How Much Water Do We Have

TIME REQUIRED: About 50 minutes.
SCIENCE INFORMATION:

All of the land area that is drained by a stream or river is a watershed. Every square meter of land is part of a watershed. Each stream has its own watershed. A watershed may be as small as a single field or as large as several states. The watershed of the Colorado River, for example, includes almost a quarter of the United States.

Prevention of pollution alone will not insure a future water supply. To have enough water for the future, watersheds must be protected. How can the water that comes from a watershed be managed and be utilized best by as many users as possible without depriving anyone of water? The unregulated flow of many of the nation's rivers is highly variable. For example, the rate of flow may be thousands of times greater during floods than during drought.

Some streams cease flowing during drought. Even where the rate at which water withdrawn from a river (say one-tenth the average flow), there typically would be many days during which the desired amount of water is unavailable.

Thus, reliance on surface water as a source of supply usually requires a dam, creating a reservoir to store excess water from wet periods for use during dry periods. If the reservoir is located upstream from the location where the water is to be used, the water stored during the wet periods may be released to the river system during dry periods to flow downstream to the point of use.

In either situation, there usually are requirements concerning the minimum flows that mustremain in the river either below the dam or below the point of diversion. These minimum flows are established to provide sufficient water for instream uses such as waste dilution, fish andwildlife habitat and navigation.

Reservoirs are often described as having a "safe yield," which is the amount of water that can be withdrawn or released on an ongoing basis with an acceptably small risk of supply interruption.

The purpose of the reservoir is to make up the difference between the demand for water and the available streamflow during the dry periods, when the available streamflow is less than the demand.
If the desired safe yield is small in comparison to the average flow rate for the river, then the dry period for which the reservoir stores the water may be a few weeks or months during the driest part of the year.

For a safe yield approaching the annual average flow of the river (safe yield between 50 and 90 percent of the average flow), the dry period for which the reservoir stores water may span several years.

The required size of a reservoir to satisfy a given demand is determined by the volume of water that must be stored to carry the users through several dry periods. This volume is the product of the flow deficiency (demand minus flow) and the duration of the dry period. Reservoirs are generally used for flood control, hydropower, recreation, to regulate streamflow, to provide a reliable diverted supply for domestic, industrial, or agricultural purpose, or to maintain reliable downstream flow to satisfy instream use or downstream commitment.
PURPOSE: The purpose of this activity is to demonstrate how reservoirs can augment and provide an adequate water supply during times of water budget deficits.
OBJECTIVES: The learner will be able to:
1. Identify the phases of the hydrologic cycle.
2. Identify and tell how the hydrologic cycle affects a watershed.
3. Interpret the model of a watershed.
4. Demonstrate streamflow, return flows, and augmentation.
5. Understand how reservoirs augment a water budget.

PROCESS SKILLS: Interpreting, synthesizing, observing, predicting and communicating.

TEACHER PREPARATION:

MATERIALS AND EQUIPMENT:

- 1 two-liter plastic bottle
- 4 clear plastic canisters
- 16 clear plastic tumblers

1. Fill a clear two liter bottle full of water. The bottle represents the watershed that supplies water to the river.
2. Arrange 16 students in a line that simulates a river. These students have empty plastic tumblers.
3. Arrange 4 students outside the 16, they represent reservoirs. These students have plastic canisters full of water. These students represent four different ditch companies who drive water from the stream.

INSTRUCTIONAL STRATEGIES:

Engage: Review the hydrologic cycle and how it affects a watershed. Provide the students the opportunity to explain what happens to precipitation falling on a watershed.

Explore: Select one student to pour from the two liter bottle. Have him/her fill the first student's plastic tumbler full of water, then have student 1 pour about 1/4 of the water back into the bottle. (The 2 ounces represent the return flow to the river that was not consumed and can be used downstream).

Fill the second glass full of water, then have that student pour about 1/4 of the water back into the bottle.

The student with the bottle continues to fill each of the other students tumbler and they continue to pour back about 1/4 of the water.

At about the 10th or 11th student the bottle will be empty. (This represents the river being dry because of the ditch companies using all the water in the river.)

When the bottle is empty have one of the students that represents a reservoir pour the plastic canister of water into the pitcher. (This represents augmentation to the river by stored water in reservoirs).

Each time the bottle is empty or about empty, have another student that represents a reservoir pour their water into the bottle.

The water from the 16 canisters should allow all the glasses to be filled with water. (This represents the different ways ditch companies use water --- hydropower, recreation, to regulate streamflows, to provide a reliable, diverted supply for domestic, industrial, or agricultural purpose, or to maintain reliable downstream flows to satisfy instream use or downstream commitment).

Explain: Provide closure by discussing the summary questions.

VOCABULARY:

- ditch company
- augmentation
- diversion
- hydrologic cycle
- water call
- commitment

CONCLUSION:

1. What does the two liter bottle of water represent?

The bottle of water represents the watershed that supplies the water to the river.

2. What does each of the 16 students with plastic tumblers represent?

The 16 students represent different ditch companies and the water they divert from the river.

3. What do the students with plastic canister's represent?

The students with canisters represent water storage reservoirs.

4. The water that is poured back into the two liter bottle by each of the 16 students represents what?

The water that is poured back into the two-iter bottle is called return flow to the river and is that portion of water that is not consumed (the ditch company uses all of the water diverted, but consumes only a part) by the ditch company.

5. The water that is poured into the two-liter bottle by the four students with plastic canisters represents what?

The water poured back into the bottle represents augmentation by reservoirs.

APPLICATIONS:

1. Contact the local city water board and /or water district, get the water budget and find out what times the community is in a water surplus or water deficit.
2. Contact a local ditch company or local water commissioner and have them explain how water is allocated in times of drought and times of water surplus.

EXTENSION:

1. Have the students perform the same activity but fill the bottle only 3/4 full of water. Ask the students to predict how far the water will go. How can all 16 students be assured a portion of the available water.
2. Have students perform the same activity, but use a one liter bottle, fill the pitcher 3/4 full of water and the canister full. Ask the students what can be done with the excess water?
3. Research the number of ditch companies there are in your area. On a map of the area identify the water diversion site where water is taken out for each reservoir and where the return flow enters the river. The Division of Water Resources is a good resource for this information.

PROCEDURE:

1. The student who is acting as the watershed fills the two liter plastic bottle.
2. Select 16 students to form a line that represents a river or stream. Each student will need a clear plastic tumbler.
3. Select 4 students to sit outside the line. Each student will need a clear plastic canister filled

with water.
4. The student who is acting as the watershed will fill the first student's clear plastic tumbler full of water. Student 1 will pour about 1/4 of the water back into the plastic two-liter bottle.
5. The student who is acting as the watershed will continue to fill each of the following student's tumbler and each will return about 1/4 of the water back into the plastic two liter bottle.
6. Once the two-liter bottle is empty, have one of the students with the clear plastic canister pour their water into the two liter bottle and continue filling the plastic tumblers, one at a time.
7. Each time the two liter bottle is empty, pour another canister of water into the two liter bottle until all the canisters are empty.

OBSERVATIONS:

1. Observe how many tumblers the two liter bottle will fill.
2. Observe how all 16 students were able to have their tumblers filled.
3. Observe how much water is left in the two liter bottle after all 16 tumblers have been filled.

CONCLUSION:

1. What does the two-liter bottle of water represent?
2. What does each of the 16 students with plastic tumblers represent?
3. What do the students with plastic canisters represent?
4. The water that is poured back into the two-iter bottle by each of the 16 students represents what?
5. The water that is poured into the two-liter bottle by the four students with plastic canisters represents what?

APPLICATIONS:

1. Contact the local city water board and/or water district, get the water budget and find out what times the community is in a water surplus or water deficit.
2. Contact a local ditch company and have them explain how water is allocated in times of drought and time of water surplus.