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THE AMERICAN FORUM FOR GLOBAL EDUCATION

A private, not-for-profit organization founded in 1970. Our mission is to educate United States citizens for responsible participation in our communities, our nation and our interdependent world. We offer consultation to global education programs and to those schools planning to “internationalize” or “globalize” their curriculum. We provide global and international education materials for classroom use and professional development programs for teachers and administrators. We are a forum for the exchange of ideas and practices on content and directions of global education.

Fresh Water: Enough for You and Me?

By FRED CZARRA

Occasional Papers from the American Forum for Global Education

It's easy to take water for granted if you live in the economically developed world. Open the tap or turn on the sprinkler and you have a seemingly unlimited supply of fresh, clean water, hot or cold, at any time of day, any time of year. But a shockingly high percentage of the world's people do not enjoy this privilege, and something must be done.

The series of readings and activities that follow are meant to increase student awareness of this most valuable of resources, which, like clean, fresh air, is something we all need for survival.

2003 The International Year of Freshwater

A MESSAGE FROM SECRETARY-GENERAL KOFI ANNAN

The International Year of Freshwater (2003), proclaimed by the United Nations General Assembly, comes at a crucial time. At the Millennium Summit in 2000, world leaders agreed to reduce by half, by the year 2015, the proportion of people who are unable to reach, or to afford, safe drinking water. And at the World Summit on Sustainable Development in Johannesburg earlier this year, a matching target was adopted—a commitment to halve the proportion of people without access to basic sanitation services, also by 2015. Grave consequences lie ahead if we fail to meet these goals: the persistence and spread of deadly diseases; further damage to the global environment, threats to food security and stability itself. And while water problems are most acute in the developing world, developed countries are also at risk.



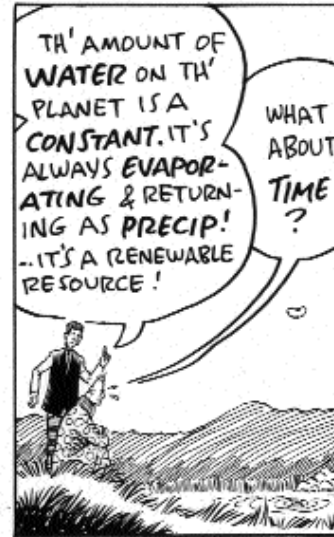
The world needs to improve its stewardship of water resources. We need much more efficient irrigation, far less toxic agriculture and industry, and new investments in water infrastructure and services. And we need to free women and girls from the daily burden of walking great distances in search of water—time and effort that could be better spent on education and building better lives for themselves, their families and their communities. The International Year of Freshwater should mobilize the world behind these goals by raising awareness, by generating new ideas and strategies, and by promoting participation, partnerships and peaceful dialogue. Let us pool our efforts; let us use the knowledge and technology at our disposal; and let us do our utmost to protect the world's precious freshwater resources—our lifeline for survival and sustainable development in the twenty-first century.

For info about the International Year of Freshwater, visit <<http://www.wateryear2003.org>>.

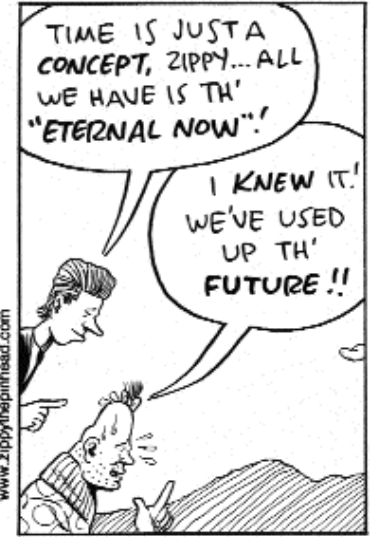
ZIPPY



"CLOCKING OUT"



BILL GRIFFITH



Fresh Water:

WHERE DO WE GET IT?

Fresh water comes to us from a variety of sources.

- Melting snow from high mountains flows down to feed rivers and lakes, including large freshwater lakes such as the Great Lakes in the United States and Canada.
- Aquifers—large natural underground reservoirs—can be tapped, if they are close enough to the surface, by drilling wells. One of the major aquifers in the United States is the Ogallala which runs from Wyoming and South Dakota south to Texas. This aquifer supplies water for farm, ranch and household use.
- Fresh water is also found in very deep aquifers far below the surface of the Earth. Present technology cannot bring this water to the surface.
- Groundwater is fresh water that is on or just below the surface of the ground. It may be a stream or a shallow well that brings water to a house.
- Rainwater is used in both primitive and developed cultures. Washington, DC, for example, has facilities for catching and storing rainwater to augment its water supply.
- Icebergs and glaciers are potential fresh water sources.
- Potable water can be produced by removing the salt (and other minerals) from seawater. The process, called desalinization, is expensive and inefficient.

WHAT CAN GO WRONG?

You probably don't consider water a problem. After all, you have water to drink, you take showers, and perhaps you water your lawn or have a swimming pool. Every now and then, particularly during the summer, there might be a drought caused by lack of rain. At these times there may be restrictions on such uses as washing cars or watering lawns. But in some areas of the world, there are severe, constant restrictions. What if you were limited to three glasses of water a day and a computer measured how many times you turned on the faucet and how much you used? What would you be willing to pay for a five-minute shower? Five dollars? Twenty dollars?

A number of international water companies are buying up fresh water supplies all over the world. They are investing their money in the hope that fresh water will be a profitable venture for them. This outside control of water supplies can have a devastating effect on the local population, even as it benefits certain individuals or industries.

Of the 6 billion people in the world, 2 billion face water shortages today. By 2025 that figure will increase to 5.5 billion.

- 1.2 billion people drink unclean water.
- 2.5 billion people lack proper toilets or sewage systems.
- More than 5 million people die each year from water-related diseases such as cholera and dysentery.

FOUR EXAMPLES OF WHAT CAN GO WRONG

Sharing waters is a major global problem. About 300 rivers are the focus of disputes, including the Nile, the Danube, the Colorado and the Rio Grande. Each of these rivers is subject to major disputes over water rights.

1. THE EUPHRATES: WHO CONTROLS THE WATER?

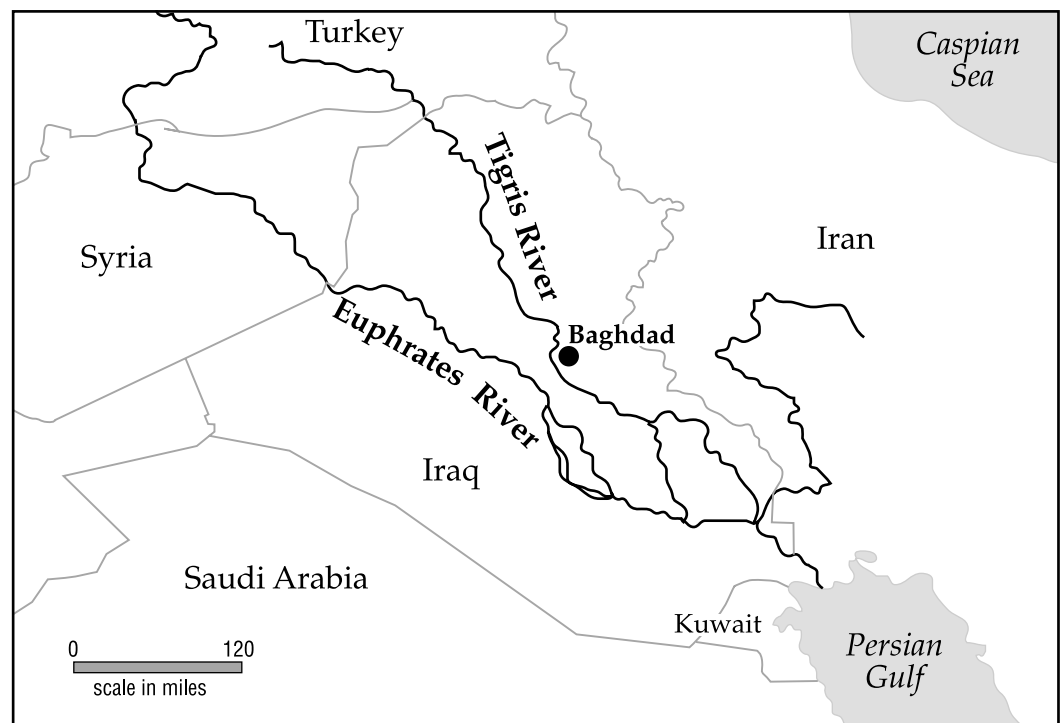
The plains of Mesopotamia, located between the Tigris and Euphrates rivers, extend from the mountains of Asia Minor in the north to the Persian Gulf in the South. This area was the seat of the early civilizations of Babylon and Assyria from 3000 BCE to 625 BCE. These ancient kingdoms thrived because they set up irrigation systems to support their agriculture. People gathered in this area, formed settlements, developed communities. Crops were abundant enough that food could be stored for the future. The people who were not involved in farming wove fabrics, made ceramics, and metal wares, and went on to develop writing, mathematics and architecture. Eventually cities rose up. This growth depended on a system of storing and moving fresh water using dams, canals and levees, all of which had to be constantly maintained.

Today, we know there are problems with maintaining water. Primarily, the soil that grew the crops can buildup salt. In dry climates when water evaporates from the upper layers of soil a layer of salt can develop at the roots of the plants and the plants will die. If this problem is not corrected, the whole basis of a civilization—food and water—disappear, and people starve or migrate elsewhere. Even in ancient times, there was competition between cities for fresh water.

There are also other issues. Turkey, Syria, and Iraq

are all affected by the southern flow of this river, the Euphrates. Turkey controls the high ground in the mountains to the north. Both the Tigris and Euphrates rivers originate in the mountains of eastern Turkey. Turkey is starting a new irrigation project in the south-eastern part of the country. Iraq and Syria are fearful that they will lose as much as one-third of the water they currently receive.

Syria and Iraq want each of the three nations to get equal amounts of the water. Turkey claims more than half for itself. The Turkish authorities point out that the water source is on their land, and that their population is half again as big as the populations of



The Euphrates and Tigris River Basin

Jill Freund Thomas, Cartographic Services Laboratory, Normal, Illinois

Syria and Iraq combined. A UN Convention, or international agreement, was completed in 1997, but Turkey, China, and Burundi refused to sign it. Nations that control rivers often do not want to give up control of water downstream.

2. CENTRAL ASIA: WHEN WATER GOES AWAY

In the 1960s the Soviet Union, which politically controlled many nations from Eastern Europe to Asia, decided to turn a large area of Central Asia into an irrigated cotton plantation. This area, the size of

WATER FACTS

- Oceans cover 71 percent of the Earth's surface.
- Oceans contain 96.5 percent of the Earth's water.
- Almost 70 percent of the world's fresh water is frozen in glaciers, permanent snow cover, ice, and permafrost.
- Thirty percent of all fresh water is underground, most of it very deep in the earth in hard to reach areas.
- The lakes and rivers of the world contain just a little more than .25 percent of all fresh water.
- At least 70 percent of the fresh water in the world is used for agriculture.

own water-management systems. The Soviet cotton-growing plan was a mistake, but at least there was a central government to attempt to control the water supply. Today, the solution to the lack of water in Central Asia may be depend on cooperation among these newly-independent nations.

Western Europe, encompassed the nations of Turkmenistan, Kazakhstan, Uzbekistan, Tajikistan and Kyrgyzstan. These nations, known as the “Stans,” were arid lands.

The experiment worked, and this area which extends from the Chinese border to the Caspian Sea, became one of the world's great cotton-growing regions. Today, the region's 58 million do not have enough water. What happened?

The experiment greatly limited the flow of the great rivers of Asia, the Amu and the Syr. In the same region, the Aral Sea, once the sixth largest inland ocean, is almost dry except for some lakes whose water have become saturated with salt. At one time more than 40,000 people worked in the Aral Sea's fishing industry, providing one sixth of the fish consumed in the Soviet Union.

In 2003, the demand for water from the rivers Amu and Syr exceeds their annual flow by 25 percent. Afghanistan, which made no claims to river water in the past, is now asking for water from the Amu. Population is growing in the region, which means more jobs are needed, as well as food to feed the new inhabitants. Where will the water come from?

To make matters worse, some parts of the irrigation system waste more water than they deliver. One canal loses about 60 percent of its water into the sand. Another problem is that rice, historically a staple food for the people of the “Stans,” requires paddies which use a tremendous amount of water. Cotton also requires a lot of water, and the successful but poorly conceived cotton growing of the early years of this experiment depleted the water supply and damaged the farmland.

The situation is complicated by the fact that each of the nations involved in this experiment gained independence from the Soviet Union and started its

3. CALIFORNIA: WHEN WATER IS CUT OFF

On New Year's morning 2003, three of the eight pumps that bring water 242 miles from the Colorado River to 17 million people in Southern California were shut off by the Federal Government. Why did this happen?

Two years before the shut-off the Department of the Interior had ordered that California could not have more than its share of water from the Colorado, in compliance with a plan worked out with six other states that get their water from the same source. Interior said that if California needed more water for residential use, it would have to come from the agricultural water allotment. This problem came about because of a nearly 20-percent population increase in the West in the 1990s. California grew by more than 4 million. Since most fresh water is used for farming, the farmers of the Colorado River basin control most of the water. The Interior Department wanted the farmers to sell some of their water to the cities along the California coast. The cities were willing to pay as much as \$250.00 per acre-foot as opposed to the \$15.00 that the farmers pay to get water for their crops. An acre-foot is the volume of water that would cover one acre to the depth of one foot. An agreement was not completed and the water was cut off on January 1.

How can there be enough water for everyone? Many suggestions have been made. Some call for drastic conservation measures for coastal California. Native, drought tolerant plants should replace thirsty lawns, shrubs and trees. Poor quality water can be recycled and made fresh for reuse. Also, seawater can be converted to fresh water—expensive, but possible. The farmers can reduce water use by rotating their crops, that is, leaving some fields idle for a year or two so that the soil can be replenished with nutrients before another crop is planted.



Jill Freund Thomas, Cartographic Services Laboratory, Normal, Illinois

Colorado River Basin

The states that use Colorado River water—Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming—have had to work together to control their water use since 1963 when the United States Supreme Court ruled that each state had to live

within its allotment. These Western states will have to continue to work together to conserve the water they have, even with high rates of population growth.

4. THE BLUE DANUBE: CLEAN OR POLLUTED?

After the Volga, the Danube River, 1776 miles long, is the second longest in Europe. It originates in Germany's Black Forest and flows east through Austria, Hungary, Slovakia, Yugoslavia, along the Ukraine, Romania and Bulgaria and into the Black Sea. Long a major avenue for commerce the Danube is a vital artery for eastern and western Europe.

In the mid 1980s, the Communist dictator of Romania, Nicolae Ceausescu, ordered the draining of marshland where the Danube forms a delta near the Black Sea, so that wheat and rice could be grown. Draining these wetlands drove off the birds and other wildlife and destroyed an area that once was mostly free of pollution. A delta wetland such as this acts as a "kidney" for a river by purifying water. When the wetlands are drained algae builds up and the cycle of pollution can begin.

Moreover, after the breakup of the Soviet Union, it appeared that the Danube and some of the smaller rivers that flow into it were becoming very polluted. A Romanian mineral waste plant was dumping toxic waste into the rivers. Fish were dying and people were getting sick and could not grow vegetables in the polluted earth.

More than a decade after Ceausescu's execution, the delta area and the wetlands are showing signs of recovery. But the restoration process has been slow.

ONGOING POLLUTION...

- Pollution of fresh water can come about in a number of ways. In China the Yellow River serves more than 400 million people. This river ran dry for 226 days in 1997. The river is severely polluted, and farmers are depleting aquifers.
- The Volga, in Russia, the longest river in Europe, supplies very little potable water. Over 40 million tons of toxic waste accumulates each year in the Volga basin, causing huge health problems.

A SUCCESS STORY

- In Turkey the Golden Horn, one of the great natural harbors of the world (it leads into the Bosphorus Strait), which divides Europe from Asia—was once a cesspool of industrial waste. The government shut down or destroyed over 600 factories that were dumping waste into this 4 1/2 - mile strait.

Fresh Water in History: Getting a Global Perspective

How do we know about fresh water and its uses in the past?

- Cultivation terraces have been found in Africa, Asia, Europe and South America that are over 3,000 years old.
- Darius the Great, King of Persia (present-day Iran), more than 2,400 years ago, exempted his subjects from taxes for many generations if they found sources of water.
- People who find water are called “water diviners” or “dowsers.” They have existed in all cultures and in all times. Today “dowsers” still look for water in the United States, South African desert areas, and other parts of the world.
- In modern-day Iraq, in the site of the world’s first great urban civilization, the Fertile Crescent of Mesopotamia, the earliest irrigation schemes were called qantas. A qanta is a horizontal well that draws water from streams at high altitudes and by gravity distributes the water in a fan-like pattern across land where crops are grown. If you fly over areas of Southwest Asia, in places like Iran, you can see the tracks of the longest qantas.
- In the ancient world the Romans were the greatest builders of aqueducts, artificial water channels that were the most effective water distribution system of that time. Most of the water was moved underground through tunnels made of stone, terra cotta, and materials such as brass, wood and lead. The Romans learned their techniques from the qantas builders of the Fertile Crescent. Most of the Roman Aqueducts were built in the fourth and fifth centuries CE. Many can still be seen today in Italy, Greece, Spain, Syria, and Morocco. This system was used for centuries and was only improved upon by Americans in the nineteenth century who designed pipes that could hold water pumped under pressure. These pipes were made of asphalt-treated wood and banded with iron.
- In the last century, it was ascertained that 47 percent of the Earth’s surface is made up of river basins shared by more than one country. In Africa the figure is more than 60 percent. The only international law that exists to regulate disputes between nations over water rights is the UN Convention on the Law of the Non-navigational Uses of International Watercourses, adopted in 1997 but not yet implemented.

How Do We Use Fresh Water?

AGRICULTURE — USES 69 PERCENT

Australia is, for the most part, a dry continent. In the eastern part of the nation is the Murray Darling River system, which supplies 75 percent of the water used in Australia. Seventy percent of Australia’s irrigated agriculture occurs within this system and it is also the main source of water for 16 cities. Farms, cities, and industry drain off 75–80 percent of the river’s annual flow, leaving little water for fish and other in-stream needs. The water used for irrigation

slowly poisons the land and kills plants with salt. Salinity has affected 20 of the world’s agricultural lands. Each year it forces farmers to abandon a million hectares (about 2.5 million acres). This is the most important environmental issue facing Australia. Something has to be done.

INDUSTRY — USES 21 PERCENT

One of the biggest man made projects in the world is the construction of the Three Gorges Dam on

the Yangtze River. China expects the dam to provide about 10 percent of the country's electricity, and to promote jobs for its people. But the dam has displaced people, drowned cities along the Yangtze, covered some of China's finest farmland, and generally destroyed a way of life for more than 2 million people. Will the dam provide a net gain, in the end, for the people of China, or has too much damage been done?

HOMES AND BUSINESSES — USES 10 PERCENT

What happens when there is a drought? People are asked to conserve water. This is considered a good thing. But what if you conserve too much water and

there is very little flow from showers, sinks and toilets into sewers, drains and the ground?

In the Maryland and Virginia area around Washington, DC, some of the water that leaves a home is treated at sewage treatment plants and then released into the ground to trees, plants, and then eventually flows into streams and rivers. There is another side to this story. If these streams and rivers did not have this water, trees and plants may die and rivers and wetlands will be drier. What would be the effect of this on the environment? People need water, but land and streams and rivers also need water. What is the answer for water during a drought? Should states regulate water flow or should local governments make decisions?

FACTS TO REMEMBER

- Of all the water on Earth, 97.5 percent is salt water and only 2.5 percent is fresh water.
- Of the fresh water on Earth, 68.7 percent is in glaciers, 30.1 percent is groundwater, 0.4 percent is permafrost, and 0.4 percent is surface and atmospheric water.
- Of the 0.4 percent of surface and atmospheric water, 67.4 percent comes from freshwater lakes, 12.2 percent is soil moisture, 9.5 percent is atmospheric, 8.5 percent is from wetlands, 1.6 percent from rivers, and 0.8 percent from biota.

Storing Fresh Water

ARE DAMS GOOD OR BAD NEWS?

WHERE ARE THE DAMS?

China has 45 percent of the world's dams; the United States has 14 percent; India, 9 percent; Japan, 6 percent; and the rest of the world, 26 percent.

HOW MANY DAMS ARE THERE IN THE WORLD?

One hundred years ago, around 1900, there were no dams in the world higher than 15 meters (about 50 feet). By 1950 there were 5,270 high dams, and two thirds of them were in China. Thirty years later there were 36,562, of which no fewer than 18,820 were in China. Today, there are few rivers left worth damming and ecologists are beginning to count the costs of having a dam.

WHAT IS THE VALUE OF A DAM?

People have been building dams for more than a thousand years. Dams certainly have their uses. First of all, a dam can produce hydro-electricity, a clean source of energy compared to burning coal or oil, which pollute the air. A dam can also prevent floods. Many of the world's rivers, such as the Colorado and the Yangtze, can, during rainy seasons, overflow their banks and flood cities, towns, and farmland causing a great deal of destruction. Also, a dam can help make navigation of wild rivers easier enabling movement of people and products from place to place along a river. Dams also provide for controlled water storage, allowing the operators to hold or release water according to availability and need.

WHO OPPOSES DAMS?

In the last twenty years there has been a growing opposition by people and organizations around the world to the building of dams. Groups such as the Union for the Conservation of Nature (IUCN), usually known as the World Conservation Union, feels that dams are almost always bad. Other groups, such as the International Rivers Network, have attacked organizations such as the World Bank, which has funded a number of dams in nations around the world.

*Floods are acts of God.
Flood losses are largely acts of men.*

Gilbert F. White, Human Adjustments to Floods, 1945

WHY DO PEOPLE OPPOSE DAMS?

The Aswan High Dam in Egypt provides an example of all of the bad things a dam can do. It does prevent the Nile River from flooding. But most of its dangers are hidden from view. It has done far more damage than good. At this point the dam cannot be demolished, but Egypt faces dramatic problem as long as the dam stands.

When the Aswan High Dam was built, a reservoir, called Lake Nasser, formed behind it. Formerly, silt—rich soil deposited along the riverbanks—flowed downstream in the Nile. Periodic floods could be dangerous, but they left behind enriched farmland. Now, the silt is trapped behind the dam, and farmers are forced to use chemical fertilizers and pesticides to enrich and protect the soil. These chemicals pollute the river and kill marine life. Yes, the dam prevents the floods that used to occur, but it has seriously damaged agriculture and fishing.

Around the world dams cause problems. An overabundant amount of silt destroys deltas in our rivers such as the Mississippi. Dams also alter the flow and sometimes the temperature of a river. Rivers run much faster below dams, thus causing more damage in periods of heavy rain.

WATER FOR PROFIT: A NATURAL RIGHT?

Do you buy bottled water for lunch or when exercising? If so, you are one of a growing number of Americans who pay for the fresh water they drink. Why don't you fill a bottle of water from your tap at home and take it with you? Does your tap water smell or taste unpleasant? People in the United States, for the most part, have fresh water to drink and wash with. Why is there an increase in sales of bottled water?

In most of the world fresh water is not easy to come by. Look at the figures scattered throughout this publication, and you see that there is not a lot to go around. Global companies have recognized that there is a market for water sales.

It is not just drinking water that is being sold. It is water for agricultural and household use as well. There are three major water companies in the world. Two, Suez and Vivendi, are French, and one, Thames Water, is British. These three serve almost 300 million people worldwide and take in more than 50 billion dollars a year in water revenues. When you add other smaller companies the dollar figure rises to about 200 billion serving about 7 percent of the world's population.

Much of the business of the large global companies is in the developing world in Latin America, Asia and Africa as well as in Europe. The companies manage the water systems of cities and other areas around the globe. These companies were brought in because the local governments could not manage their water systems very well. The basic idea is that the water company makes improvements in the local water system and then charges the people who are part of that system for the water they use.

In Argentina, the people of Tucuman Province have been complaining about their water company. They say the company is raising the price of the water they are now forced to buy, and the company has not made the necessary repairs to the water system. Elsewhere in Latin America, in Bolivia, Ecuador and Panama, as well as in South Africa, water and its price are hot issues.

Some say that water belongs to the people and everyone has a right to use it because it is natural and free. Other contend that fresh water is an increasingly valuable commodity and must be regulated before all of it is gone. If farmers and factories take all they want, there will be little left for household use. Since much of the world does not have access to fresh water, controlling its use seems to make sense. Many poorer countries do not have the money to develop a good, efficient water system for their citizens. One resident of Tucuman Province was quoted as saying the “Water is a gift from God”; a representative of one of the

largest global water companies replied, “Yes, but he forgot to lay the pipes.” Experts predict that by 2015 private water companies will serve about 17 percent of the world’s population.

*“You never miss the water
‘til the well runs dry.”*

Traditional blues song

Protecting Fresh Water: What we can do

START AT HOME

- A water saving showerhead which costs only about \$12.00 can save many gallons of water. Some showerheads have a lever that lets you stop the flow of water briefly while you soap up.
- Turning the water on and off as needed rather than letting it run constantly as you brush your teeth or wash dishes, saves a lot of water.
- Homeowners may be able to catch rainwater and store it in quantities sufficient for some household and outdoor uses. Installation of the necessary tanks and pumps is not prohibitively expensive.
- On a smaller scale, buckets set out to catch rainwater can provide water for garden or household plants.
- Leaky faucets should be fixed. Even a small leak adds up a lot of water in the course of days and weeks.
- Washing a car with a bucket and sponge rather than a hose, saves a tremendous amount of water
- Water lawns and plants early in the morning or in the evening when less water will be lost to evaporation.

MOVE ON TO THE COMMUNITY

- Write to Members of Congress and Senators urging them to work on cleaning up polluted rivers, enacting legislation to conserve water, and promoting research into desalinization of sea water for human, agricultural and industrial use.
- Urge science and social studies teachers to study water as a topic, and to ask students to investigate the fresh water situation in the community.
- Write a letter to the editor of the local newspaper.
- Ask the local library to do a display on water.
- Urge the local Rotary Club or other service groups to hold a public discussion on local water issues.
- Meet with friends and neighbors to discuss the local water supply what individuals can do to make sure water is a primary topic of concern in the community.

Questions and Activities for Learning

FRESH WATER

1. Try this exercise to show how much fresh water exists on Earth.

Fill a 5-gallon bucket, a small coffee cup and a teaspoon with water. Put them side by side. The bucket represents all of the water in the world. The coffee cup shows all of the fresh water in the world and the teaspoon represents the only fresh water we can reach and use.

2. Look at the two highlighted areas: “Of the 6 billion people in the world” (page 2) and “Water Facts” (page 4).

Develop two pie charts to show:

- (1) how many people have fresh water, and
- (2) how the Earth is divided into salt and fresh water, and how much of it is freshwater that we can access and use. See how many variations of pie charts can be made to illustrate “fresh water problems.” How will the circle be measured to determine percentages of the whole?

3. Look in the community, county, town or city and determine any problems that might be facing the fresh water supply. Consider:

- If located in a farming area – the salinity level of the fresh water, or salt in the soil. What can be done?
- If there are wetlands nearby – are they protected from pollution? How can you find out?
- What is the condition of streams, lakes and rivers in the area? Who can be contacted locally, at the state level, or nationally to find out?

If a problem is identified – record in writing the problem and a description of its context; record specific criteria used to evaluate to the problem; identify and evaluate alternative solutions to the problem.

4. Consider the statement: “People in the United States should pay their local governments for fresh water use.” Make a case for or against this idea:

- State clearly the position to be argued.
- Gather and organize relevant information in support of the position.
- Demonstrate logic in support of the position.

FRESHWATER IN HISTORY

1. Many nations in the world have historically shared the same rivers. Here are a few examples: In North Africa, Egypt and eight other nations share the Nile. In the Middle East, many Arab nations share the Jordan River with Israel. In South Asia, India, Bangladesh, and Pakistan share 140 rivers. In Europe the Rhine runs through France, Switzerland, Germany and the Netherlands.

- What does the UN International Convention of 1997 say about water rights?
- Why did Turkey and China refuse to sign the agreement?

Research one particular river on the Internet and try to determine how that river has been used and/or

abused by one or more of the nations that uses it.

Determine the following:

- Have the nations cooperated in using the river? If so, how?
- Is the river polluted? If so, who contributes to the pollution and what is being done about it?
- If there are disputes over the use of the river, what is the nature of the disputes? Is it possible to resolve them?

2. The following events were significant in the global history of water.

- 7000 BCE: Irrigation is practiced in the Nile Valley.
- 400 BCE: China’s Grand Canal is functioning with 1,700 miles of waterways.

- 100 BCE to 400 CE: Aqueducts carry water for drinking, bathing and sanitation through the Roman Empire.
- 1400 CE: The introduction of force pumps (water wheels) changes the way water is transported.
- 1774 CE: Chlorine is discovered as a water purifier in Sweden

“In the world there is nothing more submissive and weak than water. Yet for attacking that which is hard and strong nothing can surpass it.”

Lao-tzu (Sixth Century BCE)

Research one of these topics, exploring its significance in world history.

- State the topic clearly or pose a question that gives direction in researching the topic.
- Look for appropriate resources of information offered by a reliable source. Where did they get their information?
- Organize and then analyze the gathered information.
- Are findings consistent with the analysis of information?
- Cite the sources used.

FRESH WATER AND INDUSTRY

1. Global warming makes the oceans warmer. What global effect will this have on the amount of water that is available in the form of rain? What role does the “greenhouse effect” play in this process?
2. Manufacturing processes can require a lot of water: For example a Hershey Bar may take a quart of water to produce; a bicycle, 34 gallons, and a tire for a car, 50,000 gallons. Find out about other products you use and how much water is required to make them.
3. Pollution of lakes and rivers is a major problem around the world. The acid in polluted waste kills the life of river systems. In Canada, 14,000 lakes are dead because of acid waste. In Sweden the figure is 16,000. Acid rain can fall into water or can drift up to mountains and come back down in acid rain or snow. It can burn holes in clothes.
4. Find out whether factories in your area are releasing industrial waste into the air or water. How are they treating acid pollution? Is it in the air or does it flow into bodies of water? If a factory is treating their pollutants, how is it done and how effective is the treatment?

STORING FRESH WATER

DAMS

As an interpretation activity for use in a classroom, divide the class into two groups, one in favor of building a dam and the other opposing dam construction. Ask each group to research their side of the argument by finding information about an existing dam. Once each group is done set up study groups on each of the dams.

Positive arguments for building a dam will challenge Stegner’s quote (right) about “greatest good” and whether several “goods” are enough to

validate construction of a dam. Have the students explore the positive and negative impacts of building a dam. They should decide whether the dam should be built.

“The difficult problem is to determine what is the greatest good, and whether the several goods are compatible or whether one will destroy others.”

Wallace Stegner, The Myth of the Western Dam, 1965

WATER: A STRATEGIC RESOURCE

Our need for oil and the effect that need had on gas prices became an issue for residents of the United States in late 2002 and the beginning of 2003. The issue was brought to a head by a political crisis in Venezuela, the world's fifth largest oil producer, which resulted in a strike of oil workers. Canada supplies us with most of our crude oil and other petroleum products followed by Saudi Arabia, Mexico, Venezuela and Nigeria. Now, water has become a strategic commodity, apportioned largely between state and private ownership.

Examine the web sites of the major global water companies Suez, Thames, and Vivendi and determine the types of water services they offer. Find out where some of these services are offered in the United States. Are any in your area? Determine who pays for these services. If citizens are directly charged for these services, how much do they pay? Based on what you find, determine one or more issues you think citizens of the United States will face in the twenty-first century regarding water. Select one issue and then do the following.

- State the issue and its significance.
- Describe the significant components of the issue and the interrelationships among those components.
- State clearly the different perspectives on the issue.
- Develop conclusions that are logical and consistent with your analysis.

“Water will be for the twenty-first century what oil was for the twentieth.”

Fortune Magazine

PROTECTING FRESH WATER

1. Here are some facts about water and its use in the home. The numbers will vary from home to home. Add up how much your household might use in a given day. Compare your numbers with those of your classmates. Keep in mind that many people in the world have only about 1.5 gallons of water to meet all of their daily needs. This is a good example of acting locally, but thinking globally!

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| • Taking a bath: 32 gallons | • Washing dishes with a dishwasher: 14.5 gallons |
| • Taking a 10-minute shower: 35 gallons | • Washing clothes in a front-loader: 26 gallons |
| • Brushing teeth with the water running: 1.5 gallons | • Washing clothes in a top-loader: 41 gallons |
| • Brushing teeth with the water off: .25 gallon | • Washing the car with a hose: 79 gallons |
| • Flushing the toilet: 3.5 gallons | • Washing the car with a bucket: 40 to 50 gallons |
| • Washing dishes by hand: 5 gallons | • Filling a swimming pool: 5,000 to 15,000 gallons |

Vocabulary

Aqueduct	Desalinization	Irrigation system	Qantas
Aquifer	Diviners	Levees	Reservoir
Atmospheric water	Dowsers	Marshland	Salinity
Biota	Drought	Nutrients	Silt
Canals	Fresh water	Paddies	Surface water
Dams	Glaciers	Permafrost	Terraces
Delta	Groundwater	Potable	Wetlands

2. The water that flows down household drains is called sewage. In the past, in the United States and other areas of the world, this sewage was dumped into rivers or oceans or simply ran into the street. Today most of the sewage is treated, which means it is cleaned so it can be returned to the water cycle. Find out how your community or city treats sewage. Determine if the water is re-used and if so, how.

3. “Storm water” is the water that remains on the ground after it rains. In non-urban areas, most of the water goes into the ground. But in urban areas, where much of the ground is paved, the only place the water can go is into drains. From these drains it may go directly into a waterway. As the rainwater goes into the drains it picks up pollution. Unlike sewage, which may be treated, storm water continues to carry detergents, animal droppings, soil, leaves and trash dumped in gutters as well as paint or oil that may have been dumped in a drain. Find out what happens to the “storm water” in your community.

4. Cholera, spread by unclean drinking water, is a major killer of people worldwide. The disease causes severe diarrhea which leads to massive loss of fluid from the body and can cause death in a few hours. In the United States and Europe over 100 years ago cholera was a serious problem in the cities. Today, the population of cities around the world in Latin America, Asia and Africa are growing at tremendous rates. Not all of these cities can provide clean water for drinking so many people drink unsafe water and develop cholera or other diseases from bugs that get into their bodies through the water.

Research cholera and examine it as a global problem in cities around the world. Why are cities growing at an alarming rate? What can be done about cholera, and how does this global disease affect us? Typhoid is another disease common in areas without good sanitation. Research and examine it as well.

Malaria is a mosquito-borne disease that affects 300 to 500 million people. West Nile Virus is another mosquito-borne illness. Are we in danger of any

one of these diseases? If so, how can we work to prevent them from occurring?

5. Leaky pipes in homes and businesses cause a lot of water to be lost. In the United Kingdom, a quarter of the water is lost in this way. In parts of Central Asia, over half the water is lost through leaky pipes. Check your home for leaky pipes or faucets and then ask members of your class or close friends to do the same. Do a survey in the school or community to determine how many homes have leaky pipes. Create a chart showing the number of homes surveyed and the number that have leaks. If there is a significant number (up to you and/or your class) state it as a problem in the community and attempt to engage the school and/or community in solving the problem. To bring this problem before students and citizens in the community, do the following.

- State the problem and a description of its context.
- Identify specific criteria to be considered in evaluating solutions to the problem.
- Identify and evaluate possible solutions to the problem.
- Find a reasonable solution consistent with the criteria.

6. Students in other areas of the world are working on water problems. To see what they are doing, visit ASPnet (Associated Schools Project Network) on the UNESCO website <<http://www.unesco.org/education/asp>>. For more information about ASPnet and its networks in the United States contact Susie Rauch, <IC21@compuserve.com> or explore their website <<http://www://IC21.org>>.

Resources

SELECTED BOOKS

- Ball, Philip. *H2O: A Biography of Water*. New York: Farrar, Straus and Giroux, 2000.
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- De Villiers, Mark. *Water*. New York: Houghton Mifflin Company, 2000.
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- Postel, Sandra. *Pillar of Sand: Can the Irrigation Miracle Last?* New York: W.W. Norton, 1999.
- Reisner, Marc. *Cadillac Desert: The American West and Its Disappearing Water*. New York: Penguin Books, 1986.
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- Ward, Diane Raines. *Water Wars: Drought, Flood, Folly and the Politics of Thirst*. New York: Riverhead Books, 2002.

PERIODICALS

“Water Pressure,” *National Geographic*, September, 2002. pp. 2–51.

ARTICLES

“Running Dry,” Jacques Leslie. *Harper’s Magazine*, July, 2000. pp. 37–52.

“Water: Pushing the Limits of an Irreplaceable Resource.” *New York Times*, December 8, 1998. ppE1 ff.

“Running on Empty,” Philip Ball. *Financial Times Weekend*, October 2 and October 3, 1999. p. 1.

“Running Dry,” A Series of Four Articles appearing in the *New York Times* from August 25 through August 28, 2002.

TELEVISION/ VIDEOS

“Cadillac Desert,” PBS Videos

“The Yangtze,” PBS Video

**“Millions have lived without love.
No one has lived without water.”**

A Turkish businessman

SELECTED WEB SITES

The sites noted here represent a few resources. There are hundreds listed under “water.” You can narrow your results on search engines such as Google by entering “Water in India” or “Water in Brazil,” for example.

INTERNATIONAL WATER RESOURCES ASSOCIATION

<http://www.wra.siu.edu>

INTERNATIONAL WATER ACADEMY

<http://www.thewateracademy.org>

FRIENDS OF THE EARTH (US)

<http://www.foe.org>

US GEOLOGICAL SURVEY

<http://www.usgs.gov>

WATER AND SANITATION PROGRAM

<http://www.wsp.org>

AMERICAN RIVERS

<http://www.americanrivers.org>

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*If you are between 13 and 18 years old, consider this:
In 2025, when you are in your 30s more than 66
percent of the world will face a shortage of water.
How will this affect your life?
How can you find out?*

2003 The International Year of Freshwater

For info about the International Year of Freshwater,
visit <<http://www.wateryear2003.org>>.