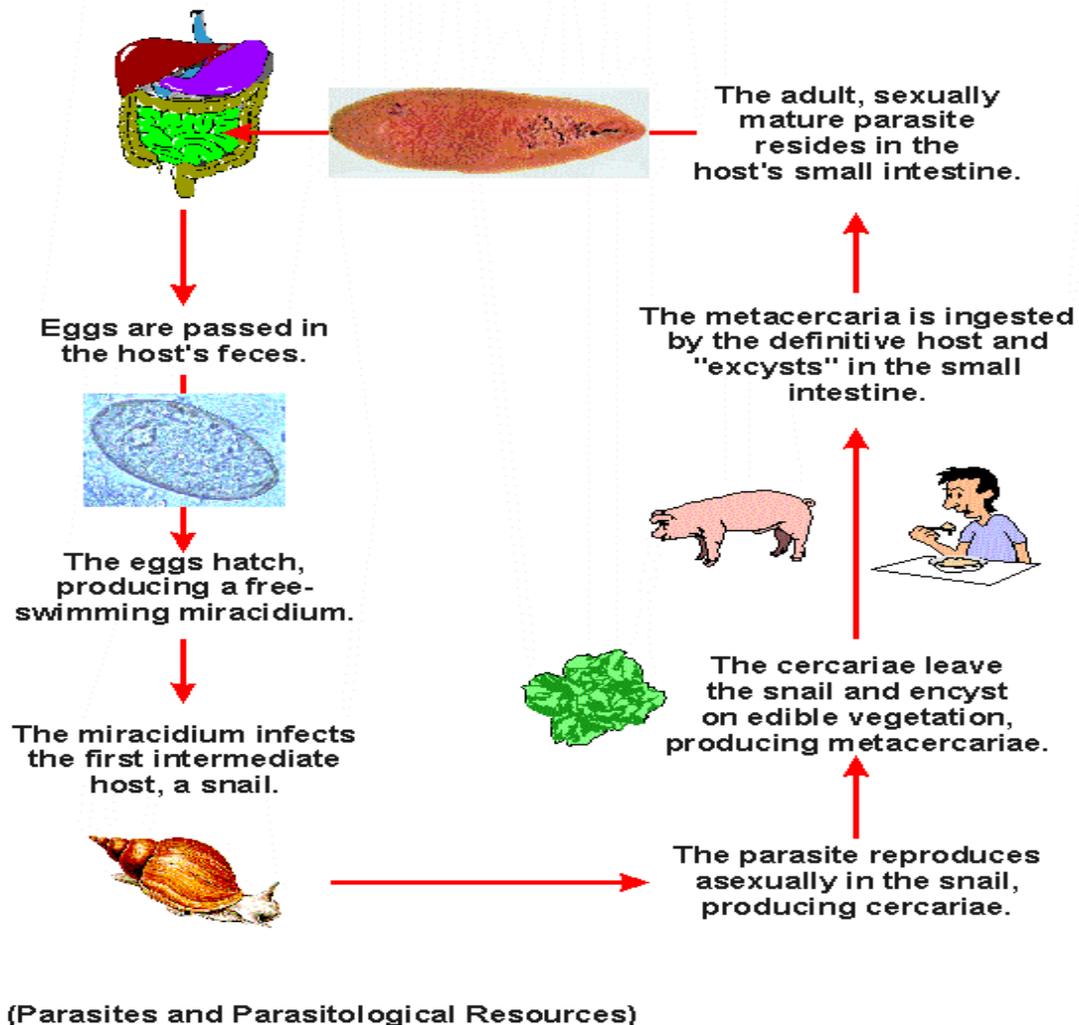


## Life cycle

**Site of inhabitation: small intestine**

2. **Infective stage:** metacercaria
3. **Infective mode:** eating raw water plants with metacercariae
4. Intermediate hosts: Planorbis snail
5. Reservoir host: pig
6. Life span: 1-4 years

## THE LIFE CYCLE OF *FASCIOLOPSIS BUSKI*



### Symptomatology

Enteritis due to the attachment of the adults manifests abdominal discomfort, nausea, vomiting and diarrhea. Malnutrition

### Diagnosis

Stool examination: 1. Direct fecal smear 2. Water sedimentation method

## Prevention

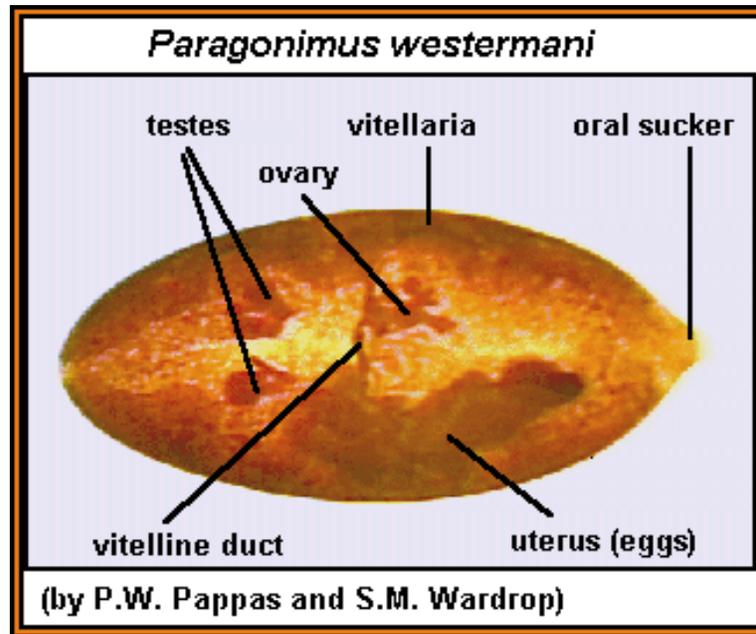
- (1) Health education, (2) Deal with night soil.
- (3) Avoid feeding pigs on raw water plants

## C-LUNG FLUKE:

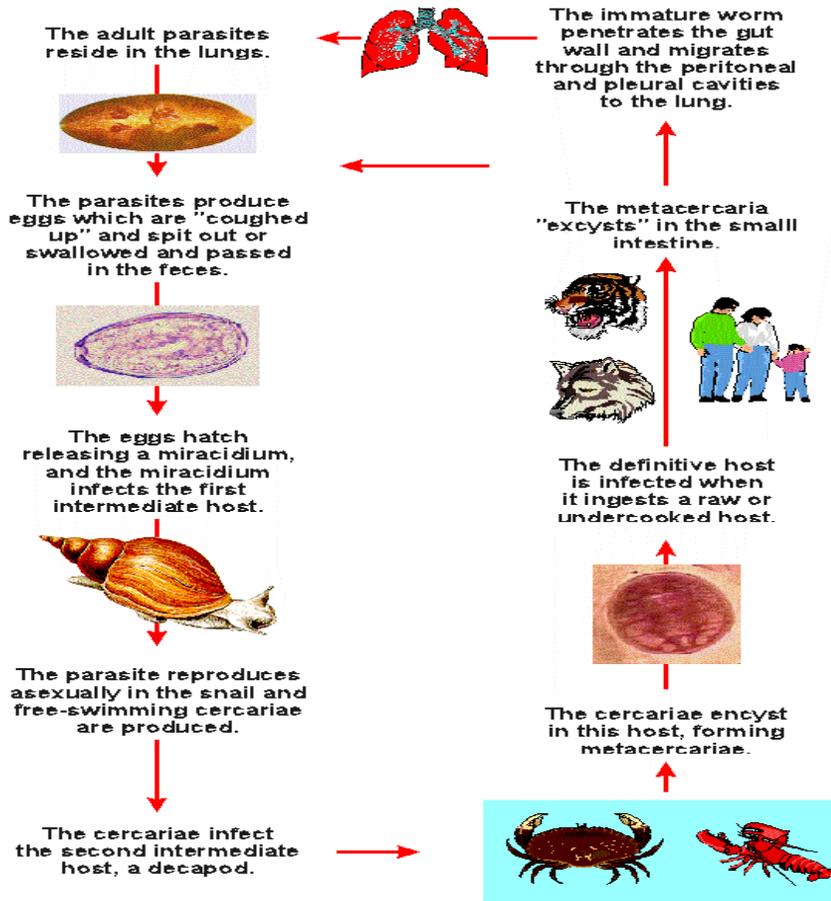
### 1- *Paragonimus westermani*-an agent of paragonimiasis

- **Mode of transmission:** ingestion of metacercarial cysts in crabs or crayfish.
- **Final hosts:** carnivorous mammals, pigs, humans.
- **Intermediate hosts:** 1) snail (sporocyst, redia, cercaria);
- 2) crabs or crayfish (metacercaria).
- **Infective stage:** metacercariae

**Morphology:** an egg-like form of the body, from 7,5 to 16 mm



**THE LIFE CYCLE OF *PARAGONIMUS WESTERMANI*  
(THE HUMAN LUNG FLUKE)**



(Parasites and Parasitological Resources)

- **Clinical disease:** a chronic cough with bloody sputum, dyspnea, pleuritic chest pain, and pneumonia.
- **Laboratory diagnosis:** eggs in sputum or feces.
- **Prevention:** cooking crabs and crayfish properly.