AROUND THE WORLD

Searching to find safe drinking water.

OUTCOME: WHAT STUDENTS WILL LEARN

- Water is essential for life.
- Why there is a global water crisis.
- How communities adapt to create safe drinking water.

Louisville pure tap®

Core Content Standards

Core Content

Social Studies

SS-M-3.1.1 Productive resources are limited and do not satisfy all the wants of individuals, societies and governments.

SS-M-4.1.2 Different factors affect where human activities are located and how land is used in urban, rural and suburban areas.

SS-M-4.3.2 Human populations may change or migrate because of factors such as war, famine, disease, economic opportunity and technology.

Science

SC-M-2.1.2 Earth materials provide many of the resources humans use.

SC-M-3.1.2 Organisms have basic needs.

Practical Living

PL-M-3.3.2 Improving environmental conditions and preserving natural resources impact personal and community health.

Writing

WR-M-1.4 Transactive writing

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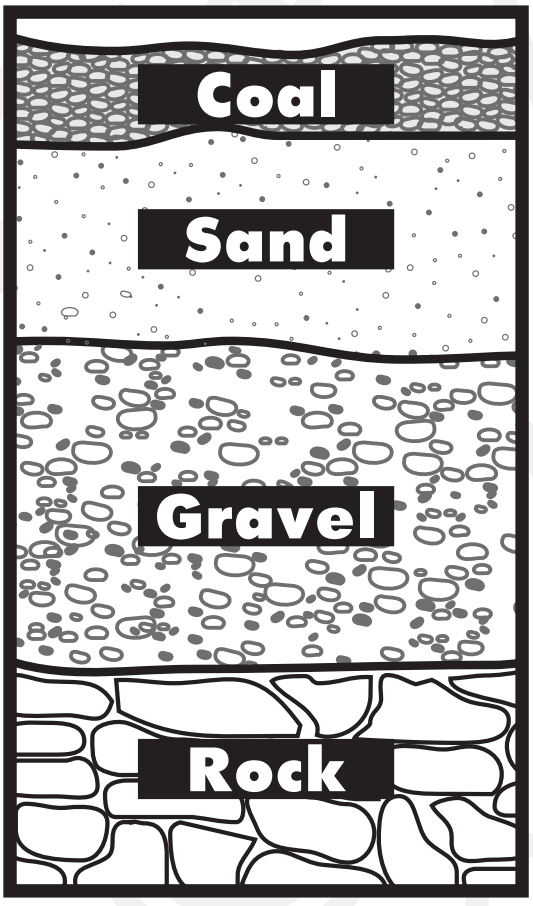
WATER = EXIS

Water sustains life, economies and the environment. Earth is a "blue" planet, but only 1% of the earth's water is fresh water we can use for drinking. The lack of safe drinking water and sanitation is a global issue. Each day 6,000 people, mostly children die as a result of unsafe drinking water and sanitation. The United Nations believes the water crisis is at the heart of our population's survival on earth. The UN estimates that 60 countries and seven billion people will face water shortages by 2050. Seven billion is 75% of the world's projected population of 9.1 billion in 2050. In some countries supply is the issue; for many it's a contaminated source.

The Water You Drink

Drinking water is a manufactured product. In the United States public water supplies use surface or ground water then "treat it." The water is most often settled, coagulated, chlorinated and filtered. Engineers in Louisville pioneered the filtration method most water utilities use. George Warren Fuller, the father of sanitary engineering experimented with filters in Louisville in the late 1800's. His design, combined with chlorination, helped to eliminate incidences of cholera in drinking water.



Louisville Water Company's filters are made of anthracite coal, sand, small and large rocks. The filters remove particles in the water including those you can and cannot see.

The Ohio River provides an abundant supply of water for our community. Worldwide the issue is supply and quality. But science helps people adapt.

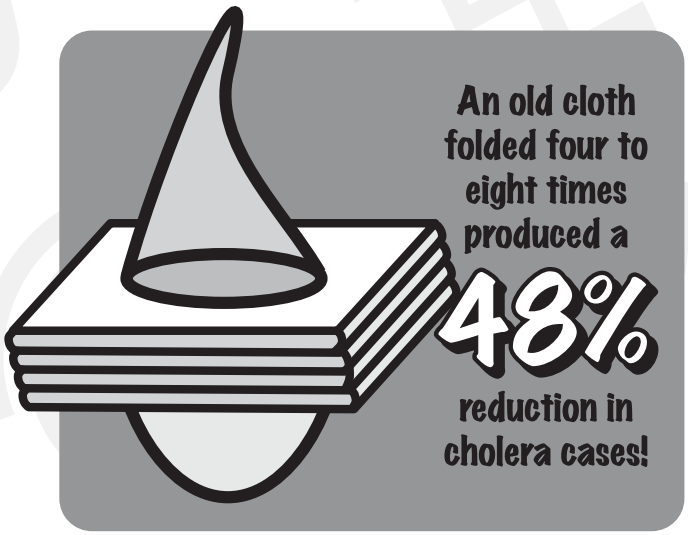
India and Bangladesh

You can look for a source of drinking water on the surface (lakes and rivers) or in the ground. In India and Bangladesh there are problems with both supplies. For surface water, the problem is often cholera, a bacteria that thrives in water. In the ground the problem is arsenic, a toxic element.

A Cloth Filter

Bangladesh is in southern Asia. The country is poor and overpopulated. Monsoons flood the country each year meaning most residents live in areas that will be under water for several months. Because of this, waterborne diseases in surface waters (lakes and rivers) like cholera are widespread. Cholera is created by a bacteria in water. The disease causes severe diarrhea, dehydration and sometimes death. Places that do not use chlorine and filters to treat drinking water are at risk.

Boiling water is the most effective way to purify water when there's no water treatment plant. But fire wood is scarce in Bangladesh. The idea for using a piece of cloth came from watching the people in Bangladesh. A "sari" is the traditional material worn by Indian women. Researchers learned people used an old sari cloth to filter insects out a sugar drink made in the home. Rita Colwell with the University of Maryland took the experiment a step further and tried it with drinking water. Her team found that an old cloth folded four to eight times produced a 48% reduction in cholera cases.



The researchers found that the cholera bacteria "hang" on to planktons (microscopic crustaceans much larger than the bacteria). The planktons and cholera are removed with the sari cloth.

Water = Existence

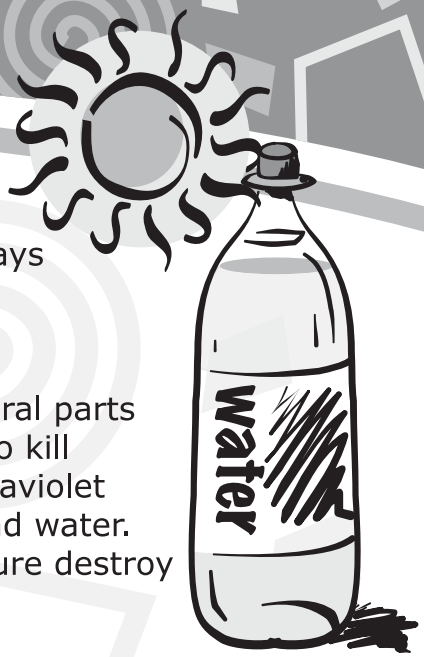
Arsenic and the AMAL Filter

Thousands of people in India dug wells to look for a safer supply of drinking water. However in 1993, researchers found the groundwater, especially in rural areas, contained high levels of arsenic. Arsenic is an element, AS on the periodic table. It's very toxic even in small amounts. Arsenic is part of the Earth's crust and is usually found where copper, gold and zinc are mined. There is arsenic in parts of the western United States. Manufactures use it to help make electronics and glass products. But arsenic and drinking water do not mix. We do not find arsenic in the Ohio River.

Villagers work together and share filters. They also pay about 22-cents a month to help cover operating costs.

In West Bengal, a state in eastern India, several million people - as many as Kentucky's population – have been exposed to arsenic poisoning. Over time, arsenic can cause serious health problems including cancer and skin lesions.

Water For People, a non-profit group that works to help bring safe drinking water and sanitation to developing countries, partnered with the Bengal Engineering College to create a simple filter villagers could use. Researchers found that activated alumina was most effective in removing the arsenic from water. Better yet the alumina was available locally, it was cost effective and could be used over and over. The AMAL filter (named after the engineer who helped create it) allows the groundwater to pass through 51-inches of activated alumina and eight inches of gravel. The alumina adsorbs arsenic and iron in the water. The water that leaves the filter contains arsenic levels well below Indian drinking water standards.



A Two-liter Bottle and the Sun

You wear sunglasses to help protect your eyes from the harmful rays of the sun. Now scientists use those rays to clean drinking water.

SODIS stands for Solar Water Disinfection Process. Researchers in Switzerland helped develop the process. It's used most often in rural parts of developing countries. SODIS uses a plastic bottle and the sun to kill microorganisms that can live in water and make you sick. The ultraviolet radiation from the sun are invisible but can penetrate your skin and water. For drinking water, the UV rays and the increased water temperature destroy bacteria like e.coli and viruses.

There are water treatment plants in the United States that use ultraviolet rays to clean water, but SODIS can only treat small amounts of water; it's intended for individual households. Many factors make this process work:

- Bottles must be clear, clean and not broken or split.
- Water must be clear, not turbid. That means the water cannot have large amounts of mud or sand.
- Bottles must be filled completely - air bubble deflect the sunrays.
- The bottles have to be exposed to the sun on something to help conduct heat - like a metal roof, piece of tile or zinc sheet.
- The bottles must be in the sun for at least six hours - especially during the hours of the sun's largest intensity.

Since heat is important, SODIS works in the hot areas of the world like Latin America and Thailand. In Thailand, many villages store rainwater in large containers for drinking. The water is clean but people often get sick because of problems with handling and transporting the water. Two villages began using SODIS before they drank they rain water. Doctors reported a 86% decrease in the number of people looking for help with diarrhea and other stomach problems.

Educate or It's Not Safe

In all of these projects, education is just as important as the science. In Thailand villagers had to learn the importance of cleaning the plastic bottles, where to place the bottles and how to clean the caps.

In West Bengal, villagers watched a play to learn about the problems of arsenic poisoning and how the activated alumina filter could help. In Bangladesh, the villagers learned that the old sari cloth they used had to be rinsed and dried in the sunlight after each use.

In all three cases, people had to learn basic hygiene like when and how to wash hands, bathroom habits, and how easy it is to spread germs from one person to another.

Vocabulary Words

Adapt: Modifing to meet changing circumstances.

Arsenic: A toxic element found in the Earth's crust.

Cholera: Waterborne disease.

Groundwater: Water that's stored in the ground.

Filter: Something that separates particles.

Hygiene: Practicing good sanitation or good health standards.

Surface Water: Water that's found in a lake, river or reservoir.

Ultraviolet Rays: Invisible rays from the sun.

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Activity #1: How Clean Is It?

Activities 1 and 2 accompany the filtration experiment from Louisville Water Company.

The Question. What do I want to know?

My Filter Design
1. Draw a picture of your filter. Label the items inside.

Why I chose the items for the filter design.

Activity #2: Observe and Infer.

You observe using your five senses. You infer when you tell about what you observe.

OBSERVE What did you see when the water was poured into the filter?	**INFER** What can you infer from your observations?

What questions do you still have?

What would you do different if you did this experiment again?

Open Response Question

How Clean Is It?

Our class did an experiment to see what items could filter dirt from water. We constructed different filter designs then collected data.

1. List two items that worked well as a filter.

List two items that did not work as a filter.

2. For all the items you list explain why they did or did not work.

Open Response Question

How Clean Is It?

Our class did an experiment to see what items could filter dirt from water. We constructed different filter designs then collected data.

1. List two items that worked well as a filter.

List two items that did not work as a filter.

2. For all the items you list explain why they did or did not work.

Scoring Guide

4–Student correctly identifies two items that did and did not work as filters. Student explains the reasoning behind ease. Student has a good understanding of why something does or does not work as a filter.

3–Student correctly identifies two items that did and did not work as filters. Student has a general understanding of why they did or did not work.

2–Student correctly identifies one item that did and did not work **OR** student only answers part of #1. Student has a limited understanding of items did or did not work.

1–Student answers #1 but does not answer #2.

0–No response.

Open Response Question

Safe drinking water is essential for existence. However people in many places of the world do not have access to a safe drinking water supply.

1. List two consequences when there is a lack of safe drinking water.

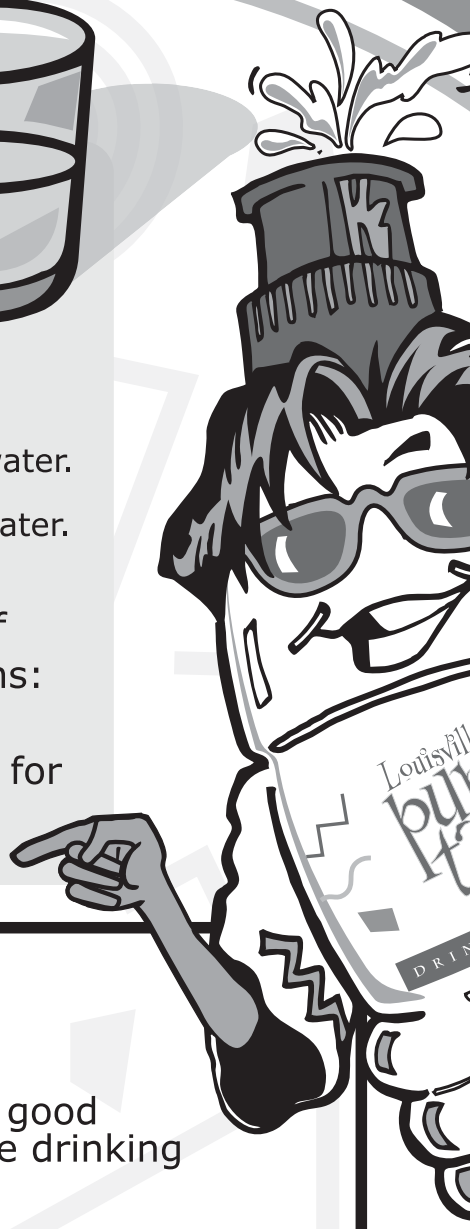
2. Explain how communities can adapt to create safe drinking water.

Open Response Question

Safe drinking water is essential for existence. However people in many places of the world do not have access to a safe drinking water supply.

1. List two consequences when there is a lack of safe drinking water.
2. Explain how communities can adapt to create safe drinking water.

Look for: Consequences like poor health, death, lack of education for children and poor economies. Adaptations: look for using resources to clean water – firewood for boiling, things in the environment to use as filters, sun for u-v rays.



Scoring Guide

4–Student correctly lists two consequences and has a good understanding of how adaptation helps create a safe drinking water supply.

3–Student correctly lists two consequences and has a general understanding of how adaptation helps create a safe drinking water supply.

2–Student correctly lists two consequences but has a limited understanding of adaptation.

1–Student answers part one but not part two.

0–No response.

Around The World

Extra, Extra!!

Books:

Cossi, O. (1993) *Water wars*. New York, NY: New Discovery Books. Case studies examine water issues in California and the Middle East.

Swanson, P. (2001) *Water, the drop of life*. Minnetonka, MN: NorthWord Press. This book accompanies a public television series by the same title.

Web sites:

www.waterforpeople.org Site about the organization that works to bring safe drinking water and sanitation to underdeveloped countries.

www.sodis.ch Site that describes SODIS projects around the world.

www.cia.gov/cia/publications/factbook/geos/bg.html Site that lists information and maps for countries worldwide.

http://www.pnas.org/cgi/content/full/100/3/1051 Read Dr. Colwell's report on the sari cloth.

Louisville Water Company Opportunities:

Learn more about the efforts to bring safe drinking water to people around the world. Louisville Water Company has created a curriculum regarding Water For People's work in Bolivia. The material includes a video.

www.tappersfunzone.com Louisville Water Company's web site for teachers and students. You'll find information, activities, quizzes and additional resources.

For information regarding Louisville Water Company's education programs, contact Kelley Dearing Smith, 569-3600 x2436 or **ksmith@lwcky.com**.

Acknowledges:

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