Water Management - Stream Side Science

Summary

In this exercise, students will be assigned roles as community members, develop questions and positions, and participate in a mock "community meeting" to discuss the development of a water use plan that addresses water shortages, distribution, and water quality.

Materials

Access to the internet and background resources.

Background for Teachers

Purpose:
To analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.
Background:
Utah is the second driest state in the nation, yet has the second highest per capita water use in the nation. These seemingly contradictory facts are a result of our extensive system of storage and distribution of irrigation water -- snowmelt that is trapped and used throughout the growing season. Utah also has a very high growth rate, primarily in urban areas. As our population increases, many water related issues will need to be addressed: How will water that has been used traditionally for agriculture be used in the future? How will the water needs of urban populations be met? Is there a need to build more water reservoirs and is the public willing to pay that cost? How does water conservation fit into this picture? You may want to check with your local Extension or city offices to obtain more detailed information for your area.
For more information on water use, planning and water law in Utah, see:

- Western Water Law - Utah
- Utah Division of Water Resources
- Utah Division of Water Rights
- Utah Division of Drinking Water
- Utah Division of Water Quality
- EPA Watershed Management
- The Utah Stream Team Manual's Water Pollution and Water Regulations Sections (pdf)

Intended Learning Outcomes

- Use Science Process and Thinking Skills
  - Distinguish between factual statements and inferences.
  - Form alternative hypotheses to explain a problem.
- Manifest Scientific Attitudes and Interests
  - Voluntarily read and study books and other materials about science.
  - Raise questions about objects, events and processes that can be answered through scientific investigation.
  - Maintain an open and questioning mind toward ideas and alternative points of view.
  - Reject pseudoscience as a source of scientific knowledge.
- Demonstrate Understanding of Science Concepts, Principles and Systems
  - Know and explain science information specified for the subject being studied.
  - Apply principles and concepts of science to explain various phenomena.
- Communicate Effectively Using Science Language and Reasoning

Provide relevant data to support their inferences and conclusions.
Use precise scientific language in oral and written communication.
Use proper English in oral and written reports.
Use reference sources to obtain information and cite the sources.
Use mathematical language and reasoning to communicate information.

Demonstrate Awareness of Social and Historical Aspects of Science

Cite examples of how science affects human life.

Demonstrate Understanding of the Nature of Science

Science is a way of knowing that is used by many people, not just scientists.
Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one "scientific method."
Science findings are based upon evidence.
Understand that science conclusions are tentative and therefore never final.
Understandings based upon these conclusions are subject to revision in light of new evidence.
Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.
Understand that scientific inquiry is characterized by a common set of values that include logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results and honest and ethical reporting of findings. These values function as criteria in distinguishing between science and non-science.
Understand that science and technology may raise ethical issues for which science, by itself, does not provide solutions.

Instructional Procedures

Classroom Activity:

Ask the students to provide examples of different water uses occurring in their community. Make a list of these uses on the board. For a complete breakdown of public water use (residential, industrial, institutional, and commercial), and a breakdown of water use in the home, see the Teacher Resource pages provided.
Ask the students to tell you what kind of decisions need to be made about water use and distribution and about protecting water quality. Ask them how these decisions are made. Refer to the timeline of Utah's role in water management and planning since statehood in the Teacher Resource pages.
Discuss with the students the importance of public input when developing water use plans.
Tell the students that they will be assigned different roles and participate in a "mock" community meeting to give their input on a water use plan focusing on water shortages, distribution and water quality. Divide the students into groups and assign them roles found on the Teacher Resource pages.
Tell the students that during the mock town meeting, they will need to discuss their role in the community as it relates to water shortages, distribution and water quality. How will a change in one of these issues affect them? What are the issues they would like to see covered in a water plan?
To help this activity run smoothly, assign a student to be the meeting facilitator. Before the meeting, they should develop a list of questions and concerns to be addressed by the group. Alternatively, this role can be played by the teacher. The students will also need to create rules and guidelines for the format of the meeting as a class.
If you are limited in time, you may need to let the students come up with their positions and needs quickly in class, and have the "meeting" on the same day. To give the debate a little more

context, have the students research their positions further as an assignment and hold the "community meeting" another day.

NOTE: You may want to share the following resources with your students as they are formulating their concerns and needs. These are included in the Teacher Resource pages (pdf).

The guidelines the Utah State Water Plan uses when developing documents
Present and Projected Total Municipal And Industrial Water Use by Basin
Water Prices of Various Western Cities
Typical Water Use Within the Home
Population Trend and Projection
Per Capita Use of Public Water Supplies in the United States

Applying the Data:

After the "meeting,", have the students write a brief summary of the arguments presented.
Ask the students how they would decide to allocate limited water.

Further Discussion:

1. Define western water law and discuss the role it has played in determining how water can be allocated in Utah.
   In states governed by western water law, water may not be removed from a source unless the user has a "water right" to that water. Water rights are owned and sold separately from the land itself. "First in time, first in right" (the doctrine of prior appropriation) is a central theme of western water law. Water is allocated based on seniority of the water right. In times of drought, when water is scarce, the oldest or most "senior" rights will receive their allocations before less senior water right owners.

   Water rights are tightly regulated, providing for the diversion of specific amount of water, from a specific point, for a specific use, over a specific amounts of time. Under current western law, water rights can be issued to anyone who is putting the water to a "beneficial use." Water must be used or the right to it may be lost. Recent changes in Utah law allow water owners to transfer their rights to the Utah Division of Parks or Wildlife Resources. This water can then remain in the stream to provide the beneficial use of aquatic habitat.
2. Discuss culinary water sources vs. irrigation water (secondary water) sources. How do these differ? What water quality considerations are there for both types of water?
   There is no single definition of "clean water" used in water quality. Instead, the Department of Water Quality has determined the "designated beneficial uses" for each water body in the state and has determined the quality of water necessary to maintain those uses (see table on the next page). The level of protection varies according to the designated use. For example, drinking water sources must be free of many contaminants, while salts are the main contaminant of concern for irrigation water.

   All waters of the state that do not meet their "designated uses" require a watershed protection plan. Water used for culinary purposes (e.g. Big Cottonwood Canyon) requires a separate source water protection plan. For example, dogs are not allowed up Big Cottonwood Canyon in Salt Lake City because the water coming from this area is used for drinking water. This is an example of regulation that is enforced for drinking water sources, but would not be an issue for agricultural water sources.
   Beneficial uses of water (partial list)
   Class 1 -- Drinking water designations
   1C -- Domestic purposes with prior treatment (drinking water)

Class 2 -- Protected for recreation and aesthetics
2A -- Primary contact for recreation (swimming)
2B -- Secondary contact for recreation
Class 3 -- Protected for aquatic wildlife
3A -- Coldwater species of game fish and other aquatic life
3B -- Warmwater species of game fish and other aquatic life
3C -- Nongame fish and other aquatic life
3D -- Waterfowl, shore birds and other water oriented wildlife
Class 4 -- Protected for agriculture uses (irrigation and stock watering)
Class 5 -- Protected for the Great Salt Lake only (primary and secondary contact recreation, aquatic wildlife and mineral extraction)

3. Discuss conservation versus new water development. Discuss the table on the Teacher Resource page of costs/1000 gallons in different cities. Do you think that price of water is a "tool" for encouraging conservation practices? What other approaches might work?
   - *"Rewards" for conservation (e.g., lower prices for users who consume under a certain level of gallons per month).*
   - *Penalties for exceeding a certain level of water use per month.*
   - *More education on the need for water conservation.*
   - *Different prices for water used for different purposes (e.g., irrigation water is subsidized).*

Extensions

Interview a local politician or community decision maker about the water use plan. (Utah agencies involved in water decisions include the Divisions of Water Resources, Water Rights, Wildlife Resources, Drinking Water and Water Quality. Other entities include county and city governments and planning offices, irrigation companies and water conservancy districts).

Bibliography

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Additional resources can be found on the USU Stream Side Science 9th Grade Curriculum web page.

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