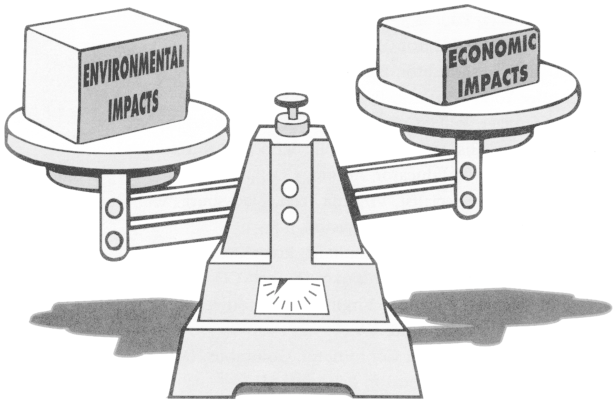
Public Policy & Environmental Management

A generation ago, in the 1960s, Virginians faced a wide variety of environmental problems, from the pollution of air and water to the decline of wildlife and other living resources. For example: fish in the James River were contaminated due to illegal kepone disposal; people could not swim in the Potomac River due to inadequate sewage disposal; and the bald eagle and osprey became nearly extinct due to DDT bioaccumulation. While many environmental problems still persist, most Virginians today live in an age when the risk of human exposure to potentially harmful pollutants has dropped significantly.



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Natural Resource Management

Improved environmental quality in many areas is a result of scientific investigation, public concern, private efforts, new technology, and environmental laws. Environmental laws passed by Congress and the Virginia General Assembly place limits on the amount of pollutants that can be discharged into the land, air, or water. Across the state, dozens of private organizations as well as businesses have adopted educational campaigns and stewardship initiatives. Research into the fate of toxic chemicals discarded into our rivers has helped set environmental policy. Participation of individuals, communities, and private groups also helped foster environmental protection. An example of this type of participation is the Chesapeake Bay Program, a cooperative effort by state and federal governments, private industries, and citizen groups to restore the quality and ecological integrity of the Bay.

Much of Virginia's environment, including the Chesapeake Bay, has been altered over the last 400 years by people plowing, planting, cutting trees, and building cities, roads, dams, or reservoirs. Some of these alterations have immediate and obvious environmental problems (clearing a forest or building a dam, for example), while other effects are more subtle and long-term (e.g., introduction of a competing species, loss of a species, change in water quality). It is the job of environmental managers to constantly weigh the costs, or consequences, of all management actions against the benefits to society.

Management Challenges and Tools

Natural resources management involves setting goals and making choices that benefit people while preserving a clean, healthy environment. Everyone has a unique perspective and as a result, some management options, such as harvest restrictions, can lead to conflicts among different members of society.

Today, computer models help managers assess the effects of various management options and scenarios, and project the cumulative impacts of individual actions (e.g. one more car per household, or one less pound of trash per household). Much emphasis is being placed upon "sustainable development," or ways of benefitting from resources without using them up. Scientists are also looking at new ways of reusing and disposing of wastes. For example, sometimes waste by-products from one industry can become the raw materials for another. Sawdust turned into paper board and used tires that help produce mulch or asphalt paving are two good examples.

Pollution Prevention

When natural resources are used to make goods, usually some "waste" is created in the process. Think about it: even when you make a glass of fresh lemonade, you have the rinds left to deal with.

Pollution prevention is a relatively new way of thinking about managing waste. By reducing or eliminating pollutants *before* they are created, we can minimize the cost of disposing of the waste and protect the

environment at the same time. For example, the final cost to clean up contamination from Avtex Fibers in Front Royal is estimated to be $100 million.

The idea behind pollution prevention is to have as little waste to deal with in the first place. Companies have come to realize that they can substitute less toxic raw materials and actually save money (and the environment) in the process. They may also discover a way to recycle by-products and re-use them during production processes. Businesses that use efficient equipment and maintain it well are saving raw materials and preventing waste-producing spills and accidents along the way. Also, by keeping strict track of their inventory, companies can prevent waste and loss from products expiring or decomposing.

POLLUTION PREVENTION AT WORK

u At Dupont (Richmond) a maintenance program and ground water protection system prevents chemical leaks.
u By segregating its chemical solvents and monitoring methods, Hercules, Inc. (Hopewell) reduced its hazardous waste generation by 95%.
u Colonial Circuits (Fredericksburg) has saved $25,000 per year in water and sewer fees by installing a wastewater recycling system that removes heavy metals and organics. The metals are then recycled rather than disposed as hazardous waste.
u Fewer chemicals are used at White Oak Semiconductor (Sandston) due to an on-site sulfuric acid waste reclamation system and an innovative chemical delivery /storage system.
u Through a comprehensive environmental management system, Nestles (Danville) reduced its energy consumption, food, and nonfood wastes and saved more than $500,000 annually.
u At Coors Brewing Company (Elkton) the wastewater treatment process was altered by adding an anaerobic treatment process followed by an aerobic process which reduced the volatile organic compounds by 95% and eliminated the need for ammonia and phosphoric acid.
u Boaters who use Wormley Creek Marina (Yorktown) must sign a "protecting the environment" agreement and use the dock-side sewage pump-out station and other "clean" practices.
u Steel paint drums and other metal used for aircraft carriers at Newport News Shipbuilding (Newport News) is recycled instead of being sent to a landfill.
u At NASA Langley Research Center (Hampton) hazardous wastes from laboratories have been reduced by 70% through solvent replacements, best management practices, and materials reuse.
u The Naval Amphibious Base Little Creek (Norfolk) is reducing its paint, solvent, and gasoline waste as part of its commitment to reduce its hazardous waste by 50% by the end of 1999.

These examples illustrate the goals of cost-effective pollution prevention. Industries may never be able to eliminate waste production altogether, but they can try to reduce it. If that is not possible, they can strive to reduce the toxicity of the waste, while conserving natural resources and raw materials by preventing spills and accidental losses.

One response to this new consciousness is Virginia DEQ's new "VIP2" program (Virginia Innovations in Pollution Prevention). The VIP2 program encourages businesses and other organizations to adopt pollution prevention methods, and it signals a new era of environmental management in Virginia. In return for their efforts, participants will be offered incentives such as technical assistance and recognition.

A Case in Point

Fisheries managers are struggling with an issue they call "sustained yield," which raises many public policy and environmental issues. At its core is the following question: How can we manage a fishery in such a way to maintain the livelihoods of the fishermen and provide a product in high demand, while at the same time prevent depletion of a species?

Scientists are working to understand the dynamics of blue crab populations in the Bay. Many variables affect populations, including harvest levels, ocean currents, and habitat conditions—making the idea of "sustainable yield" that much harder to pin down. While scientists struggle to understand the effects of each variable, the Virginia Marine Resources Commission has implemented a conservation plan to stabilize blue crab numbers and halt expansion of the commercial fishery. Recent measures established fishing seasons and placed limits on the sale of crabbing licenses and the amount of equipment used by commercial fishermen, among other things. Even stricter limits have been proposed on crabbing licenses and, if implemented, they will significantly reduce harvesting activity in the coming years.

Scientists also are examining the possible effects of a blue crab sanctuary to cover the length of the Bay. The sanctuary would expand beyond the lower Bay spawning grounds to include a deep water migratory path at mid-Bay and shallow water nursery areas in the upper Bay and tributaries. It is believed that such a protective zone could help more female crabs reach their spawning areas each summer.

Crabbing is a $70 million-a-year industry and the mainstay for commercial fishermen in Virginia and

Maryland. The Commonwealth is a national leader in the seafood industry because of the volume and value of its crab harvest. Sustaining this industry, therefore, has wide-reaching economic and ecological benefits. Scientists and fisheries managers are working to strike a balance between preserving the species over the long term and maintaining the ongoing economic benefits of this fishery.

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When it comes to setting public policy, a number of state agencies have environmental management responsibilities (see each chapter for specific duties).

The Department of Environmental Quality (DEQ) is the agency responsible for clean air, clean water, proper waste management, environmental impact assessment, and pollution prevention. Industries and public facilities, like waste treatment plants, must get permits from DEQ to discharge pollutants into the air, land, or water. DEQ's engineers inspect permitted facilities, monitor the air and water, and ensure that such facilities comply with the environmental standards set forth in existing laws.

In essence, public policy and environmental management can be considered two sides of a coin that rolls along the pathway of human development. Like any coin, the more hands it touches along the way, the higher its yield.

Additional Resources

Web Sites:

u Virginia Department of Environmental Quality, Office of Pollution Prevention;
www.deq.state.va.us/opp/opp.html
u U.S. Environmental Protection Agency;
www.epa.gov/opptintr/p2home/
u U.S. EPA Enviroene program;
http://es.epa.gov/
u Businesses for the Bay;
www.chesapeake.bay.net/pol/tsc/b4bay.htm
u Additional environmental education resources are available by contacting:
www.enviro-source.com/us/us12.cfm

Fundamental Learnings Related to Public Policy & Environmental Management:

R Natural resources can be harmed or damaged by pollution.
R Environmental problems, including pollution, result from the overuse or misuse (exploitation) of natural resources (air, water, forests, etc.).
R The environment has a limited capacity to cycle or disperse pollutants. Some pollutants, such as organic wastes, decompose in weeks or months into harmless components. Other materials, such as plastics, decompose after many years, and still others (chemicals such as PCBs and radioactive materials) persist as toxic compounds and may never decompose.
R Environmental management seeks to identify all the "costs" or potential impacts of the action or alteration of the environment and weigh them against the benefits to society. Some management options such as harvest restrictions can lead to conflicts among different members of society.
R Preventing pollution costs less financially and environmentally than cleaning up after it has occurred.
R New technologies (both equipment and processes) can improve environmental quality and be cost-efficient.
R Government has adopted and enforces various environmental laws and regulations to protect the environment. Government also provides incentives for voluntary actions to protect or enhance the environment.
R Environmental policy is based on either regulation or voluntary action (meaning people are compelled to act either by law or through their own initiative.)

Pollution Prevention Audit Activity

Pollution prevention is a way that businesses and manufacturing facilities can reduce wastes by maximizing raw material use and minimizing the leftovers. You may not think of schools as producing much pollution, but they certainly have room for improvement in waste reduction and energy conservation. Think of all the paper that is used in a school, not to mention the materials and energy students and teachers use in their everyday lives.

Here are some suggestions for schools to conserve energy and prevent pollution:

- u Use energy efficient lights and heat, and turn them off when not needed.
- u Install high-pressure/low-volume water faucets and showerheads.
- u Use hot-air hand dryers instead of paper towels.
- u Install low-volume toilets.
- u Replace cleaners with less toxic alternatives.
- u Provide recycling bins for aluminum, glass, plastic, and paper.
- u Save paper by using 2-sided copying, and reuse mistakes as scrap or draft paper.

Schools can start preventing pollution by taking an inventory of the places and activities which may be creating waste. Here are some suggestions of where to look:

PLACES	MORE PLACES	ACTIVITIES
Cafeteria	Laundry Room	Heating
Green House	Shop	Air Conditioning
Offices	Outdoor Areas/Playground	Water Use
Gymnasium	Bathrooms	Landscaping
Locker Rooms	Student Areas	Housekeeping
Vending Machines	Classrooms	Cleaning
	Copy Rooms	Lighting
	Parking Lots	Energy Use
		Construction

Procedure

1. Choose the place or activity which you think is producing waste or is difficult or expensive to clean up. Then ask yourself:

Grade Levels: K-6

Science SOLs: K.10, 1.8, 2.8, 3.11, 4.8, 6.11

Materials Needed:
r Copy of "Waste Generation" chart

Objectives:
To predict types of waste produced and analyze ways to decrease it.

Vocabulary Words:
pollution prevention (P2)
raw materials
waste

u How much and what types of waste are produced and why?
u What types of raw materials are used and how?
u How much does it cost to dispose of the wastes or purchase the raw materials?
u Are any P2 measures already being used?
u What are some P2 ideas?

2. Have your students fill out the following chart. It will help make the connection between the raw materials schools are using and the waste they are generating.

POLLUTION PREVENTION ASSESSMENT FOR SCHOOLS

PLACE or ACTIVITY: _____

❒ Types of Waste: _____ _____ _____ _____ _____
Quantity:_____ _____ _____ _____ _____ _____

Why are wastes produced? _____

❒ Types of Raw Materials Used: _____ _____ _____ _____
Quantity: _____ _____ _____ _____

❒ Disposal Costs/Raw Materials:
Solid Waste: $_____
Hazardous Waste: $_____
Cost of Wasted Raw Materials: $_____

❒ Types of Energy Efficient Fixtures and Appliances: _____ _____ _____
_____ _____ _____

❒ Are any P2 measures already being used?

❒ P2 ideas?

Sum of the Parts

From the James River to the Chesapeake Bay

(A Virginia Adaptation of Project WET's Sum of the Parts Activity)

Summary

Students will map and collate different land uses in a simulation "puzzle" exercise that shows the cumulative effects of each land use on water quality.

Background

The water that flows into the Chesapeake Bay is collected from 150 rivers, streams, and creeks located in a 64,000-square-mile drainage basin, or "watershed," and includes not only Virginia, but parts of New York, Pennsylvania, West Virginia, Delaware, Maryland, and the District of Columbia. The Bay's water quality is affected both by the individual actions of people living in this watershed as well as by the way land located in the watershed is used.

The environmental conditions of the Bay have deteriorated dramatically over the past 50 years. One example of this deterioration is a decline in living resources due to pollution.

There are two main sources of pollution: *point-source pollution* (contaminants that can be traced to a stationary source, such as the pollutants discharged from a pipe), and *nonpoint source pollution (NPS)*, or pollution that has no one identifiable source (such as the contaminants that result from a large land area that includes mining, agriculture or construction). One of the most important differences between point source and NPS pollution is that while there are federal and state laws that regulate point source polluters, there are no such regulations for NPS pollution.

The increasing pollution resulting from sedimentation, or sediment runoff, is an example of nonpoint source pollution. Sediment deteriorates water quality because it blocks the sunlight needed by submerged aquatic vegetation (SAV) resulting in low dissolved oxygen levels, and clogs the gills of fish and insects, causing a corresponding decline in fish and shellfish.

Excess nutrient enrichment is a form of NPS. While a "healthy" Bay needs nutrients to sustain life, an excess of nitrogen, phosphorus, and sediments found in the nutrient runoff from farms and lawn fertilizers activates a chain effect. First, the excessive nutrient enrichment, called *eutrophication,* causes blooms of algae that block the sunlight normally used by underwater plants to survive. As these plants and algae die and decompose, they deplete the water of oxygen that the fish and small macroinvertebrates who live in the water depend upon to survive.

Without the macroinvertebrates, the food chain is compromised and the stream can no longer support a balanced ecosystem. In addition to depleted oxygen levels, high levels of nutrients have been associated with recent outbreaks in Virginia of *Pfiesteria piscicida,* a microbe that causes large fish kills and illness in people.

Grade Level: 6

Science SOLs: 6.1, 6.11

Time: 1-2 class periods

Materials Needed:

- **Paper to draw 6-acre lots**
- **Markers and pencils**
- **Items designating pollutants such as "packaging peanuts" and**
- **(Optional) Small toys designating land use**

Objectives:

Using an ecosystem perspective, students will understand the effect of different land uses and the impact on water quality as it enters the James River (or any other tributary river) and flows into the Chesapeake Bay. They will also understand the concepts of watershed and Best Management Practices (BMPs) and learn how their actions can affect water quality both positively and adversely.

Vocabulary Words:

BMPs
Chesapeake Bay tributary
erosion
nonpoint source pollution
nutrients
point source pollution
sediments
watershed

Unfortunately, forests that once filtered out pollutants from the water have been replaced by roads, housing developments, farms, businesses, and other hard, or "non-porous," surfaces. This increase in hard surfaces results in a decreased water cleaning capability and decreased habitat for the living resources that make their homes in the Bay. Best Management Practices (BMPs)—such as planting buffers, terracing, and building catch basins—and erosion controls help to improve threatened water quality. But more help is needed to keep our water clean.

Environmental Management

How can water quality be improved? The United States has been concerned about water quality for many years. Over 15 years ago, the Chesapeake Bay Act Agreement established a cooperative effort among Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission, and the federal government to improve water quality in the Bay. Because nutrient enrichment is a primary threat to the Bay's health, in 1987 the Chesapeake Bay Program launched a goal to reduce the amount of nutrients by 40% by the year 2000.

As mentioned, there are laws that regulate point source pollution. For example, the Clean Water Act mandates that municipal and industrial sites must obtain discharge permits and are required to incorporate technology controls to meet state water standards. And while there are no federal laws mandating how much NPS pollution is released or discharged, Virginia is developing water pollution programs to measure and control it. One such program that is part of the Chesapeake Bay restoration effort is the Chesapeake Bay Tributary Strategies. And another program, the Total Maximum Daily Load (TMDL), is a provision of the Clean Water Act. The concept of TMDL is similar to "carrying capacity" and can be described as the maximum amount of pollutant(s) allowed to enter a given body of water while still meeting the state's water quality standards.

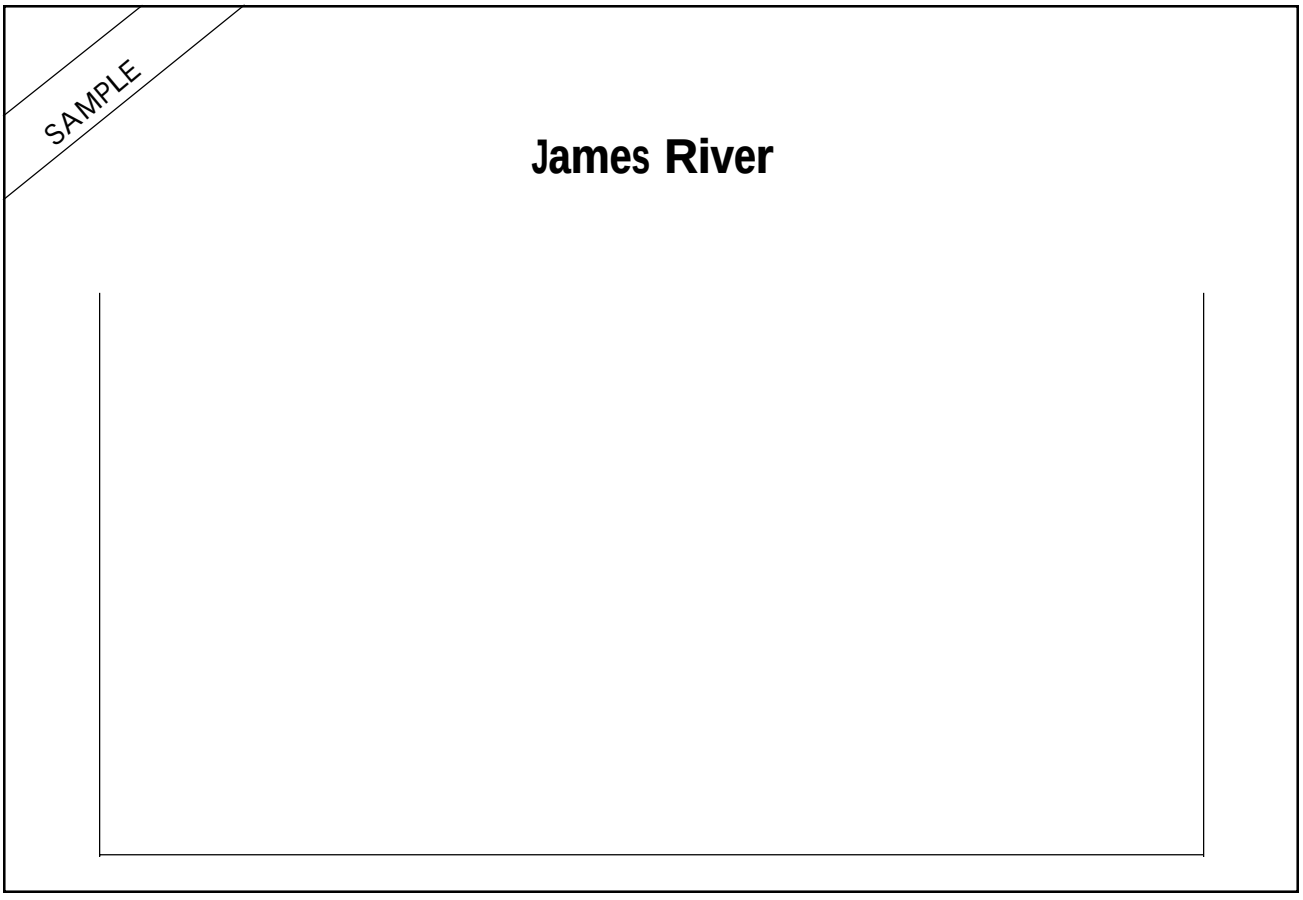
Chesapeake Bay Tributary Strategies—specific nutrient reduction plans to control nutrients in the rivers that feed into the Bay—are being developed for each major tributary. These strategies focus on controlling agricultural and urban and suburban runoff, shoreline erosion, and point sourcepollution, including wastewater treatment plants. The TMDL program focuses upon Virginia's 2,000 miles of impaired waters, those rivers and streams that do not meet Virginia's water quality standards. Plans for the first 14 rivers should be completed by April 2000 and plans for the remaining approximately 243 rivers should be completed by the year 2010. Upon pinpointing the sources of pollution, implementing a program to effectively improve water quality is the next step in this comprehensive, yet vital, process.

Procedure

1. Using maps as visual aids, discuss your location, nearby bodies of water, and identify your class "watershed address." You can get watershed maps from the local Soil and Water Conservation District (SWCD). Also, discuss what the primary land uses in your area are (farming, commercial, residential, etc.). You can get the actual percentages for land uses in your area from your local SWCD. Ask students to predict how each land use potentially affects nearby water quality. Record their predictions on the board or overhead where they can refer to them later.
2. Explain the following scenario to students: Each student has just inherited 6 acres of land along the James River and $500,000 to develop the property from their "Aunt" in her Last Will and Testament (see diagram).
3. To achieve a variety of land use types, have the group count off from one to six and have individuals fill in the blank on their worksheet with their respective land use function: 1 as residential, 2 as agricultural, 3 as commercial, 4 as industrial, 5 as recreation, and 6 as municipal services/public utilities.
4. Have students draw their own land use function using pens and markers.
5. Have students calculate the amount of nutrients that run off their property using the following scale of estimates per acre. Remember that each student must account for all of their land (roof tops, etc.) The land must total 6 acres.

Land Type/Function	Nitrogen Discharge (lbs./per acre)	Phosphorous Discharge (lbs./per acre)
Residential	12	3
Agricultural	24	3
Commercial	20	1
Industrial	20	1
Recreation Based	10	3
Municipal Services/Utilities	5	2

6. Have students line up on either side of the "James River" to depict how the land would be developed along the banks of the river. Use the "packing peanuts" or other props to depict pollution and land use. Start at the top of the river or line and have students "pass along" the pollution they produce.
7. Discuss the list of some examples of BMPs below. How much money would each student be willing to spend to install BMPs on their property? How would these BMPs affect the environment?



Your Aunt Rosemary Newport remembered you in her *Last Will and Testament* when she died. She left you 6 acres of land along the James River along with $500,000 to develop the property. The *Deed Restrictions* stipulate that you must develop the land for _____ .
Signed, Mrs. Regn, Executor of Aunt Rosemary's Estate.

Scale: 10 square inches = 1 acre
Use an 8"x11" piece of paper to draw a lot 6"x10" (60 sq. in. = 6 acres)

Examples of Best Management Practices (BMPs)

u *Residential* -

Dispose of household hazardous wastes, such as used motor oil at approved disposal sites.

Plant buffers near water and create wildlife habitat areas.

Use nonchemical fertilizers and compost.

Use nonchemical de-icers (sand, ash, clay litter) on driveways and sidewalks.

u *Agricultural* -

Read and follow labels & ask for application directions before using chemicals, fertilizers and pesticides (can be used in residential as well).

Leave filter/buffer strips and field boarders along wetlands and streams.

Plant shelter belts and windbreaks.

Fence waterways to reduce riparian zone impact by livestock.

u *Commercial* -

Construct a sediment catch basin to collect storm water runoff.

Reduce road construction runoff by building terraces and catch basins and planting cover crops.

Dispose of paints, oil and solvents and petroleum at approved disposal sites, not in storm drains or street gutters.

Use nonchemical deicers (sand, ash and clay litter) on roads, sidewalks and other paved areas.

u *Industrial* -

Dispose of solvents and other hazardous wastes at approved disposal site.

Construct a sediment catch basin to collect storm water runoff.

Reduce erosion by building terraces and catch basins and planting cover crops.

Catch and treat/clean contaminated water.

u *Recreation based* -

Read labels prior to using pesticides and fertilizers and apply sparingly.

Terrace areas prone to erosion. Leave or plant buffer strips of plants along stream banks to improve water quality and prevent erosion.

Use nonchemical deicers (sand, ash and clay litter) on roads, sidewalks and other paved areas.

u *Municipal Services - Waste Treatment/Utilities* -

Construct a sediment catch basin to collect storm water runoff from paved areas.

Terrace and plant areas prone to erosion.

Catch and treat/clean contaminated water.

Intercept and reroute clean/uncontaminated water away from contaminated areas.

8. Students can subtract 20% of their total nutrient amount for each BMP they establish on their property. Have them select the BMPs they want to use and re-calculate the total discharge.

***Teachers Note**:* both the nutrient amounts listed above and the 20% deduction per BMP are estimates developed for students to be able to calculate the amounts readily while gaining conceptual insight. The actual amounts would vary by site and BMP used. Contact your local Soil and Water Conservation District or the Department of Conservation and Recreation for details.

Extension Ideas

Assign costs for each type of land use/development and for each BMP, and have students calculate a budget and make decisions about developing and installing BMPs for pollution prevention on their site.

References and Resources

u *Bay BC's: A multi-disciplinary approach to teaching about the Chesapeake Bay,* Chesapeake Bay Estuary Program, USFWS and National Aquarium in Baltimore.

u *Chesapeake Bay, Introduction to an Ecosystem,* Chesapeake Bay Program, 9/97.

u Chesapeake Bay Watershed Activity Guide, USFWS, 2/94.

u *Virginia Tributary Strategies,* Virginia Chesapeake Bay Program, 2/95.

u *The Bay's Recovery: How long will it take?,* USGS and Alliance for the Chesapeake Bay, 4/98.

u *Saving Our Watersheds, A Field Guide to Watershed Restoration Using TMDLs,* National Wildlife Federation, 1/98.

u *What You Should Know About Pfiesteria piscicida,* USEPA, 6/98.