



## Helminths (Platyhelminthes)

### Helminthology:

- **Medical helminthology**: study the worm that parasitized man.  
The helminthic parasites are multicellular belong to the Kingdom Metazoa
- The term **helminth** (Greek helmins –worm ) originally referred to intestinal worms, but now comprises many other worms.
- Helminthes, which occur as parasite in humans belong to phylum:

1. Platyhelminthes      2. Nematelminthes

### Phylum Platyhelminthes

- The Platyhelminthes are tape-like dorsoventrally flattened worms.
- They either lack alimentary canal (as in Cestodes) or their alimentary canal is incomplete, lacking an anus (as in Trematodes).
- Body cavity is absent.
- They are mostly hermaphrodites (**monoecious**).
- The phylum Platyhelminthes includes 2 classes:

1) Class- Cestoda

2) Class- Trematoda

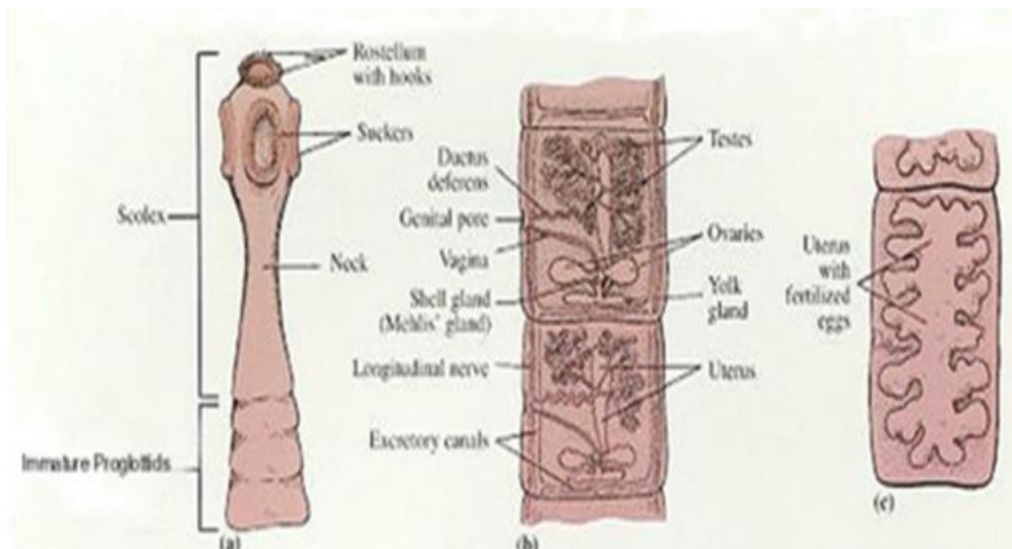
3) Class - Nematoda

### Class ((cestoda))-Tapeworm:

- Cestodes have tape-like, dorsoventrally flattened, segmented bodies.



- Adult worms - Flat & ribbon-like; body consists of an anterior attachment organ (scolex) , neck –region of growth 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



Class(cestoda)

### Class (Trematoda) – The flukes.

- Trematodes have leaf like unsegmented bodies .
- The alimentary canal is present but is incomplete i.e., without an anus.
- They possess suckers but no hooks.
- The sexes are separate in the Schistosomes, while the other flukes are hermaphroditic and capable of self-fertilization.
- They have complex life cycles requiring one or more intermediate hosts.

### 3) Class ( ~~Nematoda~~ ) – Roundworm:



- Elongated worm, cylindrical, unsegmented and tapering at both ends.
- Sex separate and male is smaller than female.
- Head no hooks no suckers.
- well-developed alimentary canal (complete, anus present).
- Present of body cavity.
- Has direct life cycle (only one host).
- Has digestive system ,no circulatory &respiratory system.

## Class–Cestoda

### Taxonomic position

Phylum platyhelminthes

Class Cestoda

Order Cyclophyllidae

Order Pseudophyllidae



Differences feature	pseudophyllides	cyclophyllides
scolex	Two sucking grooves (bothria)	Four muscular suckers
Genital pore	Center of each proglottid	Margin of each proglottid
Uterine pores	Center of proglottid on ventral surface	absent
Uterus (gravid)	Long & coiled	Sac & branched
Eggs	Operculated	Non-operculated
Oncosphere	Ciliated	Non-ciliated
larvae	Proceroid & plerocercoid both forms solid	Cysticeroid, cysticercus & hydatid all forms cystic

## Life cycle patterns for

### 1. Pseudophyllidae

- Need two intermediate hosts

1. aquatic crustaceans

2. fish or other vertebrate animals

- Life stages :



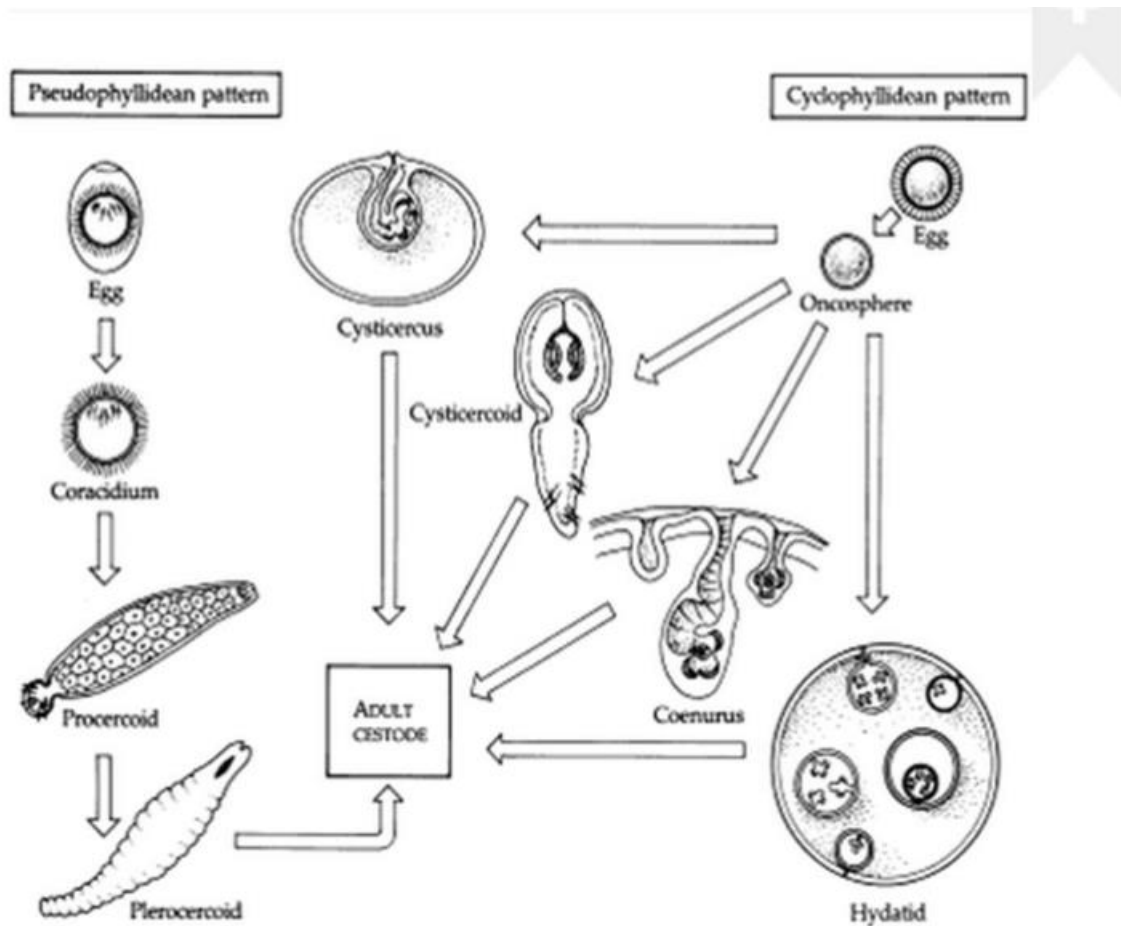


## 2. Cyclophyllidae

- Need one intermediate host only -- usually mammals
- Life stages :

Egg  $\Rightarrow$  hexacanth  $\Rightarrow$  metacestode stage  $\Rightarrow$  adult worm.

e.g. ~~Diphilobothrium~~ *Diphilobothrium* ~~haturata~~ *haturata* accidental infection in humans.



Life cycle patterns of tapeworm that infect human



## Larval stage of cestodae:

**Metacestode stage:** mean larval stage of a cestode that develop in the intermediate host

- **Cysticercus:** Resting stage of larva in intermediate host – develops into ‘bladder worm’
- **Cysticercoid:** A small bladder containing invaginated head proximally and a solid elongated portion
- **Coenurus:** Larval stage in form of Bladder worm contain many invaginating.
- **Hydatid cyst:** Larval stage of Echinococcus
- **Procercoid:** First larval stage of Diphyllbothrium found in cyclops, contain embryonal hooklets.
- **Plerocercoid:** solid elongated worm like larva with head invaginated onto the neck . e.g :D.latum.

Man may be infected with the adult tapeworms (Definitive host) or their larval stages (Intermediate host):

- Human infection with adult cestodes (Intestinal cestodes):

**Taeniasaginata**

**Taeniasoliun**

**Diphyllobothrium**

**Hymenolepisnana**

**Hymenolepisdiminuta**

**Dipylidiumcaninum**



• Human infection with larval cestodes (Extraintestinal cestodes):

- 1- **Hydatid cyst** of *Echinococcus granulosus*.
- 2- **Alveolar hydatid cyst** of *E. multilocularis*.
- 3- **Cysticercus cellulosae** of *Taenia solium*.
- 4- **Sparganum (pleroocercoid)** of *Spirometra* spp.
- 5- **Coenurus** of *Multiceps* tapeworm.

**Differences between Cestodes, Trematodes & Nematodes:**

	Cestodes	Trematodes	Nematodes
shape	Tape like segmented	Leaf like unsegmented	Elongated, cylindrical, unsegmented
Sexes	Sexes not separate Monoecious	Hermaphrodite Sexes not separate Monoecious except <i>Schistosoma</i>	Sexes are separate Diecious
Head and Suckers	often with hooks & Suckers	no hooks	no hooks No suckers
well developed Alimentary canal	Absent	Present, incomplete, no anus Present	complete, anus present
Body cavity	Absent	Absent	Present



## Order Cyclophyllidae

### Taeniasaginata (Beef tapeworm)

Man is the only definitive host, cause disease called taeniasis.

#### Habitat:

- Adult worms live in human small intestine causing taeniasis.
- Larval stage (*Cysticercus bovis*) lives in cattle tissues.

#### Geographic Distribution:

- *T. saginata* is worldwide in distribution, but the infection is not found in vegetarians and those who do not eat beef.

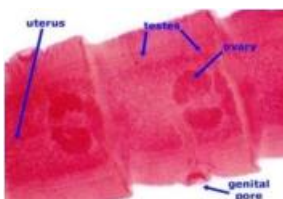
#### Morphology:

**Scolex** : Unarmed (no hooks); 4 sucker.



**Mature segment**: Has one set of male & female reproductive systems,

genital opening mid lateral in position.



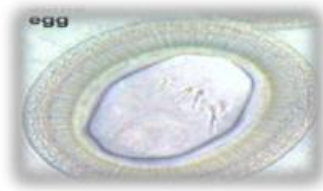




**Gravid segment** : One inch, uterus contains 15 to 20 primary branches. The uterine pore is located in a lateral position.

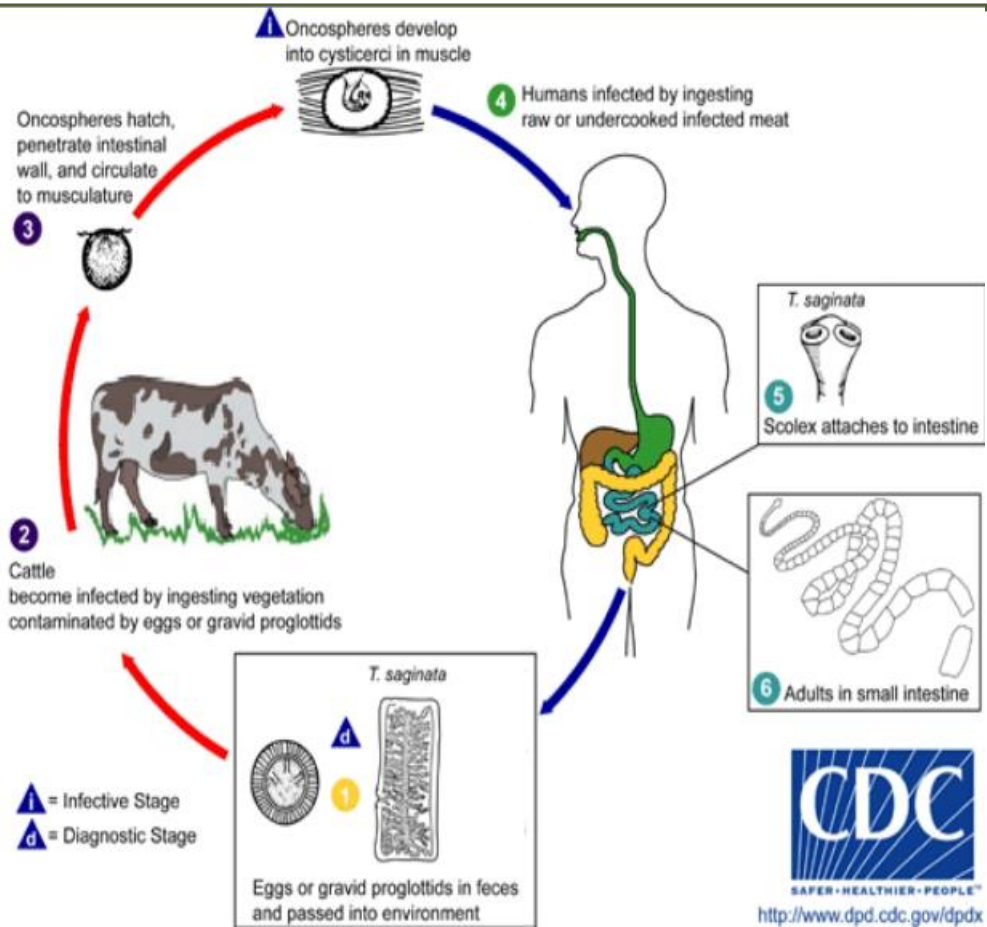


**Egg** : Identical to *T. solium*, with hexacanth embryo.



### Life cycle:

- **The definitive host**: man which harbours the adult worm.
- **The intermediate host**: Cattle which harbours the larval stage.
- **Infective stage**: Larval stage (*cysticercus bovis*) encysted in raw or undercooked beef.
- **Mode of infection**: Eating raw or undercooked beef with *T. saginata* larvae.



Life cycle of *T. saginata*

### Pathogenesis:

- Usually only single worm is present and the patient is no symptom.
- Some patients may complain of migrating proglottids from anus with pruritus at the perianal region. Abdominal discomfort, nausea, vomiting, constipation or diarrhea may occur.



## Diagnosis:

- Finding of gravid proglottids or eggs at the perianal region by cellophane tape method.

## Treatment:

Praziquantel

## Order Cyclophyllidae

## Taeniasolium (pork tapeworm):

Man is the only definitive host, but he can also be the intermediate host for *T. solium* cause disease called Taeniasis or Cysticercosis.

## Habitat:

- Adult worms live in human small intestine .
- Larval stage ( *cysticercus cellulosae* ) in pigs muscles or in human tissues.

## Geographic Distribution:

Worldwide in distribution & infection is cosmopolitan in countries where pork is eaten raw or undercooked.



## Morphology:

**Scolex:** globular with 4 circular suckers; armed with a double row of alternating large and small hooklets.



**Gravid segments:** The number of main branches on each side of the uterus stem is 7-13.



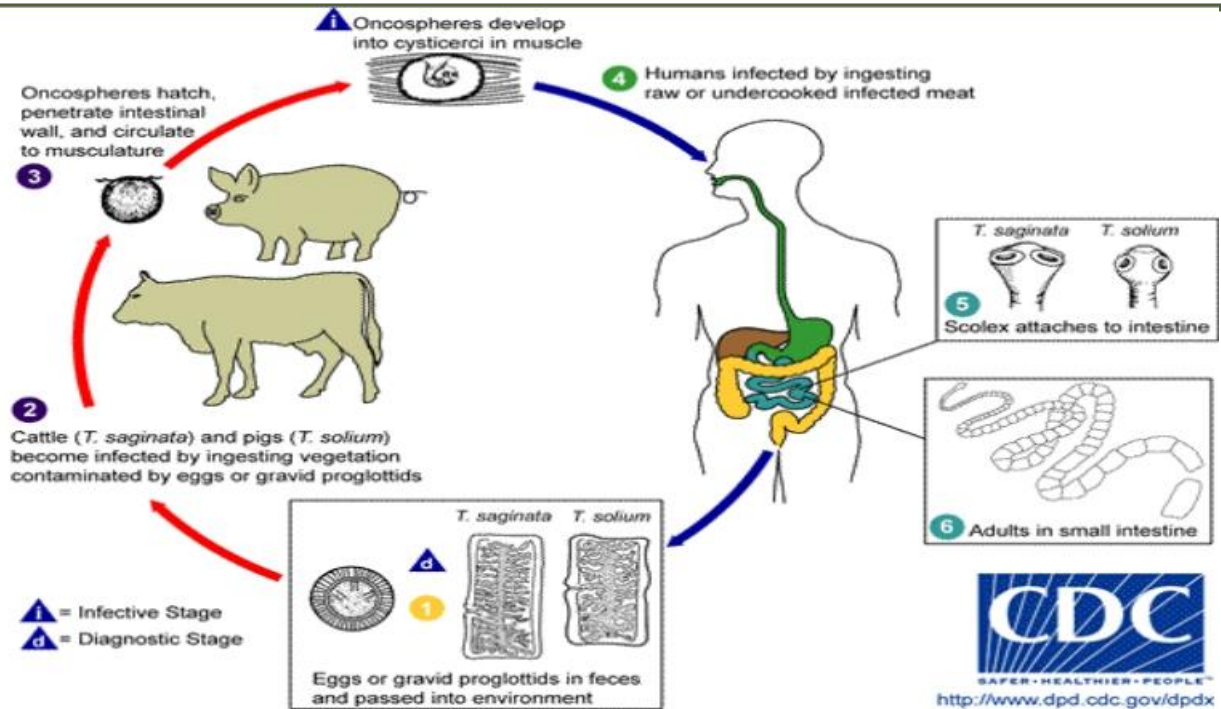
**Ova:** Same as those of *T. saginata*

## Life cycle:

- **The definitive host:** man which harbours the adult worm.
- **The intermediate host:** Pig (accidentally Man, cysticercosis).
- **Infective stage:** both egg/gravid proglottid and cysticercus for *T. solium*.
- **Mode of infection:**

1- Eating undercooked pork meat containing larvae.

2- Ingestion of *T. solium* egg either in contaminated food or by autoinfection.



### Life cycle *Taeniasolium*

#### Pathogenesis:

- **Taeniasis**: Mild, non-specific abdominal complaints Proglottids are not as motile as *T. saginata* so organ obstruction is less likely.
- **Cysticercosis**: It is caused by the cysticercuscellulosaeliving in human tissues. The manifestations vary with the number of larvae and the tissues and organs involved like:

Cerebral Cysticercosis, **muscular** cysticercosis, **ocular** cysticercosis  
subcutaneous cysticercosis



## Diagnosis:

1. **Taeniasis:** Confirmative diagnosis of taeniasis is made by finding gravid proglottides or egg in stool or by cellophane-tape technique.

2. **Cysticercosis:** Biopsy of subcutaneous nodules, X-ray ,CT

Or MR are used for the diagnosis of brain type.

## Treatment:

- Praziquantel
- Niclosamide

## Differences between *T.solium*&*T.saginata*

	<i>T. solium</i>	<i>T. saginata</i>
<b>Size</b>	2-4m	4-8m
<b>Scolex</b>	Rostellum & hooks	No
<b>Mature Proglottid</b>	3 lobes of ovary	2 lobes of ovary
<b>Gravid proglottid</b>	Uterine Branches<13	>15
<b>Intermediate Host</b>	Swine & Human	Cattle
<b>Disease caused</b>	Taeniasis & cysticercosis	Taeniasis only
<b>Infective stage</b>	Egg & Cysticercus	Cysticercus Only
<b>Mode of infection</b>	Cross or autoinfection	Cross only
<b>Diagnosis</b>	Egg may be found in stool	Perianal egg exam

Order Cyclophyllidae



## Hymenolepis nana (Dwarf tapeworm)

- Smallest tapeworm infecting man.
- Only human tapeworm that can complete its life cycle in a single host
- Man can harbour both the adult and larval stages of the parasite
- Exception to the general rule that: “Helminthes do not multiply inside the body of the definitive host”

### Geographic Distribution:

Most common tapeworm throughout the world Mainly among children.

**Habitat:** Adult found in the ileum

### Morphology:

- **Adult:** is small, 2 to 4 cm in length.
- **Scolex:** 4 sucking disks & short rostellum with hooks.
- **Proglottids:** proglottids are broader than long; rarely seen in feces specimens (disintegrate in intestine).
- **Eggs:** the egg is the most often seen stage in specimens. It measures 30 to 47 microns in diameter and exhibits polar filaments lying between the egg shell and the hexacanth embryo.





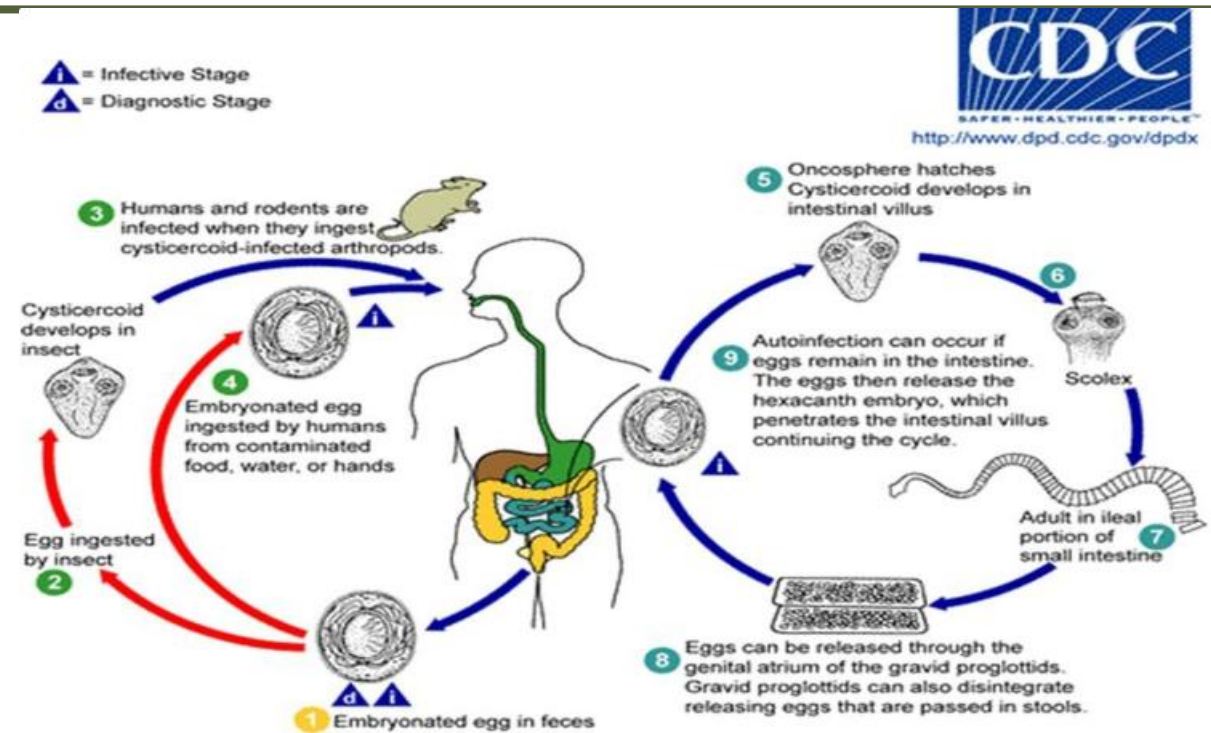
## Life cycle:

- **Definitive hosts** : Man, rodents.
  - **The intermediate host**: Insect ,grain beetle and larva of flea.
  - **Diagnostic stage**: Embryonated egg in feces
  - **Infective stage**: Embryonated egg.
- **Mode of Infection:**
    - 1- **Direct**
      - i. Ingests eggs by contaminated food & water .
      - ii. Self infection via hand (external autoinfection).
      - iii. Internal autoinfection (egg hatch in small intestine).

### 2- **Indirect pathway:**

Accidental ingestion of infected arthropod intermediate host like rice and flour beetles in which cysticercoid larvae are released and develop into adult worms in the small intestine of the host.





### Life cycle of *H.nana*

#### Pathogenesis:

- Light infections are asymptomatic.
- When large numbers of worms are present, they may give rise to abdominal pain, diarrhea, headache, and various non-specific symptoms.
- *H.nana* can be deadly in children or people with a weak immune system.
- Dehydration can result from prolonged diarrhea.

#### Diagnosis:

- Demonstration of characteristic ova in the stool
- Proglottids are not recovered because they undergo degeneration inside intestine.

#### Treatment:



- Praziquantel is the drug of choice.

## Order Cyclophyllidae

### Non-human cestodes infection

### Hymenolepis diminuta (Rat tapeworm)

Common parasite of rats and mice Accidental human infections.

#### Morphology:

considerably larger than *H.nana* (adult as well as egg).

**Adults:** Size measure 20 to 60 cm in length.

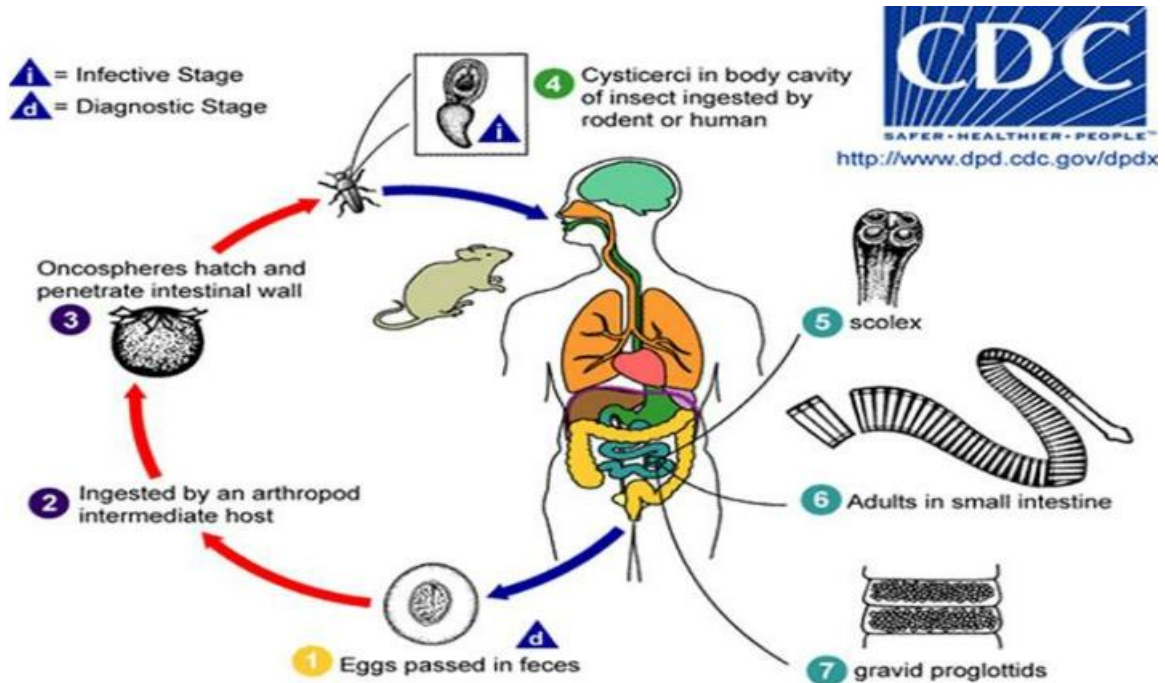
**Scolex :** larger than that of *H.nana*. with no hooks.

**Eggs:** Measure 60 to 80 microns in diameter and do not exhibit polar filaments.





## Life cycle



## Life cycle of *H. diminuta*

### Order Cyclophyllidae

### Non-human cestodes infection

## *Dipylidium caninum* (dog tapeworm)

*Dipylidium caninum* (the double-pored dog tapeworm) mainly infects dogs and cats, but is occasionally found in humans, especially children.

### Morphology :

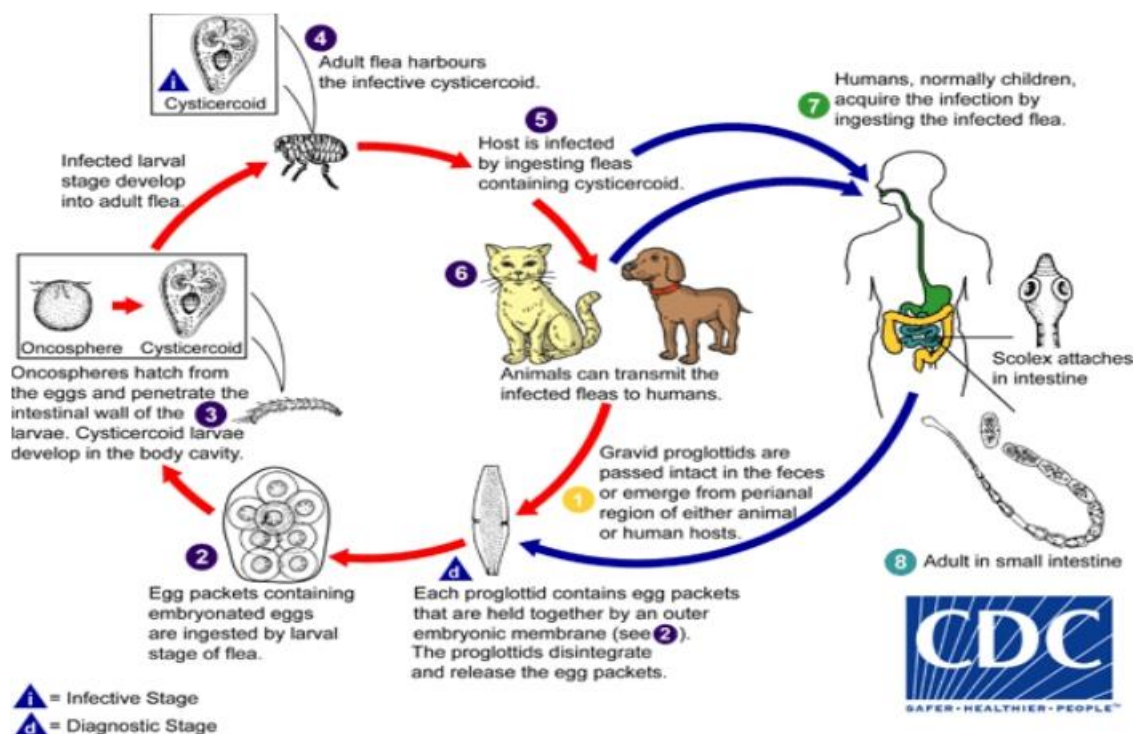
- **Scolex**: conical-shaped and has four suckers. There is rostellum armed with several rings of small hooks.
- **Eggs**: round to oval and contain an oncosphere that has 6 hooklets. And present as egg capsule contain 5 to 30 or more eggs.



- **Segments:** have two genital pores, one in the middle of each lateral margin. They are pumpkin seed-shaped.
- **gravid segments:** contain egg capsule, The number of eggs can range from 5 to 30.

### Life cycle:

- **Final Hosts:** Dogs, Cats, Humans
- **Intermediate host:** larva of dog fleas.
- **Infective stage for man:** cysticeroid.



## Life cycle of *D. caninum*

## Pseudophyllidea



## Diphyllobothrium latum (fish tapeworm)

The cestode *Diphyllobothrium latum* (the fish or broad tapeworm), the largest human tapeworm.

### Geographic Distribution:

Diphyllobothriasis occurs in the Northern Hemisphere and in South America.

### Habitat:

Adult worms in small Intestine

### Morphology:

**Scolex:** spoon-shaped or spatulate. Scolex bears 2 slit-like grooves called bothria. Scolex has no rostellum and no hooklets.

**Ova:** unembryonated ovum with operculum at one end and a small knob at the other end.

### Larvae:

- i. **Procercoid:** Spindle-like solid body with cephalic invagination Found inside the Cyclops.
- ii. **Plerocercoid:** Head is invaginated in the neck Found in the fresh water fish

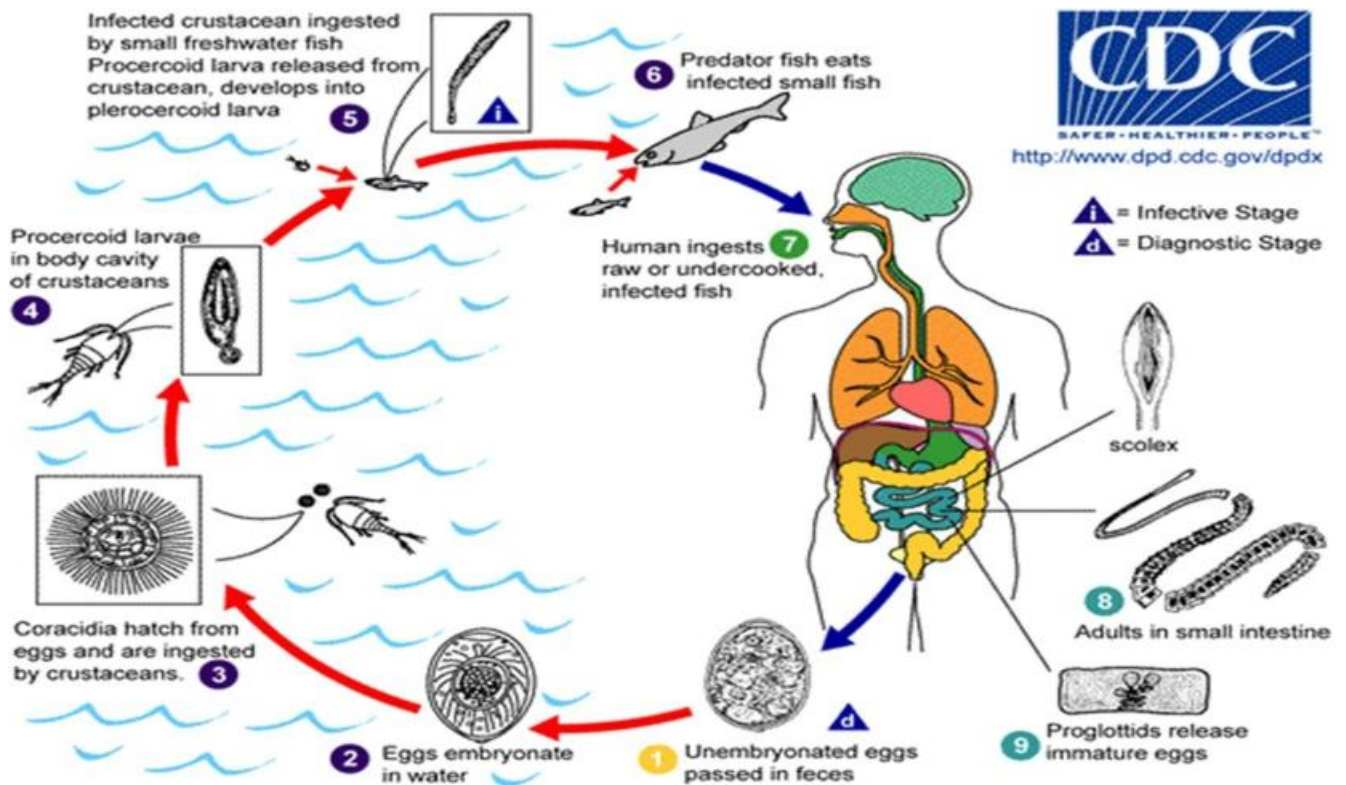
### Life cycle:

- **Definitive host:** Man, dog, cat .





- **Intermediate host:**
  - i. Cyclops or Diaptomus
  - ii. Fresh water fish, pike ,salmon, perch
- **Diagnostic stage:** Unembryonated egg
- **Mode of Infection:** For humans Ingestion of undercooked infected fish containing plerocercoid larvae.



Life cycle of *D.latum*

### Pathogenesis :

- Diphyllbothriasis can be a long-lasting infection.



- Most infections are asymptomatic.
- Manifestations may include abdominal discomfort, diarrhea, vomiting, and weight loss.
- Vitamin B12 deficiency with pernicious anemia may occur.
- Massive infections may result in intestinal obstruction.
- Migration of proglottids can cause cholecystitis or cholangitis.

### Diagnosis:

- Identification of eggs in the stool is the basis of specific diagnosis.
- Examination of proglottids passed in the stool is also diagnostic .

### Treatment:

Praziquantel.

- Human infection with larval cestodes (Extraintestinal cestodes):

- 1- Hydatid cyst of Echinococcus granulosus.
- 2- Alveolar hydatid cyst of E. multilocularis.
- 3- Cysticercus cellulosa of Taenia solium.
- 4- Sparganum (plerocercoid) of Spirometra spp.
- 5- Coenurus of Multiceps tapeworm

## Order Cyclophyllidae

### 1- Echinococcus granulosus – The Hydatid Tapeworm



- Echinococcosis or Hydatid disease in man is caused by the larval stage of the dog tapeworm. Disease
- Ecchinococcosis (serious disease).

### Geographic Distribution:

- Worldwide.
- most extensively found in Africa, the Middle East and parts of South America and Australia.

### Habitat:

- **Adult**: lives in intestine of dogs but never in human intestine.
- **Larvae**: Sites of larvae in man → liver, lungs, abdominal cavity, spleen, kidneys, heart, bones, central nervous system etc.

### Morphology:

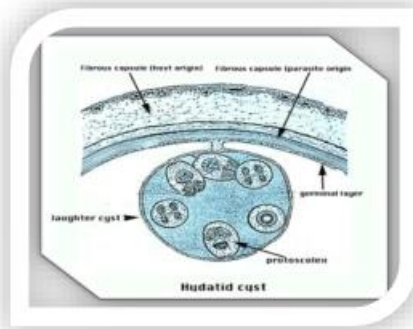
- **Adult worm**: approximately 3 – 8.5 mm long.
- **Scolex** : has 4 suckers and a rostellum with hooks.
- **Segments**: has only 3 – 4 proglottids, immature, mature and the final one is gravid.
- **Egg**: The eggs of *E.granulosus* and *Teniaspp.* are indistinguishable
- **Hydatid cyst**: It is a fluid filled cyst The wall of the cyst is made up of an inner cellular germinative layer and an outer acellular laminated layer. The host connective tissue covers the outer layer. Brood capsules develop inside the cyst on the germinative layer 5–6 months later. Each brood capsule contain 20 or



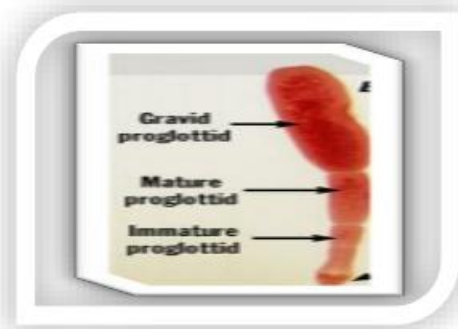


more protoscolices. The brood capsules burst to release free protoscolices in the hydatid fluid Contents:

- **Daughter cysts:** cysts formed of the 2 layers of the mother cyst, giving rise to scolices, brood capsules and even grand daughter cysts.
  - **Hydatid sand:** detached scolices, brood capsules and daughter cysts that fall in the hydatid fluid are called hydatid sand.



Hydatid cyst



adult

### Life cycle:

- **Definitive host:** dog & other canine
- **Intermediate host:** sheep, cattle, camel & human.
- **Infective stage:** ova by fecal oral route.



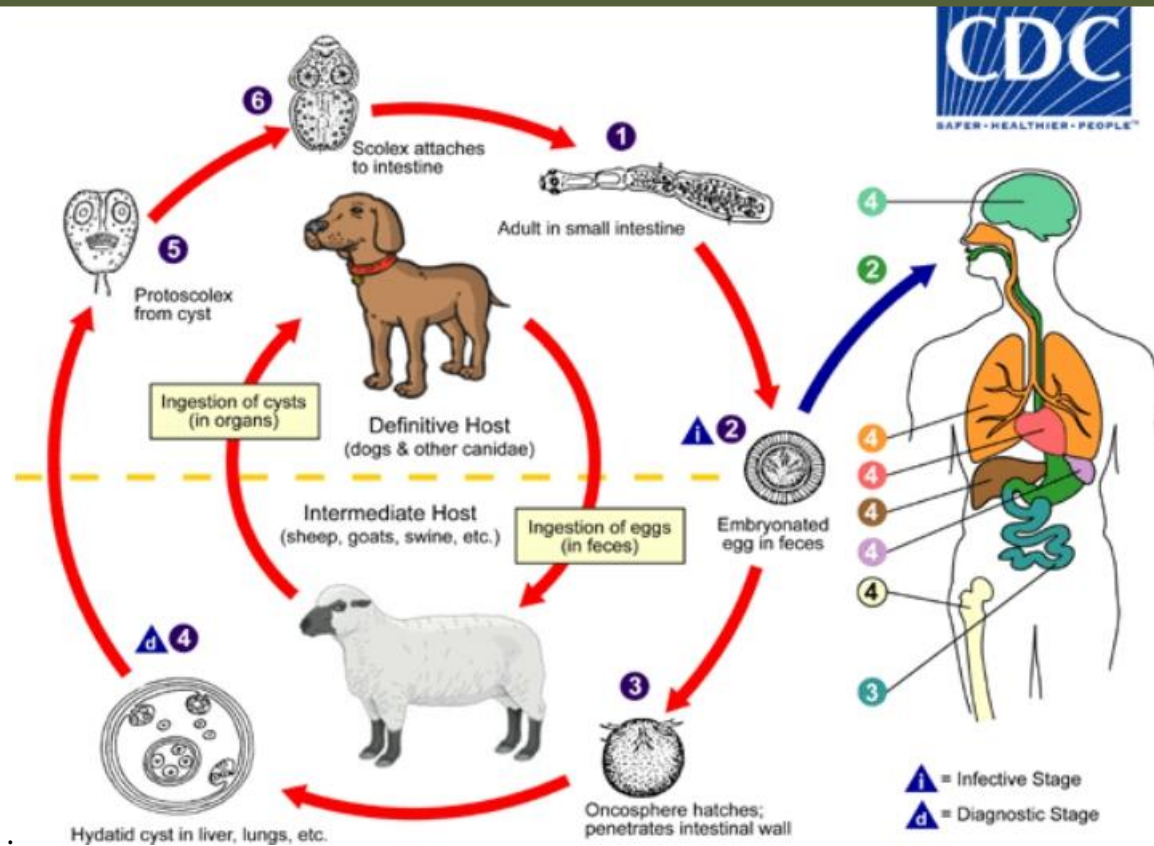
- **Mode of infection:**

- 1- Ingestion of water or vegetable contaminated by infected dog faeces.
- 2- Handling or caressing infected dogs where the hairs are usually polluted with eggs.

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**Life cycle:**

- Adults are only in canines. Eggs are shed in the feces of infected animals.
- Humans accidentally ingest eggs from an infected animal or from canine feces.
- Hexacanth embryo penetrates the intestinal mucosa and migrates to tissues & develops into the larval stage (hydatid cyst) in the tissue (liver, lung or brain, most often). **Human is dead end.**
- Viscera containing hydatid cysts are eaten by canines. Adult worms develop in small intestine.



### Life cycle of *E. granulosus*

#### Pathogenesis:

Depends on the size, the location and the number of cyst.

**Unilocular cysts.** There is usually surrounding inflammatory reaction and fibrosis. After years, the cyst may die, shrink and calcify. There is general allergic reaction with eosinophilia. Pressure effects can cause local tissue damage and obstruction. Rupture or leakage of the cyst lead to allergic reaction. There can be anaphylactic shock and secondary implantation in the surrounding tissues like the peritoneum. There can be secondary infection with formation of abscesses.

#### Diagnosis:



- History of contacting with sheep & dogs
- Clinical symptoms of a slow-growing tumor accompanied by eosinophilia.
- Parasitological examination for finding scolexes, brood capsules & daughter cysts
- Cysts in organs or calcified cysts can be visualized using x-rays, CT & ultrasound examination

### Biopsy are forbidden unless during operation

- Serological examination for specific Ab .
- Intradermal (Casoni) test with hydatid fluid is useful.
- Antibodies against hydatid fluid antigens have been detected in a sizable population of infected individuals by ELISA or indirect hemagglutination test.

### Treatment:

- Surgery: with the goal of leaving the cyst intact so new cysts do not form
- Mebendazole can be taken over a long period of time at low dosages
- Praziquantel

2- ~~Echinococcus multilocularis~~ (alveolar hydatid disease)



- The larvae of *Echinococcus multilocularis* is a dangerous species causing (alveolar hydatid disease) in man and animals.
- The most common definitive hosts are foxes and wolves in addition to domestic cats and dogs.
- Rodents are the intermediate hosts. Man is an accidental host.
- Man get infection by ingestion of eggs.
- Unlike *E. granulosus*, cysts of *E. multilocularis* in man do not contain daughter cysts with scolices.
- Cysts are formed primarily in the liver.

### 3-Cysticercosis:

Infection of human tissues by *Cysticercus cellulosae*, the larval stage of *Taeniasolium*

**Mode of infection:** man acquires infection on

- Ingestion of the egg of *Taeniasolium* (the infective stage) by contaminated food or water
- External autoinfection: hand to mouth infection.
- Internal autoinfection: eggs hatch in small intestine in patient infected with *T. solium* adult.

### Pathogenesis:

- The cyst produces a foreign body inflammatory reaction which usually ends in fibrosis and calcification.
- Manifestations depend upon the tissue invaded and the number of cysticerci.



- The commonest sites are subcutaneous tissues, muscles, viscera, brain and orbit.
- There may be muscle pains, mild fever and eosinophilia.

### Treatment:

- Surgical removal, Praziquantel with corticosteroids.
- Vitamin D and calcium to help calcification.

## 4-Coenurosis

Human infection with *Coenurus cerebralis*, the larval stage of *Multiceps multiceps*.

- The adults worm, *Multiceps multiceps*, lives in the small intestine of dogs and wild canines. Eggs pass in the faeces.
- When the egg is swallowed by the intermediate host (herbivores specially sheep and rarely man) it develops into the larval stage.
- **Diagnosis:** difficult, diagnosed as brain tumor (X-ray and CT).

## 5-Sparganosis



- Infection of human tissues by the plerocercoid larva of **Diphyllobothrium mansoni**(*Sparganum mansoni*) .
  - The adult lives in the small intestine of dogs and cats.(definitive host).
  - The first intermediate host is Cyclops containing the proceroid larva.
  - The second intermediate host is a frog, snake, bird or mammal containing the plerocercoid larva (*Sparganum*).
  - Human is intermediate host.
  - Mode of infection by ingestion proceroid or plerocercoid & the larvae cannot develop to adult in man.