WETLAND IN A BOTTLE

OBJECTIVES

The student will do the following:

1. Differentiate between constructed wetlands and natural wetlands.
2. State that constructed wetlands can be used to treat domestic, agricultural, industrial, and mining wastewater.
3. Observe how plants in wetlands remove wastes from water.
4. State that plants have limited abilities to remove wastes.

SUBJECTS:
Science, Art, Language Arts

TIME:
90-120 minutes

MATERIALS:
teacher sheet (included)
student sheets (included)
8 celery stalks
food coloring
water
paring knife
2 glass jars or beakers
butcher paper or poster board (1 piece per group)
crayons
scissors
glue sticks
gallon (4 L) jar with lid
gravel
sand
soil
sphagnum moss
humus
plants (see teacher sheet)
small animals (see teacher sheet)

BACKGROUND INFORMATION

Natural wetlands are areas like marshes, swamps, bogs, sloughs, and floodplains that are covered with water at least part of the year. Constructed wetlands are similar to natural wetlands, but constructed wetlands are built to treat wastewater from domestic, agricultural, industrial, and mining processes. The water flow in a constructed wetland is spread evenly over the wetland area while the water flow in a natural wetland is confined to small channels.

As a means of treating wastewater, constructed wetlands are much less expensive to build (50 to 90%) than conventional treatment systems. The initial building costs of constructed wetlands are less than the costs of one year of conventional chemical treatment and, once built, the maintenance costs are little to none.

In a constructed wetland, wastewater flows through a septic tank or other primary treatment and into the cell or compartment of the wetland. The bottom and sides of the cell are lined with a waterproof liner to prevent leaks and keep the water level even. Plants such as cattails and bulrushes absorb trace metals. Suspended solids and other trace metals settle to the bottom of the wetland as sediment. As is the case in a wastewater treatment plant, bacteria do most of the work of removing pollutants. Though wetlands plants remove some pollutants, their chief benefit is to provide an enhanced environment for bacterial growth.

Another benefit of constructed wetlands is the creation of wildlife habitat. Constructed wetlands also become areas for educational opportunities.

Terms

constructed wetlands: wetlands that are designed and built similar to natural wetlands; some are used to treat wastewater. Constructed wetlands for wastewater treatment consist of one or more shallow depressions or cells built into the ground with level bottoms so the flow of water can be controlled within the cells and from cell to cell Roots and stems of the wetland plants form a dense mat where biological and physical processes occur to treat the wastewater. Constructed wetlands are being used to treat domestic, agricultural, industrial, and mining wastewaters.

natural wetlands: swamps, marshes, bogs, and low pieces of land soaked or flooded by water at least part of the year.

ADVANCE PREPARATION

A. Gather all the materials needed for the "Wetland in a Bottle."

B. Photocopy the student sheets "Wet What?" and "Plants, Animals, and Soils" for each student.

C. In order to simulate how wetland plants absorb pollution, put the freshly cut celery stalks in colored water 24 hours before the lesson (divide the stalks between 2 glass jars or beakers).

PROCEDURE

I. Setting the stage

A. Write the terms "Constructed Wetland" and "Natural Wetland" on the board.

1. Ask the students to define a wetland.

2. Write the definitions of the terms on the board.

3. Discuss the differences between constructed and natural wetlands.

B. Pass out the student sheet "Wet What?"

1. Ask volunteers to read aloud from "Wet What?"

2. Ask the students to write the definitions of constructed and natural wetlands on their papers.

C. Divide the class into teams and do the following:

1. Show the class the celery in the colored water.

2. Explain that the food coloring represents pollutants in wastewater.

3. Explain that the celery absorbs the colored water like some plants in a wetland absorb the pollutants in wastewater.

4. Give each team a stalk of celery.

a. Have each team cut the celery so everyone has a piece.

b. Have each student observe how the piece of celery shows absorption of the "pollution."

II. Activity

A. Having observed their pieces of celery, the students will write answers to the following questions on the back of their "Wet What?" student sheets.

1. If the food coloring represents pollutants, how does the celery represent a wetland plant? (It absorbs pollutants in the water.)

2. Was all the food coloring (pollutants) absorbed by the celery? (no) Explain why not. (Plants only absorb as much water as they need.)

B. Demonstrate a constructed wetland by building a wetland terrarium. (See the teacher sheet "Wetland in a Bottle.")

1. Explain step-by-step how to build the wetland as you build it.

2. Ask the following questions and discuss the answers with the students:

a. What absorbs the pollutants in our terrarium? (The plants soak up the pollutants.)

b. Where would a constructed wetland be beneficial? (to treat mine run-off, for failed septic tanks and field systems, for areas where septic tanks cannot be used, for small communities that cannot afford to build a conventional treatment plant, for industries and farm operations that cannot use a conventional plant)

III. Follow-Up

Divide the students into groups. Pass out the student sheet "Plants, Animals, and Soils," poster board or butcher paper, and art supplies.

A. Explain that each group will make a mural of a constructed wetland terrarium.

B. First, have them color soils and water as shown on the student sheet.

C. Next, have them color and cut out all the plants and animals.

D. Then, they will decide where to place their plants and animals on their piece of paper or poster board with the soils and water drawn on.

E. The students will complete their constructed wetland collage by drawing more plants and animals of their own to fill in. (Remind them that wetlands have lush vegetation.)

IV. Extensions

A. Students can research wetlands in encyclopedias, magazines, newspapers, and library books and give oral reports to the class.

B. Each student can imagine he/she is an animal who lives in a wetland and write a creative story about one day in his/her life.

RESOURCES

Breazeale, Janet, "What's in the Boxes? One Way of Handle Wastes," Inside TVA, Vol. 13, No. 15, Tennessee Valley Authority, Knoxville, Tennessee, 7/14/1992.

DeBruin, Jerry, Creative, Hands-On Science Experiences Using Free and Inexpensive Materials, Good Apple, Inc., Carthage, Illinois, 1986, p. 79.

McCarthy, Dennis, "The Wonders of Wetlands," Inside TVA, Vol. 13, No. 15, Tennessee Valley Authority, Knoxville, Tennessee, 7/14/1992.

"Natural Wetlands/Constructed Wetlands, (Factsheet)," Tennessee Valley Authority, October 1989.

Slattery, Britt Eckhardt, "WOW! The Wonder of Wetlands," Environmental Concern, St. Michael's, Maryland, 1991, p. 43.

WET WHAT?

Name _____ Date _____

Swamps, marshes, bogs, and low pieces of land that stay soaked or flooded by water are natural wetlands. Constructed wetlands are designed and built to treat wastewater from domestic, agricultural, industrial, and mining activities.

In a constructed wetland, wastewater flows through a septic tank or other primary treatment and into the cell or compartment of the wetland. The bottom and sides of the cell are covered with a waterproof liner to prevent leaks and to keep the water level even. Plants such as cattails and bulrushes absorb trace metals and other pollutants. Suspended solids and other trace metals settle to the bottom of the cell as sediment. The wastewater then flows into another cell, where it nourishes thick-growing wetland plants. Extra water soaks into the ground because the second cell is not lined. Water left over from this cell is clean enough to discharge.

Define the following:

Constructed wetlands - _____

_____

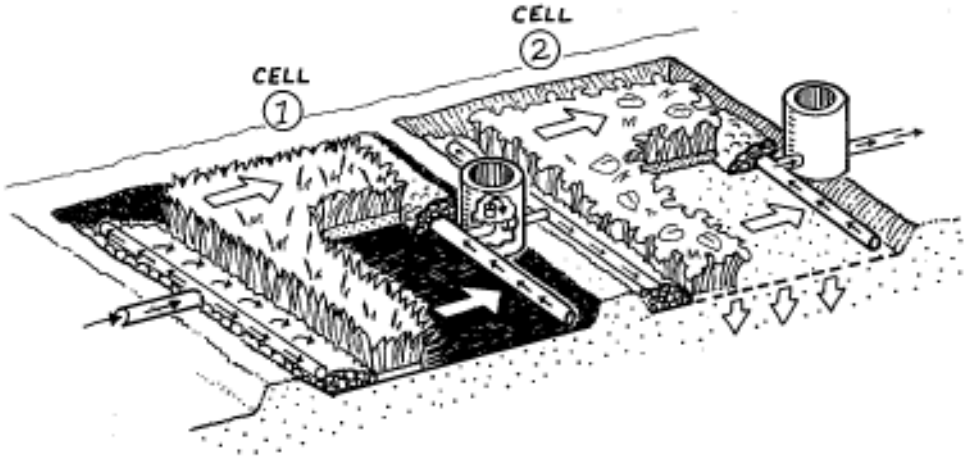
_____

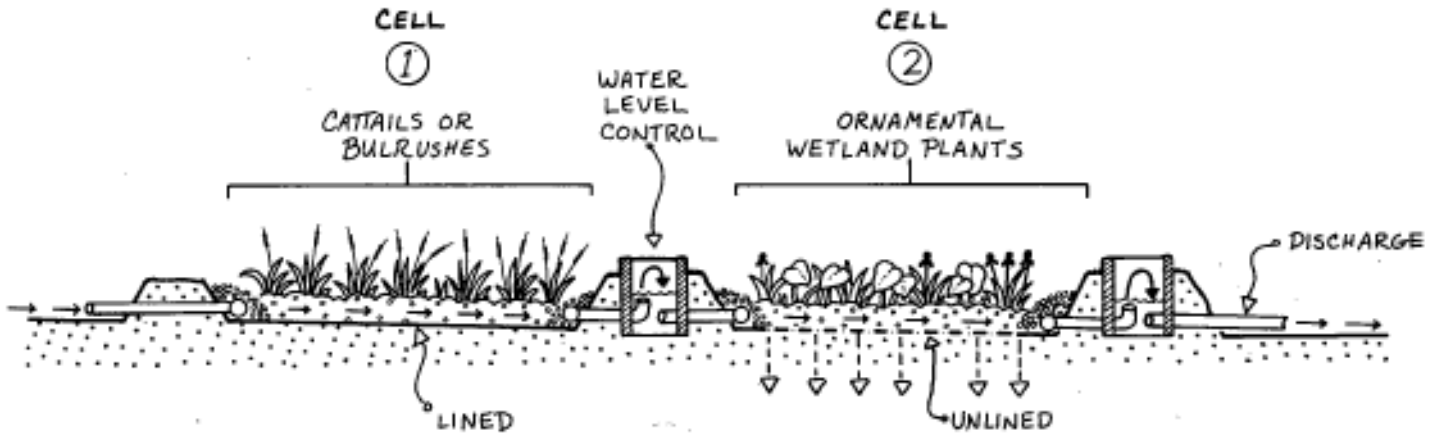
Natural wetlands - _____

_____

_____

WET WHAT?
(continued)





WETLAND IN A BOTTLE

Gallon (4 L) jar with lid
Gravel
Sand
Soil
Sphagnum Moss
Humus
Water
Plants (such as Venus' flytrap, bladderwort, ferns)
Small Animals (such as salamanders, frogs, turtles)

(NOTE: If you use Venus' flytraps, you will need to add live flies. Also, if you use salamanders, frogs, or turtles, you will need to obtain the proper foods and feed them.)

The soil of a wetland is very moist and surface water can vary from shallow to deep. Our terrarium needs shallow water.

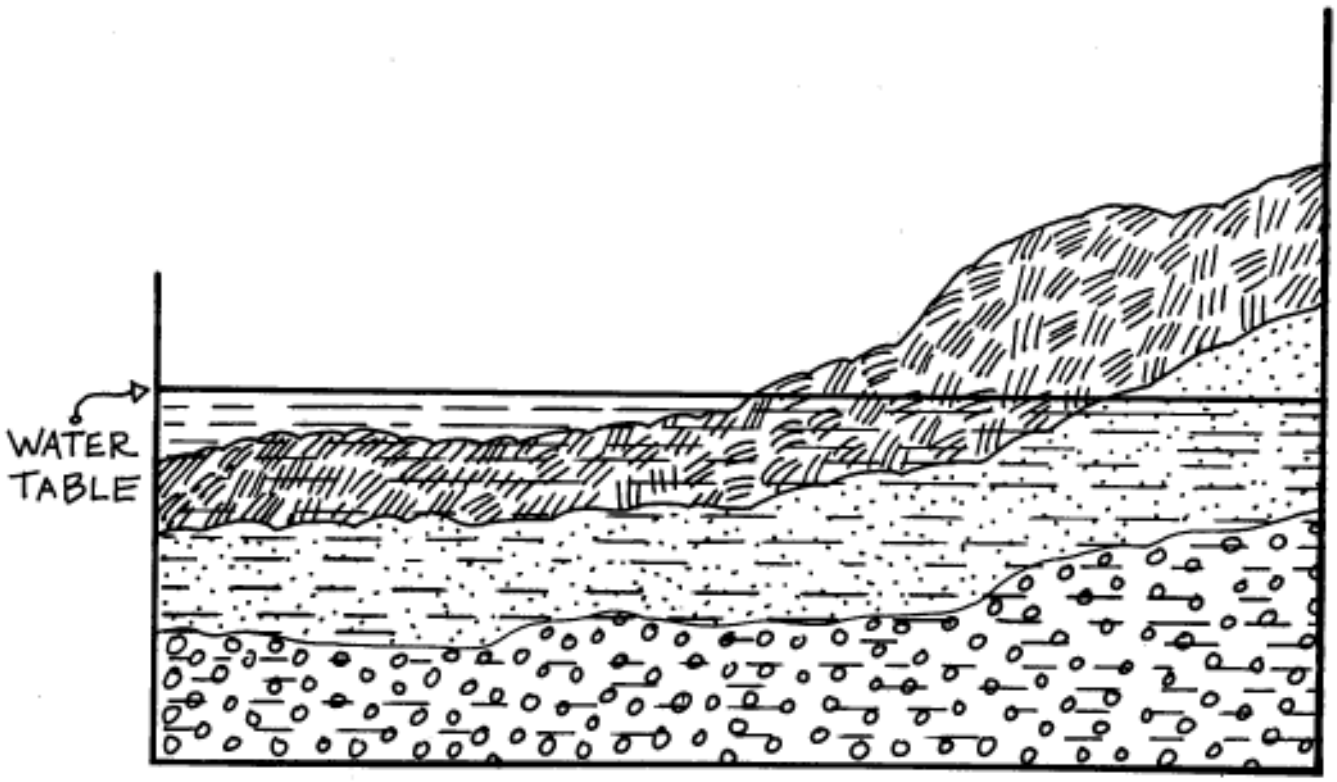
1. First add a layer of gravel.
2. Add a thin layer of sand and soil mixture.
3. Next, add a mixture of 2 parts sphagnum moss and one part humus in a thin layer.
4. Slope all the layers and the surface to make a low spot on one side.
5. Evenly space the plants.
6. Add water to the lowest level of soil.
7. Add animals last.
8. Then cover and place in a location with filtered sun.

PLANTS, ANIMALS, AND SOILS

Name _____ Date _____

To make a constructed wetland mural:

1. Draw a rectangle or jar shape on your group's butcher paper or poster board.
2. Color layers of soil as shown below.
   a. Gravel layer
   b. Sand layer
   c. Sphagnum moss and humus layer
3. Color in the water in the wetland.
4. Color and cut out plants and animals and glue them on the mural.
5. Draw in more of your own plants and animals.

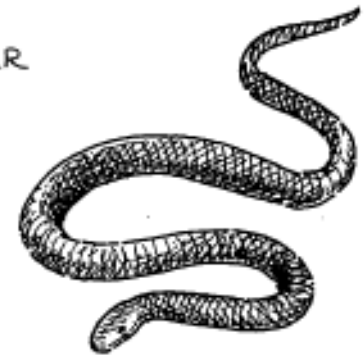


PLANTS, ANIMALS, AND SOILS
(continued)

SALAMANDER

BLUEGILL SUNFISH

WATER BOATMAN



WATER SNAKE

FERN

DETRITUS

BLUE HERON

BEAVER

SWAMP ROSE MALLOW

DRAGONFLY

CATTAIL

FROG

RACCOON

CARDINAL FLOWER

TURTLE