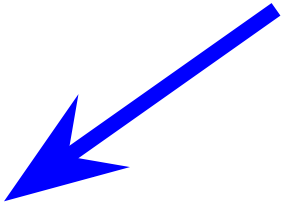
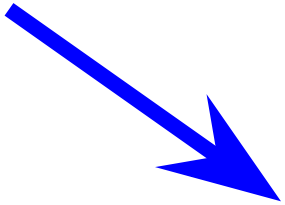
Phylum Plathelminthes is divided into three classes: **Turbellaria, Trematoda** and **Cestoda**. *But only Trematoda and Cestoda are parasites.*

Phylum: **FLATWORMS**
(PLATHELMINTHES)





class:
FLUKES
(TREMATODA)

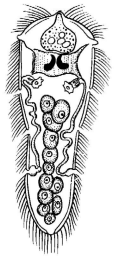
class:
TAPEWORMS
(CESTODA)

FLUKES class (TREMATODA)

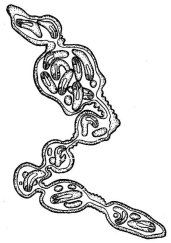
Flukes have several life forms

1 EGG 

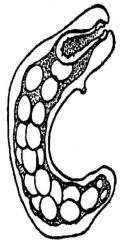
2 LARVAE



MIRACIDIUM

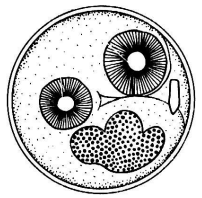


SPOROCYST *I*



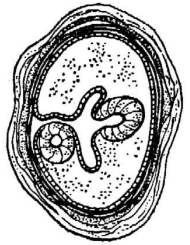
SPOROCYST *II*

CERCARIAE



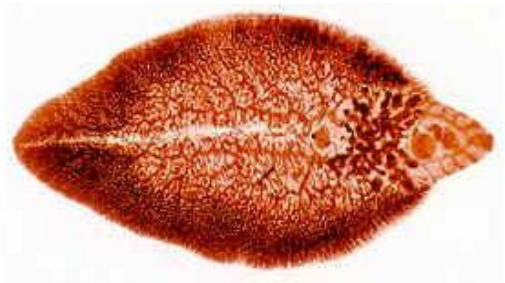
METACERCARIA

REDIAE

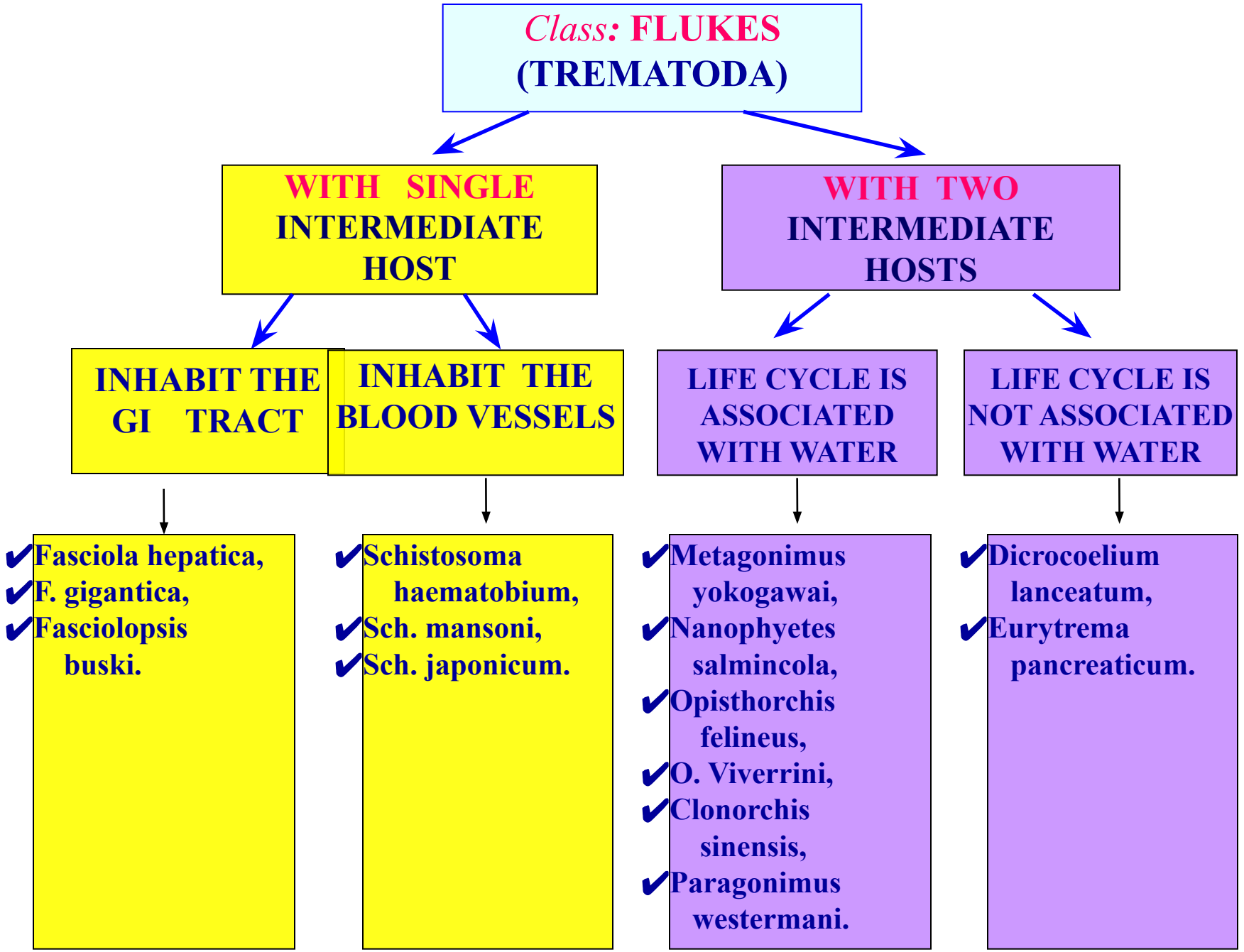


ADOLESCARIAE

3 MARITA



Trematodes may be divided into two groups depending on the number of intermediate hosts.



All members of a subgroup have the same type of life cycles that differ only in the intermediate hosts.

THE LIFE CYCLE OF TREMATODES THAT HAVE A SINGLE INTERMEDIATE HOST AND ARE LOCALIZED IN THE GASTROINTESTINAL TRACT

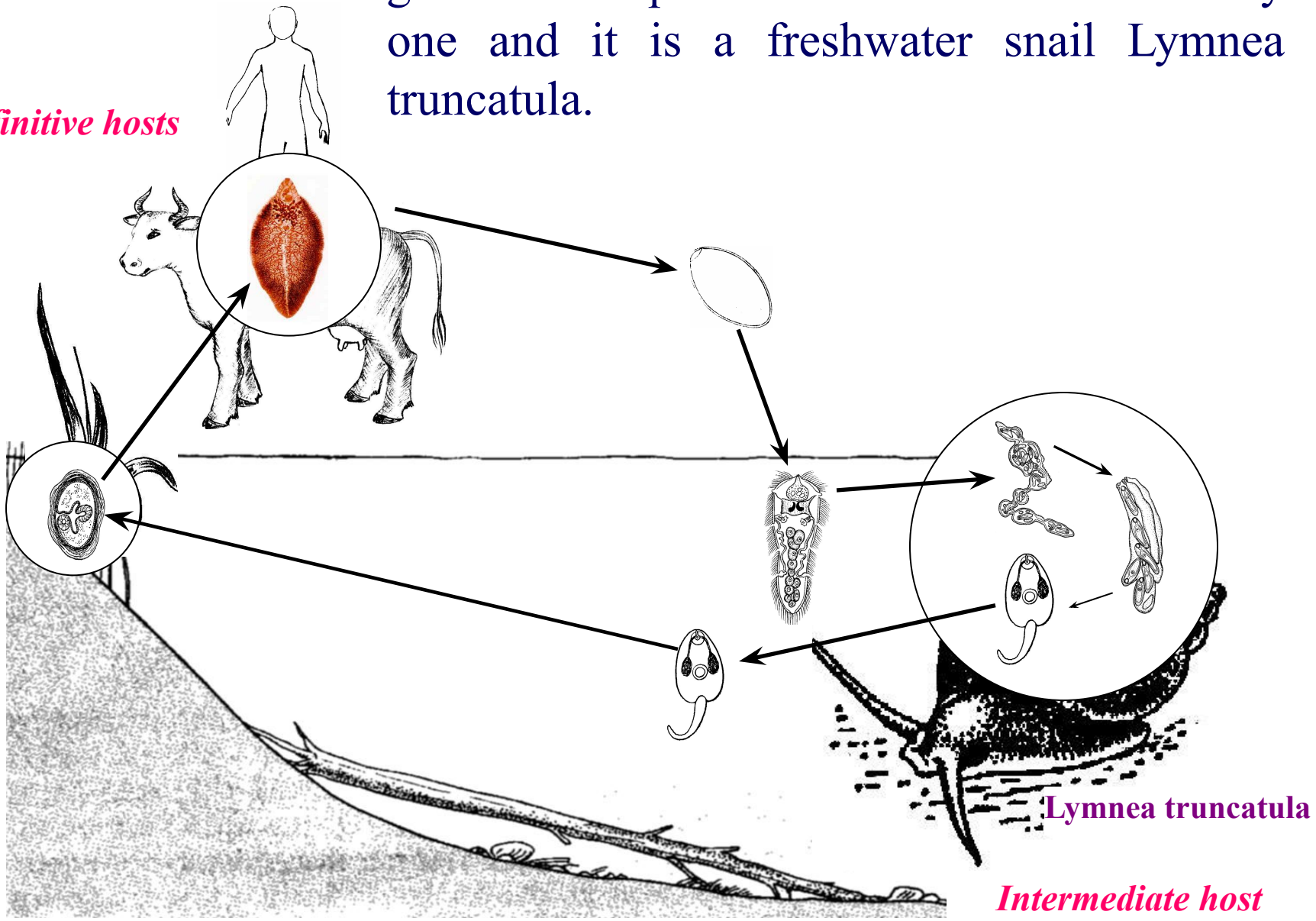
LIVER FLUKES (FASCIOLA HEPATICA)

Phylum – **Plathelminthes**
Class – **Trematoda**
Genus - **Fasciola**
Species - **F. hepatica**

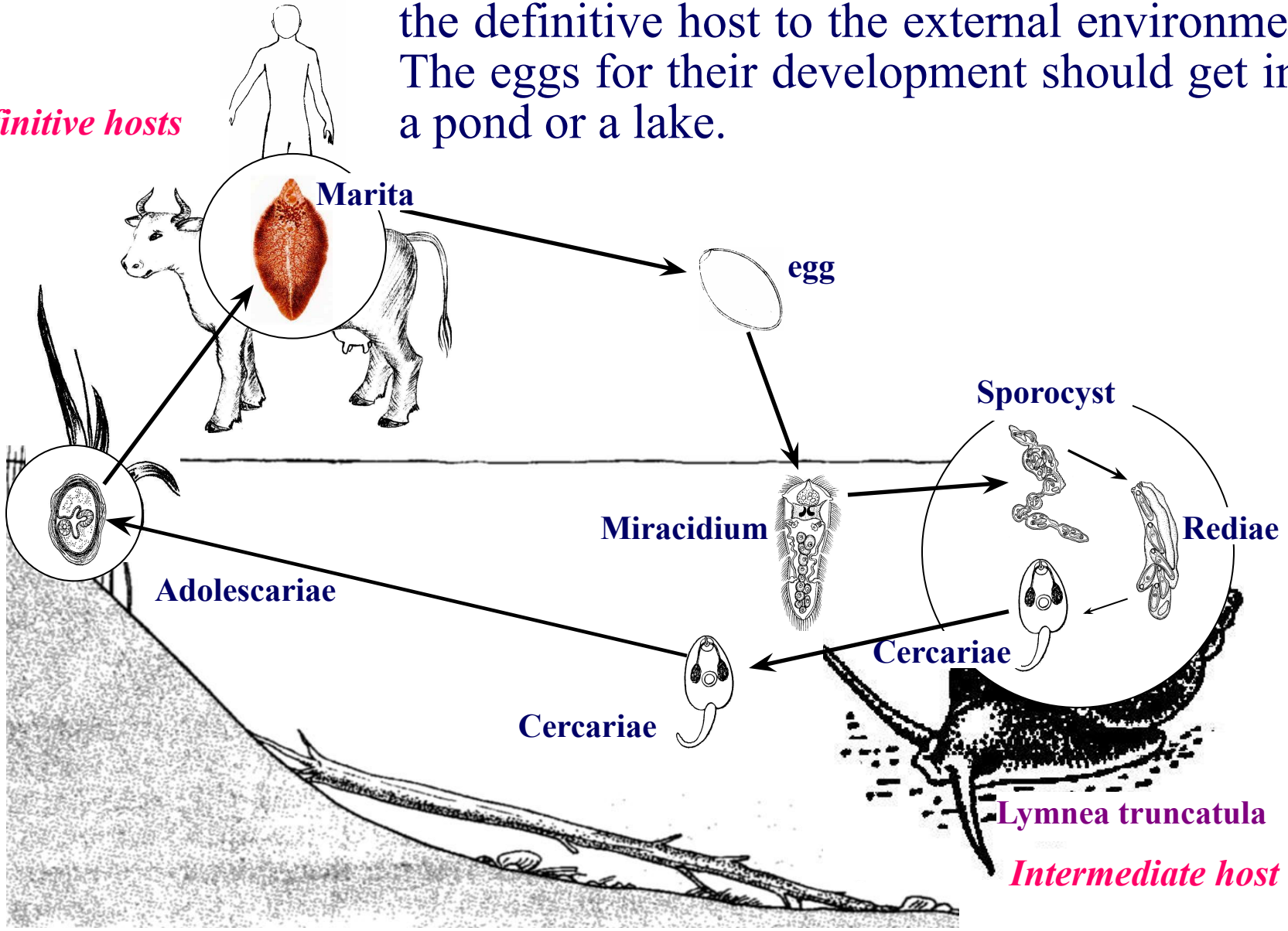
It is the causative agent of the disease, which is called "fascioliasis".

F. hepatica is localized in the liver and bile ducts of sheep, goats, cattle and humans.

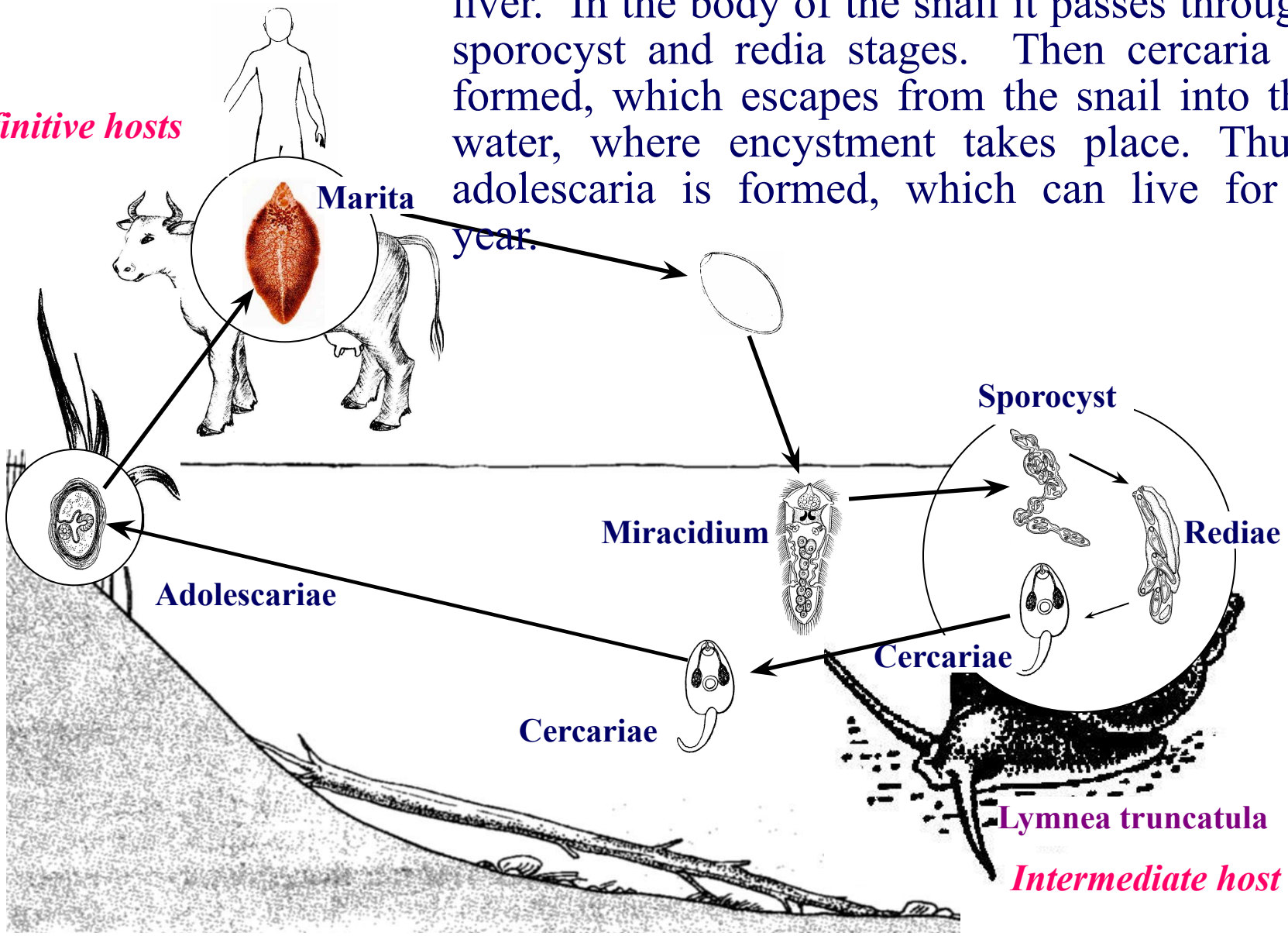
Its definitive hosts are the people, cattle, goats or sheeps. An intermediate host is only one and it is a freshwater snail Lymnea truncatula.



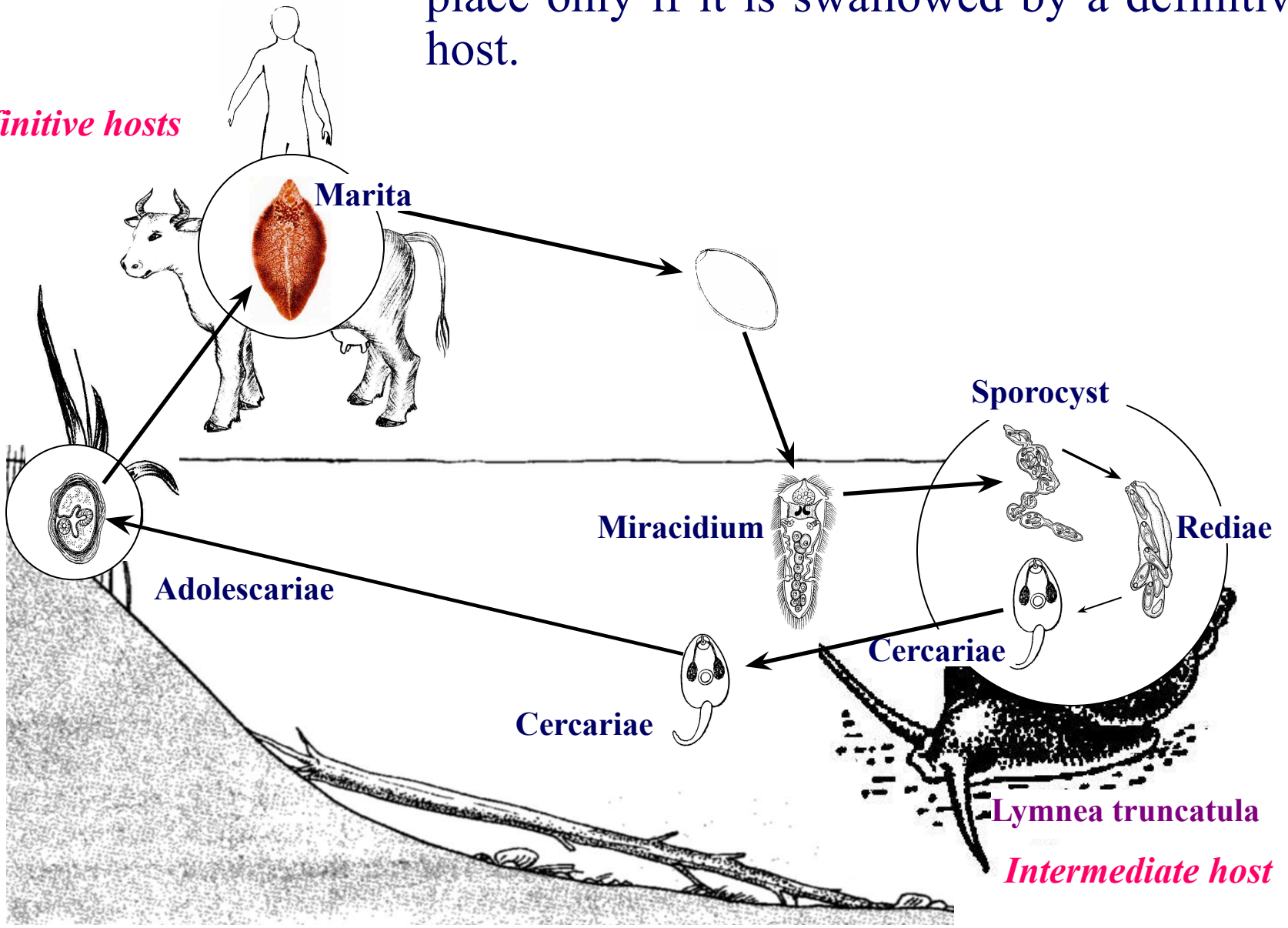
The mature stage of the fluke (Marita) forms fertilized eggs and releases them with feces of the definitive host to the external environment. The eggs for their development should get into a pond or a lake.



In two weeks a small miracidium is formed. Miracidium finds a snail and penetrates into the liver. In the body of the snail it passes through sporocyst and redia stages. Then cercaria is formed, which escapes from the snail into the water, where encystment takes place. Thus, adolescaria is formed, which can live for a year.



Further development of the adolescaria takes place only if it is swallowed by a definitive host.



Similarly, before enzymes in the intestine act upon a young fluke, it bores through the wall of the intestine to enter the body cavity of the host. After about three days it enters the liver. Its movements in the liver may cause serious injuries. The young flukes stay in the liver for seven or eight weeks and then they enter the bile duct and bile passages. They have been growing in the liver and after several weeks in the bile duct they become sexually mature adults. The period of incubation is from 3 to 4 months. Adult flukes remain within the biliary tract for many years.

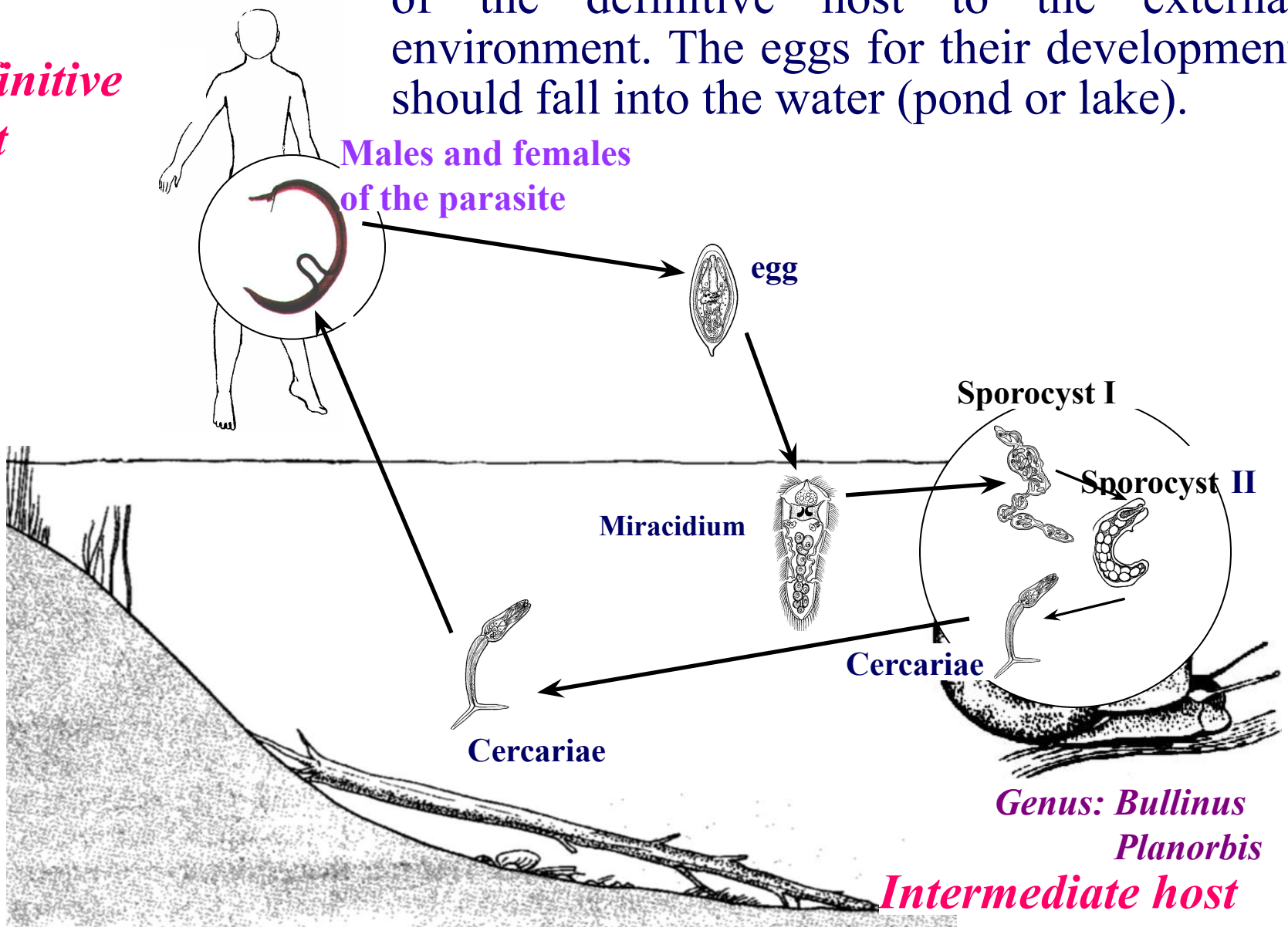
THE LIFE CYCLE OF TREMATODES THAT HAVE A SINGLE INTERMEDIATE HOST AND ARE LOCALIZED IN THE BLOOD VESSELS

Phylum – **Plathelminthes**
Class – **Trematoda**
Genus - **Schistosomes**
Species - **Sh. Haematobium**
Sh. Mansoni
Sh. japonicum

We will study this group of parasites on the example of Sh. Haematobium. It is the causative agent of the disease, which is called "Urinary schistosomiasis". Sh. haematobium is localized in the blood vessels surrounding the urinary bladder, prostate and uterus.

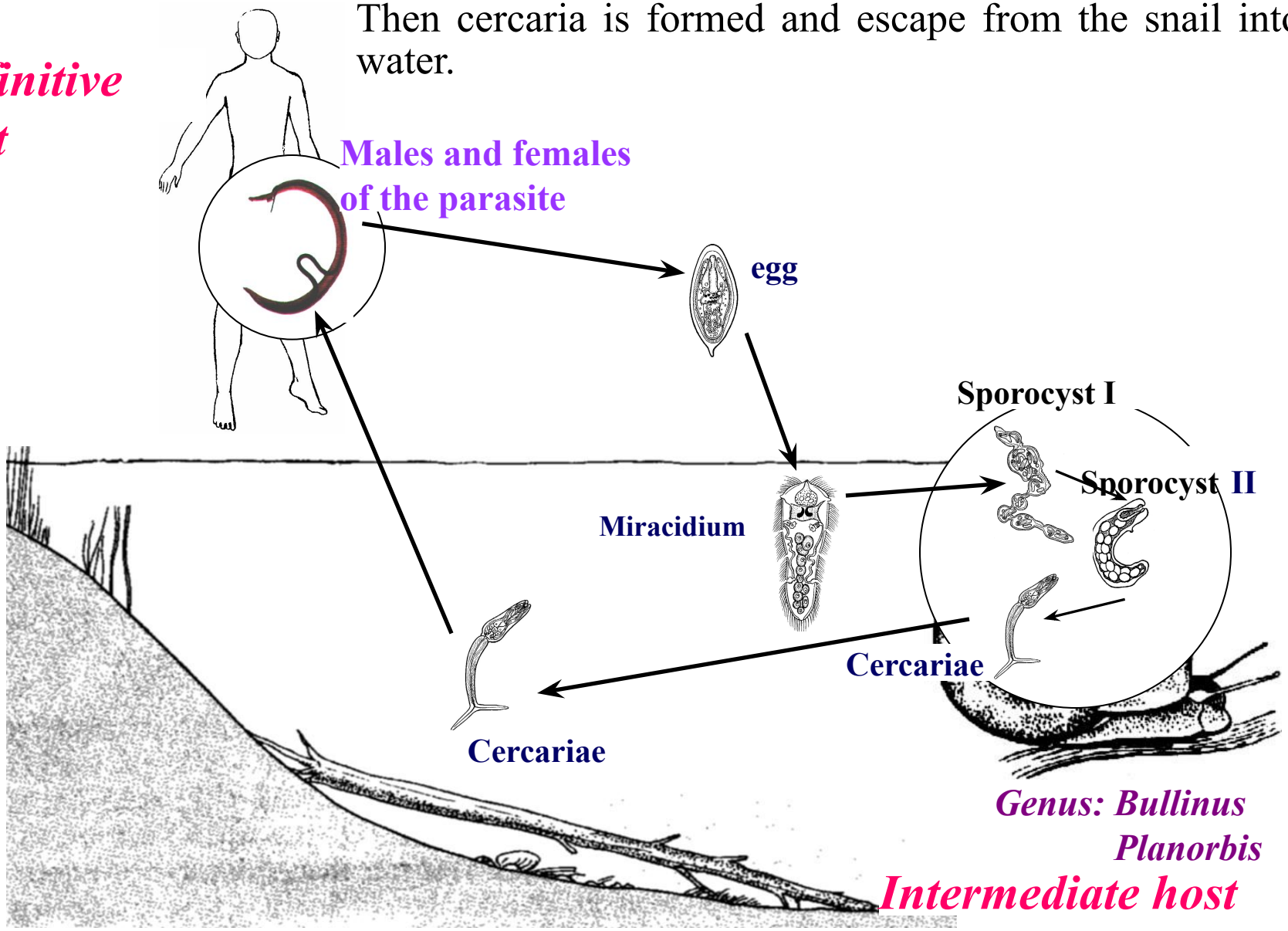
The mature stage of the fluke (Marita) forms fertilized eggs and highlights them with urine of the definitive host to the external environment. The eggs for their development should fall into the water (pond or lake).

Definitive host



Soon, a small miracidium is formed. Miracidium finds a snail and penetrates in to the liver. Into the body of a snail, the parasite passes the two stages of the sporocyst. Then cercaria is formed and escape from the snail into water.

Definitive host

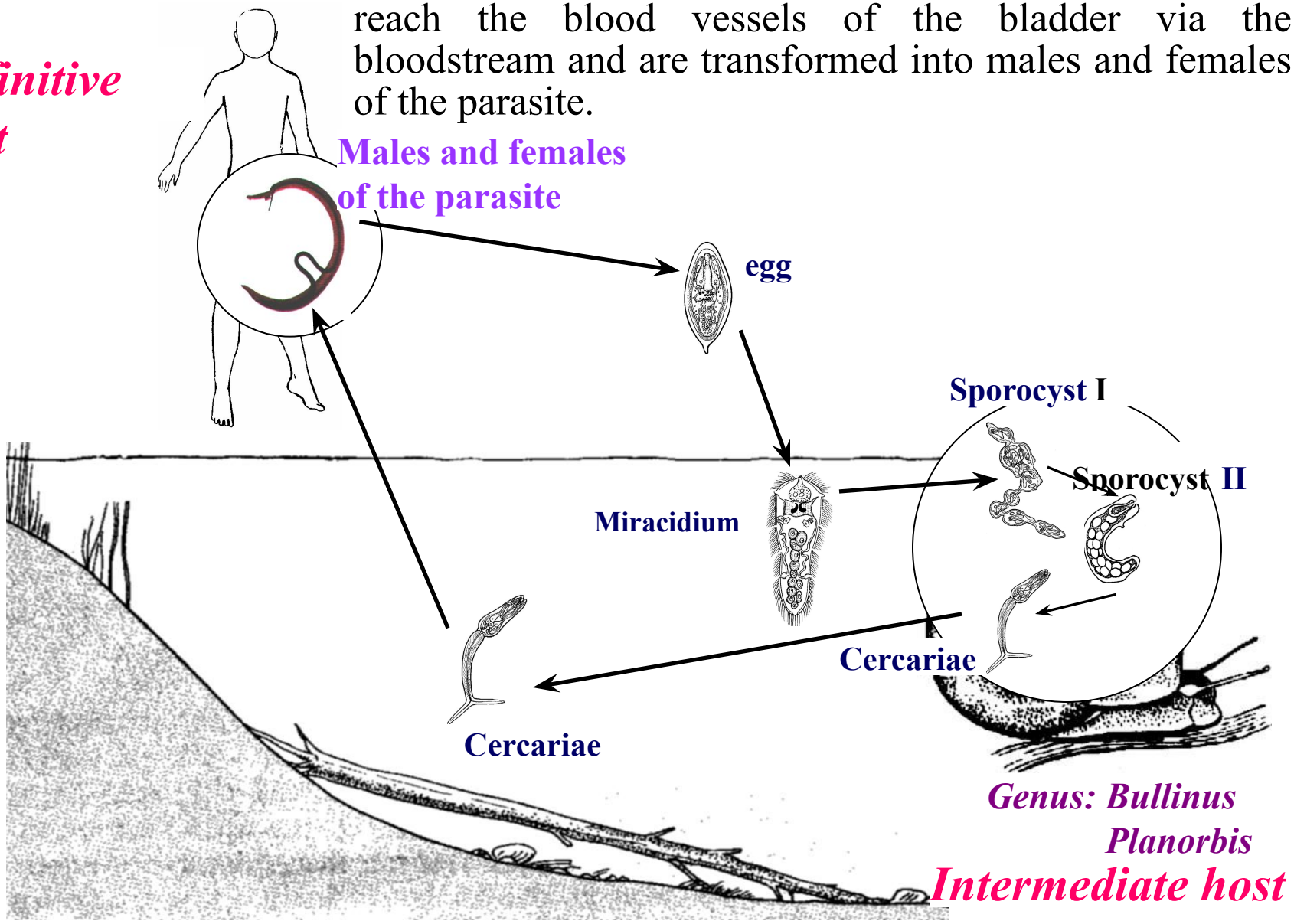


Genus: Bullinus Planorbis

Intermediate host

If the final host has a contact with water (will bathe or wash clothes), the cercariae penetrate through the skin into the vessels of the systemic circulation. Cercariae reach the blood vessels of the bladder via the bloodstream and are transformed into males and females of the parasite.

Definitive host



Genus: Bullinus Planorbis

Intermediate host

General Characteristics of blood flukes:

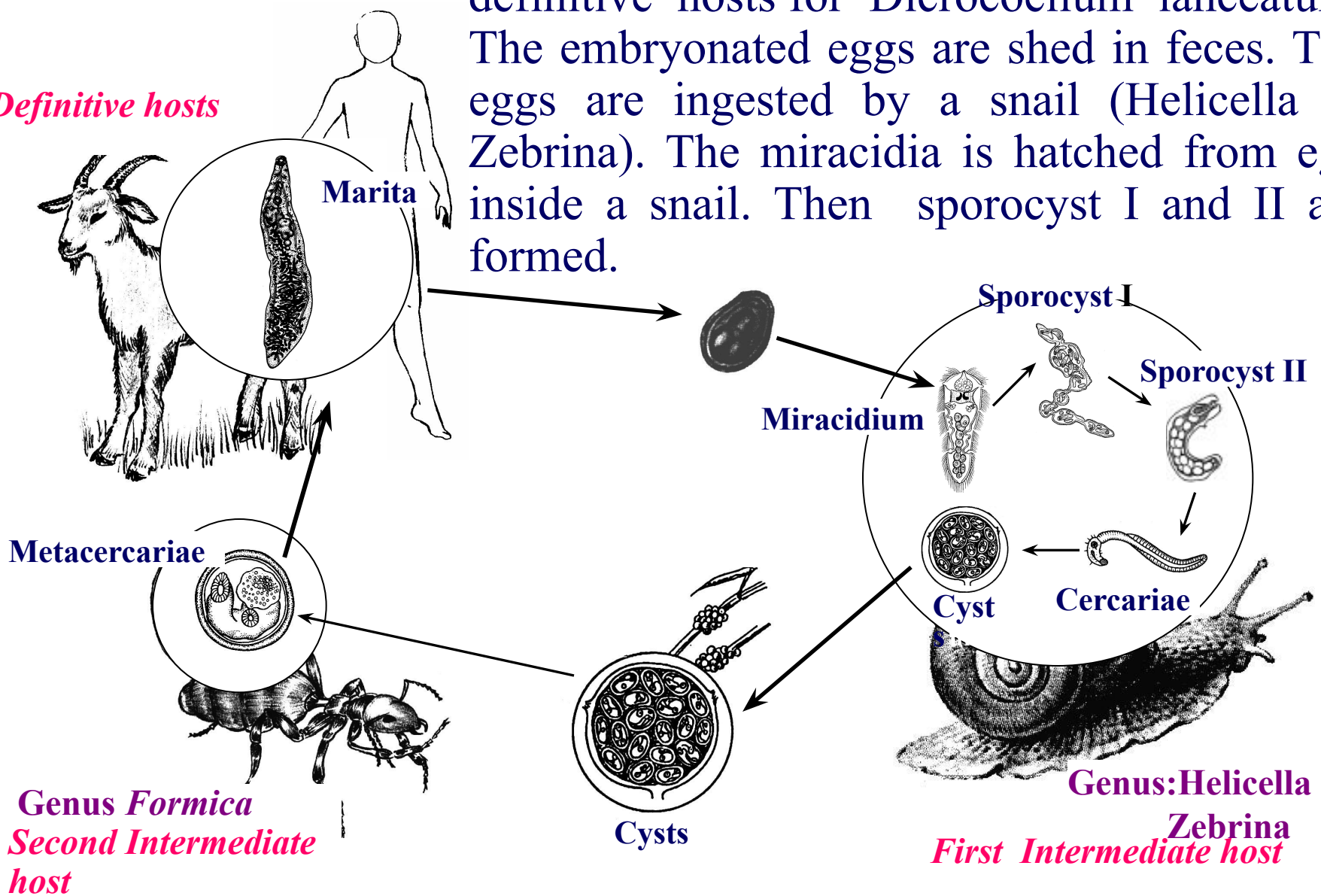
- Sexes of the blood flukes are separate (diecious)
- They are cylindrical (other flukes have a flat shape)
- The parasite has no redia stage and metacercaria. Cercaria is an invasive stage for humans.

TREMATODES WHICH HAVE TWO INTERMEDIATE HOSTS AND WHOSE LIFE CYCLE IS NOT ASSOCIATED WITH WATER

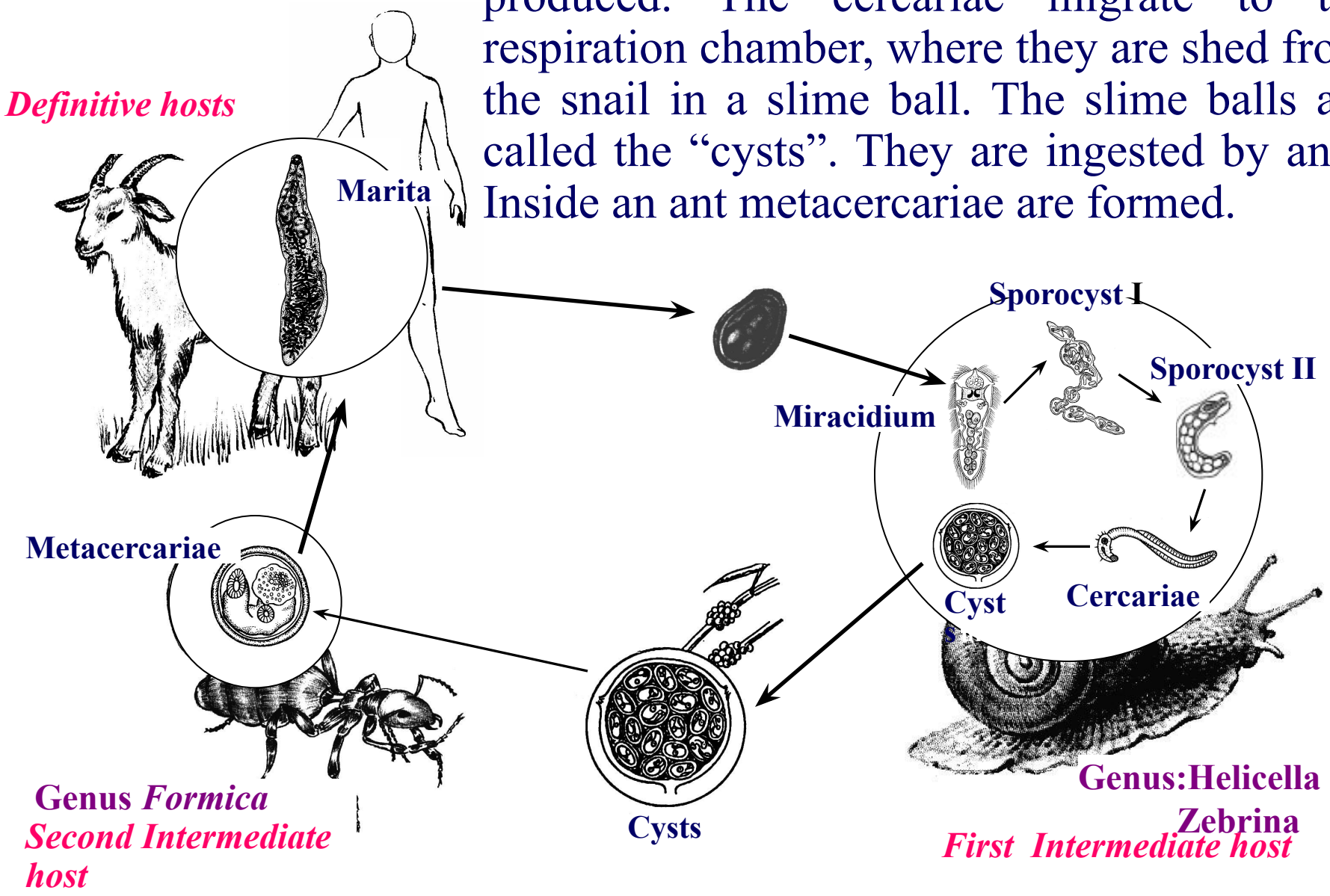
Phylum – **Plathelminthes**
Class – **Trematoda**
Genus - **Dicrocoelium**
Species - **D. lanceatum**

We will study this group of parasites on the example of lanceolate liver fluke. It is the causative agent of the disease, which is called “dicrocoeliasis”. D. lanceatum is localized in the liver and bile ducts of the small ruminant mammals and humans.

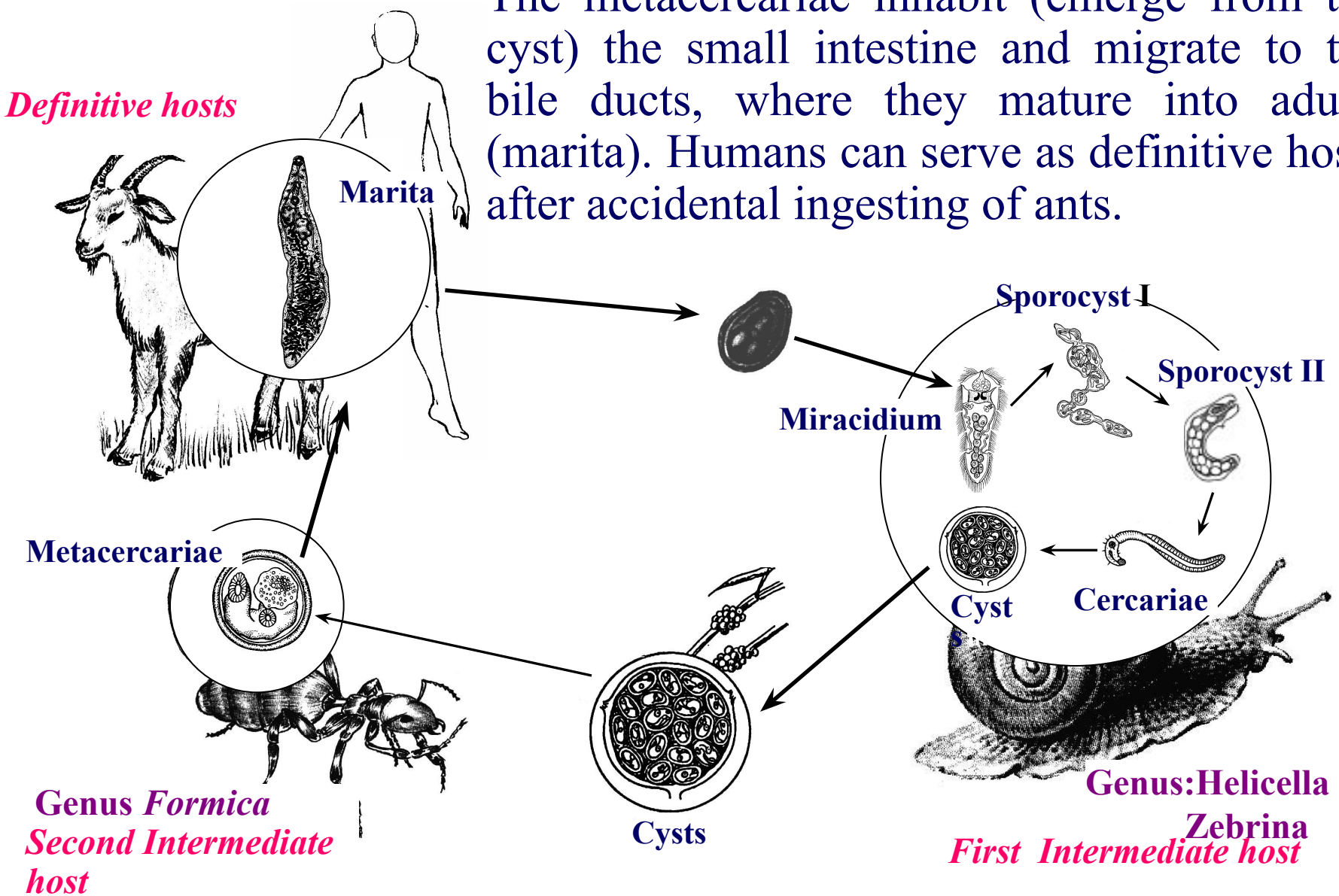
Small ruminant mammals are the usual definitive hosts for Dicrocoelium lanceatum. The embryonated eggs are shed in feces. The eggs are ingested by a snail (Helicella or Zebrina). The miracidia is hatched from egg inside a snail. Then sporocyst I and II are formed.



Inside each sporocyst II, cercariae are produced. The cercariae migrate to the respiration chamber, where they are shed from the snail in a slime ball. The slime balls are called the "cysts". They are ingested by ants. Inside an ant metacercariae are formed.



Further, the ants are eaten by a definitive host. The metacercariae inhabit (emerge from the cyst) the small intestine and migrate to the bile ducts, where they mature into adults (marita). Humans can serve as definitive hosts after accidental ingesting of ants.

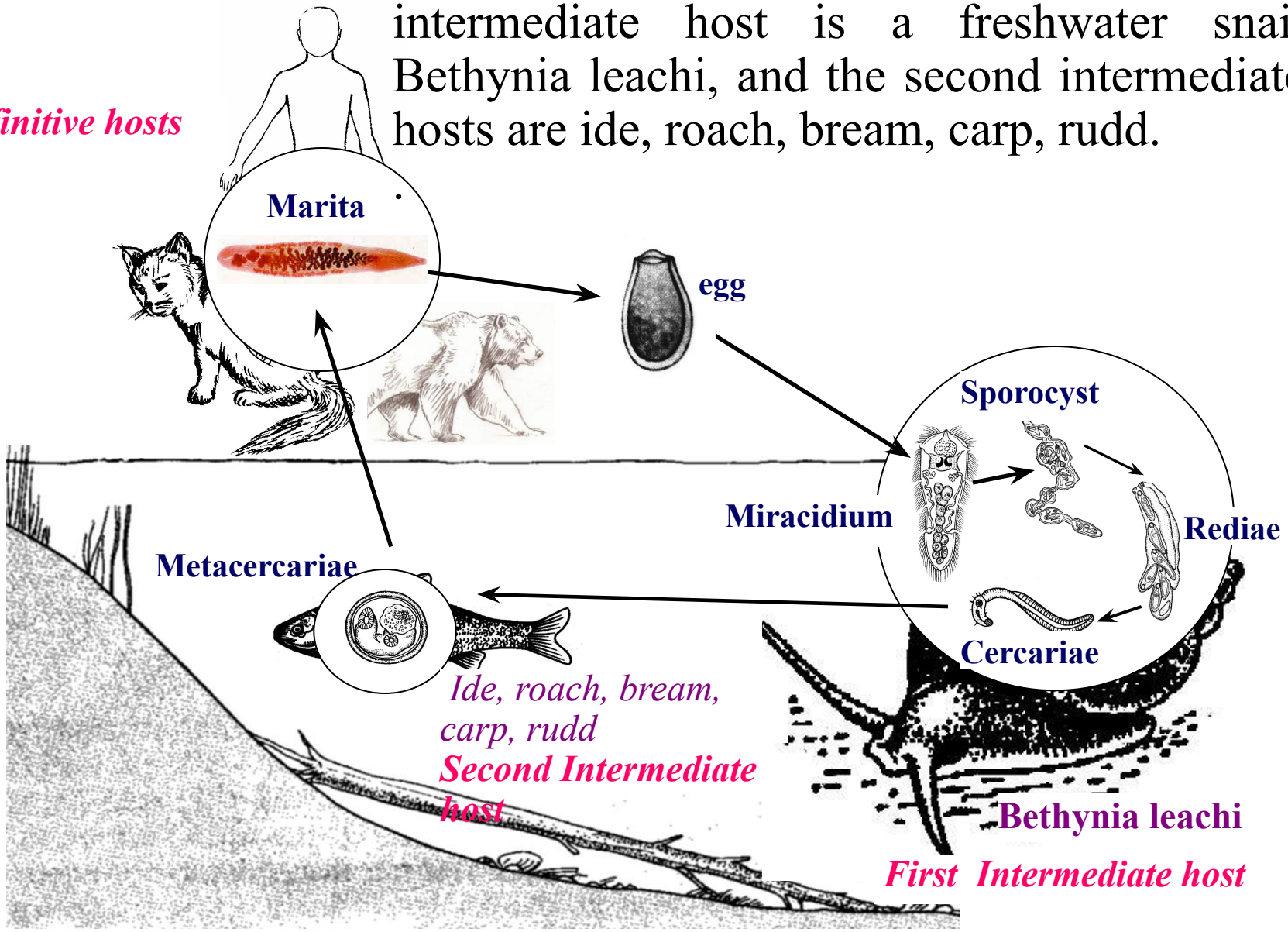


TREMATODES WHICH HAVE TWO INTERMEDIATE HOSTS AND WHOSE LIFE CYCLE IS ASSOCIATED WITH WATER

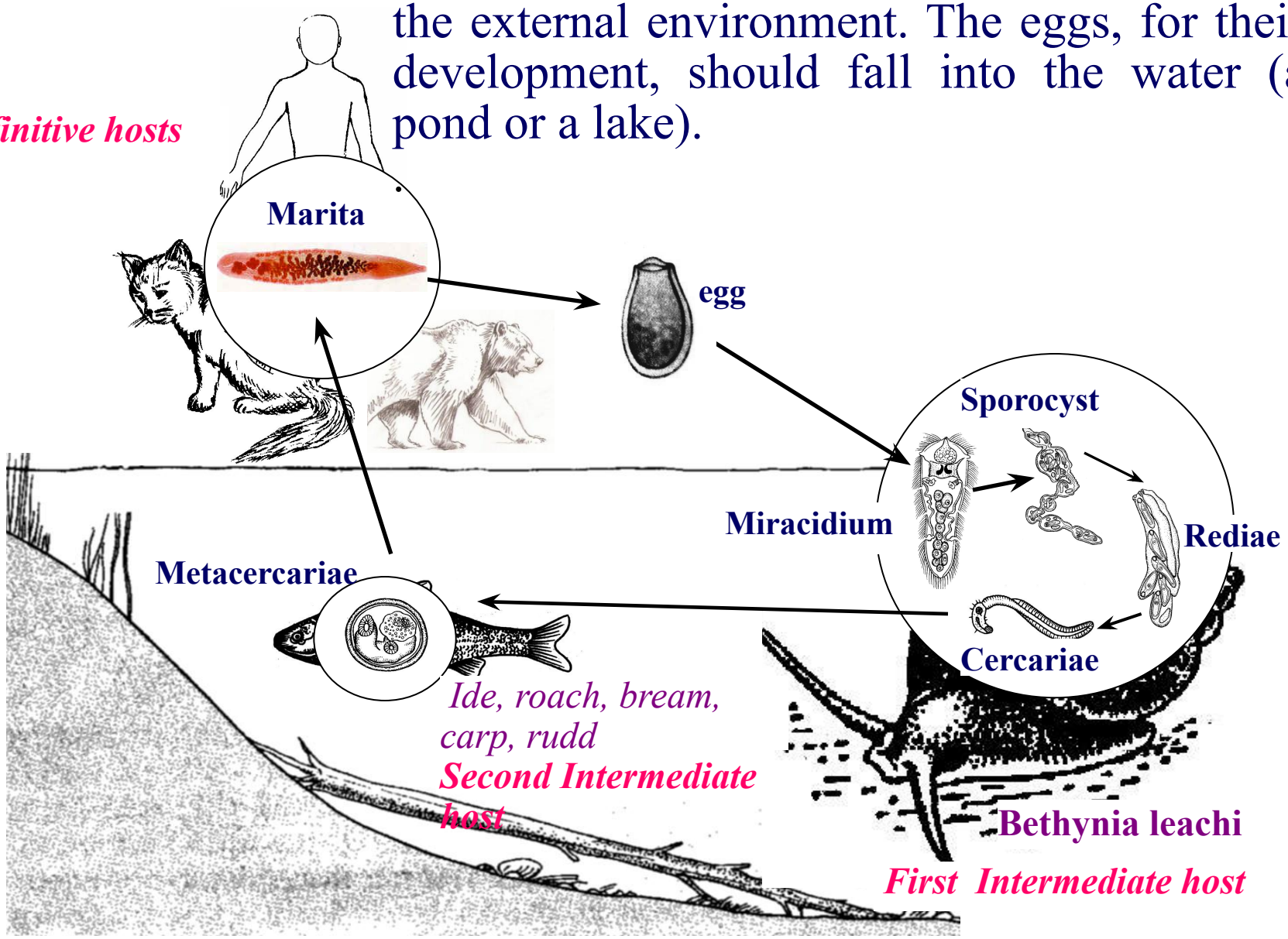
Phylum – **Plathelminthes**
Class – **Trematoda**
Genus - **Opistorchis**
Species - **O. felineus**

We will study this group of parasites on the example of Cat-liver fluke. It is the causative agent of the disease, which is called “opistorchiasis”. O. felineus is localized in the liver and bile duct of the fish-eating mammals and humans.

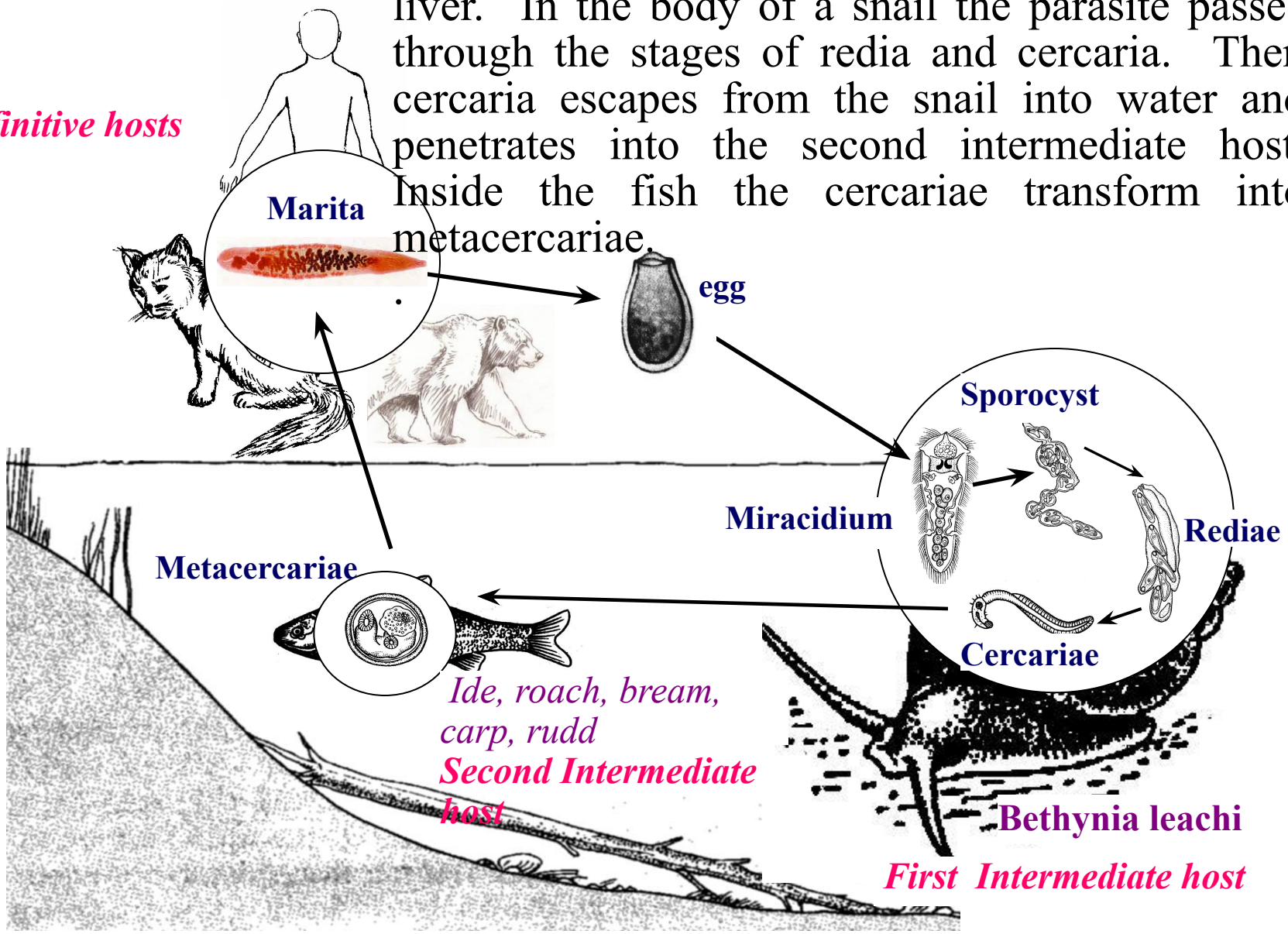
The definitive hosts are domestic and wild cats, bears, wolves and humans. The first intermediate host is a freshwater snail Bethynia leachi, and the second intermediate hosts are ide, roach, bream, carp, rudd.



The mature stage of the fluke (Marita) forms fertilized eggs and releases them with feces to the external environment. The eggs, for their development, should fall into the water (a pond or a lake).



Next, a miracidium comes out of an egg. Miracidium finds a snail and penetrates into the liver. In the body of a snail the parasite passes through the stages of redia and cercaria. Then cercaria escapes from the snail into water and penetrates into the second intermediate host. Inside the fish the cercariae transform into metacercariae.



If the final host eats raw or undercooked fish, metacercariae enter the body of the final host. The metacercariae get into the liver and bile duct and are transformed into marita.

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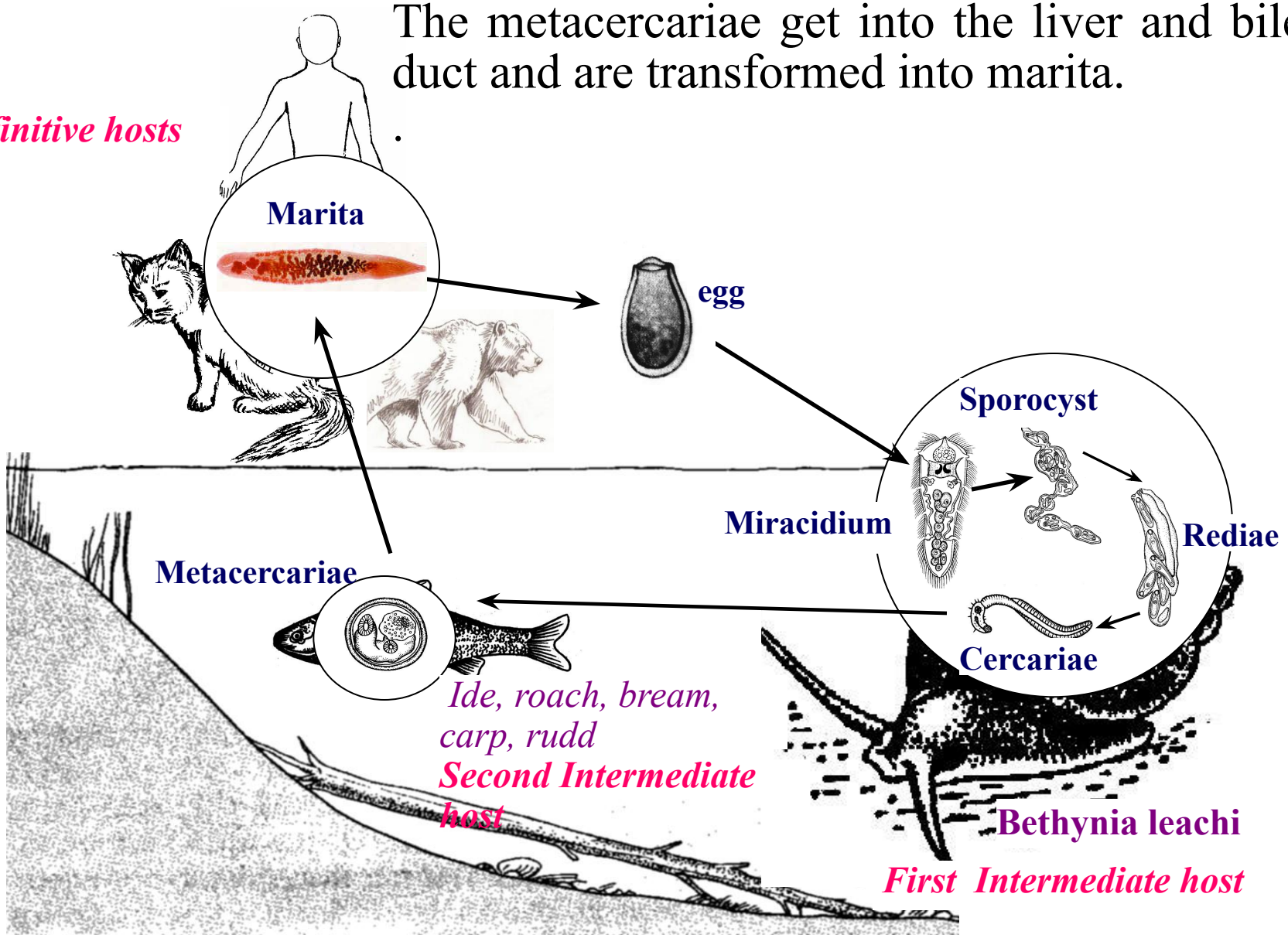
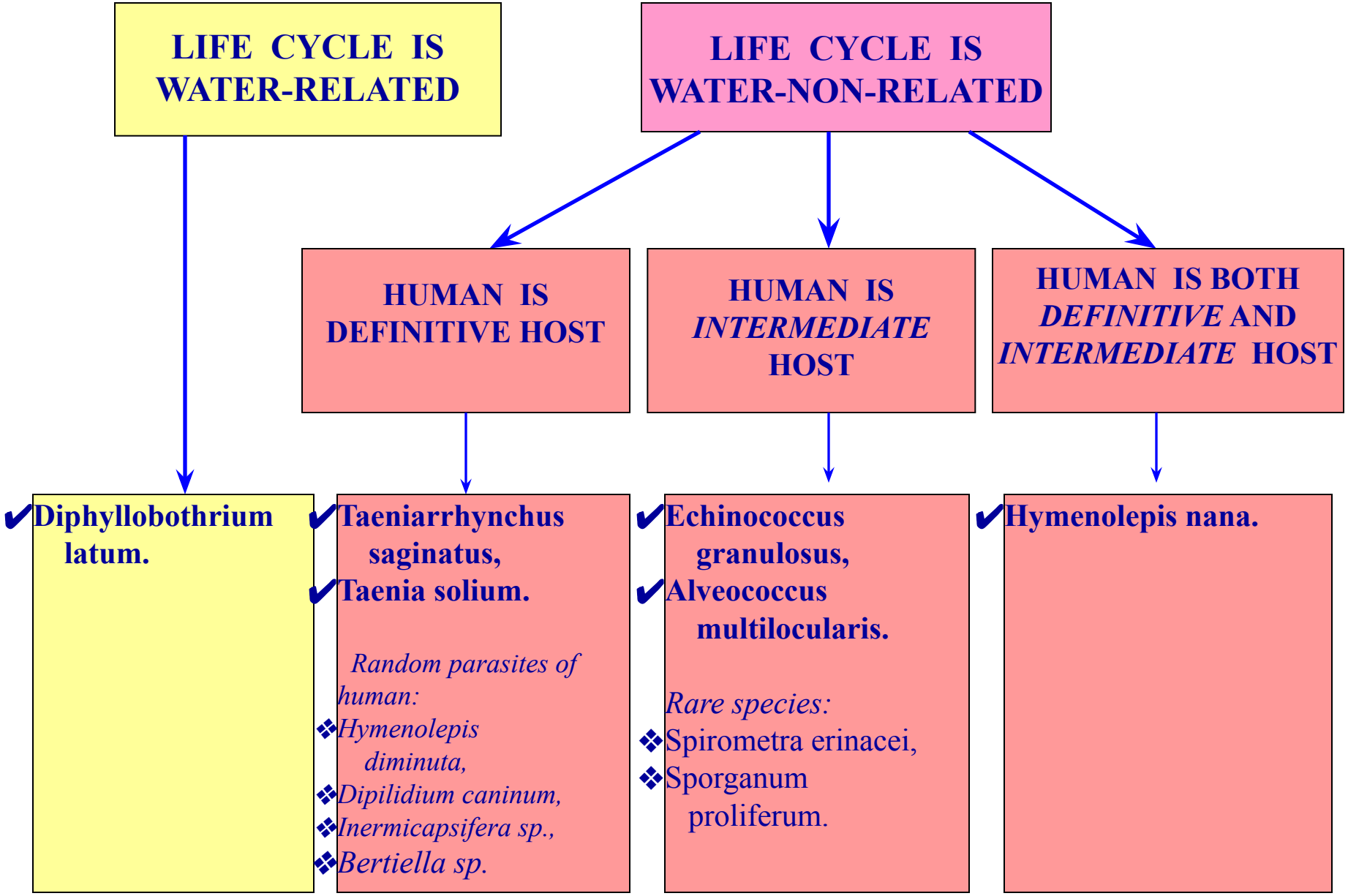


Next we'll talk about parasites, who are representatives of tapeworm class.

Phylum: **FLATWORMS**
(PLATHELMINTHES)

class: **FLUKES** **(TREMATODA)**	*class:* **TAPEWORMS** **(CESTODA)**


CLASS: TAPEWORMS
(CESTODA)
LIFE CYCLE IS
WATER-RELATED
LIFE CYCLE IS
WATER-NON-RELATED


LIFE CYCLE IS WATER-RELATED
LIFE CYCLE IS WATER-NON-RELATED
HUMAN IS DEFINITIVE HOST
HUMAN IS INTERMEDIATE HOST
HUMAN IS BOTH DEFINITIVE AND INTERMEDIATE HOST
✔Diphyllobothrium latum.
✔Taeniarrhynchus saginatus,
✔Taenia solium.
Random parasites of human:
❖Hymenolepis diminuta,
❖Dipilidium caninum,
❖Inermicapsifera sp.,
❖Bertiella sp.
✔Echinococcus granulosus,
✔Alveococcus multilocularis.
Rare species:
❖Spirometra erinacei,
❖Sporganum proliferum.
✔Hymenolepis nana.

1. The class includes about 3500 species. All are parasites mainly of vertebrates.
2. Parasites have a ribbon-like body shape.
3. The body (strobe), consists of segments (proglotids). At the front end of the strobe is the head (scolex). The scolex has attachment organs. The neck is behind the scolex. The neck is the growth region, proglottids proliferate from this region. The young proglotids (which have undeveloped reproduction organs) are separated from the neck. In the middle part of the strobilae there are hermaphrodite segments (with the development of the male and female reproductive system). At the end of the strobe there are the mature proglotids. They contain the uterus which is filled with mature eggs and have the rudiments of other organs.
4. The digestive system is absent.
5. The excretory and nervous systems are like in flukes, but are copied by the number of segments.
6. The reproductive system has several differences from that of the flukes.

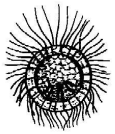
LIFE FORMS OF CESTODES

with H_2O

without H_2O

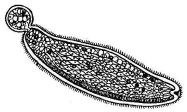
1 EGG

2 LARVAE



CORACIDIUM

ONCOSPHERE

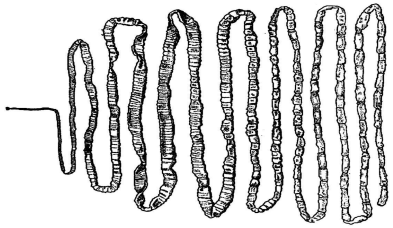


PROCERCOID

FINNS

PLEROCERCOID *CYSTICERCOID* *CYSTICERCUS* *CENUR* *ECHINOCOCCUS*

3 MARITA



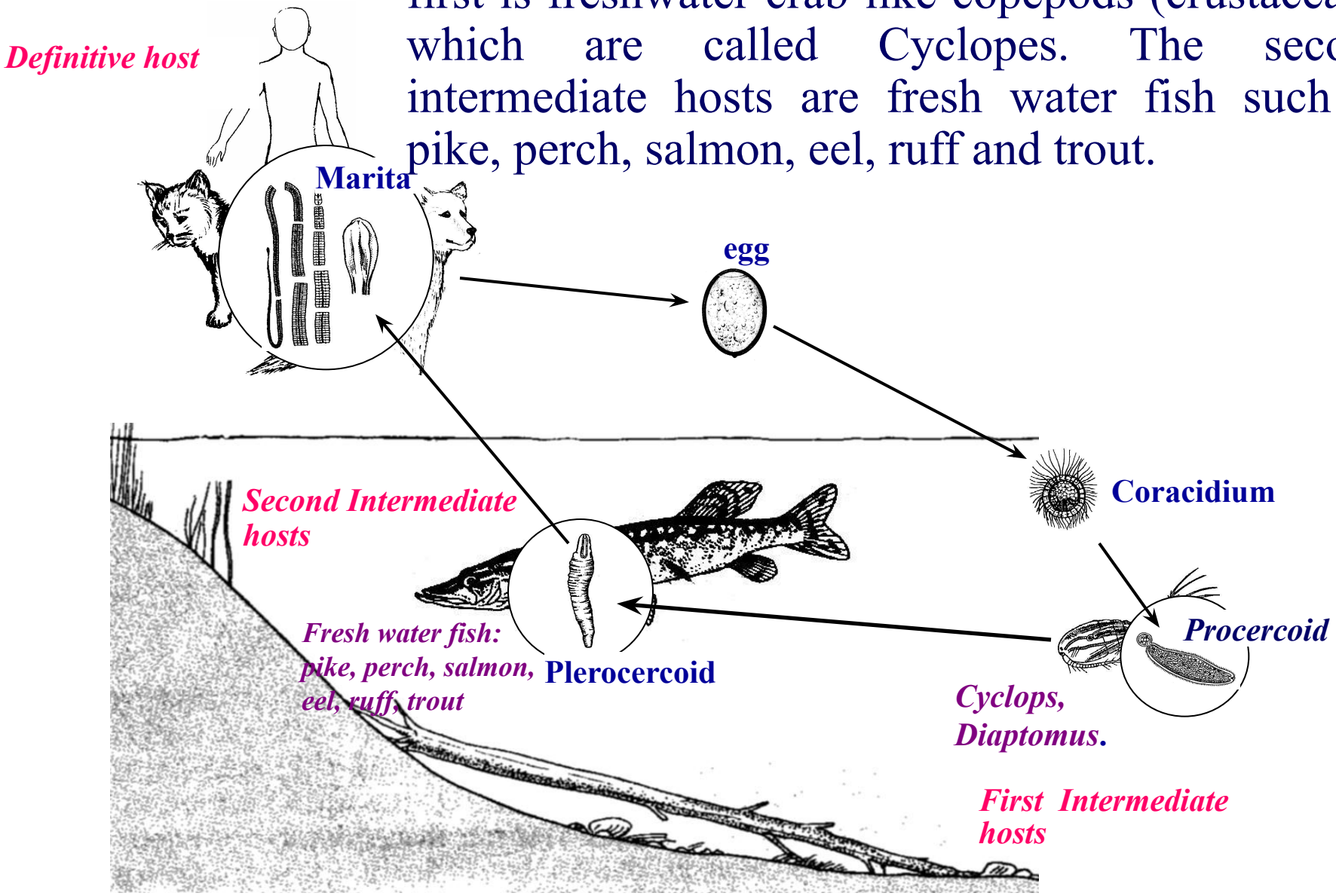
CESTODES WHICH HAVE WATER-RELATED LIFE CYCLE

FISH (OR BROAD) TAPEWORM (DIPHYLLOBOTHRIUM LATUM) IS A TYPICAL REPRESENTATIVE OF THIS SUBGROUP

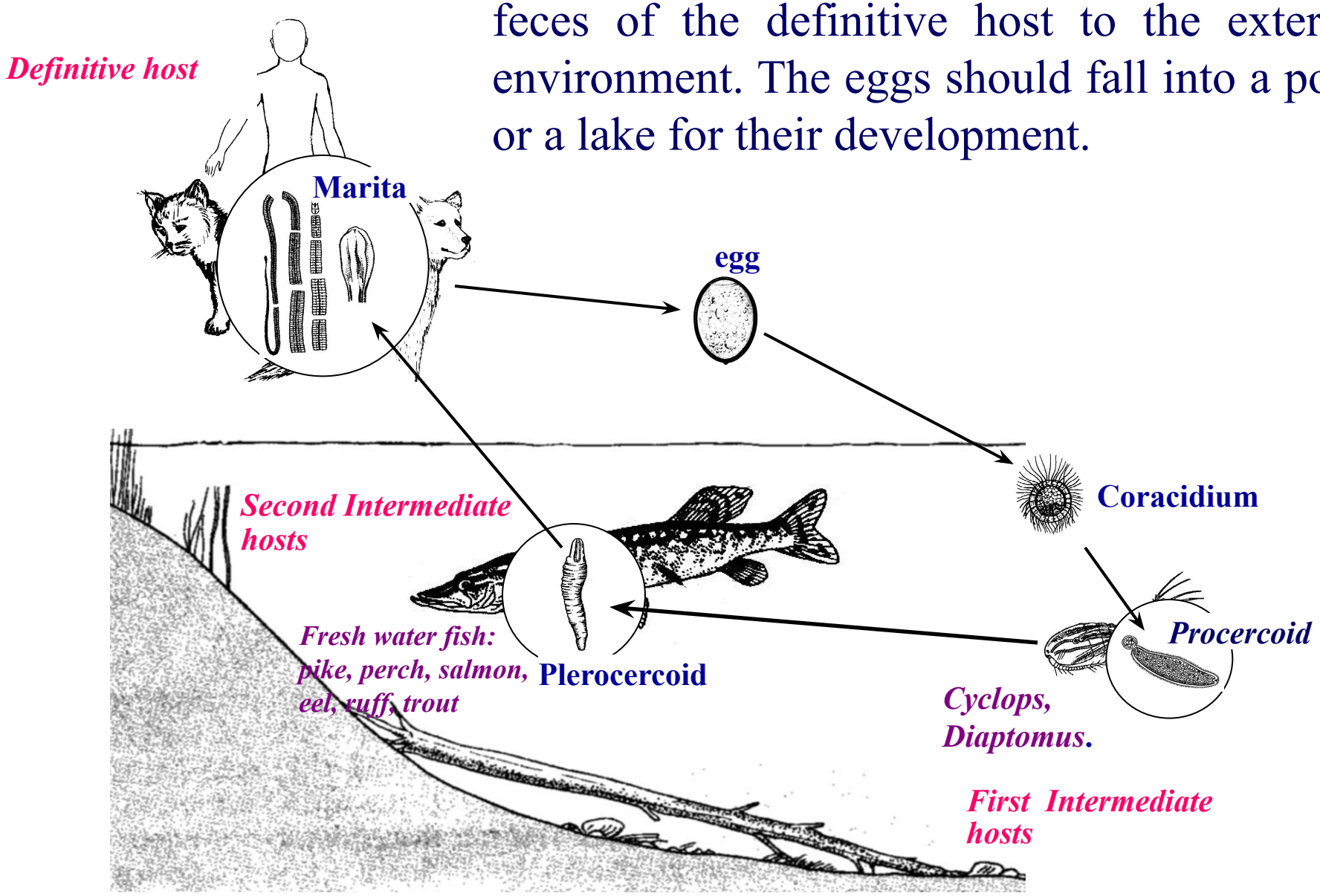
Phylum – **Plathelminthes**
Class – **Cestoda**
Genus - **Diphyllobothrium**
Species - **D. latum**

Fish tapeworm is widely distributed in the lake areas of Europe, Asia, Far East, North America, South America and Central Africa. It is the causative agent of the disease, which is called “diphyllobothriosis”. D. latum is localized in the small intestine of the fish-eating mammals and humans.

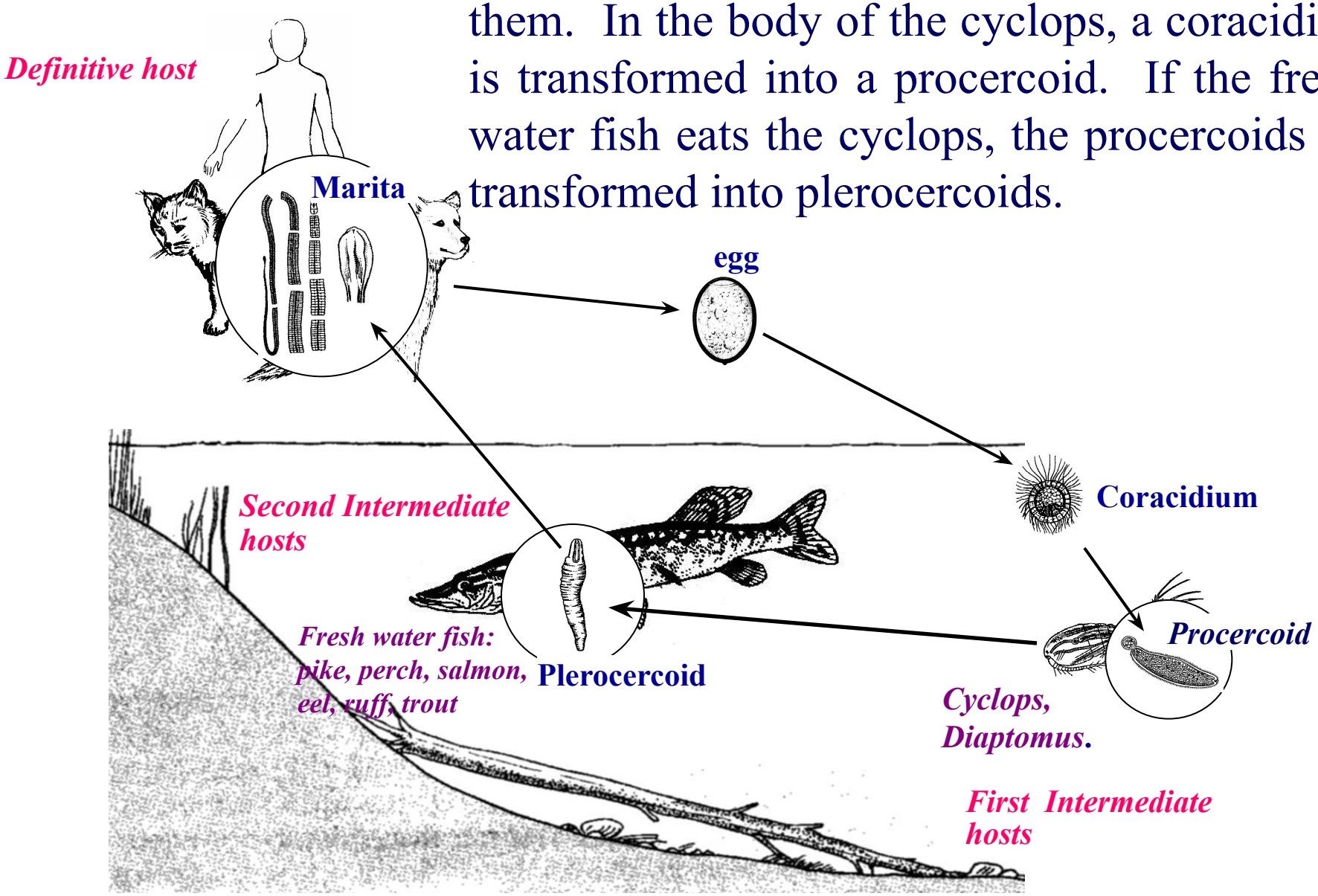
Its definitive hosts are fish-eating mammals and humans. There are two intermediate hosts. The first is freshwater crab-like copepods (crustacean): which are called Cyclopes. The second intermediate hosts are fresh water fish such as pike, perch, salmon, eel, ruff and trout.



The mature stage of the parasite (Marita) forms fertilized eggs and releases them with feces of the definitive host to the external environment. The eggs should fall into a pond or a lake for their development.



After some time a small coracidium is formed. Coracidium finds cyclops and penetrates into them. In the body of the cyclops, a coracidium is transformed into a procercoid. If the fresh-water fish eats the cyclops, the procercoids are transformed into plerocercoids.



If the final host eats raw or undercooked fish, plerocercoids enter the gastrointestinal tract of the final host. The plerocercoid gets into the small intestine and is transformed into marita.

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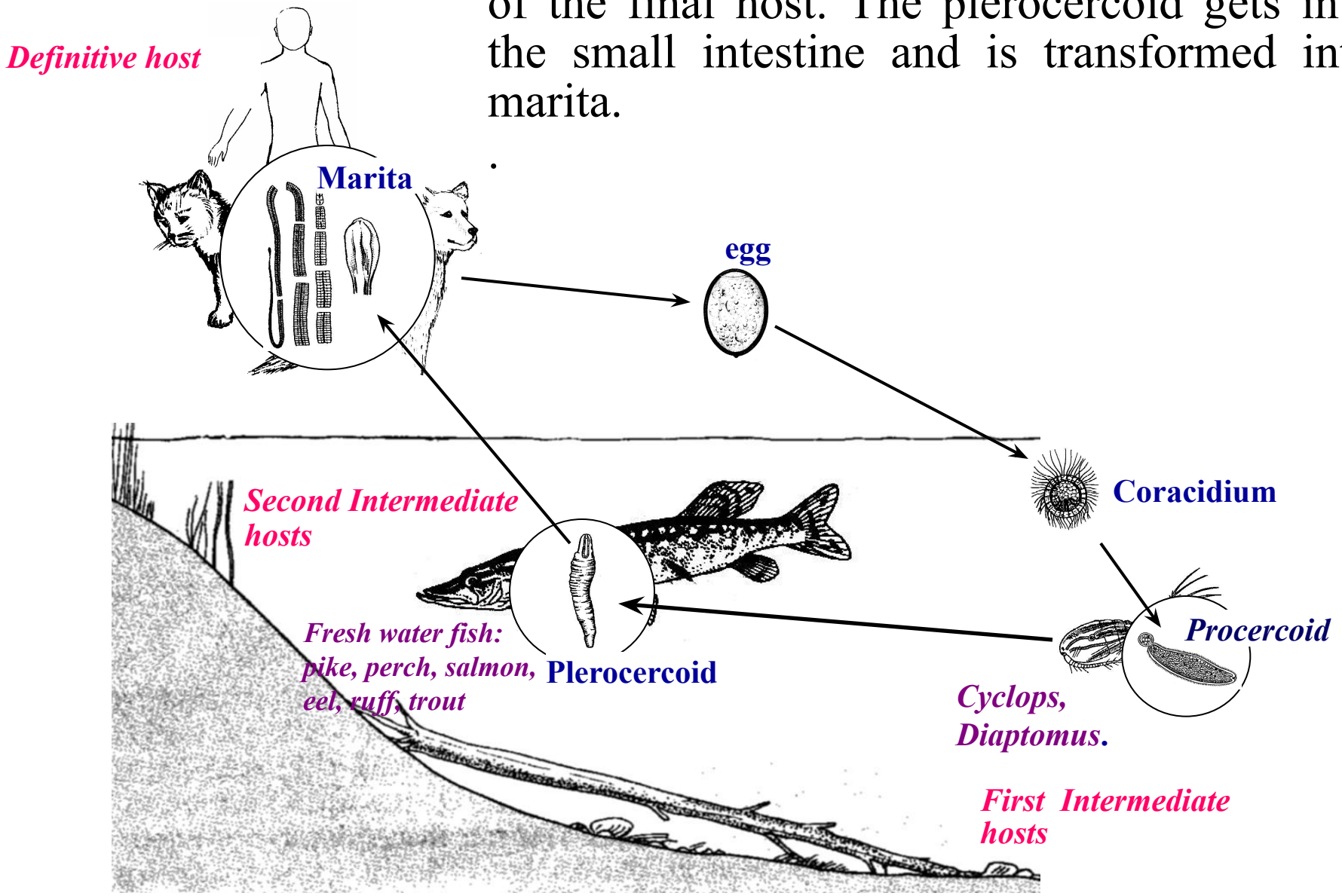


The major symptoms of the diphillobotriasis are: abdominal pain, diarrhea, constipation, loss of weight, intestinal obstruction, pernicious anemia and eosinophilia.

Prevention and Control:

1. Avoid eating raw or undercooked fish
2. Fish inspection for larvae
3. Treatment of infected individuals and health education.

CESTODES WHICH HAVE WATER-NON RELATED LIFE CYCLE

MAN IS A DEFINITIVE HOST

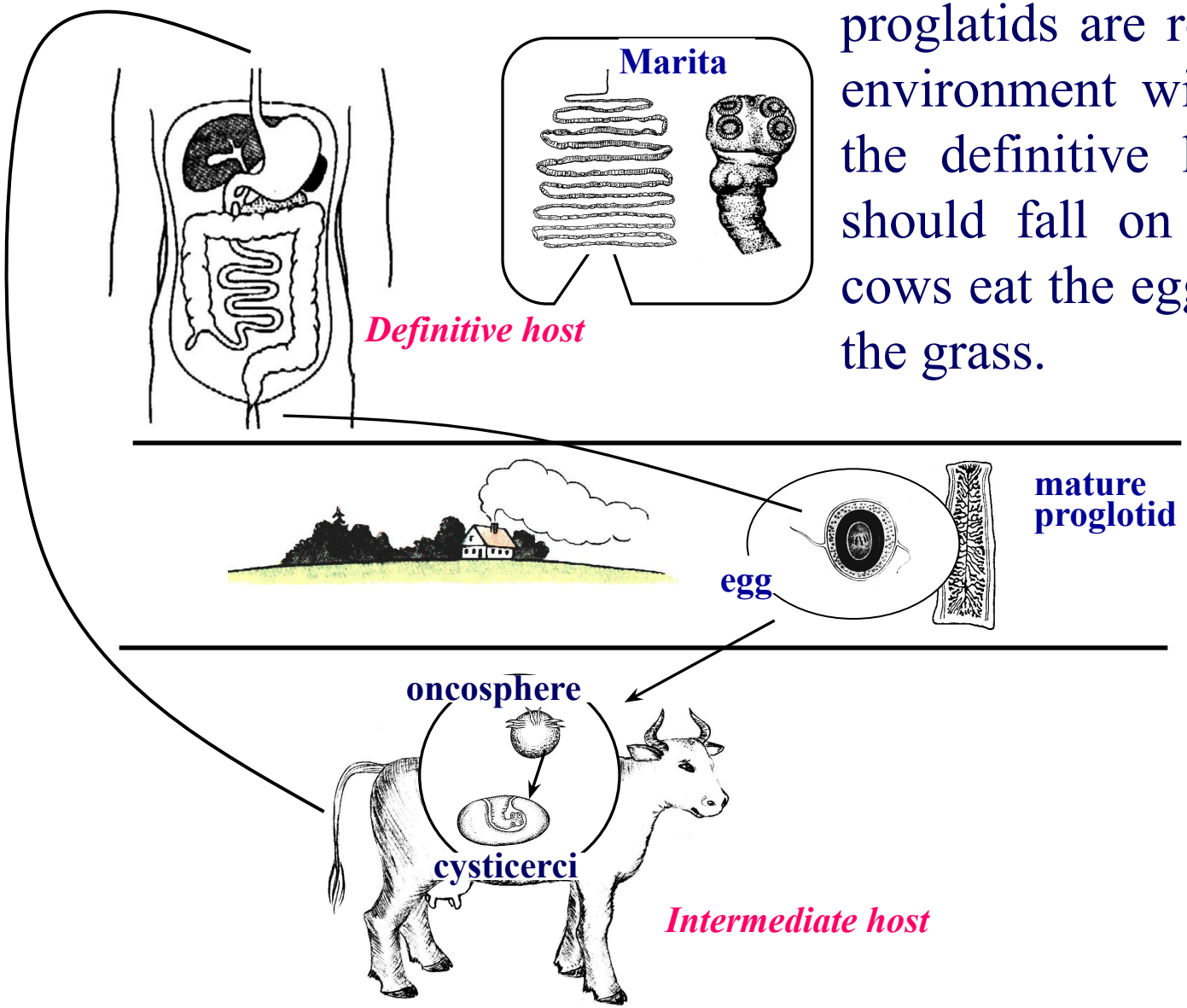
BEEF TAPEWORM (TAENIARRHYNHUS SAGINATUS) IS A TYPICAL REPRESENTATIVE OF THIS SUBGROUP

Phylum – **Plathelminthes**
Class – **Cestoda**
Genus - **Taeniarrhynhus**
Species - **T. saginatus**

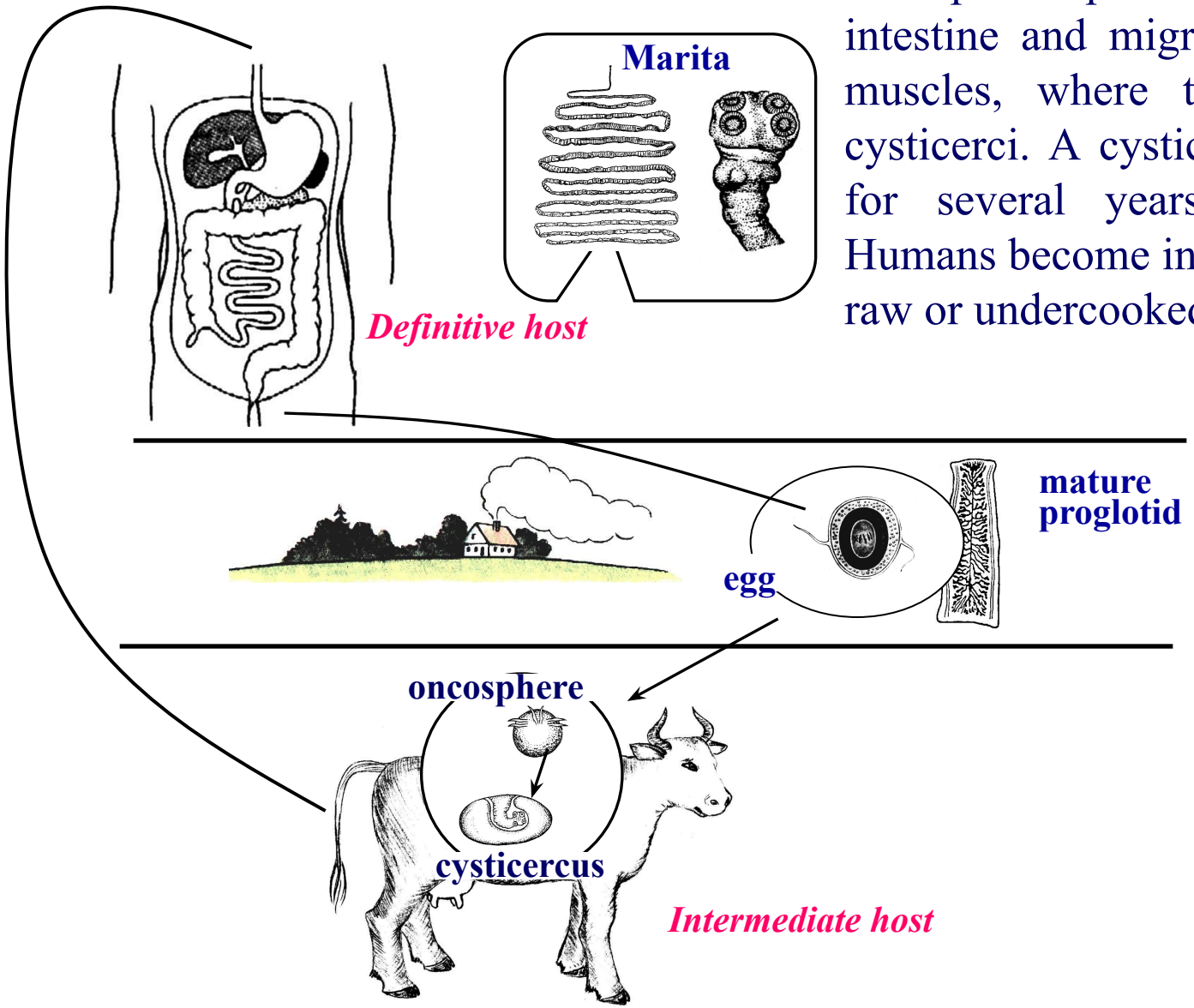
Beef tapeworm is widespread in the regions of the world where the cattle is bred. The parasite is the causative agent of the disease, which is called “Taeniarhynhosis”. Marita of the T. saginatus is localized in the small intestine of humans.

The size of the marita is from 3 to10 m.
Mature segment is 1-2 cm long.
Scolex (head) has a quadrate shape with four suckers.
Strobila has 1000-2000 proglottides.

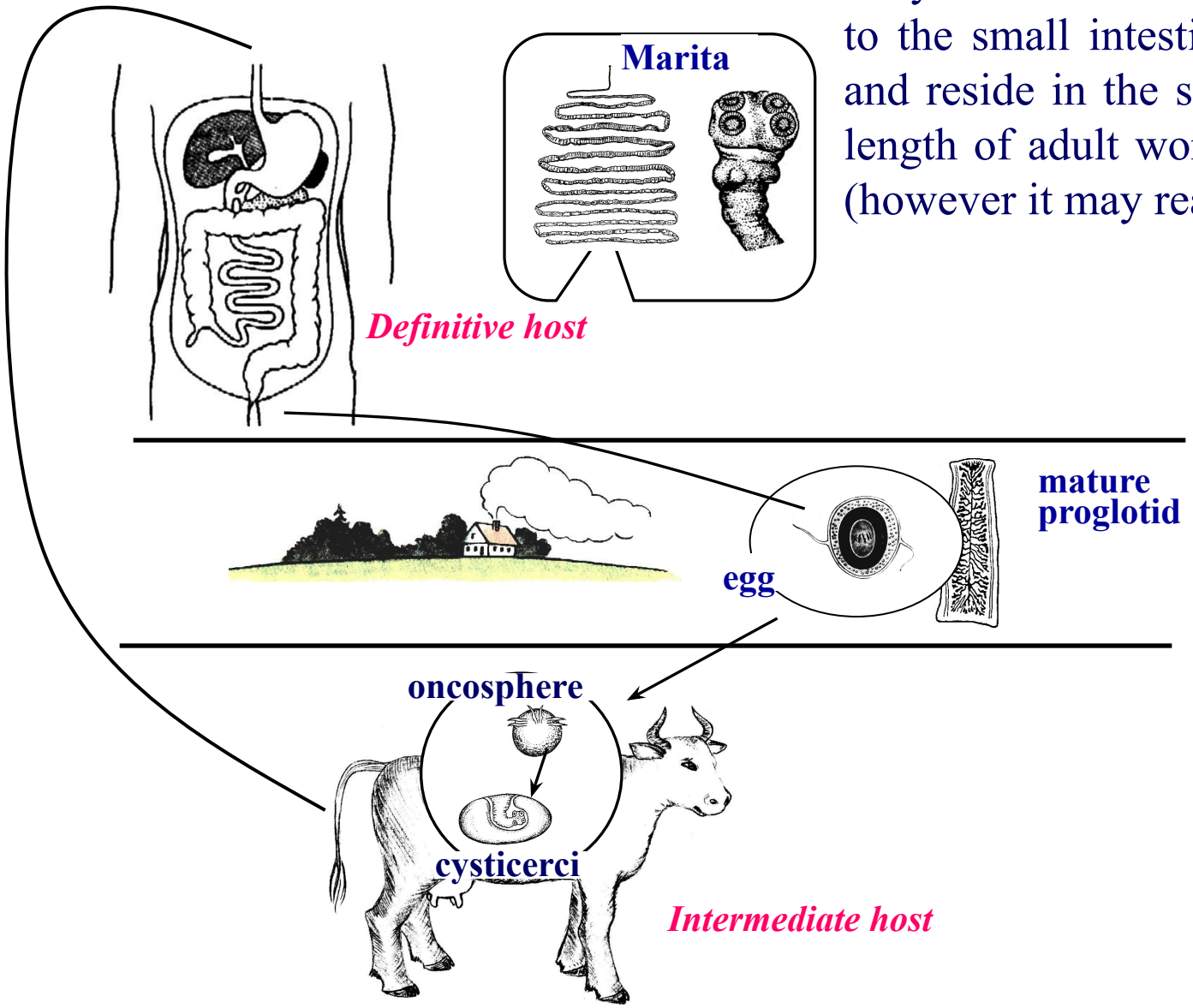
The definitive host is only a human. The intermediate host is the cattle. The mature proglatids are released into the environment with the feces of the definitive host. The eggs should fall on the grass. The cows eat the eggs together with the grass.



In the intestines of the cattle an egg shell dissolves and the oncosphere comes out from an egg. The oncospheres penetrate the wall of the intestine and migrate to the skeletal muscles, where they develop into cysticerci. A cysticercus can survive for several years in the animal. Humans become infected by ingesting raw or undercooked infected meat.



In the human intestine the cysticerci develop for about 2 months into an adult tapeworm, which can survive for years. The adult tapeworms attach to the small intestine by their scolex and reside in the small intestine. The length of adult worms is usually 5 m (however it may reach up to 25 m).



Beef tapeworm can cause digestive problems including abdominal pain, loss of appetite, weight loss, and upset stomach. In rare cases, the segments of T. saginatus become lodged in the appendix, or the bile and pancreatic ducts.

Diagnosis of taeniarhynhosis is made by examination of stool samples. Stool specimens should be examined in the lab for eggs using a microscope.

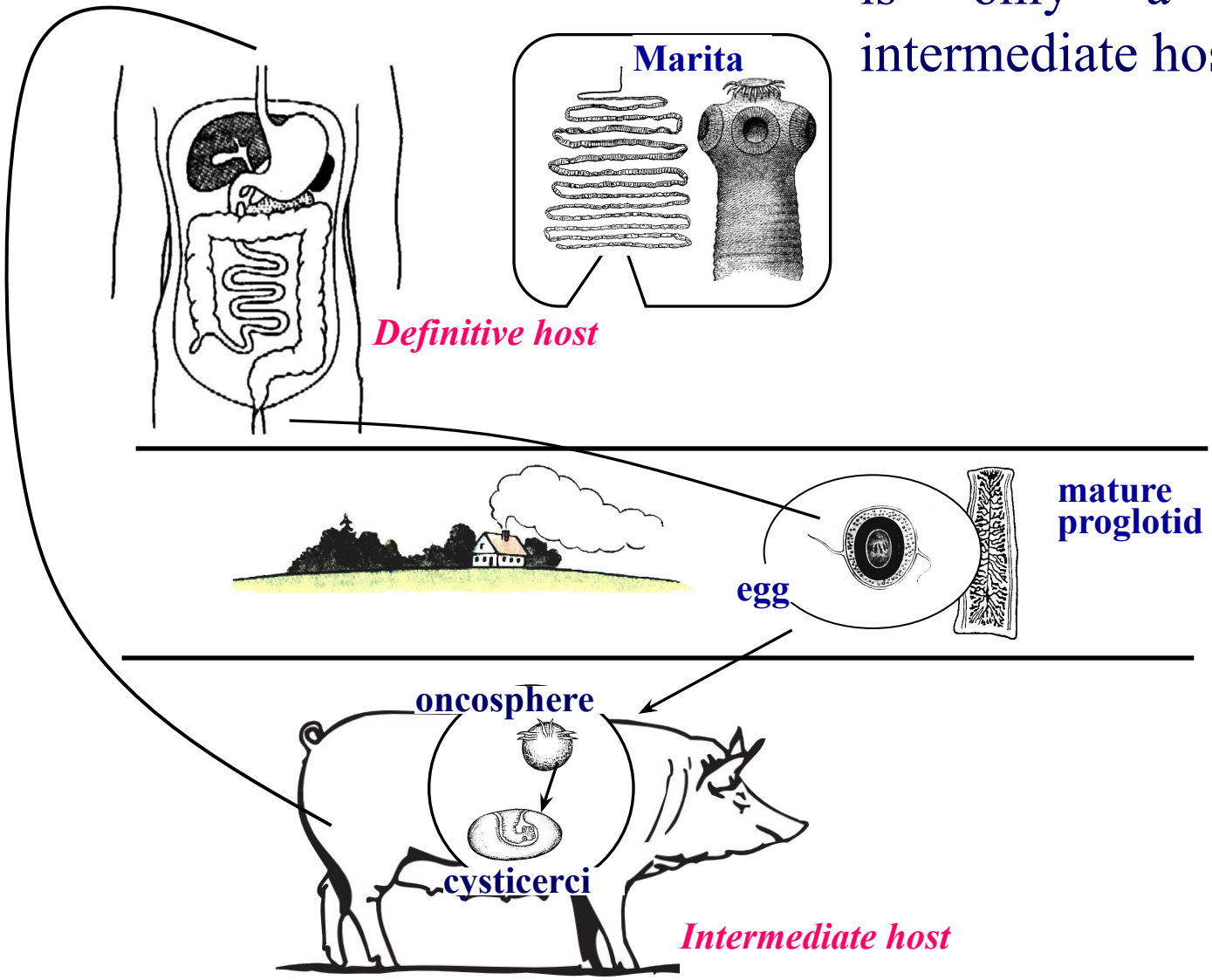
PORK TAPEWORM OR ARMED TAPEWORM (TAENIA SOLIUM) HAS A SIMILAR DEVELOPMENT CYCLE

Phylum – **Plathelminthes**
Class – **Cestoda**
Genus - **Taenia**
Species - **T. solium**

Pork tapeworm is widespread in the regions of the world where pigs are bred. The parasite is the causative agent of two diseases. The first disease is called “Taeniasis”, and the second one is called “Cycticercosis”.

The size of marita is from 3 to 6 m.
Mature segment is 1-2cm long.
Scolex (head) has a quadrate shape with four suckers and several hooklets.
Strobila has 1000-2000 proglottides.

The definitive host of T. solium is only a human. The intermediate hosts are the pigs.



The marita of the pork tapeworm secretes very toxic products of its metabolism. Therefore, in patients with taeniasis often arises the reverse peristalsis of the intestine. In this case, the food mass together with the pork tapeworm eggs move from the small intestine into the stomach. The hydrochloric acid dissolves the shell of the egg and stimulates the release of the oncospheres. The oncospheres migrate to various tissues of the patient (brain, eyes, liver, etc.) and cause serious damage. In a cysticercosis a person is an intermediate host for a parasite .

If the human brain is affected by cysticerci, severe headaches, vision loss and seizures are observed.

CESTODES WHICH HAS A WATER-NON RELATED LIFE CYCLE

MAN IS AN INTERMEDIATE HOST

ECHINOCOCCUS GRANULOSUS IS A TYPICAL REPRESENTATIVE OF THIS SUBGROUP

Phylum – **Plathelminthes**
Class – **Cestoda**
Genus - **Echinococcus**
Species - **E. granullosus**

Echinococcus granulosus is widespread in various regions of the World: Europe, East Africa, the Middle East, Iran, western Australia, Chile, Argentina, and Uruguay. The parasite is the causative agent of the disease, which is called “Echinococcosis” or “Cystic hydatid disease”. It is the smallest tapeworm.

The size of the marita is from 2.5 to 9.0 mm long

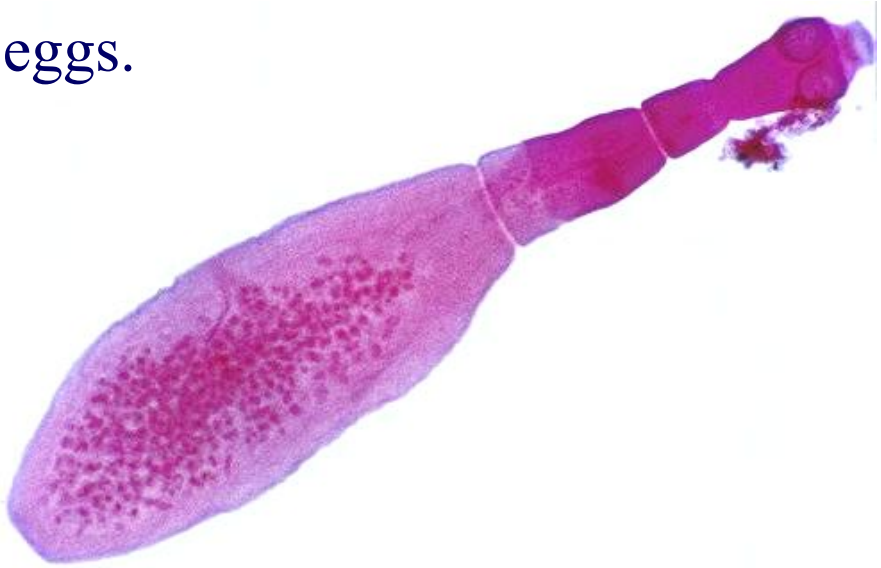
The body consists of a head, neck and three proglottids.

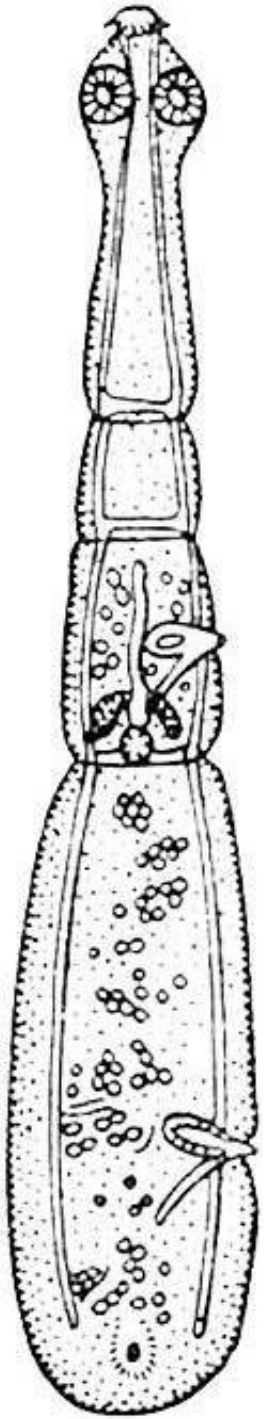
The globular scolex contains four suckers and a rostellum that has about 25–50 hooks.

The first proglottid is immature.

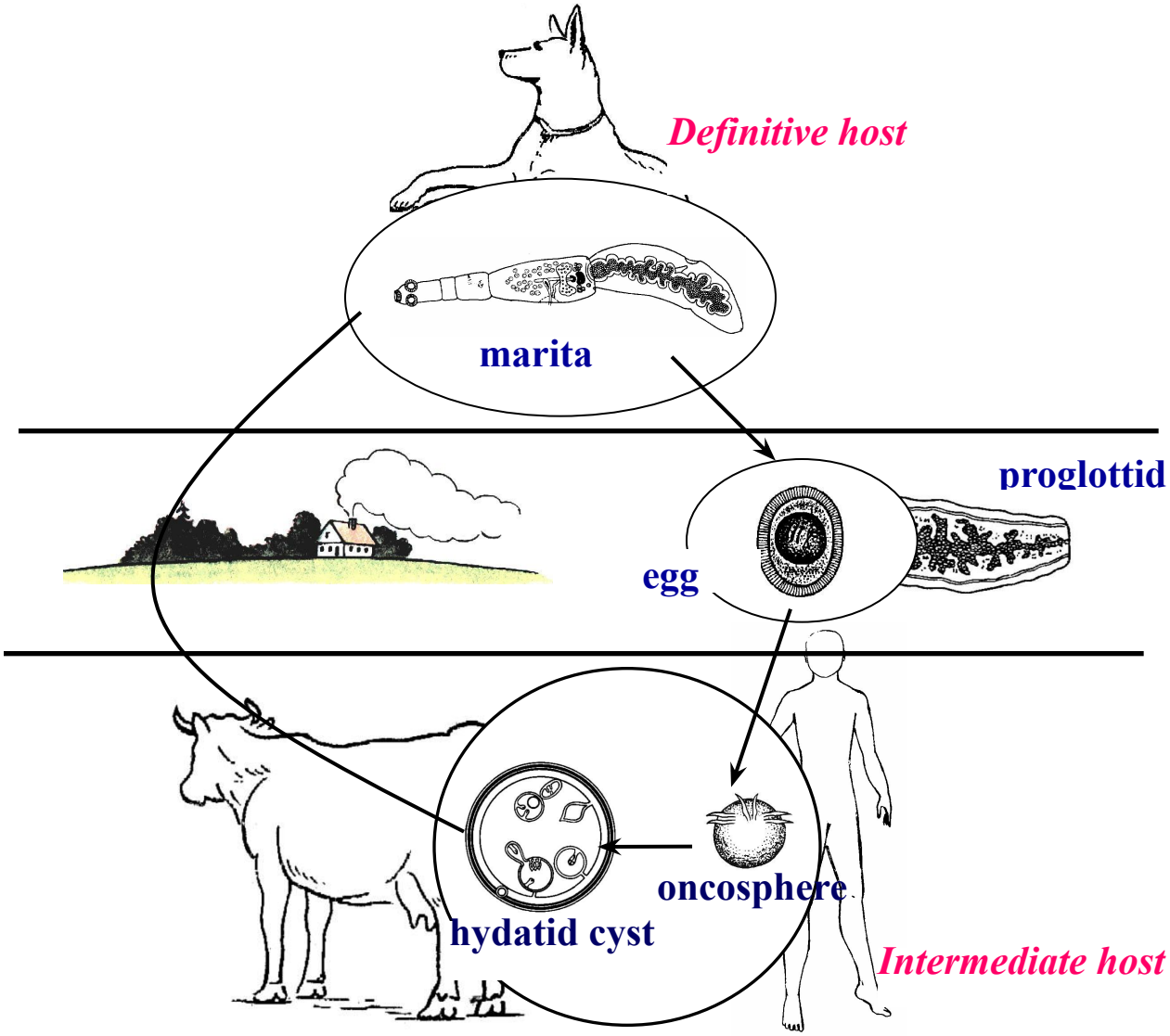
The second is proglottid with fully developed reproductive organs.

The third proglottid is gravid, which has a uterus with 12 to 15 branches filled with some 500 eggs.

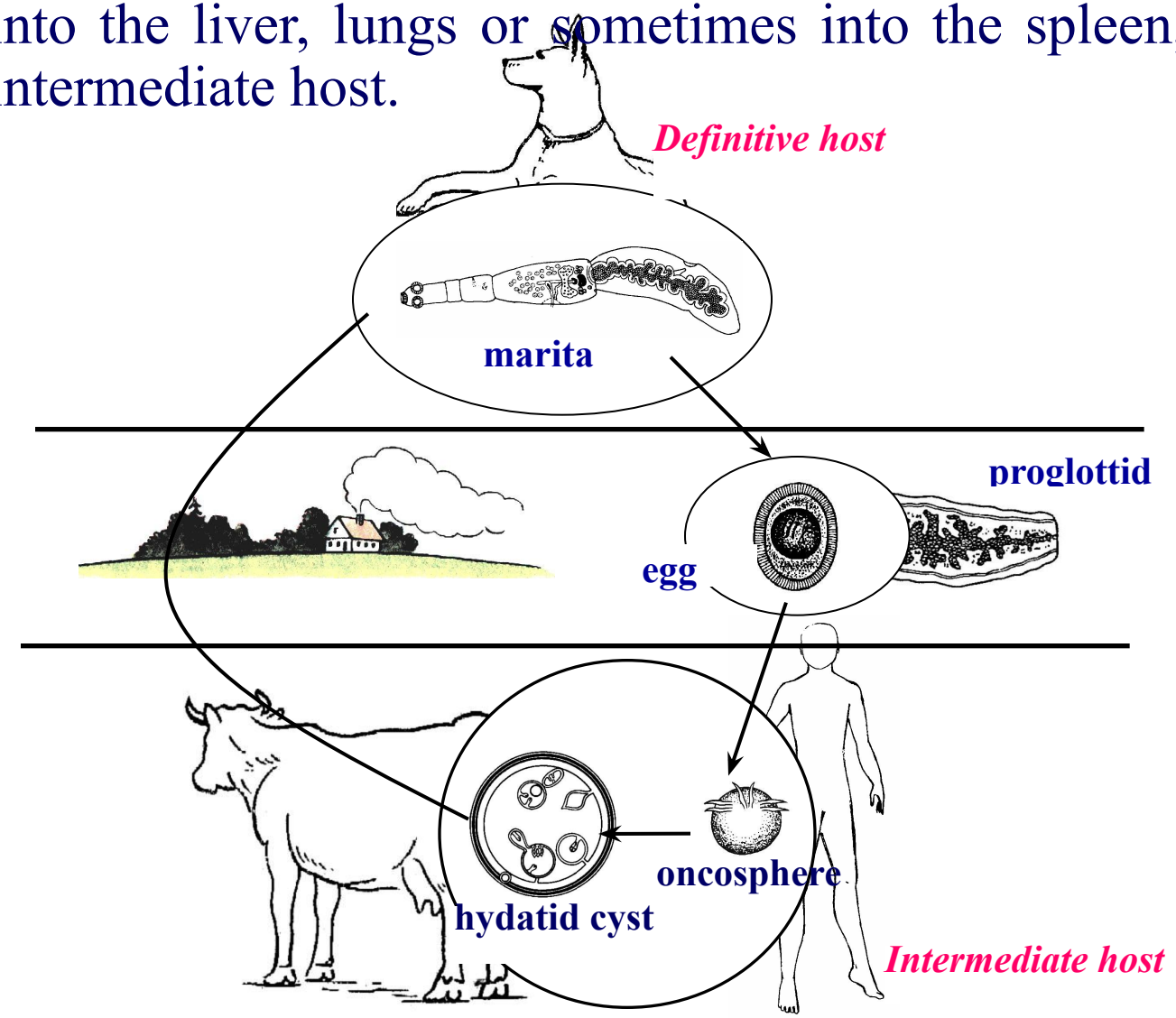




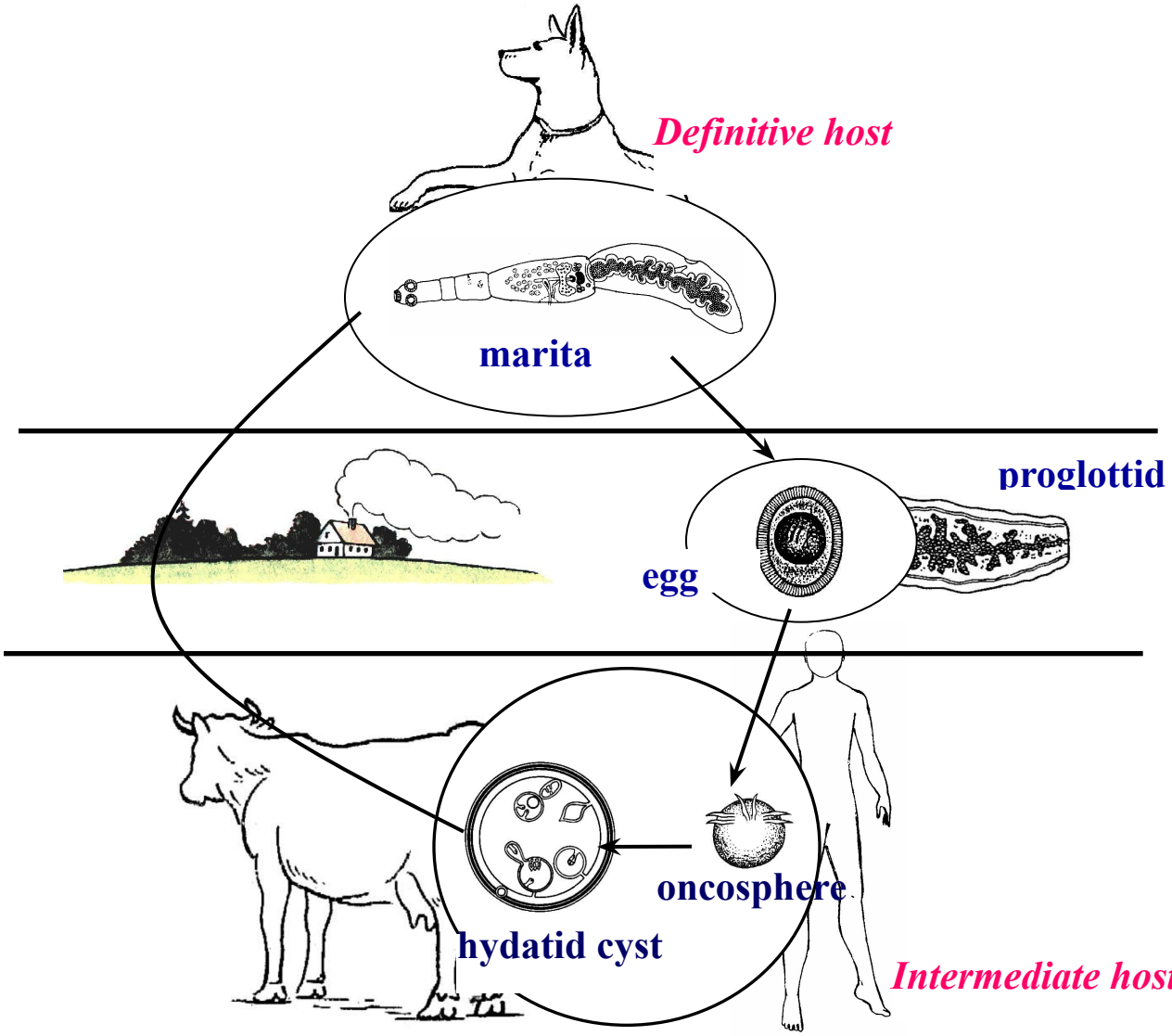
The definitive hosts of Echinococcus are dogs, wolves, jackals, coyotes, foxes, rarely in cats, and in other carnivora. The intermediate hosts are herbivores mammals and humans.



An adult worm lives in the small intestine of the definitive host. The eggs pass out with the feces of the definitive host and are swallowed by an intermediate host. Inside the intermediate host the shell of egg is dissolved and six-hooked embryo (onchosphere) hatch and migrate into the liver, lungs or sometimes into the spleen, bones, brain of the intermediate host.



In these organs oncosphere is transformed into the hydatid cyst. The hydatid cyst is a bubble filled with toxic liquid. Numerous scolexes grow from the bubble wall into the interior space. Also small bubbles with scolex float in liquid.

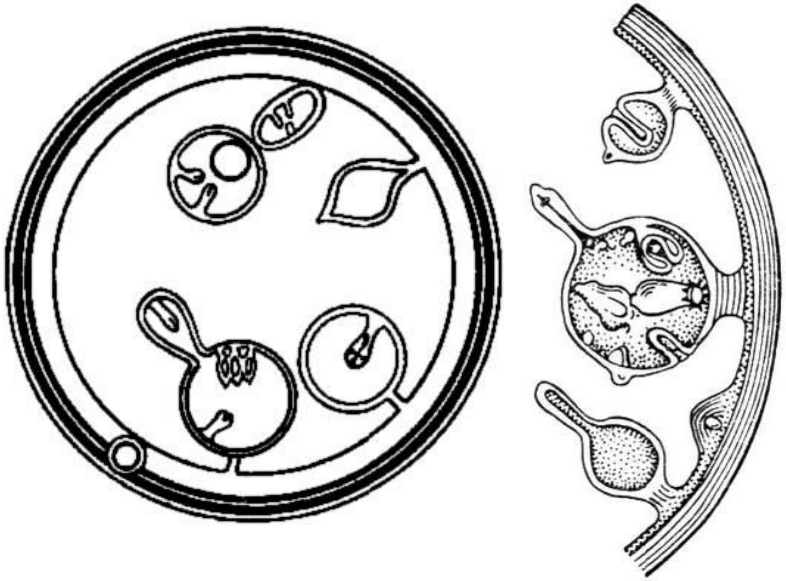


As soon as the hydatid cysts reach the definitive host they develop into adult Echinococcus. The definitive host ingests the flesh of the infected intermediate host and this way the parasite reaches the definitive host.

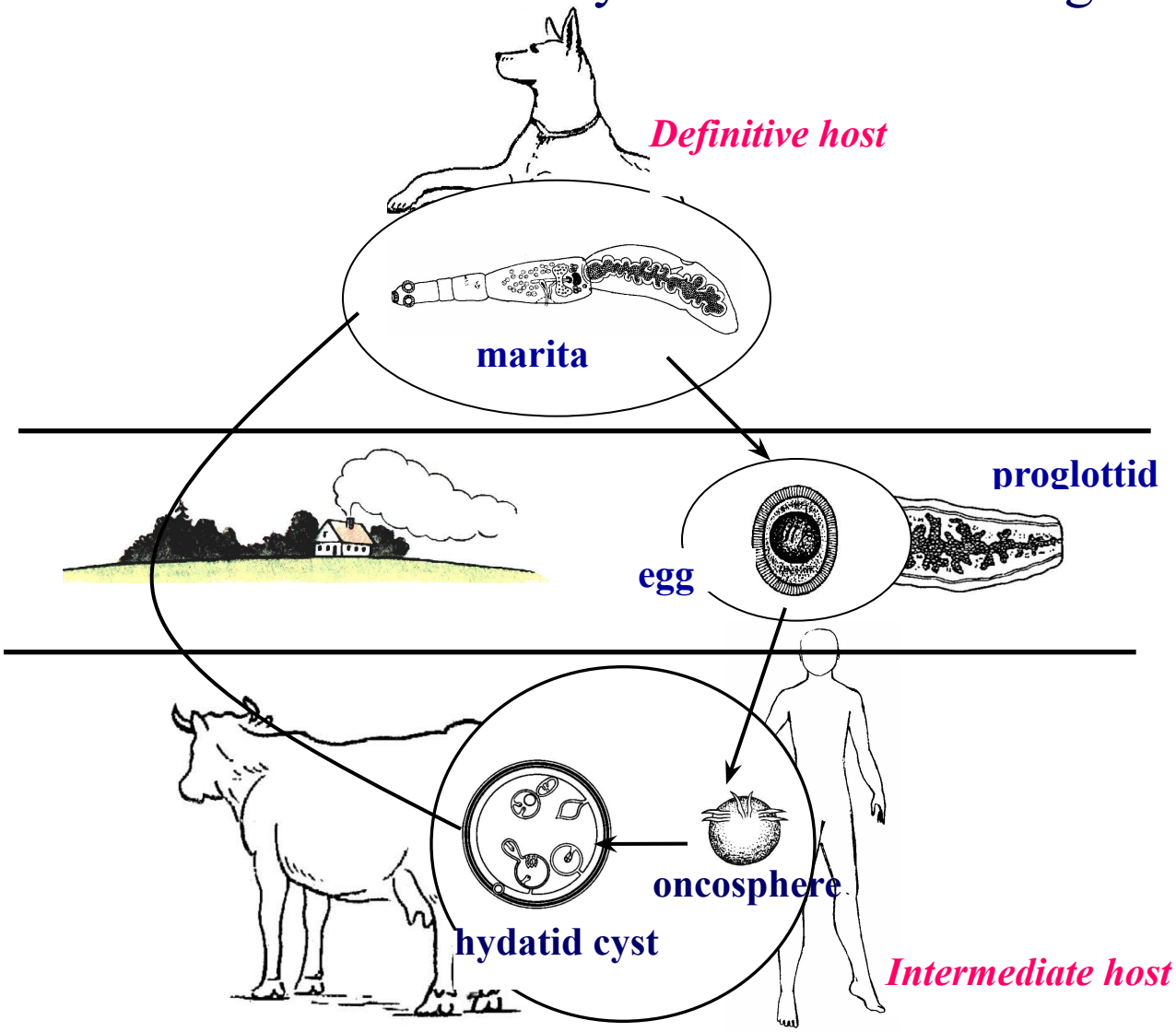
The hydatid cyst is a bubble filled with toxic liquid.

The hydatid cysts sometimes grow so large, that by the end of several years or even decades, they can contain several liters of fluid.

Numerous protoscolexes grow from the bubble wall into the interior space. Also small bubbles with protoscolex float in liquid.



The definitive host becomes infected after ingesting the cyst-containing organs of the infected intermediate host. After ingestion, the protoscolices attach to the intestine. They then develop into adult worms and the cycle starts all over again.



In the film you can see an echinococcus cyst removal from the patient's liver.

FOR DIAGNOSIS OF ECHINOCOCCOSIS X-RAY EXAMINATIONS, ULTRASONIC EXAMINATION AND SEROLOGICAL TESTS ARE USED

CESTODES WHICH HAVE A WATER-NON-RELATED LIFE CYCLE

MAN IS BOTH A DEFINITIVE AND AN INTERMEDIATE HOST

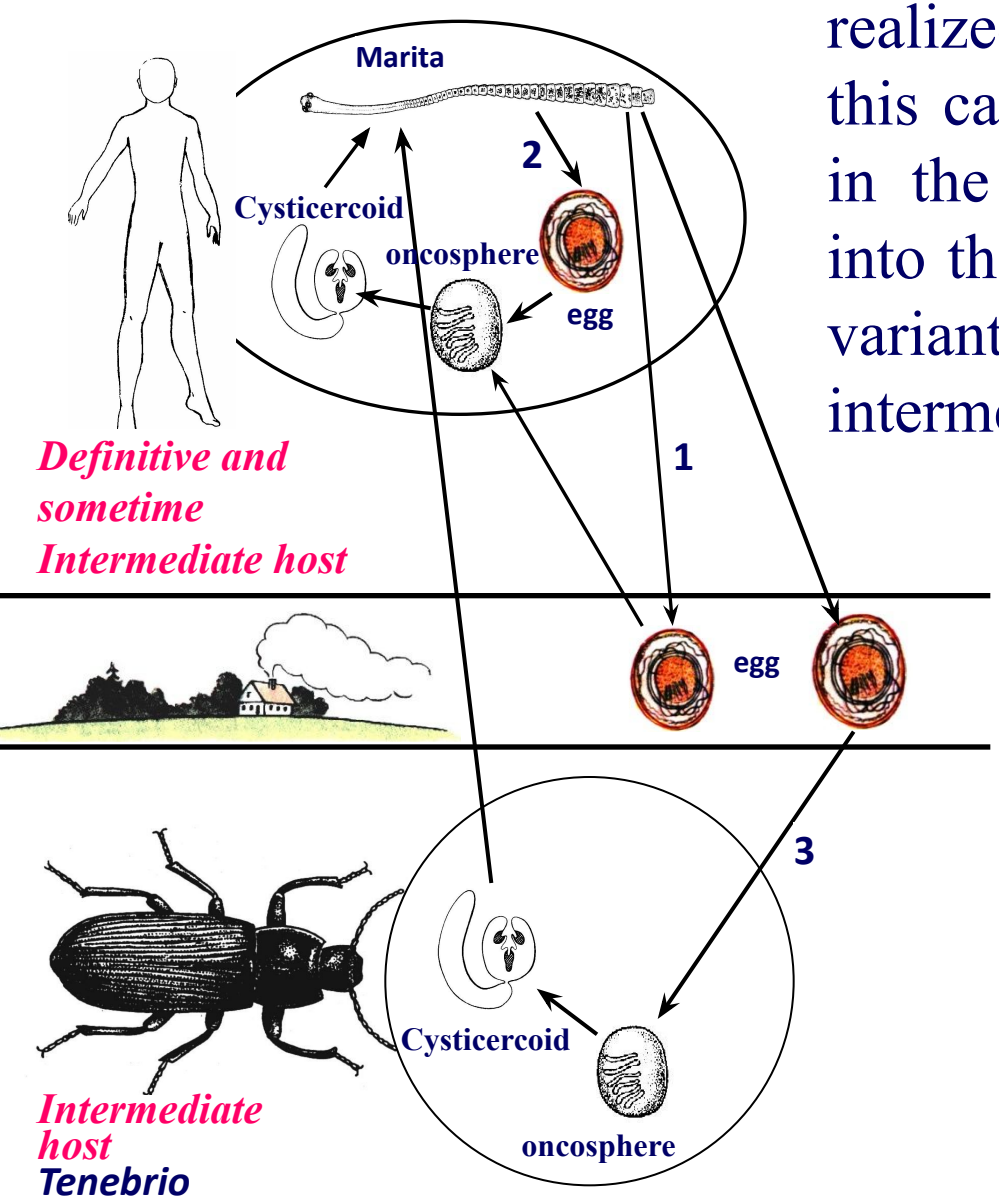
DWARF TAPEWORM (HYMENOLEPIS NANA) IS A TYPICAL REPRESENTATIVE OF THIS SUBGROUP

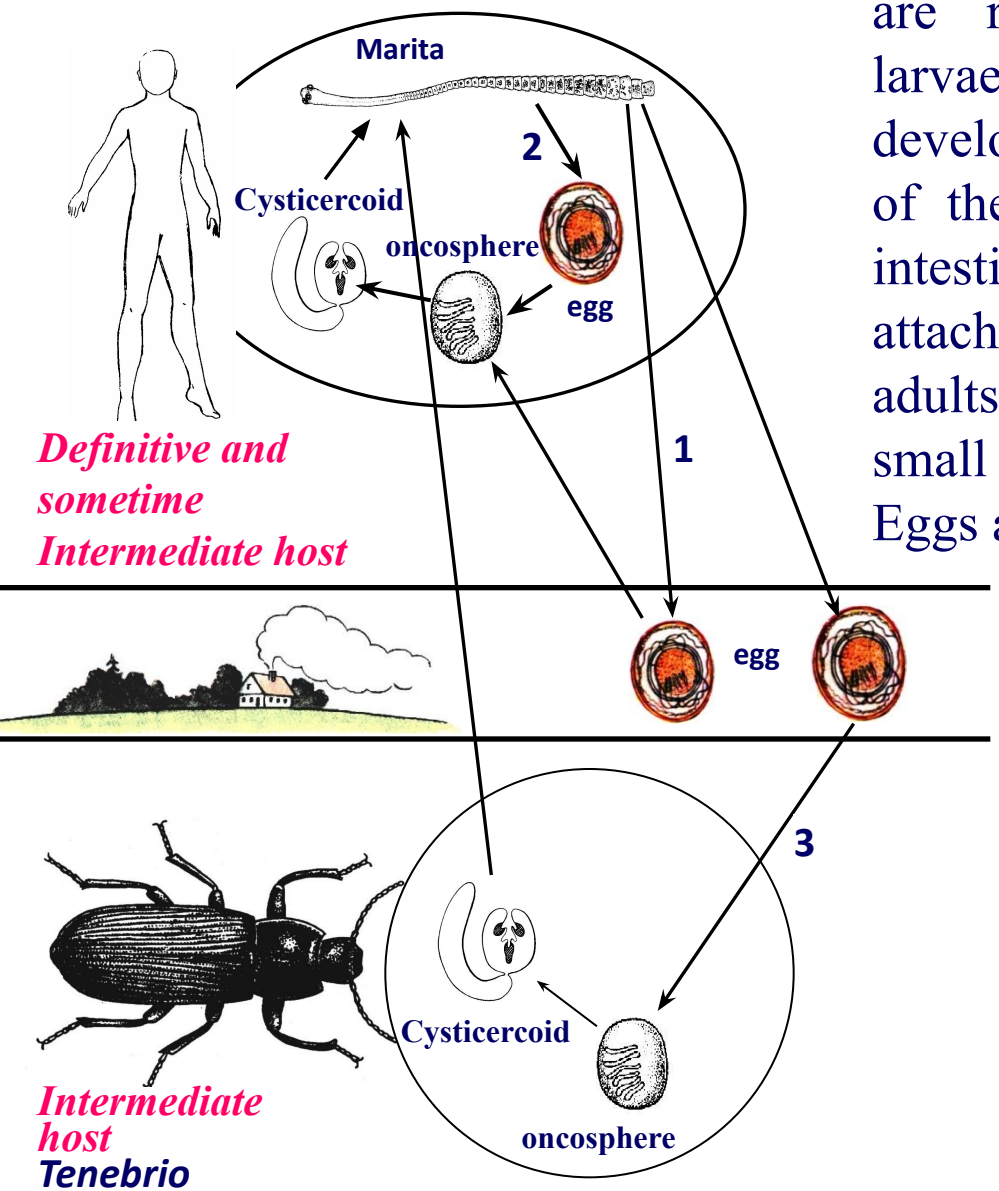
Phylum – **Plathelminthes**
Class – **Cestoda**
Genus - **Hymenolepis**
Species - **H. nana**

Dwarf tapeworm is found worldwide. It is most often seen in children in countries in which sanitation and hygiene are inadequate. The parasite is the causative agent of the disease, which is called “Hymenolepiasis”. Usually Dwarf tapeworm do not have an intermediate host and the entire development from the larval to the adult stage takes place in one host. But, sometimes insects (Flour beetles of genus Tenebrio) are intermediate hosts.

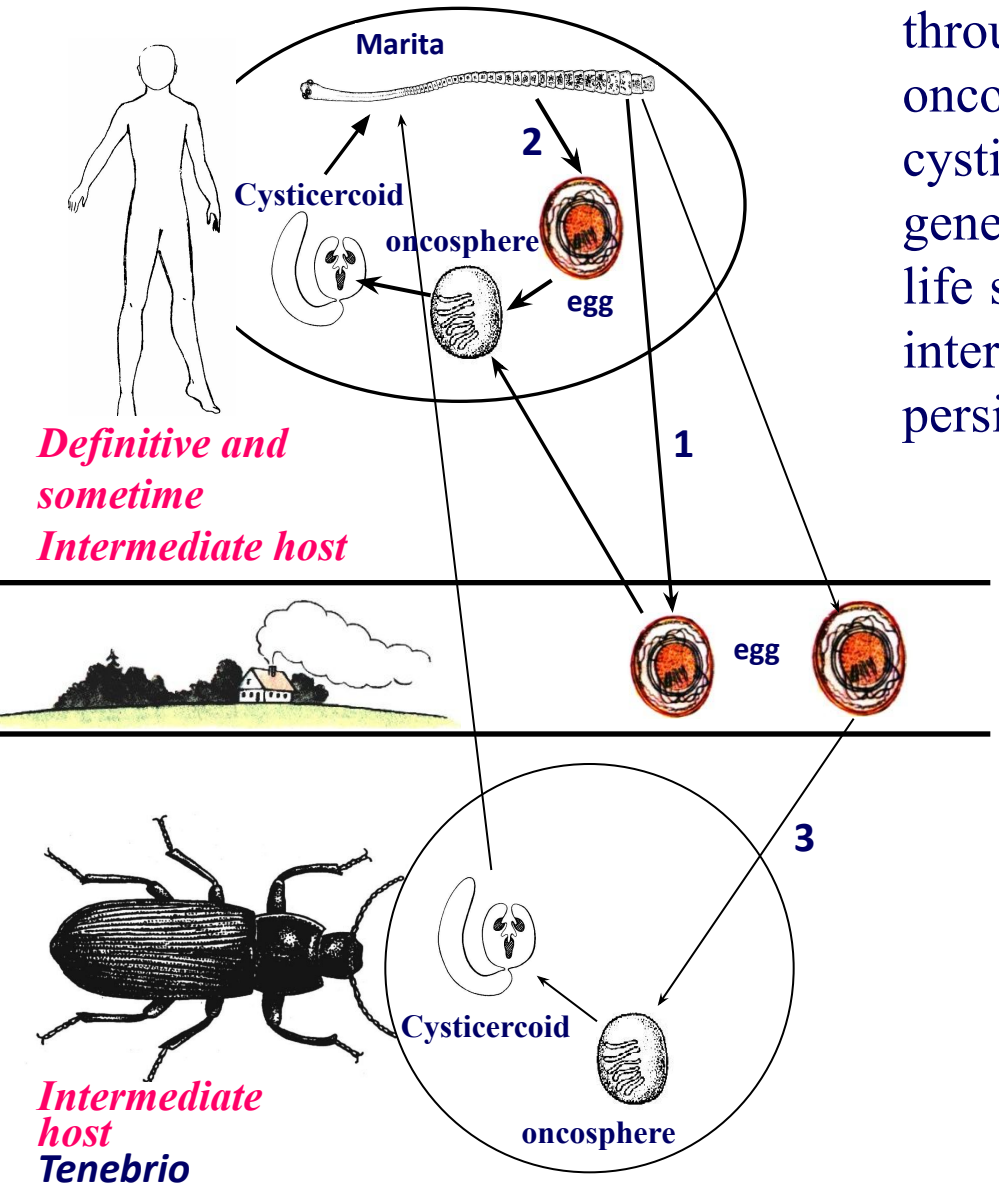
The habitat of the worm is the upper two thirds of the ileum. Its life-time is several weeks.
The size of the marita is 15 to 40 mm in length. It may have as many as 200 proglottides.
The globular scolex contains four suckers and a short rostellum that has about 20–30 hooks. The neck is very long.

Hymenolepis nana has three variants of the life cycle. The first two options are realized without an intermediate host. In this case the parasite eggs may develop in the human intestine or be released into the external environment. In a third variant the parasite develops with the intermediate host.

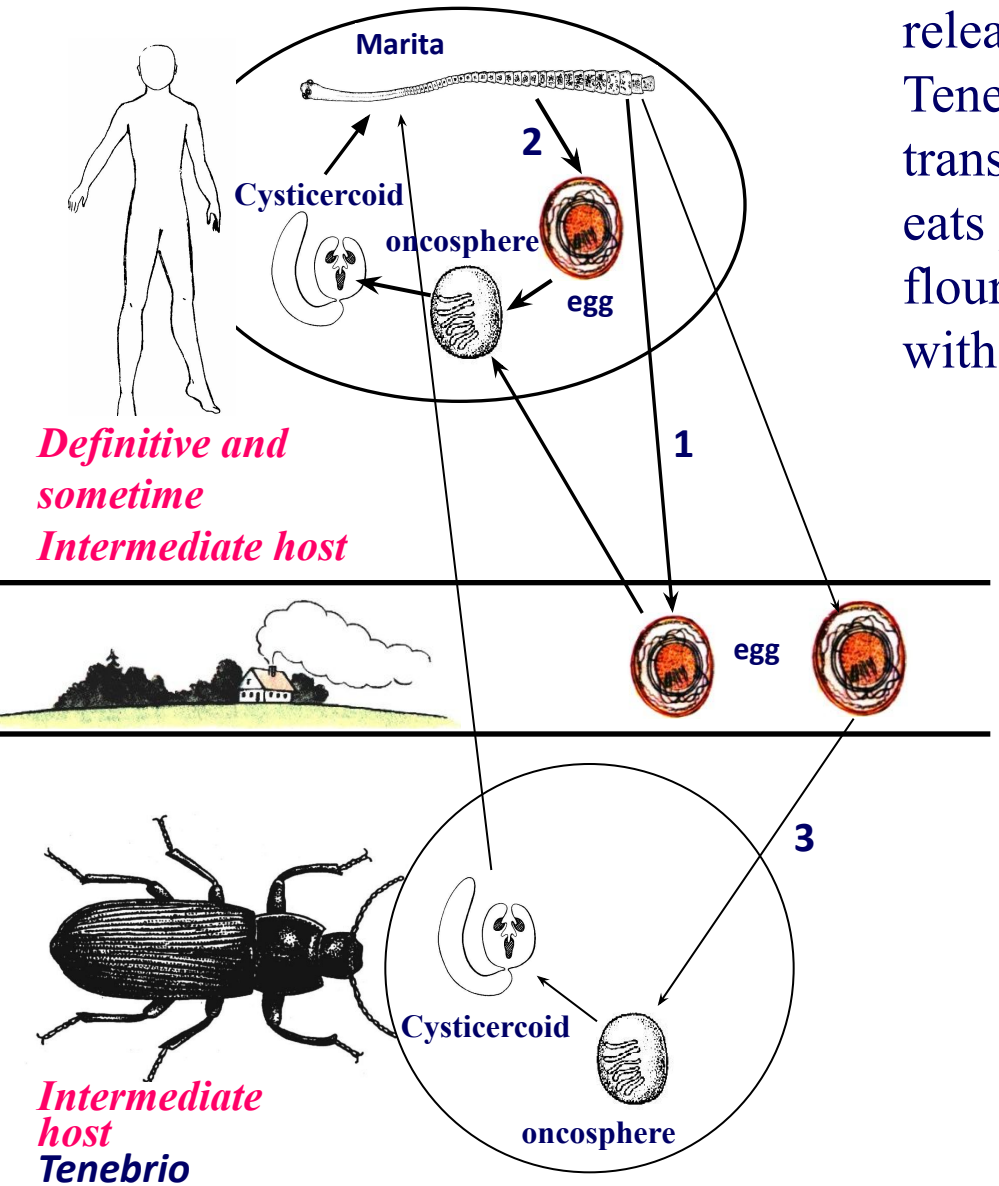




1. When eggs are ingested (in contaminated food or from hands contaminated with feces), the oncospheres which are present in the eggs are released. The oncospheres (hexacanth larvae) penetrate the intestinal villus and develop into cysticercoid larvae. After rupture of the villus, the cysticercoids return to the intestinal lumen, invaginate their scoleces, attach to the intestinal mucosa and develop into adults,. Then they migrate to the ileal part of the small intestine and produce gravid proglottids. Eggs are released with the feces.



2. An alternate mode of infection consists of internal autoinfection. In this case the eggs release their oncospheres without passage through the external environment. Next, oncospheres quickly transform into cysticercoids. After some time a new generation of adult flatworms is formed. The life span of adult worms is 4 to 6 weeks, but internal autoinfection allows the infection to persist for years.



3. Sometimes eggs are ingested by an arthropod intermediate host (by Flour beetles of genus Tenebrio). In this case the eggs release their oncospheres inside the body of Tenebrio. Then oncospheres quickly transform into cysticercoids. When a person eats poorly baked flour products he swallows flour beetles (Tenebrio) which are infested with cysticercoids.

MEDICAL IMPORTANCE

Ordinarily in hymenolepiasis there is no material damage to the intestinal mucosa, but enteritis may be produced by severe infections. Light infections produce either no symptoms or vague abdominal disorders. In fairly severe infections, the patients may show lack of appetite, abdominal pain with or without diarrhea, anorexia, vomiting, and dizziness.

Diagnosis is based on detection of specific eggs in a microscopic examination of feces samples.