

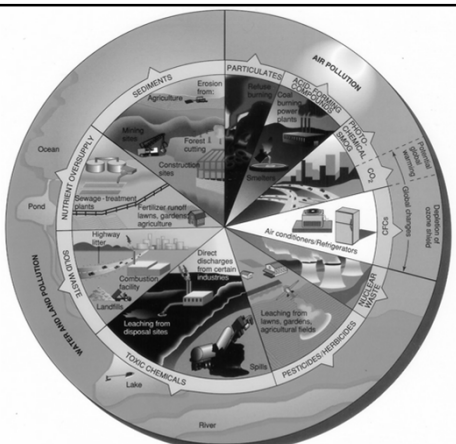
Water

Is the solution to pollution,
dilution?

Miller Chapter 21

The World Health Organization (WHO)
estimates that 3.3 million die every
year from contaminated water

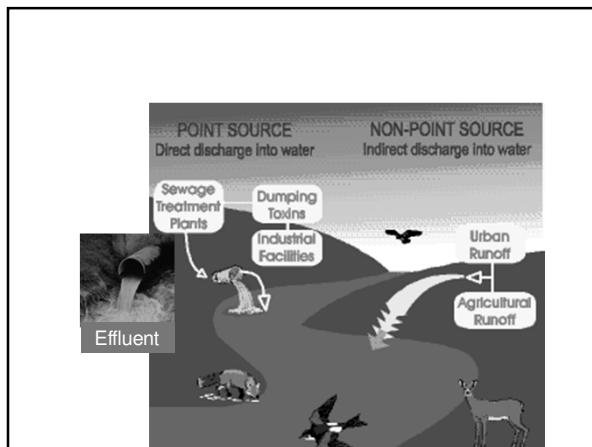
The
Different
types of
pollutants
that effect
our
environment



Runoff from anthropocentric sources creates a multitude of problems

Federal Water Pollution Control Act.

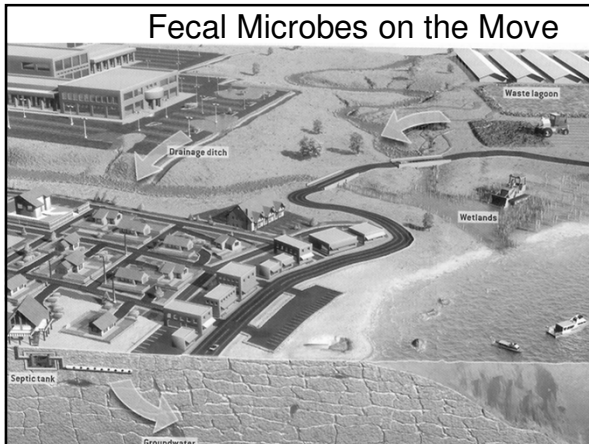
- Established the basic structure for regulating discharges of pollutants into U.S. waters
- Allowed EPA to set wastewater standards for industry
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution .



How does urbanization affect water quality?

DRUGS IN OUR WATER

- Surfactants are disruptors, field studies show that fish are becoming "intersex", males bear immature eggs
- In Germany barbiturates are found in the water even though they were replaced 30 years ago
- Up to



Orange County is now treating grey water and injecting it into the groundwater basins to recharge the aquifers

Alternatives to Wastewater Treatment




Arcata, CA. A diverse community whose resourcefulness has demonstrated that a constructed wetland system can be a cost-efficient and environmentally sound wastewater treatment solution. Stimulate and encourage this kind of sound environmental design in your community.

For practical low-scale purposes of water treatment on a school campus, onsite wastewater can be provided by means of a product similar to a "Living Machine". Pictured above, these products have been designed and constructed to utilize the natural processes to purify wastewater. This technology is an excellent teaching tool.

THE MOST CONTAMINATED BEACHES IN AMERICA

How do we improve water quality?



BEACH LOCATION	TYPE OF BACTERIA MEASURED	HIGHEST COUNT (CFU PER 100 MILLILITERS)	NUMBER OF CLOSURE OR ADVISORY DAYS IN 2004
Dehang State Beach Orange County, California	Enterococcus	38,800	312
Phil Foster Park Palm Beach County, Florida	Enterococcus	600	108
South Shore Beach Winnebago County, Wisconsin	Escherichia coli	2,419	72
Myrtle Beach Horry County, South Carolina	Enterococcus	1,330	54
Cole Park Harris County, Texas	Enterococcus	14,400	53

HOW DOES THE DISCHARGE OF ORGANIC MATTER AFFECT AQUATIC ORGANISMS?

Oxygen Sag Curve

Oxygen Sag Curve

Amount of oxidizable pollutant

Time / Distance Downstream

Amount of oxidizable pollutant

Dissolved oxygen

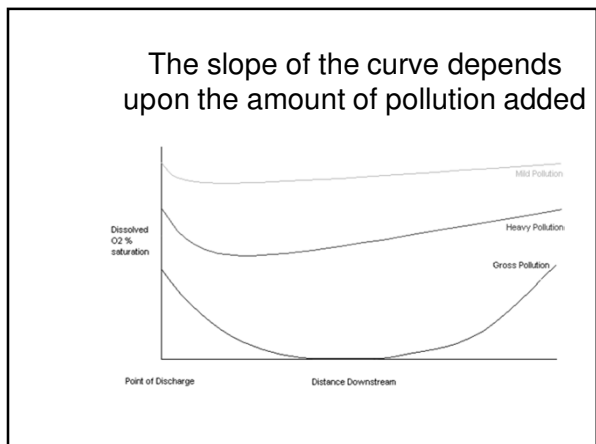
Oxygen Sag Curve with Critters

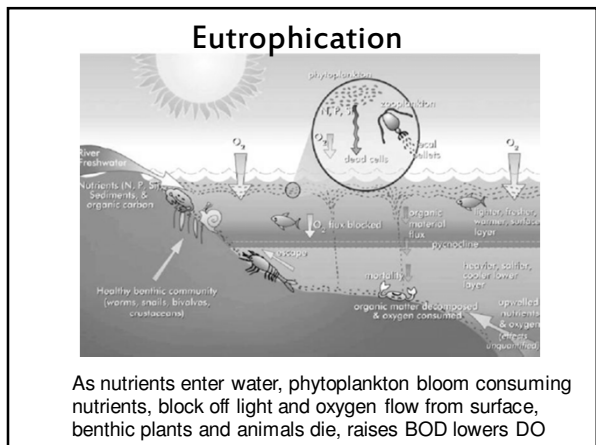
Clean Zone	Decomposition Zone	Septic Zone	Recovery Zone	Clean Zone
Trout, perch, bass, mayfly, stonefly, caddis fly larvae	Trash fish; leeches	Fish absent; sludge worms; midge and mosquito larvae	Trash fish; leeches, isopods	Trout, perch, bass; mayfly, stonefly, caddis fly larvae
8 ppm	Oxygen sag	2 ppm		8 ppm
Direction of flow				

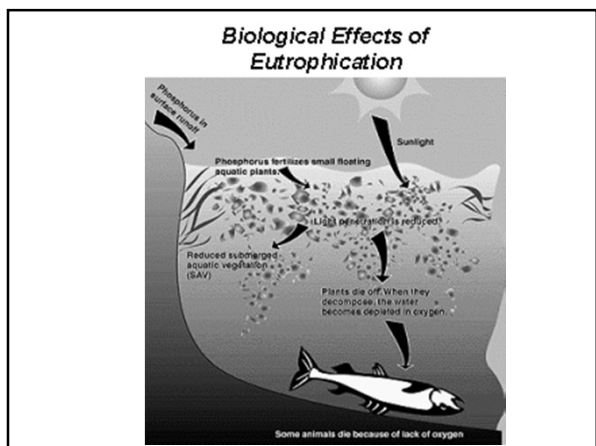
The time & distance for a water system to recover depends upon the volume, flow rate, temperature, pH, and amount of incoming oxidizable pollutants

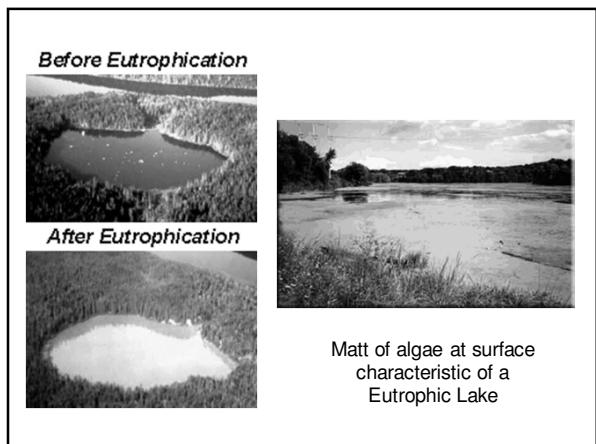
The amount of dissolved oxygen in water is a measure of water quality

Water Quality	ppm of DO at 20° C	ppm of DO at 20° C
Good	8-9	8-9
Slightly polluted	6.7-8	6.7-8
Moderately polluted	4.5-6.7	4.5-6.7
Nearly polluted	below 4.5	below 4.5
Gravely polluted	below 4	below 4

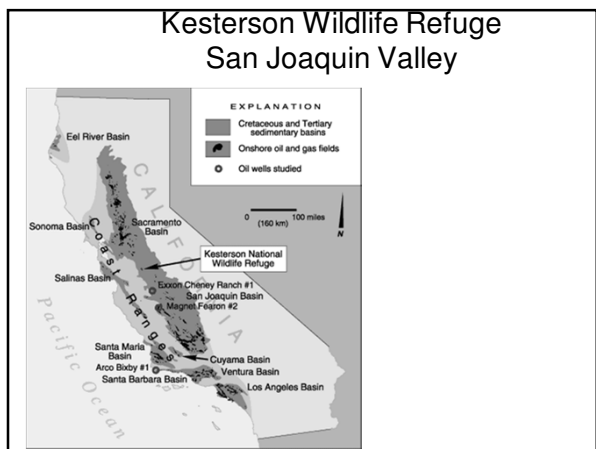






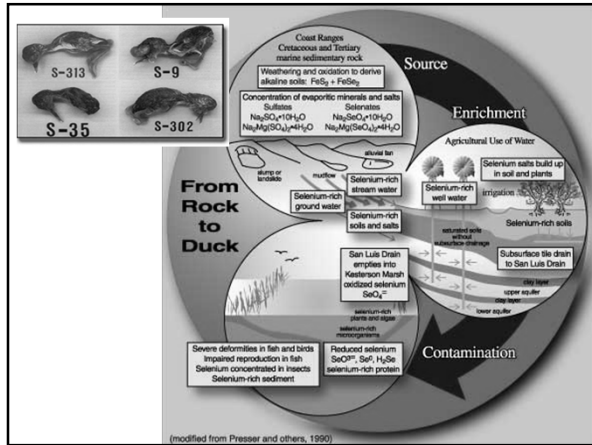




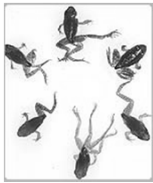


The Kesterson Story

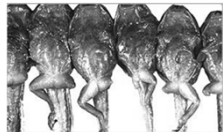
- In the early 1980s, waterfowl in marshy areas of San Joaquin Valley started appearing with birth deformities. Scientists traced the cause of this disaster to the element
- The selenium was carried into the refuge in the irrigation water flowing from the drainage canal. Selenium concentration was low in the original irrigation water, but in the dry California valley, water used in irrigation evaporated quickly from the soil, concentrating the selenium.



Catfish living in a polluted water system



Frogs mutated from pesticides



Common water pollutants

- **Heavy metals-**
mercury -due to acid rain, burning coal:
damages nervous system
lead-paint
arsenic-herbicides and wood preservatives
aluminum- leaching from acid deposition-
role in dementia and Alzheimer's
- **Heat**-thermal
- **Nutrients**- nitrates and phosphates
- **Sediment**
- **Organic material**- sewage and agricultural runoff

SIERRA CLUB
Mercury Survival Guide
For Women of Childbearing Age and Small Children

Nearly all fish and shellfish contain traces of mercury. Some fish contain higher levels of mercury that may harm an unborn baby or young child's developing nervous system. The risks associated with eating fish contaminated with mercury depend on the amount you consume and the levels of mercury in the fish and shellfish.

The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to eat fish and shellfish that are lower in mercury.

To learn more and to learn how you can find out how much mercury you have in your body visit:
www.sierraclub.org/mercury

Eat in Moderation
Anchovies, Butterfish, Catfish, Clams, Crab (Blue/Snow), Crawfish, Croaker (Atlantic), Fluke, Haddock, Hake, Herring, Jackmullet, Mackerel Atlantic (N. Atlantic), Mackerel Chub (Pacific), Mulllet, Oysters, Ocean Perch, Plaice, Pollock, Salmon, Sardine, Shad (American), Squid, Tilapia, Trout (Freshwater), Whitefish, Whiting

Eat Sparingly
Bass (Saltwater, Sea/Striped/Rockfish), Buffalo, Carp, Mackerel Spanish (S. Atlantic), Perch (Freshwater), Sole, Sheephead, Skate, Tilapia (Atlantic), Tuna (Canned, Light)

overfished*
Halibut, Monkfish, Snapper

DON'T EAT!
Bluefish, Croaker White (Pacific), Lobster (Northern/American/Maine), Mackerel Spanish (Gulf of Mexico), Marlin, Scorpionfish, Tuna (Canned, Albacore), Tuna (Fresh/Frozen), Weakfish (Sea Trout)

Tilapia (Gulf of Mexico), Mackerel King*

overfished*
Chilean Bass, Groupers, Orange Roughly,* Shark,* Swordfish* X

LEGEND:
* Do Not Eat (highest mercury >0.51 ppm)
** Fish to "avoid" according to the Monterey Bay Aquarium National Seafood Guide because they come from sources that are overfished and/or caught or farmed in ways that harm other marine life or the environment. Find out more at www.mbayaq.org

Mercury content information was last updated in 2006 and comes from the EPA and the FDA websites. To find out specific fish advisories in your state, visit <http://epa.gov/waterscience/fish/status.htm>

The categories in this guide are determined according to the mercury levels found in tested fish (ppm=parts per million):
Eat in Moderation: <0.2 ppm
Eat Sparingly: 0.2 to 0.5 ppm
Don't Eat: >0.5 ppm

Sediment pollution from construction, contained due to Environmental Regulations

Sources of Groundwater Pollution

12 million tons of radioactive uranium mill tailings are sitting a couple hundred feet from the Colorado River in Moab, Utah. LA Times 3/5/05

The diagram illustrates various sources of groundwater pollution. On the surface, there are a mining site, a waste lagoon/pond/basin, a road salt application area, a landfill, a sewer, a cesspool/septic tank, and a hazardous waste injection well. A buried gasoline and solvent tank is also shown. A pumping well is used to draw water from the unconfined freshwater aquifer. A discharge point is shown where water is released into the confined aquifer. Arrows indicate the flow of groundwater from the unconfined aquifer down into the confined aquifer, and from the confined aquifer towards the discharge point. Labels include: Mining site, Waste lagoon, pond, or basin, Road salt, Landfill, Sewer, Cesspool, septic tank, Buried gasoline and solvent tank, Hazardous waste injection well, Leakage from faulty casing, Discharge, Confined aquifer, Confined freshwater aquifer, Groundwater flow, Groundwater, and Unconfined freshwater aquifer.

MTBE

Methyl tertiary butyl ether

In 1996 Santa Monica closed down 7 of its 11 municipal wells due to MTBE contamination

The block contains two maps of Santa Monica, California, showing the locations of various wells. The top map is a general map, and the bottom map is a more detailed map showing well locations. To the right of the maps is a ball-and-stick model of the MTBE molecule, with labels for Carbon, Hydrogen, Oxygen, Tertiary carbon, and Ether bonds.

Point Source Pollution

- The textile industry discharges 53 billion gallons of waste effluent a year, this is loaded with reactive dyes and hazardous waste
- The paper and wood pulp industry produces more than 100 million metric tons of effluent
- The bleaching of wood pulp with chlorine is a major source of dioxin

Some Pathological Contaminants of Drinking Water

- **Bacteria**
 - Typhoid Fever
 - Cholera
 - Dysentery
- **Virus**
 - Hepatitis
- **Parasitic**
 - Amoebic Dysentery
 - *Cryptosporidium*

Coliform Bacteria are an indicator of water quality
*

Green Chemistry

A class of catalysts created by chemists to destroy pollutants

- A group of catalysts called TAML's mimic biological catalysts and work with hydrogen peroxide and other oxidants to break down a wide variety of stubborn pollutants.
- Most of the catalysts incorporate carbon, hydrogen, oxygen, nitrogen, and iron, all of these are chosen due to their low toxicity

“The Industrial Revolution has unfolded, for the most part, without design or forethought. Perhaps now we can take some creative steps to reverse that trend and help make a world, and a future, that we can live with.”

Terrance Collins; Chemist Carnegie Mellon University
Institute for Green Oxidation Chemistry
