

**Flagellates:**

- *Giardia lamblia*
- *Dientamoeba fragilis*
- *Chilomastix mesnili*
- *Trichomonas hominis*
- *Enteromonas hominis*
- *Retortamonas intestinalis*

**Ameba:**

- *Entamoeba histolytica*
- *Entamoeba dispar*
- *Entamoeba coli*
- *Entamoeba hartmanni*
- *Endolimax nana*
- *Iodamoeba bütschlii*

**Apicomplexa:**

- *Cryptosporidium parvum*
- *Cyclospora cayetanensis*
- *Isospora belli*

**Microsporidia:**

- *Enterocytozoon bienewisi*
- *Encephalitozoon intestinalis*

**Other:**

- *Blastocystis hominis*
- *Balantidium coli*

**INTESTINAL PROTOZOA**

**Typical Fecal-Oral Life Cycle**

**excystation**

**encystment**

**CYST**

- passed in feces
- resistant
- infective

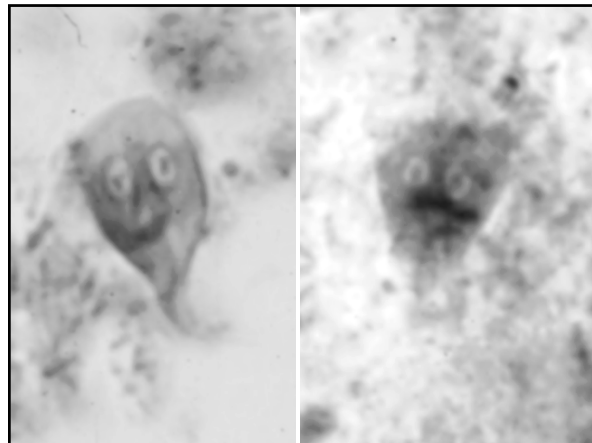
**TROPHOZOITE**

- feeding
- motile
- replication

**monoxenous vs heteroxenous**

**Other Lumen-Dwelling Protozoa**

- *Trichomonas vaginalis* (urogenital)
- *Trichomonas tenax* (oral)
- *Entamoeba gingivalis* (oral)



***Giardia lamblia***

- worldwide distribution
- higher prevalence in tropical or developing countries (20%)
- 1-6% in temperate countries
- most common protozoa in stools
- ~200 million cases/yr
- giardiasis
  - often asymptomatic
  - acute or chronic diarrhea

**Taxonomy**

- one human species, aka:
  - *G. duodenalis*
  - *G. intestinalis*
- morphologically similar forms in other mammals

**Historical Notes**

1681	van Leeuwenhoek observed
1859	Lambl documented clinical symptoms, but controversial
1920's	
1954	Rendtorff fulfilled Koch's postulate

**Fecal-Oral Transmission Factors**

- poor personal hygiene
  - children (eg, day care centers)
  - food handlers
- developing countries
  - poor sanitation
  - endemic
  - travelers diarrhea
- water-borne epidemics
- male homosexuality
  - oral-anal contact
- zoonosis?
  - *Entamoeba* =no
  - *Cryptosporidium* =yes
  - *Giardia* =controversial

**Is giardiasis a zoonosis?**

- no definitive documentation
- transmission between humans and dogs rare (J.Parasit. 83:44, 1997)
- person-to-person transmission is most prevalent

**Giardia Life Cycle**

**CYST**

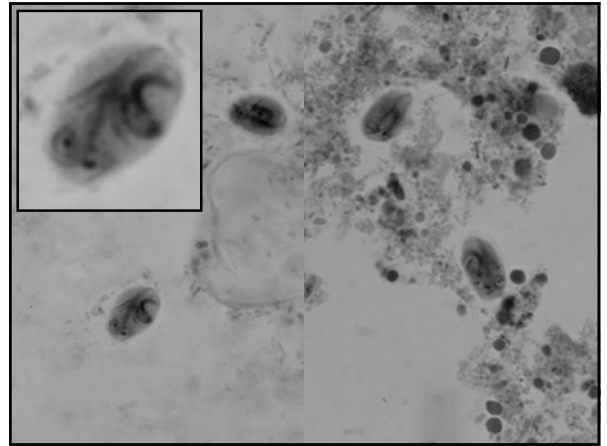
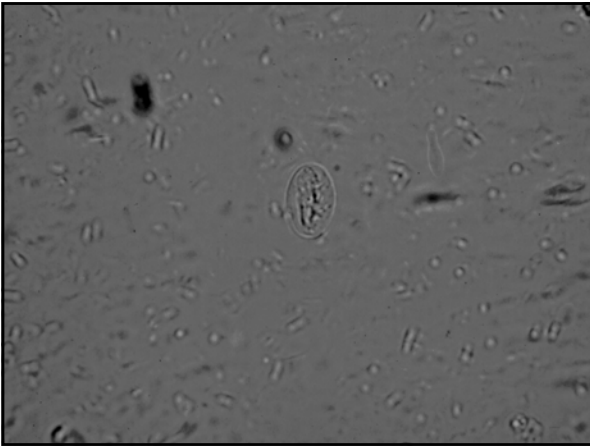
Infective stage passed in feces

**TROPHOZOITE**

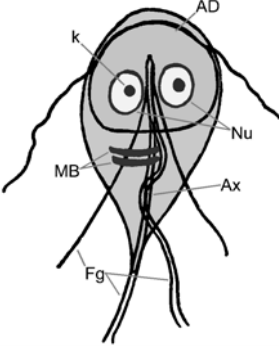
Replicative stage inhabiting sm. intestine

**Key Features of Cysts**

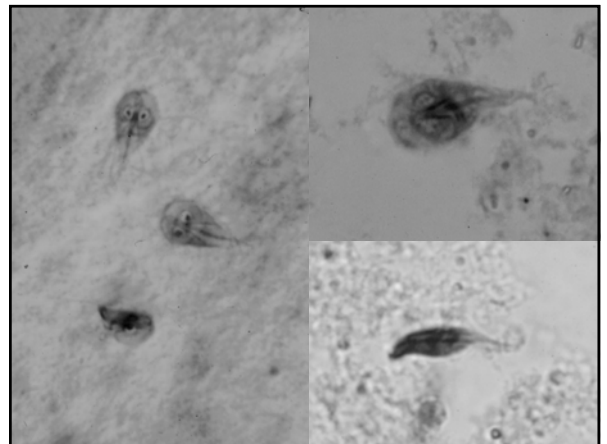
- oval shape
- 11-14 x 6-10 μm
- distinct cell wall set apart from cytoplasm
- 4 nuclei at anterior end
  - large karyosome, no peripheral chromatin
- fibrils (axonomes) evident
- median bodies



### Key Features of Trophozoites

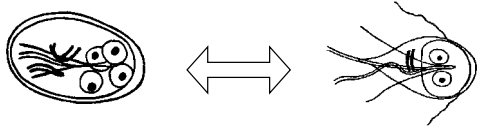
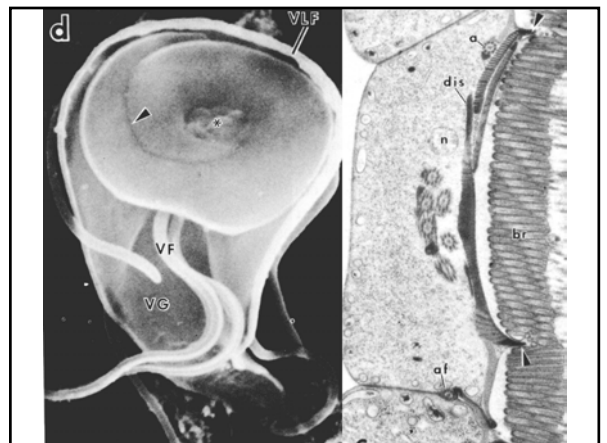


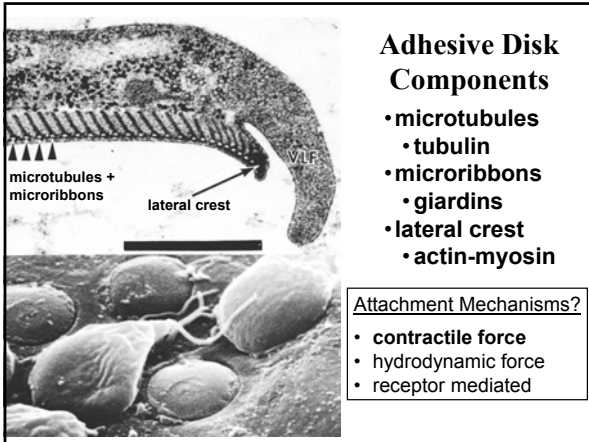
- pear shape
- 12-15 x 5-10 x 2-4  $\mu\text{m}$
- 2 nuclei
  - large karyosome, no peripheral chromatin
- fibrils (axonemes) evident
- bilateral symmetry
- pair of median bodies
- adhesive disk (not always evident)
- 4 pair flagella
  - motility likened to falling leaf



### In Vitro Culture of Giardia

Excystation	Encystation
<ul style="list-style-type: none"> <li>• brief exposure to acidic pH (~2)</li> <li>• flagellar activity within 5-10 min after return to neutral pH</li> <li>• breakdown of cyst wall (proteases)</li> <li>• trophozoite emerges from cyst</li> <li>• cytokinesis within 30 min</li> </ul>	<ul style="list-style-type: none"> <li>• exposure to pH 7, no bile</li> <li>• exposure to pH 7.8, high bile</li> <li>• cyst wall secretion (appearance of vesicles)</li> <li>• loss of disk and flagella</li> <li>• nuclear division</li> </ul>



### Adhesive Disk Components

- microtubules
- tubulin
- microribbons
- giardins
- lateral crest
- actin-myosin

#### Attachment Mechanisms?

- contractile force
- hydrodynamic force
- receptor mediated

## Clinical Features and Symptoms

#### Range of Outcomes

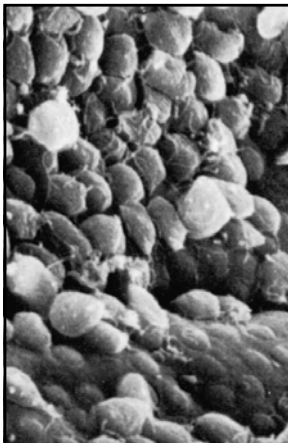
- asymptomatic/latent
- acute short-lasting diarrhea
- chronic/nutritional disorders

#### Subacute/Chronic

- recurrent diarrheal episodes
- cramps uncommon
- sulfuric belching, anorexia, nausea frequent
- can lead to weight loss and failure to thrive

#### Acute Symptoms

- 1-2 week incubation
- sudden explosive, watery diarrhea
  - bulky, frothy, greasy, foul-smelling stools
  - no blood or mucus
- upper gastro-intestinal uneasiness, bloating, flatulence, belching, cramps, nausea, vomiting, anorexia
- usually clears spontaneously (undiagnosed), but can persist or become chronic



## Pathogenesis

- epithelial damage
  - villus blunting
  - crypt cell hypertrophy
  - cellular infiltration
- malabsorption
- enzyme deficiencies
  - lactase (lactose intolerance)

#### Possible Mechanisms

- mechanical irritation
- obstruction of absorption

## Diagnosis

- suspect: acute or chronic symptoms
- confirmed: detection of parasite in feces or duodenal aspirate or biopsy
- parasite easy to identify
- parasite can be difficult to detect
  - inconsistent excretion in feces
  - patchy loci of infection

#### Parasite Detection

##### Stools

- 3 non-consecutive days
- wet mounts or stained
- IFA, copro-antigens

##### Aspirate or Biopsy

- Enterotest (or string test)



## Treatment

#### Drug of Choice

- metronidazole (Flagyl)
- 750 mg/tid/5d
- >90% cure rate

#### Alternatives

- tinidazole (single dose)
- paromomycin (pregnancy)
- quinacrine
- furazolidone

Prognosis is good with no sequelae

## Control

- avoid fecal-oral transmission
- improve personal hygiene
  - especially institutions
- treat asymptomatic carriers
  - eg, family members
- health education
  - hand-washing
  - sanitation
  - food handling
- protect water supply
- treat water if questionable
  - boiling
  - iodine
  - not chlorine