


ENVIR 202: Lesson No. 9



**Water & Health**

January 25, 2006

Keith Goyden  
University of Washington  
Program on the Environment

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**WHO**

❖ The World Health Organization says that 60,000 children die each day from lack of water and/or dirty water, by far the largest health problem in the world.

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**Water & Health**

- ❖ ...in history.
- ❖ miasma, bacteriological, ecology periods
- ❖ four main categories of water & disease
- ❖ drivers of pathogens in water
- ❖ water-related disease of unknown etiology

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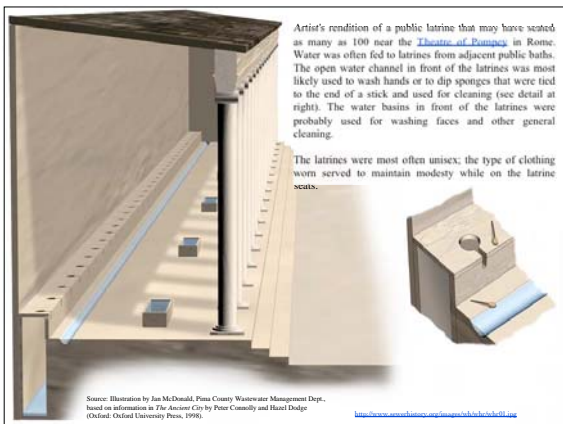
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## "Modern" Technology

The use of technology to treat water is not a modern innovation. Greek and Sanskrit texts dating back 6000 years contain guidance on the use of charcoal filters, boiling, straining and exposure to sunlight to improve the aesthetic quality of drinking-water. Over 4000 years ago, the Egyptians used coagulants to reduce the turbidity of water. With the development of large conurbations throughout the Roman Empire (from 200BC), intricate drinking-water distribution and waterborne sanitation systems were introduced in order to protect the quality of supplies. These piped water systems offered great benefits to the population being served; however, the potential for disseminating pathogens was greatly increased if the source protection and rudimentary treatment systems were breached. Piped distribution without adequate treatment can spread contamination to large populations.

Source: 2003, World Health Organization. *Emerging issues in water and infectious disease*, p.11

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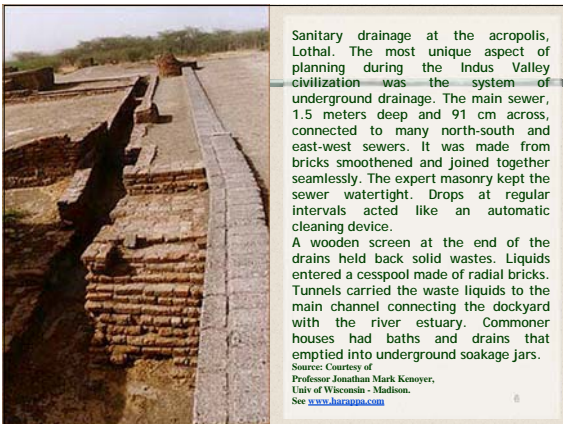
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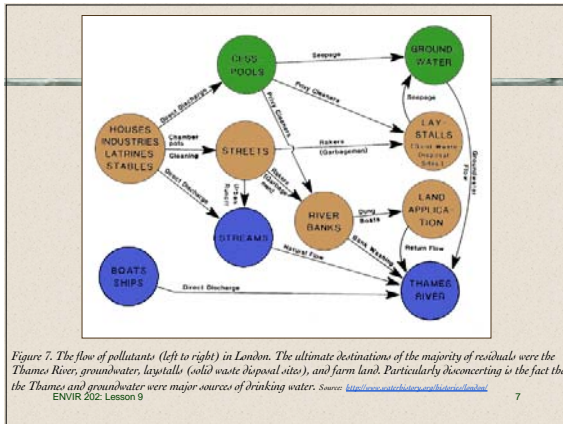


Figure 7. The flow of pollutants (left to right) in London. The ultimate destinations of the majority of residuals were the Thames River, groundwater, laystalls (solid waste disposal sites), and farm land. Particularly disconcerting is the fact that the Thames and groundwater were major sources of drinking water. Source: <http://www.epa.gov/epaosrp/pollution/lesson9.html> ENVIR 202: Lesson 9

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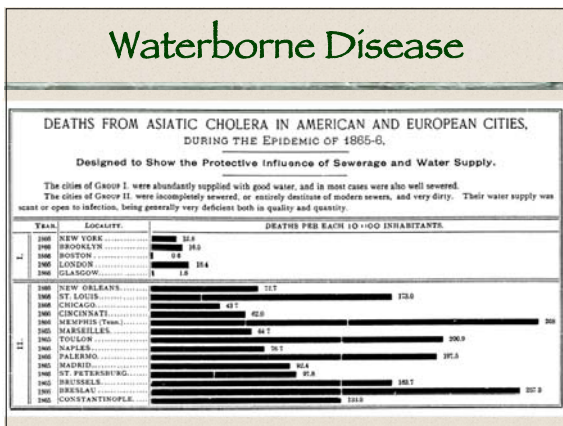
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### Cholera

**Title:** Cholera Attacks (Computer-generated Image)  
**Artist:** Rongguang Zhang  
**Date:** unknown  
**Location:** Argonne's Structural Biology Center (SBC)  
**Notes:** This 3-D image helped scientists understand how the cholera bacterium attacks cells.

Cholera causes diarrhea that can rob the body of 60 percent of its weight in a single day. It is caused by the bacterium *Vibrio Cholerae*. This bacterium thrives in the small intestine where it produces a toxin that induces the bowel lining, the epithelium, to secrete massive amounts of water.

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### Water & Health

- ❖ Adverse human health effects from water can be divided into four main categories
  - Water-borne diseases
  - Water-based diseases
  - Water-related vector diseases
  - Water-scarce diseases

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### Water-borne Diseases

- ❖ Those caused by water that has been contaminated by human, animal, or chemical wastes.
- ❖ Water-borne diseases include cholera, typhoid, bacillary dysentery, polio, meningitis, hepatitis A and E and diarrhoea, among others.
- ❖ These are diseases caused by dirty water, and most can be prevented by treating water before use.

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### Water-based Diseases

- ❖ Those caused by aquatic organisms that spend part of their life cycle in the water and another part as parasites of animals.
- ❖ Water-based diseases include Guinea worm disease, filariasis (also a vector disease), paragonimiasis, clonorchiasis and schistosomiasis.
  - These diseases are caused by a variety of flukes, tapeworms, roundworms and tissue nematodes, often referred to as helminths, that infect humans. Although these diseases are not usually fatal they prevent people from living normal lives and impair their ability to work. The prevalence of water-based diseases often increases when dams are constructed, because stagnant water behind dams is ideal for snails, the intermediary host for many types of worms.

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### Water-related Vector Diseases

- ❖ Those transmitted by vectors, such as mosquitoes and tsetse flies, that breed or live in or near water.
- ❖ Millions of people suffer from infections transmitted by these vectors.
- ❖ Infections such as malaria, yellow fever, dengue fever, sleeping sickness and filariasis.
  - Malaria, the most widespread, is endemic in 100 developing countries, putting some 2 billion people at risk. In sub-Saharan Africa alone, malaria costs an estimated \$1.7 billion a year in treatment and lost productivity.

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### Water-scarce Diseases

- ❖ Those diseases that thrive in conditions where freshwater is scarce and sanitation poor, such as trachoma and tuberculosis.
- ❖ These diseases are becoming rampant throughout the world. They can be controlled easily through better hygiene, but adequate supplies of clean freshwater must be available.

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### Water-related Diseases

- ❖ Water-related diseases are a growing human tragedy, killing more than 5 million people each year - 10 times the number of people killed in wars.
- ❖ About 2.3 billion people suffer from diseases linked to dirty water.
- ❖ Some 60% of all infant mortality worldwide is linked to infectious and parasitic diseases, most of them water-related.

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## Sanitation Related Diseases

Anaemia	Lead Poisoning
Arsenicosis	Leptospirosis
Ascariasis	Malaria
Campylobacteriosis	Malnutrition
Cholera	Methaemoglobinemia
Cyanobacterial Toxins	Onchocerciasis (River Blindness)
Dengue/Dengue Haemorrhagic Fever	Ringworm (Tinea)
Diarrhoea	Scabies
Drowning	Schistosomiasis
Fluorosis	Spinal Injury
Guinea-Worm Disease ( <i>Dracunculiasis</i> )	Trachoma
Hepatitis	Typhoid/Paratyphoid Enteric Fevers
Japanese Encephalitis	

World Health Organization Source: [http://www.who.int/water\\_sanitation\\_health/diseases/diseasesfacto/print.html](http://www.who.int/water_sanitation_health/diseases/diseasesfacto/print.html)

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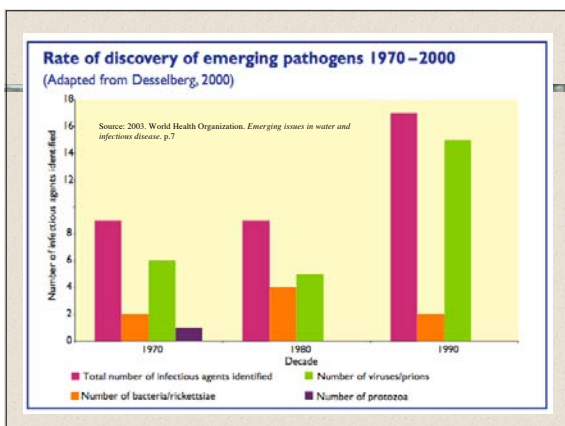
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## Potential Drivers

of the emergence and re-emergence of pathogens in water

- ❖ New Environments:
  - Climate shifts/deforestation
  - Water resources development projects (dams and irrigation)
  - Water-cooled air conditioning plants
  - Changing industrial and agricultural practices (eg intensive livestock rearing)
  - Piped water systems and their inadequate design and operation
  - An increasing number of humanitarian emergencies

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### Unintended Effects

- ❖ Deforestation Boosts Malaria Rates, Study Finds
  - > by [Christopher Joyce](#)
  - > [Morning Edition](#), January 5, 2006
- ❖ A new study shows that tropical deforestation increases rates of malaria adding to evidence that development in fragile ecosystems can markedly harm public health. The research was published in The American Journal of Tropical Medicine and Hygiene.

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### Potential Drivers

*of the emergence and re-emergence of pathogens in water*

- ❖ New technologies:
  - > Water resources development projects (dams and irrigation)
  - > Water-cooled air conditioning plants
  - > Changing industrial and agricultural practices
  - > Waterborne sewage and sewage treatment alternatives

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### Potential Drivers

*of the emergence and re-emergence of pathogens in water*

- ❖ Changes in human behaviour and vulnerability:
  - > Human circulation and the accessibility and rapidity of transport worldwide
  - > Demographic changes
  - > Increasing size of high risk populations
  - > Deliberate and accidental release of pathogens to water
  - > An increasing number of humanitarian emergencies

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## Potential Drivers

*of the emergence and re-emergence of pathogens in water*

- ❖ Scientific advances:
  - Inappropriate, excessive use of antibiotics anti-parasitic drugs and public health insecticides
  - Changing industrial and agricultural practices
  - Improved methods of detection and analysis
  - Inappropriate use of new generation insecticides

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## Waterborne Disease

- ❖ "...despite advances in diagnostic technology water-related disease of unknown etiology remains a significant percentage of the total outbreaks of disease. Published statistics from the USA show that between 1991 and 2000, the etiological agent of around 40% of drinking-water associated outbreaks was not identified."

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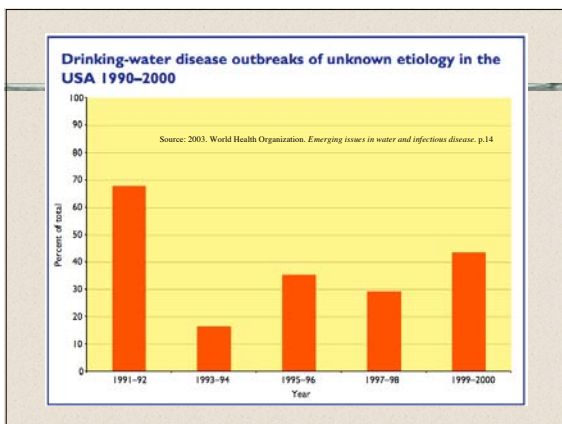
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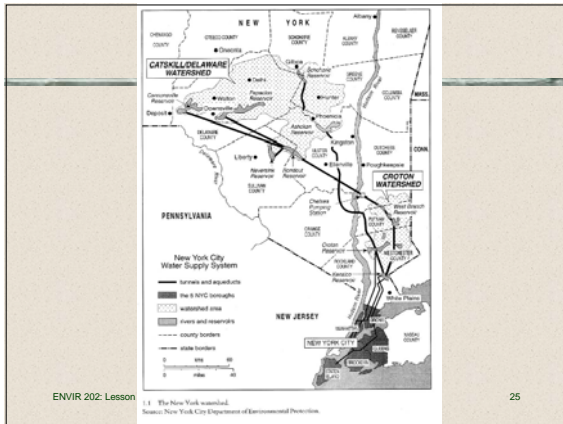
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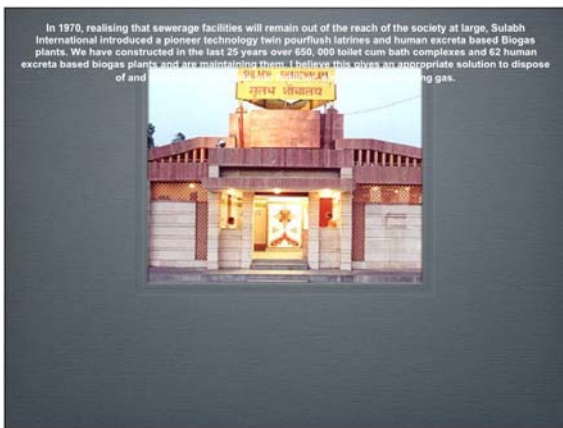
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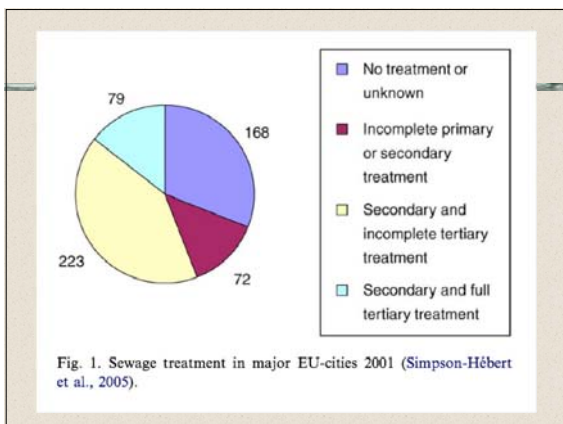
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❖ Few of the sanitation solutions used today, so-called "improved sanitation" are sustainable.

❖ The two dominating types of sanitary solutions are the 'flush-and-discharge' and 'drop-and-store' solutions.

(Winblad & Simpson-Hebert, 2005)

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❖ It is estimated that a person produces 400-500 l of urine and 50 l of faeces a year.

❖ By present usage, these are flushed away with an estimated 15,000 l of pure water from the toilet and an additional 15,000-30,000 l of water from the household.

❖ The relatively small amount of faeces is thus allowed to contaminate more than 35,000 l of water per person and year.

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❖ ... a water-based sanitation system to flush excrement away, thus polluting drinking water, appears to be an absurd alternative. In addition, the existing sanitation solutions are not affordable to the vast majority of the people, nor do they offer an approach ensuring sustainable society growth.

(Winblad & Simpson-Hebert, 2004)

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❖ After numerous years of research and field experience (Jonsson, Stintzing, Vinneras, & Salomon, 2004; Schonning & Stenstrom, 2004) the conclusion reached is that dry methods diverting urine and faeces kill pathogens more effectively than other commonly used methods.

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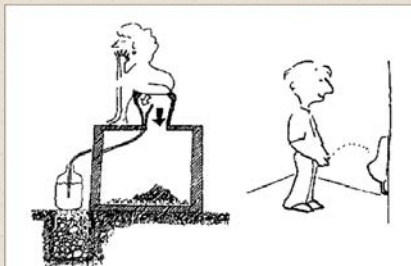
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L.E. Dellstrom Rosenquist / Journal of Environmental Psychology 25 (2005) 335-346



Picture 1. Urine diversion (drawings by César Añorve, Cuernavaca, Mexico).

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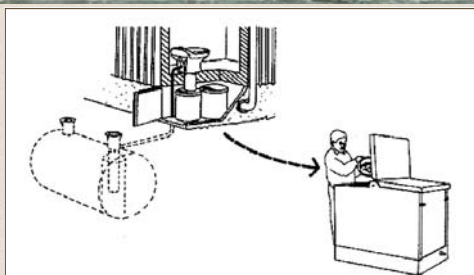
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L.E. Dellstrom Rosenquist / Journal of Environmental Psychology 25 (2005) 335-346



Picture 2. Primary processing in a chamber directly under the urine diverting eco-toilet followed by secondary processing at an eco-station.

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### Damming the Flow of Drugs into Drinking Water

- ❖ Roughly 100 pharmaceuticals have now been identified in rivers, lakes, and coastal waters throughout Europe and the United States in concentrations of parts per billion to parts per trillion.
- ❖ So far there is no evidence of adverse human health effects due to traces of pharmaceuticals in water. But scientists have linked certain pharmaceuticals with disturbing ecosystem changes.
- ❖ However [Environmental Health Perspectives](#)

ENVI 202: Lesson 9 <http://www.niehs.nih.gov/> 34  
Environmental Health Perspectives (EHP) is a monthly journal of peer-reviewed research and news on the impact of the environment on human health. EHP is published by the National Institute of Environmental Health Sciences and its content is free online. Print issues are available by paid subscription.

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### Damming the Flow of Drugs into Drinking Water

- ❖ in volume 8 (1994) of *Chemistry and Ecology*, researchers demonstrated that the feminization of fish -- male carp and trout producing vitellogenin, an egg protein usually found only in females--was associated with exposure to sewage effluent now known to contain ethinyl estradiol, the active ingredient in birth control pills.

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### Boston Pee Party

- ❖ So much caffeine flows into and out of people daily that it could offer the best test yet for water pollution, says a scientist in Boston, Massachusetts, who has measured the caffeine content of the city's harbor.
  - But caffeine may prove inadequate as a sole marker of human sewage, say several environmental chemists. According to a 3 July 2000 Associated Press article, studies in Puget Sound discovered caffeine everywhere in otherwise relatively clean waters, rendering the marker invalid.

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## Polluted Water Prevents Men From Getting Married

- ❖ The single men hailing from the Dudu Town of India's Rajasthan are unable to find brides, as a result of the high fluoride content in its water. The excessive fluoride has given rise to several orthopedic problems in the people living in the area.
  - > 'I have two sons of marriageable age but all my efforts to find brides for them have failed due to the water problem,' said Ramji Lal Jat, a Dudu resident, who also added that the local people wanted to give their daughters in marriage to people living in other places.
  - > 'I have been here for the last 55 years. I cannot leave the place as all my fields and houses are here. The only thing we can do is to wait for a slow death from drinking the fluoride-contaminated water,' said Shankar Chaudhary, another resident of a village near Dudu.

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Source: <http://www.medindia.net/new/060504.htm> 37

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## Questions



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Next Lesson

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Midterm Review

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The slide features a light beige background with a darker beige rectangular area in the center. The text 'Midterm Review' is written in a large, bold, black serif font within this central area. Above the slide, the text 'Next Lesson' is written in a green serif font. At the bottom of the slide, the text 'ENVIR 202: Lesson 9' is on the left and '40' is on the right.

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