

The Water Crisis

**A lack of clean water
results in poverty,
disease and death**

NanoSense
the basic sense behind nanoscience



Question

Have You Ever Gotten Sick from Drinking Impure Water? Do You Know Someone Who Has?



Clean Water is Necessary for Life

- **Drinking**
- **Bathing**
- **Agriculture**
- **Sanitation**



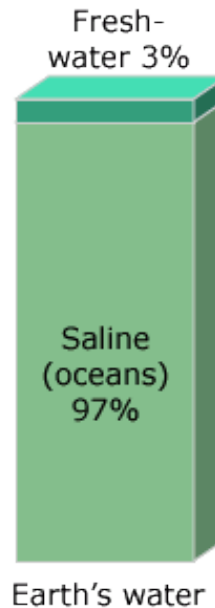
World Water Gap

- **Despite the apparent abundance of clean water in the US and most of the developed world, more than 20% of the Earth's population lacks clean, safe drinking water.**



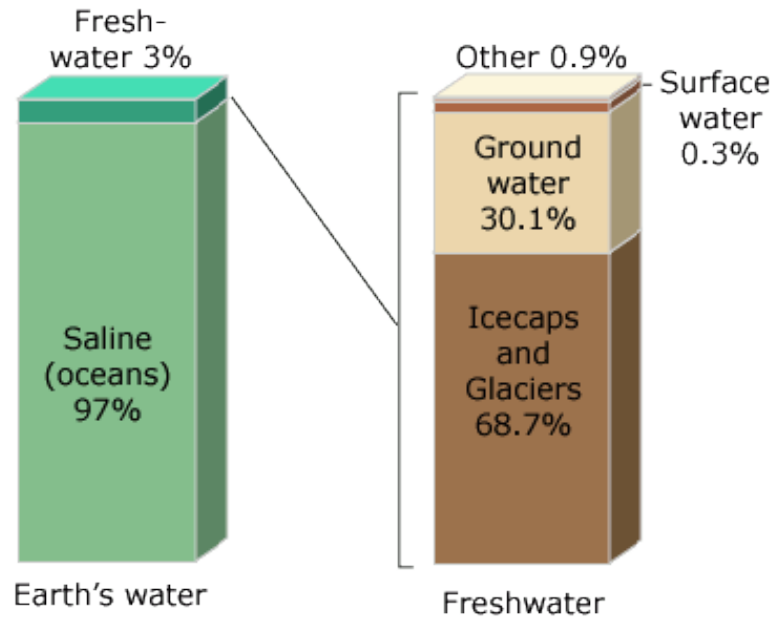
How is the World's Water Distributed? I

- **Less than 3% of Earth's water is fresh water**
- **The vast majority (97%) is undrinkable salt water in the oceans**



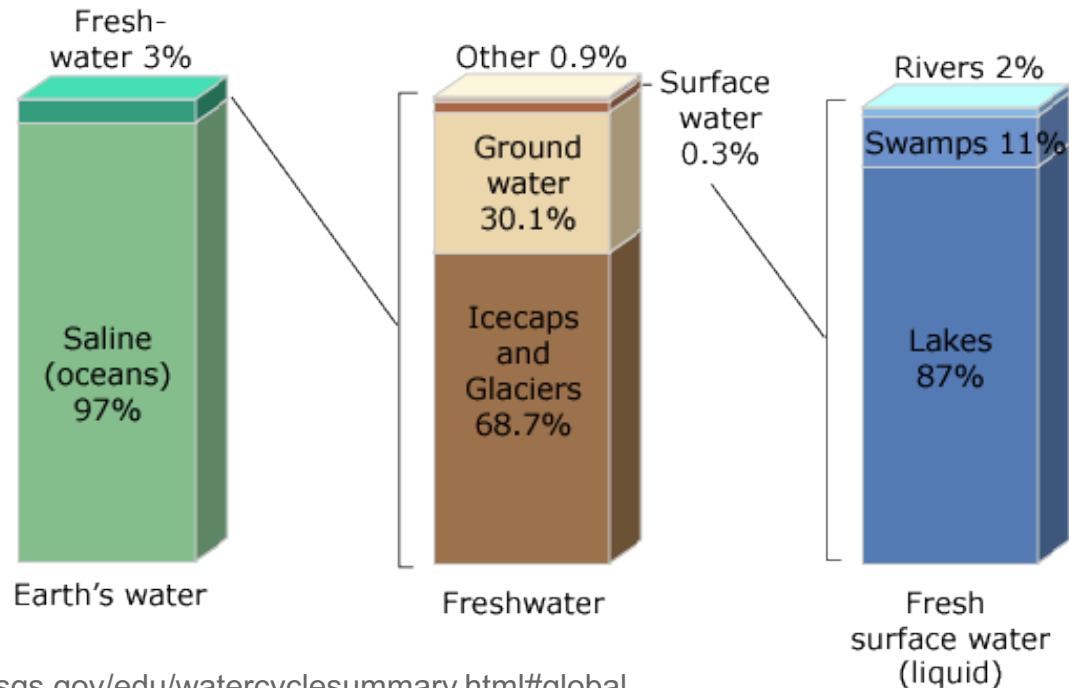
How is Water Distributed? II

- Of the fresh water, most is in ice caps and glaciers, and some is in ground water
- Less than 1% is in more easily accessible surface water (lakes, swamps, rivers, etc.)



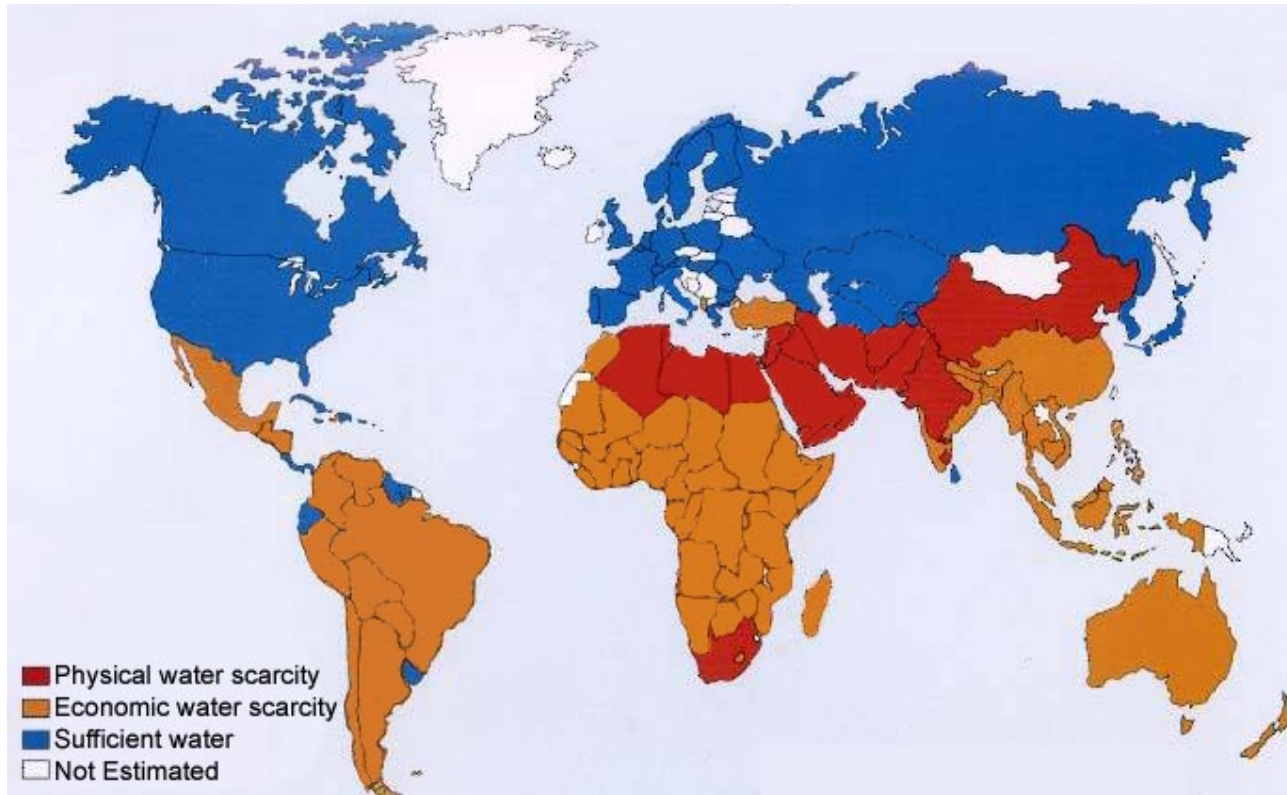
How is Water Distributed? III

- Most of the surface water is in lakes; a bit is in swamps and rivers
- The point: **very little** water is easily available for drinking



Water is Scarce in Some Regions

- 2.4 billion people live in highly water-stressed areas



Current Water Scarcity: 2006



No Single Cause for the Water Crisis

- **Many factors**
 - Climate and geography
 - Lack of water systems and infrastructure
 - Inadequate sanitation
 - 2.6 billion people (40% of the world's population) lack access to sanitation systems that separate sewage from drinking water
 - Inadequate sanitation and no access to clean water have been highly correlated with disease

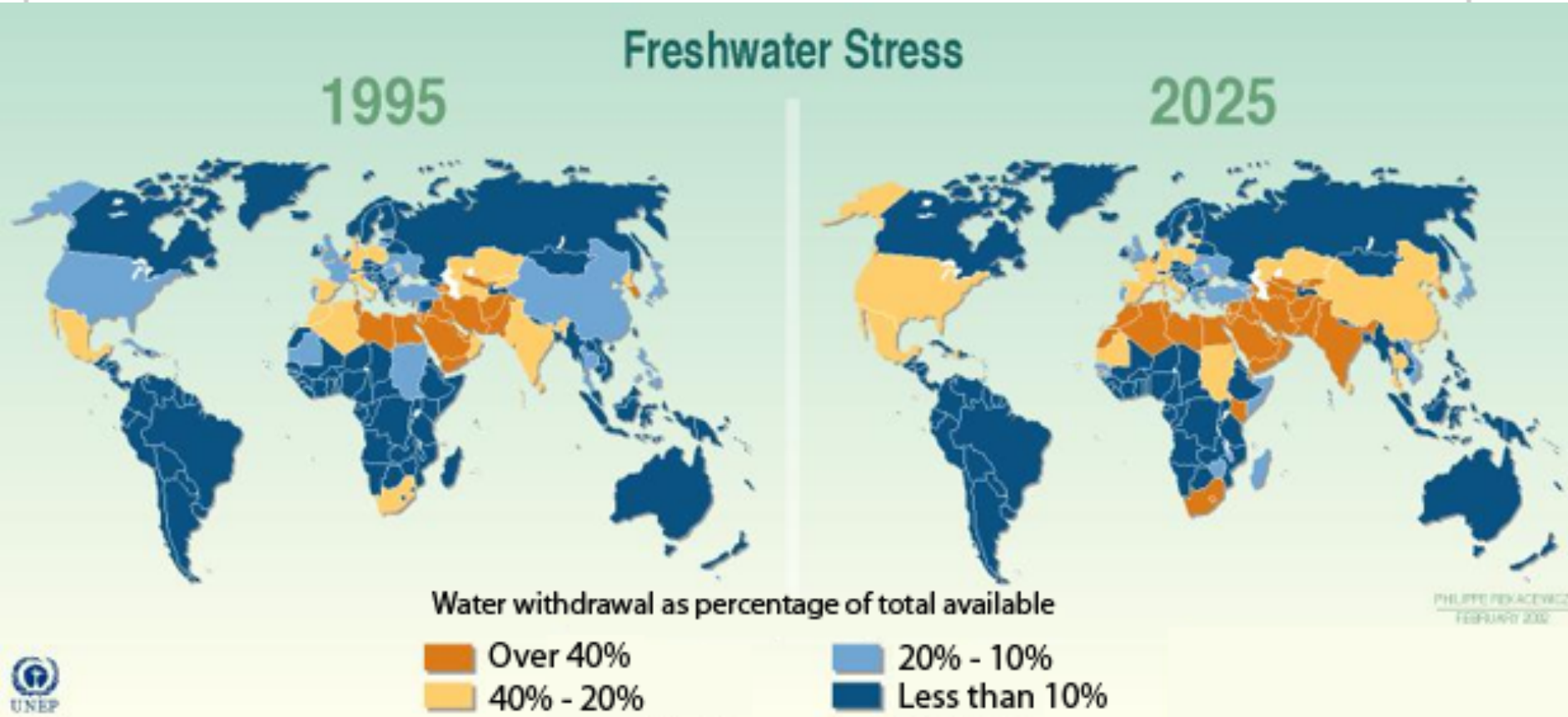


Pollution is a Big Problem Too

- **Types of pollution in fresh water:**
 - Sewage is the most common
 - Pesticides and fertilizers
 - Industrial waste dumping
 - High levels of arsenic and fluoride



Water Scarcity is Projected to Worsen



Source: World Meteorological Organisation (WMO), Geneva, 1996; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

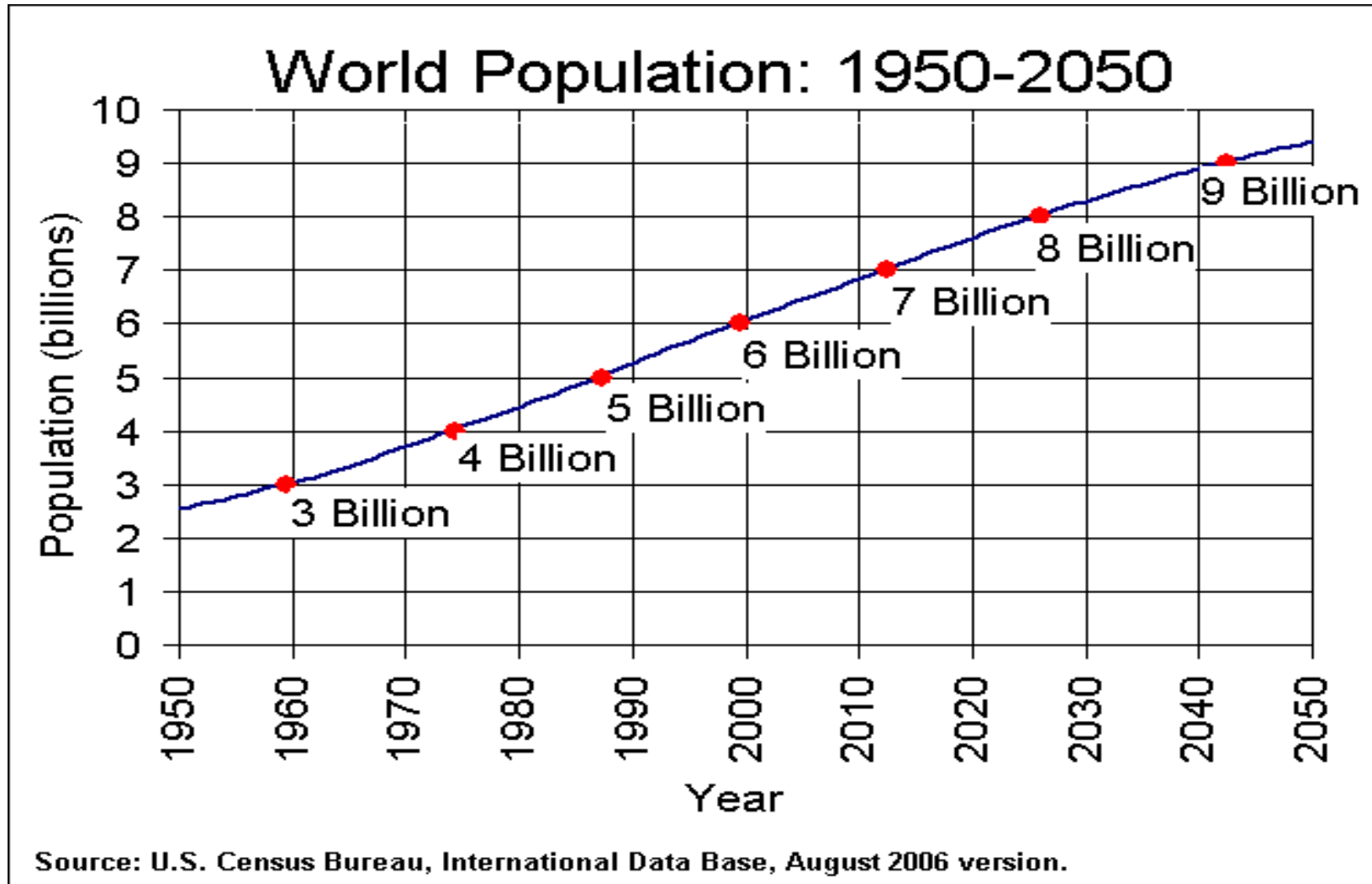


Question

**Why is the Water Shortage
Projected to Worsen?**



World Population is Increasing



Question

In What Ways Would an Increasing World Population Affect Water Consumption?



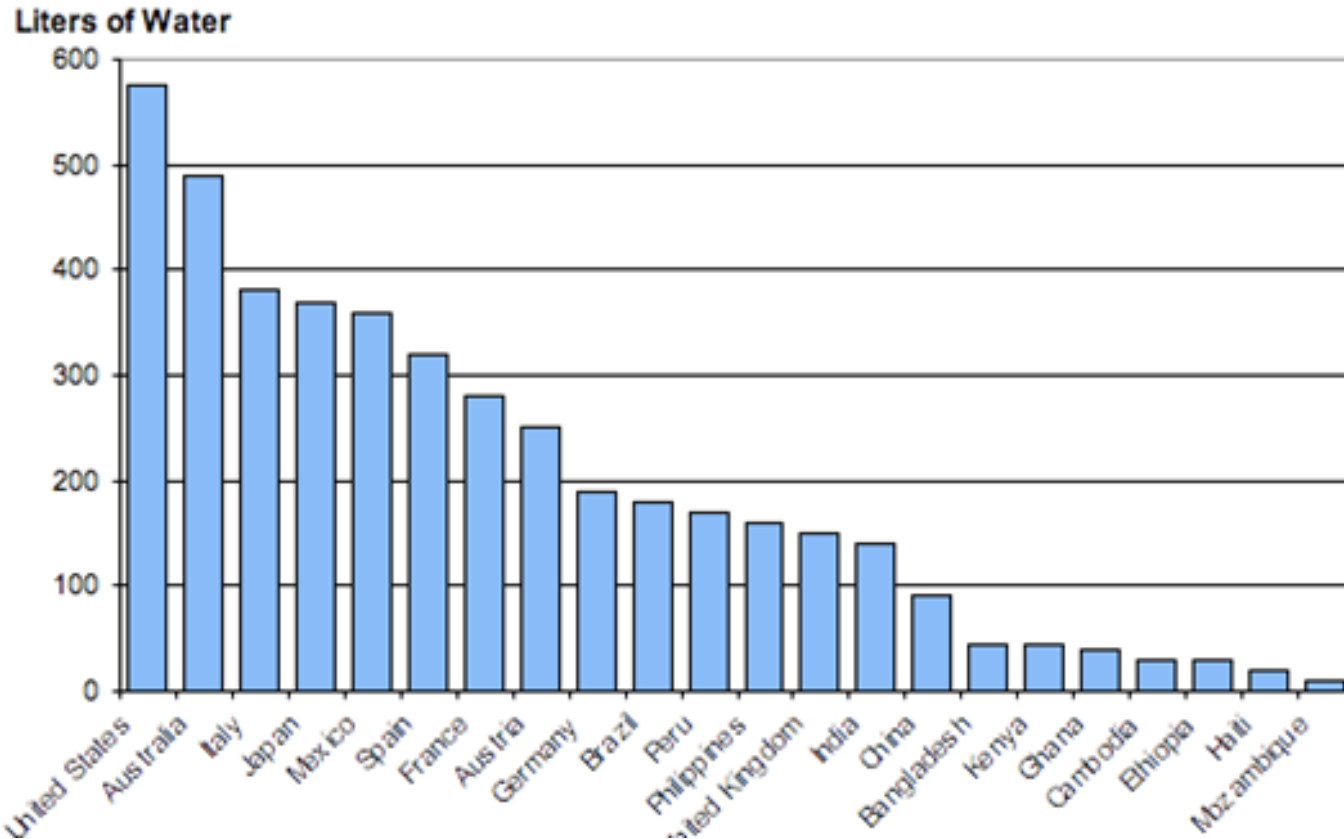
Question

Is There a Relationship Between Poverty and a Lack of Clean Drinkable Water?



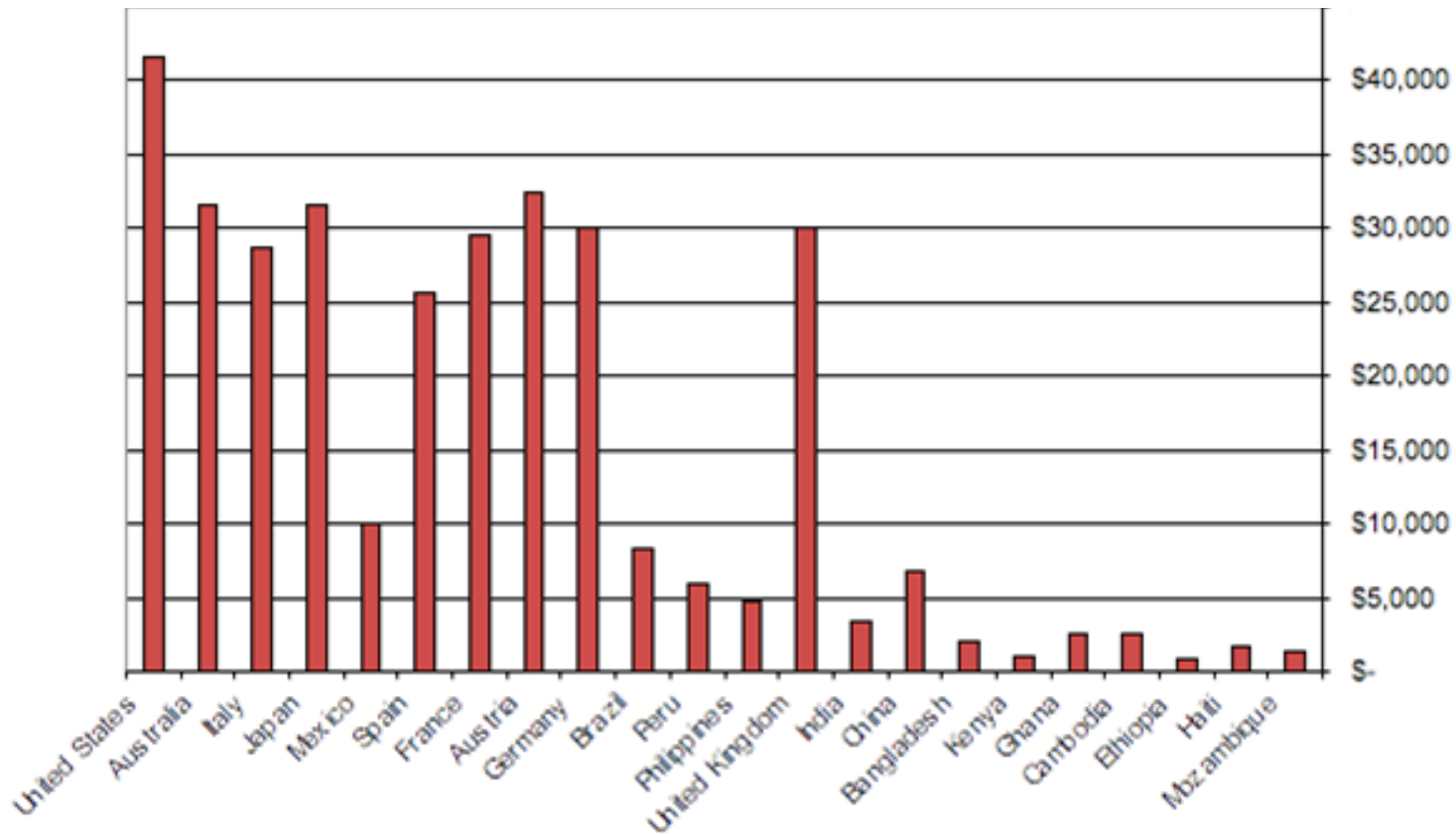
Countries Differ Widely in Water Usage

Average Daily Water Use Per Person (1998-2002)
For Selected Countries



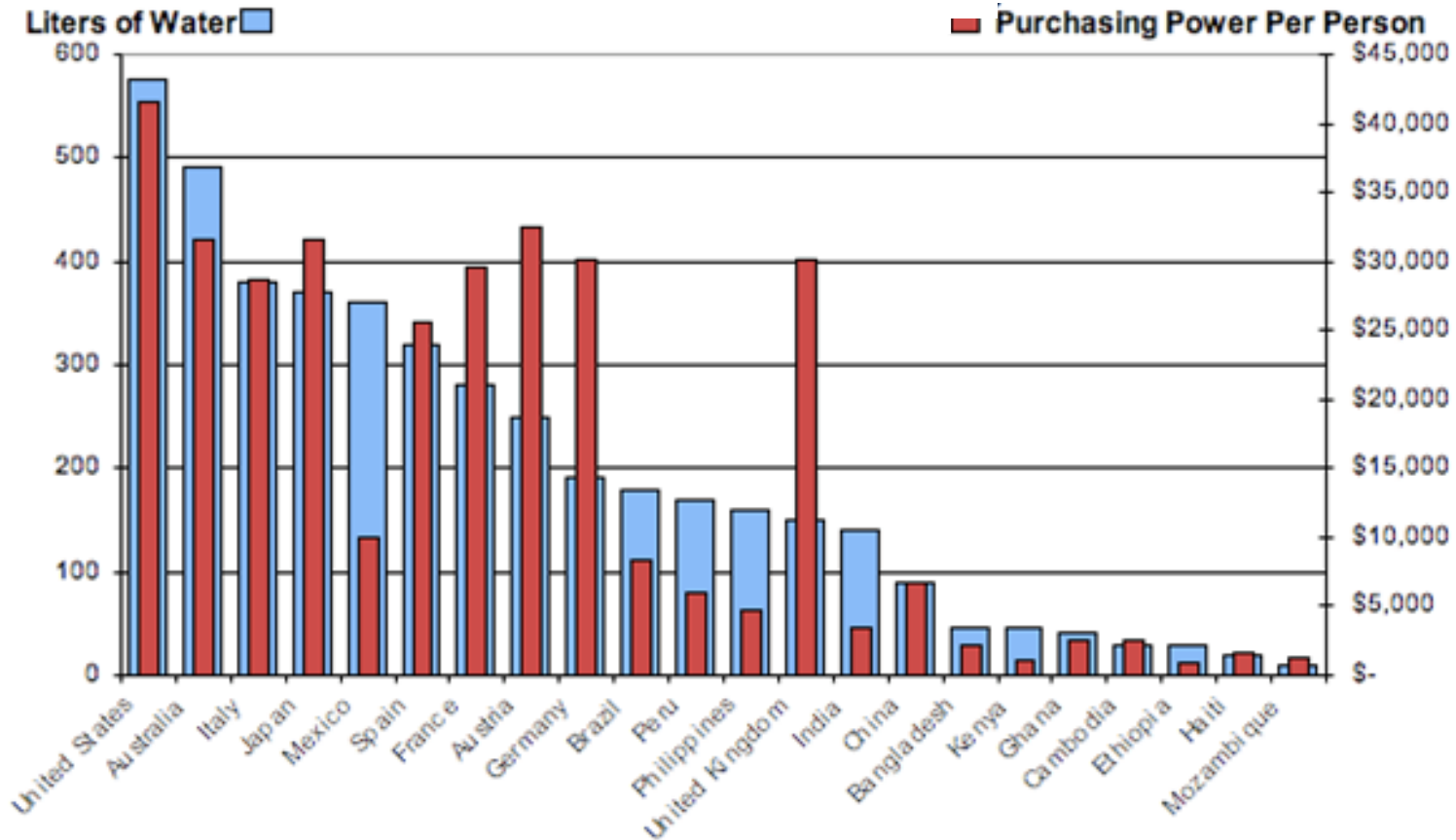
Countries Differ Widely in Wealth

Average Wealth (Purchasing Power Per Person in 2005) For Selected Countries



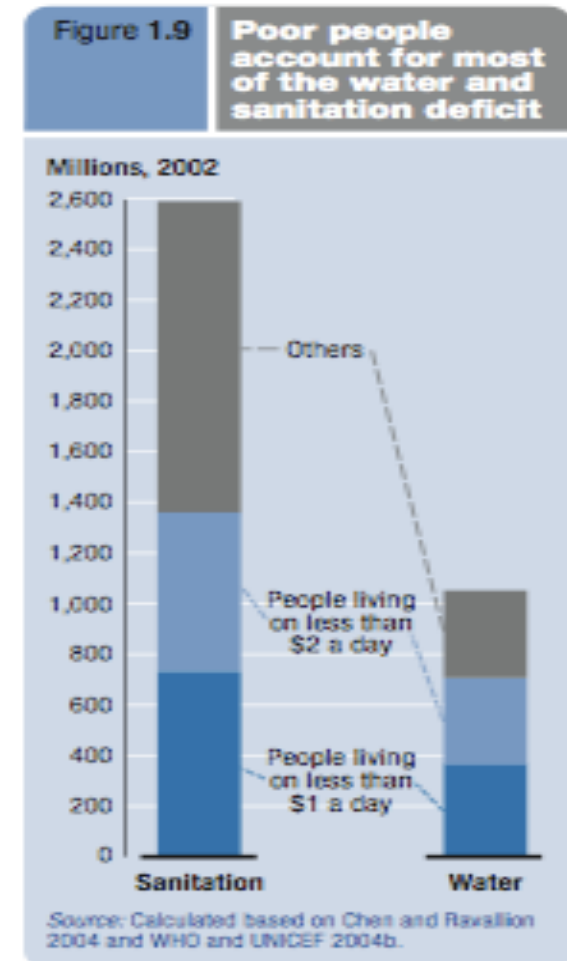
Notice Any Correlations?

Average Daily Water User Per Person
& Wealth For Selected Countries



Many Without Access Live in Poverty

- **People without clean water**
 - Almost two in three people survive on less than \$2 a day, with one in three living on less than \$1 a day
- **People without sanitation**
 - Of the 2.6 billion people who do not have adequate sanitation, a little more than half live on less than \$2 a day



Impact of Water Scarcity I

- **Health, education, and economic growth are impacted**
- **World Water Forum estimates:**
 - 1.4 billion people lack clean drinking water
 - 2.3 billion people lack adequate sanitation
 - 7 million people die yearly from diseases linked to water
 - Half the world's rivers and lakes are badly polluted
 - Shortages could create millions of refugees seeking homes in a location accessible to water



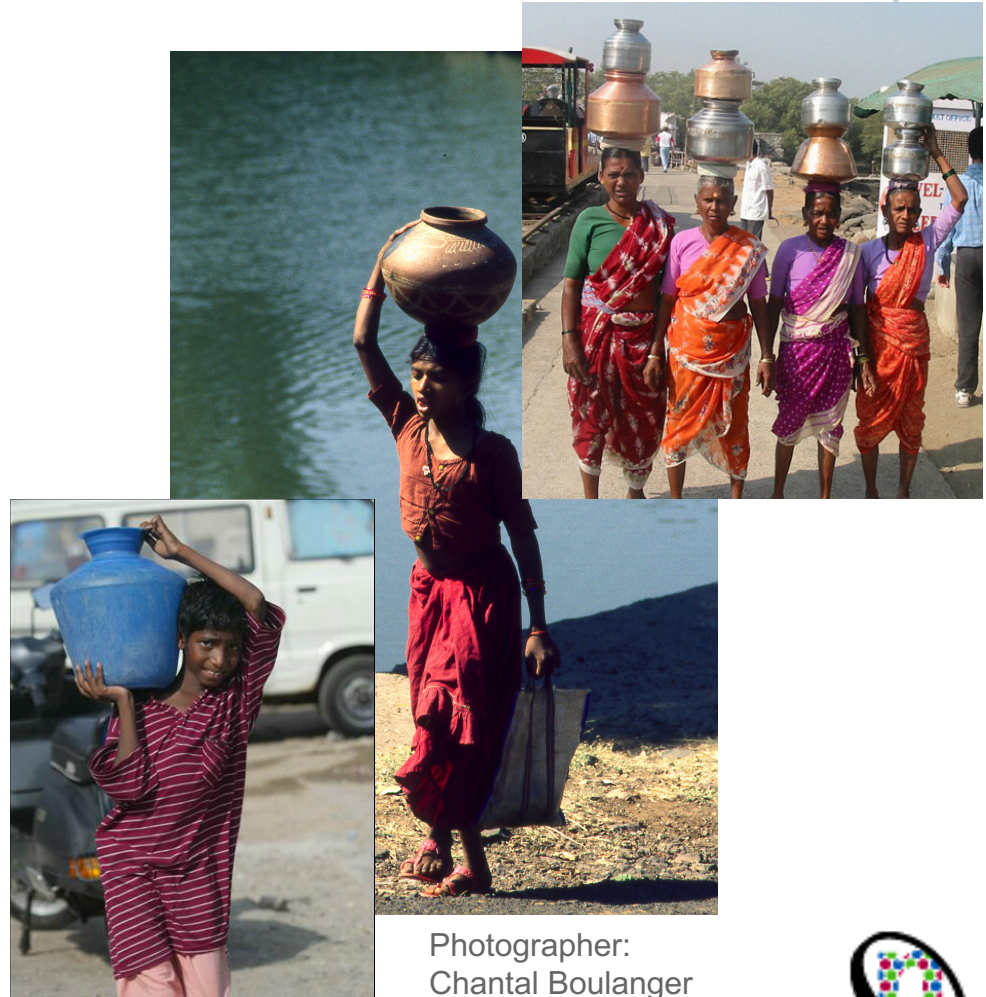
Impact of Water Scarcity II

- **World Health Organization estimates:**
 - 80% of all sickness in the world is attributable to unsafe water and sanitation
 - The leading causes of death in children under 5 are related to unclean water; there are about 5,000 child deaths every day
 - Without action, as many as 135 million people could die from water-related diseases by 2020



Impact of Water Scarcity III

- **Carrying water takes time!**
 - Women and children can trek miles every day to retrieve water
 - This hard manual labor takes time that they might otherwise spend pursuing education or earning additional income



Children Carrying Water



Sources:
<http://www.flourish.org>
<http://www.lcweb2.loc.gov>

http://www.unhcr.ca/earthwater/images/water_on_head.jpg
<http://www.lwr.org/news/00/images/ethwelfd.jpg>
<http://ag.arizona.edu/OALS/ALN/aln57/gifs/reed7b.jpg>



War for Diminishing Resources?

**“The next world war will be over water,” says
Vice President Ismail Serageldin from the
World Bank**



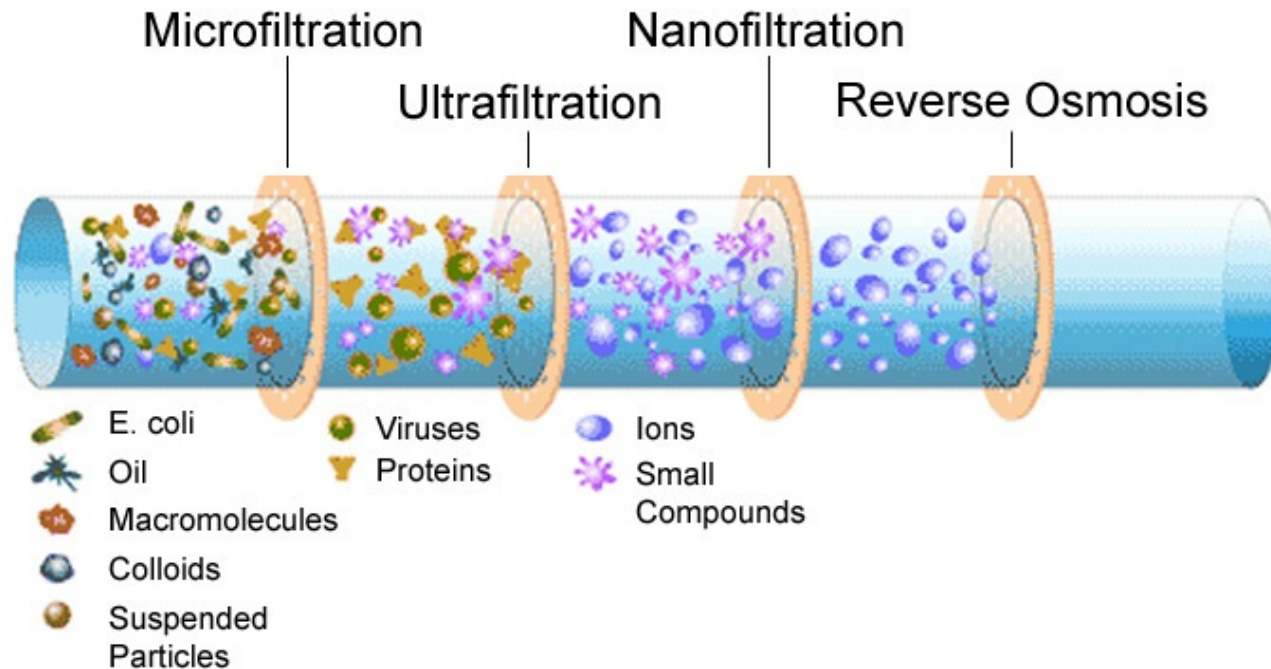
How Can We Address the Water Crisis?

- **Use less water**
 - More efficient irrigation, like drip irrigation
 - Low-flow shower and toilets
 - Use native plants for crops and landscaping
 - Eat less meat
- **Find new sources of clean water**
 - Um... Where? On the moon?
- **Treat the undrinkable water that we have**
 - Use reverse osmosis to desalinate salt (ocean) water
 - Clean polluted water using filters, chemicals, and UV light



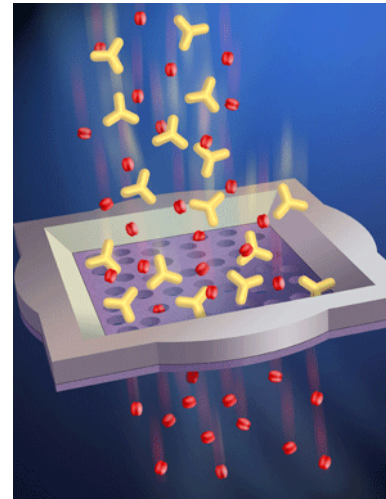
Using Filters to Clean Water

- Pebbles, sand, & charcoal filter out large particles
- Membranes filter out smaller particles
- It is efficient to use a series of membranes to filter increasingly smaller particles



Can Nanotechnology Help?

- **Nanotechnology offers new solutions to filter small particles**
 - Unique properties at the nanoscale mean that membranes can be made to filter by electrical and chemical properties
 - A huge effort to create better, cheaper nanomembrane filters is currently underway!



Membranes clean water by filtering out unwanted substances



Professor Eric Hoek at UCLA is patenting a new nanomembrane filter

