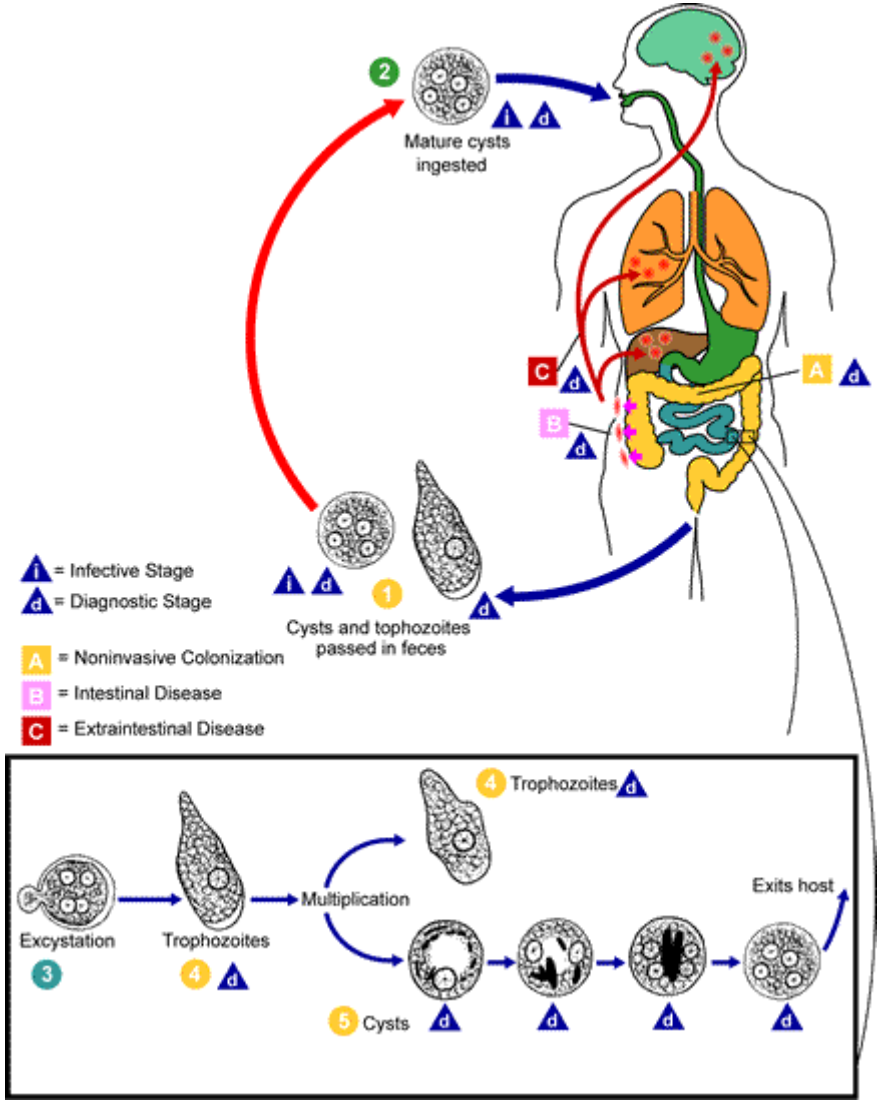
1

Protozoa

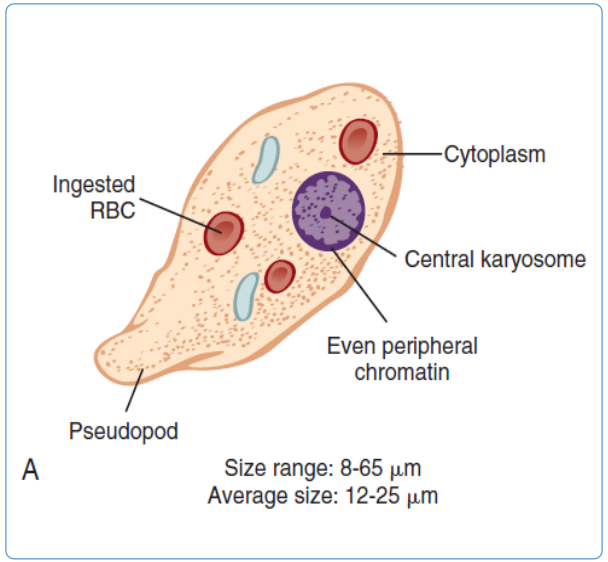
Entamoeba histolytica

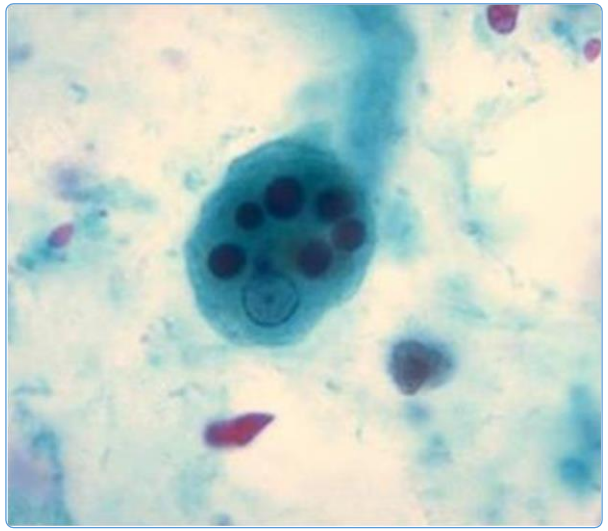
Host	Human and other primates
Transmission	▪ Consuming water or food contaminated with *mature cyst*, ▪ Flies & cockroaches as a *mechanical factor* ▪ unprotect sex
Natural habitat	Large intestine
Infective stage	Mature cyst
Diagnostic stage	Trophozoite & cyst
Specimen	Stool sample



Entamoeba histolytica - Trophozoite

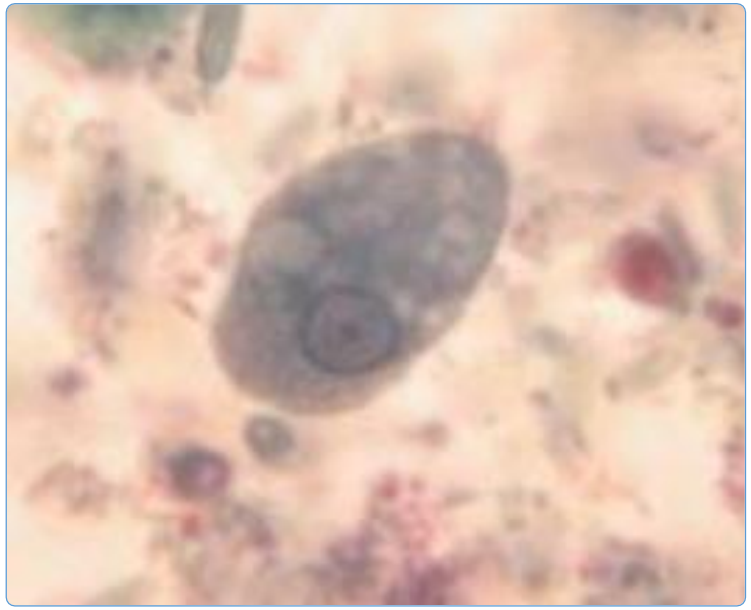
Shape	Amoebic shape
Size	8-65 µm
Projection	Has long, finger like pseudopodium
Nucleus	One rounded nucleus: ▪ Surrounded by a delicate ***nuclear membrane*** which has minute chromatin granules arranged regularly. ▪ With centrally located karyosome.
Cytoplasm	Outer glassy **ectoplasm** and inner granular **endoplasm**, contains: ▪ Food vacuoles containing RBCs at different stages of digestion. *Seen in diarrial state only, in a fresh fecal smear*



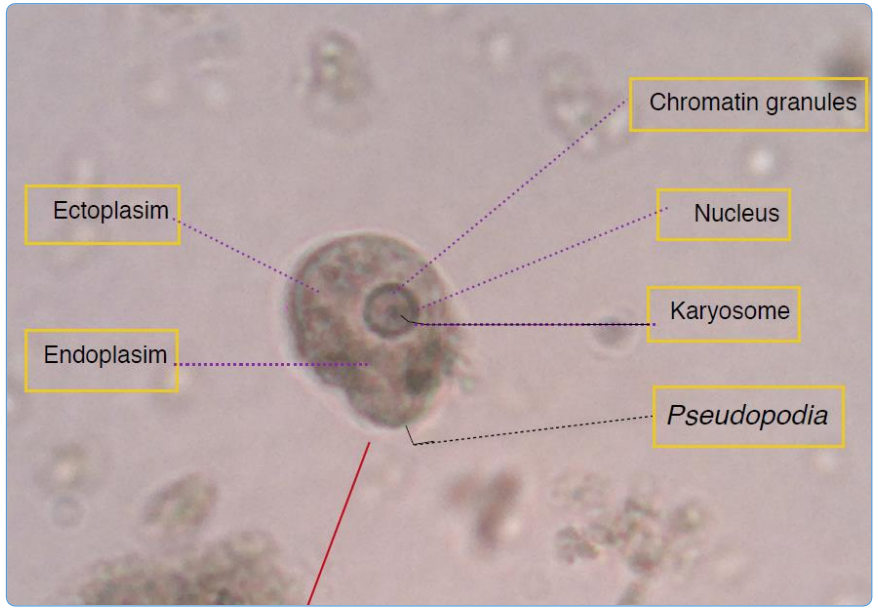


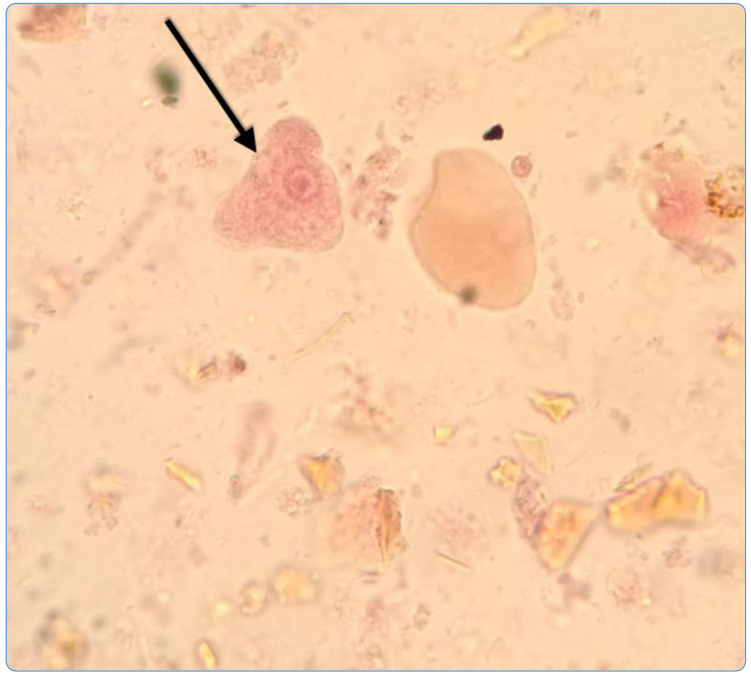
Characteristic Features

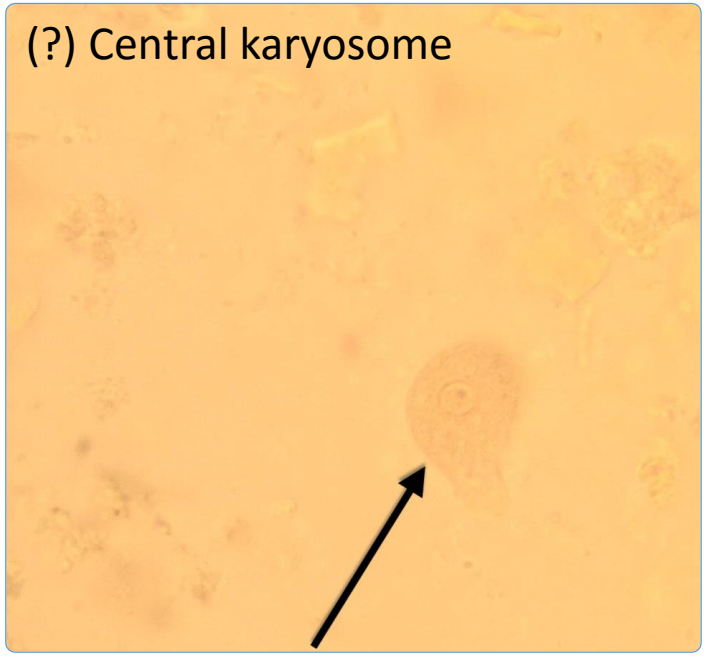
- Single nucleus with centrally located karyosome
- Food vacuoles containing RBCs at different stages of digestion.

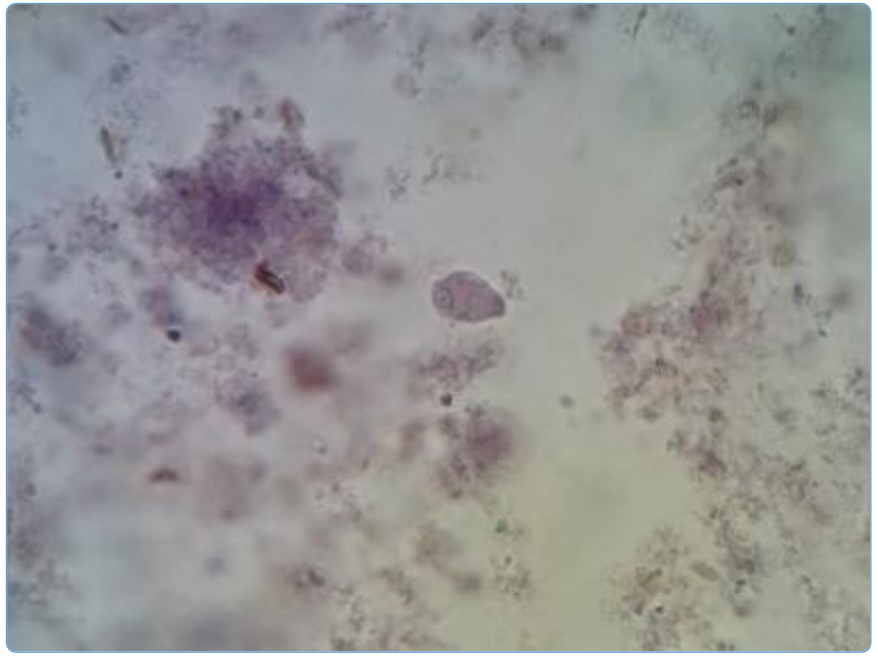



(?) Central karyosome


Chromatin granules
Ectoplasim
Nucleus
Karyosome
Endoplasim
Pseudopodia



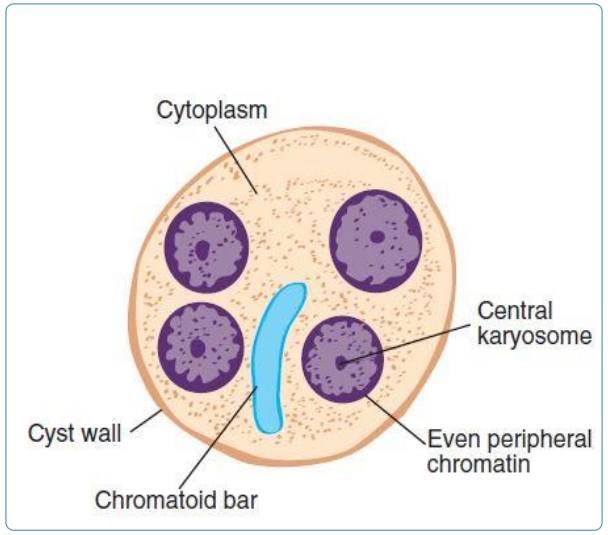

(?) Central karyosome

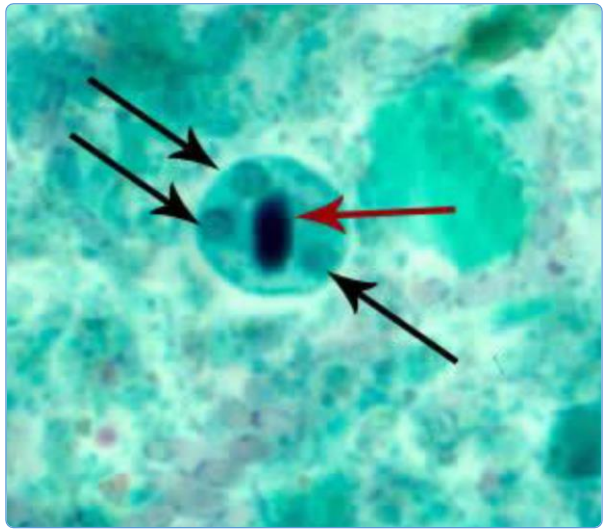


Entamoeba histolytica - Cyst

Shape	Spherical
Size	8-22 µm
Nucleus	*Four* rounded nuclei: ▪ Surrounded by a delicate ***nuclear membrane*** which has minute chromatin granules arranged regularly. ▪ With centrally located karyosome.
Cytoplasm	Contains: ▪ Fine chromatin granules. ▪ Cigar-shaped chromatoidal bar with rounded ends.

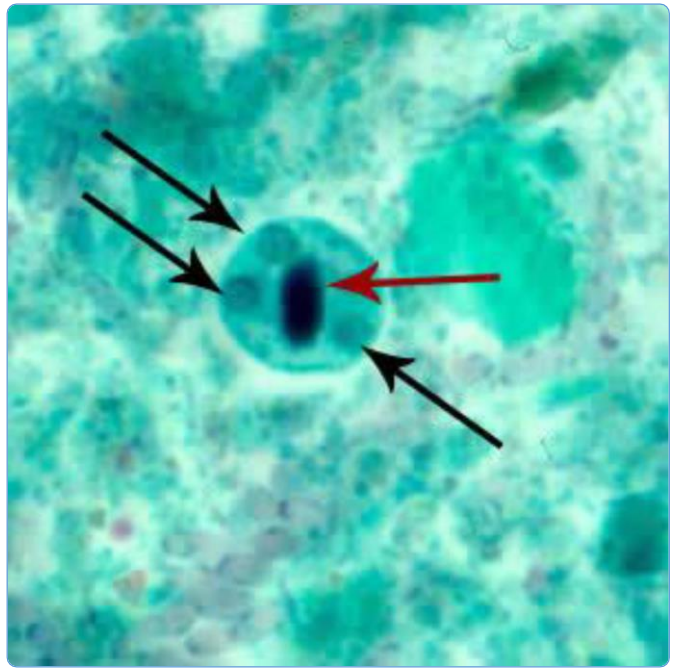
Seen in an ordinary stool sample

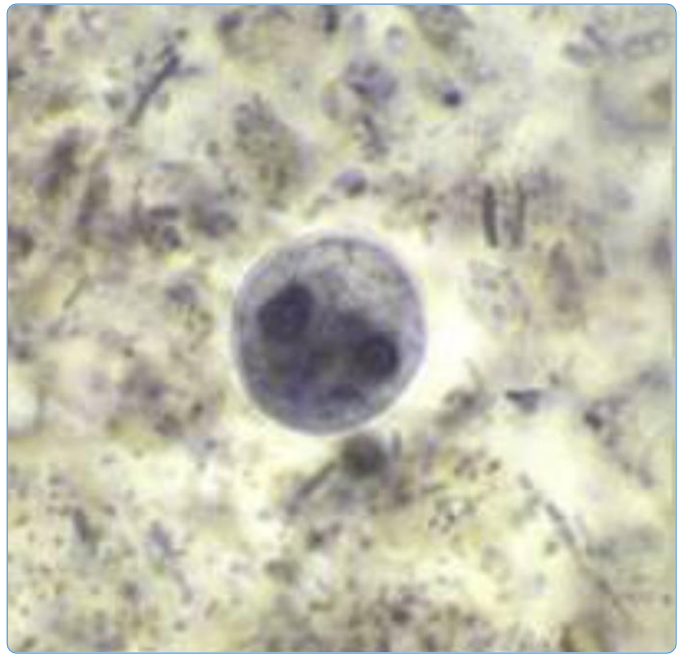


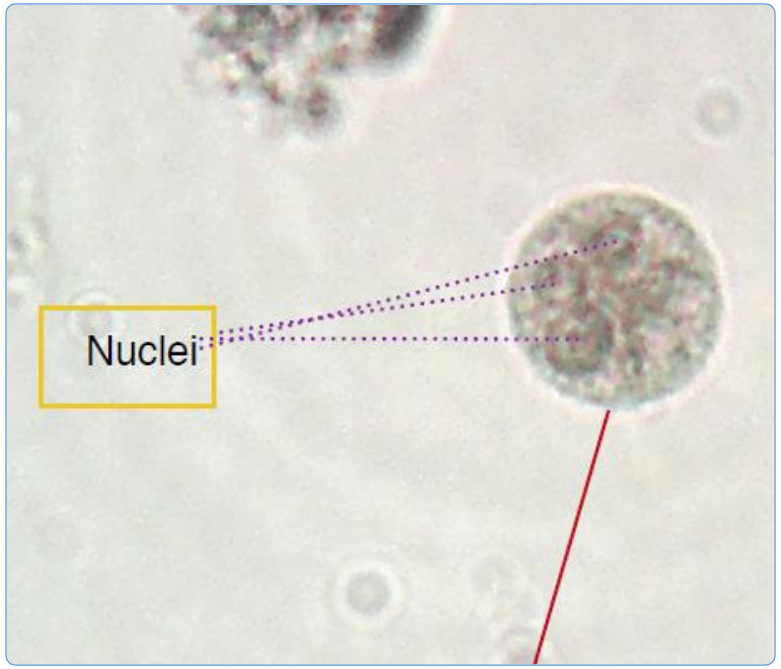


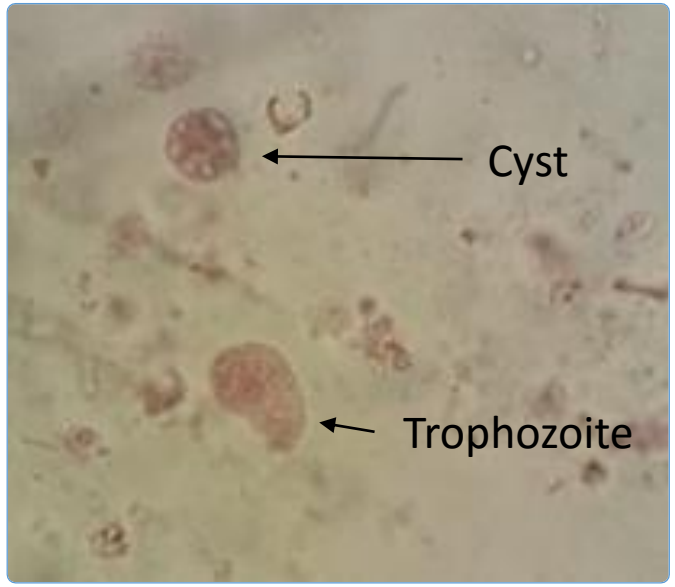
Characteristic Features

- Four rounded nuclei each one has centrally located karyosome.
- Cigar-shaped chromatoidal bar with rounded ends in the cytoplasm.



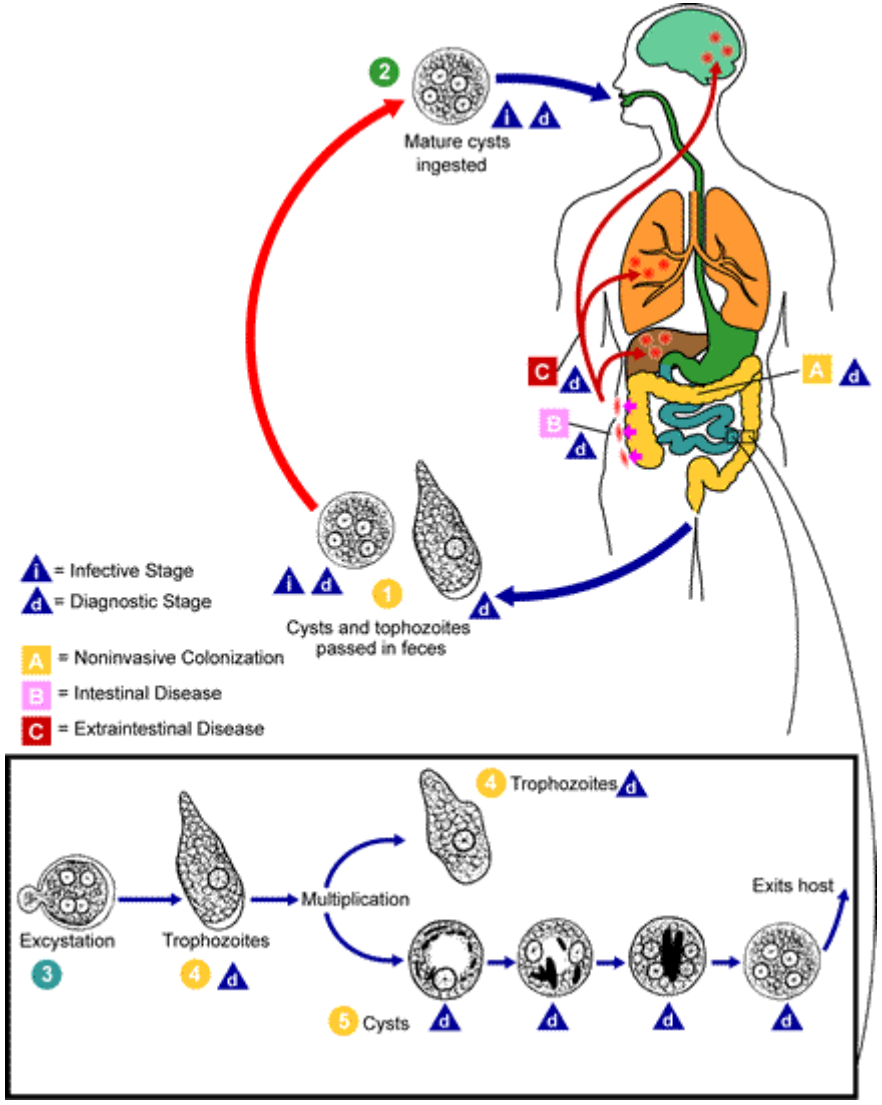



Nuclei


Cyst
Trophozoite

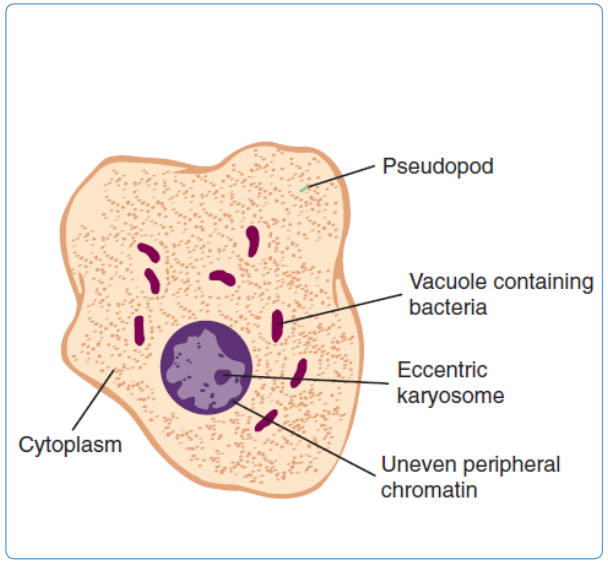
Entamoeba coli

Host	Human
Transmission	▪ Consuming water or food contaminated with *mature cyst*,
Natural habitat	Large intestine
Infective stage	Mature cyst
Diagnostic stage	Trophozoite & cyst
Specimen	Stool sample



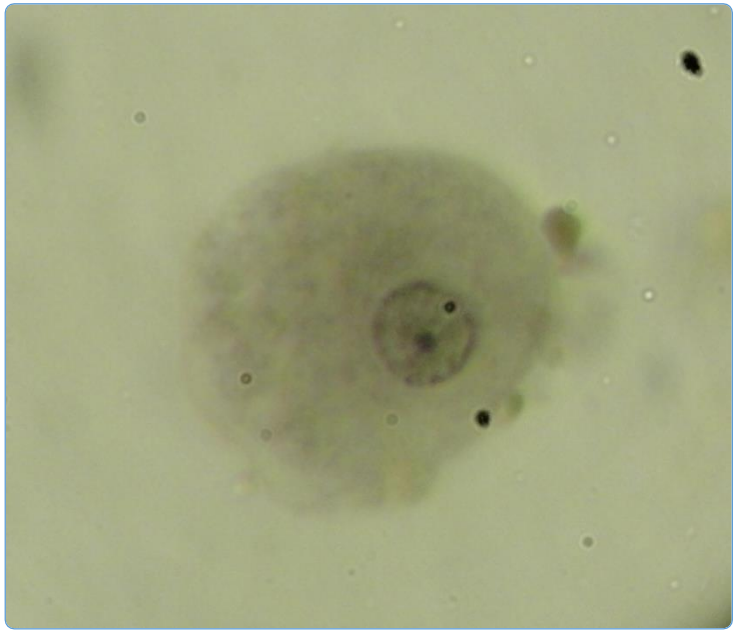
Entamoeba coli - Trophozoite

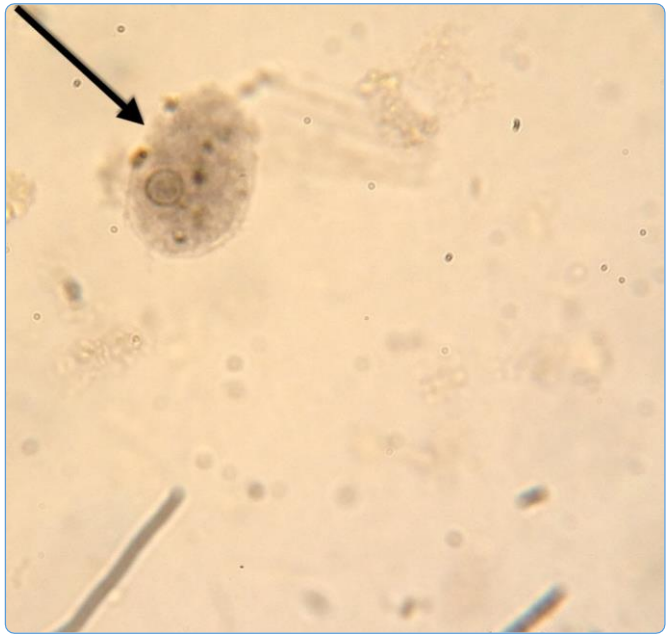
Shape	Amoebic shape
Size	12-55 µm
Projection	Short and broad pseudopodia (more than one)
Nucleus	One spherical nucleus with: ▪ Large eccentric karyosome ▪ Course chromatin granules arranged irregularly on the nuclear membrane.
Cytoplasm	No remarks between the **ectoplasm** and the **endoplasm**, contains: ▪ Food vacuoles containing bacteria and organic debris but not RBCs.

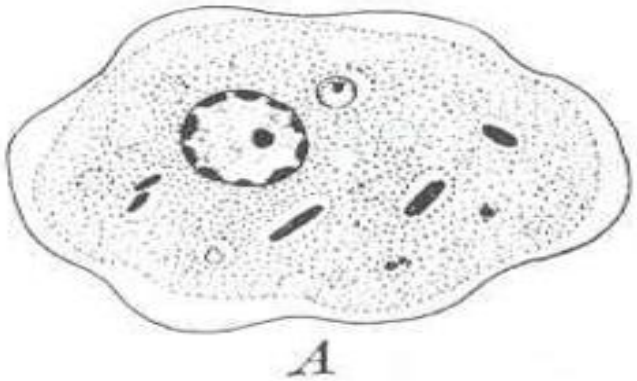


Characteristic Features

- Large eccentric karyosome within the nucleus, with course chromatin granules arranged irregularly on the nuclear membrane.
- Food vacuoles containing bacteria and organic debris.



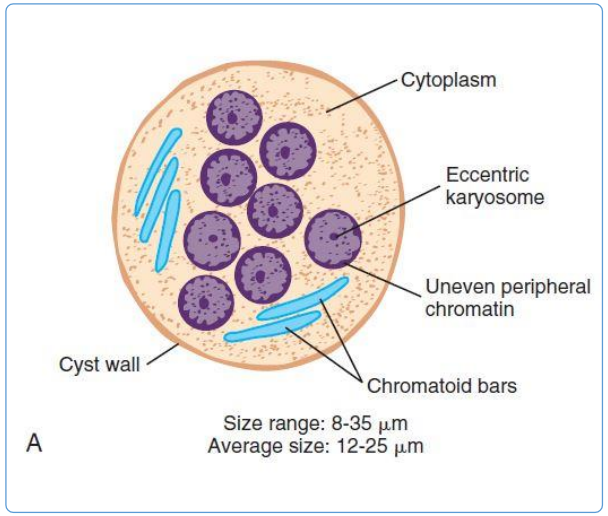


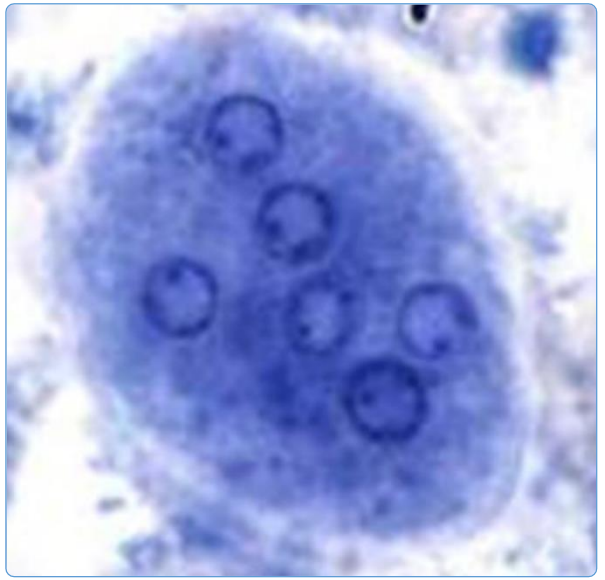


A

Entamoeba coli - Cyst

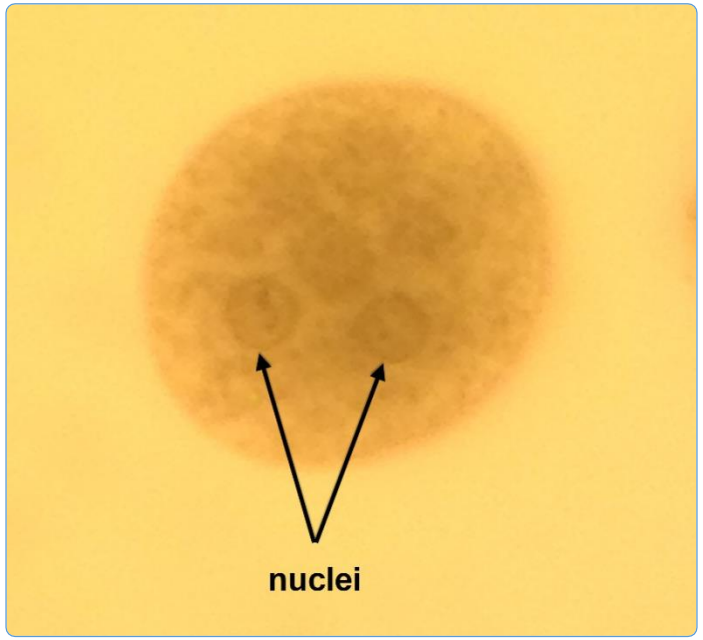
Shape	Spherical
Size	8-35 µm
Nucleus	Mature contain 8 spherical nuclei with: ▪ Large eccentric karyosome ▪ Course chromatin granules arranged irregularly on the nuclear membrane.
Cytoplasm	Granular with: ▪ No chromatoidal bars, but if it present, they are fine splinter or needle-like in shape. ▪ Diffuse glycogen mass usually visible in young cysts.

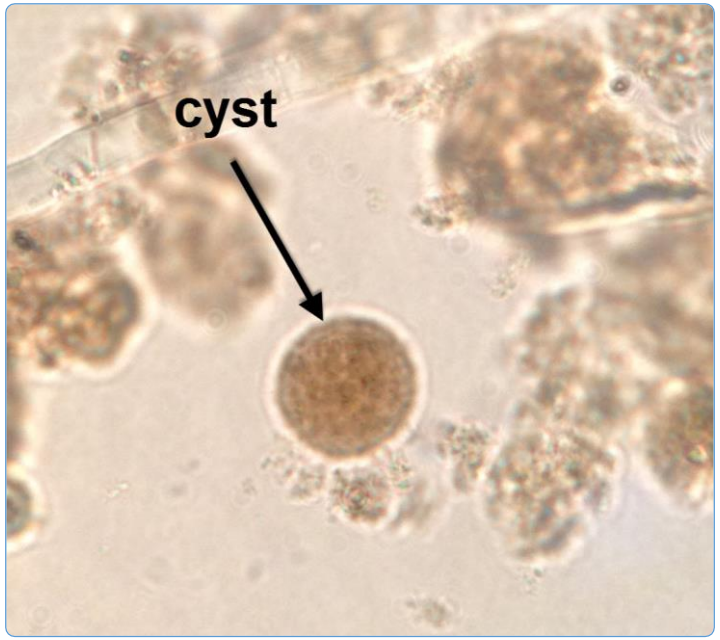




Characteristic Features

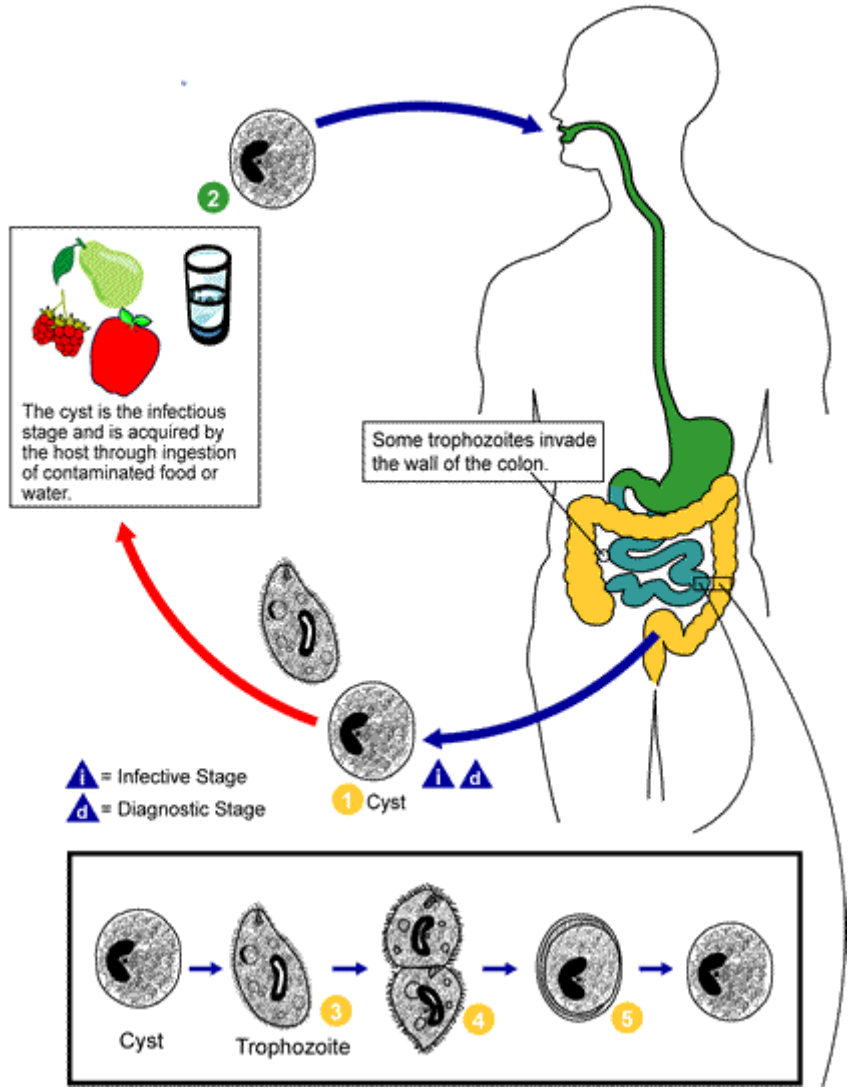
- Spherical with 1-8 nuclei each one contains large eccentric karyosome.
- No chromatoidal bars in the cytoplasm, but if it present, they are fine splinter or needle-like in shape.


nuclei


cyst

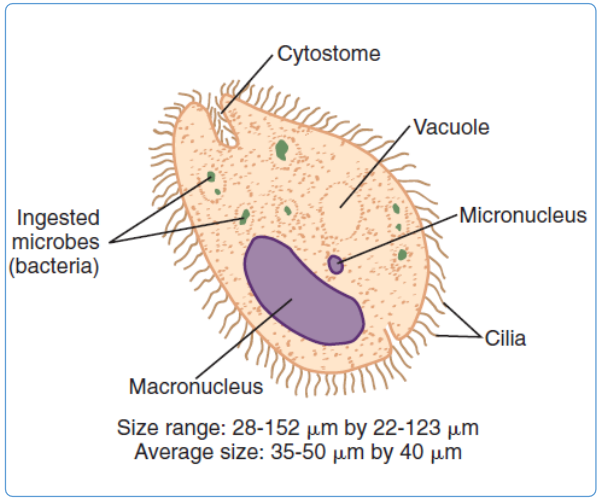
Balantidium coli

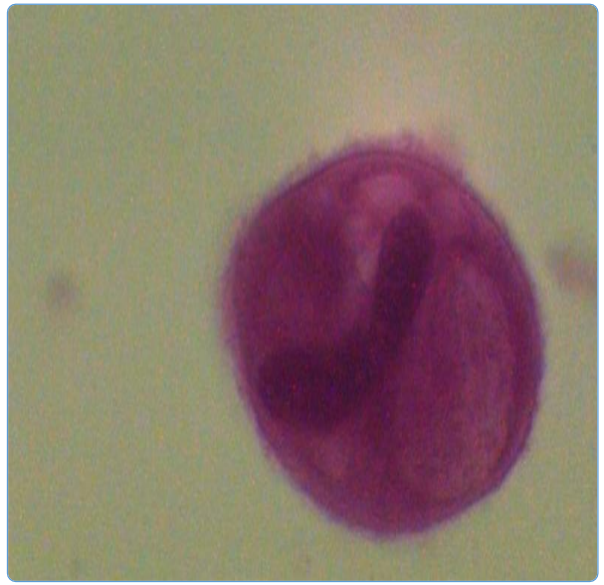
Host	Human and other mammales
Mode of infection	▪ Balantidiasis is a zoonotic disease and is acquired by humans. ▪ ***Contaminated water*** is the most common mechanism of transmission
Natural habitat	▪ Balantidium coli lives in the ***cecum and colon*** of humans, pigs, rats and other mammals
Infective stage	Cyst
Diagnostic stage	Cyst & trophozoite
Specimen	Stool sample



Balantidium coli – Trophozoite

Shape	Ovoid to sac-shaped with taper in an anterior end & rounded in posterior end & covered with cilia
Size	------
Nucleus	2 Nuclei, small one is spherical (micronucleus) and the big one is kidney shape macronucleus.
Cytoplasm	Contains 2 contractile vacuoles



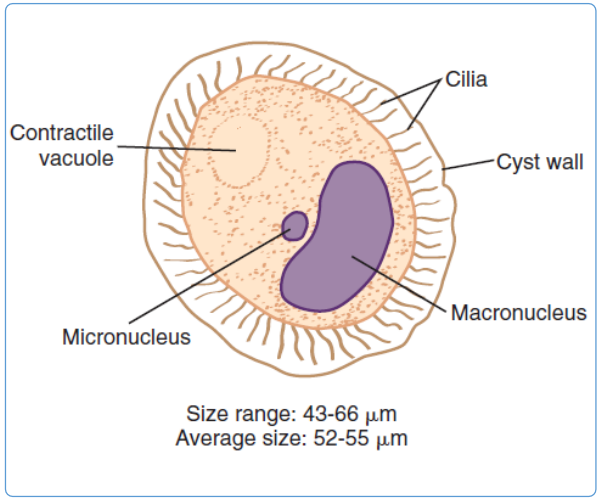


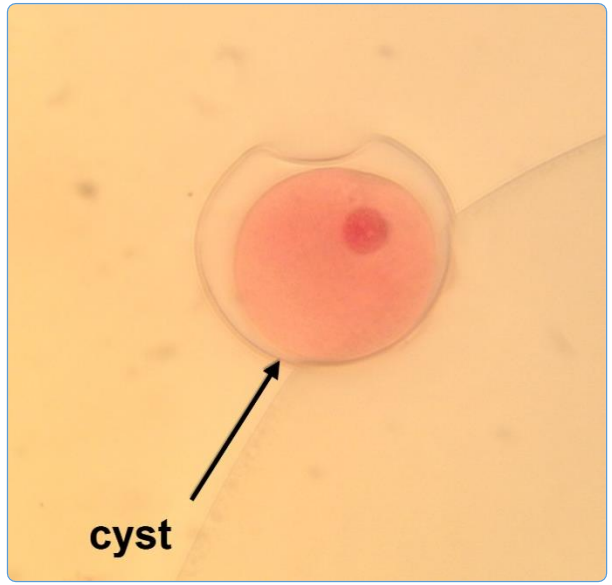
Characteristic Features

- Ovoid to sac-shaped with taper in an anterior end & rounded in posterior end & covered with cilia
- 2 Nuclei, small one is spherical (micronucleus) and the big one is kidney shape macronucleus.
- Cytoplasm contains 2 contractile vacuoles

Balantidium coli – Cyst

Shape	Subspherical to oval, with double protective cyst wall
Size	------
Nucleus	2 Nuclei, small spherical micronucleus & kidney shaped macronucleus





Characteristic Features

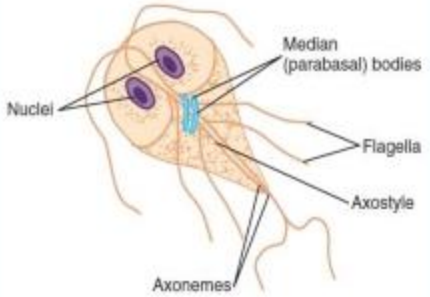
- Subspherical to oval with double protective cyst wall
- It has 2 nuclei, small spherical micronucleus & kidney shaped macronucleus

Giardia lamblia

Host	▪ Infects ***humans***, ▪ But is also one of the most common parasites infecting ***cats, dogs and birds***. ▪ Mammalian hosts also include ***cattle, beavers, deer, and sheep.***
Transmission	▪ Giardia infection can occur through ingestion of dormant cysts in ***contaminated water, food***, or ▪ By the ***feco-oral route*** (through poor hygiene practices).
Natural habitat	***Small intestine***
Infective stage	Cyst
Diagnostic stage	Trophozoite & cyst
Specimen	Stool sample

Giardia lamblia – Trophozoite

Shape	Pear or tear-drop shape with 4 pairs of flagella
Size	----- µm
Nuclei	*Two ovoid to spherical* ▪ With central ***karyosome***, ▪ Each nucleus is situated in an ***adhesive disk***
Others	*Parabasal body* posterior to nucleus.



Characteristic Features

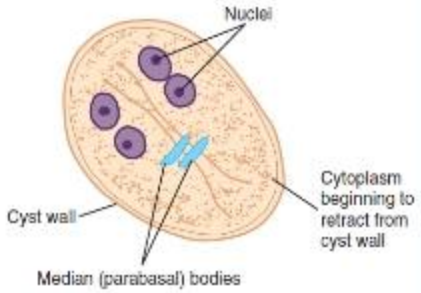
- Pear or tear-drop shape with 4 pairs of flagella
- Two ovoid to spherical nuclei with central karyosome, each nucleus is situated in an adhesive disk.
- Parabasal body post to nucleus

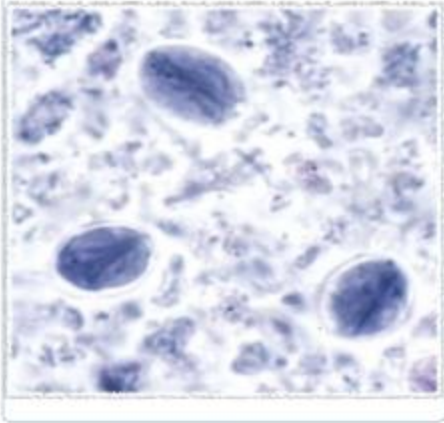
Giardia lamblia – Cyst

Parasitology Atlas

2015
2016

Shape	Ovoid
Size	----- µm
Nuclei	*4 nuclei* located at one end
Cytoplasm	Contain: ▪ Fibrils that represent axonames in trophozoite.
Wall	Double cyst wall & cytoplasm retracted to from *clear zone* between the cyst wall and the cytoplasm





Characteristic Features

- Ovoid in shape has 4 nuclei located at one end.
- Contain fibrils that represent axonames in trophozoite.
- Has double cyst wall & cytoplasm retracted to from clear zone between the cyst wall and the cytoplasm.

Trichomonas vaginalis

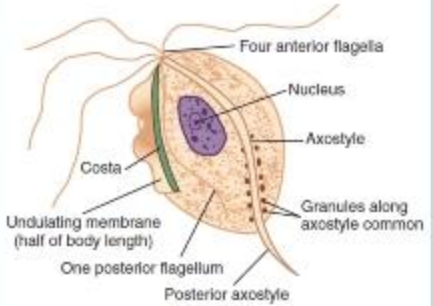
Parasitology Atlas 2015 2016

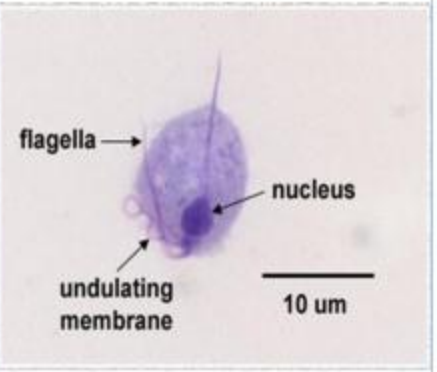
Host	Human
Transmission	▪ Mostly through sexual intercourse.
Natural habitat	▪ Vagina in female ▪ Genital tract in male (prostate & urethra)
Infective stage	Cyst
Diagnostic stage	Trophozoite & cyst
Specimen	▪ ***In women***, a swab of secretion is collected from the vagina; ▪ ***In men***, swab from urethra or urine may be used.

Only trophozoite stage

Trichomonas vaginalis – Trophozite

Shape	Ovoid or pear in shape.
Size	----- µm
Nucleus	Single ovoid nucleus at the anterior end.
Others	- 3-5 flagella - Short undulating membrane extend to the half of the body. - Axostyle extend posteriorly beyond the body.



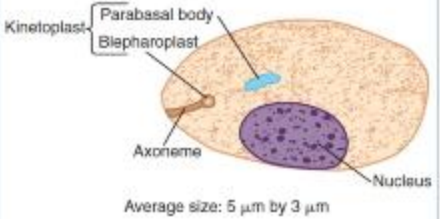


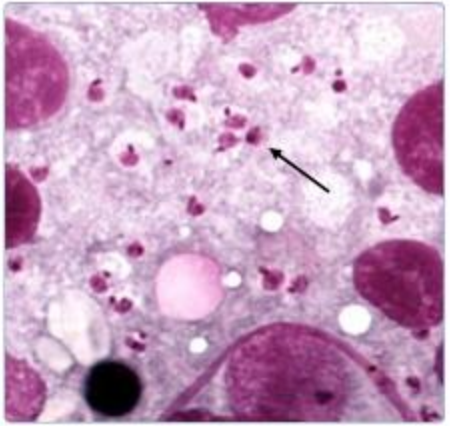
Leishmania donovani

Host	*Two hosts:* ▪ Mammalian host ▪ Insect vector (***Phlebotomus***)
Mode of infection	▪ Skin penetration by infected sandfly.
Natural habitat	▪ ***Macrophages*** in the *spleen*, *liver* and *bone marrow*.
Infective stage	Promastigote
Diagnostic stage	Amastigote
Specimen	Amastigote: blood Promastigote: culture

Leishmania donovani – Amastigote

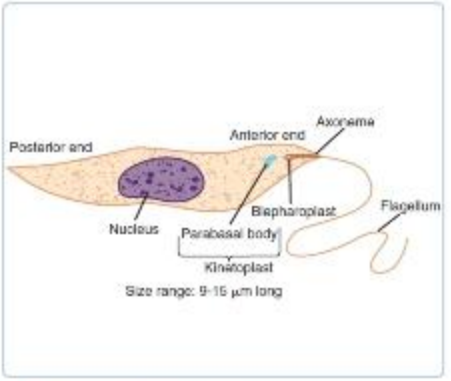
Shape	Small oval in shape.
Size	----- µm
Nucleus	Spheroidal nucleus lies against cell membrane.
Others	- ***Kinetoplast*** is dot–like attached to small ***axonema***

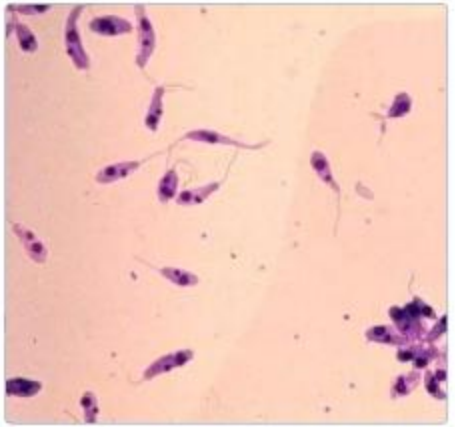




Leishmania donovani – Promastigote

Shape	Slender in shape
Size	----- µm
Nucleus	large single central nucleus.
Others	- ***Kinetoplast*** is located in the anterior end. - A single free flagellum extend anteriorly from kintoplast.





Phylum : Protozoa

Class: Sporozoa

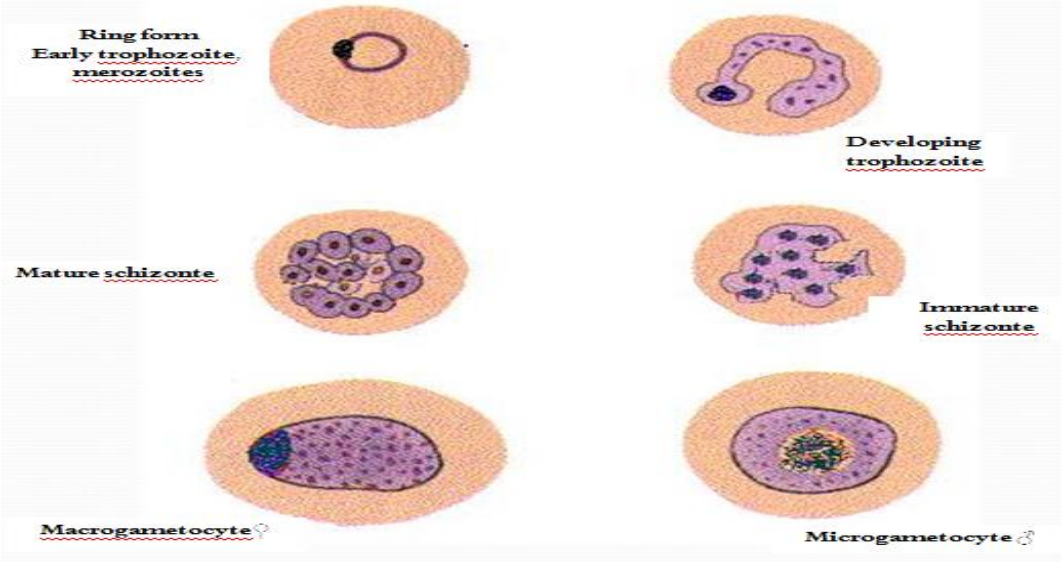
1--Plasmodium sp.

There are four species normally infecting humans: -
Plasmodium falciparum: causes malignant tertian malaria.
P. malariae: causes Quartean malaria.
P. vivax: causes benign tertian malaria.
P. oval: causes benign tertian malaria.
Habitat: Blood (inside the R.B.Cs)
Definitive host: female Anopheles mosquito
Intermediate host: Man.
Infective stage : sporozoite to all types of Malaria.
Diagnostic stage : Ring stage schizont or micro and macrogametocyte .

Transmission :

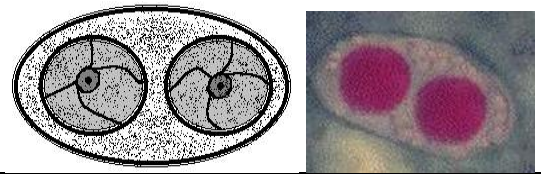
- Malaria transmitted normally via the bite of on infected mosquitoes.
- In some cases can be transferred via organ transplant or blood transfusion.
- By injection needles.
- Also can cross the placenta to transmit from mother to her baby (congenital malaria).

Stages of *Plasmodium* sp. in Red Blood cell (RBc).:
1-Ring stage 2-Amoeboid 3- Shizont 4- Merozoites 5- Macro and microgametocyte

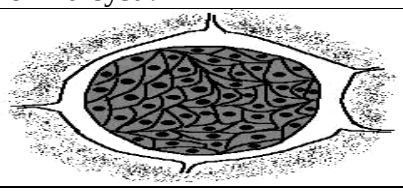


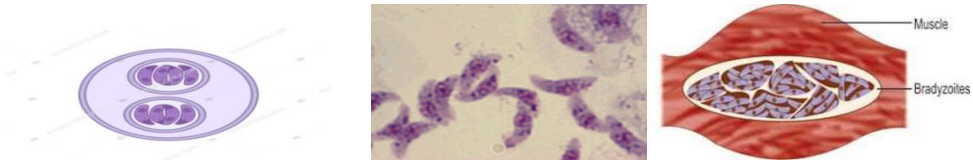
2- Toxoplasma gondii

Disease: Toxoplasmosis.
Habitat: Epithelial cells of small intestine or other tissue of the host.
Definitive host :Cats
intermediate host: Human, Mammals, Birds
Infective stage : Oocyst, Bradyzoite.
Diagnostic stage : Tachyzoite , Bradyzoite.
Mode of infection :
1. Consuming undercooked meat of animals that had tissue cysts
2. Consuming food or water contaminated with infected cat feces
3. Infection of a fetus transplacentally from the mother .
4. A less likely method of infection is receiving a blood transfusion or organ transplant from individuals harboring tissue cyst.

Oocyst	
Size range	25 to 35 µm long , 10 to 15 µm wide
Appearance	Transparent
Shape	Oval
Other features	**Mature oocyst** contains two sporocysts, each containing four sporozoites.
Figure	

Tachyzoite (Trophozoite)	
General comment	Actively multiplying morphologic form
Size	3 to 7 µm by 2 to 4 µm
Shape	Crescent shaped , often more rounded one end
Number of nucleui	One
Other features	Contains a variety of organelles that are not readily visible
Figure	

Bradyzoite (Cyst)	
General comment	Slow - growing morphologic form
Size	Smaller than tachyzoites
Physical appearance	Similar to that of the tachyzoites
Number of nucleui	One
Other features	Hundreds to thousands of bradyzoites enclose themselves to form a cyst .
Figure	



Oocyst Tachyzoite Bradyzoite

Helminths

Taenia saginata (beef tapeworm)

Host : Final host: man

Intermediate host : cattle, camels

Mode of infection : Eating undercooked beef containing infective stage.

Natural habitat :

- Adult in small intestine;
- Cysticercus in tissues

Infective stage : Cysticercus bovis

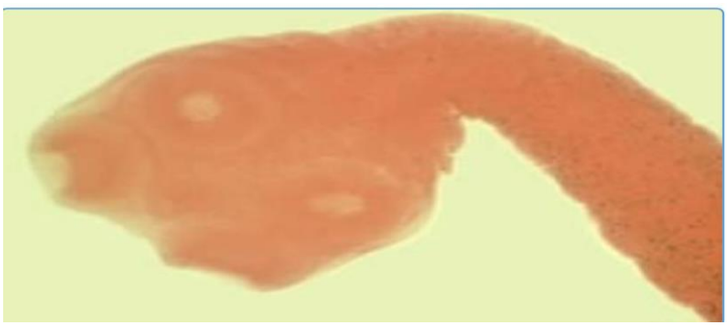
Diagnostic stage : Egg with hexacanth-embryo or Gravid proglotids

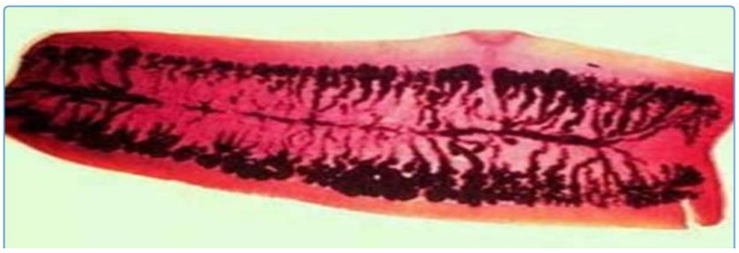
Scolex :

- Quadrate
- Four hemispherical suckers
- No rostellum and no hooks

Gravid segment :

- Each one is longer than wide averaging 17.5-5.5 mm.
- Common genital pore is mid-lateral in position.
- (15-20) uterine branches on either sides of the median uterine stem





Taenia solium (pork tapeworm)

Host : Final host: man

Intermediate host: pigs (human is also a dead end intermediate host)

Mode of infection :

- Eating undercooked pork containing infective stage or
- Ingestion of *T. solium* egg either in contaminated food or by autoinfection (fecal-oral transmission).

Natural habitat :

- Adult in small intestine of man.
- Cysticercus cellulosae in pigs muscles or in human tissues

Infective stage :

- Cysticercus cellulosae
- Egg

Diagnostic stage :

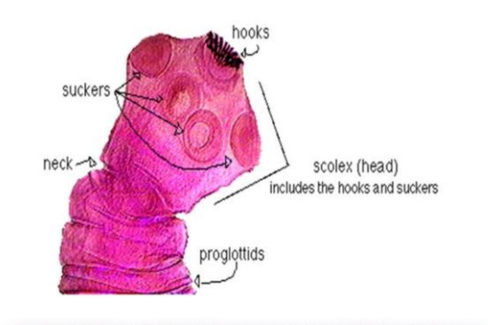
- Egg with hexacanth-embryo or
- Gravid proglotids
- Cysticercus cellulosae

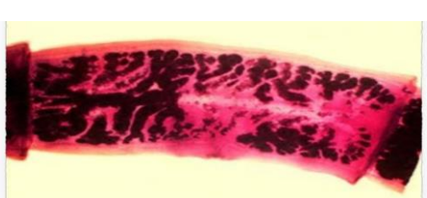
Scolex

- Quadrate :
- 4 cup-shaped suckers,
- Double rows of hooklets (22-36),
- Rostullum

Gravid segment :

- Each one is longer than wide averaging I I by 5 mm,
- With common genital pore is mid-lateral in position.
- (7 -13) lateral branches on each side of the central uterine stem.





Hymenolepis nana (dwarf tapeworm)

Host : Definitive host: human or rodent Intermediate host: various species of beetles and flea

Mode of infection :

I. Ingestion of eggs in contaminated food, water, or anything contaminated by feces.

2. Internal autoinfection.

3. External autoinfection.

4. Ingestion infected insects

Natural habitat : Small intestine

Infective stage :

- Egg and
- Cysticercoid (larval stage)

Diagnostic stage : Egg

Specimen : Stool sample

Scolex

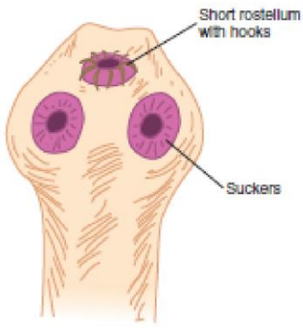
- Knob-like with 4 cup shaped suckers.
- Has long retractile rostellum carrying a crown made of one circle of 20-30 hooks.

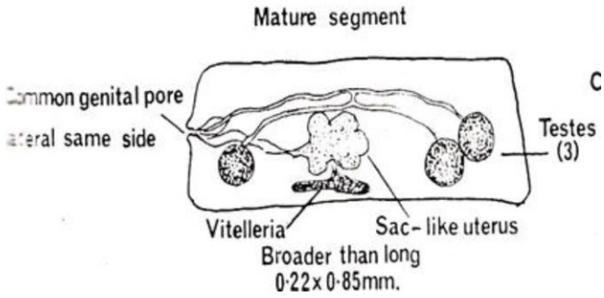
Gravid proglottid :

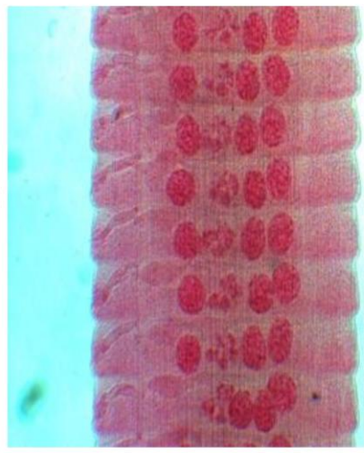
- The width is twice the length
- It has sac-like uterus filled with eggs that take majority of the available space.
- Genital pore unilateral in position

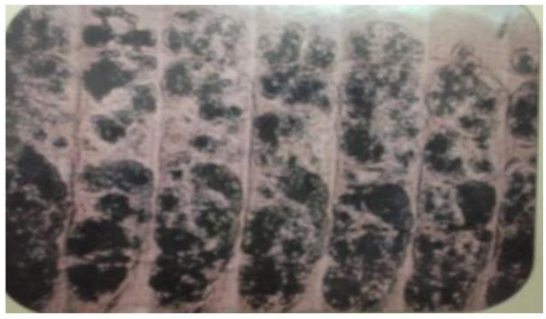
Egg :

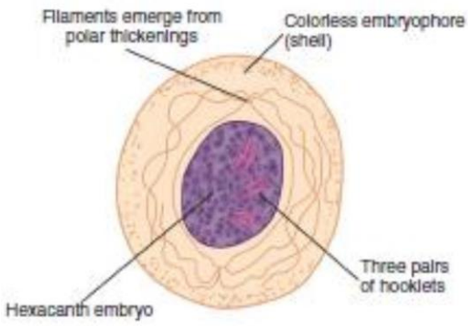
- Grayish hyaline spherical shaped contain hexacanth (3 pairs of hooks) embryo.
- There are 2 membrane shells, inner one has bipolar thickening from each 4-8 filaments are extended toward outer shell.

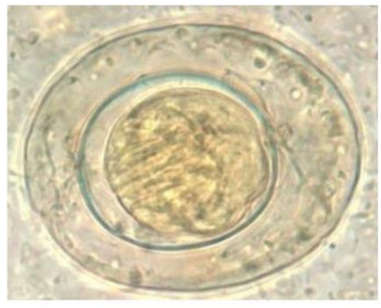

Short rostellum with hooks
Suckers


Mature segment
Common genital pore
lateral same side
Testes (3)
Vitelleria
Sac-like uterus
Broader than long
0·22 x 0·85mm.






Filaments emerge from polar thickenings
Colorless embryophore (shell)
Three pairs of hooklets
Hexacanth embryo



Echinococcus granulosus

Common name : The hydatid worm or dog tape worm

Disease : Hydatid cysts or echinococosis

Definitive host : Dogs.

Intermediate host : Sheep, cattle and other herbivorous animals.

Habitat : Adult worm in small intestine of dogs & other definitive host.

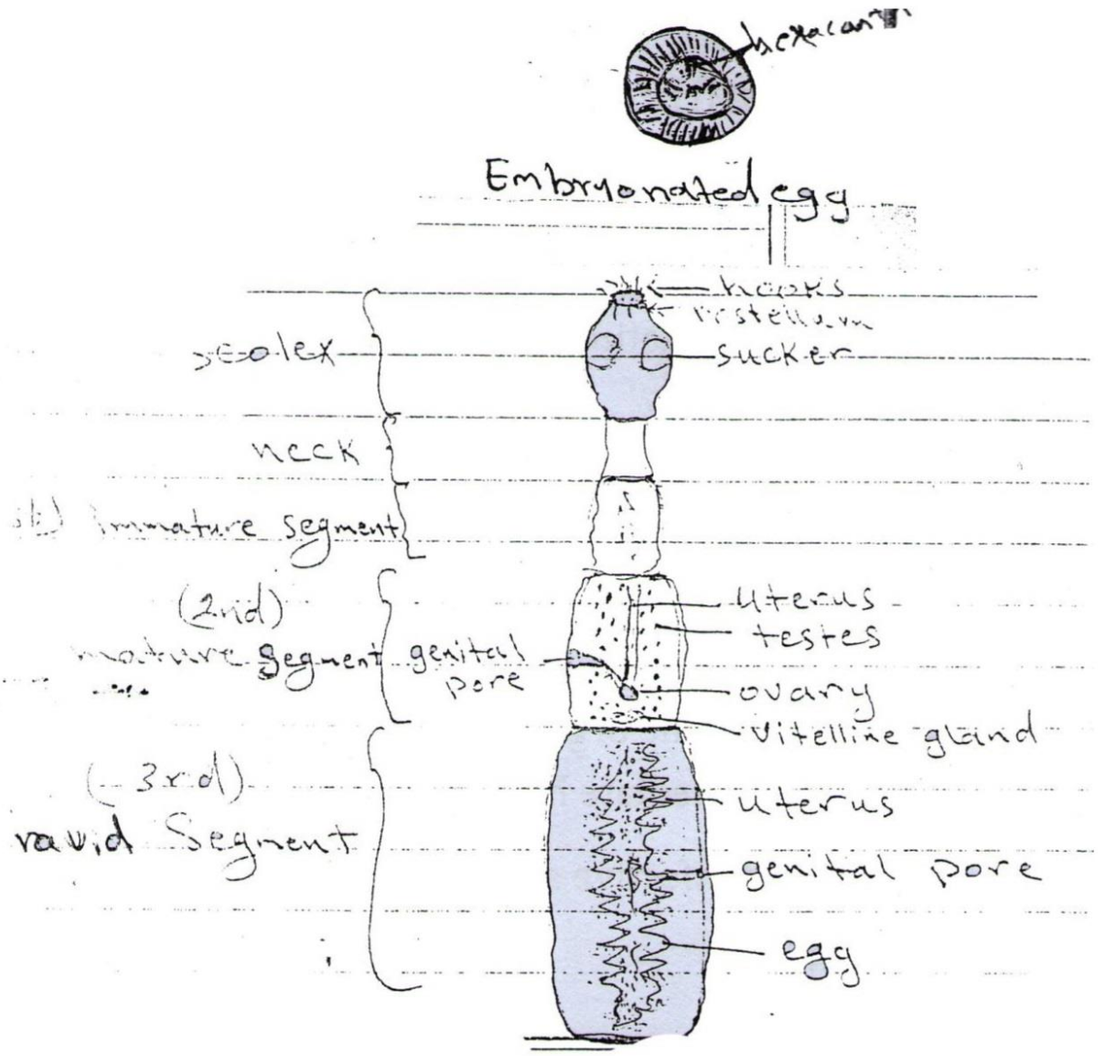
Infective stage : Egg

Mode of infection : Oral rout by ingestion of eggs with contaminated vegetables or water. Morphological characters : Adult worm is very small measures about 2-4mm in length and 0-5mm in width. It consists of scolex, neck and usually three segments more long than wide. The first segment is immature the second is mature & the third (last) is gravid segment.

A) Scolex : Pyriform shaped, contain (4) suckers and long rostellum with two crowns of hooks (28-50) hooks.

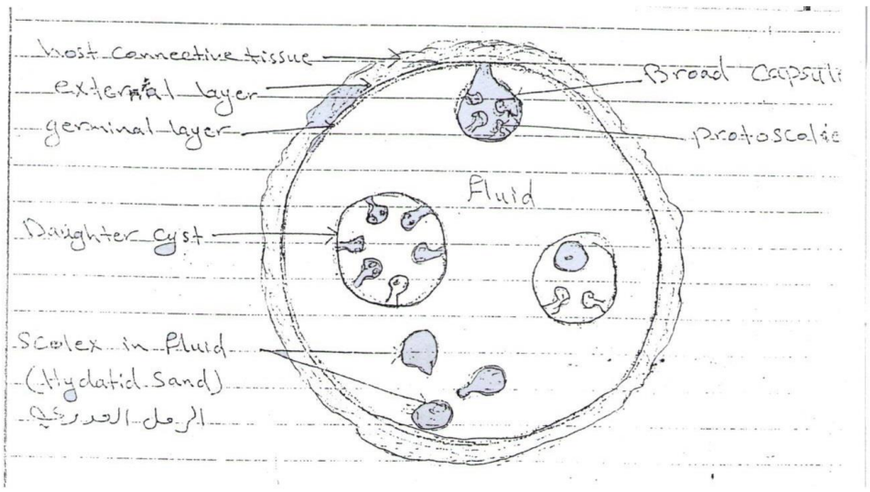
B) Mature segment : contain one set of male and female reproductive organ, genital pores irregularly alternating .

C) Gravid segment : measure about half the whole length of the worm, has a medium uterus with 12-15 branches which filled with egg.



from out to inside consist of:

1. An external layer : non nucleated, hyaline, supporting cuticle .
2. An inner layer : thin, nucleated, germinal epithelium layer.
3. Colorless or light-yellow sterile fluid that causes distention of the limiting membrane.
4. Broad capsule : which have only the germinal layer containing protoscolex .
5. Daughter cyst : which are rising from broad capsule or from protoscolex.



Host : Definitive host: dogs & other canines Intermediate host: sheep, cattle, camel & human (dead end host).

Mode of infection :

- Transmitted to intermediate hosts via the ingestion of eggs
- Transmitted to definitive hosts by means of eating infected, cyst-containing organs.

Natural habitat : Various organs, especially the liver and lungs

Infective stage : Egg (gravid proglottid)

Diagnostic stage : hydatid cyst

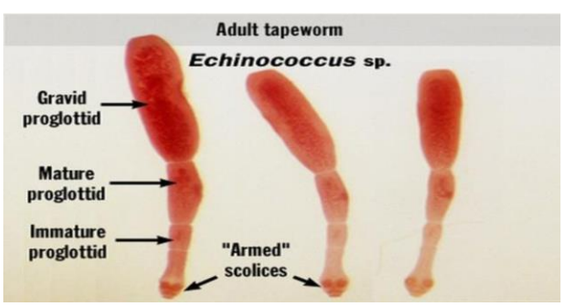
Echinococcus granulosus - Adult

Adult

- Only 2-8 mm long

• Usually comprises of :

1. Scolex (with four suckers and 2 circular rows of hooks),
2. Neck,
3. Immature proglottid,
4. Mature proglottid &
5. Gravid proglottid



Class Nematoda Worms

Ascaris lumbricoides

(Roundworm of man, Common roundworm)

Host :

Definitive host: humans

Intermediate host: none.

Mode of infection: Ingestion of water or food (raw vegetables or fruit) contaminated with *A. lumbricoides* eggs.

Natural habitat : Small intestine

Infective stage : Embryonated egg.

Diagnostic stage : unembryonated egg.

Adult

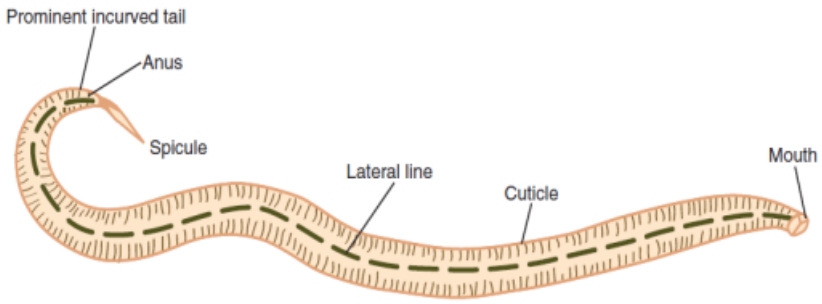
- Cylindrical in shape with tapering ends.
- Creamy white or pinkish.
- Mouth of the worm is surrounded by 3 lips (1 dorsal and 2 ventral) with minute teeth.
- Whitish lines along the entire length of the body

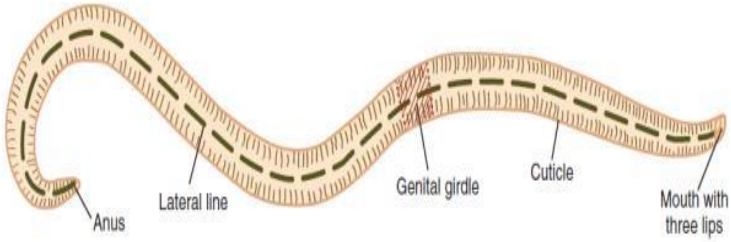
Adult female:

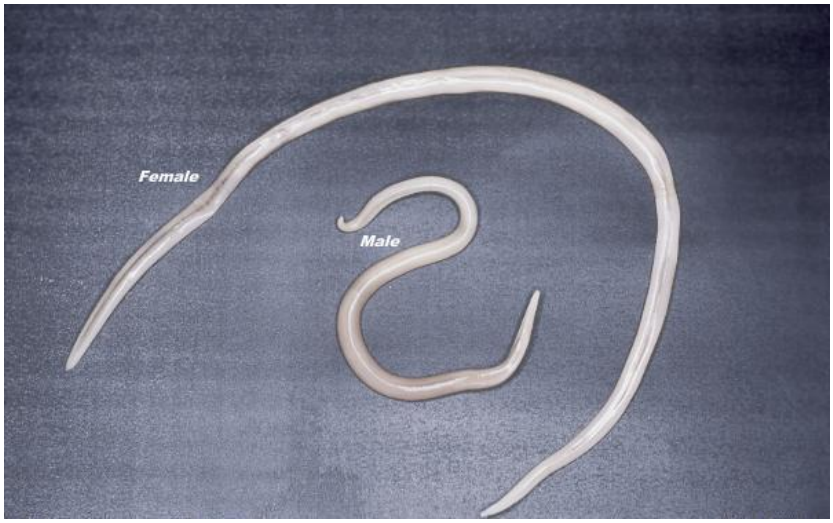
- Post. end is straight and pointed

Adult male:

- Smaller than female
- Curved tail contains a pair of spicules

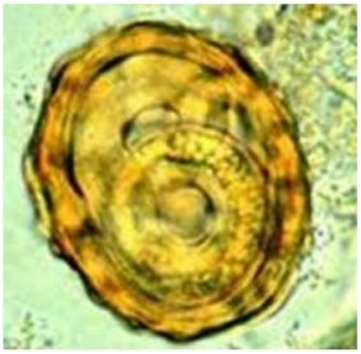






Fertilized corticated egg:

- Oval in shape, golden brown, bile stained.
- The shell is thick with the mammillated albuminous outer coat.
- Contains one-cell stage
- Embryo surrounded by: (1) impermeable thin membrane, (2) smooth, relatively thick, colorless middle layer with clear crescentic space at each pole.



Enterobius vermicularis

(Pin worm, Thread worm?, Seat worm)

Host :

Definitive host: monoxenous (single host), human

Intermediate host: none.

Mode of infection:

- Self- infection: anus-hand s-mouth route
- Cross-infection: contact transmission, inhalation and retro infection

Natural habitat : Large intestine (Caecum, Appendix, Ascending colon).

Infective stage : Embryonated egg.

Diagnostic stage : Egg in perianal region

Specimen : stool.

Adult :

- Short, white, fusiform, with pointed ends, resemble white threads
- At the anterior end
- (I) Cephalic aloe (2) Three lips (3) Cuticle expansions
- Double-bulbed oesophagus

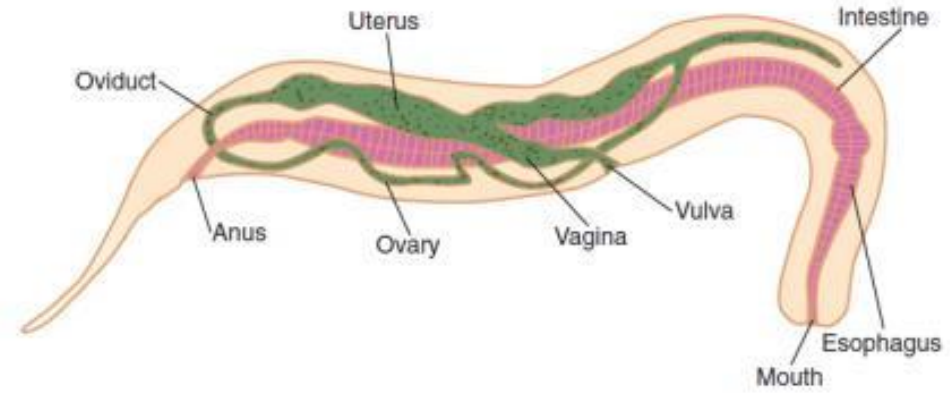
Female :

- Sharp pointed posterior end.
- Cephalic inflation in anterior part.
- Two lateral cuticular thickening along the full length of the parasite

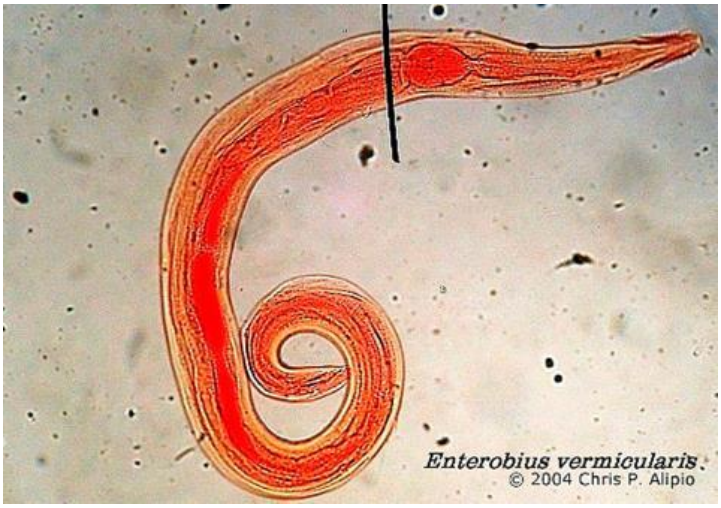
- Double-bubled oesophagus
- Vulva is at the junction of anterior I I4 with the rest of the body

Male :

- Posterior end is curved
- With single copulatory spicule

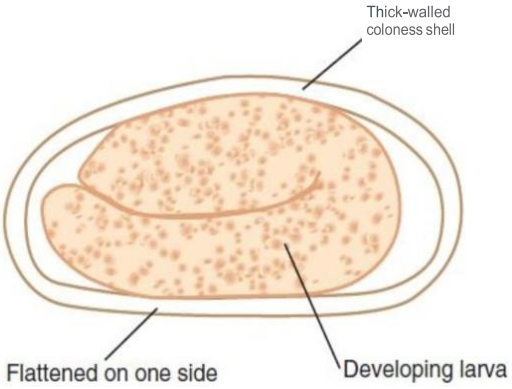


Size range: 7-14 mm long by up to 0.5 mm wide



Egg :

- Colorless, non-bile stained
- Shape: Plano-convex
- Shell: double layered, (1) transparent & (2) sticky outer albuminous layer Contains: coiled larva



Trichuris trichura (Whipworm)

Host :

Definitive host: man.

Intermediate host: none.

Mode of infection : Ingestion of infective stage in fecal contaminated soil or food.

Natural habitat : Large intestine

Infective stage : Embryonated egg.

Diagnostic stage : unembryonated egg.

Specimen : stool **.**

Adult Male :

- Anterior thin part and posterior thick part.
- Single spicule inside a retractile spine.
- Posterior part curved ventrally

Adult Female :

- Anterior thin part and posterior thick part, looks like a whip
- Oesophagus lies anteriorly
- Intestine and a single set of reproductive organ lie posteriorly Vulva is situated at the junction of the thin and the thick parts.

Egg :

- Barrel-shaped
- Contains one-cell stage embryo
- Thin transparent inner membrane and gold en outer membrane.
- Blister-like prominence at each end .

Hookworms

A. duodenale (old word hookworm)

N . amencanus (new orld hookworm)

Host:

Definitive host: (single host) humans, cats and dogs.

Intermediate host: none.

Mode of infection : Filariform larvae penetrate the skin of human

Natural habitat : Small intestine

Infective stage : filariform

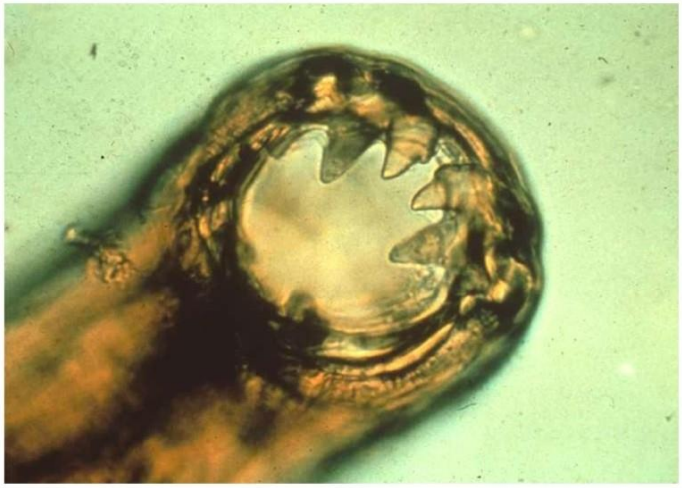
Diagnostic stage : Egg in stool

Specimen : stool

Hookworm - Ancylostoma duodenale

Buccal capsule

- Cup-shaped
- 2 pairs of teeth on the ventral side
- in the depth of the capsule there is a pair of small teeth
- A plate with cleft on the dorsal side

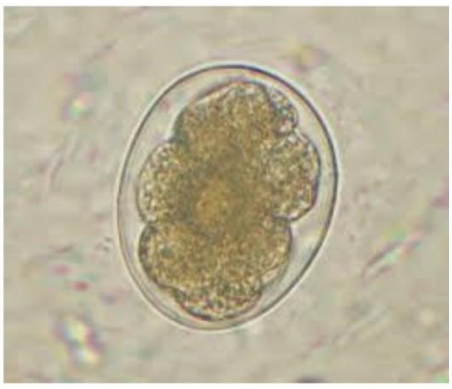


Copulatory bursa

- Umbrella-like
- Two long spicules well separated
- Seven pairs of flesh rays

Egg :

- Oval with broad rounded ends.
- 4-8 cell stage embryo
- The shell is thin , smooth and colorless
- Clear space between the embryo an d egg shell



Class:Trematoda

1-Schistosoma sp. (Blood flukes)

There are three types of *Schistosoma* sp.

A-Schistosoma haematobium

Definitive host: human

Intermediate host: snails from the genus *Bulinus*

Mode of infection : The free swimming infective larval cercaria burrow into human skin when it comes into contact with contaminated water

Natural habitat : Veins of urinary bladder .

Infective stage : Cercaria (bifid tail).

Diagnostic stage : Embryonated egg **.**

Specimen : Urine sample.

Diagnosis :

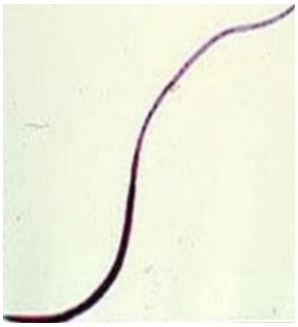
1-The most common way to diagnose *S. haematobium* infection is by identification of eggs in urine .

2- Biopsies of the bladder.

Adult female :

- Cylindrical
- Oral and ventral suckers

- An oval ovary is lying just in front of the junction of the two intestinal caeca (in the posterior half).



Adult male :

- Shorter than female
- Oral and ventral suckers
- (3-5) small globular testes situated in one line just behind the ventral sucker

Egg :

- Large elongated
- Rounded at both ends with terminal spine
- Contains fully developed embryo

B-Schistosoma mansoni

Definitive host: human

Intermediate host: snail (*Biomphalaria*)

Mode of infection : The free swimming infective larval cercaria burrow into human skin when it comes into contact with contaminated water.

Natural habitat : Veins of colon

Infective stage : Cercaria (bifid tail) .

Diagnostic stage : Embryonated egg .

Specimen : Stool sample.

Diagnosis :

1-The most common way to diagnose *S. haematobium* infection is by identification of eggs in stool .

2- Biopsies of the rectal.

Adult female : Simi lar to *S. haematobium* (cylind rical, oral and ventral suckers) but the ovary is situated anteriorly and the uterus is shorter.

Adult male :

- Shorter than female
- Oral and ventral suckers
- 6-9 small testes forming g rape like clusters behind the ventral sucker

Egg :

- Large elongated
- Rounded at both ends with lateral spine
- Contains fully developed embryo.

The larval stages in life cycle of *Schistosoma sp. :-*

1-Miracidium(ciliated free –swimming) in water.

2- Sporocyst (first- generation), in snail.

3- Sporocyst (second- generation), in snail.

4- Cercaria (bifid –tail or forked))free- swimming in water (infective stage).

2-Fasciola hepatica (liver fluke)

Definitive host: sheep, goat, cattle or man .

Intermediate host: snail s of the genus *Lymnaea*.

Mode of infection : Metacercariae are ingested by humans eating un-cooked foods such as water- cress .

Natural habitat : Bile duct & gallbladder.

Infective stage : Metacercariae.

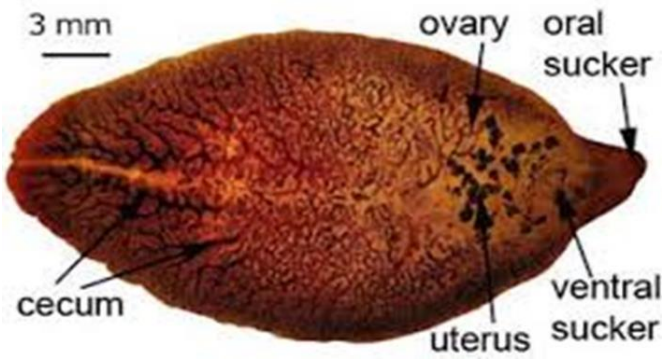
Diagnostic stage : Unembryonated egg.

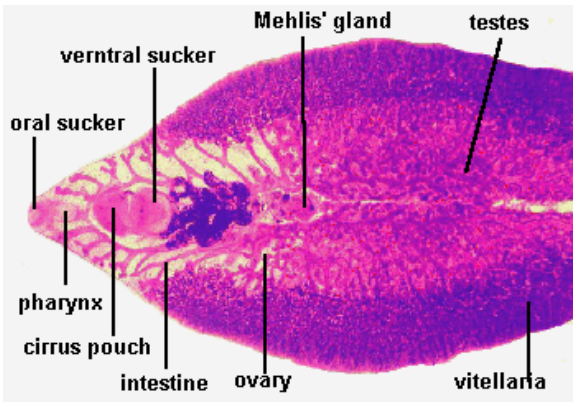
Specimen : Stool sample

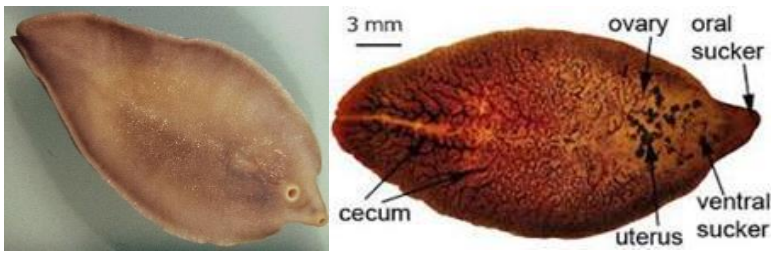
Diagnosis : By identification of eggs in the feces.

Adult :

- It is a large leaf-shaped fluke, measuring 3cm in length by 1.5 cm in breadth and
- brown to pale grey in color.
- Has an anterior elongation where oral and ventral suckers are located.
- The anterior end bearing the oral sucker forms a conical projection.
- Intestines are very branched







Actual size

Egg :

- Large, operculated, ovoid in shape, brownish yellow in colour (bile stained).
- Size 140 µm by 80µm.
- Contains a large unsegmented ovum in a mass of yolk cells.

The larval stages in life cycle of *Fasciola hepatica*:-

1-Miracidium(ciliated free swimming) in water.

2- Sporocyst in snail.

3- Redia in snail.

4- Cercaria (free- swimming in water).

5- Metacercaria on the water plants(infective stage).