

## WATER AND WATER POLLUTION



NATIONAL MATH + SCIENCE INITIATIVE

## Groundwater

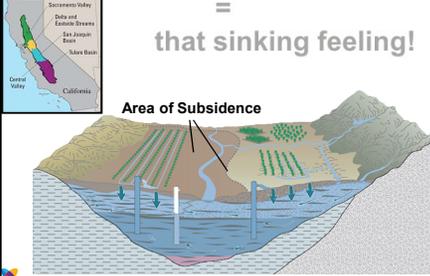
**Water found below the surface**

- As precipitation infiltrates and **percolates** through voids in soil and rock
  - Pores, fractures, crevices, etc.
- Zone of saturation** is at a depth where ground is filled with water
- Top of this zone is **water table**
  - Falls in dry weather
  - Rises in wet weather

NATIONAL MATH + SCIENCE INITIATIVE

## Aquifer Subsidence

= that sinking feeling!



NATIONAL MATH + SCIENCE INITIATIVE

## Properties of Water

- High specific heat allows for constant temperatures.
- Buoyant nature minimizes energy spent by organisms struggle with gravity.
- Aquatic organisms easily obtain dissolved nutrients.
- Mitigates world's climates by redistributing energy.



NATIONAL MATH + SCIENCE INITIATIVE

## Aquifers

- Porous, water-saturated layers of sand, gravel or bedrock through which groundwater flows
- Area of land that supplies water to aquifer is called the **recharge area**
- Natural recharge is when water percolates downward, but sometimes **lateral recharge** occurs

NATIONAL MATH + SCIENCE INITIATIVE

## Groundwater Depletion

Going, going, gone...

95% of water removed from Ogallala Aquifer is for irrigation and the removal rate is **six times** greater than the refreshing rate.

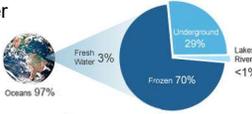


USGS

NATIONAL MATH + SCIENCE INITIATIVE

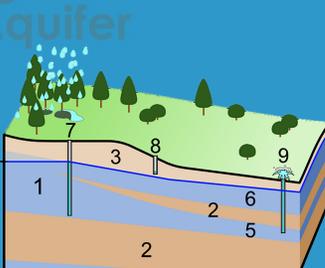
## Available Water

- 97% of Earth's water is saltwater or marine
- 2.3% of freshwater is locked up in ice caps and glaciers
- 0.7% is easily accessible
  - Groundwater
  - Streams
  - Lakes



NATIONAL MATH + SCIENCE INITIATIVE

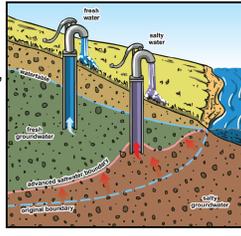
## Diagram of Aquifer



NATIONAL MATH + SCIENCE INITIATIVE

## Saltwater Intrusion

The movement of saltwater into freshwater aquifers, which can lead to contamination of drinking water sources.



NATIONAL MATH + SCIENCE INITIATIVE

**Question:**

1. All of the following are problems associated with the overuse of groundwater **except**

- Land subsidence
- Aquifer depletion
- Saltwater intrusion
- Gray water increase
- Declining water quality

### Streams and Lakes

Reservoirs and man-made lakes are created by dams. These dams not only provide a means for water storage, but can also be used to produce electricity through **hydroelectric** means. Hydroelectric energy production limits greenhouse gas emissions.



### Three Gorges Dam

- World's largest hydroelectric dam, Yangtze River
- 1.2 - 1.9 million people displaced



**Question:**

1. All of the following are problems associated with the overuse of groundwater **except**

- Land subsidence
- Aquifer depletion
- Saltwater intrusion
- Gray water increase**
- Declining water quality

### Streams and Lakes

Problems associated with dams:

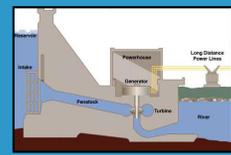
- dams can destroy habitat reducing biodiversity
- downstream reduced water quality
- blocked fish migration
- dams trap sediments
- increased water-borne illnesses in reservoir
- dams greatly disrupt the flow of rivers.



### James Bay

Problems project created:

- the release of organic mercury into the water of the reservoirs from decaying trees
- interference with fish populations
- disruption of animal populations
- severe alteration of a traditional way of life of the local native people



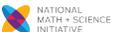
### Streams and Lakes

Lake facts:

- Largest surface area – Superior (US and Canada)
- Deepest and largest volume – Baikal (Russia)

River facts:

- Longest – Nile (many)
- Largest – Amazon (many)

### Dam Construction

1800

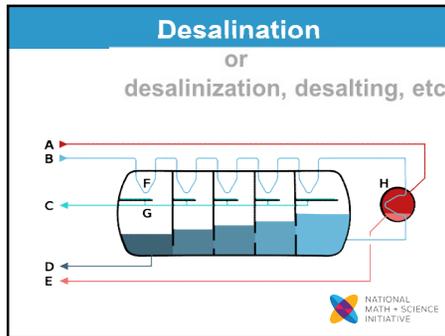


1800-2009

### + H<sub>2</sub>O

#### Increasing Water Supplies

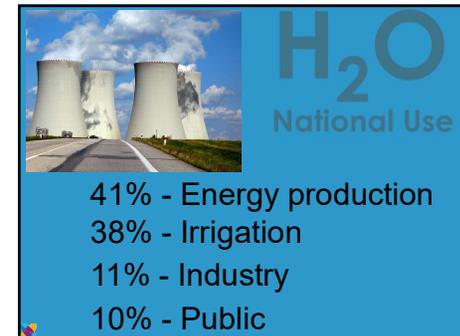
- Build dams and reservoirs to store runoff
- Bring in surface water from another area
- Withdraw groundwater
- Convert salt water to fresh water (desalination)
- Improve the efficiency of water use**



**Question:**

5. All of the following statements are true about desalination projects **except**

- Use distillation
- Low-energy use
- Use reverse osmosis
- Relied on heavily in the Middle East
- Production of large amounts of brine



**Question:**

Refer to the following water diversion projects

- Aral Sea
- Caspian Sea
- Three Gorges Dam
- James Bay Watershed

- Largest hydroelectric dam in the world. Spans the Yangtze River.
- Shrinking inland sea located in the former Soviet Union. Irrigation practices have led to its reduction of water.
- Site of several major hydroelectric projects found in Canada

**Question:**

5. All of the following statements are true about desalination projects **except**

- Use distillation
- Low-energy use**
- Use reverse osmosis
- Relied on heavily in the Middle East
- Production of large amounts of brine

**Question:**

6. Which of the following types of irrigation conserves the most water?

- Terracing
- Flooding
- Long lining
- Center-pivot
- Drip irrigation**

**Question:**

Refer to the following water diversion projects

- Aral Sea
- Caspian Sea
- Three Gorges Dam
- James Bay Watershed

- Largest hydroelectric dam in the world. Spans the Yangtze River.

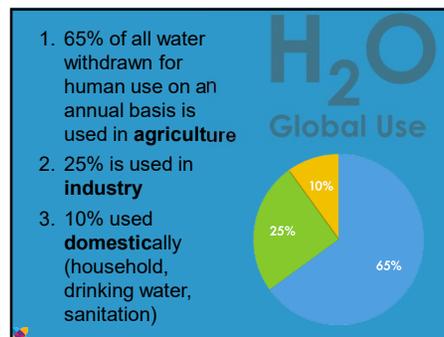
**Three Gorges Dam**

- Shrinking inland sea located in the former Soviet Union. Irrigation practices have led to its reduction of water.

**Aral Sea**

- Site of several major hydroelectric projects found in Canada

**James Bay Watershed**



**Question:**

6. Which of the following types of irrigation conserves the most water?

- Terracing
- Flooding
- Long lining
- Center-pivot
- Drip irrigation**

### Too Little Water...

Dry climate and poor conservation practices lead to:

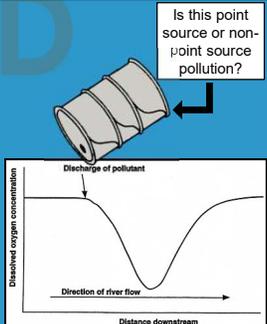
- 1. Drought** - a period in which precipitation is much lower and evaporation is much higher
- 2. Desiccation** - drying of soil because of such activities as deforestation and overgrazing
- 3. Water stress** - low per capita availability of water caused by overpopulation



### BOD

**Biological Oxygen Demand** is a measure of the oxygen used by microorganisms to decompose this waste.

Is this point source or non-point source pollution?



Discharge of pollutant

Dissolved oxygen concentration

Direction of river flow

Distance downstream

### Classes of Water Pollution

**Disease Causing Agents** (pathogens) bacteria, viruses, protozoa, and parasitic worms from domestic sewage from human and animal wastes

**Oxygen Demanding Wastes** organic wastes that can be decomposed by aerobic bacteria which depletes oxygen

**Question:** 7. Most water in the United States is used for

- Industry
- Irrigation
- Public use
- Aquaculture
- Energy production

Turn and TALK

### Water Quality Tests

**Macroinvertebrates** Organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate).

**Coliform Bacteria** WHO recommends 0 colonies for drinking. EPA recommends max of 200 colonies for swimming (100 mL-sample).

**Chemical Tests**

- pH
- Dissolved oxygen
- Nitrate
- Heavy metals

### Classes of Water Pollution

**Water-Soluble Inorganic Materials** water-soluble nitrates and phosphates, can cause excessive growth of producers that die and deplete the oxygen content

**Organic Chemicals** threatens human, animal and aquatic plant life, i.e., oil, gas, plastic, pesticides, detergents, ext.

**Question:** 7. Most water in the United States is used for

- Industry
- Irrigation
- Public use
- Aquaculture
- Energy production**

Turn and TALK

### Eutrophication

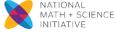
"enrichment of lakes and rivers"

**Cultural Eutrophication:** process of human activities accelerating the input of nutrients



Eutrophication

CLICK THE ARROW TO FIND OUT WHAT HAPPENS WHEN IT RAINS.



### Classes of Water Pollution

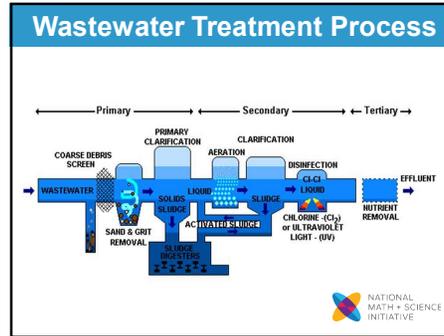
**Sediments or Suspended Matter** (largest class) Suspended solids that make water cloudy reducing photosynthesis which disrupts food webs and clogs water ways

**Thermal Pollution** rise in temp due to heat absorbed in water to cool power plants; increases disease

### Classes of Water Pollution

**Genetic Pollution**

deliberate or accidental addition of nonnative species; disrupts aquatic systems and crowd out natives; reduces biodiversity:

Turn TALK

8. Which of the following types of water pollution is often associated with electricity production?

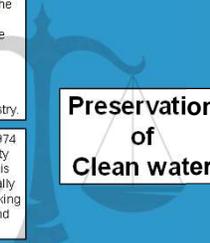
- Toxic waste
- Organic waste
- Genetic pollution
- Thermal pollution
- Sediment pollution

### Clean Water Policies

**Clean Water Act** established the basic structure for regulating discharges of pollutants into the waters of the United States; it gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.

**Safe Drinking Water Act** of 1974 established to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources.

Preservation of Clean water



Turn TALK

8. Which of the following types of water pollution is often associated with electricity production?

- Toxic waste
- Organic waste
- Genetic pollution
- d) Thermal pollution**
- Sediment pollution