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Be Part of Something Big!

DNR-14-0104-0030

March, 2005

Contents

Introduction

Welcome to *Be a Part of Something Big*! This guide is designed for Grades 3-8 and provides educators and students the opportunity to gain hands-on experiences with water quality monitoring.

This series of activities is designed to help your class or student group learn more about the Chesapeake Bay and its tributaries. It does not need to be conducted in any particular order, however, some activities do build on one another. Please read through the entire guide before implementing it with youth.

The first part of this guide addresses basis watershed information and the flow of water. Students will learn what a watershed is, how to identify their watershed, and how water flows through the watershed. The second part of this guide addresses the impact of nutrients in the Chesapeake Bay. A hands-on activity demonstrates to students the problems associated with excess nutrients. The next section deals with streams and tributaries. Students will learn about chemical and biological characteristics of a stream and how to assess their local stream. The last section of this guide introduces students to action strategies that they can take to improve water quality in their local streams, and ultimately, the Chesapeake Bay. Activities in which they can participate include trash clean ups, stream buffer plantings, and personal conservation measures.

We hope that upon completion of the activities, students will be able to connect science concepts with their actions and that everyone will become active stewards of our watershed. Thank you for taking the time to teach youth about our rivers, streams and Chesapeake Bay. It is an important part of our lives and heritage. So, get out there and *Be Part of Something Big!*

Preparing for Streamside and Outdoor Activities

Many of the activities in “Be a Part of Something Big” are designed to be carried out at a stream or other outdoor location. The following steps are recommended to prepare for a safe and enjoyable streamside event.

1. Visit the stream yourself ahead of time. Determine which portion of the stream and how much of the stream is practical for your group to walk. Decide whether or not you can do activities that require wading in the stream.

2. Contact the property owner(s) whose lands are crossed by the stream you will visit. Venturing onto private property without permission is trespassing. **Please do not trespass under any circumstances!** Ask the owner(s) to grant permission for your group to walk the stream where it passes through their land.

   The owner of a given property may be determined by:

   a) Talking to the people who live nearest this particular stream section.

   b) Consulting property ownership maps prepared by the Maryland Department of Assessments & Taxation (MDAT). These maps may be viewed in the local MDAT office for your county or the local land records office. Real estate offices frequently have property ownership maps, as do some local libraries.

   c) Contacting the local Department of Public Works or Planning & Zoning Office. These professionals know who the local property owners are and might have an idea of how cooperative they may be in granting permission for your activities.

3. Prepare your group for their streamside event:

   a) The activities in “We’re on the Map!” and “Building a Watershed Model” are especially valuable in helping children understand the concept of a watershed and to visualize the relationship of the stream to their community, to the state of Maryland and to the Chesapeake Bay.

b) Review “Do’s and Don’ts by the Stream” **before** you travel to the stream and again at the streamside.

4. Make sure the children and their parents understand the importance of appropriate clothing and shoes for safety and comfort at the stream. You might advise them to bring extra pants, shoes and socks to school or the meeting place to change if necessary.

5. Have an adequate number of adult supervisors at the event. It is suggested that there is a 1:6 or 1:10 adult to child ratio depending on the age of the child.

6. Have a plan for how to deal with accidents and injuries should they occur. Know where you would need to call or go for medical treatment. Bring a first aid kit to take care of minor scrapes, cuts and bites.

7. Grouping of students may be done either prior to the event or at the meeting place to save time and confusion. If several activities are to be accomplished, make groups of at least three students each for safety reasons: one to get help, one to stay with the injured person.

8. Give instructions while students are at the meeting place. Let students know exactly what is expected of them and when and where they are to meet back (use a whistle if needed).

A Note About Rain…

Don’t let rain stop you unless conditions are hazardous.

Be cautious, but use nature to your advantage. Rainy weather provides opportunities to see run-off and sediment pollution as it happens. Be very careful about currents at all times, especially during rain. An adult should always check the depth and strength of the current before children enter a stream.

9. While you are streamside, try to review the data gathered while it is still fresh in their minds and able to be corrected.

10. Warn students not to drink water from the stream, even if it looks clean and clear.

11. Make sure to follow-up the trip by discussing data and “Wrap-Up” questions.

Be Part of Your Watershed

Activity 1: We're on the Map!

Goal

- To identify Maryland water systems by locating them on a map
- To discuss how the health of the water is affected by the community
- To instill a sense that students' actions are important

Voluntary State Curriculum

1.0 Skills & Processes
  A. Scientific inquiry: 1
6.0 Environmental Science
  C. Natural Resources & Human Needs: 1
  D. Environmental Issues: 1

Time 45 minutes

Materials

- ✓ Maryland Maps showing major river systems (1 map for every 1-2 students)
- ✓ Local maps showing local streams (1 map for every 1-2 students)
- ✓ Large sheets of paper, masking tape, and magic markers

OR

- ✓ Blackboard and chalk
- ✓ Colored Pencils or Markers
- ✓ "We're On the Map" Student worksheet

Resource

National Geographic Online Map Machine. Print out local topographical or street maps.

http://plasma.nationalgeographic.com/mapmachine/

Overview

Building background to develop concept of watersheds

Motivation

KWL chart – Healthy Water (include concept of pollution)

Procedure

1. Find out what students already know about the importance of clean water and water pollution. Ask questions to stimulate input and list responses on the blackboard or sheets of paper hung around the room. For example:
   - ❖ Why is clean water important?
   - ❖ What is pollution?
   - ❖ Why is so much of our water polluted?

2. Distribute the maps.

3. Point out the many rivers and streams in Maryland on the large map. Explain what it means to restore a stream; how the stream, the Chesapeake Bay, and the ocean are all connected.

4. Let students become familiar with the state map by asking them to find cities, rivers, the Chesapeake Bay, Atlantic Ocean, etc. Read aloud the name of a place and have them point to it. Use these as reference points later on.

Vocabulary

Mouth - the point where a stream empties into a larger body of water

Pollution – contamination of the natural environment

Source – where a stream first begins; the headwaters of a stream

Tributary – a stream flowing into a larger stream or body of water

5. Have students locate the areas that are listed below and write these names on the activity sheet.

Annapolis	Atlantic Ocean	Baltimore
Chesapeake Bay	Chester River	Choptank River
Elk River	Nanticoke River	Patapsco River
Patuxent River	Potomac River	Severn River
Susquehanna River	Washington, DC	Your town

6. Using the appropriate map(s), have students take colored pencils or markers and follow their stream from the headwaters to the mouth. Circle the stream's source and mouth.

7. Have students make a drawing of their stream on the activity sheet.

Wrap-Up

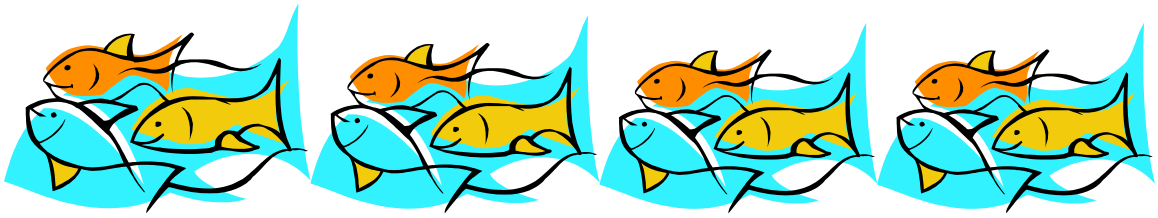
- Is your stream a tributary of a major river? Which one?
- How does your town affect your stream?
- How does your stream affect your town?

Assessment

- Completed activity sheet
- Participation
- Journal entry (What I have learned….) "Water Log"

Optional Challenge/Extensions

- Follow a stream's flow from the mouth to the Chesapeake Bay. Note: 5 percent of Maryland's streams do not flow into the Bay. Guess where they might be? (Western Garrett County flows to the Mississippi River, Christina River flows into the Delaware River and eastern Worcester County flows into Assawoman Bay)
- Examine maps of other watershed and major rivers, within North America and worldwide, such as the Mississippi River; Colorado River (Grand Canyon); Danube River and Vienna, Austria; Nile River and Cairo, Egypt.
- Journaling.
- Project WET Activities – Branching Out; Capture, Store and Release; Rainy Day Hike; Color Me a Watershed
- Healthy Water, Healthy People Activities – A Snapshot in Time; Water Quality Monitoring: From Design to Data



Sample Topographical Map & Watershed Outline

Determining watershed boundaries will be useful in discovering potential pollution sources of a particular waterway. What follows is a list of useful tips to help you draw the outline. Don't get discouraged. Even the experts have difficulty drawing watershed boundaries.

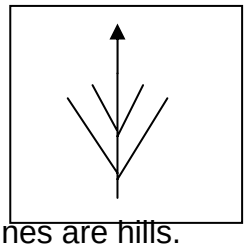
Tips and clues to help you draw watershed outlines:

- Color the streams you want to find in the watershed, and color streams surrounding your particular stream.

- Locate churches, schools and large buildings on the map. Many important buildings are built on hilltops.

- Look for small circles. These are hills, which will indicate watershed boundaries.

- You may see some V-shaped lines. These are streams or gulleys that will become streams in wet weather. The water travels through the V toward a stream like this:



U-shaped lines are hills.

- After coloring the streams, look for roads as watershed boundaries. Roads tend to follow the ridge lines and therefore follow the watershed boundaries.

- Watershed boundaries usually follow the "in between rule": whenever you find two different streams, the watershed boundary may be in-between the two streams. Often a road will bisect the streams.

- You may have several hills to choose from within the borders of your stream or waterway. Plan ahead! Mark those hills that you are certain are boundaries and plot your watershed boundaries by connecting the hills.

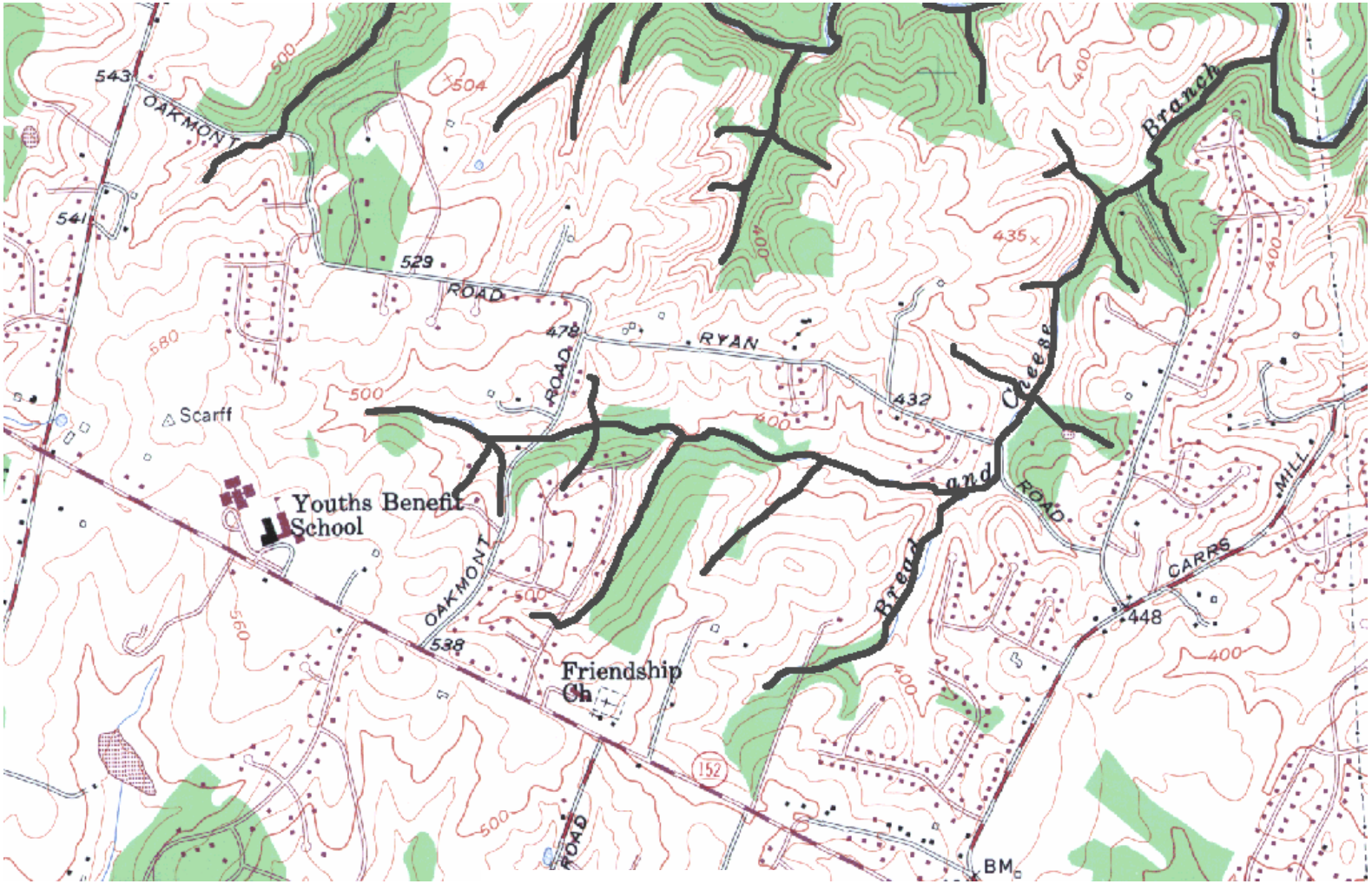
- Go through the middle of the circles and watch on either side of the hill for V-shaped lines pointing up towards the hill. Avoid the V's but go through the U's.

- Watershed boundaries are almost never in a smooth line. Often you may have hairpin turns to avoid another stream's drainage.

Student Page

Watershed Outline Exercise

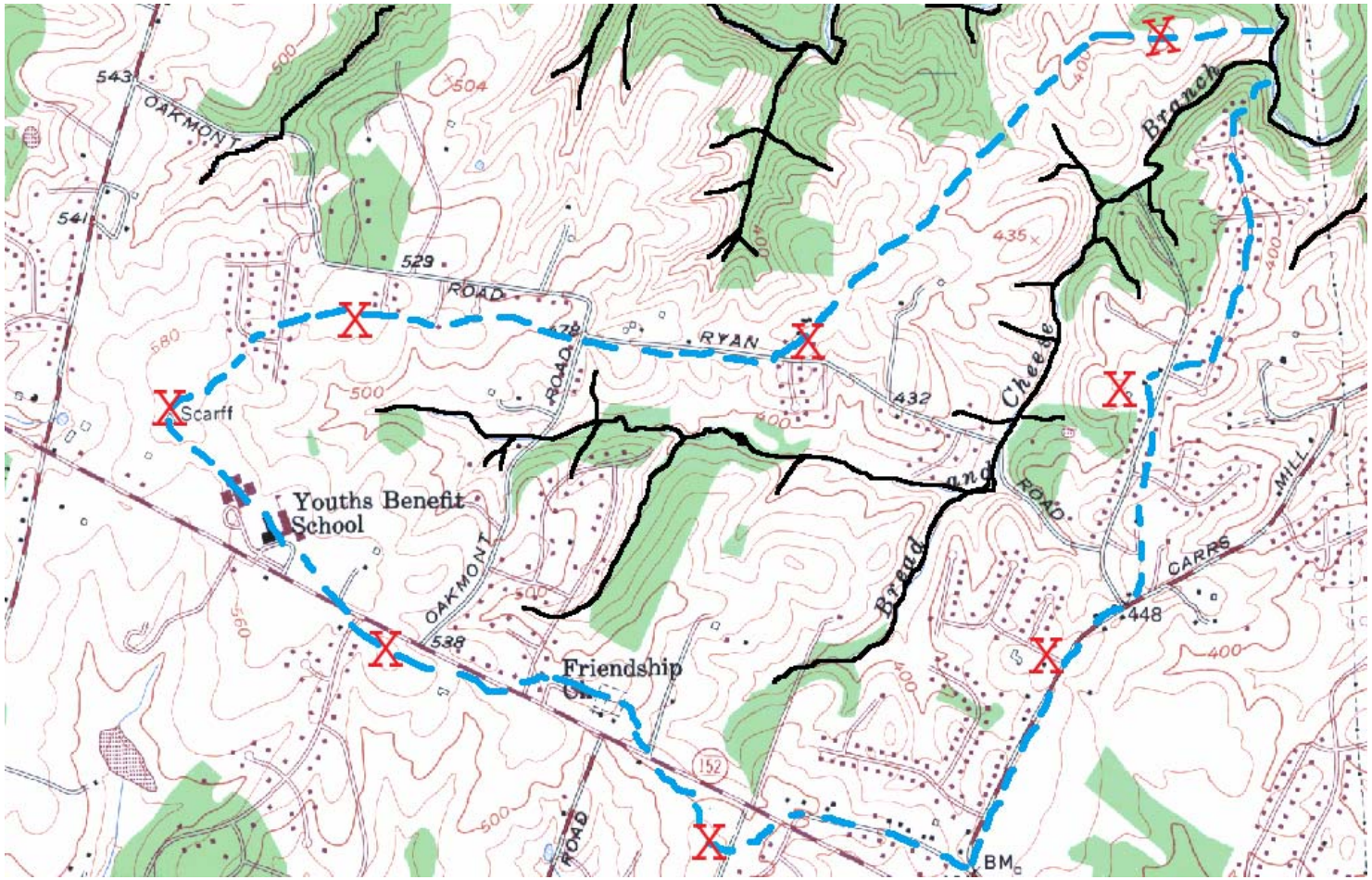
Below is a topographical map. Try to draw the watershed of the Bread and Cheese Branch Stream. Compare your outline with the completed watershed map on the next page.



Student Page

Completed Watershed Map

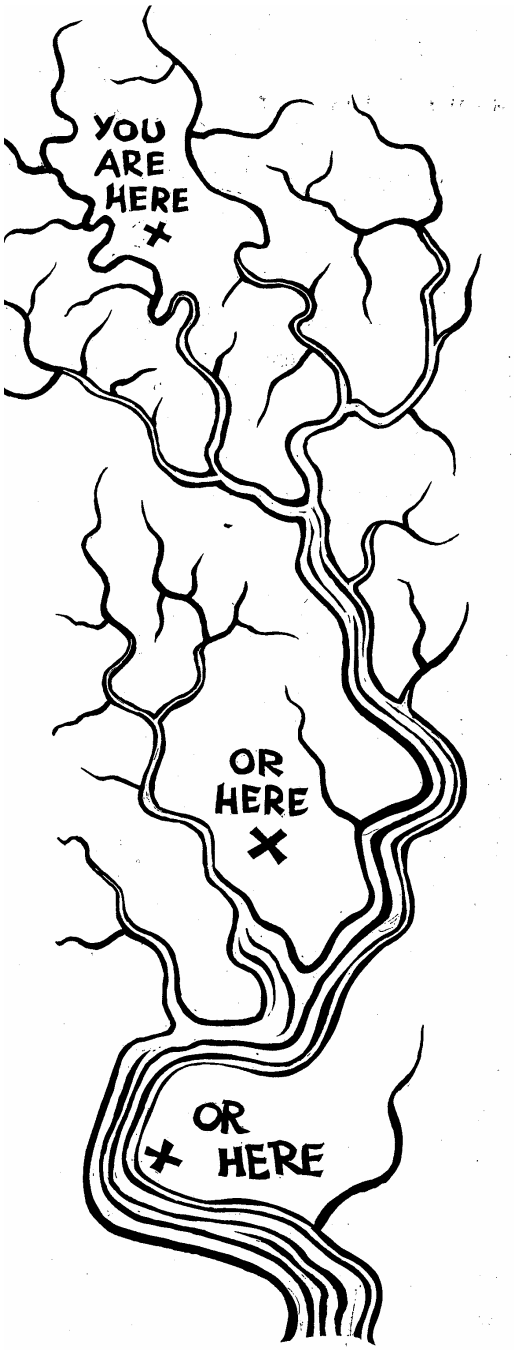
Compare your watershed outline to this one.



Student Page

We're On the Map!

Before you visit your stream, you need to have a "picture" in your mind of the stream. In what part of Maryland is the stream? How close is it to your home?



What You Will Need

- ☐ A large map of Maryland
- ☐ A map of your county
- ☐ Colored pencils or markers

Know the Meaning….

Tributary – a stream flowing into a larger stream or body of water.

Source – where a stream first begins; the headwaters of the stream.

Mouth – the point where a stream empties into another body of water.

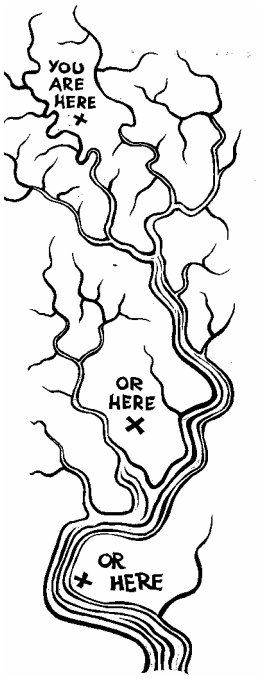
What to Do

On your large map find the cities and rivers your teacher names. List them on your activity sheet. On your county map, locate your stream. Find its headwaters and its mouth if you can (you may need help to use both maps). Mark the stream on your map.

Talk about what your group can do to improve your stream.

Student Page

We're On the Map!
Worksheet



Name: _____ Date: _____

My town is_____

The name of our local stream is _____

I found these places on the map

Vocabulary

Mouth_____

Pollution _____

Source_____

Tributary _____

This is a drawing of _____ stream

Student Page

Name: _____ **Date:** _____

We're on the Map!
KWL Chart

Before you begin your research, list details in the first two columns. Fill in the last column after completing your research.

Topic

_____

What I know	What I want to know	What I learned

Student Page

Be Part of Your Watershed

Activity 2: What is a Watershed: Building a Watershed Model

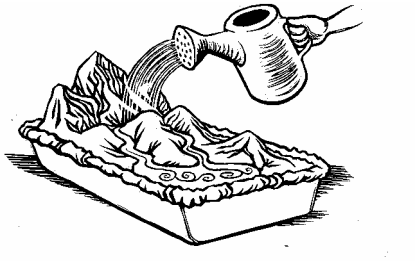
Goal

- To demonstrate a watershed
- To understand that land use and people affect water use and quality

Voluntary State Curriculum

1.0 Skills & Processes
- A. Scientific Inquiry: 4, 8, 9
- B. Critical thinking: 5

6.0 Environmental Science
- C. Natural Resources & Human Needs: 1
- D. Environmental Issues: 1



Time 45 minutes

Materials

- ✓ 1 baking pan
- ✓ Sheet of aluminum foil, 1 ½ times length of pan
- ✓ Blocks or rocks
- ✓ Food coloring
- ✓ Loose soil—small amount
- ✓ Kool-aid powder
- ✓ Water
- ✓ Watering can with shower spout or paper cups with holes in the bottom
- ✓ Sample topographical map and watershed outline
- ✓ "Building a Watershed Model" Activity Sheet

Motivation

Building the initial watershed.

Procedure

1. Have students read “What’s a Watershed?”

2. Prepare the model by placing blocks or rocks at the corners of one end of the pan (to form the shape for mountains). Cover the blocks and remainder of the pan with aluminum foil making valleys and streams. (Use crumbled paper under the foil to make smaller hills if needed).

3. Use the cup or watering can to make it “rain” on the model. Have students identify the mountains, streams, rivers, and bay.

4. Using a few drops of food coloring to represent pollutants; loose soil for sediment from farming, construction and erosion; and powdered drink mix to represent natural nutrients and minerals, place small portions of these materials on the model, either one at a time or all together. Make it “rain” again.

Wrap Up

- Ask group to define “watersheds”. Write an agreed upon definition on paper or blackboard. Show students the sample topographical map and outlined watershed. Explain how the watershed boundaries were determined. Show students the topographical map with the outline of the stream’s watershed.
- How does water get to a stream?
- What does the water bring with it?
- What affects the water on its way?
- What were some of the pollutants we added?
- What might be some actual pollutants in our local stream?
- What are some natural things the water carries with it? (Soil, nutrients, minerals).
- What effect did the soil have on the flow of water?

Vocabulary

Elevation – a measure of how high land is above sea level.

Nutrients and minerals – natural substances that help plants and animals grow; too much of them can be harmful.

Pollutant – something that contaminates the natural environment.

Runoff – water which is not absorbed by the land and which flows directly into streams or other bodies of water.

Sediment – soil that washes into a stream or river and settles on the bottom.

Watershed – an area of land that is drained by a river or stream.

Topography – the shape of the earth’s surface.

- What effect do pollutants have on the lakes, bay, plants and animals living in the watershed?
- How is it possible for someone who lives in the mountains to pollute the bay?

Modifications

- Work in a small group.
- Assign jobs for everyone.

Assessment

- Completed project
- Participation in discussion

Optional Challenge/Extensions

- Modify model by building a dam on a major stream in the model. How does it affect the land formation and water flow?
- Add sponges as buffer zones along the stream banks to see if they filter the water.
- Place the mountains in the center of the pan to illustrate two watersheds.
- Make clay models with towns, farms, boats, etc.
- Journaling
- Project WET Activities – Branching Out!; Capture, Store and Release; Rainy Day Hike, Color Me a Watershed
- Healthy Water, Healthy People Activities – A Snapshot in Time; Water Quality Monitoring: From Design to Data

What is A Watershed?

When we define a **watershed** we say that it is an area of land that is drained by a river or other body of water. But what *does* that *mean*? It's not easy to understand.

When you look at a map, you see lines for streams and rivers all over. All the land between the waterways "belongs" to the watershed of a particular stream or river or lake. How can you tell where one watershed ends and another begins?

The land between rivers and streams is never completely flat—even in places like Kansas. Some parts are always higher than others. We measure how high a particular spot of land is by how many feet it is above the level of the ocean. The measurement is called **elevation**.

For any area of land that lies between two bodies of water, the place that has the highest elevation will be the dividing line between the two watersheds.

Is it still hard to picture what a watershed is? Imagine you are on the beach. You make a mountain range on the beach by building a long mound of sand that runs toward the ocean. On each side of the "mountain range" you now dig a line that will be your streambed. If you pour water on the very top of your "mountain range," some water will roll off on one side and flow into stream 1; some will slide off on the other side and flow into stream 2. Now you can see that each stream has its own watershed and the highest point on your "mountain range" is the dividing line. Both streams flow into the ocean. So the watershed for the ocean includes the watersheds of both streams.

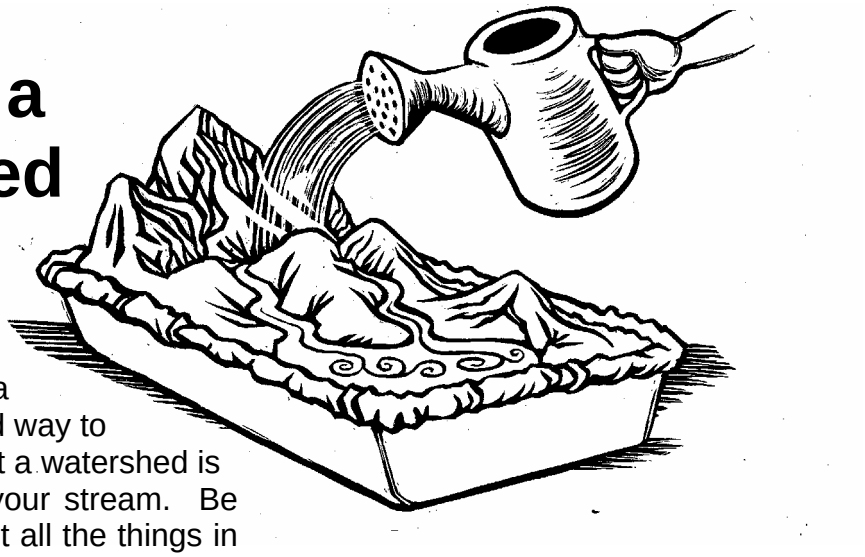
To find the boundaries of a watershed, you need a topographic map that shows the elevation of the land. Even with a topographic map, you can't always tell the exact dividing line between two watersheds, but you can make a good guess. Unless you live near the area of the highest elevation, you can probably tell which watershed your town is in.

Why is it important to know about watersheds? Every inch of land is part of some watershed. Anything that goes onto the land anywhere in the watershed will end up in the water. If you put toxic weed killer on your lawn, the poison will end up in the stream. If you pour used oil on the street or sidewalk, rain will wash it down the storm drain and then into the stream.

No matter how far away you are from the water, what you do on the land will affect some stream or other body of water. You can see why it's everybody's business to protect and restore our waterways.

Student Page

Building a Watershed Model



Building a model of a watershed is a good way to understand just what a watershed is and how it affects your stream. Be creative. Think about all the things in your community that might affect your stream. How many can you show in your watershed?

What You Will Need

☐1 baking pan ☐ Blocks or rocks
☐ Food coloring ☐ Loose soil
☐ Powdered drink mix ☐ Water
☐ Sheet of aluminum foil 1 ½ times the length of the banking pan
☐ Watering can with shower spout or paper cups with holes in the bottom

Know the Meaning…

Elevation – a measure of how high land is above sea level.

Nutrients and minerals – natural substances that help plants and animals grow; too much of them can be harmful.

Pollutant – something that contaminates the natural environment.

Runoff - water which is not absorbed by the land and which flows directly into streams or other bodies of water.

Sediment – soil that washes into a stream or river and settles on the bottom.

Watershed – an area of land that is drained by a river or stream.

What To Do

Build a model of a watershed. Use blocks or rocks for mountains. Cover the rocks and the rest of the pan with aluminum foil. Shape the foil to make valleys and streams and hills. Use the watering can or cup to make it "rain" on the model. Watch how the rain travels over the watershed. Pretend the food coloring is pollutants, soil is sediment from farming, construction and erosion, and the drink mix is nutrients and minerals. Place small bits of these materials on the model. Make it "rain" again. What happens? Talk about what your model tells you about a watershed.

Student Page

Building a Watershed Model

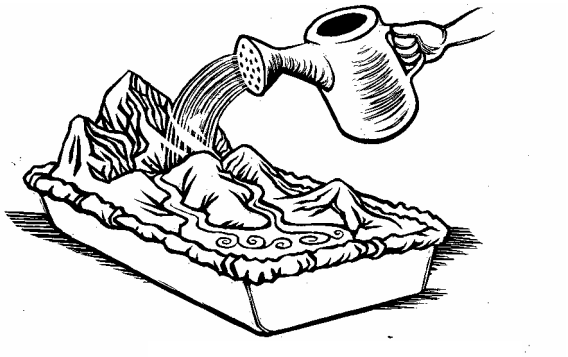
This is a sketch of our watershed model. Draw arrows showing how the water flows.

We think these pollutants might be getting into our stream.

_____ _____

_____ _____

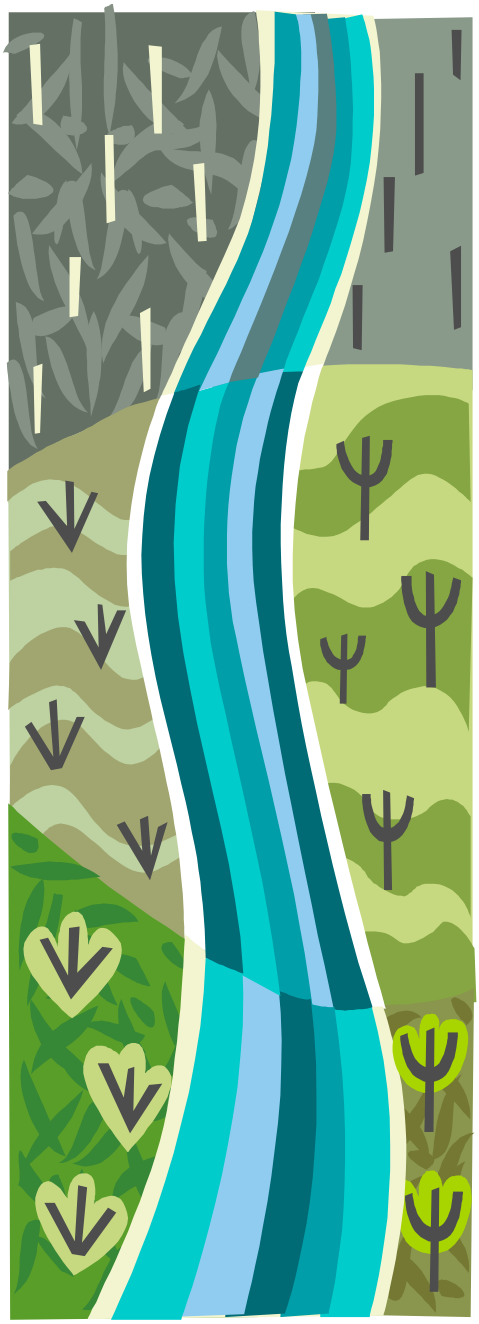
_____ _____



Student Page

Nature's Water Recycling Program and How People Change It

Introduction



The previous activities were designed to be conducted prior to a stream visit. The purpose is to help students develop an understanding of the natural water cycle and how people change it.

It is not essential that your group carry out any of these activities before a stream visit. You may choose to go directly to the streamside activities. However, it is recommended that you review the following written materials before conducting any of the outdoor activities:

- How Nature Recycles Water
- Where Does the Rain Go?
- Too Much of a Good Thing

This information is essential for understanding the importance of streamside and community activities.

If your group is unable to participate in streamside activities, the exercises in Part II and IV provide options that do not require a stream visit.

The directions for these activities are suggested ways of carrying out the exercises. Feel free to expand and elaborate if you have the resources.

Be sure to engage the students in your group in discussions about how these activities relate to the particular watershed of your stream. Help them make the connections.

Most importantly, ***HAVE FUN***!

Activity 3: Water Cycle Theater

Goal

- ❖ To describe the movement of water through it's natural cycle.

Voluntary State Curriculum

1.0 Skill and Processes
- A Scientific Inquiry: 1, 9
- B Critical Thinking: 5

6.0 Environmental Science
- C Natural Resources & Human Needs: 1

Time 60 Minutes

Materials

- ✓ Paper and Pencils
- ✓ Your imagination
- ✓ Water Cycle Theater Activity Sheet
- ✓ "How Nature Recycles Water"

Motivation

Read, "How Nature Recycles Water"

Procedure

1. Have the students read "How Nature Recycles Water" and talk about the water cycle. Make sure the terms are understood.

2. Lead the group in brainstorming how they might represent the water cycle in a play. Work with them to write and act out their own play. You can make this as simple or elaborate as you want (e.g., design and make costumes or create placards saying what each actor represents).

3. Have students color and/or label the parts of the cycle on the diagram on the activity sheet.

Vocabulary

Condensation – the process of water vapor in the air changing into a liquid or solid.

Evaporation – when liquid water turns into a vapor or gas.

Precipitation - when water molecules fall to the ground in the form of rain, sleet or snow.

Groundwater - water that flows or seeps through the soil and saturates soil or rock, supplying springs and wells.

Infiltration – the flow of water from the land into the ground.

Runoff – the water which is not absorbed by the land and which flows directly into streams or other bodies of water.

If there is not enough time to write the play, or if the group cannot come up with an idea, use or adapt the script on the following page.

Wrap Up

- Where does the water we use come from? (Groundwater, rain, the whole cycle)
- When it rains, is the rain that falls new water? (No, part of the cycle)

Modifications

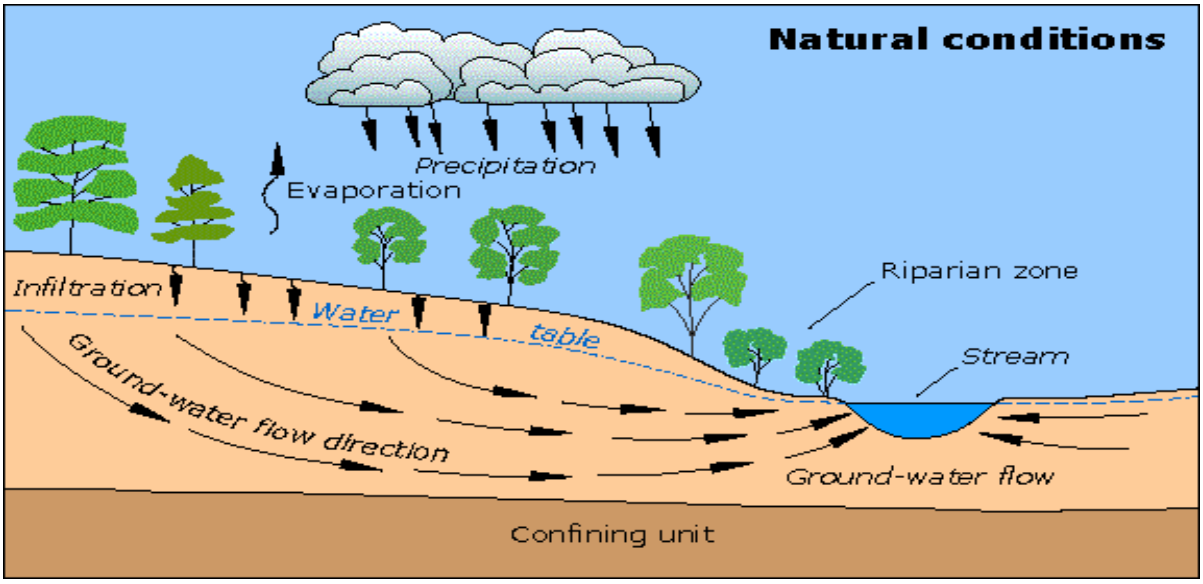
- Color Worksheet
- Help prepare for the play

Assessment

- Completed worksheet.
- Participation in play and discussion.

Optional Challenges/Extensions

- Modify play to include alternative scenarios.
- Journaling
- After learning about pollution and erosion, adapt the drama to incorporate these concepts (e.g. have the water molecules pick up and carry symbols of pollution as they pass over towns or carry symbols of pesticides and sediment as they flow over farms and construction sites).
- Project Wet Activities: Imagine, The Incredible Journey, Just Passing Through, Poetic Precipitation, The Rainstick, Stream Sense, The Thunderstorm, Water Match, Water Models, Where are the Frogs?
- Healthy Water, Healthy People Activities: Pollution-Take it or Leave it, A Snapshot in Time, From H to OH!



Water Cycle Theater Skit

What You Will Need

☐ Paper and Pencils
☐ Your imagination

Know the Meaning…

Condensation –
the process of water vapor in the air moving closer together and turning into liquid water.

Evaporation – when liquid water turns into a vapor.

Precipitation –
when water molecules fall to the ground in the form of rain, sleet or snow.

Groundwater - water that flows or seeps through the soil and saturates soil or rock, supplying springs and wells.

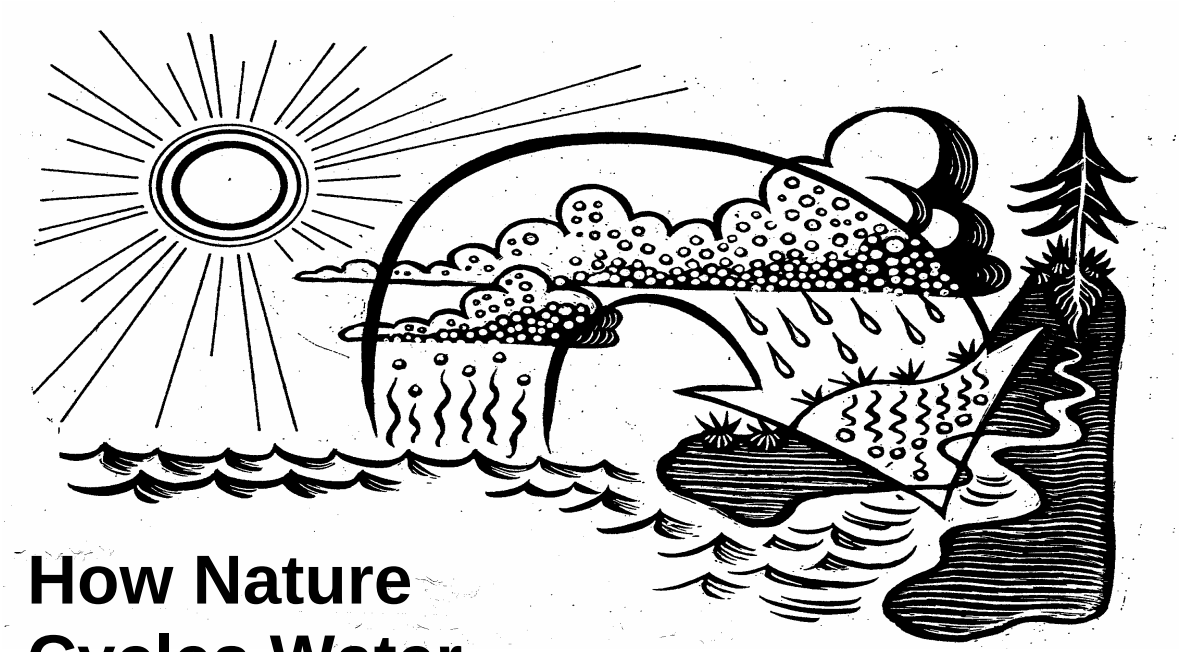
Infiltration - flow of water from the land into the ground.

Runoff – water that hits hard surfaces (concrete asphalt, roofs), is not absorbed into the soil and runs quickly downhill into a stream.

What To Do

Read "How Nature Recycles Water" and then try being a playwright. Write a play that shows how the water cycle works in a natural setting (Your teacher or leader has a sample script if you need some ideas). Decide what parts people will need to play to act out the cycle. A water molecule is made of two hydrogen atoms and one oxygen atom. You might have several groups of three people each be water molecules. Other people can be mountains and bodies of water. Decide who will play each part. Write a script for a narrator to read while the actors play their parts. Decide if you will have costumes or just use your imagination. BE CREATIVE!

After the play, talk about the water cycle. Does it make sense to you? Why is it important to the earth? To people?



How Nature Cycles Water

Water is essential for life on earth, yet we often take it for granted. Under natural conditions, water goes through certain “recycling” steps. As the water recycles it is cleaned and made healthy for plants and animals. The steps of the recycling process are:

Evaporation occurs off of any body of water. Water on the surface of a lake, river or stream is taken up into the air in tiny particles or molecules. The water changes from a liquid form to a gas. An example of this would be a puddle after the rain that disappears on a hot sunny day.

Condensation in the atmosphere happens when more and more molecules of water rise and hit colder parts of the air. The gas then turns into liquid again. Clouds are molecules of water that are not yet close enough together to be pulled to Earth by gravity. Often condensation happens early in the morning in the form of dew that forms on grass and plants.

Precipitation occurs when the condensed water falls to the earth. Precipitation takes different forms (rain, snow or sleet).

In a natural setting when water is returned to the earth through precipitation, most of the water seeps into the soil gradually; this is called **infiltration**. Beneath the surface, the water reaches layers of porous rock and becomes **groundwater**. Groundwater gradually seeps back out to form a source of streams. When a lot of rain falls in a short period of time, the ground becomes saturated. Then some water flows over the ground and runs into streams and rivers; this is natural runoff.

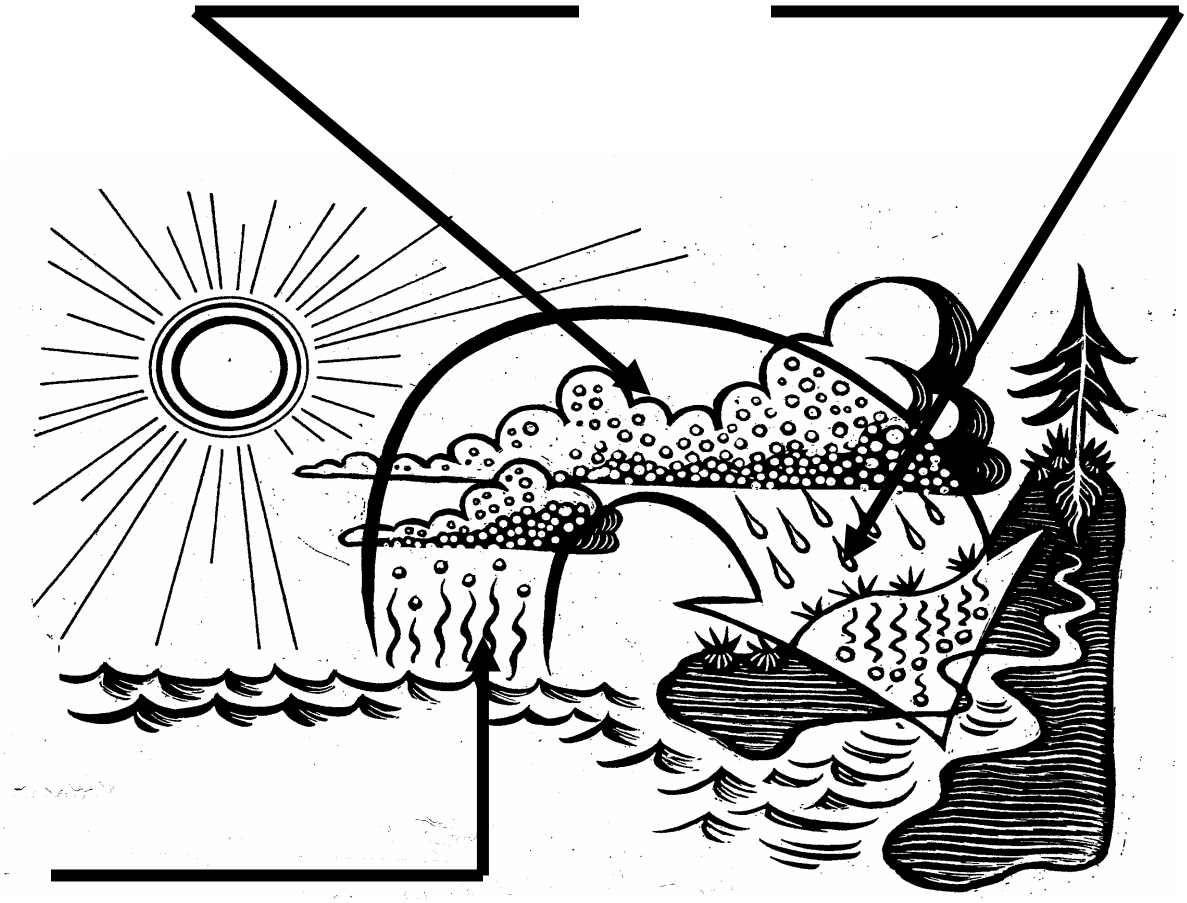
The cycle continues with more surface water evaporating into the air.

Student Page

Water Cycle Theater

Write each word on the line where it belongs:

CONDENSATION **EVAPORATION** **PRECIPITATION**



What did you learn from the water cycle theater?

Water Cycle Theater Sample Script

Water Cycle Theater Sample Skit

Roles:

- 1 Person represents a mountain.
- 1 Person represents the lake.
- 3 People represent a water molecule (2 hydrogen, 1 oxygen).

Place the mountain and body of water on opposite sides of the "stage". The water molecules should be positioned near the body of water.

Narration: (The teacher or leader can be the narrator, or one of the students may be asked to take the role. Adapt the narration to the level of students.)

I would like to introduce you to our (name of school or group) Prime Time Players who will act out the water cycle for you. On my right, we have Lake (student's name).

Near the lake we have a large molecule of water (students' name). What two elements make up water? (Hydrogen & Oxygen). How many hydrogen atoms are in a molecule? (2) The hydrogen atoms are the two outside people.

The person in the middle represents our oxygen atom. Energy bonds hold the three atoms together. Notice that they are holding hands. (If boys and girls are uncomfortable doing this together, use all girls or all boys). If they break that bond, they are no longer a molecule of water.

Now, let's use our imagination! This molecule is sitting on top of Lake (student's name). Use your imagination; we don't want to squash our lake! The sun starts to warm our body of water making our molecule move faster and spread apart but not disconnect. As they move and bump into other molecules, they "fly" off of the water into the atmosphere, up and across the sky toward the mountain (molecule should "float" on tiptoes as they move); i.e., evaporation. The higher they go, the colder it gets, making them slow down and cling together (molecule moves closer together); i.e., condensation.

Imagine more molecules forming a cloud that then bumps into the mountain (stand near mountain; don't knock the mountain over!) The cloud becomes too heavy to float, so the molecules drop to the ground (squat down if it is not practical to lay on the ground); i.e., precipitation.

The molecules are then absorbed into the ground, but we can't show this step because we would have to bury our molecule in the ground; i.e., infiltration. Some molecules can't be absorbed into the ground. These molecules flow into little streams back to the body of water (stand up and walk back toward the lake); i.e., run-off. Let's give our actors a big round of applause!!!

Where Does the Rain Go?

Activity 4: Soak it Up!

Goal

- To determine the best material for infiltration by quantitative measurements.
- To understand the importance of natural “buffers” along waterways.

Materials

- ✓ 3 baking pans
- ✓ 2 cup measuring container (or 500 ml)
- ✓ 3 coffee cans or 3 flower pots
- ✓ Aluminum foil
- ✓ Can opener
- ✓ Hammer & nail or ice pick/knife
- ✓ Soil
- ✓ Gravel
- ✓ Plant
- ✓ Water
- ✓ Soak It Up! Data Form

Voluntary State Curriculum

1.0 Skills and Processes
A Scientific Inquiry: 1, 4, 6, 2
B Critical Thinking: 5

Time 45 – 60 minutes

Background

In a natural forest setting there are many “buffers”. Buffers do two important things: they slow the flow of rainwater into a stream and they filter pollutants from the water.

Buffers such as trees, shrubs, weeds, and tall grasses all help to protect the soil from being washed into the stream. They keep the rain from hitting the soil directly. The roots hold the soil and keep it from washing away. Most of the rain soaks into the soil. Very little water runs right into the stream.

When rainwater has a chance to soak into the ground, the soil filters out many of the pollutants the rain collected. This reduces the pollution that enters the streams and rivers.

When areas are developed, most of the natural buffers disappear. Rain hits hard surfaces (concrete, asphalt, roofs) that cannot absorb the water. The rain runs off very quickly downhill and toward the stream.

Why is runoff bad for the stream? Runoff carries pollutants into the streams that make the water unfit for plants and animals. Some examples of pollutants include: air pollution such as sulfur and nutrients, pet wastes, fertilizer, pesticides, oil, and toxic metals from cars, rainspouts and paint. Run off causes more flooding and floods occur more often. It increases stream erosion. Less water soaks into the ground and into the stream channel. The stream level falls or may even dry during times when there is no rain. Runoff can also change the temperature of the stream. As the rain flows over roads on a warm day, it gets very warm. Many plants and animals that need cool temperatures to live cannot survive.

Buffers help prevent pollution, floods, erosion, and temperature changes from affecting streams.

Vocabulary

Buffers – trees, shrubs, weeds and tall grasses planted along a stream.

Runoff – water that hits hard surfaces (concrete asphalt, roofs), is not absorbed in the soil and runs quickly downhill into a stream.

Erosion – the wearing away of soil by rain, wind, water or ice.

Headwaters – small streams that are sources of water.

Algae – microscopic plants.

Riffles – fast flowing shallow areas.

Sediment – soil in streams.

Stream bank – side of stream.

Velocity - speed

Motivation

Review “The Natural Stream Environment”
Read “Where Does the Rain Go?”

Procedure

This activity can be done as a demonstration individually or by students in a small group.

1) Prepare containers ahead of time or have students do it. (Use either coffee cans or flower pots.)

   Coffee can: Remove one end with a can opener and punch several holes in the opposite end using the hammer and nail or ice pick.

   Flower pot: Remove saucer and make sure it has several drainage holes.

2) Prepare filters. Fill one can ¾ full with a mixture of soil and gravel. Wet the soil so that it is damp but not saturated. Fill the second can with the plant and soil so it is ¾ full. Wet the soil but do not saturate it. In the third can, place several loose clumps of aluminum foil.

3) Place each can in individual baking pans to collect the water that drains through the coffee can or flower pot.

4) Explain the following procedure and have students predict the final amounts collected for each pan on their Soak It Up! Activity sheet.

5) Pour two cups (16 oz.) or 500 ml of water into each pot.

6) After two minutes, quickly pour the water that has collected in the baking pans back into the measuring cup. Return the pan to collect further drainage. Record the amount collected and discard the water.

7) While waiting for next measurement, talk about the differences observed. Relate observations to what happens to rainwater. What kinds of surfaces will absorb water and filter it slowly? What kinds of surfaces will cause excessive runoff? Why is runoff bad for the stream? Think of your community: What does the rain fall on? What does it mean for your local stream?

8) After eight more minutes, measure what is collected. Record the results and answer questions.

Modifications

- Work with a partner.

Assessment

- Participation (discussion and/or group activity)
- Successfully completed bar graph.

Wrap Up

- Clean up materials. Do not pour sediments down the drain.
- Discuss the results of eight minute measurements and totals.
- Why is the rate of infiltration or runoff important to streams? (Slow infiltration helps purify water; runoff can carry pollutants with it; heavy flows of water into a stream cause erosion; heavy runoff can cause temperature of a stream to rise.)

Optional Challenges/Extensions

- Do two more trials and compute the average. Does the infiltration capacity change after several "rainfalls"?
- Make a bar graph of the results for total drainage.
- Journal.
- Project Wet Activities: Imagine, The Incredible Journey, Just Passing Through, Poetic Precipitation, The Rainstick, Stream Sense, The Thunderstorm, Water Match, Water Models, Where are the Frogs?
- Healthy Water, Healthy People Activities: Pollution-Take it or Leave it, A Snapshot in Time, From H to OH!

Where Does the Rain Go?

How healthy is your local stream?

A lot will depend on where the rain goes when it falls. What kind of surfaces does it hit? How fast does it travel to the stream?

In a natural forest setting there are many "buffers". Buffers do two important things: they slow the flow of rainwater into a stream and they filter pollutants from the water.

Buffers such as trees, shrubs, weeds and tall grasses all help protect the soil from being washed into the stream. They keep the rain from hitting the soil directly. The roots hold the soil and keep it from washing away. Most of the rain soaks deep into the earth. Very little water runs right into the stream. When rainwater has a chance to soak into the ground, the earth filters out many of the pollutants the rain collected. This means less pollution will enter the streams and rivers.

When people build houses, roads and parking lots, most of the natural buffers disappear. Rain hits hard surfaces (concrete, asphalt, roofs) that don't absorb water. Instead, the water runs very quickly downhill and toward the stream. This is called runoff.

Why is runoff so bad for the stream?

1. Runoff carries all kinds of pollutants into the stream. Pollutants make the water unfit for plants, animals and unsafe for people. Some of the examples of pollutants carried in runoff are:

   - ❖ Air pollution such as sulfur and nutrients,
   - ❖ Pet wastes,
   - ❖ Fertilizer and pesticides,
   - ❖ Oil leaking from cars,
   - ❖ Toxic metals from cars, rainspouts and paint.

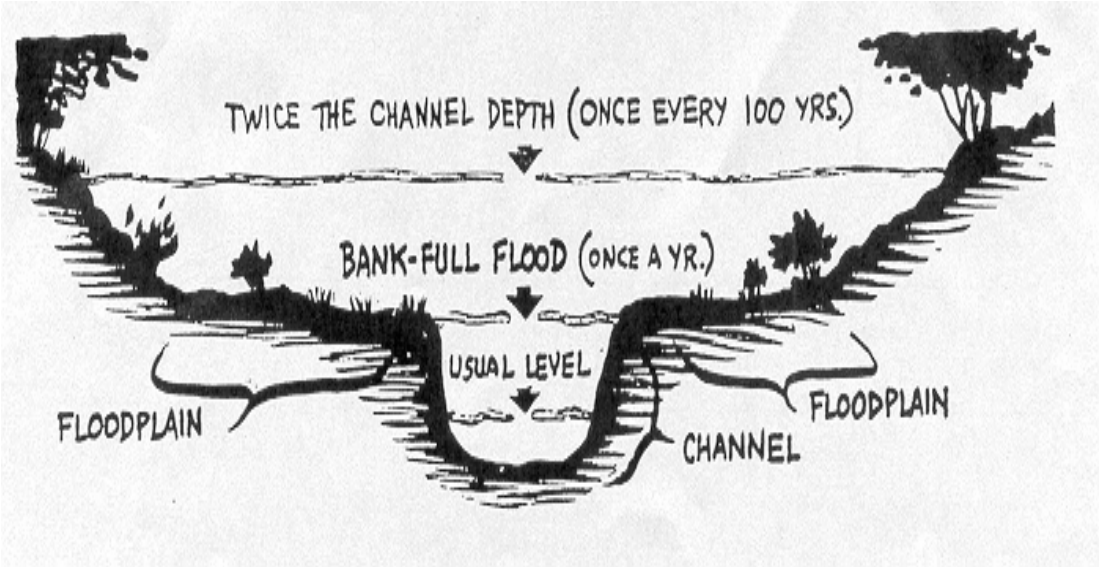
2. Runoff causes more flooding and floods occur more often.

3. Runoff increases stream erosion.

4. Less water soaks into the ground to seep slowly into the stream. The stream gets very low or even dry during times when there is no rain.

5. Runoff can also change the temperature of the stream. Think about how hot the streets and sidewalks are on a warm summer day. As the rain flows over these surfaces, it gets very warm. Many plants and animals that need cool temperatures to live cannot survive.

6. Buffers help prevent pollution, floods, erosion and temperature changes. They are important to the health of the stream. If you know what makes a good buffer and what causes runoff, you can figure out how to restore your stream.



Natural Stream Environment

A healthy stream, in its natural condition, has water that is clear, cool, and odorless and flows through a setting that is pleasing to the eye. What makes a natural stream healthy?

The chemistry of a natural stream is much as it has been for the last 10,000 years. Most of the chemicals contained in a stream are carried in by groundwater. The amount of chemicals such as dissolved oxygen, nutrients and acidity varies. The living things that dwell in these waters have adapted to these variations. Chemicals only become harmful when the amount exceeds the natural range that is safe and healthy for fish and other aquatic life.

Natural stream flows tend to be stable over time. The dry weather flow of a stream is fed by water that originally fell on the watershed (all the land draining into the stream) as rain. The rain soaks into the forest floor, travels through the earth, and flows into a stream. Storms produce flooding. The frequency of floods is regular on a long-term basis. For instance, once every year a flood will occur that fills the stream to the bank and, once a century, a flood will swell to twice the channel depth. Stream life adjusts its reproductive patterns in one to three years to replace the number lost as a result of the flood.

As groundwater comes out of the earth, it averages 55 degrees Fahrenheit and warms very gradually as it journeys downstream. The dense shade of streamside trees and shrubs limits the daily temperature range to only a few degrees. Under these beneficial conditions, aquatic life is very diverse. Many different kinds of creatures will live in the stream. There may be as many as 20 aquatic insect species and a dozen or more fish species living there. Plant material, such as decomposing leaves, serves as the basis of the stream food web in headwater areas (small streams that are the sources of rivers). This plant material comes mostly from nearby trees, shrubs and the forest floor. Some insects shred leaves into

smaller parts, others feed upon the feces of the leaf shedders. Farther downstream, the channel widens and sunlight reaches the water. More sunlight allows algae (microscopic plants) to grow. These microscopic plants are the beginning of the food chain.

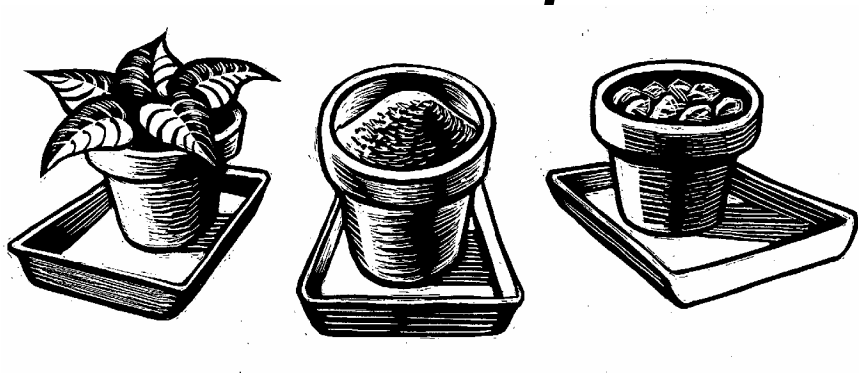
The natural stream provides many kinds of habitats for various types of aquatic life. Many aquatic insects live in riffles (fast flowing shallow areas) where they attach to a rock and collect food from the flowing water. Larval fish also look for riffles to hide from predators. Schooling fish cruise about the depths of pools. Game fish, (trout and bass) lurk in sheltered places, such as fallen logs, behind boulders, under an undercut bank or at the bottom of a dark pool. For many of these game fish, hiding places are nature's way of controlling their number.

Under natural conditions, balance is maintained by the floods, the quantity of eroded soil washed into the stream from the watershed, and the amount of sediment (soil) eroded from the channel. For each ton of sediment carried in, a ton of sediment is removed from the bed and transported down stream. Because of this balance, the streambed is very stable. There are only a few soft spots and exposed sand bars are rare. Dry-weather flow tends to fill the channel from one end of one stream bank (side of the stream) to the other. Healthy stream banks, well vegetated with trees and shrubs, have very few bare, eroded spots.

Like the banks, the flood plain tends to be well covered with vegetation. Floodplain vegetation contributes more than just food to the stream. The trees and shrubs also slow flooding. When a floodplain lacks trees, floodwater elevations will be much higher and have a greater velocity (speed). Slower floodwater velocity controlled by the trees also increases the amount of sediment trapped in these streamside flat lands.

What happens when humans change a natural stream? If the amount of chemicals allowed to flow into the stream is more than the natural level of chemicals in the groundwater that feeds the stream, the aquatic life may not be able to adapt to the changes. Cutting down trees along the streams will reduce the amount of food available for aquatic insects. The lack of trees will allow flooding and erosion. The rise in water temperature from the lack of shade will be too warm for the aquatic life that live in the stream and they will die. Without the tree roots that once helped stabilize the banks, soil will erode into the stream causing sediment to fill up pools and cover riffles. Paving large amounts of the watershed will decrease the amount of rainwater soaking into the ground to become groundwater. Runoff from paved areas will cause water to flow quickly into the stream causing flooding and taking pollutants with it. When people alter stream channels, important habitat such as undercut banks, pools, riffles and submerged logs that are home to fish and aquatic insects are eliminated.

Soak It Up!



Know the Meaning…

Buffers – trees, shrubs, weeds and tall grasses along a stream

Runoff– water that hits hard surfaces (concrete asphalt, roofs), is not absorbed into the soil and runs quickly downhill into a stream.

Erosion – the wearing away of soil by rain, wind, water or ice

What You Will Need

- 3 baking pans
- 2 cup measuring container (or 500 ml)
- 3 coffee cans or 3 flower pots
- Aluminum foil
- Can opener
- Hammer & nail or ice pick/knife
- Soil
- Gravel
- Plant
- Water
- "Soak It Up!" Data Form

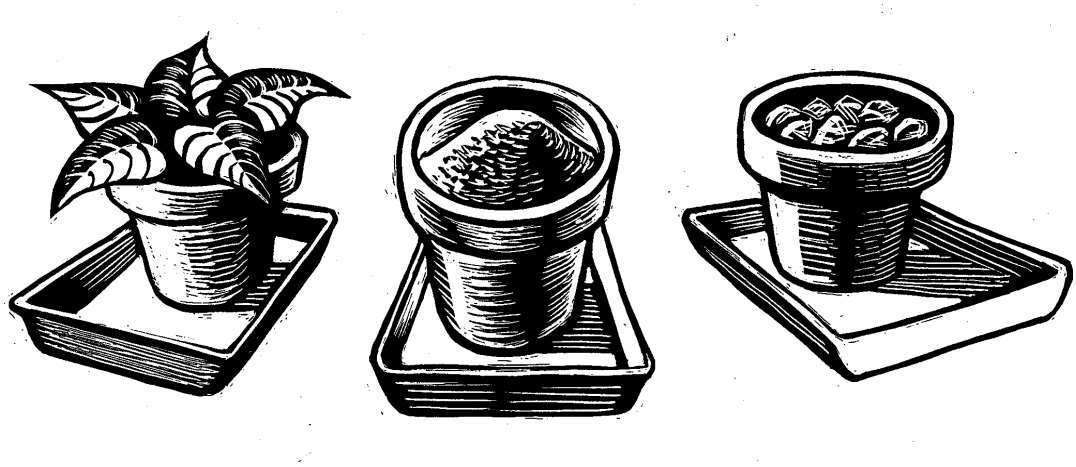
What To Do

Follow your teacher's instructions for preparing your three containers. Fill one container with the plant and soil; pack the soil well and dampen a little with water. Fill one container with soil and gravel; dampen a little with water. Put loose clumps of aluminum foil in the third container. Put each container in a baking dish.

Get ready to pour two cups of water into each container. Before you start, make a prediction on how much of the two cups will run out of each container; write your prediction on your "Soak It Up!" Data Form. Pour the water into each container. Wait two minutes and measure the water in each baking dish. Measure again after eight more minutes. Discuss what is happening to the water and why. What makes a good buffer? What creates runoff?

Student Page

Data Form



	Plant & Soil	***Soil & Gravel***	***Aluminum Foil***
Prediction			
2 Minute Measurement			
10 Minute Measurement			
Total			

"Think A Bit" Questions

How close were your predictions?_____

Which filter absorbed the least amount of water?_____

_____

Which filter absorbed the greatest amount of water?_____

_____

What makes a good filter?_____

_____

_____

Activity 5: Nature's Sponge

Goal

- ❖ To demonstrate how "buffers" absorb rainfall to reduce runoff.
- ❖ To show that infiltration rates differ, depending on the type of soil and ground cover.

Materials

- ✓ 2 soup cans for each team (1 "test can" with both ends removed and 1 "water can" with only one end removed)
- ✓ Bucket of water
- ✓ Stopwatch or watch with a second hand
- ✓ Nature's Sponge Data Form

Voluntary State Curriculum

1.0 Skills and Processes
A Scientific Inquiry: 1, 4, 6, 2
B Critical Thinking: 5

Time 60 minutes

Background

- ❖ Review "The Natural Stream Environment"
- ❖ Read "Where Does the Rain Go?"
- ❖ Read "Soak It Up!"

Vocabulary

Buffers – trees, shrubs, weeds and tall grasses planted along a stream

Erosion – the wearing away of soil by rain, wind, water or ice

Infiltration - flow of water from the land into the ground

Runoff– water that hits hard surfaces (concrete asphalt, roofs), is not absorbed into the soil and runs quickly downhill into a stream.

Sediment – soil

Motivation

- ❖ Testing buffers.
- ❖ Teams conducting experiments.

Procedure

Test steps 1 – 3 ahead of time. If it takes a long time for the water to soak in, have students fill the "test can" only halfway. Mark the cans if needed.

1) Twist the "test can" into the ground ½ inch deep, making sure the soil seals around it.

2) Use the "water can" to fill the "test can".

3) Time how long it takes for the water to soak into the soil. Do steps 1-3 as a demonstration so that students understand how to run the test.

4) Divide students into teams of three (one to handle "test can", one to use "water can", one to record time) with their own set of equipment.

You can use one bucket of water for all to draw from and one stopwatch.

5) Pick four locations to test or have the students discuss and choose: forested area, sandy area near the playground, grassy area, well-traveled path, etc.

6) Have all teams start at the first location and write a description of the soil and/or ground cover on the Nature's Sponge Data Form (rocky, fine sand, large grains, grassy, bushes and trees, etc.).

7) Have all teams pour the water into the "test cans" at the same time as you start the timer. Call out time in 20-second intervals. Record time on Nature's Sponge Data Form. You can do several tests at each location and take the average.

8) Move to each location and repeat testing.

Wrap Up

- Have students fill the bar graph on the Data Form.
- Discuss the meaning of the results. Is it better to have a fast infiltration rate or a slow one? (Answer: Fast. Slow would indicate run-off that can cause erosion.) Sometimes a sandy area is loose enough to absorb water faster than one with lots of ground cover, yet the sandy area would be more susceptible to erosion. Help students understand the difference between infiltration, runoff and erosion.
- Describe the location that had the best time (i.e. fastest time).
- What could be done to reduce erosion or increase absorption?

Modification

- Work with a partner

Optional Challenges/Extensions

- Mark locations and test again following a rainstorm to develop the ideas of saturation, groundwater and water table.
- Journal.
- Project Wet Activities: Imagine, The Incredible Journey, Just Passing Through, Poetic Precipitation, The Rainstick, Stream Sense, The Thunderstorm, Water Match, Water Models, Where are the Frogs?
- Healthy Water, Healthy People Activities: Pollution-Take it or Leave it, A Snapshot in Time, From H to OH!

Assessment

- Completion of Nature's Sponge Data Form
- Participation

Nature's Sponge

Know the Meaning…

Buffers – trees, shrubs, weeds and tall grasses planted along a stream.

Erosion – the wearing away of soil by rain, wind, water or ice.

Infiltration - flow of water from the land into the ground.

Runoff– water that hits hard surfaces (concrete asphalt, roofs), is not absorbed in the soil and runs quickly downhill into a stream.

What You Will Need

- 2 soup cans
- 1 test can with both ends removed
- 1 water can with one end removed
- Bucket of water
- Stop watch or watch with second hand
- Nature's Sponge Data Form

What To Do

The group will decide on four "test sites": forested, grassy, sandy, and well-traveled path. At each site twist your test can into the ground ½ inch deep. Fill your water can and pour the water into the test can. Your teacher will call out the time. Write on your activity sheet how long it took for each can to become empty. Color in the bar graph to show the average time. Talk about what you have learned about buffers and runoff.

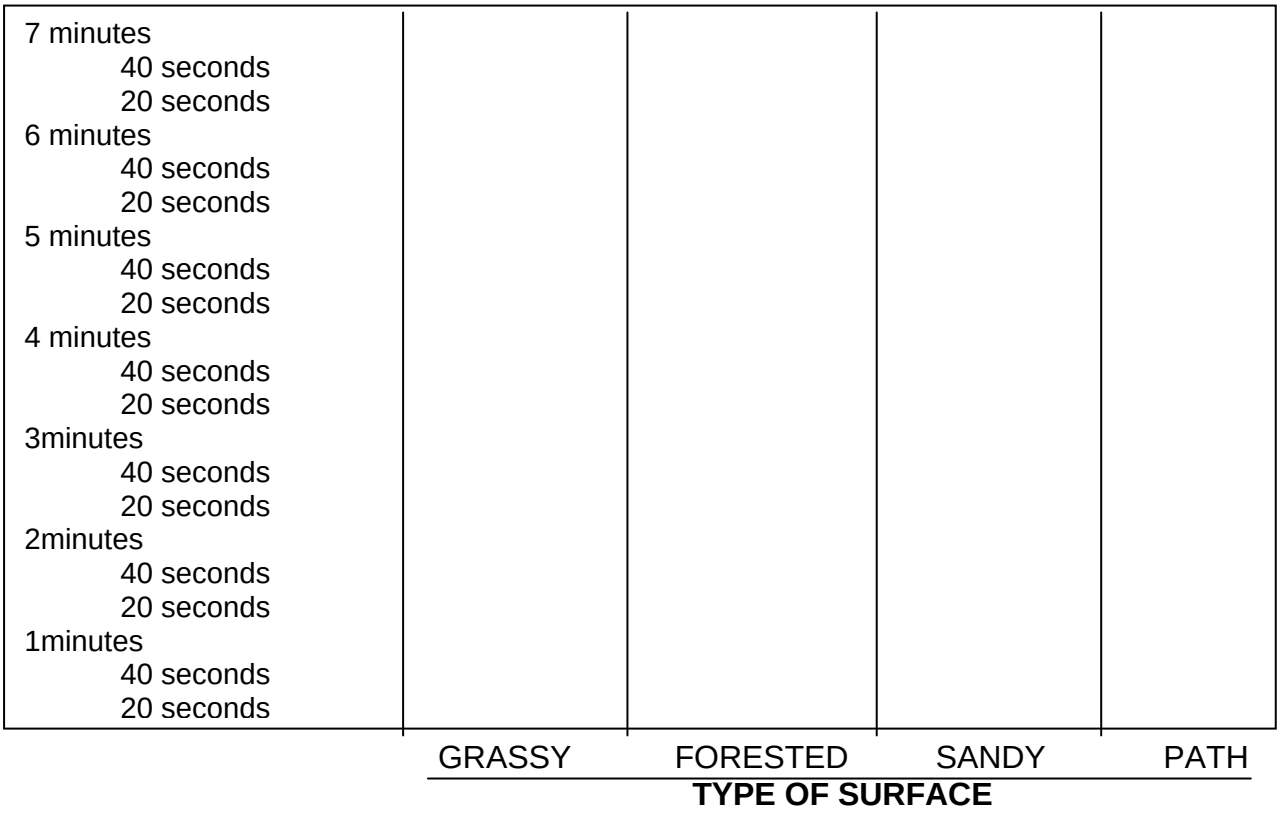
Student Page

Nature's Sponge
Data Form

Grassy Area	**Forested Area**	**Sandy Area**	**Well Traveled Path**
Describe:	Describe:	Describe:	Describe:
Test 1 ____	Test 1 ____	Test 1 ____	Test 1 ____
Test 2 ____	Test 2 ____	Test 2 ____	Test 2 ____
Test 3 ____	Test 3 ____	Test 3 ____	Test 3 ____
Average ____	Average ____	Average ____	Average ____

Bar Graph:

Color in this bar graph to show the average time it took for the ground to soak up the water at each test site.



Too Much of A Good Thing

Activity 6: Algae Soup!

Goal

- To demonstrate how too many nutrients affect the water.

Voluntary State Curriculum

1.0 Skills and Processes

A Scientific Inquiry: 1, 2, 4,6, 9

B Critical Thinking: 1, 5

Time Several Weeks – document observations frequently.

Materials

- ✓ 5 clear quart jars
- ✓ Labels for jars
- ✓ Houseplant food
- ✓ 1 gallon of water from a stream, pond or aquarium
- ✓ Aluminum foil
- ✓ Magnifying glass (optional)
- ✓ Algae Soup! Data Form

Vocabulary

Algae – microscopic plants

Nutrient - substance (such as fertilizer or decayed leaves and grass) that supplies food for plant growth, but which in large concentrations can cause pollution

Motivation

- Review "Nutrients and the Chesapeake Bay"
- Read "Too Much of a Good Thing"

Procedure

This activity may take several weeks to complete. To speed up the experiment, add an equal amount of algae culture or small bits of algae collected from a stream to each water sample.

1) Wash jars, making sure to rinse well.

2) Prepare water samples.
   a. Fill one jar with tap water and set it aside as your control. Label this jar "Tap Water." No algae should grow in this jar.
   b. Fill the remaining four jars with stream water.
   c. Label one jar "No Nutrients Added" and set it aside.

d. Label the next jar “1 Serving Nutrients” and add enough plant food to make a regular solution, according to package directions.
e. Label the next jar “3 Servings Nutrients” and add three times the required plant food.
f. Label the last jar “6 Servings Nutrients” and add six times the required plant food.

3) Cover the jars lightly with foil and place them in a cool, sunny spot but not in direct sunlight that can heat up the water.

4) Present the question, “What will happen to the water with more nutrients?” On the Data Form, have students write their hypothesis and record the date the algae soup was started.

5) Every few days, stir the water and check the samples for any algae growth on the glass. It might be a thin gray or green film or small green splotches. Place a white piece of paper behind the jar to help highlight the color.

6) Record the date of the first appearance of algae growth. Using the magnifying glass describe the appearance of each sample on that date. Continue checking, recording, describing until there is a visible difference in your samples.

.

Wrap Up

- Review the dates and descriptions recorded.
- What does the plant food represent? (Nutrients and fertilizers added to the stream.)
- Which jar had more algae? Why?

Modifications

- Home assignment

Assessment

- Completed data form.

Optional Challenges/Extensions

- Journal.
- Project Wet Activities: Imagine, The Incredible Journey, Just Passing Through, Poetic Precipitation, The Rainstick, Stream Sense, The Thunderstorm, Water Match, Water Models, Where are the Frogs?
- Healthy Water, Healthy People Activities: Pollution-Take it or Leave it, A Snapshot in Time, From H to OH!

Nutrients and The Chesapeake Bay

The Chesapeake Bay is like a soup. Both are composed of many ingredients. But just as too much of any ingredient can spoil the flavor of the soup, too much of a particular substance can harm the Bay. One current problem with the Bay is too many nutrients such as nitrogen and phosphorus.

Nutrients are substances that help plants grow. Once the nutrients are in the Bay, they become food for plants. But excess nutrients cause too much plant growth, especially algae (microscopic floating plants). When there is too much algae, the water becomes cloudy and blocks the light needed by underwater plants called bay grasses. Algae can also coat the leaves of the bay grasses blocking the light received by the plants. These grasses are very important to fish and blue crabs because they provide food, shelter and nursery areas. Research has shown that the density of young crabs is ten times greater in grass beds than in unvegetated Bay areas.

Too much algae can cause other problems. When algae die, they settle to the bottom where they are naturally decomposed by bacteria. During this process, the bacteria use oxygen from the Bay's bottom waters. When bacteria decompose large amounts of algae, too much oxygen is removed from the water. Blue crabs and other aquatic life that live on and near the bottom need the oxygen to live. The low oxygen levels drive blue crabs and fish away in search of more oxygen. Sometimes the crabs will even come up on land (“Crab Jubilee”) to escape. Many of the small bottom aquatic life that blue crabs and fish eat die off. In the summer, the lack of oxygen is worse when several natural factors act to lower the amount of oxygen in the Bay's water. The low oxygen conditions caused by excess nutrients are the primary reason large bottom sections of the Bay are unsuitable for bottom dwelling organisms (oysters, crabs, etc.). This is sometimes called the “Dead Zone”.

Plant and animal matter (including human waste), fertilizer, and even air pollution from car exhaust and power plants all contain nutrients. If left untreated, these nutrients will find their way into creeks, rivers and eventually the Bay. Reducing nutrient pollution has been a priority of the Chesapeake Bay cleanup for over a decade. Progress is being made due to the combined efforts of citizens, industry and the government. Since 1985, Maryland has greatly reduced phosphorus and nitrogen pollution. By monitoring water quality, scientists are already seeing results in the Bay and its tributaries such as cleaner water and more bay grasses. These improvements show that the cleanup is on the right track, but we also know we still have a long way to go.

Presently, many people are trying to restore the Chesapeake Bay by reducing the nutrients that ultimately harm the habitats for blue crabs and many other aquatic organisms. Here are a few things that you can do to prevent too many nutrients from entering the Bay:

- ❖ Don't use too many fertilizers on your lawn.
- ❖ Compost your lawn wastes.
- ❖ Try not to get fertilizers on the sidewalks and driveways.
- ❖ Pump out your septic system once every three years.
- ❖ Use your garbage disposal sparingly to reduce grease and solids in your septic system, and reduce stress on municipal wastewater treatment plants.
- ❖ Plant trees, shrubs and ground cover to protect bare soil and reduce runoff.
- ❖ Create a "rain garden" to keep rain water in your yard and to replenish plants.
- ❖ Encourage your parents to become involved with the Maryland Tributary Strategy Team in your watershed. The Maryland Tributary Strategies are a program designed to involve the public and local governments in activities to reduce nutrient pollution and help the State reduce the nutrient goal for a healthier Chesapeake Bay. For more information on the Tributary Strategy Teams visit http://www.dnr.state.md.us/bay/tribstrat/index.html

When citizens, industry and government work together, we can make a difference in the health of the Chesapeake Bay for future generations to enjoy.

Student Page

Too Much of A Good Thing

Have you ever put too much salt on your food? The right amount of salt tastes good. Too much salt can ruin the food. It's too much of a good thing.

A stream can have too much of a good thing. Nutrients are substances that cause plants and animals to grow. Plant and animal matter (including human waste), fertilizer, and even air pollution from car exhaust and power plants all contain nutrients. If left untreated, these nutrients will find their way into creeks, rivers and eventually the Bay.

Algae Soup!

What You Will Need

- 5 1-quart glass jars
- Houseplant food
- Aluminum foil
- Labels for the jars
- Water from a stream, pond or aquarium

Know the Meaning…

Algae – microscopic plants

Nutrient - substance (such as fertilizer or decayed leaves and grass) that supplies food for plant growth, but which in large concentrations can cause pollution

What To Do

Wash all the jars and rinse them well. Fill jar #1 with tap water and label it "Tap Water". Fill the other four jars with water from a stream, pond or aquarium. Label jar #2 "No nutrients added." Follow the directions on the plant food container and mix enough fertilizer with the water in jar #3 to make a regular solution; label the jar "1 serving nutrients." In jar #4, use three times more fertilizer to make the solution; label "3 servings nutrients." In jar #5, make a solution six times stronger than normal; label "6 servings nutrients."

Cover the tops of the jars lightly with aluminum foil to keep the water from evaporating. Place all the jars in a cool, sunny place (avoid direct sun – it makes the water too hot). Every few days, stir the water and check to see if any algae is growing on the glass. The algae will look like a thin grey or green film. Be patient! It could take weeks for the algae to start growing. When you first see algae, mark the date on your data form and describe how each jar looks. Keep checking, recording and describing until you see clear differences between the jars.

Talk with your group about your algae soup. What did you learn about nutrients? What happens in a stream when too many nutrients are washed into the water? Can you think of ways to decrease the nutrients that enter a stream.

Algae Soup!

What will happen to the jars with more servings of nutrients? Write your prediction here:

_____

_____

_____

Date Algae Soup was started:_____

Record below the dates that you look at the jars. Write a description of what each jar looks like.

Date	Tap Water	No Servings	1 Serving	3 Servings	6 Servings

Was your prediction correct?_____

What happened?_____

_____

_____

Student Page

Helping Restore Our Stream

Streamside Activities

Do's and Don'ts by the Stream

Important Safety Information:
When you visit the stream, be sure you remember every one of these Do's and Don'ts. It's easy to hurt yourself around a stream if you don't know what to look for or what to do.

Do's

- Stay near a friend at all times. If one of you gets hurt, the other will be nearby to help or to call for help.
- Wear long pants, long sleeves, and socks to protect your body from poison ivy and insects.
- Wear shoes that won't be ruined if they get wet. Washable tennis shoes work well for walking along a stream. If you will be wading, rubber boots are best.
- Watch for swift currents. If the water looks like it might be moving fast, it could carry you with it! Have your teacher check the current before entering the stream.
- Wear bright colors. It's easier for others to see you. In hunting season, it's a must!
- Be a good stream neighbor. Crawl under fences; if you climb over a fence you might break it. Close all gates after yourself. If you must walk through a planted field, walk between the rows.

Don'ts

- **NEVER** visit a stream alone. Always have someone with you who can go for help if an accident happens.
- **NEVER** drink from any stream. The water can look clean and clear and still be unsafe. It might contain toxic chemicals, bacteria from animal waste, or other things you DON'T want to drink.
- **NEVER** put your hands or feet in places where you cannot see. Watch where you're going and know where your next step will land.
- **NEVER** trespass on private property. You should always have permission from the land owner(s) before you visit a stream.

Activity 7: Design Your Own Stream Study Kit!

Goal

- To create street activity tools from inexpensive materials.

Voluntary State Curriculum

1.0 Skill and Processes

A Scientific Inquiry: 1

Time

30 minutes

Vocabulary

Riparian Zone – an area along the bank of a stream, river or other water body.

Materials

- ✓ 1 waterproof carrying bag
- ✓ 1 small magnifying glass
- ✓ 1 pencil
- ✓ 3x5 spiral notebook
- ✓ Milk jug
- ✓ Screen, cheesecloth or white panty hose
- ✓ Silver duct tape
- ✓ Twine or yarn (at least 100 yards)
- ✓ 1 dishpan or bucket
- ✓ 1 small white shallow pan or plate
- ✓ pH kit
- ✓ Stream thermometers
- ✓ Juice can with both top and bottom cut off
- ✓ Plastic wrap

Optional items

- ✓ Tweezers
- ✓ Waterproof boots
- ✓ 2 plastic bottles for stream samples (can use pill bottles)
- ✓ Plastic bug boxes
- ✓ Stream study journal with plastic cover
- ✓ Pocket field guides
- ✓ 6 inch stick

Motivation

- Review “Maryland Water: An Evaluation of Stream Health”
- Read “Design Your Own Stream Study Kit”

Procedure

Before going to the stream have students make the items below for their stream study kit. You might have individual kits for each student or you may want to have one kit for the entire group. Encourage children to use recycled materials as much as possible.

Strainer

1) Cut top & bottom portion off milk jug.
2) Cut screening material to fit bottom.
3) Tape securely to outside with duct tape.

Handmade Tape Measure

1) Cut twine or yarn at least 100 yards long.
2) Mark off foot lengths by tying knots.
3) Tie one end of the twine or yarn to a stick.
4) Wrap the remaining twine or yard around the stick.

Water Looking Glass

1) Make sure that both ends are cut off the juice can.
2) Cut a piece of plastic wrap large enough to cover one end.
3) Tape securely to outside of can with duct tape.

Now assemble all of the above items and the other stream sampling equipment into a waterproof carrying bag and you are ready to go out to the stream.

Modifications

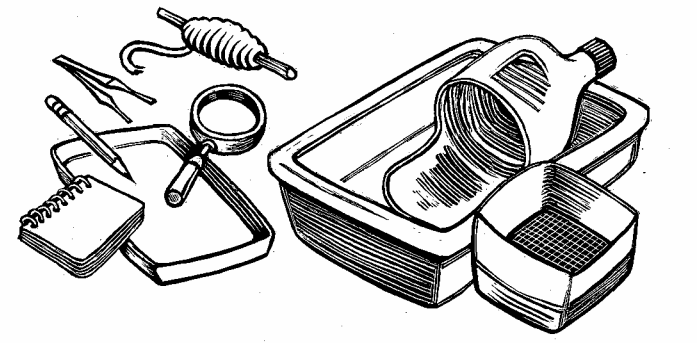
- Home assignment.

Assessment

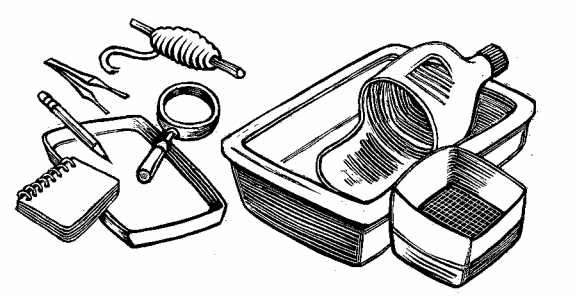
- Completed assignment.

Optional Challenges/Extensions

- Journal.



Design Your Own Stream Study Kit



List the items in your stream study kit here.

Check Off	Item	Check Off	Item

Use this list before each stream visit to check the contents of your stream study kit.

Student Page

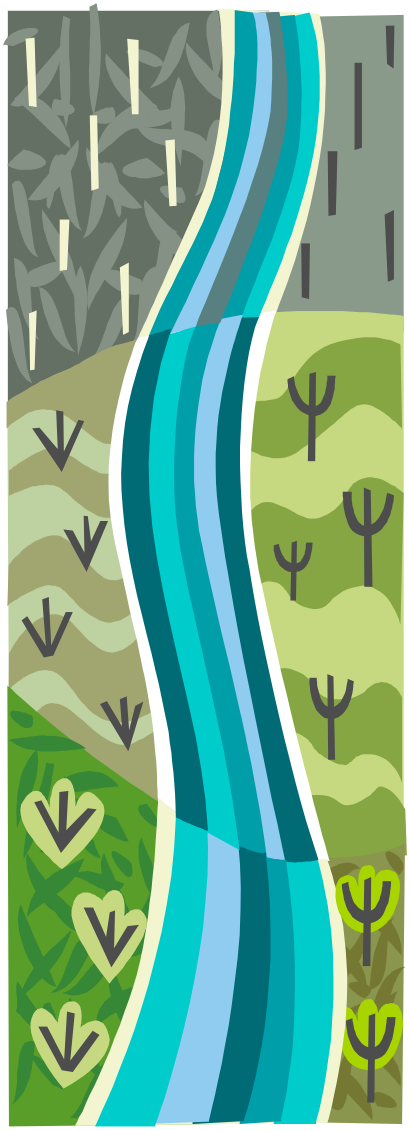
Maryland Waters: An Evaluation of Stream Health

Freshwater streams are a valuable resource to us all. They are the lifeblood of the land around us. They connect our backyards, shopping malls, and farming fields to the Chesapeake Bay, the Atlantic Ocean, and the Gulf of Mexico. Our streams provide us with drinking water, recreation (places to swim, fish, canoe), transportation or simply places to escape from the bustle of daily life. It is important for us to understand how human activities affect natural processes; because what we do determines the health of our streams.

Nutrients and Agriculture: Are They Related?

Although Maryland DNR evaluates individual aspects of stream health, it is useful to combine several *indicators* of stream health (in this case fish and stream insect communities) to get a snapshot of overall stream condition. In a study released in 1997, the Maryland Biological Stream Survey rated almost half (46%) of all Maryland freshwater stream miles as poor, 42% fair, and only 12% good. These findings are consistent with the level of human disturbance in Maryland - even our forested watersheds are impacted by stresses like acid rain and logging.

The primary and most widespread source of nutrients (nitrogen & phosphorus) in Maryland streams is



excess fertilizer from farm fields. Failing septic systems and animal manure also contribute to the problem, as well as air pollution from smoke stacks, auto exhaust, and lawn mowers. Statewide, 57% of all freshwater stream miles have higher

than normal levels of nitrogen and about 2% have nitrogen levels at which human health can be affected. In the Chesapeake Bay, the decomposition of algae blooms (caused by these elevated nitrogen levels) consumes the oxygen that fish and other aquatic life need to survive. By one estimate, Maryland's stream and river network is almost 13,000 miles long. When small, unmapped streams are included, the actual number is much higher! Human activity is readily evident throughout Maryland; the quality of streams closely reflects the level of human disturbance.

The *riparian zone* is an area along the banks of a stream, river, or other water body. Vegetated riparian zones act as a *buffer* against pollution and are therefore very important in reducing the impacts of human activities. Forested riparian buffers provide the best stream protection. They provide shade, stabilize stream banks, and supply food and shelter for aquatic and land animals.

Streams

Once more than 3 million, there are now only about 300,000 brook trout living in Maryland streams. One important factor in the decline may be water temperature. As trees were cleared for agriculture and housing, previously forested streams were exposed to direct sunlight and hot water runoff from surfaces that cannot absorb the rain such as roads and rooftops. Other threats to brook trout include silt from construction and agriculture and acid rain.

To find out more about Maryland streams and their problems, check out our website at *www.dnr.maryland.gov*

How can I determine the health of my stream?

One way is to take a look at the aquatic life that lives in the stream. You will find fish, crayfish, shellfish and a variety of aquatic insects under the rocks and in the leaf litter in your stream. The aquatic insects can tell us a great deal about the health of a stream. Unlike fish, aquatic insects cannot move around very much, so they are less able to escape the effects of sediment and other pollutants that harm water quality. Some species are very sensitive to water quality. They are particularly sensitive to the amount of oxygen in the water. In a healthy stream there are a variety of aquatic insect species. Only the hardiest of insects can survive in a polluted stream.

Mayfly

Stonefly

Caddisfly

Student Page

What Is a Healthy Stream?

Activity 8: Portrait of Our Stream

This activity includes a series of tasks to enable you to record measurements and observations about the stream. Select the tasks you would like to include in your stream portrait.

Task A: How Our Stream Measures Up

Task B: The Temperature of the Stream

Task C: The pH of the Stream

Task D: Stream Banks and Bottoms

Task E: The Bug Test

Task F: Who Lives in the Stream?

You can organize the activity in two ways:

a) If your stream visit is short, divide the group into teams and assign each team one or two tasks.

b) If you have more time, have each team complete all of the tasks you have selected for your stream portrait.

Goal

- To identify potential water quality problems of the stream.

Voluntary State Curriculum

1.0 Skill and Processes
- A Scientific Inquiry: 1, 2, 4, 5, 6, 9
- B Critical Thinking: 1, 5

Time 2 hours streamside

Motivation

- Review “What’s a Healthy Stream”
- Review “Stream Macroinvertebrates” Fact Sheet
- Read “The Bug Test”
- Read “Testing the Stream”
- Prep for on-site stream sampling

Modifications

- Work with a partner

Assessment

- Completion of worksheets
- Participation

Optional Challenges/Extensions

- Journal.
- Project Wet Activities: Back to the Future, Macroinvertebrate Mayhem, Water Address
- Healthy Water, Healthy People Activities: Benthic Bugs and Bioassessment, Invertebrates as Indicators, Water Quality Windows

Vocabulary

pH – a measurement of the acidity of the water.

Macroinvertebrates - animals without backbones that are larger than a pencil dot. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. They include crayfish, clams and snails, aquatic worms and the immature forms of aquatic insects such as stoneflies and mayflies .

Fish barrier – any place where there is a section of the stream where fish cannot swim or jump (a dam, water too shallow to swim, etc).

Sedimentation – soil deposited on the bottom of a stream

Riffle – a shallow area in a stream where water flows swiftly over gravel or larger stones

Pool – an area of stream where the water is fairly deep and flowing softly.

Stream Width – width of stream at the widest part

Stream Depth – depth of stream at the deepest or shallowest point

Velocity – speed of water

Task A: How Our Stream Measures Up

Goal

- To determine the width, depth and velocity of the stream

Materials

- ✓ Handmade Tape Measure - 30 foot lengths of string or twine marked off by feet
- ✓ Stop watch or watch with second hand
- ✓ 2 markers or pencils
- ✓ Floating objects: cork, twig, etc.
- ✓ Portrait of Our Stream Data Sheet
- ✓ Rock
- ✓ Clipboard

Procedure

1) Take the following measurements in a 30 ft length section of stream:
    a. The width of the stream at the widest point.
    b. The width of the stream at the narrowest point.
    c. The depth of the stream at its deepest point. (Tie rock or weight to end of knotted string)
    d. The depth of the stream at its most shallow point.

2) Measure the velocity in a section of stream that has easy access and where the water is fast moving.

    a. Measure off a 30 foot section of the stream with knotted string.
    b. Place markers in the beginning and end of the section.
    c. Place the floater in the center of the stream at the upstream end of the section. Time it from release until it crosses the other end of the section. Record the time. Retrieve your floater and repeat the process several times. Take an average of the results. Always retrieve your floater so you are not polluting your stream. Compute the velocity in feet per second.

Task B: Stream Temperature

Goal

- ❖ To determine the average stream temperature.
- ❖ To discover the effects of shade on stream temperature.

Materials

- ✓ Thermometers with a range of 35 degrees fahrenheit to 85 degrees fahrenheit (can be obtained from a biological supply company or pet store)
- ✓ String in 2 ½ foot lengths; securely tie one on each thermometer
- ✓ Portrait of Our Stream Data Form
- ✓ Clipboard
- ✓ 2 markers or pencils

Procedure

1) Teach students the proper use of thermometers.
   a) Hold the thermometers firmly in hand. Do not swing them around.
   b) Place the thermometer in the water until covered by water. Do not drop them in.
   c) Do not let go of the thermometer or string attached to it.
   d) Read the temperature as soon as it is removed from the water since air will alter the reading.
   e) Teach students to read the scale. "How many degrees does each line represent?" Have them take a reading and check the scale.

2) Choose an area of the stream for each team to measure and record the temperature. Make sure some areas are in shade, others in sun. Measure spots where the stream is shallow and deep, where water is slow-moving and fast-moving. Measure the air temperature over each site before measuring the water temperature.

3) Record the temperature for each site on the Portrait of Our Stream Data Sheet

Task C: Stream pH

Goal

- ❖ Understand the importance of pH to plant and animal life of a stream.
- ❖ Learn to measure pH.

Materials

- ✓ pH paper (litmus paper) with a broad range color chart (obtain from a biological supply company or pet store; range should cover 3.0 to 8.5)
- ✓ Portrait of Our Stream Data Form
- ✓ Clipboard
- ✓ 2 markers or pencils

Procedure

1) Demonstrate how to use pH test materials using liquids that show a strong difference such as vinegar, baking soda water, and lemon juice.

2) Ask each team to sample pH in three different places; in a pool area; in a riffle area, and in one other place—perhaps where another stream joins the stream or where run-off enters the stream.

3) Record the pH for each site on the Portrait of Our Stream Data Form.

Task D: Stream Banks and Bottoms

Goal

- ❖ Identify signs of run-off and erosion.
- ❖ Identify signs of sedimentation and excess algae.
- ❖ Identify fish barriers.
- ❖ Examine relationship between condition of stream and the surrounding land.

Materials

- ✓ Portrait of Our Stream Data Form
- ✓ Clipboard
- ✓ 2 markers or pencils

Procedure

1) Describe the signs of run-off and erosion on the stream bank (gullies, trails of trash, exposed soil, steep "carved out" slopes).

2) Have students sketch a cross section of the stream to show what the banks and bottoms look like.

3) Ask students to look carefully at the streambed and surrounding land. Are there any visible sewer lines or pipes? Is the land farmland, residential, or industrial?

4) Ask students to look for fish barriers. Draw them in on their sketch of the stream.

5) Ask students to note any unusual odors or any signs of foam, oil, or other contaminants.

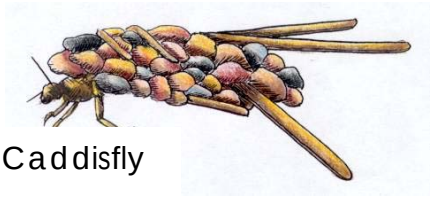
6) Ask students to look at the bottom of the stream. Look for sedimentation, excess algae, gravel and stones.

Task E: The Bug Test

Goal

- ❖ To rate the general health of the stream.

Materials



Caddisfly

- ✓ Portrait of Our Stream Data Form
- ✓ Clipboard
- ✓ 2 markers or pencils
- ✓ A bucket for rinsing rocks
- ✓ Stream Sampling Kits (see Design Your Own Stream Study Kit)
- ✓ "How Clean is the Stream?"
- ✓ "Stream Macroinvertebrates" Fact Sheet

Procedure

Stonefly

Mayfly

1) Decide ahead of time what part of the stream will provide a good and safe sampling site.

2) Review the sensitive organisms on the "Stream Macroinvertebrates" Fact Sheet. Talk about how to tell them apart (mayfly three tails; stonefly two tails; caddisfly curved body; etc.).

3) Choose riffle areas to test. Fill a bucket with water from the stream and set it in a stable place.

4) Select three stones from the riffle area. The stones should be two to six inches in diameter, bathed in rapidly flowing water, and lying loose upon the streambed.

5) Using your fingers, rub all the insects, casings and debris into the bucket of water. Replace the rocks after scraping them thoroughly.

6) Pour the water through the strainer. Being careful not to lose any material still in the bottom of the bucket, scoop up more water and pour it again through the strainer.

7) Use tweezers to move around the material on the strainer and to look for insects. Count and record all aquatic organisms on the Task E portion of the "Portrait of our Stream". According to the directions on the data sheet rate the overall condition).

8) If you have time, do a second test in another riffle.

Task F: Who Lives in This Stream?

Goal

- To realize the variety of animal life in a stream.
- Study one specimen in depth.

Materials

- ✓ Portrait of Our Stream Data Form
- ✓ Clipboard
- ✓ 2 markers or pencils
- ✓ Stream Sampling Kits (see Design Your Own Stream Study Kit)
- ✓ "Stream Macroinvertebrates" Fact Sheet

Procedure

Have students choose one aquatic specimen that they have found to study carefully. Have students complete the data sheet section Task F, including drawing the animal.

Wrap Up

- Ask students to share data from their site.
- Discuss how the pH of the stream affects the animals and plants that live there.
- Discuss the temperature results by determining if the data support the following:
  - More water movement = Lower water temperature
  - Sunny areas = Warmer water
- What were the measurements of width, depth, and velocity of your stream? What did they tell you about the stream?
- Was there evidence of run-off or erosion in your stream?
- What was the bottom of the stream like?
- Were there fish barriers in the stream?
- What kind of land surrounds the stream?
- What were the results of the bug test? How did you rate the overall health of the stream?
- What kinds of animals were found in the stream? How many different kinds were found?

Student Page

What is a Healthy Stream?

A truly healthy stream is a stream in its natural condition. The waters of a healthy stream are clear, cool and odorless. The stream is safe for people to swim, fish and wade. We judge how healthy a stream is by comparing it to a stream in its natural condition. What is a natural stream like?

A natural stream has just the right chemical balance. There is enough oxygen for the fish and other aquatic life in the stream. There are enough nutrients from decaying plants and animal waste for stream life to feed on but no more than a healthy stream needs. The water in the stream is neither too acid nor too alkaline. Most of the substances that come into the stream are carried in by groundwater; they don't rush in with runoff. There are no toxic chemicals from factories, farms, and lawns washing into the stream.

The amount of water flowing into the stream changes according to natural cycles determined by the season of the year and the amount of rainfall.

Rain soaks into the forest floor, travels through the earth, and emerges in the stream. Now and then heavy rains cause floods, but the natural stream is able to adjust to the changes.

Groundwater emerging from the earth is cool and warms up slowly as it flows downstream. Shade from the trees and shrubs keep the temperature of the water stable, making it a good home for fish.

Many different kinds of creatures live in the natural stream. They are well adapted to the range of temperature, water level, and chemical balance. The trees and shrubs around the stream provide plenty of food for the plant-eating insects. The insects become food for the fish.

The natural stream is like a town. It provides different kinds of living quarters for different needs. Insects live in the shallow, fast flowing areas called *riffles w*here they can attach to rocks and collect food from the flowing waters. Baby fish, called *larval fish*, also seek out riffles as good hiding places from larger fish. Deep pools in the stream provide cruising spots for schools of fish. Some fish hide under logs, boulders or undercut banks waiting for prey.

In the natural stream the amount of eroded soil washing into the stream from the watershed is not harmful to the stream. The stream digs soil from the banks and bottom of its bed and carries it downstream. The soil washed in from the watershed replaces the soil carried away. Balance is the key to a healthy stream.

What happens when the balance of a natural stream is disturbed?

When an area of land in a watershed gets developed, it usually brings many changes to the natural stream. The changes can harm the stream in several ways.

Sediment running into a stream from exposed soil settles on the bottom of a stream. Too much sediment is very bad for a stream's health. It can kill fish eggs and clog the gills of small fish. Fish have to see their food. Sediment ruins the fishes' homes by filling in the pools where they like to stay.

Fish barriers stop fish from traveling up and down the stream. Culverts and dams across streams are major problems. Dumping and runoff can lead to large objects blocking the stream. Maryland fish are not like salmon. Salmon can leap several feet into the air. For Maryland fish, any barrier that is more than a few inches high will make it impossible for fish to pass. Water that is too shallow for fish to swim through is also a barrier. Barriers keep fish from getting to areas where they can find food and safe places for laying eggs.

When trees and shrubs in the watershed are cut down and replaced with structures and pavement, the rain can't soak in and runoff water flows into the stream too quickly. The water hits the stream banks and carves out big chunks of soil. Too much soil in the water leads to excess sediment and the natural shape of the stream is changed too quickly.

The pH of a stream is a measure of how acidic the water is. Most creatures that live in water can only survive when the pH is within a certain range (pH 5 to pH 7). Some cannot live in water that has any acid in it. Many of the chemicals and nutrients that enter the stream through runoff change the pH of the water.

Development also changes the **temperature** of a stream. When people build houses or have farms along a stream, they often cut down the trees and shrubs, so there is no longer shade. The water gets warmer faster. Runoff from hot concrete and pavement brings warm water into the stream. The warmer the stream water gets the fewer kinds of fish that can live there.

Our goal is to restore polluted streams to the point where people can safely wade, fish and swim in them. Making streams safe for people, fish and other animals will mean our whole environment will be much better off. And think of all the fun we can have around our streams!

Stream Macroinvertebrates

Maryland Department of Natural Resources

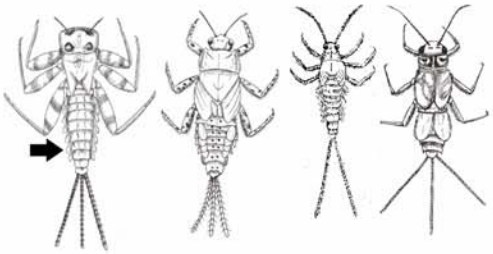
C. Ronald Franks, Secretary

Robert L. Ehrlich Jr., Governor

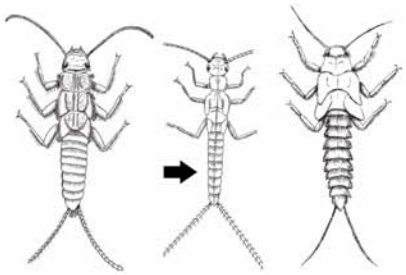
Relative abundances in Maryland are indicated by "rare", "common", or "abundant". The number of families in Maryland for higher taxonomic levels are also listed (if applicable). Sizes are for "full grown" animals. To learn more about these fascinating creatures, go to http://www.dnr.maryland.gov/bay/cblife/insects/index.html. To learn about DNR's volunteer stream monitoring program, Maryland Stream Waders, send an inquiry to streamwaders@dnr.state.md.us.

SENSITIVE ORGANISMS

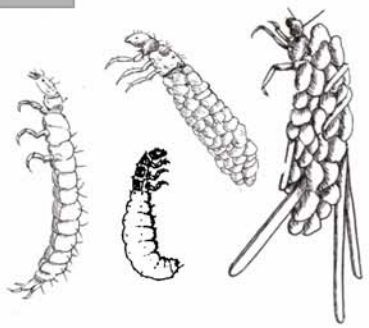
POLLUTION-SENSITIVE ORGANISMS TYPICALLY FOUND IN HEALTHY STREAMS



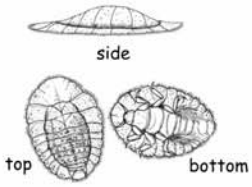
Mayfly: Order Ephemeroptera- Plate-like or feathery gills on sides of lower body (arrow); three (sometimes 2) long, hair-like tails; 1"; abundant; 11 families.



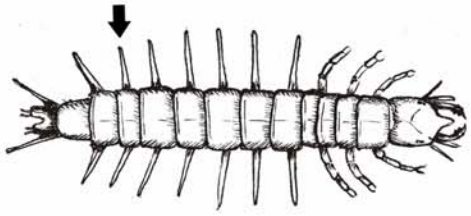
Stonefly: Order Plecoptera-Two hair-like tails; six jointed legs with two hooked tips each; big antennae; no gills on lower half of body (arrow); 1½"; abundant; 9 families.



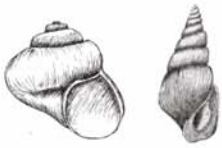
Caddisfly: Order Trichoptera- Six jointed, hooked legs just behind head; 2 hooks at back end; may be in a case made of stones, leaves or sticks; non-netspinning caddisflies have no bushy gills along bottom; 1"; abundant; 20 families.



Water Penny: Order Coleoptera- shaped like a tiny, grey, oblong frisbee; 6 tiny legs on bottom; slow crawler; ⅛"; common.



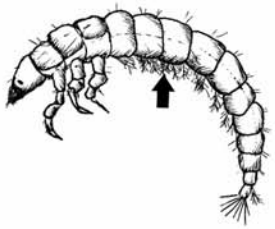
Hellgrammite and Fishfly: Order Megaloptera- dark body; six jointed legs; large, pinching jaws; many pointed feelers along edge of body (arrow); two small hooks at back end; hellgrammites have feathery tufts of gills along side of body; 4"; rare.



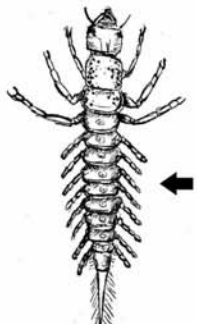
Gilled Snail: Class Gastropoda- shell opens on the right and is covered by a hard shield-like operculum; 1"; rare; 4 families.

MODERATELY-SENSITIVE ORGANISMS

MODERATELY POLLUTION-SENSITIVE ORGANISMS FOUND IN HEALTHY OR FAIR QUALITY STREAMS



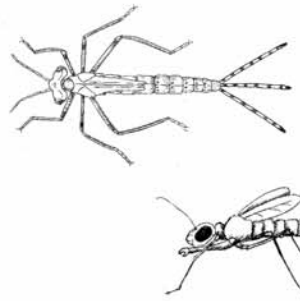
Net-spinning Caddisfly: Order Trichoptera- six jointed, hooked legs just behind head; 2 hooks at back end; bushy gills along lower half (arrow); 1"; abundant.



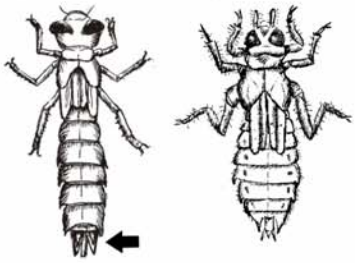
Alderfly: Order Megaloptera- six jointed legs; pinching jaws; many pointed feelers along edge of body (arrow); long tail at the end; 1"; rare.

Crane Fly: Order Diptera- worm-like; no jointed legs; head hidden inside the light brown body; 4 finger-like lobes at back end (arrow); 2"; abundant.

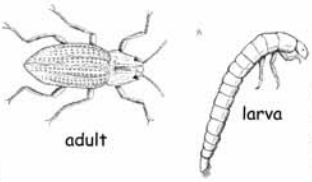
MODERATELY-SENSITIVE ORGANISMS (continuted)



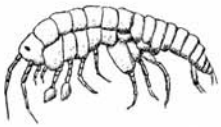
Damselfly: Order Odonata- 6 long, thin legs; 3 broad oval tails at end (arrow); may have wing pads; no gills along sides of body; 2"; common; 3 families.



Dragonfly: Order Odonata- large eyes; bullet-shaped, round or leaf-like body; 6 long legs; 3 short-spike-like tails (arrow); may have wing pads; 2"; common; 6 families.

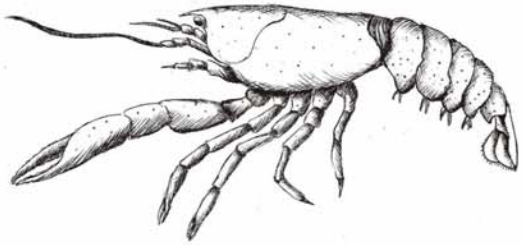


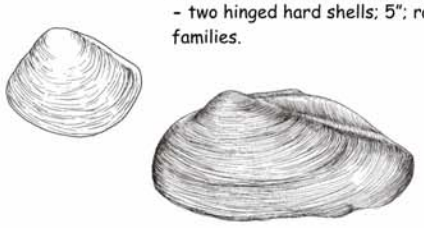
Riffle Beetle: Order Coleoptera - 6 jointed legs; brown or black; adults have hard covering over the wings, body with fairly hard covering; 3/8"; abundant.



Scud: Order Amphipoda - white to gray; more than six legs; swims on its side; looks like a small shrimp; 1/4"; abundant; 3 families.

Crayfish: Order Decapoda- 8 walking legs and 2 pinching claws; 6"; abundant.





Clams and mussels: Class Bivalvia - two hinged hard shells; 5"; rare; 2 families.

TOLERANT ORGANISMS

POLLUTION-TOLERANT ORGANISMS FOUND IN HEALTHY, FAIR OR POOR QUALITY STREAMS

Black Fly: Order Diptera - shaped like a little bowling pin; black head with tiny bristles for filtering food (arrow); suction pad on end; no jointed legs; ½"; abundant.

Non-biting Midge: Order Diptera - dark head; body white, gray or reddish; worm-like segmented body; 2 tiny unjointed legs on both ends (arrow); ½"; abundant.

Leech: Order Hirudinea - brown or grey, slimy, suction pads on both ends (arrow); 2"; rare; 3 families.

Ramshorn Snails: Class Gastropoda - No hard cover over opening; shell coiled in one plane; ½"; common.

Aquatic worm: Class Oligochaeta - thin and hairlike or thicker like an earthworm; 2 ½"; common; 8

Pouch Snail: Class Gastropoda - shell opens on the left; no hard covering over shell opening; 3/4"; common.

Maryland Department of Natural Resources; Resource Assessment Service; 580 Taylor Avenue; Annaoplis, Maryland 21401 Published September 2004
www.dnr.maryland.gov; toll free in MD 1-877-620-8DNR (dial 9 then extension 8623)
TTY users call via MD Relay

Testing the Stream

KNOW THE MEANING….

pH – a measurement of how much acid is in the water.

Macroinvertebrates - animals without backbones that are larger than a pencil dot. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. They include crayfish, clams and snails, aquatic worms and the immature forms of aquatic insects such as stoneflies and mayflies.

Erosion – the wearing away of soil by water, wind or other forces.

Fish barrier – any place where there is a section of the stream where fish cannot swim or jump (a dam, water to shallow to swim, etc).

Sedimentation – soil deposited on the bottom of a stream.

Riffle – a shallow area in a stream where water flows swiftly over gravel or larger stones.

Pool – an area of stream where the water is fairly deep and flowing softly.

Stream Width – the width of stream at the widest part.

Stream Depth – the depth of stream at the deepest or shallowest point.

Velocity – speed of water.

Specimen - sample

Larval fish - baby fish.

WHAT TO DO

Temperature of the Stream

Measure the temperature of the stream in three different places. Make sure you get variety: shady area, sunny areas, deep water, and shallow water. Record your temperature measurements on your data sheet.

The pH of the Stream

Make sure you understand how to use a pH kit. Follow the instructions in the test kit. Test the pH of the stream water in three different places; in a pool, in a riffle, and one other place – perhaps where another stream comes into the stream or a place where the street runoff enters the stream.

Record your pH measurements on your data form.

Stream Banks and Bottoms

You can tell a lot about what's wrong with a stream just by using your eyes and nose.

Look at the banks of the stream. Are there signs of erosion? Runoff? Look at the bottom of the stream? Is there sedimentation? Excess algae? Do you see any fish barriers in the stream? Are there any unusual odors? Describe them. Do you see foam, oil, or any other unusual substance in the water? What is the color of the water? Look around at the surrounding land. What is it used for? Draw a sketch of the stream to show what the banks and bottom look like. Answer the questions on your data sheet.

The Bug Test

Before restoring a stream, you need to know how healthy the stream is now. The kind of insects that live in the stream can tell you a lot about the general quality of the water in the stream. By doing the "bug test" you can give your stream a "grade" of excellent, good, fair or poor. The test is easy and fun!

Portrait of Our Stream:
How the Stream Measures Up

You will need a partner for this activity.

WHAT YOU WILL NEED

☐ A watch with a second hand
☐ 2 markers
☐ Corks or other objects that float
☐ Your measuring string
☐ pH kit ☐ Thermometer

KNOW THE MEANING…

pH – a measurement of how much acid is in the water

Riffle – a shallow area in a stream where water flows swiftly over gravel or larger stones

Pool – an area of stream where the water is fairly deep and flowing softly

Velocity – speed of water

WHAT TO DO

Using the measuring equipment in your kit:

1) Measure the stream at its widest point and narrowest points (You will be able to do this only if it is possible for one person to get to the other side).
2) Measure the deepest point and the shallowest point.
3) Measure the velocity of the stream. Mark off the beginning and end of a 30-foot section of the fast moving portion of the stream with your markers.

To measure speed, throw a cork in the center of the stream up from the first marker. Record the number of seconds it takes to float between the markers on your activity sheet. Repeat the process several times and take an average. Divide the 30-foot distance by the average number of seconds to get the velocity in feet per second.

EXAMPLE: Seconds recorded for 5 tests: 8, 7, 14, 9, and 12.
Average the number of seconds:
(8+7+14+9+12) ÷ 5 = 10
seconds. Velocity: 30 feet ÷ 30 seconds = 3 feet per second.

Student Page

Stream Temperature

KNOW THE MEANING…

Erosion – the wearing away of soil by water, wind or other forces

Fish barrier – any place where there is a section of the stream where fish cannot swim or jump (a dam, water to shallow to swim, etc)

Sedimentation – soil deposited on the bottom of a stream

WHAT YOU WILL NEED

- ☐ Thermometers
- ☐ String in 2 ½ foot lengths; securely tied on each thermometer
- ☐ Portrait of Our Stream Data Form
- ☐ Clipboard
- ☐ 2 markers or pencils

WHAT TO DO

1. Hold the thermometers firmly in hand. Do not swing them around.

2. Place the thermometer in the water until covered by water. Do not drop them in.

3. Read the temperature as soon as it is removed from the water since the air temperature will change the reading.

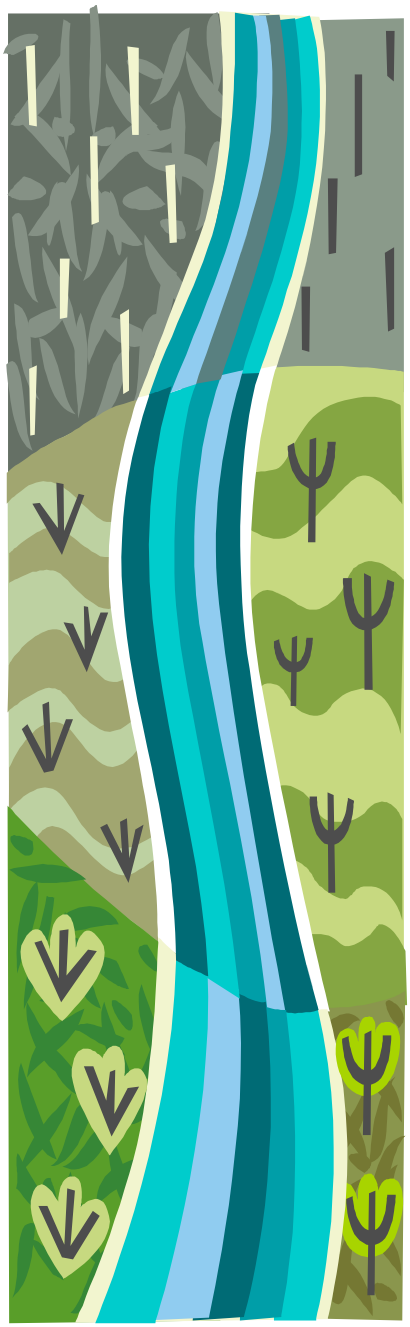
4. Measure the temperature of the stream in three different places. Make sure you get variety: some shade, some sunny spots, deep water, shallow water.

5. Record temperature measurements on the data form. Do not let go of the thermometer or string attached to it.

6. Record the temperature for each site on the Portrait of Our Stream Data Sheet

Student Page

The pH of the Stream



WHAT YOU WILL NEED

- ☐ pH paper (Litmus paper) with a broad range color chart (obtain from a biological supply company or pet store; range should cover 3.0 to 8.5.)
- ☐ Portrait of Our Stream Data Form
- ☐ Clipboard
- ☐ 2 markers or pencils

WHAT TO DO

1. Make sure you understand how to use the pH paper.

2. Test the stream in three different areas; in a riffle area, and in one other place—perhaps where another stream joins the stream or where run-off enters the stream.

3. Record the pH for each site on the Portrait of Our Stream Data Form

KNOW THE MEANING….

pH – a measurement of how much acid is in the water

Student Page

Stream Banks and Bottoms

WHAT YOU WILL NEED

- ☐ Portrait of Our Stream Data Form
- ☐ Clipboard
- ☐ 2 markers or pencils

KNOW THE MEANING…

Erosion – the wearing away of soil by water, wind or other forces

Fish barrier – any place where there is a section of the stream where fish cannot swim or jump (a dam, water to shallow to swim, etc)

Sedimentation – soil deposited on the bottom of a stream

WHAT TO DO

You can tell a lot by what's wrong with a stream by just using your eyes and nose.

1. Describe the signs of run-off and erosion on the stream bank (gullies, trails of trash, exposed soil, steep "carved out" slopes).

2. Sketch a cross section of the stream to show what the banks and bottoms look like.

3. Look carefully at the streambed and surrounding land. Are there any visible sewer lines or pipes? Is the land farmland, residential, or industrial?

4. Look for fish barriers. Draw them in on your sketch of the stream.

5. On your data form, note any unusual odors or any signs of foam, oil, or other contaminants.

6. Look at the bottom of the stream. Look for sedimentation, excess algae, gravel and stones. Record these signs on your data form.

The Bug Test:

Giving your stream a grade!

WHAT YOU WILL NEED

- ☐ Portrait of Our Stream Data Form
- ☐ Clipboard
- ☐ 2 markers or pencils
- ☐ A bucket for rinsing rocks
- ☐ Stream Sampling Kit
- ☐ Person with rubber boots who can wade in the stream
- ☐ "Stream Macroinvertebrates" Fact Sheet
- ☐ "How Clean is the Stream?"

KNOW THE MEANING…

Macroinvertebrates - animals without backbones that are larger than a pencil dot. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. They include crayfish, clams, snails, aquatic worms and the immature forms of aquatic insects such as stoneflies and mayflies.

Riffle – a shallow area in a stream where water flows swiftly over gravel or larger stones

Pool – an area of stream where the water is fairly deep and flowing softly

WHAT TO DO

1. Review the sensitive organisms on the "Stream Macro-invertebrates" Fact Sheet. Notice how to tell them apart (mayfly three tails; stonefly two tails; caddisfly curved body; etc.)

2. Fill a bucket with water from the stream and set it in a stable place.

3. Select three stones from the riffle area. The stones should be four to eight inches in diameter, bathed in rapidly flowing water, and lying loose upon the streambed.

4. Using your fingers, rub all the insects, casings and debris into the bucket of water. Replace the rocks after scraping them thoroughly.

5. Pour the water through the strainer. Being careful not to lose any material still in the bottom of the bucket, scoop up more water and pour it again through the strainer.

6. Use tweezers to move around the material on the strainer and to look for insects. Count and record all stoneflies, mayflies, caddisflies and other insects. Rate the overall condition of the stream according to the directions on "How Clean is the Stream" (excellent, good, fair or poor).

7. If you have time, do a second test in another riffle.

8. Using the Stream Macro invertebrates fact sheet, tally the number of aquatic organisms you found.

9. Record the estimated numbers with the following code:

   A = 1 to 9
   B = 10 to 99
   C = 100 or more

10. Total the number of letters. (Example: If you had two A's, the answer would be 2 or if you had one A and one C the answer would also be 2.)

11. Multiply the total by the number given below which is weighted based on the importance of that group of organisms.

12. Add the answers from each letter code column.

13. Using that total, look for the box that indicates the range that includes that number. This will tell you the health of your stream.

Student Page

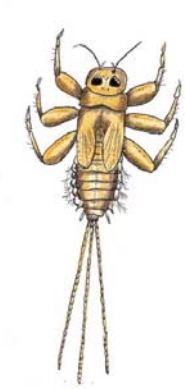
Who Lives in This Stream?

WHAT YOU WILL NEED

- ☐ Portrait of Our Stream Data Form
- ☐ Clipboard
- ☐ 2 markers or pencils
- ☐ Stream Sampling Kit
- ☐ "Stream Macroinvertebrates" Fact Sheet

WHAT TO DO

1. Pick out one aquatic specimen that you found to study carefully.
2. Complete the "Portrait of Our Stream Data Form", section F, including drawing the animal.
3. Share data from your site.
4. How does the pH of the stream affect the animals and plants that live there?
5. Discuss the temperature results. Is the temperature of the water in the riffles lower or higher than the other temperatures?
6. What were the measurements of width, depth, and velocity of the stream? What do they tell you about the stream?
7. Was there evidence of run-off or erosion in the stream?
8. What was the bottom of the stream like?
9. Were there fish barriers in the stream?
10. What kind of land surrounds the stream? How is it used?
11. What were the results of the bug test? How did you rate the overall health of the stream?
12. What kind of animals were found in the stream? How many different kinds were found?



Mayfly

Stonefly

Caddisfly

Student Page

PORTRAIT OF OUR STREAM

TASK A: HOW OUR STREAM MEASURES UP

WIDTH - Measure the stream at its

Widest Point: ____ feet Narrowest Point: ____feet

DEPTH (tie a rock or weight to the end of your string to measure depth)

Deepest Point: ____ feet Shallowest Point: ____feet

VELOCITY

Number of seconds for each measurement

Average number of seconds (Total divided by number of tests):_____

Velocity in feet per second (30 feet divided by average number of seconds):
_____ feet per second

TASK B: STREAM TEMPERATURE

Record the temperature for each site. Put an "X" in the boxes that describe the place where you took the temperature.

Site	Temperature	THE SITE WAS		THE WATER WAS			
		Sunny	Shady	Shallow	Deep	Fast	Slow
1							
2							
3							

TASK C: THE pH OF THE STREAM

The pH of the water in each site was:

Pool: _____ Riffle:_____ Other:_____

Student Page

TASK D: STREAM BANKS AND BOTTOMS

Describe the signs of erosion or runoff and what you think may be causing it:

Draw a cross section of the stream to show what the banks and bottom looks like.

The stream flows through land that is used for: (Check appropriate boxes)

Homes	Woods	Factories	Parks	Farms	Fields	Stores	School/Hospital

People have done the following to the stream:_____

Fish barriers in the stream are:

Culvert	Dam	Water Too Shallow	Object in Water	Other

The stream smells like:_____
Water Color:_____ (Check one) Patches of: Foam ___Oil___ Other_____

Student Page

TASK E: THE BUG TEST: GIVING YOUR STREAM A GRADE!

1) Using the Stream Macro invertebrates fact sheet, tally the number of aquatic organisms you found.
2) Record the estimated numbers with the following code:
   A = 1 to 9 B = 10 to 99 C = 100 or more.
3) Total the number of letters. (Example: If you had two A's, the answer would be 2 or if you had one A and one C the answer would also be 2.)
4) Multiply the total by the number given below which is weighted based on the importance of that group of organisms.
5) Add the answers from each letter code column.
6) Using that total look for the box that indicates the range that includes that number. This will tell you the health of your stream.

Pollution Sensitive Organisms	**Letter Code**	**Pollution Moderately Sensitive**	**Letter Code**	**Pollution Tolerant**	**Letter Code**
Mayfly		Net Spinning Caddisfly		Blackfly	
Stonefly		Alderfly		Aquatic Worms	
Caddisfly		Cranefly		Midge	
Water Penny		Damselfly		Leech	
Hellgramite/ Fishfly		Dragonfly		Ramshorn Snail	
Gilled Snails		Riffle beetle		Pouch Snail	
		Scud			
		Crayfish			
		Clams and Mussels			
Add the Number of Letters		***Add the Number of Letters***		***Add the Number of Letters***	
Multiply by 3		***Multiply by 2***		***Multiply by 1***	

Total of the three letter code columns: _____

Excellent (more than22)	Fair (11-16)	Good (17-22)	Poor (under 11)

Student Page

TASK F: WHO LIVES IN THIS STREAM?

Carefully study a stream animal. Answer these questions about it and draw its picture.

1) Where did I observe it?_____

2) What did it seem to be doing when I observed it?_____

3) How many legs did it have?_____

4) What kind of eyes?_____

5) What kind of wings, if any, did it have?_____

6) How did it move around?_____

7) What body part did it use to move?_____

8) What color was it?_____

9) Draw a line here to show how long it was.

Draw the animal on the back of this data form. Draw it bigger than life-size so you can show details. Return the animal to the location where you found it.

Student Page

Trash is Worse Than Ugly!

Activity 9: Stream Clean Up

Goal

- ❖ Help the stream by removing trash and litter.

Voluntary State Curriculum

1.0 Skills and Processes
- A Scientific Inquiry: 5, 6, 8, 9
- B Critical Thinking: 1, 2
- C Application of Science: 1,2

6.0 Environmental Science
- C Natural Resource & Human Needs: 1
- D Environmental Issues: 1

Time Two hours at the stream site.

Materials

- ✓ Boots or waterproof/old shoes
- ✓ Long pants
- ✓ Gloves (garden or work type)
- ✓ Sturdy trash bags
- ✓ First Aid kit
- ✓ Hand wipes (optional)
- ✓ Clipboard
- ✓ Pencils
- ✓ "Stream Clean Up" Data Sheet

Vocabulary

Landfill – an area of land used for trash disposal

Recycling - to use something again

Background

The effect of accumulations of trash such as construction debris, junked cars, discarded appliances, and litter is not merely aesthetic. Pollutants can be released into the stream as these materials decompose. Large objects, such as cars, can lodge in stream channels and aggravate flooding or bank erosion. The damage associated with litter along a waterway is compounded when it becomes a dumping ground, inviting more debris to be heaped alongside what is already there. For many of Maryland's most neglected and abused waterways, a good old-fashioned trash clean up is the logical first step towards creating a cleaner aquatic environment.

Motivation

- ❖ Prep for site visit.

Procedure

1. The teacher should pre-walk the stream to determine the extent of the clean up and logistics of trash removal. Choose a meeting site where students are to leave full bags for pick-up.

2. Contact landfill and recycling centers to determine hours, location, items acceptable, and how the items should be prepared. One source of information is the Maryland Environmental Service Recycling Information Center, 1-800-492-9188. Determine who will transport the trash to the landfills and recycling centers.

3. Determine the method of clean up:

    a. Assign sections of the stream per team of students.

    b. Assign teams specific types of trash to pick up along the stream section: aluminum, paper, glass, plastic, etc. (NOTE: This method lets you have trash ready for recycling).

4. Divide the group into teams and explain the method chosen. Each team will have trash bags and a data sheet for recording.

    a. Pick up the trash along the stream. Have one participant of each team record on the data sheet what is collected.

    b. Relate these precautions to the students:

        i. Don't let the trash bag get too heavy. Drop the bag off at the meeting site, get a new bag and continue.

        ii. Do not pick up broken glass.

        iii. Empty cans and bottles of liquids on a grassy area away from the stream, then put them in the bag.

        iv. Never drink from the stream or from cans or bottles collected.

        v. Any suspicious containers or barrels should be

left alone, not touched or moved. Note each item's location.

vi. Do not go on private property.

vii. Report any scrapes or cuts.

viii. Do not pick up any trash from sewage overflow, personal sanitary materials or needles.

c. Return to the meeting site at designated time.

d. Have teams separate and prepare recyclable trash.

Modifications

- Work with a partner.

Wrap Up

- Let students share stories of what they found and what happened to them during the clean up.
- Have students analyze their recorded data and discuss the following information:
  - What type of trash did they collect the most of?
  - What percentage of trash was recyclable?
  - Describe evidence of other pollutants: oil in the water, mud pollution from erosion, etc.
  - What effect did the trash have on the stream?
  - Could you determine the source of the trash?
  - Were there larger amounts of trash downstream from storm drains or near bridges and roads?
  - What can students do to reduce litter and pollution in streams?

Optional Challenge/Extensions

- Make a list on the activity sheet of pollutants or objects that could not be removed or taken care of by students. Contact the appropriate county office to handle the problem. Check the stream later to see if anything has been done.
- Do a clean up at the same site in a month's time. Compare data.
- Start a recycling system at school or in the neighborhood, or visit a recycling center.
- Do a school ground or neighborhood clean up, recognizing that trash thrown on the ground can end up in the stream by being washed into storm drains.
- Journal.
- Project WET Activities – A-maze-ing Water; The Pucker Effect; Sum of the Parts

Assessment

- Completion of data sheet.
- Participation

Trash Is Worse Than Ugly!

Trash in and around a stream is an ugly sight! Have you seen streams where tires, boxes, plastic and other garbage has been dumped or washed into the water? Rather than have their trash taken to a junkyard, sometimes people leave things like refrigerators or cars in streams.

It would be important to clean trash out of our streams just for the sake of having a pretty stream again. But, trash is worse than ugly. It can be very harmful to the stream. All materials break down slowly when they are exposed to air and water. You can see this kind of breakdown when metals rust. Most of the time you can't see it. Usually chemicals that pollute the stream are released. Some can be very poisonous.

Large trash items, like refrigerators and cars, can also cause erosion. They are so big that the stream has to change its course to get by. Soil is taken out of the stream bank as the stream "digs" its way around the trash.

Cleaning up your stream helps restore its beauty <u>and</u> its health.

Student Page

Stream Clean Up

Name of the Stream:_____

Date:_____

1. Describe the part of the stream your group cleaned. Use the names of streets or other landmarks to explain where you worked.

   _____
   _____
   _____

2. Clean Up Record
   What kinds of trash were most common?

   _____
   _____
   _____

   How do you think the different kinds of trash got into the stream or on its banks?

   _____
   _____
   _____
   _____

3. What's next?

   Will you recycle any of the trash you picked up? ☐ Yes ☐ No

   Which trash will you recycle?_____
   _____
   _____

   Will your group need to contact anyone about picking up the trash you collected?_____

   Is there anything your group can do to help keep trash out of the stream?

   _____
   _____
   _____
   _____

Stream Clean Up
Data Form

Date:_____ Stream: _____ County:_____
School:_____

Number of miles cleaned (Example: 1/8 mile, ½ mile, etc) _____

Location of Stream Cleaned: (List names of roads that cross the stream, where possible. Example: Mill Run between Oak Street and Baltimore Pike). Find the location on a map.

Type of trash found. Check all those found:

Paper	Plastic	Glass	Appliances	Aluminum	Styrofoam	Cars or car parts	Other

Most unusual item(s) found:

Comments:

Student Page

The Neighborhood and the Stream

Activity 10: Neighborhood Survey

Goal
- ❖ Locate activities occurring in the neighborhood that could cause degradation to the streams and rivers.
- ❖ Practice reading and using map.

Voluntary State Curriculum
1.0 Skill and Processes
- A Scientific Inquiry: 1, 6, 8, 9
- B Critical Thinking: 1, 4, 5

6.0 Environmental Science
- C Natural Resources & Human Needs: 1
- D Environmental Issues: 1

Time 90 Minutes

Materials
- ✓ Detailed street map of your targeted neighborhood
- ✓ Highlighted markers
- ✓ Clipboards
- ✓ Red felt-tip pens
- ✓ Neighborhood Survey Data Form

Motivation
- ❖ Read "The Neighborhood and the Stream"
- ❖ Review "What to Look For: Potential Pollution Sources"

Procedure
1. Decide how large an area of the watershed your group can cover in a walking survey. You can do a series of surveys if you want to cover more of the watershed. Also decide if you will divide into smaller groups, each with an adult chaperone.

2. Use highlighter to mark the route for your survey on the map.

Vocabulary

Commercial – land filled with stores, malls and parking lots

Industrial – land that contains businesses that produce a product or provide a service for sale

Institutional – land with hospitals or government buildings

Residential – land with homes and yards

3. Review with the group what you will be looking for on the survey. Make sure students understand the connection between the potential pollution sources and the stream.

4. Provide each group with a clipboard, street map, red marker and data sheet.

5. Follow your mapped out route and identify potential pollution sources. Mark the location on the map and fill in the Neighborhood Survey Data Sheet.

6. When you have completed the survey, talk about what you found. Brainstorm ideas about how the group might take action to decrease pollution sources in the neighborhood.

Modifications

- Work with a partner or in a team.

Assessment

- Completed survey
- Participation

Optional Challenges/Extensions

- Journal
- Project Wet Activity: What's Happening

WHAT TO LOOK FOR:
Potential Pollution Sources

Following is a list of land uses, human activities, and other features that may be potential pollution sources for the stream. These are the activities you will be looking for during the Neighborhood Survey.

Developed Lands

Developed lands include any area of residential, commercial, industrial or institutional (hospitals, schools government buildings, etc.) development.

Storm water runoff and sewage from developed areas pose the greatest threat to water quality. Storm water runoff is the rainwater and other precipitation that flows over surfaces such as rooftops and roads. These areas are known as **impervious surfaces** because they do not absorb the water rushing over them. Rainwater runoff from these impervious surfaces contains high amounts of toxic metals, nutrients, and other pollutants. The sheer volume of runoff may cause flooding and severe channel erosion in waterways.

Directing runoff through grassy areas can slow its momentum and help filter out harmful pollutants. Look to see if the downspouts on the houses run onto the grass, onto sidewalks or driveways, onto the street or directly into the ground.

Storm drains or swales may also serve residential neighborhoods in an effort to handle storm water. **Swales** are depressions or ditches that run between the residential property and the street; they should be filled with grass or other vegetation.

Swales are beneficial because they slow the erosive flow of storm water over land, reduce the volume of water rushing into a stream and help filter out pollutants.

Storm Drains

If a storm drain system is present, you should find inlets with grates at most intersections. Water carried by storm drains does not go through a sewage treatment plant. Storm drains may carry rainwater runoff plus any mud, toxics or other pollutants directly into a nearby stream.

Farmland

Not all farm land harms water quality. Cornfields and other croplands treated with a special environmental management method called **conservation tillage** may have little impact upon waterways. You can recognize the farmlands where this conservation method is used by the mat of dead vegetation blanketing the soil. To slow erosion, crops should be planted in rows running across hillsides rather than up and down.

Construction Sites

Sediment runoff is the principal environmental offense associated with construction sites.

Sediment pollution is mud or soil on the move. Mud is a problem when it is carried from land into the streams. Sediment smothers bottom-dwelling plants and animals, clogs fish gills, and clouds the water preventing sunlight from reaching aquatic plants.

The barren soils of a construction site may erode and wash into nearby waters at a rate that is potentially harmful. Effective control of mud pollution at a construction site can be achieved through temporary stabilization. The two most common examples of temporary stabilization are straw mulching and grass seeding. Any unbuilt portion of a construction site that has been disturbed by bulldozers or other earth moving equipment and is not covered with straw mulch or with grass is considered bare exposed soil.

Sewage Station

A sewage pumping station is installed along sewer lines at any point where gravity alone is not sufficient to keep wastewater flowing to a treatment plant. Pumping stations also tend to be the most likely point where sewage may escape into the aquatic environment. Most pumping station buildings are constructed of red brick, with few, if any windows. The station is frequently enclosed with a fence and identified with a sign.

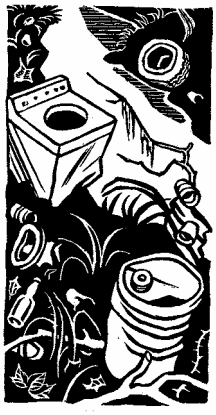
Mining or Quarry Operations

The coal mines of western Maryland may be a source of mud pollution and acidic water. The limestone and rock quarries of the central portion of the state, along with the sand and gravel operations of southern Maryland and the eastern shore may reduce stream flow as well as cause a mud pollution problem.

Landfill

A landfill is the place where the trash from your home may end up. Most landfills are large pits, which may or may not be lined with a barrier of plastic or other material. As rainwater and soil moisture seep into the buried, decaying trash, a wide variety of pollutants are carried with it. If the

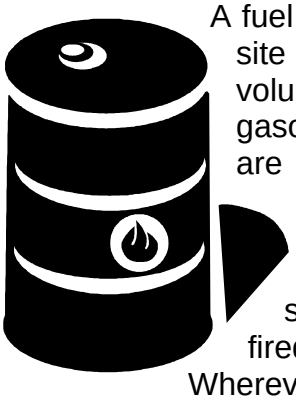
landfill is unlined the contaminated liquid, called **leachate**, will pollute nearby ground and surface water. Even lined landfills may pose a problem because the liners can leak.



Overgrazed Pasture

A grass covered pasture will not generally threaten stream water quality as long as the turf is lush and thick. Overgrazed pastures will be subject to mud runoff and erosion.

Fuel Storage



A fuel storage site is any site where large volumes of heating oil, gasoline, or other fuels are stored. Obvious examples are service stations, home heating oil suppliers and oil-fired power plants. Wherever these fuels are stored, the potential exists for an accidental release into the environment. Fuels may then soak into the soil or be washed into a storm drain. Either way the pollution ends up in a stream, river and eventually in the Chesapeake Bay. Fuel oils are highly toxic to all aquatic plant and animal life.

Auto Graveyard

An automobile graveyard may range from a site where a dozen cars lie rusting away to the resting places for thousands of junkers. The potential water quality impacts are obvious; fuel and lubricants leaking from the engine and drive train, asbestos from brake linings, and toxic metals from the long-term disintegration of the vehicle itself.

Livestock Area

A livestock area may range from a dairy barn or barnyard to an area where thousands of chickens or cattle are held and fed. If not properly handled, the wastes from livestock can severely pollute a waterway.

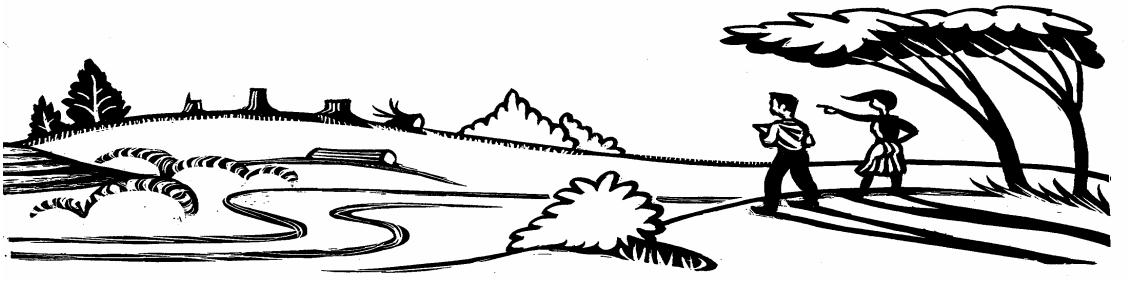
Forested

Nothing is more effective in protecting water quality than trees. Trees filter out pollutants, slow down storm water flow, prevent erosion, reduce sediment runoff, and provide wildlife habitat.

Look for areas that may be a suitable tree-planting site.

Student Page

The Neighborhood and the Stream



Is your neighborhood close to or far from a stream? No matter what the distance, what happens in your neighborhood can make a difference in your local stream.

How developed is the land? How much is filled with stores and malls and parking lots (commercial)? How much has industrial plants or large hospitals or government buildings (industrial/ institutional)? How much is used for houses and yards (residential)? How much is farmland?

The more developed the land is, the more storm water **runoff** there will be. Buildings, roads, sidewalks, and parking lots are all hard surfaces; they do not absorb water. Instead the water runs off quickly carrying toxic metals, chemicals, and other pollutants.

Areas with houses and lawns also cause problems. Rainwater often runs off roofs and out gutters right onto hard driveways or sidewalks. If gutters are aimed at grass instead, more water will be absorbed instead of running off. Lawns that are mowed close to the ground may look neat, but they don't absorb water very well. Keeping the grass at least 2 ½ inches tall makes the lawn a much better buffer. Trees and shrubs planted in the yard help even more. If a yard runs right up to a stream, it is very important not to mow right up to the stream; tall plants, shrubs and trees will help the stream.

Construction sites can be harmful to a stream if soil is allowed to stand exposed to rain and wind. There are laws to prevent soil from washing away and polluting streams.

Farmland can be a source of pollution and soil erosion. Too many livestock can pollute a stream unless the wastes are properly handled. Fertilizers and pesticides contain substances that are toxic to the stream. Plowed land can lead to soil erosion.

Other possible polluters to look out for are: sewage pumping stations, mining and quarry sites, landfills, fuel storage sites, automobile graveyards, and logging operations.

In every kind of area, from highly developed to farmland, there are places where planting trees can help the stream. Identifying places for tree planting in neighborhoods is a great way to improve your local stream.

By understanding how activities in your neighborhood affect your stream, you can spot the problem areas. You can also help come up with ways to improve your neighborhood and your stream.

Neighborhood Survey

WHAT YOU WILL NEED

- ☐ Street map with survey route
- ☐ Clipboard
- ☐ Red felt-tip marker
- ☐ Stream Sampling Kit
- ☐ Neighborhood Survey

WHAT TO DO

Talk about what you will look for on your survey. Review the route you will walk. Agree on the safety rules you will need to follow.

As you walk the route, look for all potential pollution sources. Note whether a particular block is residential, commercial, industrial/ institutional, farmland or forested. Use the red marker to put a number on the map for each location you want to note for certain potential problems. Make notes about anything else you see that might affect your stream.

When you have completed your route, talk about what you found. How is your neighborhood affecting the stream? What are some ways you might help reduce pollution from your neighborhood?

AT HOME…

Look at your own home and yard. Are there ways you could help decrease runoff and pollution? Talk with your family about what you have learned and what you might do at home.

Student Page

Neighborhood Survey

Write the number of each location you mark on your map on the checklist below. Check all boxes that describe what you see at each location.

Location #_____

Major Land Use: ☐ Residential ☐ Commercial ☐ Farmland
☐ Institutional/Industrial ☐ Forested

Potential Pollution Sources:

☐ Storm Drains ☐ Construction Site ☐ Crop Fields
☐ Sewage Station ☐ Landfill ☐ Overgrazed Pasture
☐ Mining or Quarry ☐ Fuel Storage ☐ Auto Graveyard
☐ Livestock Area ☐ Gullies or Eroded Soil
☐ Downspouts – empty to:
☐ Grass ☐ Driveway
☐ Sidewalk ☐ Underground

Other things that might affect the stream:

Location #_____

Major Land Use: ☐ Residential ☐ Commercial ☐ Farmland
☐ Institutional/Industrial ☐ Forested

Potential Pollution Sources:

☐ Storm Drains ☐ Construction Site ☐ Crop Fields
☐ Sewage Station ☐ Landfill ☐ Overgrazed Pasture
☐ Mining or Quarry ☐ Fuel Storage ☐ Auto Graveyard
☐ Livestock Area ☐ Gullies or Eroded Soil
☐ Downspouts – empty to:
☐ Grass ☐ Driveway
☐ Sidewalk ☐ Underground

Other things that might affect the stream:

Trees Are a Stream's Best Friend

Activity 11: Tree Planting

Trees and shrubs planted anywhere in the watershed help improve water quality by slowing down stormwater runoff and reducing soil erosion. They also help lessen flooding. In the woods, trees trap and use up excess nutrients. The forest floor is made up of many layers of decaying leaves, twigs and branches. This organic material acts as a natural sponge. Forests are such an effective infiltration system that they can filter six inches of water or more each hour. Trees and shrubs planted along shorelines act as a buffer, retaining as much as 89% of the nitrogen and 80% of the phosphorous that runs off the adjacent land. Vegetation helps to stabilize the stream banks by reducing erosion caused by water, ice, debris and direct rainfall. In addition, falling leaves decompose in the water and provide food for many aquatic insects that, in turn, becomes food for fish. Trees provide shade, food and cover for wildlife and brighten a drab landscape.

Goal

- Improve water quality by planting trees in your stream's watershed.

Voluntary State Curriculum

1.0 Skill and Processes
- A Scientific Inquiry: 1, 9
- B Critical Thinking: 4
- C Applications: 2

6.0 Environmental Science
- C Natural Resources & Human Needs: 1
- D Environmental Issues: 1

Vocabulary

Riparian – an area along the bank of a stream, river or other water body

Buffers – trees, shrubs, weeds and tall grasses planted along a stream

Time Prep/Planting/Follow-up may span several weeks.

Materials

- ✓ Seedlings
- ✓ Shovels
- ✓ Watering Cans
- ✓ Garden Stakes – Wooden
- ✓ Permanent Felt-tip Markers
- ✓ Tree Planting Data Sheet

Motivation

- ❖ Read "Tree Planting"
- ❖ Building background on native plants and trees

Resources

National Arbor Day Foundation Web Site:
http://www.arborday.org/

Native Trees & Shrubs:
www.dnr.maryland.gov/criticalarea/trees.html

Department of Natural Resources Education:
www.dnr.maryland.gov/education

TEAM: Teaching Environmental Awareness in Maryland
http://www.dnr.state.md.us/education/teamdnr/

Procedure

1) The best time for tree planting is March/April or October/November. You may want to conduct your planting on Arbor Day, which in Maryland is the first Wednesday in April. Consider planting the Maryland State Tree - the white oak. Whatever tree you chose, be sure it is a native tree.

2) Have students use a decision-making process to produce a plan for tree planting in your watershed. It is important for the teacher to guide them in this process, but not give them answers unless it is necessary.

   a) Define the problem.

   b) Brainstorm answers to the following questions:

      - ➢ Where will we plant? (Determine areas of erosion or bare earth. Check land ownership.)
      - ➢ Who will plant? (Groups, classes, individuals)
      - ➢ When will we plant? (Set possible dates)
      - ➢ What do we need? (Materials, plants, transportation)

Optional Challenges/Extensions

- ❖ Check on the tree each month. Record the height. Check for soil erosion and replace soil around tree if needed. Water the tree. Replace dead trees. Remember replacement planting must be done in appropriate months.

- ❖ Conduct several buffer restoration projects (Plant or transplant grasses and weeds along ditches to create swales instead of washouts.) around the neighborhood, school grounds or at the students' homes. Remember to obtain permission from the landowner.

- ❖ Journal

- How will we handle maintenance of trees?

3) Planting Day

   a) Have students make tree markers by writing the group's name, date and type of tree on garden stakes with permanent ink. (This can be done ahead of time.).

   b) Plant the trees
      - Dig holes deep enough for the roots to fill in without being bent or broken.
      - Hold the tree in the hole and carefully fill the hole with good soil. Pack soil firmly.
      - Water the tree after planting and several times during the next few weeks.

   c) Put the markers in the ground, one next to each tree.

Wrap Up

- Have students evaluate the plan they used.
- What problems or situations did they overlook?
- Were they prepared for the actual planting?
- What would they do differently next time?
- How does it feel to actually do something to improve your neighborhood?
- Why are trees and plants important to the stream and the environment?

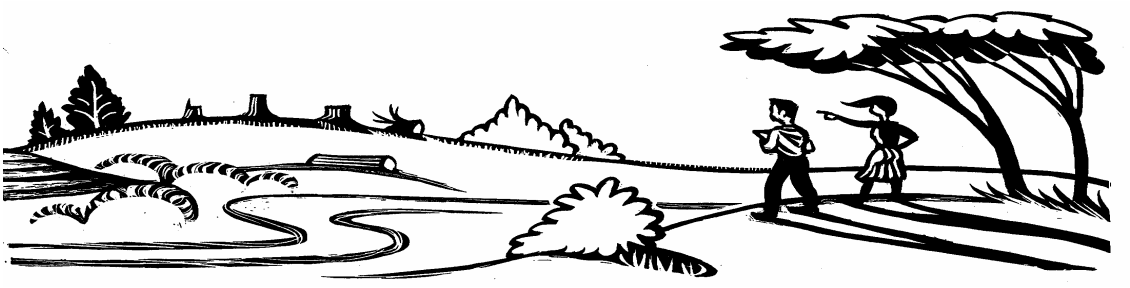
Modifications

Group work.

Assessment

Completed worksheet
Participation in project

Tree Sources



The State of Maryland has two tree planting programs.

John S. Ayton State Forest Tree Nursery takes orders in September for the following spring planting season. Various native hardwoods and conifers are sold in bundles of 25 seedlings designed for wetland, wildlife or upland plantings. For more information call 1-800-TREESMD or visit : www.dnr.marylandgov/forests/nursery

Tree-mendous Maryland is a program that takes orders for trees planted in honor or memory of someone. You may purchase an individual tree or a grove of ten trees. These trees are then planted on public land, in parks and forests, on school grounds, along streams, creeks and river to support Stream ReLeaf, and along county and state rights-of-ways. Student and other youth groups may participate in these plantings. For more information on Tree-mendous, visit: www.dnr.maryland.gov/forests/treemendous/giftoftrees.html or email tgalloway@dnr.state.md.us

Trees may be obtained from private sources:

Seedlings and balled trees may be obtained from commercial nurseries. Your local nursery can help you with selecting the proper species for your site, and can provide advice on planting and maintenance.

The **Arbor Day Foundation** distributes bare root saplings for reforestation and beautification projects. For a nominal fee they will send you a selection of trees for planting. These trees are selected for suitability to local growing conditions, and are shipped to arrive at the right planting time for your area. For more information:
www.Arborday.org
The National Arbor Day Foundation
100 Arbor Avenue
Nebraska City, NE 68410
1-888-448-7337.

Consider getting a grant for your trees and planting equipment and supplies. There are two grant programs that will fund tree planting:

Maryland's Aquatic Resources Education Grant reimbursement program assists public and private schools (Grades K-12) and school systems by providing teacher training and funding for aquatic resource education projects. For a grant application visit:
http://www.dnr.maryland.gov/education/are/aregrants.html
or contact:
Cindy Etgen
DNR/Watershed Services
580 Taylor Avenue, E-2
Annapolis MD 21401
410-260-8716
cetgen@dnr.state.md.us

Chesapeake Bay Trust awards more than $1.9 million in grants that engage Marylanders in the protection and restoration of the Chesapeake Bay. For a grant application and information visit:
http://www.chesapeakebaytrust.org/grantopportunities.html
or contact:
Kerri Bentkowski, Grants Manager
Chesapeake Bay Trust
60 West Street, Suite 405
Annapolis, MD 21401
phone: 410-974-2941 (extension 3)
fax: 410-269-0387
kbentkowski@cbtrust.org

Maryland
Department of Natural Resources
Project Forester's Phone List

County	Phone
Anne Arundel	410-768-0830
Allegany	301-777-2027
Baltimore City & County	410-665-5820
Calvert	410-535-1303
Caroline	410-479-1623
Carroll	410-848-9290
Cecil	410-287-5777
Charles	301-923-2543
Dorchester	410-228-1861
Frederick	301-473-8417
Garrett	301-334-3296
Harford	410-836-4551
Howard	301-854-6060
Kent	410-758-5254
St. Mary's	301-475-8551
Somerset	410-651-2004
Talbot	410-882-1800
Washington	410-473-8417
Wicomico	410-543-1950
Worcester	410-749-2206

Tree Planting

WHAT YOU WILL NEED

- ☐ Tree seedlings
- ☐ Shovels
- ☐ Watering can
- ☐ Wooden garden stakes
- ☐ Permanent magic markers
- ☐ Tree Planting Data Sheet
- ☐ Pencils

WHAT TO DO

Before planting day, take time to look at the information about trees that your teacher has. Work with your groups to decide how many trees you will plant, what kind(s) and when. Determine what you need to do to buy the tree seedlings and get ready for planting day.

On planting day, write your group's name, the date, and the kind of tree on the garden stakes. Dig holes deep enough for the root of your tree to be completely covered. Make sure the roots are not bent or broken when you place the tree in the hole. Have one person hold the tree in place while others pack the soil around the tree. Pack it very firmly so your tree won't fall over in the wind. Water the tree well.

Decide who will be able to come back to water the tree until it can get by on its own.

AT HOME…

Tell your parents about your tree planting and why it is important to the stream. Are there places in your yard where trees might be planted as buffers for rainwater? Talk to your family to see what they think. If you live in the city and don't have a large yard, are there parks where your group could do a tree planting? Maybe your parents have ideas!

Student Page

Tree Planting Data Form

Trees planted:

Kind of Tree	Number Planted

Describe where the trees were planted:

_____

_____

_____

How do you think the trees will make a difference to the stream?

_____

_____

_____

Will you be able to return to check on your trees? How often?

_____

_____

Student Page

It's All Connected

Activity 12: Storm Drain Stenciling

Storm drains were designed to be the fastest and most efficient way of getting rainwater off streets and parking lots. Unfortunately, the water that flows into your storm drain carries trash and sediment from the street, nutrients in the form of fertilizers, toxics in the form of pesticides, household cleaners, gasoline and motor oil. All of the water in the storm drains ends up in your local stream, river and eventually, the Chesapeake Bay.

When scheduling your storm drain stenciling, consider weather conditions. Storm drain surfaces must be perfectly dry and air temperature must be at least 50 degrees fahrenheit. Because spray paint cannot be used in very windy weather, you can use a small roller and paint.

Vocabulary

Discharge Point – the place where the water traveling from storm drains in underground pipes empties into a stream

Outfall – same as discharge point

Stencils - A sheet of plastic that has lettering cut out so that when you paint the sheet, the lettering will reproduce on the surface beneath

Storm Drain - A storm drain is designed to prevent flooding by safely carrying rainwater to streams, creeks, the bay and the ocean

Watershed – an area of land that is drained by a river or other body of water

Goal

- ❖ Complete a project that will make citizens aware that their actions affect the streams and the Chesapeake Bay.

Voluntary State Curriculum

1.0 Skill and Processes
- A Scientific Inquiry: 1
- C Application of Science: 2

6.0 Environmental Science
- C Natural Resources & Human Needs: 1

Time 2 hours

Materials

- ✓ Map of area
- ✓ Stencils for each team
- ✓ Light colored water based latex paint (1 quart for 20 drains) for the background

- ✓ Green water based latex paint (1 can for 6 drains).
- ✓ Water (for brush clean up)
- ✓ Drop cloth
- ✓ Masking tape
- ✓ Wire brushes and hand brooms
- ✓ Screwdriver (to open cans)
- ✓ Paint stirrers (1 per team)
- ✓ "Wet Paint" Signs
- ✓ 3" paint brushes
- ✓ Trash bags (1 per team)
- ✓ Traffic Cone

Motivation

❖ Read "It's all Connected".

Procedure

1. *Locate a storm drain near your school.* Look for storm drains in your school parking lot and/or along the streets that surround your school. Consider contacting your Department of Public Works for a map of the storm drain system in your area to find out where the storm drain system empties.

2. ***Get permission***. If you are planning to stencil storm drains on school grounds, you will need to get permission from your principal. For all other sites, contact your local Department of Public Works for permission. You may need to obtain a permit, so contact them several weeks prior to the date you want to begin. Be prepared to provide the following information:

   - ✓ The location of the storm drain(s) you wish to stencil;
   - ✓ What you plan to stencil onto the storm drain: "Don't Dump!" on the horizontal side, "Chesapeake Bay Drainage" on the vertical side; and
   - ✓ Who will provide supervision for the project?

3. ***Purchase or borrow supplies.*** Some of the materials required for this project (paint brushes, masking tape, etc.) can probably be borrowed from your home. Ask people in the community, local businesses, or organizations to donate supplies or money for the supplies. This is your chance to get people in the community involved and educate them about the storm drain issue. Storm drain stencils can be borrowed from the Maryland Department of Natural Resources. For more information, visit the DNR web page (http://www.dnr.maryland.gov/education/are/stormdrain.html) to download a Storm Drain Stencil Form.

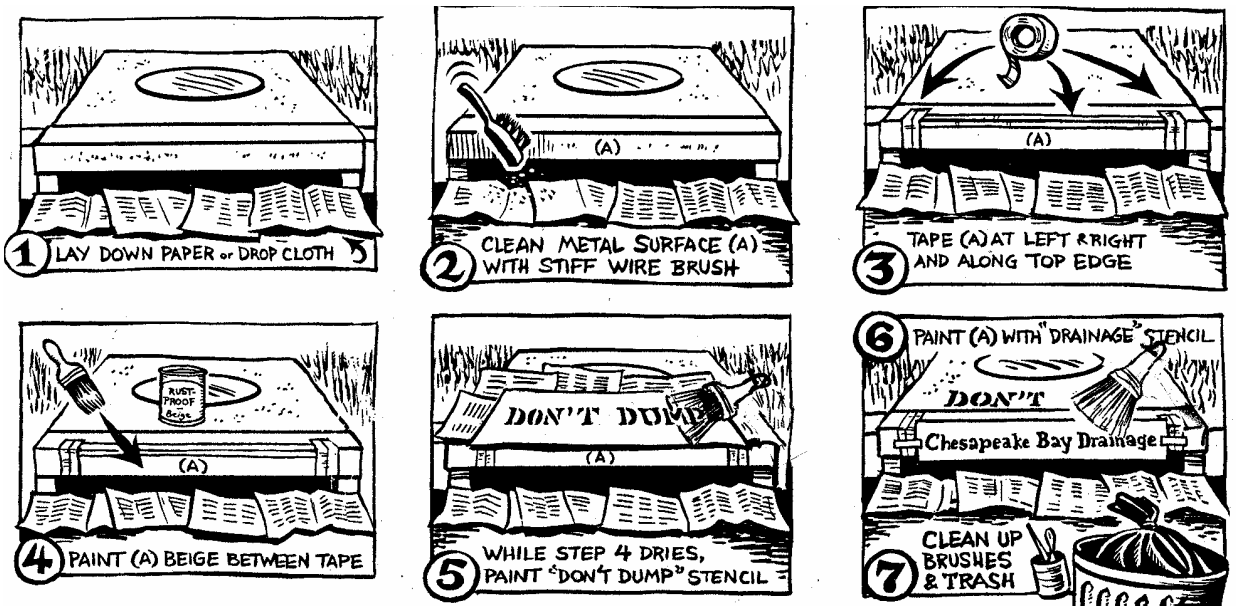
4. ***Publicize.*** Contact the news media (radio and television stations) at least two weeks in advance and provide them with details about the project (time, location, and contact names). Remind the media of the event a day or two before. If possible, announce the project over the school's PA system. In addition, distribute flyers to residents who live near the storm drains to be stenciled.

   Your flyer should include:

   - ✓ the date and time;
   - ✓ the purpose of the event;
   - ✓ the exact location of the drains to be painted;
   - ✓ a person to contact with questions or concerns, and
   - ✓ a request to move cars blocking designated storm drains on the day of the event.

5. *Safety first!* Since drivers may not see you standing or kneeling near parked cars, plan to have an adult hold a traffic flag and alert oncoming cars. If your storm drain stenciling is on a very busy street, arrange for police to direct traffic. Call your local police station several weeks in advance to ask for help.

6. *Practice.* Use a flat paper bag to do a practice run with the stencil. Remember, less is more with paint- if applied too thick it will "run" under the stencil. *Dab* the paint into the stencil, to get into the crevices of the surface you are stenciling.



7. The pavement must be dry for the paint to stick. In addition, the paint will not dry well if it is colder than 50° F. If it is raining cancel the project and choose an alternative date instead.

8. Place traffic cones 2-3 feet in front of the storm drain and clean up any debris on or around the storm drain. Be sure to wear protective gloves and put all debris found in a trash bag. Separate any recyclable materials from regular trash. Use a wire brush to remove rust if you will be stenciling any metal part of the storm drain. Place the drop cloth in front of the drain to prevent any of your materials from falling into the storm drain.

9. Center the "Don't Dump!" stencil on the horizontal (top) face of the storm drain, and the "Chesapeake Bay Drainage" stencil on the vertical (bottom) face. Outline the stencils with masking tape to create a straight, rectangular border on the areas you are painting. Set the stencils aside, leaving the rectangular borders.

10. Paint inside the rectangular borders with white or beige paint. Wait 15-30 minutes, or until paint is dry to the touch.

11. Once again, center the "Don't Dump!" stencil on the horizontal surface and the "Chesapeake Bay Drainage" stencil on the vertical surface. Tape both stencils into place.

12. As one or two students apply paint to the letters, other students can help them, by holding the stencil flat and firmly in place. Be careful not to use too much paint or it will run and smear! Generally, if you are using the right amount of paint, you will need to "reload" your brush with paint every two letters. When you are finished stenciling all of the letters, lift the stencils off carefully so that you don't smudge the wet paint. Remove the masking tape borders.

13. Clean up the stenciling site. Use paper towels to wipe any excess paint from the stencil. Place any paint brush used in a plastic bag while you go to the next stenciling site. Tape a "Wet Paint!" sign next to drain. Clean your bushes thoroughly with water and dry them with newspaper. If you have used a water-based latex paint, you will be able to rinse brushes and containers in a bathroom sink.

Optional Challenges/Extensions

- Journal – reflect on the project. What went well? What didn't? How would you change the project if you were to do it again? What were the benefits of the project – to the community, the environment and you?
- Monitor trash around storm drain one-week prior to and one week following stenciling. Assess whether the project has made a difference in the amount of trash that enters the storm drain.
- Design another stencil or sticker that you could use in a similar way to encourage people to help the environment by changing their behavior.
- Extend the project to cross-aged teaching experience. Teach older and younger people in the community why it is important to stencil storm drains.

Wrap Up

- Mark on the map where drains are painted; use a different marking to show the locations of drains you would like to stencil in the future.

- Discuss the impact of the storm drain painting that was done. Check the stream in future months to see if pollution has decreased.

Assessment

- Participation in the project

Tips for Clean Up

- Put non-hazardous trash in trash bag.

- Clean brushes.

- Give away leftover paint or pour kitty litter into the can of paint, let dry, and dispose in the regular trash.

- To get rid of hazardous materials (paint thinner, mineral spirits, non-latex paint) call the local Solid Waste, Public Works or Environmental Health Office.

It's All Connected!

Have you ever watched rainwater rushing over the ground during a storm? It travels very quickly. Lots of water runs together from different areas. It sweeps along everything in its path. Streams of water pour into the nearest storm drain. After it disappears inside the storm drain, where does the water go?

The rain you see racing into your neighborhood storm drain goes into concrete pipes. Then it is carried to a discharge point or outfall, usually located on a stream. The stream joins other streams. The streams flow into rivers. The rivers empty into the Chesapeake Bay. You can see how the storm drain in your neighborhood is a connection between your community, the streams and the Bay. Anything that goes into a storm drain will end up in a stream or river or the Bay.

A lot of people don't know this. They think a storm drain is like a big dumpster. They throw trash and toxic substances into the drain. Maybe you've thrown a wrapper into a storm drain thinking it was okay.

Any substance that is dumped or poured on pavement or hard surface can be washed into a storm drain by rainwater. That's why people should not drain oil or other fluids from cars onto a driveway or street. A good thing to do is to always ask yourself this question before spilling or pouring something on the ground: "Would this be safe to put in a fish aquarium?" If the answer is "No", then you shouldn't place it on a paved surface.

Educating people about the connection of storm drains to our community waterways and the Bay is a very important way to help restore our streams.

Storm Drain Stenciling

An easy way to teach people that storm drains should not be used as trash cans is to stencil a message right on the storm drain

WHAT YOU WILL NEED

- ☐ Stencils
- ☐ 3" Paint brushes
- ☐ Container for cleanup
- ☐ Mineral spirits/paint thinner
- ☐ Light colored water based latex paint
- ☐ Green water based latex paint
- ☐ Map of area
- ☐ Water (for brush clean up)
- ☐ Drop cloth
- ☐ Masking tape
- ☐ Wire brushes and hand brooms
- ☐ Screwdriver (to open cans)
- ☐ Paint stirrer
- ☐ Wet Paint" Signs
- ☐ Trash bag
- ☐ Traffic Cone

KNOW THE MEANING…

Discharge Point – the place where the water traveling from storm drains in underground pipes empties into a stream

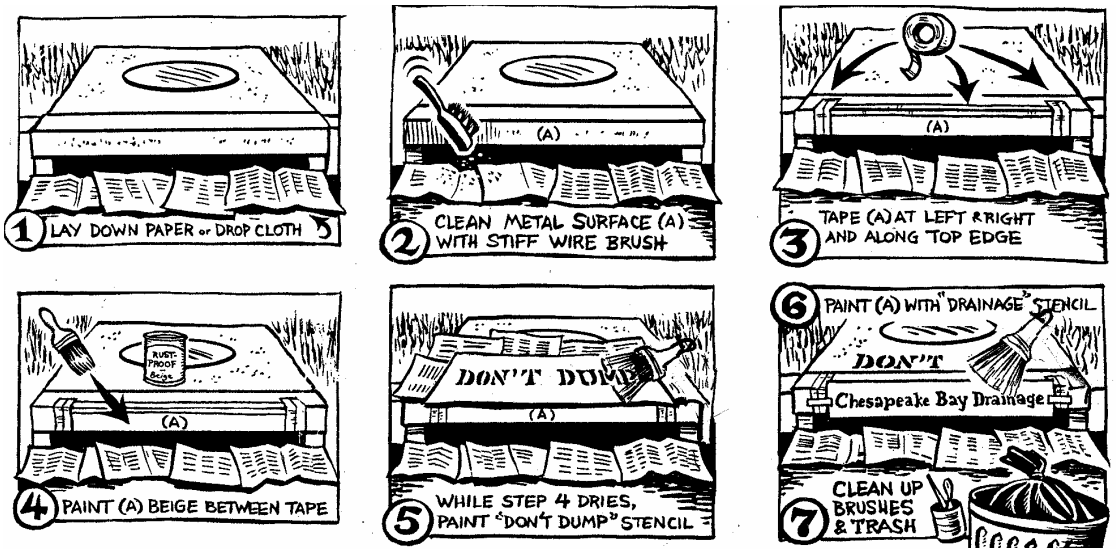
Outfall – same as discharge point

Stencils - A sheet of plastic that has lettering cut out so that when you paint the sheet, the lettering will reproduce on the surface beneath

Storm Drain - A storm drain is designed to prevent flooding by safely carrying rainwater to streams, rivers, creeks, the bay and the ocean.

Watershed – an area of land that is drained by a river or other body of water

WHAT TO DO



Student Page

Are YOU A Water Waster?

Goal

- ❖ Recognize that solutions to water problems require taking responsibility for personal use of water.

Voluntary State Curriculum

1.0 Skill and Processes
- A Scientific Inquiry: 1
- C Application of Science: 2

6.0 Environmental Science
- C Natural Resources & Human Needs: 1

Time 45 minutes

Materials

- ✓ Water Use Activity (1 deck for every 2-5 students)
- ✓ Water You're Using Data Sheet

Motivation

- ❖ Self-use survey
- ❖ Read "Are You a Water-Waster?"

Procedure

1) Have students complete the "Water You're Using: Self Use Survey" (estimated) to point out the amount of water used by individuals and families. Have students circle the letters of the type of water use that they think they could reduce.

2) Let the students play the Water Use Activity to learn of possible solutions to waste problems. Prepare Activity ahead of time. Make one copy of the master for each deck needed. Laminate cards, if

possible, then cut them apart. Following the Activity, discuss each set of problem areas and solutions used in the Water Use Activity.

3) Using the Self Use Survey (calculated), have students time and record their water use for the day. Using the information learned from the Activity, have students develop a plan of action that is practical and attainable. EX: Take a 10-minute shower instead of 25 minutes. Have students do the Self Use Survey (calculated) again about a week after they develop their plan. This is more of a reminder than a true test of conservation.

Wrap Up

- Do we really have to save our water? Or do we have plenty?
- Why do you think people waste so much water?
- What happens when sewage treatment plants can't handle the amount of water to be treated? (Relate that excess wastewater can result in pollution in our streams.)

Modifications

- Play in pairs, groups.

Assessment

- Participation

Optional Challenges/Extensions

- Set up a water conservation plan for the group. Example: Do not run water while lathering your hands at the sink.
- Study a country that lives in drought conditions and their methods of water use and conservation.
- Do a home-use survey checking for leaks and obvious water waste. How many homes have to pay water and sewage fees? How can they reduce their use and save money?
- Create your own problem, solution and Water Wonders question cards.
- Have students complete the worksheet entitled, "Water Shortage" as a follow-up. It provides a way for students to experience directly what severe water shortage means for everyday activities. Ask students to make a commitment to do the activity at home. Discuss the results at your next class.
- Project Wet Activities: Water Meter, Money Down the drain, Long Haul
- Journal

Are YOU a Water Waster?

Have you ever seen the science fiction movie “Dune” ? The people in “Dune” lived on a planet with almost no water. They invented amazing ways to conserve water to stay alive.

Most of us live in places where we have no shortage of water. We tend to think that we can use all the water we want – even waste it - and there is no harm done. This is a mistake. There are limits to the amount of safe water available. In the past, certain areas of Maryland have put restrictions on water use in residential areas. You may remember times in summer droughts when you were not permitted to wash your car or water your lawn.

Using more water than you need also adds to the pollution of our streams and rivers. Too much water in sewage systems can lead to leakage.

There are many ways to stop being a Water Waster. Take short showers. Put a water saver in your toilet flush box (it’s possible to make your own by filling a milk bottle with water or using a brick). Make sure leaky faucets are fixed fast. Don’t let the water run while you brush your teeth. What are other ways you can conserve water?

Water You’re Using

WHAT YOU WILL NEED

☐ Water Use Activity and Activity Sheets

WHAT TO DO

Your teacher has instructions for the activity. Play the activity and see who wins and how. Fill out your own water use form. Talk about ways you can stop being a water waster. Decide on actions you will take at home.

AT HOME…

Share what you learned about being a water waster with your family. See if they’ll agree to join you in changing some ways you do things in order to waste less water.

Student Page

Water You're Using

Self-Use Survey (estimated)

Gallons

- Number of times you flush the toilet per day ___x 5 gal = ____
- Minutes faucet runs while washing & brushing teeth ___x 3 gal = ____
- Length of your shower, in minutes ___x 5 gal = ____
- Water to wash your dishes, in minutes ___x 4 gal = ____
- Water to wash a load of clothes, in minutes ___x10 gal= ____

Add up the gallons column to determine the average amount of water you use per day. ____

Multiply your average by the number of people in your house to determine the average amount for your family ____

Self-Use Survey (Calculated)

	Normal	Reduced
Actual flushes per day		
Actual minutes washing and brushing		
Actual minutes in the shower		

PLAN OF ACTION

I will reduce water waste by:

1. _____
2. _____
3. _____

Student Page

Water Shortage
An Activity to Do at Home

1. Did you run out of water before the day was over? ___
2. Did you have any water left? ___ If so measure how much._____
3. What did you learn about your water use habits?

4. What were some “tricks” you learned for conserving water?

5. What was the hardest thing about your “water shortage” day?

6. What can you do every day to conserve water at home and at school?

Student Page

Water Wonders

Activity 13: Water Use

The Rules

The object of the activity is to get one problem area card and four solution cards that fit the problem. Five cards are dealt to each player. The remaining cards become the "Faucet" pile. Turn over the top card to create a "Drain" or discard file.

Shuffle the "Water Wonder" cards and place in a separate pile, with the question side up.

Upon his turn, a player must draw a card from the "Faucet" pile and discard an unwanted card, face up, in the "Drain" pile. When the "Faucet" is empty, recycle the "Drain" pile.

The player may pick up the top card on the "Drain" pile if he/she needs that particular card.

Special Cards:
"Fix Leaks" cards are a solution wild card that can help any problem.

If a player draws a card that says "Water Wonders", they must answer the question found on the top card of the "Water Wonders" pile. If the question is answered correctly, that player chooses another player and asks for a card that he needs. The other player must give up that card in exchange for a card of player #1's choice. Player #1 then discards the "Water Wonders" card to the top of the "Drain" pile and returns the question card to the bottom of the "Water Wonders" pile.

If the question is answered incorrectly, the player does not draw another card – in effect, he/she looses a turn this go round. He discards the "Water Wonders" card to the top of the "Drain" pile and returns the question card to the bottom of the "Water Wonders" pile.

Solution Cards Needed to Solve Problems:

Bathroom Sink Blues: 1, 2, 3, 4, 9, 10, and 11
Toilet Turmoil: 5, 6, 7, and 8
Bumbling Baths: 4, 9, 10, 11, and 12
Kitchen Sink Kinks: 4, 9, 13, 14, 15, and 16
Outdoor Dilemma: 17, 18, 19, and 20

WATER WONDER CARDS – QUESTIONS

Question: A 10 minute shower uses how many gallons of water? Water Wonders Card #1	Question: Which usually uses less water: A shower? or A bath? Water Wonders Card # 2	Question: A slow steady drip can waste how many gallons of water per month? 80 gallons 200 gallons 350 gallons Water Wonders Card # 3	Question: The best time to water your lawn is noon time: True or False Water Wonders Card # 4	Question: Lots of suds are better. True or False Water Wonders Card # 5
Question: How much water on the earth is fresh water? 3% 20% 40% Water Wonders Card #6	Question: Hot water costs more to use than cold water. True or False Water Wonders Card # 7	Question: It is better to wash a few dishes by hand than to use the dishwasher. True or False Water Wonders Card # 8	Question: The average amount of water a person uses per day on the east coast is: 50 gallons 100 gallons 150 gallons Water Wonders Card # 9	Question: Keeping your grass cut short (1”) requires less watering. True or False Water Wonders Card # 10

Photocopy these cards back to back with “Water Wonder Cards - Answers

WATER WONDER CARDS – ANSWERS

Answer: False Requires more rinsing which uses more water. Water Wonders Card #5	Answer: False Early morning or late evening. Water Wonders Card # 4	Answer: 350 gallons Water Wonders Card # 3	Answer: A shower Water Wonders Card # 2	Answer: 40-70 gallons Water Wonders Card # 1
Answer: False It holds less moisture and therefore needs more watering. Water Wonders Card #10	Answer: 100 gallons Water Wonders Card # 9	Answer: True Water Wonders Card # 8	Answer: True Water Wonders Card # 7	Answer: 3% Water Wonders Card # 6

Photocopy these cards back to back with "Water Wonder Cards – Questions"

SOLUTION CARDS – PAGE 1 OF 2

Turn off water when brushing teeth and washing face.  Card #1	*Use a cup for brushing your teeth.*  Card # 2	*Fill the sink only half full when saving.*  Card # 3	*Change the faucet or showerhead to a water saving model.*  Card # 4	*Keep toilet in good repair so it doesn't stick.*  Card # 5
Reduce water in the toilet tank. Use plastic bottles or toilet dams.  Card #6	*Stop flushing trash, tissues or bugs!*  Card # 7	*Replace toilet with a water saving model.*  Card # 8	*Make sure stopper is tight.*  Card # 9	Keep faucet in good repair. Stop drips!  Card # 10

SOLUTION CARDS – PAGE 2 OF 2

Don't spill water through the overflow pipe. Too full!  Card #11	*Take a quick shower.*  Card # 12	*Use the largest dirty dish or pan as the sink instead of filling the sink.*  Card # 13	*Fill a pan with rinse water and dip dishes instead of running water.*  Card # 14	*Only use the dishwasher when full.*  Card # 15
Use garbage disposal only when full and needed.  Card # 16	*Wash the car using a bucket of water instead of a running hose.*  Card # 17	*Water the lawn in the evening or early morning.*  Card # 18	*Sweep sidewalks and driveways. Don't hose them down.*  Card # 19	*Don't water the street. Adjust the lawn sprinklers.*  Card # 20

PROBLEM AREA CARDS

 **BATHROOM SINK BLUES** Solution cards: 1, 2, 3, 4, 9, 10, 11	 **TOILET TURMOIL** Solution cards: 5, 6, 7, 8	 **BUBBLING BATHS** Solution cards: 4, 9, 10, 11, 12	 **KITCHEN SINK KINKS** Solution cards: 4, 9, 13, 14, 15, 16	 **OUTDOOR DILEMMA** Solution cards: 17, 18, 19, 20
 **BATHROOM SINK BLUES** Solution cards: 1, 2, 3, 4, 9, 10, 11	 **TOILET TURMOIL** Solution cards: 5, 6, 7, 8	 **BUBBLING BATHS** Solution cards: 4, 9, 10, 11, 12	 **KITCHEN SINK KINKS** Solution cards: 4, 9, 13, 14, 15, 16	 **OUTDOOR DILEMMA** Solution cards: 17, 18, 19, 20

WILD CARDS

 ***WATER WONDERS***	 ***WATER WONDERS***	 ***WATER WONDERS***	 ***WATER WONDERS***	 ***WATER WONDERS***
 ***FIX LEAKS***	 ***FIX LEAKS***	 ***FIX LEAKS***	 ***FIX LEAKS***	 ***FIX LEAKS***

LOCAL ENVIRONMENTAL EDUCATION RESOURCES

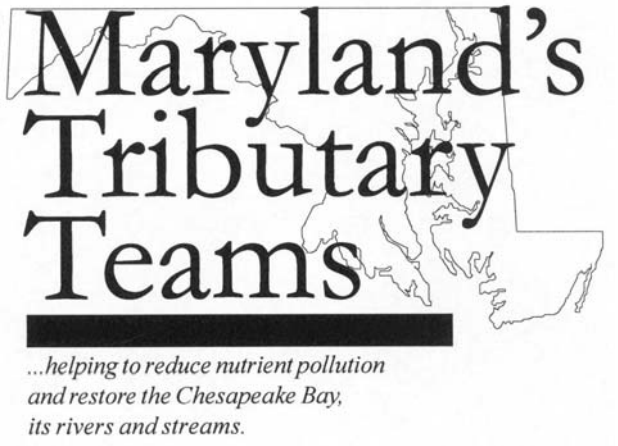
Maryland's Aquatic Resource Education Program

Established in 1990, WET (Water Education for Teachers) is an interdisciplinary water education program which targets educators and young people in grades K-12. The goal of **Project Wet** is to facilitate and promote the awareness, appreciation, knowledge, and management of water resources through the development and dissemination of classroom ready teaching aids. A trained network of teachers, resource professionals, and citizens organize and teach Project WET workshops throughout Maryland. By familiarizing educators with current water resource issues, Project WET ultimately reaches students by incorporating interesting activities, simulations, exhibits, and models into the classroom. For more information about Project WET, please contact Cindy Etgen at 410-260-8710 or cetgen@dnr.state.md.us

Aquatic Resources Education Conferences

This program introduces educators to workshops and class projects related to aquatic resources. Regional mini-conferences are held during the school year to prepare educators for developing their own environmentally sound projects with their students. Educators are also taught how to write grant proposals for an ARE grant and for the Chesapeake Bay Trust. Past workshops have included schoolyard habitat projects, Wonder of Wetlands, Be Part of Something Big!, and a yellow perch project. For more information, or a grant application, please contact Cindy Etgen at 410-260-8710 or cetgen@dnr.state.md.us

Healthy Water, Healthy People is an innovative water quality education program sponsored by Project WET and the Hach Scientific Foundation; offers hands-on activity guides, testing kits, training, and much more. Healthy Water, Healthy People is for anyone interested in learning and teaching about contemporary water quality topics. For more information about Healthy Water, Healthy People, please contact Cindy Etgen at 410-260-716 or cetgen@dnr.state.md.us



Your River, Your Bay

Not everyone lives next to a stream or river, but all of us live in a watershed. Whether you live right on the water—or, like most Marylander's, within a half mile of your neighborhood stream—your actions on the land can affect water quality in the streams and rivers that feed the Chesapeake Bay.

Maryland's Tributary Teams—comprised of local citizens, farmers, business leaders and government official appointed by the Governor—are working to keep your local waterways clean and healthy.

Maryland's Tributary Teams meet regularly in each of the Bay's ten major tributaries to help implement pollution prevention measures needed to address local water quality problems. These teams are laying the groundwork to ensure clean water and healthy rivers for future generations. A major focus of their efforts is controlling nutrient pollution from farm fields and horse pastures, wastewater treatment plants, construction and road building activities, and hundreds of thousands of suburban properties.

What can these teams do for teachers and youth organizations?

- Connect teachers and groups with water quality data.
- Provide "expert" guest speakers on various environmental issues.
- Partner with them in restoration projects such as oyster gardening, tree grow-out projects, and rain gardens.

Get Connected !

To get involved in your local Tributary Team call 410-260-8710.
http://www.dnr.maryland.gov/bay/tribstrat/brochure.html

Chesapeake Bay National Estuarine Research Reserve in Maryland

This Reserve system is one of 26 Reserves in 17 states and Puerto Rico established to protect estuarine areas as natural field laboratories for research, monitoring and education. The Maryland reserve system encompasses 4,800 acres in three distinct portions of the Bay: Otter Point Creek in the upper Bay, Jug Bay on the Patuxent River, and Monie Bay on the lower eastern shore. The environmentally diverse habitats represented by these three regions include flooded hardwood forests, freshwater wetlands, and expansive salt marshes. The educational programs of the Chesapeake Bay Reserve in Maryland focus on a wide range of audiences from legislators and coastal decision makers, to environmental professionals, educators, and students. The Anita C. Leight Estuary Center at the Otter Point Creek component serves as the Reserve center for the state. Check out Maryland CBNEER's Web Site: http://www.dnr.maryland.gov/bay/cbnerr/index.html

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Department of Natural Resources Educational Programs

This is a list of resources that Maryland Department of Natural Resources offers for people interested in educating students or furthering their own natural resources skills. They include student activities, in-class presentations, educator professional development opportunities, and outdoor education opportunities for people of all ages. If you have any questions, please contact:

Elena S. Takaki
Tawes State Office Building, E2
580 Taylor Ave.
Annapolis, MD 21401
410-260-8715
etakaki@dnr.state.md.us

Program	Target Audience	Key Goal of Program	Website
FISHERIES			
Hooked on Fishing, Not on Drugs™ Donna Fahres 410-260-8721	Ages 7-15	Teach fishing & conservation ethic; drug avoidance.	http://www.dnr.maryland.gov/education/hofnod.html
WATERSHED EDUCATION			
Aquatic Resources Education Grants Cindy Etgen 410-260-8716	Educators	Promote aquatic resources projects in schools.	http://www.dnr.maryland.gov/education/aregrantapp.pdf
Project WET Cindy Etgen 410-260-8716	Educators	Promote teaching of water-related issues.	http://www.dnr.maryland.gov/education/projectwet.html

Program	Target Audience	Key Goal of Program	Website
Storm Drain Stenciling Cindy Etgen 410-260-8716	Educators	Promote teaching of water-related issues.	http://www.dnr.maryland.gov/education/projectwet.html
Check-Up Elena S. Takaki 410-260-8715	Grades 6-12	Guide on how to assess the natural resource use in your school (waste, water, and energy).	http://www.dnr.maryland.gov/smartgrowth/ed/checkup.html
Where Do We Grow from Here? Sandy Olek 410-260-8979	Grades 6-12	A teacher's resource guide on growth and its impacts in Maryland. Includes lesson plans, maps, and background information.	http://dnrweb.dnr.maryland.gov/smartgrowth/home.htm
Maryland Biological Stream Survey Paul Kazyak 410-260-8607	Educators	Use the website to obtain information about chemical and biological sampling conducted throughout the state	http://www.dnr.maryland.gov/streams/mbss

Program	Target Audience	Key Goal of Program	\ Website
Surf Your Watershed Kevin J. Coyne 410-260-8985	Grades 8-Adult	Website provides data, profiles, bibliographic references, information about on-going projects in Maryland's watersheds.	http://www.dnr.maryland.gov/watersheds/surf
CHESAPEAKE BAY			
Horseshoe Crabs in the Classroom Elena Takaki 410-260-8715 Cindy Etgen 410-260-8716	Grades 3-12	Teach about value of and threats to this resource.	http://www.dnr.maryland.gov/education/horseshoecrab
National Estuarine Research Reserve Bob Finton	K-12 Educators	Teach about coastal ecosystems.	http://dnr.maryland.gov/bay/cbnerr/index.html
Bay Grasses in Classes Mark Lewandowski 410-260-8634	K-12	Teach about value of and threats to this resource.	http://www.dnr.maryland.gov/bay/sav/bgic/grass_class.html
Eyes on the Bay Chris Heyer 410-260-8692	Grades 8 - adults	View real-time data on Chesapeake Bay conditions. Includes lesson plans to support use of the website.	http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm

Program	Target Audience	Key Goal of Program	Website
HUNTER & BOATER SAFETY			
Boater Education Dave Street 410-260-3288	Adults	Environmentally responsible boating behavior.	http://www.dnr.maryland.gov/nrp/boatingsafetyedu.html
Hunter Education	Adults	Safe hunting behavior - required by law .	http://www.dnr.maryland.gov/nrp/education
STATE PARKS			
Junior Rangers Steve McCoy 410-260-8150	K-12 (ages 7-14)	Understanding & appreciation of natural resources at State Parks.	http://www.dnr.maryland.gov/publiclands/jrranger.html
Park Naturalist Programs Steve McCoy (Park Naturalists) 410-260-8150	K-12 Adult	Understanding & appreciation of natural resources at State Parks.	http://www.dnr.maryland.gov/publiclands
Outdoor Discovery Camp Cindy Hawkins 410-260-8154	K-12 (ages 8-17)	Understanding of natural resources & recreational opportunities at State Parks.	http://www.dnr.maryland.gov/publiclands/outdoordisc.html

Program	Target Audience	Key Goal of Program	Website
Scales & Tales Steve McCoy 410-260-8150	K-12 Adult	Understanding & appreciation for wildlife and stewardship of natural resources	http://www.dnr.maryland.gov/publiclands/snt.html
Tawes-Natural Resources Club Tawes Garden Day Camp Amy Henry 410-260-885	Ages 6-12	Understanding & appreciation of natural resources at State Parks.	http://www.dnr.maryland.gov/publiclands/daycampapplic.html
Leave No Trace Steve McCoy 410-260-8150	All ages	Teaches stewardship and outdoor ethics through minimum impact recreation.	http://www.dnr.maryland.gov/outdooradventures/lnt.html
FORESTRY			
Project Learning Tree Dave Reinecke 410-673-7507	Educators	Understanding of forestry concepts.	http://www.dnr.maryland.gov/forests/kids/plt.html
Arbor Day Curriculum Dave Reinecke 410-673-7507	Educators, 3rd graders	Provide curriculum and free trees to classes.	http://www.dnr.maryland.gov/forests/education/arborday.html
School Forests Pam Kelly 410-260-8589	K-12	Establish school forests for study and environmental benefit	

Program	Target Audience	Key Goal of Program	Website
Tree-mendous Maryland Terry Galloway 410-260-8510	Adults	Tree planting skills.	http://www.dnr.maryland.gov/forests/treemendous
WILDLIFE			
Project WILD Marilyn Mause 410-836-4557	Educators	Understanding of habitat, wildlife and conservation concepts.	http://www.dnr.maryland.gov/wildlife/projectwild.html
Wild Acres Marilyn Mause 410-836-4557	Adults	Promote creating backyard habitat.	http://www.dnr.maryland.gov/wildlife/wildacres.html
Junior Hunter Days Karina Blizzard 410-260-8559	Ages 16 or younger	Safe hunting behavior.	http://www.dnr.maryland.gov/wildlife/wmaintro.html
ADULTS			
Becoming An Outdoors Woman Karina Blizzard 410-260-8559	Adults	Experience outdoors; learn recreational skills.	http://www.dnr.maryland.gov/wildlife/bow.html
Tributary Teams Jamie Baxter 410-260-8987	Adults	Environmentally responsible behavior	http://www.dnr.maryland.gov/bay/tribstrat

Program	Target Audience	Key Goal of Program	Website
GEOLOGY			
Maryland Geology Dale Shelton 410-554-5505	K-12	Teaching of the wonderful and varied geology of Maryland.	http://www.mgs.md.gov/
OTHER			
Bay Game John Wald 410-260-8006	All ages	Teach environmental concepts through a travel game along Route 50.	http://www.dnr.maryland.gov/baygame
Green Schools Elena Takaki 410-260-8715	Educators	Integrate environment into curriculum, school buildings & grounds, and community.	http://www.dnr.maryland.gov/education/greenschools.html
Envirothon Elena Takaki 410-260-8715	9-12	Trains high school students in forestry, wildlife and aquatics issues.	http://www.dnr.maryland.gov/education/envirothon/
Natural Resources Magazine ***Dorie Coleman*** 410-260-8002	All ages	Information about DNR's various programs, hot topics, calendar of events, DNR @ Work, and a Natural Education	http://www.dnr.maryland.gov/dnrnews/publications.asp

Maryland Outdoor Education And Nature Centers

Allegany County

WESTERN MD 4-H EDUCATION CENTER
1916 Maryland Highway. Suite A
Moutain Lake Park, MD 21550
Phone: 301-334-6967
Contact: JAMES SIMS

Anne Arundel County

ARLINGTON ECHO OUTDOOR EDUCATION CENTER
975 Indian Landing Road
Millersville, MD 21108
410-222-3822
Contact: Stephen Barry
sgbarry@aacps.org

CAMP LETTS OUTDOOR EDUCATION CENTER (YMCA CAMP)
Po Box 208
Edgewater, MD 21037
Phone: 410-269-6697 or 301-261-4286
Contact: GLORIA BROWN or KYLE IORIO

WEST RIVER OUTDOOR EDUCATION CENTER
975 Indian Landing Road
Millersville, MD 21108
Phone: 410-222-1688 or call Arlington Echo @ 410-222-3822 or -3823

WOODLANDS OUTDOOR EDUCATION CENTER
975 Indian Landing Road
Millersville, MD 21146
Phone: 410-222-5825 or call Arlington Echo @ 410-222-3822
Contact: Stephen Barry

Baltimore City

BRAGG NATURE CENTER
6601 Baltimore National Pike
Baltimore, MD 21228
Phone: 410-747-8336
Contact: BEN WALLACE

Baltimore County

IRVINE NATURAL SCIENCE CENTER
ST. TIMOTHY'S SCHOOL
8400 Green Spring Ave
Stevenson, MD 21153
Phone: 410-484-2413 Fax: 410-484-3573
Contact: ROB MARDINEY

CAMP PUH'TOK (SALVATION ARMY)
Contact: ROBERT W. ELDREDGE
Summer Address:
17433 Big Falls Road
Monkton, MD 21111
Phone: 410-329-6590

Winter Address:
2602 Huntingdon Avenue
Baltimore, MD 21211
Phone: 410-366-5081

GENESEE VALLEY OUTDOOR LEARNING CENTER
1717 Rayville Road
Parkton, Md 21120-
Phone: 410-343-0101 or -0138

Fax: 410-343-1451
Contact: JIM CURTIS

OREGON RIDGE NATURE CENTER
13555 Beaver Dam Road
Cockeysville, MD 21030
Phone: 410-887-1854 or 771-0034
Contact: KIRK DREIER, SUE LESLIE, or GLENN SWISTON

SOLDIER'S DELIGHT
5100 Deer Park Road
Owings Mills, MD 21117
Phone: 410-922-3004

Calvert County

BATTLE CREEK CYPRESS SWAMP
C/O Calvert County Courthouse
Prince Frederick, MD 20678-
Phone: 410-535-5327
Contact: ANDY BROWN

FLAG POND NATURE PARK
Address and Phone same as for Battle Creek Cypress Swamp

JEFFERSON PATTERSON PARK AND MUSEUM
10545 Mackall Road
St Leonard, MD 20685-
Phone: 410-586-0050 or -9700
Fax: 410-586-9705
Contact: GEORGE ABBEE

KING'S LANDING
King's Landing Road
Huntingtown, MD
Phone: 410-535-2960
Fax: 410-535-7372
Contact: JACKIE WEYMEYER

Carroll County

CARROLL COUNTY OUTDOOR SCHOOL
Hashawha Environmental Center
300 John Owings Road
Westminister, MD 21158
Office: 125 N. Court Street
Westminster, MD 21157
Phone: 410-751-3301
Contact: Steve Heacock

FAIR HILL NATURE CENTER
30 Martz Road
Sykesville, MD 21784
Phone: 410-795-6474
Fax: 410-795-6235
Contact: LOREN LUSTIG, Administrator

HASHAWHA ENVIRONMENTAL CENTER
300 John Owings Road
Westminister, MD 21158
Phone: 410-848-9040
Email: Hashawha@carr.org

Cecil County

FAIR HILL NATURE AND ENVIRONMENTAL CENTER
630 Tawes Drive
Elkton, MD 21921
Phone: 410-398-4909
Contact: HOLLY HANNUM or KAREN ASPINWALL

Charles County

NANJEMOY CREEK ENVIRONMENTAL EDUCATION CENTER
Charles County Public Schools
Po Box D
La Plata, MD 20646-0170
Phone: 301-743-3526
Contact: STEVE CARDANO
scardano@erols.com

Frederick County

FREDERICK OUTDOOR SCHOOL (CAMP GREENTOP)
C/O Monocacy Middle School

8009 Opossumtown Pike
Frederick, MD 21702
Phone: 301-696-9261
Contact: EDDIE MAIN

SUMMIT LAKE OUTDOOR EDUCATION CENTER
Emmitsburg, MD 21727
Phone: 301-924-3123

Garrett County

HICKORY ENVIRONMENTAL EDUCATION CENTER
604 Pride Parkway
Accident, MD 21520
Phone: 301-746-8461
Fax: 301-746-8461
Contact: JOSEPH L. WINTERS
heec@excite.com

WESTERN MARYLAND 4-H EDUCATION CENTER
1916 Maryland Highway
Suite A
Moutain Lake Park, MD 21550
Phone: 301-334-6967
Fax: 301-334-6961
Contact: PAUL WEBSTER
pw82@umail.umd.edu

Harford County

HARFORD GLEN ENVIRONMENTAL EDUCATION CENTER
502 West Wheel Road
Bel Air, MD 21015
Phone: 410-638-3903
Fax: 410-638-3907
Contact: MARK HERZOG

Kent County

ECHO HILL OUTDOOR SCHOOL
13655 Bloomingneck Road
Worton, MD 21678
Phone: 410-348-5303 or –5880
Fax: 410-348-2010
Contact: PETER RICE or BETSY McCOWN
ehos@bluecrab.org

Montgomery County

LATHROP E. SMITH ENVIRONMENTAL CENTER
5110 Meadowside Lane
Rockville, MD 20855
Phone: 301-924-3123
Contact: Dave Honchalk
Dave_honchalk@fc.mcps.k12.md.us

Prince George's County

CLEARWATER NATURE CENTER
11000 Thrift Road
Clinton, MD 20735
Phone: 301-297-4575
Fax: 301-297-5743
Contact: SANDY LYON

PATUXENT NATIONAL WILDLIFE VISITOR'S CENTER
10901 Scarlet Tanager Loop
Laurel, MD 20708
Phone: 301-497-5760 or -5763
Fax: 301-497-5765
Contact: NEL BALDACCHINO @ Ext 5766

PATUXENT RIVER 4-H CENTER
18405 Queen Anne Road
Upper Marlboro, MD 20774
Phone: 301-390-7259
Fax: 301-390-7883
Contact: Bonnie Dunn

WILLIAM S. SCHMIDT CENTER
Prince George's County Public Schools
18501 Aquasco Road
Brandywine, MD 20613

Phone: 301-888-1185
Fax: 301-888-1236
Contact: JOHN NEVILLE
jnevile@erols.com

Queen Anne's County

CAMP WRIGHT
400 Camp Wright Lane
Stevensville, MD 21666
Phone: 410-643-4171
Fax: 410-643-8421
Contact: VAN E. BEERS or NOAH KEGLEY

St. Mary's County

ELMS ENVIRONMENTAL EDUCATION CENTER
St. Mary's Co Public Schools
Department Of Instruction
27190 Point Lookout Road
Loveville, MD 20656
Phone: 301-475-4230 Fax: 301-475-4229
Contact: MARIANNE CHAPMAN

Talbot County

PICKERING CREEK ENVIRONMENTAL CENTER
11450 Audubon Lane
Easton, MD 21601
Phone: 410-822-4903
Contact: RICK LEADER, Executive Director
rleader@pickeringcreek.org

Washington County

FAIRVIEW OUTDOOR EDUCATION CENTER
12808 Draper Road
Clear Spring, MD 21722
Phone: 301-766-8138
Fax: 301-842-1152
Contact: CARL STARK, Principal
starkcar@mail.wcboe.k12.md.us

Wicomico County

PEMBERTON HISTORICAL PARK AND ENVIRONMENTAL CENTER
Pemberton Drive
Salisbury, MD 21801
Phone: 410-860-2447

Worcester County

POCOMOKE RIVER STATE PARK
(Milburn Landing And Shad Landing)
Pocomoke River State Parks
Route 3, Po Box 237
Snow Hill, MD 21863
Phone: 410-632-2566
Contact: Lt. Gary Edelhardt

Alliance for The Chesapeake Bay

is a regional nonprofit organization that builds and fosters partnerships to restore the Bay and its rivers. The Alliance does not lobby or litigate. Instead the Alliance does the slow, hard word of bridging dialogue between groups that don't see eye to eye, forming strategies for joint solutions, and building the capacity of communities for local-level action. To this end, the Alliance:

- Develops methods and tools for restoration activities and trains citizens to use them.
- Mobilizes decision-makers, stakeholders, and other citizens to learn about Bay issues and participate in resolving them.
- Provides analysis, information, and evaluation of Bay policies, proposals, and institutions.

The Alliance for the Chesapeake Bay mobilizes citizens to learn about Bay issues and participate in resolving them, providing opportunities for everyone to get involved in some way to help restore the Bay. Getting involved can mean helping a lot or a little.

It can be something as simple as spending a Saturday canoeing a river and learning about its connection to the Chesapeake, or it can mean joining the ranks of a local watershed organization and becoming a leader in local restoration efforts.

For more information about the Alliance, you can go to its web site at http://www.acb-online.org or call (410) 377-6270

The Chesapeake Bay Program is unique regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983.

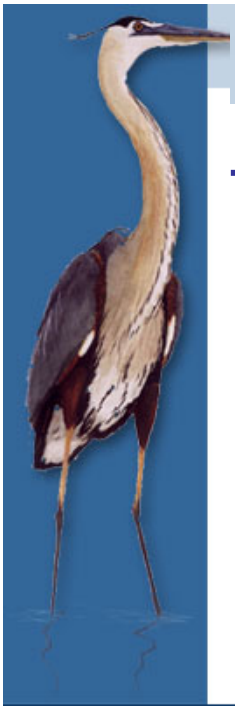
The Chesapeake Bay Program partners include:

- The State of Maryland,
- The State of Virginia,
- The State of Pennsylvania,
- The District of Columbia,
- The Chesapeake Bay Commission (a tri-state legislative body),
- The Environmental Protection Agency (representing the federal government; and participating citizen advisory groups.

Education is certainly one of the greatest potential allies of the Chesapeake Bay. As the purveyors of education, teachers and other educators are a crucial link in restoring and protecting the Bay for generations to come. However, for teachers to teach effectively about the Bay, they must have access to the proper resources.

For more information on **Chessie**, Chesapeake Science on the Internet for Educators, a great new resource for Bay area educators, visit us at: Http://www.bayeducation.net/

For more information on the Chesapeake Bay Program, go to: Http://www.chesapeakebay.net/ or call us at: **(**410) 267-5700 or 1 (800) YOUR BAY (968-7229)



CHESAPEAKE BAY TRUST

The Trust is a private, nonprofit grant making organization created by the Maryland General Assembly in 1985 to promote public awareness and participation in the restoration and protection of the Chesapeake Bay and its Maryland tributaries.

To accomplish its mission, the Trust receives financial contributions from the general public and the private sector and distributes those contributions in the form of financial support grants to Bay-related programs. Recipients include nonprofit organizations, civic and community groups, schools and public agencies.

Thousands of organizations, agencies and schools throughout Maryland have shared in grants for stream cleanups, tree and marsh grass plantings, erosion control projects, water quality monitoring, habitat restoration, aquaculture projects, recycling activities and the development of awareness programs and educational materials to instill in people of all ages a better understanding of the Bay.

In addition to gifts from private citizens and the business community, the Trust is supported by voluntary donations via the tax check-off on the Maryland income tax return and by sales of the commemorative "Treasure the Chesapeake" license plate.

In 2002, the Chesapeake Bay Trust exceeded its grant giving goals, awarding more than $1.2 million in grants, and involved thousands of Maryland school children and other volunteers in towns, cities, and counties across the State.

For fiscal 2003, the Trust has set a goal of $1.3 million for projects that engage Marylanders in the protection and restoration of the Chesapeake Bay, For more information on grants opportunities and a grant application form go to: http://www.chesapeakebaytrust.org/grantopportunities.html. To reach us by phone, call: 410-974-2941

ONLINE ENVIRONMENTAL EDUCATION RESOURCES

Maryland Department of Natural Resources
www.dnr.maryland.gov

Project Wet Water Education
http://www.projectwet.org/

Alliance for the Chesapeake Bay
www.acb-online.org/

Chesapeake Bay Acid Rain Foundation, Inc.
http://www.chesbay.org

Chesapeake Bay Trust – Grant opportunities for schools and other groups.
www.chesapeakebaytrust.org

Chesapeake Bay Programs
www.chesapeakebay.net

Chessie - Chesapeake Science on the Internet for Educators
http://www.bayeducation.net

Chesapeake Bay Commission
http://www.chesbay.state.va.us/

Chesapeake Bay Foundation
www.cbf.org

Living Classrooms Foundation
http://www.livingclassrooms.org

National Aquarium in Baltimore - Conservation Education
http://aqua.org/teachandlearn.html

All Species Project
www.allspecies.org

Animal and bird sound sites on the Internet
http://members.tripod.com/Thryomanes/AnimalSounds.html

Bioneers - visionary and practical ideas for restoring the Earth.
www.bioneers.org

California State Education & Environmental Roundtable
www.seer.org

Center for Ecoliteracy
School gardens, creek restoration, collaboration ideas, and more!
www.ecoliteracy.org

Endangered Species
www.animalinfo.org

Enature
US students can type in a zip code and see field guides, maps and more for their location
www.enature.com

European environmental education resources
www.feee.org/

Exploratorium - SF's wonderful hands-on science and art museum has loads of cool stuff
www.exploratorium.edu

Give Water a Hand - Action programs for student-led community projects.
www.uwex.edu/erc/gwah/

Lawrence Hall of Science-Lots of experiments, activities & projects
www.lawrencehallofscience.org/kids

Marine Fish Conservation Network
http://www.conservefish.org/

Maryland Conservation Council
http://www.marylandconservationcouncil.net/Default.htm

NAAEE's (North American Association for Environmental Education) online resources
http://eelink.net

National Math Trail
Integrating math into outdoor education, especially good section on evaluation
www.nationalmathtrail.org

Natural History of North America
www.nearctica.com

Orion Society
quality publications and nature-based curricula.
www.orionsociety.org

Salmon Web

has interactive stream maps for the Pacific Northwest
www.cqs.washington.edu/salmonweb/

Sound Safari
Click on a map of the world and go on a Sound Safari**.**
www.wildsanctuary.com/frameset.html

The Nature Conservancy
http://nature.org/

View the world through a bee's eye!
http://cvs.anu.edu.au/andy/beye/beyehome.html

US EPA's environmental education site
www.epa.gov/enviroed/

General Information

Adopt-a-Watershed
a comprehensive place-based education curricula**.**
www.adopt-a-watershed.org

EPA's Surf Your Watershed
US students can type a zip code to find their watershed
http://cfpub.epa.gov/surf/locate/index.cfm

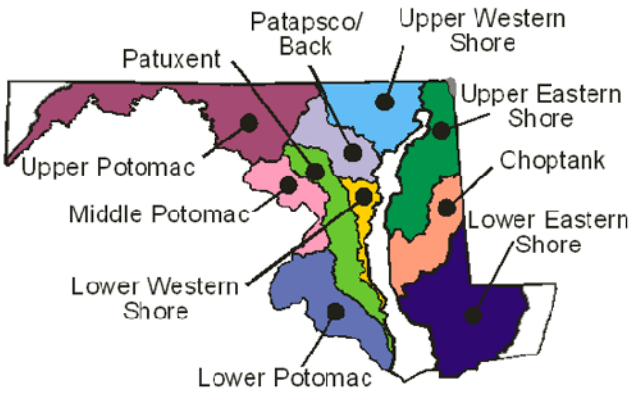
Maryland's Coastal Bays
http://www.mdcoastalbays.org

Maryland's Surf Your Watershed
Information on Maryland's 134 watersheds
http://www.dnr.state.md.state.us/watersheds/surf/index.html

What's a Watershed?
www.ctic.purdue.edu/KYW/glossary/whatisaws.html

Maryland Tributary Strategy Teams

http://www.dnr.maryland.gov/tribstrat/



Choptank River

Adkins Arboretum
http://www.adkinsarboretum.org

Chesapeake Bay Acid Rain Foundation
http://www.chesapeakebay.org

Eastern Shore Land Conservancy
http://www.eslc.org

Environmental Concern
http://www.wetland.org

Pickering Creek Audubon Center
http://www.pickeringcreek.org

Coastal Bays

Assateague Costal Trust
www.actforbays.org

Assateague Coastkeeper
http://www.waterkeeper.org/subsites/subcontact.aspx?userid=8

Coastal Bays Program
http://www.mdcoastalbays.org

Lower Eastern Shore

Dorchester MD Cooperative Extension
http://www.agnr.umd.edu/users/agron/nutrient/About2002/Conslst.html

Dorchester County Soil Conservation District
http://www.mda.state.md.us/dorchester/scd.htm

Friends of Blackwater National Wildlife Refuge
http://www. Friendsofblackwater.org

Friends of the Naticoke River
Judith Stribling (410)548-4767

Nanticoke Watershed Alliance
http://www.nanticokeriver.org

Salisbury Zoo
http://salisburyzoo.org

Somerset County MD Cooperative Extension
http://umesde.umes.edu/1890-mce/staff_directory.html

Somerset County Soil Conservation District
http://www.ctcnet.net/scrip/somccd.htm

Somerset County Tourism
http://www.visitsomerset.com/

Wicomico County MD Cooperative Extension
http://www.agnr.umd.edu/Wicomico/index.cfm

Wicomico County Department of Recreation, Parks and Tourism
http://www.wicomicorecandparks.org/

Worcester County MD Cooperative Extension
http://www.agnr.umd.edu/Worcester/index.cfm

Worcester County Tourism
http://www.visitworcester.org/

Worcester County Soil Conservation District
http://www.md.nrcs.usda.gov/programs/rcd/esrcd/sponsordir.html

Lower Potomac River

Accokeek Foundation

http://www.gmu.edu/bios/potomac/af/

Friends of the Potomac
http://wwww.potomacfriends.org

Friends of Mt. Aventine (FOMA) & Campaign to Preserve Chapman Forest
http://www.smartergrowth.net/about/members.php#foma

Izaak Walton League
http://www.iwlasomd.org

Nanjemoy Creek Environmental Education Center
http://www.ccboe.com/nanjemoy/

Nanjemoy-Potomac Environmental Coalition, Inc.
http://www.nanjemoy.net/protect

Potomac Conservancy
http://potomac.org

Potomac River Association
http://www.p-r-a.org

Potomac River Greenways Coalition, Inc.
http://www.potomaciver.org/get_involved/imap15/hot/lowerpotomacgroups.htm

Potomac River Keeper
http://potomacriverkeeper.org

Potomac Trail Council
http://www.potomactrail.org

Potomac Watershed Partnership
http://potomacwatershed.net

Sierra Club, Southern Maryland Group
http://maryland.sierraclub/southern-md/

Wicomico Scenic River Commission
http://co.saint-marys.md.us/voluntr/page50.asp

Lower Western Shore

American Chestnut Land Trust
http://www.acltweb.org/

Anne Arundel County Volunteer Water Quality Monitoring Program
http://yosemite.epa.gov/water/volmon.nsf/0/2943e16f6b6f3b9b8525671d006c4585?OpenDocument

Friends of the Annapolis' Creeks
http://www.dnr.state.md.us/tribstrat/low_west/annap_creeks.html

Herring Bay
http://www.rosehavenmaryland.com/pages/herringbaysurvey.html

Magothy River Association
http://www.magothyriver.org/Who_We_Are.html

Magothy River Land Trust
http://www.magothyriver.org/Land_Trust.html

Severn River Association
http://www.severnriver.org

Severn River Land Trust, Inc.
http://www.srlt.org/

South River Federation
http://www.southriverfederation.org

Severn Riverkeeper
http://www.waterkeeper.org/subsites/subcontact.aspx?userid=117

Weems Creek Conservancy
http://www.weemscreek.org

Middle Potomac River

Anacostia Watershed Society
http://anacostiaws.org

Audubon Naturalist Society
http://www.audubonnaturalist.org/

College Park Committee for a Better Environment (CBE)
http://www.ci.college-park.md.us/committee_for_a_better_environme.htm

Eyes of Paint Branch
http://eopb.org

Friends of Sligo Creek
http://fosc.org/fosc.htm

Izzak Walton League
http://www.Bcciwla.org

Montgomery County Stream Teams
http://www.montgomerycountymd.gov/mc/services/dep/education/streamteam.htm

National Capital Chapter Trout Unlimited
http://www.ncc-tu.org/

Potomac Conservancy
http://www.potomac.org/

Prince George's County Stream Teams
http://www.co.pg.md.us/government/agencyindex/der/ppd/community/stream_teams.asp

Potomac-Patuxent Chapter Trout Unlimited
http://potomac.org

Potomac River Association
http://www.p-r-a.org

Potomac River Greenways Coalition, Inc.
http://www.potomaciver.org/get_involved/imap15/hot/lowerpotomacgroups.htm

Potomac Riverkeeper
http://potomacriverkeeper.org

Potomac Trail Council
http://www.potomactrail.org

Potomac Watershed Partnership
http://potomacwatershed.net

Sierra Club, Southern Maryland Group
http://maryland.sierraclub/southern-md/

Patapsco & Back Rivers

Center for Watershed Protection

http://www.cwp.org

Friends of Gwynns Falls/Leakin Park
http://www.leakinpark.com/main.shtml

Greater Patapsco Community Association
http://www.gpca.net/

Gwynns Falls Watershed Association
http://www.gwynnsfalls.net

Herring Run Watershed Association
http://www.herringrun.org

Jones Falls Watershed Association
http://www.jonesfalls.org

Living Classrooms Foundation
http://www.livingclassrooms.org

Irvine Nature Center
http://www.explorenature.org

National Aquarium in Baltimore-Conservation Education
http://aqua.org/teachandlearn.html

Parks and People Foundation
http://www.parksandpeople.org/

Patapsco Riverkeeper
http://www.waterkeeper.org/subsites/subcontact.aspx?userid=56

Patuxent River

Friends of St. Leonard Creek
Joan Wohlgemuth (410)326-3626

Izaak Walton League, Wildlife Achievement Chapter
http://www.members.aol.com/rumriverc

Patuxent Tidewater Land Trust
http://www.patuxent-tidewater.org

Prince George's County Stream Teams
http://www.co.pg.md.us/government/agencyindex/der/ppd/community/stream_teams.asp

Potomac-Patuxent Chapter Trout Unlimited
http://www.pptu.org/

Sierra Club – Howard County
http://www.maryland.sierraclub.org/hc

Upper Eastern Shore

Chesapeake Bay Environmental Center
http://www.wildfowltrust.org/about.htm

Chesapeake Bay Exploration Center
http://www.wildfowltrust.org/index.htm

Chesapeake Wildlife Heritage
http://www.cheswildlife.org/

Chester River Association
http://www.chesterriverassociation.org/

Chester Riverkeeper
http://www.waterkeeper.org/subsites/subcontact.aspx?userid=56

Eastern Neck Wildlife Refuge
http://easternneck.fws.gov

Eastern Shore Land Conservancy
http://www.eslc.org

Echo Hill Outdoor School
http://www.ehos.org

Environmental Concern
http://www.wetland.org

Lower Eastern Shore Heritage Committee
http://skipjack.net/le_shore/heritage/

Pickering Creek Environmental Center
http://www.pickeringcreek.org/

Upper Potomac River

Citizens for the Protection of Washington County
http://www.savewashco.org/

Community Commons
http://www.communitycommons.org

Friends of the Potomac
http://www.potomacfriends.org

Potomac Conservancy
http://potomac.org

Potomac River Association
http://www.p-r-a.org

Potomac Riverkeeper
http://www.waterkeeper.org/subsites/subcontact.aspx?userid=56

Potomac River Greenways Coalition, Inc.
http://www.potomaciver.org/get_involved/imap15/hot/lowerpotomacgroups.htm

Potomac River Keeper
http://potomacriverkeeper.org

Potomac Trail Council
http://www.potomactrail.org

Potomac Watershed Partnership
http://potomacwatershed.net

Thorpewood Foundation
http://www.thropewood.org/main.html

Upper Western Shore

Deer Creek Watershed Association
Lee McDaniel (410) 275-7314

Harford Land Trust
http://www.harfordlandtrust.org/

Fair Hill Nature Center
http://www.fairhillnature.org

Gunpowder Valley Conservancy
http://www.gunpowdervalley.org/

Otter Point Creek Alliance
http://www.otterpointcreek.org/default.aspx

Be Part of Something Big

Activity Evaluation

Please take a few minutes and fill out this evaluation. Your responses will help us improve this document. Send completed evaluation to:

Elena Takaki
Watershed Services
580 Taylor Avenue, E-2
Annapolis MD 21401

Check completed activities:

___ Be Part of Something Big!
___ What's a Watershed?
___ How Nature Recycles Water
___Where did the Rain Go?
___Too Much of a Good Thing
___Design Your Own Stream Study Kit
___Portrait of Our Stream
___Trash is Worse Than Ugly
___Neighborhood and the Stream
___Trees are a Stream's Best Friend
___It's All Connected
___Are YOU a Water Waster?

Stream:_____ Number of Students:_____

Ratings:
1Strongly Agree 2 Agree 3 Disagree 4 Strongly Disagree 5 Don't Know

Statement	1	2	3	4	5
The activities in "Be Part of Something Big" were helpful Comments:					
Instructions on how to organize and prepare for the activities were clear and easy to follow. Comments:					
Time frames were realistic. Comments:					

Instructions on how to conduct the activities were clear and easy to follow. Comments:					
Data collection forms were clear and easy to use. Comments:					
Students gained more knowledge of water quality problems and solutions. Comments:					
I would recommend "Be Part of Something Big" to others. If not, why? Please be specific.					

Thank you for using "Be Part of Something Big" and taking the time to complete this evaluation.

Optional Information:

School:_____

Contact Name:_____

Address:_____

Phone Number:_____