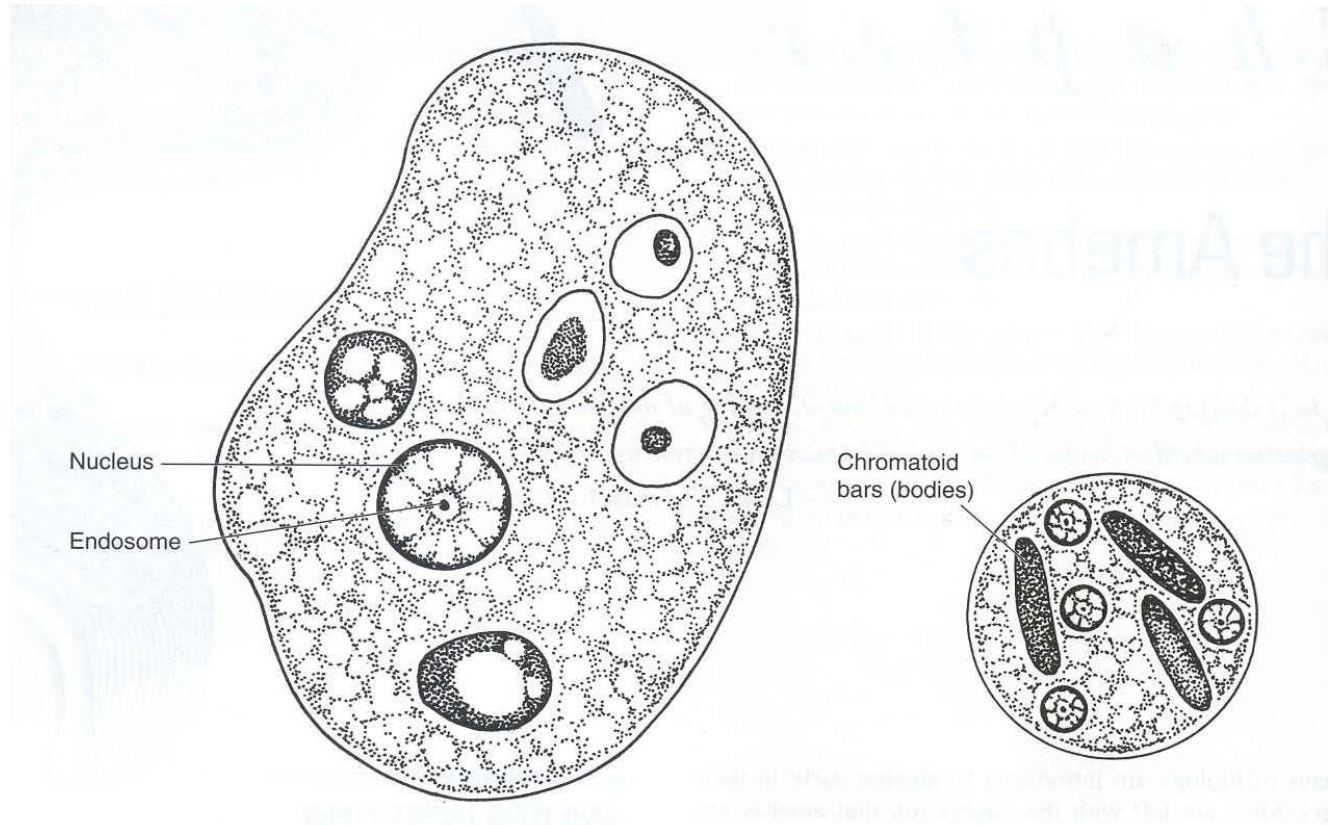


Entamoeba histolytica



Trophozoite: 20-30 μm

Cyst: 10-20 μm

Trophozoite

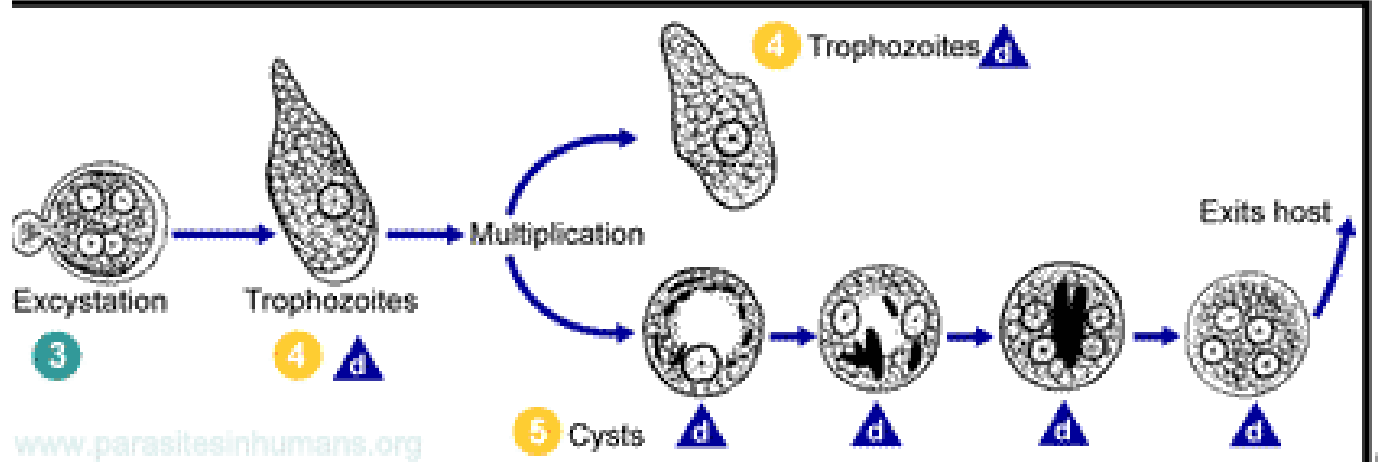
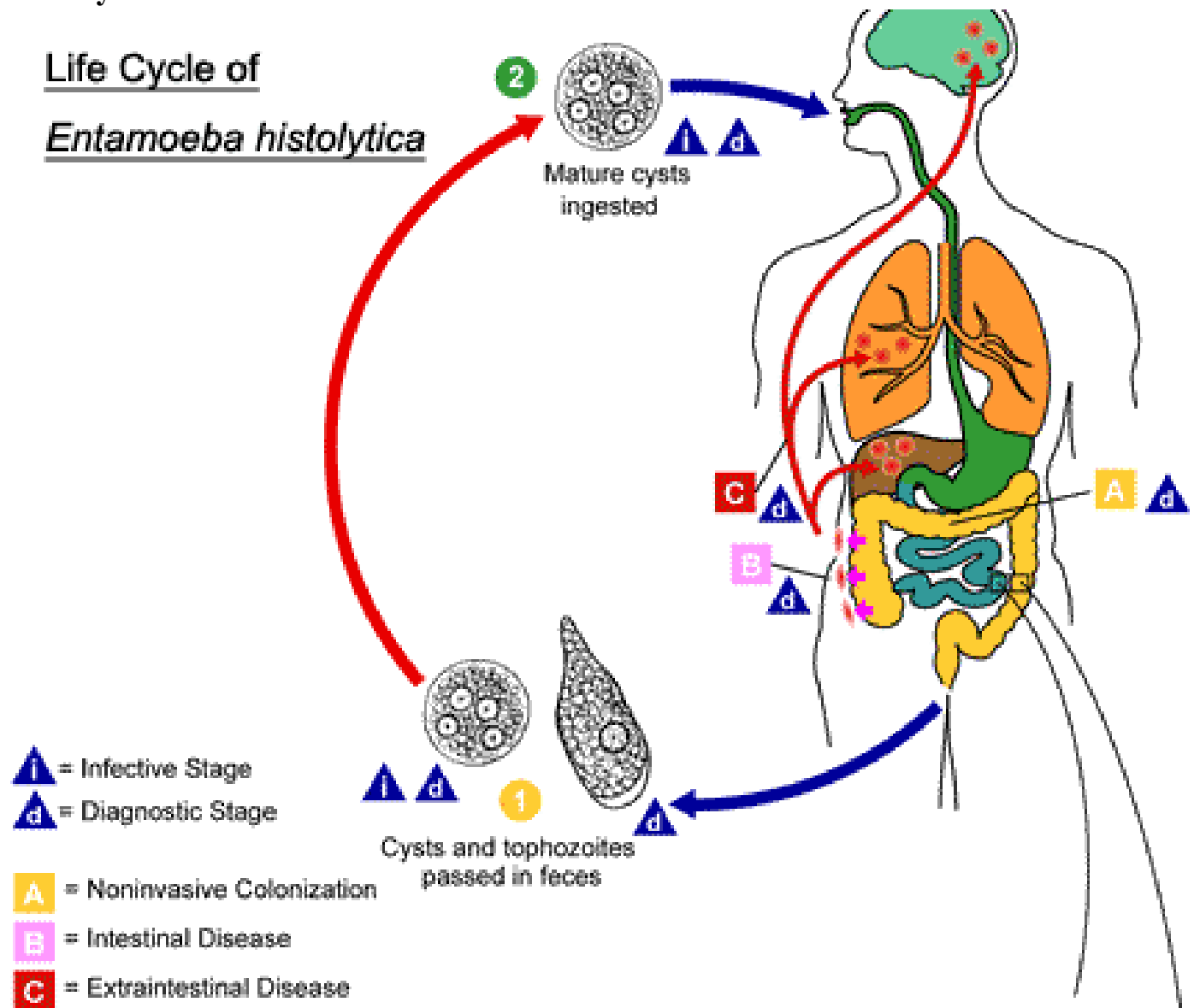
- Active, feeding stage
- Cytoplasm
 - Clean, not foamy
- Nucleus
 - Central “bullseye” endosome
 - Thin, even chromatin lining nucleus
- Found in loose stools and ectopic infections

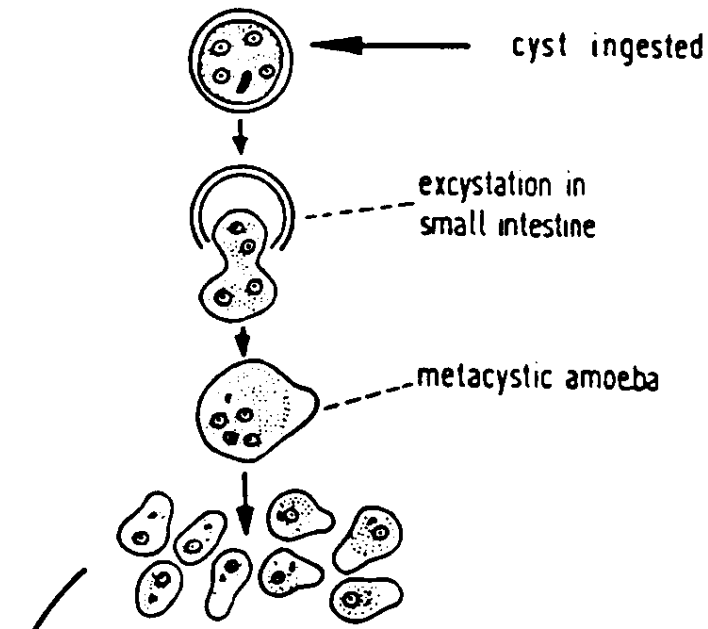
Cyst

- Dormant/resistant stage
 - **Cysts** are susceptible to heat (above 40 C.), freezing (below -5 C.), and drying.
 - **Cysts** remain viable in moist environment for 1 month.
- Spherical
- 1-4 nuclei, (4 in mature cysts)
- Bluntly rounded chromatoidal bars
- Found and released in formed feces

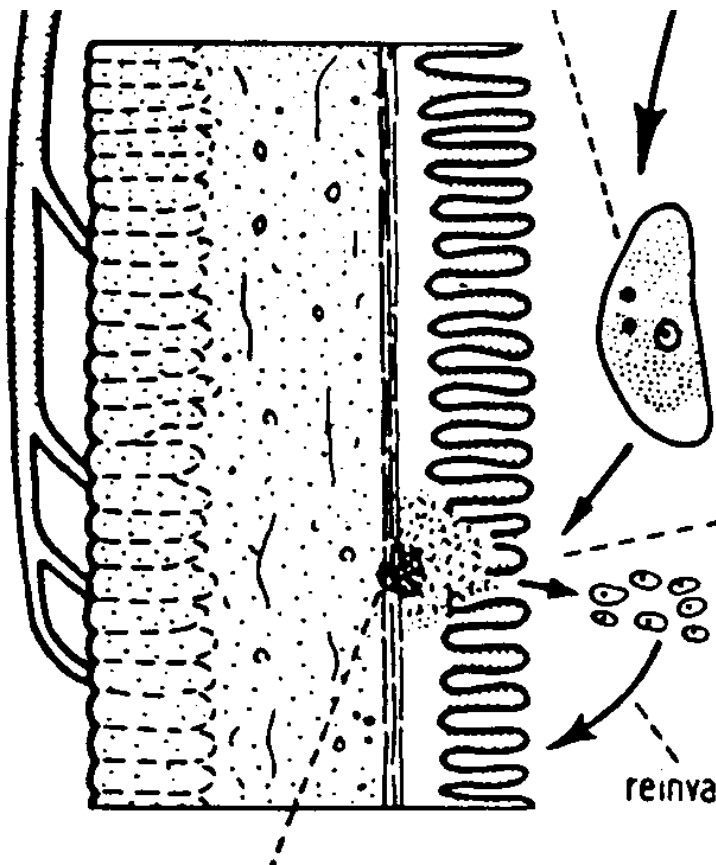
Life Cycle

Life Cycle of *Entamoeba histolytica*

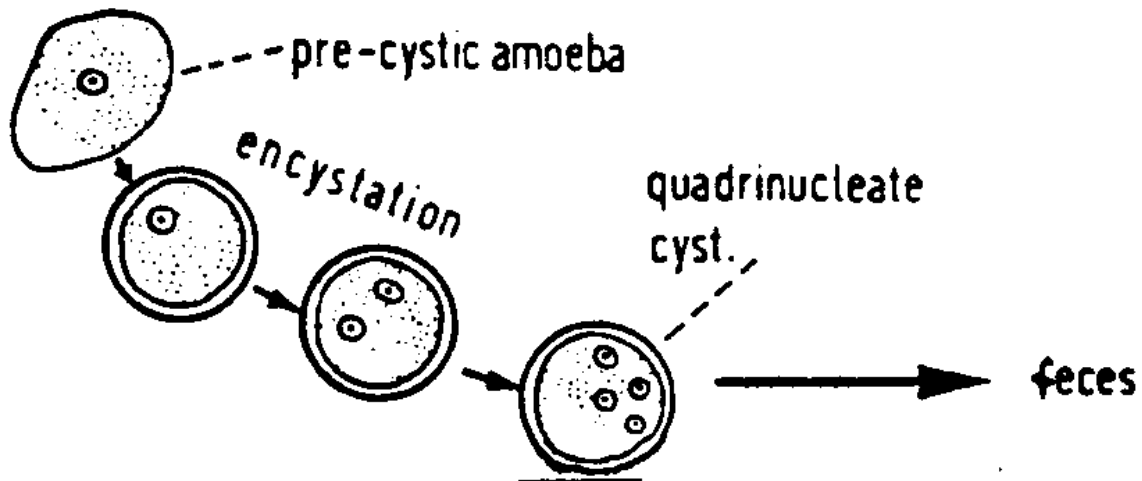




- **CYST** is ingested with food or water contaminated with feces
- **Excystation** occurs in the small intestine in an alkaline environment.
- **Metacystic amoebas** emerge, divide and move down into the large intestine.



Habitat: Trophozoites live and may multiply indefinitely within the crypts and mucosa of the LI mucosa feeding on starches and mucous secretions.



INFECTIVE STAGE: Cyst

Cysts form in response to unfavorable (deteriorating) environmental conditions, as they move down the LI.

DISTRIBUTION: Parasite has worldwide distribution but is most common in the tropical and subtropical areas of the world

- ~ 500 million people may be affected
- ~ 100,000 deaths each year
-

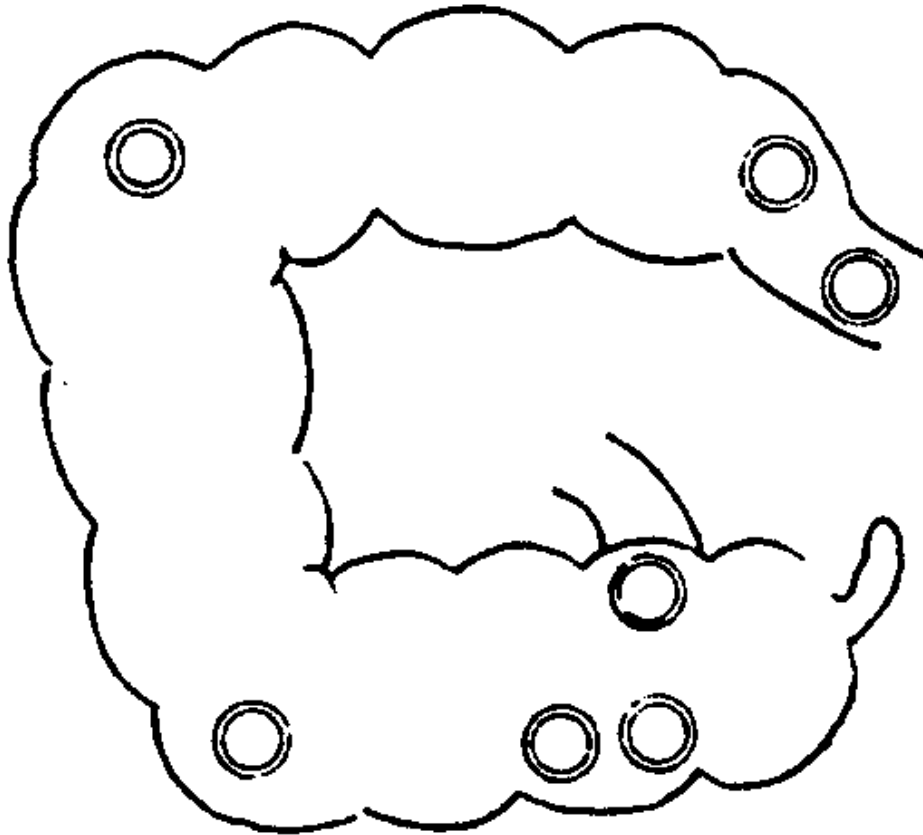
PREVALENCE:

- < 1% in Canada and Alaska
- 0.9% in U.S.
- 40% in the tropics
-

This parasite is likely under-reported in developing countries and potentially one of the most prevalent parasitic infections in the world.

Pathology

- *E. histolytica* has surface enzymes that can digest epithelial cells and therefore hydrolyze host tissues and cause pathology.
- Usually the host's repair of the epithelial cells can keep pace with the damage.
- However, when the host is stressed, immunocompromised, has too much HCl, or a high bacterial flora, the digestion will be ahead of repair.

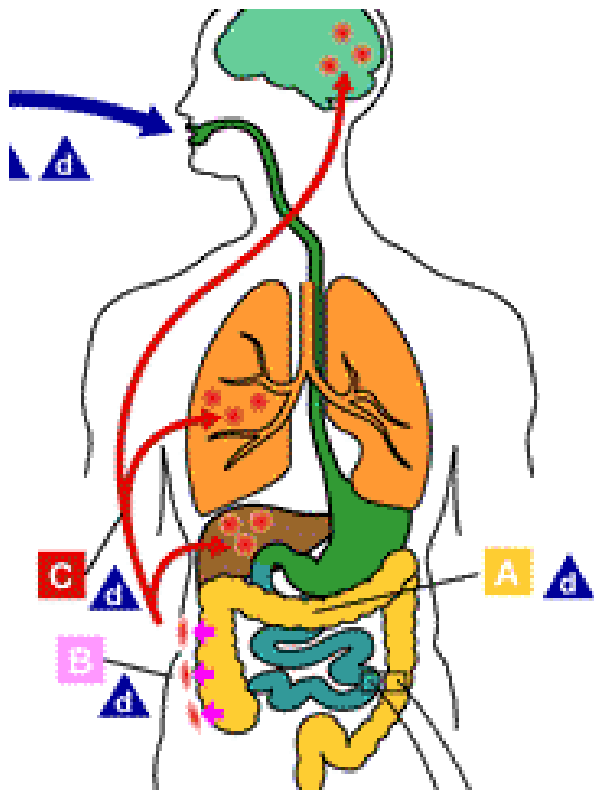


Amebas that reach the muscularis mucosa often cannot hydrolyze tissue fast enough to break into submucosa, causing a lateral spread leading to flask shaped ulcers



Amebas that reach the muscularis mucosa often cannot hydrolyze tissue fast enough to break into submucosa, causing a lateral spread leading to flask shaped ulcers.

Trophozoites can move from large intestine to liver via hepatic portal vein



Internal Infections

Primary or Intestinal lesions-

Infection is confined only to intestine.

- Ascending
- Descending

Secondary or Metastatic Lesions-

Infections are seen in liver, lung, brain, spleen, pericardium, penis, skin, and eyes.

Incubation period is generally four or five days.

Symptoms

- Cramps, vomiting, malaise, abdominal discomfort (mimics appendicitis), rectal tenesmus, and Dysentery - diarrhea with blood
- 10% of people in the world infected with amebas, but only 3% ever have some sort of clinical signs
- This means that most people infected with *E. histolytica* do not know it – Dangerous!

Treatment

- Current drug of choice → Metronidazole (Flagyl) – 3 rounds.
 - Also: tetracycline and diiodohydroxyquin
- Side effects: Insomnia, headaches, vomiting, intense vasodilation, mutations on bacteria, and carcinogenic in mice.

Prognosis

- 90% recovery after treatment
- Body will repair itself but repaired connective tissue in bowel will not function.

Epidemiology

Transmission

1) Contaminated water.

- Most people in the world don't have indoor plumbing/running water.
- Get water by ground/surface water.

2) Contaminated food.

- Defecation in vegetable gardens, fields.
- Night soil (human excrement used as fertilizer).
- The practice of humans using their bare hands to clean toilet pits continues to this day-"night soil men".
-

3) Mechanical contamination.

- Medical Equipment
- Flies, roaches, etc.
- Hand to mouth (finger nails, contaminated objects, toys, etc.)
- Hand to eye (ectopic)
- Hand to open sore (ectopic)
- Anal sex (ectopic)

Outbreaks in US – Examples

- ~ 1864 + Civil war -Andersonville prisoner-of-war camp
- 1933 - World's Fair in Chicago caused by defective plumbing (cross connections between water lines and sewer lines) caused over 1000 cases of Amebiasis resulting in 58 deaths.
- 1980- Outbreak in Colorado due to contaminated colonic machinery

Exposure is simply being exposed to a pathogen

- It does not guarantee infection!!
- Ex. Someone can be exposed to several thousand cysts of *E.histolytica* and only become INFECTED with a hundred

Diagnosis






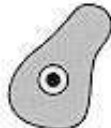






- Direct - Most reliable:
 - look for cysts in fecal smear
 - Biopsy of lesion or abscess

- Indirect -Molecular/immunological diagnosis
 - Nested PCR and monoclonal antibody methods
 - Serological/Immunological tests (ELISA)

Associates -

- *Entamoeba coli*
- *Iodamoeba buetschlii*
- *Endolimax nana*
- *Chilomastix mesnili*

All are non-pathogenic and have the same lifecycle as *E. histolytica*

Amebae						
	<i>Entamoeba histolytica</i>	<i>Entamoeba hartmanni</i>	<i>Entamoeba coli</i>	<i>Entamoeba polecki*</i>	<i>Endolimax nana</i>	<i>Iodamoeba buetschlii</i>
Trophozoite						
Cyst						

*Rare, probably of animal origin

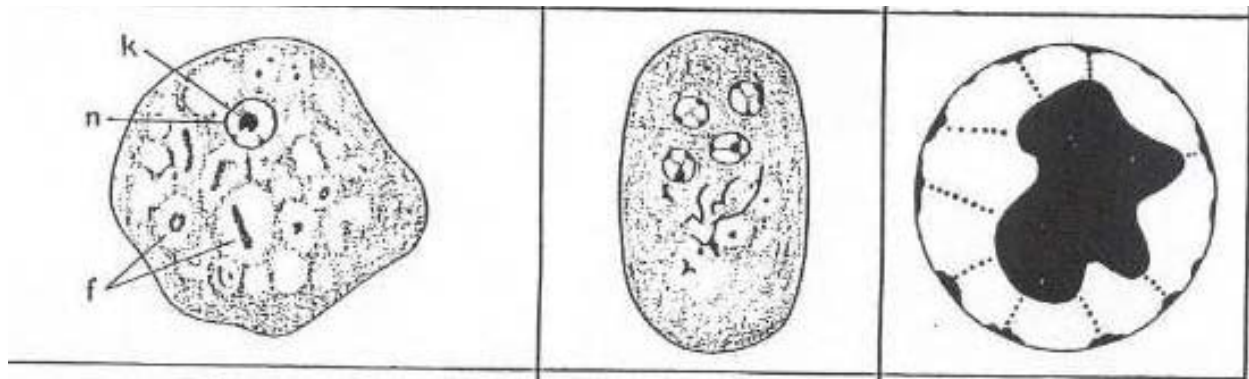
Entamoeba coli

- Life cycle and location identical to *E. histolytica*.
- Most common endocommensal in people; has a worldwide distribution and 10-50% of the population can be infected in different parts of the world.
- Not pathogenic.
- Feeds on bacteria and any other cells available; does not invade tissue.

Trophozoites 20-30 μm in diameter (15-50 μm)

Cysts 10-30 μm

***Endolimax nana* “The dwarf internal slug”**



Trophozoite

Cyst

Nucleus

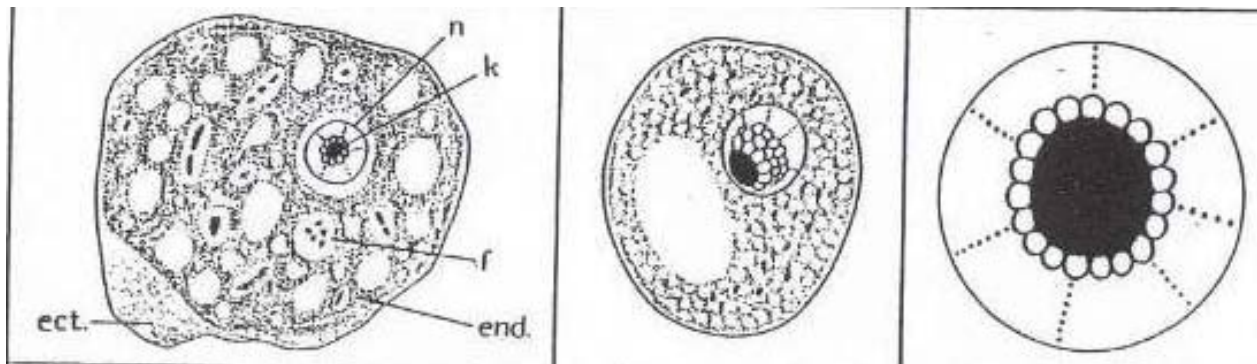
Trophozoites

- tiny 6-15 μm in diameter.
- Large glycogen vacuoles are often present.
-

Mature cyst

- 5 – 14 μm in diameter
- Contains 4 nuclei
- Shape is round to elliptical

Iodamoeba buetschlii



Trophozoite

Cyst

Nucleus

Trophozoites

- 9-14 μm long but may be as large as 20 μm

Cysts

- 6-15 μm long
- have a large glycogen vacuole.

Trichomoana

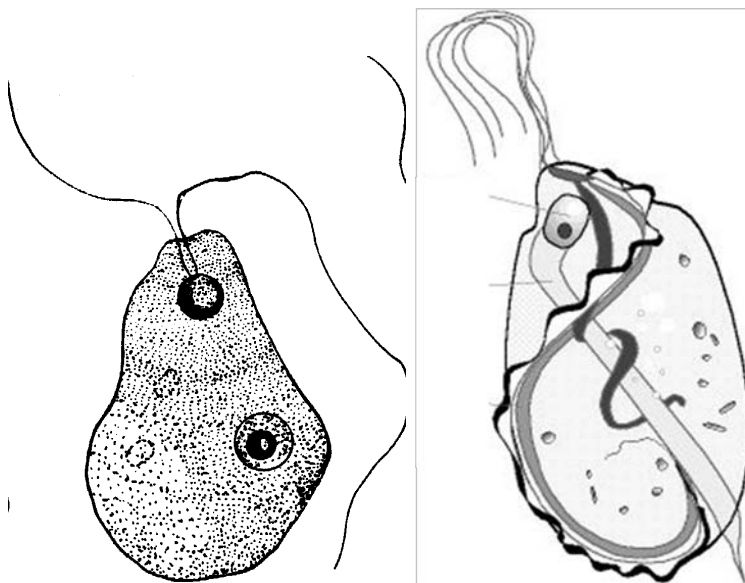
Flagellates

2 groups of parasites:

- intestinal and reproductive track flagellates
- blood and tissue-dwelling flagellates

General Flagellate Anatomy

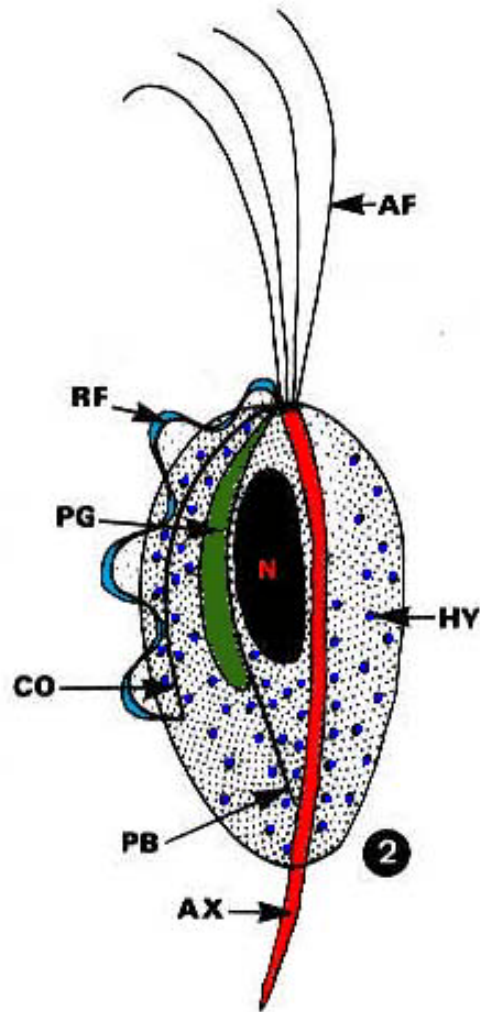
- Pellicle- Combination of plasma membrane and thin, translucent, secreted envelope.
- This gives the flagellate a more defined shape, they are stiff but still flexible, therefore they have a fixed shape.
- This gives the flagellate a more defined shape, they are stiff but still flexible, therefore they have a fixed shape.
-



- **Flagella-** used for locomotion; present/not; how long are they, how many present.
- **Flagella** arise from granules and may be free (unattached) or attached.
- **Basal granule**
- **Blepharoplast** **Where flagella**
arise from.
- **Kinetosome**



- **Undulating Membrane-** Thin line of extending plasma membrane which flagellum attaches to before becoming a free flagellum.



Axostyle- Tube like organelle, may or may not be present.

It arises from the kinetosome

- **Parabasal body-** This is a Golgi Body located near the kinetosome, from which the parabasal filament runs to the kinetosome.
- **Kinetoplast-** A conspicuous part of a mitochondrion in some flagellates found near the kinetosome.

Intestinal and Reproductive Track Flagellates

- *Trichomonas vaginalis* (pathogenic)- occurs in reproductive and urinary system of people.
- *Trichomonas tenax*- endocommensal in mouth (tooth sockets).
- *Trichomonas hominis* (*Pentatrichomonas hominis*)- endocommensal in large intestine and cecum.
- *Chilomastix mesnili* (endocommensal)- lives in the large intestine.
- *Giardia lamblia* (pathogenic)- small intestine.

- Merthiolate-Iodine-Formalin (MIF) Widely used technique.
- Reagents that serve to fix cysts, trophs, and even helminth eggs and aid in identification of parasites.

Trichomonas vaginalis

- Phylum Parabasalia: With parabasal fibers originating at kinetosomes; axostyle non-motile; up to thousands of flagella.
- They are 7-32 μ m long by 5-12 μ m wide.
- It lives in the reproductive and urinary system of people.
- More specifically it is found in the vagina and urethra of women, and in the prostate, seminal vesicles, and urethra of men.
- It is more common in women, and hard to find in men because most are asymptomatic.
- It is cosmopolitan in distribution, however prevalence is not uniform because of sanitary and hygiene habits (depends on surroundings).
- 20-40% in Women
- 15% in Men

See Life Cycle diagram (CDC)

- It is pathogenic and causes **Vaginitis**.
- Suffix means “inflamed” or “inflammation of “
- So inflammation of the vagina.
- Also can be called **Trichomoniasis**
- Emphasis on a organism.
- Etiological agent → organism that causes something.
-

Symptoms

- Usually none.
- Particularly in males. They don't show symptoms.
- In females it ranges from: chaffing, itching, frothing/clear/creamy discharge that is profuse from vagina (leukorrhea).

Pathology

- Eventually females get a disintegration of vaginal epithelial lining
- Natural flora (bacteria) keep the pH of the vagina at 4-4.5 and ordinarily this discourages infections.
- *T. vaginalis* can survive at a low pH.
- Once established it causes a shift toward alkalinity (pH 5-6) which further encourages its growth.
- There is a tendency to explain stillbirths, spontaneous abortions, morbidity to women who have vaginitis.
- No real studies done on this → so dealing with correlations.
- Flagyl- 3 times a day for 4-5 days.
- Reinfection can happen almost immediately.
- Vaginal smears to see if infected for diagnosis.
- Prognosis → full recovery (100%).

Epidemiology

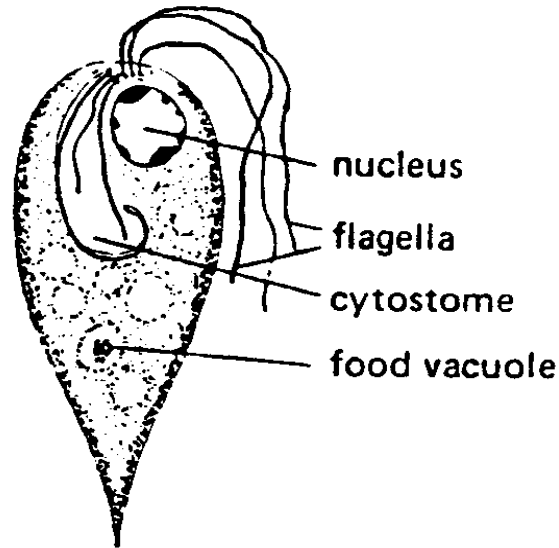
- Sexual contact.
- Soiled clothing/linens; sharing of wash cloth, clothing, etc.
- *T. vaginalis* can live in moist clothing for one day!

Chilomastix mesnili

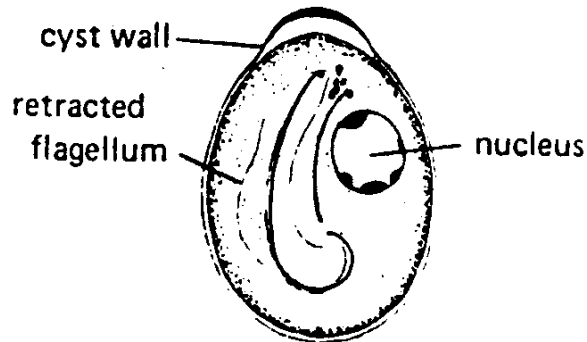
- **Non-pathogenic; endocommensal.**
- **Trophs and cysts in the life cycle.**
- **Lives in the cecum.**
- **Divides by binary fission.**
- **Water borne parasite → infected by contaminated water.**

TROPHOZOITE - 6-24 μm long by 3-20 μm wide.

- 4 flagella arise from kinetosomes at anterior end; 3 flagella extend anteriorly, 1 extends into the cytostome (flagella are difficult to see in



stained trophozoites).



-
- **CYST** is lemon-shaped; 6 to 10 μm in diameter.
- Contains single nucleus, cytosome, and retracted flagella.

Treatment

Flagyl- 3 times a day for 4-5 days.

- Reinfection can happen almost immediately.
- Vaginal smears to see if infected for diagnosis.
- **Prognosis** -- full recovery (100%).

***Giardia duodenalis* (*G. lamblia*; *G. intestinalis*)**

- Giardiasis
- Distinctive flagellate
- Has both a trophozoite and cyst stage.

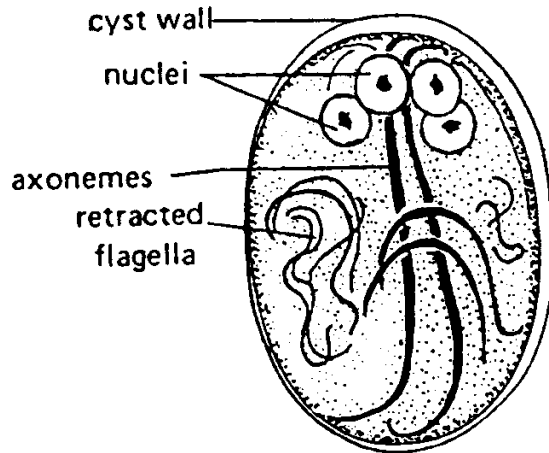
Trophozoites are binucleated (looks like a face). 12-15 μm .

- Ventral surface bears adhesive disk to adhere to surface of intestinal cell.
- 8 flagella (2 anterior, 2 posterior, 2 ventral, and 2 caudal) - all arise from kinetosome.
- Median bodies occur behind adhesive disk - function is unknown.
- Lives in the upper part of the small intestine (duodenum, jejunum, and upper ileum). The trophozoites attach to the epithelial cells with an adhesive disk.
- Feeds on mucous that forms in response to irritation.
 - *Giardia* can also interfere with host absorption of amino acids, lipids, and Vitamins A & D. Long standing infection can lead to issues with vision and rickets.

The **cyst** forms as trophozoites become dehydrated when they pass through the large intestine.

Morphology:

Giardia is ovoid in shape; 8-12 μm long x 7-10 μm wide and has a thin cyst wall. Four nuclei are present and often concentrated at end. Flagella shorten and are retracted within cyst. Axonemes provide internal support.



Cysts can remain viable in the external environment (usually water) for many months. 300 million cysts can be found in a moderate infection, but 14 billion cysts can be passed in 1 stool sample.

Symptoms

- Range from none to abdominal discomfort causing acute or chronic diarrhea and other GI signs.
- Gray, greasy, voluminous malodorous diarrhea.
- Flatulence.
- *Giardia* trophs are attracted to bile salts: so sometimes you can get infections in bile ducts and gall bladder, causing jaundice and colic.

Pathogenesis and Pathology

- Nutrient malabsorption and physical blockage and damage to microvilli.
- Trophs attach to small intestine → cause damage (mechanical and toxins).
- 1) Fat/CHO digestion decreases and causes maldigestion.
- 2) Absorption decreases due to villus blunting causing malabsorption.
- 3) Malabsorption and maldigestion causes diarrhea.
- 4) Physical damage: clubbing of villi; decreases villus-to-crypt ratio; brush borders of cells are irregular.

Epidemiology

- Get infected by ingesting cysts through contaminated water.
- Most common intestinal flagellate of people.
- Worldwide distribution; prevalence ranges from 2.4-67.5%.
- Reservoir hosts can play a significant role.
- There are hot spots: Vacations and Travels → Camping.
- Colorado ski resorts are notorious for outbreaks → drinking from Mountain Springs, washing utensils/drinking water that is not treated.
- Day care centers.

Diagnosis

- Trophs in diarrheic feces; cysts in formed feces.
- At least 3 exams (one every other day) before judge negative.
- ELISA tests: detect soluble antigen.

Treatment

- Drug of choice is Flagyl.