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Medical Helminthology

أستاذه المادة

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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 helmintic diseases.

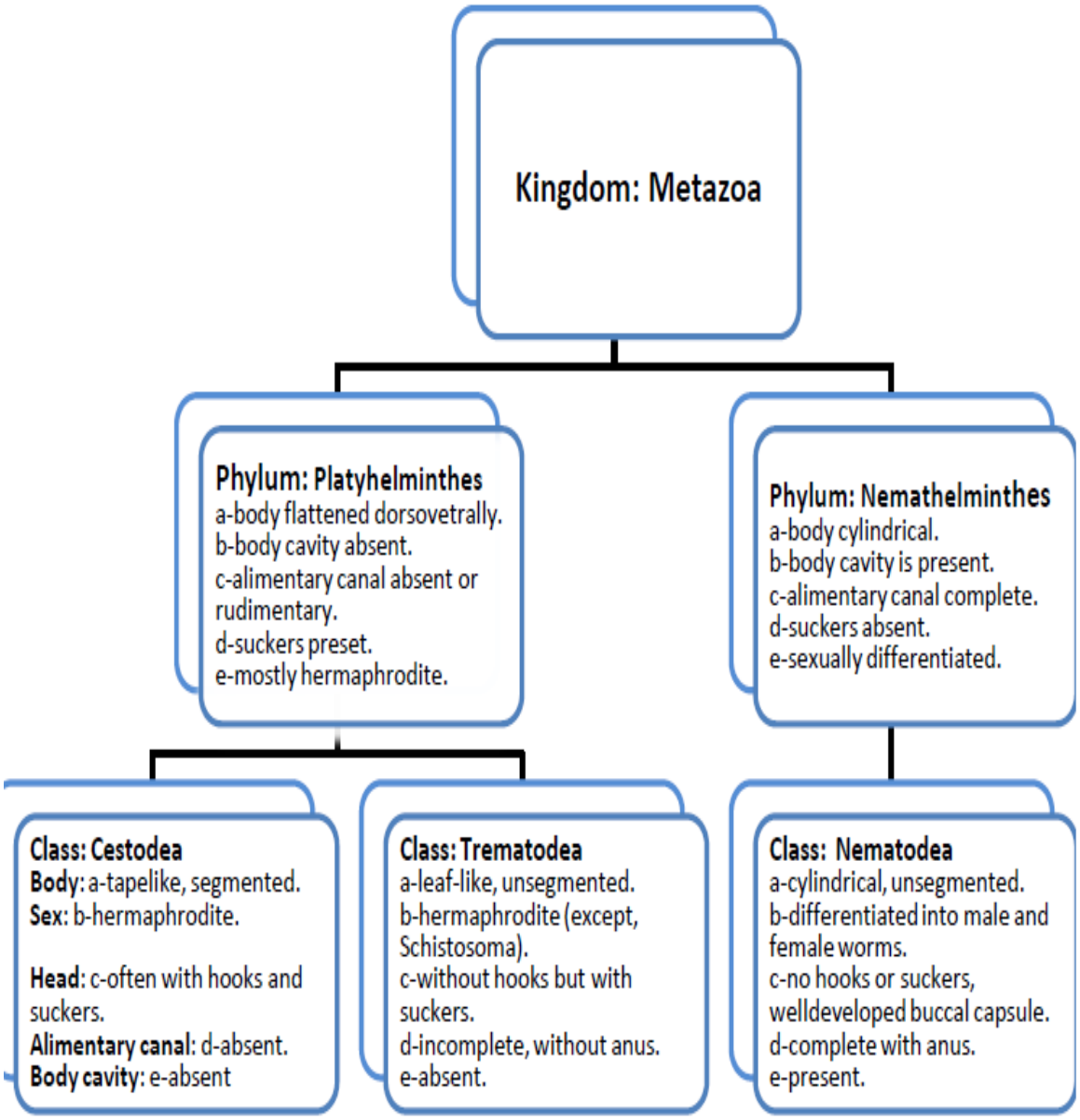
Helminths: are invertebrates that develop through egg, larval (juvenile), and adult stages.

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) include: Tapeworms (Cestodes) and Flukes (Trematodes).

2-Nemathelmintes (roundworms).



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 helmintic 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 *Taenia 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).or by

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.

Note-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 ***Schistosoma haematobium,***

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.

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

– Food animals

- Public health (zoonotic infections)

**** Helminths Feeding:**

1- Passive feeders: absorption

2- Tissue feeders:– Solid tissues – Blood

-Reproduction

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

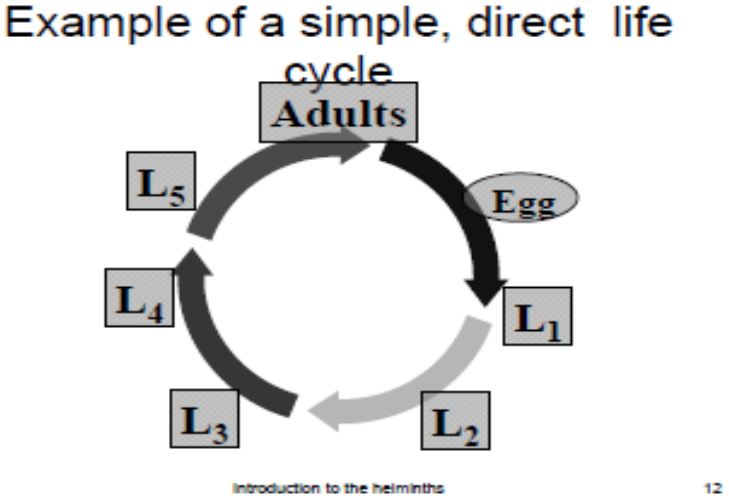
2- **Sexual: A**– Monoecius **B–** Dioecius

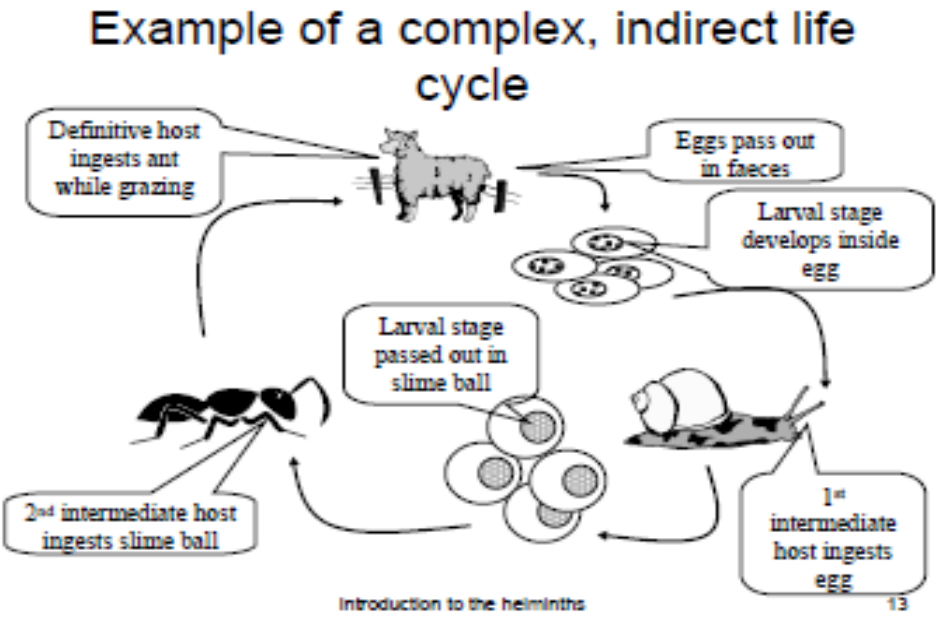
- **Types of Life cycles**

1- **Direct: with one host**

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

Born





Characteristics of helminths

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

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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. Humans get this infection by mouth and by autoinfection**.**

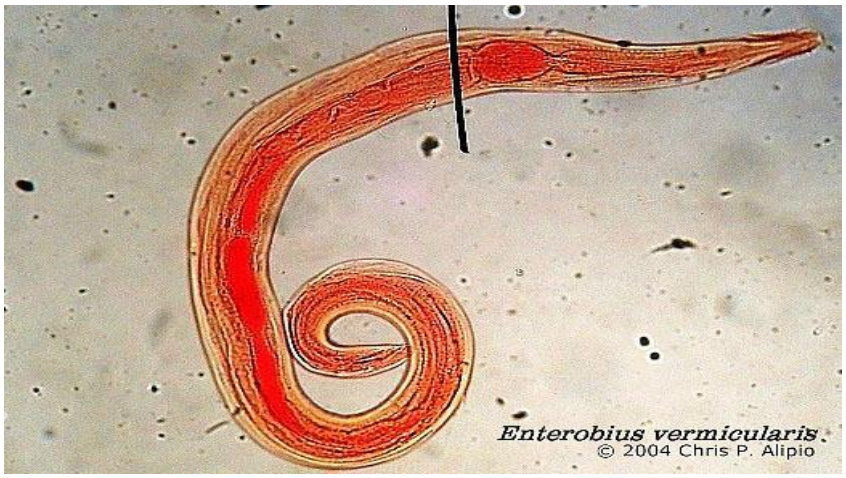
Morphology

1.**Adults**:The adults look like a pin and are white in color. The female worm measures about8to13mminsize and is fusiform in shape. The male adult is only 2-5mm. The tail of a male is curved The anterior end tapers and is flanked on each side by cuticular extensions called “cephalic alae”. The esophagusiss lender,terminatinginaprominentposteriorbulb,whichiscalledesophagealbulb.Thecephalicalaeandesophagealbulbareimportantinidentificationofthespecies

.**2.Egg**:50 to 60m by 25µm ,color less and transparent ,thick and asymmetric shell, content is a larva.

MALE WORM:

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

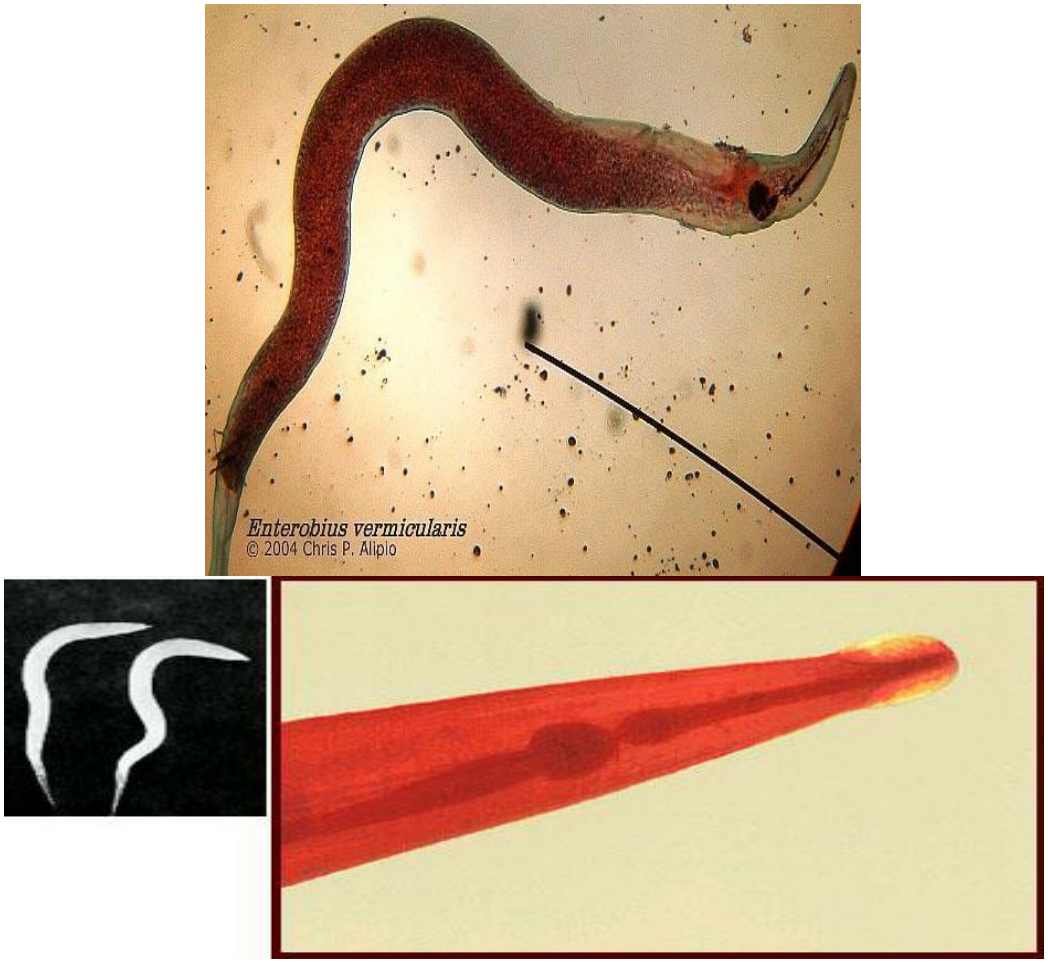


FEMALE WORM

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

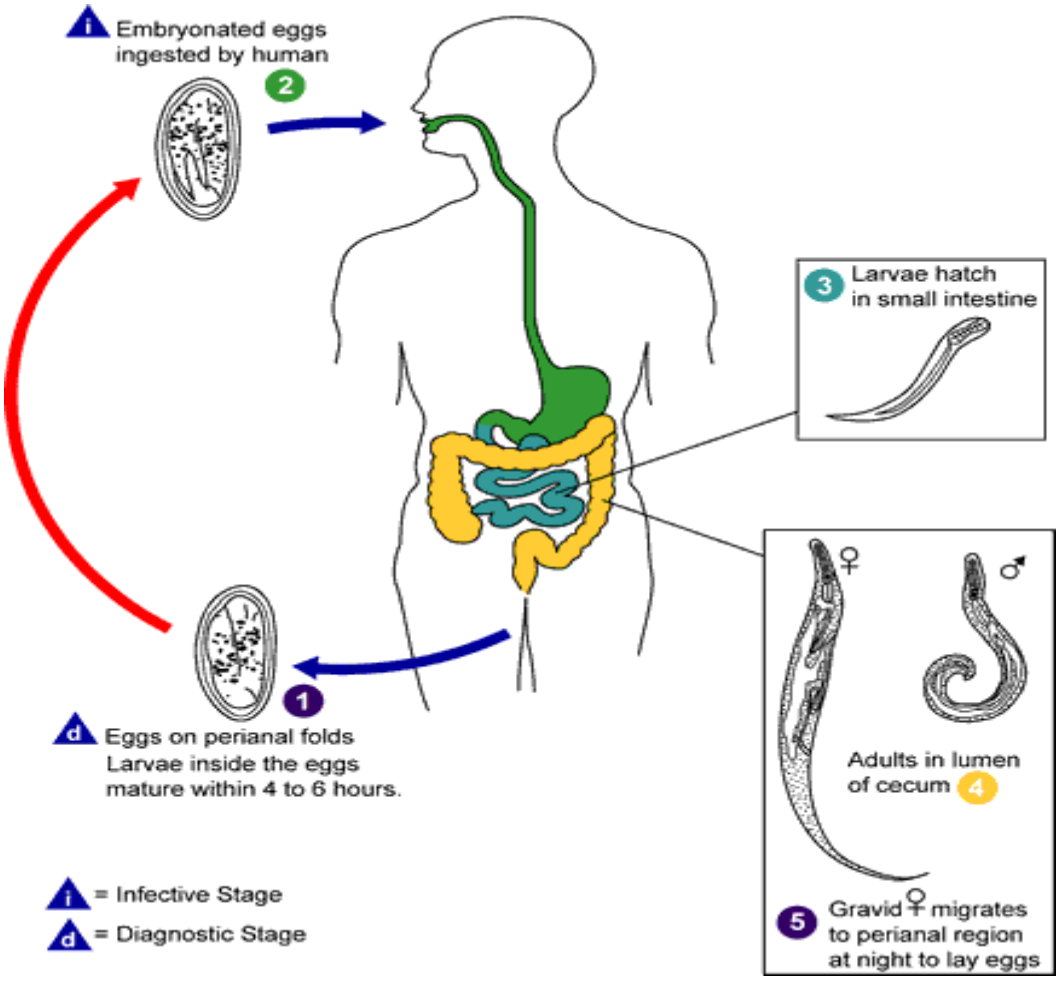
1. site of inhabitation: cecum and colon

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.treatthepatientsandcarriers2.individual health 3.public health 4.health education and hygienic habits

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

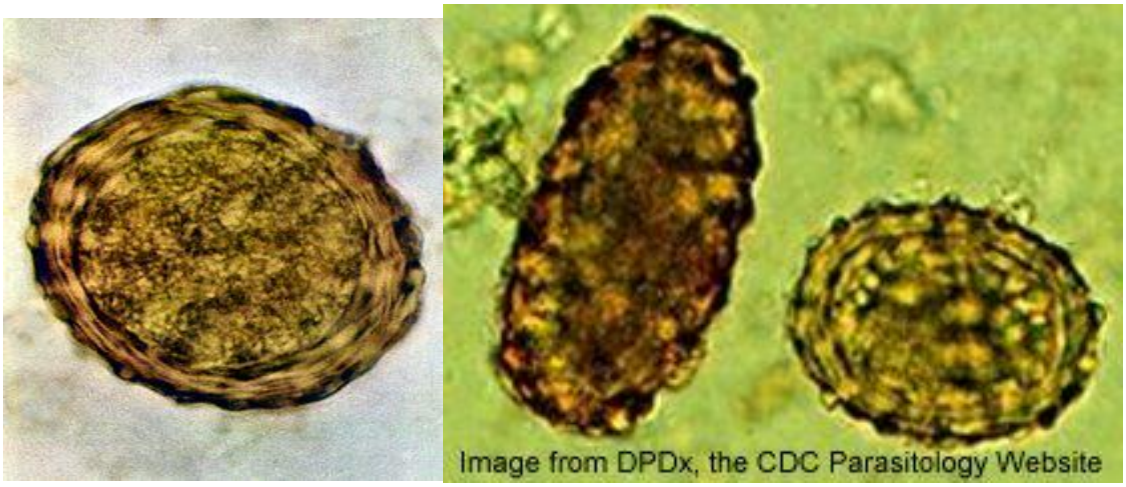
in diameter and 10-30 cm long. The male posterior end **is curved ventrally with two spicules, but no copulatory bursa**. Females are 3-6mm wide and 20-35cm long. The **vulva is located in the anterior end and accounts for about a third of its body length**. Uteri may contain up to 27 million eggs at 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-latreral.

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

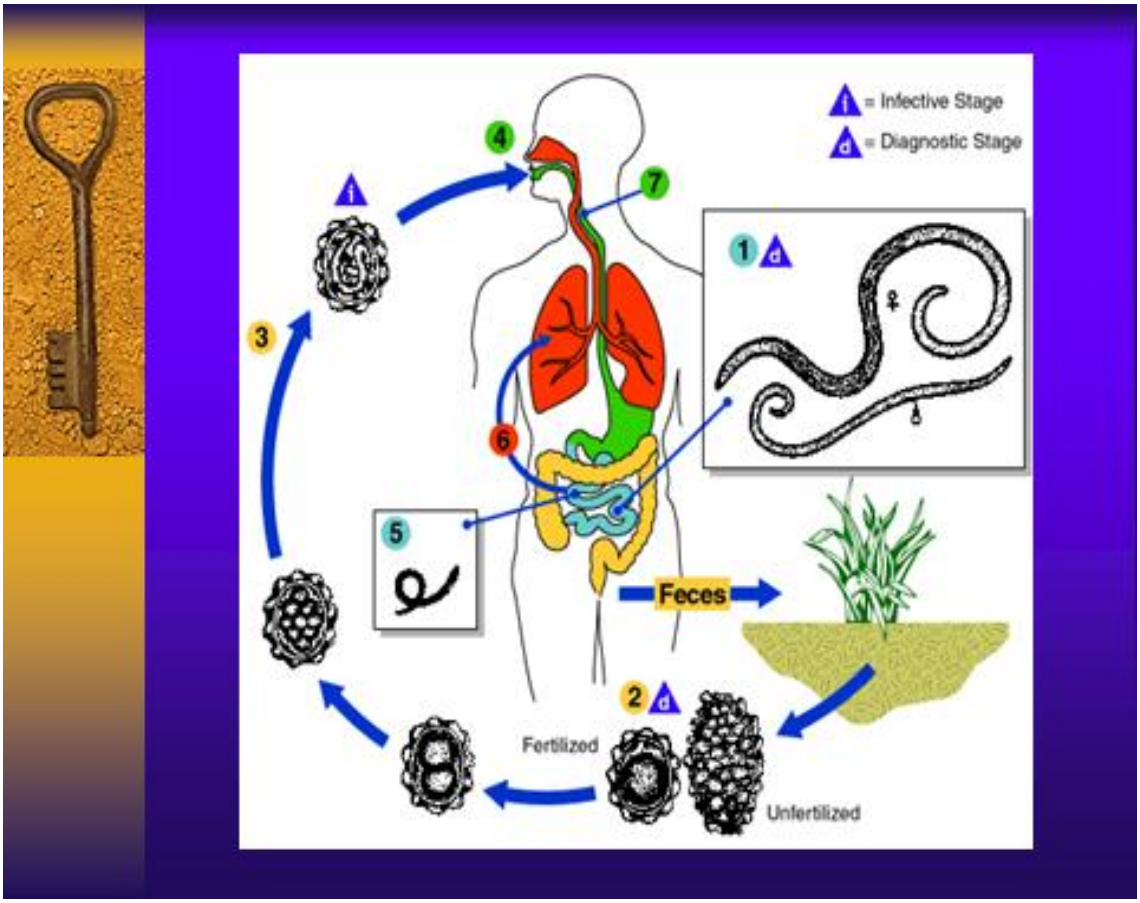
_Site of localization : Small intestine

_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.

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

- ***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

- *Neactor 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.

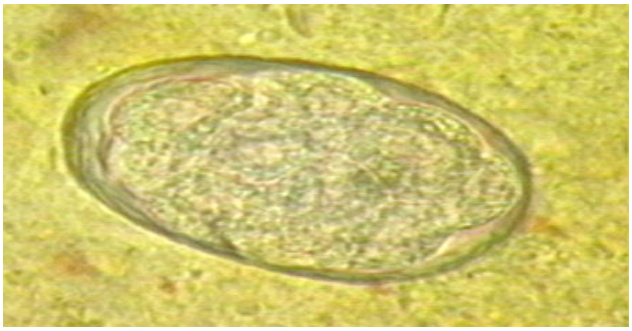
- ***Ancylostoma duodenale*:** Associated with miners because mines offer an ideal habitat for egg and juvenile development due to constancy in temperature and humidity.

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 spicules have simple tips and are never fused distally.

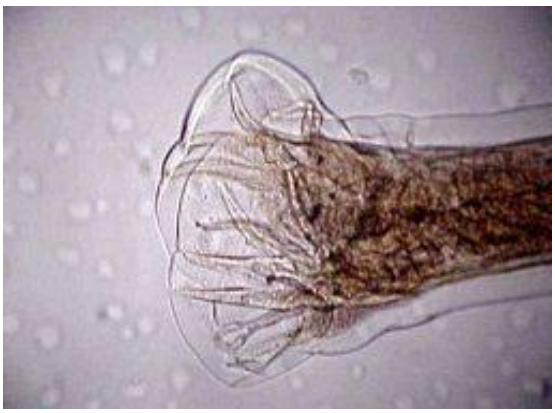
Morphology

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*)

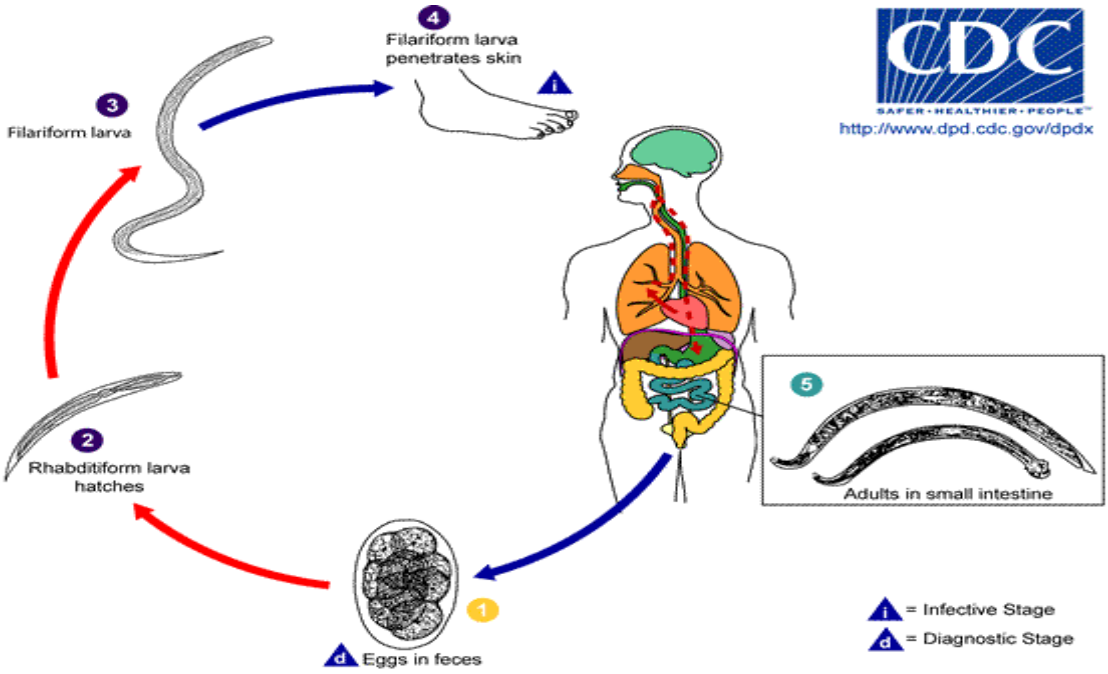
The male worm is equipped with a characteristic copulatory bursa, used to catch and hold the female during mating.



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 inhabits 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

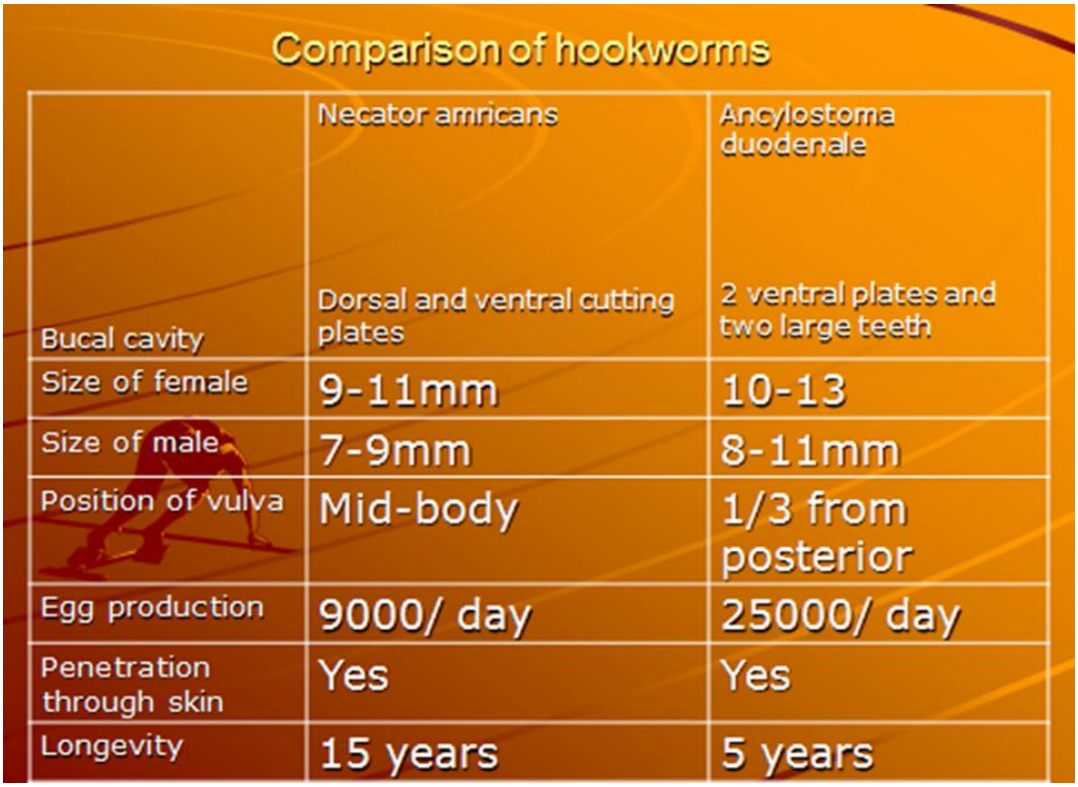
Diagnosis

- 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.



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).

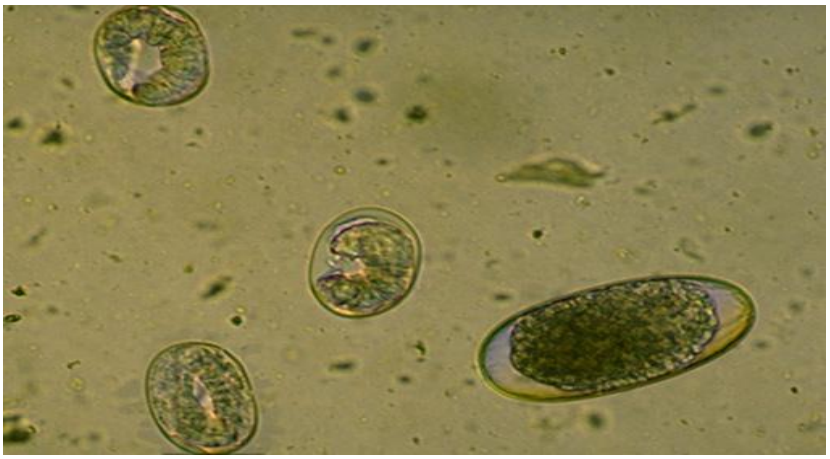
- Diagnostic stage: First stage larvae(Rhabditiform) in feces

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):

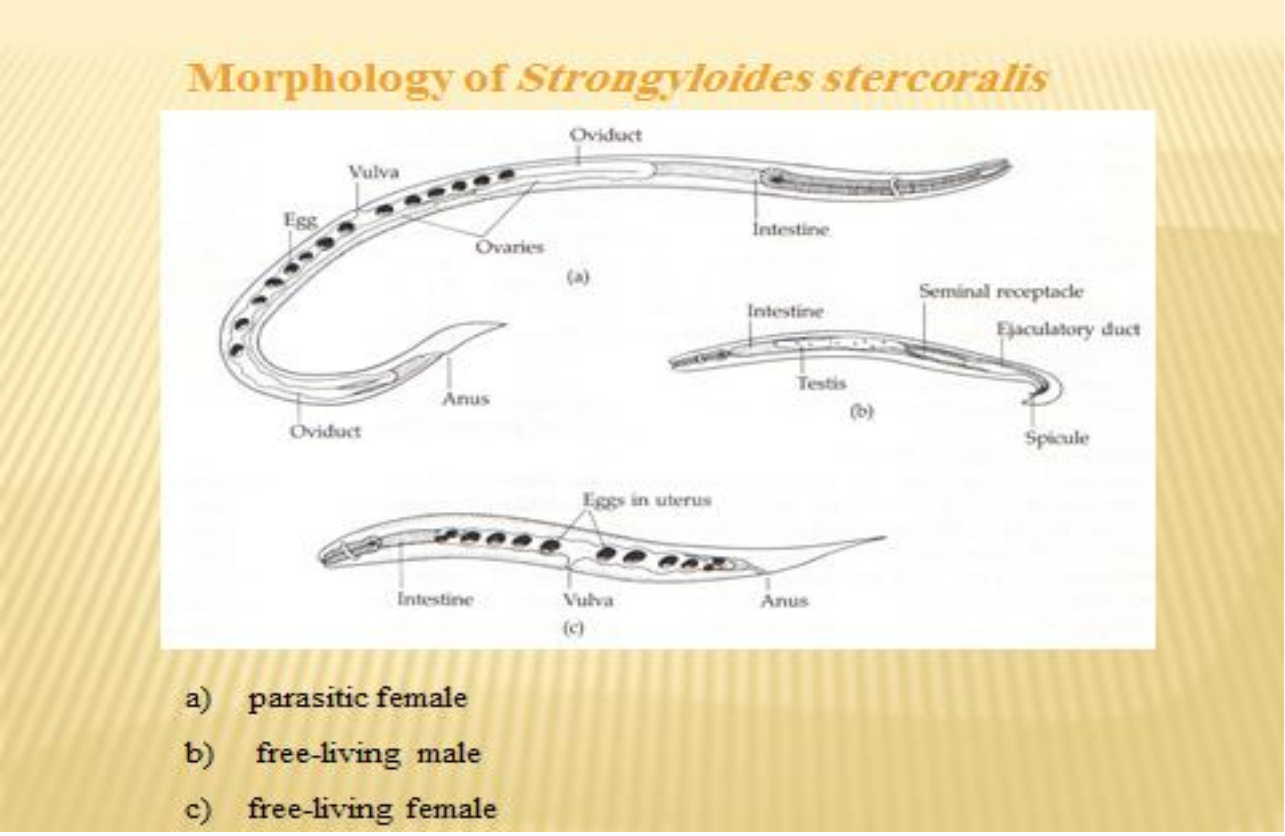
- 0.7 mm in length,- Rhabditiform oesophagus- Posterior end curved ventrally with Spicules

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

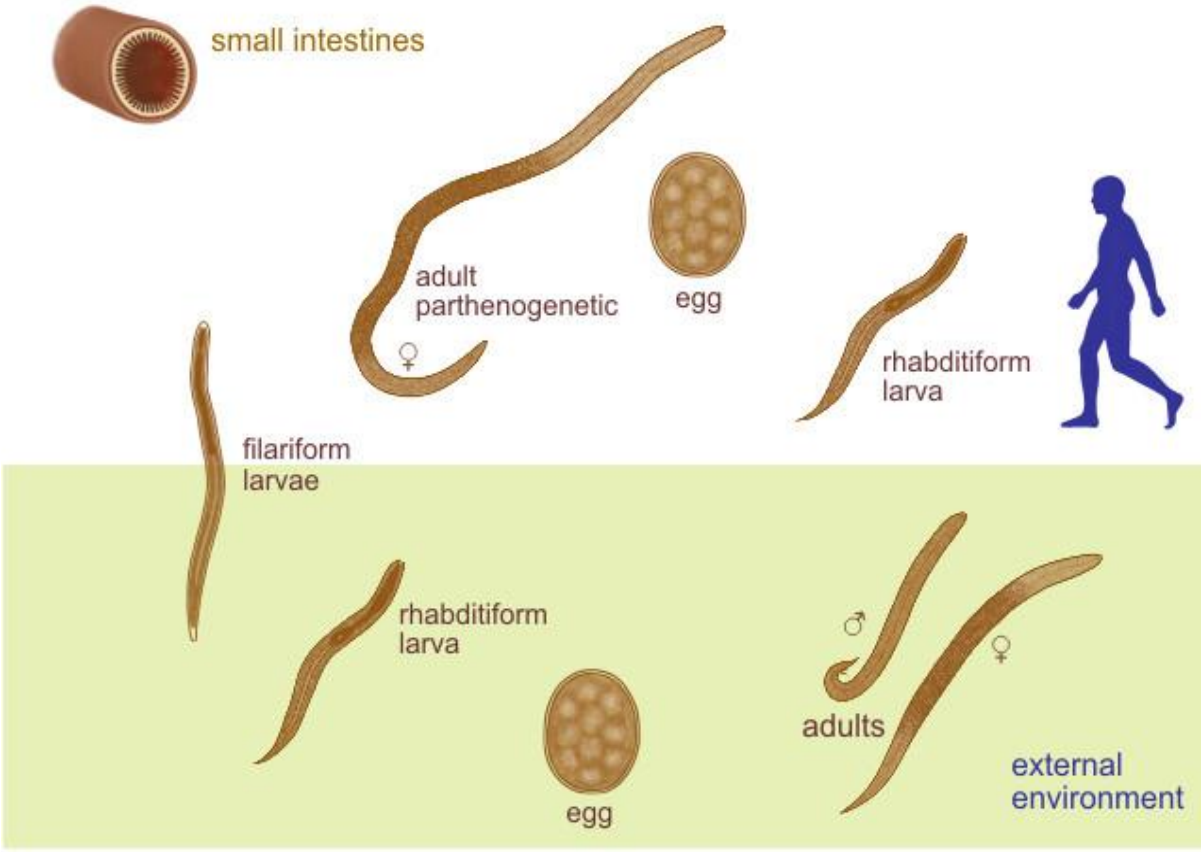


Rhabditiform larvae

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

***Filariform larvae* posterior part**

Filariform larva with,notched tail. Infective stage



Life Cycle:

Free-living cycle

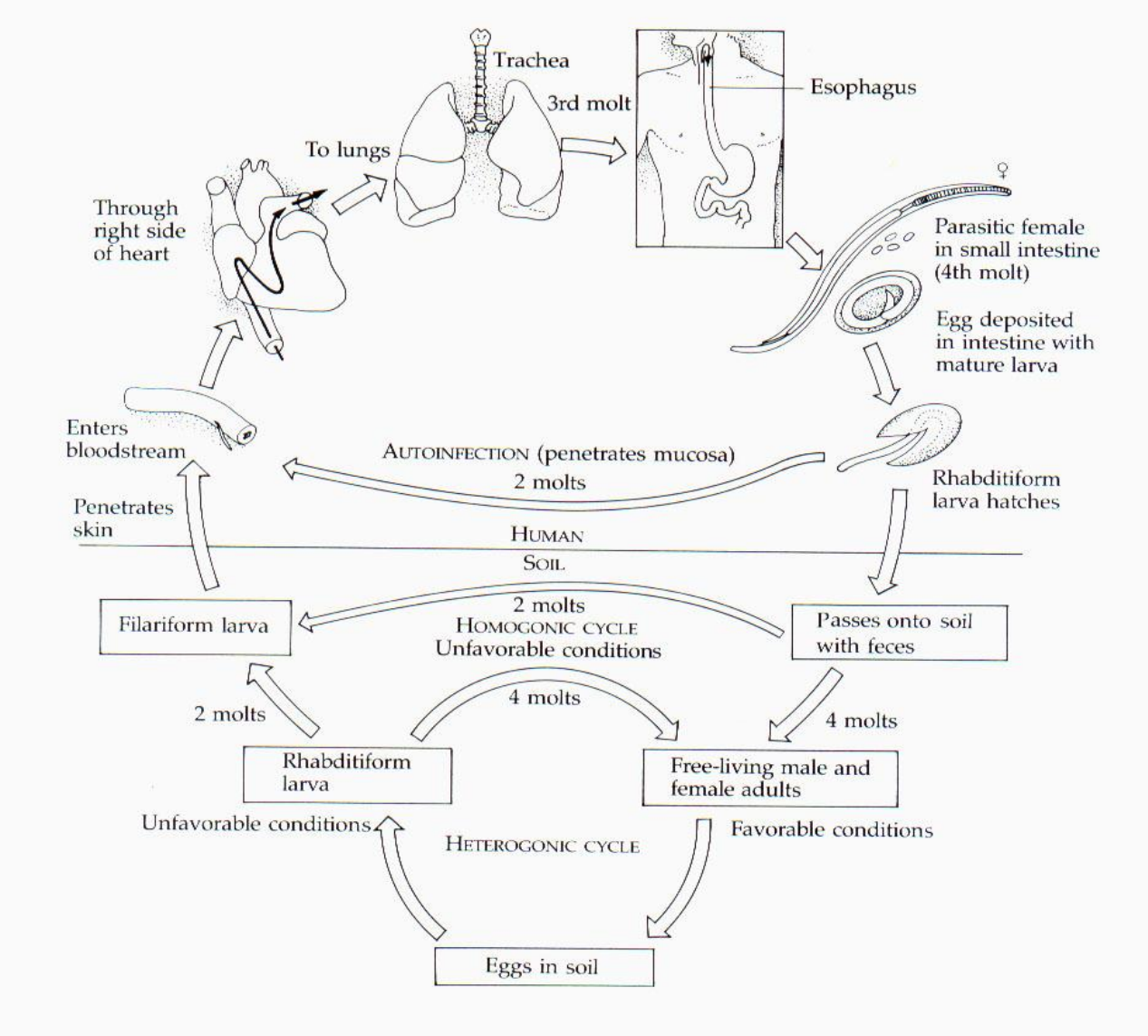
Parasitic cycle: In the parasitic stage, no male form of this organism has been reliably identified, and the female reproduce in a parthinogenitic manner.

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 rhabditform 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 parhenogenetically
- 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

✖ ELISA for IgG *anfi-Strongyloides antibodies is effective.*

Prevention

❖ wearing shoes

❖ improved sanitation

5- *Trichostrongylus*

Trichostrongylus is similar to Hookworm but requires a different treatment

Disease caused by *Trichostrongylus spp.*
Called:**Trichostrongyliases**

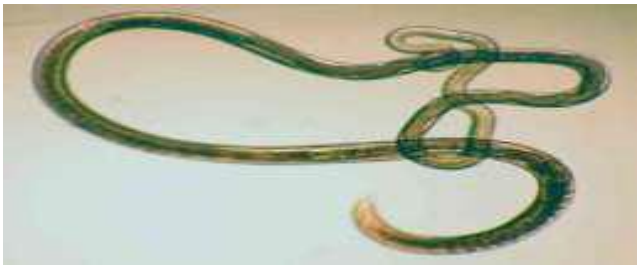
 Habitat: in small intestine

 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 nearthe tip of the tail.



Life cycle:

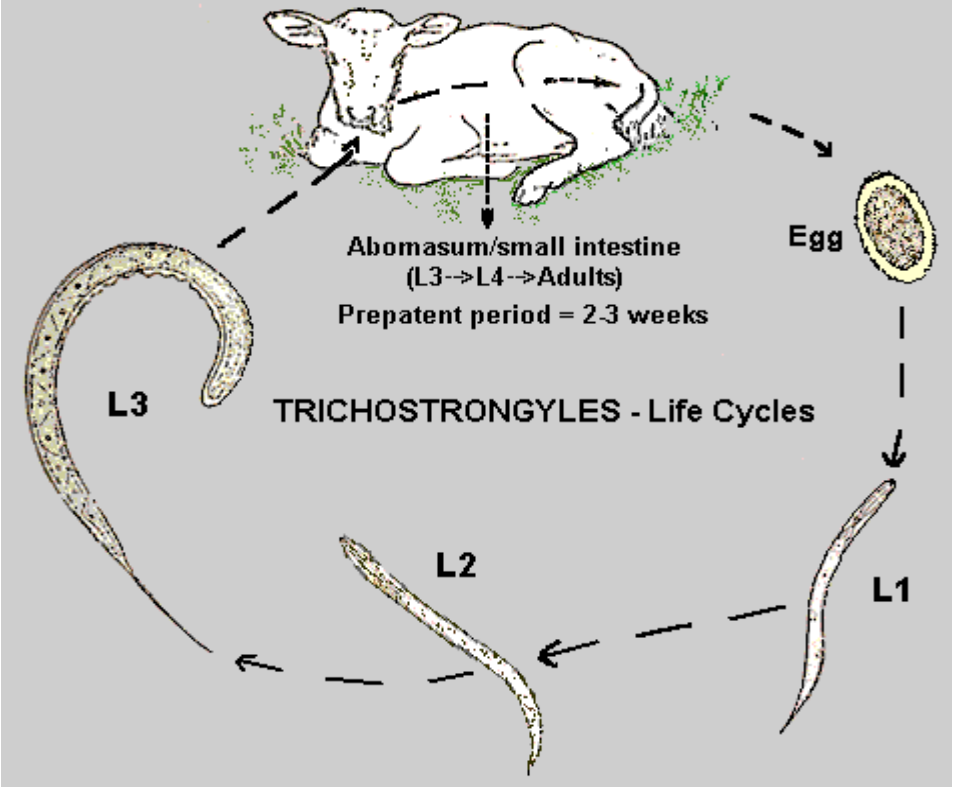
 The eggs produced by the female will pass in the feces and hatch outside the host. They are already segmented when laid and develop into infective larvae within 6 days. The L1 and L2 stages of the larvae are

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*

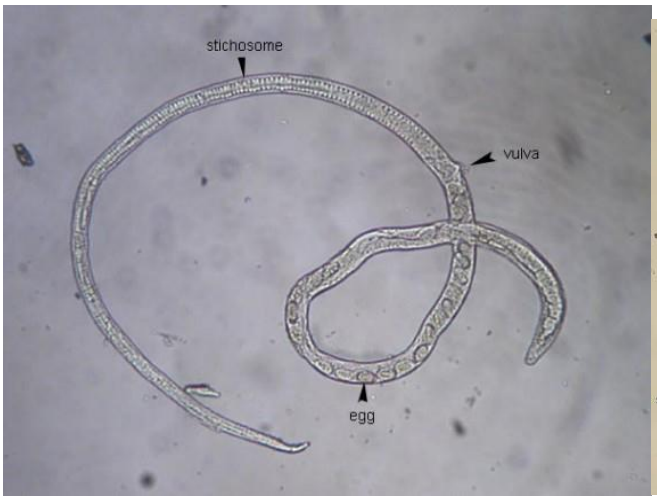
MORPHOLOGY :

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
-

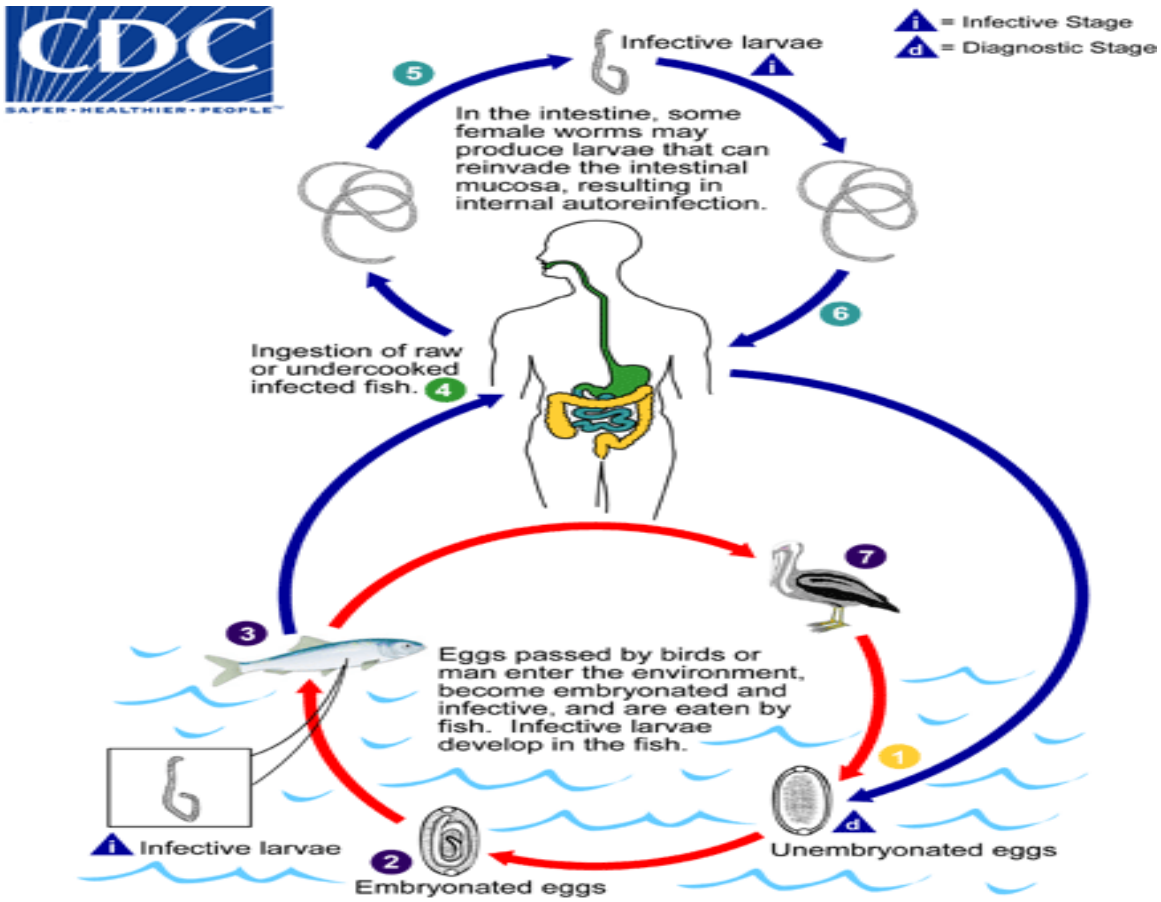
LIFE CYCLE

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

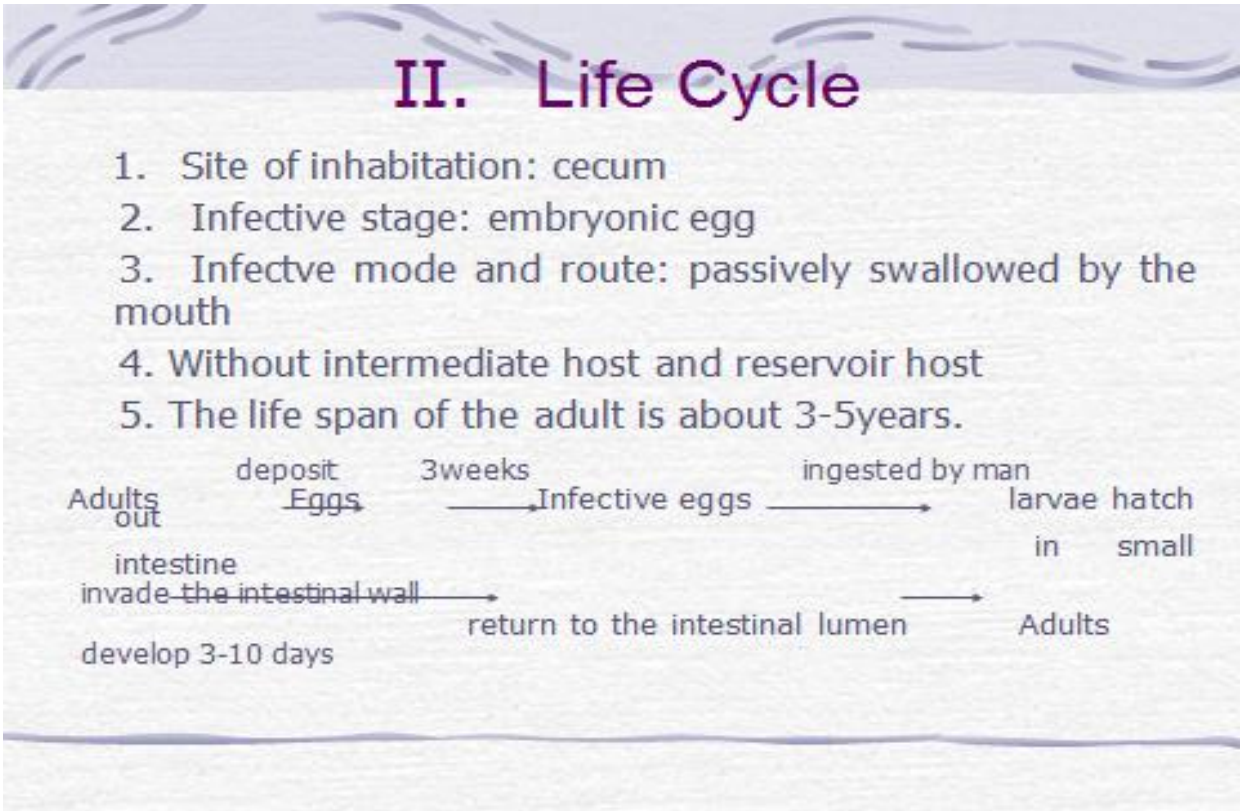
7-Trichuris trichiura(whip worm)

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 x 20µm 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 mucosaof the intestine and encysment 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

- Caudal end of the female is bluntly rounded ,while the male is curved ad has a single .
- The female single ovary and the vulva is near the level of the base of the esophagus
- The females are vivaporous
- The adult in habit in 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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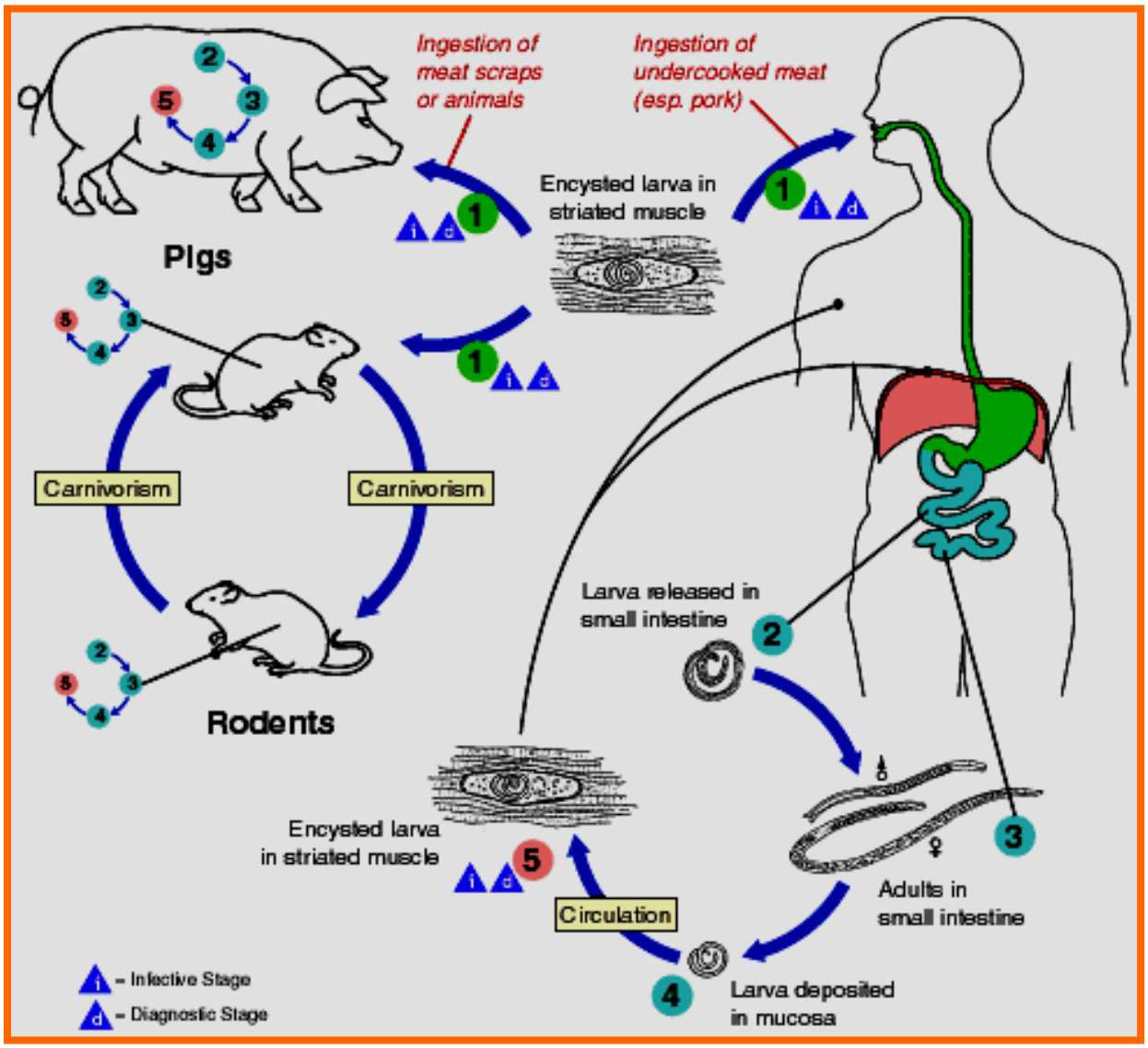
- The amount of damage to the intestinal lining is depend on the number of invaiding organisms and the time and number of previous exposures.

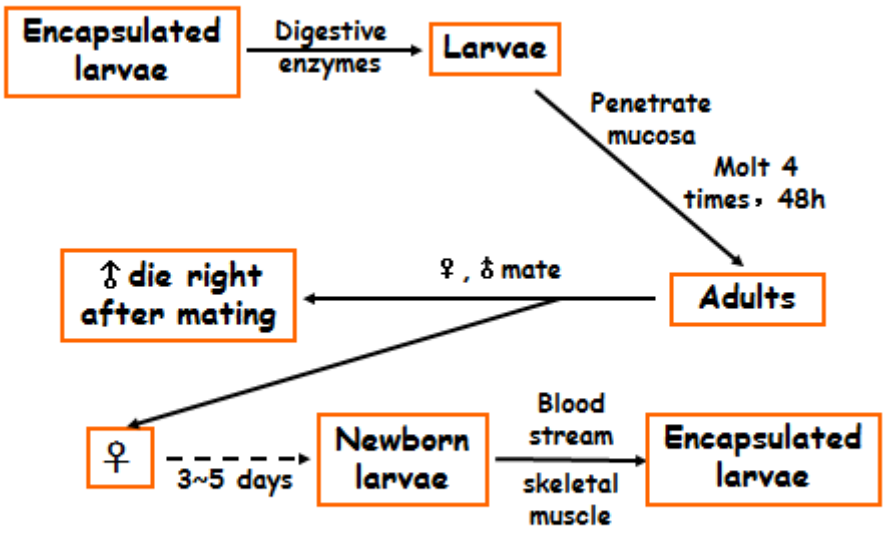
In 18 to 24 hours may be differentiated in male and female

* 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

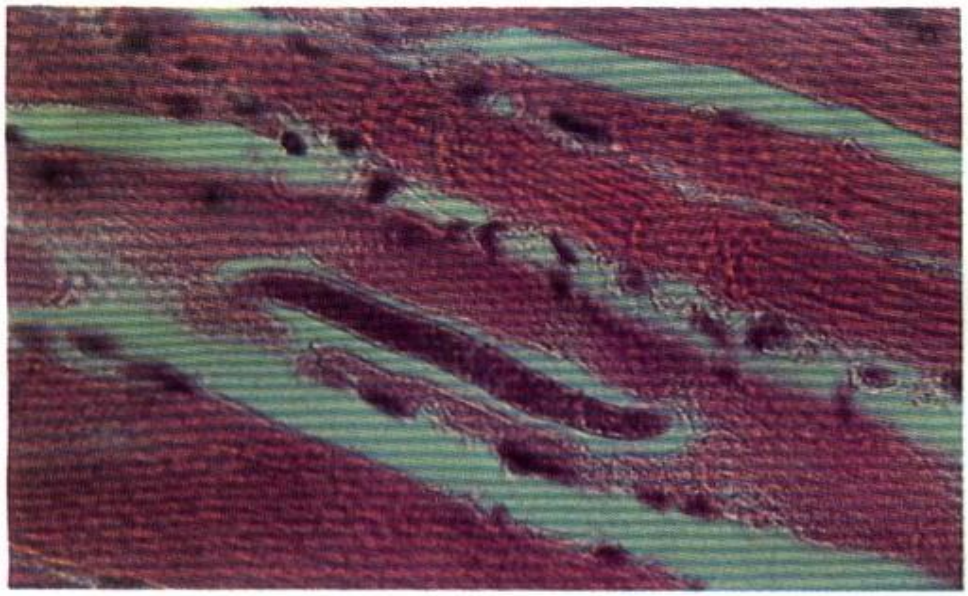
* Lungs: bronchitis, bronchopneumonia,:

* 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. cannis, 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 bi 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

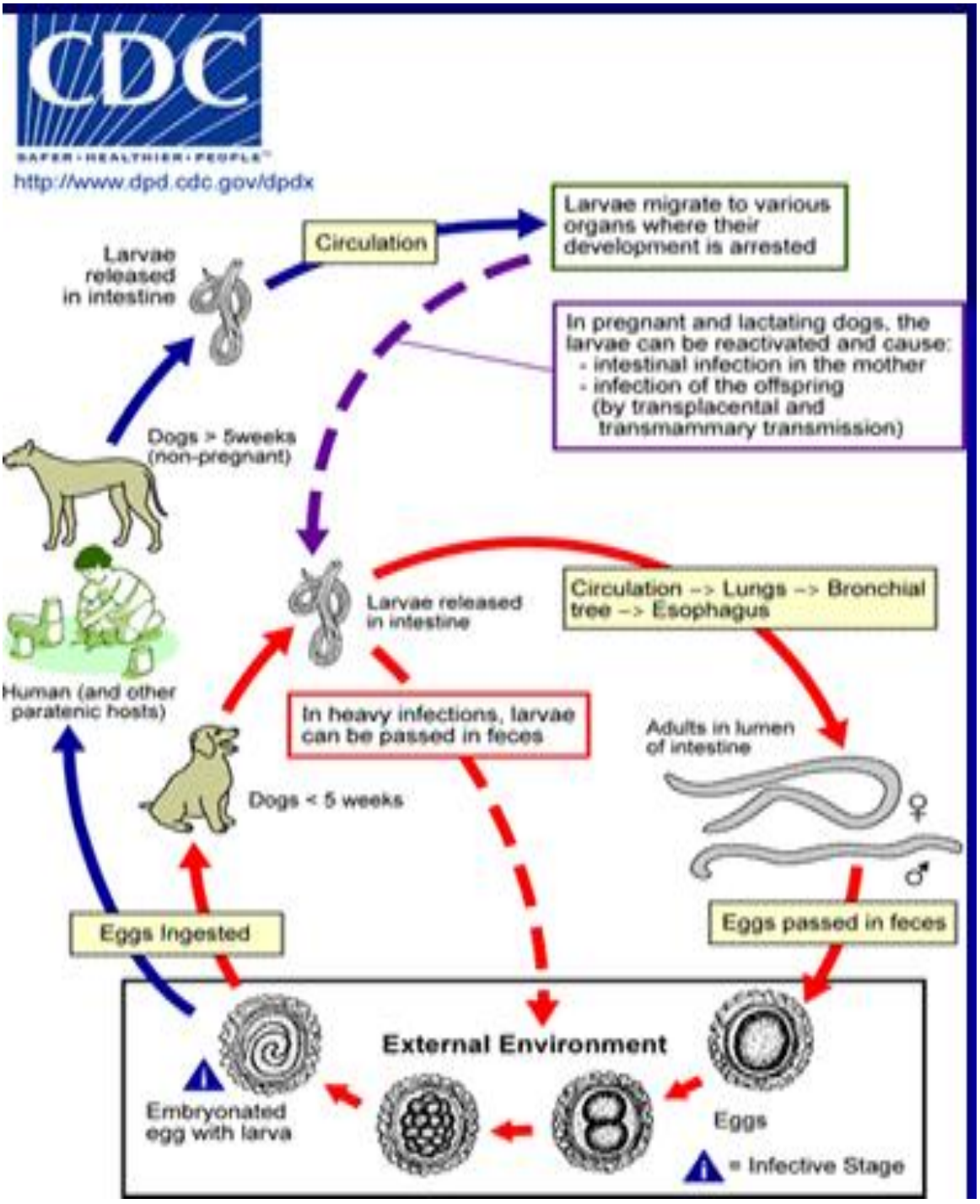
In Humans: Abdominal Pain,Decreased Appetite,Restlessness

Fever,Other symptoms vary with site larvae infection.

Diagnonsis

- 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-splenmegaly.

-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 (accidently) **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?

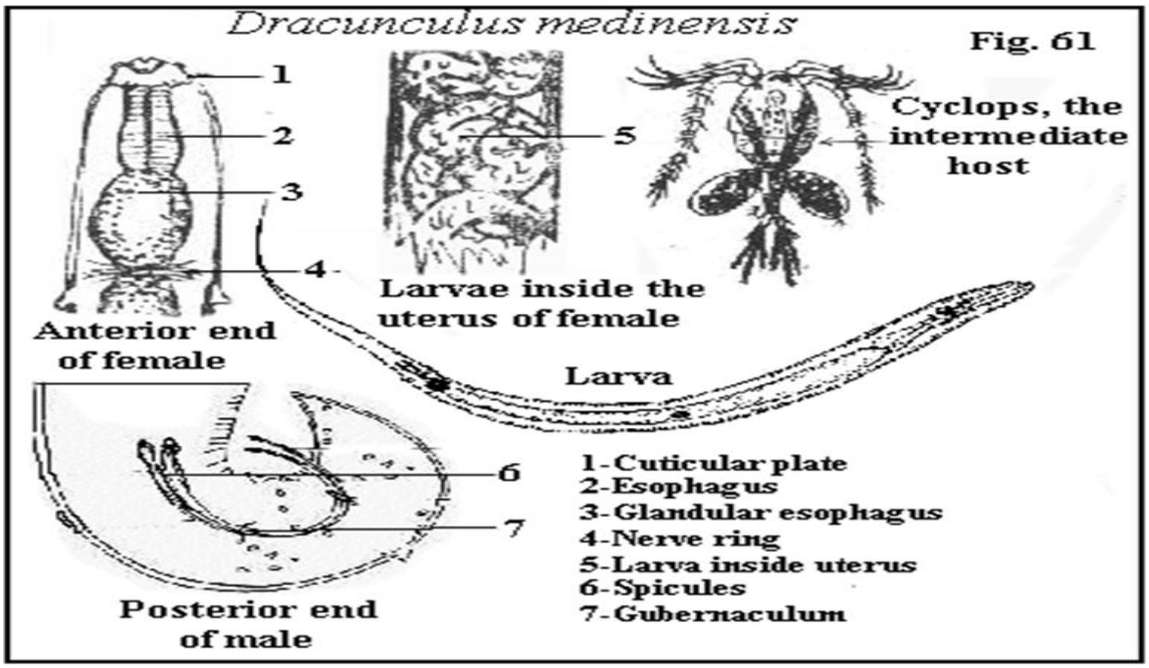
Good hygiene and regular deworming of pets will reduce the chance of human exposure. Children should not play in areas possibly contaminated with animal feces

3-***Dracunculus medinensis***

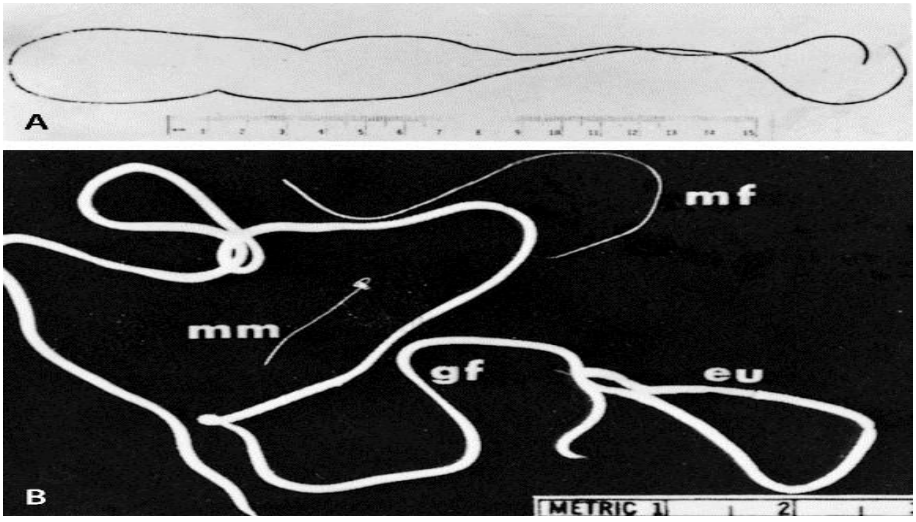
- **Common names-** Guinea Worm, Dragon Worm
- **Definitive**: Humans
- **Intermediate**: Copepod

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 um long. The gubernaculum ranges from 115 to 130 um long.



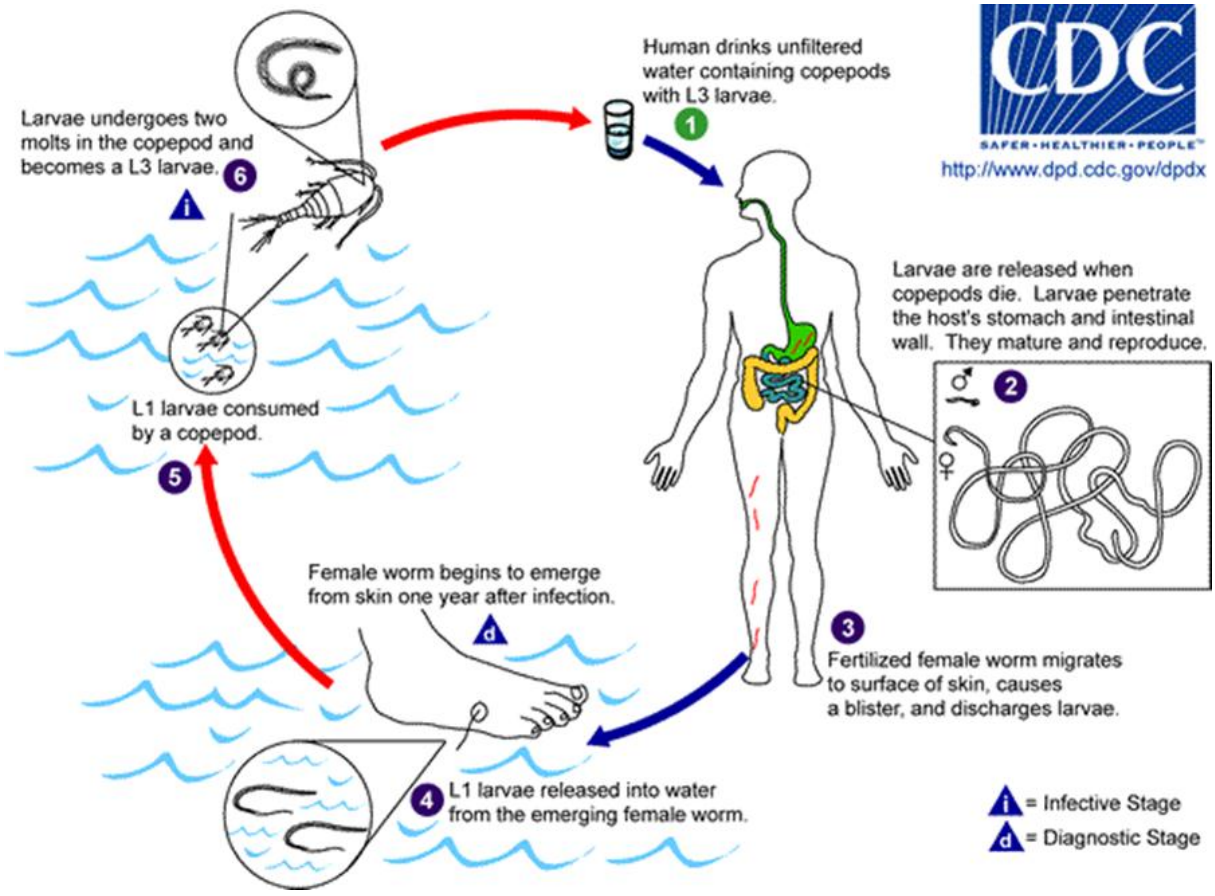
- **Adult *D. medinensis* worms.** The adult female guinea worm is a long, slender worm ranging from 30 to 120 cm in length and from 0.09 to 0.17 cm in width**.**



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

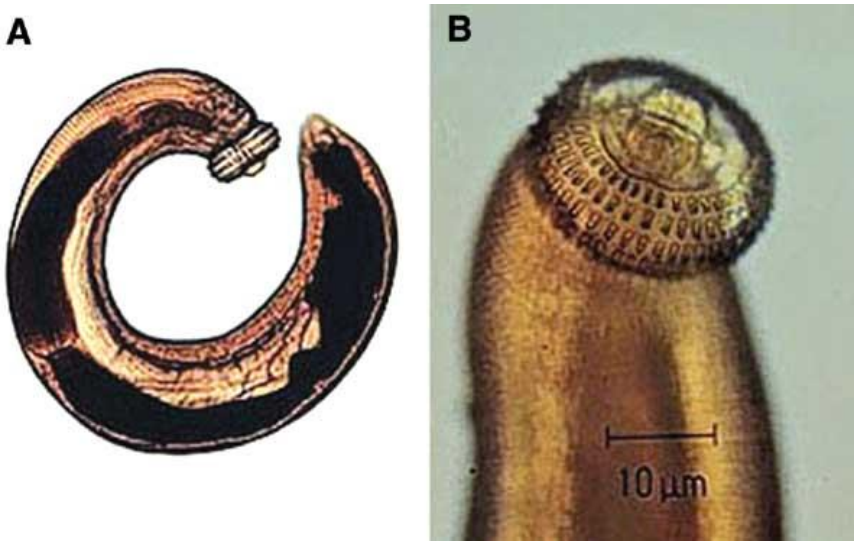


Diagnosis

- 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*

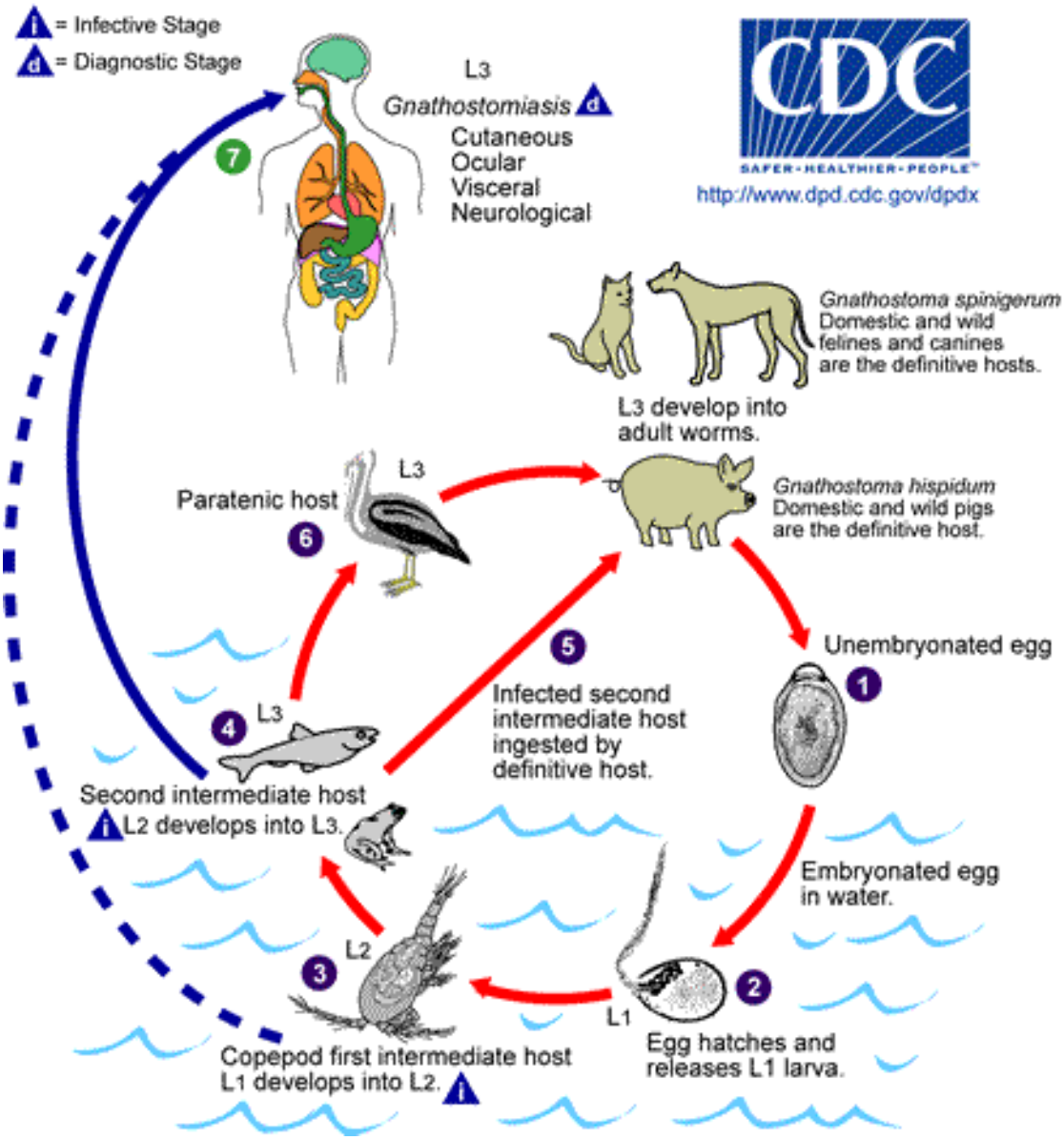
- Caused by the third stage larvae of several species of the nematode genus Gnathostoma, most commonly *G. spinigerum* in humanscauses gnathostomiasisThe larval nematode is acquired by eating raw or undercooked fish and meat.



Morphology

This species grows to a length of 11 to 54 mm

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

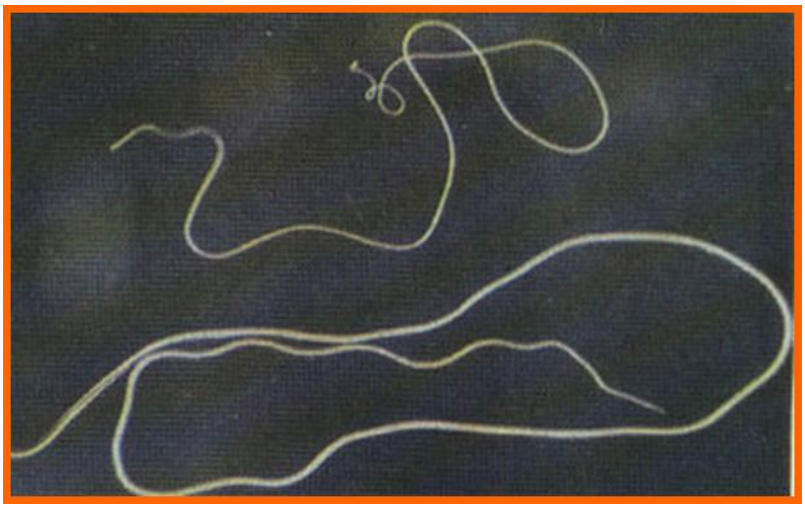
- Mortality of 8-25% if central nervous system involved due to eosinophilic meningitis
- **Diagnosis**
- **Serologic Tests:** ELISA (for IgG antibodies)
- **Prevention:** Avoid undercooked meat

3-Nematodes :Blood and other body fluids and skin

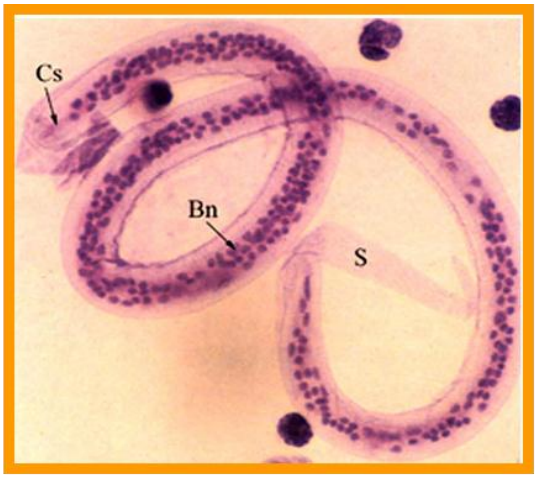
1-Filaria

- 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

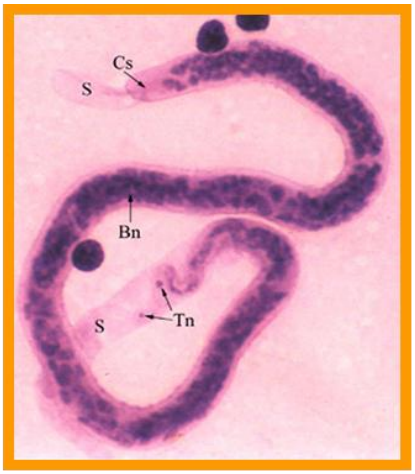
- ***Wuchereria bancrofti and Brugia malayi***
- **Morphology –** Adult,Slender, thread-like,White in color
- Male -- 2.5-4 cm long and has a curved tail, female -- 5-10 cm in length



- **Microfilaria--**177~296 µm 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



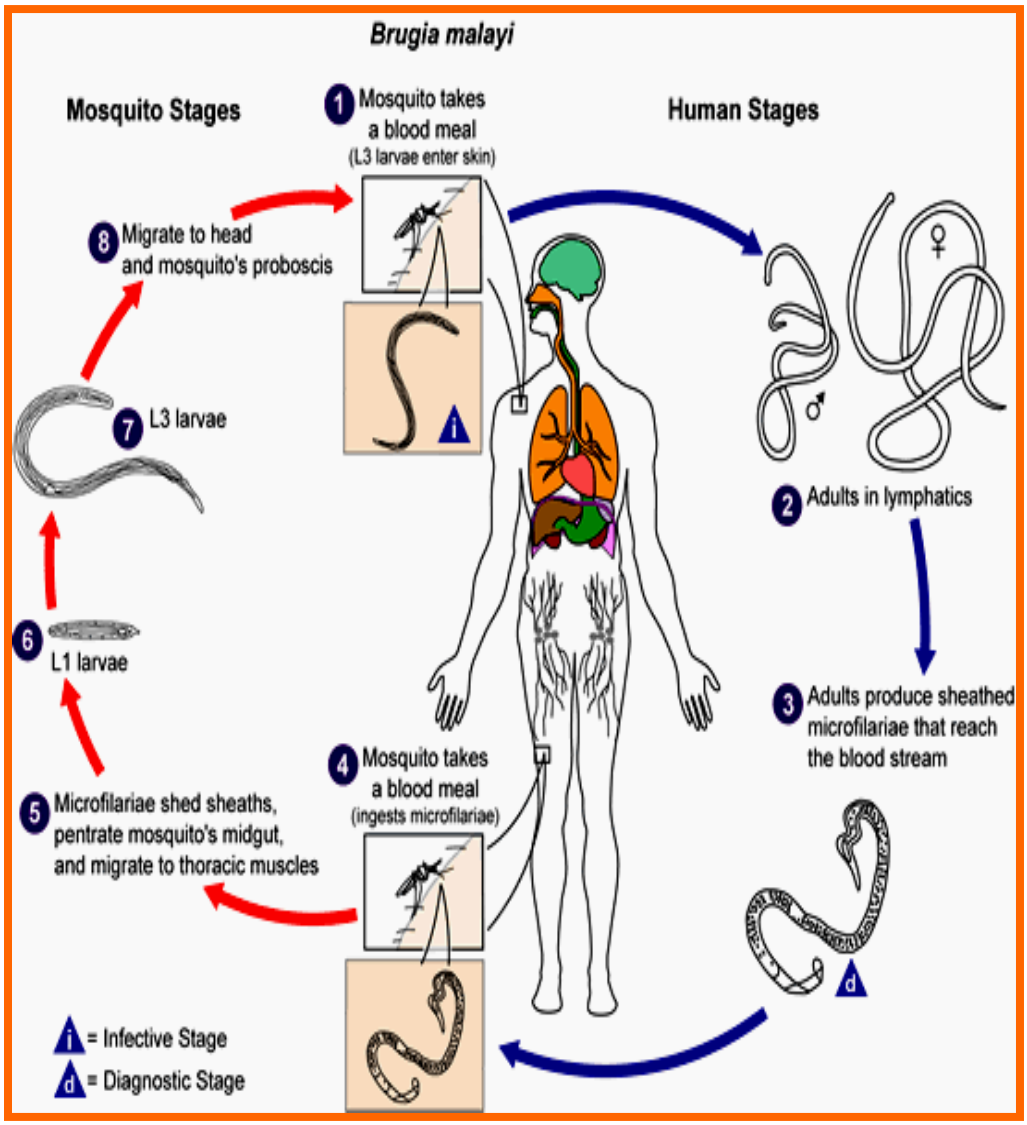
Wuchereria bancrofti



Brugia malayi

The morphological differentiation of bancroftian and malayan microfilariae

	W. bancrofti	*Brugia malayi*
Size	Larger, 244~296 by 5.3~7 μm	Smaller, 177~230 by 5~6 μm
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 obstructionDilated 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

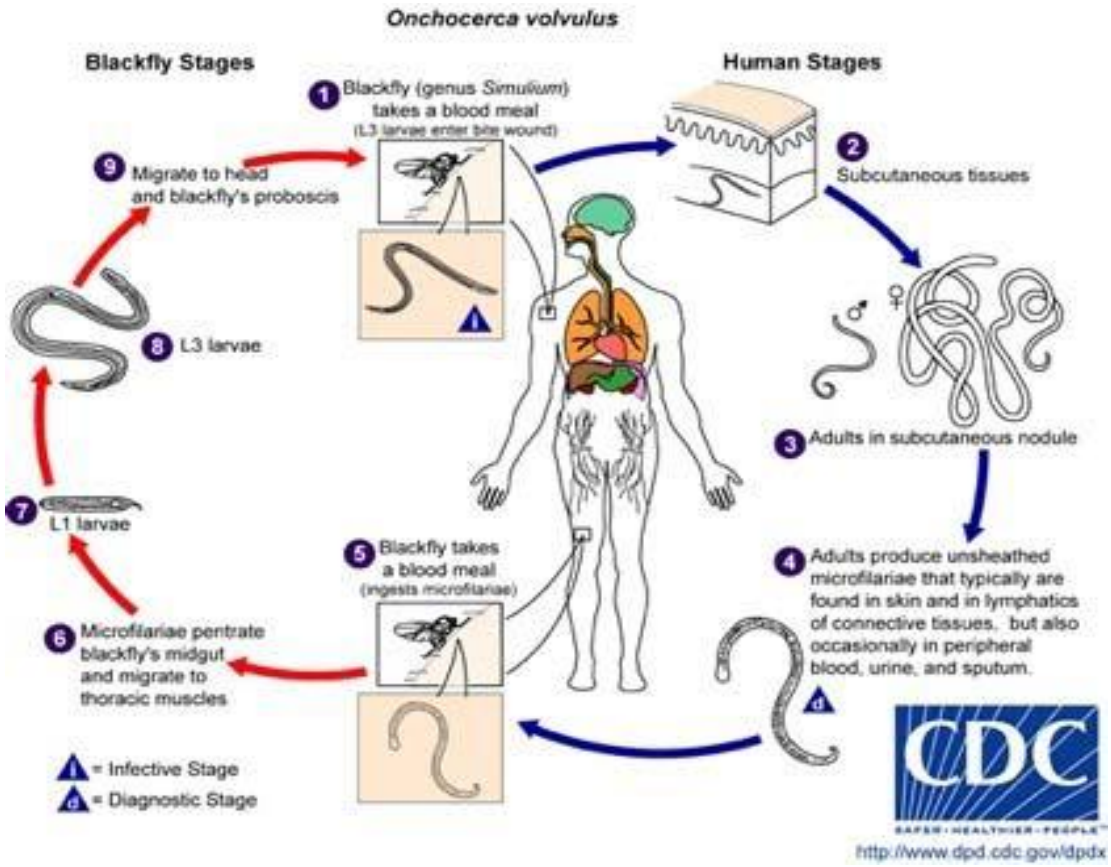
• The male measures 3 cm in length by about 0.13 mm in breadth, it has acoiled tail.

• 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 microfilariea which migrate・microfilariae taken up by blackflyduring 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

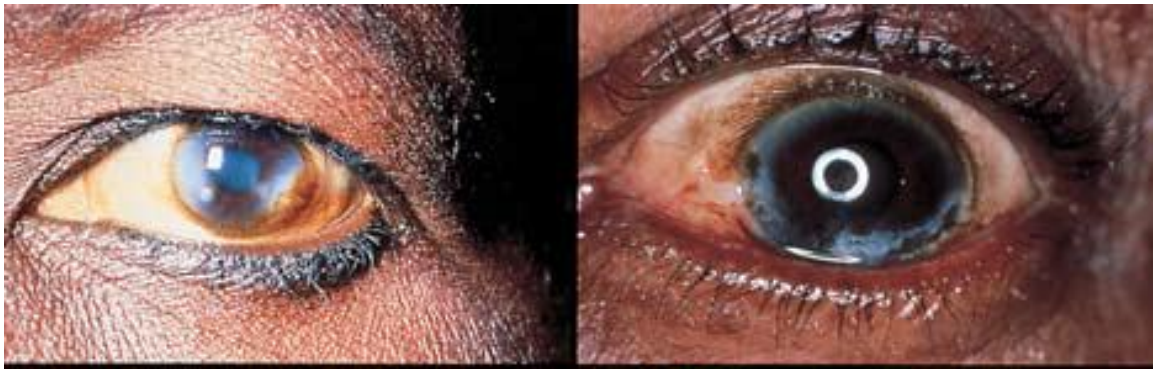
Skin Nodules: “Onchocercomata”: ・ Subdermal nodules usually over bony,prominences, “Robles Disease” in South America, ・ Raised, round, firm, 2-3 cm, contain at least 1 adult

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), placeon slide with saline, microfilariaecrawl out overnight into saline ,ELISA PCR tissue, Rapid serum antibody, Rapid urine antigen,

Prevention

Black flies 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 innumber 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

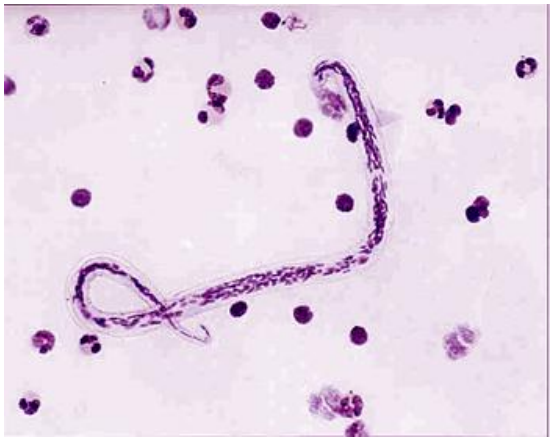
The worm produces the disease in man called loisis

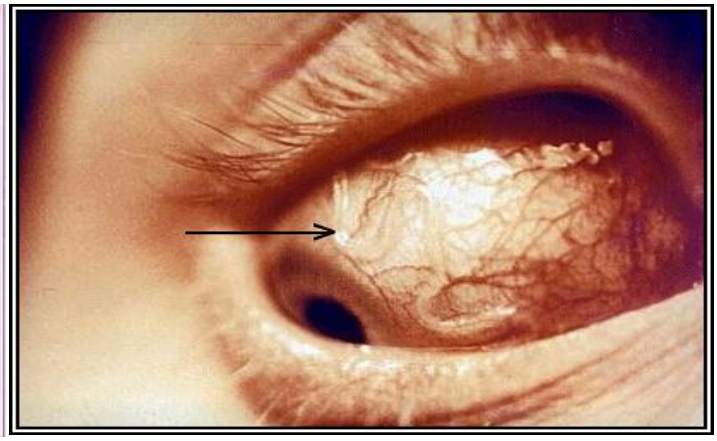
Microfilariae climb into dermis through hole cut in skin by fly

- 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

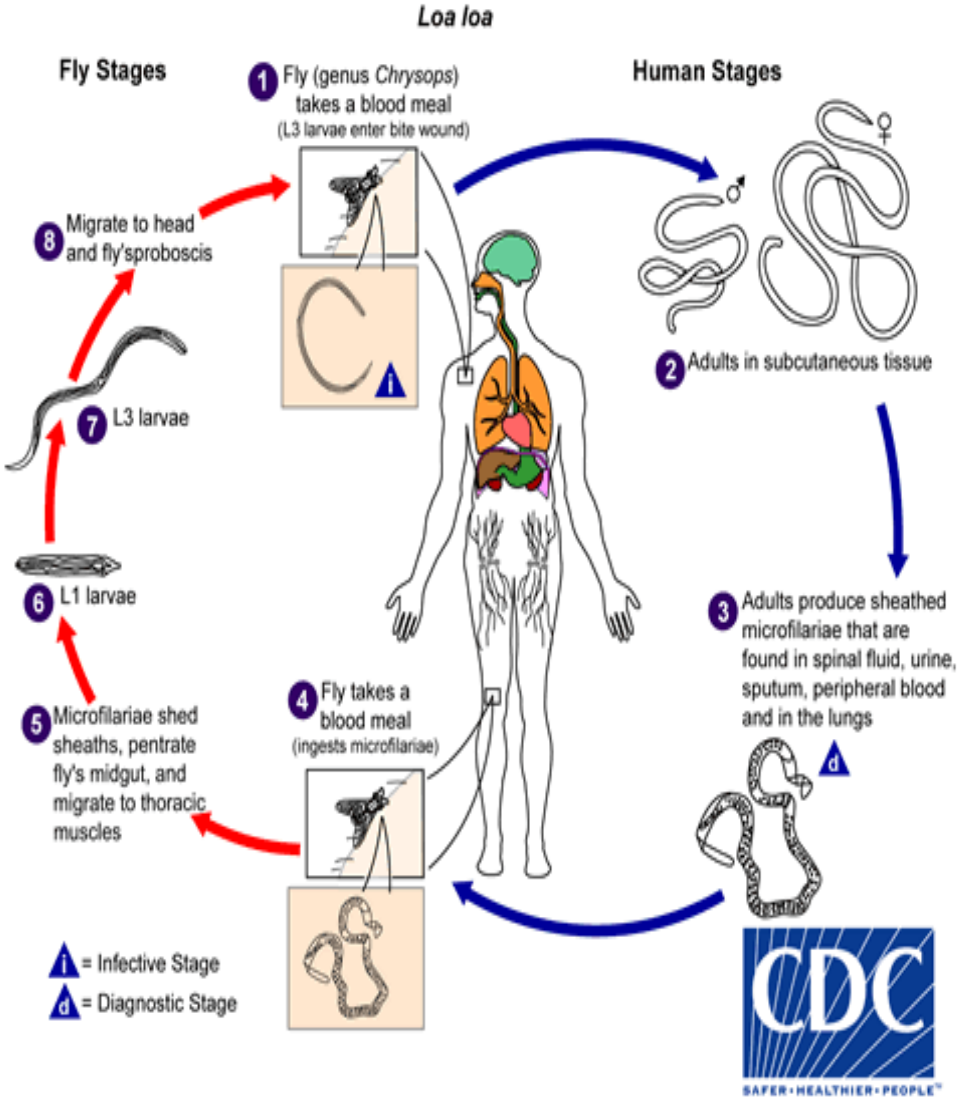
Diurnal periodicity: Densities of microfilariae peak by noon, and decrease to low levels at night

- Chrysops flies active in **daytime**





Life Cycle:


Loa loa
Fly Stages
Human Stages
1 Fly (genus Chrysops) takes a blood meal
(L3 larvae enter bite wound)
2 Adults in subcutaneous tissue
3 Adults produce sheathed microfilariae that are found in spinal fluid, urine, sputum, peripheral blood and in the lungs
4 Fly takes a blood meal
(ingests microfilariae)
5 Microfilariae shed sheaths, pentrate fly's midgut, and migrate to thoracic muscles
6 L1 larvae
7 L3 larvae
8 Migrate to head and fly'sproboscis
i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™

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,.

1-Class Trematoda

Flattened dorsoventrally (leaf-like).

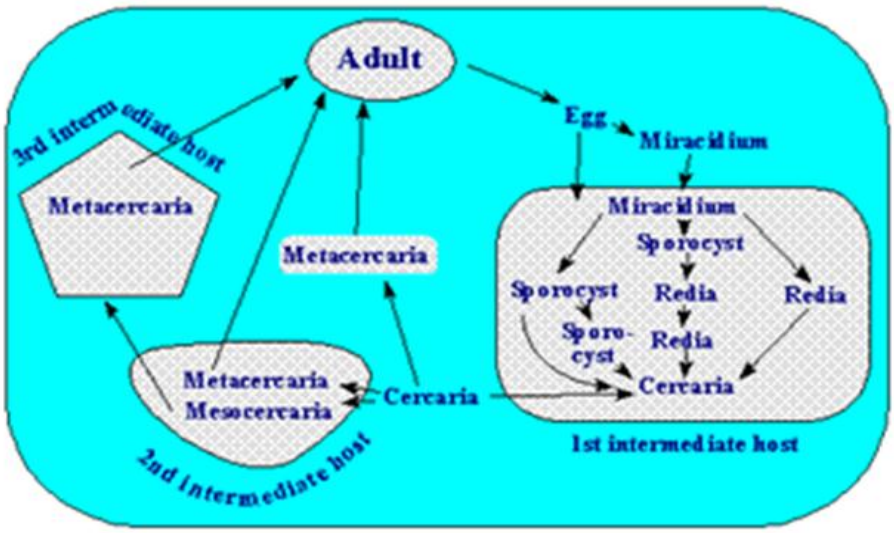
- Unsegmented.

- 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)



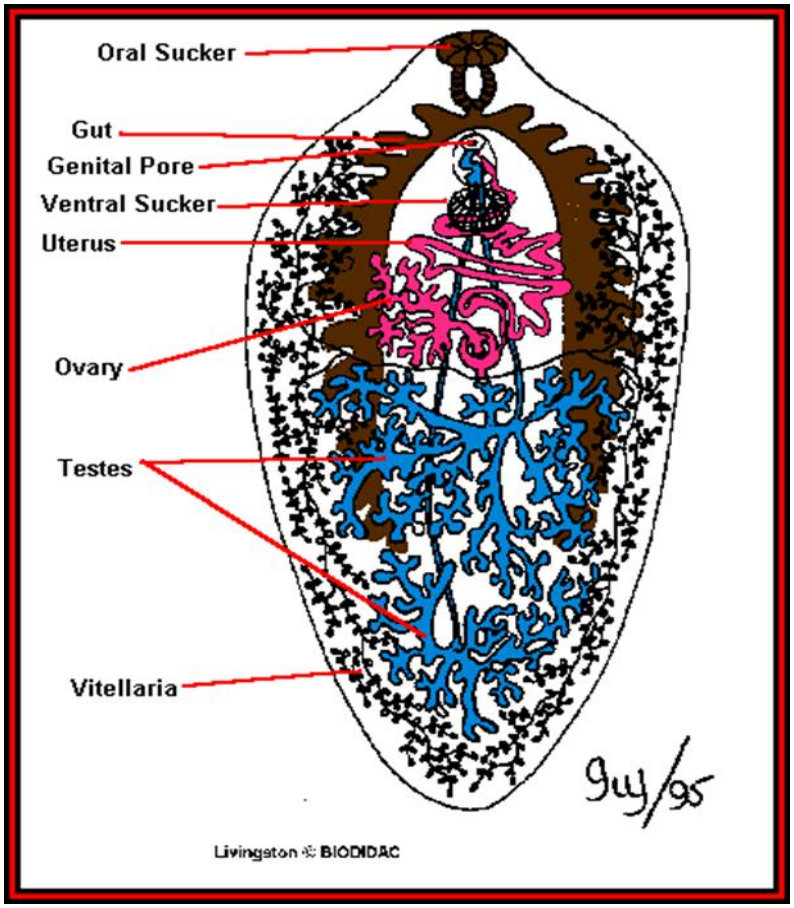
Egg---miracidium---sporocyst or redia---daughter sporocysts-cercariae---

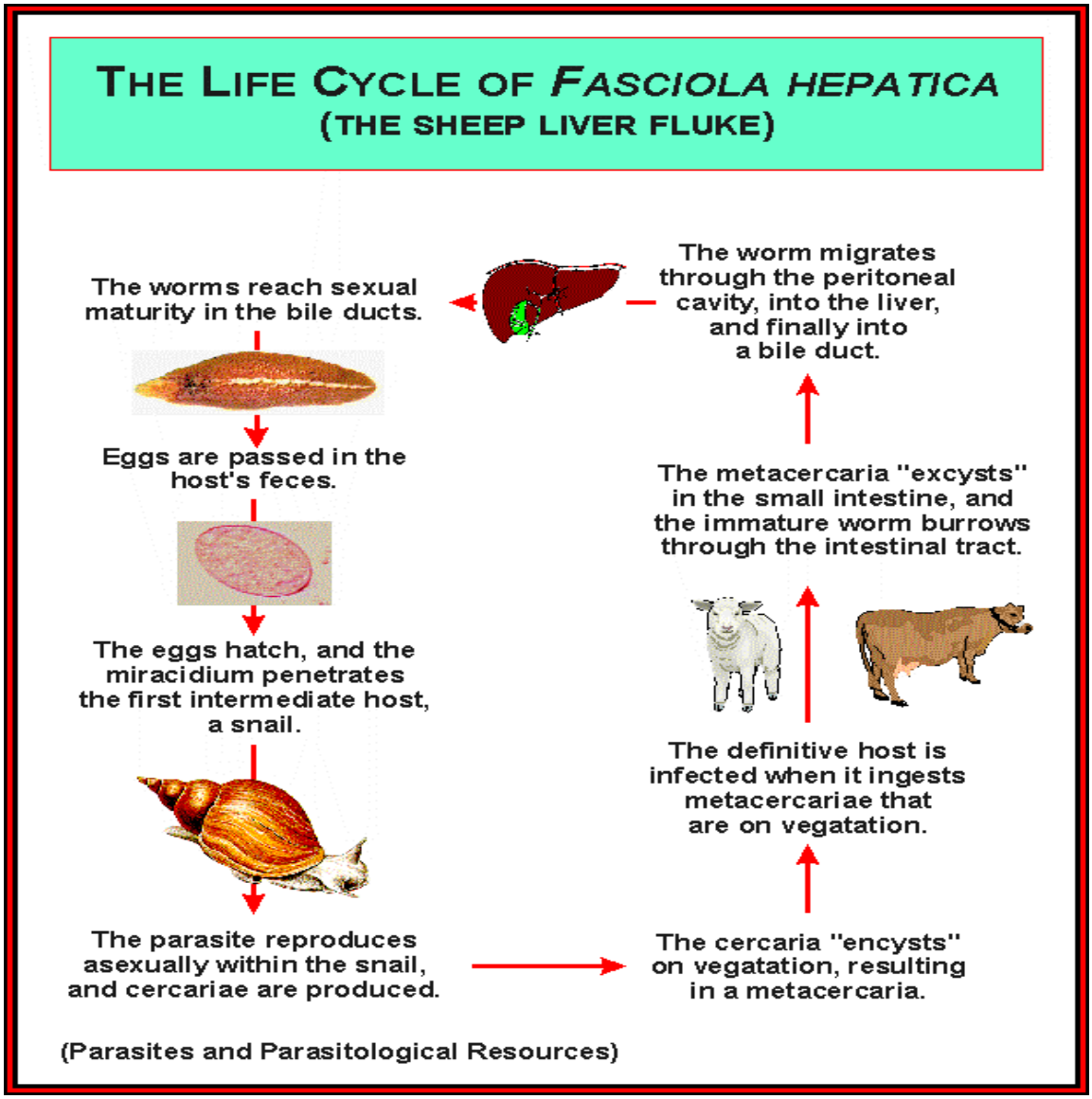
Metacercariae/mesocariae-adults

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

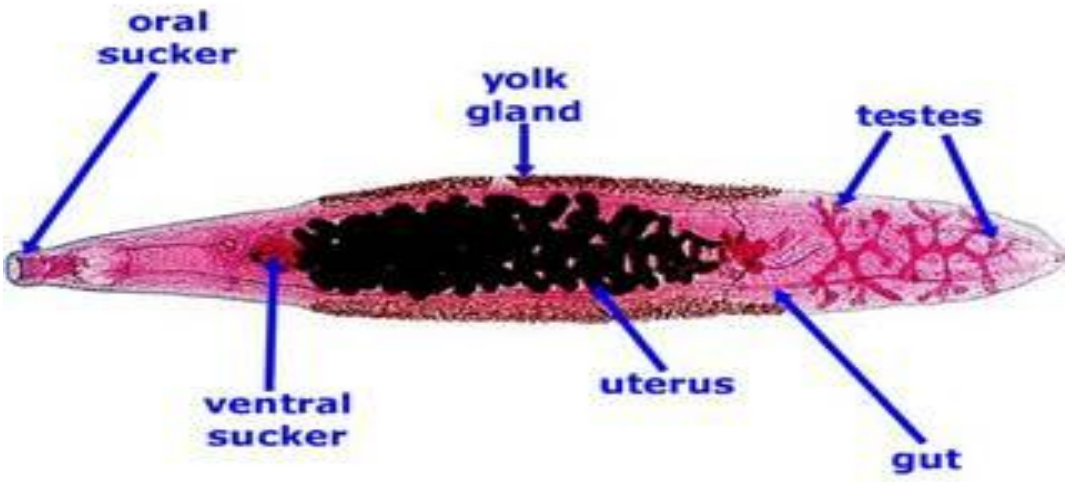




- ***Clinical disease:*** Parasites obstruct bile ducts and lay eggs within them, leading to cholelithiasis (gallstones).
- Biliary obstruction can occur, sometimes causing biliary cirrhosis**.**
- ***Diagnosis:*** immature eggs in feces.
- ***Prevention:*** involves not eating wild aquatic vegetables.

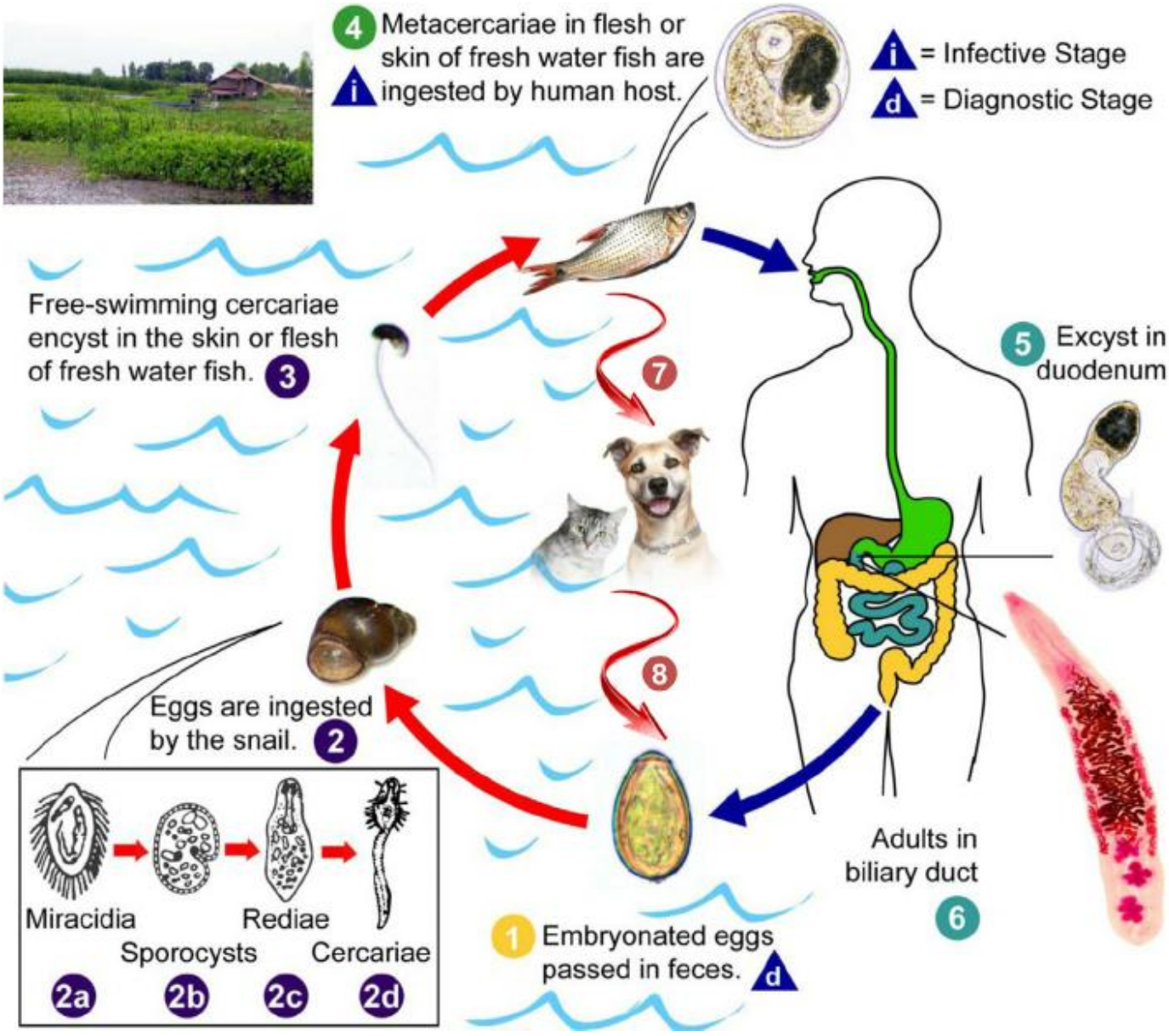
2- ***Clonorchis (Opisthorchis) sinensis, Opisthorchis felines,viverrini***

- **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, cirhosis.
- 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,

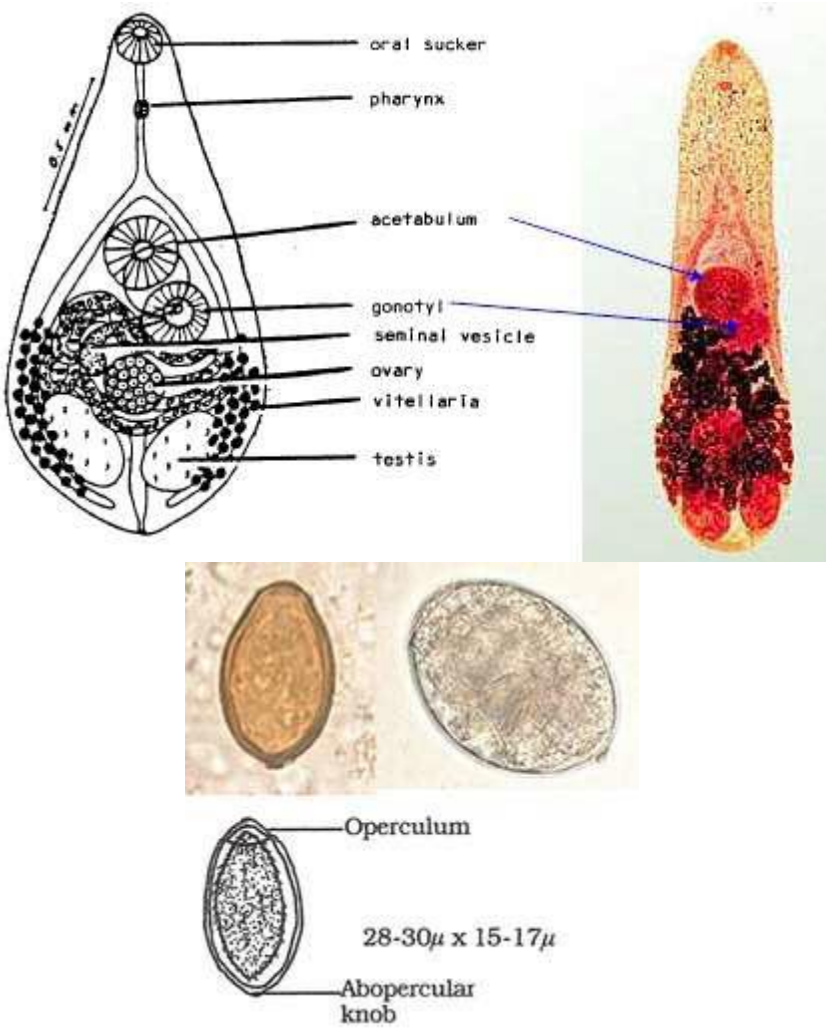
spines cover the cuticle anterior.3)Suckers: three suckers.

– 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:

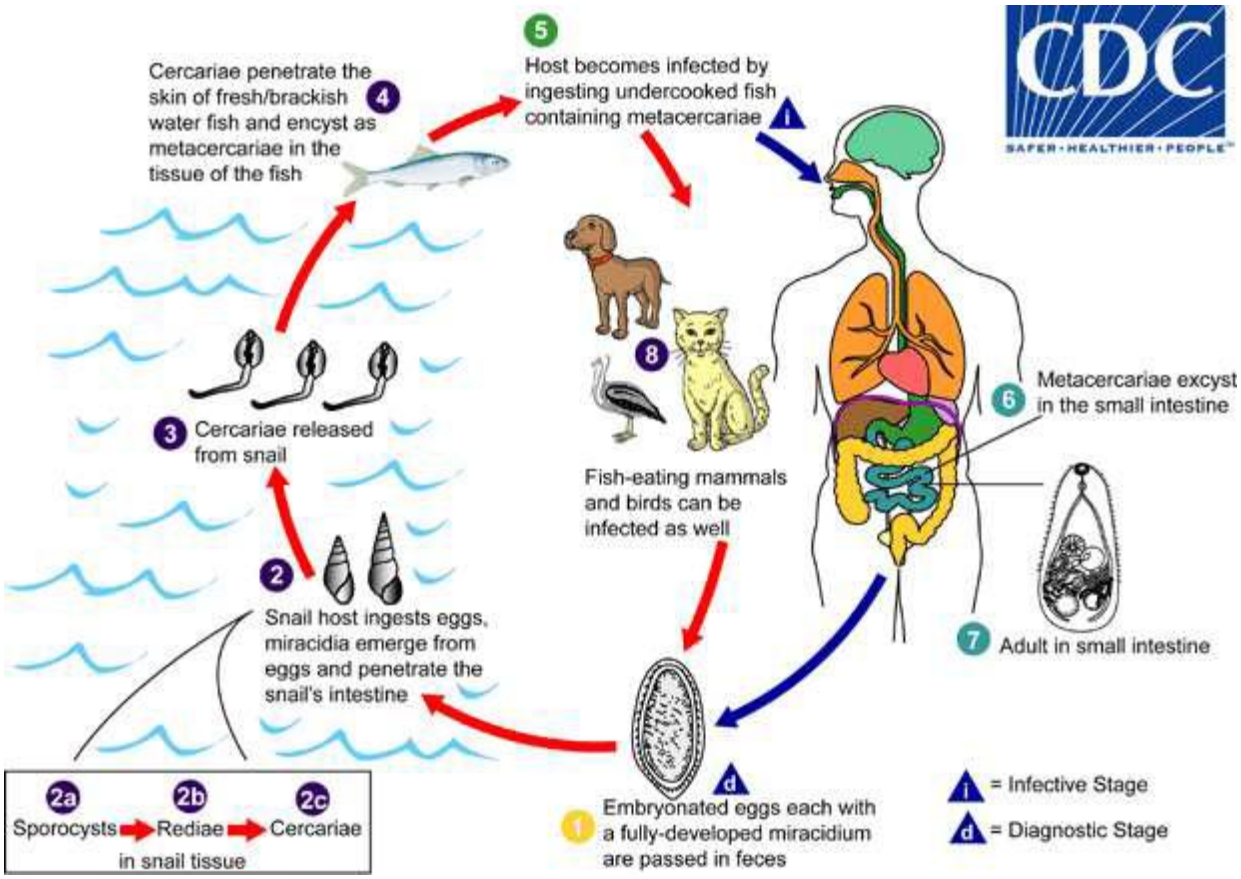
Habitat: embeded between villi of smallintestine.

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, insufficient cooked fish or

salted less than 10 days.

• Proper grilling of fish.

2-*Fasciolopsis buski*(gaint intestinal fluke)

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

Morphology

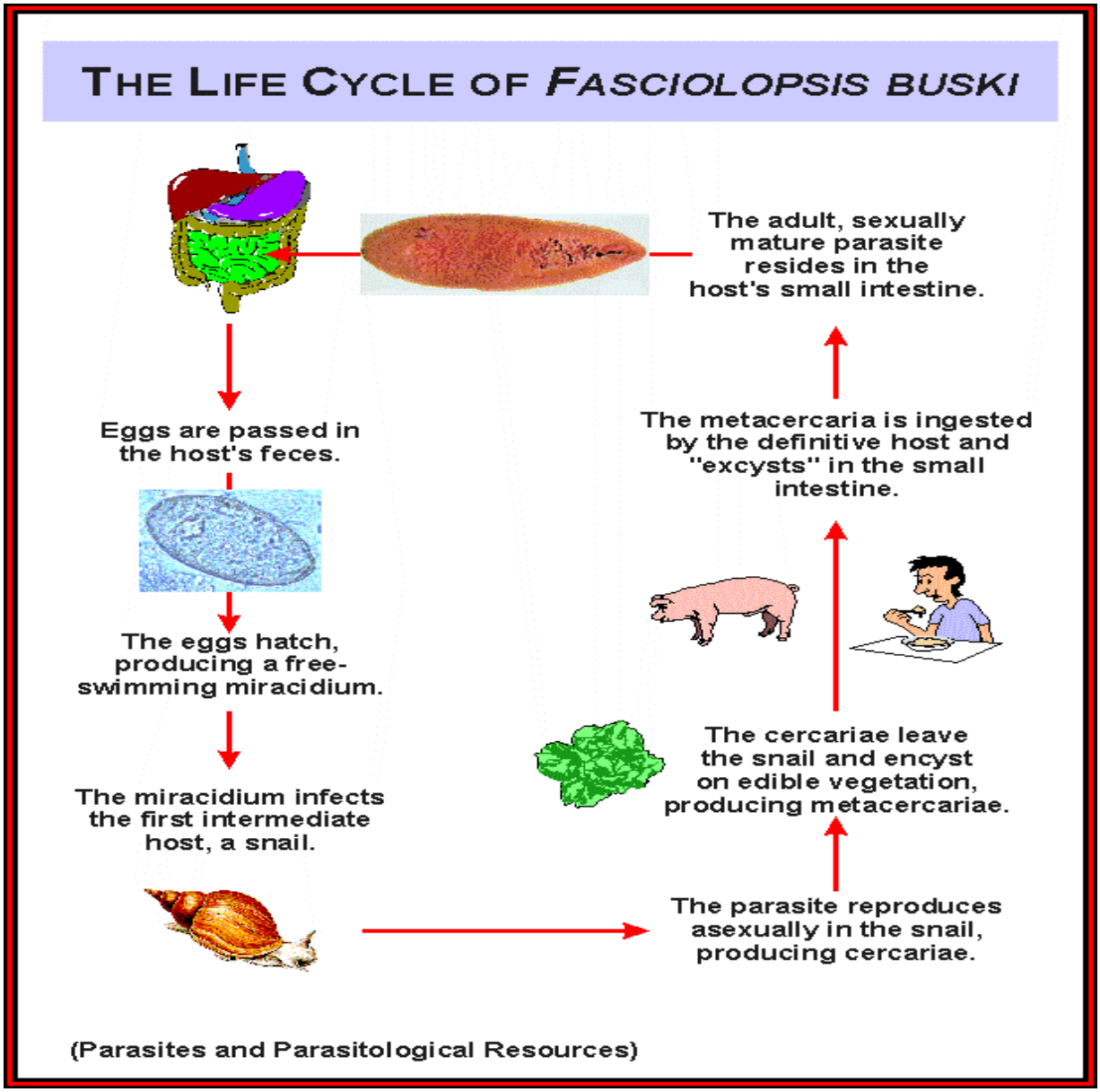
Adult: the body is long elliptic, flesh-colored, looks like a slice of raw meat. The size is about 20-75× 8-20 ×1-3mm, the largest one of human trematodes. The ventral sucker is near by the much smaller oral sucker.

Two coral-liked 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



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.

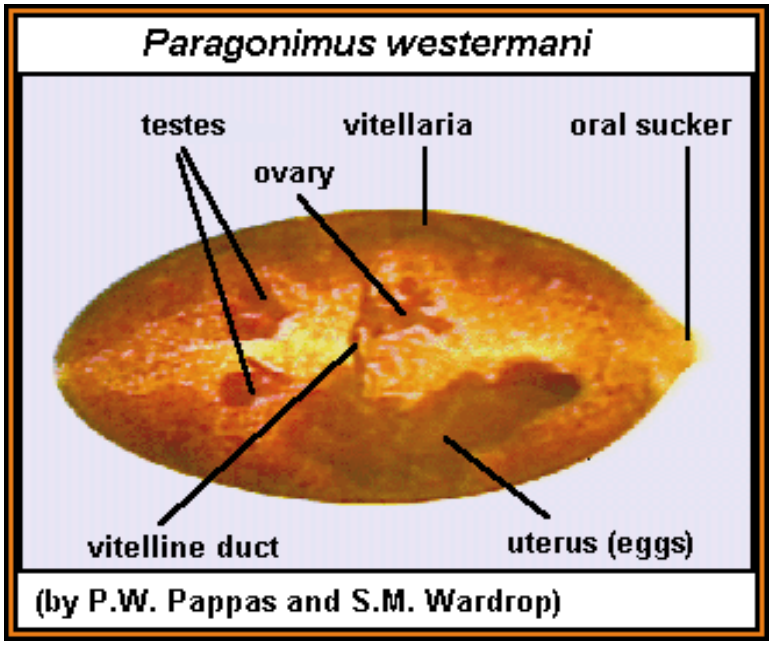
(3) Avoid feeding pigs on raw water plants

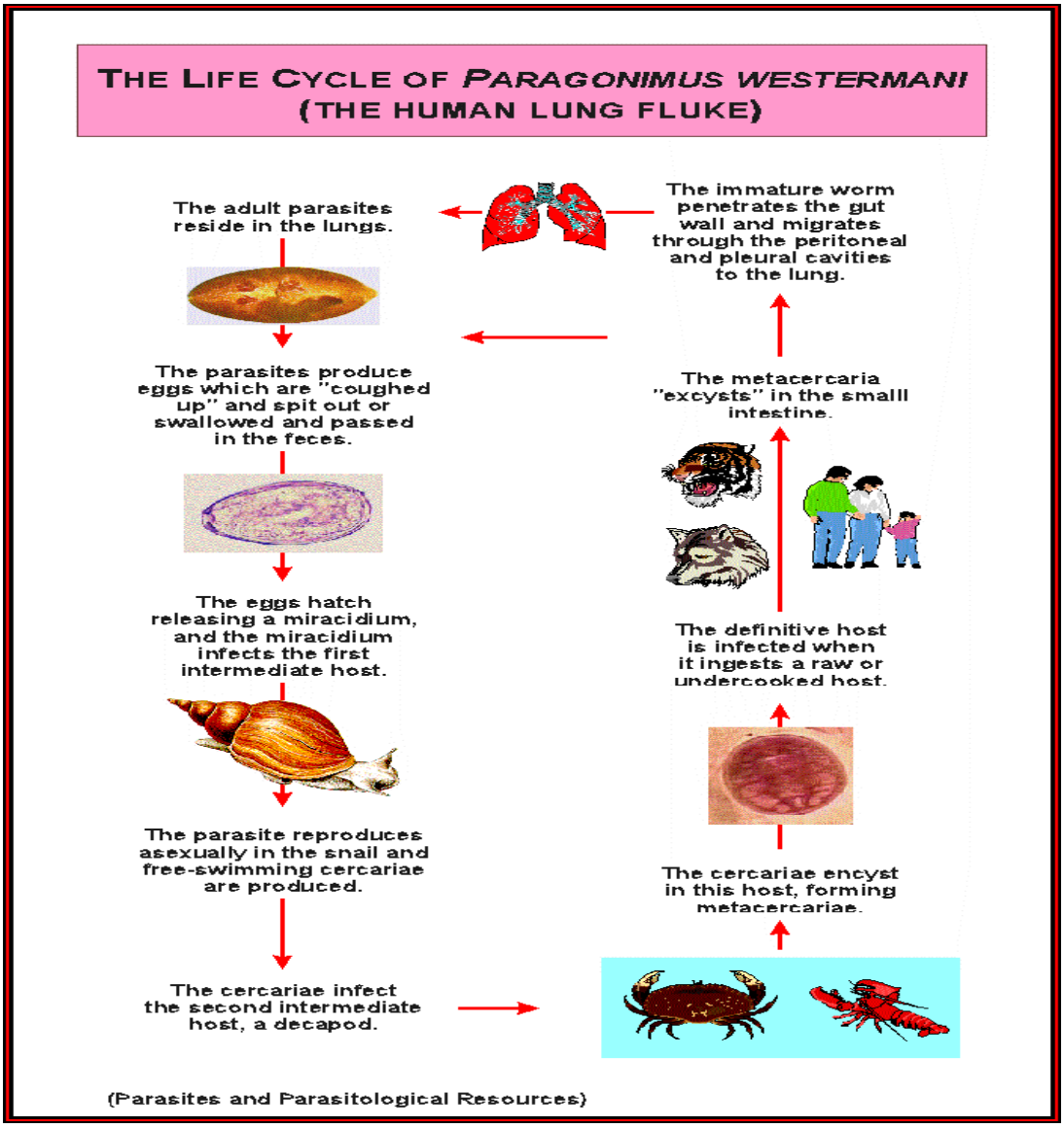
C-LUNG FLUKE:

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**





- ***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.

4-Trematodes-Blood(Blood Flukes)

- ***Schistosoma s*pp**

Species: ***S. mansoni***
S. japonicum
S. haematobium

Blood flukes differ from other trematodes in:

1- Separate sexes.

2- Parasitic in vascular system.

3- Female cylindrical, longerthan male and carried in its gynaecophoric canal.

4- Testes are more than 2.

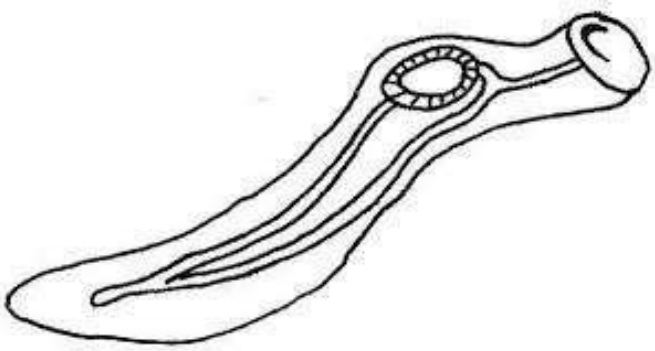
5-No pharynx.

6- Intestinal caeca reunite to form a single caecum.

7- Eggs are not operculated and are provided with a spine or a knob.

8-No redia stage.

9- Forked cercaria is the infective stage



Morphology:

1-***Schistosoma haematobium***

Male:

-Size: 1 –2cmx1mm.

-Shape: flat, margins are folded to form gynaecophoric canal.

-Cuticle: fine tubercles on the dorsal surface.

-Suckers: oral sucker and a larger ventral sucker.

-Digestive system: intestinal caeca unite in the posterior 1/2.

-Testes: 4-5 separate large testes.

Female: deposits 20-200 eggs/day.

-Size : 2 - 2.5 cm × 0.25mm.

-Shape : cylindrical.

-Cuticle: smooth.

-Digestive system: intestinal caeca unite in the posterior 1/3.

-Ovary: oval, infront of intestinal union.

-Uterus: long, contains one raw of 20 – 30 ova.

-Vitelline glands: extend from behind the ovary

2-***Schistosoma mansoni***

Morphology: similar to *S. haematobium* with fewdifferences:

• **Male:**

– Size: shorter, 8-10mm ×1mm.

– Cuticle: coarse tubercules.

– Digestive system: intestinal caeca unite at the anterior third.

– Testes: 6-9 as a mass

Female: deposits 300 eggs/day.

– Size: shorter, 14-22mm ×0.15mm.

– Digestive system: union of intestinal caeca

occurs at the anterior third.

– Ovary: at the anterior third.

– Uterus: short with 1-4 ova.

3-*Schistosoma japonicum*

similar to *other* schistosomes with

few differences:

• **Male:**

• Size: 9-22 mm × 0.5 mm

• Cuticle: smooth.

• Intestinal caeca unite very late posteriorly.

• Testes: 6-8 small testicles in a single column.

Female:

• Size : 12-26 mm × 0.3 mm.

• Intestinal caeca: unite at the posterior two fifths.

• Ovary: posterior.

• Uterine tube: long, contains 50– 100 eggs

Life cycle(basic)

Definitive host: man.

Intermediate host: snail

Infective stage: cercariae.

Stages in the life cycle: egg→ miracidium→

sporocyst→ cercariae → adult

Mode of infection:1) Skin penetration by cercaria,

2) Drinking water, when cercaria penetrates the

mucous membrane above the gastric acidity.

1. Parasite eggs released into freshwater (from human urine, feces)
2. Eggs hatch → ciliated miracidia, free swimming
3. Miracidia find & infect snail host
4. Each miracidia transforms into many fork-tailed, free swimming forms called cercariae within 4-6 weeks of entering snail. Cercariae leave snail and move into water fork-tailed

5-Cercaria enters the skin or mucous membrane → **Schistosomulum**. It is carried after 2 days by blood □Rt side of heart□lung □Lt side of heart □systemic circulation□ □mesentric-portal vessels□ intrahepatic branches of portal vein □matures in 7 wk.

5. In liver, m & f pair up → female inserts herself into the gynecophoral canal of male → they are now 'paired'.

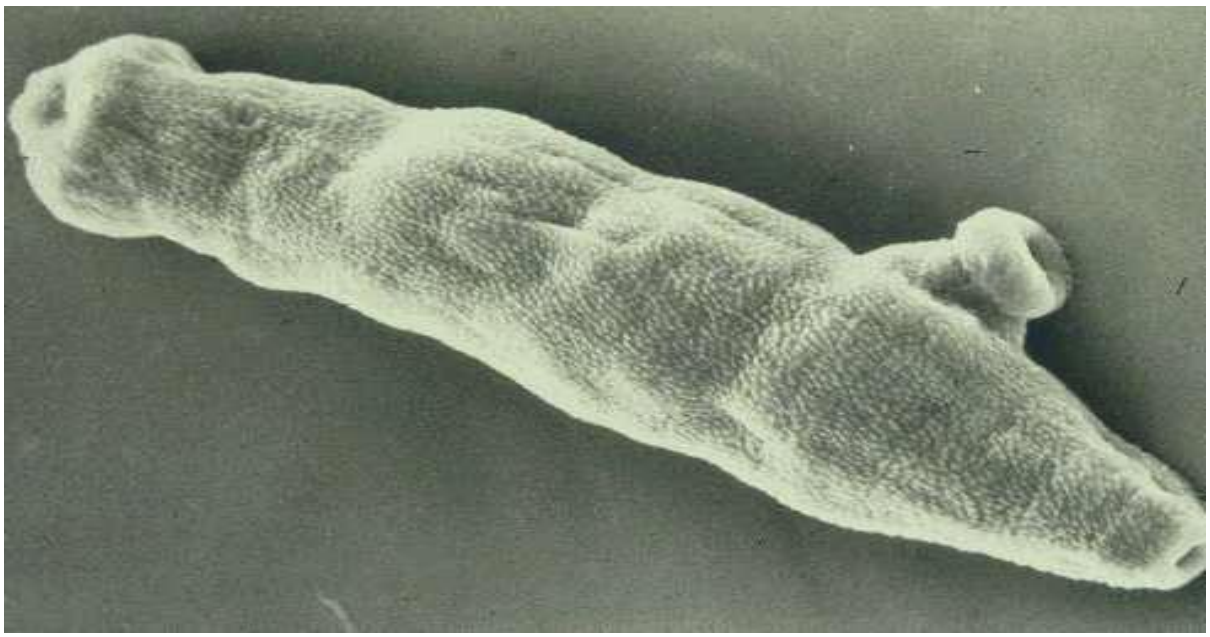
. Migrate to favoured sites:

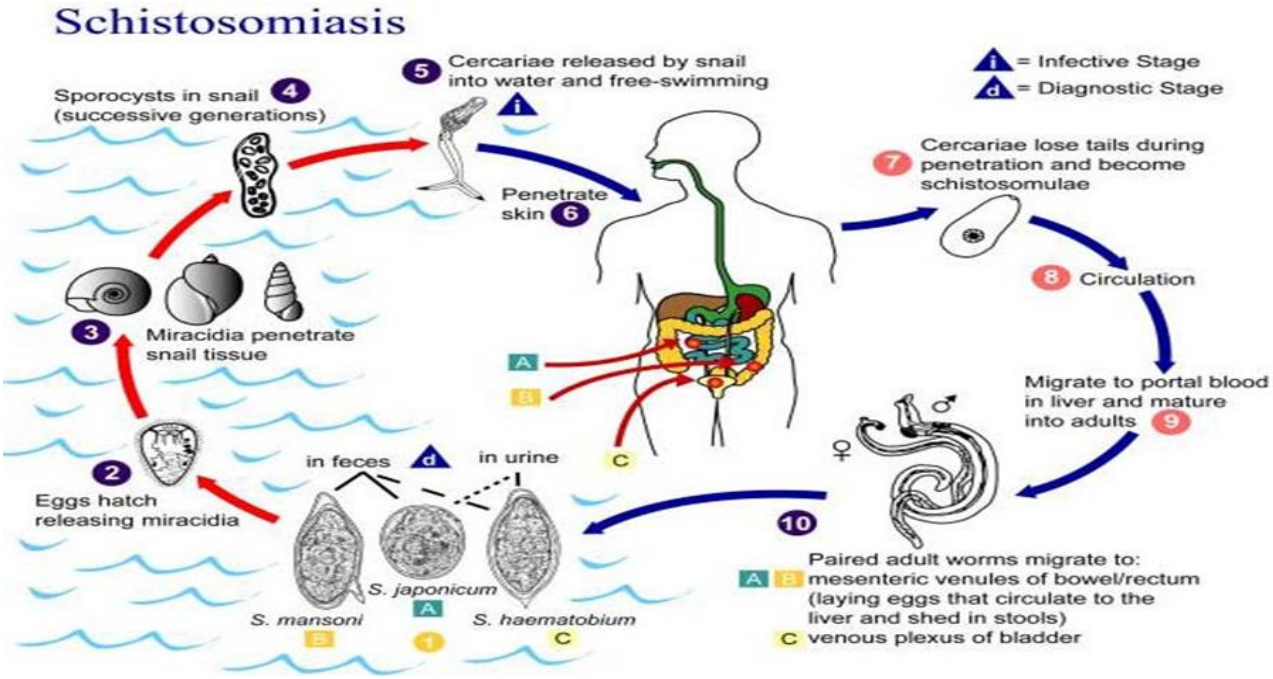
S. mansoni – mesenteric venules of large bowel & rectum and**Reservoir host:** monkeys and rodents

S. japonicum – mesenteric veins of the small intestine and**Reservoir hosts:** cats, dogs, cattle, horses, pigs,

rodents, sheep and goats

S. haematobium – perivesical venous plexus surrounding the bladder. Females release eggs. and**Reservoir host:** no reservoir host.





Symptoms:

- Cercariae penetrate skin → rash- called <u>schistosome</u> or <u>swimmer's itch</u>.
- Eggs laid in target organs release antigens → cause Katayama fever:
  - fever, - urticarial, - malaise, - diarrhea
- <u>Genitourinary complications</u>
- Eggs lodge themselves in wall of bladder & can develop into polyps can erode, ulcerate & cause hematuria (blood cells in urine)

Diagnosis

<u>Microscopic Detection</u>

1-Take stool or urine sample to detect eggs

- *S. haematobium* eggs are oval and have a spike at the tip
- *S. japonicum* eggs small and almost spherical with tiny spine

- *S. mansoni* eggs have a spike on the side (spine)

2-Antibody tests

Prevention

1-don’t swim in fresh, stagnant water

- 2-Focused on education, eliminating snail nesting grounds

3-Molluscicides can be used to eliminate snails

3-Cestoda

General Characteristics:

- Multicellular animals characterized by a flat, bilaterally symmetric body. It is dorsoventrally flattened and is solid (no body cavity).
- Most are hermaphroditic, having both male and female reproductive organs in the same individual.
- Overall size varies greatly, some members are as small as 1mm, and others may be 20 meters or longer.
- **Adult worms -** Flat & ribbon-like; body consists of an anterior attachment organ (scolex) and a body (strobila) consisting of a chain of segments called proglottids.
- **Scolex (head) -** Characterized by the presence of sucking disks or lateral grooves. Some have hooks (armed).
- **Rostellum -** A small button-like structure on the scolex of "armed" tapeworms from which the hooks protrude. It may be retractable
- **Dioecious -** each proglottid has both male & female reproductive organs; can fertilize itself.
- **Reproductive organs -** male: testes are spread throughout the segment; sperm is collected in the seminal vesical; **Female:** ovaries produce eggs, which are stored in the uterus.

A-Intestinal cestoda

1-*Diphyllobothrium latum*(broad,fish tape worm)

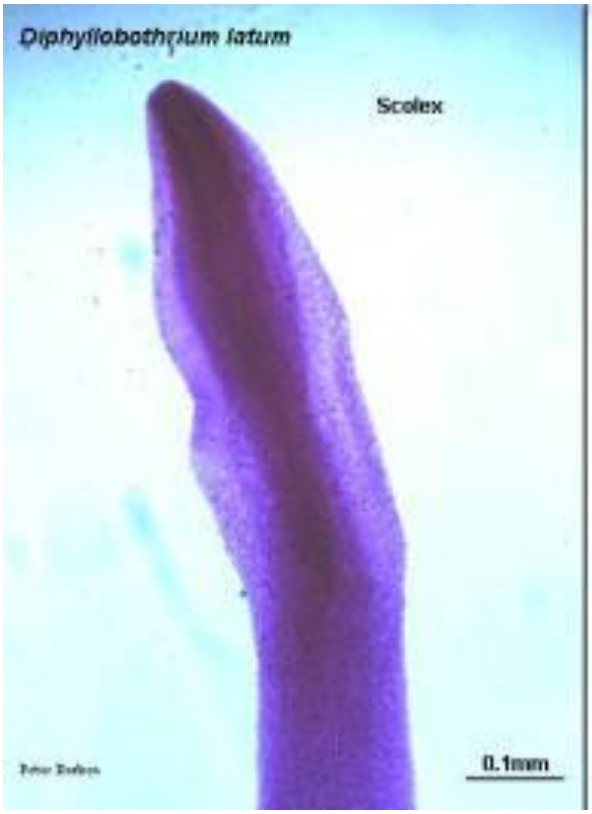
General:

- Two intermediate hosts : copepods (water flea) and fish.

- Several fish-eating mammals serve as **definitive hosts**: bears, cats, dogs and humans.
- The infective stage :plerocercoid larva, which is ingested in raw or undercooked fish.
- Diagnostic stage - eggs or proglottids in feces.

Morphology.

The adult worm reaches up to 10 m with 3,000 proglottids. The scolex is elongated and spoon shaped with two long sucking grooves. It measures 1 mm in width by 2.5 mm in length. The mature and gravid proglottids are broader than long, with the typical rosette-shaped uterus. They measure up to 2 cm in width. The eggs are oval and operculated



Life Cycle

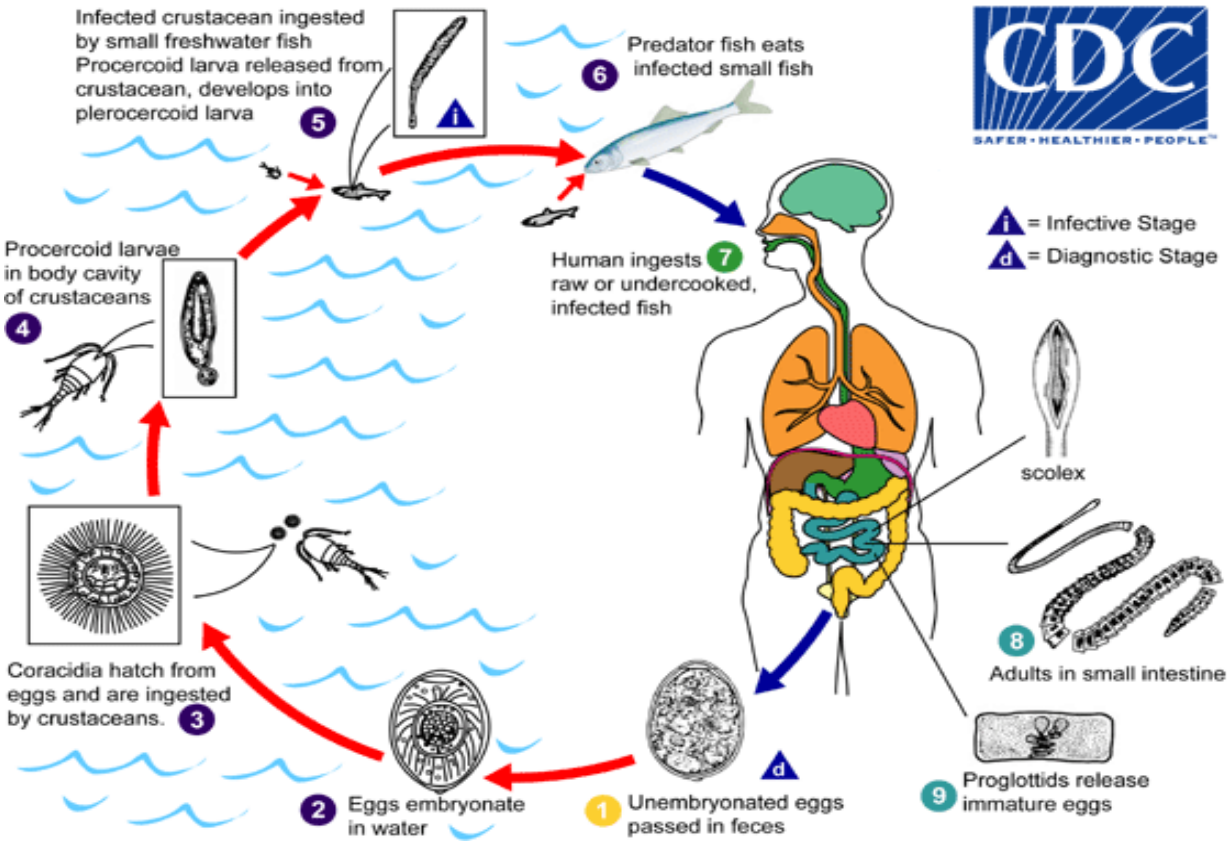
< Infection occurs by ingesting plerocercoids in undercooked or raw fish

<The plerocercoid passes undigested through the stomach as the fish tissue is digested away

< The plerocercoid develops into an adult in the small intestine where it attaches to the mucosa. The proglottids mature and eggs are produced in as few as 2 weeks. Worms may contain 3,000 proglottids and reach lengths over 10 meters

< Immature eggs are released from gravid proglottids and passed in the feces in very large numbers - up to 1,000,000 eggs may be produced per day by one worm! Spent proglottids may also be passed

The life cycle continues to a first intermediate host (copepod) and second intermediate host (fish)



Diagnosis

Diagnosis is usually based on the recovery and identification of the characteristic eggs and/or proglottids

Prevention

- Cook fish properly. If you eat sashimi or sushi, freeze it first at -10 °C (or below) for two days to kill the tapeworm larvae.
- Do not defecate in water. If the fish tapeworm larvae cannot get in touch with the intermediate hosts, they cannot infect humans.

2-Hymenolepis nana (dwarf tapeworm)

– 2-Hymenolepididae ***Hymenolepis nana, Hymenolepis diminuta***

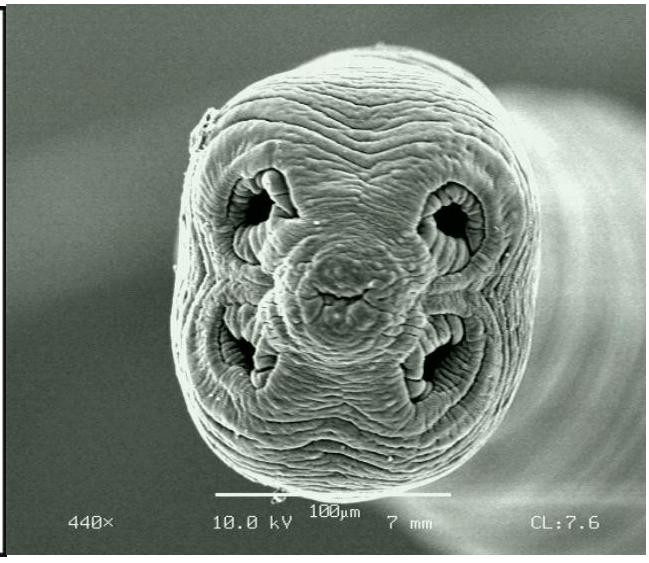
- Only two species of this family can infect humans.

– Hymenolepis nana

– Hym*enolepis diminuta*

- **Hymenolepiasis** is the term when a human is infected with either *H. diminuta* or *H. Nana*

nana



diminuta

Hymenolepis nana

- *H. nana* is commonly called the ***dwarf tapeworm***. *Nanos* = dwarf
- *H. nana* is the most common tapeworm in humans worldwide.

H. nana has been called *Vampirolepis nana* because H. *diminuta* has an unarmed rostellum

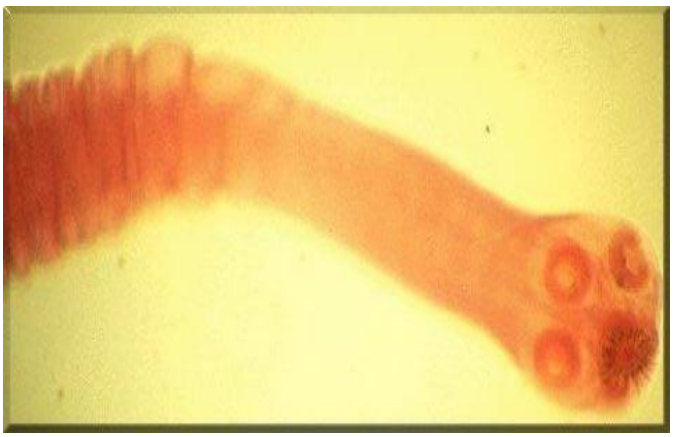
3-Hymenolepis diminuta

- **Commonly called Rat tapeworm.**
- Female rats parasitized with *H. diminuta* were quicker to retrieve their young than non-infected rats. *In humans, H. diminuta* is very similar to *H. nana*
- **Hosts of *H. nana***
- **Definitive host:**Human,Mice ,Rats
- **Intermediate host (Optional):**Fleas,Beetles
- **Note:** The only cestode that parasitizes humans without requiring an intermediate host.
- **Hosts of *H. diminuta***
- **Definitive host :**Rats,Dogs,Humans
- **Intermediate host :**Grain beetle,Lots of other arthropods

Note: Only when the intermediate host is ingested by the definitive host will *H. diminuta* mature

Morphology *H. nana*

- Adult worm are only 10-45 mm long and 0.5-1 mm wide
- Neck is long and slender,They have 100-200 segments that are wider then they are long

-  
- They are round to oval, and should contain a six-hooked oncosphere. They have polar filaments that lie between the egg shell and the oncosphere.
- Scolex bears a retractable rostellum armed with a single circle of 20-30 hooks.also has four suckers.Genital pores are unilateral (side of the segment) ,Each mature segment contains three testes

Morphology *H. diminuta*

- Grows to be about 20 - 60cm or more in length.
- Consists of up to 1000 proglottids that are approximately four times as wide as they are long.
- Each proglottid contains three round testes, a bi-lobed ovary, a compact vitelline gland and a large uterus opening to a lateral genital pore.

The scolex has four suckers and a retractable rostellum that does not have hooks

- Eggs are a round or slightly oval and **yellowish brown in color**.Eggs are larger than *H. nana* eggs.
- The oncosphere (hexacanth) has six hooks (of which at least four are visible in top photo).

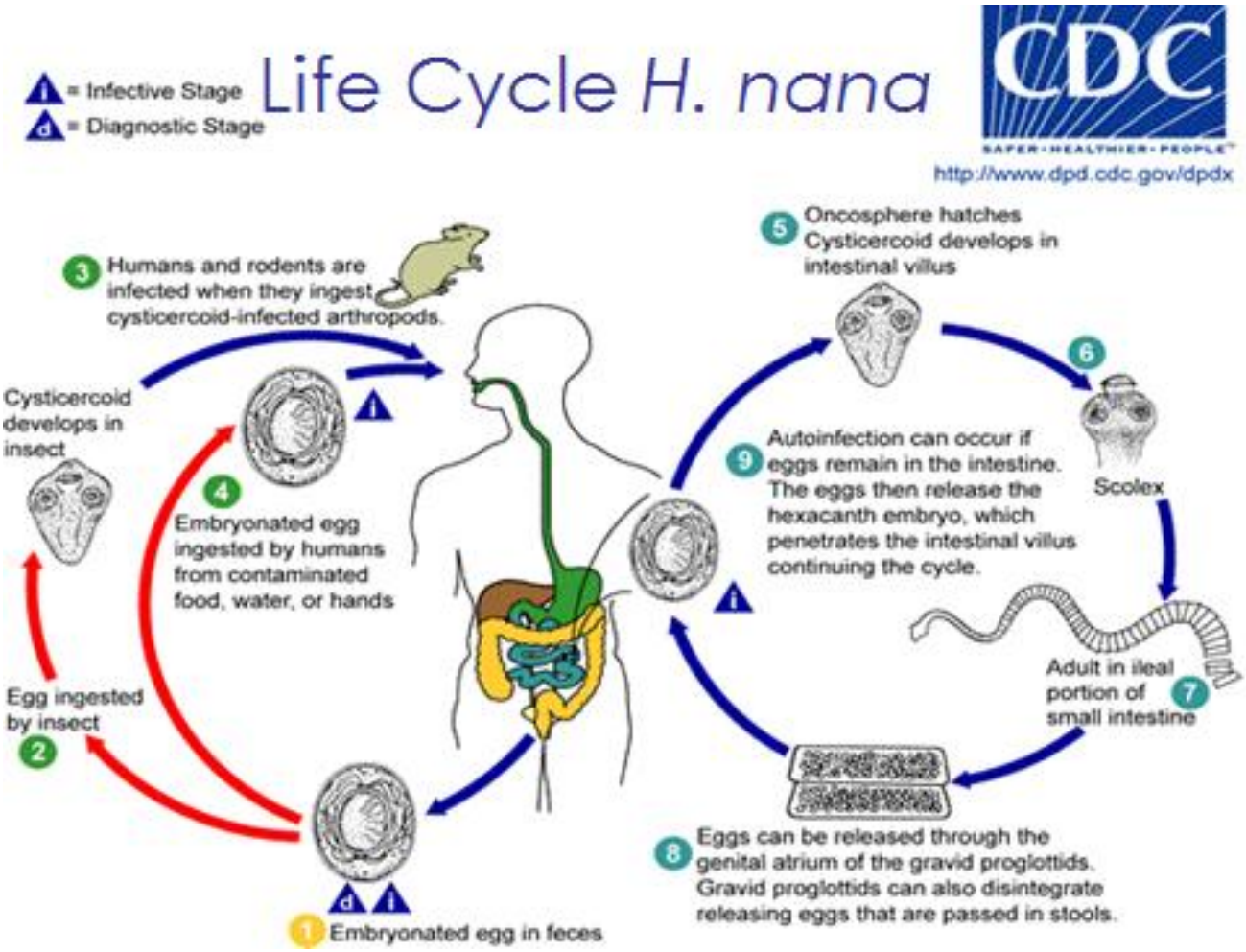
Life Cycle *H. nana*

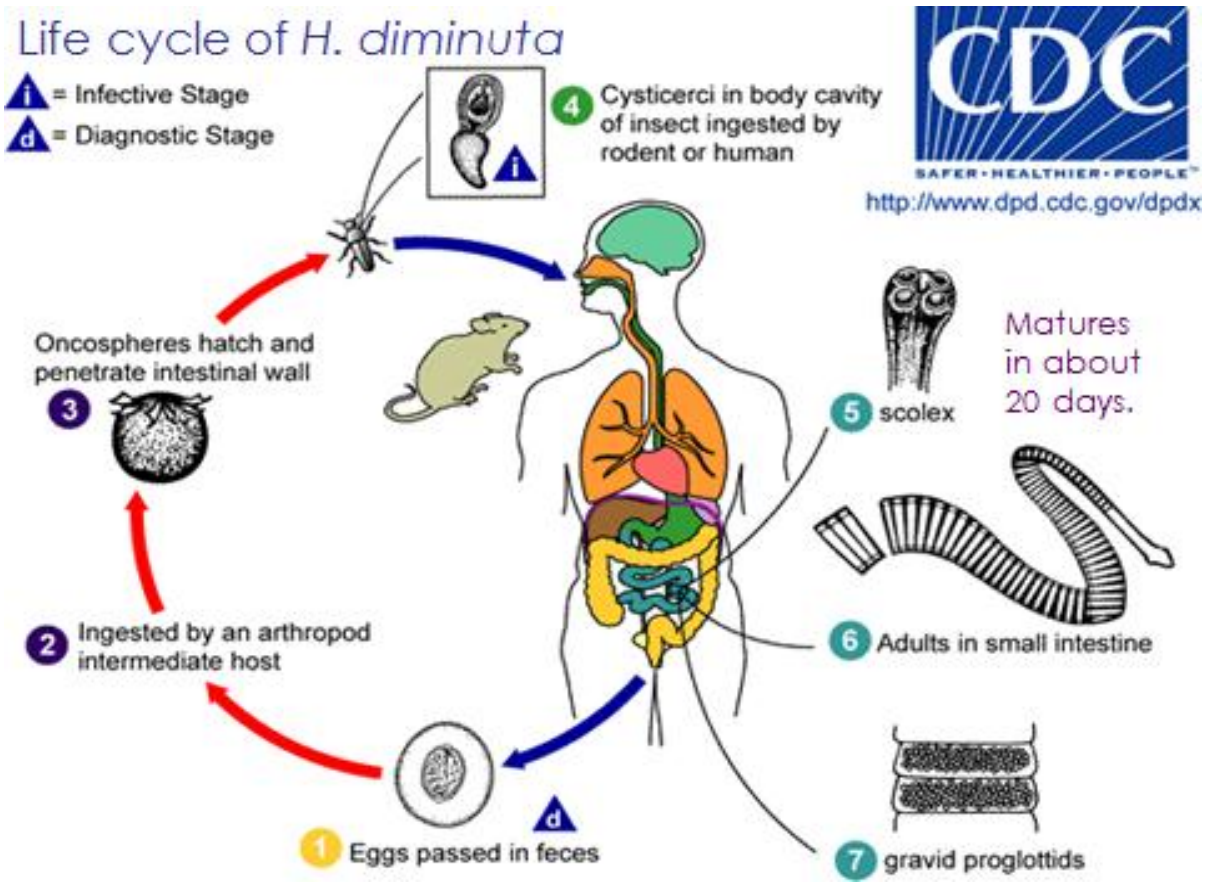
- Eggs are ingested by an arthropod intermediate host where they develop into cysticercoids, which can infect humans or rodents upon ingestion.
- When eggs are ingested (food, water, hands) the oncospheres contained in the eggs are released. The oncospheres penetrate the intestinal villus and develop into cysticercoid larvae.

Upon rupture of the villus, the cysticercoids return to the intestinal lumen, evaginate their scoleces and attach to the intestinal mucosa where they develop into adults that reside in the ileal portion of the small intestine producing gravid proglottids.

- Eggs are passed in the feces when released from proglottids after the proglottids disintegrate in the small intestine.
- An alternate mode of infection consists of internal autoinfection, where the eggs release their oncospheres, which penetrates the villus continuing the infective cycle without passage through the external environment.

- The life span of adult worms is 4 to 6 weeks, but internal autoinfection allows the infection to persist for years.
- Eggs of *H. nana* are immediately infective when passed with the stool and cannot survive more than 10 days in the external environment.





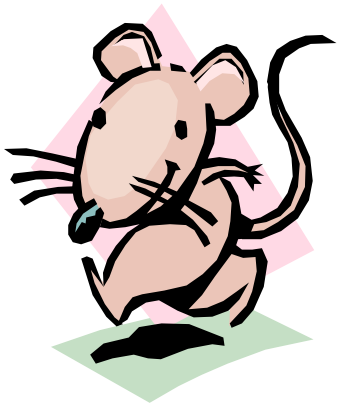
How do you get infected?

From *H. nana*…..

- By accidentally ingesting tapeworm eggs.
  - by ingesting fecally contaminated foods and water
  - by touching your mouth with contaminated fingers
  - by ingesting contaminated soil.
  - **From *H. diminuta* ….** *Human infection results from eating such foods as dried fruits and precooked breakfast cereals in which the infected grain insects larvae are present.
  - *Eating an intermediate host of H. diminuta
  - **Diagnosis**
  - Detection of eggs in feces.

Prevention

- Good hygiene
- Elimination of rats and mice
- A well-balanced diet to promote resistance to infection
- Public health and sanitation programs



4-*Dipylidium caninum*(dog tape worm)

Dipylidium caninum is a tapeworm that commonly infects dogs and cats. And occasionally affects humans, especially children

Common name: Dog or cat tapeworm; double-pored dog tapeworm

-Name of disease: Dipylidiasis

-Final Hosts: Dogs, Cats, Humans

-Reservoir: unknown

-I.M.H.: larva of dog fleas (*Ctenocephalide* species)

Infective stage: cysticercoid for F.H & egg for I.M.H.

Incubation Period: approximately 20 days

Morphology

10-70 cm in length

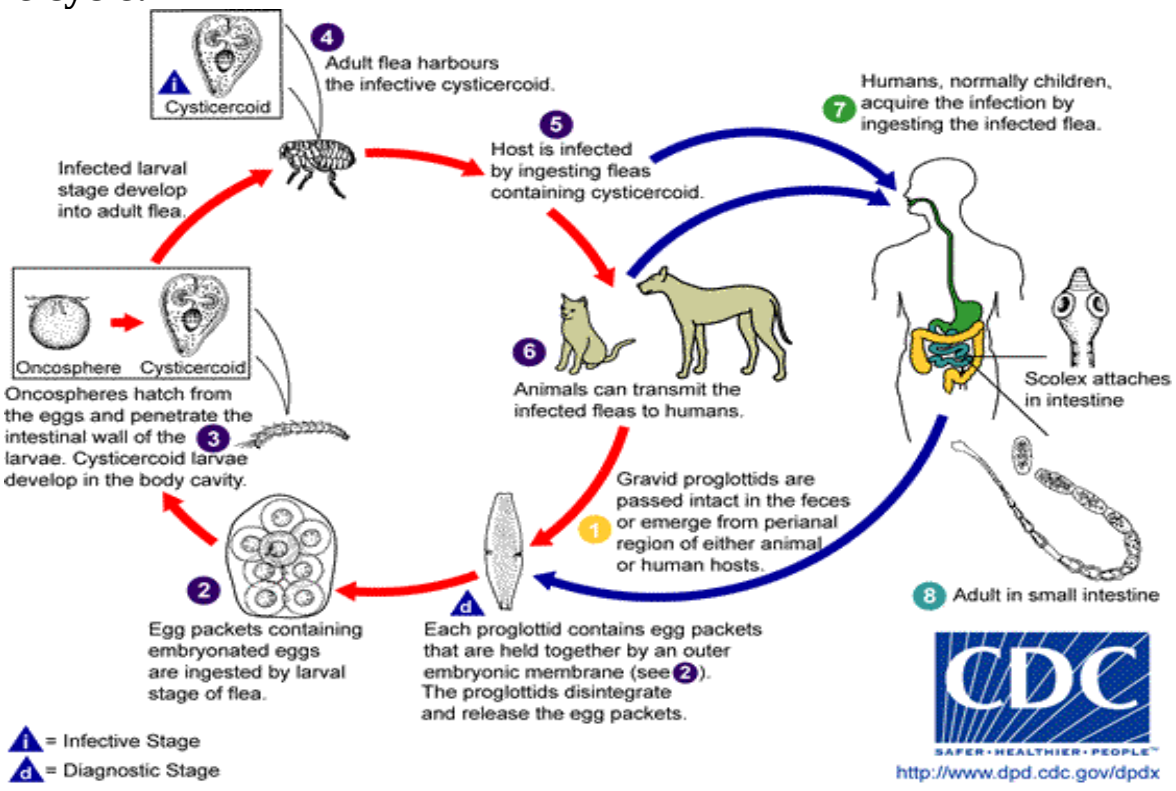
Scolex:- conical-shaped and has four suckers. There is a rostellum armed with several rings of small hooks.-provided with 15-30 of hooks



Segments(stroblia): 200) segments ,diagnostic feature(pumpkin-seed shape).they contain two sets of male and female reproductive organs. **They therefore demonstrate two genital pores that lead to their name as the "double-pored.**

gravid segments :contain egg capsule, egg similar to egg of taenia spp. (hexacanth embryo, embryophore, outer membrane). The larvae of D. caninum are known as cysticercoids **because the scolex is enclosed in a fluid-filled cyst at this stage.**

Life cycle:



Symtoms:

Human infection are rare and normally restricted to young children .

- Light infections of *D. caninum* often are asymptomatic.

- Infection, however, can still cause abdominal pain, diarrhea, and anal itch in some individuals.

Diagnosis

Examination of stool for characteristic segments and eggs capsule (less common).

Control:

Flea control program.

B-Cestoda tissue (larval form)

1-*Taenia solium* and *Taenia saginata*

***Taenia saginata* – (The Beef Tapeworm)**

General:

- Man is the only definitive host.
- **Infection -** ingestion of **cysticercus** in flesh of cow.
- Adult worm lives in the small intestine of man

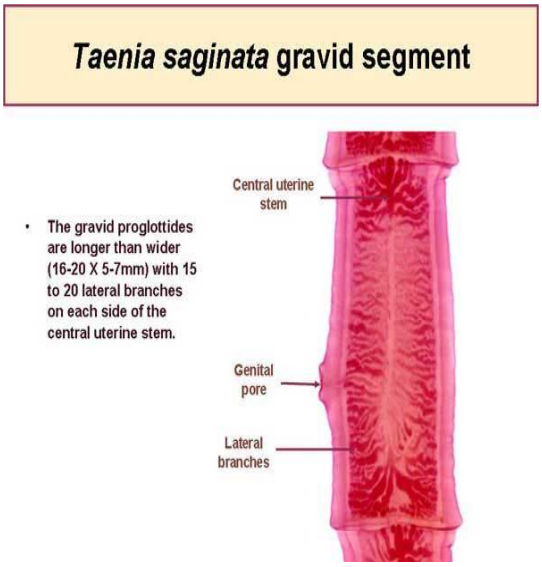
Morphology:

Scolex - unarmed (no hooks); is quadrate in outline and

has 4 circular suckers.

- **Gravid proglottids -** one inch or slightly longer; **uterus contains 15 to 20 primary branches.** The uterine pore is located in **a lateral position.**
- **Size -** up to 10 meters in length life expectancy - 25 years or more.

Eggs: are identical to *T. solium,* measuring about 40 microns in diameter.

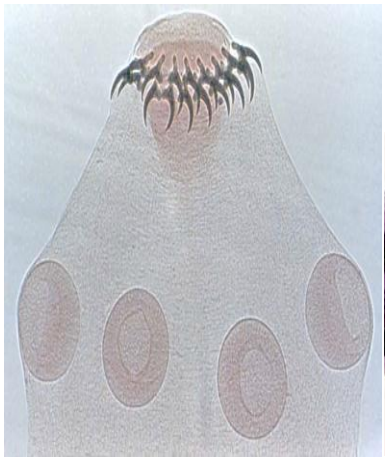


-*Taenia solium* – (The Pork Tapeworm)

Morphology:

Scolex -is globular in outline armed, with 4 sucking disks.

- **Gravid proglottid :has 7-13 primary uterine branches.**
- **Size -** up to 7 meters in length.
- The restellum resembles the conventional figures of the sun, hence the name "solium".
- **Autoinfection –** called cysticercosis, due to ingestion of eggs from feces if infected with adult worm**.**
- **Racemose form** of infection may develop in the brain. **A Racemose is:** a larva which is branching, spreading throughout tissue.



Adult worms of T.saginata and T.solium		
	T.saginata	T.solium
Length	5 to 10 metres	2 to 3 metres
Head	Large,quadrate,without rostellum and hooks,suckers may be pigmented	Small,globular with rostellum and hooks, suckers not pigmented
Proglottides		
Number	1000 to 2000	Below 1000
Expulsion	Expelled singly and may force anal sphincter	Expelled passively in chains of 5 or 6
Uterus	Lateral brances 15 to 30 on each side,thin and dichotomous.	Lateral branches 5 to 10 on each side, thick and dendritic
Vagina	Vaginal sphincter present	Vaginal sphincter absent
Ovaries	2 in number,without any accessory lobe	2 in number, with an accessory lobe
Testes	300 to 400 follicles	150 to 200 follicles.

Life cycle of *T.saginata*-

The worm passes its life cycle in two hosts:

1. **The definitive host: man which harbors the adult worm.**

2. The intermediate host: Cattle which harbors the larval stage.

• The eggs or gravid segments are passed out with the faeces on the ground.

• **The animals** swallow these eggs while grazing in the field.

• On reaching the alimentary canal of the intermediate host, the radially striated walls of the eggs rupture and oncosheres are liberated.

These penetrate the gut wall with the aid of their hooks and gain entrance into the portal vessels or mesenteric lymphatics then to the systemic circulation into the muscular tissues.

• Ultimately they settle down in the muscular tissue and undergoes further development.

• It takes about 60 to 70 days for the oncospheres to metamorphose into the cysticercus stage.

Human beings are infected through the eating of undercooked beef containing the cysticerci.

• Inside the alimentary canal of man, the scolex, on coming in contact with the bile, exvaginates and anchors to the gut wall by means of its suckers.

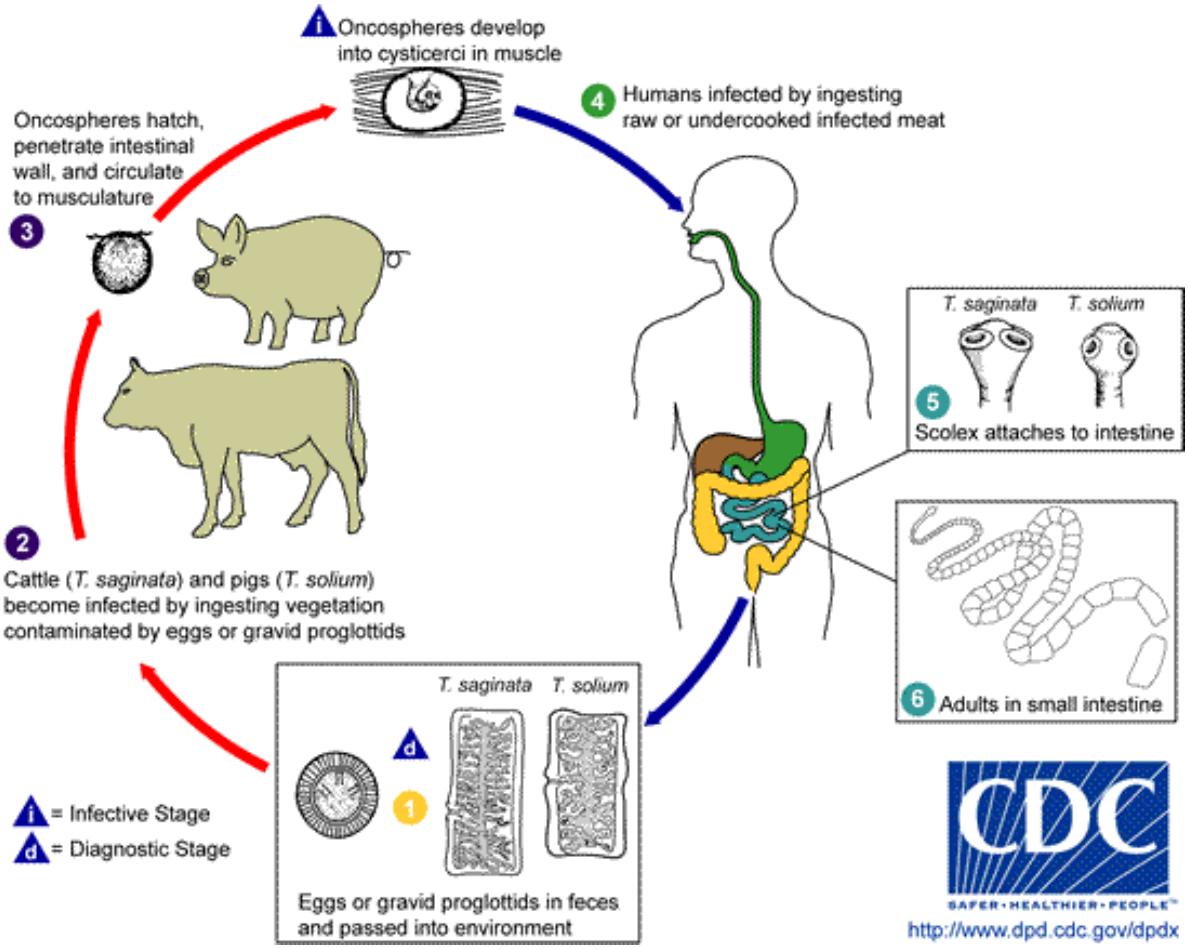
• It develops into an adult worm by gradual strobilisation.

• The worm grows to sexual maturity in 2 to 3 months and starts producing eggs.which passed in the faeces along with the gravid segments, thereby repeating the cycle.

Life cycle of T.solium-The intermediate host is the pig.

• Human beings are infected through the eating of undercooked pork,

containing the cysticerci.



Cysticercus bovis-This is the larval stage of *T.saginata* developing in the muscles of a cow or a buffalo.

Cysticercus cellulosae-This is the larval stage of *T.solium* developing in the muscles of the pig.

Diagnosis

This is carried out by the examination of stool.to found egg or gravid segment

Control:

All beef to be eaten by man should be inspected for cysticerci.

• Through cooking of beef ensures complete protection.

• Proper sanitary disposal of faeces.

• In order to break the parasitic life cycle, infected people should be treated.

3-*Echinococcus granulosis and Emulticularis*

- ***Echinococcus granulosus*:** causing hydatid disease
- ***Echinococcus multilocularis*:** causing alveolar hydatid disease

- Both produce hydatid disease in many mammals, including rodents and humans
- Unlike *E. granulosus*, *E. multilocularis* produces many small cysts that spread throughout the infected animal

Larvae Stage:

- ***E. granulosus***
    - Hydatid cysts are large, roughly spherical, fluid filled hollow bladders containing numerous protoscolices.

- They vary in size;

E. multilocularis

The cyst grows invasively by external budding, forming a **diffuse growth** through the infected organ, replacing that organs tissues. In contrast to *E. Granulosus* this growth is very rapid,

Adult Stage

- ***E. granulosus***
  - The adult parasites in the dog represent one of the smallest of the tapeworms (3-9 mm in length, usually with 3 proglottids).
  - Scolex is globular in shape and has a prominent rostellum
  - ***E. multilocaris***
  - Slightly smaller than *E. granulosus* (max. length of aprox 4 mm and consisting of 4-5 proglottids
  - **Definitive Hosts**
  - *E. granulosus:*Dogs,Wolves
  - . *multilocularis:* Mostly foxes

Intermediate Hosts

*E. granulosus:*Sheep,Horses,Camels,Pigs,Humans

*E. multilocularis:*Small rodents

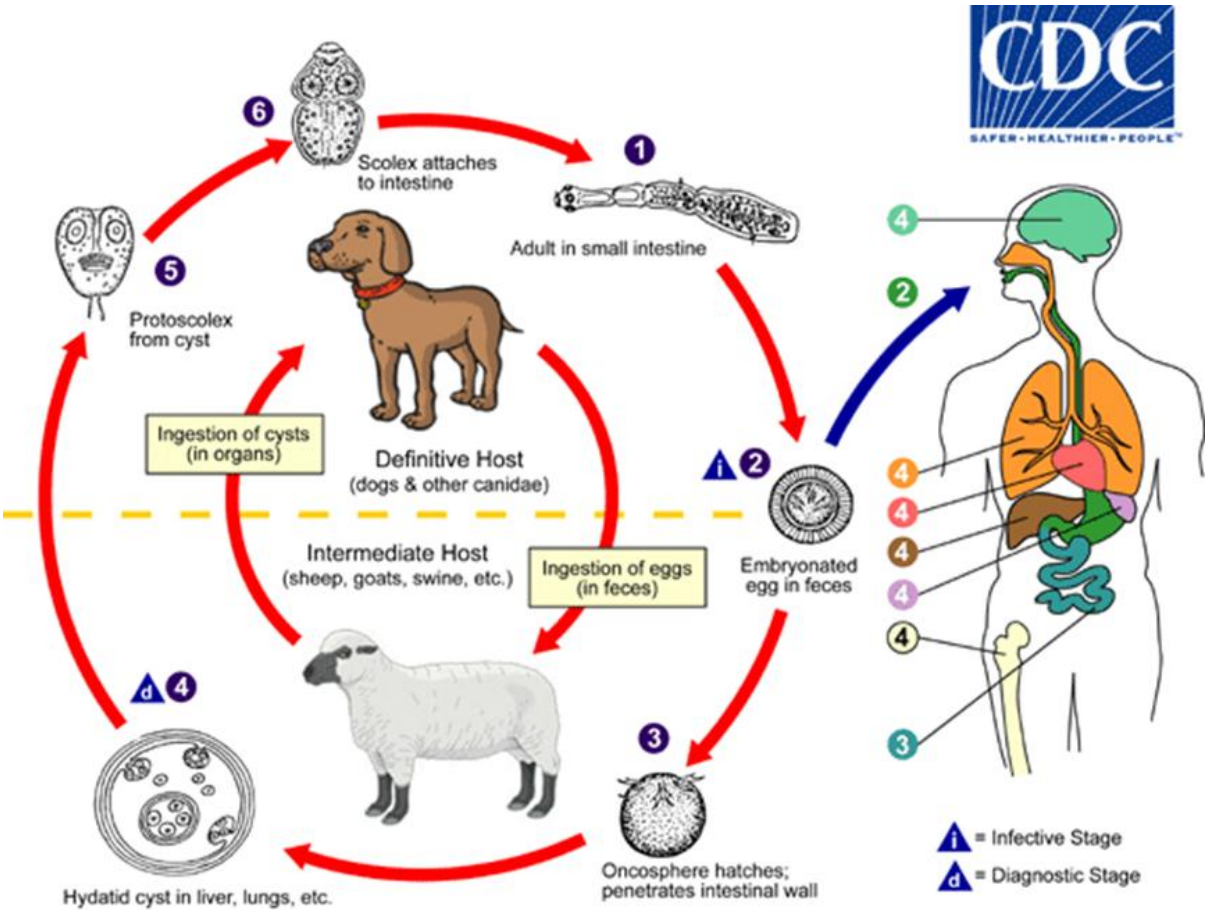
Life Cycle: *E. granulosus*

- The adult is in the small bowel of the definitive host
- Gravid proglottids release eggs that are passed in the feces
- In the intermediate host the egg hatches in the small bowel and releases an oncosphere
- The oncosphere penetrates the intestinal wall and moves through the circulatory system to various organs
- In the organs they develop into cysts and enlarge gradually
- The cysts produce protoscolices and daughter cysts
- Definitive host eats the infected organs and becomes infected
- After ingestion, the protoscolices evaginate, attach to the intestinal mucosa and develop into adult stages
- In 32-80 days, the cycle starts over

Life Cycle: *E. multilocularis*

- The life cycle is basically the same E. *granulosus* Except:

- There are different definitive and intermediate hosts
- Larval growth in the liver remain indefinitely in the proliferative stage, which causes invasion of the surrounding tissues (sometimes this can take over the whole organ)



- **Pathology;**
- ***E.granulosis*:** causes harmful, slowly enlarging cysts in the liver, lungs, and other organs that often grow unnoticed and neglected for year

- ***E. multicularis***:, causing parasitic tumors that can form in the liver, lungs, brain, and other organs. If left untreated, AE can be fatal.
- **Diagnosis**
- ELISA is currently the best available technique
  - (PCR) is also used to identify the parasite from DNA isolated from eggs
  - **Prevention**

    The best way to keep dogs from being infected is to prevent them from eating infected feces, or contaminated meat

    The best way to avoid human infection is to avoid ingesting food or other substances contaminated with dog feces

4- *Taenia multiceps* (coenurosis)

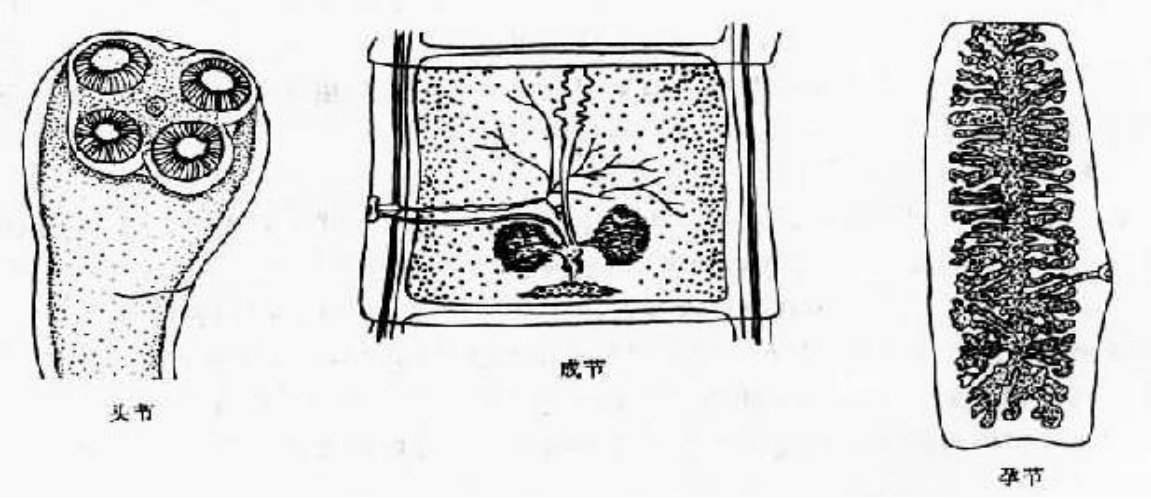
- Ceonurosisis a parasitic disease caused by ***Taenia*** *multiceps*(which is parasitic in the small intestineof dogs and other kind of wild carnivorous animal. When the coenurus is ingested by cattle , goat and sheep, it will infect the CES(central nervous system, including the brain and the spinal cord).It can cause high death rate in goats and sheep.

Morphology

- **Larval stage**——coenurus Shape: cyst full of transparent liquid Size: about 2-3mm. There are many protoscolexes growing on the in tine of the cyst membrane
- Adult :Length：48-100cm; Width:3-6mm
- **Scolex:** pear shape, 4 suckers, 22-32 rostellar hooks on the rostrum in circle.

- **Mature proglottid:** square, about 200 testis distributing in between both sides of excretory ducts, the ovary divided into two leaves---the big one and the small one**.**

- **Gravid proglottid:** length:8—10mm, width:3—4mm. the uterusis full of eggs



Life cycle

- **Intermediate host:** sheep, goat, cattle, pig, etc.

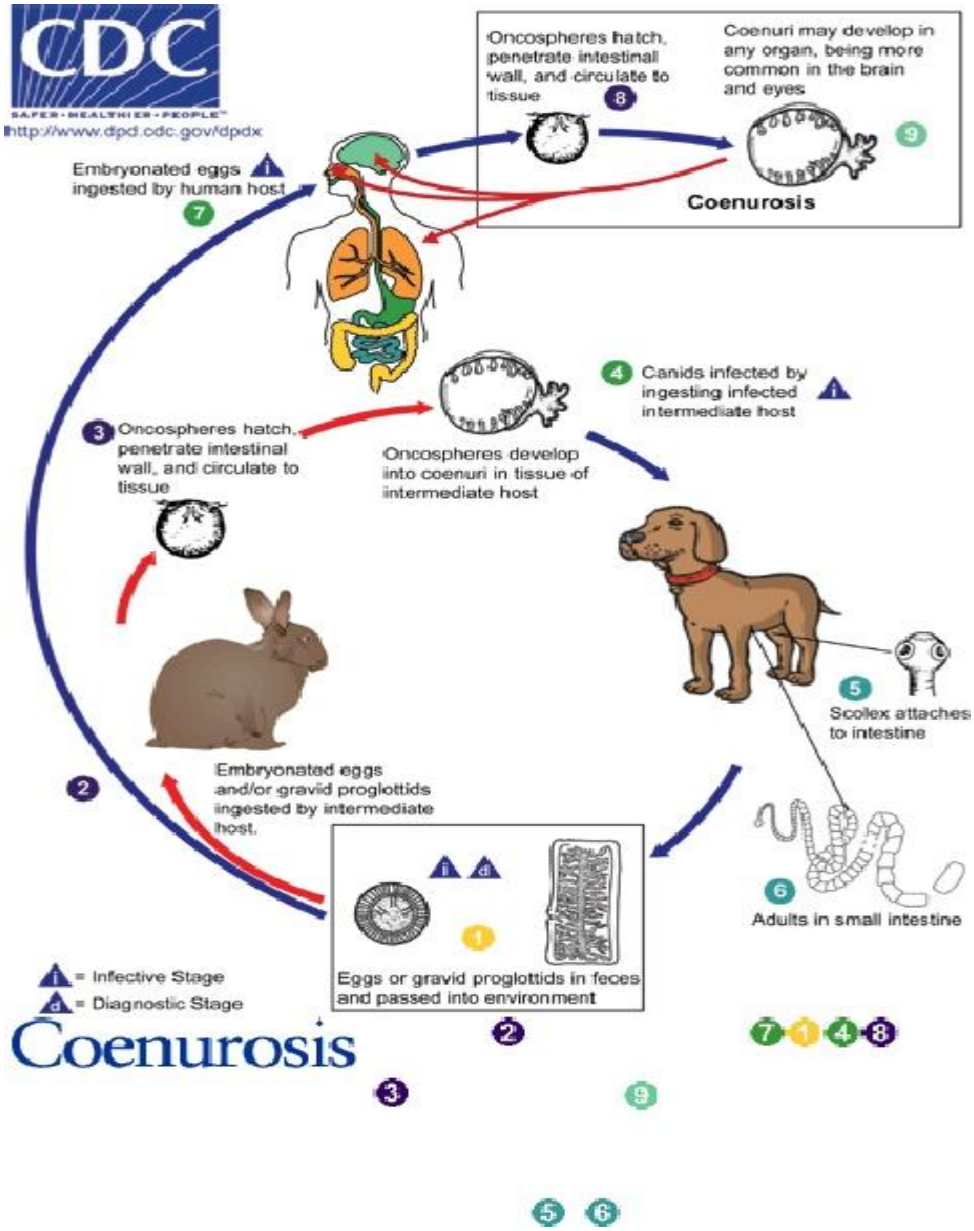
  Parasitic site: brain, spinal cord

- **Definitive host:** canid, wolf, fox, etc.

  Parasitic site: small intestine.

- Adult is parasitic in the intestine of dog, wolf, fox or other kind of wild carnivorous animal. When Gravid proglottids are eliminated from host, eggs can spread on the ground of pasture or cause the pollution of drinking water and fodder. Eggs can be absorbed by the intermediate host like goat or sheep through the polluted water and fodder. When it reach the gastrointestinal tract,the onchosphere escapes from the egg and drills into the blood vessel of intestinal mucosa. Along with the blood, it flows to the brain. After 2 or 3

months later, it grows into coenurus. However, the onchosphere flowing to other part of the body will die soon.



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Symptoms

- In chronic cases,we can see some particular symptoms, such as movement incoordination and walking in circle.
- Depending on the parasitic site, it will show different symptoms.

-Occipital lobe: Movement incoordination, lying on the ground, head hypsokinesis), blindness

-In acute deaths ,it shows some lesions like meningitis and encephalitis

Diagnosis

- Clinical diagnosis: Ultrasonic detection, X-ray, CT scan, MRI.
- Immunology diagnosis: IHA, ELISA, etc.

Prevention

- Dogs should be deworm periodically.
- Canid dog, wolf, fox should be caught and killed.
- Do not let the dog eat the brain or spinal cord taken from the infected cattle or sheep

GOOD LUKE