

# L:4 Parasitology

Helminths or Worm (Metazoa)

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# Helminthes

## Phylum:

- A. Cestodaes: Platyhelminthes (flatworms) (Tape Worm)
- B. Trematodes ( Flukes)
- C. Nematodes (Roundworms)

## Cestodaes (Tape Worm)

1. *Taenia saginata*=Beef Tape Warm
  2. *Taenia solium*=Pork TW
  3. *Hymenolepis nana* =Dwarf TW
  4. *Diphyllobothrium latum* =Broad fish TW
  5. *Echinococcus granulosus*=Dog TW
- A) *Echinococcus vogeli* : **polycystic disease**
  - B) *Echinococcus multilocularis* : **alveolar echinococcosis, or multilocular hydatid cyst.**

# General properties of Helminthes

1. Helminthes: are multicellular and contain internal organ system.  
All cestode helminths are **Monoecious or hermaphrodites** are not Separated sexes (Both male and female reproductive organs at the same mature segment)
2. All cestoda have stages: ovum, larva (juvenile) and adult.
3. They lack a digestive system and absorb soluble nutrient directly through their **cuticle**, causing mechanical blockage of the intestine.
4. cestodes segmented that primarily intestinal parasite. Adult worm consist of :
  - A. **head or scolex**, with hooks and sucker that function to attach the worm to the intestinal wall.
  - B. **neck** is very short after scolex, & the region of segment proliferation and production of segments
  - C. **body segment or strobila (proglottids)**. Three types of segments:
    - I- **Immature segments**: the beginning of segments after the **neck**.
    - II- **Mature segment**: has both male and female reproductive organs.
    - III- **Gravid segment**: has uterus contain fertile eggs, these pass out of the body in the stool. Mature egg has internal embryo is called oncospheres (hexacanth embryos) which contain three pairs of hooks (Six hooks).
5. cestodes utilize more than one host.
6. The infection occur in human during **ingestion the larva in mediated host in most parasites OR may be occur ingestion the egg**.
7. The diseases transmitted from animals to human, are called Zoonosis diseases



# 1. *Taenia saginata* = Beef Tape Worm

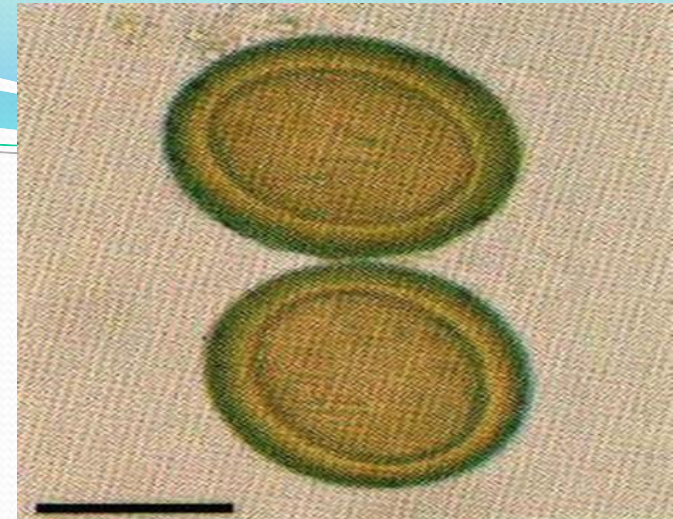
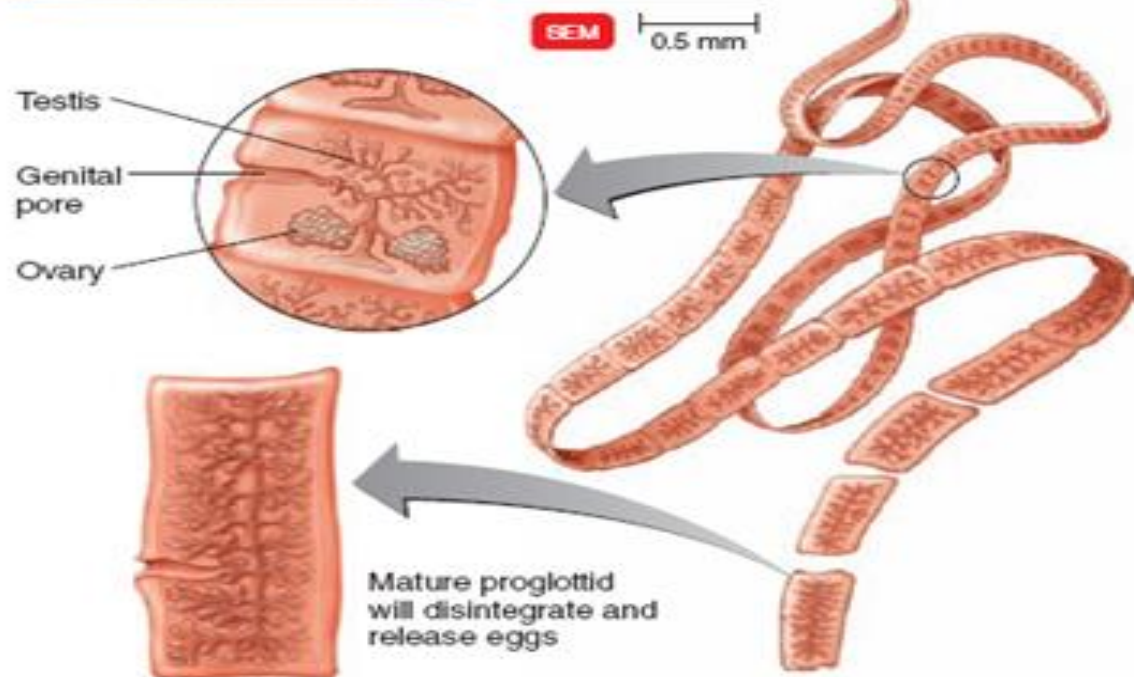
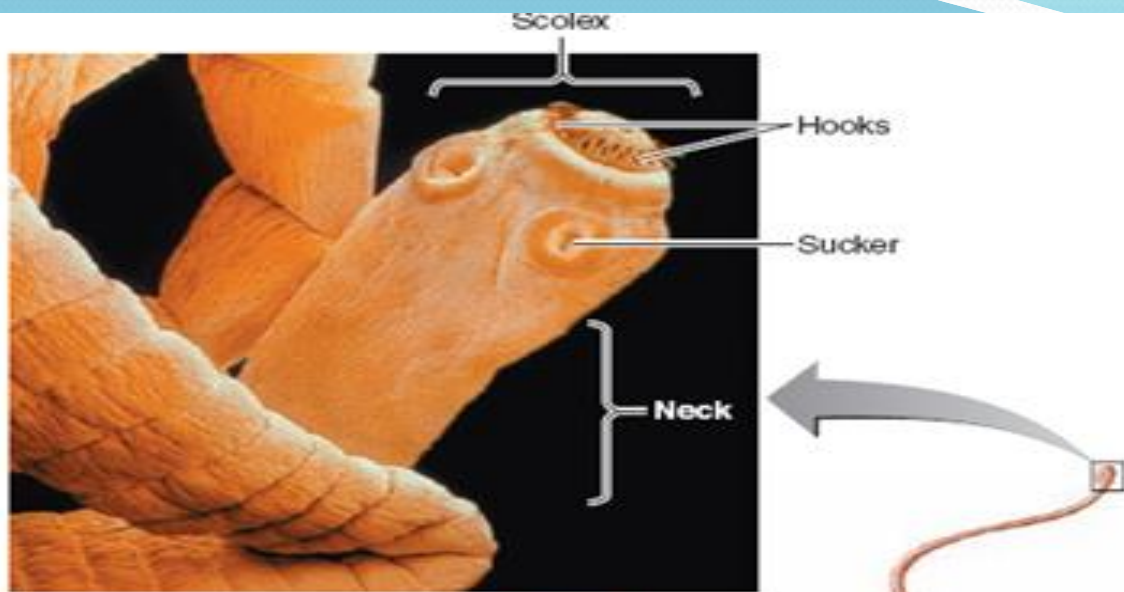
Adult worm develop in the small intestine, in human measure about 5 m and the body consist of the following:

**scolex** which is rounded in shape & have 4 sucker, neck, **immature segment** which the genital organ are not develop, **mature** contain full set of sexual male & female organ , **gravid segment** contain uterus with lateral arms about (15-30 arm ) & fertile eggs. Eggs of this worm are spherical in shape & consist of 3 hexacanth embryo and has three paris of hooklet.

*T. saginata* causes **Taeniasis**; this disease caused by the larval form of *T.saginata*. This disease is transmitted by larvae in undercooked or raw beef (**mediated host is beef**), most infected individual are asymptomatic.

- Infective stage is larva (**cysticercus bovis**)
- Diagnostic stage is eggs or proglottides (**gravid segment**) in stool
- Pathogenic stage is Adult Worm





*Taenia* spp. eggs are all identical i.e. 31–43  $\mu$ m in diameter, with a thick, prismatic-appearing shell wall, and contain a 6-hooked embryo, the oncosphere. Occasionally a thin, hyaline primary embryonic membrane may be retained around these eggs.



*Taenia saginata*, *Taenia solium*, or *Echinococcus*



## • Life cycle

Infection with *Taenia saginata* occurs following ingestion of raw / undercooked **cow** meat contaminated with a **cysticercus larva**. Scolex attachment to the intestinal mucosa occurs in the small intestine where maturation into an adult worm occurs. The resulting adult multiplies, producing numerous eggs, some of which may be passed into the feces. These eggs are then consumed by the proper animal species (beef), where the onchosphere hatches. The onchosphere then migrates via the blood to the animal tissue and converts into the infective cysticercus larva stage. A new cycle is initiated upon human ingestion of the infected animal meat.

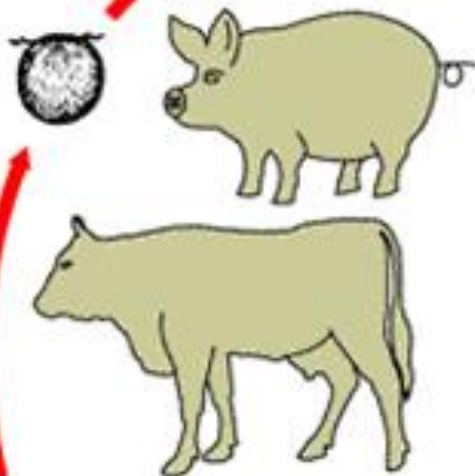
## • Clinical symptoms of Taeniasis

Nondescript symptoms, such as diarrhea, abdominal pain, change in appetite, and slight weight loss, may be experienced by *Taenia*-infected patients. In addition, symptoms including dizziness, vomiting, and nausea may also develop in such patients. Laboratory tests often reveal the presence of a moderate Eosinophilia. The prognosis is usually good.

**i** Oncospheres develop  
into cysticerci in muscle

Oncospheres hatch,  
penetrate intestinal  
wall, and circulate  
to musculature

**3**

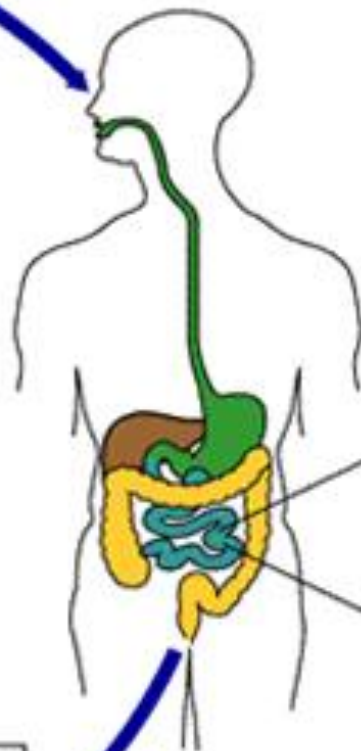


**2**

Cattle (*T. saginata*) and pigs (*T. solium*)  
become infected by ingesting vegetation  
contaminated by eggs or gravid proglottids

**4**

Humans infected by ingesting  
raw or undercooked infected meat



*T. saginata* *T. solium*

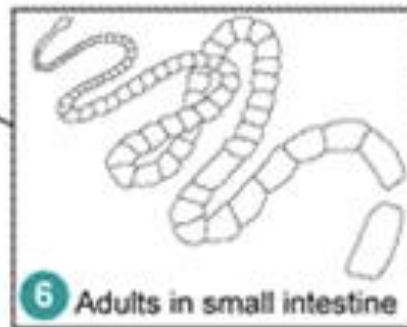
**5**

Scolex attaches to intestine



**6**

Adults in small intestine



*T. saginata* *T. solium*

**d**

**1**



Eggs or gravid proglottids in feces  
and passed into environment

**i**

= Infective Stage

**d**

= Diagnostic Stage



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## 2. *Taenia solium*=Pork TW

Adult worm develop in the middle of small intestine, in human measure about 3 m and the body consist of the following: **scolex** which is rounded in shape & **have 4 sucker ,also has rostellum and contain double circle and small hooks**. The neck, immature, mature segment, & eggs are same in *T. saginata* , while **gravid segment** contain uterus with lateral arms about (7-15arm ) & fertile eggs. ***T. solium* causes :**

**A: Taeniasis;** this disease caused by the larval form of *T. solium*. this disease is transmitted by larvae in undercooked or raw pork (mediated host). This worm causes diarrhea, most infected individual are asymptomatic. **Infective stage is cysticercus cellulosae** in the muscle of different organs of pigs and human.

Taeniasis dignosed by detection of proglottides or egg in stool.

**B:cysticercosis** this disease follows by **ingestion of *T. solium* eggs** from human feces & produces infection in the brain and eyes.

**Intermediate host: human (accidently) and pigs.**

- **Final host is: human only.**
- **Human may be as intermediate and final host**
- **Habitat: adult worm in the small intestine of human.**



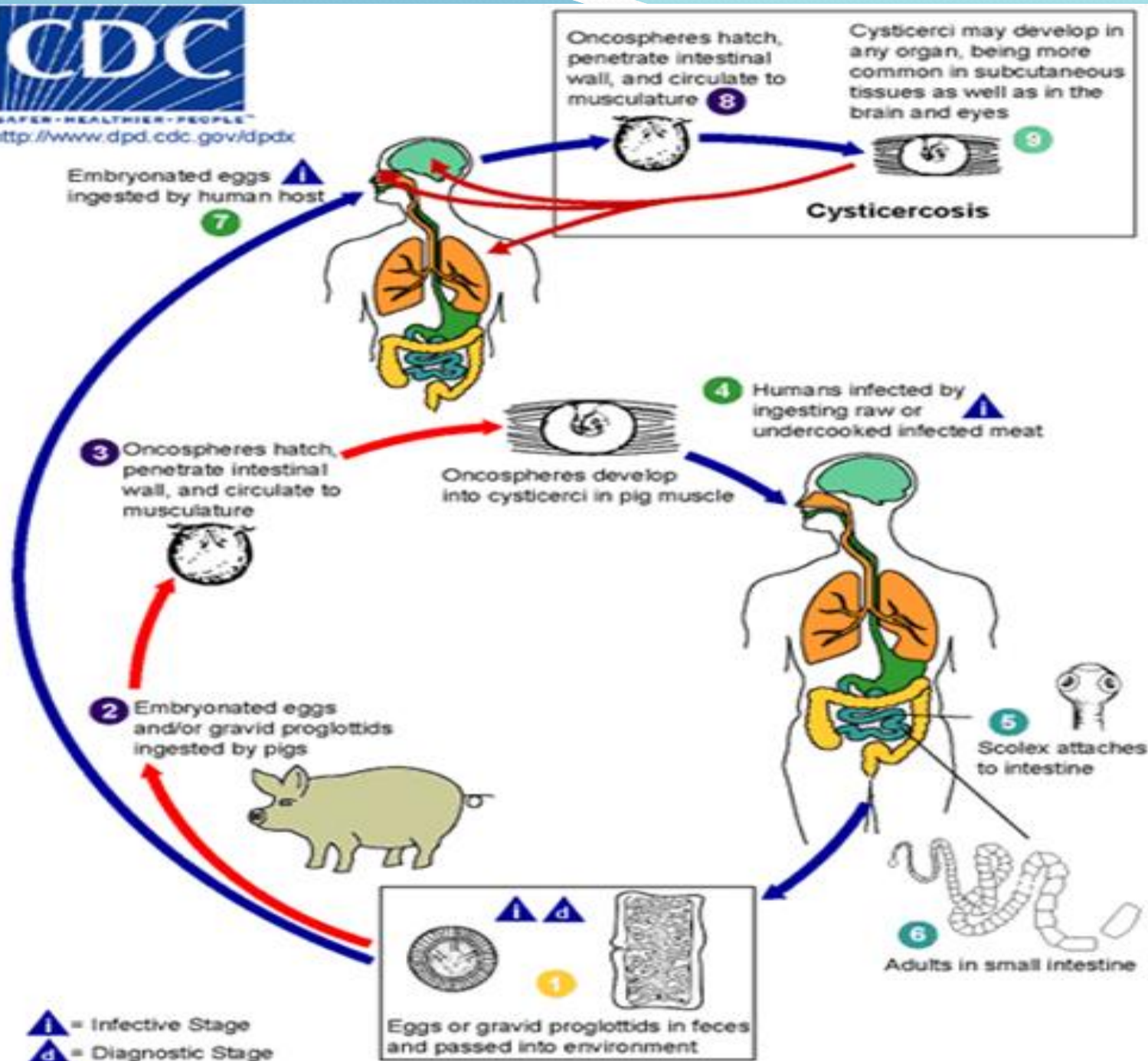
## • Life cycle

Infection with *taenia solium* occurs following ingestion of raw / undercooked pork meat contaminated with a **cysticercus larva**. Scolex attachment to the intestinal mucosa occurs in the small intestine where maturation into an adult worm occurs. The resulting adult multiplies , producing numerous eggs, some of which may be passed into the feces. These eggs are then consumed by the proper animal species (pig), where the onchosphere hatches. The onchosphere then migrates via the blood to the animal tissue and converts into the infective cysticercus larva stage . a new cycle is initiated upon human ingestion of the infected animal meat.

- Infective stage is larva(**cysticercus cellulosae** ) & egg
- Diagnostic stage is eggs or proglottides (gravid segment) in stool
- Pathogenic stage is Adult Worm



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- **Clinical symptoms**

- **-Taeniasis / pork Tape worm infection**

Nondescript symptoms, such as diarrhea, abdominal pain, change in appetite, and slight weight loss, may be experienced by *Taenia*-infected patients. In addition, symptoms including dizziness, vomiting, and nausea.

- **-cysticercosis**

***Taenia solium* is produced neurocysticercosis after ingestion of the egg.**

It is more dangerous because of human is the intermediate host

In human larvae can cause serious symptoms if they localize in the brain, resulting in Neurocysticercosis

The severity of cysticercosis depends on location, size and number of larvae in tissues, as well as the host immune response.

- Cysticercosis in the brain causes headache, vomiting, and seizures.
- Cysticercosis in the eyes can appear as uveitis or retinitis, or the larvae can be visualized floating in the vitreous.
- Subcutaneous nodules containing cysticerci commonly occur.
- Cysts also are commonly found in skeletal muscle.

Laboratory tests often reveal the presence of a moderate Eosinophilia.

### 3. *Hymenolepis nana* = Dwarf TW, tiny intestinal tapeworm

Adult worm is **smallest tape worm of man** it has length about 25-40 mm.

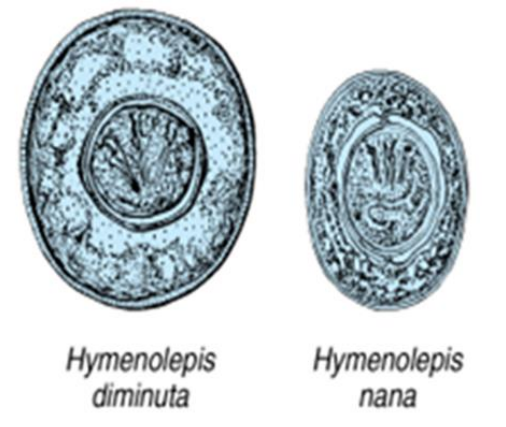
**Scolex** contain 4 sucker with short rostellum armed with circle of hook. Eggs are oval in shape with hexanth embryo, 3 pairs of hooklet and has polar thickening protect the embryo. *H. nana* causes *Hymenolepiasis*

- Life cycle: is direct no intermediate host.
- Infective stage to human: ova by food and water.
- Diagnostic stage to human by ova and gravid segment in stool



### Mode of infection

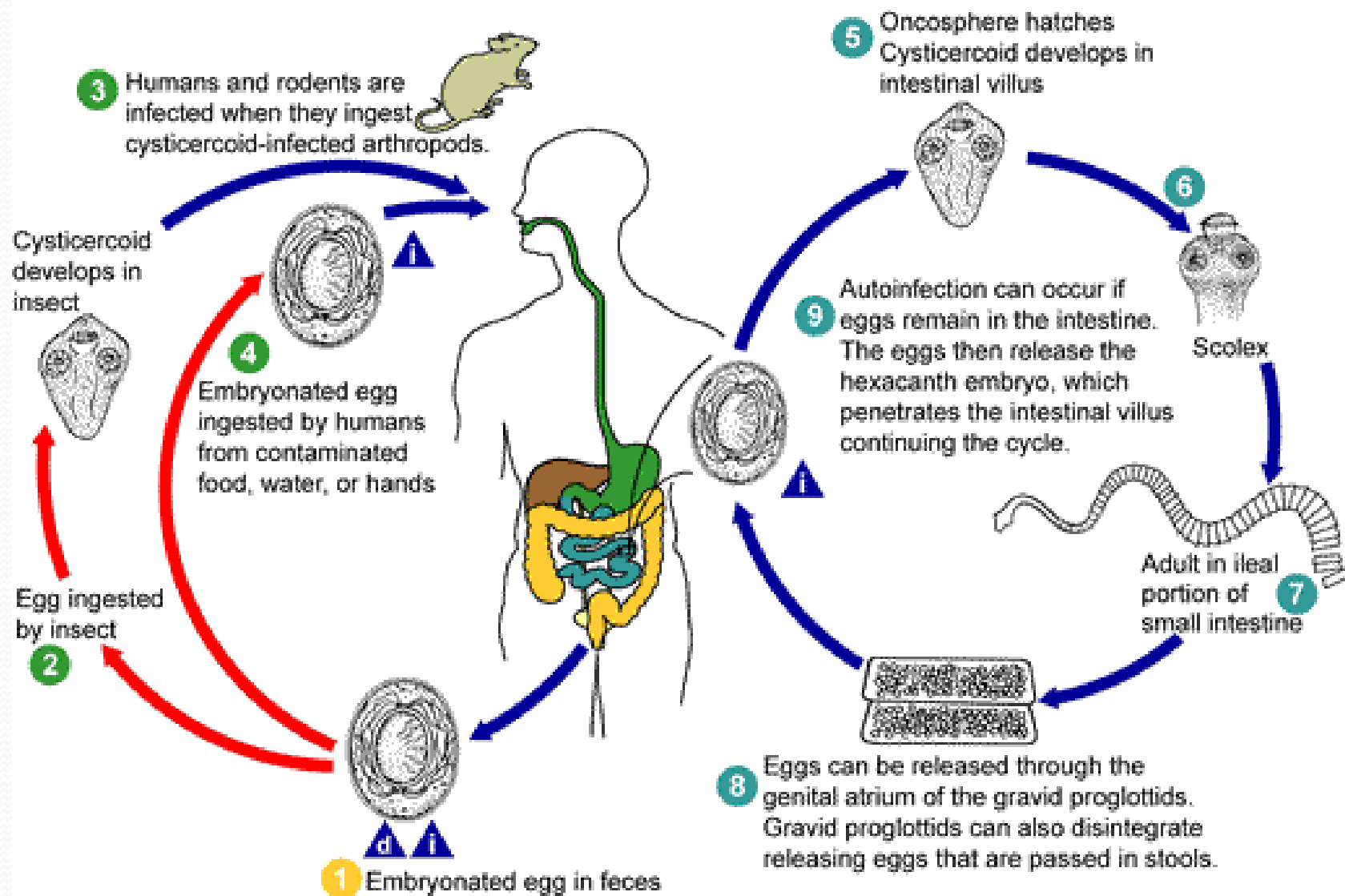
- 1-Contaminated food and water with ova or
  - 2- Auto infection, ova remains and hatches in the intestine.
- Habitat: Adult worm in the small intestine of human.



**Symptoms:** Rare symptoms include anorexia, vomiting nausea and behavioral disturbances



**i** = Infective Stage  
**d** = Diagnostic Stage



#### 4. *Diphyllobothrium latum* = Broad fish TW

The length of *D. latum* about 10m-15m . **scolex** is spatulate shape ,it have contain 2 long sucking groove.

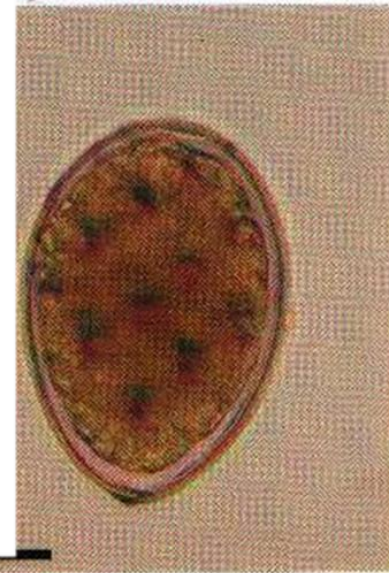
**eggs** of *D. latum* are oval shape & have opericulum at anterior end & have knob in posterior end.

*D. latum* causes **Diphyllobothriasis**, that transmitted by **larvae in undercooked or raw fish**.

- Infective stage is larva
- Diagnostic stage is eggs or gravid segment in stool
- Pathogenic stage is Adult Worm



*Diphyllobothrium latum*



*Diphyllobothrium latum*. These operculate cestode eggs usually measure 58-75 µm by 40-50 µm, are unembryonated in faeces, and may have a knob or small protuberance at the abopercular end.



## 5. *Echinococcus granulosus* = Dog TW

- *E. granulosus* causes **Echinococcosis**, infection produce large **hydatid cysts** in in the liver, lung, ovary, brain. This disease follows ingestion of egg in dog feces.  
**The human is a dead-end life cycle.**

- Infective stage to human is : eggs by ingestion food & water.
- Mode of infection: contaminated food and water with eggs.

**Egg is the infected stage comes from**

- I. Ingested of water or vegetable Contaminated by infected dog feces.
- II. handling or caressing infected dog where the hairs contaminated with eggs.

Intermediate host: human, sheep cattle, camels all carry hydatid cyst.

- Habitat: adult worm in the small intestine of dogs.
- Final host: is only the dogs (dogs, wolf, fox)

Larval stage (hydatid cyst) in intermediate host.

- Hydatid cyst is found in Humans and animals. Anaphylactic reaction to worm antigens can occur if the cyst ruptures.

**Echinococcosis** is diagnosed by X ray, CT scan or ultrasound scan or biopsy of infected tissue.

**Casoni test** for diagnosis of *Echinococcus granulosus* eggs

- It is world wide specially in dogs regions.

# Pathogenesis

After Ingested of eggs which hatch in duodenum or small intestine into embryos which penetrate wall enter portal veins migrate via portal blood supply to organs: lungs, liver, brain thus causing **extra intestinal infections**.

In these organs, larvae develop into hydatid cysts. The cyst may be large , filled with clear fluid and contain characteristic proto-scolices (immature forms of the head of the parasite). These mature in to developed scolices. Echinococcus forms one large fluid-filled cyst that contains thousands of individual scoleces as well as many daughter cysts within the large cyst. Individual scoleces lying at the bottom of the large cyst are called “hydatid sand”. The outer layer of the cyst is thick, fibrous tissue produced by the host.

- The cyst fluid contains parasite antigens, which can sensitize the host.

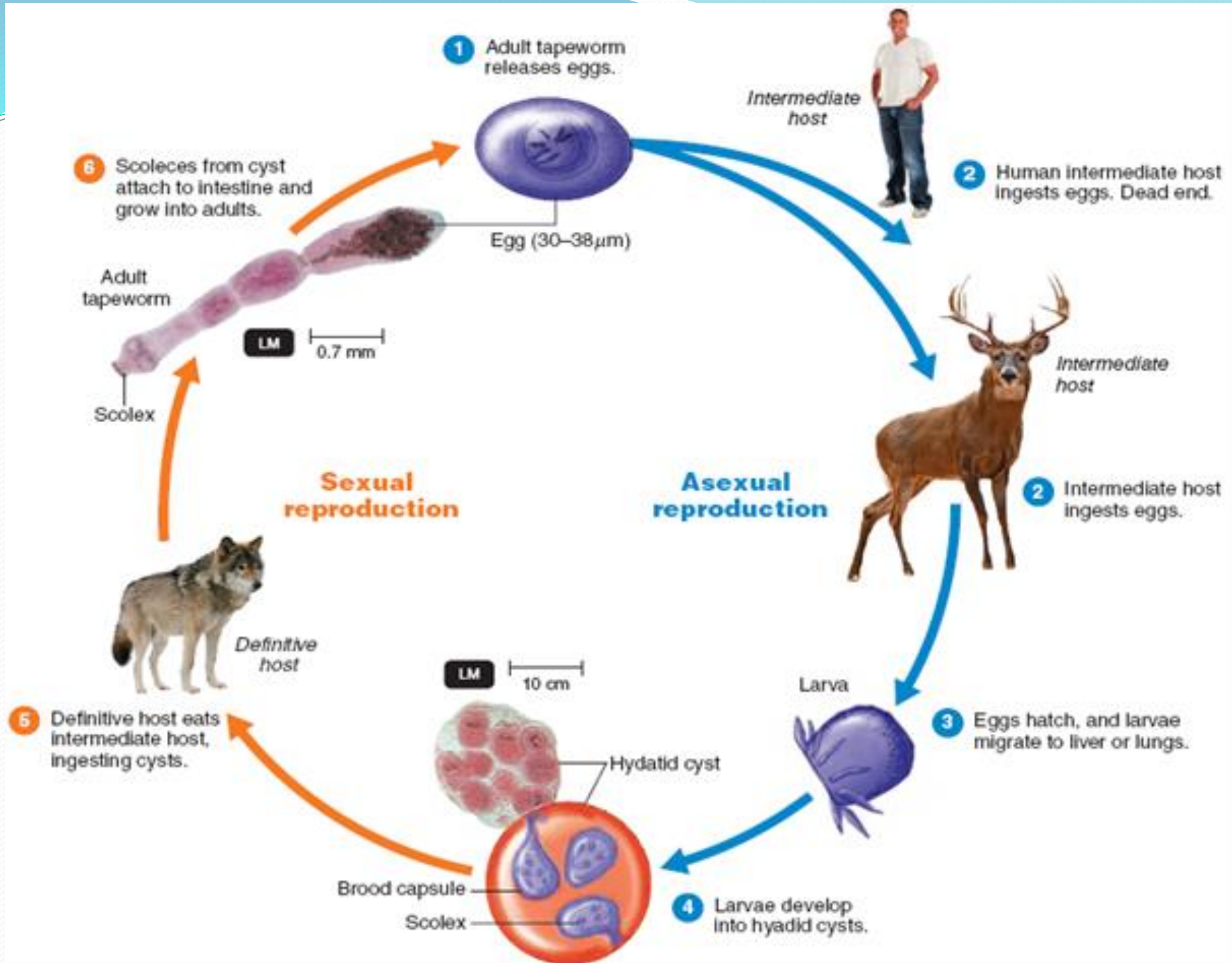
If the cyst ruptures spontaneously or during trauma or surgical removal, life-threatening anaphylactic shock can occur. Rupture of a cyst can also spread protoscoleces widely.

## Symptoms

Rare symptoms because the cyst grow slowly unless it rupture causing Anaphylactic shock due to release of protoscolices and toxins of hydatid cyst.

Pathogenesis If the cyst ruptures, either spontaneously in the body or during surgery, the danger from death from anaphylactic shock is high. Metastatic cystic lesions can also develop in virtually any of the visceral organs if the primary cyst ruptures. If the cyst material seeds the peritoneal lining, massive proliferation can occur with vascular invasion and spread to other organs.





- **Prevention and Control**
- **control** of **Cestodaes** = Avoid taken uncooked meat containing infective stage in the muscles.
- **control** of **Taenia saginata**= Avoid taken uncooked beef meat containing infective stage in the muscles.
- **control** of **Taenia solium**= Avoid taken uncooked pig meat containing infective stage in the muscles. hygiene, Improvement of water supply and sewage and Good health education.
- **control** of **Diphyllobothrium latum** = Avoid taken uncooked fish meat containing infective stage in the muscles.
- **control** of **Echinococcus granulosus**= Avoid taken contaminated food and water. keep the dogs away with human contact
  
- **Treatment** of **Cestodaes** = Praziquantel, Albendazole
- **Treatment** of **Taenia saginata**= Albendazole *Alternatively, niclosamide*
- **Treatment** of **Taenia solium**= Albendazole
- **Treatment** of **Diphyllobothrium latum** = Albendazole
- **Treatment** of **Echinococcus granulosus**= Albendazole and surgical excision of cysts.



# Trematodes (flukes)

- Trematodes are small (about 1 cm), **flat, leaf-like worms or flatfish** that, depending on the species, infect various organs of the human host (**intestinal veins, urinary bladder, liver, or lung**). **All trematodes use freshwater snails (Biomphalaria) as an intermediate host, human as final host**
- The sexual stages or adult stages in the (definitive host) and asexual or larval stages in the (intermediate host).
- The life cycle stage of the digenetic trematodes that cause "swimmer's itch" is a Miracidium. it is the larval stage of a fluke that is covered with cilia and swims about seeking out **a snail to serve as an intermediate host**
- **All are hermaphrodite (monoecious) except Schistosoma in which sexes are separated (dioecious).**
- The alimentary canal of flukes like an inverted Y. There are three types :
  1. **Schistosomes (Blood flukes)**
  2. ***Fasciolopsis buski* (giant intestinal fluke)** causes Fasciolopsis. Live in Small intestine
  3. ***Fasciola hepatica* (sheep liver fluke )** causes Fasciolosis. live in Liver.  
**Cause Liver rot** (bile ducts, after migration through parenchyma)
  4. ***Paragonimus westermani* (Japanese lung fluke)** eggs in passed sputum



miracidia enter the snails (mollusks) develop into cercariae

## Life cycle of schistosomes

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miracidia enter the snails develop into cercariae

## Life cycle of *Fasciola hepatica* & *Fasciolopsis buski*



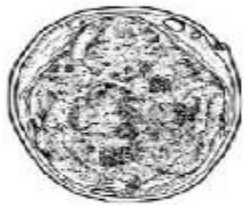
- 1. **Schistosomes (Blood flukes)** **The disease is transmitted by direct skin penetration (cercaria is infective stage).** has three sp.

***A.S. haematobium***: Shape of egg: oval, contain terminal or polar spine. Resident the vein surrounds the urinary bladder & Present in veins of the vesical and pelvic plexuses. causes **urinary bilharziasis**. the main symptoms are **hematuria**, fibrosis, granulomas. The loss of blood can lead to iron deficiency anemia blocking of urinary tract & bladder cancer. **Diagnosis (egg in urine is diagnostic stage).**

***B. S. msnsoni***: Shape of egg large oval, contain lateral spine.

***C. S. japonicum (Oriental schistosomiasis or Katayama disease)***: The egg: oval contain lateral knob & blunt projection spine.

***S. msnsoni* & *S. japonicum*** causes **intestinal bilharziasis or Schistosomiasis**. Resident in the mesenteric or rectal vein surround small intestine. The eggs causes damage in intestine, liver, gastrointestinal tract causes **bleeding diarrhea**. Damage to the intestinal wall is caused by the host's inflammatory response to eggs deposited at that site. The eggs also secrete proteolytic enzymes that further damage the tissue. **Diagnosis (egg in stool is diagnostic stage).**



egg



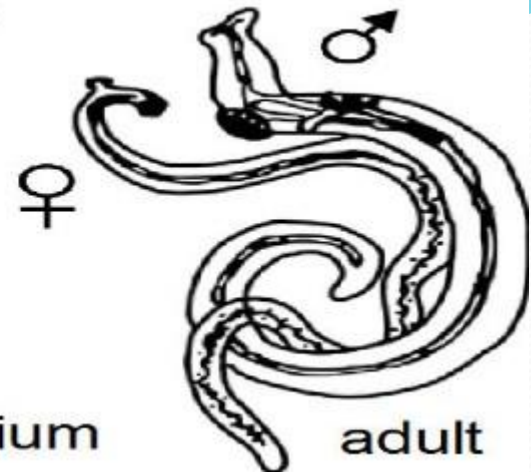
miracidium



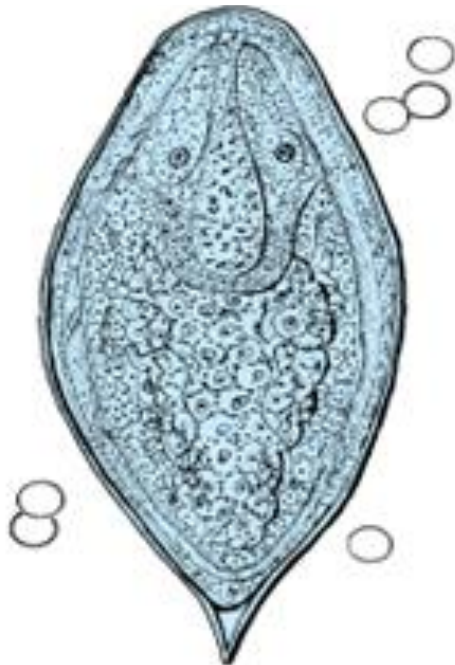
sporocyst



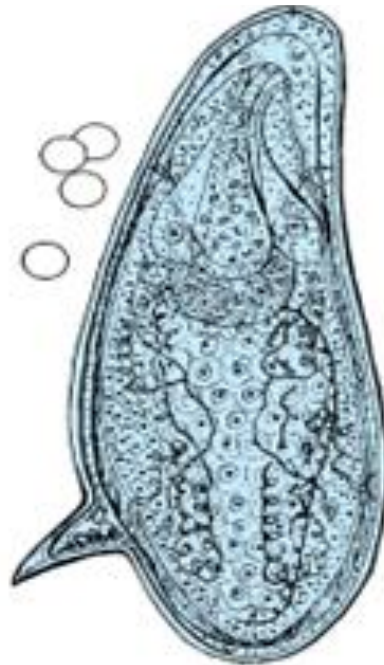
circarium



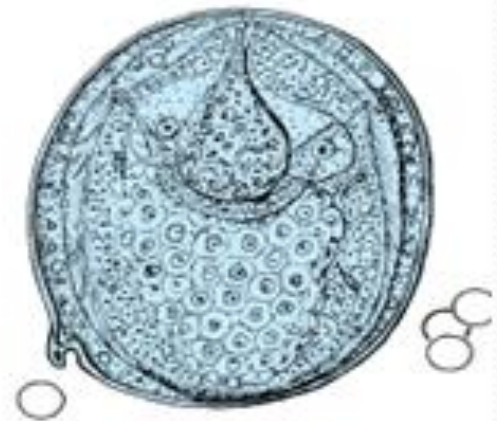
adult



*Schistosoma haematobium*.  
Terminally spined



*Schistosoma mansoni*.  
Laterally spined

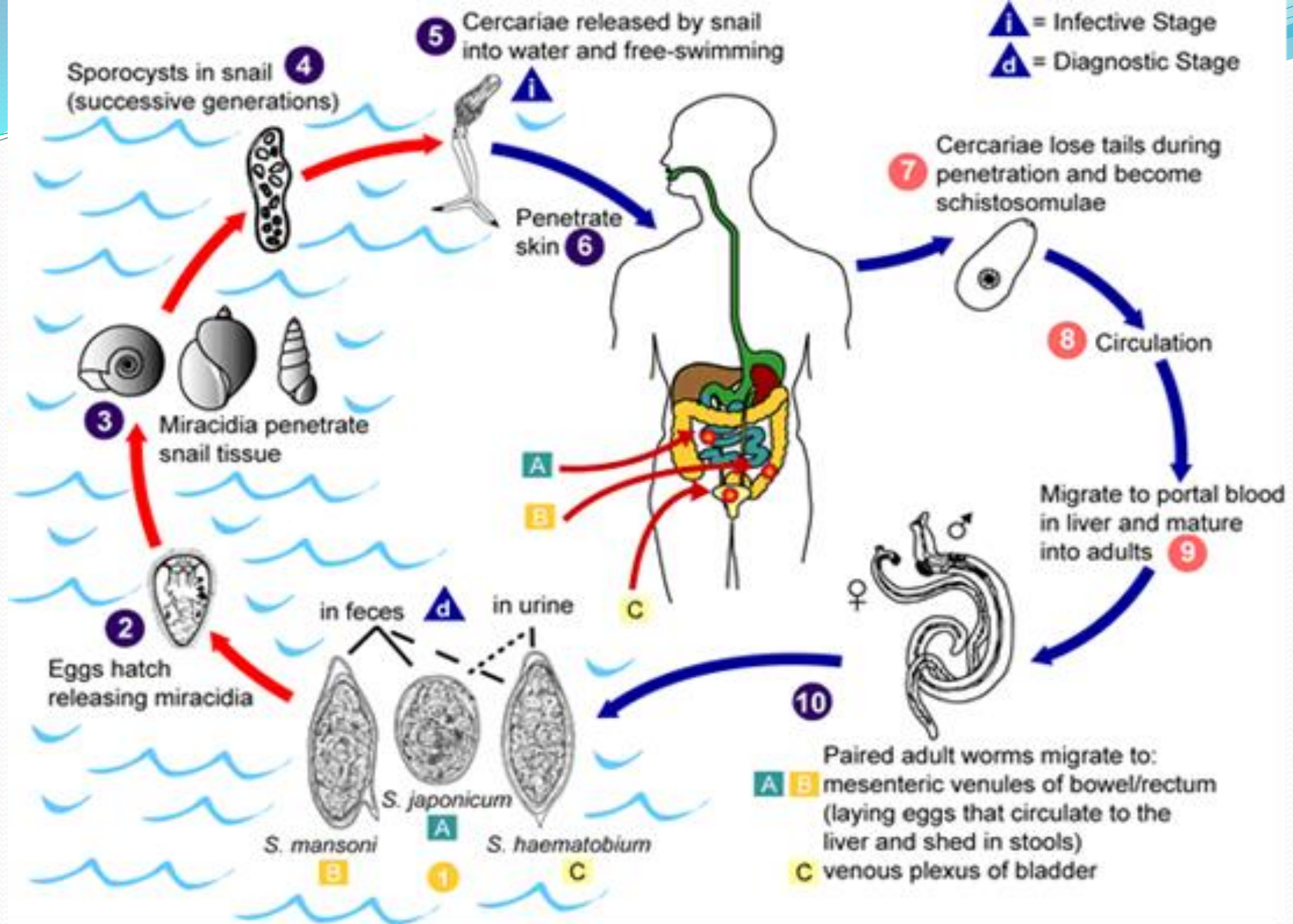


*Schistosoma japonicum*.  
Embryonated ovum with small  
lateral spine, often not visible.



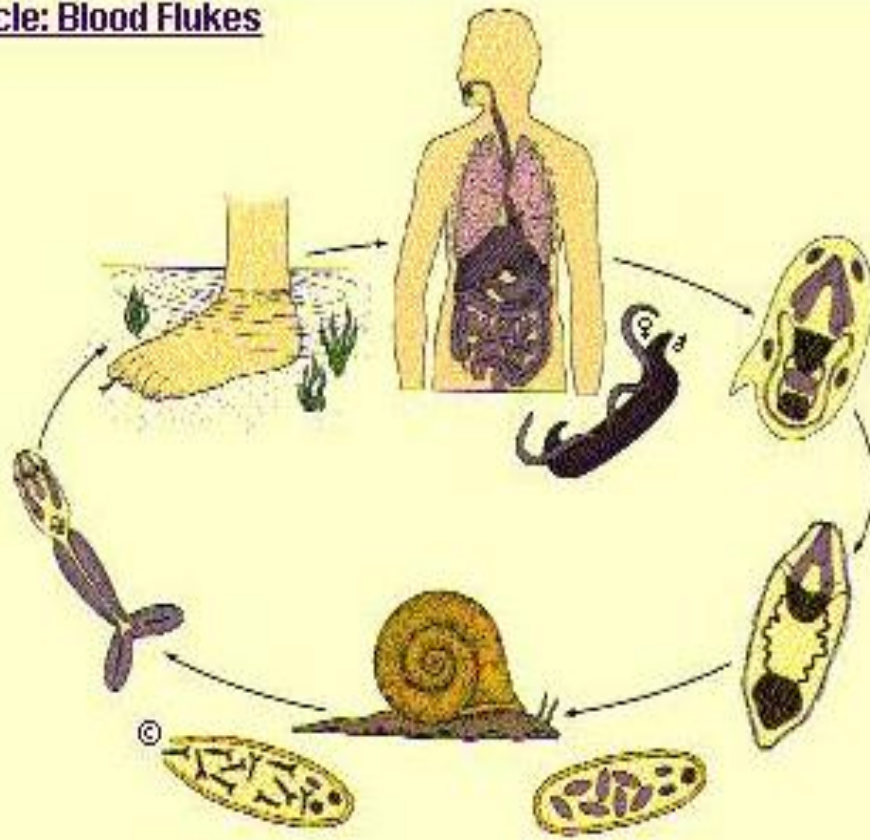
## • Life cycle of schistosomes

schistosomes have only one intermediate host (the snail). schistosome cercaria acquired directly penetrating the skin of swimmers in contaminated rivers and lakes. After dissemination and development in the human host, adult schistosomes take up residence in various abdominal veins, depending on the species. schistosomes have separate, distinctive sexes. male in which the smaller female resides and continuously mates with the male (Female of *Schistosoma* settled with male in place Gynecophoric canal. This mating takes place in the human liver. Fertilized eggs penetrate the human host's vascular walls and enter the intestine or bladder, emerging from the body in feces or urine. In fresh water, the organisms infect snails in which they multiply, producing cercaria (the final, free-swimming larval stage (swimmers itch)), which are released into the fresh water to complete the cycle.





### Life Cycle: Blood Flukes

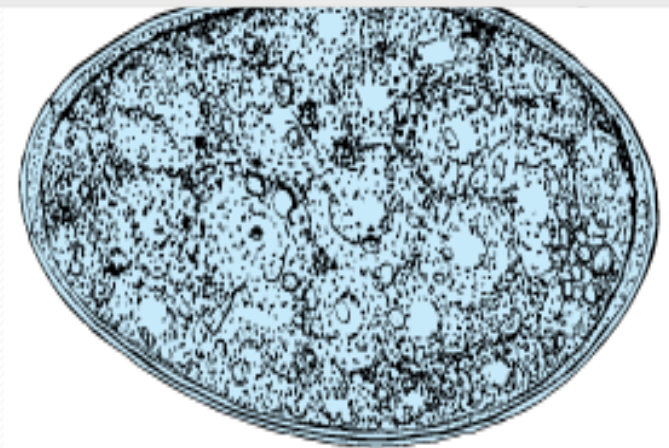


- **control & Prevention** of Schistosomes = Prevention of pollution of water in rivers by human
- Urine, Eradication of Mollusks (snail), Avoiding swimming or washing, or bathing in or contact with infected or polluted water.
- **Treatment** of Schistosomes = praziquantel

## 2. *Fasciola hepatica* (sheep liver fluke)

### *Adult*

The adult *Fasciola hepatica* worm is flattened, leaf like shape, equipped with shoulders, somewhat oblong. Adult *Fasciola hepatica* measuring 3cm by 1cm in size, grayish in color. There are two suckers, oral sucker and ventral sucker, they located in cephalic zone. The intestine is branched. The uterus is short and coiled filled with grayish eggs.



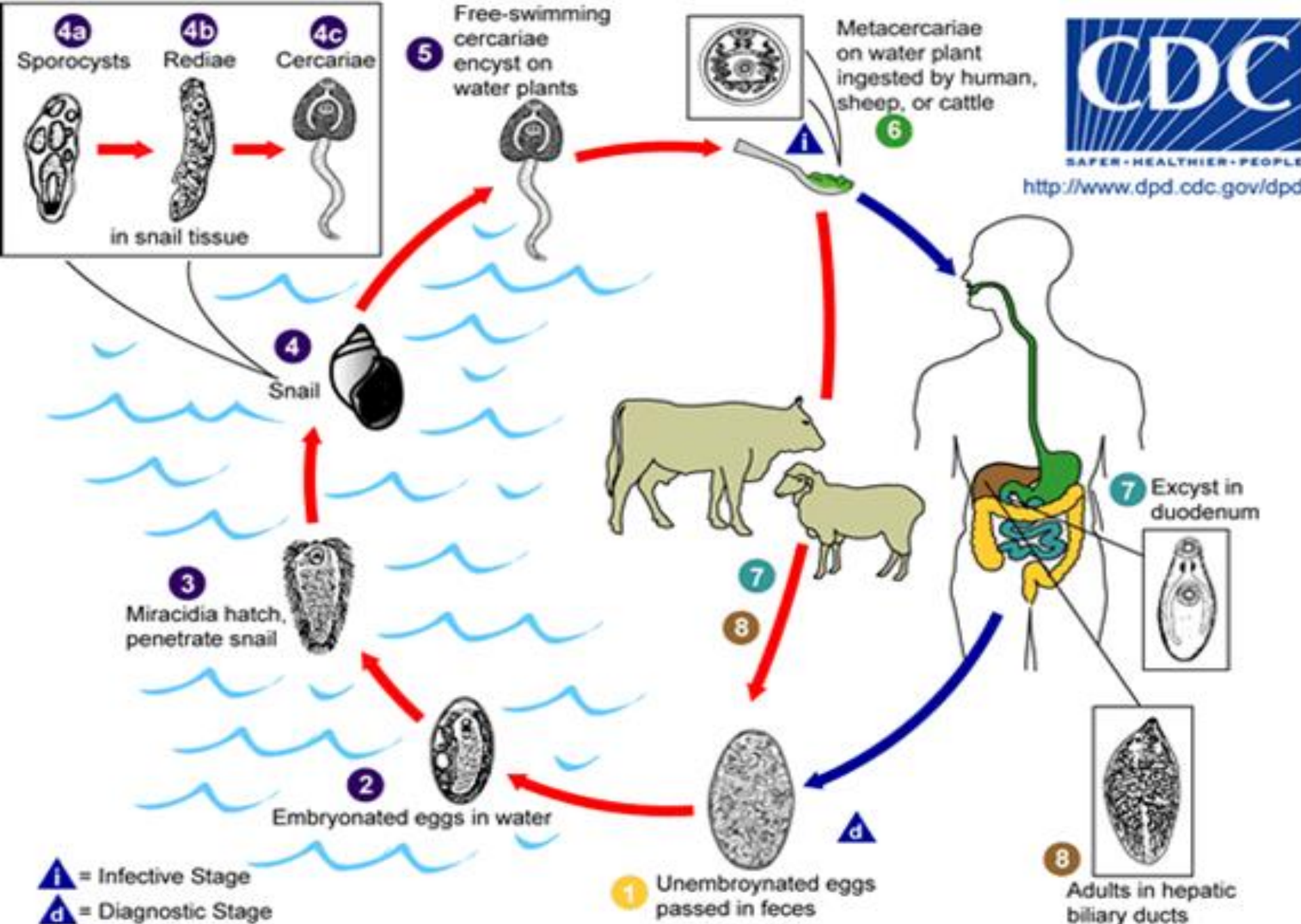
*Fasciola hepatica* or *Fasciolopsis buski*.  
Unembryonated operculated ovum.

The adult flukes are acquired by eating raw sheep liver. Or by swallowing metacercariae of the fluke found on water plants, as raw watercress.



# Life cycle

*Fasciola hepatica*, **the sheep liver fluke**, causes disease primarily in sheep and other domestic animals in Latin America, Africa, Europe, and China. Humans are infected by eating watercress (or other aquatic plants) contaminated by larvae (**metacercariae**) that **excyst in the duodenum**, penetrate the gut wall, and reach the liver, where they mature into adults. Hermaphroditic adults in the bile ducts produce **eggs (unembryonated operculated ovum)**, which are excreted in the feces. The eggs hatch in fresh water, and miracidia enter the snails. Miracidia develop into cercariae, which then encyst on aquatic vegetation. Sheep and humans eat the plants, thus completing the life cycle.



.Fig. ( ) : Life cycle *Fasciola hepatica*



**Clinical symptoms of Fascioliasis caused by *Fasciola hepatica***  
**Symptoms** are due primarily to the presence of the adult worm in the biliary tract. It is marked by stomach and bowel pain, fever, a liver disease (**jaundice**), and diarrhea. In early infection, right-upper-quadrant pain, intermittent fever, and **hepatomegaly**.

**Halzoun** is a painful pharyngitis caused by the presence of adult flukes on the posterior pharyngeal wall. but most infections are asymptomatic.

**Acute fascioliasis:** In its severe and its occurs in sheep but rarely in man and requires large numbers of parasites. The larvae migrating & invade the liver and cause a traumatic hepatitis that is frequently fatal. **Sometimes the liver capsule may rupture into the peritoneal cavity, causing death from peritonitis.** The invasive phase lasts many weeks

**Chronic fascioliasis:** the latent phase lasting months or even years, may be an obstructive phase causing hepatitis, cholangitis, pancreatitis, and so the flukes may cause ectopic infections, especially in the lungs and subcutaneous tissues.

**Diagnosis:** eggs in the feces. Adult flukes in the pharynx and larynx can be removed surgically. There is no serologic test.

**control** of *Fasciola hepatica* = Avoid or not eating contaminated aquatic vegetables and water and uncooked or raw liver sheep

**Treatment** of *Fasciola hepatica* = Albendazole, sulphoxide Praziquantel and ithionol

- **Fasciolopsis buski (intestinal fluke)**

It 's causes Fasciolopsis. Humans are infected by eating aquatic vegetation that carries the **metacercariae**. After excysting in the small intestine, the parasites attach to the mucosa and differentiate into adults. Eggs are passed in the feces; on reaching fresh water, they differentiate into miracidia. The ciliated miracidia penetrate snails and, after several stages, develop into cercariae that encyst on aquatic vegetation. The cycle is completed when plants carrying the cysts are eaten.

**Pathologic findings** are due to damage of the intestinal mucosa by the adult fluke. Most infections are asymptomatic, but **ulceration, abscess formation, and hemorrhage diarrhea** .

**Diagnosis** is based on finding typical eggs in the feces.

**Prevention** consists of proper disposal of human sewage.

- **control** of Fasciolopsis buski = Avoid taken contaminated food and water
- **Treatment** of Fasciolopsis buski = praziquantel