Instructional Models

For Use With

Enviroscapes

Activities for Grades K - 12

A Publication of the
Kentucky Environmental Education Council
And
The Kentucky Division of Water
With Assistance from
Northern Kentucky University
And
The Northern Kentucky Environmental Education Alliance

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800/882-5271 or www.state.ky.us/agencies/envred/

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Introduction

This instructional model, developed by teams of classroom teachers, with the help of resource consultants, is intended to be used in conjunction with the Enviroscape model. There are 18 activities which target all grade levels K-12. The activities are grouped according to the grade level areas of primary (grades K-3), intermediate (grades 4-5), middle school (grades 6-8), and high school (grades 9-12). The activities were designed to be used in the following ways: 1) introductory activities prior to using the enviroscape; 2) with the enviroscape; or 3) follow-up activities to use of the enviroscape (community studies, field trips, local research, etc.)

The Program of Studies (POS) and Core Content for Assessment addressed is identified in each activity. Each of the grade level activities addresses science and social studies POS and Core Content for Assessment. Other POS areas addressed by the instructional model include reading, writing, math, and practical living.

Within each grade level area, there are activities to teach concepts and skills related to the following enviroscape models:

- Non-point source pollution
- Groundwater
- Wetlands
- Riparian

Table of Contents

K-12 Enviroscape Model

Primary Activities

Intermediate Activities

Middle School Activities

High School Activities

Instructional Model Project Coordinator
Yvonne Meichtry
Northern Kentucky University

Primary Grades Teachers
Reeda Hart
Grant's Lick Elementary School

Gale Mendes
North Pointe Elementary School

Intermediate Grades Teachers
Nancy Burns
Grant's Lick Elementary School

Bridget McGee
St. Therese Elementary School

Middle School Teachers
Peggy Kelly
St. Agnes School

Rita Thiel
St. Therese Elementary School

High School Teachers
Judy Gammon
Scott High School

Lisaann Hampton
Newport High School

Resource Consultants
Quentin Terry
Boone County Coop. Extension

Jill Crowe
Region 4 Service Center

Ruthie Staley
Region 4 Service Center

Cathy Neeley
Eastern KY Center for Science

Enviroscape Activities

for

Grades K - 3

Freddy the Fish

Grade Level: K-3

Enviroscapel Model: Non-point Pollution

Objective: The student will be able to identify sources of point and non-point pollution.

Program of Studies

- Students will understand how science fosters understanding of issues.
- Students will pose questions to obtain ideas & information for authentic tasks.
- Students will ask questions about scientific investigations.
- Students will use observing, listening, speaking & writings skills to communicate for an authentic purpose & audience.
- Students will demonstrate how "Freddy the Fish: activities help explain changes in environments (e.g., pollution).

Core Content

SC-E-3.3.2, 3.3.3; SS-E-4.15; WR-E-1.4; RD-E-3.08, 4.06

Academic Expectations

1.3, 1.4, 1.11, 2.1, 5.1, 5.3, 6.1, 6.2, 6.3

Materials

a large goldfish bowl
a light colored sponge
a weight or fishing sinker
6 small paper cups
powdered plant fertilizer
salt
liquid detergent
green and red food coloring
cold tap water
string
a pencil
soil
pancake syrup
punched paper dots
hot tap water
index cards

Procedure

1. Cut a fish shape out of the sponge. Using the string, attach a weight to the bottom of the fish. Suspend the fish in the bowl by tying it to a pencil suspended across the bowl's mouth.
2. Place a small amount of soil in cup #1, fertilizer in cup #2, pancake syrup in cup #3, salt in cup #4, paper dots in cup #5, and warm water and detergent in cup #6.
3. Cut apart the attached script. Glue the 9 individual scripts (attached) to index cards and laminate for future use.
4. Assign 9 students to read the script cards to the group.
5. As the students with the scripts read, call students to get the corresponding cups and dump the ingredient into the fish bowl.

6. All students should stop after each ingredient is dumped to record an adjective describing how Freddy felt (see attached recording sheet). Younger students may draw pictures, draw sad faces, etc.)
7. At the end of the activity, lift Freddy out of the jar. Have the students reflect on what has happened and why. Identify sources of point and nonpoint source pollution in our human and natural environment.
8. Ask the students what should be done with the water. Help the students discover that they cannot just pour it down the sink drain, dump it in the trash, or pour it on the ground. Evaluate the environmental consequences of all alternatives. Lead them to discover that they could be polluting fish like Freddy in the rivers around their neighborhood.
9. When someone suggests filtering the water, talk about the kinds of filters young children may have seen (aquarium pumps that use cotton and charcoal, coffee filters, etc.). Let the inquiry begin! Ask students to work together in cooperative learning groups to make a drawing of a filtration system to dispose of some of the water in the jar. Have older students label their diagrams. Guide students in describing their systems and have them discuss the most important part. Why is it the most important part?
10. With all students gathered around, try some of the methods for filtering.

Definition/Explanation of Concept/Skill

Connect the filtering solutions the students generate directly to the Enviroscape Non-point Pollution model and real-world applications. Lead the students to realize we cannot always identify the source of pollution. For example, knowing a certain factory pollutes the water is knowing the source. Other examples of point source pollution in "Freddy the Fish" are known problems in the waste treatment plant and chemical spills. However, residential areas may be contributing to the pollution as well. That would be considered non-point pollution. In the exercise "Freddy the Fish" fertilizers and chemicals from farms and lawns are examples of non-point pollution. Oil leakage from cars, salt from winter storms, and the trash mentioned in the story are also contributors. Lead students to discover the importance of each individual playing a part by examining their own personal role in pollution.

Assessment

The students will draw, write, or dictate where pollution in our water comes from in their "Water Logs" (Discovery Journals).

References and Resources

The Magic School Bus at the Waterworks, JoAnna Cole

Many versions of this activity have been printed over the years. It was originally "A Fish Story", an activity Pat Chilton designed for Michigan's Kalamazoo Soil Conservation District in July, 1979.

Script for Freddy the Fish Activity

1. Imagine a clean river as it meanders through a protected wilderness area. In this river lives Freddy the Fish. How does Freddy feel? Freddy has lived in this stretch of the river all of his life. Now he decides to go on an adventure and explore the area downstream.

2. Freddy swims into farm country. He passes a freshly plowed riverbank. It begins to rain and some soil erodes into the river. *(Dump the soil into the bowl.)* How does Freddy feel?

3. Freddy nears a suburban housing development. Some fertilizer from the farms and lawns washed into the river awhile back. *(Place fertilizer in the jar.)* The fertilizer made the plants in the river grow very fast and thick. Soon, the river couldn't furnish them with all the nutrients they needed. They died and are starting to decay. Their decomposing is using up some of Freddy's oxygen. How does Freddy feel?

4. Freddy swims under a highway bridge. Some cars travelling across it are leaking oil. The rain is washing the oil into the river below. *(Pour pancake syrup into the bowl.)* How does Freddy feel?

5. During a recent cold spell, ice formed on the bridge. County trucks spread salt on the road to prevent accidents. The rain is now washing the salt slush into the river. *(Put salt into the jar).* How does Freddy feel?

6. Freddy swims past the city park. Some picnickers didn't throw their trash into the garbage can. The wind is blowing it into the river. *(Sprinkle the paper dots into the jar.)* How does Freddy feel?

7. A few factories are located downriver from the city. Although laws limit the amount of pollution the factories are allowed to dump in the river, the factory owners don't always follow them. *(Pour warm soapy water into the jar.)* How does Freddy feel?

8. The city's Wastewater Treatment Plant is also located along this stretch of the river. The pollution laws aren't as strict as they should be and a part of the plant is broken down. *(Squirt two drops of red food coloring into the jar.)* How does Freddy feel?

9. Finally, Freddy swims past a hazardous waste dump located on the bank next to the river. Rusty barrels of toxic chemicals are leaking. The rain is washing these poisons into the river. *(Squeeze one drop of green food coloring into the jar for every leaking barrel.)* How does Freddy feel?

Water Usage

Grade Level: K-3

Enviroscape Model: Ground Water

Objective: Students will explain how water is our most valuable resource.

Program of Studies

- Students will understand how science fosters understanding of issues.
- Students will pose questions to obtain ideas & information for authentic tasks.
- Students will ask questions about scientific investigations.
- Student will use appropriate research tools to locate information & ideas for authentic tasks.
- Students will use observing, listening, speaking & writing skills to communicate for an authentic purpose & audience.
- Students will communicate results of scientific results using procedures &/or designs.

Core Content
SC-E-3.1.2; SS-E-4.3.2; RD-E-2.06, 2.09; WR-E-1.4;
MA-E-3.1.3, 3.2.1, 3.2.2, 3.2.3, 3.2.5

Academic Expectations
1.3, 1.4, 1.5-1.9, 1.11, 1.12, 2.1, 5.1, 5.3, 6.1, 6.2, 6.3

Materials
- Students and family members
- Information sheet with interview question for student's family
- Information sheet with interview question for student's to use at school

Procedure

1. Provide background information for students by using both literature and non-fiction reading on water.
2. Discuss the topic of water using Water as your semantic organizer on a big piece of chart paper. Hang this chart paper on the wall and you and the students add to the organizer each time you read something related to water.
3. Design an interview question with your students which will help the students interview their family regarding the many uses of water they use in their own homes.
4. Students will take the interview question home on an Interview Question Sheet. The students will ask their family members to talk about how they use water in their home.
5. Students bring their Interview Question Sheet back and together as a class record and tally their answers.

6. Make a graph from the tallies to help show the students how water is used at home and how important water is in their lives.
7. Take a walk around the school with your students. Have the students observe and record how water is used and needed at school.
8. Make a graph from your water observation walk around the school. Have the students compare the uses of water at home and at school. Have them discuss their observations.
9. On your class Water Web write down student observations together as a class. Discuss what they have discovered.
10. Students should record their observations and findings in their "Water Logs" (Discovery Journals).

Definition/Explanation of Concept/Skill

The goal of this activity is to help students first discover the importance water plays in their everyday lives. As the students discuss their discoveries and findings, they will begin to make the connection that water is everywhere including in the ground. Guide the students to think about what it would be like for all living things, people, animals, and plants, to live without water. At the third grade level have the students think about what would happen if there was not enough water or if the water became unsafe to drink or cook with. Ask the students to think about how the farmers would water their crops. Lead the students to help think about what our role is in keeping water clean and safe.

Assessment

Teachers will monitor student learning through participation in project, through the on-going assessment of student "Water Logs" and finally in the student's ability as a group to come up with a plan to keep water safe and clean for all living things on earth.

References and Resources

Burton, Jane & Taylor, Kim. The Nature & Science of Rain.

De Paola, Thomas. Cloud Book.

Dineen, Jacqueline. Let's Look At Rain.

Frost, Helen. Series: We need water, The Water Cycle, &
Water as a liquid.

Fowler, Allan. Life in a pond & It could still be water.

George, Lindsay Barrett. Around the pond: who's been here?

Gibbons, Gail. Farming.

Greenfield, Eloise. Water, water.

Hewlitt, Sally. Water.

Hooper, Meredith. The drop in my drink.

Locker, Thomas. Water dance.

Madgwick, Wendy. Water play.

Martin, Bill. Listen to the rain.

Powell, Jillian. Rain and Us.

Scholastic. Water. (A first discovery book)

World Book Encyclopedia. How & why science in the water.
(Special World Book How & Why Series)

How Do Wetlands Work?

Grade Level: K-3

Enviroscape Model: Wetlands

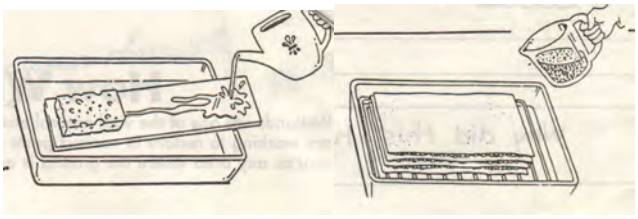
Objective: The student will be able to identify roles that wetlands play in the environment.

Program of Studies
- Students will understand how science fosters understanding of issues.
- Students will pose questions to obtain ideas & information for authentic tasks.
- Students will ask questions about scientific investigations.
- Students will label pictures & drawings.
- Students will use observing, listening, speaking, & writing skills to communicate for authentic purpose & audience.
- Students will connect observing, listening, reading & inquiry to personal experience through applying writing-to-learn strategies in "Water-Logs" (Discovery Journals).

Core Content
SC-E-3.3.2, 3.3.3; SS-E-4.1.5; WR-E-1.4; RD-E-3.08, 4.06

Academic Expectations
1.3, 1.4, 1.11, 1.12, 2.1, 2.19, 5.1, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3

Materials
2 large pans
a long board to fit inside the pan
a sponge
a pitcher of water
sheets of cardboard to fit inside the pan
muddy water
small sticks
aquarium stones



Procedure

Part One
1. Discuss with the students that today they will be scientists observing a pretend wetland. Their task is to find out if wetlands do any important jobs for the environment.

2. Have students predict by drawing pictures and/or writing in their Water Logs what they think would happen to flood water or heavy rains if they flow over a non-wetland area.
3. Place the board at a slant, resting on the side of the pan. Using the pitcher, pour water on the top of the board and let it flow down into the pan. Observe what happens and discuss
the results.
4. Place a sponge on the bottom of the board. Predict what will happen to flood water or heavy rains if they flow over the pretend wetland.
5. Pour the water on the top of the board. Observe what happens and discuss the results. From these observations, have students tell what they learned about how wetlands can be helpful. End the demonstration giving the students time to reflect in their
Water Logs.

Part Two
1. Ask the students what they think is under the top layer of soil in a wetland. Show them a second pretend wetland. This wetland will be a pan with layers of cardboard, separated by layers of aquarium gravel and small sticks to represent roots.
2. Explain that sometimes, as water moves along the ground from rains or flooding, it gets muddy. Ask the students what they think will happen if muddy rainwater flows over a paved parking lot. Allow them to once again make a prediction using drawings and/or writing in their Water Logs.
3. Pour muddy water onto the top of the cardboard. Have students observe the flow of water over the sides of the cardboard. Discuss with the students the importance of wetlands for filtering and absorbing water.

Part Three
1. Review the two demonstrations and their results. With the teacher and students taking turns with the pen, compose a letter to an owner of a supermarket chain wanting to build a new store on the pretend wetland the class just observed. Focus on the environmental impact statements the students generate.

Definition/Explanation of Concept Skill

Lead the students to realize the importance of wetlands in their own environment. Ultimately, students should see the importance of wetlands in filtering water, absorbing water, and providing a habitat for many plants and animals.

Connect the model wetland demonstrations directly to the Enviroscape Wetland model (oatmeal works really well as an absorbent material for the model) and real-world applications. Are there any local wetlands to visit? Have their been local issues with wetland sites? Is there an active role they would like to take?

Assessment

The students will be assessed through teacher observation. Anecdotal records will be kept throughout the demonstrations. Participation in writing the "shared pen" group letter explaining the need for a wetland will also be part of the assessment. Finally, the students will once again document their learning through pictures and/or writing in their Water Logs.

References and Resources

Fowler, Allan. Life in a Wetland.

Freeman, Marcia. Wetlands: Big Book. Newbridge Communication, 1998.

Ranger Rick Nature Scope Series. Wading in Wetlands.

Stille, Darlene R. Wetlands.

Tanner, C. Kenneth. (2001). Into the Woods, Wetlands, and Prairies. Journal of Educational Leadership. 58 (7), 64-66.

Building a Riparian Model

Grade Level: K-3

Enviroscape Model: Riparian Model

Objective: The student will build a riparian sponge model to show that plants moderate the flow of water, and describe how root mats absorb the water.

Program of Studies
- Students will understand how science fosters understanding of issues.
- Students will pose questions to obtain ideas & information for authentic tasks.
- Students will ask questions about scientific investigations.
- Students will use observing, listening, speaking & writing skills to communicate for an authentic purpose & audience.

Core Content
SC-E-2.1.2, 3.3.2, 3.3.3; SS-E-4.15; WR-E-1.4; RD-E-3.08, 4.06

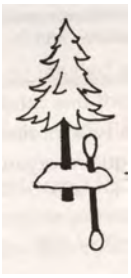
Academic Expectations
1.3, 1.4, 1.11, 1.12, 2.1, 2.2, 2.3, 2.5, 2.6, 5.1, 5.3, 5.4, 6.1, 6.2, 6.3

Materials
- small sponge strips to fit the riparian model
- cotton swabs
- small bits of clay
- green construction paper cut into small strips
- brown construction paper
- cards with directions for the heartwood, taproot, lateral roots, sapwood, cambium, phloem, and outer bark

Procedure

Part One
1. Ask students what they know about the parts of a tree. Introduce each part and its function. Pass out cards to each student (See attached, *A Human Tree Model*). The number of students you need for each part is listed on the bottom of the card. Adjust the numbers for the number of students in your class. Have the students work cooperatively to build the tree.

Part Two
1. Look at the Enviroscape Riparian model. Using a small dab of clay, connect one cotton swab along side the tree trunk to each of two tall trees (page 11 in the Riparian Kit User's Guide). Insert the two trees with roots through the slit in Wetland A, and through the model itself. Add some pesticides (red drink mix) and fertilizers (green drink mix) to the residential area above the shoreline.



2. Make it rain over the residential area and above the Wetland A area. Look underneath the Wetland A area at the groundwater.
3. Discuss how the trees roots absorbed the nutrients. Lead students to discover that trees and other plants need nutrients to grow. Absorbing and filtering runoff improves water quality.

Part Three
1. Give students small strips of sponge. Have them make trees out of cotton swabs by gluing small strips of construction paper to them. Have the students poke the "trees" into the sponge in small groups.
2. Have the students discuss in their small groups where they would like to put their strips of trees on the model. The students should address why they are placing them where they
are.
3. Allow each group to place their strips on the model and test their ideas.

Definition/Explanation of Concept Skill

Guide students in discovering that the strips of lush vegetation and trees along stream banks and river beds are important transitional areas (riparian zones). They help to control the flow of water through the model by absorbing it. When the students have placed their sponges in the model, they will have effectively absorbed and filtered the water, thus showing that riparian zones produce higher water quality and help control flooding.

Assessment

Teachers will continue to monitor student learning through the on-going assessment of their Water Logs. The student model and reasons stated for the location of the sponges will be the assessment.

References and Resources

Revkin, Andrew, C. (2001). New Pollution Tool: Toxic Avengers With Leaves/Plants as Pollution Sponges. The New York Times.
Science Section. Tuesday, March 6. (D1 & D7).

A" Human Tree" Model

You are the *Heartwood.* Stand in the center of the area and cross your arms.

1

You are the *Taproot.* Cross your legs and sit at the feet of the heartwood.

1

You are the *Lateral Roots.* Lay down on the ground, on your back, with your feet close to the
heartwood. Make slurping noises as if you are taking in water.

2

You are the *Sapwood.* Join hands with the other sapwood in a circle around the heartwood. Don't stand on the roots. Raise and lower your joined hands as if you are taking water up from the roots.

2

You are the *Cambium.* Join hands in a circle around the sapwood. Chant "We make new cells, we make new cells".

4

You are the *Phloem.* Join hands and make a circle around the cambium. Hold your hands above your heads and then lower them. Do it over and over again, as if you were taking food to the lateral roots.

6

You are the *Outer Bark.* Hold hands and form a circle around the phloem. Face away from the phloem.

Wonderful Water Water/Culminating Activity

Grade Level: K-3

Enviroscapes Models: Ground Water, Non-point Pollution, Wetlands

Objective: The students will be able to create a paper bag vest by synthesizing information during the Wonderful Water Ways Unit.

Program of Studies

- Students will understand how science fosters understanding of issues.
- Students will demonstrate how Instructional Models help explain changes in environments.
- Students will use observing, listening, speaking, & art to communicate for an authentic purpose & audience.
- Students will use pictures to convey meaning and demonstrate learning.

Core Content

SC-E-3.3.2, 3.3.3; SS-E-4.1.5, SS-E-4.3.2, SS-E-4.4.4;
PL-E-1.1.1, 1.1.3, 3.1.5, 3.3.2, 4.4.1, 4.4.3.

Academic Expectations

1.1, 1.3. 1.4, 1.11, 1.12, 1.13, 2.1, 2.3, 2.19, 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3

Materials

- 1 paper bag for each student vest
- scissors & glue

Procedure

1. Students may choose to work alone or in pairs.
2. Students may interview their classmates to gain information they need to help them create their own story vests.
3. Explain to the students the vest will be used for them to share with their classmates what they learned during this units.
4. Cut hole in the bottom of the bag to match each student's head
5. Cut slit down the front to create the vest.
6. Tell the students the seams in the bag will help them to
7. organize the information that they have learned into the sections of the paper bag.
8. The students may draw directly onto the bag or use other media to make a collage of the information they learned. The students may also write on the bag any information that they may feel will be helpful to them when sharing their vest with their classmates.

Assessment

The authentic assessment will be an oral presentation of the water conservation and water stewardship ideas presented on the story vest itself.

Additional References & Resources

Deason, Hilary. (1983). The AASS Science Booklist for Children.
Washington, D.C.: American Association for the Advancement of Science.

Butzow, Carol M. and John W. (1989). Science through Children's Literature: An integrated approach. Englewood, California: Teacher Idea Press.

Professional Journals and Children's Magazines Booklist.
American Library Association. Chicago, Ill. Published semimonthly

Chickadee. Young Naturalist Foundation. Des Moines, Iowa.
Published 10 times a year.

Hornbook: Horn Book, Inc. Boston, Mass. Published 6 times a year.

Green Teacher. Integrated Learning. Issue 59. Fall 1999.
Subscriptions: e-mail **greentea@web.net**. (416) 925-1244.

National Geographic World. National Geographic Society. Washington, D.C. Published monthly.

Owl, The Discovery Magazine for Children. Young Naturalist Foundation. Des Moines, Iowa. Published 10 times a year.

Ranger Rick. National Wildlife Foundation. Vienna, VA. Published monthly.

Science and Children. National Science Teacher's Association. Washington, D.C.
Published 8 times a year.

Lost Wetlands: http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/
peril_wetlands.html

Wetlands International: **www.wetlands.agro.nl/**

Water Watch Teacher's Materials. Kindergarten – Second Grade. (August 1990).
Kentucky Division of Water. (502) 564-3410.

Geisel, Theodore (Dr. Seuss) (1971). The Lorax.

Lionni, Leo. (1970). Fish is Fish.

Enviroscape Activities

for

Grades 4 - 5

Are You Clear About What You're Drinking?

Grade Level: Intermediate Level (Grades 4-5)

Enviroscape Model: Nonpoint

Objectives:
1. Students will be able to explain that clear water does not necessarily mean that water is free from pollutants.
2. Students will explain that pollution cannot always be seen and that it can come from seemingly "unseen" sources.

Program of Studies
PS 2.1 (Scientific Inquiry)

Core Content
SC-E 3.3.3
SC E 2.1.1.

Materials Needed for this Activity
- 1 cup of tap water mixed with teaspoon of white granulated sugar (labeled #1)
- 1 cup of tap water mixed with teaspoon of white vinegar (labeled #2)
- 1 cup of tap water mixed with teaspoon of salt (labeled #3)
- 1 cup of tap water mixed with teaspoon of lemon juice (labeled #4)
- 1 cup of plain tap water (labeled #5)
- 5 clear plastic cups to hold liquids
- cotton swabs (5 for each student)
- paper and pencil for students to make observations and record data

Activity Procedure
Prior to the activity, ask students if they can "see" pollution. Students may say that pollution is visible and indicate that litter such as pop cans, paper bags, trash in rivers and oil spills in oceans can be seen. Ask students if pollutants are always visible. Guide students into a discussion on water pollutants, and their types and causes.

Have the labeled clear cups of water in stations ready for the students to sample. Students are not to know what is in any of the cups. Students are to insert a clean cotton swab into each labeled cup of water mixture and place the cotton swab on their tongues. Students are to throw away their cotton swab each use so that the cups of liquid mixture remain sanitary for other students. Students are to record on their papers the "taste" of each cup and what each cup "looked" like. Students will recognize that even though each cup of liquid was clear, it did not mean that it was free of "pollutants."

Students should then take a look at the ***EnviroScape Nonpoint Source Model***. The teacher will explain to the students that nonpoint pollution contributes a great deal of pollution in our bodies of water without us even realizing it. Nonpoint pollution can have

a tremendously adverse impact upon our environment. The teacher can then use either colored tempera paints or colored drink mixtures to demonstrate the impact of nonpoint source pollution using the ***EnviroScape Nonpoint Source Model.***

Definition/Explanation of Concept/Skill: "Unseen" sources of water pollution include:

PASTURED LIVESTOCK (NON-POINT)
TIMBER HARVESTING (NON POINT)
DIRT ROAD (NON-POINT)
STRIP-MINING (NON POINT)
UNDERGROUND OIL TANK (NON-POINT)
ROAD SAND/SALT (NON-POINT)
HOME CONSTRUCTION (NON-POINT)
PARKING LOT (NON-POINT)
GAS STATION/UNDERGROUND TANKS (NON-POINT)
DRINKING -WATER WELL (NON-POINT)
CITY BUS/EXHAUST PIPE (NON POINT)
LANDFILL (NON-POINT)
UNDERGROUND OIL TANK (NON-POINT)
STORM SEWER (POINT, OR NON-POINT)

Assessment: Students will list or label sources of non-point source water pollution.

Where Does All the Water Go?

Grade Level: Intermediate Level (Grades 4-5)

Enviroscape Model: Groundwater

Objectives:
1. Students will be able to describe how rainwater sinks into the earth and supplies well and springs for us to use as drinking water.
2. Students will be able to explain the terms "porous" and "permeable."

Program of Studies
PS 2.1 (Scientific Inquiry)

Core Content
SC – E 3.3.3
SC – E 2.1.1

Materials Needed for this Activity
Colored sand
Small pea sized gravel
Two plastic clear cups for each group of students
Blue food coloring
Green food coloring
Tap water
Measuring spoons
Magnifying glasses for each group of students
Paper and pencils for each student to make observations and record data

Activity Procedure
Give each group of students two clear plastic cups and pass around the sand and gravel. Have students put sand in one container and gravel in the other container. Students should fill their cups up about half way. Students should make diagrams of what their cups of gravel and sand looked like. Have the students make predictions on their papers of what will happen when they fill their cups of with the colored dyed water.

Have each group of students slowly pour a tablespoon of dyed water into each cup (blue dyed water for sand and green dyed water for gravel). After each tablespoon of dyed water is added, the students should record their observations on their papers. Encourage students to use the magnifying glasses for close observations. Students should continue to pour a tablespoon at a time into their cups and record observations each time a tablespoon is added. Continue until their containers are filled.

After the students have conducted their experiments, ask the following questions:

1) Where is the water that was poured into the container?

Answer: Among the sand and gravel.
2) What was between the sand or gravel before we added the dyed water?
Answer: Just air.
3) Which container looks like it has more water?
Answer: The container with the gravel.
4) Why do you think this is so?
Answer: Gravel doesn't absorb as much water as the sand does. The gravel is not as **porous**. *Gravel does allow the water to move and flow so it is* **permeable.**
Where is the water in the sand container? *Answer: the sand absorbs it.*

Definition/Explanation of Concept/Skill:

See "Answers" in Procedure section.

Assessment : Informal interviewing of the above questions. After the experiment, students should then look at the ***EnviroScape – Groundwater Component*** that demonstrates how groundwater works. Teacher should lead students in a discussion of how we can prevent groundwater contamination.

Where is all that pollution coming from?

Grade Level: 4-5

Enviroscape Model: Point, Non-Point

Objectives: Students will be able to:
1. Define the term "water pollution"
2. State why water pollution is a serious problem
3. Identify specific water pollutants.
4. Define and categorize two major categories of pollution; Point and Non-point

Program of Studies:

Scientific Inquiry
- Students will identify questions that can be answered through scientific investigations combined with scientific information.
- Use appropriate equipment (e.g., watches), tools (e.g., rain gauges), techniques (e.g., classifying), technology (e.g., calculators), and mathematics in scientific investigations.

Scientific Ways of Thinking and Working (2.1)
- Use evidence (e.g., classifications), logic, and scientific knowledge to develop scientific explanations.
- Design and conduct different kinds of scientific investigations to answer different kinds of questions.
- Communicate (e.g., draw, speak) designs, procedures, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other students.

Patterns, Systems**,** Scale and Models, Constancy, and Change over time (2.2-2.6)
- Recognize how Science is used to understand changes in populations, issues related to resources and changes in the environments.

Core Content: SC-M-1.1.3, SC-M-1.2.2, SC-M-2.1.2, SC-M-2.1.4, SC-M-2.1.5, SC-M-3.1.1, SC-M-3.1.3, SC-M-3.2.1, SC-M-3.4.1, And SC-M-3.5.1, SS-E-1.1.1, SS-E-1.1.2, SS-E-1.1.3, SS-E-1.2.2, SS-E-1.3.1, SS-E-1.3.3, SS-E-2.4.2, SS-E-3.1.1, SS-E-3.1.3, SS-E-3.2.3, SS-E-3.4.2, SS-E-4.1.1, SS-E-4.1.4, SS-E-4.1.5, SS-E-4.2.2, SS-E-4.3.2, SS-E-4.4.1, SS-E-4.4.3, SS-E-4.4.4, SS-E-5.2.3

Materials
- Drawing Paper
- Scenery of farming area, industrial areas, housing area using well water, city block, water cycle
- Poster board
- Scissors, glue sticks or spray adhesive

- Markers or crayons,
- Old Magazines
- Index card
- Local map (Use the internet to find a specific area) www.yahoo.com has a map selection

Activity Preparation

1. Provide the students with background information on water pollution. ***The definition is that water pollution is generally defined as contamination of a water source by humans***. This contamination leads to the reduction of useful water to humans and other living organisms. There are two major classes of water pollution. One is "point source". You can easily and distinctly determine the source of the pollution, i.e. Industrial dumping in a stream. The second class is "non-point". It usually covers a large area such as a farm or logging road, construction site, abandoned parking lots, city streets, and mine.
Non-point pollution can be caused by a variety of reasons some of which are humans, littering, dumping trash, improperly disposing of motor oils, and Freons from old refrigerators or cooling units. The list is extensive. Non-point does not enter the water system in one specified area but covers a range of entrance points. Advise the students that water pollution occurs when water above or below the ground becomes contaminated by pollutants. Explain there are different kinds of pollutants. Emphasize water pollution can be a major health concern, it's unattractive, and can be harmful to all living things. Again reemphasize "Point and Non Point" pollutions. Point is from a particular source, and that from a large are is non-point.
2. Have students prepare the index cards by selecting various scenes. This WORKS WELL IN GROUPS. Students will use their index cards to prepare a Point, Non-Point Bulletin board. Their scenery may be drawn or cut from magazines, but should include the following; *FARMING-NP, PASTURED LIVESTOCK-NP, TIMBER HARVESTING-NP, DIRT ROAR-NP, STRIP-MINING-NP, LANDFILL-NP, WASTEWATER TREATMENT PLANT-P, ROADS WITH SAND/SALT-NP, UNDERGROUND OIL TANKS-NP, HOME CONSTRUCTION-NP, FACTORY-P, PARKING LOT-NP, GAS STATION, UNDERGROUND GAS TANKS-NP, STORM SEWER-P OR NP, DRINKING WATER WELL-NP, CITY BUS/EXHAUST PIPE-NP. (**NP=NON-POINT P=POINT)***
REMIND STUDENTS ANY LAND USE CAN POTENTIALLY CAUSE WATER POLLUTION
3. Explain there are many poisons in the water we cannot see or smell but can be very harmful.
4. Hold up two Mason jars, one full of clear, clean water, and the other polluted with any substance you choose to add, i.e., motor oil, laundry detergent, lawn fertilizer. Ask the students which water they would rather swim in.
5. Pollution bingo- Create bingo cards with point, non-point squares. You pass out to each student a group of three pictures. They must decide if they are point or non-point. If they need the card to fill a square they must hold the cards, other wise they pass at your prompt. A student who uses all three cards and has none to pass card can choose 2 from

a selected pile in the center of the room. The process continues until someone's card is full. That student then stands up and details his/her pollutant sites.

Definition/Explanation of Concept/Skill: Provided within procedure section above.

Assessment: Students will evaluate and determine if a pollutant source is point or non-point.

- **References**: http://www.pembrokeshirecoast.org.uk/english/Learning/pollute.htm

  http://school.discovery.com/sciencefaircentral
  http://www.enviroscapes.com/index4.htm
  http://school.discovery.com/lessonplans/programs/finiteoceans/
  http://www.baylink.org/lessons/pollution_left.html
  http://es.epa.gov/oeca/ag/lteachers.html

Dangerous Pesticides I

Grade Level: 5th Grade

Enviroscape Model: Point-Non-Point

Objective: Students will identify useful and harmful aspects of pesticide use.

Program of Studies

Scientific Inquiry

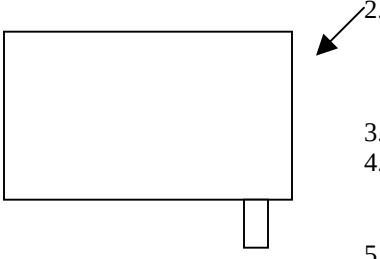
- Students will identify questions that can be answered through scientific investigations combined with scientific information.
- Use appropriate equipment (e.g., watches), tools (e.g., rain gauges), techniques (e.g., classifying), technology (e.g., calculators), and mathematics in scientific investigations.
- Scientific Ways of Thinking and Working (2.1)
- Use evidence (e.g., classifications), logic, and scientific knowledge to develop scientific explanations.
- Design and conduct different kinds of scientific investigations to answer different kinds of questions.
- Communicate (e.g., draw, speak) designs, procedures, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other students.
- Applications/Connections, Patterns, Systems, Scale and Models, Constancy, and Change Over Time (2.2 - 2.6)
- Demonstrate the role science plays in everyday life and explore different careers in science.
- Recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.

Core Content: SC-M-1.1.2, SC-M-1.1.3, SC-M-2.1.4, SC-M-2.1.5, SC-M-3.2.1, SS-E-1.1.1, SS-E-1.1.2, SS-E-1.1.3, And SS-E-1.3.1

Materials:
Cardboard box
Plastic garbage bag
Tape or plastic sealant
Knife
Plastic tubing (old garden hose)
Piece of gauze or cloth
Sand
Quart (liter) size clear container
Salt shaker
Green or red powdered drink mix
Illustrations (included)

Activity Procedure

A. **Make model**



1. Line a cardboard box with a plastic garbage bag. Secure with tape.
2. Cut a hole in the box according to illustration. Place a drain in the box using the garden hose or tubing. Secure in place with tape or sealant. Place a piece of cloth or gauze over the holes inside the box to keep sand from pouring out of the box. (See attached illustration page)
3. Fill the box with clean sand.
4. Place the box on a table, using a book to prop up one end, and place a clear container under the hose to collect runoff (a clear bowl, or jar will do)
5. Rinse any dirt out of the sand by pouring water into the model. Continue this process until the water collected is clear

B. **Fill Salt Shaker with Green or Red Powdered Drink Mix**

C. **Make transparencies of "Groundwater" and Application of Pesticides (included)**

Procedure

Setting the Stage

1. Define the term Pesticide (Note; term includes insecticides, herbicides, rodenticides, and fungicides.)
2. Explain why people use pesticides, how they are applied (self-contained spray canisters, crop dusting by plane, landscaping lawn care services, etc.) and how they benefit us.
3. Explain that pesticides are often made from ingredients that are poisonous to people and the environment. If some are inhaled, or touched to the skin, they can make us sick and even kill us or other living things for which they were not intended.
4. Explain how rain can wash pesticides into the water bodies. Explain how they become nonpoint sources of pollution when they travel to new locations, and how they get into the streams and rivers where our drinking water comes from. Display the "Application of Pesticides" illustration and have students discuss all possible hazards that the pesticide could cause. For example, the person spraying the insecticide could inhale the spray being used on the rose garden. In addition, that spray could be washed off the plants by rain, or watering of the lawn, and travel as runoff to the storm sewer and into nearby streams, to our rivers and back to our drinking table! Crop dusting planes can deposit pesticides on nearby buildings, or ponds, possibly poisoning the fish and plant life. School children playing in the yard could inhale the pesticide. Runoff again could be a problem
5. Explain that not only do pesticides cause a problem above the ground, but they can do damage beneath as well: Illustrate Groundwater
    - Illustration should include; Layers of Soil: sand, gravel and rock all contain water
    - Indication of the Water Cycle
    - Run-off areas
    - Farming community utilizing fertilizers
    - Industrial Area with pollutants
    - Landfill

- Many people and animals get their drinking water from sources stored underground (Well water).
- Pesticides can be absorbed into the ground, into the groundwater, thus polluting the water.
- People unaware the water is polluted use it and get sick
- Discuss how rain will affect pesticides will react to rain, wind. Remind them pesticides disintegrate at different rates, how will this affect the soil and groundwater.

6. Remind the students the purpose of this lesson is to make them aware of the dangers of pesticides and what alternatives are available to the most poisonous pesticides being used.

Definition/Explanation of Concept/Skill:
Possible scenarios for students to evaluate and conclude pesticides can be helpful are; Mrs. Grote was miserable because her roses were dying. The clerk at the Nursery told her they may have a fungus and recommended a fungicide for the plants. In a few weeks the roses were healthy again. The local farmer was concerned about weeds in his cornfields He knew if he did not kill the weeds the corn stalks would not get enough sun or have enough room to grow. He hired a crop duster to spray his fields. After the weeds died the corn grew and he had a good harvest. Mrs. Jones was worried about what was eating her apples from the trees. She knew if she didn't kill the insects her trees could be damaged and the fruit would be lost. She would have nothing to take to market to sell. The county extension agent advised her to use a spray pesticide. It killed the insects and the fruit and trees blossomed.

Assessment: Provide the students with a variety of situations where Pesticides are used. Students will identify how pesticides can be helpful. Students will also describe the pollution problems related to pesticides.

Dangerous Pesticides II

Grade Level: 5th Grade

Enviroscape Model: Point-Non-Point

Objectives: Students will:

1. List pesticides and uses of pesticides.
2. Create a family log of their pesticide use.
3. Describe ways pesticide use could be reduced and evaluate situations to determine possible solutions to problems caused by pesticide pollution.

Program of Studies

Scientific Inquiry
- Students will identify questions that can be answered through scientific investigations combined with scientific information.
- Use appropriate equipment (e.g., watches), tools (e.g., rain gauges), techniques (e.g., classifying), technology (e.g., calculators), and mathematics in scientific investigations.

Scientific Ways of Thinking and Working (2.1)
- Use evidence (e.g., classifications), logic, and scientific knowledge to develop scientific explanations.
- Design and conduct different kinds of scientific investigations to answer different kinds of questions.
- Communicate (e.g., draw, speak) designs, procedures, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other students.

Applications/Connections, Patterns, Systems, Scale and Models, Constancy, and Change Over Time (2.2 - 2.6)
- Demonstrate the role science plays in everyday life and explore different careers in science.
- Recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.

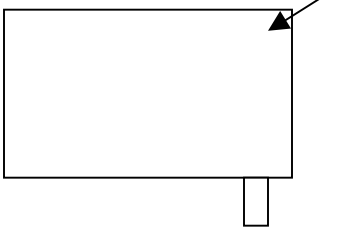
Core Content: SC-M-1.1.2, SC-M-1.1.3, SC-M-2.1.4, SC-M-2.1.5, SC-M-3.2.1, SS-E-1.1.1, SS-E-1.1.2, SS-E-1.1.3, And SS-E-1.3.1,SS-E-1.1.1, SS-E-1.1.2, SS-E-1.1.3, SS-E-1.2.3, SS-E-1.3.1, SS-E-1.3.3SS-E-2.4.2, SS-E-3.1.2, SS-E-3.1.3, SS-E-3.2.3, SS-E-4.1.1, SS-E-4.1.4, SS-E-4.1.5, SS-E-4.2.1, SS-E-4.2.2, SS-E-4.3.2, SS-E-4.4.1, SS-E-4.4.2, SS-E-4.4.3, SS-E-4.4.4, SS-E-5.2.3,

Materials:
- Cardboard box

- Plastic garbage bag
- Tape or plastic sealant
- Knife
- Plastic tubing (old garden hose)
- Piece of gauze or cloth
- Sand
- Quart (liter) size clear container
- Salt shaker
- Green or red powdered drink mix
- Illustrations (included)

Activity Procedure:

A. **Make model**



1. Line a cardboard box with a plastic garbage bag. Secure with tape.
2. Cut a hole in the box according to illustration. Place a drain in the box using the garden hose or tubing. Secure in place with tape or sealant. Place a piece of cloth or gauze over the holes inside the box to keep sand from pouring out of the box. (See attached illustration page)
3. Fill the box with clean sand.
4. Place the box on a table, using a book to prop up one end, and place a clear container under the hose to collect runoff (a clear bowl, or jar will do)
5. Rinse any dirt out of the sand by pouring water into the model. Continue this process until the water collected is clear.

B. Fill Salt Shaker with Green or Red Powdered Drink Mix FARMING (NON-POINT)

C. Make drawings of "Groundwater" and Application of Pesticides illustrations for students to use throughout the lesson. Include potential sources of water pollution and label point or non-point sources. Possible sources could include the following:

PASTURED LIVESTOCK (NON-POINT)
TIMBER HARVESTING (NON POINT)
DIRT ROAD (NON-POINT)
STRIP-MINING (NON POINT)
UNDERGROUND OIL TANK (NON-POINT)
ROAD SAND/SALT (NON-POINT)
HOME CONSTRUCTION (NON-POINT)
PARKING LOT (NON-POINT)
GAS STATION/UNDERGROUND TANKS (NON-POINT)
DRINKING -WATER WELL (NON-POINT)
CITY BUS/EXHAUST PIPE (NON POINT)
LANDFILL (NON-POINT)
UNDERGROUND OIL TANK (NON-POINT)
WASTEWATER TREATMENT PLANT (POINT)
FACTORY (POINT)
STORM SEWER (POINT, OR NON-POINT)
*ANY LAND USE CAN POTENTIALLY CAUSE WATER POLLUTION

Procedure

Setting the Stage

1. Define the term Pesticide (Note; term includes insecticides, herbicides, rodenticides, and fungicides.)
2. Explain why people use pesticides, how they are applied (self-contained spray canisters, crop dusting by plane, landscaping lawn care services, etc.) and how they benefit us.
3. Explain that pesticides are often made from ingredients that are poisonous to people and the environment. If some are inhaled, or touched to the skin, they can make us sick and even kill us or other living things for which they were not intended.
4. Explain how rain can wash pesticides into the water bodies. Explain how they become nonpoint sources of pollution when they travel to new locations, and how they get into the streams and rivers where our drinking water comes from. Display the "Application of Pesticides" illustration and have students discuss all possible hazards that the pesticide could cause. For example, the person spraying the insecticide could inhale the spray being used on the rose garden. In addition, that spray could be washed off the plants by rain, or watering of the lawn, and travel as runoff to the storm sewer and into nearby streams, to our rivers and back to our drinking table! Crop dusting planes can deposit pesticides on nearby buildings, or ponds, possibly poisoning the fish and plant life. School children playing in the yard could inhale the pesticide. Runoff again could be a problem
5. Explain that not only do pesticides cause a problem above the ground, but they can do damage beneath as well: Illustrate Groundwater
6. Layers of Soil:, sand, gravel and rock all contain water
7. Many people and animals get their drinking water from sources stored underground (Well water).
8. Pesticides can be absorbed into the ground, into the groundwater, thus polluting the water.
9. People unaware the water is polluted use it and get sick
10. Discuss how rain will affect pesticides will react to rain, wind. Remind them pesticides disintegrate at different rates, how will this affect the soil and groundwater.
11. Remind the students the purpose of this lesson is to make them aware of the dangers of pesticides and what alternatives are available to the most poisonous pesticides being used. * Discuss alternatives to pesticide use.

Definition/Explanation of Concept/Skill:

Pestcides include insecticides, herbicides, rodenticides, and fungicides. Pesticides are applied (self-contained spray canisters, crop dusting by plane, landscaping lawn care services, etc.) to help control damage done to plants by live organisms. Alternatives to pesticide use include washing plants with soapy water, introducing predator insects, and making your yard attractive to birds, reptiles, amphibians, and bats to help control insects.

Assessment: Students will list pesticides and their uses. They will create a "family" log of their own pesticide use. Students will discuss ways pesticide use could be reduced.

They will evaluate a variety of situations and determine possible solutions to the problems.

References:

Pesticides News, ***December 1998, No.42***

http://www.ci.san-jose.ca.us/esd/pesticides.htm

http://enviroscapes.com

http://es.epa.gov/techinfo/facts/nc/nc-fs7.html

"Your guide to the United States Environmental Agency" United States Environmental Protection Agency, Office of Public Affairs (A-107) Washington, D.C.

Wallace, Dan(ed), The Natural Formula Book for Home and Yard, Rodale Books, Emmaus, Pennsylvania, 1982 1st ed

Lilienfeld, Robert M, Rathje ,William L. **Use Less Stuff: Environmental Solutions for Who We Really Are**

Enviroscape Activities

for

Grades 6 - 8

Making a Watershed Model

Grade Level: 6-8

Enviroscape Model: Non-point Source Pollution

Objectives:

1. Students will be able to create mini-watershed models that will include examples of possible point and non-point pollution sources of a community.
2. Students will be able to identify the interrelationships between a community and its watershed.

Programs of Studies

Scientific Inquiry

- Identify and refine questions that can be answered through scientific investigations combined with scientific information.
- Design and conduct different kinds of scientific investigations to answer different kinds of questions.

Conceptual Understanding

- Investigate the structure of the Earth system (e.g., lithosphere, rock cycle, water cycle, weather, climate).
-

Applications and Connections

- Use science to evaluate the risks and benefits to society for common activities.

Core Content

SC-H-3.5.5 Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities on threaten current and future global stability, and if not addressed ecosystems can be irreversibly affected.
SS-H-4.4.2 Human modification of the physical environment has possible global effects.

Materials

- Plastic, 3-part salad containers with fold-over clear lid
- Modeling clay for creating contour on the model
- Materials to build and represent different natural and man-made areas in a community such as an industrial area, a residential area, a recreational area, agricultural areas, and a landfill. Materials could include: sponge bits, soil, plastic railroad sized fences, houses and animals, pebbles, dried grasses, twigs, balloons (pond and landfill liners), toothpicks, plastic wrap, aluminum foil (pipes and drainage areas), household non-toxic powdered materials such as kool-aid, spices, flour, sugar etc.
- Water and spray bottle

Activity Procedure

1. After demonstration of the Enviroscape Non-Point Source Pollution Model, divide students into groups of 2-4 students.
2. Give each group a clean, closed salad container with the divided section up to represent the landscape. Furnish the other materials in a central area.
3. Tell each group that they will be designing a community that will include at least 3 of the following areas: Residential, Industrial, Recreational, Agricultural, Forests, and Landfills (you may add other areas as appropriate). Students may even want to model a part of their own community.
4. Students must identify possible types of pollutants produced in each area. For example: septic tank leakage, fertilizers, herbicides and pesticides from lawns, golf courses etc.; sediment from clear-cut areas and construction zones; oil and gas from parking areas.
5. After the model has been completed, students will sprinkle the appropriate pollutants in each area (i.e. Spices for sediments, dry kool-aid for pesticides etc.) Predict what will happen after a heavy rain.
6. Spray water until runoff occurs and record observations in their notebooks.

Definition/Explanation of Concept or Skill

On earth, water is carried from the earth to the atmosphere and back again by the Hydrologic Cycle. This cycle consists of evaporation (including transpiration), condensation and precipitation. During precipitation, materials spilled or placed on the ground will eventually become part of the surface water (through runoff), or percolate into the ground where it will become part of the groundwater system. Human activities such as landfill use, the use of chemicals in and around the home, industrial waste disposal, farming, etc. have a direct effect on the surface and groundwater.

Assessment

1. Students will demonstrate their models, explaining how each pollutant is generated.
2. Students will devise and implement possible solutions to the runoff problems.
3. Students should be able to explain the correlation between human activities and pollution of our waterways. They should also understand ways to prevent or reduce this pollution.

Soak it Up!

Grade Level: 6-8

Enviroscape Model: Watershed

Time limit: 1-2 class periods

Objectives:
1. Students will demonstrate knowledge of the function of a wetland by creating models of a homestead with wetland areas on the property that serve in flood control.
2. Students will use scientific skills to measure the water retention capabilities of several wetland soil models.
3. Students will compare the effects of different wetland components such as soil and plant composition

Program of Studies

Scientific Inquiry
- design and conduct different kinds of scientific investigations to answer different kinds of questions
- identify and refine questions that can be answered through scientific investigations combined with scientific information

Conceptual Understanding
- Investigate the structure of the Earth system (e.g. lithosphere, rock cycle, water cycle, weather, climate)

Application and Connection
- recognize how science is used to understand changes in environments
- recognize that science is a process that generates conceptual understandings and solves problems

Core Content

SC-M-2.1.4 Soil consists of weathered rocks and decomposed organic materials from dead plants, animals, fungi, protists and bacteria. Soils are often found in layers, with each having a different chemical composition and texture

Materials
- foil pans (2 for each group of 4 students)
- thin household sponges - enough for each group to have several pieces to use as wetland areas
- modeling clay
- water, measuring cup for each group
- cotton - enough for each group to use several clumps as wetland areas or vegetation

Procedure

1. Divide students into groups of 4
2. Give each group 1 pan, 2 sponges, cotton, measuring cup, modeling clay, water
3. Tell students they will be designing a homestead that includes a creek and several wetland areas on the property.
4. Have students build a creek lengthwise down their pan with their clay. The sides of the clay creek should represent sloped creekbanks (it will essentially be a path of clay with raised sides and edges to hold water.
5. Make a house and barn from clay and place on the property Students have the choice of where to place their home, keeping in mind they will also be including several wetland areas placed around the property.
6. On each side of the creek, have students place several areas for wetlands, using pieces of sponge (can represent areas of exposed wetland soils), cotton (can be areas with wetland vegetation & soil), and clay that represents areas of more or less impermeable soils that serve as short-term wetland areas. * The object is for the wetland areas to catch or reduce the flow of flood waters that will soon be coming down the creek and spilling onto the property and heading for the homestead.
7. Have students measure water a cup at a time and slowly pour into the clay creek bed until it begins to overflow. Students should record the amount of water used, and continue pouring cup by cup until the flood waters reach the house and/or barn. As the floodwaters reach the different wetland areas, students should record what happens to each area (the sponge is soaking up water the fastest; the cotton is completely saturated first, the clay area is holding a pool of water).
8. Have students remove their wetland materials and wring out or empty into a measuring cup to see how much water each area really held compared to the total amount of water used to flood the property. (Students should also measure the water left in the creek at the end of the flooding and consider this amount in their totals)
9. Have groups share their model's design considerations with each other and explain the effects of their wetland areas for flood retention (or not).
10. Next, have students remove all wetland materials and repeat the experiment, measuring the amount of water used to reach flooding at the homestead. Compare these results with results when wetland areas were present.
11. Have students write an essay on the benefits of wetland areas and an opinion on why wetland areas should or should not be protected for the benefit of the environment and society.

Definition/Explanation of Concept or Skill: See Procedure section above.

Assessment

* Students' models of the homestead/wetland area is assessed for students' understanding of the function and benefits of wetland areas in water retention. Placement of the wetland areas on the model will demonstrate practical knowledge of the function and usefulness of wetland areas.

* Students' data for measuring water retention amounts for the different wetland materials will be used to assess students' knowledge of mathematical measuring skills and data recording.

* Students will individually write an essay on the benefits of wetland areas and why they should or should not be protected for the benefit of the environment and society.

References:

Adapted from Project WET - Wetland activities

Reasons for Riparian

Grade Level: 6-8

Enviroscape Model: Riparian

Time Limit: 3-4 class periods

Objectives:

1. Students will use a variety of resources to locate information for local riparian plant species.
2. Students will assess a local waterway for evidence of healthy riparian zones and evaluate the local community in terms of the amount of development of riparian zones.
3. Students will create a field guide for local riparian plants.

Program of Studies:

Scientific Inquiry
- Identify and define questions that can be answered through scientific investigation combined with scientific information
- use appropriate equipment, tools, technology and mathematics in scientific investigations

Conceptual Understanding
- examine Earth's processes (e.g. erosion, deposition, and catastrophes)

Applications/ Connections
- use science to evaluate the risks and benefits to society for common activities
- examine the role of science in explaining and predicting natural events

Core Content

SC-M-2.1.2 Landforms are a result of a combination of constructive and destructive forces. Constructive forces include crustal formation, volcanic eruptions and depositions of sediment, while destructive forces include weathering and erosion

SS-H-4.4.2 Human modifications of the physical environment has possible global effects

Materials
- Enviroscape model for demonstration of riparian areas
- Maps of local waterway (a river, or well-known creek)
- Maps of community development including a waterway if possible(your community's Area Planning Commission should have community development maps)

- Pictures of local waterways and their riparian areas. If possible, a video of local floods would be helpful, especially if the video shows river and creekbanks being washed by flooding waters.
- Resources for researching riparian plants - (internet sites, Division of Water materials, Ky. Waterways Alliance, Ky. Waterwatch program handouts, plant fieldguides)

Procedure

1. After using the Enviroscape demonstration, ask students if there are any riparian areas in your community (any creek, stream, and river). Ask what students can recall about areas of trees and vegetation along the waterways (they may remember trees hanging over the riverbank or creek, or banks of creeks with wildflowers blooming in the spring)
2. Divide students into groups of 4 and distribute a map of the local community to each group. Have students locate where you are, where any waterways are, major streets, businesses, parks, or other development, especially along the waterways.
3. Groups should brainstorm ways that healthy riparian areas would benefit the surrounding community (help prevent or decrease flooding, wildlife habitat, protection from bank erosion).
4. Groups should then research species of riparian vegetation found in the area and collect information on these species for an informative fieldguide.
5. Groups should compose a fieldguide for local riparian species, using pictures and written text.
6. Take a fieldtrip to a local waterway and have students use their homemade fieldguides to identify plant species along the riparian zones, fill in survey charts, and have students look for clues to the riparian vegetation's effects on soil erosion and habitat creation (what wildlife activity is observed in and around the riparian areas?). Students should also observe the locality and record the surroundings (buildings, paved areas, wooded, highway nearby?) Later, an analysis of the severity of soil erosion compared to the development in and around the riparian zone should be examined by each group, using their data collected.
7. If a fieldtrip is not possible, or a waterway isn't close, use pictures, video clips, internet access or other resources to provide visuals of waterways and their riparian plant species. Flood videos, nature videos- any source that shows a waterway 's banks protected and inhabited by vegetation. Photos or visuals of areas that are developed along riparian zones would be helpful, also, so the students can brainstorm ways that this development has harmed the environment and society (increased flooding, loss of wildlife habitat).
8. After the fieldtrip or other visual activity that has students observing waterways and their riparian zones, have students work in groups to come up with a community "action" plan that would give suggestions for developing in and around riparian zones that is "eco-friendly".
9. Have groups design and create a brochure to send to community development leaders and associations that explains the benefits and importance of maintaining healthy, unspoiled riparian areas.

Explanation of Concept

A riparian zone is the area that lines or surrounds a waterway where vegetation grows. Riparian areas can be stream banks, lake borders, marshes, and river banks. Vegetation that has adapted to wet conditions can thrive in these areas. Riparian vegetation serves many purposes, such as erosion control on the banks of swiftly flowing rivers or streams, water filtration and retention of silt and sediments eroding from surrounding land areas into the waterway, and wildlife habitat and nesting grounds. Many communities' development has destroyed natural riparian zones with devastating flooding and soil erosion resulting.

Assessment

1. Students will design a fieldguide for local riparian plant species that must include correct written and pictorial information.
2. Students will record data for evaluating the riparian area on the fieldtrip. Data charts should be assessed for general accuracy and skill in measuring and recording the # of species seen.
3. Students write an analysis of their observations for the correlation between riparian zones and community development. Analysis should be assessed for the students' depth of understanding that where development has encroached upon waterways, the riparian zones disappear.
4. Students will design a brochure that explains riparian zones, their benefits, and possible threats from the community, along with suggestions for preserving these areas.

Resources

Kentucky Division of Water: WaterWatch Program materials and information sheets
Project Learning Tree - Activity #48," Field, Forest, and Stream" survey sheets

Where is the Watershed?

Grade Level: 6-9

Enviroscape Model: Groundwater

Time: 3-5 lesson periods

Objectives:
1. Students will use maps to identify their local watershed areas.
2. Students will use maps to identify the watershed areas for 3 of Kentucky's major rivers
3. Students will use mathematical skills to create a scale map of one of Kentucky's major rivers, identifying its' watershed area.
4. Students will identify risk factors to the local watershed area and devise possible solutions
5. Students will evaluate the impact of human settlement and the interactions of humans and their environment
6. Students will analyze the physical and human characteristics of places and regions

Program of Studies

Scientific Inquiry
- identify and refine questions that can be answered through scientific investigations and scientific information
- communicate results and designs, procedure of scientific investigations
- use appropriate equipment, tools, technology and mathematics in scientific investigations

Conceptual Understanding
- examine Earth's processes
- investigate the structure of the Earth system

Application and Connections
- use scientific inquiry and conceptual understanding to design technological solutions to problems
- use science to evaluate the risks and benefits to society for common activities.

Core Content

SC-M-2.1.5: Water, which covers the majority of Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to he oceans.

SC-H-2.2.1: Earth is a system with elements that can exist in several different reservoirs. Each element on Earth moves among reservoirs in the solid Earth, oceans, and atmosphere as part of geochemical cycles.

SS-M-4.2.1. Places can be made distinctive by human activities that alter physical features

Materials

- Maps of Kentucky(1 for each group of 4 students)
- Maps of your local community or city with a nearby waterway (river, stream) included
- poster board/markers/tape measures
- computer use for web site research on watersheds

Procedure

1. After demonstrating the Enviroscape Groundwater Model, distribute Kentucky maps to small groups. Have each group locate and highlight several major rivers in Kentucky (the Ohio, Kentucky, Green, Cumberland, Licking,).
2. Have students use computer resources or other research materials to help them define a watershed area and locate general information on Kentucky's waterways and watershed regions (Your County Conservation and Water Districts or the Ky. Division of Water have Ky. waterway and watershed maps and information). If you live in a karst area, there are many "Groundwater Watch" programs being enforced, and much information can be obtained from these committees.
3. Using information from research, have student groups shade in the watershed area on their Ky. map for 1 of Kentucky's rivers. (using a 50 mile area on either side of the river works sufficiently)
4. Students then transfer this information on a scale map of Kentucky, which they as a group have drawn. The scale map should have the state of Ky. (or at least the section that has their river), the students' river of choice, and major towns, cities or marked developments that are within 50 miles of their river. Students shade in the immediate watershed area of their river. Students should list possible threats to their river's watershed area on their poster.
5. Student groups share final map projects with other groups and discuss man's effects on his environment and possible solutions to these threats in the watershed areas and to the local groundwater supply.
6. Student groups use community maps to locate possible threats to their own watershed area. (local factories, homeowners, littering, etc.)
7. Students individually write an essay that explains what a watershed area is, how it is connected to the local groundwater system, and what effects man's activities have on watershed areas and the groundwater system.
8. Student groups design brochures that highlight one area of watershed/groundwater protection for their community (proper oil disposal, solid waste disposal, chemical emissions from local industry, homeowners use of chemical, pesticides, fertilizers in the home) and give alternative disposal suggestions, or alternative product suggestions for homeowners to use. These brochures can be handed out to appropriate community leaders or community groups for distribution.

Definition/Explanation of Concept or Skill: see Procedure section above.

Assessment

- Students' scale maps are assessed for scale accuracy
- Students' understanding of watershed areas is assessed from their identification on their maps of a watershed area and the potential threats to this watershed.
- Students' knowledge and understanding of the concept of a watershed area and the groundwater system is assessed using their essay on watersheds which must include information on a watershed's importance and relationship to the groundwater system, threats to this system, and possible solutions.

Resources

Kentucky State Highway Dept. (maps)
Kentucky Division of Water - resources for watersheds and groundwater
Kentucky Conservation District - publications on watersheds and groundwater

Enviroscape Activities

for

Grades 9 - 12

Dirty Water

Grade Level: High school grades 8 – 12

Enviroscape Model: Groundwater

Objectives: Students will be able to describe a variety of ways groundwater becomes polluted, how pollutants affect the water, and understand the importance of preventing water pollution.

Program of Studies The Interdependence of Organisms: Students will explore how human activities alter ecosystems.

Core Content for assessment: SC – H-3.5.5: Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.

Materials:

- 2 one-gallon glass jars
- Kitchen strainer
- Paper coffee filter
- 10 cups containing items highlighted below

Activity Procedure:

Add water to both glass jars. This represents clear glacial melt-off before human impact. One jar serves as the control. Distribute the 10 cups of material to each student or pair of students. Give them a few minutes to think how their items might affect the water. Then, add one item at a time to one of the jars. As the item is added, discuss how the item might have entered the water system and affected the water.

1. **Twigs, leaves.** Natural pollutants that fell from trees decomposed and slowly released minerals into the soil. The minerals leached into the water.
2. **Ashes.** Residue from forest fires started from lightning and forest clearing activities by early settlers rapidly released minerals that percolated through the soil into the water.
3. **Cloth, paper.** Early traders brought these to this country. When discarded, they added chemicals to the soil.
4. **Apple core, onion skin.** Food wastes, from the time of early inhabitants until today, have always been concentrated in high population areas. These areas are also the places where there is the greatest demand for groundwater.
5. **Animal waste.** Throughout history, as populations grew, so did sewer systems. Early treatment facilities did little to "clean up" the waste. Today, many cities have overworked treatment plants, or storm sewers combined with sewage systems, allowing partially or untreated waste to enter waterways.
6. **Oil.** Some careless auto owners discard used motor oil on the ground, send it to the landfill, or dump it straight into storm sewers.

7. **Detergent.** Phosphates leach into the soil.
8. and 9**: agri-chemicals and soil**. Fertilizers, pesticides, and soil are continually washing off cropland and entering our water system.
10. **Baking soda and vinegar (mixed together).** Manufacturers and chemical handlers are often careless about disposal of toxic waste. Improperly buried materials filter through the soil.

After all the items have been added to the jar, ask about each jar, "Would you drink the water? Swim in it? Go boating in it? Water plants with it? "
Then say "let's try to clean up the dirty water." Pour the water through the kitchen strainer. Ask the same questions. Pour the water through the coffee filter. Ask the same questions. Ask students to think of other ways to clean the water.
Discussion:

- Which way is easier to have clean water – before things are added to it, or after? What are some ways in which we could lessen the amount of items from entering the water?
- Ask each student to think of one habit that she he or she would be willing to change so that our water will be cleaner.
- How can the students help other people in the community to change one habit?
- Ask students, "how could we demonstrate the process of leaching and percolation?" Follow through with the ideas and let the students conduct the experiments.

Concept Explanation:
Thirty-five states are pumping groundwater faster than it is being replenished by nature. And in many areas, our groundwater is in serious jeopardy from pollutants. This activity helps students to graphically see the impact on groundwater**.**

Assessment:
Open response question: Water is such a precious resource. Describe a variety of ways groundwater becomes polluted, how pollutants affect the water, and understand the importance of preventing water pollution.

References: This activity came from "The KAEE Newsletter", published by the Kentucky Association for Environmental Education. It is based on a previously-published article submitted by Carey Tichenor.

Groundwater Model

Grade Level: High School grades 8 – 12

Enviroscape Model: Groundwater

Objective: Students will demonstrate through building a model how aquifers are formed and groundwater becomes polluted.

Program of Studies: The Interdependence of Organisms: Students will explore how human activities alter ecosystems**.**

Core Content: SC – H- 3.5.1: Atoms (e.g. carbon, nitrogen) and molecules (e.g. water) cycle among the living and nonliving components of the biosphere.

Materials: For each model:

- Groundwater model handout
- One 20 ounce clear plastic tumbler
- 12 inches of clear plastic tubing
- a small piece of nylon fabric to cover the end of the tubing
- masking tape
- small pebbles
- clean sand
- filter paper (e.g. a section of a coffee filter)
- pump-type sprayer (e.g. from window cleaner)
- a disposable syringe
- red food coloring
- a clear glass container

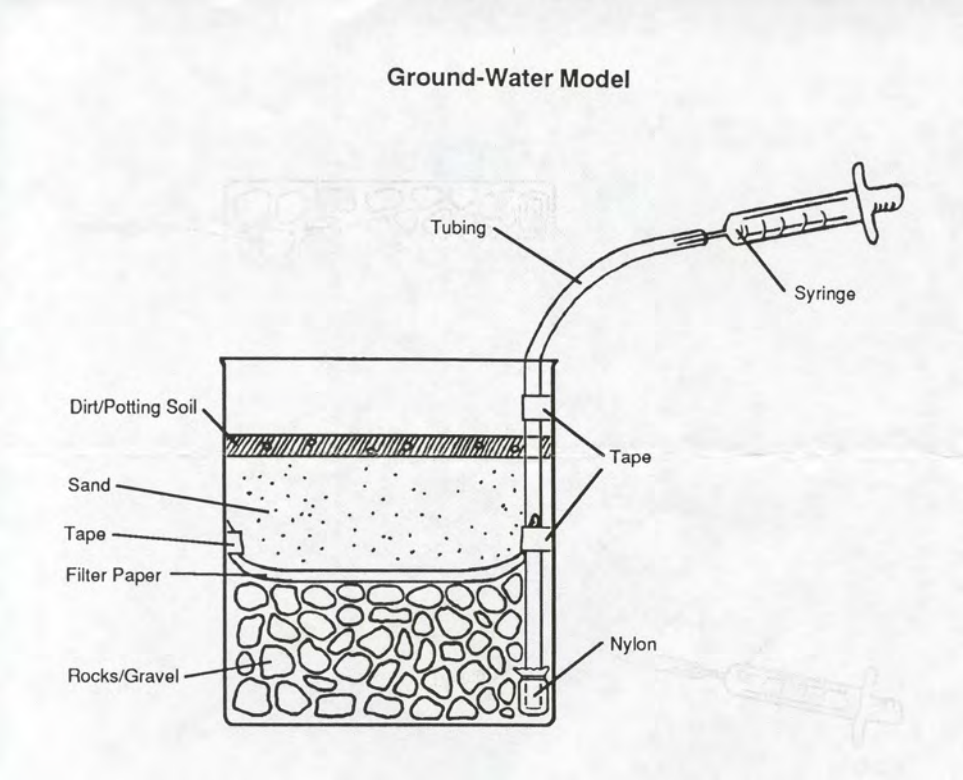
Procedure

Older students can be divided into small groups to build the model, or can each build the model individually if there are enough materials. Have them use the Groundwater Model handout for reference.

1. Define groundwater and aquifers. Discuss with students the importance of ground water in the United States and the Ohio River Valley.
2. Secure nylon fabric over one end of the plastic tubing with masking tape or a rubber band.
3. Tape the tubing to the inside of the tumbler so that the nylon-covered end of the tubing *almost* touches the bottom of the tumbler.
4. Fill about one-third of the tumbler with pebbles.
5. Cut the filter paper into a circle with a diameter slightly larger than the diameter of the inside of the tumbler. Place the filter paper on top of the pebbles and tape it securely to the sides of the tumbler.
6. Fill the rest of the tumbler with sand.

Note: a shallow layer of potting soil can be added to the top of the sand to represent the Earth's crust.

7. With the sprayer, apply water to the sand until it is saturated. The water will filter down into the pebbles.
8. Put the end of the syringe into the tubing and make sure the connection is tight.
9. Pull back the plunger of the syringe to create a vacuum. Water will be drawn from the pebbles/sand into the tubing and ultimately into the syringe. Discuss with students that this represents how groundwater is pumped from aquifers.
10. Add a few drops of red food coloring to the sand. Explain that the red food coloring represents a pollutant. Discuss what kinds of substances can pollute the ground water.
11. Apply more water to the sand.
12. Continue "pumping" water from the tumbler with the syringe. When the syringe fills with water, remove it from the tubing and pour water into the clear glass container. Refasten the syringe to the tubing and continue "pumping" water. Ultimately, the water in the clear glass container will have a reddish hue. Discuss how the "pollutant" applied at the surface level has "contaminated" the "groundwater" in the experiment.



Explanation of Groundwater Contamination:

Groundwater is water that exists in spaces in rock, gravel, and soil below the surface of the ground. Groundwater accumulates in formations called *aquifers* when rainfall and

surface water percolate through the ground. There are two major environmental problems that can affect groundwater. The first is overuse of groundwater supplies. In general, water filters down into aquifers at very slow rates. This percolation of water into the aquifer is called *recharge*. When water is pumped from the aquifer at faster rates than it is recharged, the amount of water in the aquifer is reduced. This means that less water will be available for future use. In addition, the water takes up space in the aquifer. When the water is removed, void spaces open up and rock or sediments around these void spaces sometimes collapse. With the loss of void spaces, the aquifer's ability to hold water is reduced, and future recharge of the aquifer is more difficult. In addition, the collapse of void spaces can cause the ground to sink, a process known as subsidence. Roads, buildings, and natural features can be damaged when subsidence occurs.

The second major environmental problem is contamination. Groundwater is generally contaminated when chemicals and other pollutants filter down with water into the aquifer. The sources of these contaminants include runoff from agricultural and residential areas containing pesticides, herbicides, and fertilizers; runoff from roads containing oil, gasoline and other chemicals; releases of contaminants from landfills and other storage facilities; septic tank discharge; and sewer leakage. In some cases, contaminants are released directly into the aquifer from leakage or discharge from underground wells that are used to dispose of wastes. Once groundwater is polluted, it is very difficult and costly to treat.

Assessment

Open response question: Discuss how groundwater contamination occurs in real-life situations and how it can be prevented.

References

"Always a River" – Supplemental Environmental Education Curriculum on the Ohio River and Water Grades K – 12. Published by the U.S. Environmental Protection Agency 1991

How the Water Gets Dirty

Author: Lisaann Hampton

Grade Level: 9 – 12, Social studies or Science

Enviroscape Model: Nonpoint source pollution

Objectives:
1) Students test models of water pollution
2) Students predict which human activities in their own neighborhoods might cause water pollution.
3) Students propose modifications to their neighborhood that decrease water pollution.

Program of Studies

Social Studies:
Geography 2.19
- explore how modifications of the physical environment have impacted life in the United States
- explore how modifications of the physical environment impact human life

Science:
Scientific Ways of Thinking and Working 2.1
- communicate designs, procedures, and results of scientific investigations.

Patterns, Systems, Scale and Models, Constancy, and Change Over Time 2.2 – 2.6
- explore how human activities alter ecosystems

Core Content for Assessment

Social Studies:
SS-H-4.2.2
Physical characteristics create advantages and disadvantages for human activities in a specific place.
SS-H-4.4.2
Human modification of the physical environment (e.g., a canal's impact on trade, clearing of rain forest reducing oxygen production, damming a river and its impact on climate) has possible global effects.

Science:
SC-H-3.5.5
Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.

Materials
- Nonpoint Source Model
- Worksheet
- Map of local area chosen to investigate and replicate with model

- 2 per student group
  - Markers for above in same colors as model powders provided

Procedure:

Before Class:
1) Copy worksheets/maps for students.
2) Divide maps into areas equal to the number of groups assigned.
3) Assign groups of 3 – 4 students to chosen areas of map.
4) Organize materials for Nonpoint Source Model.
5) Review teacher information.

Assessment
- See Results and Reflections section below, *How the Water Gets Dirty ActivityProcedure for Students.*
- Students predict which human activities in their own neighborhoods might cause water pollution and propose modifications to their neighborhood that decrease water pollution.

Reference: adapted from Living in Water
Department of Education
National Aquarium in Baltimore
ISBN 0-7872-4366-3
www.aqua.org

How the Water Gets Dirty
Teacher's Information

People typically think of water pollution as something that comes from big factories. Children's books generally blame some nameless company for water quality problems. In fact, federal regulations have made great strides in dealing with many forms of industrial water pollution. The kind of water pollution that has not improved is the kind that each and every one of us contributes to. The solution to many current problems cannot be regulation-no one can watch and monitor all of us? Only public education and changes in our behavior will help.

Water dissolves chemicals that it contacts as it runs over the surface of land and as it sinks into the soil (our water table for drinking water). In the natural world, many of these chemicals are essential mineral nutrients for plants living in the water. Humans have modified the natural world in ways that greatly increase the amount and kinds of chemicals dissolved in water as well as the soil particles suspended in water. These materials can have a serious impact on things living in water as well as on all organisms that depend on that water for drinking, including humans. This activity allows students to visualize and model how pollution enters the water holding areas and the water table.

Water pollution is divided into two categories, depending on how it reaches water: POINT SOURCE and NONPOINT SOURCE. The same chemical can show up as both. For example, nitrate can enter water as a point source from sewage discharge or as nonpoint source from lawn fertilizer runoff. Either way, it causes the same problems in the water. Point source pollution has been reduced since the original Clean Water Act because the federal, state and local governments have written and enforced regulations about what can come out of the pipes that are the point sources. A fertilizer factory cannot dump fertilizer into local water as part of the manufacturing process. A person who uses too much of the same fertilizer on his/her fields, lawn, golf course, etc., and has it wash away during rain into a local stream as nonpoint source pollution is not regulated. Education is needed to address nonpoint source pollution.

How the Water Gets Dirty.
Activity Procedure for Students

INTRODUCTION

1. Ask your students to describe ways they have observed water getting dirty when it rains. What kinds of water pollution have they observed? Their answers may range from oil or trash from a city street entering a storm drain to soil washing off a newly plowed farm field in a heavy storm.

2. Try to steer them away from the big factory syndrome and toward local, numerous smaller sources of pollution.

3. In groups of 3 – 4 have students view map of local area and discuss areas where water gets dirty from pollutant runoff during storms. Using colored markers, identify these areas on the map with letters A, B, C, etc. for each identified corresponding to the powder colors (pollutant types) provided. Have students identify their areas with corresponding colors on the back of the map and describe the source of the pollution. Correspond the pollutant colors to the powder colors using the markers.

4. Introduce them to the chemical, nitrate, which was discussed in the introduction to this section and the environmental effects it has on systems.

5. They are going to model what happens when too much of this chemical is used, spilled or dumped on land.

ACTION

- ✓ INTRODUCTION: Have students observe the Nonpoint model. Introduce the areas of the model as local areas the students are familiar with using local golf courses, playgrounds, parks, creeks, streams, etc. The instructor will have to assist the students in “seeing” the relationship to their local area. The model will be different geographically from the local area, but with similarities the instructor chooses to display. Challenge them to find out what happens to a chemical that is spilled or dumped from a specific site on their model. Have them verbally trace this to the large

body of water with the path or paths it takes. This is the point source of the pollutant

TEACHER NOTE: When a pollutant comes from a specific identifiable source that can be measured and regulated, it is called POINT SOURCE pollution. The primary chemical in question could be nitrate. Point sources of nitrate could be a sewage treatment plant outfall, a cattle feed lot, manure pile, a mismanaged fertilizer plant or storage facility. Brain storms on point source pollutants related to your local area. You should define all powders as a type of pollutant prior to this lesson.

1. Using the corresponding powder chosen for pollutants (such as brown for soil, green for fertilizer, red for oil, etc.), have students sprinkle on their area of point source pollution explaining their choice as they perform. They should put the pollutant in a concentrated circle; dime to quarter size is good, to reflect point source pollutants. Allow the next group to do the same. Continue this process until all groups have placed powder on their chosen point source pollution areas.

2. Discuss the point source pollutant areas with the students to insure understanding of this term.

3. Have the students make it rain using the spray bottle on their area of the model. Repeat this with each group until it has rained on each area and the students witness the pollutants running into the waterways.

4. Clean the model for nonpoint pollutant trial.

5. Repeat step 1 for nonpoint areas. Sprinkle the pollutants liberally over the areas identified as nonpoint pollutant sources. Compare this, with the students, to the point source pollutants to insure understanding of this term.

   TEACHER NOTE: Nonpoint source pollutants are not directly linked to one incident or area. Nonpoint source pollutants are usually run-off from community areas where no regulation standards are required. Examples would be from lawns, golf courses, fields, etc.

   Pollutants effect groundwater. Most pollutants do run off the land, but some are absorbed into the ground and passed through the water table. This groundwater pollution is much harder to correct than point source and nonpoint source pollutants.

6. Have the students make it rain using the spray bottle on their area of the model. Repeat this with each group until it has rained on each area and the students witness the pollutants running into the waterways. Compare the runoff to the point source pollutant trial.

7. While fresh in the student's mind, discuss the pollutants and paths it took. Challenge the students to hypothesize about the effects these pollutants have on the areas and the areas they ran through due to the rainwater.

8. Challenge students to describe what they think will happen to the pollutants as they spread across the land as nonpoint source pollution. It might be fertilizer spread on a lawn, pasture, field, golf course or garden. In cities, dog feces can be a major contributor to nonpoint nitrate pollution.

RESULTS AND REFLECTION

Have students describe their observations in an open forum, then write about them as an eyewitness reporter.

- ⇨ Can any of them relate their own observations of rain flow around their homes to what they observed in their models?
- ⇨ Where did the pollutants go in each case?
  (ANSWER: They dissolved in the water and were carried to the river)
- ⇨ Which had more runoffs of pollutants, the point source or the nonpoint source?
  (ANSWER: The nonpoint source should have more pollutant runoff)
- ⇨ Based on their observations, which would return to normal faster after pollution is stopped---a creek, a lake or the river.
  (ANSWER: The lake would be the last to show normal levels due to the filling from groundwater. Pollutants make their way into the water table and groundwater areas as they dissolve into the grasses, etc.)
- ⇨ Have students reflect on the accuracy of the model.
  - ✓ How is the model of pollution they used in this activity like and unlike real pollution?
  - ✓ What did you learn about pollution form observing the model?
  - ✓ What might make this model more realistic or useful?

CONCLUSION

In either case – point or nonpoint source pollutant – it is as necessary to regulate the general public as well as the large corporations. Regulation of the general public must come through education. No matter what the source, anything that dissolves in water gets into lakes, streams, rivers and groundwater---our source of drinking water. These chemicals can effect the natural ecosystems and their inhabitants as well as the humans that drink the water.

EXTENSION /ASSESSMENT/PORTFOLIO ACTIVITY

1. While viewing run-off, have students trace this onto their maps of areas, relating it to the local environment.
2. Have students create a poster with information of nonpoint source pollutants.
3. Have students investigate the effects pollutants and people have on ecosystems and the inhabitants of the area.
4. Have students write about three current pollution sources viewed in class and suggest modifications to the areas that will decrease the pollutant run-off. Using the second

copy of the map, have students make the modifications on the map. Students are to hand in the written report and map with modifications for assessment.

PORTFOLIO

5. Students are to write about the effects humans have on their local environment to a local paper. Include the above requirements for this piece.

How the Water Gets Dirty Activity Sheet

NAME: _____

DATE: _____

CLASS: _____

1) Before making source pollution on the Enviroscape®, discuss with your group what you want to represent and how it might have gotten there. Mark this on your map and clearly explain on the back of your map.

2) When you made it rain, describe what happened to the pollution and where it went.

⇨ Point source pollution

⇨ Nonpoint source pollution

3) Describe a story for how the nonpoint source pollution occurred in your map area.

4) Discuss why pollution in the water table is more difficult to clean than pollution above ground. What long term effects will this have?

5) Discuss one pollutant mentioned today and give two ways to lessen the amount of this pollutant into the water.

Wetland Information

More Than Just A Swamp

Author: Lisaann Hampton

Enviroscape Model: Wetland

Grade Level: 9 – 12 Science

Objectives:

- Students will be able to define different types of wetlands.
- Students will map types of wetlands across the United States.
- Students will be able to explain the importance of wetlands.

Program of Studies

Patterns, Systems, Scale and Models, Constancy, and Change Over Time (2.2 – 2.6)

- examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms
- explore how human activities alter ecosystems
- use science to investigate natural hazards and human-induced hazards

Core Content

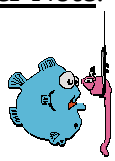
SC-H-3.5.5

Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.

Materials

- Wetland Model
- Worksheets
- Copies of United States map
- Red and blue colored pencils
- Computer lab or information printouts from websites listed above.

Teacher Note:



Information sheets are provided from the Internet sources. The fish and worm at the end of the information notes a new website follows.

Procedure

1. Ask students to describe a wetland. Place answers on the board. Answers will vary and none should be rejected.
2. Give students basic information on wetlands. Challenge students to list 3 reasons they feel wetlands are important.
3. Identify local areas that have wetlands to aid in the understanding and visualization of wetlands and their characteristics.
4. Allow students to take the photo tour of Ohio wetland plants to view digital pictures of the variety of plants in Ohio wetlands
5. www.epa.gov/owow/wetlands/bawwg/case/ohphoto2.html
6. Using the worksheets provided, have students complete the web search or paper search in groups.
7. Regroup and discuss findings from information search. Ask students to add to their list of 3 reasons wetlands are important, 6 new things they learned about wetlands.
8. Introduce the model and layout of the land.
9. Have students sprinkle soil and pollutants on the model to add realistic characteristics they experience in their area. These may be a construction site, pesticides on lawns, fertilizers, etc.
10. Have a student make it rain on the model for a given amount of time (30 seconds or 30 sprays). Observe how much water collected in the large reservoir along with the soil and pollutant colors.
11. Discuss with students the properties of the runoff water and effects it could have on the local environments.
12. Clean the model for the wetland demonstration.
13. Engage students in a discussion on where wetlands are found.
14. Have students place the wetland areas onto the model.
15. Repeat step 8.
16. Repeat step 9.
17. Compare, with students, the amount of water, soil and pollutant colors that were collected in the large reservoir.
18. Ask students to explain what they viewed and why wetlands are important.

Assessment

Students will write a report on wetlands. The information to include should be the basic definition, several types with descriptions, living organisms that depend on wetlands, the benefits of wetlands and the causes of pollutants to the environment near wetland areas. The student should include two drawings describing the flow of a water and debris with a wetland area and without a wetland area. Each drawing should be clearly labeled and organized for clarity.

Possible Portfolio:
Have the students make a two-page brochure on the information collected from this lesson advocating the conservation of wetland areas.

References: adapted from EPA

http://www.epa.gov/OWOW/

WETLAND INFORMATION

http://www.epa.gov/OWOW/wetlands/vital/what.html

What are Wetlands?

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Water saturation (hydrology) largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils.

Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Indeed, wetlands are found from the tundra to the tropics and on every continent except Antarctica. Two general categories of wetlands are recognized: coastal or tidal wetlands and inland or non-tidal wetlands.

Coastal wetlands in the United States, as their name suggests, are found along the Atlantic, Pacific, Alaskan, and Gulf coasts. They are closely linked to our nation's estuaries, where seawater mixes with fresh water to form an environment of varying salinities. The salt water and the fluctuating water levels (due to tidal action) combine to create a rather difficult environment for most plants. Consequently, many shallow coastal areas are unvegetated mud flats or sand flats. Some plants, however, have successfully adapted to this environment. Certain grasses and grasslike plants that adapt to the saline conditions form the tidal salt marshes that are found along the Atlantic, Gulf, and Pacific coasts. Mangrove swamps, with salt-loving shrubs or trees, are common in tropical climates, such as in southern Florida and Puerto Rico. Some tidal freshwater wetlands form beyond the upper edges of tidal salt marshes where the influence of salt water ends.

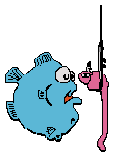
Inland wetlands are most common on floodplains along rivers and streams (riparian wetlands), in isolated depressions surrounded by dry land (for example, playas, basins, and "potholes"), along the margins of lakes and ponds, and in other low-lying areas where the groundwater intercepts the soil surface or where precipitation sufficiently saturates the soil (vernal pools and bogs). Inland wetlands include marshes and wet meadows dominated by herbaceous plants, swamps dominated by shrubs, and wooded swamps dominated by trees.

Certain types of inland wetlands are common to particular regions of the country:

2. bogs and fens of the northeastern and north-central states and Alaska
3. wet meadows or wet prairies in the Midwest
4. inland saline and alkaline marshes and riparian wetlands of the arid and semiarid west
5. prairie potholes of Iowa, Minnesota and the Dakotas
6. alpine meadows of the west
7. playa lakes of the southwest and Great Plains

8. bottomland hardwood swamps of the south
9. pocosins and Carolina Bays of the southeast coastal states
10. tundra wetlands of Alaska.

Many of these wetlands are seasonal (they are dry one or more seasons every year), and, particularly in the arid and semiarid West, may be wet only periodically. The quantity of water present and the timing of its presence in part determine the functions of a wetland and its role in the environment. Even wetlands that appear dry at times for significant parts of the year -- such as vernal pools-- often provide critical habitat for wildlife adapted to breeding exclusively in these areas.



http://www.epa.gov/OWOW/wetlands/stormwat.html#37

Wetland Types
NONTIDAL FRESHWATER

Lacustrine - Associated with bodies of water greater than 2 m in depth, or less than 8 ha in area, or less than 30 percent covered by emergent plants.
Riparian - Associated with flowing water systems. For example, bottomland wetlands are lowlands found along streams and rivers, usually on alluvial floodplains that are periodically flooded. These are often flooded and termed bottomland hardwood forests.
Palustrine -Do not have channelized flow and either are not associated with bodies of water or form the headwaters of streams. These wetlands include the following:
Marsh - A frequently or continually inundated wetland generally characterized by emergent, soft-stemmed herbaceous vegetation adapted to saturated soil conditions.
Swamp - Wetland dominated by woody vegetation.
Bog - A peat-accumulating wetland that has no significant inflows and outflows and supports acidophilic mosses, especially sphagnum.
Fen- A peat-accumulating wetland that receives some drainage from surrounding mineral soil and usually supports marshlike vegetation.
Wet prairie -Similar to a marsh.
Wet meadow - Grassland with waterlogged soil near the surface but without standing water for most of the year.
Pothole - Shallow marsh-like pond, particularly as found in the Dakotas
Playa - Term used in southwest United States for marshlike ponds similar to potholes, but with different geologic origin.

COASTAL

Tidal salt marshes - Found throughout the world along protected coastlines in the middle and high latitudes. In the United States, these wetlands are often dominated by *Spartina* and Juncus grasses. Plants and animals in these systems are adapted to the stresses of salinity, periodic inundation, and extremes in temperature.
Tidal freshwater marshes - Found inland from tidal salt marshes, but still experience tidal effects. These marshes are an intermediate in the continuum from coastal salt marshes to freshwater marshes.
Mangrove wetlands - Found in subtropical and tropical regions. These wetlands are dominated by salt-tolerant red mangrove or black mangrove trees.

WATER QUALITY/BENTHIC PROCESSES

An important function of wetlands is their role in changes that occur in water quality. Many complex chemical and biological processes that affect water quality occur in wetlands. The occurrence and timing of these processes are determined by the wetland type and the hydrologic regime of the wetland. Wetland water quality processes include:

1. Sedimentation
2. Filtration
3. Adsorption
4. Ion exchange
5. Precipitation
6. Biodegradation

STORMWATER CHARACTERISTICS

As human activities alter the watershed landscape, adverse impacts to receiving waters may result from changes in the quality and quantity of stormwater runoff.

Unmanaged storm surges increase discharges during runoff-producing storm events. These discharges result in a predictable change of waters flowing to those receiving waters. If left unmanaged, the hydraulic impacts associated with
The increased water volumes may be several orders of magnitude higher than the impact of the undisturbed watershed. In addition to causing runoff volume impacts, storm water can also be a major source of nonpoint source pollution in many watersheds.

Five main source activities contribute to surface water runoff pollution:

1) Agriculture
2) Mining
3) Construction
4) Urban activities
5) Atmospheric deposition

Sources of Urban Runoff Pollutants

1st Erosion
Sediment and attached soil nutrients, organic matter, and other adsorbed pollutants.
2nd Atmospheric Deposition

Hydrocarbons emitted from automobiles, dust, aromatic hydrocarbons, metals, and other chemicals released from industrial and commercial activities.

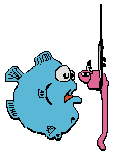
3rd Construction Materials
Metals from flashing and shingles, gutters and downspouts, galvanized pipes and metal plating, paint, and wood preservatives.

4th Manufactured Products
Heavy metals; halogenated aliphatics; phthalate esthers; PAHs; other volatiles; and pesticides and phenols from automobile use, pesticide use, industrial use, and other uses.

5th Plants and Animals
Plant debris and animal excrement.

6th Nonstormwater Connections
Inadvertent or deliberate discharges of sanitary sewage and industrial wastewater to storm drainage systems.

7th Accidental Spills
Pollutants of concern depend on the nature of the spill.



http://www.epa.gov/OWOW/wetlands/puzzle.html

Introduction

Wetlands are very important to the well-being of many plants and animals, including people. But what are these areas, and what do they do? A Wetland is the area between dry land and open water. It is sometimes covered with a shallow layer of water, but there are also wetlands, which can be dry for part of the year. The plants and animals which live there are adapted to this watery environment. There are many different types of wetlands.

Wetland Types

Swamp - Wetland where trees and shrubs grow which are flooded and rivers that experience both wet and dry periods during the year. They are often forested.

Marsh - Marshes are the wet areas filled with a variety of grasses and rushes. They can be found in both freshwater areas and in the saltwater areas near our coast.

Pocosin - These are the wet areas with evergreen trees and shrubs growing on peat or sandy soils. Peat is a spongy-feeling material made up of decaying plants. The word pocosin comes from the Algonquin Indian word meaning, "swamp on a hill."

Wetland Functions

Flood Control - Excess water from heavy rains is slowed by wetland plants and stored in the low-lying areas of wetlands, preventing the waters of nearby rivers and streams from overflowing and damaging property.

Storm Buffer - Along our coast, wetlands take a beating from high winds and waves, yet remain intact. The thick vegetation buffers the forces of storms and protects the land from erosion.

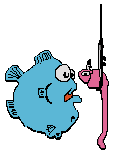
Water Banks - Wetlands hold water during the wet season. This water seeps through the soil and into our underground water supplies.

Water Filter - Wetlands help purify runoff waters, which carry pollutants. Silt and soil, which choke aquatic life, settle out. Wastes are broken down and absorbed by aquatic plants, as are many harmful chemicals.
Nurseries - Many fish and animals use wetlands as nurseries. They provide an abundant supply of food and shelter for they young.
Home Sweet Home - Wetlands are home to many animals. A thriving wetland probably has more life in it than any other kind of habitat.
Wildlife Pantry - Wetlands are so productive, many animals depend on them for food. Many migrating birds stopover in wetlands each spring and fall to rest and feed before continuing their trip, some will spend the winter in the wetlands.
Recreational Opportunities - Wetlands provide us with places to watch birds and animals, and to fish, boat, and hunt.
Economics - Commercial fisherman depend on the wetlands to supply us with crabs and many other types of seafood.

Wetlands in Danger!

More than half of the U.S. wetlands have been lost since the 1600's. They have been drained to make farm fields, or filled for developments or dredged for waterways. Wetlands become "drylands" when people fill them, build dams, or divert the water that feeds these areas.

In the past wetlands were considered useless wastelands. Now we know that they are very valuable to people and wildlife. Changing opinions are resulting in new laws to help save wetlands, but there is still much work to be done to stop the destruction and to restore our wonderful wetlands.



http://www.epa.gov/owow/wetlands/vital/nature.html

Wetlands are among the most productive ecosystems in the world, comparable to rain forests and coral reefs. An immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals can be part of a wetland ecosystem.

Physical and chemical features such as climate, landscape shape (topology), geology, and the movement and abundance of water help to determine the plants and animals that inhabit each wetland. The complex, dynamic relationships among the organisms inhabiting the wetland environment are referred to as food webs. This is why wetlands in Texas, North Carolina, and Alaska differ from one another.

Wetlands can be thought of as "biological supermarkets." They provide great volumes of food that attract many animal species. These animals use wetlands for part of or all of their life cycle. Dead plant leaves and stems break down in the water to form small particles of organic material called "detritus." This enriched material feeds many small aquatic insects, shellfish, and small fish that are food for larger predatory fish, reptiles, amphibians, birds, and mammals.
The functions of a wetland and the values of these functions to human society depend on a complex set of relationships between the wetland and the other ecosystems in the watershed. A watershed is a geographic area in which water, sediments, and dissolved materials drain from higher elevations to a common low-lying outlet or basin a point on a larger stream, lake, underlying aquifer, or estuary.

Wetlands play an integral role in the ecology of the watershed. The combination of shallow water, high levels of nutrients, and primary productivity is ideal for the development of organisms that form the base of the food web and feed many species of fish, amphibians, shellfish, and insects. Many species of birds and mammals rely on wetlands for food, water, and shelter, especially during migration and breeding.

Wetlands' microbes, plants, and wildlife are part of global cycles for water, nitrogen, and sulfur. Furthermore, scientists are beginning to realize that atmospheric maintenance may be an additional wetland function. Wetlands store carbon within their plant communities and soil instead of releasing it to the atmosphere as carbon dioxide. Thus wetlands help to moderate global climate conditions.