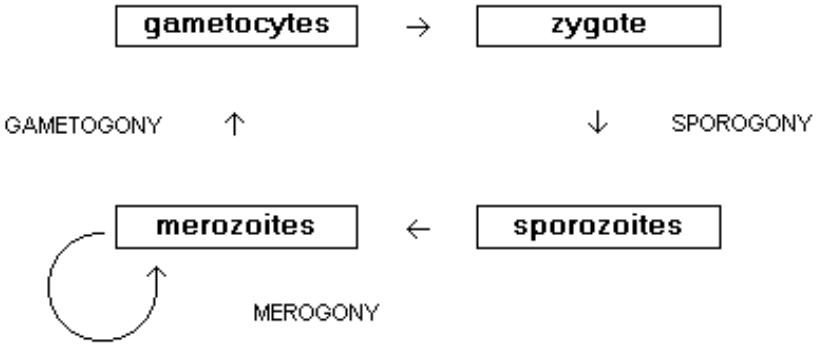
Coccidia

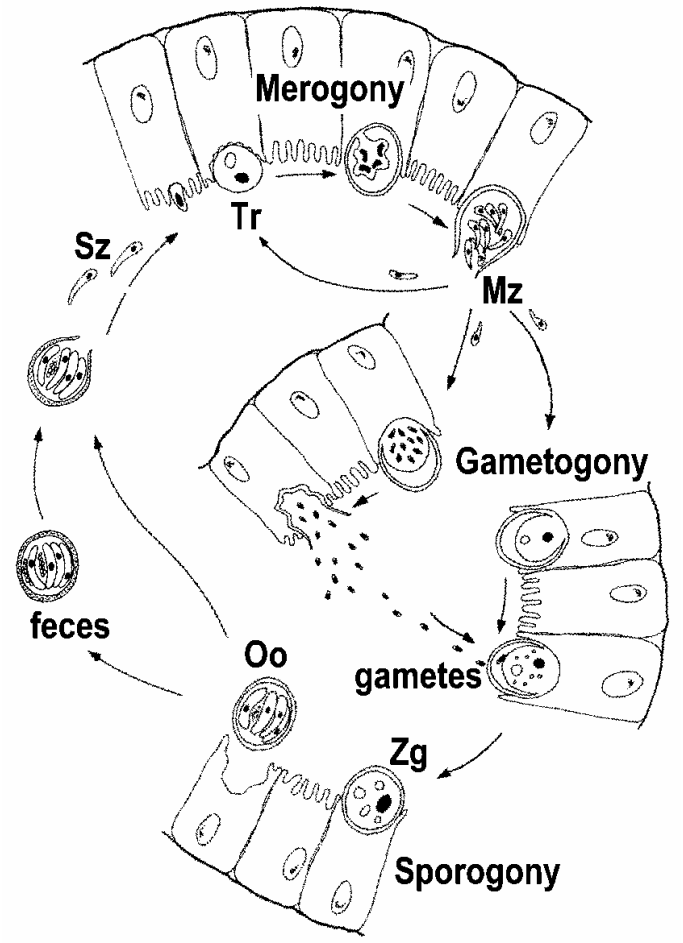
Coccidia Infecting Humans:

- *Isospora*
- *Cryptosporidium*
- *Cyclospora*
- *Sarcocystis*
- *Toxoplasma*



Cryptosporidium parvum

- monoxenous, wide range of animal hosts
  - several host-adapted species?
- self-limiting diarrhea in immunocompetent
- profuse, watery diarrhea associated with AIDS
  - life threatening



Water Borne Outbreaks of Cryptosporidiosis in the USA

Year	Location	% Inf.	suspected cause(s)
1984	Braun Station, TX	0.2	sewage contaminated well
1987	Carrolton, GA	1.3	water-treatment deficiencies
1988	Los Angeles, CA	-	inoperative swimming pool filters
1991	Pennsylvania	0.06	water-treatment deficiencies
1992	Jackson County, CO	1.5	water-treatment deficiencies
1992	Lane County, OR	-	oocysts in filter washback water
1993	Madison, WI	-	fecal accident in swimming pool
1993	Milwaukee, WI	40.3	spring thaw, water-treatment deficiencies
1994	Clark county, NV	0.008	fecal accident in swimming pool

Modified from Graczyk et al (1997) Parasitology Today 13:348

The Milwaukee Outbreak
(NEJM 331:161, 1994)

- massive cryptosporidiosis outbreak following spring thaw
  - >400,000 people may have been affected
  - based on clinical symptoms (acute watery diarrhea)
- treated water had high levels of turbidity 3/23-4/5/1993
  - oocysts identified in ice made during this period
  - 100-fold higher levels of *Cryptosporidium* oocysts in stools
  - other enterics (including *Giardia*, bacteria, viruses) were at ~normal levels

Factors Favoring Waterborne Cryptosporidiosis

- small size of oocysts (4-5 mm)
- reduced host specificity and monoxenous development
- close associations between human and animal hosts
- large number of oocysts excreted (up to 100 billion per calf per day)
- low infective dose (<30)
- robust oocysts; resistant to chlorine
- infectious sporulated oocysts excreted in feces

Molecular Epidemiology
Peng *et al* (1997), Emerg. Inf. Dis. 3:567

- 2 genotypes identified from 39 isolates:

  Genotype 1
  - only human sources
  - non-infective for mice or calves
  - anthroponotic

  Genotype 2
  - human and bovine sources
  - infective for mice and calves
  - zoonotic

Symptoms of 205 patients with Confirmed Cases of Cryptosporidiosis During the Milwaukee Outbreak

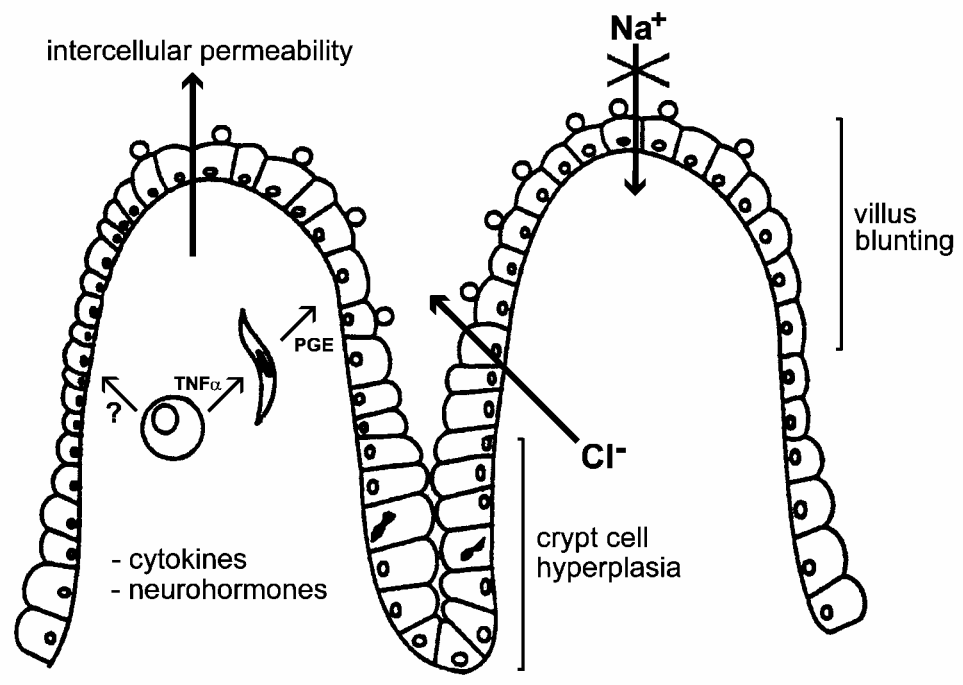
SYMPTOMS	%
Watery Diarrhea mean=12d; med=9d (1-55d) mean=19/d; med=12/d (1-90) 39% recurred after days free	93
Abdominal Cramps	84
Weight Loss med=10lb (1-40lb)	75
Fever med=38.3 (37.2-40.5)	57
Vomiting	48

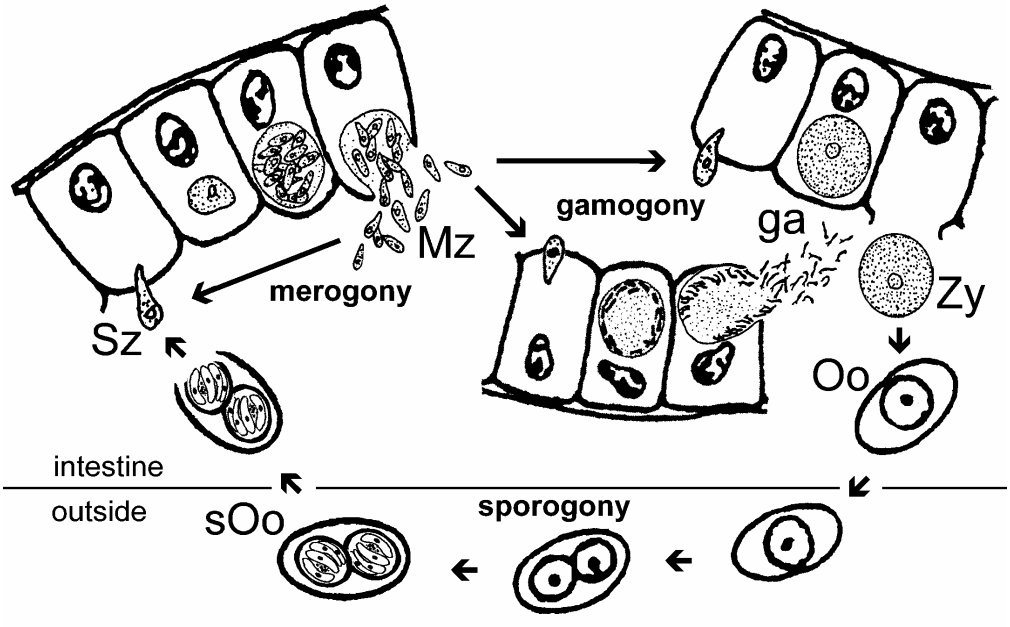
Diarrhea

- enterocyte malfunction (osmotic)
  - ♦ impaired absorption
  - ♦ enhanced secretion
- inflammatory diarrhea
  - ♦ mucosal invasion
  - ♦ leukocytes in stools
- secretory diarrhea
  - ♦ toxin
  - ♦ watery

Pathogenesis

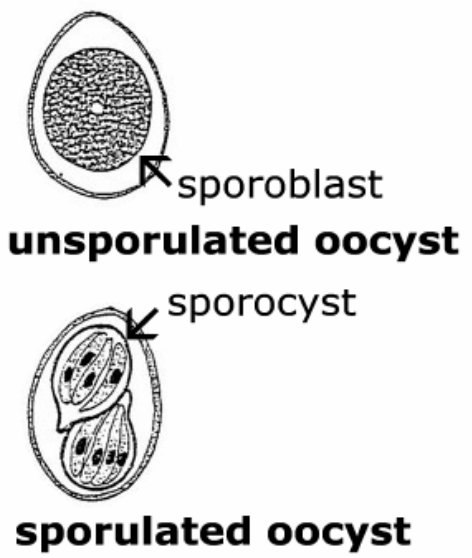
- enterocytes damaged or killed
  - villus atrophy (blunting)
  - ↑Na^+ absorption
  - ↑permeability
- crypt cell hyperplasia
  - ↓Cl^- secretion
- inflammation in lamina propria
  - cytokines and neurohormones?
  - enhanced secretion of antibodies (IgA)?





Isospora belli

- wide geographical distribution (higher prevalence in warmer climates)
- monoxenous, probably not zoonosis
- invades intestinal epithelial cells
- often asymptomatic (seldom reported)
- symptoms range from mild gastro-intestinal distress to severe dysentery
- often self-limiting, but can become chronic (wasting, anorexia)



Cyclospora cayetanensis

- first human case reported in 1979
- initially called 'cyanobacteria-like body (CLB)
  - aka large *Cryptosporidium*
  - demonstrated to be coccidian in 1993
- life cycle unknown
  - oocysts mature in environment
  - similar to *Isospora*?
  - zoonosis?
- related to *Eimeria*
- clinical symptoms similar to *Cryptosporidium* and *Isospora*
  - watery diarrhea/frequent stools
  - 1-2 week duration typical
  - relapses over 1-2 months
- associated with food-borne outbreaks

Distinguishing Coccidian Parasites Found in Human Feces

Species	Excreted Form	Size	Oocyst Structure
Cryptosporidium parvum	sporulated oocysts	4-5 μm	4 sporozoites, no sporocysts
Cyclospora cayetanensis	unsporulated oocysts	8-10 μm	2 sporocysts with 2 sporozoites each
Isospora belli	unsporulated oocysts	30 x 12 μm	2 sporocysts with 4 sporozoites each
Sarcocystis species	sporulated sporocysts*	13 x 10 μm	2 sporocysts with 4 sporozoites each

*Occasionally oocysts seen.