SOURCE WATER PROTECTION: Surface Water Sources

OBJECTIVES

The student will do the following:

1. Identify sources of contamination to water.
2. Describe management methods to protect water supply sources.
3. Develop a plan to improve watershed management.

SUBJECTS:
Science (Ecology, Physical Science), Social Studies (Economics, Government)

TIME:
2 class periods
field trips

MATERIALS:
student sheets
bus for field trip
writing materials

BACKGROUND INFORMATION

Many towns and cities obtain their drinking water from a nearby river, lake or reservoir. The quality of this source water is influenced by the quality of streams flowing into it, the land uses and activities conducted near it, and any air deposition that might occur.

EPA's Source Water Protection (SWP) Program was established to help states and communities protect their drinking water supply sources. Surface source water protection is a 3-step process involving: delineating areas contributing water to a surface water intake, identifying potential contaminant sources that may threaten the water supply, and protecting the supply using a combination of watershed management strategies for specific communities or watersheds. (Since water does not flow only within politically-established boundaries, some strategies may extend beyond these boundaries and address the entire watershed.)

Watershed management strategies incorporate broad concepts such as land use control and/or management, best management practices, and pollution prevention. They emphasize prevention of both point source and nonpoint source contamination. Specific watershed management strategies may include the following or others: protection of inland wetlands that serve as filters for pollutants, appropriate forestry management practices, erosion controls, control of adjacent zoning and urbanization, creation of buffer zones along reservoir edges, reservoir access and activity control, and community education. Homeowners, businesses, farmers, and industries may also be encouraged to use pollution prevention and best management practices to prevent surface water contamination.

Terms

best management practices (BMPs): techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point or nonpoint sources, in order to protect water quality. BMPs include, but are not limited to structural and nonstructural controls, operation and maintenance procedures, and other practices. Usually, BMPs are applied as a system of practices rather than as a single practice.

buffer zone: an area between the water supply source and the possible contamination sources where no contamination activities are likely to occur

pollution prevention: preventing the creation of pollutants or reducing the amount created at the source of generation, as well as protecting natural resources through conservation or increased efficiency in the use of energy, water, or other materials

Source Water Protection: process that involves delineating areas contributing water to a water well or surface water intake; identifying potential contaminant sources that threaten the water supply; and using management strategies to protect the source water from contamination. Source water protection is applied to both surface water and groundwater supply sources.

watershed: land area from which water drains to a particular surface waterbody

zoning: to divide into areas determined by specific restrictions; any section or district in a city restricted by law for a particular use

ADVANCE PREPARATION

1. Copy Student Sheets.

2. Arrange for field trips.

PROCEDURE

I. Setting the stage

   A. Discuss Background Information with students.

   B. Contact the local drinking water treatment plant and find out the water source in the community.

II. Activity

A. Schedule a visit to the water supply reservoir with a water system representative and ask about source water protection methods that are used, including upstream management methods in the watershed. If a field trip is not possible, have a water system representative visit the class.

B. From local, state, or other sources, define the water supply watershed on a topographic or other map and locate potential pollutant sources. (Use Student Sheet to determine potential pollution problems.)

C. Visit each pollutant source, or a location downstream of each one, to determine the type and extent of pollutants to the reservoir. (Students could be assigned this as an out-of-class assignment and report to the class.)

D. Note any pollution prevention or best management practices in place or, where none exist, make notes of recommendations (not just what is needed but how to do what is needed).

E. Make a compilation of all notes from the class into a report on protection of the water supply watershed. Include recommendations as to the location and type of pollution prevention or best management practices used or needed, and other water quality management steps which should be taken.

III. Follow-up

Share compiled information or reports with local watershed managers and ask them to comment on the class ideas.

IV. Extensions

Have students construct a solar evaporator using the materials you have provided or some they may want to bring to class. They can follow the directions on the Student Sheet or try their own design. Students should wash hands and dip a finger in salt solution and taste. Place solar evaporators in a warm, sunny place for 24 hours. Taste water in beaker (glass) using finger method after washing, and answer questions on Activity Student Sheet. Finally discuss the findings.

RESOURCES

Arms, Karen, Environmental Science, Holt, Rinehart, and Winston, Inc., Austin, TX, 1996.

Chiras, Daniel D., Environmental Science, High School Edition, Addison-Wesley, Menlo Park, CA, 1989.

Cunningham, William P. and Barbara Woodworth Saigo, Environmental Science: A Global Concern, Wm. C. Brown Publishers, Dubuque, IA, 1997.

Nebel, Bernard J. and Richard T. Wright, Environmental Science: The Way The World Works, 4th Edition, Prentice-Hall, Englewood Cliffs, NJ, 1993.

Roberts, Susan A. and S. K. Krishnaswaini, "Protecting the Source," Water Engineering and Management, Scranton Gillette Communication Inc., March 1982, p. 28.

Activities Harmful to Water Supply Reservoir

1. Unauthorized disposal of sludge, solid, septic and hazardous waste, dredge spoil
2. Erosion/sedimentation
3. Uncontrolled/illegal access
4. Atmospheric transfer of contaminants
5. Unauthorized/illegal impounding of upstream watercourses
6. Unauthorized use of pesticides
7. Accidental loss of hazardous materials from surface storage or transport
8. Discharges of animal wastes/agricultural runoff
9. Urban drainage
10. Point source discharges

Constructing a Solar Evaporator or Solar Still

1. Follow the illustration to set up your lab materials. The water level should be at least an inch below the top of the beaker.

2. Be sure that your plastic completely covers the top bucket. The plastic should sag enough when the weight is placed on it so that a cone shape is formed that points down to the open beaker. Make sure that the plastic does not touch the mouth of the beaker.

3. Place your apparatus in the heat of the sun and leave it there for a few hours.

4. During class the next day, remove the plastic covering and taste the water in the beaker.

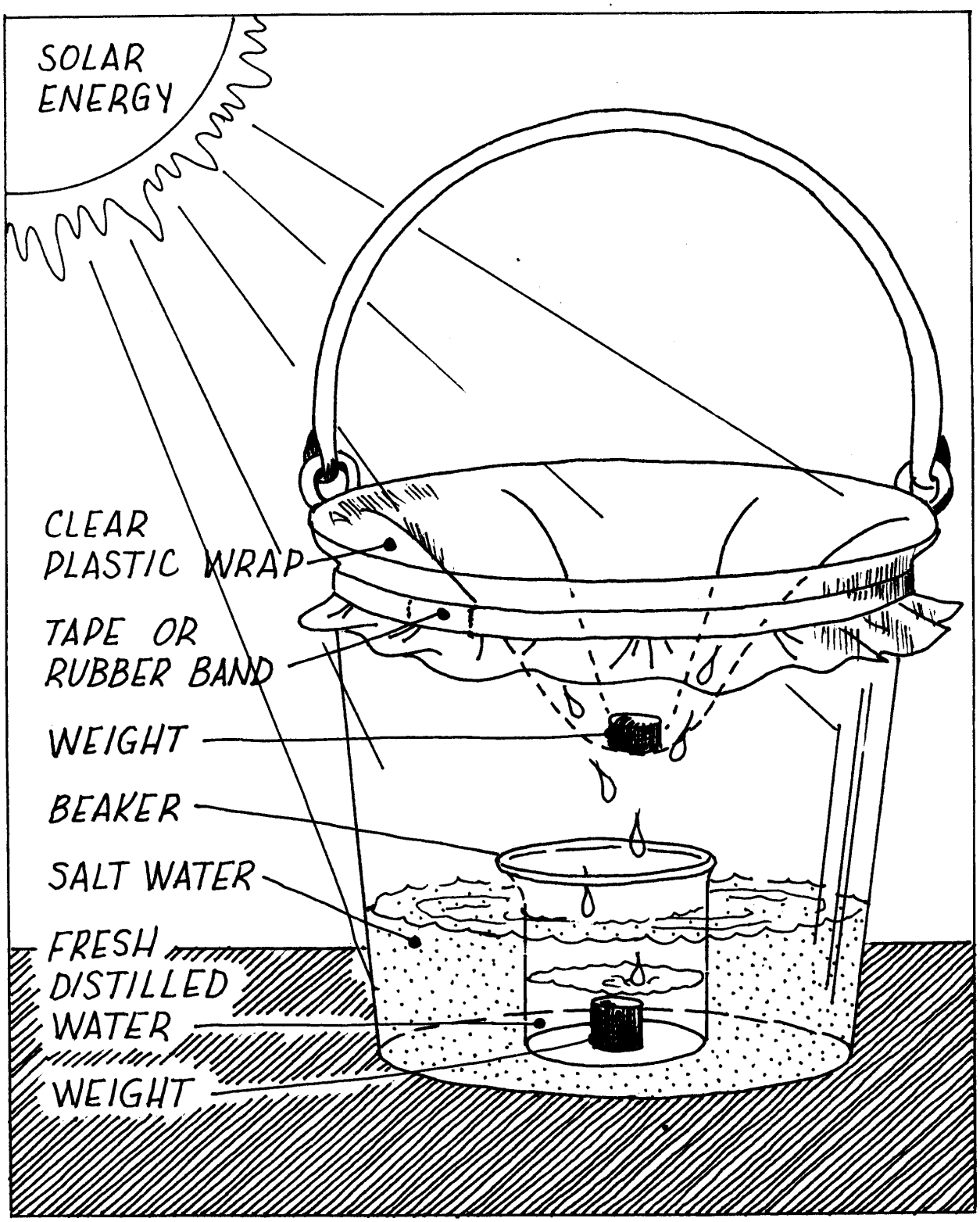
Results

1. How does it taste? _____ Is it fresh or salty? _____

2. What was the energy source that caused the water to change states? _____
_____
_____

3. What are the three states of water? _____
_____
_____

A SIMPLE SOLAR STILL



Potential sources of surface water/groundwater contamination (based upon lists compiled by U.S. EPA and ADEM)

1. Gas stations/service stations
2. Truck terminals
3. Fuel oil distributors/storage
4. Oil pipelines
5. Auto repair shops
6. Body shops
7. Rustproofers
8. Auto chemical suppliers/wholesalers/retailers
9. Pesticide/herbicide/insecticide wholesalers/retailers
10. Small engine repair shops
11. Dry cleaners
12. Furniture strippers
13. Painters/finishers
14. Photographic processors
15. Printers
16. Automobile washers
17. Laundromats
18. Beauty salons
19. Medical/dental/veterinarian offices
20. Research laboratories
21. Food processors
22. Meat packers/slaughter houses
23. Concrete/asphalt/tar/coal companies
24. Treatment plant lagoons
25. On-site sewage
26. Railroad yards
27. Storm water impoundment
28. Cemeteries
29. Airport maintenance shops
30. Airport fueling areas
31. Airport firefighter training areas
32. Industrial manufacturers
33. Machine shops
34. Metal platers
35. Heat treaters/smelters/descalers
36. Wood preservers
37. Chemical reclamation sites

38. Boat builders/refinishers
39. Industrial waste disposal sites
40. Wastewater impoundment areas
41. Municipal wastewater treatment plants and land application areas
42. Landfills/dumps/transfer stations
43. Junk/salvage yards
44. Subdivisions
45. Individual residences
46. Heating oil storage (consumptive use) sites
47. Golf courses/parks/nurseries
48. Sand and gravel mining/other mining
49. Abandoned wells
50. Manure piles/other animal waste
51. Feed lots
52. Agricultural chemical spreading/spraying
53. Agricultural chemical storage sites
54. Construction sites
55. Transportation corridors
56. Fertilized fields/agricultural areas
57. Petroleum tank farms
58. Existing wells
59. Nonagricultural applicator sites
60. Sinkholes
61. Recharge areas of shallow and highly permeable aquifers
62. Injection wells
63. Drainage wells
64. Waste piles
65. Materials stockpiles
66. Animal burial
67. Open burning sites
68. Radioactive disposal sites
69. Saltwater intrusion
70. Mines and mine tailings
71. Other