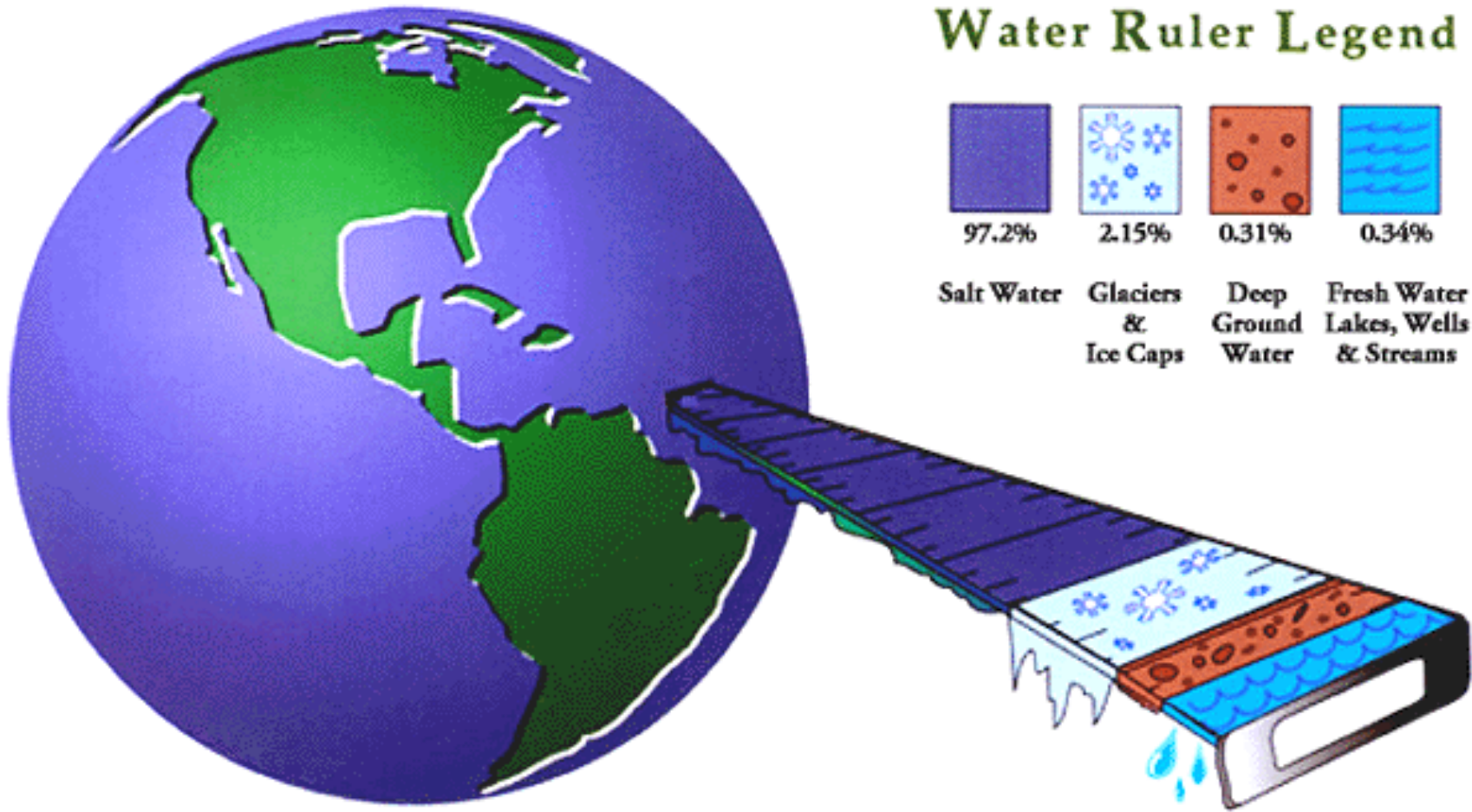


Water-Borne Diseases



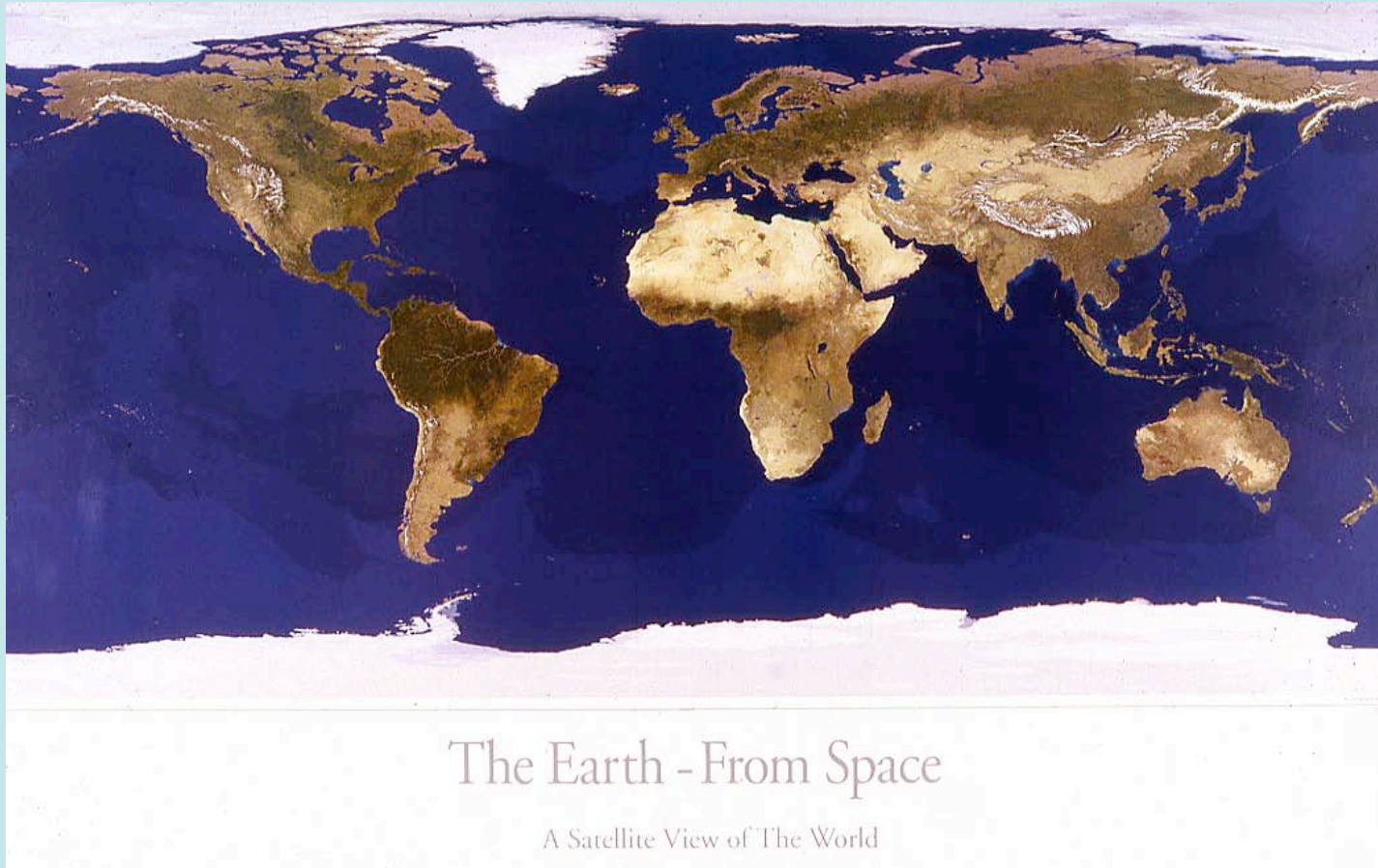


COMPUTER IMAGE BY CHUCK CARTER

The world's water supply

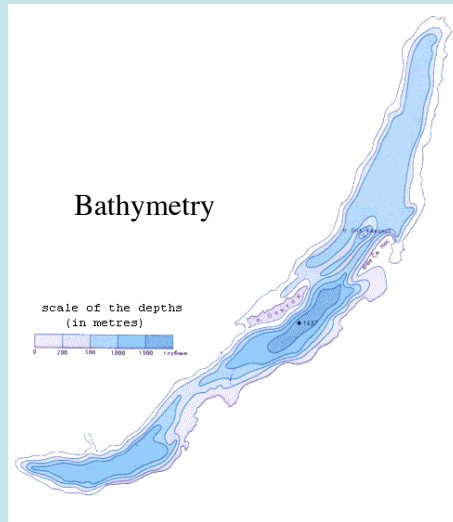
If all earth's water fit in a gallon jug, available fresh water would equal just over a tablespoon—less than half of one percent of the total. About 97 percent of the planet's water is seawater; another 2 percent is locked in icecaps and glaciers. Vast reserves of fresh water underlie earth's surface, but much of it is too deep to economically tap.

20% Of The Earth's Liquid Fresh Water Is In Just One Place



Courtesy NASA

Lake Baikal, Siberia



Maximum depth: 1,632 m

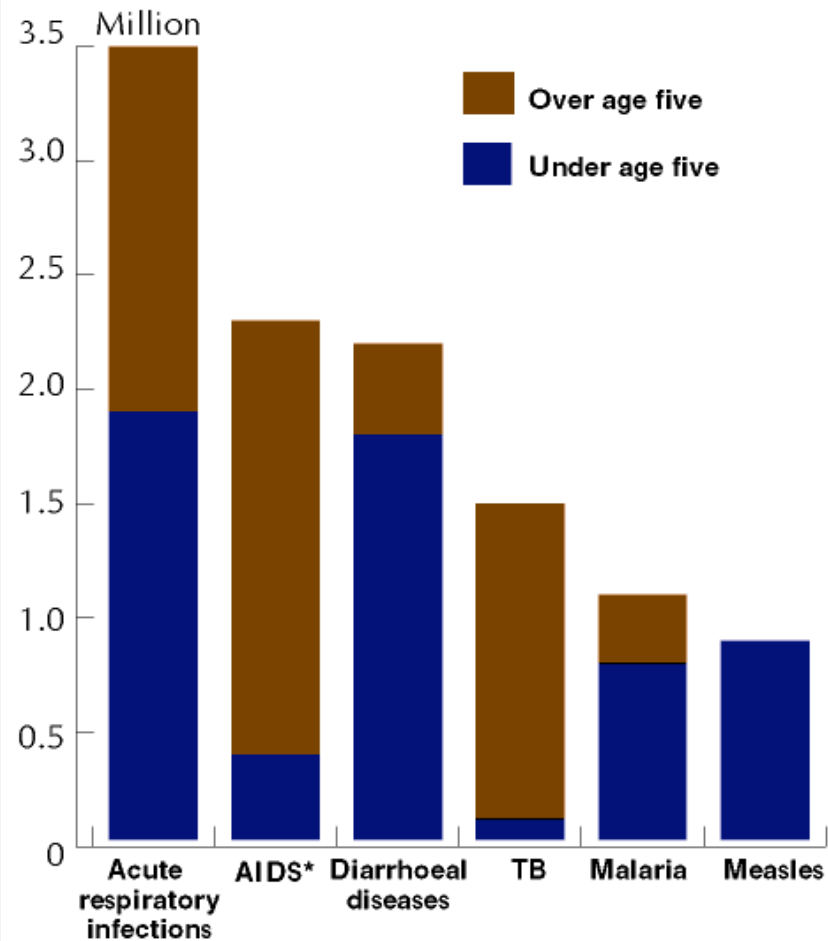


“Dehydration from diarrhea is still a constant threat to the survival of the world’s children, accounting for almost 3 million deaths each year.”

USAID Save The Children Program

LEADING INFECTIOUS KILLERS

Six high-burden diseases cause
90% of total disease deaths

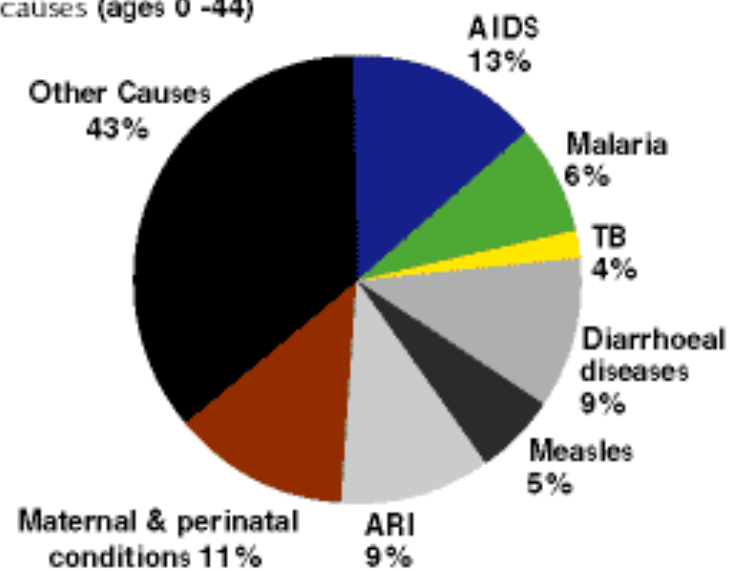


*HIV-positive people who have died with TB have been included among AIDS deaths

Source: World Health Organization/CDS 1999

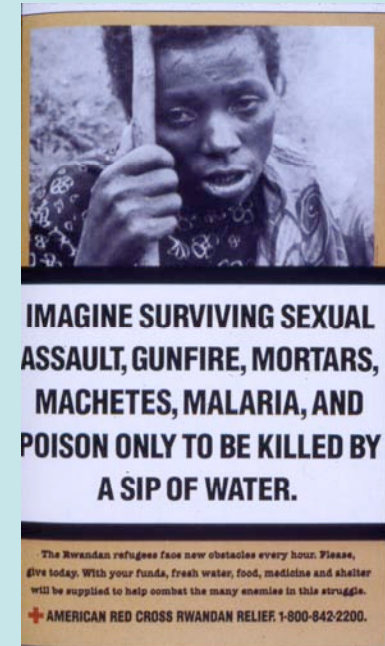
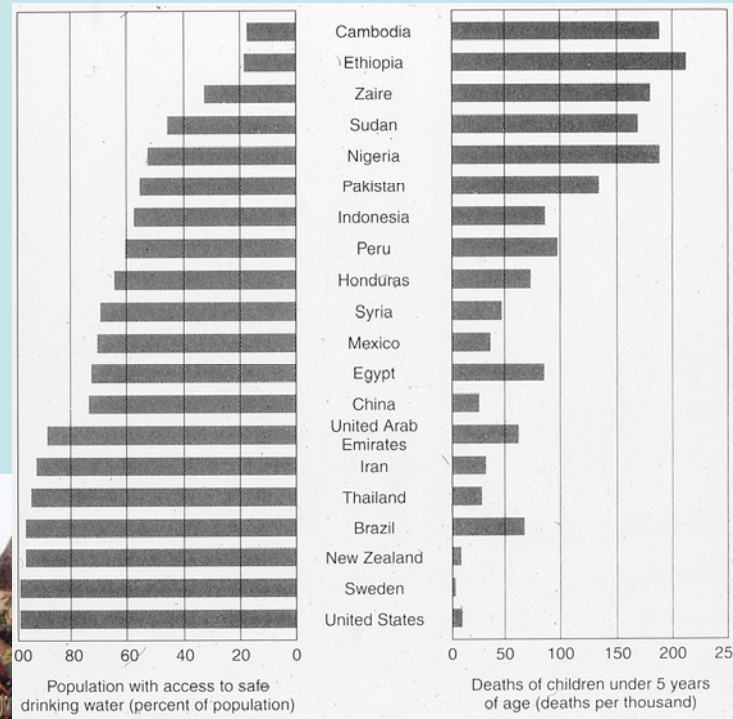
DEATHS IN DEVELOPING COUNTRIES

Two out of three deaths among children and young adults in Africa and Southeast Asia are due to seven causes (ages 0 -44)



Source: World Health Organization/CDS

Access to safe drinking water is everyone's right



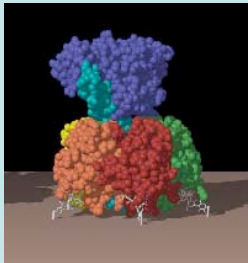
Water Borne Infectious Diseases

Clinical Syndromes

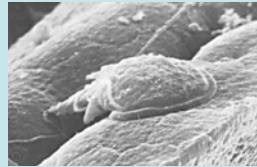
Type I

- a. Noninflammatory (enterotoxin, etc.)
- b. Proximal small bowel
- c. Watery diarrhea
- d. Examples:

Rotavirus
Vibrio cholerae
Giardia lamblia
Cryptosporidium parvum
Cyclospora cayetanensis



Cholera toxin



Giardia lamblia

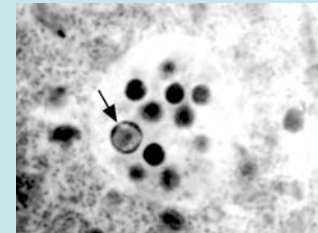


Salmonella typhi

Type II

- a. Inflammatory (invasive, cytotoxin)
- b. Colon
- c. Dysentery (bloody diarrhea)
- d. Examples:

Salmonella enteritidis
Clostridium difficile
Campylobacter pylori
Entameba histolytica



Entameba histolytica

Type III

- a. Penetrating
- b. Distal small bowel
- c. Examples:

Salmonella typhi
Yersinia enterocolitica

*Discoverer Of The First Water Borne
Infectious Disease: **Giardia lamblia***



Anton Von Leeuwenhoek

Water Borne Infectious Diseases:
Viruses

Rotavirus

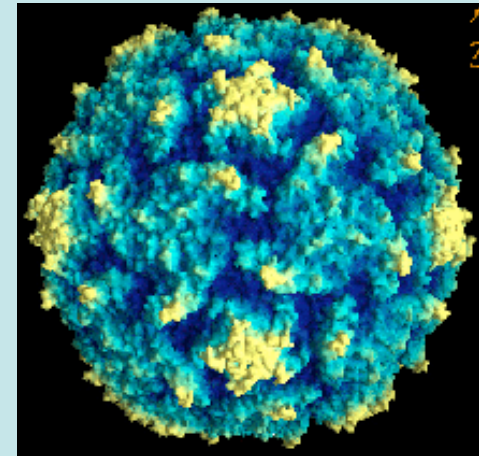
Polio

Hepatitis A

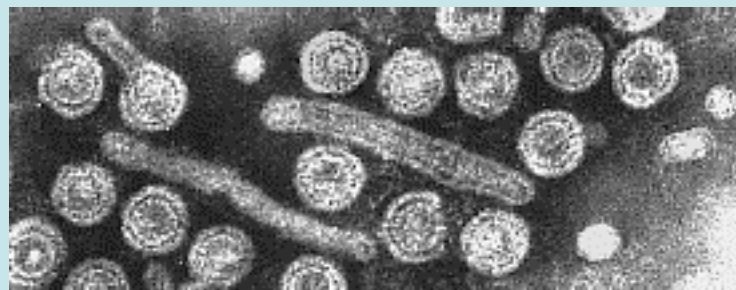
Hepatitis E



Rotavirus



Polio virus



Hepatitis virus

Water Borne Infectious Diseases:

Bacteria

Vibrio cholerae

Escherichia coli 0157

Salmonella typhi

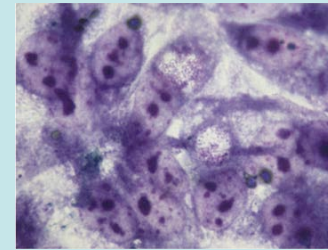
Shigella flexneri

Campylobacter pylori

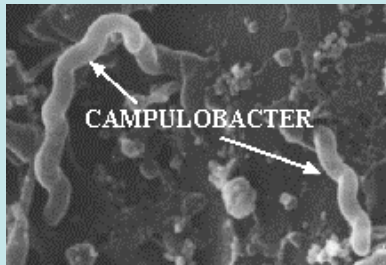
Chlamydia trachomatis



Vibrio cholerae



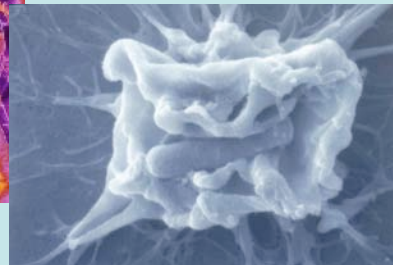
Chlamydia trachomatis



Campylobacter pylori



Salmonella typhi

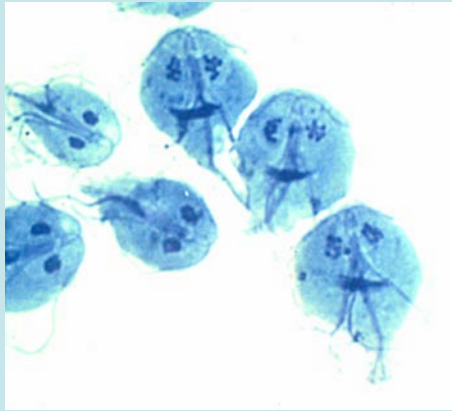


Shigella flexneri



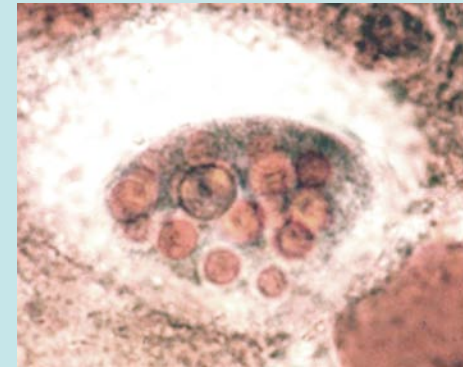
Escherichia coli

Water Borne Infectious Diseases: Protozoa

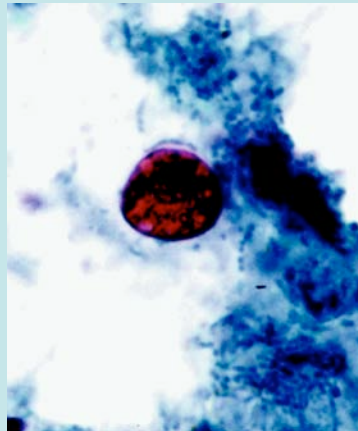


Giardia lamblia

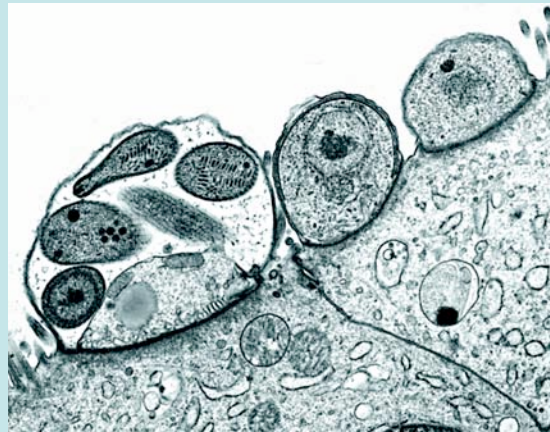
Giardia lamblia
Entameba histolytica
Cryptosporidium parvum
Cyclospora cayetanensis
Balantidium coli



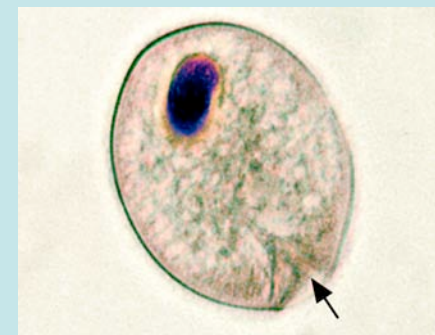
Entameba histolytica



Cyclospora cayetanensis



Cryptosporidium parvum



Balantidium coli

Water Borne Infectious Diseases:

Helminths

Strongyloides stercoralis

Dracunculus medinensis

Schistosoma mansoni

Schistosoma japonicum

Schistosoma haematobium



Strongyloides stercoralis



Schistosome adult



Water Borne Infectious Diseases:

Bacteria

Vibrio cholerae

Escherichia coli 0157

Salmonella typhi

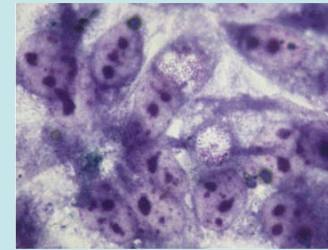
Shigella flexneri

Campylobacter pylori

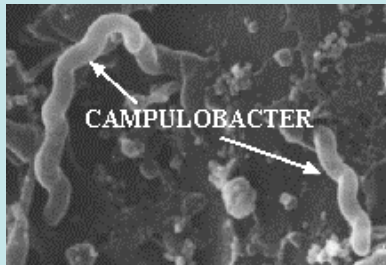
Chlamydia trachomatis



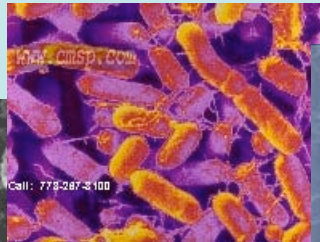
Vibrio cholerae



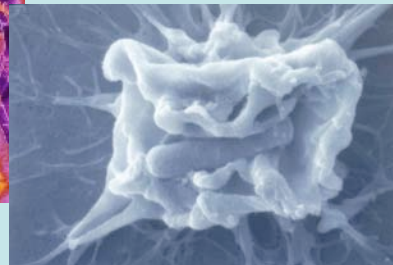
Chlamydia trachomatis



Campylobacter pylori



Salmonella typhi



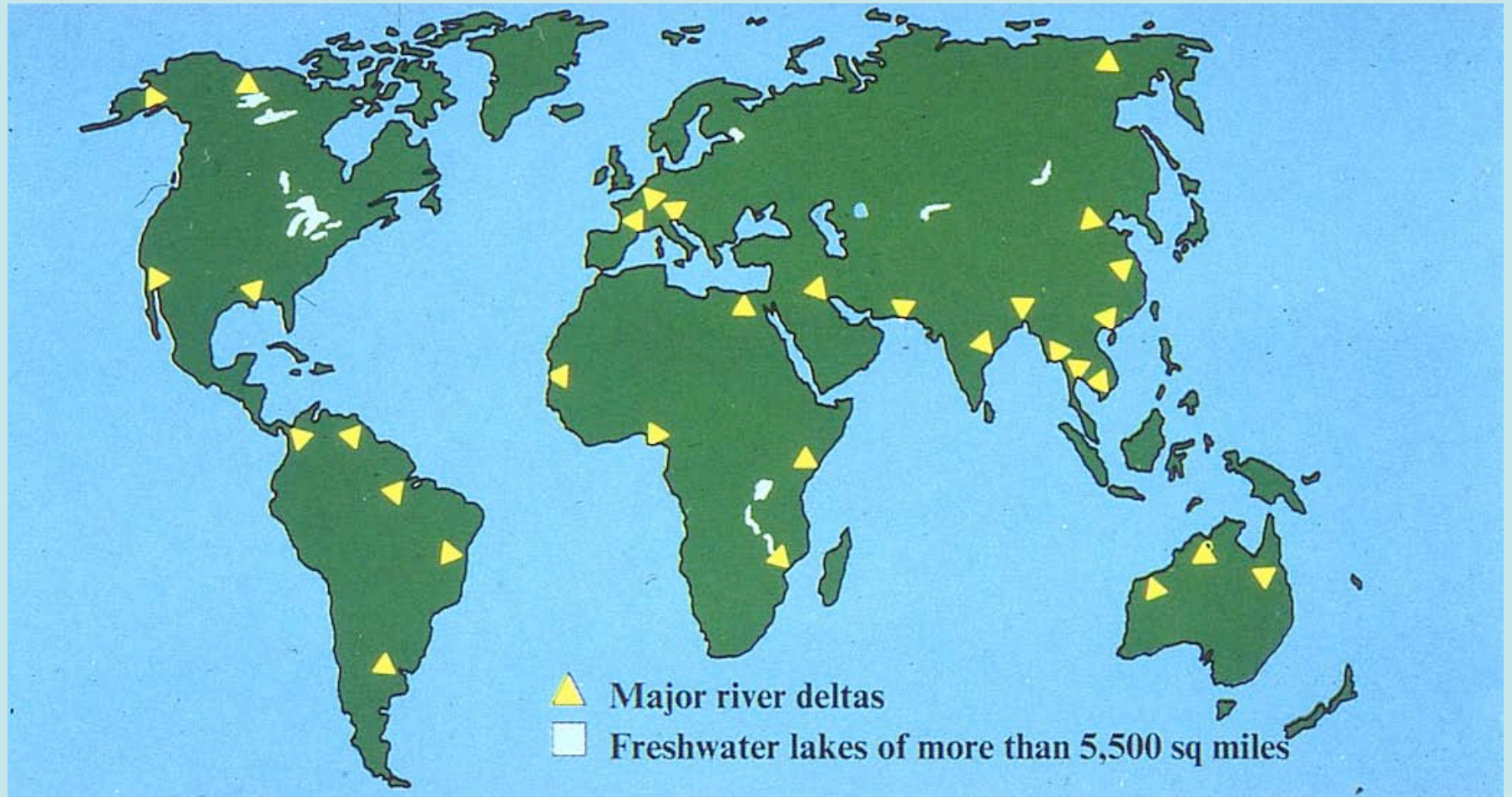
Shigella flexneri



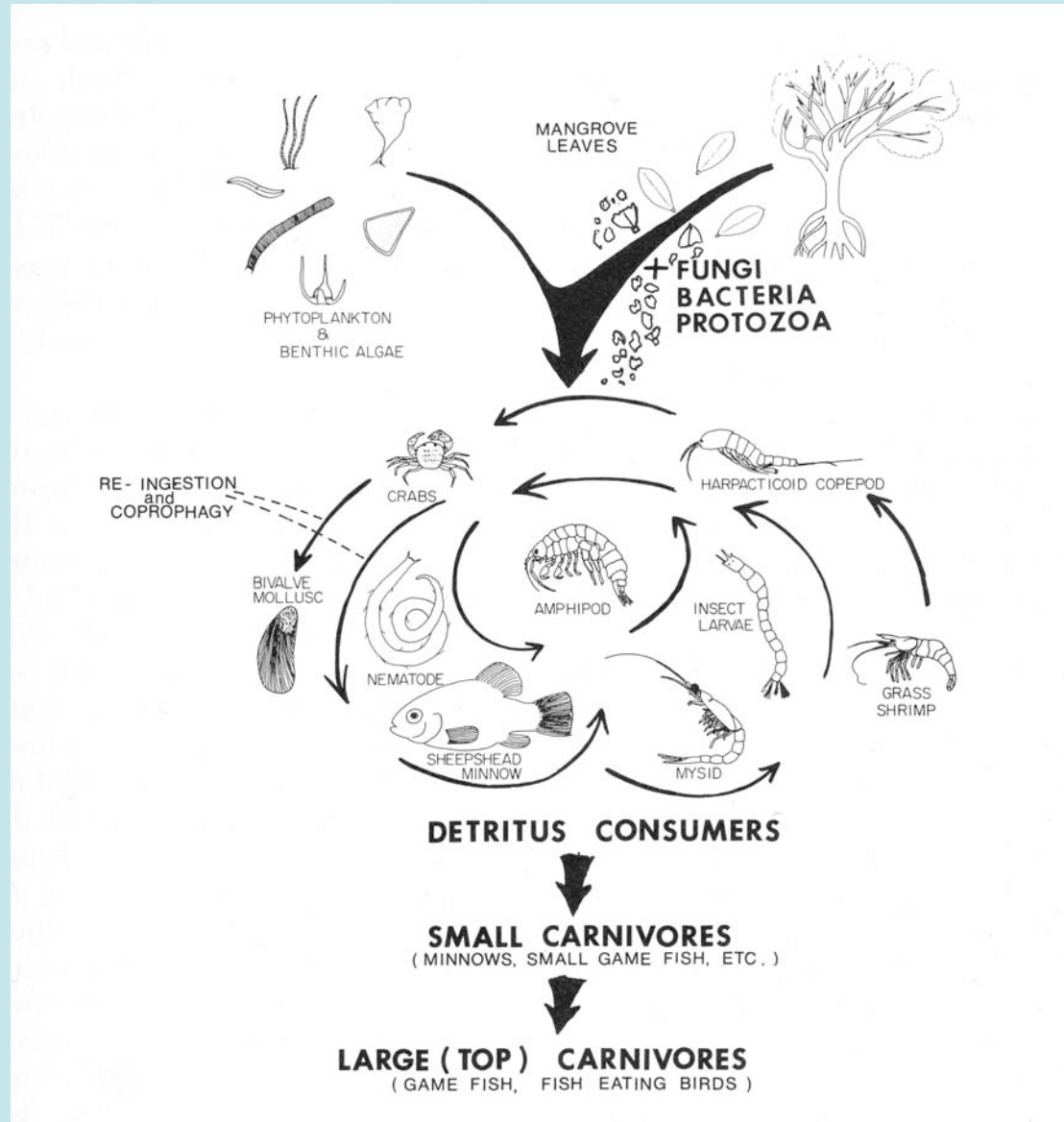
Escherichia coli

Cholera

Distribution Of Estuaries



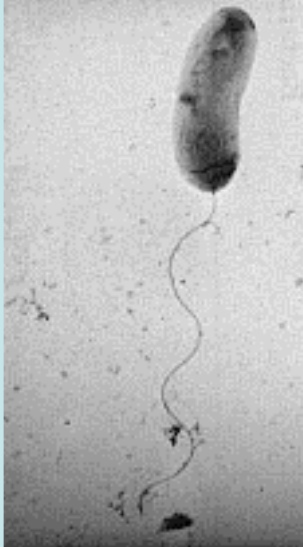
Trophic Relationships Of The Mangrove Estuary



From: E. Odum *Fundamentals Of Ecology*

*New Cholera Outbreaks Frequently Occur
In Communities Adjacent To Estuaries.*

WHY?



*Because **Vibrio cholerae** and its relatives are marine microbes, fully integrated into their respective food webs.*

Environmental Conditions Favoring Growth Of Vibrio:

- 1. Low salt*
- 2. High Nutrient Load*
- 3. 20°C*
- 4. Triggers phytoplankton bloom*
- 5. Followed by zooplankton bloom*
- 6. Followed by a cholera outbreak*

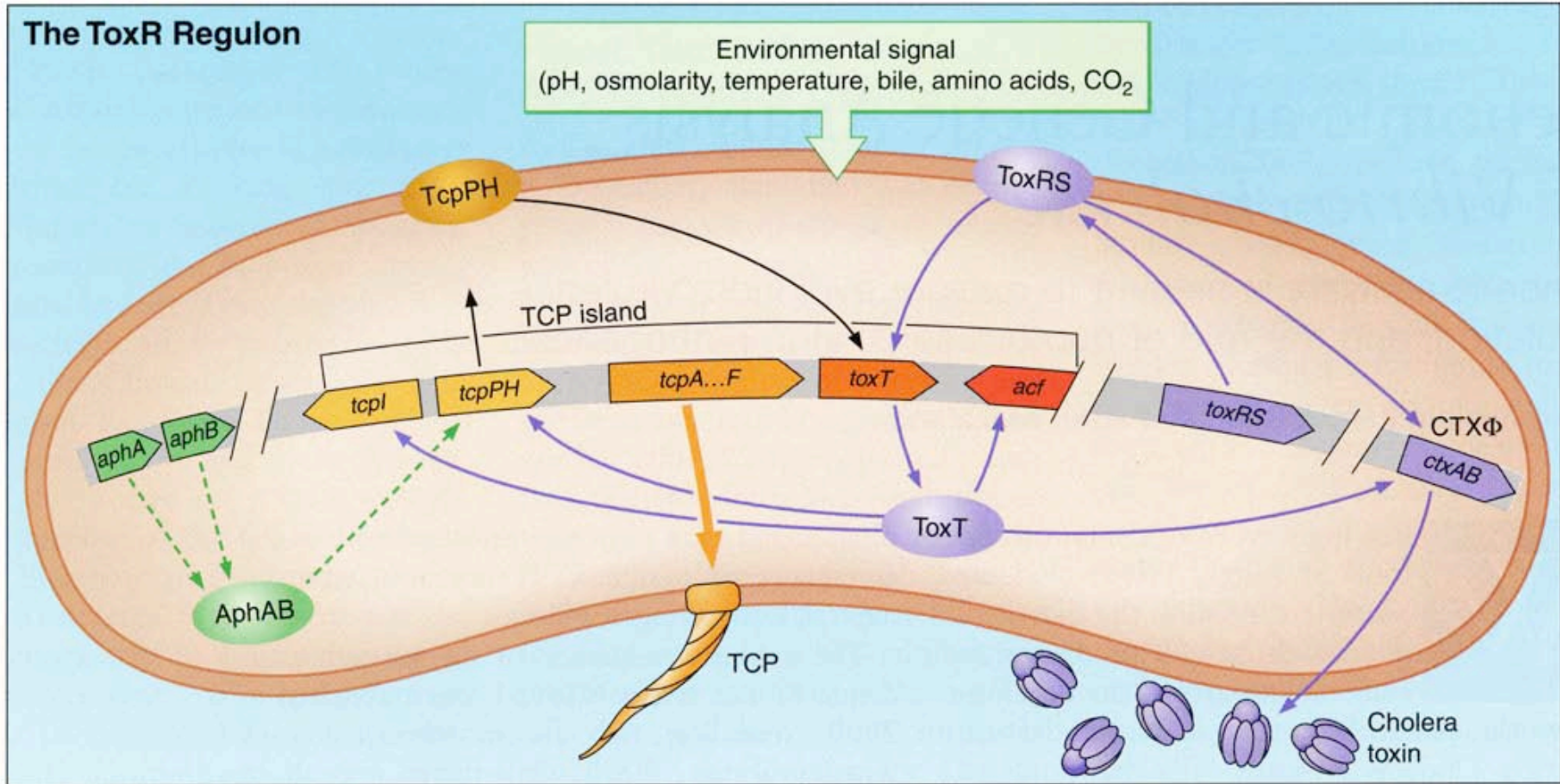


Marine copepod with *Vibrio cholerae* attached to egg cases.

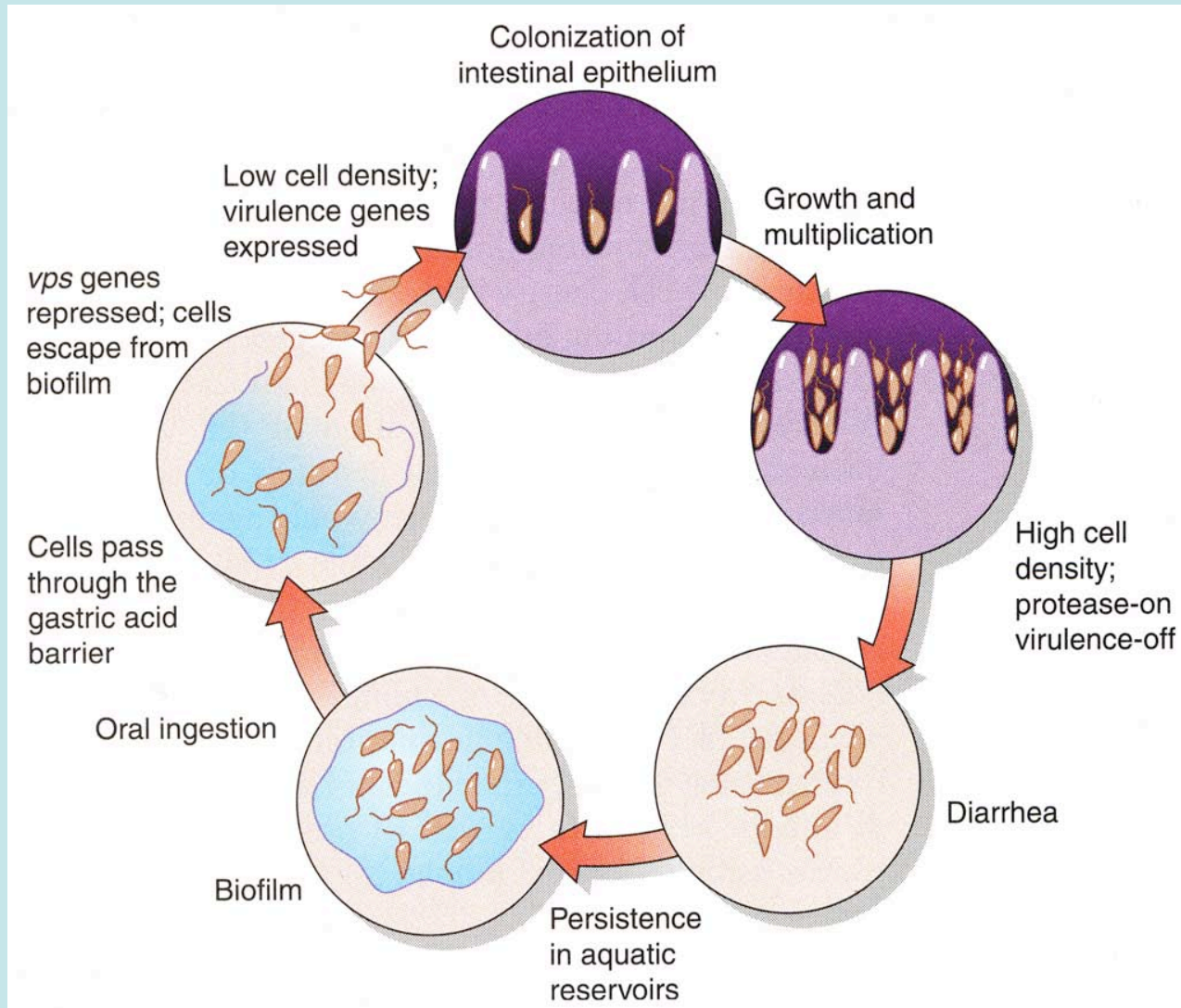
Phytoplankton Bloom



The ToxR Regulon

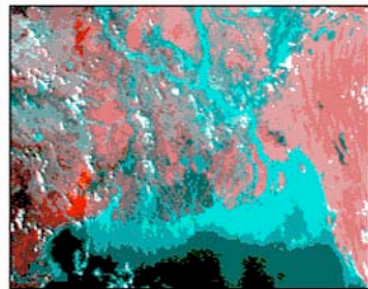
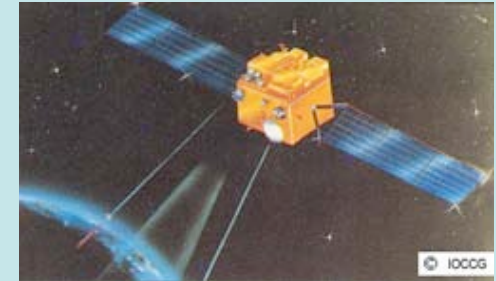


Mechanisms of Pathogenicity

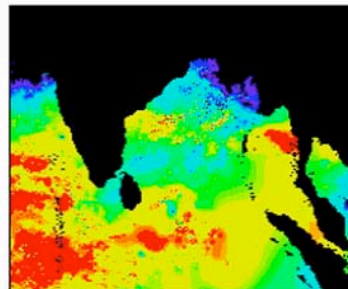


Monsoons

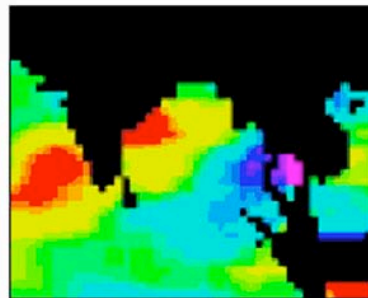
1. lower the salinity of the estuary
2. bring nutrients to the estuary
3. raise the ambient water temperature of the estuary



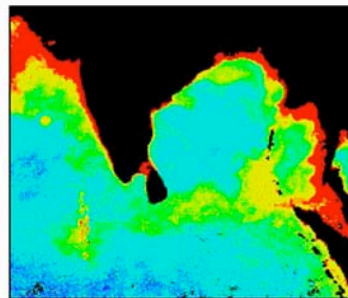
a



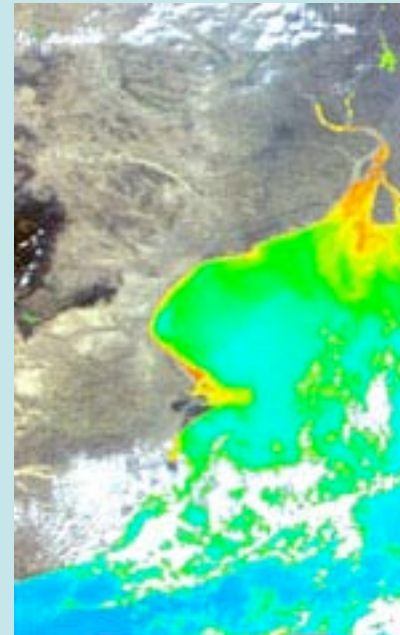
b



c

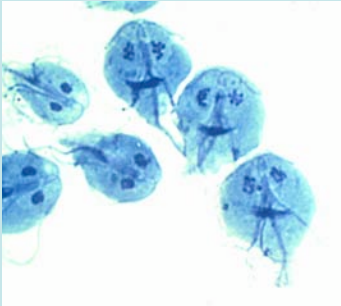


d



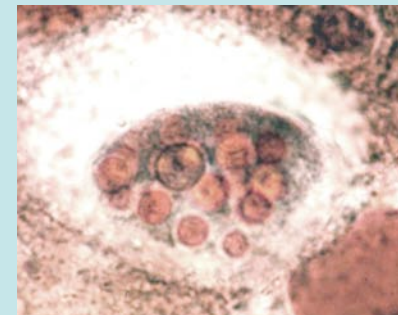
Water Borne Infectious Diseases:

Protozoa

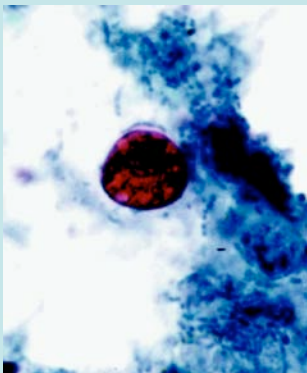


Giardia lamblia

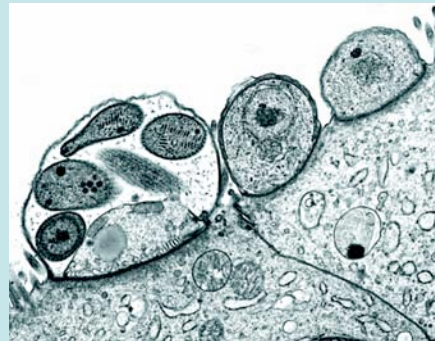
Giardia lamblia
Entameba histolytica
Cryptosporidium parvum
Cyclospora cayetanensis
Balantidium coli



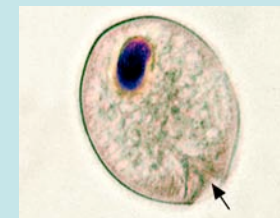
Entameba histolytica



Cyclospora cayetanensis



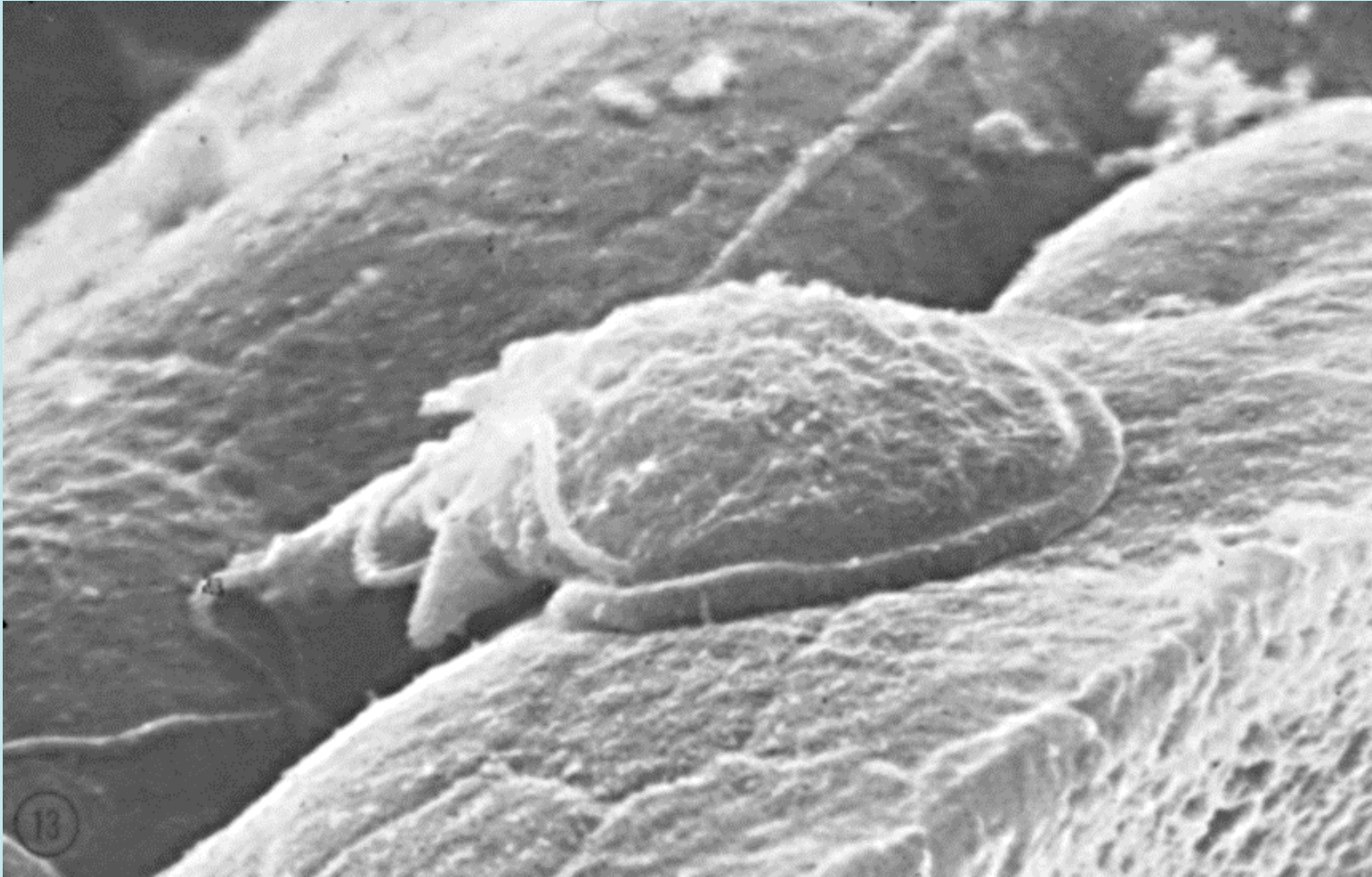
Cryptosporidium parvum



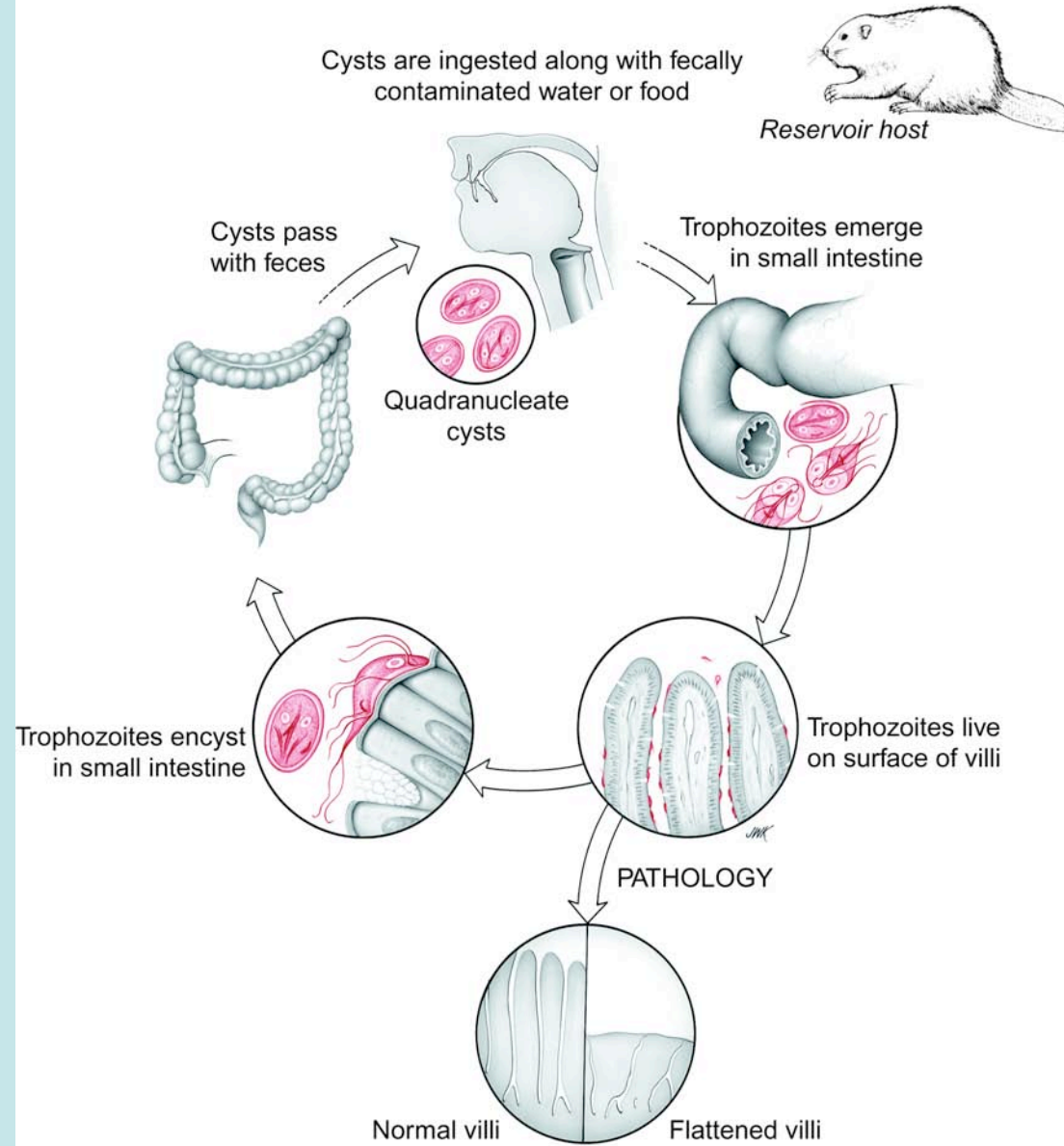
Balantidium coli

Giardia lamblia

SEM of *Giardia lamblia* in situ



Giardia lamblia

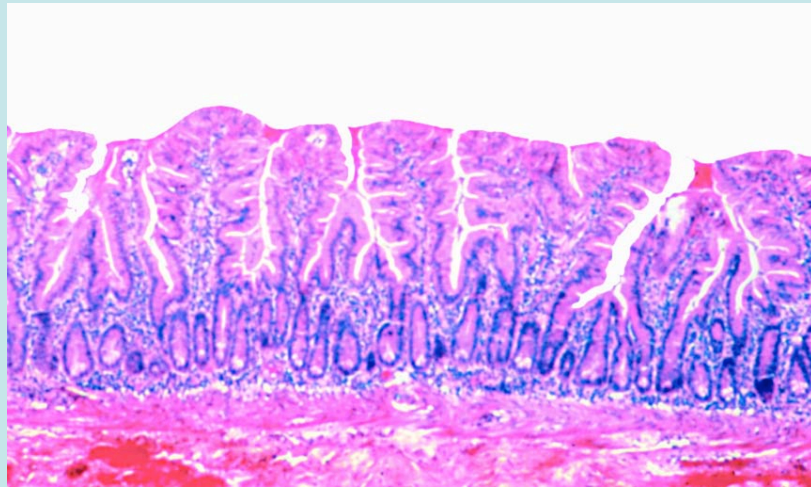


Clinical Disease:

1. Diarrhea (steatorrhea)
2. Weight loss
3. Constipation
4. Fatigue

Pathogenesis:

Trophozoites induce malabsorption of fats.
Mechanism(s) unknown.



Histopathological correlate: Flattened villi

Diagnosis:

1. Identify trophozoites and cysts by microscopic examination of stool



Trophozoite



Cyst

8 μm

Diagnosis:

2. Antigen Capture ELISA using stool sample

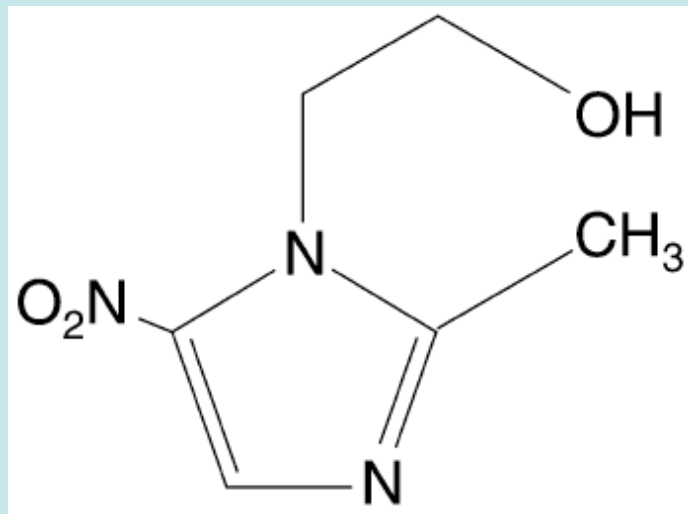
3. PCR

4. IHA serology:

Intestinal - 95% predictive of active infection

Extra-intestinal - 100% predictive of active
infection

Drug Of Choice: Metronidazole



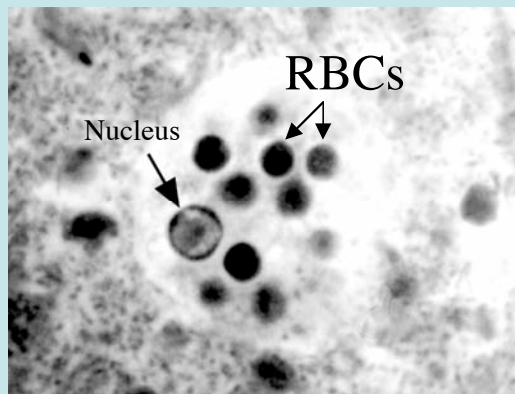
Mode Of Action:

Inhibits Oxidoreductase.

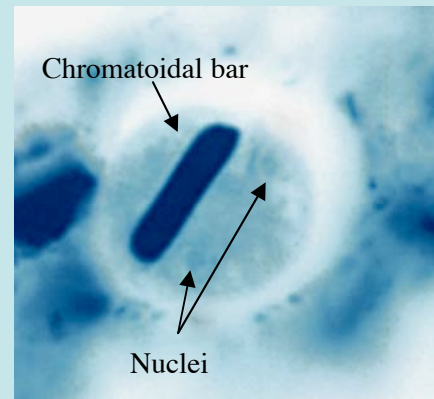
Effective Against All Anaerobic Organisms

Entameba histolytica

Morphology



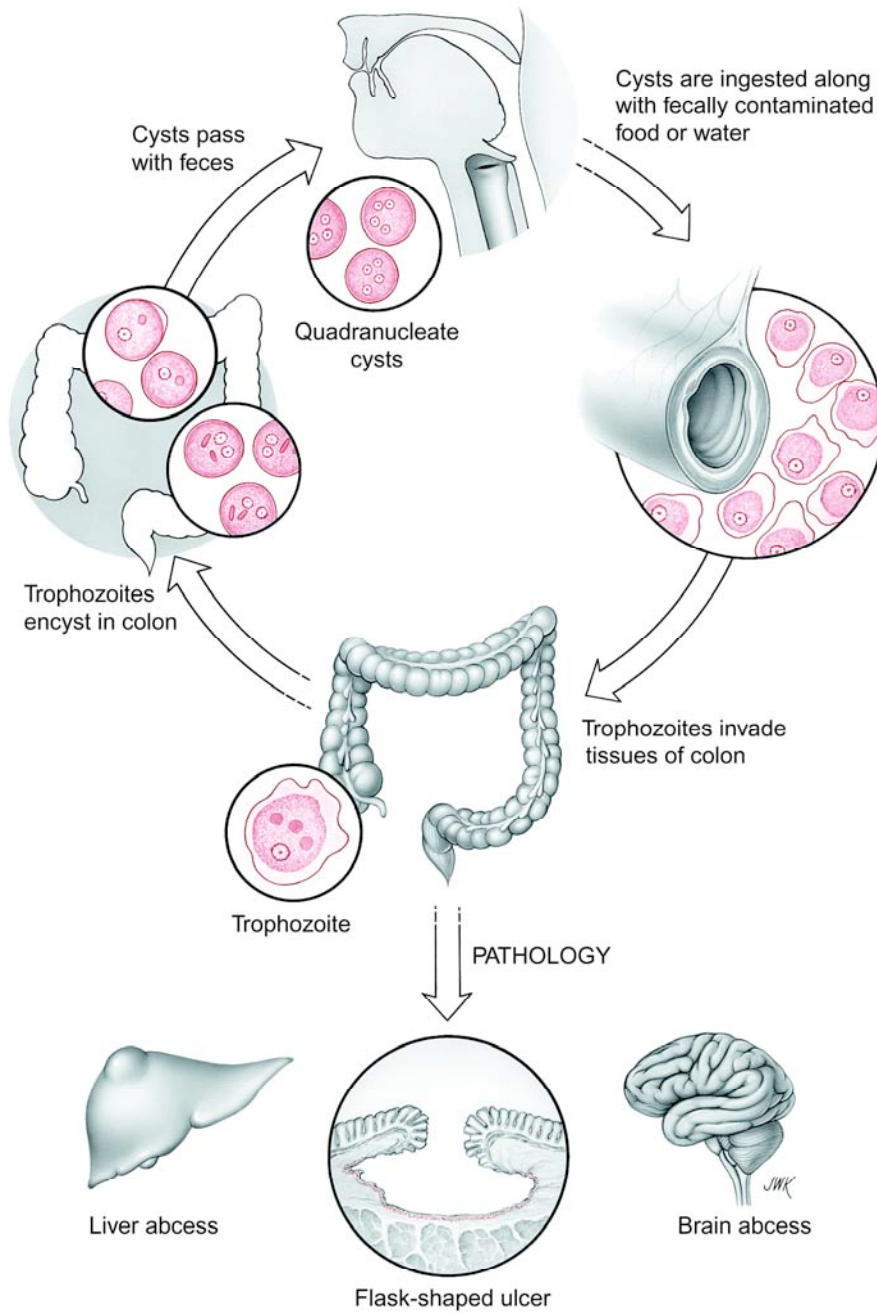
Trophozoite



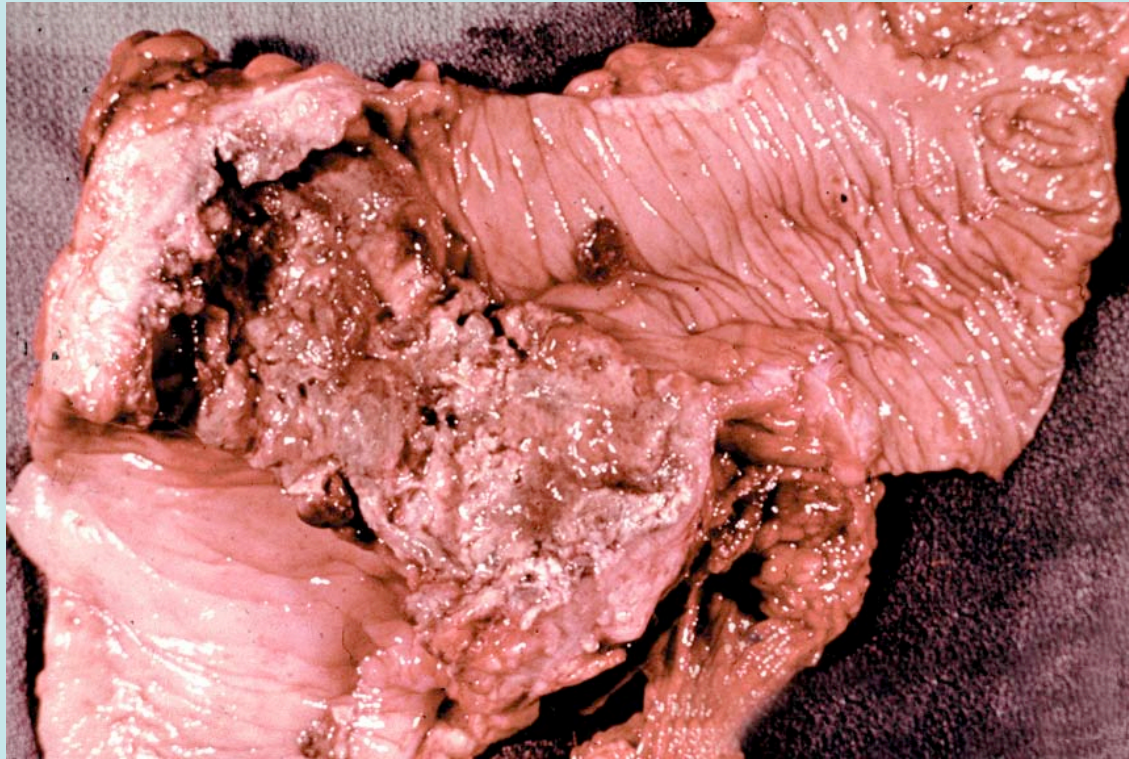
Cyst

15 μ m

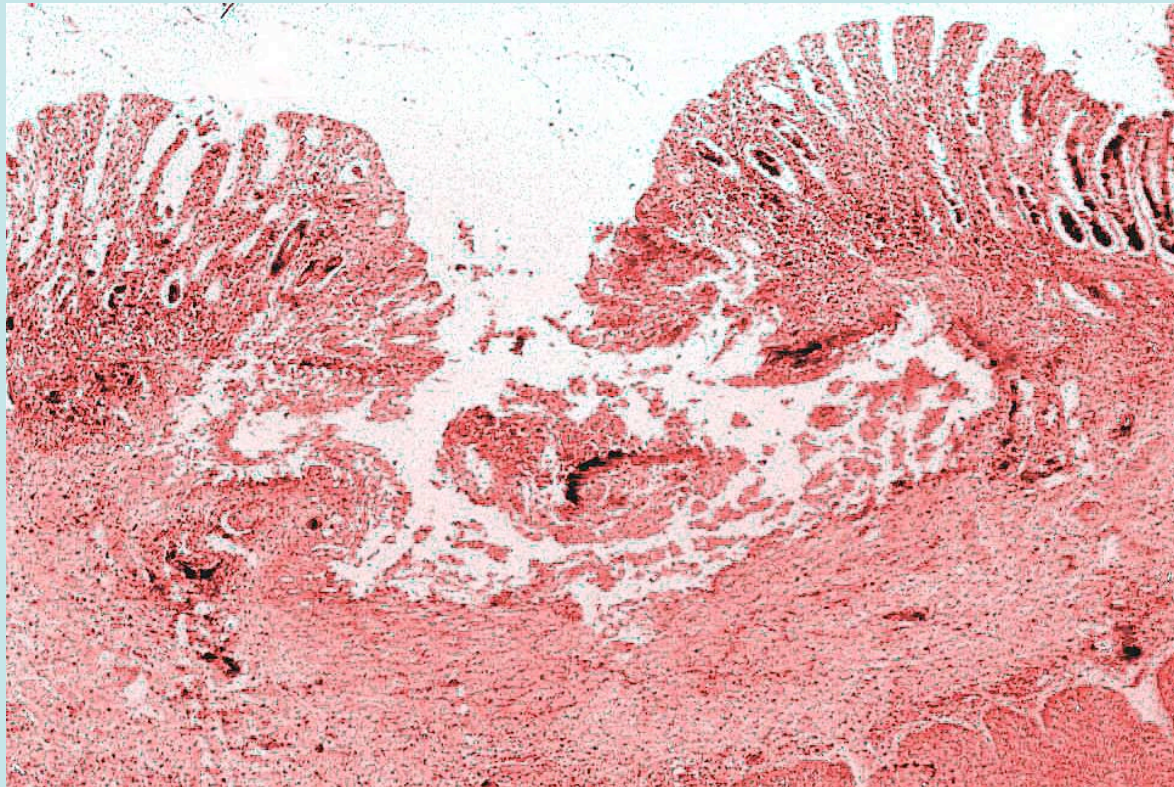
Entamoeba histolytica



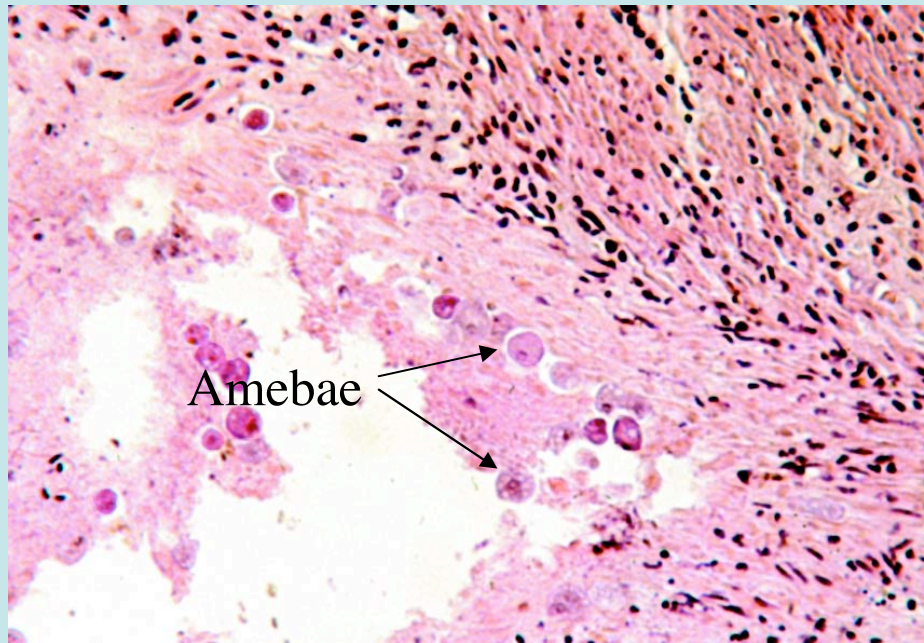
Gross pathology of large intestine due to *Entameba histolytica*



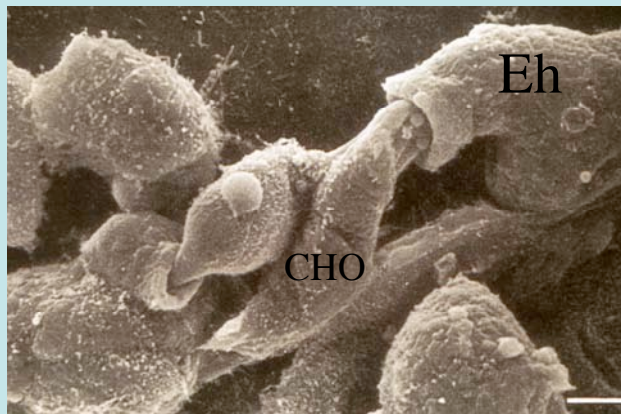
Flask-shaped ulcer due to infection
with *Entameba histolytica*



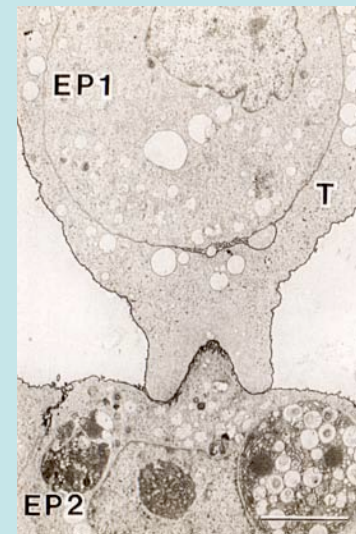
Trophozoites of *Entamoeba histolytica*
in situ in flask-shaped ulcer



Entameba histolytica in culture
with Chinese hamster ovary cells



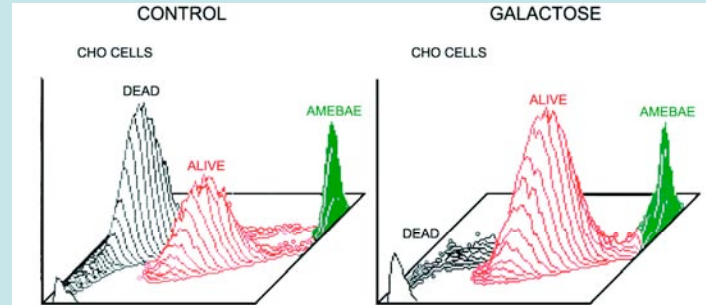
SEM



TEM

Pathogenesis:

1. Attachment of amebae to target cells mediated by galactose, then pore-forming protein disrupts target cell membrane:



From: Ravdin, J.I. (1995) Amebiasis (Review). *Clin. Infect. Dis.* 20: 1453-1466

2. Cell-cell contact induces synthesis of lysosomal enzymes in amebae at interface with target cells. Cell death ensues.

Clinical Disease:

A. Intestinal:

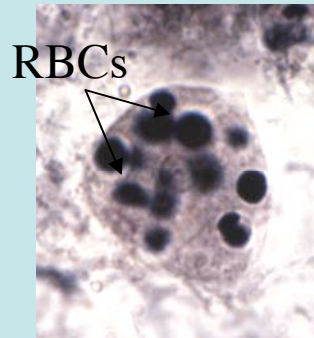
1. Diarrhea
2. Dysentery (bloody diarrhea)

B. Extra-intestinal:

1. Liver abscess (most common site)
2. Lung abscess
3. Brain abscess (usually fatal)

Diagnosis:

1. Identify trophozoites and/or cysts in feces. Cannot distinguish *E. histolytica* from *E. dispar* by morphology unless cytoplasm contains RBCs.



Trophozoite



Photo: CDC

Cyst

Drugs of Choice:

1. Intestinal:

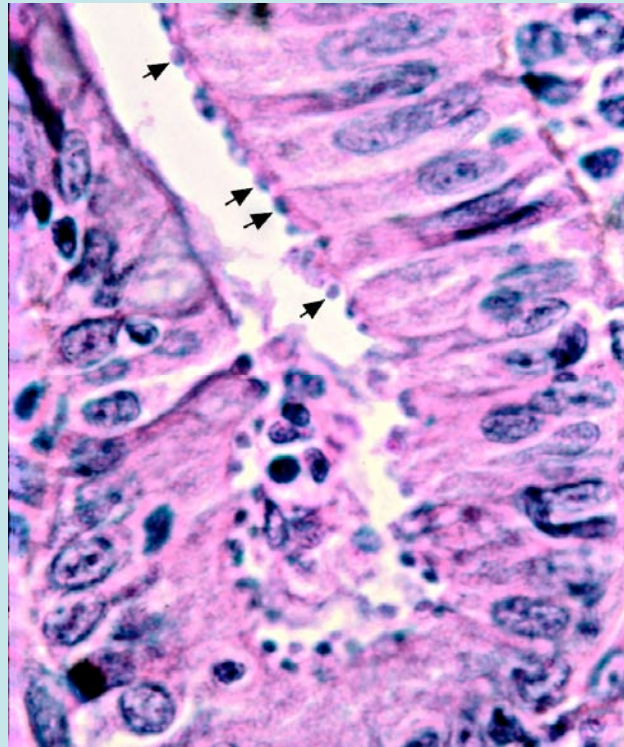
Metronidazole and Iodoquinol

2. Extra-intestinal

High doses of Metronidazole

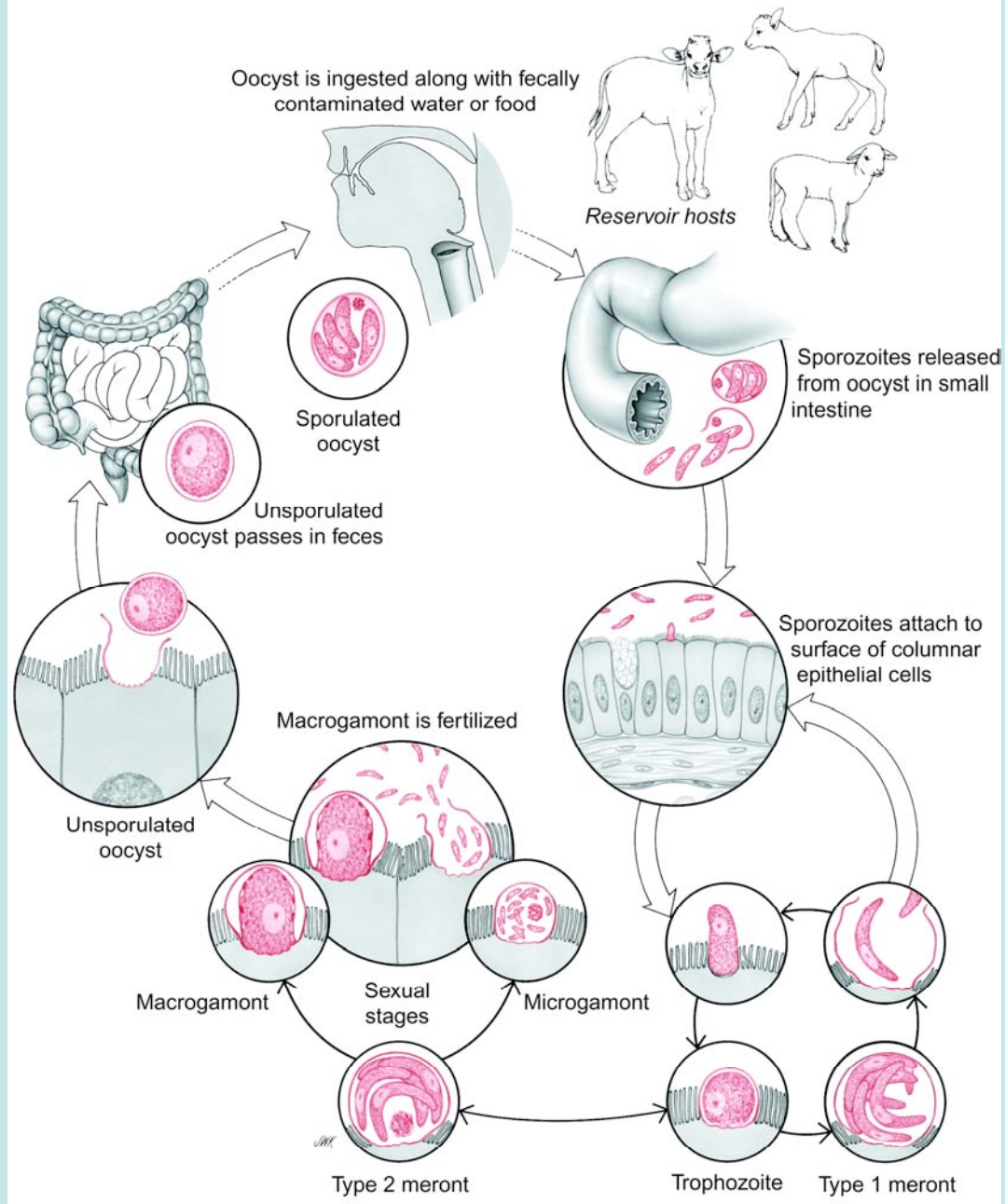
Cryptosporidium parvum

Histologic section of small intestine of patient suffering from HIV/AIDS, infected with *Cryptosporidium parvum*.



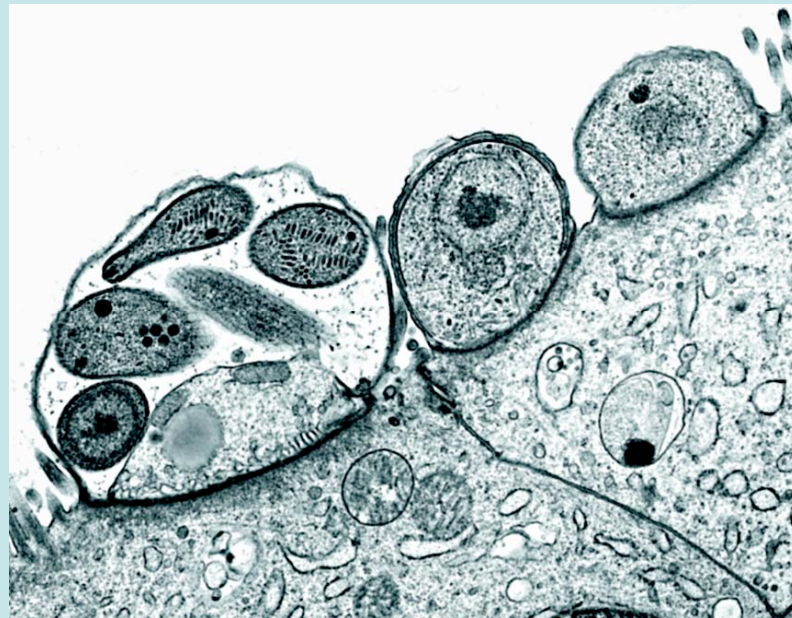
Courtesy J. Lefkowitz

Cryptosporidium parvum



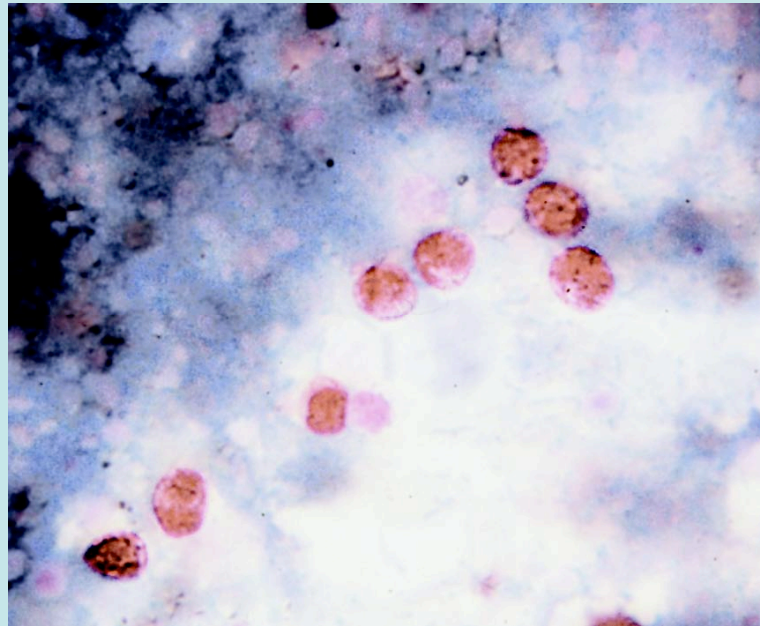
Pathogenesis:

Secretory diarrhea. May produce up to 10 liters of watery stool per day! Mechanism unknown.



Diagnosis:
Find oocysts in stool

Oocysts of *Cryptosporidium parvum*



Water Borne Infectious Diseases:
Helminths



Strongyloides stercoralis

- Dracunculus medinensis*
- Strongyloides stercoralis*
- Schistosoma mansoni*
- Schistosoma japonicum*
- Schistosoma haematobium*

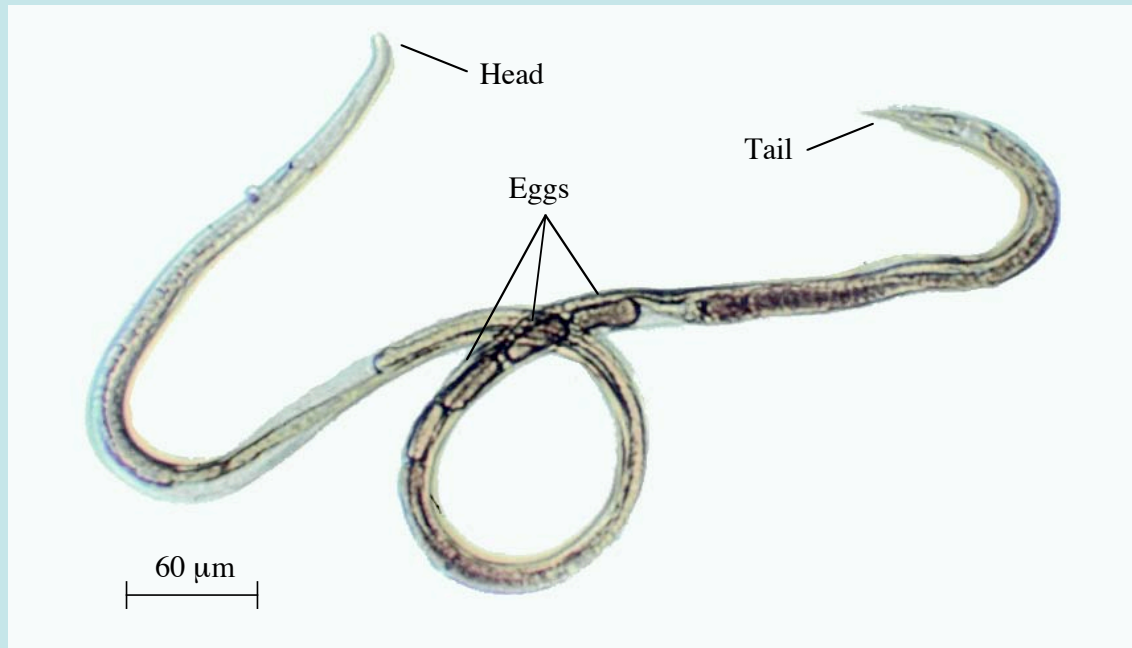


Schistosome adult

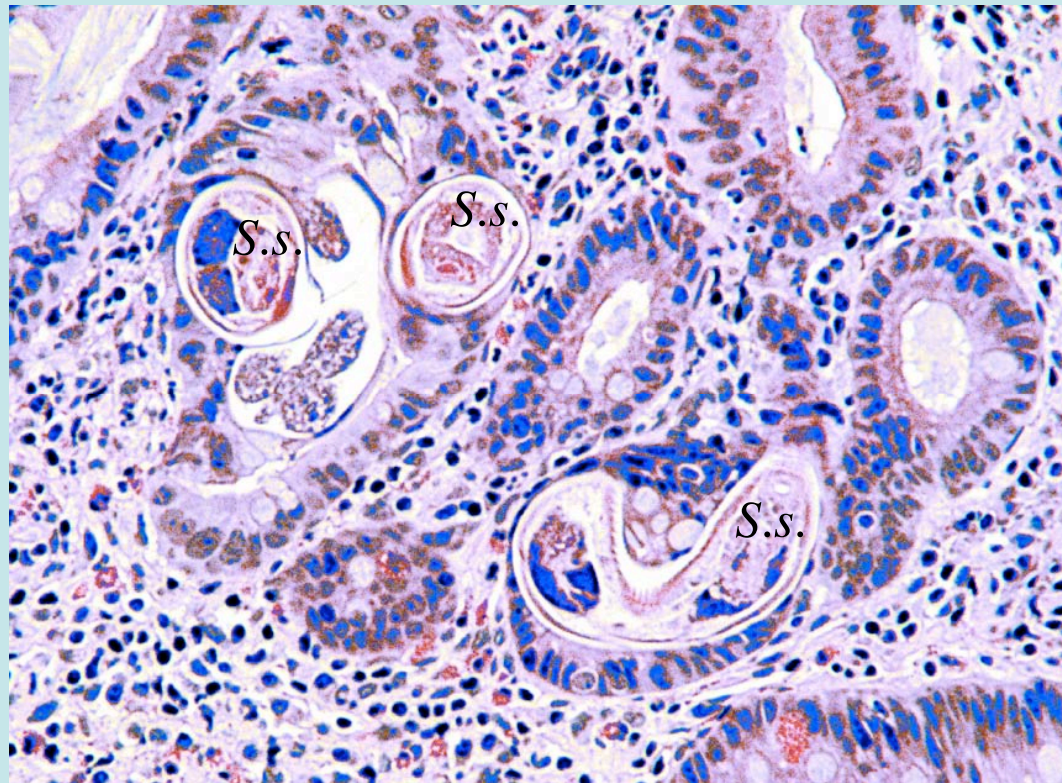


Strongyloides stercoralis

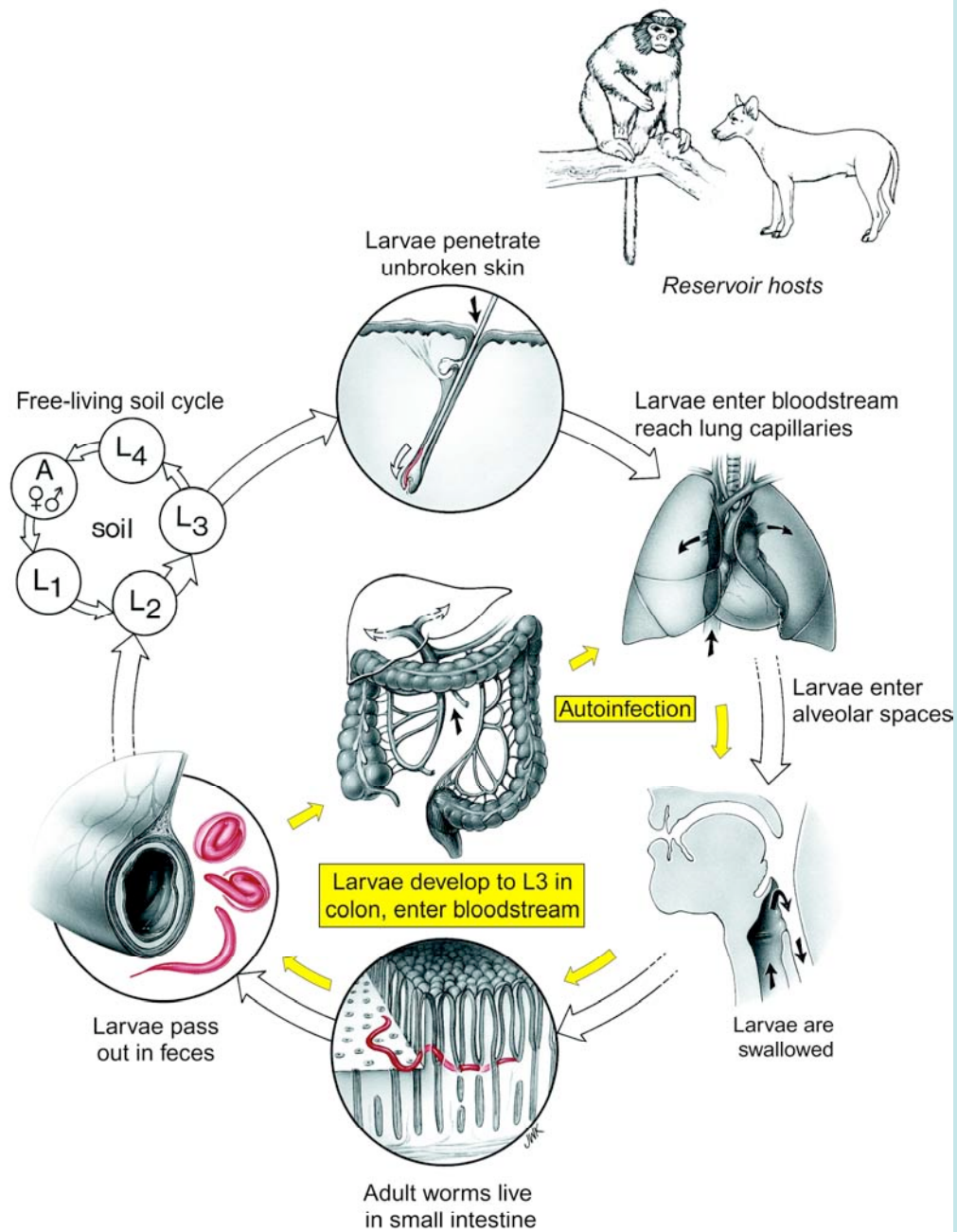
Parasitic female *Strongyloides stercoralis*



Strongyloides stercoralis in situ



Strongyloides stercoralis



Pathogenesis:

Worms invade epithelial cells, induce cell death

Clinical Disease:

1. Diarrhea
2. Malabsorption syndrome
3. Secondary bacteremia/septicemia as larvae migrate throughout body and defecate microbes that they ingested in large intestine.
4. Death due to overwhelming bacterial septicemia.

Diagnosis:

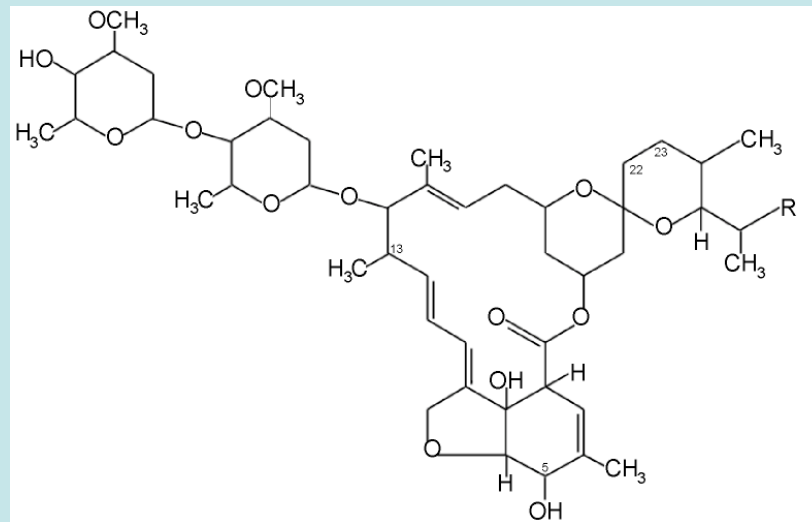
1. Microscopical examination of feces (X6)
2. “String” test



Larva of *Strongyloides stercoralis*

Drug of choice:

Ivermectin



Mode of Action:

Blocks Cl^{-} ion channels, inhibits γ -aminobutyric acid receptor complex.

Dracunculus medinensis

Dracunculus Lesion On Leg

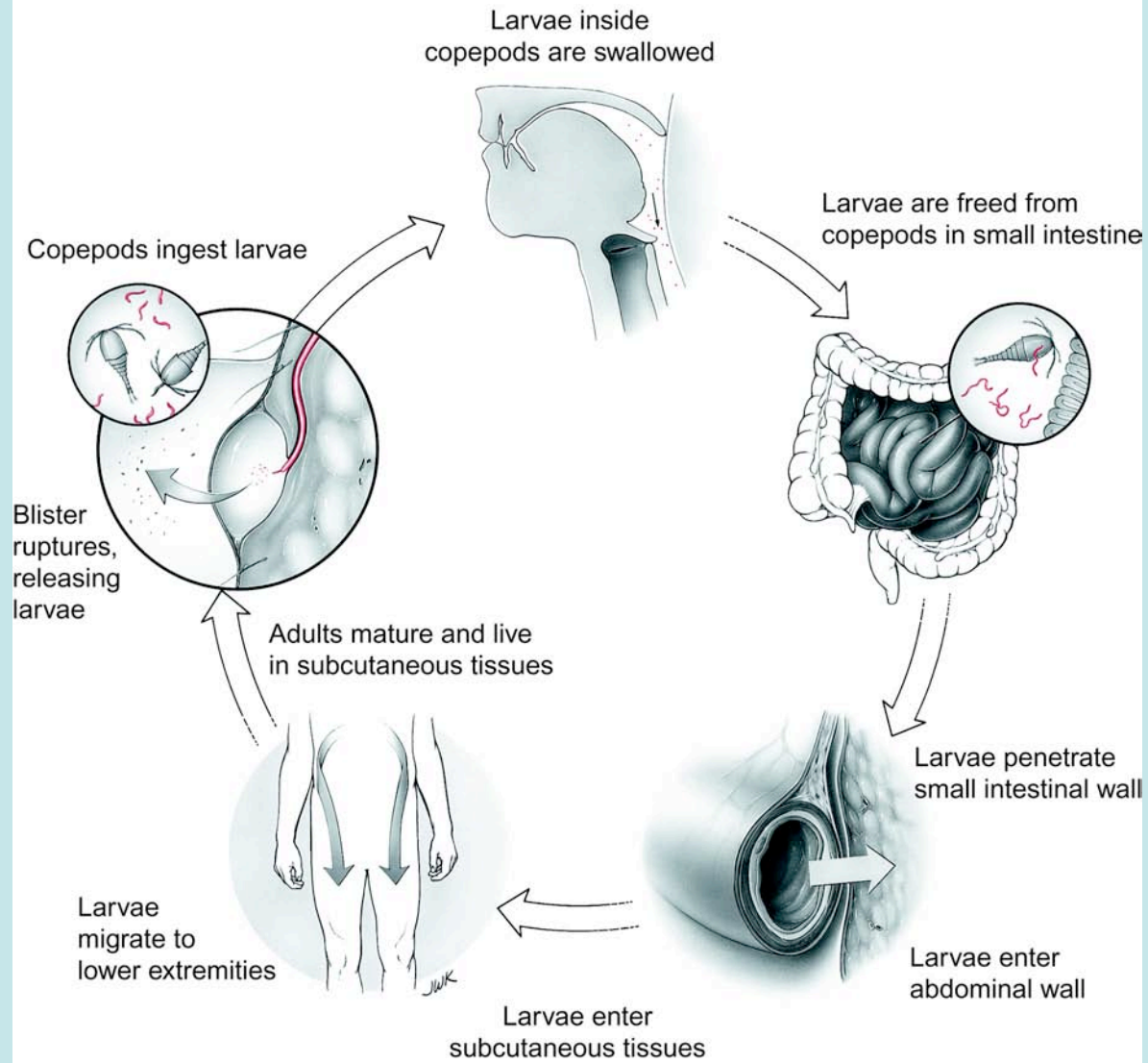


← *Adult Worm*



Origins Of The Caduceus?

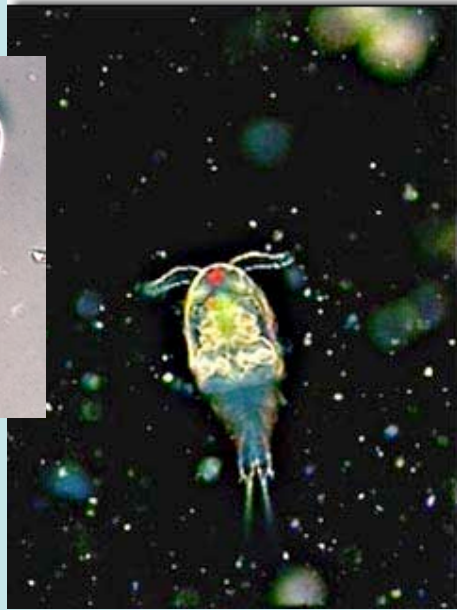
Dracunculus medinensis



Dracunculus and Step Well Ecology



Dracunculus infective larvae



Cyclops

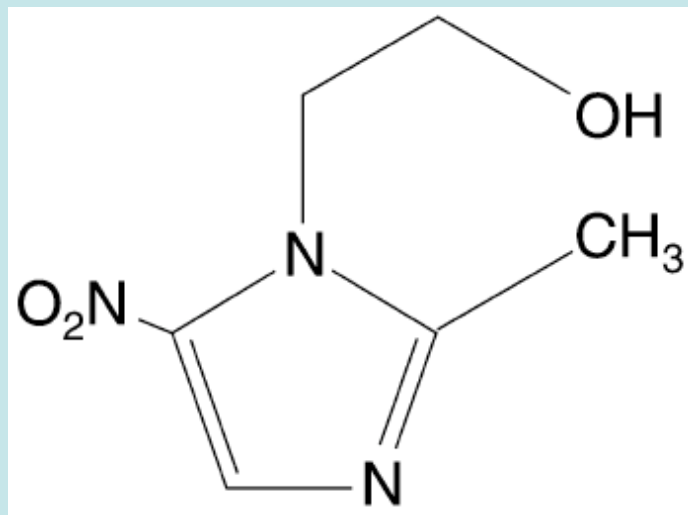


Extraction of dracunculus adult



Step Well

Drug Of Choice: Metronidazole



*Mode Of Action:
Inhibits Oxidoreductase Enzyme*

Medical Ecology

www.medicalecology.org

Medical Ecology

Statement of purpose:

Medical Ecology is an emerging science that defines those aspects of the environment that have a direct bearing on human health. The concept of ecosystem functions and services helps to describe global processes that contribute to our well-being, helping to cleanse the air we breathe, the water we drink, and the food we eat. Environmental degradation often leads to alterations in these aspects, leading to various states of ill health. The term Medical Ecology was first coined by the eminent microbiologist, Rene Dubos, who intended it to embrace the concept that natural systems, if explored fully, would provide for many of our needs, as for example, quinine did regarding the treatment of malaria. Dubos discovered gramicidin in 1939, a powerful topical anti-microbial agent. Together with Alexander Fleming's discovery of penicillin in 1928, these findings led the way into the modern era of anti-microbial therapy, in which soil organisms played a dominant role.

Medical Ecology as described here is re-defined to a much broader level. We believe that ecological principles, when applied to the human condition will offer a resolution to the dichotomy of the "man versus nature" paradigm. In fact, humans are an integral part of nature, but most of the time we are unaware of our connectedness to the rest of the world. *Medical Ecology* links natural processes with living on earth, from the point of view of being human. The environment in which we live is characterized by countless physical, chemical, and biological systems, and it is in this complex setting that we carry out our lives, whether we are aware of them or not. The more aware of them we are, the more likely it is that we can avoid those situations that take away from our sense of well-being.



Basic Sciences:

Geology

Ecology

Oceanography

Hydrology

Biochemistry and Molecular Biology

Physics

Atmospheric Sciences

Chemistry

Remote Sensing

Applied Sciences:

Biostatistics

Medical Sciences

Epidemiology

Anthropology

Agronomy

Environmental Health Sciences

Socio-Medical Sciences

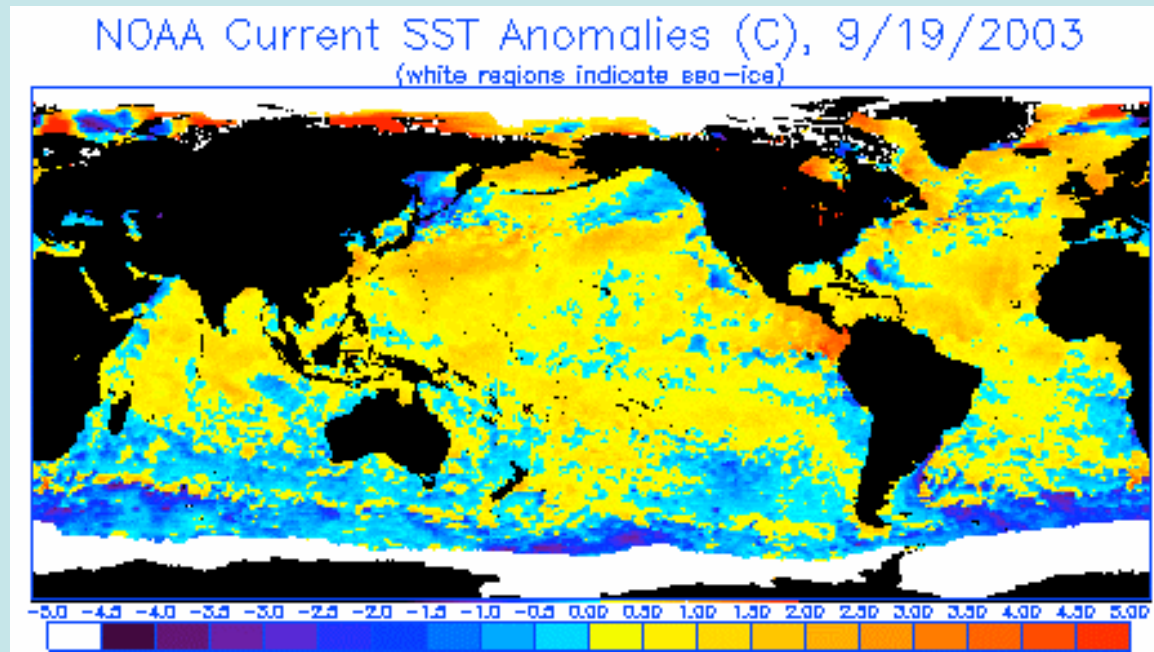
Toxicology

Medical Geography

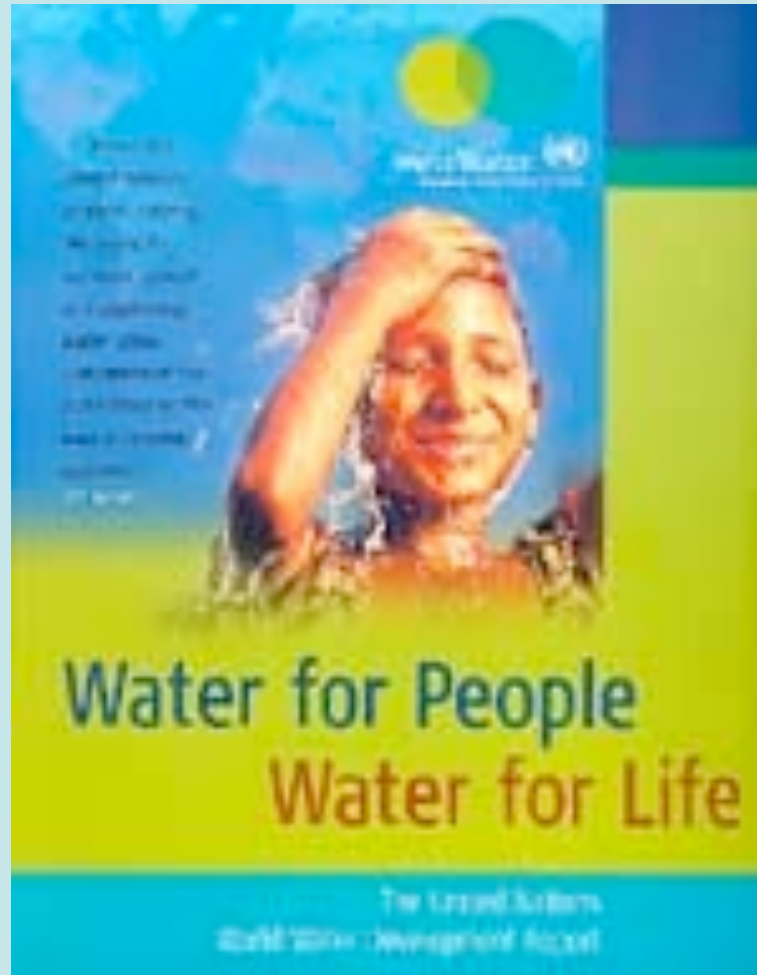
February 3, 2000

El Niño Increases Diarrheal Disease Incidence by 200 Percent

The El Niño phenomenon--the warming of the equatorial Pacific ocean that occurs every two to seven years--has been linked to outbreaks of dengue, malaria, and cholera. Now, researchers from the Johns Hopkins School of Public Health, A.B. Prisma, and the Instituto Nacional de Salud in Lima, Peru, have found that the 1997-1998 El Niño season increased hospitalizations for diarrheal disease by 200 percent, according to a study published in the February 5th issue of *The Lancet*. The results are cause for concern, said the researchers, since diarrhea already causes one billion episodes and three million deaths annually in children under five worldwide.



*It Is Everyone's Right To Have
Access To Safe Drinking Water*



Everyone's!!!

