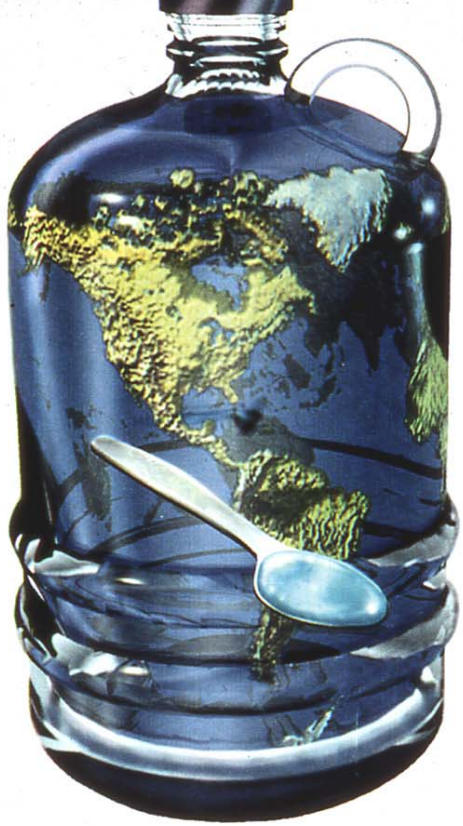
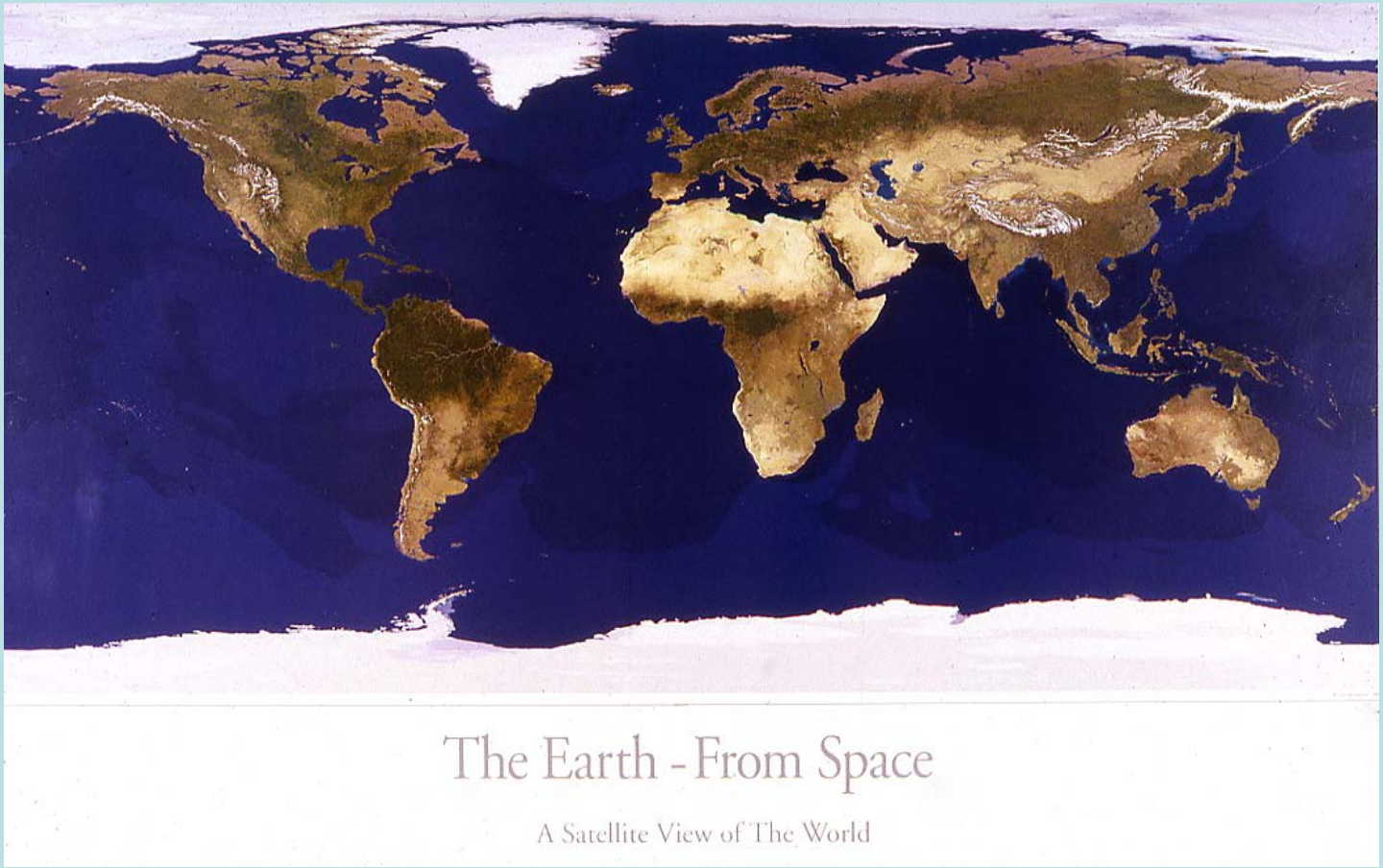


COMPUTER IMAGE BY CHUCK CARTER

The world's water supply

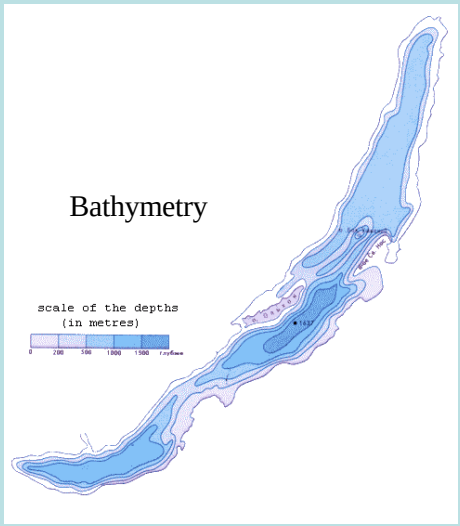
If all earth's water fit in a gallon jug, available fresh water would equal just over a tablespoon—less than half of one percent of the total. About 97 percent of the planet's water is seawater; another 2 percent is locked in icecaps and glaciers. Vast reserves of fresh water underlie earth's surface,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

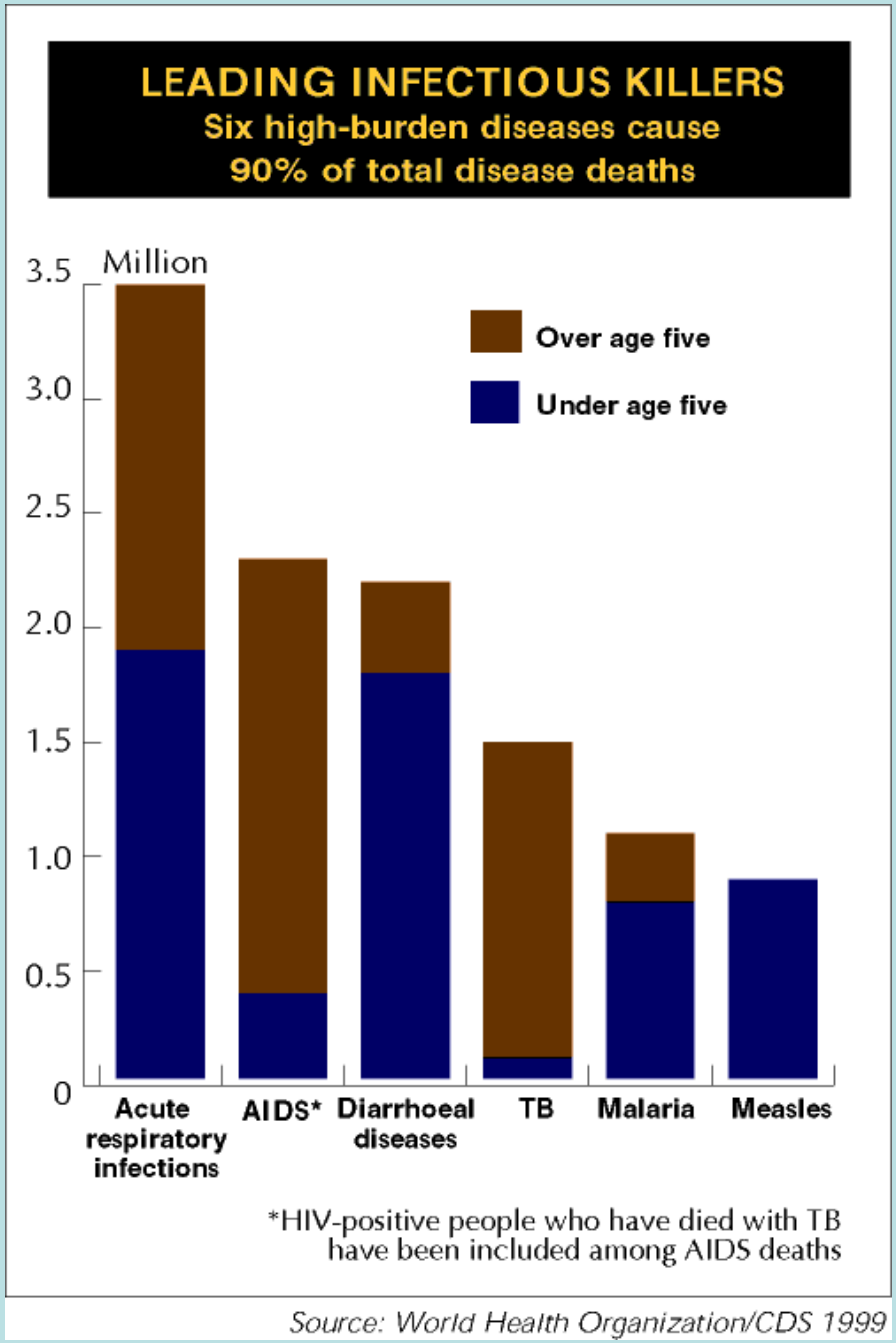
Lake Baikal, Siberia



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."

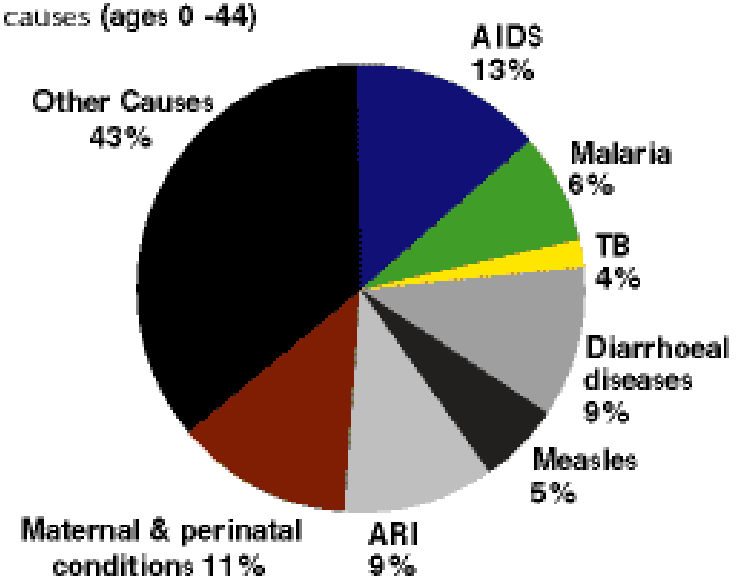
USAID Save The Children Program



Source: World Health Organization/CDS 1999

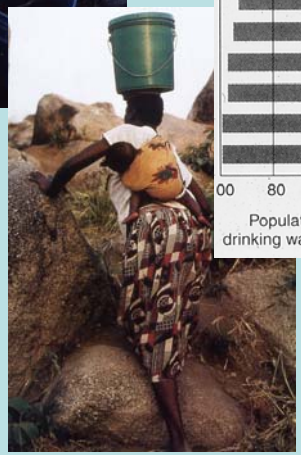
DEATHS IN DEVELOPING COUNTRIES

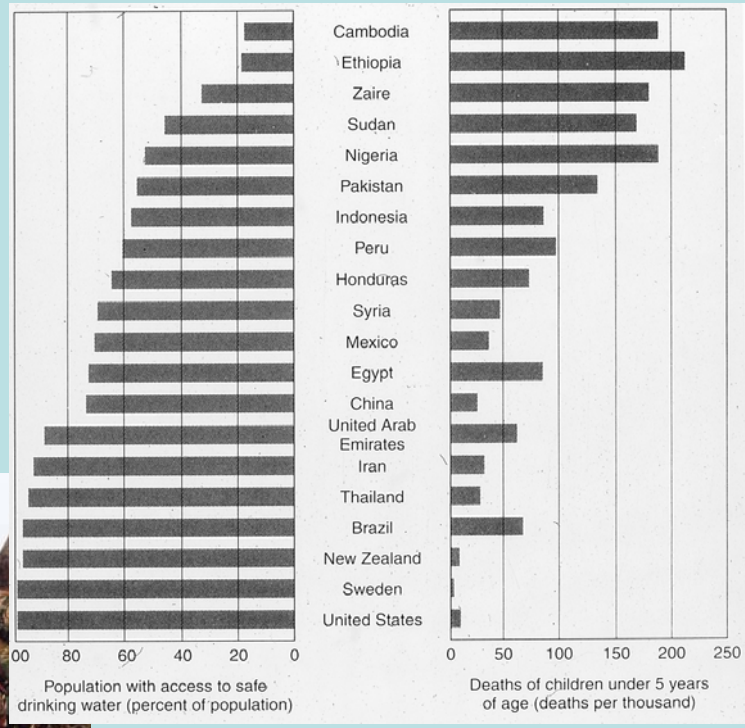
Two out of three deaths among children and young adults in Africa and Southeast Asia are due to seven causes **(ages 0 -44)**

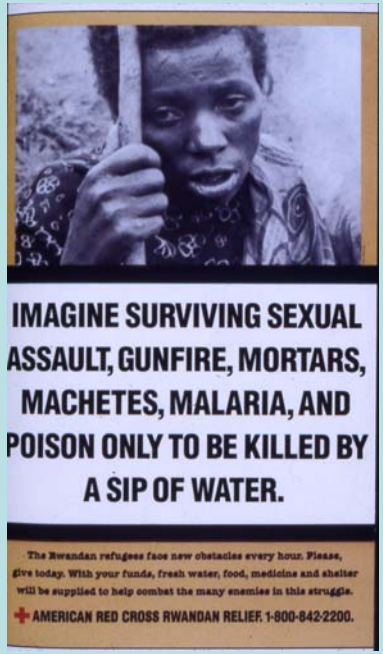


Source: World Health Organization/CDS

Access to safe drinking water is everyone ’s right





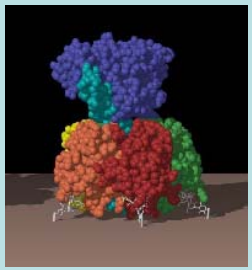


Water Borne Infectious Diseases

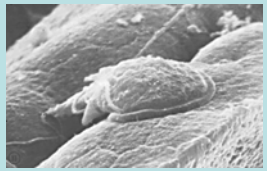
Clinical Syndromes

Type I

a. Noninflammatory (enterotoxin, etc.)
b. Proximal small bowel
c. Watery diarrhea
d. Examples:
    Rotavirus
    Vibrio cholerae
    Giardia lamblia
    Cryptosporidium parvum
    Cyclopsora cayetanensis



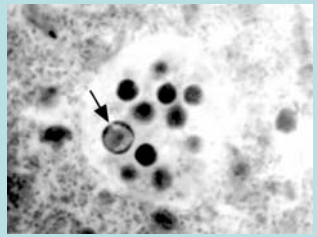
Cholera toxin



Giardia lamblia

Type II

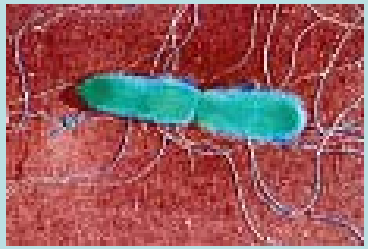
a. Inflammatory (invasive, cytotoxin)
b. Colon
c. Dysentery (bloody diarrhea)
d. Examples:
    Salmonella enteriditis
    Clostridium difficile
    Campylobacter pylori
    Enatmeba histolytica



Entameba histolytica

Type III

a. Penetrating
b. Distal small bowel
c. Examples:
    Salmonella typhi
    Yersinia enterococolithica



Salmonella typhi

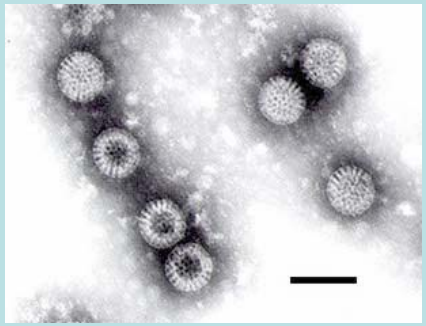
Discoverer Of The First Water Borne Infectious Disease: ***Giardia lamblia***

Anton Von Leeuwenhoek

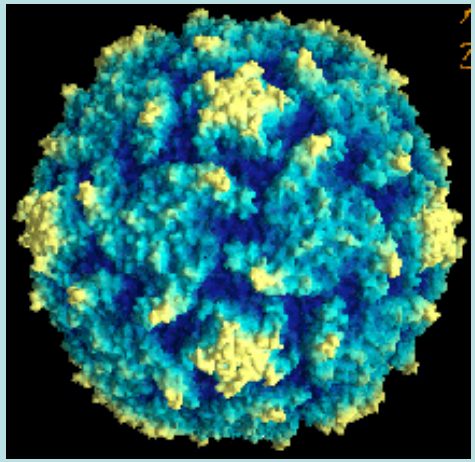
Water Borne Infectious Diseases:

Viruses

Rotavirus
Polio
Hepatitis A
Hepatitis E



Rotavirus



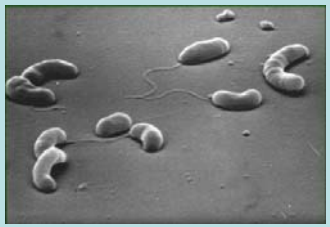
Polio virus

Hepatitis virus

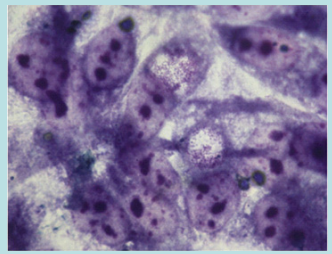
Water Borne Infectious Diseases:

Bacteria

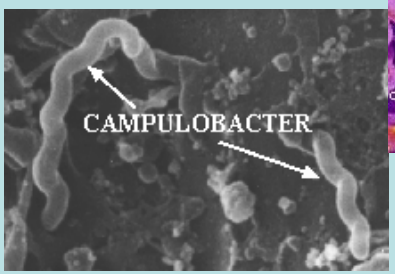
Vibrio cholerae
Escherichia coli 0157
Salmonella typhi
Shigella flexneri
Campylobacter pylori
Chlamydia trachomatis



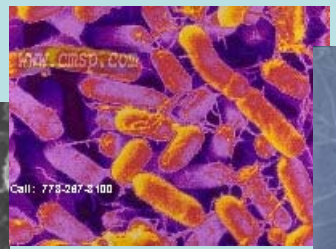
Vibrio cholerae



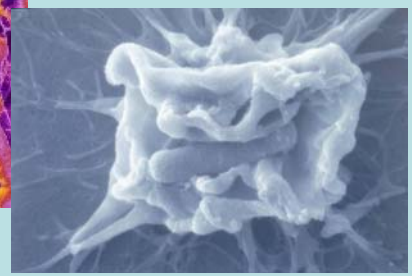
Chlamydia trachomatis



Campylobacter pylori



Salmonella typhi

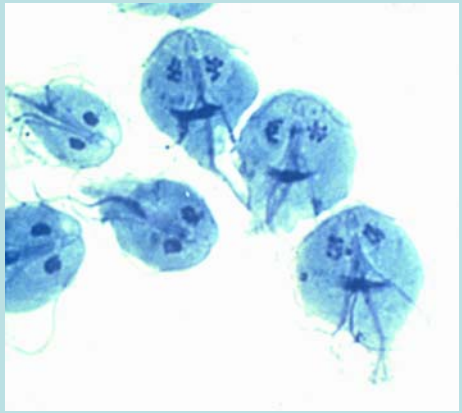


Shigella flexneri

Escherichia coli

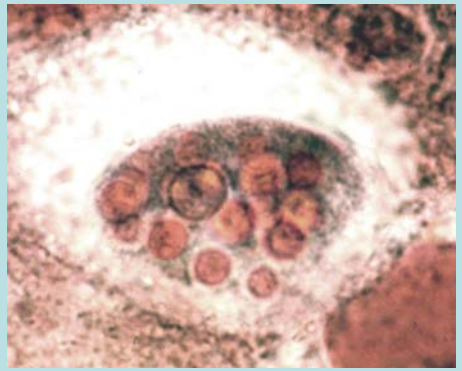
Water Borne Infectious Diseases:

Protozoa

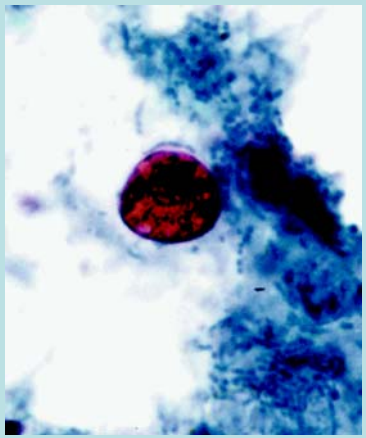


Giardia lamblia

Giardia lamblia
Entameba histolytica
Cryptosporidium parvum
Cyclospora cayetanensis
Balantidium coli

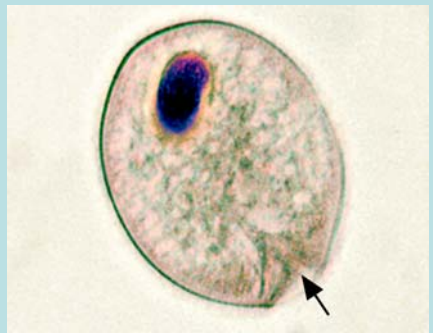


Entameba histolytica



Cyclospora cayetanensis

Cryptosporidium parvum



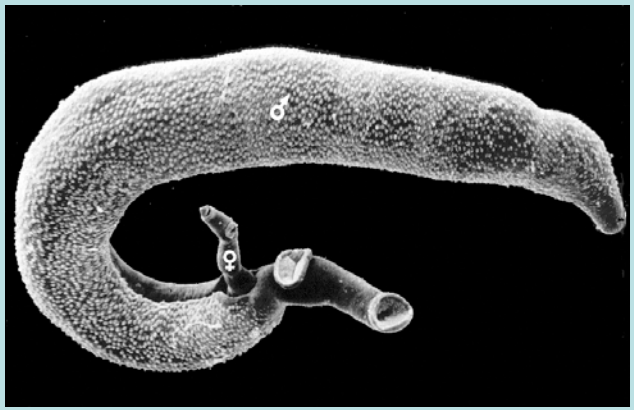
Balantidium coli

Water Borne Infectious Diseases:

Helminths

Strongyloides stercoralis
Dracunculus medinensis
Schistosoma mansoni
Schistosoma japonicum
Schistosoma haematobium

Strongyloides stercoralis

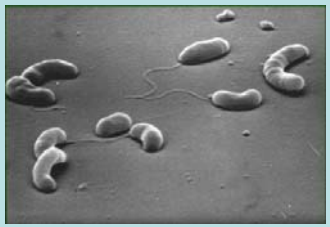


Schistosome adult

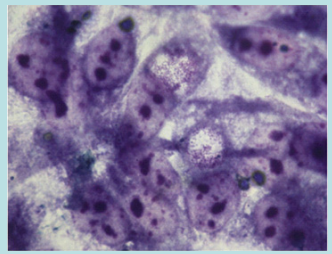
Water Borne Infectious Diseases:

Bacteria

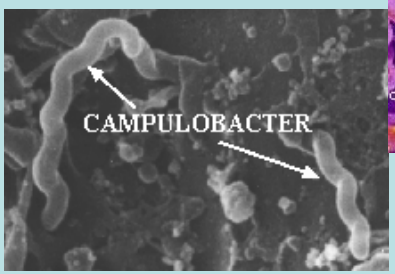
Vibrio cholerae
Escherichia coli 0157
Salmonella typhi
Shigella flexneri
Campylobacter pylori
Chlamydia trachomatis



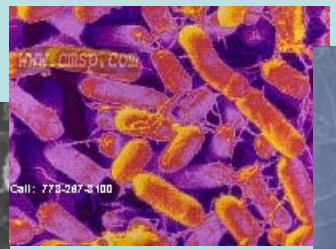
Vibrio cholerae



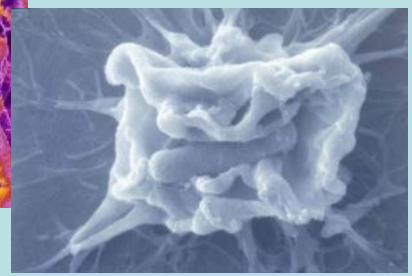
Chlamydia trachomatis



Campylobacter pylori



Salmonella typhi

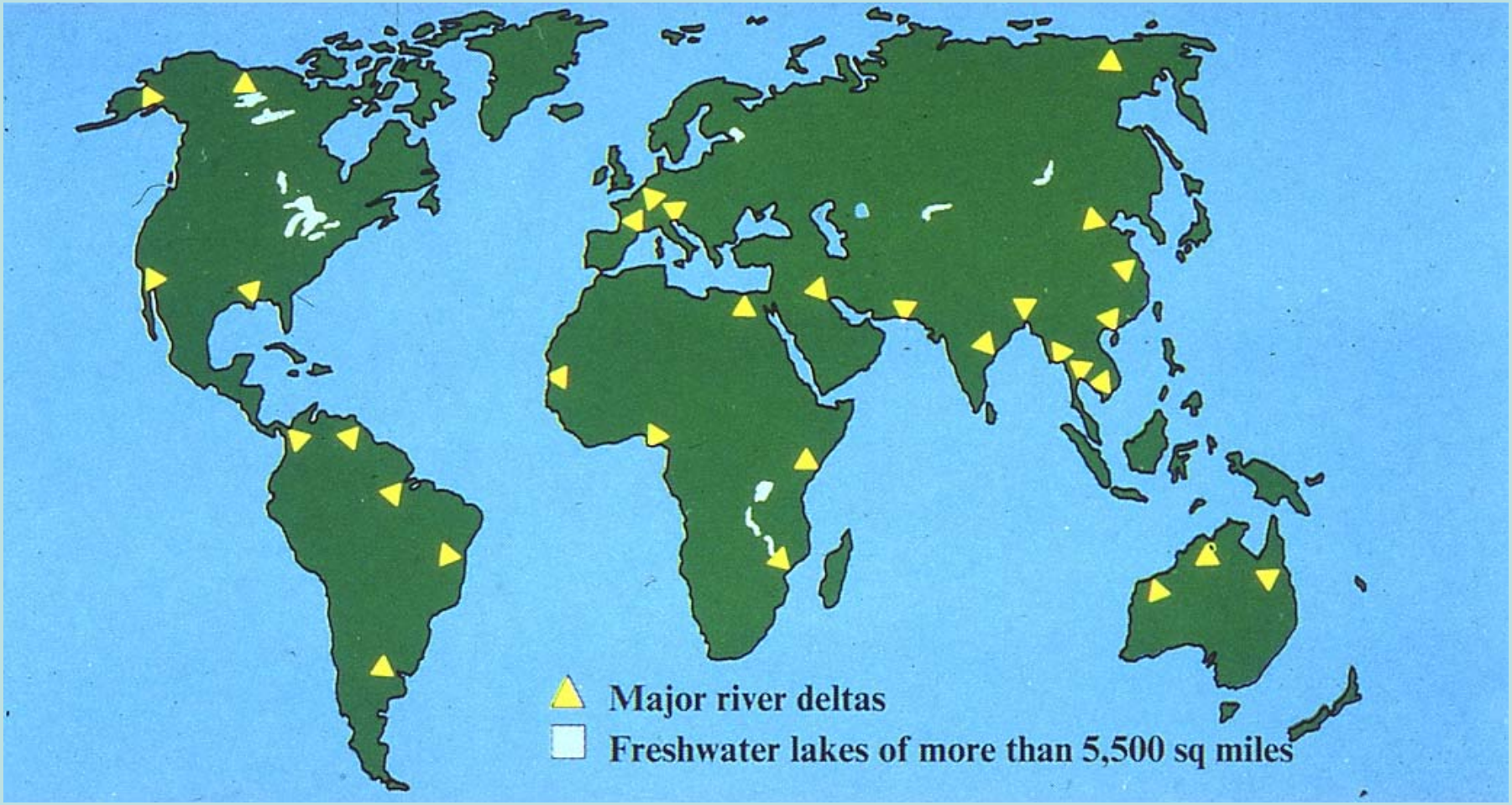


Shigella flexneri

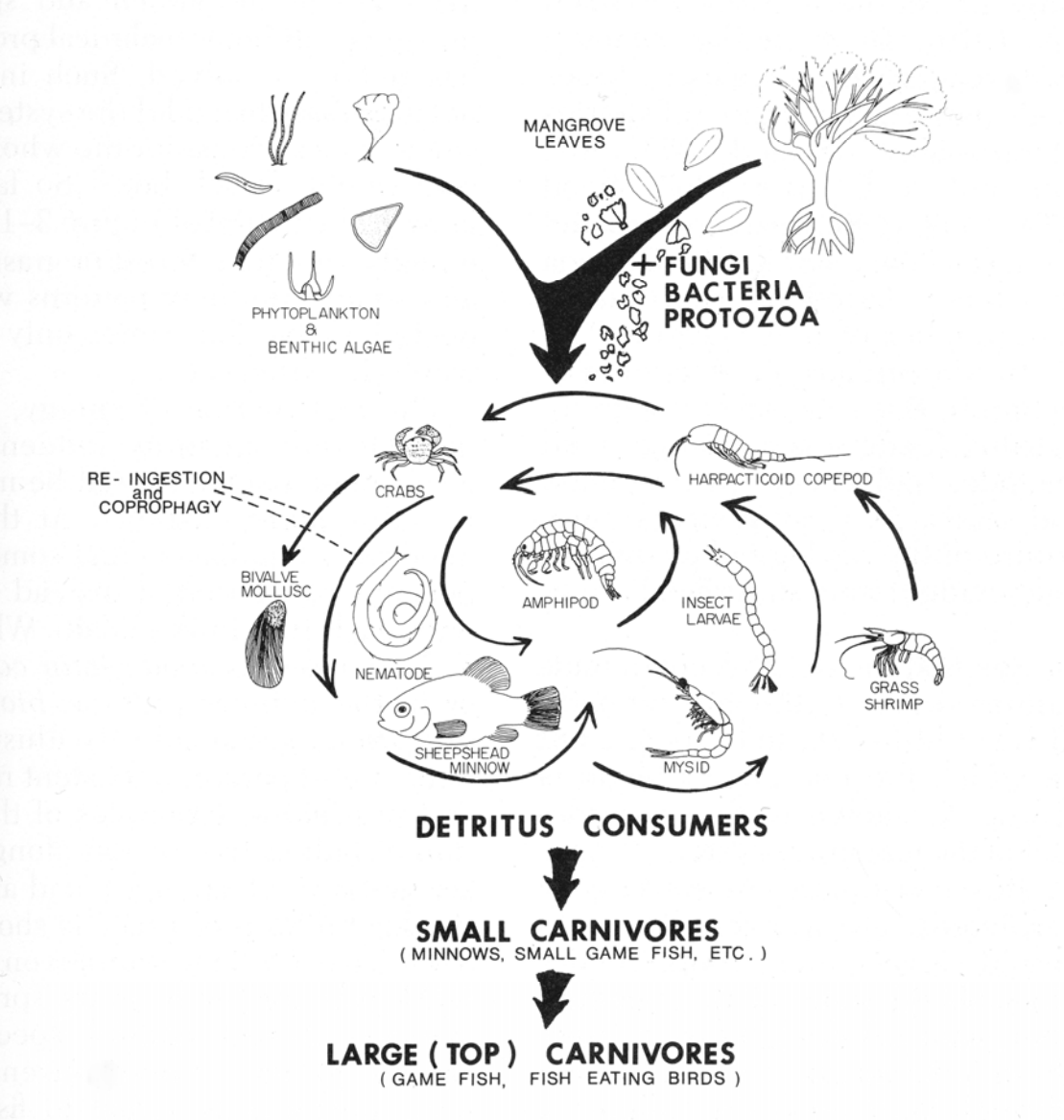
Escherichia coli

Cholera

Distribution Of Estuaries



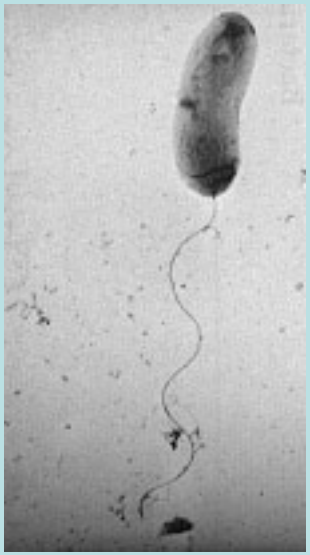
Trophic Relationships Of The Mangrove Estuary

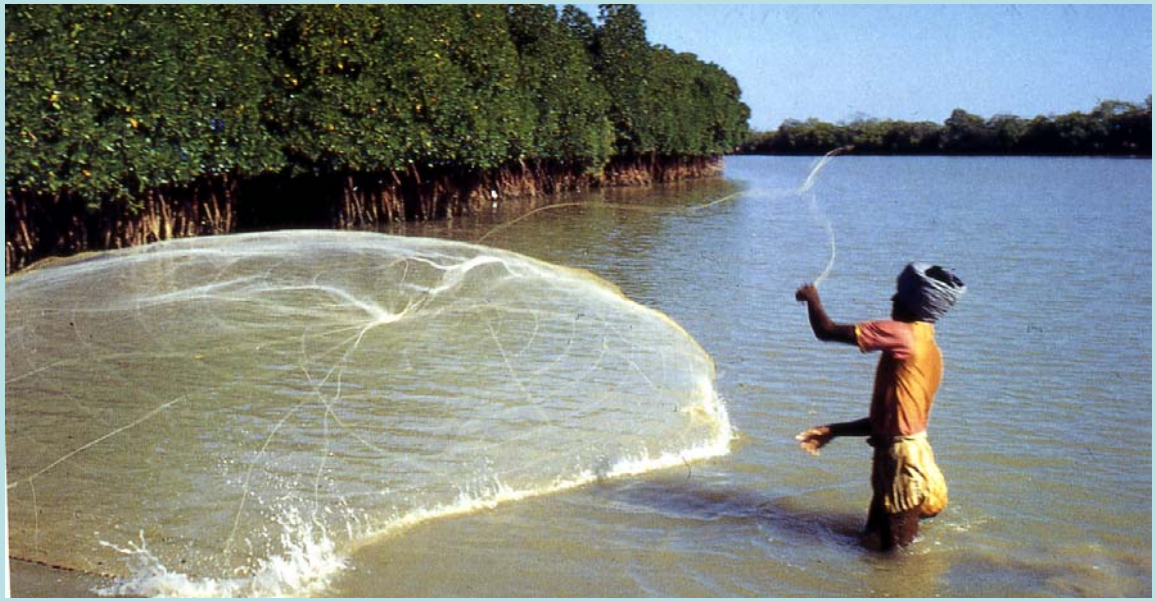


From: E. Odum *Fundamentals Of Ecology*

New Cholera Outbreaks Frequently Occur In Communities Adjacent To Estuaries.

WHY?





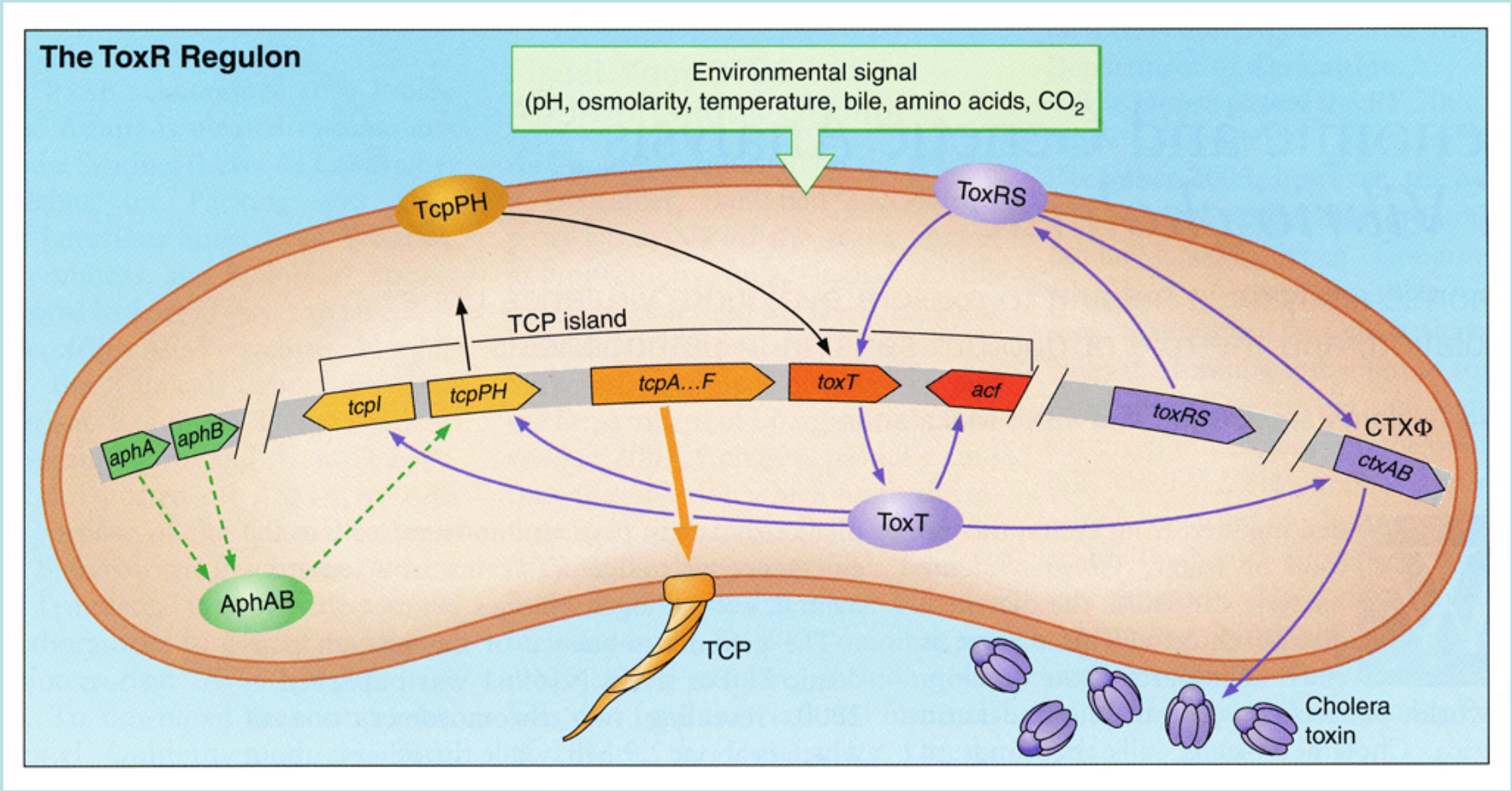
*Because **Vibrio cholerae** and its relatives are marine microbes, fully integrated into their respective food webs.*

Environmental Conditions Favoring Growth Of Vibrio:

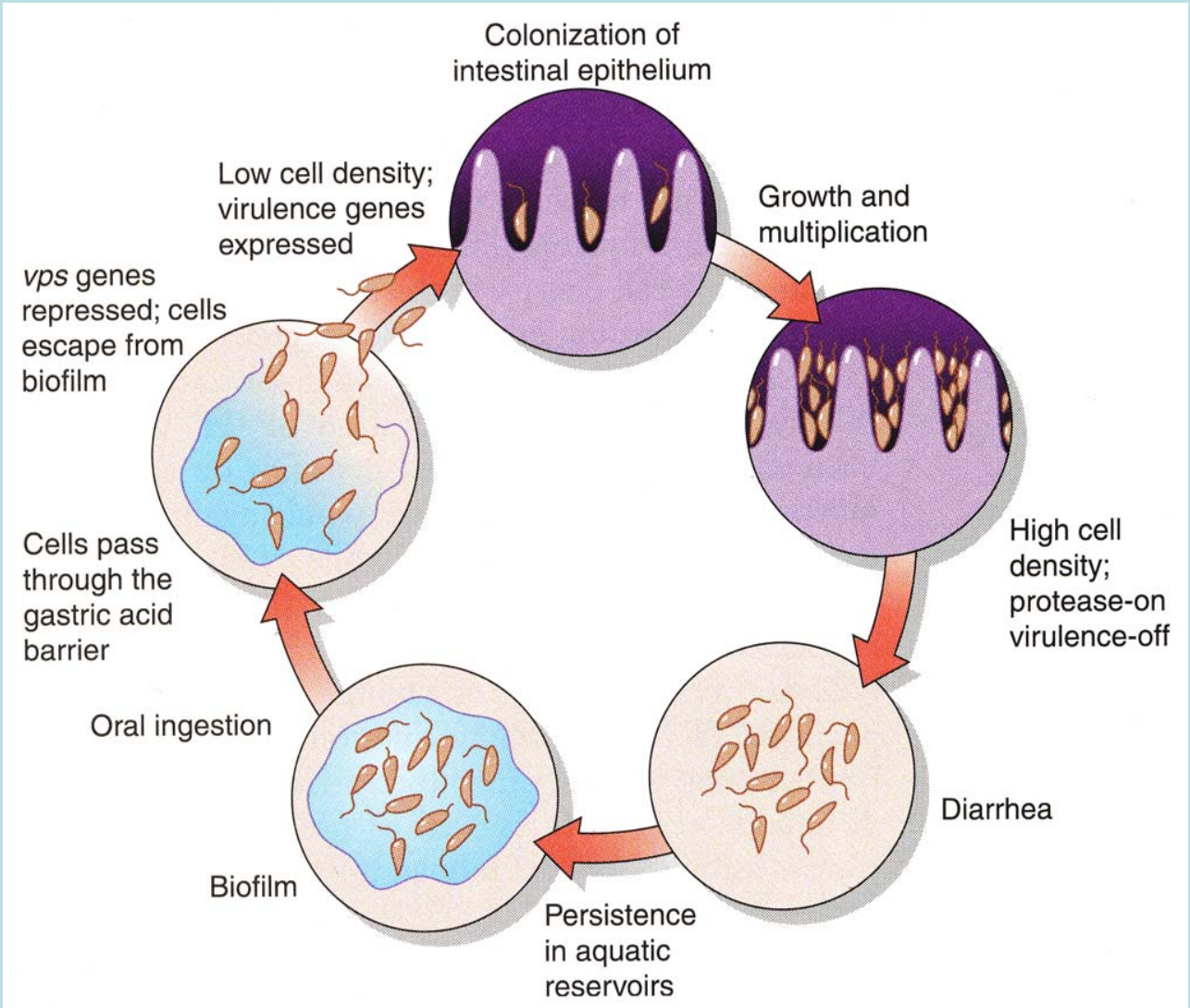
1. *Low salt*
2. *High Nutrient Load*
3. *20^{O}C*
4. *Triggers phytoplankton bloom*
5. *Followed by zooplankton bloom*
6. *Followed by a cholera outbreak*

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

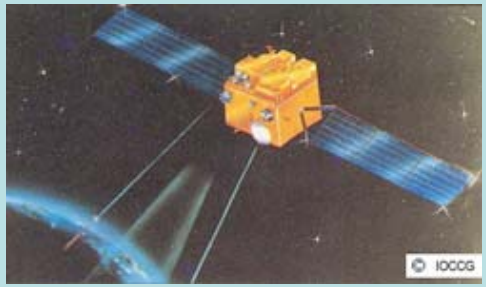
Phytoplankton Bloom


The ToxR Regulon
Environmental signal
(pH, osmolarity, temperature, bile, amino acids, CO_2
TcpPH
ToxRS
TCP island
tcpI
tcpPH
tcpA...F
toxT
acf
toxRS
CTXΦ
ctxAB
aphA
aphB
ToxT
AphAB
TCP
Cholera
toxin

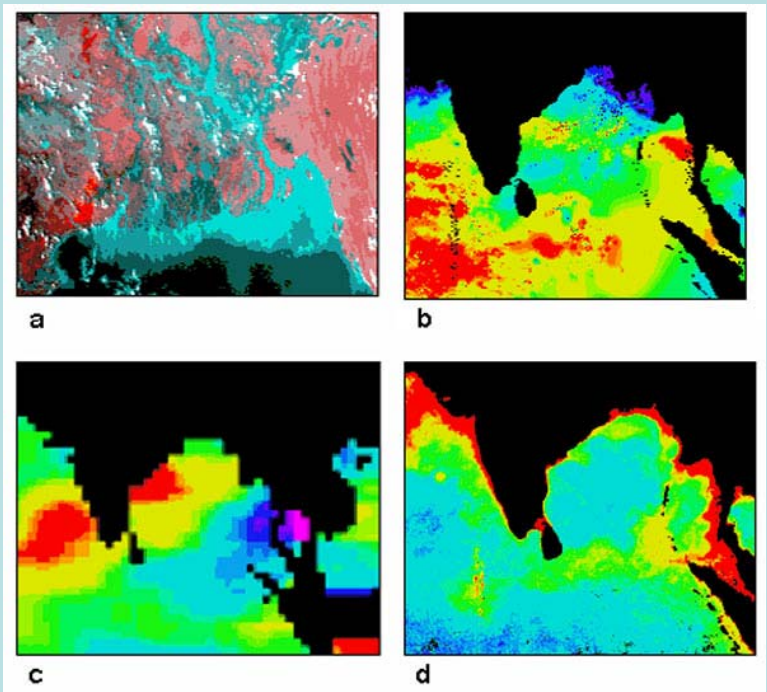
Mechanisms of Pathogenicity

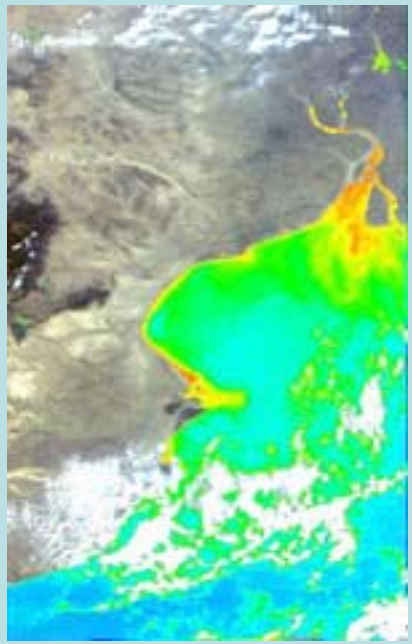


Monsoons



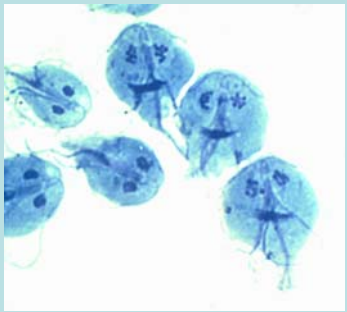
1. lower the salinity of the estuary
2. bring nutrients to the estuary
3. raise the ambient water temperature of the estuary





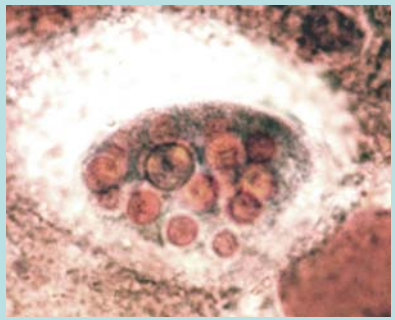
Water Borne Infectious Diseases:

Protozoa

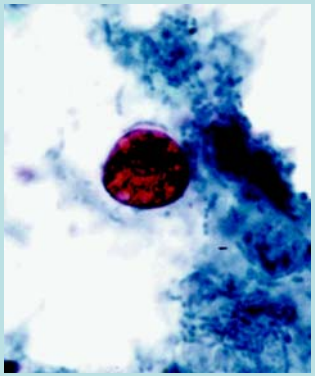


Giardia lamblia

Giardia lamblia
Entameba histolytica
Cryptosporidium parvum
Cyclospora cayetanensis
Balantidium coli

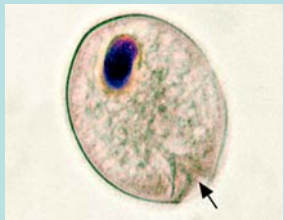


Entameba histolytica



Cyclospora cayetanensis

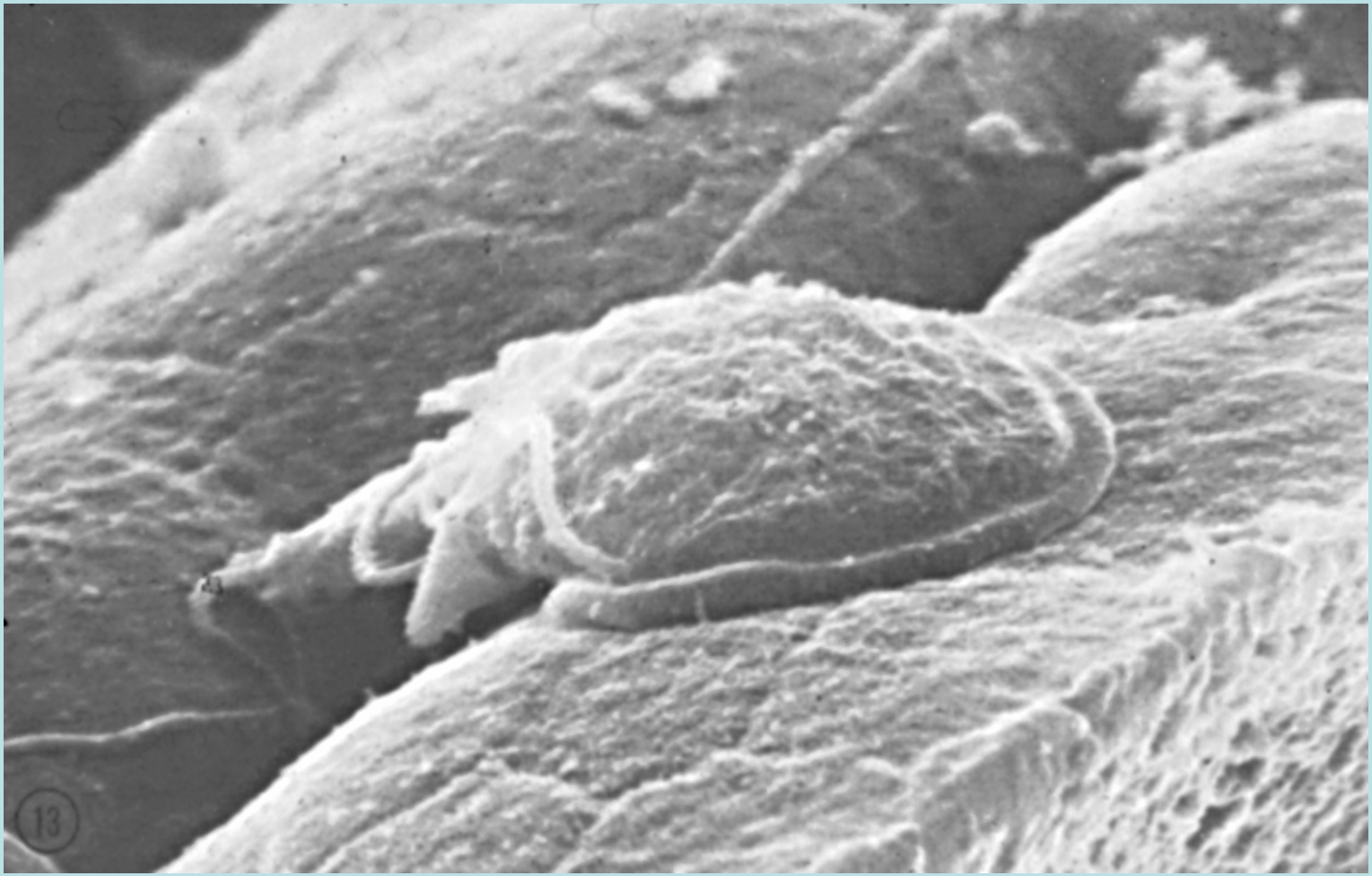
Cryptosporidium parvum



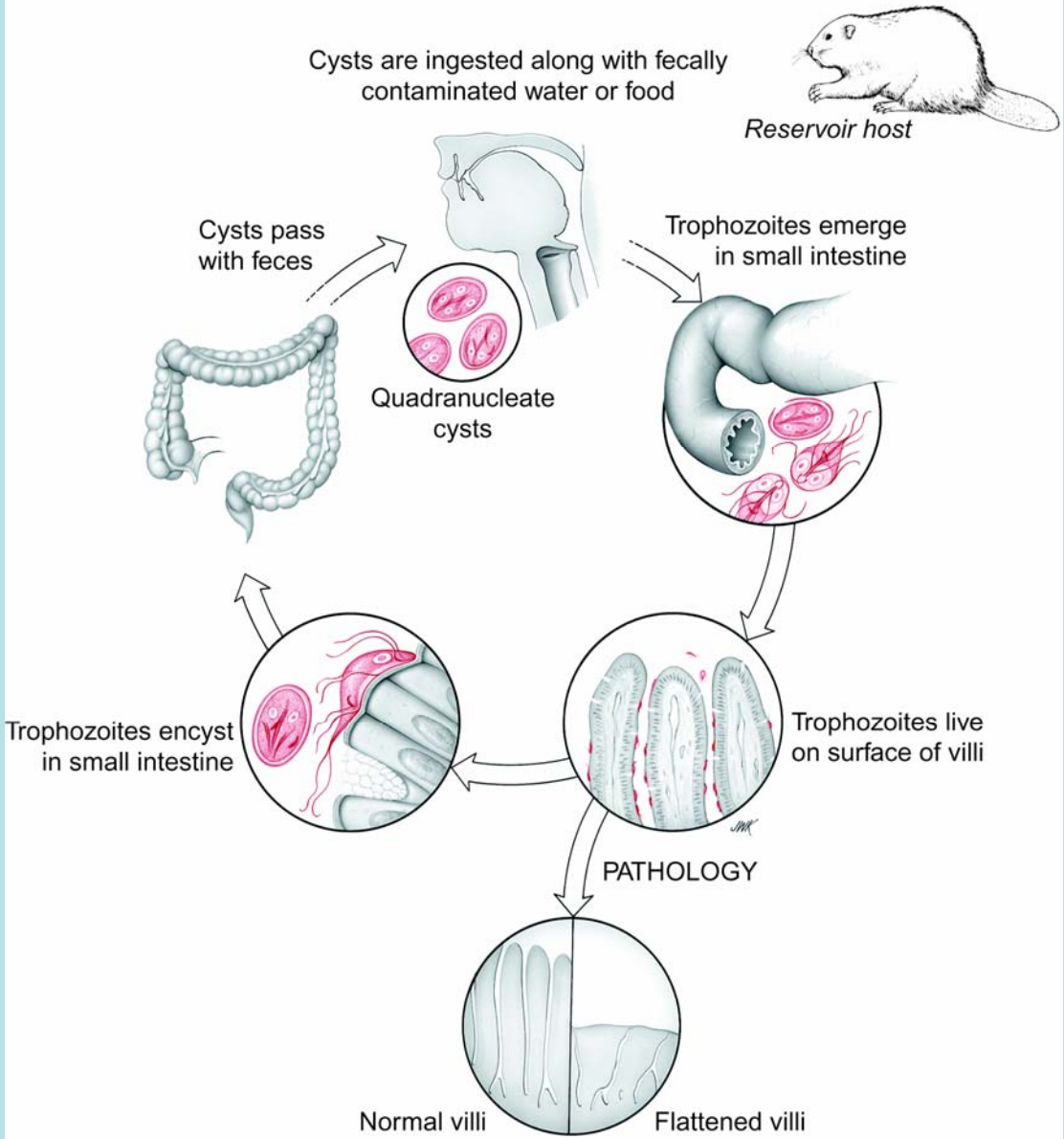
Balantidium coli

Giardia lamblia

SEM of *Giardia lamblia* in situ



Giardia lamblia



Clinical Disease:

1. Diarrhea (steatorrhea)

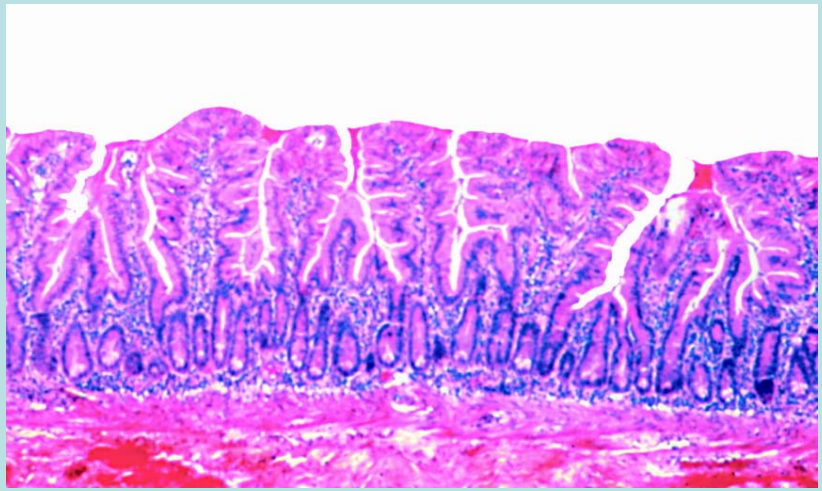
2. Weight loss

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

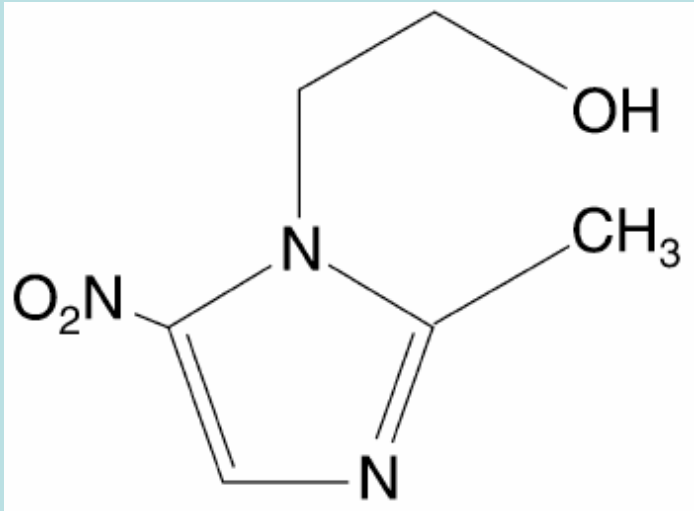
3. PCR

4. IHA serology:

Intestinal - 95% predictive of active infection

Extra-intestinal - 100% predictive of active infection

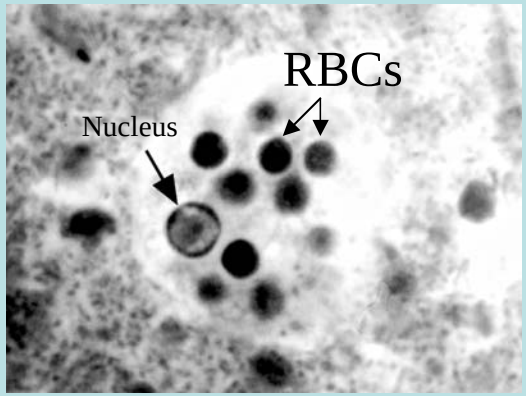
Drug Of Choice: Metronidazole



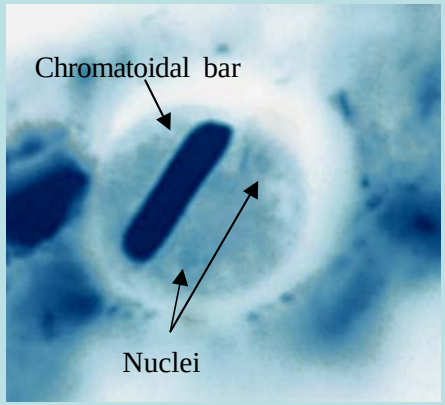
Mode Of Action:
Inhibits Oxidoreductase.
Effective Against All Anaerobic Organisms

Entameba histolytica

Morphology



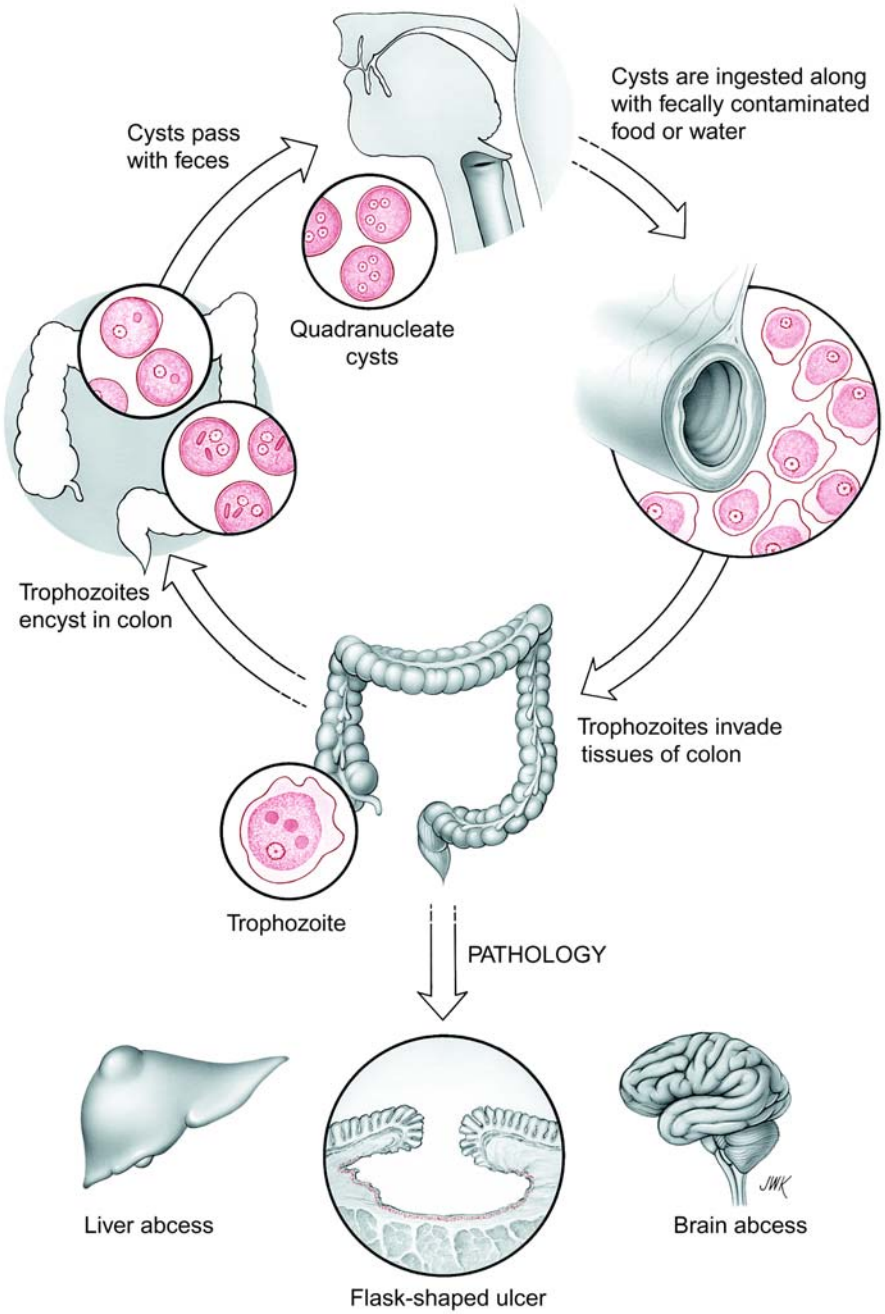
Trophozoite



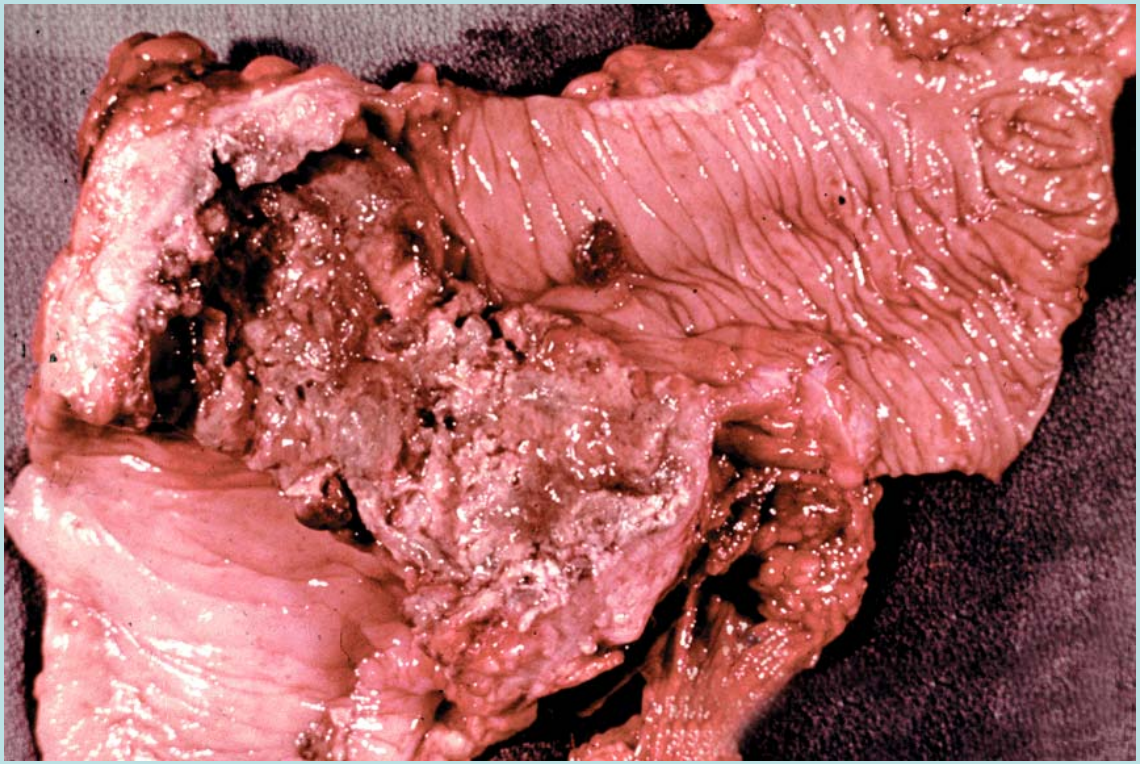
Cyst

15 µm

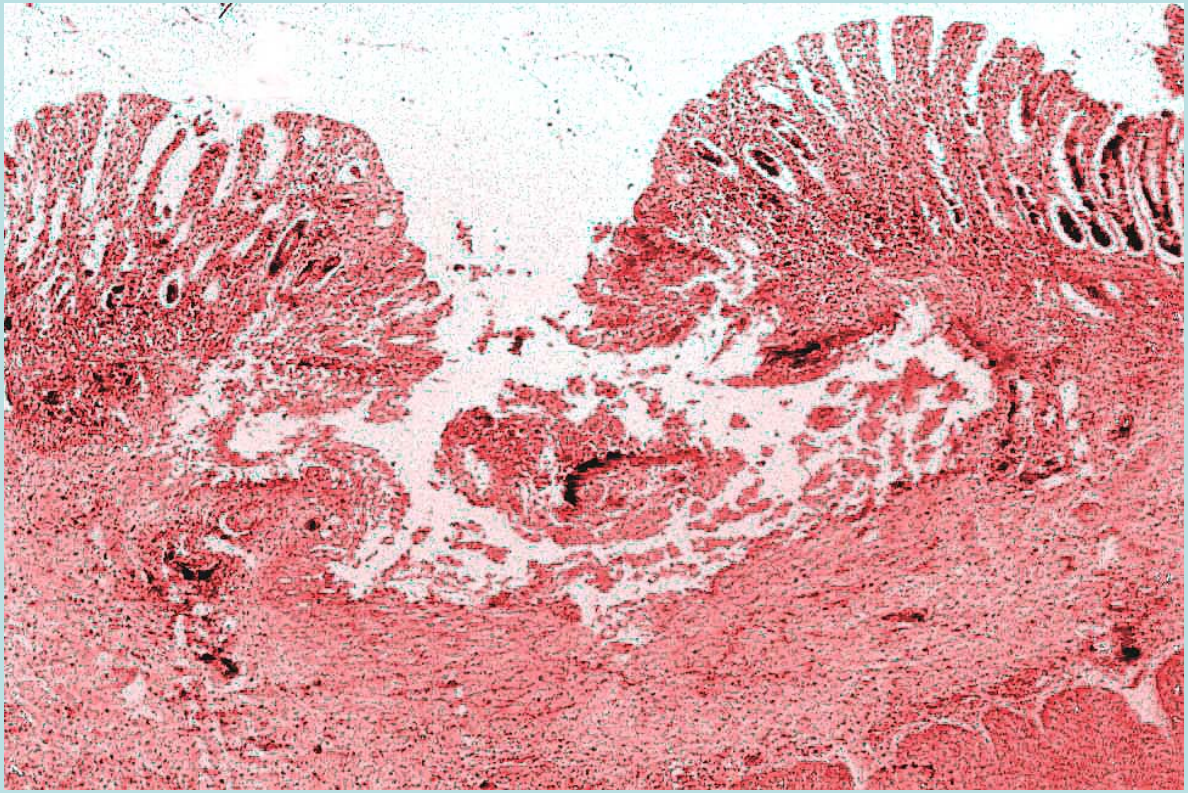
Entamoeba histolytica



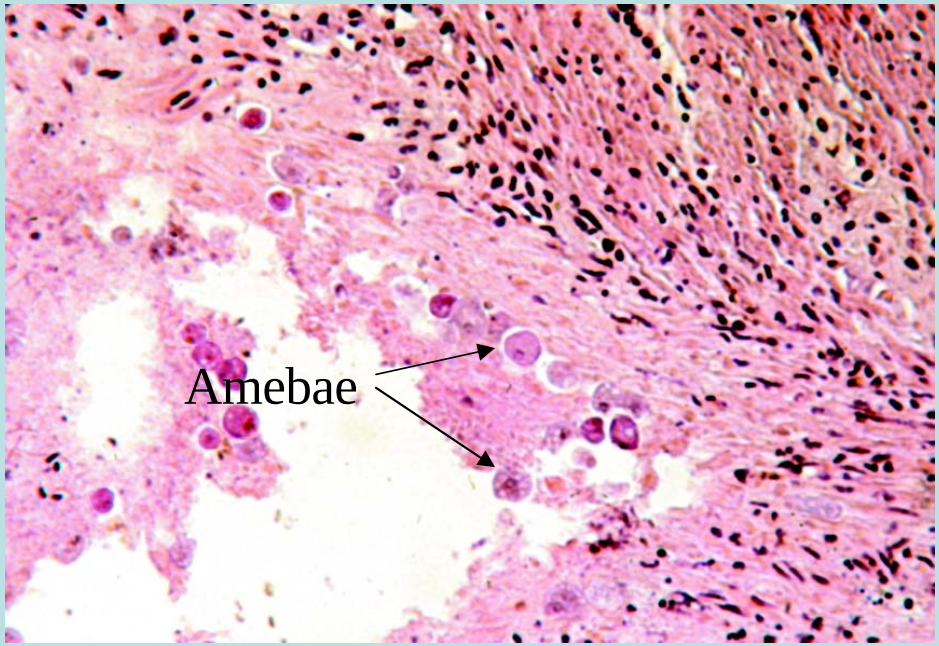
Gross pathology of large intestine due to *Entameba histolytica*



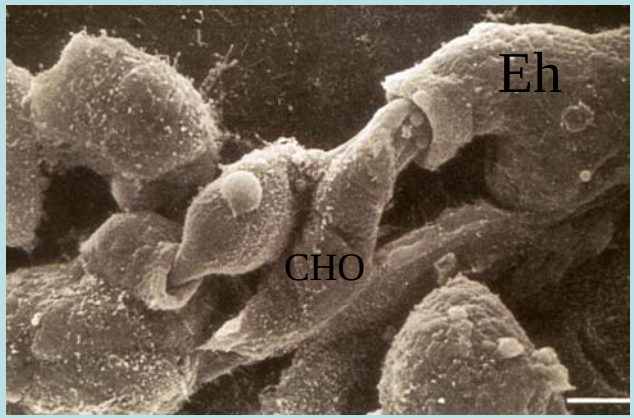
Flask-shaped ulcer due to infection with *Entameba histolytica*



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



Entameba histolytica in culture
with Chinese hamster ovary cells

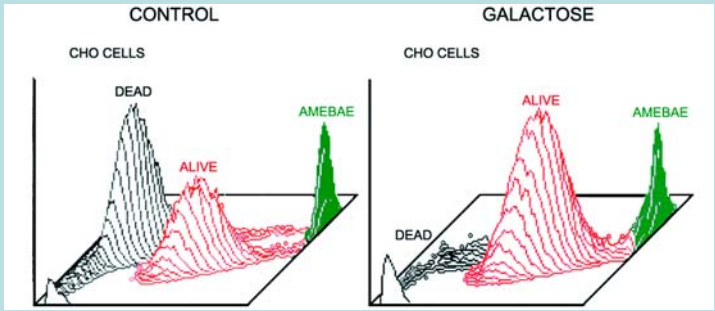


SEM

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:

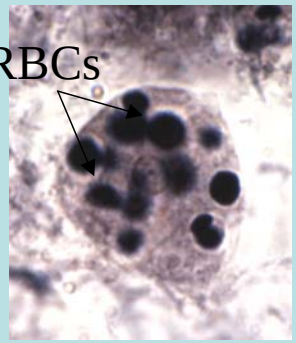
1. Diarrhea
2. Dysentery (bloody diarrhea)

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:

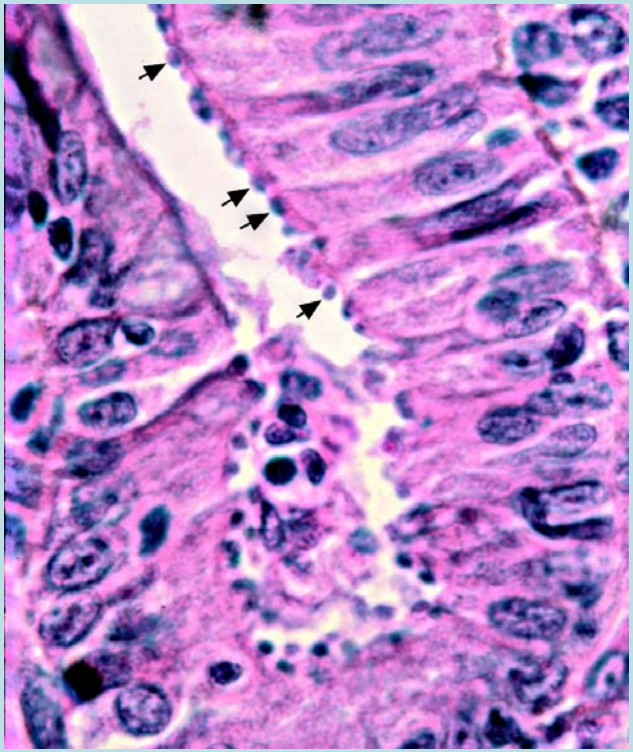
   Metronidazole and Iodoquinol

2. Extra-intestinal

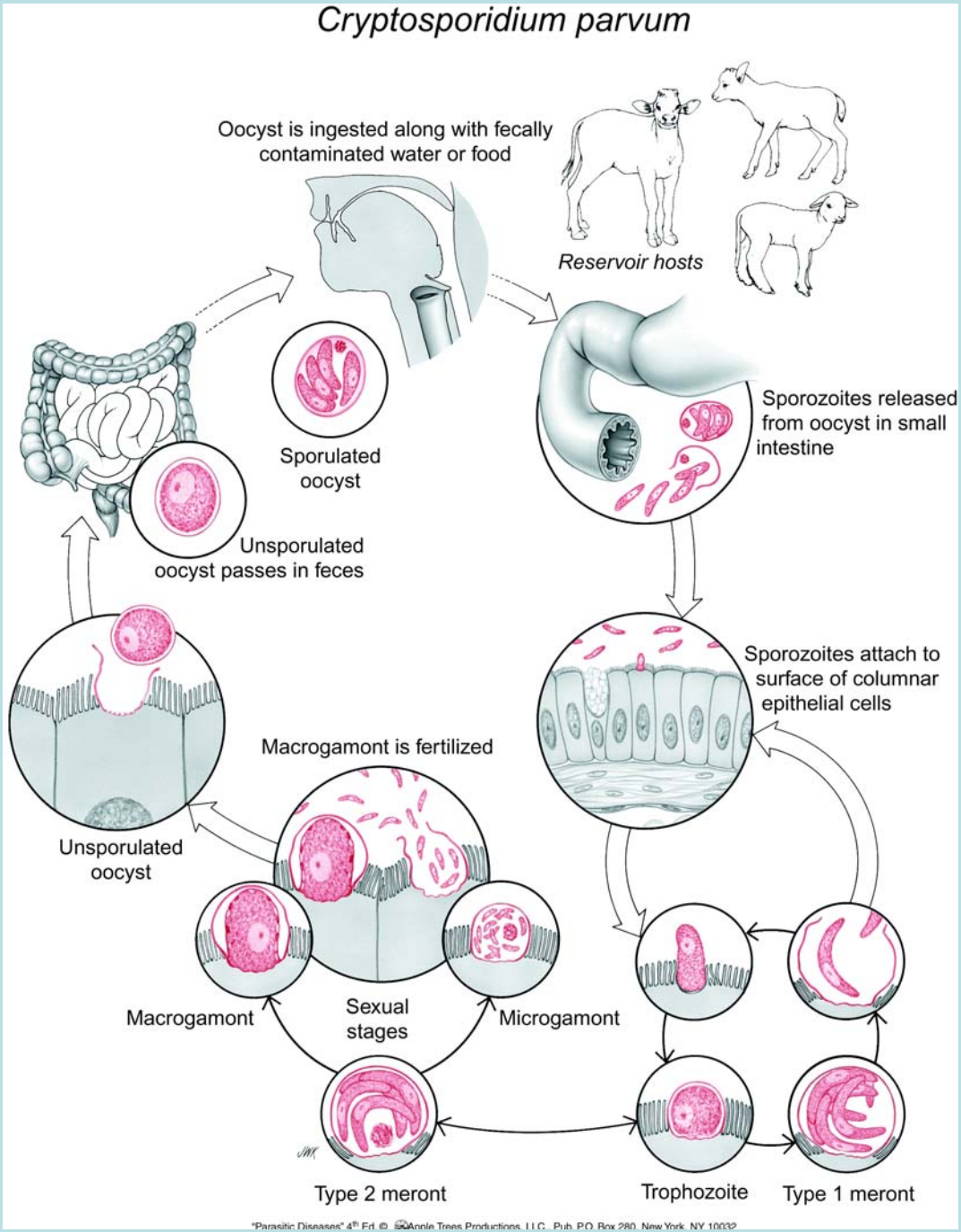
   High doses of Metronidazole

Cryptosporidium parvum

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



Courtesy J. Lefkowitch

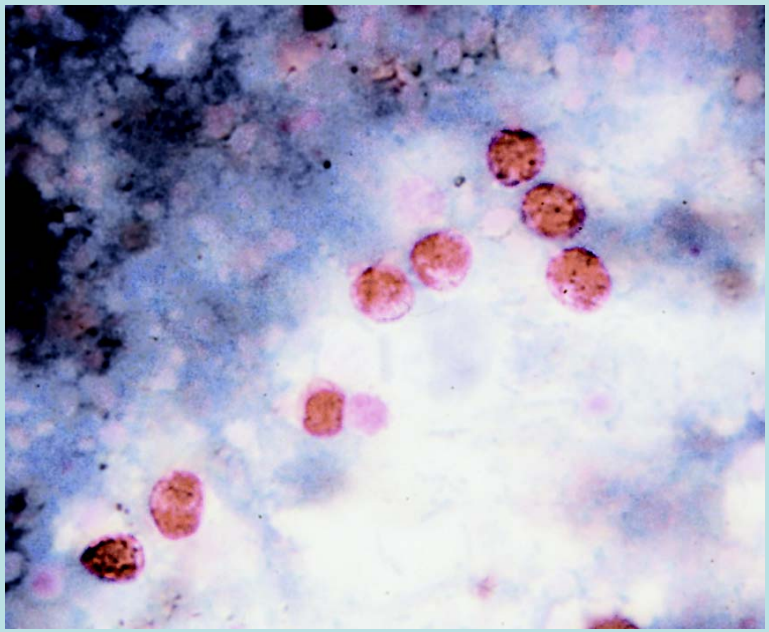

Cryptosporidium parvum
Oocyst is ingested along with fecally contaminated water or food
Reservoir hosts
Sporulated oocyst
Sporozoites released from oocyst in small intestine
Unsporulated oocyst passes in feces
Sporozoites attach to surface of columnar epithelial cells
Macrogamont is fertilized
Unsporulated oocyst
Macrogamont
Sexual stages
Microgamont
Type 2 meront
Trophozoite
Type 1 meront
"Parasitic Diseases" 4th Ed. © Apple Trees Productions, LLC, Pub. P.O. Box 280, New York, NY 10032

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*

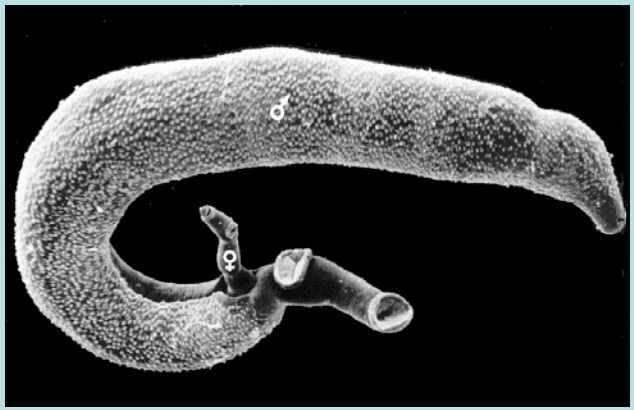


Water Borne Infectious Diseases:

Helminths

Dracunculus medinensis
Strongyloides stercoralis
Schistosoma mansoni
Schistosoma japonicum
Schistosoma haematobium

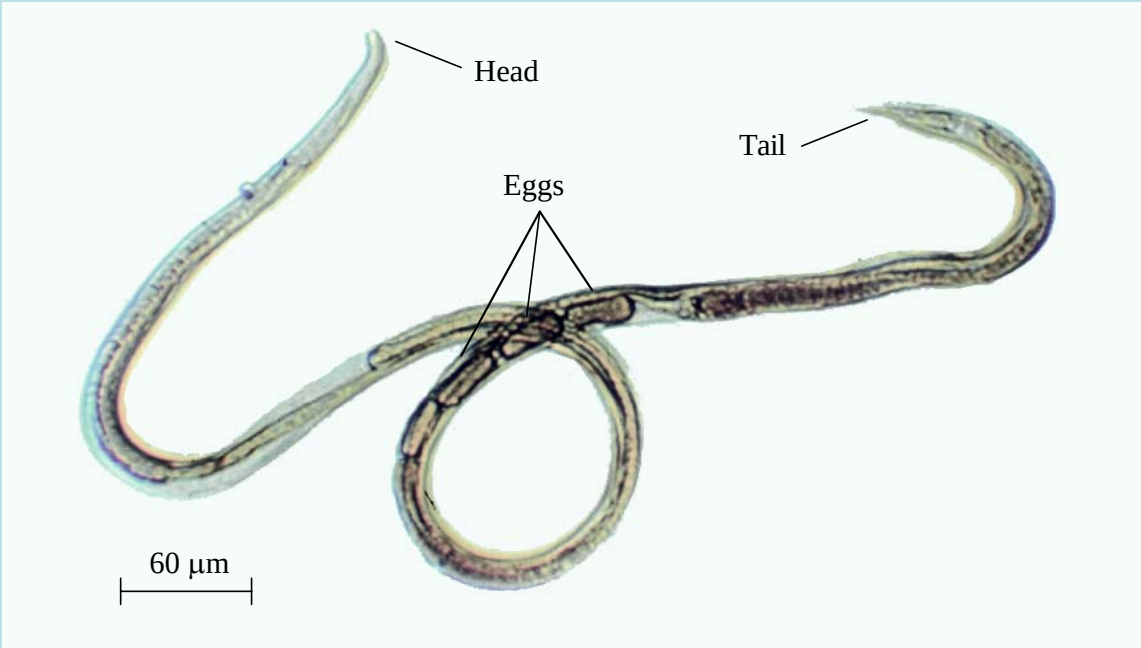
Strongyloides stercoralis



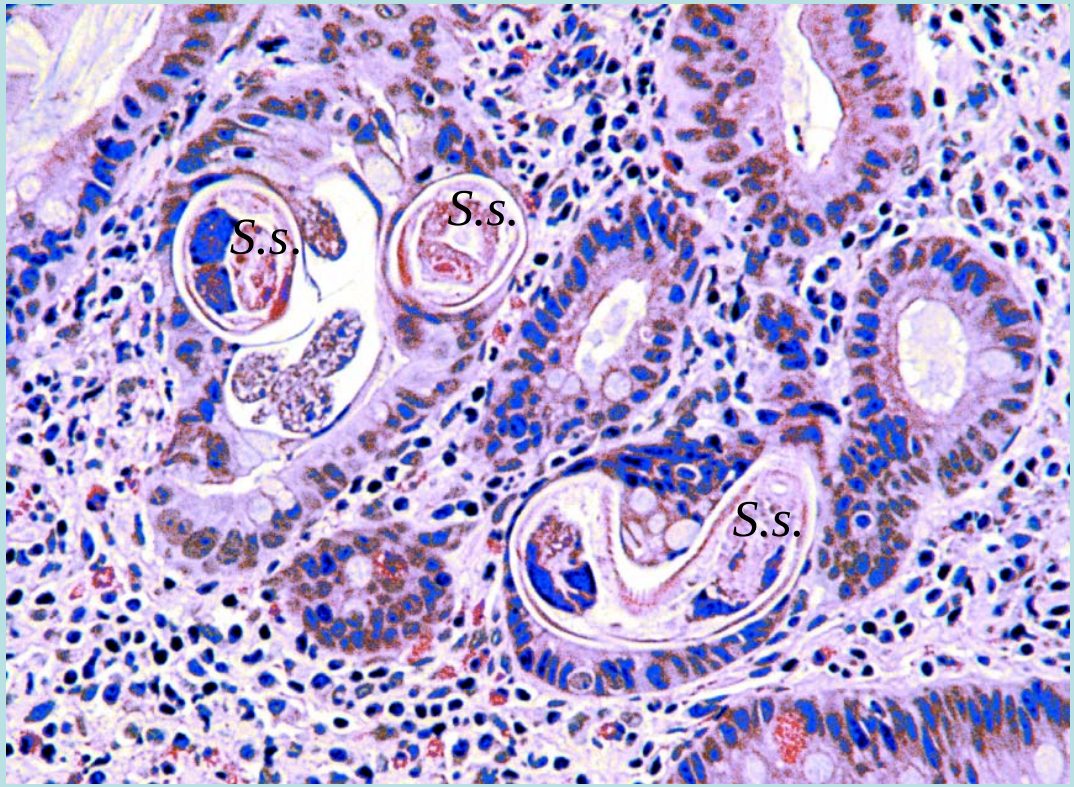
Schistosome adult

Strongyloides stercoralis

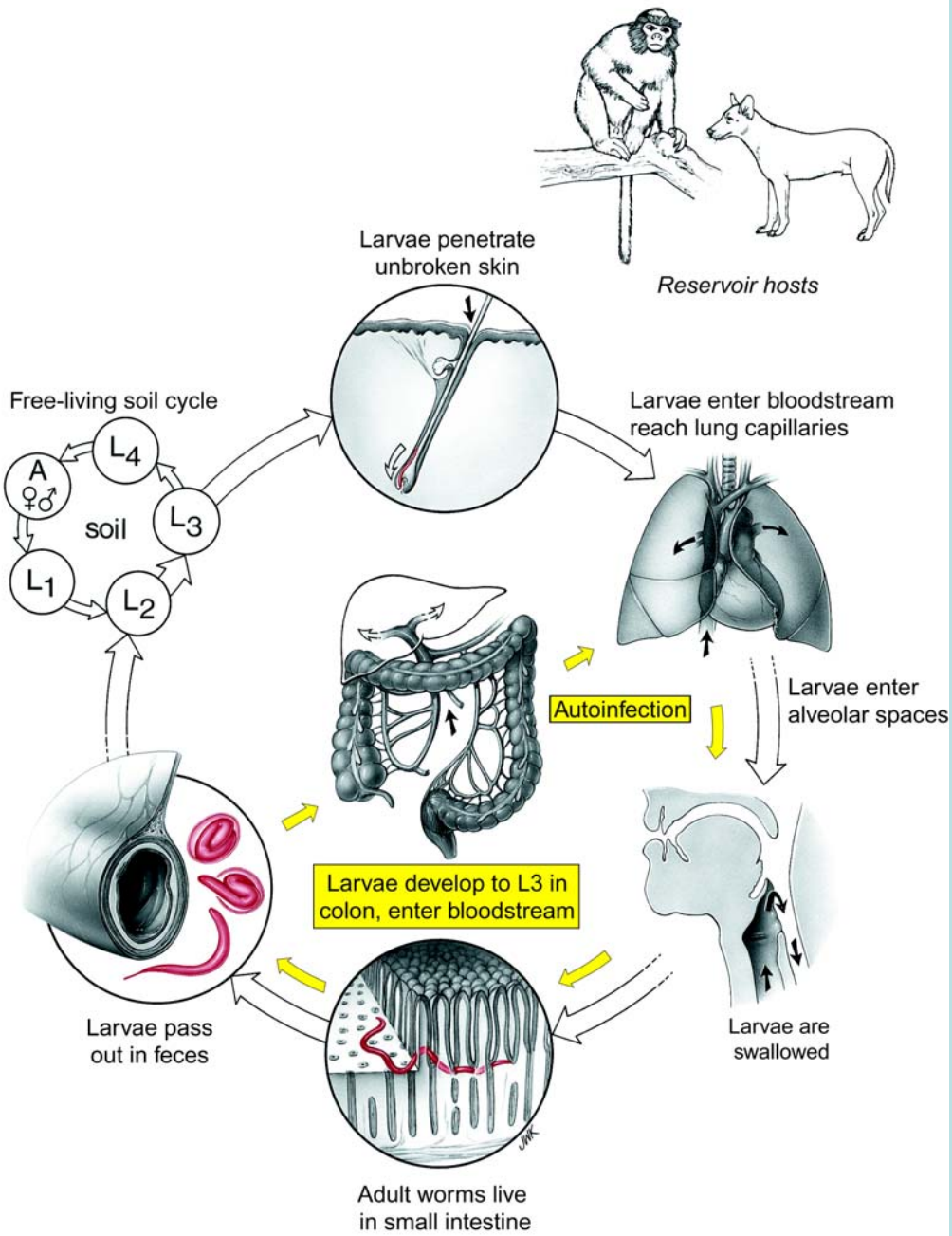
Parasitic female *Strongyloides stercoralis*



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:

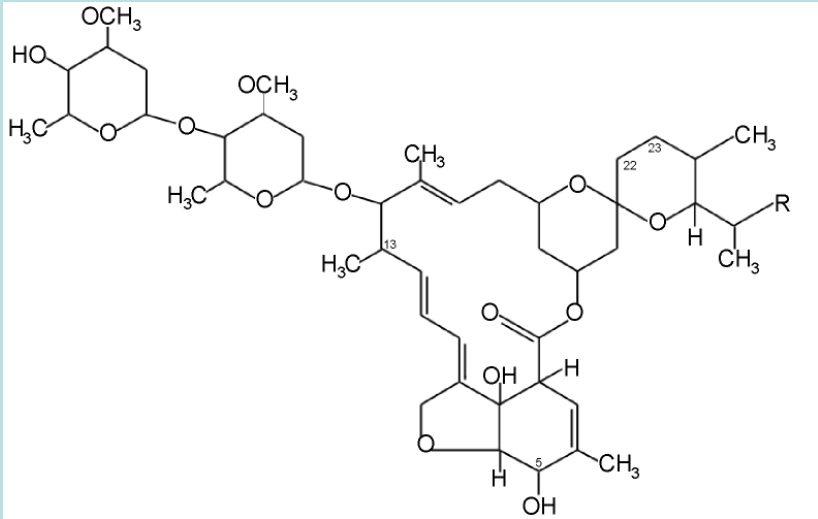
1. Microscopical examination of feces (X6)

2. “String” test

Larva of *Strongyloides stercoralis*

Drug of choice:

Ivermectin



Mode of Action:

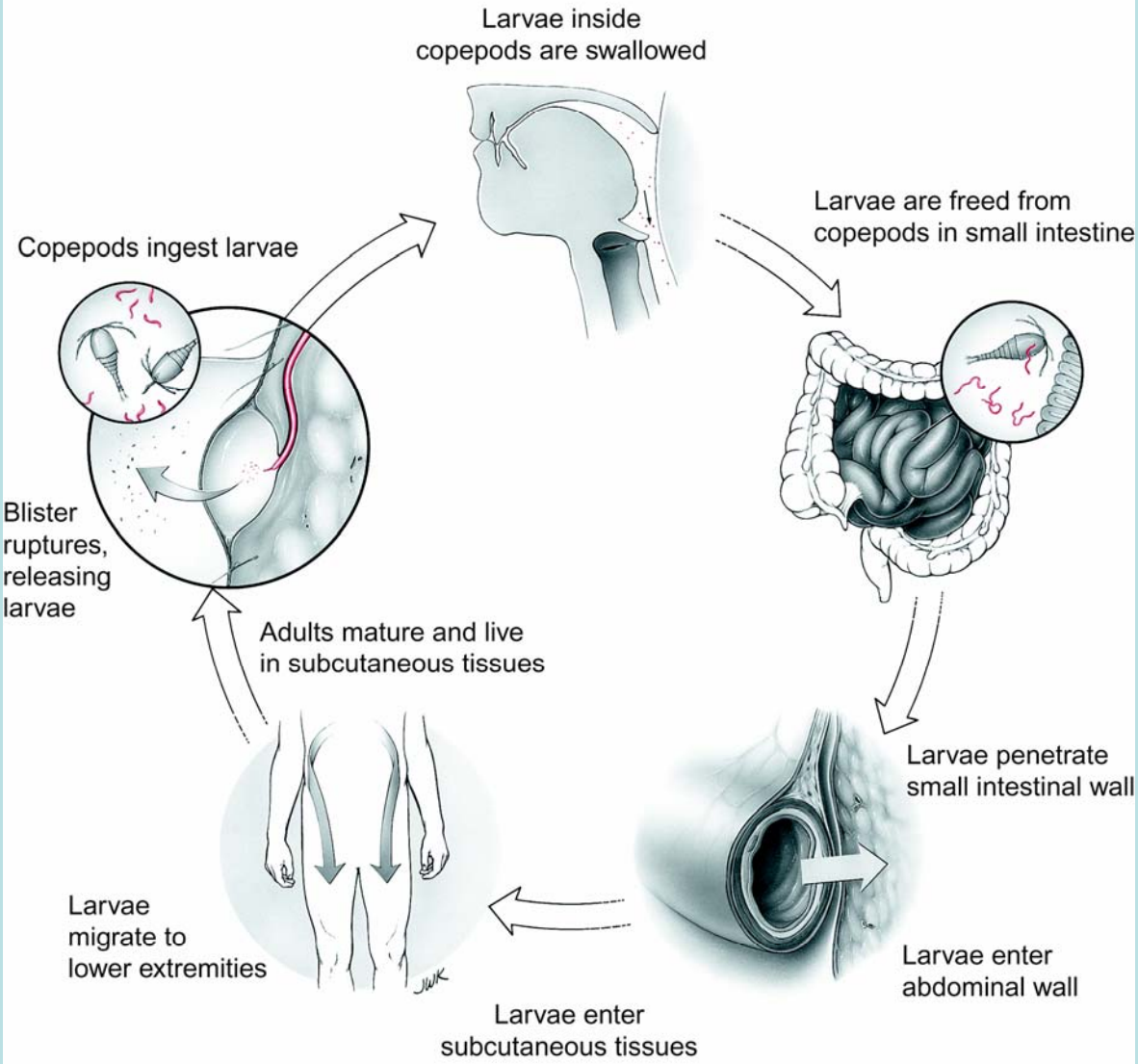
Blocks $Cl^{(-)}$ ion channels, inhibits γ-aminobutyric acid receptor complex.

Dracunculus medinensis

Dracunculus Lesion On Leg

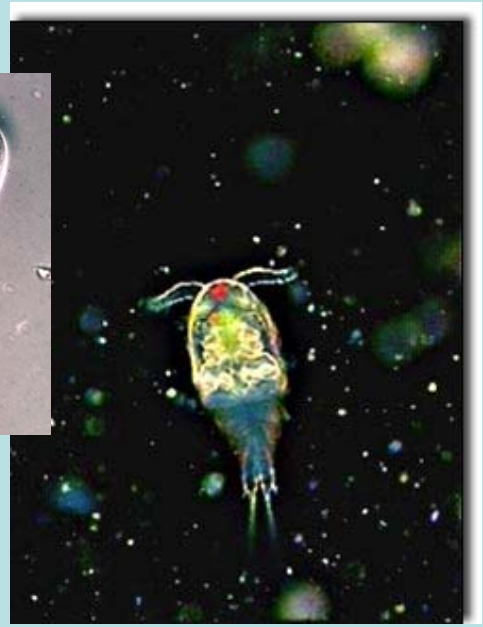
Origins Of The Cadeusus?

Dracunculus medinensis



Dracunculus and Step Well Ecology

Dracunculus infective larvae

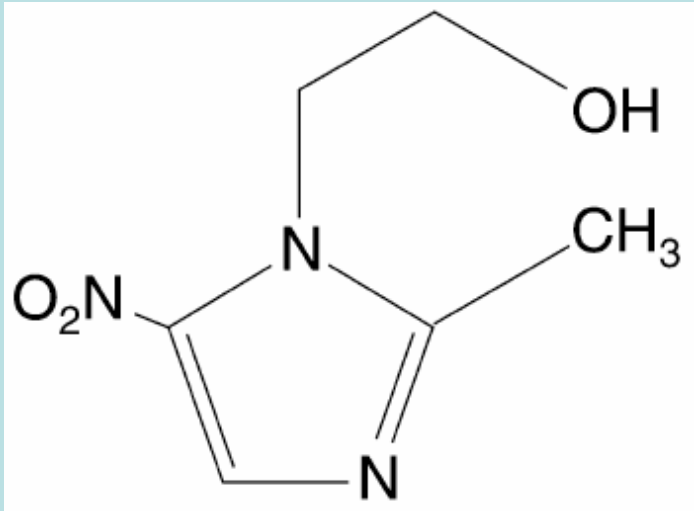


Cyclops

Extraction of dracunculus adult

Step Well

Drug Of Choice: Metronidazole



Mode Of Action:
Inhibits Oxidoreductase Enzyme

Medical Ecology

www.medicalecology.org

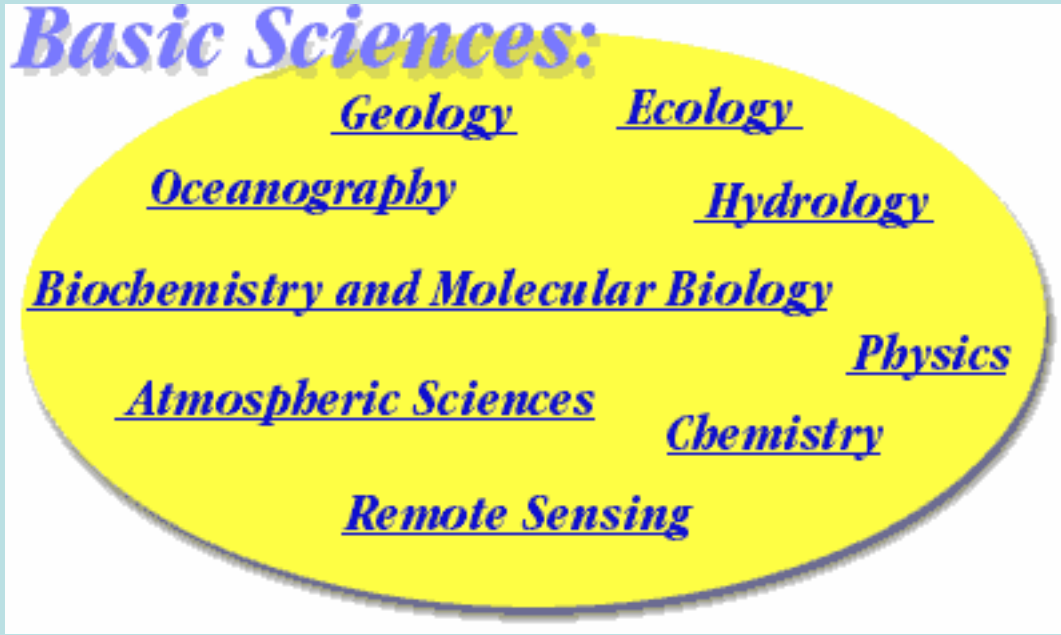
Medical Ecology

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
Science
Medical
Ecology
Applied
Science

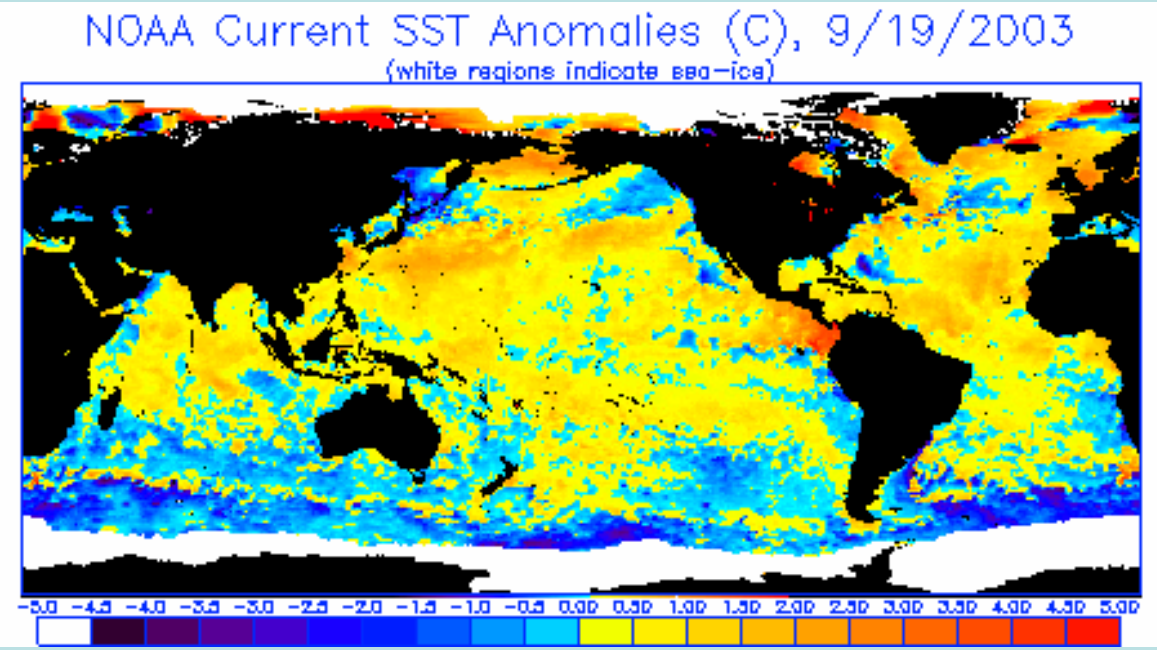

Basic Sciences:
Geology
Ecology
Oceanography
Hydrology
Biochemistry and Molecular Biology
Physics
Atmospheric Sciences
Chemistry
Remote Sensing


Applied Sciences:
Biostatistics
Medical Sciences
Epidemiology
Anthropology
Agronomy
Environmental Health Sciences
Socio-Medical Sciences
Toxicology
Medical Geography

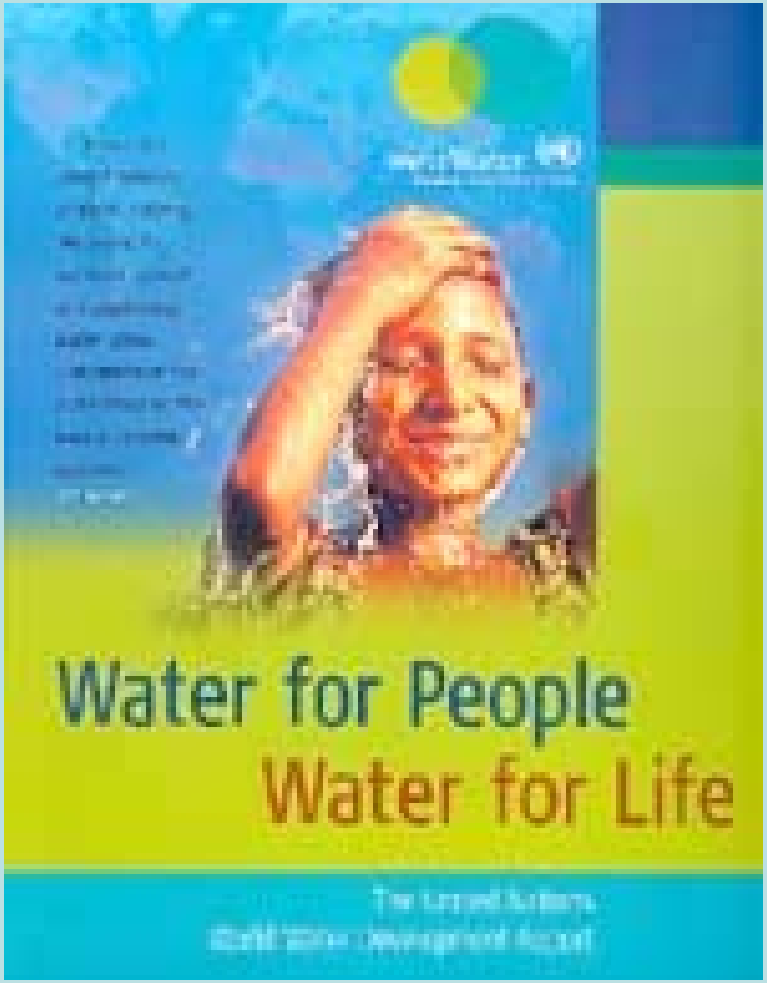
February 3, 2000

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!!!