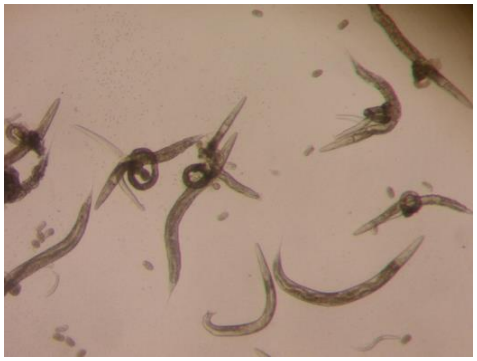
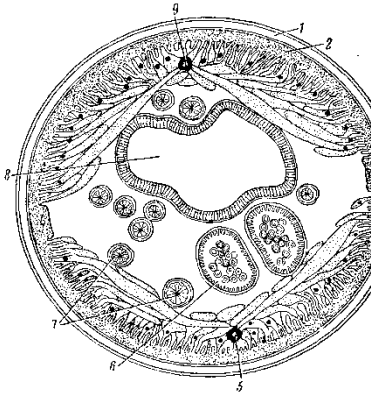


Lecter 13
TYPE NEMATHELMINTHES

Class Nematoda

Basic aromorphozis:



**The appearance of the body cavity;

** Dioecious

(sexual dimorphism)

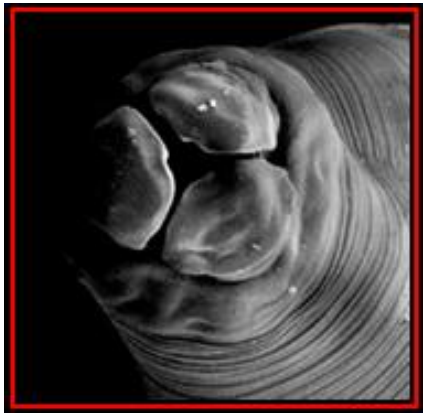
**The appearance of the rear part intestine and the anus;

Characteristic features:

- Multicellular, three-layer animals
- Have an elongated spindle-or strand-like body with pointed ends, non-segmented, covered with cuticle.
- Primary body cavity (due to this nematode's body is round in cross-section).
- Bilateral symmetry.
- Muscular, excretory, digestive (ends with anus), nervous and reproductive systems organs.
- No respiratory and circulatory systems

diagnostic features

Mouth opening at the front end of the body, surrounded by three lips.



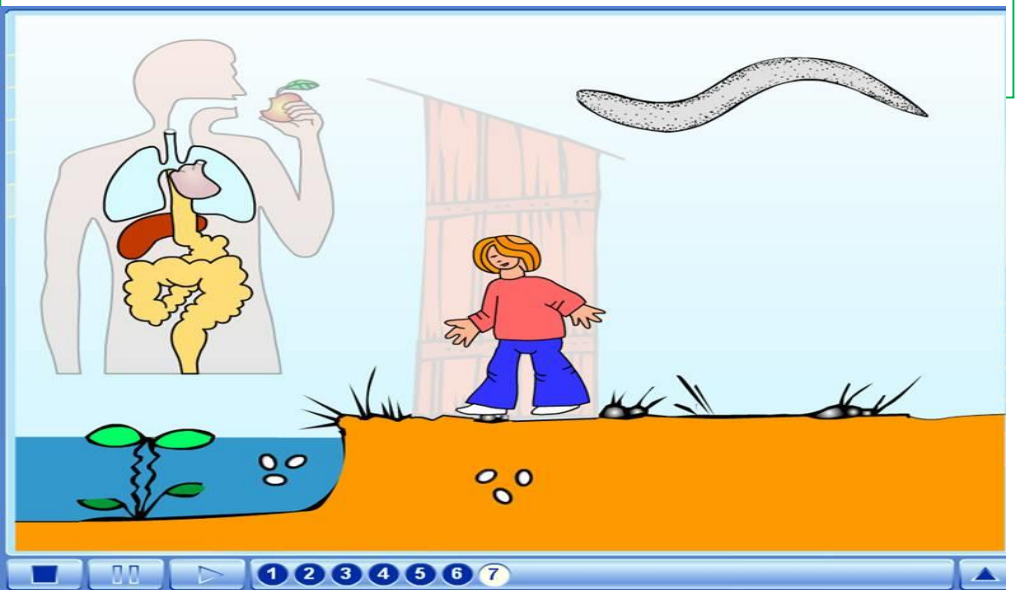
In females, the ventral surface of the body has an outer genital opening.

Males have external sex organs located in the cloaca. Location of spicules, genital papilla and sac (bursa copulatrix), as well as other features and the number of these bodies have a specific character

Nematodes

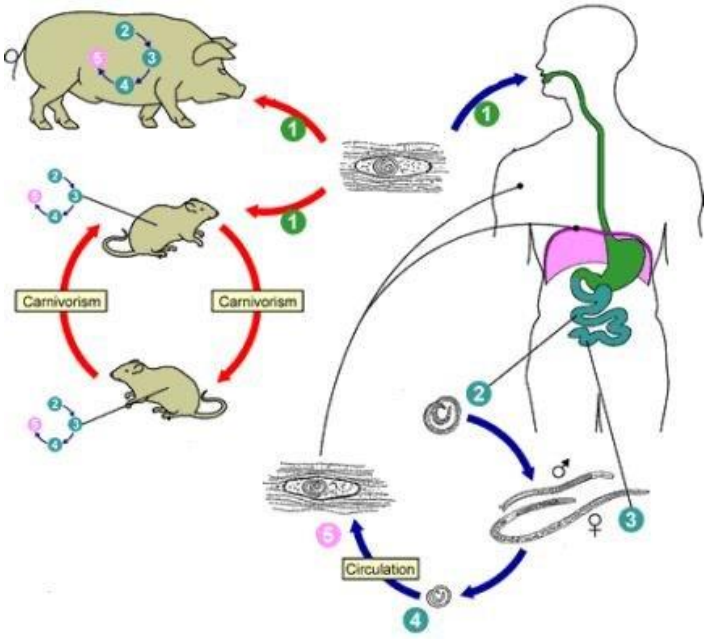
Geohelminthes

- ascaris,
- whipworm,
- pinworm,
- ancylostoma,
- follicle mite



Biohelminthes

- trichinella,
- filaria,
- guinea worm

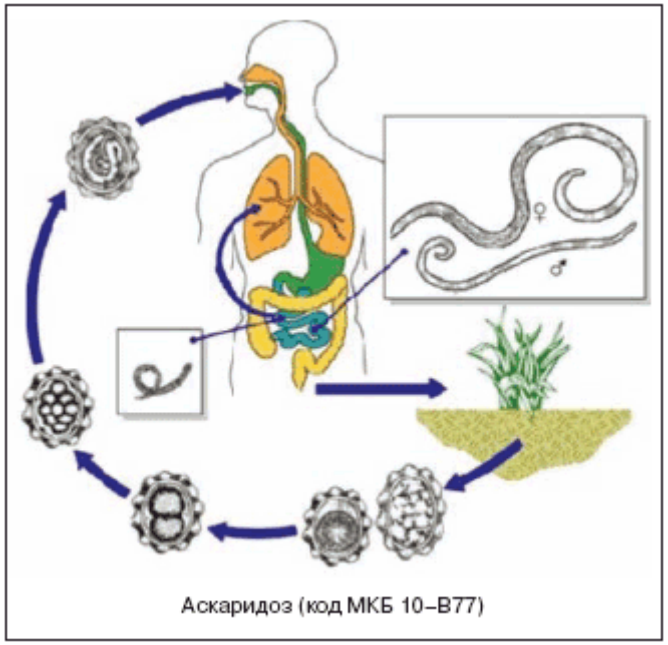


Roundworms - geohelminthes

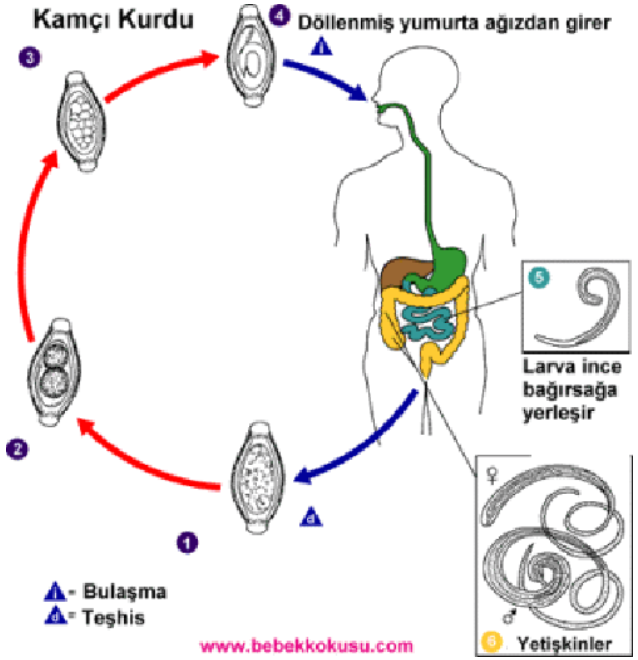
- Geohelminthes live in the intestinal lumen and breed eggs that are excreted in the feces and develop further in the soil with the presence of oxygen and sufficient moisture.
- Eggs over time become invasive, or they develop into larvae, leading a free lifestyle in soil and later becoming invasive.
- These helmintoses occur more frequently in areas with hot and humid climates.

geohelminthes

Geohelminthes developing with migration



Geohelminthes developing without migration

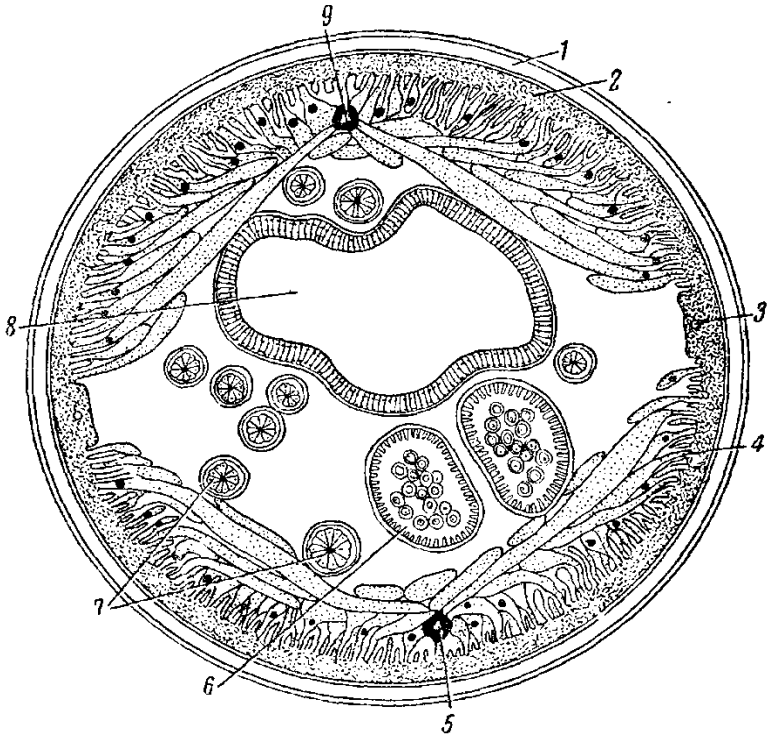


Geohelminthes developing with migration

- Ascaris lumbricoides - ascariasis pathogen
- - Ankylostoma duodenal - hookworm pathogen
- - Necator americanus - necatorosis pathogen.
- - Strongyloides stercoralis – strongyloidiasis pathogen.

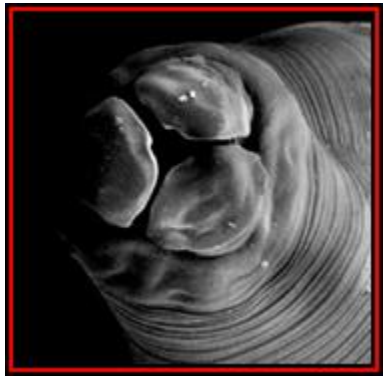
Ascaris human (Ascaris lumbricoides) – ascariasis pathogen

Cross-section of female Ascaris



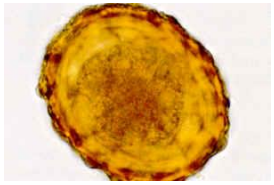
1 - cuticle; 2 - hypodermis; 3 - side channels of excretory organs; 4 - muscle; 5 – abdominal nerve trunk; 6 - uterus; 7 – ovary; 8 - intestine; 9 - spinal nerve trunk.

Ascarids appearance

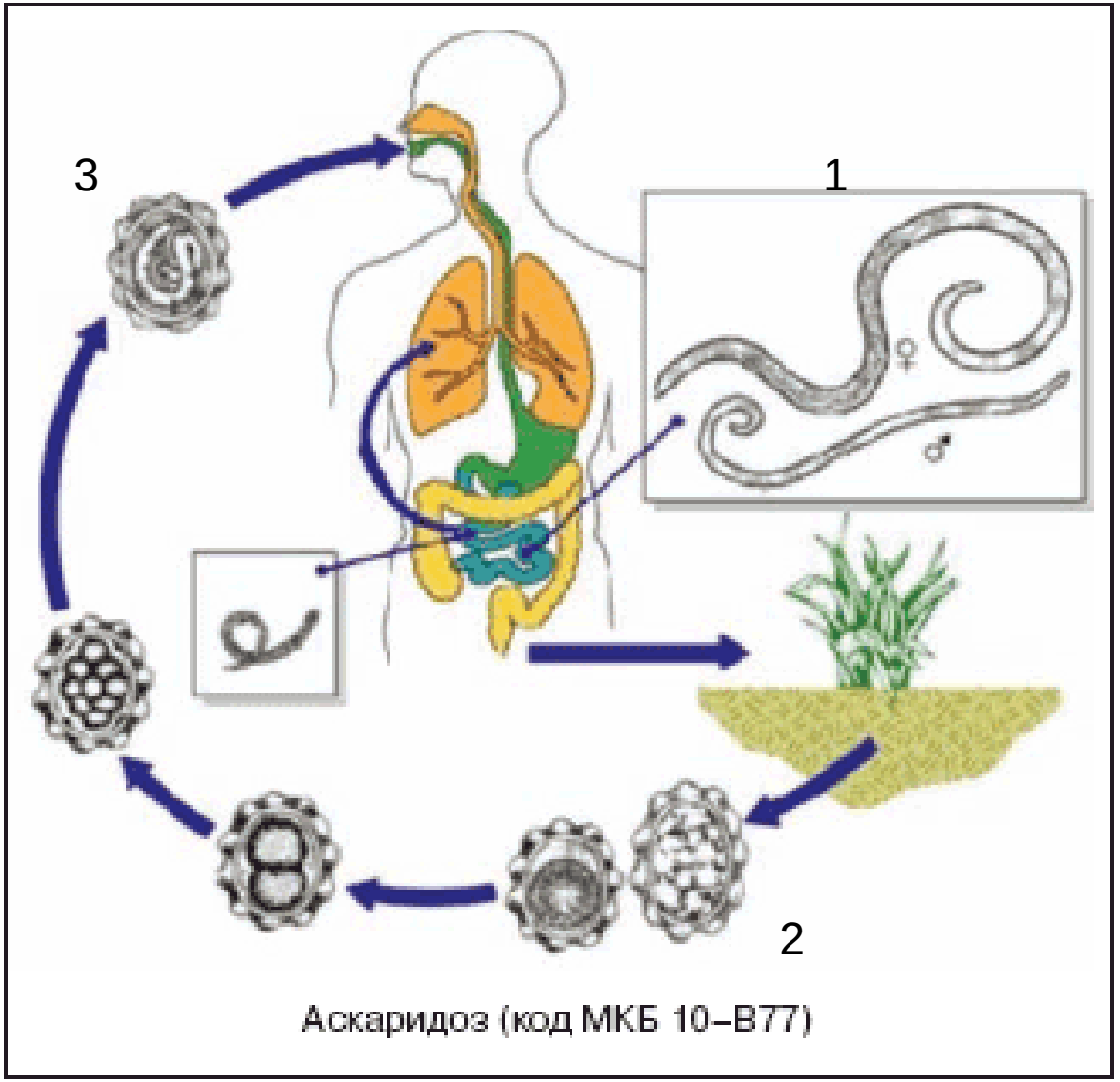


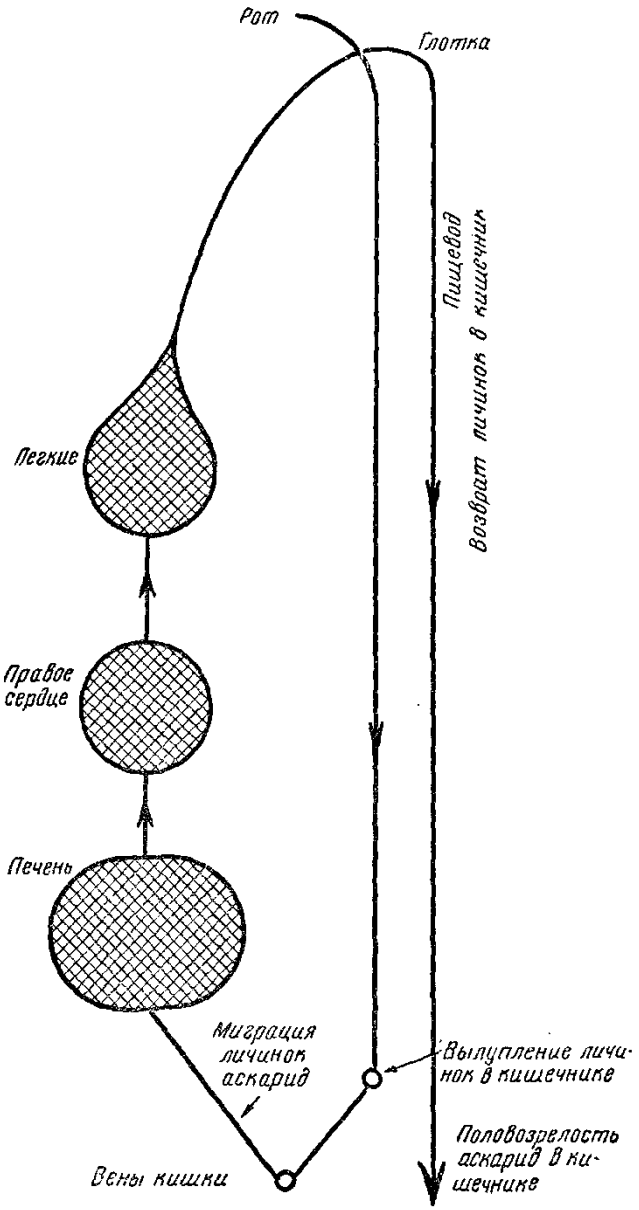
Oral end of roundworm

roundworm eggs



Development cycle of Ascaris lumbricoides



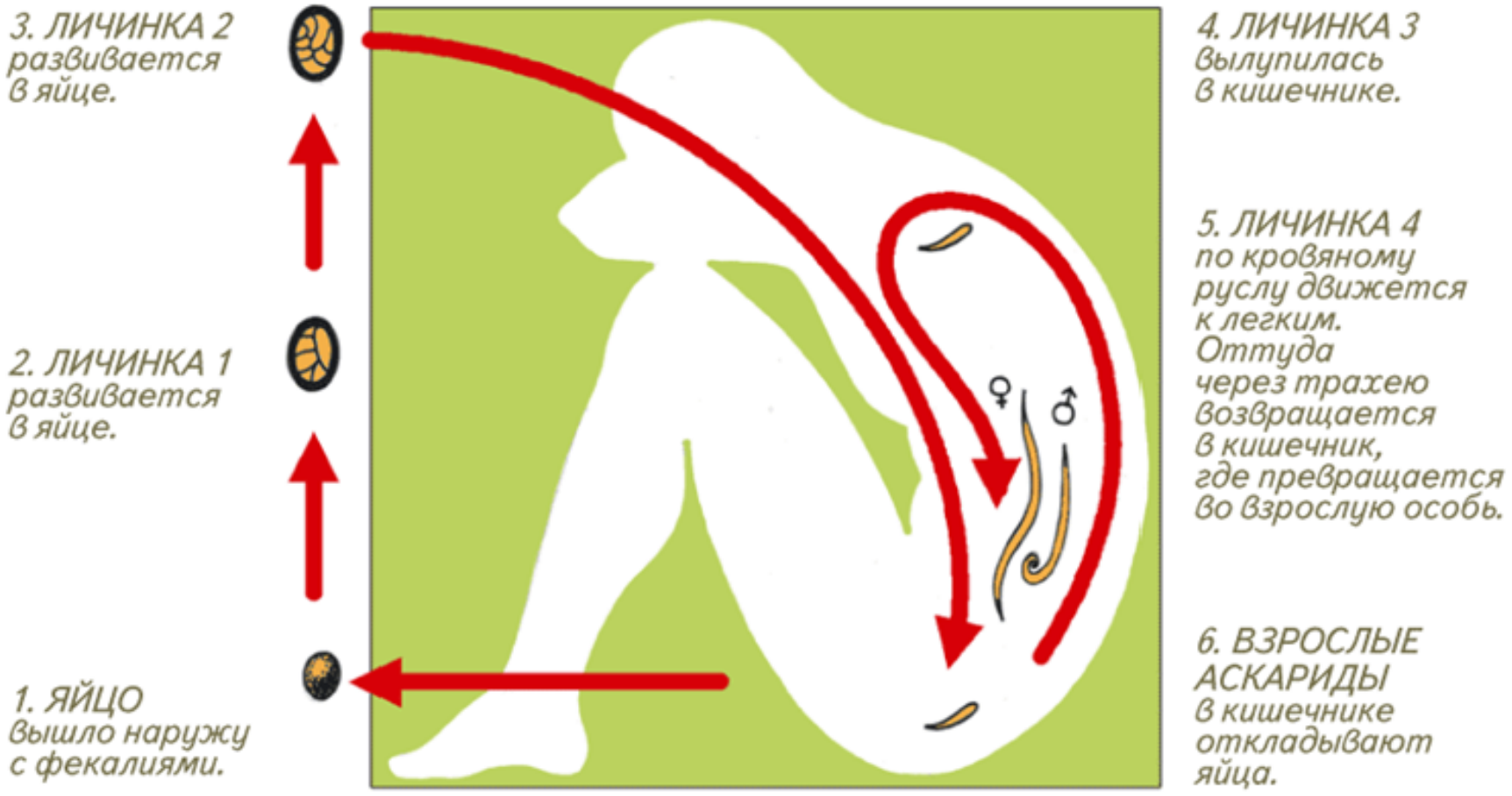


1 - **mature worm in the human gut;**

2 - eggs, maturing in the soil;

3 - eggs with infective larvae on vegetables and berries.

Migration of Ascaris lumbricoides. within the host body



Migration of Ascaris lumbricoides within the host body

- egg with feces goes into the outer environment and should get into the soil (light, humid, warm), in such conditions in the egg larva develops and egg turn to invasive.
- Without hygieny a person can swallow an egg with contaminated water and unwashed food.
- in the gut from an egg larva passes through the intestines - bryzzheyki-vein and then into the hepatic portal vein - hepatic vein – liver – heart - postcava, pulmonary artery, lungs, mouth, throat, swallowed again and returned to the intestine, where it turns into an adult ascaris

Complications of ascariasis

- ileus
- asphyxia
- allergy
- blockage of blood vessels

hookworm disease

- Ancylostoma pathogens -. Under this name unite two closely related species of parasitic roundworms of the Ancylostomatidae family : hookworm (Ankylostoma duodenal), the causative agent of hookworm and American hookworm (Necator americanus) - necatorosis pathogen.

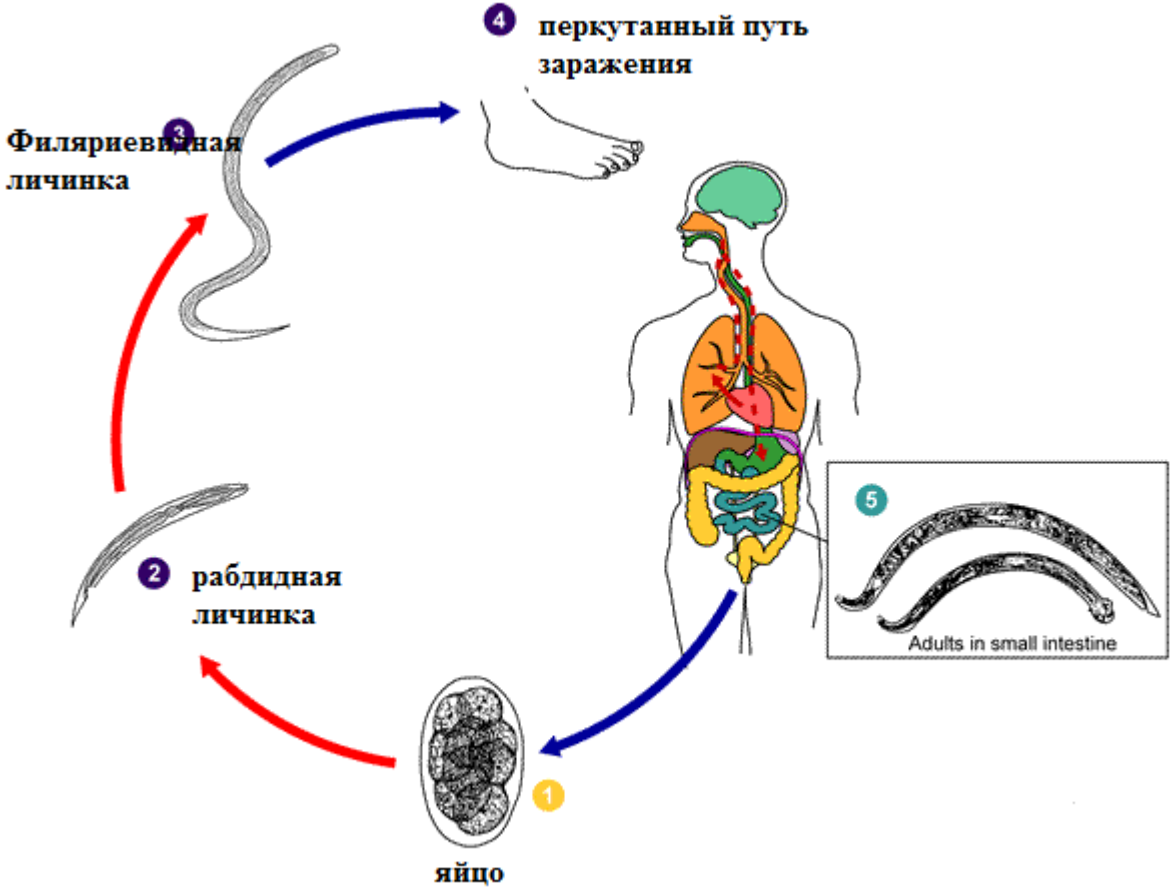
Ankylostoma duodenal

Necator americanus

Ankylostoma duodenal - hookworm pathogen.
American hookworm
Necator americanus – necatorosis pathogen

evidence	Ancylostoma duodenale	Necator americanus
Female body size	9-15 mm	8-13,5 mm
Male body size	7-10 mm	5-10 mm
form	Body along with the head end is curved dorsally	Body bent to the ventral side, facing the head end dorsally
Size and structure of oral capsule	0.21 x 0.19 mm. Two pairs of hook-like teeth. Dorsal teeth are rudimentary	0.10 x 0.10 mm. Two cutting plates. Dorsal teeth are well developed
Position of the genital opening of females	Located in the rear half of the body	Located in the front part of the body
The rear end of the female body	Has a sharp spike	Conically tapered, without cleat
The rear end of the body of the male	Carries a wide and short bursae	Bursa is long and narrow
Structure of bursae	The median dorsal lobe consists of three beams, the middle one is bifurcated into two short three-prong branches	The median dorsal lobe consists of four rays; each of the two secondary beams is split into two short branches
Spicules (appendages of the male genital apparatus)	Both ends are sharp and free spicules. Length of spicules - 2 mm	Both spicules are joined at the ends and end with a common hook

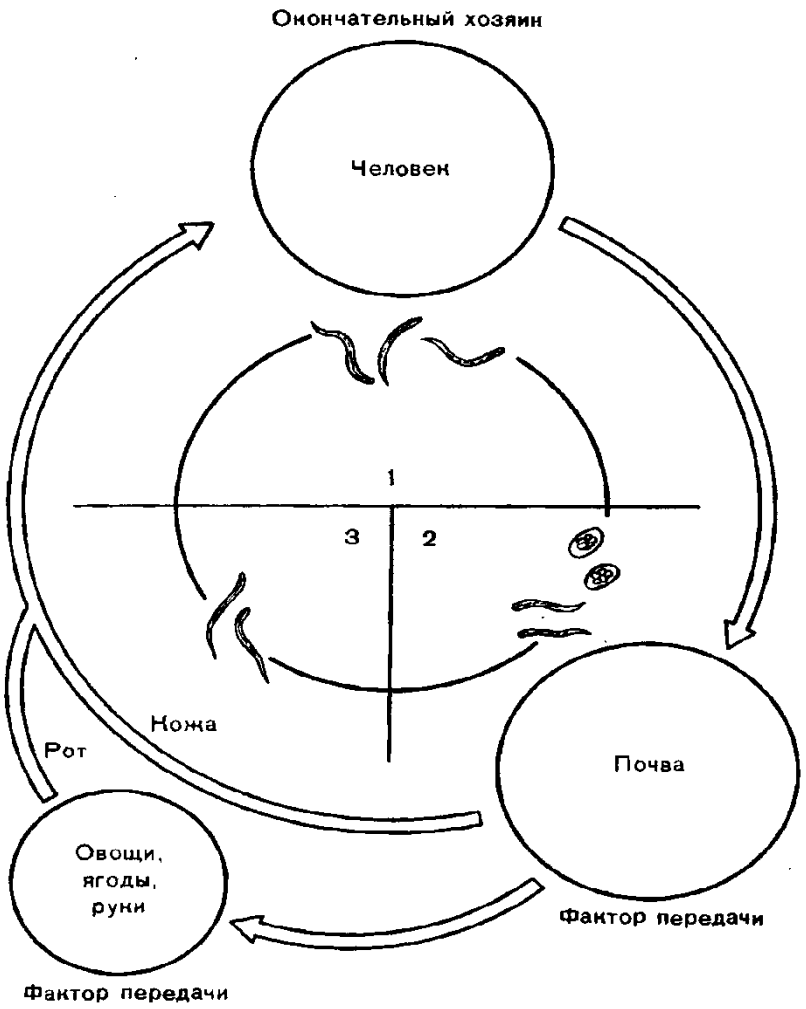
Lifecycle of Ankylostoma duodenal

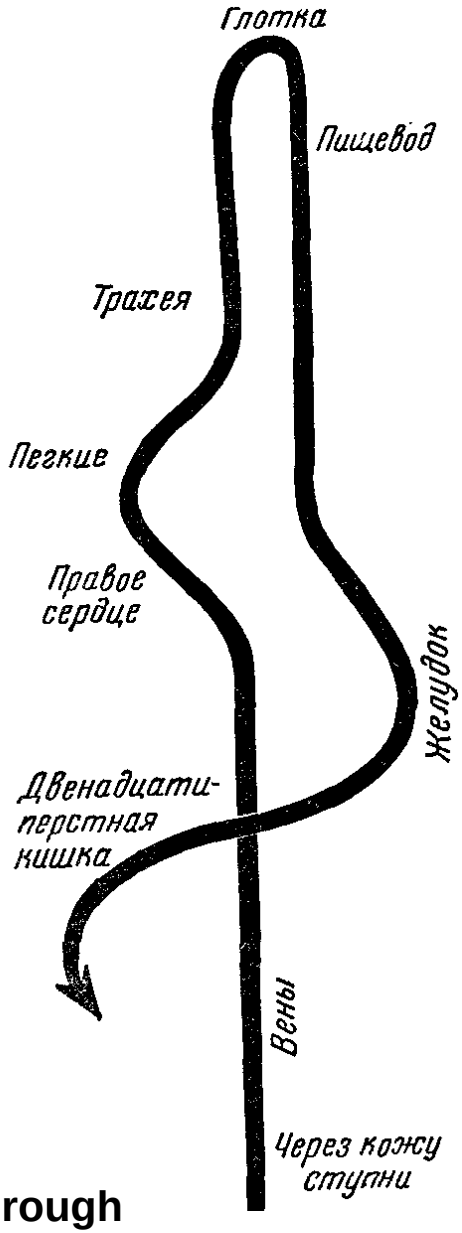


- **Location**: small intestine, duodenum
- **Main host**: people
- **Route of infection**: percutaneous, food
- **Invasion stage**: filariform larva after the second molt
- **Transfer factors:** contaminated land, contaminated vegetables
- **Diagnostics**: detection of eggs in feces and duodenal contents

Prevention: the compulsory wearing of shoes in the outbreak zones, detection and treatment of patients, the improvement of toilets and their processing

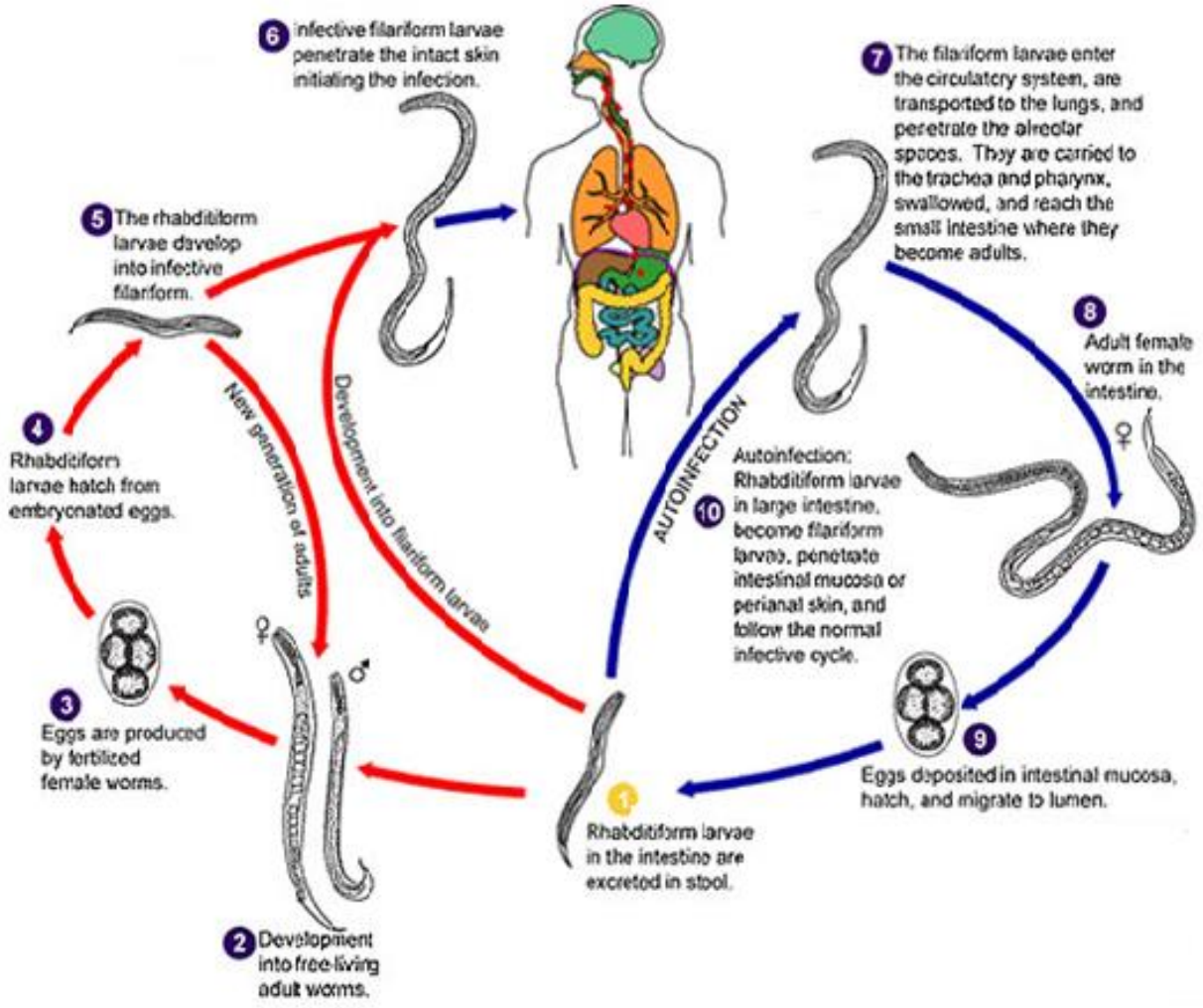
Features of the Ancylostoma development cycle





- **1 - mature worm in the body (gut) of a person;**
- **2 - Ancylostoma eggs with larvae developped in the soil;**
- **3 - infective larvae of Ancylostoma, penetrating into the host through the mouth or skin.**

Intestinal follicle mite Strongyloides stercoralis



- **Disease:** *strongyloidiasis*
- **Location:** *small intestine*
- ***Main host:*** *human, pig, wild mammals (prey)*
- **Route of infection:** *percutaneous, food, intraenteric*
- **Invasion stage:** *filariaform larva*
- **Transfer factors:** *contaminated land*
- **Diagnostics:** *detection of larvae in feces*
- **Prevention:** *the compulsory wearing of shoes in the outbreak zones, detection and treatment of patients, the improvement of toilets and their processing*

During migration worms develop into sexually mature state

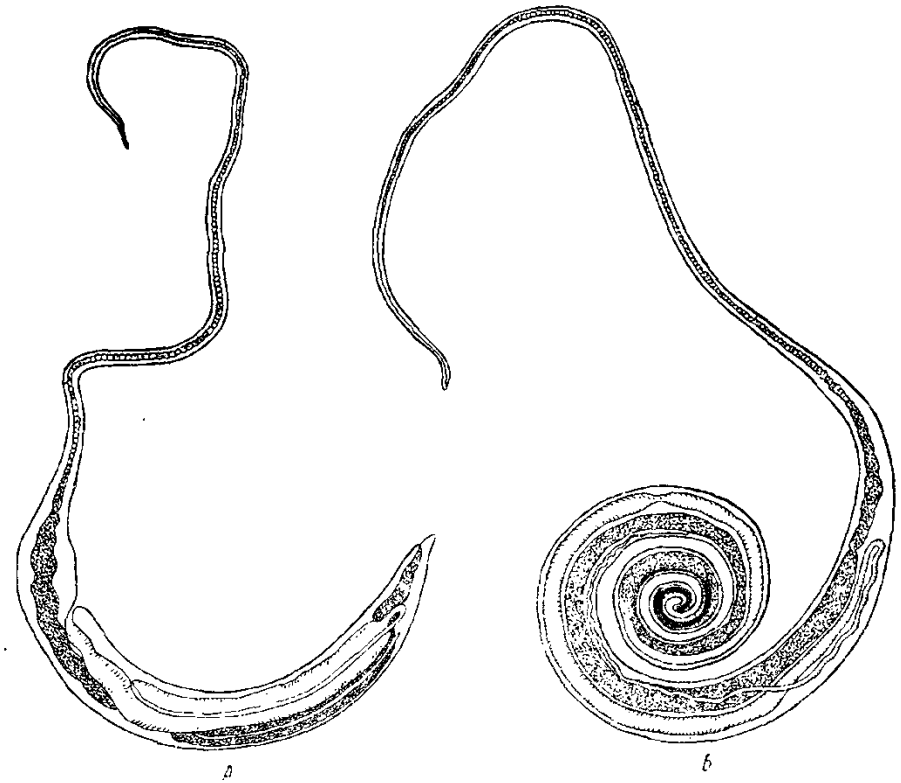
Strongyloides stercoralis

First stage larva in fecal smear

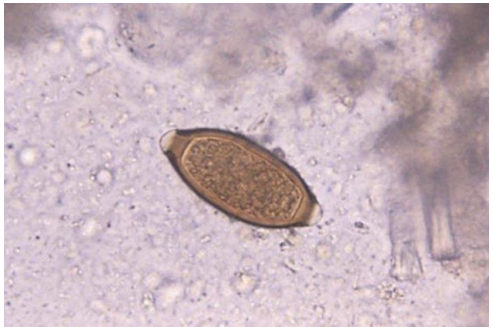
Geohelminthes developing without migration

- This group of worms represents the most specialized geohelminthes, eggs of which still require the presence of oxygen, while the developing larvae need no oxygen.
- ***Whipworm Trichocephalus trichiurus*** - *pathogen of worm infections.*
- ***Children pinworm Enterobius vermicularis*** **–**enterobiosis pathogen

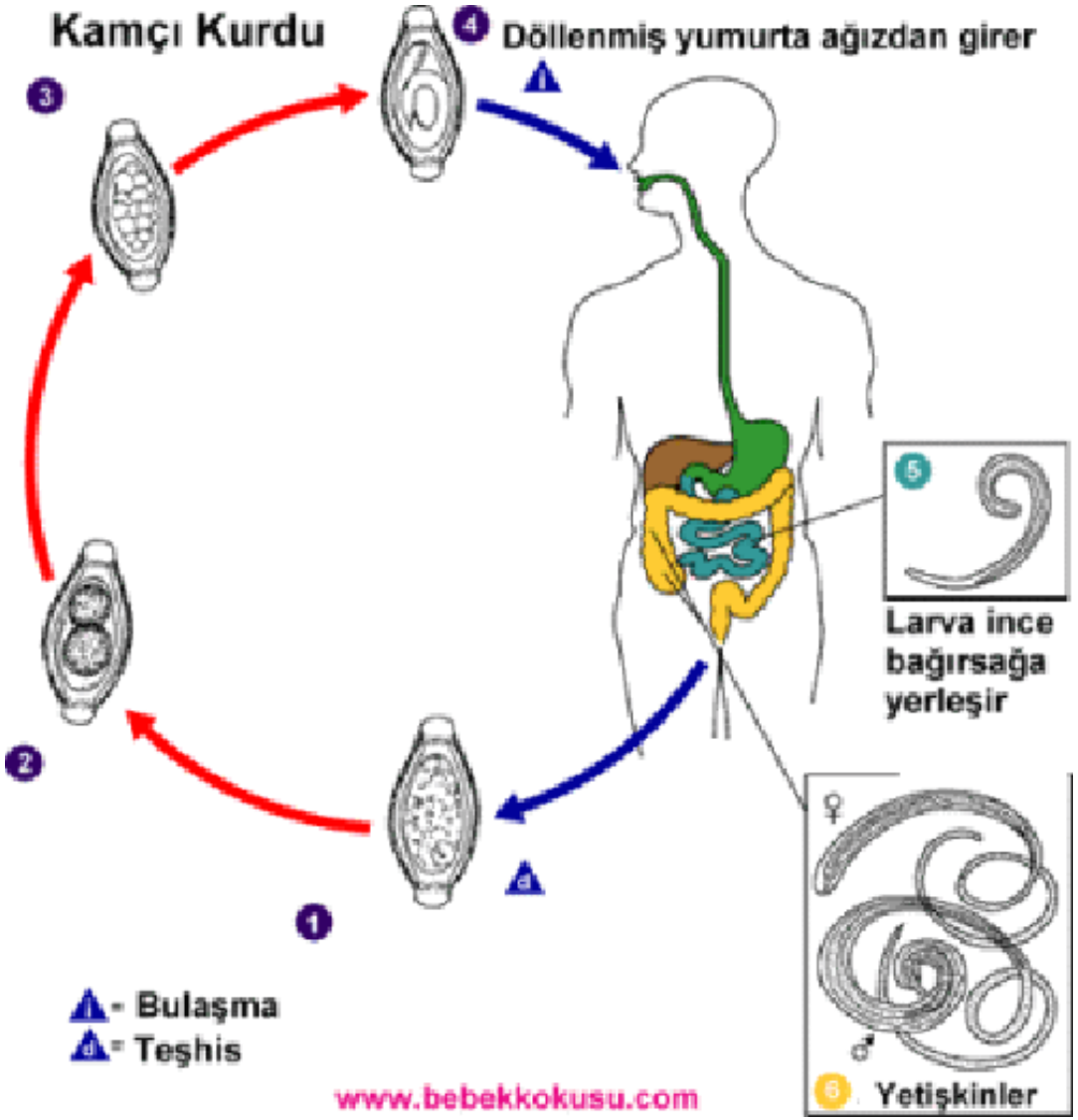
Whipworm Trichocephalus trichiurus



A - female; B - male.

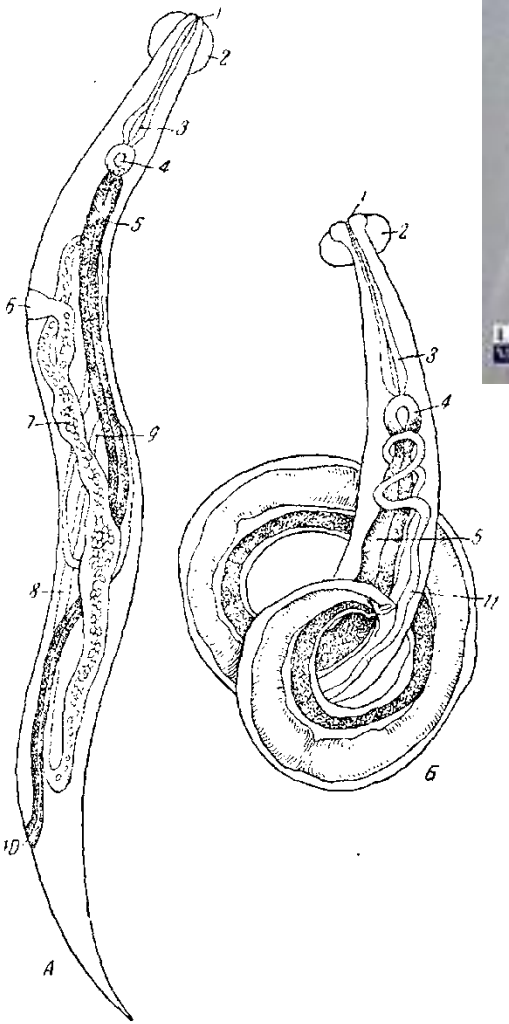


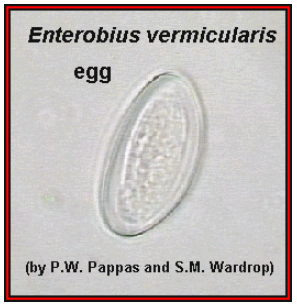
Development cycle of Trichocephalus trichiurus



- **Disease:** trichocephalosis
- **Main host:** people
- **Location:** *the cecum, the upper sections of the intestine*
- **Route of infection:** oral
- **Invasive stage:** egg
- **Transfer factors:** unwashed hands, vegetables, fruits, unboiled water
- **Carriers:** mechanical
- **Diagnosis**: detection of eggs in feces
- **Prevention:** Washing hands, vegetables, boiling water, fighting flies, cockroaches

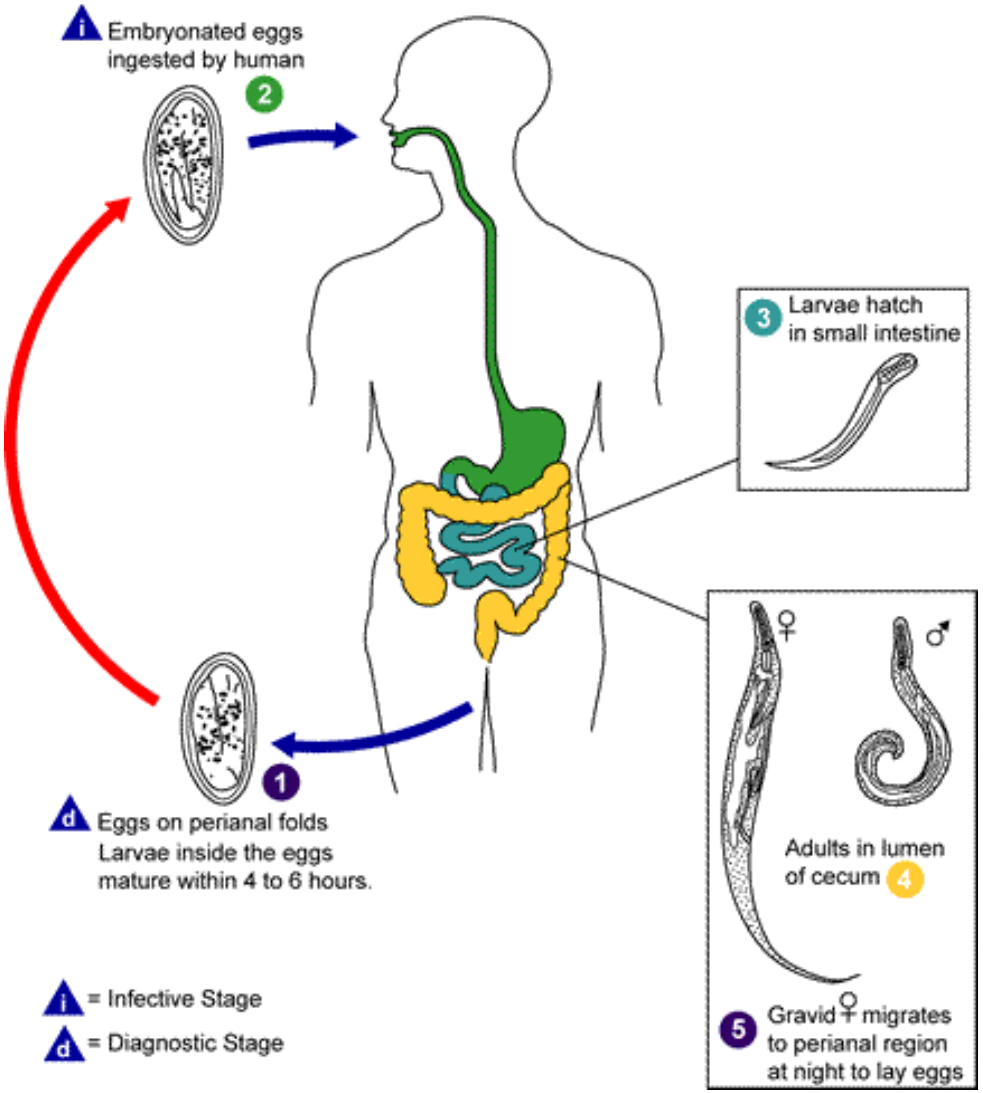
Children pinworm (Enterobius vermicularis) – enterobiosis pathogen





- **A - female; B - male:**
- **1 - mouth; 2 - vesicle; 3 - esophagus;**
- **4 - bloating (bulb); 5 - intestine;**
- **6 - genital opening; 7 - uterus;**
- **8 - oviduct; 9 - ovary; 10 - anus;**
- **11 - testis**

Development cycle of Enterobius vermicularis



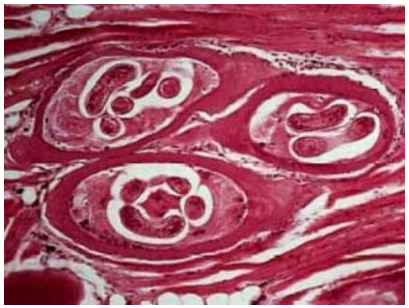
- **Disease**: *enterobiasis*
- **Main host**: *people*
- **Location**: *lower part of the small and the upper sections of the intestine*
- **Route of infection**: *oral, contact-household, autoreinvasion*
- **Invasive stage**: egg
- **Transfer factors**: *unwashed hands, vegetables, fruits, crockery*
- **Diagnostics:** *scraping with perianal folds*
- **Prevention:** *Washing hands, nail care*

Roundworms - biohelminths

- All nematodes of this group are **live-bearing,** infect humans, and most of their development cycle is carried out in the human tissues.
- Intermediate hosts are very diverse - from cyclops and insects to bears and humans.
- Definitive hosts may be different wild and domestic animals, so diseases that cause these parasites belong to the category of **natural focal**.

Trichinella (mature individuals)

People - basic and intermediate host



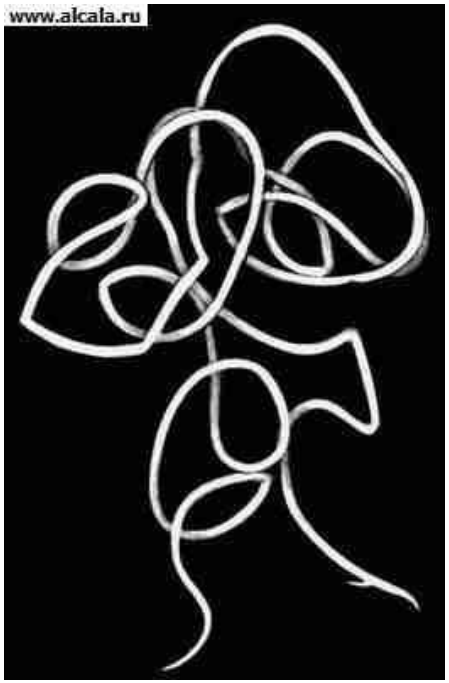
larva Trichinella

basic and intermediate host

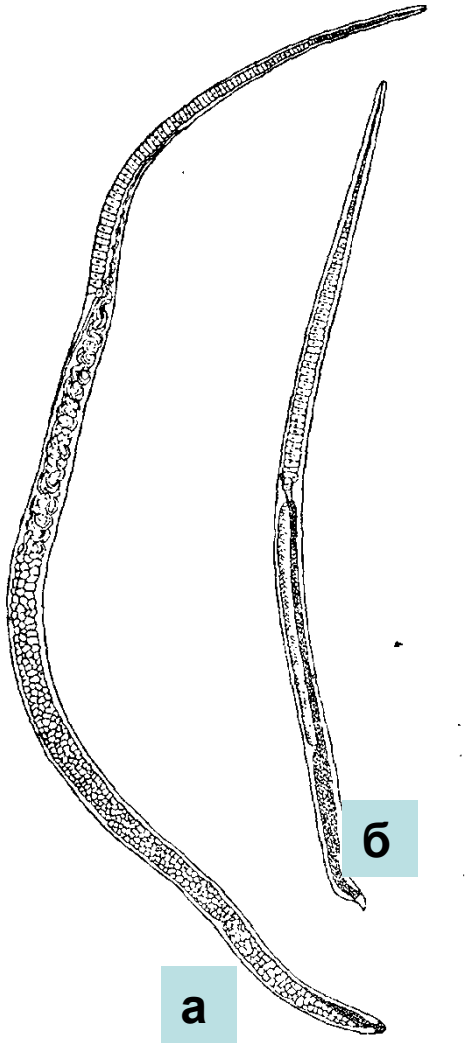
Roundworms - biohelminths

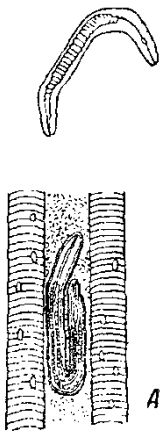
Biohelminths infection occurs by ingestion of larvae with the tissues of the intermediate host (Trichinella spiralis)

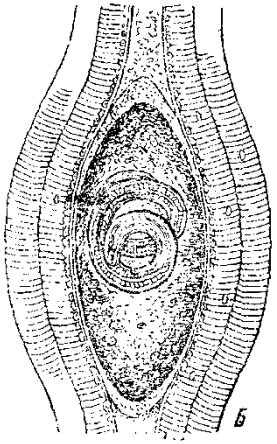
•***Biohelminths infection is transmissible (Dracunculus medinensis)***



Trichinella spiralis





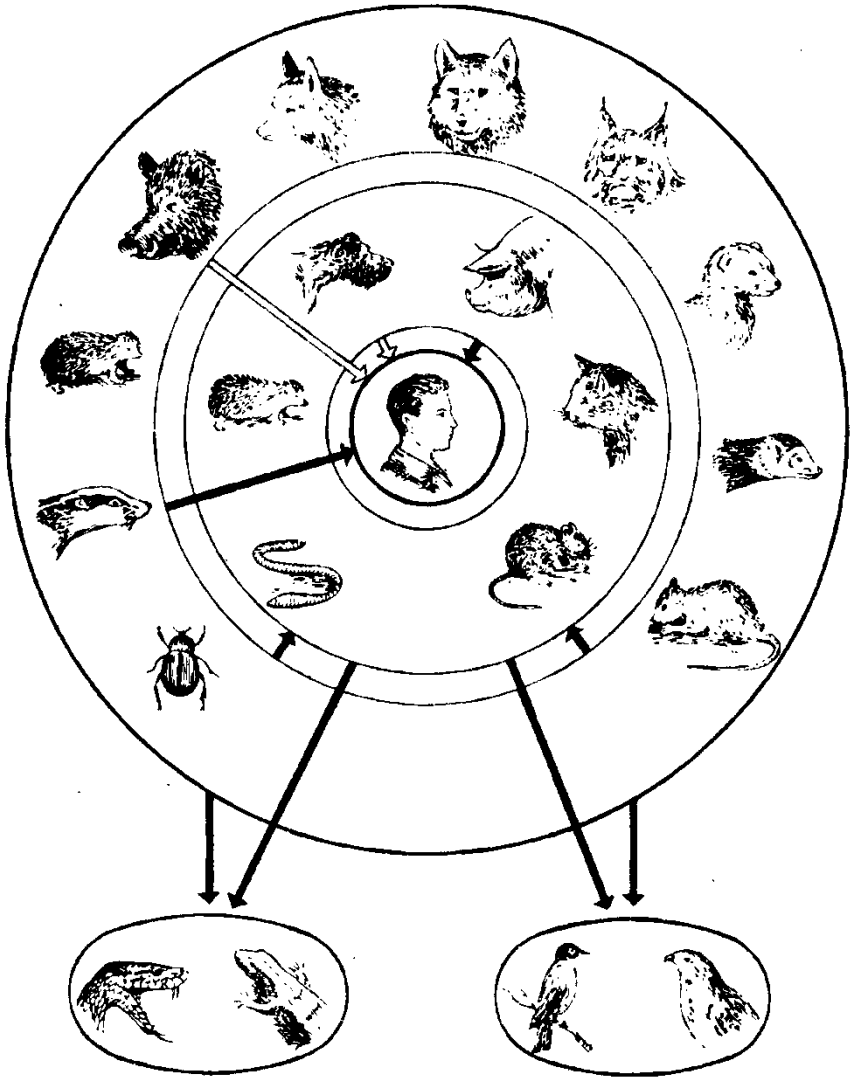


A **b** **c**

- **A**- unencapsulated-larva;
- **b, c** - encapsulated larva

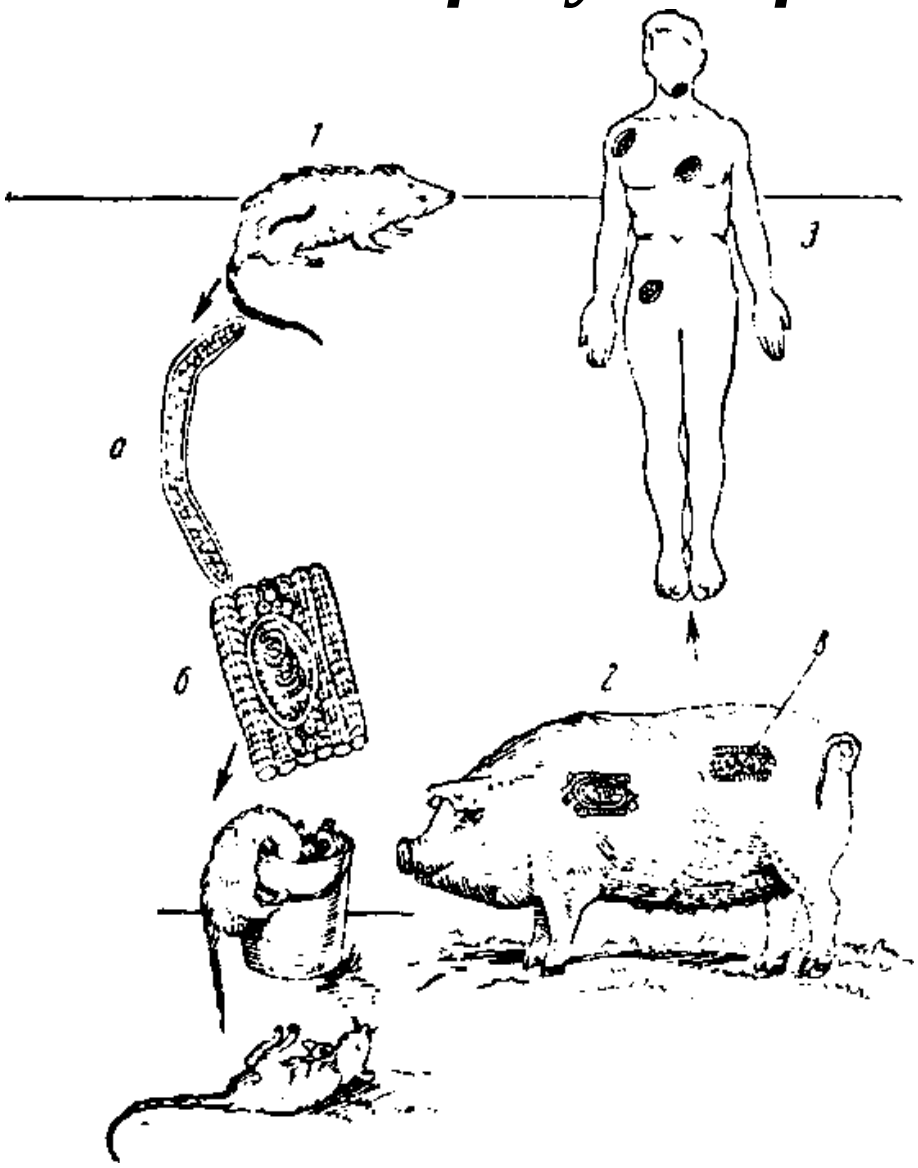
a-female; **b**-male

Circulation path of Trichinella in nature



- The outer circle includes animals of natural community (biocenosis) that eating each other support circulation of Trichinella in the wild.
- The inner circle includes animals in populated areas, that are infected by eating wild animals or each other.
- People become infected through the meat of wild and domestic animals.
- Birds and reptiles can sometimes participate in the dissemination of Trichinella as a mechanical agent.

The life cycle of Trichinella spiralis

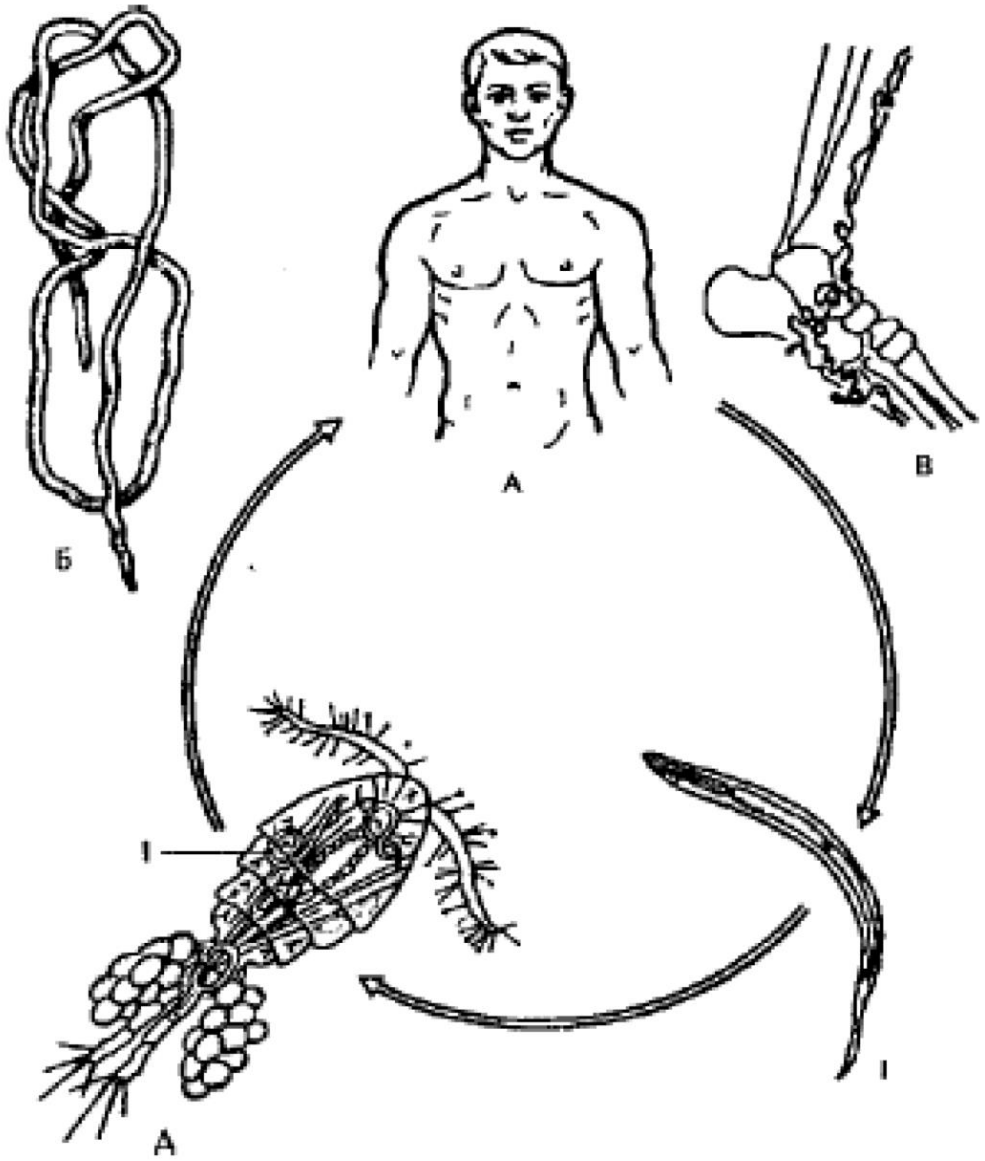


- **Disease**: Trichinosis
- **The main host and intermediate host**: humans and animals (pigs, rats, bears)
- **Location**: small intestine, striated muscle
- **Route of infection**: nutritional
- **Invasive stage**: larvae in meat
- **Diagnostics**: biopsy, immunodiagnostics
- **Prevention**: do not eat contaminated meat; personal social and health education

Development cycle of Dracunculus medinensis

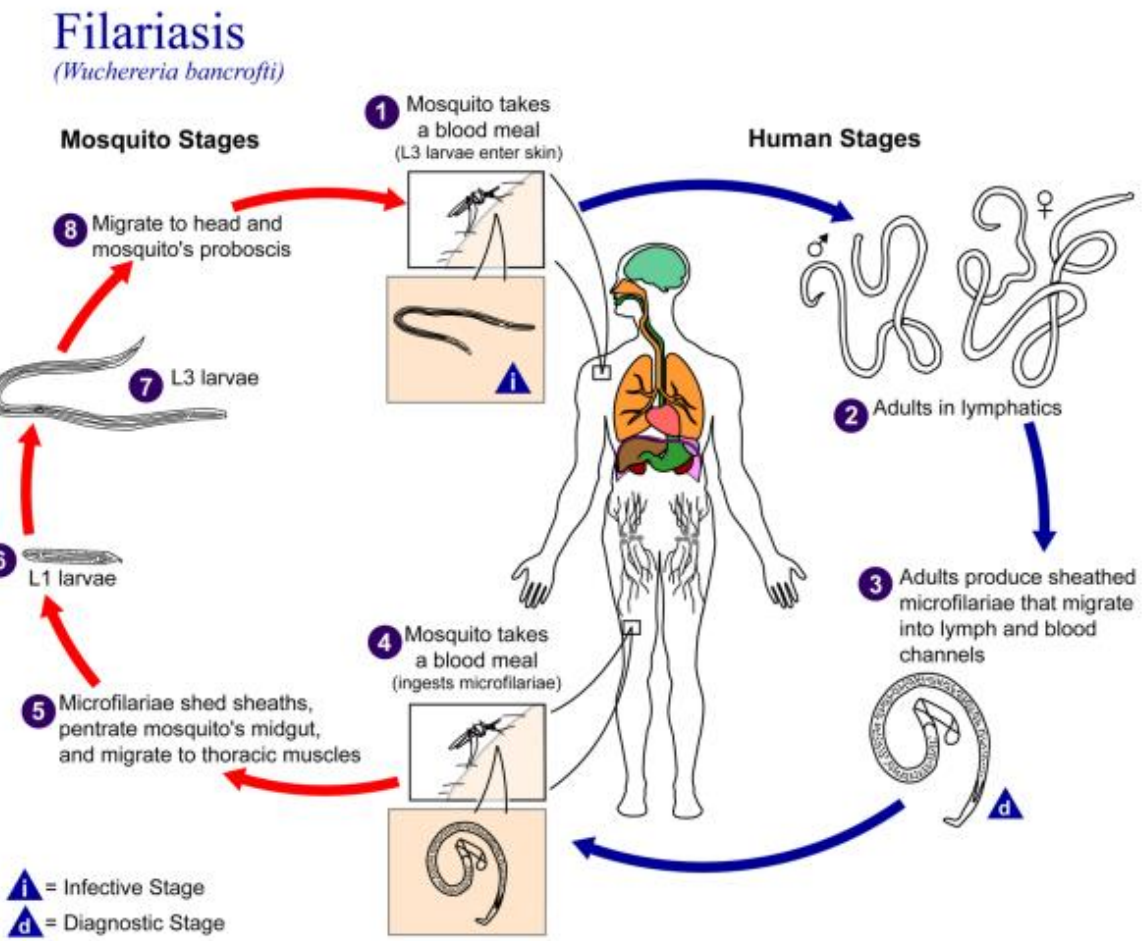
- А - Final host - the person.
- Б - female.
- В - localization of the parasite in the human leg .
- Г - invasive larva born by female.
- Д - Cyclops infected by larvae:

1 - larvae in the body cavity of the Cyclops.



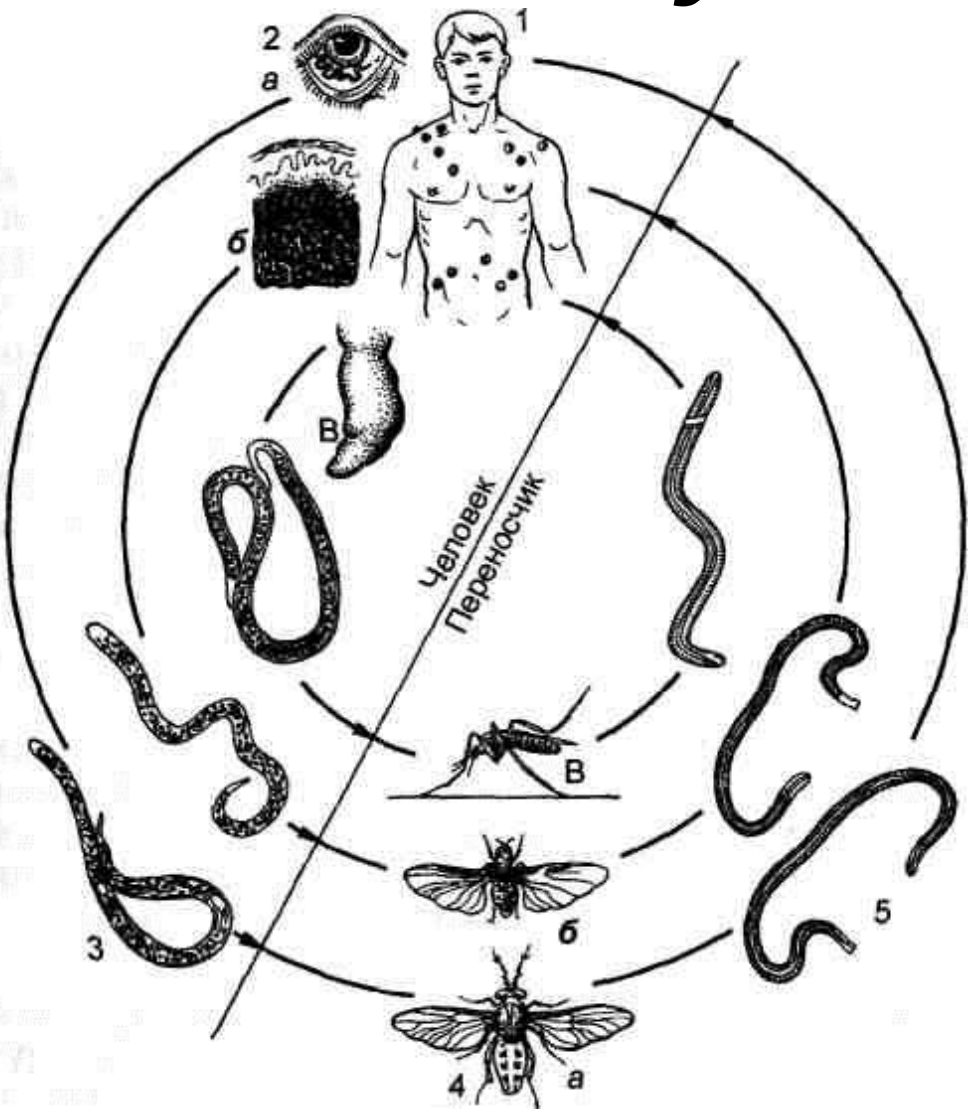
- **Disease**: dracunculiasis
- **Main host**: man, monkey, domestic and wild mammals
- **Intermediate host**: freshwater crayfish - Cyclops
- **Location**: under the skin, most often the legs, at the joints
- **Route of infection**: nutritional
- **Invasive stage**: larvae in Cyclops
- **Diagnostics**: Finding guinea worm larvae in the zone of characteristic skin changes, immunodiagnosis
- **Prevention**: boiling water, detection and treatment, personal social and health education

RARE Filariasis IN HUMANS



- ***Infection occurs in a transmissible way***.
- **Wuchereria bancrofti** – *wuchereriasis pathogen*
- **Onchocerca volvulus** - the causative agent of onchocerciasis
- **Loa loa** – Loiasis pathogen

Life cycles of filaria



а - Loa loa;

б - Onchocerca volvulus;

в-Wuchereria bancrofti

1 - definitive host - the person;

2-specific damage caused by filariae (a - migration in an eye conjunctiva, b - subcutaneous node containing adult nematodes-bucnemia);

3 - microfilariae from the bloodstream;

4 - filarial agents (a - horseflies, b – midges в - mosquitoes);

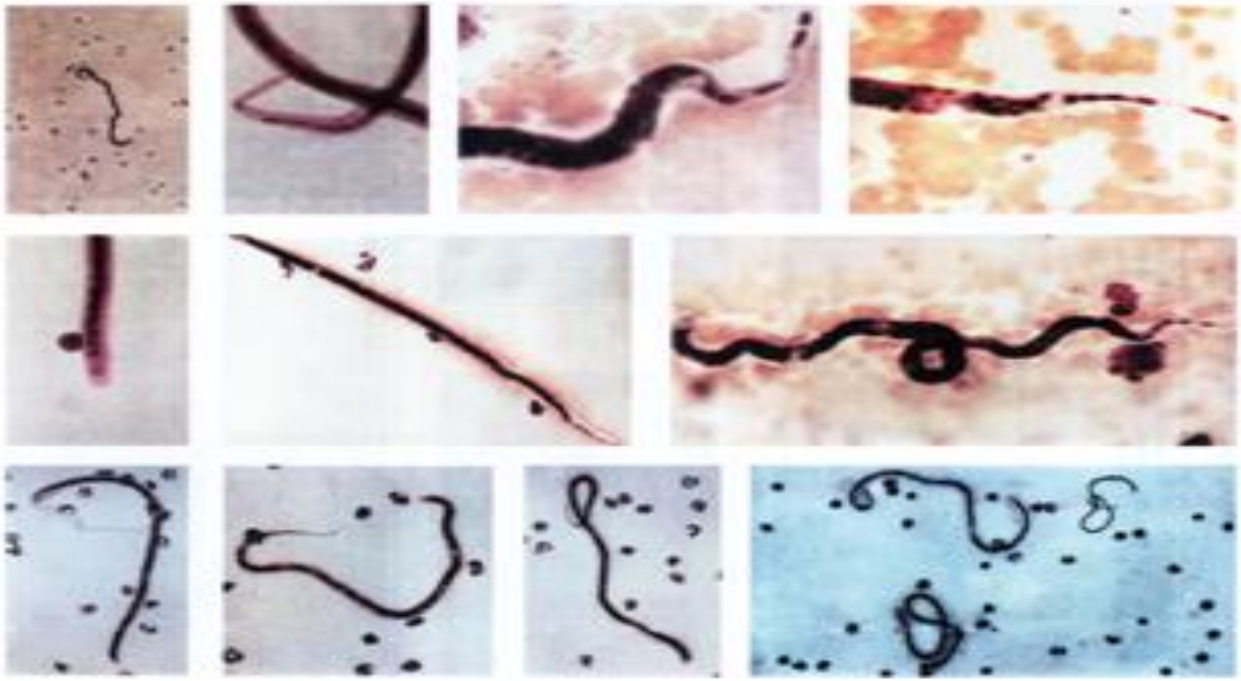
5 - infective larvae of intermediate hosts

Filaridae family, Spirulidae order (biohelminths)

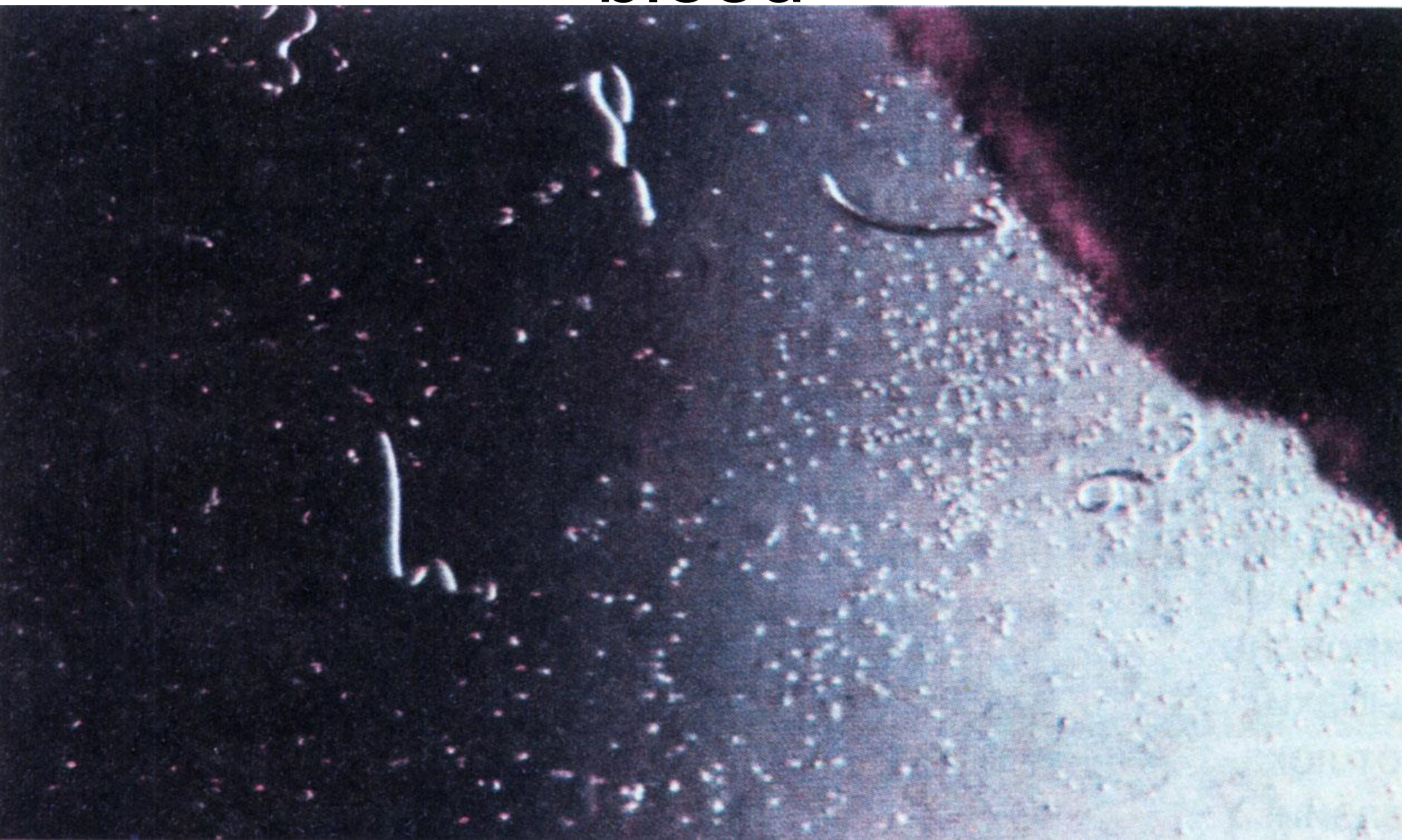
- have a log threadlike body, thin at the ends, dioecious. Females are viviparous.
- A man is an ultimate host.
- Arthropods (mosquitoes, horseflies, midges, gnats) are intermediate hosts.
- Transmissible helminthiasis.

- **Adult** filaria parasite in closed systems and cavities of the human body.
- **Larva** of microfilariae circulate in the blood.
- They are characterized by daily migration between deep and peripheral vessels, which are subject to a daily rhythm of physiological functions of the host

Микрофилярии в толстой капле крови



Mikrophilariae in a thick drop of blood



Blood-sucking insects while biting humans infect them with microfilariae . They penetrate in the body tissues and cavities, wherein they moult twice , increase in size and 2-3 weeks later return to the intestine cavity and then accumulates in the oral cavity and in the proboscis of the insect. Such an insect biting a person infects them. Through the skin microfilariae enter the blood , and then deposit in the tissues of different organs, where they continue to develop within the next 1-2 years, developing into adult parasites.

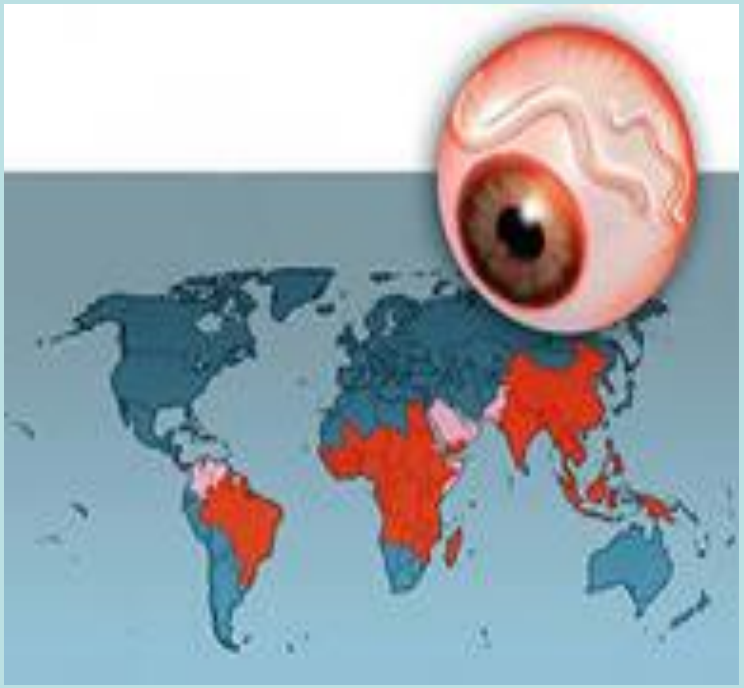
In India filariasis infections has been marked

Education plays a greater role in the fight against filariasis

bancroftosis

- ***Transmissible anroponoz, biogelmintosis***
- ***The only definitive host is people***, in whose lymph system parasitize adults helminths.
- *The female* gives birth to microfilariae, which migrate into the circulatory system, travelling during the day from the deep to surface vessels.
- In the day time high larvae are in the vessels of the lungs, heart, muscles, and at night they are moving into peripheral vessels.
- ***Intermediate hosts*** and agents are mosquitoes Anopheles, Culex, Aedes, which are infected by biting an infected person

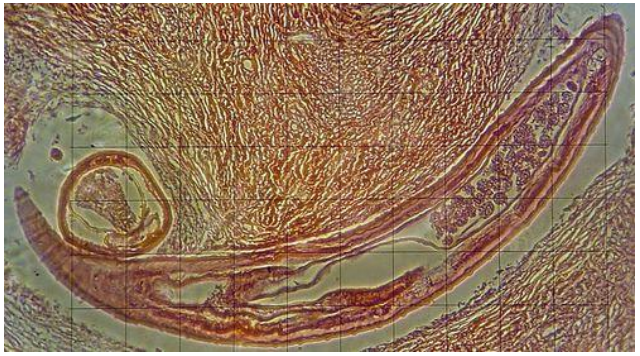
- ***Dirofilariosis*** - new parasitic disease that infects people in the summer and get sick in the winter! Helminthiasis is transmitted by mosquitoes of the genus Culex, (or Aedes) living in basements that with arrival to the apartment, can suck the blood of humans, cats, dogs.
- Tags: eye injury; migrating local tumor; cardiac pathology.
- 28 endemic regions of Russia (including the Orenburg region) and in India. 200 people have been diagnosed with tumor the size of a bean with microfilariae D.repens



Onchocerca volvulus.

Threadlike worms has flat out to the ends body length of about 350-500 mm in females and 19-42 mm in males . Host pathogen is only a man and a carrier - female blackflies Simulium damnosum. Onchocerciasis is often called river blindness because the carriers live along the river banks . Adult worms settle in human lymph nodes , where the females give birth to many larvae , called microfilariae . These larvae migrate further beneath the epidermis of the skin, where they can re- enter the body of lice and thus continue the cycle of the parasite . Part of microfilariae comes into the human eye and passes into all the tissues. In the eyeball they cause inflammation , bleeding and other complications leading to the eventual loss of vision.

There are about 18 million people suffering from onchocerciasis , of which approximately 600,000 observe a significant loss of vision or blindness . The most frequently recorded disease in West and Central Africa, India. Cases are found in Yemen and six countries of Latin America.



New and returning helminthiasis

Pentastomozy (linguathuleasis; armilliferosis snakes and humans; sparganosis - random human parasites); anixakidosis

Anizakidosis- worm infestation which causes the larval stages of nematode parasitism anisakids family in the gastrointestinal tract of humans.

Disease symptoms: cramping resembling appendicitis and acute enteritis. Introduction of larvae in the mucosa contributes to ulceration, bleeding, and perforation leading to peritonitis.

- ***Anizakidosis***.
- **Distribution**: Japan, Korea, China, Taiwan, India, England, Belgium, Norway, France, Europe, USA, Latin America, along the Pacific coast.
- **Infestation**: fish from 25 to 100% mackerel, chum salmon, herring, halibut, capelin, cod, flounder (Sea of Okhotsk), 28% squid (Pacific)
- Over 8 years of invasive fish increased 8 times (North Sea)

- ***Pentastomosis*** - old forgotten parasitic problem in the 20 years of the twentieth century
- ***There are cases of sick people in India***
- In 2004, a large outbreak in 2000 in Krasnodar region
- **Symptoms**: migration, lymphatic system, liver, strep throat, swelling of respiratory organs + airway allergy.

GNATOSTOMES-Gnatostomosis

- ***Gnatostomes***, male to 2.5 cm, and female 5.5 cm
- Intermediate host : copepods (Cyclops) in which the eggs turn into larvae and crustaceans along with the fall in the reservoir host (fish , frogs , reptiles, birds) , forming cysts to 1mm in diameter.
- Definitive host : domestic and wild cat , marten , canine and porcine (parasites in the stomach) .
- Man is an optional host. People become infected by drinking raw water , when used raw meat fish , frogs and birds . Usually a person has larvae found in the subcutaneous tissue in tumor sites or as migrating larvae. There are more than 100 cases in the countries ***of India*** , Burma, Japan, Malaysia, Thailand. Thailand has observed a case of death in patients with a clinical picture of eosinophilic encephalitis .
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- ***Sparganosis.*** Infection: eating thermally unprocessed meat of pigs, frogs, snakes, containing plerocercoid spiromery or drinking water containing cyclops with procercoids
- Found in **India**, Korea, Vietnam, Japan, Australia, America, Africa, Russia.
- First host is Cyclops; second host is amphibians, reptiles, birds, people; third - feline, canine.
- Symptoms: plerocercoid settles in the brain and forms migrating "tumor" in the subcutaneous adipose tissue, under eye conjunctiva

Toxocariasis

Pathogenesis of the disease

•People become infected with toxocarosis by ingestion of toxocara eggs with food and water contaminated by the feces of dogs, as well as by contact with infected dogs; hatched larvae migrate from the intestine through the intestinal wall and enter the blood vessels into various organs and tissues , where they are encapsulated and maintain a long-term biological activity, causing the larval form of the disease. Toxocara larvae of cats after migration come again into the intestine where they turn into a mature stage of development (adults) causing imaginal form of the disease .

Toxocariasis

- **Course of the disease . It mostly affects children of 1-4 years. The disease occurs with florid allergy symptoms : itchy rash , fever, hepatosplenomegaly , bronchopneumonia with painful bouts of coughing and choking, facial puffiness . In case of eye toxocarosis irreversible eye damage is possible, including abscess or migrating larvae in the vitreous and keratitis , including the loss of vision. Duration of illness varies from several months to several years.**

Diagnostics of the toxocariasis disease

- Diagnosis of toxocariasis is based on clinical data and laboratory results . Serological tests are carried out with toxocariasis antigen. Stable blood eosinophilia is noted (70-90 %) and erythrocyte sedimentation rate of 50 mm / h , hyperglobulinemia . Diagnosis of imaginal toxocariasis is set by detection toxocara eggs in the faeces

Prevention of toxocariasis

general sanitary measures to protect the environment from pollution by dogs and cats' feces, deworming the animals, creating special places in cities for dogs and cats walking out, personal hygiene, washing hands after contact with these animals .

- ОКСАНА