THE AMERICAN SOUTHWEST: ARE WE RUNNING DRY?
WATER RELATED HEALTH ISSUES

Post Screening Activity 2
Quantity of Water

Overview: Where will water come from in the future? The American Southwest water resources are limited. As the Colorado River dries should groundwater sources be tapped or desalination pursued? This activity provides the opportunity to desalinate water and apply this concept to addressing the world's concern about the quantity of available potable water.

Objectives:
Desalination will be investigated

Materials:
- Computer with Internet access
- Salt
- Water (distilled for best results)
- Small clear glass
- Large bowl
- Triple Beam Balance
- Graduated Cylinder
- Plastic Wrap
- Rock
- Tape
- Black construction paper

Background:
Ocean salt water is abundant and encompasses 97% of the water on Earth. Of the remaining 3% of Earth's water, about 68% is trapped in icecaps and glaciers and 30% is ground water. Of the .3% available on the surface, 2 % is contained in rivers, 11% is in swamps, and 87% is contained in lakes.

Water is scarce. Droughts, deforestation, overgrazing, and an increased population on Earth have all contributed to greater demands for water. Throughout history dams and reservoirs have been built to store water, groundwater has been extracted, and desalination have been attempted.

Desalination plants exist worldwide to remove dissolved minerals, including salt from water. Distillation, reverse osmosis, and to some degree electrodialysis and vacuum freezing are being developed. In distillation, water is heated and then evaporated to remove minerals. This process is expensive and requires an enormous amount of energy. Water pretreatment is minimal and equipment replacement or cleaning does not require distillation plant shut down.

Reverse osmosis is another option that has lower energy requirements and fewer problems with corrosion. Water is pumped through membranes at high pressure to remove minerals. The water quality varies depending on the pressure applied (http://www.coastal.ca.gov/desalrpt/dchap1.html).

There are more than 13,000 desalination plants with over 60% of them located in the Middle East. The United States produces about 12% of the desalinated water, mostly in the Caribbean and Florida. The world's largest desalination plant is the Jebel Ali, Dubai Desalination Plant. It is capable of producing 300 million cubic meters of water per year.

The largest desalination plant in the United States is in Tampa Bay, Florida (http://www.tampabaywater.org/watersupply/tbdesaloverview.aspx). Utilizing reverse osmosis, it can desalinate 95,000 cubic meters of water per day. A Wall Street Journal article states, "World-wide, 13,080 desalination plants produce more than 12 billion gallons of water a day, according to the International Desalination Association," (http://online.wsj.com/article/SB120053698876396483.html).

Activity:

1. Investigate desalination. How can salt and minerals be removed from water? Throughout this activity have students think about the practicality of the process on a large scale. What costs would be incurred and what should happen to the brine waste produced.

2. Measure 150 mL of water in a graduated cylinder.

3. Measure 5mL of salt and find the mass of the salt using a triple beam balance. Stir the salt into the water. Find the mass of the large bowl and the cup and record these measurements.

4. Pour the salt water into the large bowl.

5. Place the cup in the middle of the bowl. Cover the bowl with plastic wrap and tape it tightly to the bowl. The plastic wrap should NOT touch the cup.
6. Place the rock on the plastic wrap and center it above the cup. The rock, on top of the plastic should not touch the cup either.
7. Place the bowl on top of a piece of black construction paper in the sun.
8. Observe daily. Tap the marble gently to move water from the plastic wrap into the cup.

9. When only salt is left in the large bowl, remove the plastic wrap.

10. Calculate the mass of the salt and the mass of the water. (Remind students to subtract the original mass of the cup and bowl.)

11. What did you observe? Could this help solve the world's water crisis? How would you dispose of the brine (excess salt and minerals)?

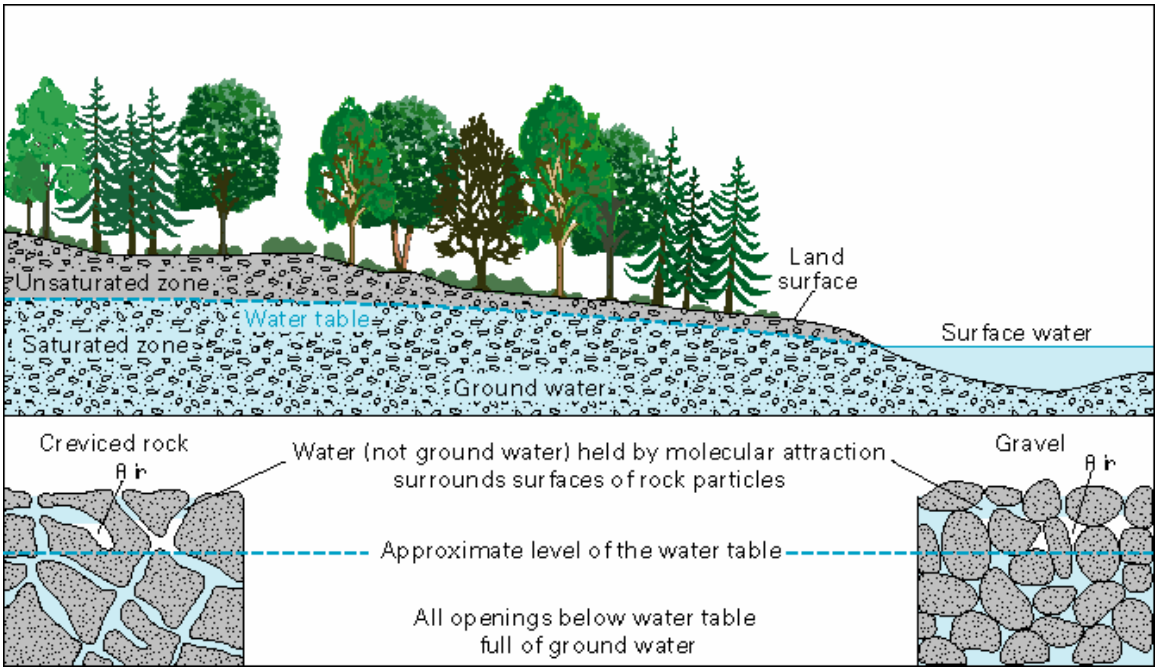
Evaluation Rubric:

Exceptional	Acceptable	Unacceptable
Scientific method steps were followed: observations were thoroughly recorded daily; data was graphically displayed; conclusions were based on data collected and questions for further experimentation were included.	Scientific method steps were followed: observations were recorded daily; data was displayed; conclusions were based on data collected	Scientific method steps were not followed; observations were incomplete or inaccurate; conclusions were not supported

Extension:

(Groups focusing on the quantity of water position should consider researching groundwater resources.)

What groundwater resources are available in the American Southwest? Is this a viable option? What are the consequences of removing ground water? Include this information in your group debate.



From the USGS

Resources:
Inquiry and Aquifer article
http://www3.nsta.org/main/news/pdf/ss0111_20.pdf

California Water Science Center http://ca.water.usgs.gov/

Water quantity frequently asked questions
http://www.lenntech.com/Water-Quantity-FAQ.htm