

*"Boundaries don't protect rivers, people do." Aristotle*

**Grade level: 9-12**

### **National Science Content Standards:**

*A: Science as Inquiry*

*G: History and Nature of Science*

### **OBJECTIVE:**

To familiarize students with ways in which freshwater is regulated, protected and conserved - both officially and unofficially - across time, cultures and countries. To enhance students' critical and collaborative thinking skills as they navigate the complex and often conflicted world of competing water rights claims and traditions.

### **DESCRIPTION:**

Students will learn about traditional systems and strategies for freshwater regulation and conservation throughout the ages and across cultures. They will then create regulations for a small village in Kenya facing specific water and health issues as well as for an urban New York community, ensuring that the problems are solved and the solutions are sustainable. Students will learn about how different attitudes toward water and water regulations and rights evolved in the United States. Specifically, students will examine how mining practices in the California Gold Mines of the 1800s influenced western water rights legislation.

**MATERIALS:** Paper and pencils for responding to questions

Water Stories Supplement: Ajia and Luis

### **BACKGROUND:**

For centuries, societies have created their own set of rules and regulations to protect water quality and to ensure that there is sufficient water for all. Traditions around the world – either based on common sense, or ancient spiritual beliefs – have discouraged people from polluting, or overusing communal water sources. A moral obligation to share water with the most needy has transcended religion and nationality according to James Salzman, an environmental policy expert from Duke Law School.<sup>1</sup> In Zimbabwe, for example, a tradition holds that if one does not share water with strangers, spirits will poison the water source - or perhaps a thirsty stranger will. When water is scarce there have been local restrictions on how much water can be withdrawn from wells, and certain polluting activities such as brick-making and clothes-washing traditionally have been prohibited close to water sources.<sup>2</sup> Because in Zimbabwe water is considered *hupenyu* (life), no one has the right to deny it of others;<sup>3</sup> "Water is a public resource, it is a gift from God," said Zimbabwe's former Attorney General Patrick Chinamasa, during the 1998 Parliamentary Debates.



Another example of indigenous conventions regulating water use is found with the Besao, one of the many native societies of the Philippines. The Besao live in the central western portion of the Cordillera Mountain Range. The community adheres to *inayan*, or cultural taboos, which define the way they value and therefore treat their natural resources. These practices are based on belief in nature spirits which inhabit water sources. The *inayan* warn people against displeasing these spirits by butchering or grazing animals near water sources; if these rules are disobeyed, the people believe the spirits will stop the flow of water. Considered a communal source, maintaining and distributing irrigated water supply requires cooperation; weeding and cleaning canals is up to the community of users, and when water supply is low, the users work together to direct water flow fairly to each field.<sup>4</sup>

Indeed, societies throughout time have commonly held the belief that water is a communal and creator-given resource, private ownership of which is inherently unjust. But as population, land development, deforestation and pollution have increased, safe water has become scarce, and communal authority frequently has been overridden by larger private interests, or a national agency. And in far too many countries, the central government is ineffectual in dealing with its thirsty nation. When freshwater supplies become depleted, age-old traditions of conservation and communal ownership are threatened. As temperatures continue to warm and droughts increase, the problem grows more urgent. Countries and communities need effective planning and water resource management. Can you help?

## STUDENTS:

*In the following activities, you are water experts. You will need to think as problem-solvers for the water issues you encounter. Your goal is to create solutions that take into account both the climate and the community needs, which may be many and varied. Your plans and systems will need to be sustainable, in that the local communities you are assisting should be able to take over management when you leave, and they will need to have the capacity to maintain whatever systems are put in place on their behalf (i.e. water pumps and wells will need repairs and maintenance). Any regulations created will need to be realistic and enforceable. Refer to the [Water Stories Supplement](#) for background on the two activities below. Your solutions will need to be environmentally viable as well, not, for example, a system that requires a diesel generator or further deforestation to operate.*

## ACTIVITY I: Ukambani region

### Background:

In Ajia's village in the Ukambani region in Kenya, villagers have fallen ill with numerous highly contagious illnesses including Cryptosporidiosis and Leptospirosis, described below. Although there is a primitive irrigation system for crops and gardens, there is no similar system established for livestock. Herdsmen allow their cattle and goats to drink from the local pond, the village's main source of water, and graze along the waterfront. In addition, several latrines have been dug at the top of a small hill, above the village - and the pond - for the use of villagers and visiting herders. Villagers have stripped the hill of any timber, using it for building and firewood. Most small shrubs have since washed away in the occasional seasonal deluges. This has caused erosion, and after heavy rains runoff from the overflowing latrines often flows down the hill, occasionally contaminating the dwindling water source and some village gardens. Because of the ongoing drought, the pond is almost dry and most homes rely on water fetched from a long distance. However, many still use the pond, and a small borehole (hole drilled deep

into the ground) nearby, both for washing and occasionally drinking, or watering household gardens.

**Cryptosporidiosis:** This parasite can be found in soil, food, water or surfaces that have been contaminated with feces from infected humans or animals. People become infected by ingesting the organism. Cryptosporidium can be spread by person-to-person or animal-to-person contact and by drinking contaminated water. Infected individuals can shed the organism in their stool for several weeks after they recover from the illness. Because cryptosporidiosis is transmitted by the fecal-oral route, the greatest potential to transmit the organism comes from infected people who have diarrhea, people with poor personal hygiene and diapered children. (CDC)

**Leptospirosis:** A bacterial disease that affects animals and humans; infection occurs through contact with water, food, or soil contaminated by animal urine. Symptoms include high fever, severe headache, vomiting, jaundice, and diarrhea. (CDC)

## INSTRUCTIONS:

You have been assigned by the government to figure out why villagers are getting sick, to design a set of rules and implement some systems that will alleviate the problems. Remember, your plan needs to be cost-effective and simple! You will form groups, or respond to questions individually. **Option:** Some students may represent community members, and others water experts. *Students may wish to refer to Guidelines listed below to help them as they develop regulations.*

### First, diagnose the problem:

- List sources of pollution or contamination in Aija's town that might affect water quality.
- Are the activities that create the contamination necessary to the community?

### Then, create a solution:

- What rules could be created and enforced to ensure that these pollution sources are controlled?
- What systems or devices could be implemented or installed to alleviate any of this pollution? (For example, could livestock or grazing animals receive water by an alternative method? How are farm animals in developed country farms traditionally provided with water?)
- Would you put certain restrictions on one group over another?
- Are there any laws you would enact for farmers and herdsman to ensure water quality?
- How would you ensure that the rules were fair and the villagers would support their enforcement?
- How would you ensure that any equipment installed will be maintained and monitored?

## ACTIVITY II: South Bronx

*As our climate continues to change, it impacts the water cycle and rainfall patterns around the world. If water is not cycling then it can't fill rivers and lakes for our use. And as human*

*populations grow, our need for water grows too. The following scenario is hypothetical, but not unrealistic for parts of the world and even parts of the United States.*

In the past ten years, two semiconductor companies, a cotton apparel factory, and a three beverage manufacturing and bottling plants have opened in the city where Luis lives. These industries are among the most water-intensive; they use billions of gallons of water to manufacture the products they sell. Also, in the past ten years, the area has suffered an unprecedented drought. Precipitation has decreased dramatically and consistently, and temperatures have steadily but slowly risen. Another simultaneous trend is that the population in nearby Manhattan has grown intensely, causing more construction, and more water requirements. The combined trends have created the “perfect storm” when it comes to water. It is running out.

In early June, Luis turns on the tap to wash his hands in the bathroom at his school in the South Bronx, but instead of water, dirt and leaves come out! What is happening? The upstate reservoir that supplied 60,000 gallons a day to the South Bronx area has reduced to the point of only being able to produce 5,000 gallons a day, not enough to supply the entire city.

The mayor proclaims a state of emergency and has water trucked in from nearby New Jersey, a neighboring state. Restrictions are enforced on water use and water is supplied to residents for only three hours a day. Eventually the city implements a more sustainable measure, creating a pipeline from New Jersey. Water costs increase due to the huge price tag of the construction. (This really happened in 2007 in the town of Orme, Tennessee!<sup>5</sup>)

## **INSTRUCTIONS:**

The mayor of New York City has elected you (or your group) as head of the NYC Water Conservation Task Force.

1. Your first order of business is to create local water laws for the city and set restrictions on water use.
  - How would you determine how many gallons each family could use per day?
  - How would you determine “necessary use” of water and “optional use” and therefore subject to restriction? (Consider the following uses: housecleaning? Landscaping? Sidewalk washing? What if “housecleaning” is in a hospital? Or restaurant?)
  - How would you enforce these laws?
2. To help residents cope with the drastic change in water allowances, create a short list of water saving tips for residents.
3. Luis’s water supply was cut by 92%! What would you miss most if your water supply were cut by 92%? What changes would you make in your water usage to adapt to a permanent drought? How would this affect your quality of life?

## **EXTENSION:**

1. What are the water laws in your state? Your country? What is their purpose? (I.e. Are they intended to protect quality, quantity, usage rights, business rights – all of the above?)

Research federal and local water laws that are in place to protect your drinking water.

(Start with [http://www.epa.gov/ogwdw/wot/pdfs/book\\_waterontap\\_full.pdf](http://www.epa.gov/ogwdw/wot/pdfs/book_waterontap_full.pdf))

2. The American West: Take a look at the way California gold miners in the 1800s dealt with the issue of water rights. How did their adoption of the rule of first possession (“first in time, first in right”) differ from behavior toward water in traditional societies described above? How did western water laws develop in contrast to eastern water laws? (see below for basic background)

*“The prior appropriation doctrine, or ‘first in time - first in right’, developed in the western United States in response to the scarcity of water in the region. The doctrine evolved during the California gold rush when miners in California needed to divert water from the stream to locations where it was needed to process ore. Customs and principles relating to water diversion developed in the mining camps, and disputes were resolved by simple priority rule. According to the rules of prior appropriation, the right to the full volume of water ‘related back’ or had the priority date as of the time of first diverting the water and putting it to beneficial use. In other words, those with earliest priority dates have the right to the use of that amount of water over others with later priority dates.” (National Science and Technology Center; Western States Water Laws. “<sup>6</sup>)*

Water rights in the early eastern North American settlements were based on English Common Law which determined that if an upstream landowner’s water use was a “nuisance” to his downstream neighbor, he was considered at fault.<sup>7</sup> The Crown of England “owned” navigable waters which were available for public use, but rights to non-navigable waters were held by those who owned the banks of the streams, and known as “riparian rights”.<sup>8</sup> English water laws developed in a land in which water was abundant, and before the Industrial Revolution, laws not necessarily well-suited for communities in areas such as the American West or Australia where arid conditions and or increasing industrial needs and resulting pollution conflicted with commonly accepted water rules.

3. Hydraulic mining in 1800s California. Learn about an important court case and argue both sides in the following activity from LearnCalifornia.org, used with permission. <http://www.learncalifornia.org/doc.asp?id=427>

### **Water Project Guidelines for optional reference during Activity P**

- “Whenever surface water sources, especially rivers and streams, are considered for development, the communities immediately upstream and downstream should be consulted and involved in the decision-making process prior to implementation. The quality and quantity of surface water is affected by how it is used upstream of the community. In turn, how the community uses the water will affect the water for the downstream users.
- Where possible, projects should use water sources that will remain reliable to meet the demand throughout the year and for the design life of the project.
- Water sources that are intermittent or seasonal can be very disruptive to community life and often pose health risks to the users. Where possible, projects should be part of an integrated watershed management approach and support multiple uses of water.
- Projects should have the capability of supplying at least 20 liters of water per person per

day to the service population.

- A water supply and sanitation committee should be established at the onset of the project to define and manage its operations. The committee should be representative of the community, including women and ethnic minorities.”

## SOURCES:

<sup>1</sup> “Thirst: A Short History of Drinking Water” James Salzman, Duke Law School Faculty Scholarship Series, Duke Law School, 1-1-2006. *Duke University Law School*. Available at: [http://scholarship.law.duke.edu/faculty\\_scholarship/1261](http://scholarship.law.duke.edu/faculty_scholarship/1261)

<sup>2</sup> “Institutional arrangements for Water Resource Use: A Case Study from Southern Zimbabwe,” by Nontokozi Nemarundwe, and Witness Kozanayi<sup>2</sup> Institute of Environmental Studies, University of Zimbabwe. <http://users.ictp.it/~eee/files/Kozanayi.pdf>

<sup>3</sup> “Intersections of human rights and customs: a livelihood perspective on water laws;” *Bill Derman, Anne Hellum and Pinimidzai Sithole*. International workshop on ‘*African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa*’, 26-28 January 2005, Johannesburg, South Africa. <http://www.nri.org/projects/waterlaw/AWLworkshop/DERMAN-B.pdf>

<sup>4</sup> “Traditional Water Management Systems of the Kankanaeys of Besao (Northern Philippines);” Eleanor BANG-OA Presentation at: Water and Cultural Diversity, Indigenous Worldviews and Spirituality. Third World Water Forum, 16-17 March 2003, Kyoto, Japan. [http://portal.unesco.org/science/fr/files/3670/10884259441Eleanor\\_BANG-OA.doc/Eleanor%2BBANG-OA.doc](http://portal.unesco.org/science/fr/files/3670/10884259441Eleanor_BANG-OA.doc/Eleanor%2BBANG-OA.doc)

<sup>5</sup> “*Water Runs Dry in Tennessee Town.*” Environmental News Network. <http://www.enn.com/ecosystems/article/25603>

<sup>6</sup> National Science and Technology Center: Western States Water Laws. “Prior Appropriation.” <http://www.blm.gov/nstc/WaterLaws/appsystems.html>

<sup>7</sup> *Stumbling Toward Sustainability*, John C. Dernbach, ed., p. 200. *Environmental Law Institute*, 2002  
Published: 07/01/2002; ISBN: 9781585760367

<sup>8</sup> Wilkinson, C. F. 1992. *Crossing the Next Meridian: Land, Water, and the Future of the West*. Island Press, Washington, D.C. [http://books.google.com/books/about/Crossing\\_the\\_next\\_meridian.html?id=fJArn4XBdwQC](http://books.google.com/books/about/Crossing_the_next_meridian.html?id=fJArn4XBdwQC)

<sup>9</sup> *Guidelines for the Development of Small-Scale Rural Water Supply and Sanitation Projects in East Africa. A Policy and Planning Framework for Activities, pgs 23-29 August 2005. USAID and other funders under Title II (Food for Peace) Program. Dr. Dennis B. Warner and Dr. Carmela Green Abate.* [http://www.ehproject.org/PDF/ehkm/crs-usaid\\_watsan.pdf](http://www.ehproject.org/PDF/ehkm/crs-usaid_watsan.pdf)