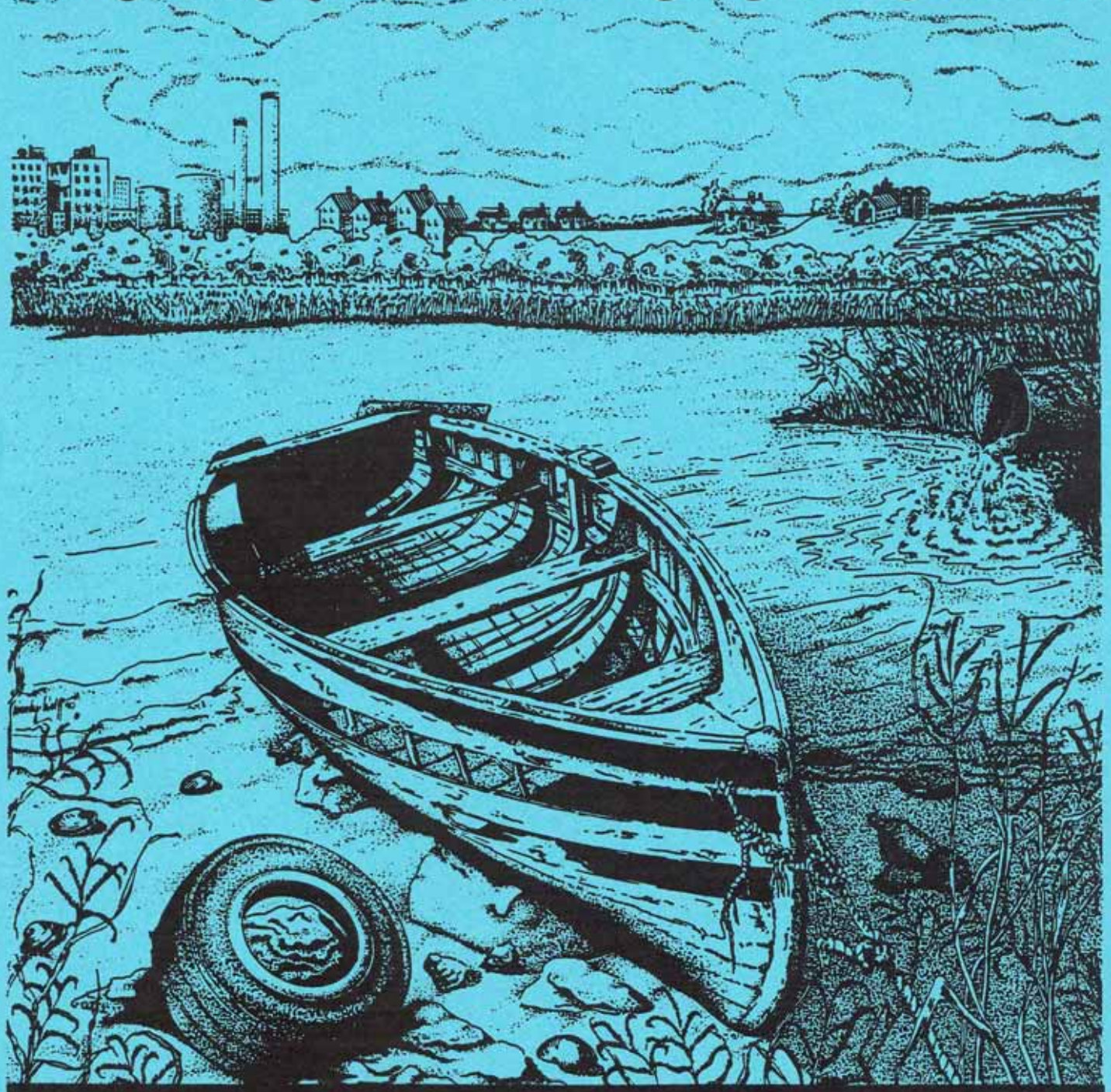
Beneath the Shell...



A Teacher's Guide to Nonpoint Source Pollution
And Its Potential Impact on New Jersey Shellfish

New Jersey Department of Environmental Protection

Acknowledgments

Beneath the Shell...

A Teacher's Guide to Nonpoint Source Pollution and Its Potential Impact on New Jersey Shellfish
has been developed by the New Jersey Department of Environmental Protection

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Introduction

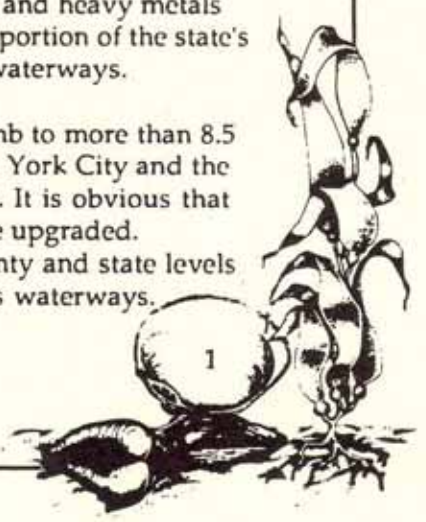
The care of rivers
is not a question of rivers,
but of the human heart.
-Tanako Shozo

New Jersey's waterways have served people for hundreds of years in numerous ways, and provided that they are taken care of and protected, they will continue to do so in the future. Residents are very dependent on these waterways, which are themselves part of an ongoing circulation of water referred to as the water cycle. As a result of hundreds of years of human use and a growing population in the state, the amounts and types of pollution entering the water and affecting its quality have always been, and should continue to be, a concern of every resident of this state, regardless of age.

Over the past 20 years, New Jersey's Department of Environmental Protection and Energy (DEPE) has worked diligently with industry, business and wastewater treatment facilities to reduce industrial and municipal water pollution and to upgrade water treatment techniques. With these sources now monitored and strictly regulated, the state's water quality has improved greatly over the last decade. Yet, current studies have determined that contamination of many waterways is caused by residents, businesses and municipalities through such "individual" actions as the dumping of motor oil and hazardous substances onto the ground or into drains, the misuse of pesticides, the improper storage or disposal of animal waste and litter, and such "local" actions as limited stormwater management techniques and improper construction practices. These examples are referred to as "nonpoint source pollution (NPS)" because chemicals, sediments, bacteria, excessive nutrients, toxic metals and other substances enter the waterways at various points by many routes and are therefore impossible to monitor individually. When these activities are minimal, they may not pose a threat to the environment; when they occur in many places over a long period of time, NPS serves to lower water quality and degrade the areas where the water flows. While portions of NPS settle in ponds and lakes, the ultimate "catch basins" are the state's estuaries and coastal waters, into which all of the state's waters eventually empty.

The coastal state of New Jersey, boasting a history rich in shellfish production, continues to produce yearly shellfish harvest yields. Most of its 400,000 acres of estuarine waters and 280,000 acres of near coastal waters are suitable and productive shellfish habitat. The state has one of the most rigorous water testing programs in the nation. In one year, 18,000 samples collected from 4,000 locations are used to determine the water quality along the coast. Testing has indicated that NPS affects 28% of the available shellfish habitat, which has resulted in the closures of harvesting areas and a gradual decrease in harvest yields over the years. Because shellfish filter food from their surrounding waters, they have a tendency to accumulate and concentrate any microorganisms, chemicals and heavy metals present in polluted waters, making them unsafe to consume. The impact of NPS on a portion of the state's productive shellfish habitat is only one example of its current effect on the state's waterways.

It is estimated that New Jersey's present population of 7.7 million (1990) will climb to more than 8.5 million by the year 2010, with the greatest densities in the regions surrounding New York City and the Hudson River, Philadelphia and the Delaware River, and along the Atlantic Coast. It is obvious that protective measures must be strengthened and the areas already impacted by NPS be upgraded. Management, planning, legislation, education and public participation at local, county and state levels are all necessary tools for proper stewardship of the health and future of the state's waterways.



ABOUT THIS GUIDE

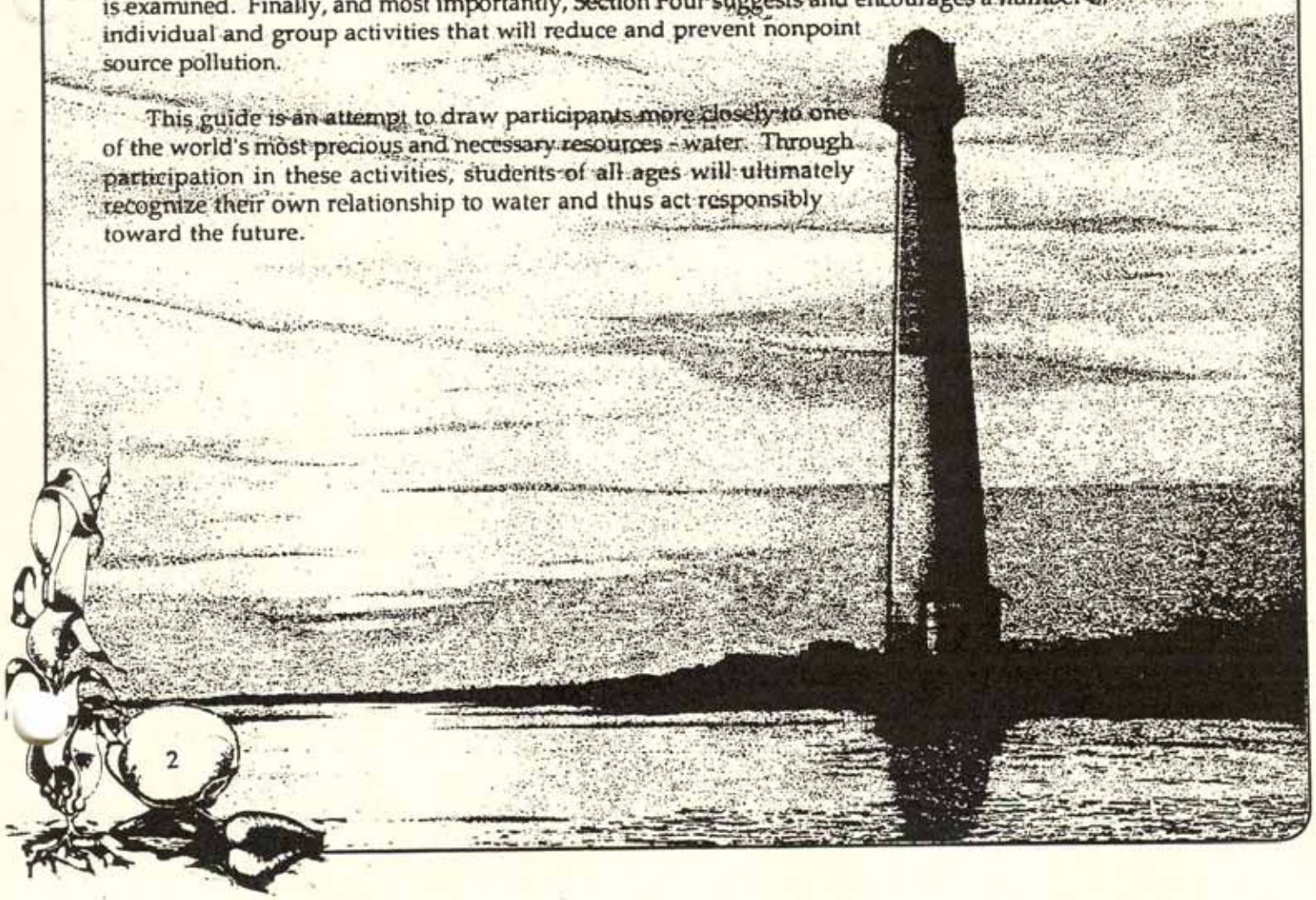
Great innovations, where in art or literature,
Science or nature, seldom take the world by storm.
They must be understood before they can be estimated.
They must be cultivated before they can be understood.
- Clarence E. Dutton

The goal of this guide is to stimulate an awareness and knowledge of, and action to prevent, nonpoint source pollution (NPS). The guide is an interdisciplinary, skill-oriented, supplemental activity guide for teachers and youth leaders. Though designed to be used flexibly with youth in grades 1 through 8, some of the activities can be adapted at the senior level.

The guide is divided into five sections. The first four are content and activity-based. They contain background information, teacher activities, worksheets and Copy Pages. Each section focuses on a number of "key words" which are introduced at the beginning of each section and explored in the section's activities. The final section contains answer keys for the guide's Copy Pages, a glossary, additional resources and an evaluation form.

Though each of the first four sections can be used separately, it is recommended that activities be used sequentially in order to experience the guide's design. Because nonpoint source pollution enters a waterway and is then transported by it, Section One familiarizes students with water movement and the relationship between it and the earth's physical and chemical make-up. Section Two explores the sources and types of nonpoint source pollution and their varied effects on the state's waterways. In Section Three, the impact of nonpoint source pollution on New Jersey's shellfish and shellfish habitat is examined. Finally, and most importantly, Section Four suggests and encourages a number of individual and group activities that will reduce and prevent nonpoint source pollution.

This guide is an attempt to draw participants more closely to one of the world's most precious and necessary resources - water. Through participation in these activities, students of all ages will ultimately recognize their own relationship to water and thus act responsibly toward the future.



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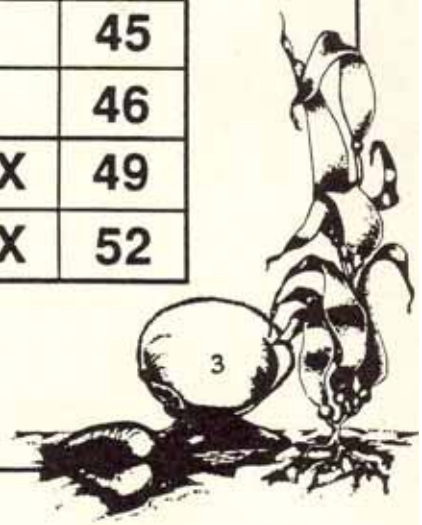


SECTION ONE

WHERE WATER MEETS LAND

Of all the substances that are necessary to life as we know it on earth,
water is by far the most important, the most familiar,
and the most wonderful; yet, most people know very little about it.
- Thomas King

KEY WORDS:

Water Quantity

Is water an abundant resource? Two-thirds of the earth's surface is covered with oceans, seas, glaciers, and smaller bodies of water, such as lakes and rivers. Water is also present underground, in the atmosphere and in every living thing. For millions of years, water has been used, and it is constantly being recycled. It is obvious that water is abundant, but because less than 1% of this valuable resource is fresh (not salt water) and available for human consumption, it is important to understand its unique characteristics and paths of travel.

Water Movement

The three states of water - ice, water and water vapor, relate to temperature. Water molecules are attracted to each other but when they are heated they vibrate and move, temporarily releasing part, then all, of that attraction. Hence, when water is warmed, the molecules separate or evaporate, and enter the air as water vapor. When cooling, the water molecules attract each other and condense to form precipitation. When cold enough, the molecules are rigidly held in place to form ice, hail and snow. These physical states of water allow it to be recycled, and are the basis of

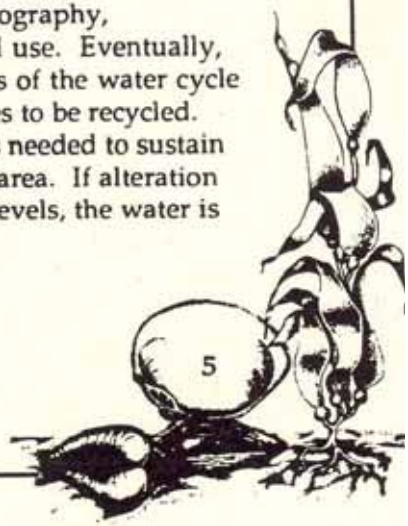
Water Cycle

the earth's water cycle, which is defined as the movement of water from the earth's surface into the atmosphere and back to the earth's surface again.

As water molecules in the cycle evaporate and return to the atmosphere, they leave behind salts and other materials found in water on the surface from which they have evaporated. As this "cleansed water" returns to the earth through the atmosphere in the form of precipitation, various impurities in the air are intercepted. When it reaches the ground, water again contains both man-made and natural impurities, such as carbon dioxide, dust and pollen. As the water runs its course on the land, it continues to collect or dissolve and carry oxygen, nutrients, minerals, nitrates, phosphates, carbon dioxide and other materials, most of which are necessary for the life of animals and plants. The types and amounts of materials vary according to the location's geology, topography, vegetation, soil type, weather, water velocity and land use. Eventually, these collected materials are deposited in various parts of the water cycle before the water re-enters the atmosphere and continues to be recycled.

Water Quality

Water quality can be measured utilizing the conditions needed to sustain the organisms that live in or use the water in a given area. If alteration and use of the land lowers these conditions to certain levels, the water is considered polluted.



Exactly where water travels and how quickly it moves also depend on various factors, such as an area's topography and surface, and its soil and rock types. Precipitation falls into water or on land where it "runs off" of a hard surface such as rock or concrete, or infiltrates a soft surface such as soil or sand. If it moves downward, it can replenish water contained in the underground rock and sediment. This supply of water is referred to as "ground water." Water remaining on the surface enters local streams, rivers and lakes. This land area from which water drains to any given point is referred to as a "watershed." For instance, a lake's watershed includes the streams entering it and the hills that drain into these streams and eventually into the lake. A large river, fed by many streams, is made up of many watersheds and is referred to as a "drainage basin." New Jersey encompasses five major drainage basins, which themselves comprise many miles of rivers and streams, acres of lakes and square miles of wetlands and estuaries.

Water Shed

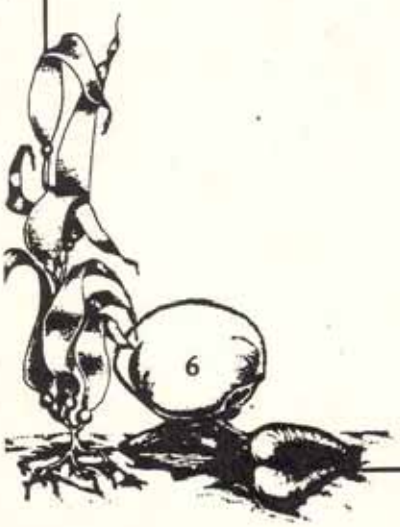
Drainage Basin

Estuary

An estuary is a special place where fresh water from the drainage basins mixes with salt water from the ocean's tides. It can include bays, marshes and tidal flats. These delicate areas produce much plant and animal life which consistently deal with changes in tide, temperature, salinity and oxygen levels. Along New Jersey's coast exist 400,000 acres of estuarine waters and an additional 280,000 acres of near coastal waters, most of which is suitable shellfish habitat.

The water flowing through New Jersey's drainage basins comes into contact with a variety of land uses in rural, suburban and urban areas, before emptying into an estuary. While a portion of the materials that collects in the water settles in such areas as ponds and lakes, the rest empties into the estuaries, earning them the nickname of "sink holes." These materials may leave an estuary quickly to mix with ocean waters, or they can remain in estuarine waters for a long time, depending on the shape of the estuary and the rates in which waters entering and exiting it can flush them out.

The process of "Water Meeting Land" must be fully understood before exploring nonpoint source pollution.



New Jersey's Five Water Regions and 20 Watershed Management Areas

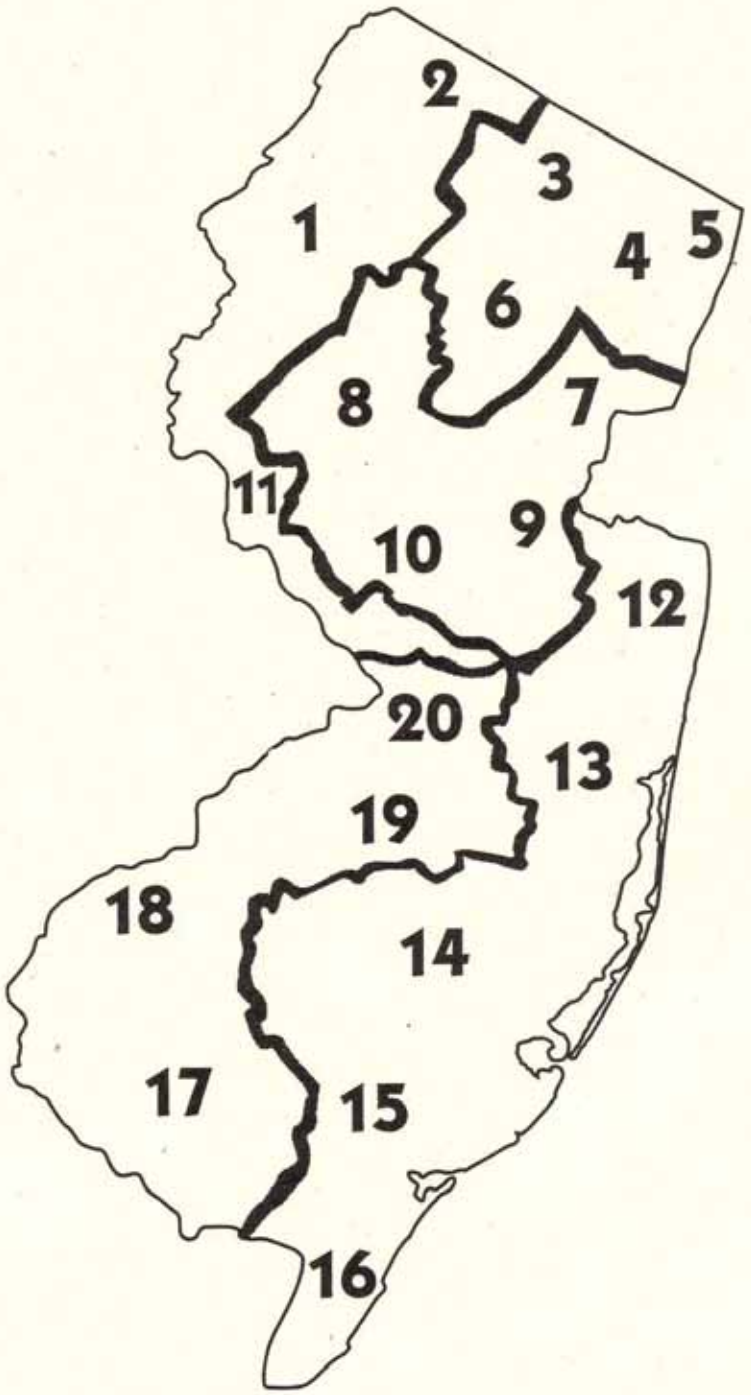
Northwest
(609) 633-3812
1. Upper Delaware River
2. Walkill, Pochuck, Papakating
11. Central Delaware Tributaries

Northeast
(609) 633-1179
3. Pompton, Pequannock, Wanaque, Ramapo
4. Lower Passaic, Saddle
5. Hackensack, Pascack, Hudson
6. Mid-Passaic, Whippany, Rockaway

Raritan
(609) 633-7020
7. Elizabeth, Rahway, Woodbridge
8. North & South Branch Raritan
9. Lower Raritan, South River, Lawrence Brook
10. Millstone River

Atlantic Coastal
(609) 984-6888
12. Monmouth Watersheds
13. Barnegat Bay Watersheds
14. Mullica, Wading River
15. Great Egg Harbor, Tuckahoe
16. Cape May Watersheds

Lower Delaware
(609) 633-1441
17. Maurice, Salem, Cohansey
18. Lower Delaware Tributaries
19. Rancocas Creek
20. Crosswicks Creek



Potential Shellfish Habitat

TITLE: **Water, Water Everywhere**

AGE LEVEL: P

OBJECTIVES: After performing this activity, students should be able to:

1) Recognize the amount (percentage) of fresh water available to living things for consumption and other uses;
2) Compare this amount (percentage) to the total amount of water available on earth;
3) Create a list of reasons that the earth's water resources should be conserved and used wisely.

KEY WORD: Water Quantity

SUBJECTS: Science, Math, Social Studies

SKILLS: Comparing, identifying, listing and mapping

MATERIALS: Crayons, copies of page 11 (one per student), scissors, a road map of New Jersey and a globe and/or map of the world

BACKGROUND INFORMATION: Introduction to Section One

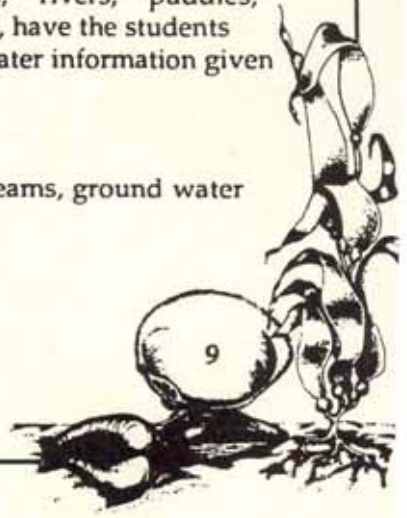
PROCEDURE:

1) Examine the globe and/or world map with the students. Ask the students where most of the world's water appears to be located. Identify these areas and write them on the board. Do humans drink salt water? How do we utilize it? What other animals and plants need salt water?

2) Distribute copies of page 11, crayons and scissors to each student. Explain that the amount of water on the earth is represented by these 100 squares. (The squares are numbered for counting purposes.) Ninety-seven squares represent the amount (percentage) of salt water in the world's oceans and seas. Have the students color numbers 1 - 97 with a blue crayon. Two of the remaining squares are fresh water but are not available to humans because they are frozen in glaciers. Color these blocks, numbers 98 and 99, grey. Finally, color the final block green. This represents the amount of fresh water available for humans to drink and to use. Discuss the differences in these amounts.

3) Have the students cut up the different squares to make three colored "piles." Focusing on the green square which represents available water, ask the students where this water might be located. Generate a list of "lakes," "rivers," "puddles," "streams," etc., on the board. Using the New Jersey road map, have the students point out these physical features. Next, discuss the ground water information given in the introduction to Section One.

4) Discuss:
   - Do you think that other states also have lakes, rivers, streams, ground water supplies, etc.? Other countries?



- Have any students visited such areas while on vacation?
- Who, then, uses our 1 square (%) of available fresh water?
- Have the class develop a list of animals and plants. Explain that the water needed and used by these living animals and plants is also part of the 1 square (%) of fresh water available and therefore, "shared" by all living animals and plants on this earth.
- Compile a list of reasons that the earth's water resources should be protected and used wisely.

EXTENSION:

Place into a hat pictures of living and nonliving objects and scenes (see below). Each student would pick one picture from the hat. Their assignment is to research the following information about their picture:

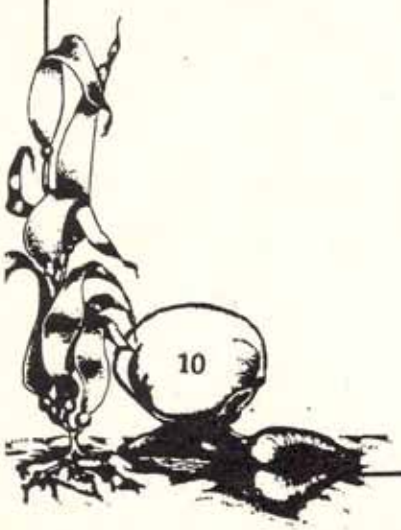
A) If the picture is a living plant or animal, does it need water? How does it use water? How might it gather or find water?

B) If the picture is a nonliving object such as a rock or concrete, does water affect it? Was water needed to produce it?

C) If the picture is of a manmade material such as clothing or paper, how was water used to produce this material?

D) If the picture is of a favorite food, how was water used to produce the food?

E) If the picture is of a water-related sport or activity, why is water necessary to perform the activity?



"Water, Water Everywhere" Worksheet

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

TITLE: What Goes Up, Comes Down

AGE LEVELS: P, I

OBJECTIVES: After performing these activities, students should be able to:

1) Recognize ice, water and water vapor;
2) Explain evaporation, condensation and precipitation and their roles in the water cycle;
3) Describe the distillation process and relate it to the water cycle.

KEY WORDS: Water Movement, Water Cycle, Water Quality

SUBJECT: Science

SKILLS: Analyzing, applying, comparing, defining, experimenting, listing, measuring, observing, relating and visualizing

MATERIALS: Paper cups, ice cubes, markers, a pot and a burner or an electric coffee pot, a pyrex pie pan, a piece of aluminum foil (about 12" X 18") and table salt

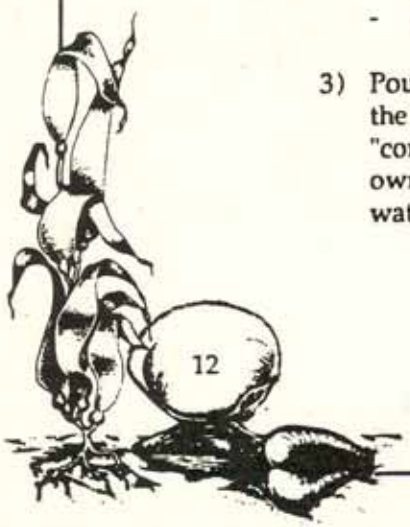
BACKGROUND INFORMATION: Introduction to Section One

PROCEDURE:

1) Give each student or group of students a paper cup and two ice cubes. Have them place the cups, at the same time, in various places around the room. When the cubes have disappeared, use the marker to draw a line at the level of the water, on the outside of the paper cup.
   Discuss:
   - Where does ice naturally occur on the earth?
   - Propose a number of changes that might take place should large amounts of ice melt in a colder climate, such as Alaska.
   - Describe how humans make ice. Discuss how and why we use it.
   - Why did the ice cubes melt? Did some melt more quickly than others? Why?
   - What forms of water have been observed?

2) Leave the cups in the same places overnight. Have the students check them the next morning. Did any levels drop below their line? Check the cups again for two or three days and discuss why some levels might go down more quickly.
   Discuss:
   - Where did the water go?
   - If this occurs indoors, can it also occur outside? List places where it would occur.
   - Create a classroom definition of "evaporation."
   - What form of water has been created?

3) Pour the remaining water into the pot or electric coffee pot and heat. While the water is being heated, discuss the definitions of "evaporation," "condensation" and "precipitation" with the class or have them create their own definitions. Observe where these begin to occur in the activity. When the water is at a boil and steam is escaping, hold the pie plate about 12" over the



water. Allow the water to evaporate enough to create condensation on the glass, which can be compared to precipitation. This simulates a mini-water cycle.

Discuss:

- What forms of water have been observed?
- What, in the water cycle, can the pie pan be compared to? (Atmosphere)
- What would the heating source compare to? (The sun)
- Discuss changes in the activity that would allow the activity to continue on for a long time. (Enclose the process, drain the water back into the pot.)
- Utilizing these three motions of water, have each student formulate a picture or narrative of how a water droplet might travel from one location to another.

4) Create a solution of salt and water in the pot or electric coffee pot (about 1 tablespoon per cup of water) and heat it slowly. (Before heating, allow one student to taste the solution.) Use a piece of foil this time, to create condensation. Mount it about 8" - 10" above the pot, slant it slightly and create a "funnel" at the lower end so that the condensation would collect and drip into the paper cup. When most of the water has evaporated, have the same student taste the water in the paper cup and compare tastes.
Discuss:
   - What is the relationship between this activity and the ocean's evaporation process?
   - With older students, discuss the process of "distillation." (See Glossary.) Try the same experiment with vinegar and with sugar. Test for acidity. What happens to a few drops of cooking oil?

EXTENSION:

1) As a long-term project, have the students create a bulletin board on water movement. Each day the students write down on an index card one "incident" in which they witnessed water changing forms. Have them briefly and completely describe the incident on the card and put their name and the date on it. Use tacks to mount the cards onto the bulletin board. Remind them that each incident can only be used once. It is up to them to read everyone's cards. At the end of a given time, the cards will be reviewed. Bonus points, etc., will be given to those students with realistic incidents. Points will be taken from inaccurate incidents or ones that have been described more than once. Samples to consider are:
   - Steam from a boiling pot of water
   - A dripping icicle
   - Ice cubes freezing overnight
   - Wet clothes becoming stiff when cold

TITLE: **Drop Pass**

AGE LEVEL: P

OBJECTIVE: After performing this activity, students should be able to:
1) Describe the major components of a water cycle.

KEY WORDS: Water Cycle, Water Movement

SUBECT: Science

SKILLS: Cooperating, developing, dramatizing and visualizing

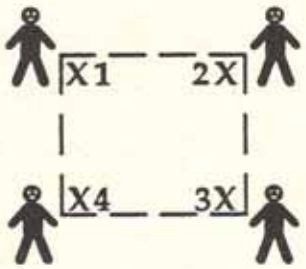
MATERIALS: Soft stuffed socks (one for every four students), a yard/meter stick, masking tape, scissors and old magazines

BACKGROUND INFORMATION: Introduction to Section One

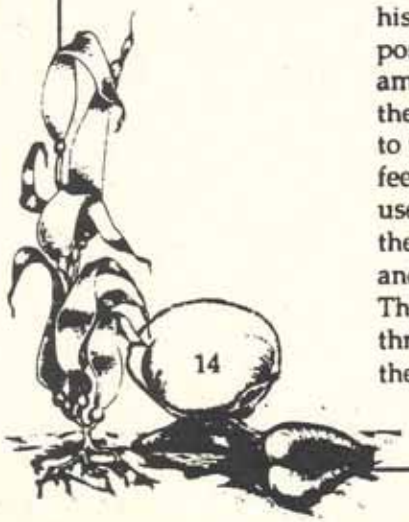
PROCEDURE:

1) Create an open playing area in front of the class. Use masking tape to mark four "X's" on the floor, representing corners of a square with 5 - 6' edges.

2) Choose 4 students from the class. Have each of them stand on an "X" and face the center of the square. The student's positions are numbered like the diagram below:



3) The four students will then proceed to act out this process: Give the student in position #1 the stuffed sock. The student places it between his/her feet and states: "I am a cloud sending rain to the earth." This student then makes a motion with his/her hands, imitating rain. The sock is then gently tossed to the student in position #2. The second student places the sock between his/her feet and states: "I am the land, that catches the rain and creates the rivers." This student can spread their arms to imitate the land catching the raindrops. The sock is then tossed to the student in position #3. The third student places the sock between his/her feet and states: "I am a river that carries water into the ocean." This student can use his/her arms to imitate a river, winding and flowing. The sock is then tossed to the student in position #4. The fourth student places the sock between his/her feet and states: "I am the ocean which holds the water until it returns to the sky." This final student can make a rippling motion with his/her arms then grandly throw them upwards. The sock is then returned to the student in position #1 and the water cycle is completed.



4) This group of 4 can then repeat the scenario until the words and the motions are recalled by heart. Other groups of 4 can be created and placed around the classroom or playground, and the water cycle can be rehearsed in unison. The challenge comes when the cycle must be completed at a faster rate.

5) Have the students go through old magazines and cut out pictures that relate to clouds and rain, streams and rivers and the ocean. Locate each picture on the square, near an "X" where it may occur. Have each of the groups travel from square to square to view each other's pictures used in developing their water cycles. (Students may want to draw and/or color their pictures instead.)

6) Discuss:
   - What are the major components mentioned in the Drop Pass game?
   - What are some natural and human related forces and objects that help to move water? (Examples: gravity, hills and slopes, pipes, canals, waterfalls, etc.)
   - Do any of the group's pictures show samples of these?

EXTENSIONS:

1) With younger students, pictures of a cloud, an area of land, a river and the ocean can be mounted on cardboard and strung with yarn. These can be hung around the student's necks to remind the group of assigned roles in this game.

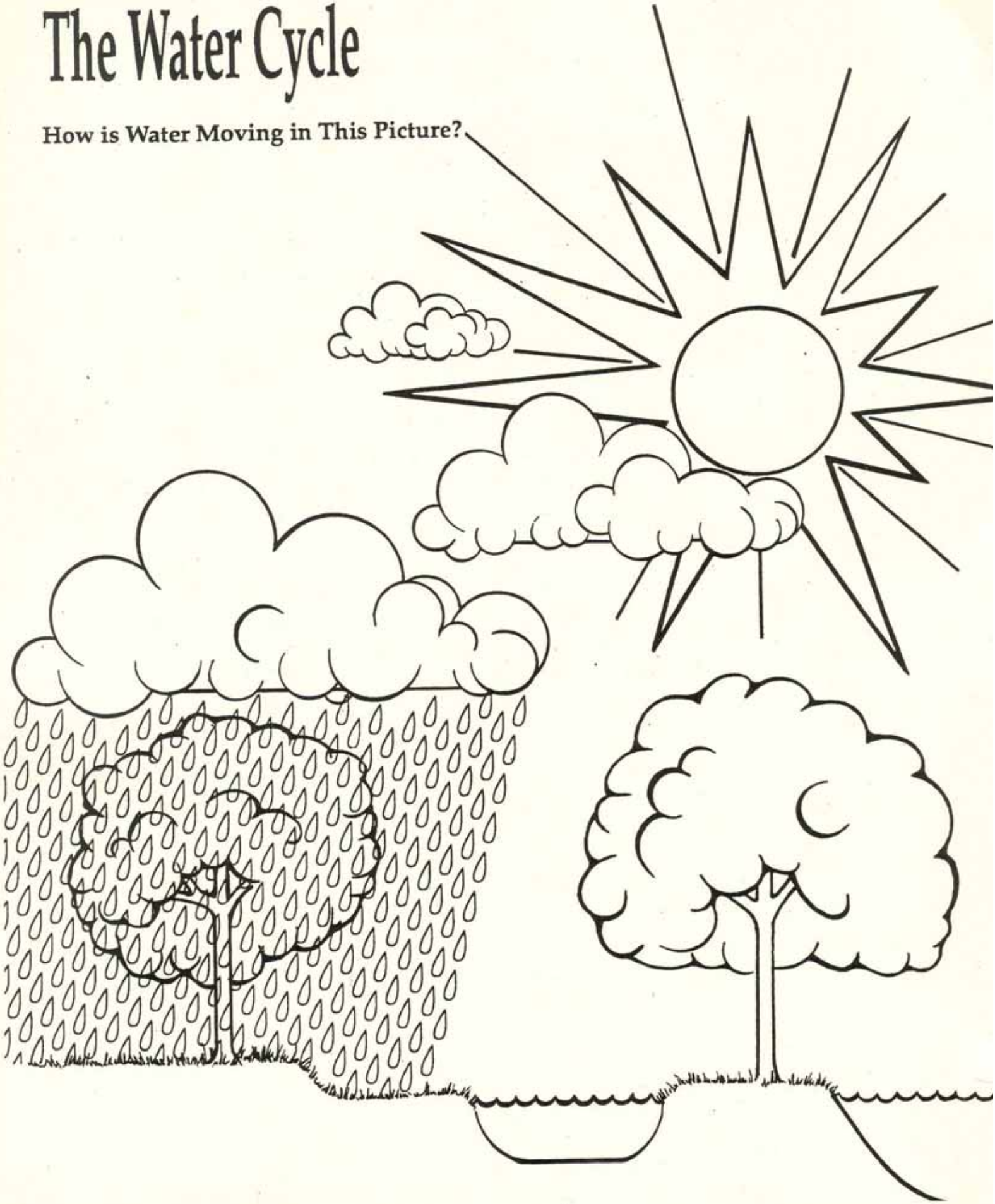
2) After performing the activity, expand the group of four students to five in each group by introducing "ground water" (See Glossary.) This person becomes the new "number two" position. He/she would state, "I am the land that catches some of the rain and stores it underground." This person can hold his/her arms and out then cradle them at his/her chest, as if holding something. The old #2 then becomes the new #3 to continue the cycle.

3) As a writing activity, have the students each write a short story or poem on "A Drop in the Cycle." This can be a story or poem tracing the possible travels of one drop of this valuable resource. With younger students, have them create a story orally, with each student contributing a line in an impromptu fashion. Use a cassette recorder to tape the story line and play it back to the students. Make a classroom picture book from the resulting story and place it on display for the rest of the school. Older students can each create a picture book from their own essays.

Copy Page

The Water Cycle

How is Water Moving in This Picture?



TITLE: **The Movement of Water**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:
1) Identify components of the water cycle;
2) Describe the movement of water within the cycle.

KEY WORDS: Water Cycle, Water Movement

SUBJECTS: Science, Art, English

SKILLS: Defining, drawing, formulating, identifying, labeling, visualizing and writing

MATERIALS: Large poster or mural paper, crayon or markers, pencils, copies of worksheet on page 19, pencils, tape, index cards and a ball of yarn or string

BACKGROUND INFORMATION: Introduction to Section One

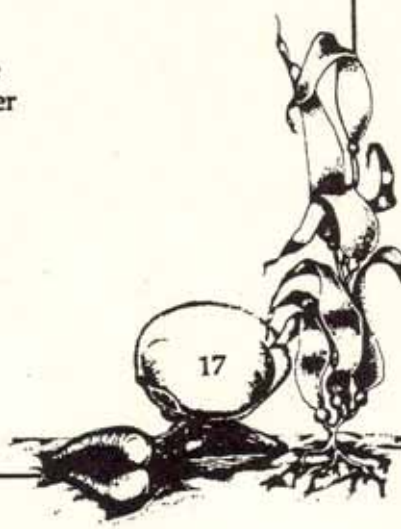
PROCEDURE:

1) Write the following terms on the chalkboard (see Glossary for some of these terms):
   - Evaporation
   - Transpiration
   - Cloud
   - Precipitation
   - Condensation
   - Estuary
   - Well
   - Ocean
   - Ground Water
   - Runoff
   - Water Table
   - Lake
   - River
   - Stream
   - Infiltration

2) Ask the students how these words relate to each other. Share the definitions of the listed terms with the students or have them create group definitions and compare them to those in the Glossary.

3) Give each student "The Movement of Water" Worksheet and a pencil. Have them fill in the blank lines on their water cycle diagram copies with the appropriate terms. (The students may work individually or in groups.)

4) When all are finished, have volunteers copy a "rough" sketch of the water cycle diagram onto a large piece of mural paper and hang it in front of the class. Have the group work together to correctly locate the terms in the proper slots, discussing each answer. The answers are as follows:
   1) Evaporation
   2) Condensation
   3) Cloud
   4) Precipitation
   5) Transpiration
   6) Runoff
   7) Lake
   8) Infiltration
   9) Well
   10) Water Table
   11) Ground Water
   12) Stream
   13) River
   14) Estuary
   15) Ocean



5) Explain to the class that the water cycle diagram is a "simplified picture" of a complex "up and down" movement of water. To better understand water movement, give each student an index card with one of the terms written on it. If extra cards are needed, duplicate card numbers 1, 2, 4 and 5.

6) Push the desks against the walls or go to a large, cleared area. Have the class stand in a circle and tape the index cards to their chests so that the rest of the students can read them. Give the ball of yarn to the student with the term "ocean," since this is where most of the water is contained. Explain to the class that as the sun heats the surface waters of the ocean an action occurs. This action is called "evaporation." After the students guess this, have the "ocean" student hold the end of the yarn ball and pass the ball to the "evaporation" student, keeping the yarn tight. This water in the atmosphere begins to form "clouds." Have the "evaporation" student hold a part of the yarn strand and pass the yarn ball to the "cloud" student. Continue the scenario until all of the students are "hooked" to the yarn at least once and the design resembles a web. Ask them questions and suggest "scenes" that show that the water cycle is a complex and interactive process.

7) Have the students use old magazines to cut out water-related pictures and add sketches, poetry and photos to the mural in the appropriate areas.

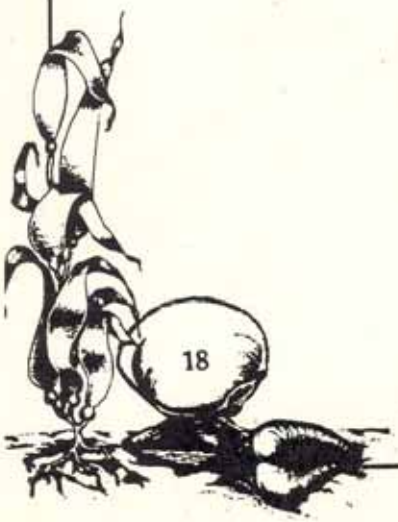
8) Discuss:
   - Which of the terms are "action related" and help to move water?
   - Which "hold" or restrain water in one place temporarily?
   - Have the students use what they've learned to formulate a theory as to when and how this cycle might have begun. Research current material and compare to the student's ideas.

EXTENSIONS:

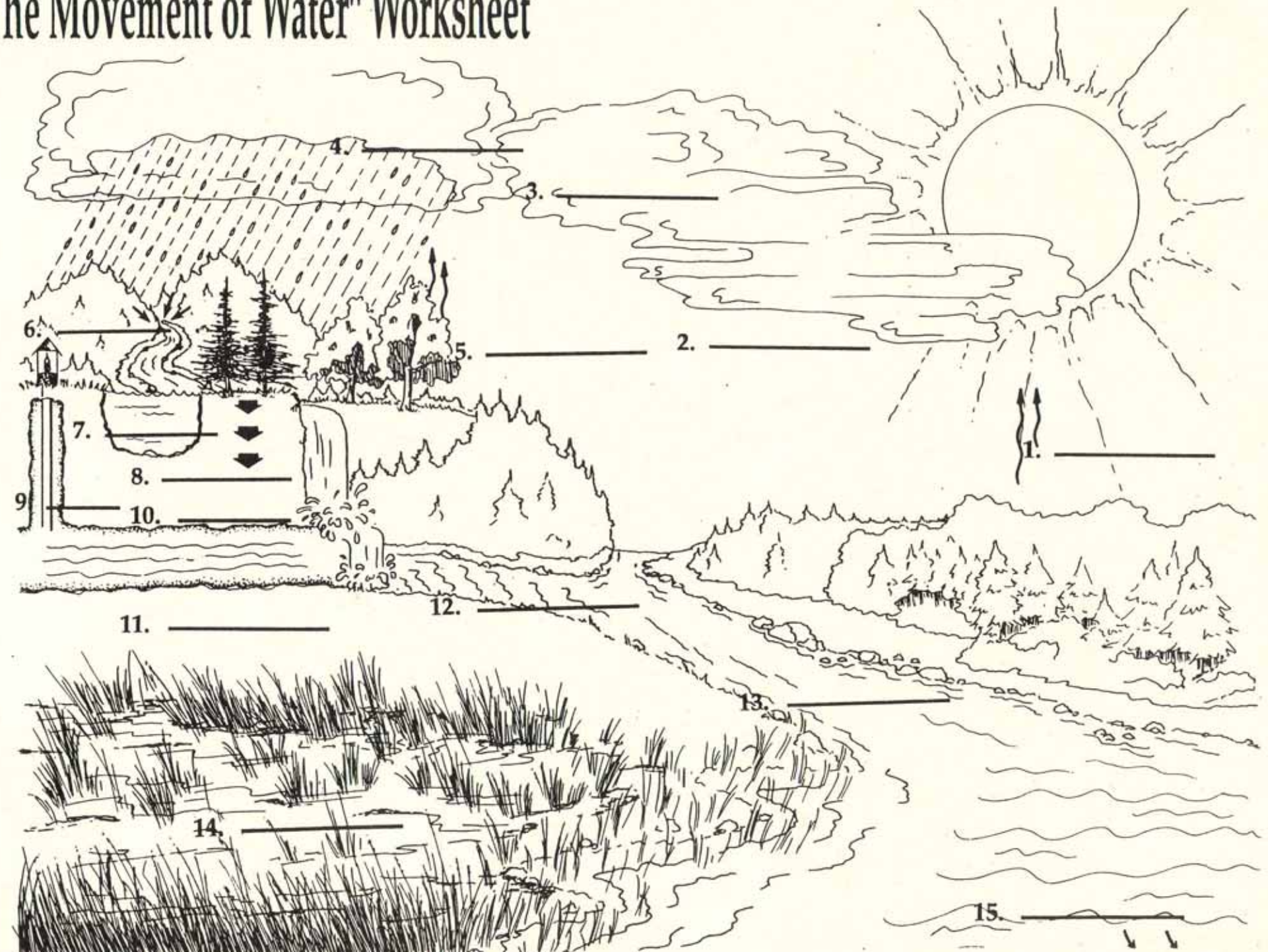
1) Have each student make up a list of 8-10 descriptive words for some of the terms used in this activity. Read sample lists aloud to the class and have them guess which term was being described. For example, the term "precipitation" can be described with such words as rainy, snowy, drippy, puddle-forming, gully-washing, etc.

2) Compare ways in which humans alter and/or assist the water cycle. Examples could include dams, reservoirs, flood control methods, irrigation, lawn sprinkling, preservation, development, etc.

3) Have the students research and compare the flow and movement of water through such specific areas as deserts, rainforests, wetlands, ridgetops, oceanic depths, etc.



"The Movement of Water" Worksheet



TITLE: **Watersheds and Drainage Basins**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:
1) Recognize a watershed and a drainage basin;
2) Define "topography" and describe its relationship to the water cycle;
3) List the manmade and natural factors that alter the water's flow.

KEY WORDS: Drainage Basin, Watershed, Water Cycle, Water Movement

SUBJECTS: Science, Social Studies

SKILLS: Comparing, cooperating, debating, listing, mapping, predicting and visualizing

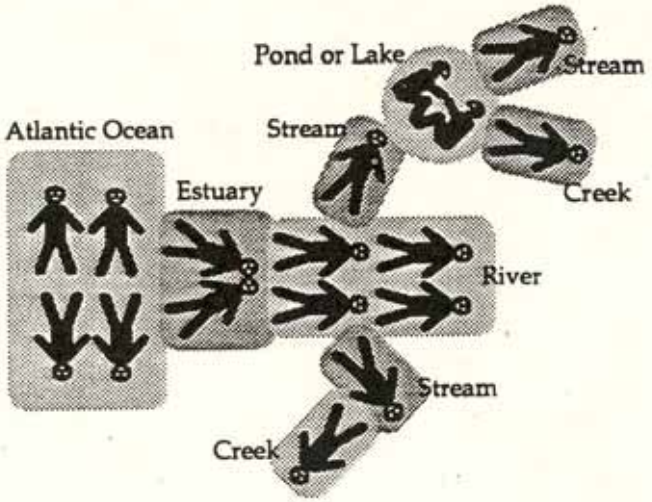
MATERIALS: Copies of "New Jersey's Watersheds and Drainage Basins" map on page 7, a road map of New Jersey and craft materials (yarn, sticks, straws, colored paper, scissors, and large pieces of drawing paper)

BACKGROUND INFORMATION: Introduction to Section One

PROCEDURE:

1) Establish a large cleared area in the classroom or outside on a grassy field.

2) Announce to the group that they will take a closer look at the water cycle by building a drainage basin and watersheds with their bodies. (The diagram shown below should help you in arranging your volunteers.) Choose four volunteers to lie face up, next to each other, on the ground. This group represents the Atlantic Ocean. These four can practice "rolling in" and "rolling out" to simulate waves or the tide. Ask the class "How does the ocean receive its water?" Some answers might be rain, snow, runoff and rivers. (Discuss the definition of "runoff.") Choose six students to attach themselves to the ocean, forming an estuary and river. "Where do rivers get their water from? " Attach three more students to the river, representing streams. Ask two students to curl up and represent a pond or a lake. Finally, attach two students to the stream, pond or lake to represent creeks. Have another volunteer draw the arrangement of students onto the board, creating a large diagram.



3) While studying the diagram on the board, ask the students what physical land features might exist in the picture that would aid in collecting water, holding it, and/or moving it to the ocean. Things to be considered would be runoff from mountains, hills and ridges, valleys, marshes and other low areas, lakes, rivers, reservoirs and streams. Together, these features make up the "topography" of the area, or "the relief features or surface configuration of a given area." Through informal debate, have the class decide where such geographic features might be located within the diagram, and draw or label them.

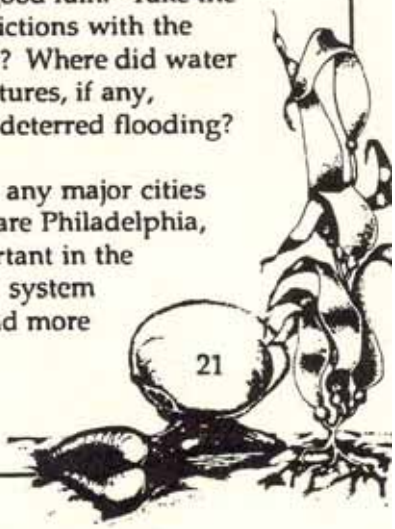
4) On the diagram, have the students circle a number of land areas where water drains to a given point. Examples include puddles, streams, lakes and ground water. These are all considered watersheds. A drainage basin is much larger and made up of many watersheds. If the entire diagram is one drainage basin, how many large watersheds might it contain? Distribute the copies of the "New Jersey's Watersheds and Drainage Basins" maps to the students. Have them locate their town, using the New Jersey road map as a reference. Locate water bodies on the NJ road map and try to pinpoint them in the school's watershed and drainage basin.

5) Discuss:
   - What causes the water to flow and move? (Gravity and the topography)
   - What things would cause the water to change direction? What would cause it to move faster? What would cause it to move more slowly? (Examples include topography of the land, the type of rock and soil in a given area, any man-made pipes, dams, reservoirs, amount of vegetation, weather conditions, amount of rainfall, types of surfaces, etc.)
   - Expand on the effects of the rock and soil types on the water's flow. (The bedrock may be a type that errodes fairly easily, such as sandstone or limestone, or very dense, like basalt. As a result, the direction of streams and rivers is often dictated by the amount of time needed by water to errode its banks or bed and alter its course. Also, rivers may flow underground along fault lines, which are cracks in the weakened rock. Finally, water percolates the soil. A loosely packed soil containing sand will allow water to flow through it at a quicker rate than tightly packed soil made up of clay.)
   - Have the students use craft materials such as pieces of yarn, colored paper, paper straws, sticks and cardboard, to create a "drainage basin" glued on paper. Compare their creations. Recycle the pieces when finished.

EXTENSIONS:

1) Take the students for two walks on the school's property, evaluating it as a watershed. Take the first trip during a dry spell, noting slopes, gullies, ditches and any other areas where runoff might occur and tiny streams could form. Record any group predictions of what might occur during and following a good rain. Take the second trip immediately after a storm, comparing earlier predictions with the group's actual observations. Where did water movement occur? Where did water collect? Where did most of the water go? What manmade features, if any, prevented flooding from taking place? What natural features deterred flooding?

2) Obtain a road map of the United States. Have the class locate any major cities built on or very close to any large bodies of water. Examples are Philadelphia, Cleveland, New York City and Boston. Why was water important in the development of these cities? What "link" did the watershed system provide for the smaller settlements upstream to these larger and more industrialized areas?



TITLE: **Topo Trouble**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Interpret a topographic map and the role of contour lines;
2) Design a contour map of a three dimensional surface;
3) Predict the locations of watersheds on a three dimensional surface, using the contour map as a reference.

KEY WORDS: Water Movement, Water Cycle

SUBJECTS: Science, Geography

SKILLS: Comparing, computing, constructing, designing, formulating, mapping, measuring, predicting and visualizing

MATERIALS: Corrugated cardboard pieces (8 1/2" x 11"), scissors, 8 - 10 classroom objects of various shapes and sizes, shower curtain or large piece of polyurethane, water, watering can with spray nozzle, copies of "Topo Trouble" Worksheet, blank pieces of plain paper, sample topographic maps and ruler

BACKGROUND INFORMATION: Introduction to Section One and information below:

A topographic (or contour) map depicts the landscape or the physical features of a given area. Man-made features symbolized on the map can include roads, bridges, railroads and power lines. Symbolized aquatic features include marshes, lakes, ponds and streams. Finally, the terrain of an area, along with its elevation, is represented by contour lines.

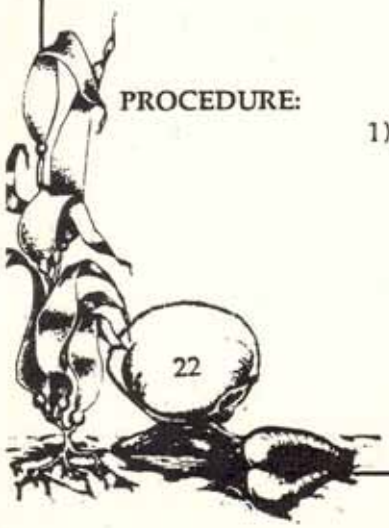
A contour line, by definition, is an imaginary line on the ground along which every point is at the same height above sea level. Certain contours note the height (in feet) of that particular line. The number of feet between each contour line is equal and is referred to as the "contour interval." The contour interval is noted along the map's bottom margin. Given this information, elevations anywhere on the map can be figured.

Topographic maps are available for most areas in the United States and are prepared by the U.S. Geologic Survey. Each state is divided up into rectangular maps, or "quadrangles." A directory of New Jersey maps and prices can be obtained by contacting:

Bureau of Revenue, Map and Publication Sales
NJDEPE
CN 417
Trenton,NJ 08625-0417
(609) 777-1038 or (609) 777-1039

PROCEDURE:

1) Show a topographic map to the class (or to smaller groups of students). Have the students compare it to a road map, a map of the continents, etc. Ask what is different about this particular map. Explain its purpose, features and functions to the students, focusing on contour lines and their references to elevation.

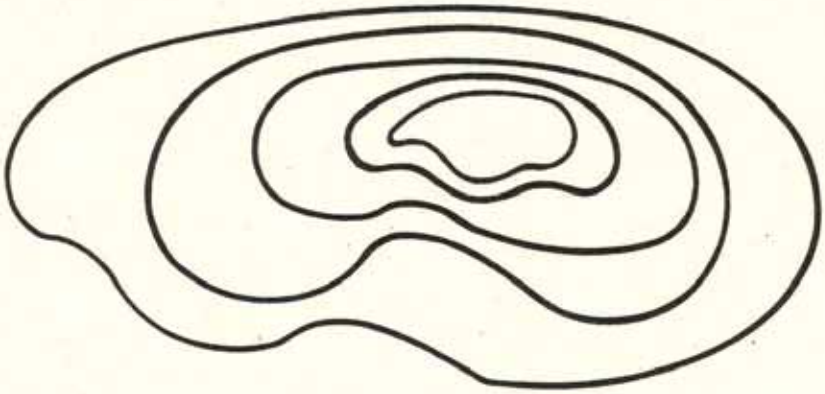


2) To reinforce the understanding of this concept, distribute to each student a piece of corrugated cardboard, scissors, glue, a copy of the "Topo Trouble" Worksheet and a piece of paper (8 1/2" x 11"). Have the students cut out the five shapes from the "Topo Trouble" Worksheet, trace the figures onto the cardboard and then cut the five shapes out of the cardboard. The paper stencils can be discarded. The students should label the cardboard pieces 1 - 5 in order of size, the largest piece being #1 and the smallest being #5.

3) Inform the students that they will each construct a cardboard hill while creating a contour map of this same hill, at the same time. To accomplish this, the students should:

A. Place piece #1 onto the blank piece of paper and trace it, then place the piece aside on the desk.
B. Place piece #2 in the middle of the outline of #1 and trace it. Apply glue to the bottom of piece #2 and press it onto the top of piece #1, arranging them identically to how they've been traced onto the paper. (The students are creating the beginning of a hill and a contour map.)
C. Place piece #3 in the middle of piece #2 and trace it. Apply glue to the bottom of piece #3 and press it onto the top of piece #2, arranging them identically to the map.
D. Place piece #4 onto the paper, trace it, and glue it onto piece #3, as before.
E. Finally, place piece #5 onto the paper, trace it, and glue it onto piece #4.

Each of their drawings should compare to the diagram below:



4) Have the students compare their contour maps to their cardboard hills. Using a ruler, have the class create a "contour interval." For instance, the width of one cardboard layer might equal .25". This would be the contour interval. If an ant crawled up to the top of the hill, the altitude during the climb would change 1.25". If the desktop is zero inches "above sea level" and the ant stood upon cardboard layer #2, what elevation would it be at? How about at layer #4?

5) To further reinforce the concept that gravity and topography direct the flow and volume of water, collect about 10 classroom/household objects that vary in size and height, and arrange them outdoors on a 4' by 4' area. Represent hills with rounded objects such as mugs, balls and mixing bowls. Represent long ridges and plains with a broom head, a stapler, a book and boxes. Cover these objects with a sheet of waterproof material, such as a shower curtain.

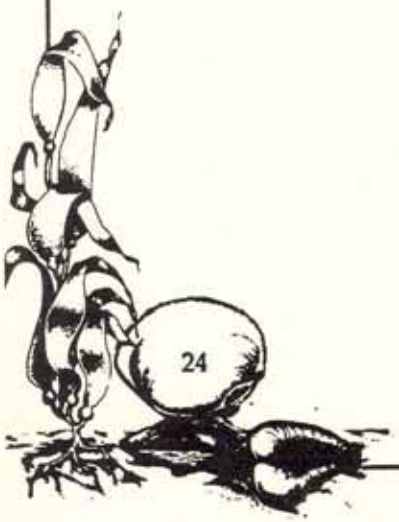
6) Have the students each create a rough contour map, drawn onto a piece of paper and modeled after the surface of the plastic. If it rained onto this area, what would the water do? Have them discuss the effects of gravity and elevation and draw, onto their maps, the places where ponds, streams and rivers might form.

7) Create a watershed by pouring the water (via watering can with a sprinkling nozzle) over the area to simulate rain. Have the students record their observations during the "downpour".

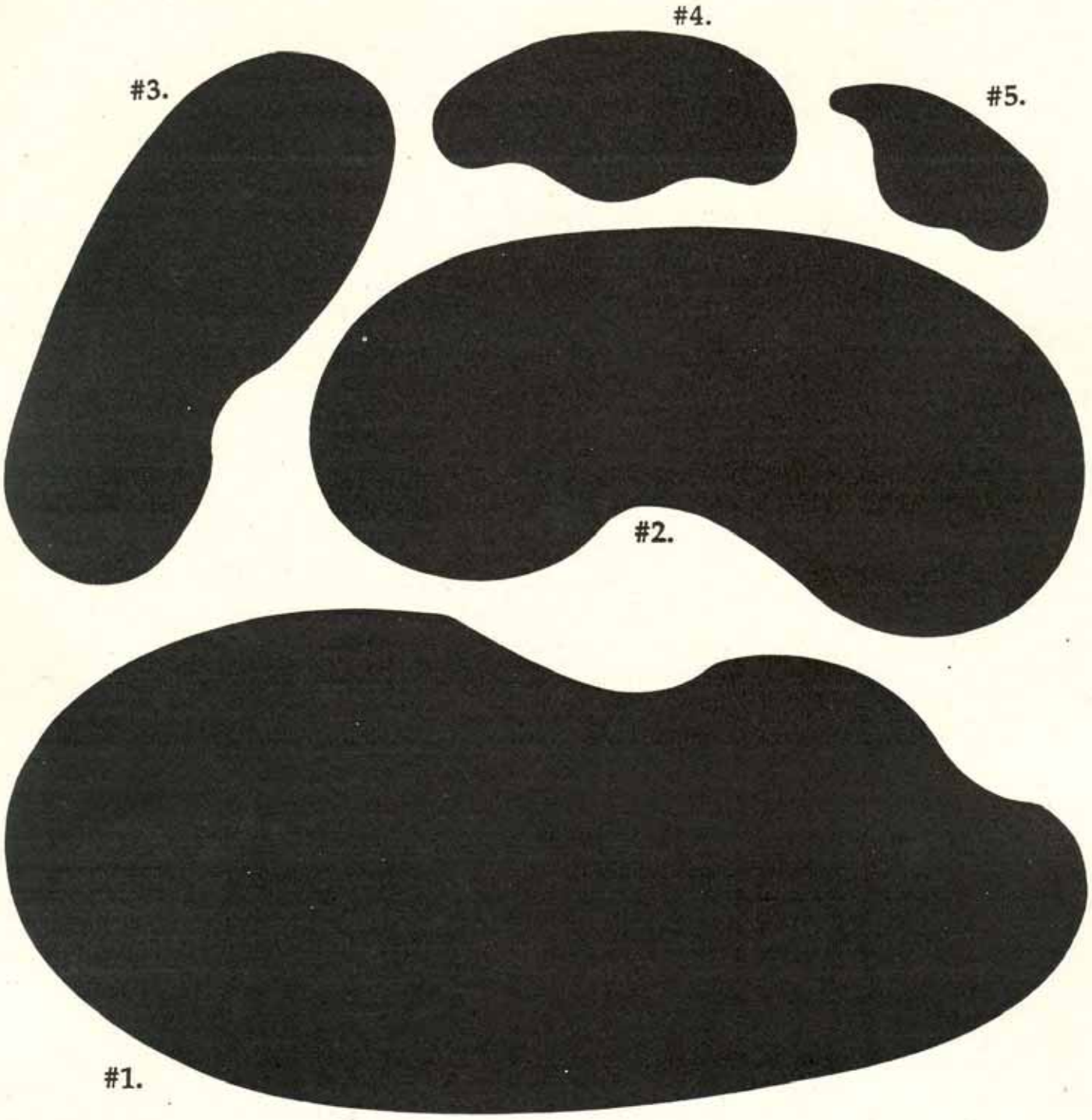
8) Discuss:
   - What effect would rock and soil types have on the water's flow?
   - What effect would surface types have on it?
   - Explain the relationship between topography and the water cycle.
   - Predict the relationships between the water's flow and the physical and chemical composition of the land and air. (Consider erosion, runoff, leachate, weathering, absorption, percolation, acid rain, etc.)

EXTENSION:

1) Invite a local landscape engineer, geologist, landscape architect, site planner or cartographer to speak to the class on watershed management, topography and mapping.



"Topo Trouble" Worksheet



Copy Page

Waters in New Jersey

*There are 25 bodies of water hidden in the puzzle below. They are printed on the horizontal (left to right and right to left) and vertical (top to bottom and bottom to top). The words ocean,river and lake do not appear as part of the puzzle-only the words in bold. (Example-*ATLANTIC.)

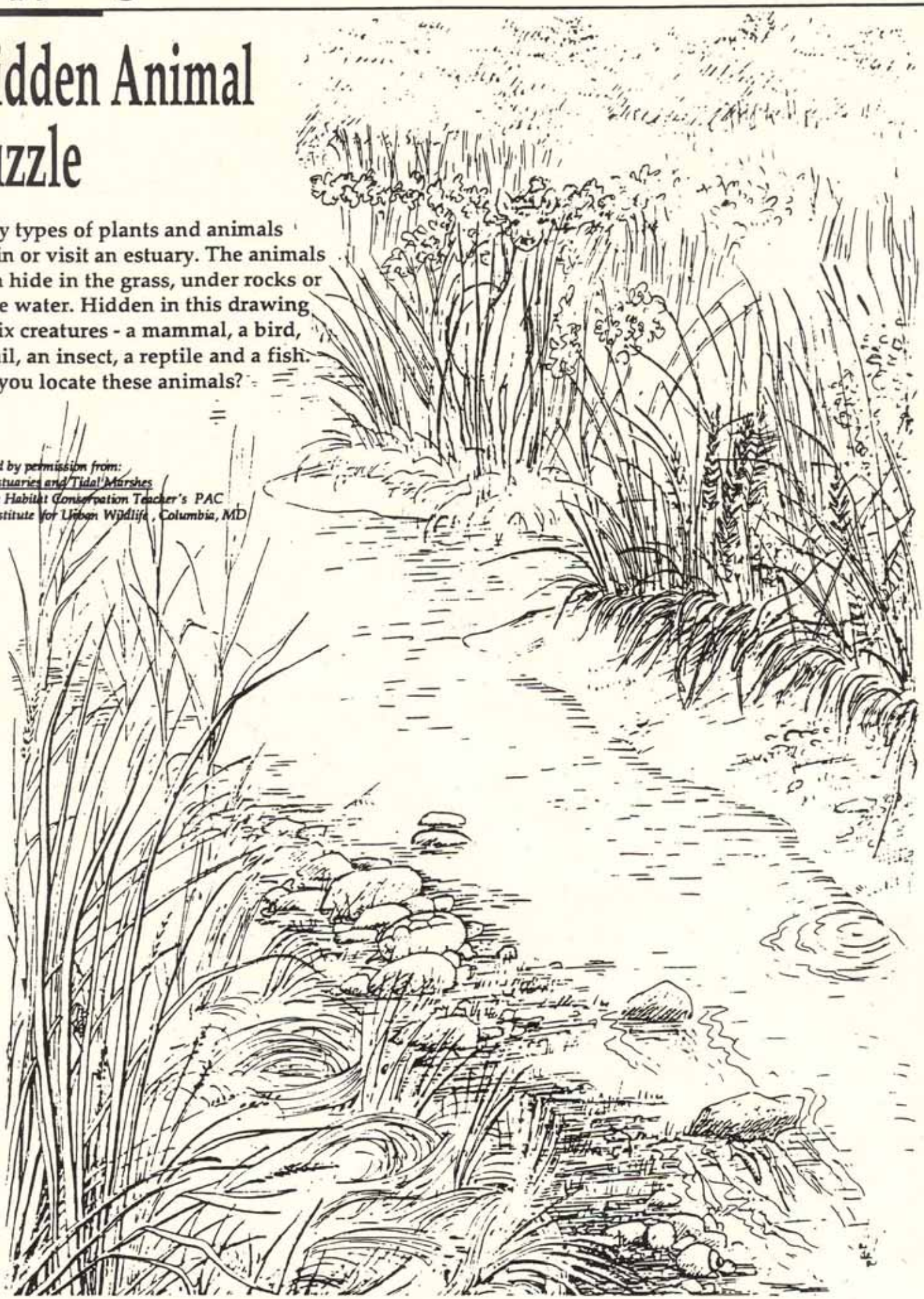
BONUS: Six words are on the diagonal (backwards or forwards).

ATLANTIC Ocean
BATSO River (Burlington)
COHANSEY River (Cumberland,Salem)
DELAWARE River (Sussex,Warren,Hunterdon, Mercer,Burlington,Camden,Salem,Gloucester, Cumberland)
GREAT EGG HARBOR River (Camden,Atlantic, Gloucester)
HACKENSACK River (Bergen,Hudson)
Lake HOPATCONG (Morris,Sussex)
Lake MOHAWK (Sussex)
MANASQUAN River (Monmouth,Ocean)
MAURICE River (Cumberland,Salem)
MILLSTONE River (Somerset,Middlesex, Monmouth)
MIRROR Lake (Burlington)
MULLICA River (Burlington,Atlantic,Camden)
MUSCONETCONG River (Hunterdon,Morris, Warren,Sussex)
NAVESINK River (Monmouth)
ORADELL Reservoir (Bergen)
PASSAIC River (Essex,Union,Morris,Somerset, Bergen,Passaic)
PEQUANNOCK River (Passaic,Sussex,Morris)
RANCOCAS Creek (Burlington)
RARITAN River (Somerset,Hunterdon,Middlesex)
ROCKAWAY River (Morris)
ROUND VALLEY Reservoir(Hunterdon)
SHARK River (Monmouth)
SHREWSBURY River (Monmouth)
SOUTH River (Middlesex)
SPRUCE RUN Reservoir (Hunterdon)
SWIMMING RIVER Reservoir(Monmouth)
TOMS River (Ocean)
UNION Lake (Cumberland)
WANAQUE Reservoir (Passaic)

B T O Y E S N A H O C I A S S A P L E V C
M A N A S Q U A N N I K O N R A T O M S X
I B D W A N A Q U E T S C E S O S E O D D
R D A A Y Z O R P U N I O N Q H H X H K M
R U M K B R E L L U A C H U I L A D A R P
O V E C A C N D H D L O I C T A C R W H Q
R E T O U H E D M F T R O C H H K R K O T
R O B R A H G G E T A E R G Y W E A N P G
A A P O R A D E L L R E I D R M N M I A W
R S E U M U L L I C A A L O U I S N S T P
I R A N C O C A S M M W Z B B L A A E C B
T H U D S O N E A H T M A Y S L C H V O E
A B A V A K T U O N E T M R W S K X A N W
N Z N A I N R A M U S C O N E T C O N G A
D X L L S I B O R T L E O N R O L K A Q U
R P E L C D L N O Z Q X P H H N S I R H C
E R R E V I R G N I M M I W S E S E V O L
P E R Y T P E Q U A N N O C K L Y R E H C

Hidden Animal Puzzle

Many types of plants and animals live in or visit an estuary. The animals often hide in the grass, under rocks or in the water. Hidden in this drawing are six creatures - a mammal, a bird, a snail, an insect, a reptile and a fish. Can you locate these animals?



Adapted by permission from:
The Estuaries and Tidal Marshes
Wildlife Habitat Conservation Teacher's PAC
Nat. Institute for Urban Wildlife, Columbia, MD

TITLE: **Nutrient Trap**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Describe the process of nutrient build-up in an estuary;
2) Construct a food chain and a food pyramid;
3) Relate the availability of nutrients and plants in an estuary to the number of a species of animals that it can or cannot support.

KEY WORDS: Estuary, Water Movement

SUBJECTS: Science, Math

SKILLS: Calculating, constructing, describing, predicting and relating

MATERIALS: Scissors, tape, pencils, and copies of the "Nutrient Trap" worksheets (one per person)

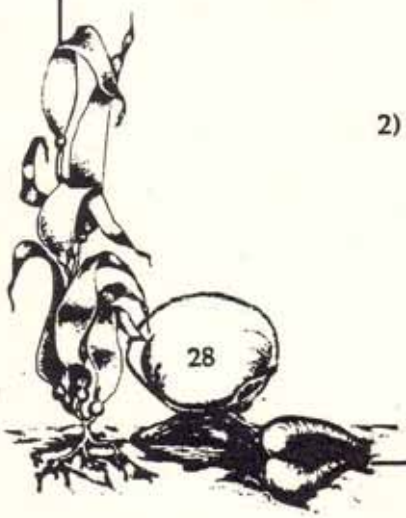
BACKGROUND INFORMATION:

Along New Jersey's coast exist 400,000 acres of estuarine waters. Estuaries are places where fresh water from rivers, streams and creeks mixes with salt water from the sea and creates an area under constant change. The many hearty plants and animals that thrive in an estuary must contend with changes in tidal levels. Inland waterways flow downward into an estuary, forming a layer atop the saline waters moving in from the ocean. As the waters mix, nutrients, plankton and decaying plants, or detritus, flow back and forth with the tide and become trapped animal species. Unfortunately, this ability also allows estuaries to accumulate waste, chemicals and other contaminants associated with human activity and development along the shoreline and further inland.

Estuaries are valuable and productive ecosystems for a variety of reasons. Productivity begins with the plankton, detritus and marsh plants that, though not consumed by humans, provide food for a number of species of shellfish, fish, crabs and shrimp. In turn, food is then provided for larger fish and mammals such as raccoons, who feed on the crabs and shellfish. The tall grasses offer cover for many animals for reproduction purposes. As a result, estuaries afford a number of recreational opportunities to clammers, crabbers, fishermen, boaters, hunters, hikers, photographers and birdwatchers.

PROCEDURE: (A metric conversion chart is included on pages 122-123.)

1) Pass out the scissors, tape and the "Nutrient Trap" sheets to each of the students. Give them time to work individually to read the directions on the sheets and construct their "Nutrient Trap." Share the "Background Information" with the class. Ask the students to explain, in their own words, how the Nutrient Trap works.
2) As mentioned, the Nutrient Trap provides an abundance of nutrients and plant material that form the foundation for many food chains (see Glossary). Tell the students that in an imaginary estuary there exists the following food chain: marsh hawk — eats seaside sparrow — eats grasshopper — eats cordgrass.



Distribute copies of the "Nutrient Trap" Worksheet to each student. Using the facts given at the top of the worksheet, have them work out the math problems. Compare their answers to the correct ones given below:

1. **600 grams** (total weight of sparrows that one hawk eats)	+	**20 grams** (weight of one sparrow)	=	**30** (number of sparrows needed to feed one hawk)
2. **50 grams** (total weight of grasshoppers eaten by one sparrow)	+	**1 gram** (weight of one grasshopper)	=	**50** (number of grasshoppers needed to feed one sparrow)
3. **15 grams** (total weight of cordgrass eaten by one grasshopper)	+	**5 grams** (weight of one plant)	=	**3** (number of plants needed to feed one grasshopper)
4. **30 sparrows** (number needed to feed one hawk)	x	**50 grasshoppers** (number needed to feed each sparrow)	=	**1,500 grasshoppers** (number needed to feed the sparrows eaten by one hawk)
5. **3 plants** (number eaten by one grasshopper)	x	**1,500 grasshoppers** (number needed to feed the sparrows eaten by one hawk)	=	**4,500 plants** (number needed to feed the grasshoppers eaten by the sparrows eaten by one hawk)

3) Using these final figures, have the students work together to create, on the board, a food pyramid (see Glossary) that would depict the number of plants, grasshoppers and sparrows needed to support one hawk.

4) Discuss:
   - How would the figures change in the food pyramid to support 3 hawks?
   - Describe the type of impact that the destruction of cordgrass, due to development or pollution, would have on the rest of the food pyramid.
   - Review the definition of "detritus," a common food source for shellfish. Predict what might occur, should acres of cordgrass be eliminated.

* To convert grams to ounces, see the Metric Conversion Charts in the "Additional Resources" Section on pages 122-123.

This activity was adapted, by permission from:
The Estuaries and Tidal Marshes Wildlife Habitat Conservation Teacher's Pac
The National Institute for Urban Wildlife
Columbia, Maryland

"Nutrient Trap" Worksheet

Cut around the outline and cut out the windows on this page. then fold the page along the solid lines and tape down the flap to make a "sleeve."

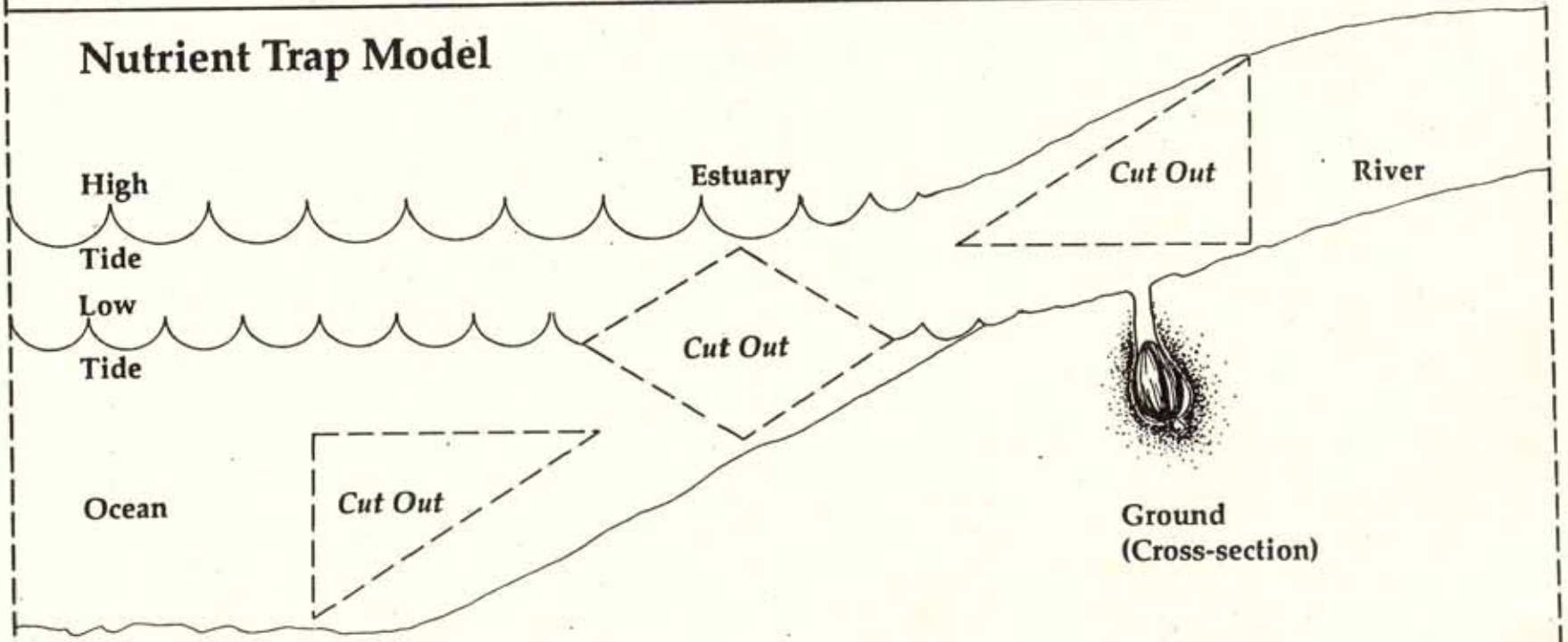
Cut out slide A on page 2 and insert it in the sleeve so that you can still see column 1. Pull it through the sleeve. Steps 1,2,3 and 4 show how the estuary builds up nutrients.

Repeat with Slide B. What happens when people dump pollution into rivers that feed estuaries?

Cut on Dotted Line

Fold Here

Nutrient Trap Model



Fold Here

"Nutrient Trap" Worksheet

1.
Fresh water carrying nutrients flows down-stream...

(pull to 2)

Nutrients

2.
...through the estuary...

(pull to 3)

4.
...they are carried back to the estuary.

3.
...to the sea. Nutrients mix with salt water and when the tide comes up...

(push back to 4)

Nutrients

Nutrients

Nutrients

Slide A

Cut on Dotted Line

1.*Pollution dumped in the river is also carried downstream...*

(pull to 2)

Nutrients and Pollutants

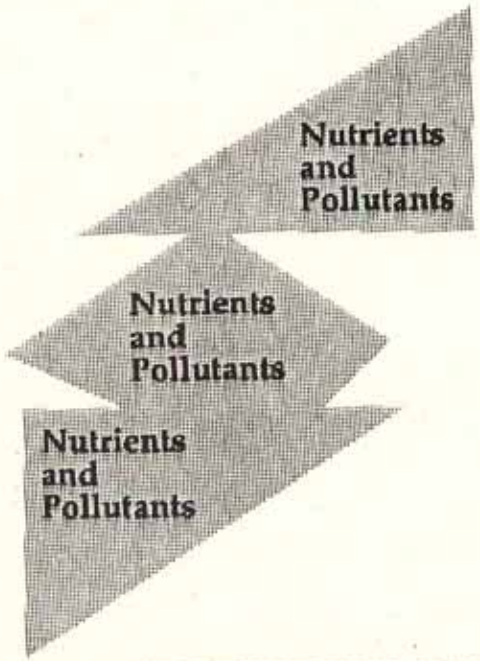
2.
...through the estuary...

(pull to 3)

4.
...pollution is also carried back to the estuary.

3.
...to the sea. When the tide comes up...

(push back to 4)



Slide B

"NUTRIENT TRAP" Worksheet

FACTS:

- A marsh hawk weighs 600 grams and eats 600 grams of seaside sparrows each week
- Each sparrow weighs 20 grams and eats 50 grams of grasshoppers each week
- Each grasshopper weighs 1 gram and eats 15 grams of cordgrass each week
- Each cordgrass plant weighs 5 grams

Use these facts to solve the following problems:

1) How many sparrows must the estuary have to feed one hawk for a week?

Hint:

Total weight of sparrows that one hawk eats	divided by	Weight of one sparrow	=	Number of sparrows needed to feed one hawk

2) How many grasshoppers must the estuary have to feed one sparrow for a week?

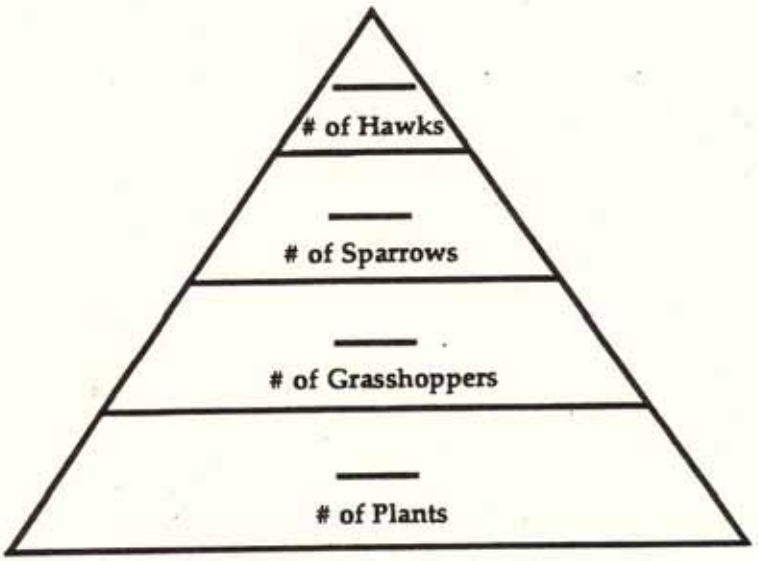
3) How many cordgrass plants must the estuary have to feed one grasshopper for one week?

4) How many grasshoppers are needed to feed the number of sparrows eaten by one hawk in a week?

Hint:

Number of sparrows needed to feed one hawk	X	Number of grass-hoppers needed to feed each sparrow	=	Number of grass-hoppers needed to feed all the sparrows eaten by a hawk

5) How many cordgrass plants are needed to feed all the grasshoppers that are eaten by all the sparrows that are eaten by one hawk in a week?



SECTION TWO

WHERE WATER MEETS HUMANS

Nature resolves everything
into its component elements,
but annihilates nothing.
Lucretius, 157 B.C.

KEY WORDS:
Nonpoint Source Pollution (NPS)

Nonpoint source pollution, or NPS, is water pollution that originates from many sources rather than one known point, such as an industrial discharge pipe, a smokestack or an automobile tailpipe. It is any man-made or natural material carried by rain water or snowmelt over hard surfaces to enter storm drains, streams, ditches, rivers, estuaries and even the ocean itself, and thus become a part of the water cycle. It is also any man-made or natural material dumped or emptied into the soil that is not reduced in concentration as it infiltrates the ground into ground water supplies.

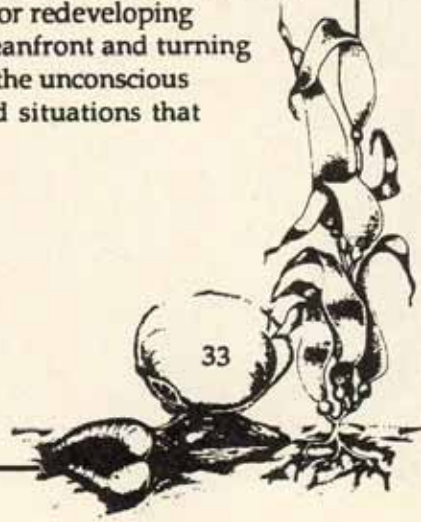
Storm Drain
Water Cycle

NPS Examples

Examples of NPS include soil eroded from construction sites, fertilizers and pesticides from fields and lawns, metals and oil from automobiles, road salts, improperly discarded household hazardous waste, inadequate septic systems, animal waste from horses, cattle, waterfowl and pets, and large amounts of grass clippings, leaves and other natural debris. Man-made or natural materials, in small amounts, may not pose a threat to the environment. However, in amounts large enough to harm the organisms living in or using the water in a given area, these materials are pollution and degrade the quality of water.

Distribution of NPS Sources

The severity of NPS statewide appears to be proportional to the state's population density and distribution, and the intensity of local agricultural activity and other land uses. First, New Jersey's growing population of more than 7.7 million people is not equally distributed, with most people living near New York City, Philadelphia and the Atlantic coastline. It is in these more "active" regions that NPS amounts are prominent, though signs of it are found statewide. Second, the growth of light industry, suburban expansion and improved transportation corridors have exposed agricultural areas and vacant lands to development. Third, New Jersey's more "rural" counties, famous for produce, dairy products and horses, also suffer with various NPS symptoms. Finally, waterfront properties continue to attract both home owners and businesses alike, developing or redeveloping properties along lakes, rivers, estuaries and oceanfront and turning summer homes into year-round residences. It is the unconscious activities of residents in all of these areas and situations that contribute to NPS sources and amounts.



The types and amounts of NPS in any given area vary throughout the state, due to the factors noted above. While rural areas have concerns with fertilizers, pesticides, sediments and animal waste, urban areas suffer more from chemicals and metals collected from paved areas by stormwater runoff, and coastal areas are damaged by construction and over-used or poorly maintained septic systems. The topography of the land, water velocity and depth, amount of rainfall and vegetation, weather conditions and the soil and rock types influence how quickly the pollutants mix with water and proceed to travel.

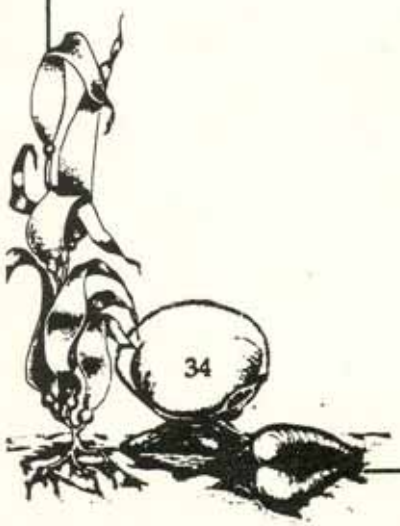
Estuary

What about the state's estuaries? An estuary acts as a "sink hole" for stormwater and natural runoff received in the estuary from its drainage basin. Stormwater runoff has often been a principal source of pollution, threatening bathing beaches and shellfish beds. In agricultural areas, runoff combines with fertilizers and pesticides, while in developed areas it mixes with road salt, oil and toxic metals. Bacteria loadings are caused by pet waste, animal husbandry and the vast waterfowl populations which inhabit coastal waters. Bacterial counts are compounded by the illegal discharge of human sewage by boaters. Spilled oil and cleansers used or dumped at marinas also add to this problem. These materials can remain in the estuary for a short or long time, depending on how quickly they are "flushed" from the estuary.

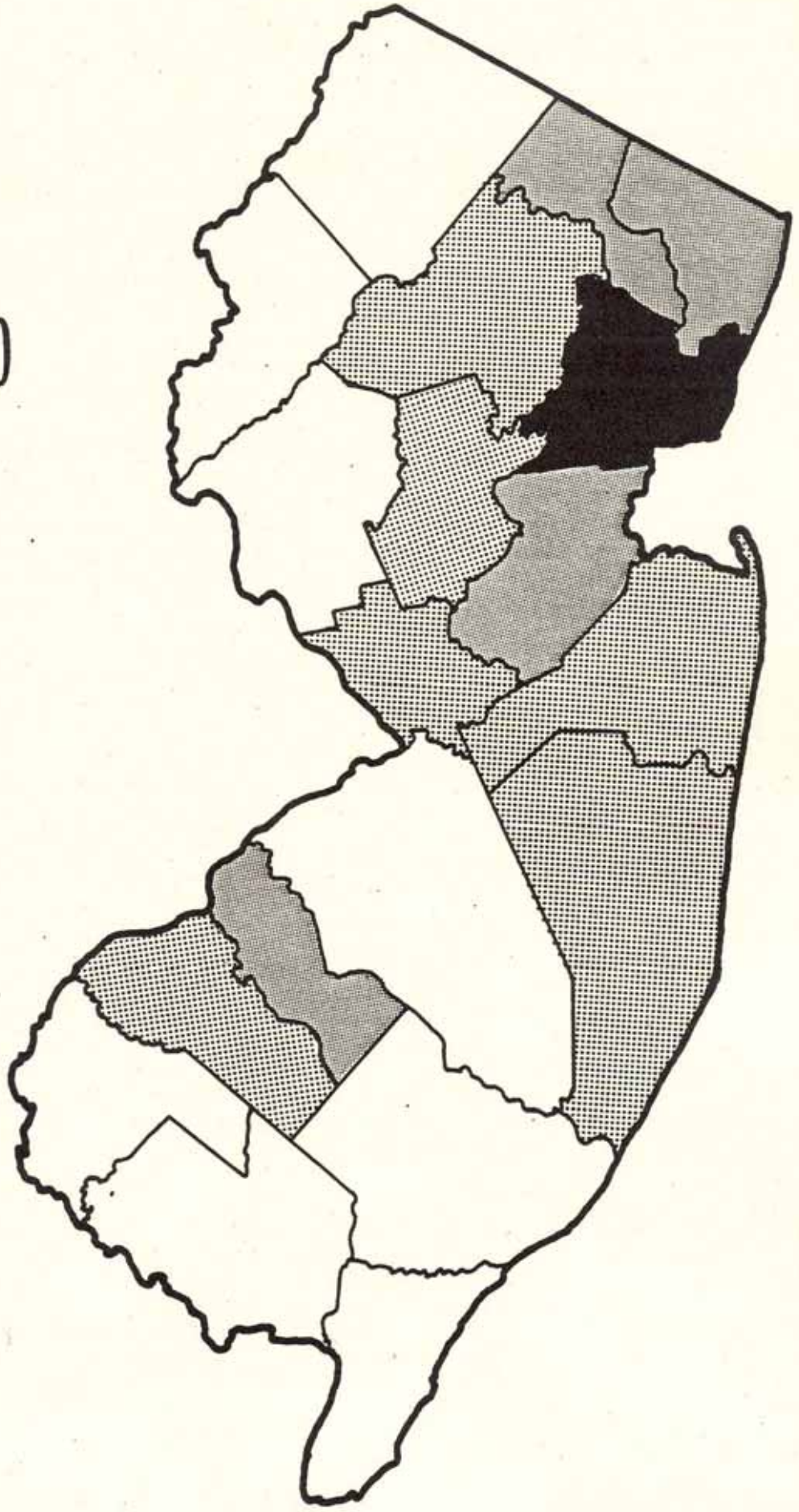
NPS Statistics

NPS has been identified as affecting water quality to some extent in all watersheds in the state. Of the streams and rivers assessed, about 40% are impaired by NPS. DEPE's Bureau of Marine Water Classification and Analysis monitors the sanitary quality of estuarine and ocean waters for the suitability of shellfish harvesting. Of the 680,000 acres of estuarine and coastal waters that are monitored and capable of supporting various shellfish populations, 28% are closed to shellfish harvesting. Many of these closures are due to NPS.

At present, very little data exists to quantify the extent of NPS in New Jersey. However, the Department of Environmental Protection and Energy has developed and is implementing NPS control strategies and a four-year, statewide management plan. Also, a number of intense surveys, studies and water monitoring programs are already in place. These, along with stronger management, the creation of new ordinances, public education and stronger participation at individual, municipal, county and state levels are the "keys" to the prevention of nonpoint source pollution.



New Jersey Population Density per Square Mile 1990



Persons per Square Mile

- Over 4500
- 1500-4500
- 500-1500
- Under 500

Source: U.S. Census Bureau 1990

EXAMPLES OF NONPOINT SOURCE POLLUTION (NPS)

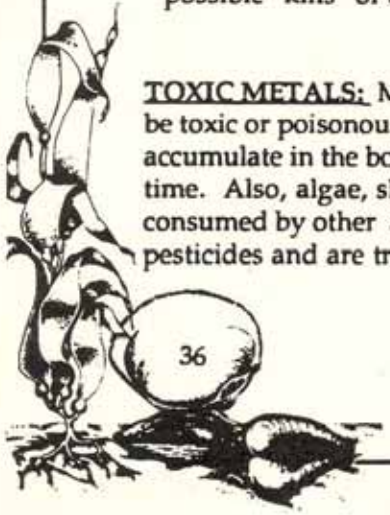
SEDIMENT: Sediment is tiny soil and rock particles carried by rain and snowmelt into streams, lakes and estuaries. It can carry chemical pollutants with it into the water. Sediment also increases the turbidity (cloudiness) of water, which reduces the penetration of sunlight. This slows the photosynthesis process in plants, which alters the amount of oxygen in the water and the availability of food for other aquatic organisms. Finally, sediment can accumulate along channels and bottoms, contributing significantly to flooding. Sedimentation can occur as the result of soil erosion, construction and other types of land disturbances in rural, urban and suburban areas.

EXCESSIVE NUTRIENTS: All plants require nutrients to survive and reproduce. Two naturally - occurring nutrients, nitrogen and phosphorus, are commonly present in fertilizers. When an over-abundance of fertilizer is used, excess nutrients are picked up by stormwater runoff and washed into nearby waterways. This excess causes increased algae and aquatic plant growth, resulting in a competition with each other, and with fish, for oxygen. This excessive growth lowers the amount of dissolved oxygen in the water, interferes with recreational use of the water, impairs potability and alters fish diversity and abundance. An oversupply of nitrogen in the water is usually the result of leaking septic systems or fertilizers and manure from farms or lawns that is carried into the waterway by stormwater runoff. An excessive amount of phosphates could indicate the presence of fertilizers, industrial waste, domestic sewage, car and laundry detergents, grass clippings and leaves.

ANIMAL WASTE: Pathogens are disease-causing microorganisms present in human and animal waste, or fecal matter. Diseases that can result from exposure to fecal matter include dysentery, hepatitis, food poisoning and parasitic infections. When pathogens are found beyond safe levels in New Jersey waters, beaches are closed and flows or sections of water are condemned for drinking and shellfish harvesting. Bacterial contamination is caused by the untreated waste of humans, pets, livestock and concentrated populations of wildlife. These materials are washed from the ground by stormwater runoff into local waterways. Contamination also occurs at marinas, docks and other areas frequented by large populations of waterfowl or by boaters discharging raw sewage overboard. Finally, improperly operating septic systems are a source of bacterial contamination from untreated human waste.

PESTICIDES: Pesticides, which include insecticides and herbicides, contain various substances that can negatively impact human health. These types of chemicals are used agriculturally and domestically. The use of "harder" pesticides, such as DDT, was banned because they can remain in the environment for years before decaying. The effects of currently-used pesticides on the aquatic environment depend on a number of factors, including the physical, chemical and biological properties of the pesticide, the amount, method and timing of the application, and the intensity of the first storm following application. Improper application and usage leads to pesticide-laden runoff and ground water, and possible "kills" of aquatic vegetation, insects and fish.

TOXIC METALS: Metals such as copper, mercury, nickel, chromium, zinc and lead are considered to be toxic or poisonous because they can cause harmful health effects should concentrated amounts accumulate in the body. Their impact on human health can occur quickly or over a long period of time. Also, algae, shellfish and fish accumulate metals in their tissues, which can then be consumed by other animals and humans. Metals originate from cars, industrial waste and misused pesticides and are transported by rain and highway runoff.



ACIDIC DEPOSITION: Acid rain is the most common form of acidic deposition and is caused, in New Jersey, primarily by car emissions. It is also associated with the burning of coal and wood and other industrial emissions. It is defined as the settling of the aerial acid particles (sulfur dioxide and nitrogen oxides) by means of precipitation. Acid rain not only removes certain nutrients from the soil and affects tree growth, but it also washes toxic metals from the soil into the waterways. Acidic deposition can lead to reproductive failure or death among aquatic animals.

MOTOR OIL: Improper disposal of used motor oil is as environmentally "offensive" as offshore drilling and tanker spills. Motor oil contains toxic substances, including lead and chemical additives, which seriously contaminate ground water and inland and coastal waterways. It stunts or kills algae and other vegetation, smothers aquatic animals and contaminates shellfish beds and drinking water supplies. The presence of oil in water is usually the result of used motor oil poured directly onto the ground or into storm drains and leakage from improperly maintained vehicles and equipment.

HOUSEHOLD HAZARDOUS WASTE: Toxic or poisonous substances in the home include oven cleaners, gasoline, turpentine, nail polish remover, antifreeze and paints, to name just a few. When they are improperly used or improperly disposed of onto the ground or down a storm drain, they enter nearby waterways or ground water without any type of treatment. When dumped into a sink , toilet or household drain, they can harm the bacteria used to treat the water, either in the septic system or at the wastewater treatment facility.

ROAD SALTS: Salt is used to de-ice highways every winter. Used in this way, however, it can contaminate ground water supplies and affect the lives of fish. It also retards the annual springtime mixing of surface and bottom waters in lakes and ponds by changing the salinity and density of the water, which decreases the amount of oxygen available for bottom dwelling animals. Road salts are presently used on highways, parking lots and other paved areas and are sometimes stored improperly adjacent to waterways.

LITTER: Roadside trash, overflowing garbage cans and dumpsters, unswept parking lots and alleys, illegally dumped tires and "junk" as well as piles of leaves, sticks and grass clippings piled along curbs or dumped into ditches, are all forms of litter. With time, wind, rain and melting snow aid in "breaking down" or decomposing some of these materials and carrying the lighter ones into nearby ditches, storm drains, streams and rivers. Not only does litter collect in piles and cause flooding, but during heavy rains it can travel far from its original location to eventually clutter the shorelines of rivers, bays and the ocean itself. Also, the contents of partially empty containers of hazardous materials, such as cleansing materials or paints, that become litter will eventually empty into a waterway and contribute to its contamination.

TITLE: **Water Keeps It Moving**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:

1) Define nonpoint source pollution;
2) Distinguish nonpoint source pollution from a "point source" of pollution;
3) List examples and causes of nonpoint source pollution;
4) Explain how nonpoint source pollution moves in the water cycle.

KEY WORDS: Nonpoint Source Pollution (NPS), NPS Examples, Water Cycle, Estuary

SUBJECTS: Science, Art, English

SKILLS: Analyzing, constructing, defining, describing, identifying and public speaking

MATERIALS: One copy of the "The Water Cycle" Copy Page on page 16, crayons or markers, scissors, tape, old magazines, glue, mural paper, clear contact paper, and three copies of the "Examples of NPS" on pages 36 and 37

BACKGROUND INFORMATION: Introductions to Sections One and Two and the "Examples of NPS" pages 36 & 37.

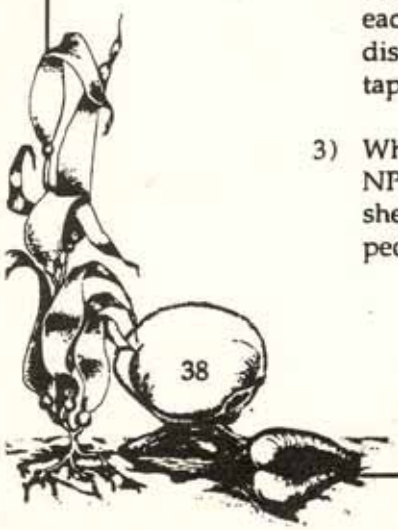
PREPARATION: (For primary grades)
Using the NPS sources listed on the "Examples of NPS" pages and in the Introduction to Section II as references, go through old magazines and cut out action-related pictures or objects that would represent these NPS samples and/or causes. For instance, a tidy garden, a crop of corn or a person fertilizing the lawn can all be related to fertilizers. A picture of a dog, cow or horse can be associated with animal waste. Copy and cut out the necessary amount of water droplets, using one per picture. With glue, tape and clear contact paper, mount the pictures on the droplets, creating at least one per student.

PROCEDURE:

1) Tape strips of newsprint or mural paper together to make a huge mural for the classroom wall. Using the "The Water Cycle" Copy Page drawing as a guide, make a similar drawing on the paper. On the land, add city buildings and a cluster of homes to represent city and suburban areas. Also draw a large barn to represent a farm.

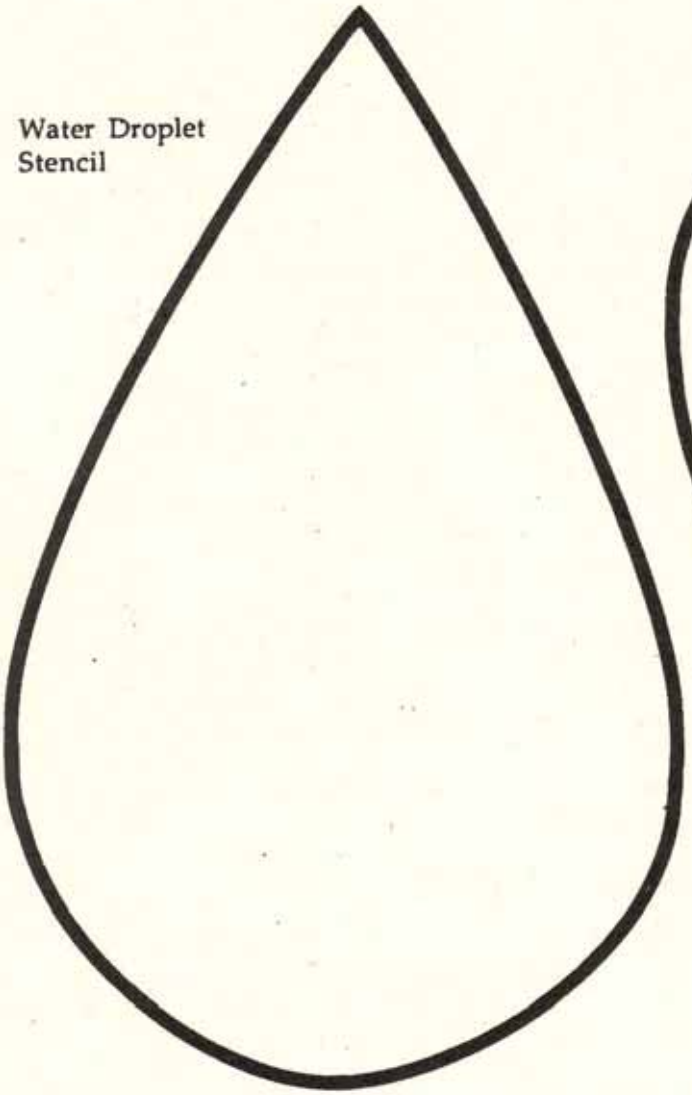
2) Use the mural to review the movement of water through the water cycle. Tell the students that the things people do are now going to be added to the mural. Give each of the students a water droplet with a NPS picture on it. Ask questions and discuss how each picture can possibly harm a waterway. Then, have each student tape his/her droplet in the proper place on the mural.

3) When they are finished, have each student go up to the mural and review his/her NPS picture and its relationship to the water cycle. Use the "Examples of NPS" sheets to explain the negative impacts that these examples of pollution have on people and the environment.

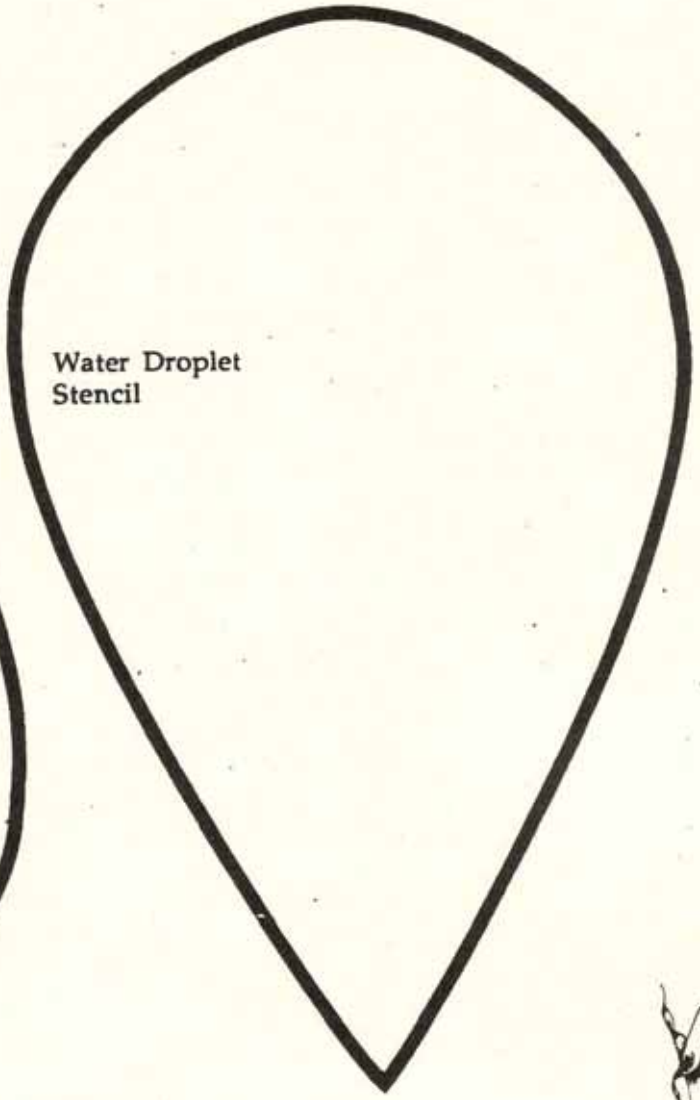


4) Discuss:
   - Show the class a picture of an industrial smokestack and discharge pipe. Cite these as examples of point sources because such major pollution contributors can be seen and "pointed at." How do these differ from nonpoint source pollution?
   - Create a classroom definition of nonpoint source pollution.
   - Use the mural to locate and discuss areas in which NPS amounts would eventually collect (the ocean, estuaries, river, lake, etc.)

Water Droplet Stencil



Water Droplet Stencil



TITLE: **Getting to the Source**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Define nonpoint source pollution and locate examples within a water cycle;
2) Design three water cycles specifically addressing rural, suburban and urban areas and their related NPS examples;
3) Recognize the various factors, such as population numbers and distribution, land uses and natural factors that aid in determining the types of NPS in a given area and how quickly they enter the water and travel.

KEY WORDS: Nonpoint Source Pollution, NPS Examples, Water Cycle, Estuary and Distribution of NPS

SUBJECTS: Science, English, Art and Geography

SKILLS: Analyzing, applying, comparing, constructing, defining, identifying and mapping

MATERIALS: Copies of "Getting to the Source" Worksheet, "Examples of NPS" on pages 36 and 37 and the NJ Population Map on page 35 (one per student), paper, pencils or pens, mural paper, crayons or markers, current newspapers, NPS-related items, glue, tape and a NJ Road Map

BACKGROUND INFORMATION: Introduction to Section One and Section Two

PROCEDURE:

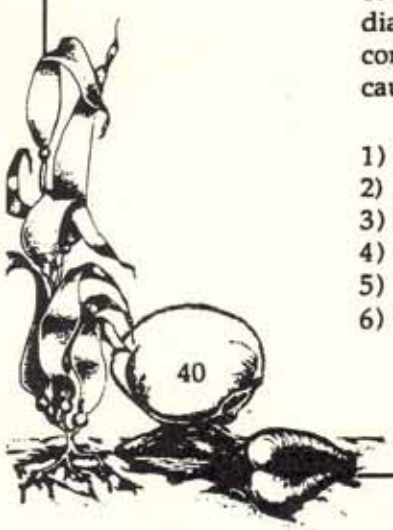
1) Write the following terms on the chalkboard:

- Pesticides
- Trash and Raw Sewage
- Pet Waste
- Stormwater Runoff
- Animal Waste
- Fertilizers
- Acidic Deposition
- Grass Clippings/Sticks
- Litter
- Dumped Oil
- Sediments/Erosion

2) Give each student (or group of students) a copy of the "Getting to the Source" Worksheet and a pen or pencil.

3) Have the students write these terms on the proper blank lines on their diagrams. Before discussing the right answers, distribute copies of the "Examples of NPS" sheets and give them time to check their answers. Tell them that the diagram included one "point source" of pollution. What was it, and why is it considered to be a "point source?" Discuss the types of pollution problems that are caused by the NPS examples in the diagram. Below are the correct answers:

1) Trash and Raw Sewage
2) Stormwater Runoff
3) Dumped Oil
4) Litter
5) Pet Waste
6) Fertilizers
7) Grass Clippings/Sticks
8) Animal Waste
9) Acidic Deposition
10) Pesticides
11) Sediments/Erosion



4) Explain that in New Jersey, different watersheds are impacted by different types of or combinations of NPS, depending on such factors as the number of people, their distribution and the use of the land . Tell the students that they will work in three groups to create three new water cycle drawings - "Rural," "Suburban" and "Urban." They are to use only the natural features, such as the stream, the sky, the land and the estuary, from the original diagram. Each new water cycle diagram should include drawings of NPS sources that would exist in that particular area. Sketches do not need to be drawn to scale. The students should try to use all of the NPS sources from the original drawing and the "Examples of NPS" Sheets. Lay mural paper on the floor and crayons, and let them begin. Below are some things to consider:

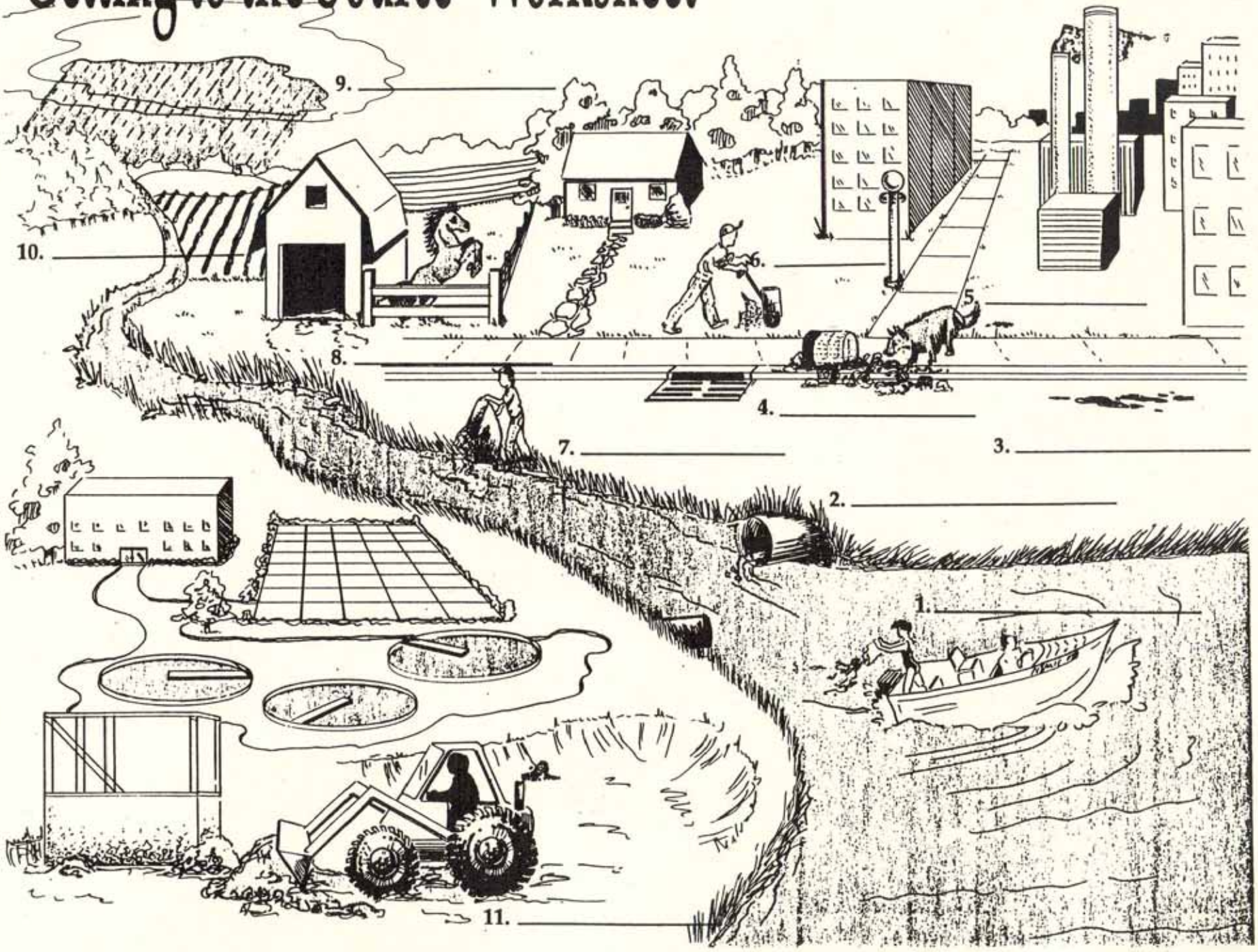
Rural:	Suburban:	Urban:
Horse farm/horses	Housing development	Large buildings
Agricultural farm/crops	Condominiums	Industrial sites
Irrigation ditches	Shopping mall/parking lot	Wastewater facility
Septic systems	Construction site	Construction site
A home	Stormwater system	Stormwater system
	Some roadways	Many roadways
	Pets	Pets
	Small marina	Large shipyard
	Apartment complex	
	Parking garage	

5) Compare their drawings. Ask the students to clip ads and newspaper and magazine articles from both local and national sources that can be directly or indirectly related to nonpoint source pollution. Hang the murals and tape these on them. Bring from home such objects as an empty oil container, empty household hazardous waste containers, an empty fertilizer bag or insecticide can and tape them on.

6) Have the students compare the NJ Road Map with the NJ Population Map. Choose towns, cities and open areas that could be represented by the rural, suburban and urban water cycle drawings.

7) Discuss :
- What is nonpoint source pollution?
- How does NPS move through the water cycle?
- Where might these types of pollution eventually collect?
- What factors would aid in determining the types of NPS sources in a given area? (Considerations might include population distribution, industry and businesses, geography, when the area was established and how quickly it has grown, location, etc.)
- How would an increase in population in these three areas affect NPS examples and amounts?
- What natural factors determine how quickly the pollutants mix with water and travel, and why? (Topography, water velocity, weather, amount of rainfall, soil and rock types, amount of vegetation.)

"Getting to the Source" Worksheet



TITLE: **Water Wash - (Two Simulation Activities)**

GRADE LEVELS: P, I, JH

OBJECTIVES: After performing these activities, students should be able to:

1) Define a watershed, aquifer and ground water;
2) Describe how nonpoint source pollution moves within a watershed and an aquifer;
3) Determine the factors related to the types of nonpoint source pollution in any given area;
4) Determine the factors related to how quickly NPS enters the water and travels.

KEY WORDS: Examples of NPS, Water Cycle

SUBJECT: Science

SKILLS: Applying, constructing, determining, observing and relating

MATERIALS: ACTIVITY #1: A 3-ring binder, a stack of books (about 6" - 8"), a rectangular baking pan slightly longer than the binder, water, food coloring, a spray bottle and enough kitchen sponges to cover one side of the notebook binder

ACTIVITY #2: Three plastic 1-gallon milk jugs, water, food dye, three baking pans, three spray bottles, a knife, three thick rubber bands, three pieces of cheese cloth (about 6" X 6"), paper towels, and sand, a mixture of topsoil (80%) and gravel (20%), and a mixture of gravel and sand (50% of each), enough of each to fill a milk jug

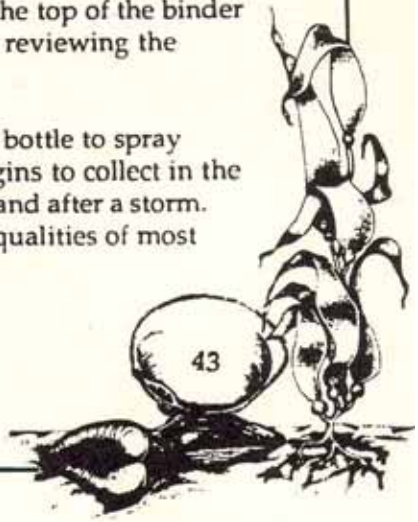
BACKGROUND INFORMATION: Introductions to Sections One and Two

PROCEDURE FOR ACTIVITY #1:

1) To construct this "simplified" watershed, place the 3-ring binder, closed, atop a stack of books, making it about 4" - 6" off the table top. Place the baking pan slightly under the edge of the binder that has the rings attached to it. Moisten the sponges and lay them on top of the binder, leaving no exposed binder surface except, if necessary, along the three edges not hanging over the pan. Adjust the height of the binder so that its bottom touches the edge of the pan underneath. Move the pan so that neither corner of the binder hangs over the pan.

   In this activity, the top surface of the binder represents rock. The sponges represent the soils atop the bedrock. A lake, reservoir, river or stream is represented by the baking pan. The slope of the shoreline in this watershed can be altered easily by placing books or other objects underneath the top of the binder to raise it. Discuss these "roles" with the students, along with reviewing the definition of a "watershed."

2) Raise the binder top to about a 45-degree angle. Use the spray bottle to spray the sponges with water to simulate rain. Spray until water begins to collect in the baking pan. Observe and discuss what normally occurs during and after a storm. Discuss or review the definition of "runoff" and the absorbant qualities of most soils.



3) Place one or two drops of food dye in the center of the sponges. Referring to the list of "Examples of NPS" on pages 36 and 37, discuss what NPS examples the dye might represent (fertilizers, animal waste, pesticides, toxic metals and substances, oils and road salts). Spray the sponges again with water and observe and discuss what happens. Rinse the sponges and perform the activity again, raising and lowering the slope. How does the angle of the slope alter the results?

PROCEDURE FOR ACTIVITY #2:

1) To construct three "simplified" aquifers, use the knife to cut out the bottoms of the plastic milk jugs. Wrap a single piece of cheesecloth around the mouth of each jug, and secure these tightly with the rubber bands. Fill one jug with sand, another with the mixture of soil and gravel, and the third with the mixture of sand and gravel. Once filled, have three students sit on a chair and trap the jugs, mouths down, between their legs. (Other students may have to take over these jobs, since it can be tiring.) Place the baking pans beneath the jugs. The jugs should not touch the pans. Layer the bottom of each pan with two or three paper towels. Fill the rest of each pan about two-thirds with gravel. Add water.

   In this activity, the materials in the jugs represent the soil layer in a watershed. The pan represents ground water supplies. The paper towels and gravel represent the porous rock and sand, and the cracks in solid rock that temporarily trap and hold water underground, slowing its movement in the water cycle.

2) Discuss the definition of an "aquifer" with the students. (See Glossary.) Have them spray the top surface of each jug with water and observe the varied rates of time needed for the water to percolate through the soils to mix with the ground water. Add drops of food dye, which represent the same NPS types discussed in activity #1. Spray the jugs again, and observe and discuss what happens. Remove the paper towels to see if they have absorbed or trapped the color of the dye.

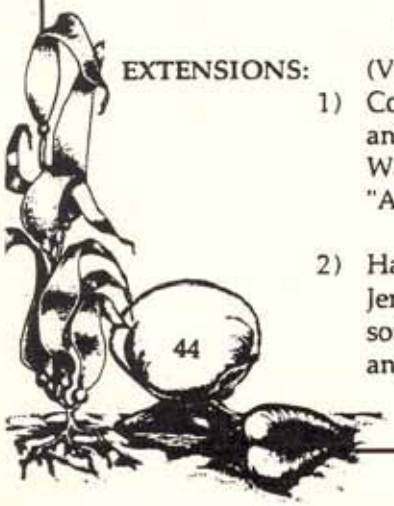
DISCUSS: (Varies according to grade level.)

- Discuss the definitions of "infiltration" and "porosity" (See Glossary.) How do they relate to each other? Using these terms, explain what was observed.
- Discuss or review what other factors would affect the nonpoint source pollution entering a watershed and aquifer, and the rate at which they would travel. (Things to consider are the amount of precipitation, types of surfaces, soil and rock types, angle of slopes, topography, rate of drainage, amount and types of vegetation, weather conditions, number of people living in or using the watershed and the usages of the land and water in the watershed.) Compile a list.
- Apply this information about an area to the citing of a landfill, a housing development, a mall, a skyscraper, etc. Why would this information be needed and how might it be used? Invite a local developer or an architect to address the class.

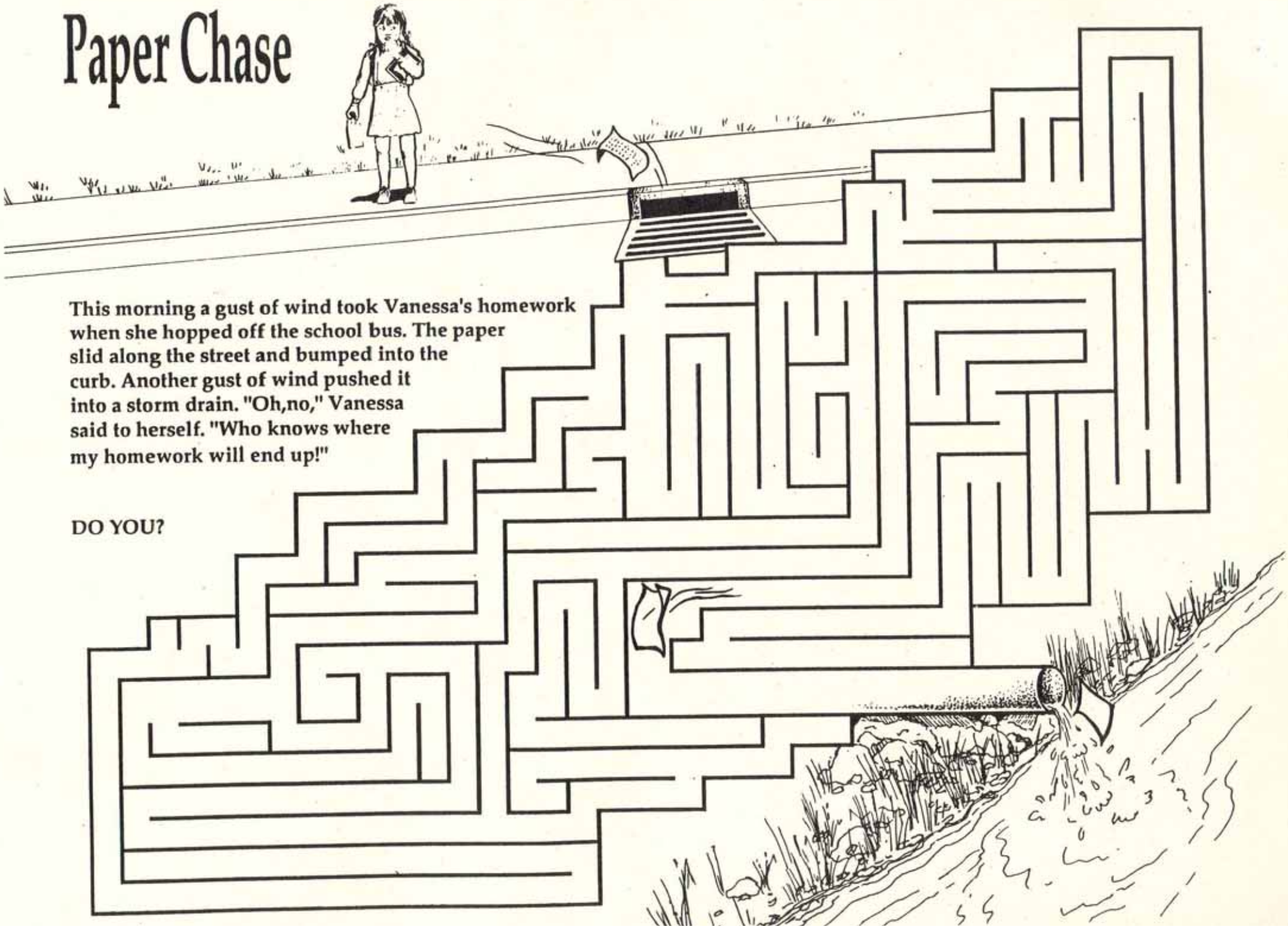
EXTENSIONS: (Varies according to grade level.)

1) Comprehensive information on water testing, site investigations and aquatic plants and animals are included in "Project Mayfly, A Guide to the Determination of Water Pollution in Local Waterways" and DEP's "Water Watch" Program. See "Additional Resources" for details.

2) Have students research the various soil and rock types and aquifers in New Jersey (See Additional Resources.) Invite speakers to the classroom from local soil conservation districts, coastal groups and watershed associations, and have them address local NPS concerns.



Paper Chase



This morning a gust of wind took Vanessa's homework when she hopped off the school bus. The paper slid along the street and bumped into the curb. Another gust of wind pushed it into a storm drain. "Oh,no," Vanessa said to herself. "Who knows where my homework will end up!"

DO YOU?

TITLE: **Storm Drain Watch**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:

1) Define nonpoint source pollution;
2) Explain the function of a storm drain;
3) Describe NPS samples and how/why they enter a waterway;
4) List ways to prevent NPS from occurring.

KEY WORDS: Nonpoint Source Pollution, NPS Examples, Storm Drains

SUBJECT: Science

SKILLS: Analyzing, defining, identifying, problem solving and relating

MATERIALS: An aquarium, water, cardboard box, food coloring, spray bottle, soil, sand, gravel, vegetable oil, cafeteria waste and trash, grass clippings or shredded paper and small sticks

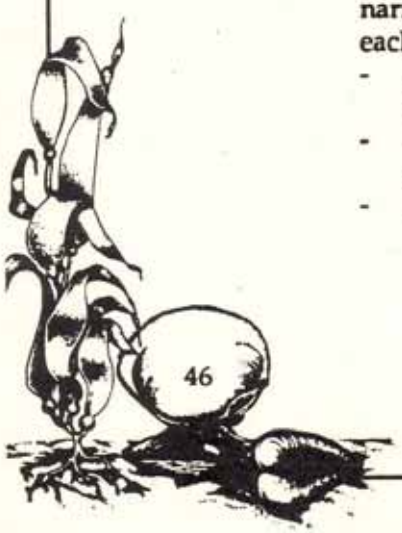
BACKGROUND INFORMATION: Introduction to Section Two and the Background Information in "Storm Drain Survey" on page 49.

PROCEDURE:

1) Show the picture of the storm drain on page 48 to the class. What is this called? Where are they found? What might enter a storm drain? List ideas on the board. (Consider trash, fertilizers, road salt, oil, sand , soil, leaves, twigs, etc.) What is the purpose of a storm drain and how does it relate to a storm? Where does the water go after it enters a storm drain? Discuss the definition of nonpoint source pollution (NPS). How would this get into a storm drain? Announce to the class that they will make a storm drain in the classroom and drop into it things that represent NPS.

2) Bring an aquarium into the classroom and place it in an accessible area where it is easy to view. Fill it 1/2 way with water. Place a box on top of the aquarium with a hole cut into it, representing the storm drain. The water in the aquarium represents the waterway where the stormwater mixes after entering the storm drain. Into this also travels many forms of pollution . Leave the aquarium's sides uncovered so that the students are able to view its contents.

3) Now that the storm drain has been created, it needs to be "fed." The following narratives are samples of what can be dropped into the storm drain. After each narrative is read and the "pollutant" is added to the aquarium, discuss:
   - Does the action in the story damage the environment? If so, how? (Use "Examples of NPS" on pages 36 and 37 as references.)
   - Do you think the people in the story really wanted to damage the environment? Why did they do what they did?
   - How can it be changed or stopped?



A) Mr. Jones has two large trees near the porch which attract wasps, mosquitoes and caterpillars. He sprayed the trees with a chemical that would kill the insects. A storm occurred after he sprayed and much of the chemical was washed into the soil or down the driveway. From there it washed into the nearby storm drain, along with the rest of the rainwater. (Mix a few drops of green food coloring with water in a spray bottle. Spray the green water into the aquarium.)

B) A small stream winds through a popular golf course. During a heavy rain, the stream is filled with fast, flowing water. The sides of the stream are crumbling and tree roots are showing. After each rain, fertilizers, soil and small rocks are swept away with the water. The land near the stream banks is slowly collapsing. (Add soil, sand and pebbles into the aquarium.)

C) Susan is proud to help her dad change the oil in the family station wagon. She clumsily carries the huge pan of black, thick oil to the storm drain where she dumps it. It's gone! Soon the oil will mix with the water of a nearby stream or river. The oil that she spilled on the ground will go into the soil and mix with water underground. (Add vegetable oil to represent the motor oil from the station wagon.)

D) One snowy winter night the Palmer family heard raccoons turning over their garbage cans out by the curb, but it was too cold to go out and chase them. The next morning, no one had time to clean up the garbage strewn all over the street. When the snow melted, some of the trash floated with the water into the storm drain. (Add samples of food and paper waste.)

E) Jeff helps his parents by cutting the lawn. When his grass catcher is full, he dumps his grass clippings into a nearby ditch or storm drain, whichever happens to be closer to the lawnmower. There, the clippings turn yellow and smell, until the next storm carries them away. (Add grass clippings or shredded paper.)

F) Sally enjoys walking the family dog, Jasper. When Jasper needs to go to the bathroom, Sally is careful to make Jasper go along the curb so that Jasper is not messing the neighbor's lawns. She doesn't worry though, eventually the mess will go down into the storm drain. (Add two twigs.)

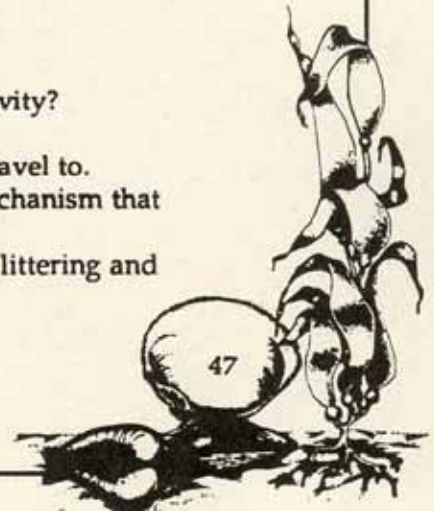
G) The Harper family likes to stop at fast-food restaurants on the way to the beach. In order to keep the car clean, they throw their bags of trash out the car window into the streets. (Add trash.)

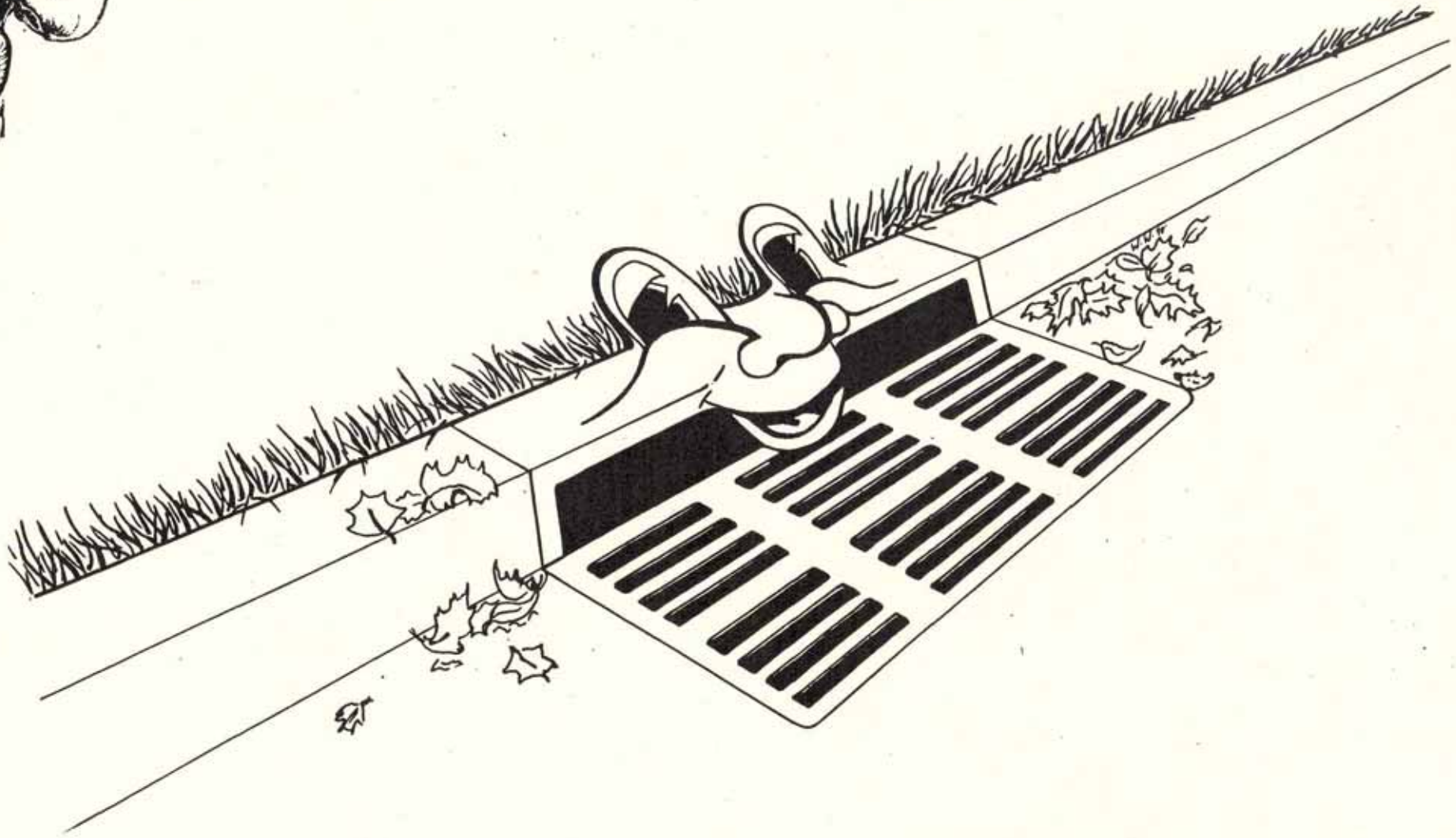
H) Use the "NPS Examples" pages to create your own stories.

4) When finished, examine the aquarium's contents and discuss:
   - How has the water changed since the beginning of the activity?
   - How does this make you feel?
   - In review, discuss where the water and pollutants would travel to.
   - Have each of the students "invent" a method, project or mechanism that would remove such chemicals and objects from stormwater.
   - Have the class create a list of ways to prevent people from littering and dumping.

EXTENSION:

1) Refer to "Nonpoint Source Pollution - Live!" on page 97 for solutions to these NPS examples.





TITLE: **Storm Drain Survey**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Define "stormwater" and describe the purpose of a storm drain and the need for stormwater management;
2) List NPS examples that are transported by stormwater;
3) Formulate solutions that would reduce and/or eliminate NPS in stormwater.

KEY WORDS: Examples of NPS, Storm Drains, Water Cycle

SUBJECTS: Science, Math, Social Studies

SKILLS: Analyzing, comparing, defining, describing, estimating, hypothesizing, mapping, measuring and observing

MATERIALS: Clipboards, pencils, copies of the "Storm Drain Survey" Worksheet, flashlights (attached to string or cord), markers or crayons, mural paper and measuring tapes

BACKGROUND INFORMATION: Introduction to Sections One and Two

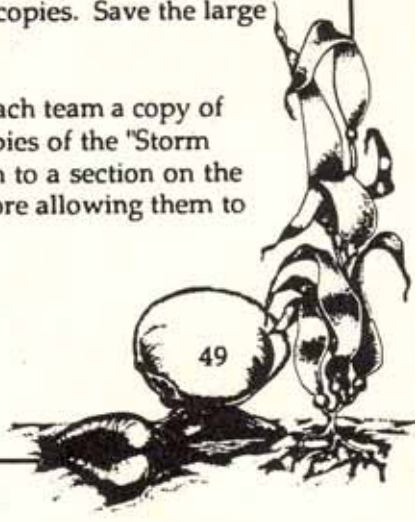
NOTE TO TEACHER: The objectives of this activity can be attained with some flexibility. To compare findings, try only two outdoor trips instead of three. Take the entire class together, instead of smaller groups. Finally, see what can be found on the school property.

PROCEDURE:

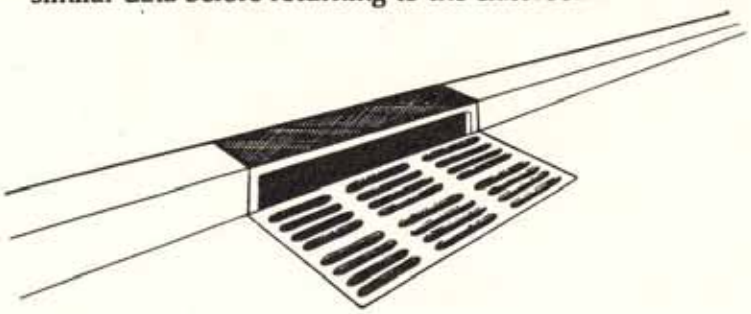
1) Show the class the picture of the storm drain and have them state what it is. Name items students have lost down a storm drain and discuss what might have happened to them. Look out of the classroom window and observe the surfaces that are touched by rainfall - grass, sidewalks roads, roofs, etc. Which surfaces will absorb water and which will not? Why do puddles form? What is stormwater? What is runoff? Why is there a need for stormwater management?

2) Inform the class that they will take a walk to examine the storm drains in the area. The purpose of this exercise is to examine the material that enters the storm drains. Before venturing out, assist the class in drawing on mural paper a realistic map of the surrounding area, which should include streets, parking lots, buildings and open areas. The boundaries of the map do not need to be any larger than the area the class can reach by foot, in the time that you allot them to go outdoors. Re-draw this map onto an 8 1/2" by 11" sheet of paper and make copies. Save the large one on the mural paper for later use.

3) Divide the class into groups and assign adults. Distribute to each team a copy of the neighborhood map, clipboard, tape measure, pencils, 3 copies of the "Storm Drain Survey" Worksheets and a flashlight. Assign each team to a section on the neighborhood map. Review step #4 with the entire group before allowing them to proceed to their assigned locations.



4) Upon arriving at the assigned area:
   - Gather at the first storm drain seen in the assigned area - this is Storm Drain #1.
   - Have a student draw this storm drain at the proper location on the neighborhood map and label it "Storm Drain #1." Have a student also label one of the "Storm Drain Survey" Worksheets as "Storm Drain #1."
   - Have the students describe any man-made or natural material that is visible within about 10' of the drain (e.g. pebbles, soil/dirt, litter, oil, etc.) and record this data in the box on the worksheet labeled "Visible NPS Outside of Drain." Estimate (or measure) the distance that each item is away from the drain.
   - Scan the surrounding area. What, in the surrounding vicinity, might be NPS contributors? (Consider lawns, roadways, animal waste, metals from cars, etc.) Record these ideas on the worksheet labeled "Other Possible NPS Contributors."
   - Finally, shine the flashlight into the drain and record observations in the box labeled "Visible NPS Inside of Drain."
   - The group should visit two more storm drains in their assigned area and collect similar data before returning to the classroom.



5) Revisit the storm drains in about 1 month and have the students note any changes in storm drain data under Trip #2. Take the third excursion and record data under Trip #3. Also record any showers, storms, snowfalls, windy days, etc., that occur between the trips. Can their effects be related to changes in data?

6) The groups will present their findings upon completion of the storm drain surveys. Before each presentation, have the groups draw their storm drains in the proper areas on the large neighborhood map. Their presentations should focus on the following:
   - Which NPS examples are natural and which are manmade?
   - How did the NPS examples end up in and around the storm drain?
   - Where do these NPS examples go after they enter the drain?
   - How do they affect the water?
   - How do they affect the things that depend upon or use the water?
   - What can be done to prevent this from happening?
   - Discuss any differences between the findings of each group.

EXTENSIONS:

1) Mold a screen to fit over the storm drain that is close to the school. Place it over the drain and anchor it. Check it daily to monitor the materials that collect on it.

2) Invite a representative from your local municipality to discuss with students the stormwater system in your local area. Encourage the use of municipal maps which illustrate the flow of stormwater in your area.

"Storm Drain Survey" Worksheet

Storm Drain #:_____

	DATA Trip #1 (Date_____)	DATA Trip #2 (Date_____)	DATA Trip #3 (Date_____)
Visible NPS Outside of Drain			
Other Possible NPS Contribu-tions			
Visible NPS Inside of Drain			

TITLE: "Clam Man" - A Play

AGE LEVELS: P, I, JH

OBJECTIVES: After observing and/or performing this activity, students should be able to:
1) List some NPS examples and cite where they originate and how they travel;
2) Describe some of the effects of NPS on marine life and certain shellfish species.

KEY WORDS: Nonpoint Source Pollution, Examples of NPS, Estuary

SUBJECTS: Science, Drama, Art

SKILLS: Constructing, listening, observing, performing, public speaking and visualizing

MATERIALS: Costumes and props are suggested in the script; drawings of the cardboard shells can be copied from the shellfish pictures on page 65

BACKGROUND INFORMATION: Introductions to Sections One, Two and Three

NOTE TO THE TEACHER: This play provides teachers with a colorful and entertaining way of bringing NPS into the classroom. It also complements a number of other activities in this guide and can be used in conjunction with them. It can be used by students in the intermediate grades, or it can be performed for the primary grade levels by older students. It requires a minimum amount of low cost costumes and props, but it can also become an elaborate and creative production.

PROCEDURE: **"Clam Man" - A Play**

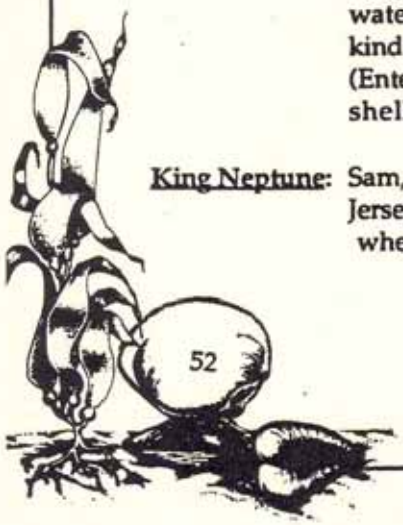
Cast of Characters:

- Narrator
- King Neptune
- Sam the Clam (Clam Man)
- Lawrence Whelk
- Orchestra Members (3)
- Bubble Blowers (3)
- Musselhead
- Olivia Oyster
- Stage Hands

SCENE ONE: The stage is dark. The lights go on. King Neptune, with crown, robe and trident, is seated on his throne. Narrator can be on or off the stage.

Narrator: Join us in the halls of King Neptune's palace on the bottom of the Atlantic Ocean. King Neptune has just summoned Sam the Clam, who lives in the ocean's deeper waters. The King wishes to speak with Sam, a mild-mannered, shy, "clammed-up" kind of guy.
(Enters Sam the Clam on his knees and sandwiched between two cardboard clam shells.)

King Neptune: Sam, you mild-mannered mud dweller, I have just received a report from the New Jersey Department of Environmental Protection and Energy. Remember those areas where the rivers mix with the ocean?



Sam the Clam: (Whispered slowly) They are called "estuaries." (Makes sucking sounds.)

King Neptune: Yes! Well, it seems that some of these estuaries are polluted and the pollution is affecting the homes of many of your relatives. No one knows what is causing it. Sam, your mission, if you choose to accept it, is to find out what or whom is responsible for this pollution. We cannot allow it to continue!

Sam the Clam: (Whispered slowly) I'm honored, your Highness, but how can I, a mild-mannered mud dweller, help out? I'm just a slow-moving filter-feeder. (Makes sucking sounds.)

King Neptune: Sam, I've thought about that. With the wave of my magical trident, you will have special superhero powers to aid you in exploring these shallow waters. I will bestow upon you a super-hydraulic siphon and a pair of expensive sneakers for your feet - er, foot. I guess I better give you another foot, too.

(Four stage hands enter. Two are holding a blanket and the other two are walking behind the blanket. The blanket is held between Sam the Clam and the audience. The stage hands behind the blanket help Sam the Clam add to his costume. The King waves his trident and mumbles some magical words. The stage hands exit with the blanket and Sam now stands erect with a short cape over his shells, sporty sunglasses and colorful high-top sneakers. He is pulling a canister vacuum cleaner, which is plugged in. He "freezes" in a bodybuilding position. While Sam is in this position, King Neptune sings the theme song from the "Batman" television show. He does this twice, then asks the audience to join him.)

King Neptune: "Da-da, da-da, da-da, da-da, da-da, da-da, da-da, da-da - CLAM MAN! (Sings twice, looks at audience.) Come on guys, Everyone sing! (Repeat one more time.)

Clam Man: (Unfreezes; stands proudly with hands on hips.) I won't let you down, King Neptune. You can depend on me.

Narrator: With that, Clam Man used his super-hydraulic siphon and his new sneakers to propel himself to shallow waters and the New Jersey shore.

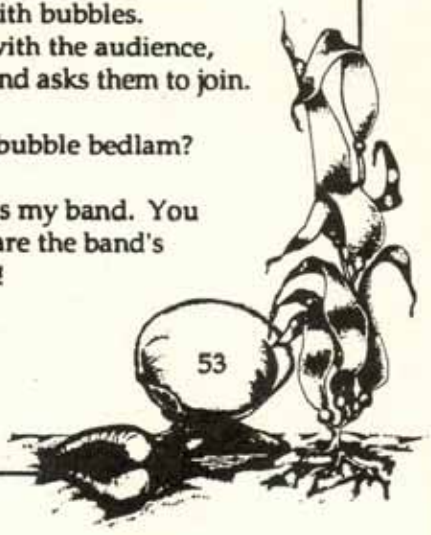
(Clam Man turns on the vacuum cleaner, puts the hose behind him, and, dragging the vacuum cleaner, trots off the stage. The lights go off.)

SCENE TWO: The stage is dark. The lights go on. On stage is Lawrence Whelk, sandwiched between two cardboard shells. (Diagrams at end of play.) He is standing behind a music stand, waving a conductor's baton. The three (or more) orchestra members are playing instruments. A tape of light orchestral music is playing. The three bubble makers are back behind the orchestra on chairs, blowing bubbles on them. Clam Man enters slowly, as if groping through a room filled with bubbles. The music stops. King Neptune, seated close to the stage but with the audience, loudly sings two or three rounds of the Clam Man theme song and asks them to join.

Clam Man: Here I've come, to save the bay! I'm Clam Man. What is this bubble bedlam?

Lawrence: Tank you, tank you, tank you. I am Lawrence Whelk, and this is my band. You know, salt water naturally has some bubbles in it and bubbles are the band's trademark, but the amount of bubbles in this area is ridiculous!

Clam Man: You mean this isn't natural?



Lawrence: No! Detergents and fertilizers from the land are reaching the estuary and creating this mess. Sometimes there are so many, my band cannot see me conduct!

Narrator: Clam Man decides to use his super-hydraulic siphon and new sneakers to suck up and stomp out the bubbles. (Clam Man turns on vacuum cleaner and bursts existing bubbles. Bubble makers stop. Lawrence holds up signs with "POP!," "SPLAT!" and "SQUISH!" on them. King Neptune, in the audience, sings a few more bars of the Clam Man theme song with the audience. The lights go off.)

SCENE THREE: "Musselhead" the Mussel is attached to a rock which is a table covered with a dark blanket or piece of carpet. Nearby is a storm pipe opening, which is an open-ended garbage can on its side coming out of the side of a large box. A stage hand is in the box. A wide, shallow pan is below the garbage can's larger opening. Other cardboard mussels are attached to the rock. Lights go on. Clam Man trots onto the stage and accidentally bumps into the rock.

Musselhead: Yo, buster, watch it. Where do you think you're going?

Clam Man: Here I am, to save the bay! I am Clam Man and I am on a mission to seek out new sources of pollution and to boldly go where no clam has gone before.

Musselhead: Listen, chowderhead, speak English because me and the gang don't have time to figure you out. We gotta deal with the garbage flowing through that pipe (nods towards the storm pipe opening). Motor oil, litter and other junk comes out of there. (As Musselhead points to the storm pipe, the stage hand throws litter and maple syrup (oil) out of the storm pipe opening.)

Clam Man: (Puffs out chest) Well, I have a super-hydraulic siphon that I can use to clean that junk off of you and your friends.

Narrator: Clam Man proceeds to clean the junk off of Musselhead and the other mussels. (Clam Man turns on the vacuum cleaner and pretends to clean off the mussels. He then grabs a labeled recycling can from behind the rock and empties the litter and oil into it. King Neptune holds up "RECYCLE!" signs and leads the audience in the Clam Man theme song. When the song is finished, Clam Man turns off the vacuum.)

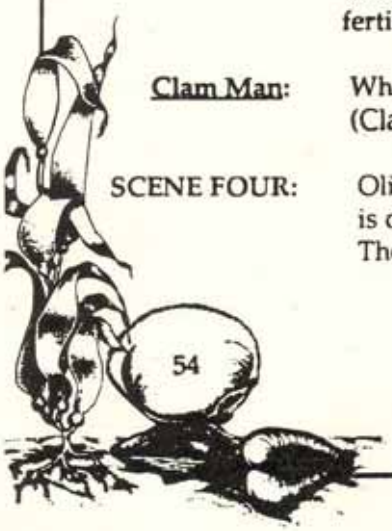
Musselhead: You're a chip off the old shell, Clam Man. Maybe me and the gang can help you out because we've got a lot of "mussel" between us.

Clam Man: Help me with my mission! Do you have any clues as to what causes this pollution?

Musselhead: All I know is that there's always motor oil and trash floating around here, but when it rains, look out! All kinds of stuff comes out of that pipe - chemicals, fertilizers and animal waste. I hear it's even worse in the oyster beds.

Clam Man: What, another shellfish in distress? I must be on my way. Thanks, all!
(Clam Man trots off of the stage and the lights go off.)

SCENE FOUR: Olivia Oyster is on stage, sandwiched between two cardboard oyster shells. She is on a mattress with pillows around her, covered with a blanket. She is moaning. The lights are dim and Clam Man trots onto the stage.



Narrator: Clam Man arrives at the oyster bed. He hears coughing, but the water is so cloudy that he can hardly see. (Clam Man fumbles and walks slowly towards Olivia.)

Olivia: (In a muffled voice) Help me! Save us!

Clam Man: Here I am, to save the bay!

Narrator: Using his super-hydraulic siphon, Clam Man vacuums the layers of silt and bacteria off of Olivia the Oyster. (Clam Man turns the vacuum cleaner on and vacuums near Olivia, being careful not to suck up the blanket. King Neptune holds up "DIG!" and "SUCK UP!" signs and the audience hum a few bars of the Clam Man theme song. Clam Man turns off the vacuum cleaner. Olivia throws the blanket off. The lights come up.)

Clam Man: I am Clam Man and I have been sent to seek out the source of pollution which occurs along the New Jersey shore and is affecting the homes of many shellfish. If you don't mind me saying, ma'am, you look a little puffy and silted over.

Olivia: I'm so happy to see you, I've been so miserable. I'm suffering from nonpoint source pollution. Its a mysterious pollution that has covered and choked me with sediment and poisoned me with metals and bacteria. I'm so irritated! (She scratches herself and coughs.)

Clam Man: You sound terrible. How long have you been suffering?

Olivia: For years! A long time ago, the water was much cleaner. Now, because many people live near the water, my home is polluted. The pollution cannot be traced to one specific place or person, so it's called nonpoint source pollution, or NPS. (After a brief pause, the lights go off and Olivia leaves the dark stage.)

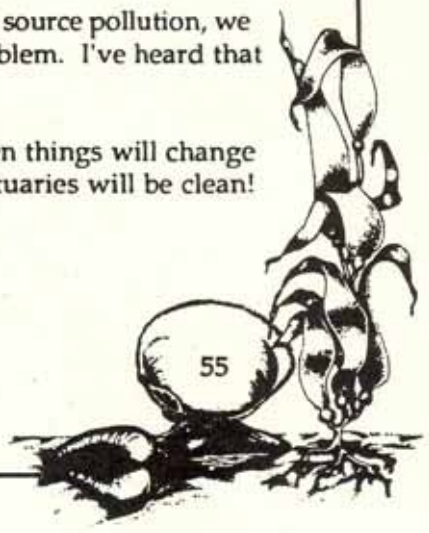
Narrator: Clam Man was overwhelmed by what he had seen - bubbles, pipes, sediment and suffering. Suddenly Clam Man understood the mystery of nonpoint source pollution! (Clam Man is alone on the dark stage. He turns on a flashlight, which he holds above his head. He smiles.)

Clam Man: All of this pollution could not be the result of one place or person, but of many. It is the result of millions of people, each contributing a small amount of pollution. Do any of them realize that they are hurting Lawrence, Musselhead and Olivia? I must tell King Neptune ! (The flashlight goes off. Clam Man turns on the vacuum cleaner and exits the stage with it. He turns it off.)

SCENE FIVE: Lights go on. King Neptune is in his throne and Clam Man stands near him.

King Neptune: Good job, Clam Man. Now that we know what causes nonpoint source pollution, we can begin to stop it. It will be a difficult job, but it is a big problem. I've heard that other states and countries have problems with it.

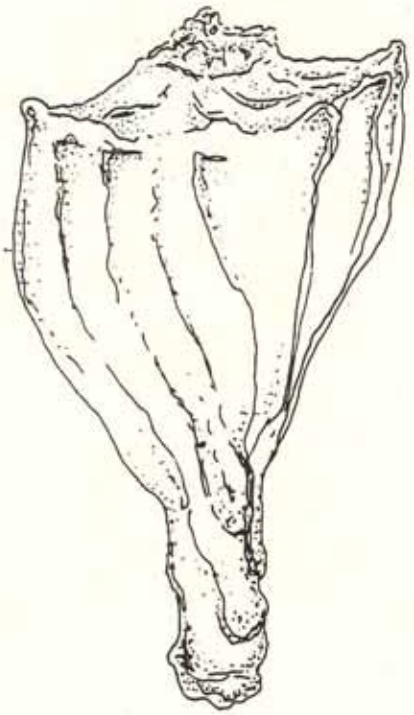
Clam Man: If everyone learns about it and what they can do to stop it, then things will change for Lawrence, Musselhead and Olivia. All of New Jersey's estuaries will be clean! (Clam Man and the King shake hands and the lights dim.)

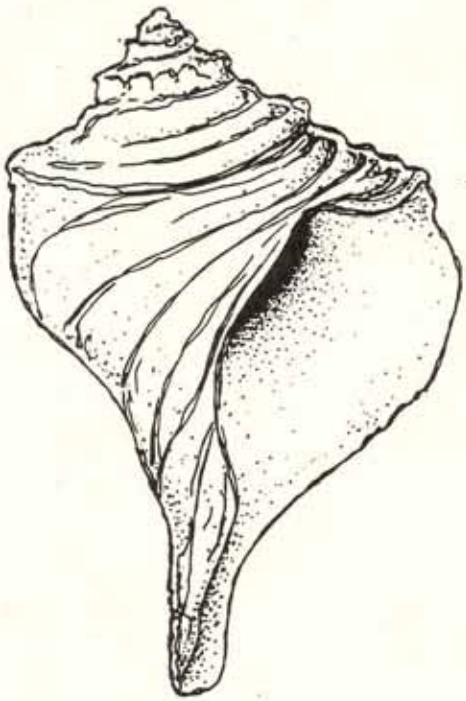


King Neptune: (Clears his throat loudly) Uh, Clam Man? I need to change you back into mild-mannered Sam the Clam. Sorry, big guy.

Clam Man: Oh. (Short silence) Can I keep the shoes?
(The lights go back on and the entire cast lines up for bows. Lights go off.)

- THE END -





SECTION THREE

BENEATH THE SHELL

When one tugs at a single thing in nature,
he finds it attached to the rest of the world.
John Muir

KEY WORDS:

Bivalves

Shellfish Species

Shellfish are animals with very soft bodies that have an envelope of flesh around them called a mantle. Shellfish also have two hard external shell coverings around the mantle to protect them and are thus referred to as "bivalves," the name meaning "two shells." Bivalves in New Jersey include eastern oysters, blue mussels, hard clams, soft shelled clams, ocean quahogs and surf clams. These shellfish are managed by the Bureau of Shellfisheries within the DEPE's Division of Fish, Game and Wildlife.

Shellfish Habitat

Shellfish habitats, depending on the species, include estuaries, the surf line and the ocean bottom, anywhere up to 50 miles offshore. While some of the bivalves burrow into the sand or mud bottom, others attach themselves either temporarily or permanently to hard surfaces such as rocks, pilings or other shells.

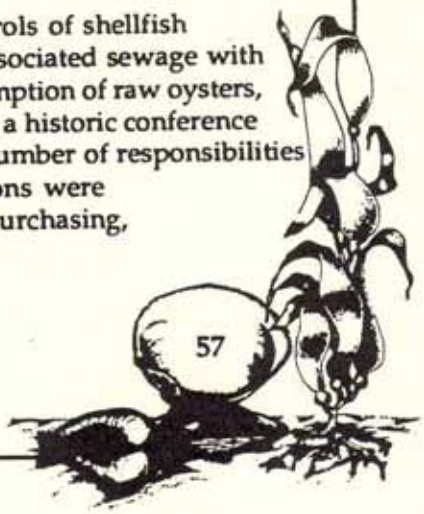
Filter Feeding Methods

Bivalves are referred to as filter feeders because they collect their food by filtering minute plant and animal cells from the water and digesting them. When feeding, the two shells separate slightly and water is drawn in through a tube-like siphon or over the bivalve's gills. Food particles are separated and moved to the bivalve's mouth to be digested. The gills also extract oxygen and nutrients from the water and the water is expelled.

Because of their filter-feeding methods and sedentary nature, bivalves ingest any contaminants that may be present in their habitat. They take bacteria, viruses and other impurities in the water and "accumulate" them while maintaining a healthy appearance. Should these same contaminated shellfish be placed in clean water, they also have the ability to eliminate contaminants. The level of contaminants found in shellfish is usually higher than that of the water itself. Eating contaminated shellfish can cause cholera, hepatitis and other sicknesses. As a result, these shellfish are excellent water quality indicators because a contaminated shellfish would indicate pollutants that may be present only at low levels or at certain times.

Regulations

In the late 19th century, public health controls of shellfish became a national concern when authorities associated sewage with a large number of illnesses caused by the consumption of raw oysters, clams and mussels. The Surgeon General called a historic conference in Washington, D.C. at which he entrusted a number of responsibilities to each state that harvest shellfish. Regulations were developed governing the growing, collecting, purchasing, handling, packaging and inspecting of



all shellfish and shellfish products. Currently, this program is dependent upon the cooperative efforts of the DEPE's Bureau of Shellfisheries and Bureau of Marine Water Classification and Analysis, and the state Department of Health.

Water Classification

The DEPE regularly tests water samples and uses these findings to classify the quality of New Jersey's estuarine and marine waters up to three miles off-shore. The state has more sampling stations than any other state in the nation. If water quality standards aren't met, the closed area is patrolled by marine enforcement officers who work year-round to enforce shellfish rules and regulations. Each year the DEPE updates and distributes "Shellfish Growing Water Classification Charts" to shellfishermen. Also, the DEPE has set up a number of programs which allow shellfishermen to remove healthy shellfish from mildly contaminated waters, for additional processing. For instance, the "Clam Relay Program" takes clams from contaminated waters to clean waters. The clams stay there for at least thirty days, the time needed for them to eliminate pollutants. The "Clam Depuration Program" removes clams from contaminated waters to a "controlled environment" in a laboratory-type setting. The clams remain there for two full days, the time needed to remove pollutants. Shellfish are then tested before being released to shellfishermen.

The NJ Department of Health (DOH) administers a certification program that requires wholesale shellfish dealers to work with shellfish under sanitary conditions and to maintain records verifying that they were harvested from coastal areas approved by the DEPE. The DOH, in conjunction with the DEPE, also collects shellfish samples from harvest areas, certified shellfish dealers and retailers for bacterial examination. The efforts of both DEPE and DOH are part of the Federal Food and Drug Administration's National Shellfish Sanitation Program, which regulates the interstate marketing of shellfish and ensures the safety of shellfish products.

Exactly 93,718,330 pounds of shellfish were harvested in 1989, a substantial amount but much less than in the earlier part of this century. Once ideal estuarine shellfish habitats in the northern areas are now closed to harvesting, largely due to NPS impact. Ironically, the cleaner, southern clamming areas are not as productive. If NPS is not reduced and prevented, the cleaner waters can be affected. If NPS is reduced and eliminated statewide, clean waters will remain clean, waters affected by NPS become clean and productive waters closed to shellfish harvesting can eventually be opened.

Shellfish Uses

For hundreds of years shellfish have met the needs of humans in numerous ways. As a protein-rich food source, shellfish are served raw or in chowders, sauces and casseroles. While whole shells are collected or used for jewelry, crushed shells are used in making roads, aquarium bedding and calcium-rich dietary supplements. The protection of and concern for these creatures and their habitat will assure humankind of their continued use.

news releases

NJ DEPT. OF ENVIRONMENTAL PROTECTION NEWS RELEASE

RELEASE: 10/15/01
01/120

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CLEANER WATER RESULTS IN THE UPGRADE OF 7,754 ACRES OF SHELLFISH WATERS
5,425 Acres to be upgraded in Raritan Bay

State Environmental Protection Commissioner Bob Shinn today announced that 7,754 additional acres of state wate soon will be open for shellfish harvesting, marking the 14th consecutive year that continuing improvement in water quality has allowed expansion of areas where shellfish may be safely taken.

"The continued expansion of our shellfish harvesting waters is a clear and reliable yardstick of our progress in improving water quality. These openings are the result of combined efforts to upgrade wastewater treatment plant operations and reduce nonpoint source pollution," Shinn said during a ceremony at the Leonardo State Marina on t Raritan Bay.

The proposed reclassification will bring the total acreage available for shellfishing to 599,505, or 89 percent of the state's coastal waters, Shinn noted.

The areas to be upgraded are: 5,425 acres from prohibited to special restricted in Raritan Bay including 4,441 acres the Flynn's Knoll section off of Sandy Hook and 984 acres in the bay near Union Beach. Special restricted means permits for depuration are required. In addition, 1,878 acres upgraded from prohibited to approved in the Atlantic Ocean off of Mantoloking (Ocean County); 360 acres from seasonal to approved in Risley Channel off of Margate (Atlantic County), and 91 acres upgraded from special restricted to seasonal in Lakes Bay near Margate. The season classification allows harvesting yearly from November through April.

"New Jersey is the only state in the 24-state Interstate Shellfish Sanitation Conference that has consistently had mo waters upgraded than downgraded each year for the past 14 years," Shinn said. "The continued upgrade is particular remarkable considering that population growth has been steady in the state's coastal counties during this time."

New Jersey harvests the most shellfish of any state, more than 75 million pounds each year.

Each year, DEP's Bureau of Marine Water Monitoring collects and analyzes over 19,000 water samples. Staff also regularly perform field surveys of the coastal shoreline to monitor any pollution sources.

The Interstate Environmental Commission and U.S. Environmental Protection Agency's Region 2 Office, under New Jersey' s Performance Partnership Agreement, also assisted in the collection and analysis of water and shellfish tiss for this upgrade.

Other ongoing clean water initiatives include the watershed management program, which works with local organizations, to establish regional plans to control nonpoint source pollution, such as runoff from development an agriculture, by. DEP also is working with municipalities and the Environmental Infrastructure Trust to replace combined sewers in older towns and reduce stormwater overflows.

Fifty-five acres east of Mystic Island are being downgraded from Approved to Seasonal in two small waterways leadi to Great Bay due to a requirement for buffers around marinas.

Adjacent to the 1,878 acres in the ocean off of Mantoloking that are being upgraded to approved, 20 acres are being closed to better define and manage the closure zone around the Northern Ocean County Municipal Utilities Authorit plant using GPS coordinates. The larger harvesting area is due to the treatment plant's improved operating efficienc and reliability.

DEP is accepting public comment on the proposed reclassification, which was published in today's NJ Register. The public comment period closes Nov. 14 and the proposal is scheduled to take effect Jan. 7, 2002.

Maps showing the reclassified areas may be viewed on the Bureau of Marine Monitoring's web page at: www.state.nj.us/dep/watershedmgt/bmw.

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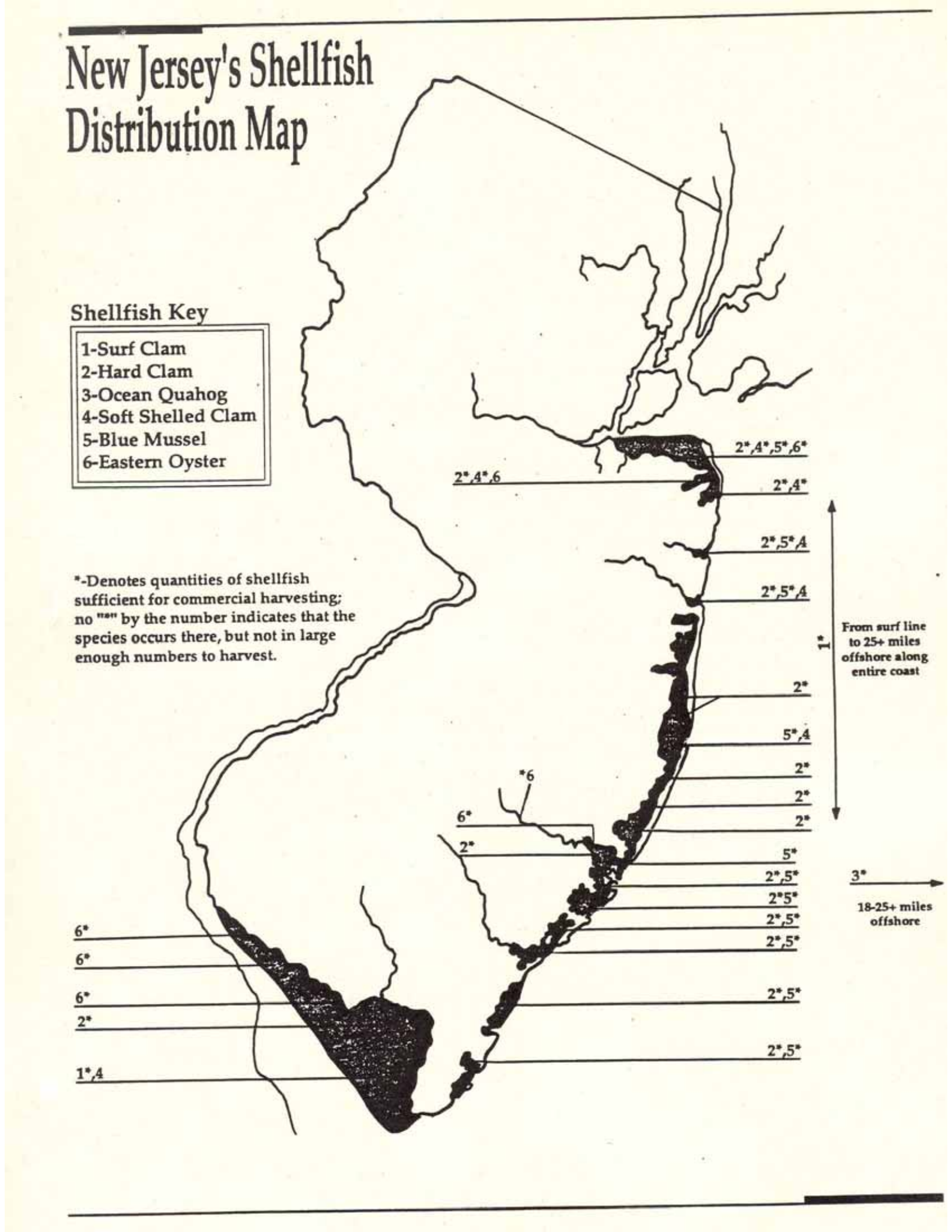
Related Links

- NJDEP Division of Watershed Management
  http://www.state.nj.us/dep/watershedmgt/
- Interstate Shellfish Sanitation Conference
  http://www.issc.org

Last Updated: October 22, 2001

New Jersey's Shellfish Distribution Map



TITLE: **Old Mermaid**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:
1) Recognize differences and similarities between New Jersey's six managed shellfish species;
2) Associate individual shellfish species with their related characteristics and needs.

KEY WORDS: Bivalves, Six Shellfish Species

SUBJECT: Science

SKILLS: Associating, comparing, identifying and matching

MATERIALS: Scissors, glue, oaktag paper, copies of the Old Mermaid and the shellfish card sets and clear shelving paper

PREPARATION: Creating an "Old Mermaid "deck of cards must be done according to the number of students in the playing group. Students collect card numbers 1 through 4 for the same species of shellfish. The deck must contain at least one full set of four cards for each student, and only one Old Mermaid card. Extra cards should be added, but the number is not important. To make the cards, glue the appropriate number of card sheets and the Old Mermaid card onto the oaktag paper, cover both sides smoothly with the clear shelving paper, and cut out the cards.

BACKGROUND INFORMATION: Introduction to Section Three

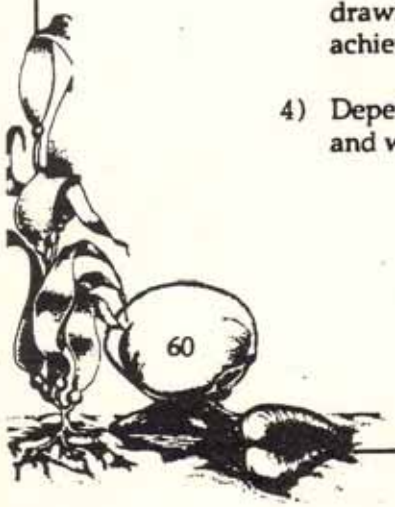
PROCEDURE:

1) Players sit in a circle. One player is the dealer. The dealer mixes the cards and proceeds to give each player one card, face down, until all of the cards have been distributed. Depending on the number of players, one or more persons may have an extra card, which will not affect the outcome of the game.

2) To win the game, a player must have four cards, numbered 1, 2, 3 and 4, all pertaining to the same shellfish species. The winner must not possess the Old Mermaid card! These cards are to be laid down on the floor, face up, along with any extra cards.

3) To play, the person to the left of the dealer draws a card from the dealer's hand. He/she then turns to the next player on his/her left, who also draws a card. The drawing from each other's hand continues around the circle until step #2 is achieved and the game has a winner.

4) Depending on the age level, the students can concentrate on identification of letters and words, pictures or numbers when trying to match up the card sets.

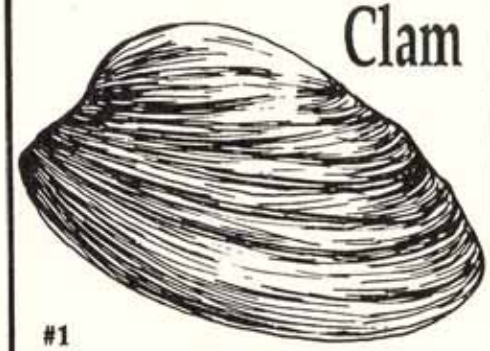
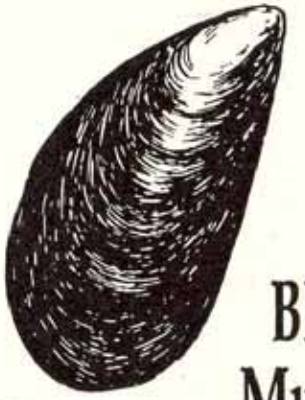
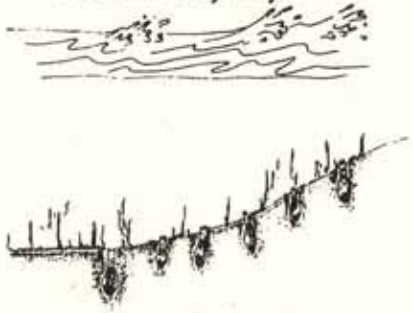


5) Discussion items:
   - Do all six shellfish species live in water? Discuss the types of areas.
   - What seems to be the most common type of food for these shellfish?
   - What is the most common usage of shellfish by humans?
   - How many students like to eat clams, oysters or mussels?
   - How do the six species seem to differ? How are they similar?
   - Discuss the definition of a bivalve.

EXTENSIONS:

1) Tell the class that a reporter from a local newspaper will be coming into the class to interview each of the shellfish species. Make sure that each student has a complete set of four matching cards, per species. Have them answer the following six questions, using information from the cards.
   - Where do you live?
   - What do you like to eat?
   - Do you need to live in the water?
   - How does it feel to be a shellfish?
   - What message would you like to give to the humans who read this paper?

   Ask for a volunteer from the class to come up and be the newspaper reporter, and have a second volunteer come up to represent his/her shellfish species. The news reporter will ask each of the questions above, and the student will answer accordingly. Continue to choose two new volunteers until all of the students have contributed.

Hard Clam  #1	*Lives in Estuaries-usually buried in sand or mud bottom.*  #1 Hard Clam	*Filters minute plant organisms for food, along with bacteria and decaying material.*  #1 Hard Clam	*Raw or steamed; used in chowders*  #1 Hard Clam
 Blue Mussel #2	*Lives in Estuaries and on ocean bottom, found in clusters on pilings and rocks or on hard bottom.*  #2 Blue Mussel	*Filters minute plant organisms for food, along with bacteria and decaying material.*  #2 Blue Mussel	*Steamed or baked; chopped up for sauce.*  #2 Blue Mussel
Surf Clam  #3	*Lives on ocean bottom, surf line to 25+ miles offshore in less than 100 feet of water.*  #3 Surf Clam	*Filters minute plant organisms for food, along with bacteria and decaying material.*  #3 Surf Clam	*Breaded, fried or used in chowders*  #3 Surf Clam

Eastern Oyster

#4

Lives in Estuaries, attached to rocks,shells, pilings or other hard objects.

#4 **Eastern Oyster**

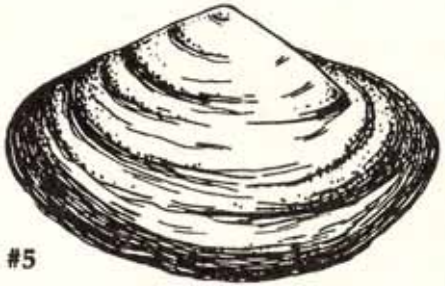
Filters minute plant organisms for food, along with bacteria and decaying material.

#4 **Eastern Oyster**

Fried, baked or eaten raw.

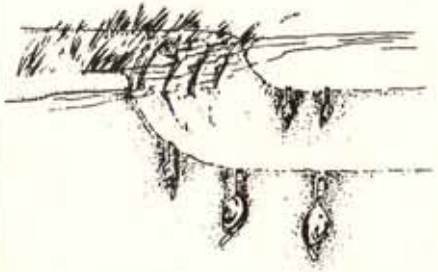
#4 **Eastern Oyster**

Soft Shelled Clam



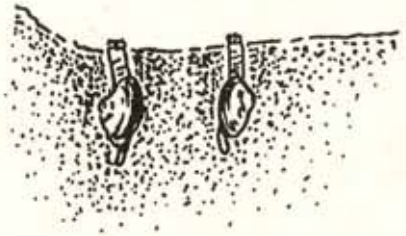
#5

Lives in Estuaries, along a sandy or muddy bottom.



#5 **Soft Shelled Clam**

Filters minute plant organisms for food, along with bacteria and decaying material.



#5 **Soft Shelled Clam**

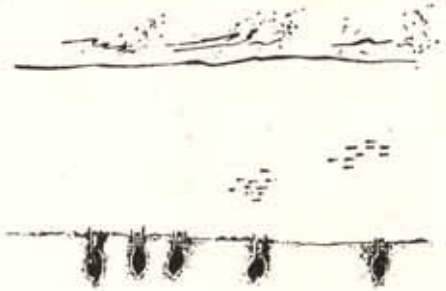
Steamed or fried

#5 **Soft Shelled Clam**

Ocean Quahog

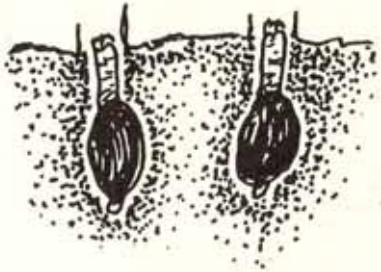
#6

Lives on ocean bottom, 20-50 miles offshore in 85-160 feet of water.



#6 **Ocean Quahog**

Filters minute plant organisms for food, along with bacteria and decaying material.



#6 **Ocean Quahog**

Baked or used in chowders

#6 **Ocean Quahog**

TITLE: **Mollusk Mural**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:

1) List the basic needs of shellfish;
2) Recognize a number of factors that determine where and how shellfish survive;
3) Predict what might happen to a shellfish population should change occur in its habitat;
4) List reasons why shellfish habitat should be preserved and protected;
5) Describe the distribution of the state's six managed shellfish populations along its coastline (intermediate grades).

KEY WORD: Shellfish Habitat

SUBJECTS: Science, Art

SKILLS: Analyzing, constructing, inferring, listing, locating, predicting and visualizing

MATERIALS: Scissors, glue, crayons, tape, large mural paper taped to the wall and copies of "Shellfish of New Jersey" page 65 (one per student,) and the "NJ's Shellfish Distribution Map" on page 59 (one per student, intermediate grades only)

BACKGROUND INFORMATION: Introduction to Section Three

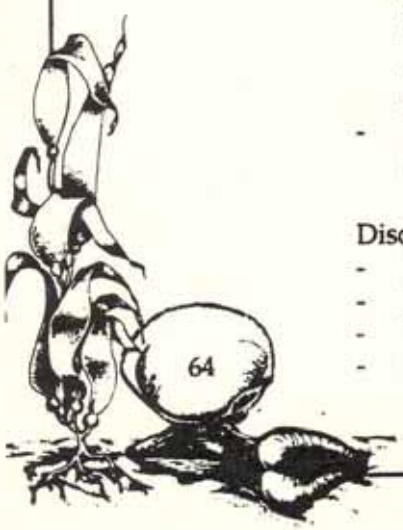
PROCEDURE:

1) Have one or two students draw the mural on page 66 onto the mural paper and allow the rest of the class to color it in with markers or crayons.

2) Distribute the "Shellfish of New Jersey" sheets and have the students cut them into six strips, with one species on each. Using tape, have them fasten each of their six species in their proper habitat on the mural, referring to the information given about each species. This can be done individually or in small groups.

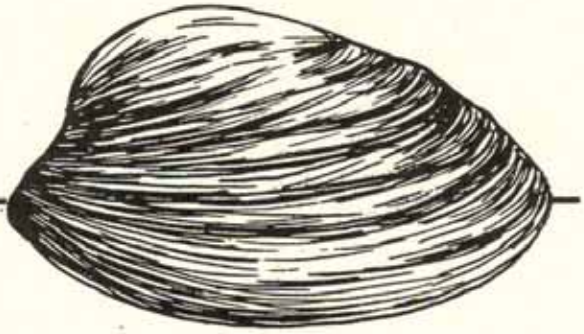
3) Discuss:
   - What do shellfish need to survive? (food, water, shelter and space).
   - What things might determine where shellfish species can live? (enough food, water and space, shelter, predators, temperature, depth, salinity, type of bottom surface, turbidity, currents, how the land and water is used and the presence of pollution).
   - Once the habitat requirements are met for a species of shellfish, it can grow and reproduce there. If a change occurs regarding the things listed in discussion item #2, what might happen to the shellfish population? (spreading disease, a decrease in growth and reproduction and a decrease in population. The population can also become contaminated if waters are polluted).
   - List reasons why it is important to keep waters clean for these species of shellfish.

   Discuss the "New Jersey's Shellfish Distribution Map" with the upper grades:
   - Is there a variety of shellfish available along New Jersey's coast?
   - Which shellfish species seem most common?
   - Which species are plentiful enough for commercial harvesting?
   - Locate an area that has a great diversity of shellfish populations.



"Shellfish of New Jersey" Worksheet

Hard Clam-*Environment*-Estuarine, found partially buried in sand or mud bottom.



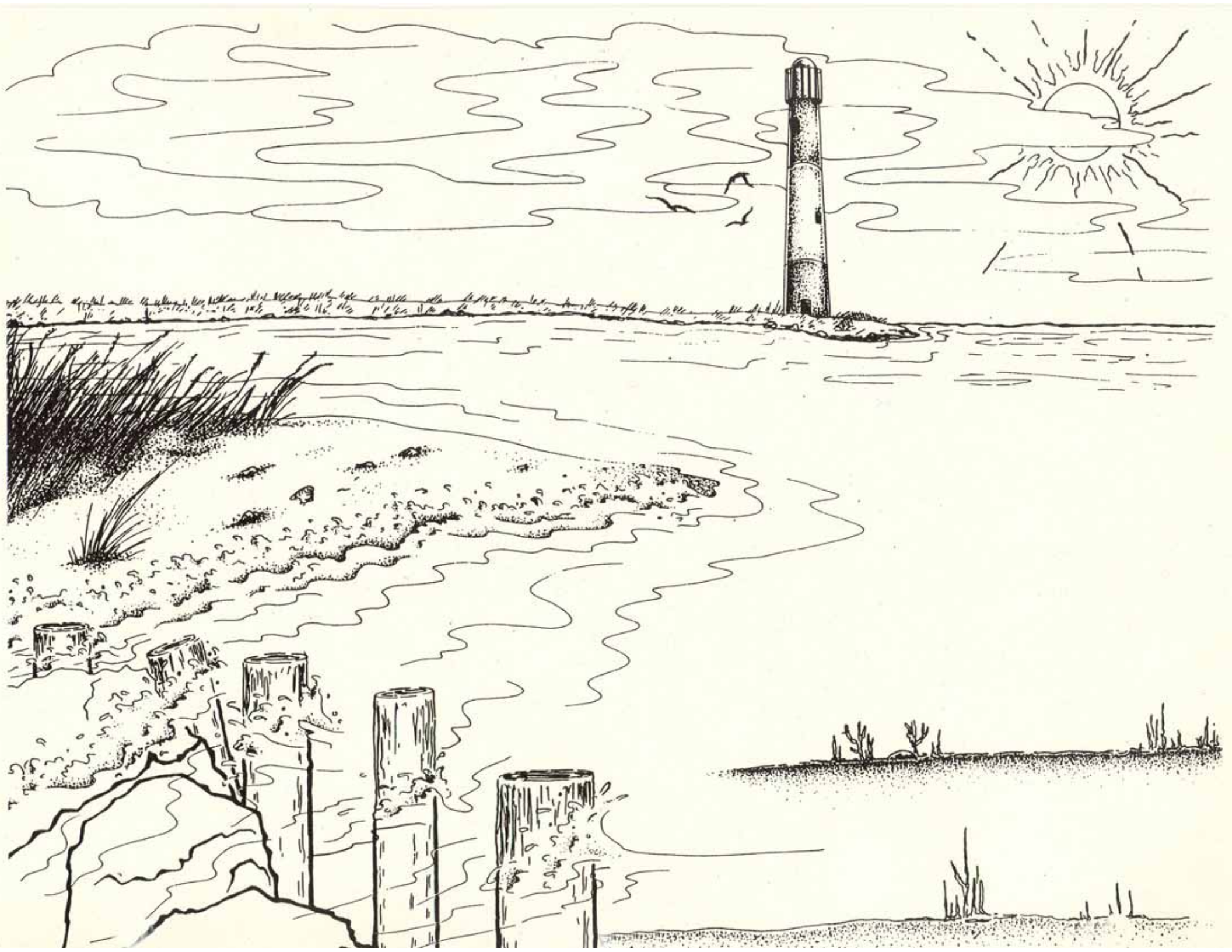
Blue Mussel-*Environment*-Estuarine and Marine, found exposed in clusters, attached to piles and rocks or in beds on hard bottom.

Surf Clam-*Environment*-Marine, in N.J. surf line to 25+ miles offshore. Mostly found in less than 100 ft. of water.

Eastern Oyster-*Environment*-Estuarine, found attached to rocks, shells, pilings or any other hard object.

Soft Shelled Clam-*Environment* - Estuarine, in N.J. 18-25 miles offshore in 85-160 ft. of water. Found partially buried in sand on mud bottom.

Ocean Quahog - *Environment*- Marine, in N.J. 20-50 miles offshore in 85-160 ft. of water.



TITLE: **Secret Word Puzzle**

AGE LEVELS: I, JH, SH

OBJECTIVES: After performing this activity, students should be able to:

1) Compare and contrast New Jersey's six managed shellfish species;
2) List factors that determine shellfish habitat;
3) Describe the distribution of the six species along New Jersey's coast;
4) Give reasons why shellfish habitat should be protected and maintained.

KEY WORDS: Six Shellfish Species, Shellfish Habitat

SUBJECTS: Language Arts, Science

SKILLS: Comparing, identifying, reading and reasoning

MATERIALS: Pencils, copies of "Shellfish Fact Sheets, "(page 68) the "Secret Word Puzzle" Worksheet (pages 69-70) and "New Jersey's Shellfish Distribution Map," (page 59) and blank paper (one per student.)

BACKGROUND INFORMATION: Introduction to Section Three

PROCEDURE:

1) Distribute pencils, the "Secret Word Puzzle" Worksheets and the "Shellfish Fact Sheets" to each student. Define such terms as habitat, detritus, and predators (See Glossary.) Allow time to fill in the blanks and learn the secret word.

2) Share the correct answers after they discuss their findings for each answer.

3) Discuss:
   - What do shellfish need in order to survive? (food, water, shelter and space).
   - What factors determine where a species of shellfish might live? (food, water, shelter, space, salinity, predators, depth, type of bottom surface, temperature of water, amount of oxygen, currents, how the land and water is used and the quality of the water).
   - If change occurs in a healthy habitat, what might happen? (disease, birth defects, decrease in reproduction and population or contaminated shellfish).
   - What differences and similarities exist between the species?
   - Distribute copies of the "NJ's Shellfish Distribution Map" and review the locations of the various shellfish populations. Give reasons why shellfish habitat should be preserved and protected.

SECRET WORD PUZZLE - ANSWER KEY

1)Bays
2)oYster
3)Spat
4)Steamed
5)lArvae
6)pLankton
7)Chowder
8)Estuaries
9)blue Mussel
10)thrEads
11)coNtracts
12)fooT

Secret Word:
Byssal Cement
Associated with:
Eastern Oyster
Function:
Anchors larvae to hard object

"Secret Word Puzzle" Worksheet

Directions: Use your shellfish fact sheets to answer the following questions. Each answer contains a letter with an asterisk (*) under it. These letters will spell out the "secret word."

1. What is one favorite habitat of the hard clam? __ __ y __ (*)

2. What is one type of shellfish preyed upon by oyster drills? __ __ __ __ e __ (*)

3. What is the stage of an oyster's growth when they remain in one place? __ __ a __ (*)

4. What is one common way that shellfish are served? __ __ __ __ m __ __ (*)

5. Young shellfish are called what? __ __ __ __ a __ (*)

6. Other than detritus, what is another food source for shellfish? __ __ a __ __ __ __ __ (*)

7. What type of soup is made with clams? __ __ __ __ d __ __ (*)

8. Where are Eastern oysters usually found? __ __ __ __ a __ __ __ __ (*)

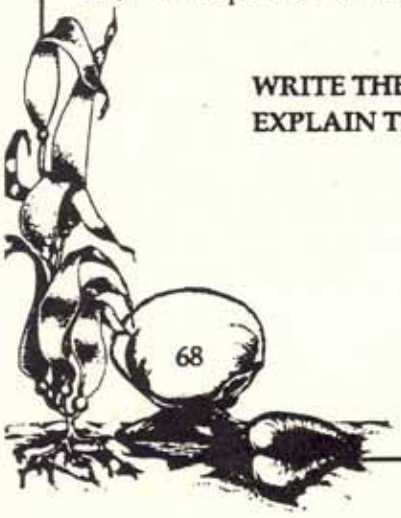
9. Which species of shellfish attaches in clusters? __ __ __ __ __ __ s s __ __ (*)

10. What do blue mussels use to attach to hard surfaces? __ __ __ __ __ d __ (*)

11. To move, what does the foot of most species of shellfish do after it expands? __ __ __ __ r __ __ __ __ (*)

12) What part of a clam's body is the primary means of locomotion? __ __ o __ (*)

WRITE THE SECRET WORD:
EXPLAIN THIS WORD:



"SHELLFISH FACTS" WORKSHEET

NAME OF SPECIES:	Hard Clam Mercenaria mercenaria	Blue Mussel Mytilus edulis	Surf Clam Spisula solidissima
PICTURE OF SPECIES:			
FOOD:	Detritus and Plankton	Detritus and Plankton	Detritus and Plankton
HABITAT:	Estuarine; bays; partially buried in sand or mud bottom	Estuarine and marine; exposed in clusters, attached to rocks and piles or in beds on hard bottom	Marine; surfline to 25+ miles offshore; found in less than 100' of water
MOBILITY AND ANCHORING:	Attach to bottom sediments with a byssal (silky) thread; burrows by expanding and contracting foot	On their foot is a byssal gland that produces threads; these are used to attach mussel to hard surfaces; they often cling together	Attaches to bottom like hard clam; "leaps" in water by bending of the foot and jetting action through siphon
PREDATORS:	Larvae eaten by many predators; spat eaten by blue crabs, rays, whelks and snails	Larvae eaten by many predators; spat eaten by fish, rays, lobsters, crabs,starfish and horseshoe crabs	Larvae eaten by many predators; spat eaten by starfish and horseshoe crabs
USES:	Served raw or steamed used in chowder	Served steamed or baked and used in sauces	Served fried and breaded and used in chowder

"SHELLFISH FACTS" WORKSHEET

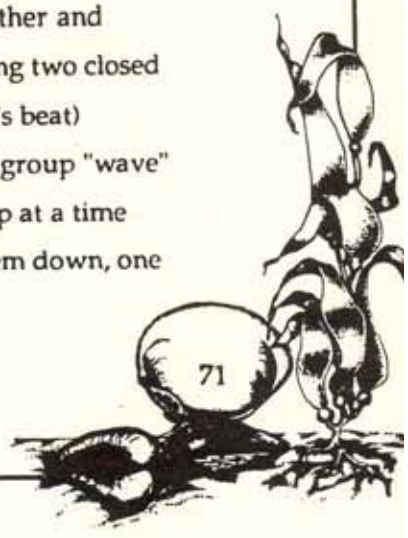
NAME OF SPECIES:	Eastern Oyster Crassostrea virginica	Soft Shelled Clam Mya arenaria	Ocean Quahog Arctica islandica
PICTURE OF SPECIES:			
FOOD:	Detritus and Plankton	Detritus and Plankton	Detritus and Plankton
HABITAT:	Estuarine; attached to rocks, pilings, old shells or any hard object	Estuarine; burrows into sandy or mud bottom	Marine; found 20-50 miles offshore
MOBILITY AND ANCHORING:	Larvae sets (anchors) on its left side by secreting byssal cement; As spat, they remain in one place for life	Larvae uses byssal thread to attach to sand grains; When older, burrows into bottom and may only move occasionally with foot expanding and contracting	Larvae uses byssal thread to anchor to bottom; uses foot to move in limited area; slow to burrow
PREDATORS:	Larvae eaten by many predators; spat eaten by oyster drills, mud crabs and moon snails	Larvae eaten by many predators; spat eaten by crabs and moon snails	Larvae eaten by many predators; spat eaten by crabs and moon snails
USES:	Served raw, fried or baked	Served steamed or fried	Served baked or in chowders

TITLE: **The "Sam the Clam" Song**

AGE LEVEL: P

Sung to the tune of "Row, Row, Row Your Boat" Lyrics by: Tanya Oznowich

LYRICS:	MOTIONS: (Stand in circle)
1) Sam	(Stick arms straight out, together and on
Sam	top of each other, resembling two closed
Sam the Clam	shells; open and close to song's beat)
Trapped between two shells	(Put your arms around yourself and hug)
Living in the ocean where	(Make "waves" motions with arms)
Life is usually swell.	
2) He	(Grab fistfuls of "food" from the
Pulls	air and stuff into your mouth)
In	
Water	
On top of his gills	(Rub and pat your stomach)
Collecting tiny plankton and	
Eating 'till he's filled.	
3) When	(Hide your face in the crook of your arm as
Po-	if a cloak or cape were attached, and peer
lu-	out at everyone)
tion	
Lurks	
He can eat that, too	(Point to your stomach)
It's stored inside his body and	
It's not good for you.	(Point at the audience)
4) Sam	(Stick arms straight out, together and
Sam	on top of each other, resembling two closed
Sam the Clam	shells; open and close to song's beat)
Needs us all, you see	(Join hands in circle - make a group "wave"
If we learn to change our ways	by lifting one pair of hands up at a time
We'll help clean up the sea!	until all are up, then bring them down, one
	at a time.



TITLE: **Clam Anatomy**

AGE LEVELS: I, JH

KEY WORDS: Bivalve, Filter Feeding Methods

OBJECTIVES: After performing this activity, students should be able to:
1) Describe the filter feeding method demonstrated by a hard clam;
2) Explain how contaminants accumulate in a hard clam.

SUBJECTS: Science, English

SKILLS: Analyzing, comparing, constructing, identifying, labeling and listening

MATERIALS: Copies of "Clam Anatomy" Worksheets, stapler, scissors, markers and glue

BACKGROUND INFORMATION: Introduction to Section Three and this additional information:

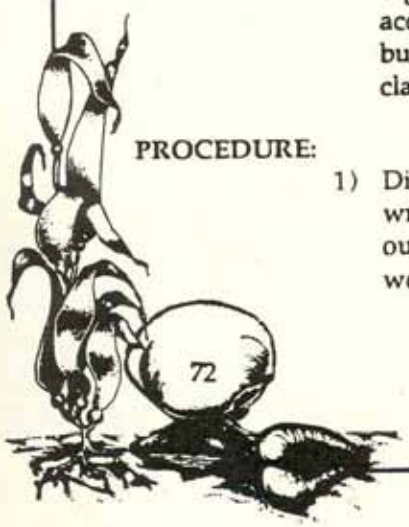
This activity focuses on the hard clam. When young, the mantle secretes a two-part shell, hinged together by a strong ligament and hinged teeth which hold the two shells together and resist any force that tries to get the shells out of alignment. The central area of the shells grows more slowly while concentric enlargements are made around the rim elsewhere, forming growth lines. Generally, the shell has three layers: an outer rough covering that protects the structure from erosion, a central region and an inner layer. The rate at which the shell grows varies considerably, being fastest when food is plentiful and slowest when the surrounding water is depleted of food, is cold or made turbid.

Like all shellfish, the body structure of the hard clam is designed to draw water with oxygen and food particles into the mantle cavity. This is referred to as filter-feeding. Food and other materials are taken in through the incurrent siphon. Tentacles on the siphon detect excessive concentrations or oversized particles in the water and cause the siphon to close. Particles brought into the siphon attach to mucus secreted by the mantle and the gills. These particles are sorted by size and weight, with undesirable materials such as sand and silt being rejected. Lighter particles are transported from the gills to the palps, a pair of folds on each side of the mouth, where further sorting takes place. Material accepted as food goes into the mouth, to the stomach and through the intestine. (The heart is actually wrapped around the intestine.) The anus opens near the excurrent siphon, from which the waste is carried away by the outgoing current.

If pollutants such as bacteria, toxic metals and other materials are present in the surrounding waters, they too will be taken in by the hard clam during the digestive process. As the clam continues to filter feed, the pollution continues to accumulate in the clam's body. The clam itself may appear to be healthy but the contaminants can be passed on, if ingested. If moved to clean waters, the clam has the ability to eliminate these contaminants from its body.

PROCEDURE:

1) Distribute to each student the three "Clam Anatomy" Worksheets. Have them write the body parts in the designated locations or use scissors and glue to cut them out and glue them down. Have them cut out the six parts of the hard clam worksheets.

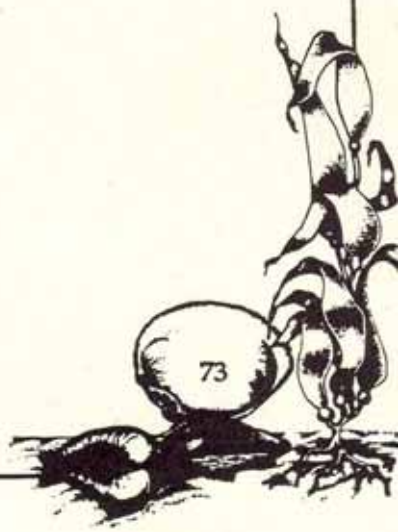


2) Arrange the six parts in the numerical order given below. **It is important that the half of each cut-out with writing on it be placed at the top when being arranged.** Lay each piece on the desktop in the following order:
   - Piece #1 **(RIGHT VALVE EXTERIOR)** - printed side down
   - Piece #2 **(RIGHT VALVE INTERIOR)** - printed side up
   - ***Staple piece #1 and #2 together*** - top, middle and bottom
   - Piece #3 **(RIGHT MANTLE EXTERIOR)** - printed side down
   - Piece #4 **(RIGHT MANTLE INTERIOR)** - printed side up
   - ***Staple piece #3 and #4 together*** - top, middle and bottom
   - Piece #5 **(RIGHT GILL, FOOT)** - printed side down
   - Piece #6 **(internal parts)** - printed side up
   - ***Staple piece #5 and #6 together*** - top, middle and bottom
   - Staple one staple horizontally in the middle
   - The completed clam should open like a sandwich, with the writing at the top.

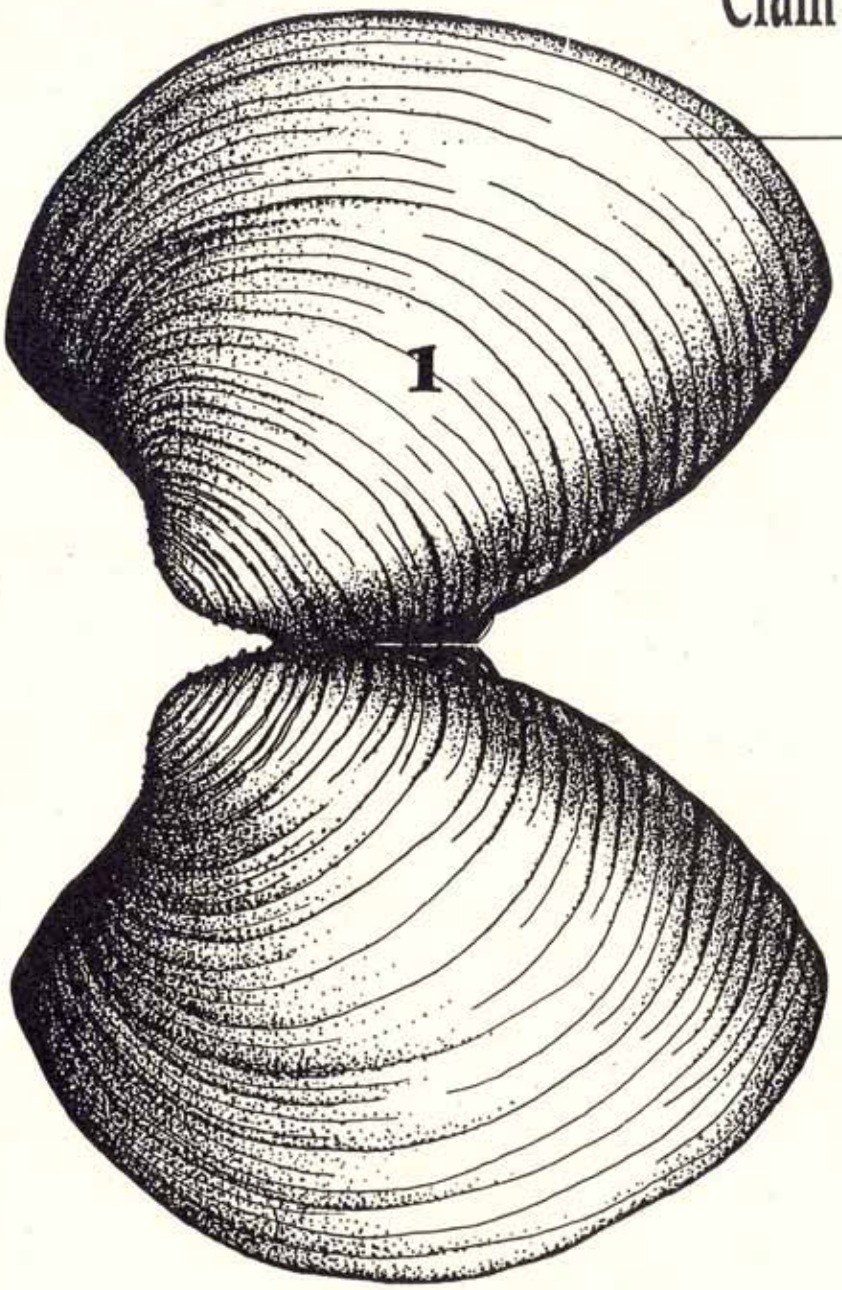
3) Read the activity's background information, and parts of Section Three's Introduction, to the students. As the digestive process is described, have the students trace the path of the particles by circling the mentioned areas on their hard clams. Any body parts not mentioned are described in the guide's Glossary.

4) Discuss:
   - Compare the clam's anatomy to that of a human. Which body parts are alike and commonly named? Associate other hard clam body parts with those of humans that they are comparable to.
   - Does the hard clam have any noticeable means of distinguishing chemicals, metal or bacteria from the water itself and possibly discharging it or not digesting it?
   - Using the information given, have the students choose a partner in the class and repeat the filter-feeding process of the hard clam.

This activity was adapted with permission from:
Atlantic States Marine Fisheries Commission
P.O. Box 2784
Tallahassee, Florida 32304



"Clam Anatomy" Worksheet



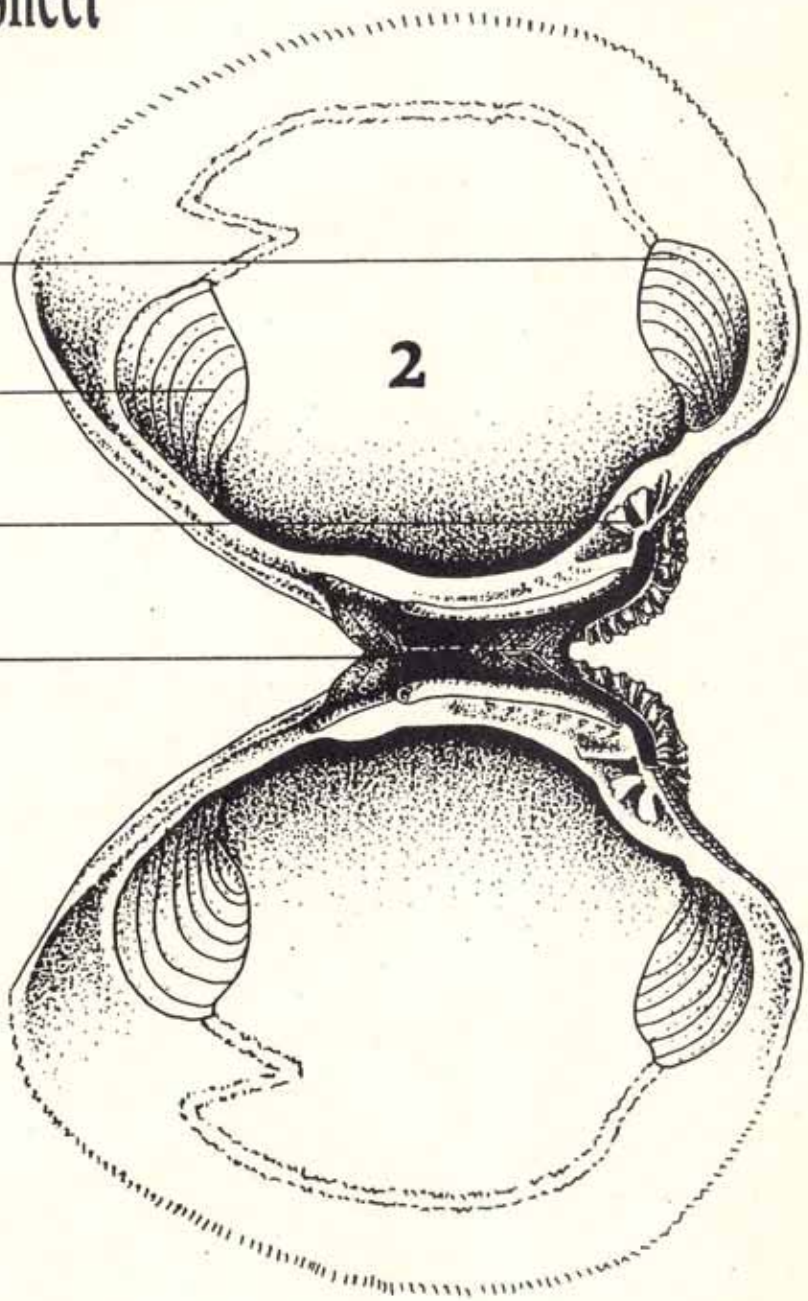
Growth Lines

Anterior Adductor

Posterior Adductor

Hinge Teeth

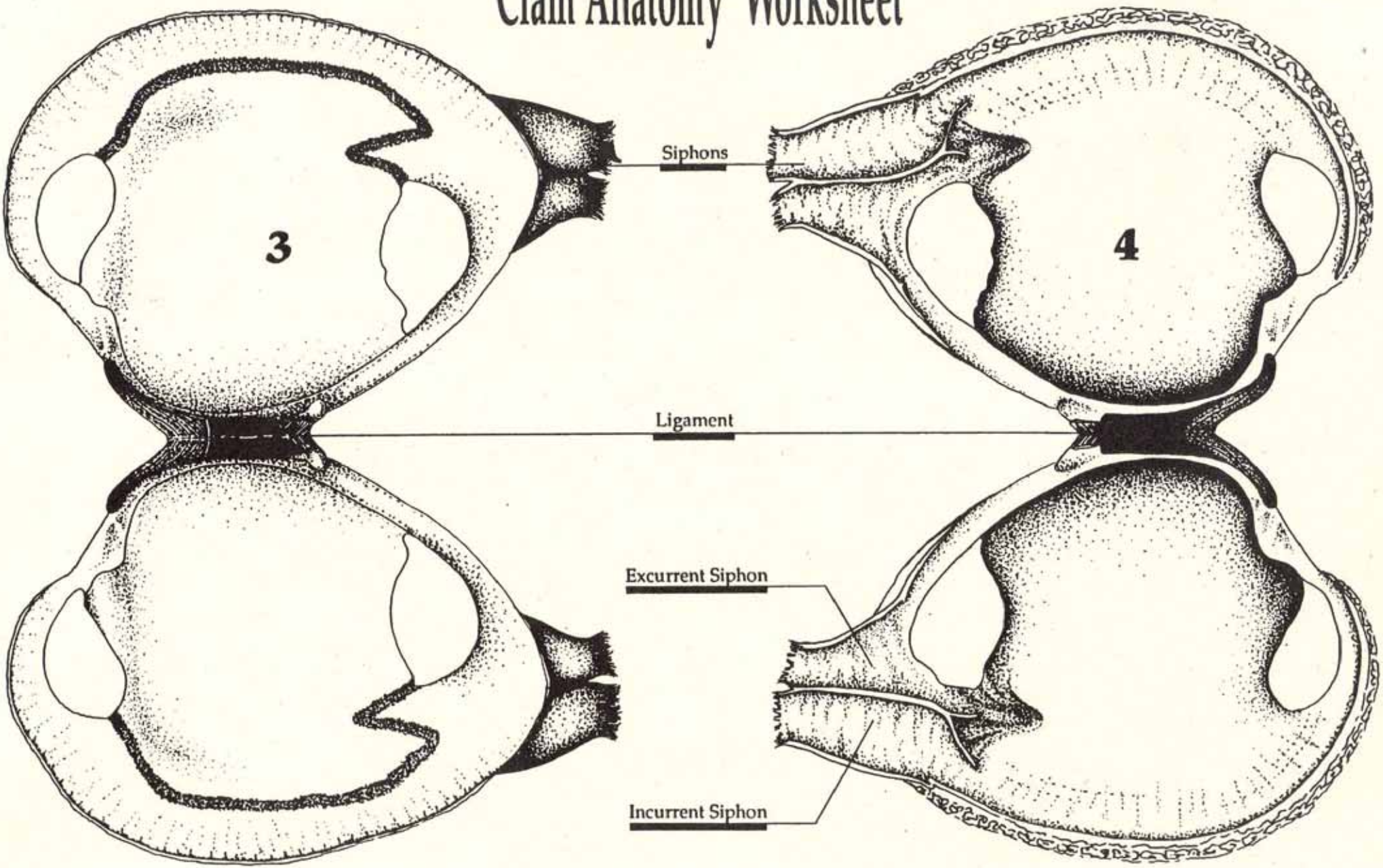
Ligament



Right Valve Exterior

Right Valve Interior

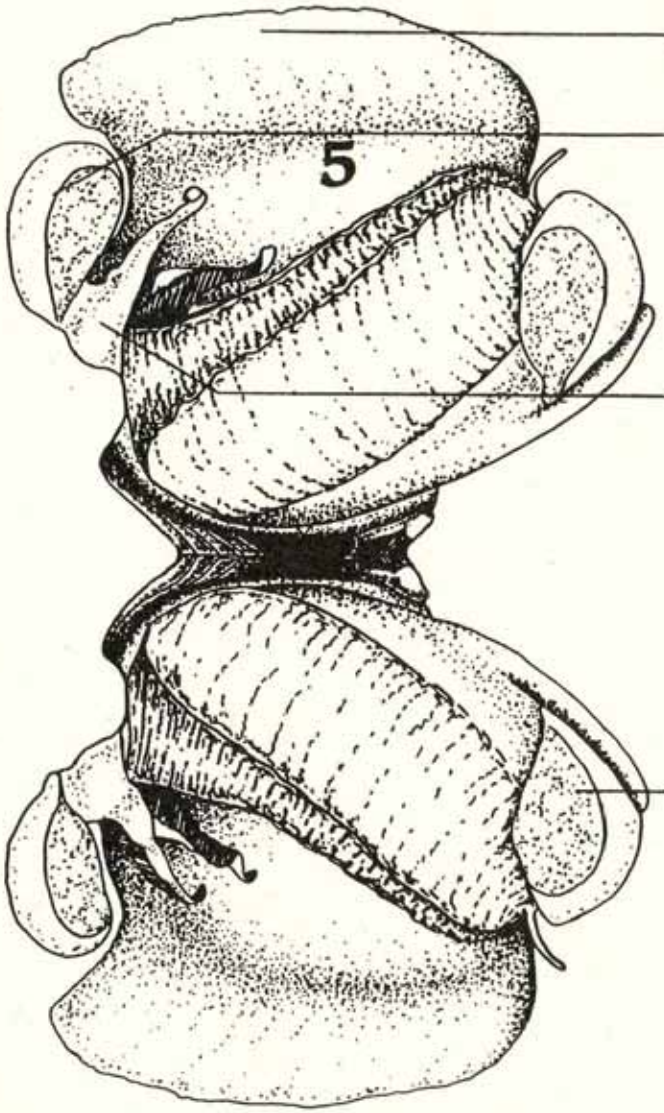
"Clam Anatomy" Worksheet



Right Mantle Exterior

Right Mantle Interior

"Clam Anatomy" Worksheet



Foot

Anterior Adductor

Mouth

Palp

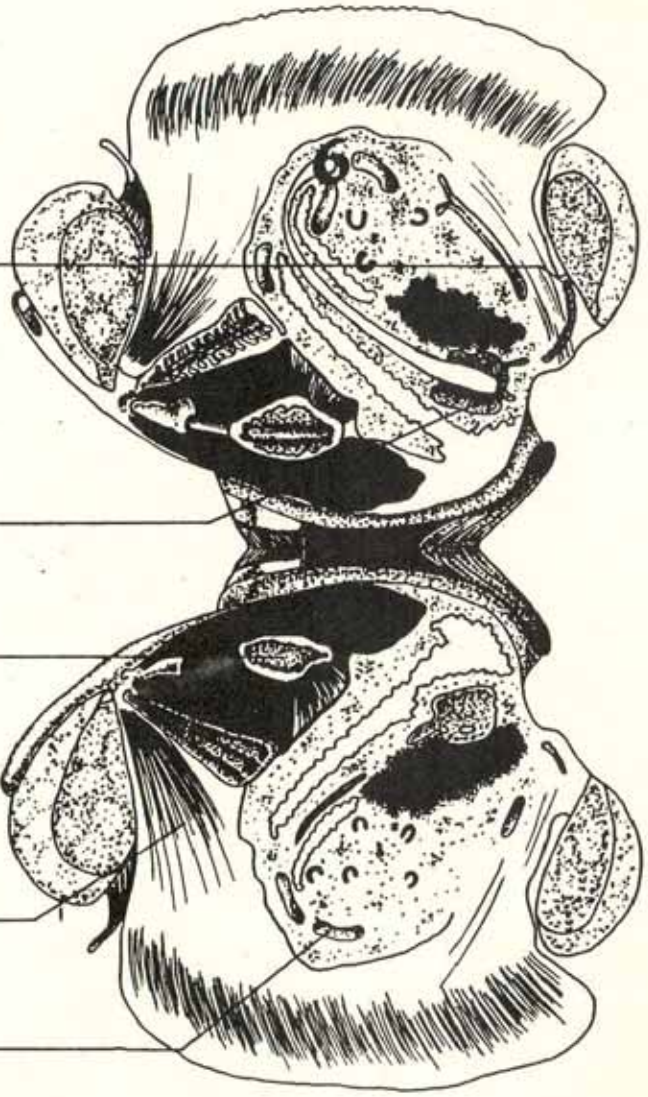
Stomach

Heart

Posterior Adductor

Foot Retractors

Intestine



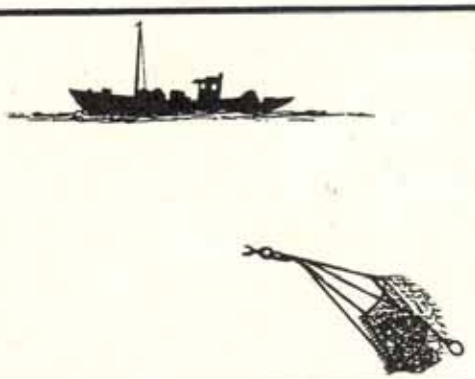
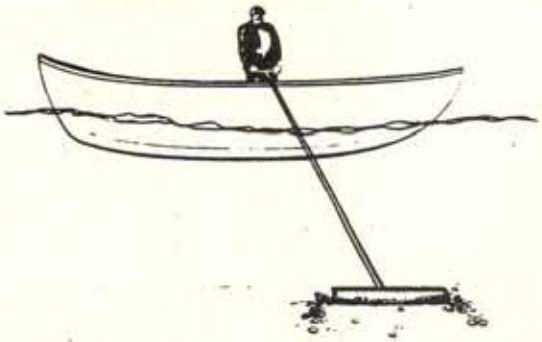
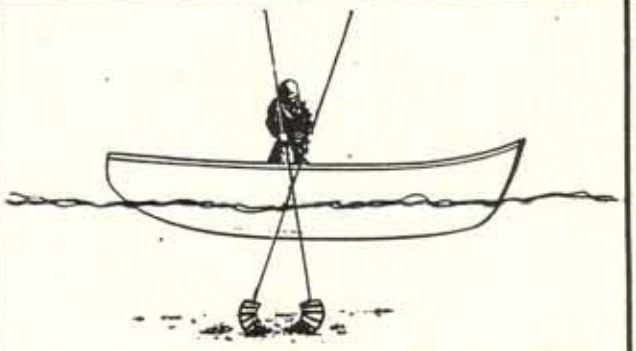
Right Gill and Foot

Internal Parts

Copy Page

Harvest Ho!

After reading the descriptions on the left, draw a line to the method of harvesting that each describes. Which would you like to try? Why?

I use a boat when I harvest shellfish, along with a pair of hand tongs. The tongs move like scissors. When I squeeze them together, I can lift them up into my boat.	
I wear shorts and old socks to harvest shellfish. My toes can feel their shells buried in the mud and sand. After I pick up the clam, I place it in my "floating basket" in an innertube.	
From my boat I use a rake to dig up the shellfish,pull them towards me and lift them up into the boat. When the rake is full, it is very heavy.	
I use my boat to pull a heavy metal frame, to which is attached a metal bag. The "teeth" along the bottom pick up the oysters. When the bag is full, I hoist it into my boat.	

TITLE: **Harvesting Relay**

AGE LEVELS: P, I

KEY WORDS: Harvesting, Regulations

OBJECTIVES: After performing this activity, students should be able to:
1) Describe three methods of harvesting shellfish;
2) Discuss the importance of regulating shellfish harvesting.

SUBJECTS: Math, Science, Physical Education

SKILLS: Collecting, counting, imitating, measuring, socializing and sorting

MATERIALS: Scissors, 75 copies of "Harvesting Relay" copy sheet, 1 watch with a second hand, 3 blindfolds, a whistle, 3 garden rakes, 3 brooms, 3 dustpans, 3 rulers, chalk and chalkboard and 4 buckets or dishpans

BACKGROUND INFORMATION: Introduction to Section Three

PROCEDURE:

1) Have the students cut out the shells. Into three buckets place 50 large hard clams and 100 small hard clam pictures, totalling 150 hard clams in each bucket. These buckets will be used in relay #1 and #2. Place the remaining oyster shells into the fourth bucket. The oysters will be used in relay #3.

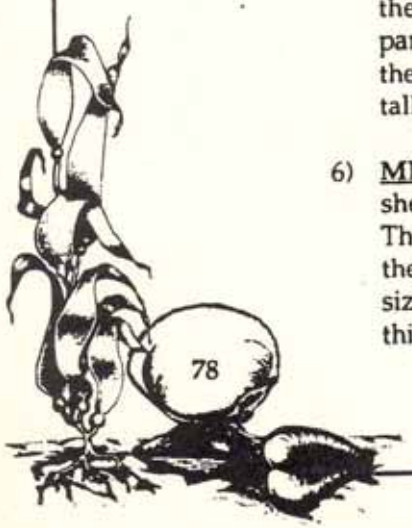
2) Push the desks against the walls and create a large playing area or go outside, if it's not breezy or wet. Divide the class into three teams and have the teams form three separate lines.

3) Divide the chalkboard into three sections, one section for each team. Divide each team's section into three horizontal segments since three different relays will be performed. A scorekeeper is needed.

4) Place the three Hard Clam buckets about 30' in front of each team. Empty each bucket and spread each of the shell piles on the floor or ground, placing the empty bucket close-by. These areas are the harvestable "shellfish beds" for each of the teams.

5) Tell the students that they will try some "harvesting" in the classroom. Three shellfish harvesting methods will be introduced. After each method is discussed, the students will harvest their team's shellfish in a manner "imitating" that particular method and their individual scores will be placed in the proper segment on the chalkboard. After all three methods have been introduced, practiced and tallied, the class will examine the resulting scores.

6) METHOD #1: (Read aloud.) Recreational shellfishermen sometimes gather shellfish in shallow waters by using their feet. This method is called "treading." They dig into the soft bottom with their toes. When a clam is struck, they duck into the water, grab it, and place it into a basket. Regulations state that the minimum size of hard clams that can be harvested is 1 -1/2 " in length. Clams smaller than this must be returned to where they were taken.



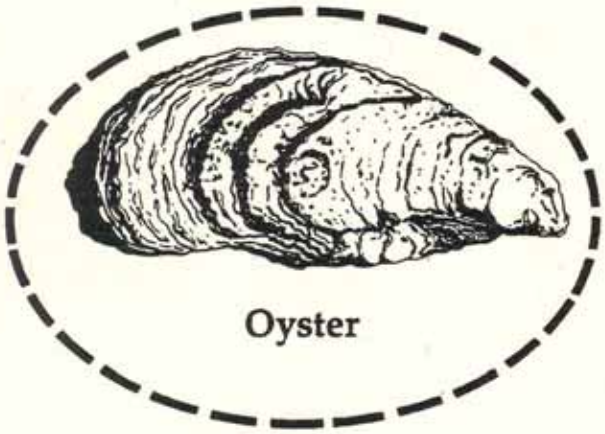
RELAY FOR METHOD #1: Have the students take off their shoes. The first student on each team is blindfolded because they cannot see through the water and must rely on their feet. Have a "sighted" partner from each team assist the blindfolded student. When all three teams are ready, a whistle is blown and the students have 30 seconds to be led to their team's shellfish bed to collect clams. They must use their toes to locate a clam and pick it up. The sighted partner then places these clams into their team's bucket. Shellfishermen cannot squat on the ground and scrape the shellfish towards them. After the second whistle is blown, the students take off the blindfolds and use the rulers to measure their catch. Any clam smaller than 1- 1/2" must be returned to the shellfish bed. Count the larger ones and put this score in the top segment of their team's section. Rearrange the clams for the next student on each team.

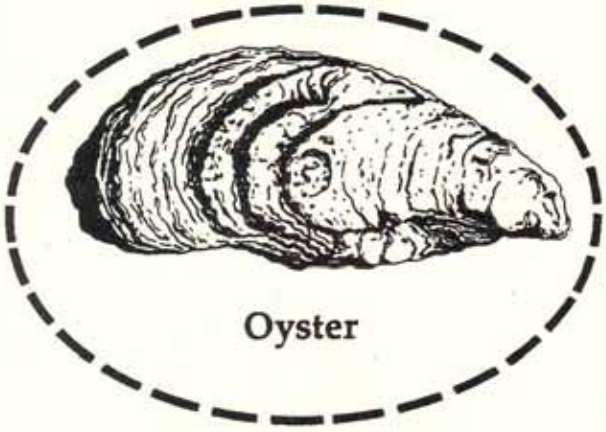
7) METHOD #2: Shellfishermen working from boats in shallow waters sometimes use a tool called a "bull rake," which is like a garden rake except that the rake's teeth are curved and spread further apart. The rake is placed into the water until it touches bottom. Using a raking motion, the shellfisherman dislodges clams and these clams fall into the curved part of the rake. When full, the rake is emptied onto the boat.
RELAY FOR METHOD #2: Give each team a rake. Instruct them that after the whistle is blown, the first student in each line will walk to their shellfish bed. They will put the rake out away from their bodies and draw it towards them once. When it is upright, the students must bend down and pick up the clams caught in the rake and place them in the bucket. They will each have 30 seconds to collect shellfish. They cannot rake up one huge pile. After the second whistle, a ruler must be used to separate the legal and illegal harvesting sizes. Write scores in the second segment of each team's section.

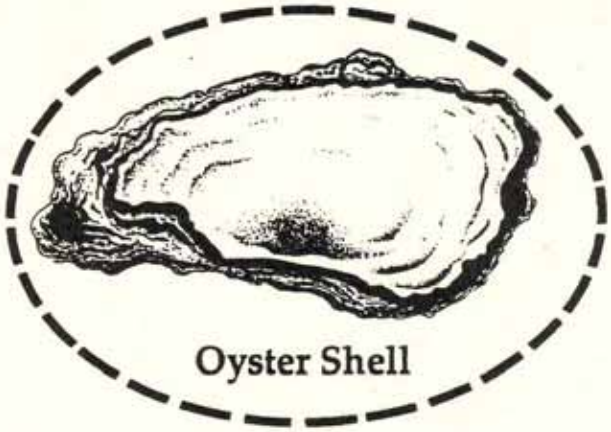
8) METHOD #3: Shellfishermen working from larger boats use a dredge to collect oysters. A dredge is made of a heavy metal frame with sharp teeth, to which is attached a metal collecting cage. As the boat moves, oysters are loosened from the bottom and collect in the cage. When the cage is filled, the dredge is hoisted onto the boat and emptied. Regulations state that empty oyster shells must be separated and returned to where they were taken from. (Shells provide a hard surface for young oysters to set, or attach to.)
RELAY FOR METHOD #3: Collect the hard clams and replace them with 50 whole oysters and 50 oyster shells in each bucket. Spread them out. Give each team a broom and dustpan. They will each have 30 seconds to sweep up oysters into the dustpan and empty it into the bucket when it's full. If their shellfish bed is empty, they cannot take oysters from another team's bed. After the second whistle, all empty shells must be "thrown back" and only the whole ones can be counted. Place these scores in the third segment of each team's section.

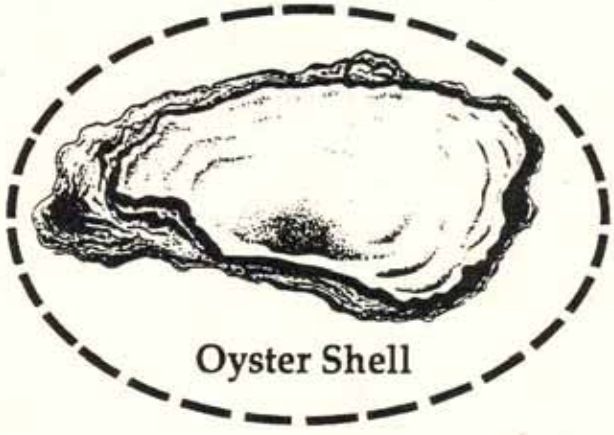
9) As a class, discuss the following:
- How could we increase the number of clams harvested by treading?
- How could we increase the number of clams harvested by raking?
- What two regulations needed to be abided by?
- Why might theses regulations exist?
- Discuss why some individuals might prefer one collecting method to another.

"Harvesting Relay" Worksheet









TITLE: **Classified Waters**

AGE LEVEL: JH

KEY WORDS: Regulations, Water Classification, Harvesting

OBJECTIVES: After performing this activity, students should be able to:

1) Describe a Shellfish Growing Water Classification Chart;
2) Explain how waterways are classified for harvesting shellfish;
3) Identify examples of NPS that serve to degrade shellfish waters.

SUBJECTS: Science, Geography

SKILLS: Calculating, interpreting, mapping and measuring

MATERIALS: Copies of "Classified Waters Chart,"Classified Waters" Worksheets and writing materials

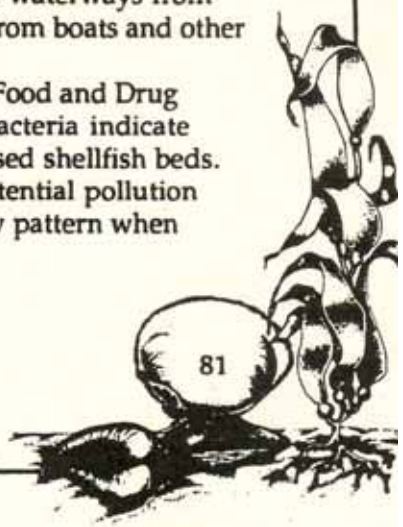
BACKGROUND INFORMATION: Introduction to Section Three and additional information:

The DEPE's Bureau of Marine Water Classification and Analysis develops and distributes the "Shellfish Water Classification Charts" for commercial and recreational shellfish harvesters. These charts are graphic representations of the entire NJ coastline with a focus on water quality. Four assigned water classifications are used: seasonal, prohibited, approved and special restricted. These classifications delineate the areas suitable for year-round harvesting, seasonal harvesting, no harvesting and harvesting only if the shellfish have additional processing in another location. Also included with the charts are harvesting rules and regulations.

The DEPE uses two assessment methodologies to determine water quality: water monitoring and evaluating. Monitored waters have an assessment based on collected data (the results of water testing, for example) and evaluated waters have an assessment based on data concerning land-use, potential pollution sources and surveys sent out to businesses and residents. Both sources of data are used in regards to NPS and shellfish harvesting.

The monitoring criteria for the charts is based solely on the concentration of coliform in the water. Coliform, a type of bacteria common in water, aids warm-blooded animals in digesting their food. Fecal coliform then travels through the digestive tracts of the animals and is released within the animal's waste products. Pet waste deposited along shorelines, in ditches, on sloped, hard surfaces and along curbs often travels with rain water. Improperly stored or treated manure can seep through the soil and impact ground water resources. The waste of concentrated waterfowl populations enters the water directly. Human waste can enter the waterways from leaking septic systems and the improper disposal of raw sewage from boats and other vessels.

The Environmental Protection Agency (EPA) and the Federal Food and Drug Administration (FDA) have determined levels at which these bacteria indicate pollution, which, when surpassed, lead to beach closures and closed shellfish beds. This data is also combined with information about actual and potential pollution sources, shoreline surveys and hydrographic studies of water flow pattern when determining the suitability of waters for shellfish harvesting.



For further information contact:
NJDEPE
Bureau of Marine Water Classification and Analysis
P.O. Box 405
Leeds Point, NJ 08220
(609) 441-3400

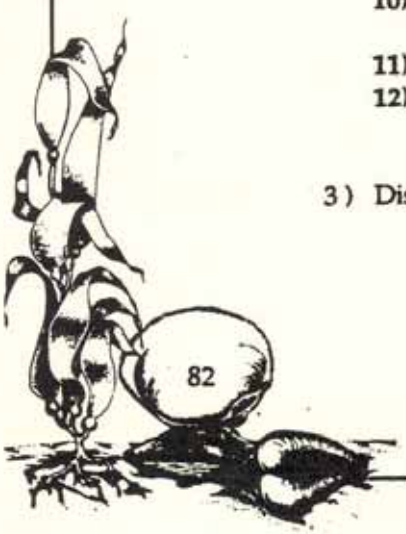
PROCEDURE:

1) Explain to the class that they will take a trip to southern New Jersey to collect clams. Using the NJ Road Map, trace the route south on the Garden State Parkway until Exit #4 is reached, near Cape May. Exit here and take route 47 north, along the Delaware Bay. Upon finding Dennisville and Dennis Creek, the search for clams will begin. Hang the road map up in the front of the classroom.

2) As clammers the students must have in their possession a recreational or commercial harvesting license, purchased through DEPE's Bureau of Shellfisheries. They should be familiar with the "Shellfish Growing Water Classification Charts." Discuss the background information for this activity and the purpose of these charts. Explain that the chart they receive has been simplified for easy use. Distribute pencils, rulers and copies of the hand-outs. Have them place their chart on the desk so that its north-pointing compass arrow points upward on their desks. Orient the chart with the southern tip of the state. Give them time to fill in the answers. The correct ones are given below:

1) **6,430 yards**
2) **Classification of POINT A: Seasonal Area**
3) **The fecal coliform count is higher in the summer due to the summer use of the homes and their septic systems, which may be over-used or operating improperly. Hence, harvesting is prohibited in the summer.**
4) **Distance from POINT A to POINT B: About 1.40 nautical miles. Classification of POINT B: Prohibited**
5) **The fecal coliform count is high year-round due to gulls and migratory shore birds.**
6) **No. It is against the law to harvest shellfish from manmade lagoons and marinas due to the number of pollutants that accumulate in these areas, such as oils, metals, animal waste from gulls and illegally disposed human waste.**
7) **Distance from POINT D to POINT C: About 1.90 nautical miles. Classification of POINT C: Special Restricted Area**
8) **Septic systems and wastewater discharge from the wastewater treatment facility allow a higher fecal coliform count in the water, which prohibits shellfish harvesting.**
9) **First offense warrants fines up to $500 and /or up to 30 days imprisonment. A second offense warrants fines up to $1000 and/or up to 6 months imprisonment.**
10) **Distance from POINT D to POINT E: About 1.35 nautical miles. Classification of POINT E: Approved Area**
11) **No, 150 clams per day is the legal limit for recreational clammers.**
12) **Site #13: Sign#3**
Site #14: Sign #2

3) Discuss:
- What examples of NPS were discussed in this activity?
- Reasons why these charts are important.
- How might this chart differ from one in a heavily populated area?



"CLASSIFIED WATERS" WORKSHEET I

1. Use your ruler and the map scale to measure the distance (in yards) from Port Elizabeth to POINT A on the map:_____yards

2. How is the water around POINT A classified?_____

3. Many summer homes exist along the shoreline near POINT A. Some leaking septic systems can cause pollution. How does this relate to the seasonal classification and the fecal coliform testing of the water?

_____

4. **Measure the distance (in nautical miles) from POINT A to POINT B: _____ (naut. miles) What is the water classification of the area surrounding POINT B?_____**

5. The drainage area to the bay at POINT B is supportive of large populations of waterfowl. How might this relate to the classification of the water and the fecal coliform testing?

_____

_____

6. If there were boating marinas within the area around POINT A, would shellfish harvesting be allowed near them?_____Why or why not?_____

_____

7. Measure the distance from POINT D to POINT C in nautical miles:_____(naut. miles) What is the water classification of the area surrounding POINT C?_____

8. **How might year-round housing developments along the Maurice River and a water treatment facility emptying into the Maurice River in Millville, NJ, affect the fecal coliform testing?** _____

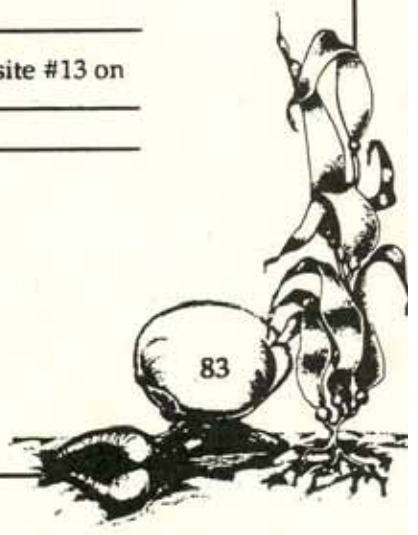
9. If you harvested shellfish illegally in the area around POINT C, how might you be penalized?_____

10. Measure the distance (in nautical miles) from POINT D to POINT E:_____(naut. miles) How is the area surrounding POINT E classified?_____

11. In six hours you manage to collect about 150 clams. Is it legal to take advantage of your success and try to collect another 50 or so with a recreational clam license?

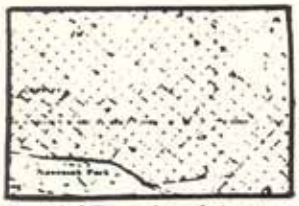
_____

12. Which of the three "Classified Waters" signs would be appropriate to post at site #13 on the map, to be read by people on shore?_____
How about site #14?_____



"CLASSIFIED WATERS" WORKSHEET II

TYPES OF WATER CLASSIFICATIONS:

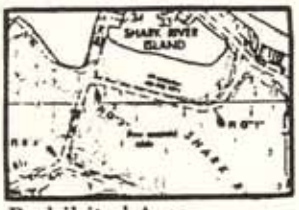


Special Restricted Area

Water condemned for the harvest of oysters, clams and mussels EXCEPT harvesting for further processing may be done under special permit from the NJ Department of Environmental Protection and Energy.

Seasonal Area

Waters which are condemned for the harvest of shellfish. Refer to specific charts for seasonal dates where applicable.



Prohibited Area

Waters condemned for the harvest of oysters, clams and mussels.

Approved Area

Waters approved for the harvest of oysters, clams and mussels.

SOME HARVESTING REGULATIONS:

1) No one may take or catch more than 150 clams per day unless he or she is a holder of a Commercial Clam License;
2) All marinas and man-made lagoons are prohibited for shellfishing.

PENALTY FOR ILLEGAL SHELLFISHING:

Harvesting shellfish illegally is punishable in the following manner:

1st Offense: Petty Disorderly Persons; fines up to $500 and/or up to 30 days imprisonment

2nd Offense: Disorderly Persons; fines up to $1000 and/or up to 6 months imprisonment

TYPES OF POSTED "CLASSIFIED WATERS" SIGNS:

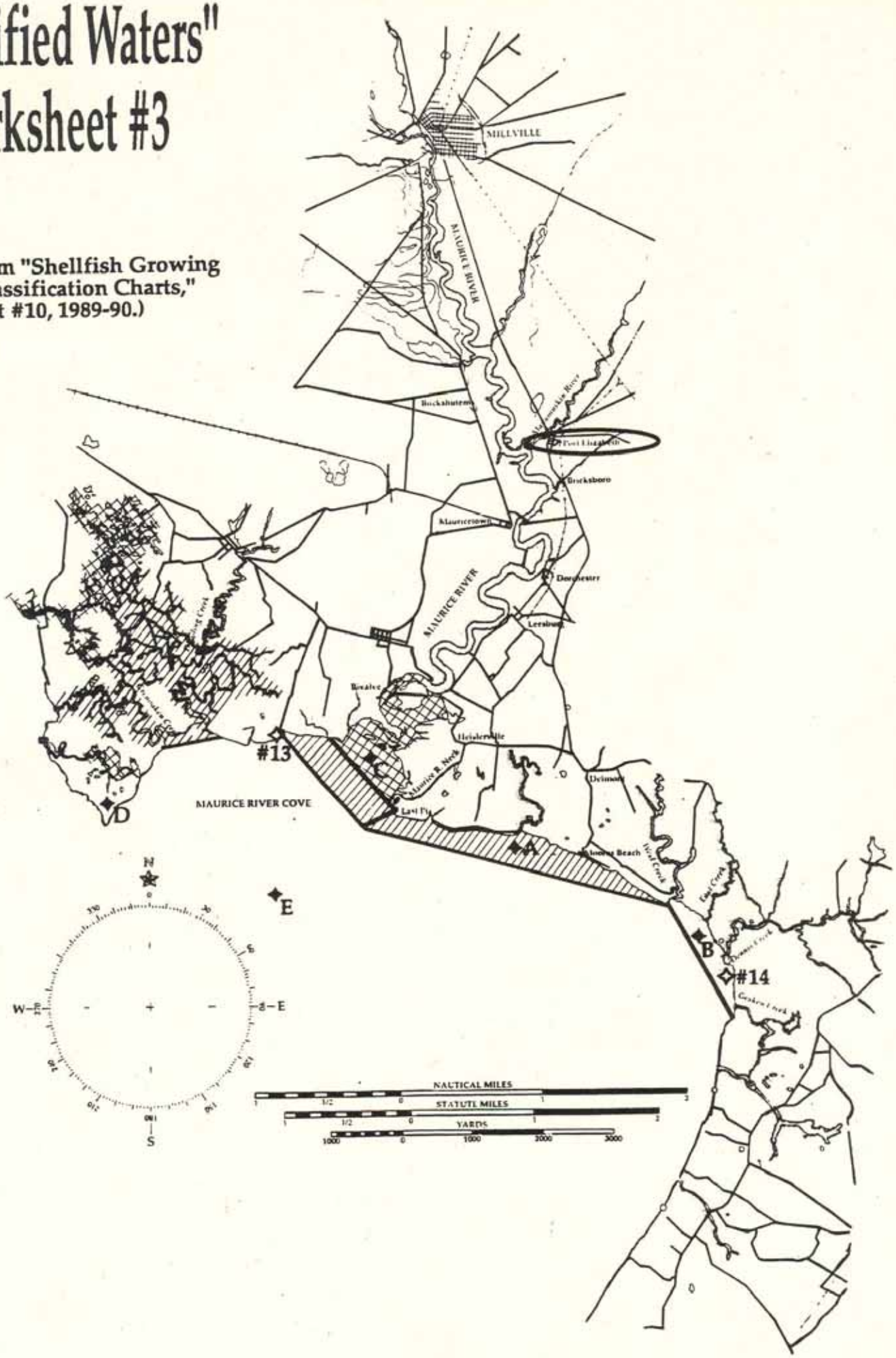
#1

#2

#3

"Classified Waters" Worksheet #3

(Excerpt from "Shellfish Growing Water Classification Charts," chart #10, 1989-90.)



TITLE: **Shellgo**

AGE LEVELS: P, I, JH

KEY WORD: Uses

OBJECTIVE: After performing this activity, students should be able to:
1) Identify a number of ways shellfish are used.

SUBJECT: Science

SKILLS: Associating, constructing, identifying and matching

MATERIALS: Glue, scissors, one copy of "Shell" card and "Shellfish and People" Worksheet per student, two copies of the "Clam Chips" Worksheet per student and a box

BACKGROUND INFORMATION: Introduction to Section Three

PROCEDURE:

1) Brainstorm a list of ways that people use shellfish. Distribute the copies of the "Shellfish and People" worksheets and compare their list with the ones on this sheet. Explain that these uses will be the focus of a game they will play called "Shellgo," modeled after the game "Bingo."

2) Have the students cut out the individual shellfish uses from the "Shellfish and People" worksheets and keep them in a pile. Next, distribute the copies of the "Shell" card and have the students glue one use onto each square. Have them work independent of each other so that each card is different. Leave the "Free Spaces" open. Finally, distribute two copies of the "Clam Chips" worksheet to each student and have them cut each clam chip out. These will be used as markers. While they are busy, cut up an additional set of shellfish uses from a "Shellfish and People" worksheet and place these into the box.

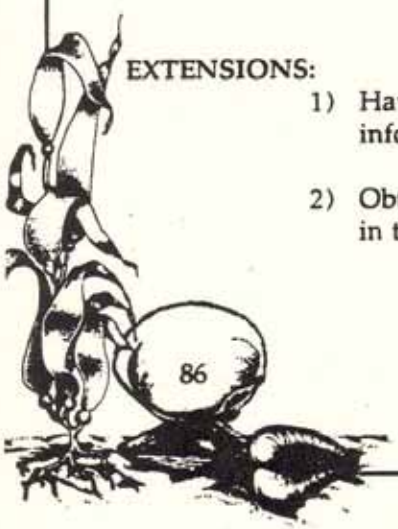
3) Pick a "use" square from the box and announce it to the class. The students will place a clam chip on top of this use on their own "Shell Card." Continue picking until a winner gets five-in-a-row, diagonally, horizontally or vertically. (You can also attempt the "four corners.") The winner yells "Shellgo!"

NOTE: After a "use" is chosen, the teacher may want to give the class hints about it until the students guess which use was chosen.

EXTENSIONS:

1) Have each of the students research one of the uses given above and report further information about it to the class.

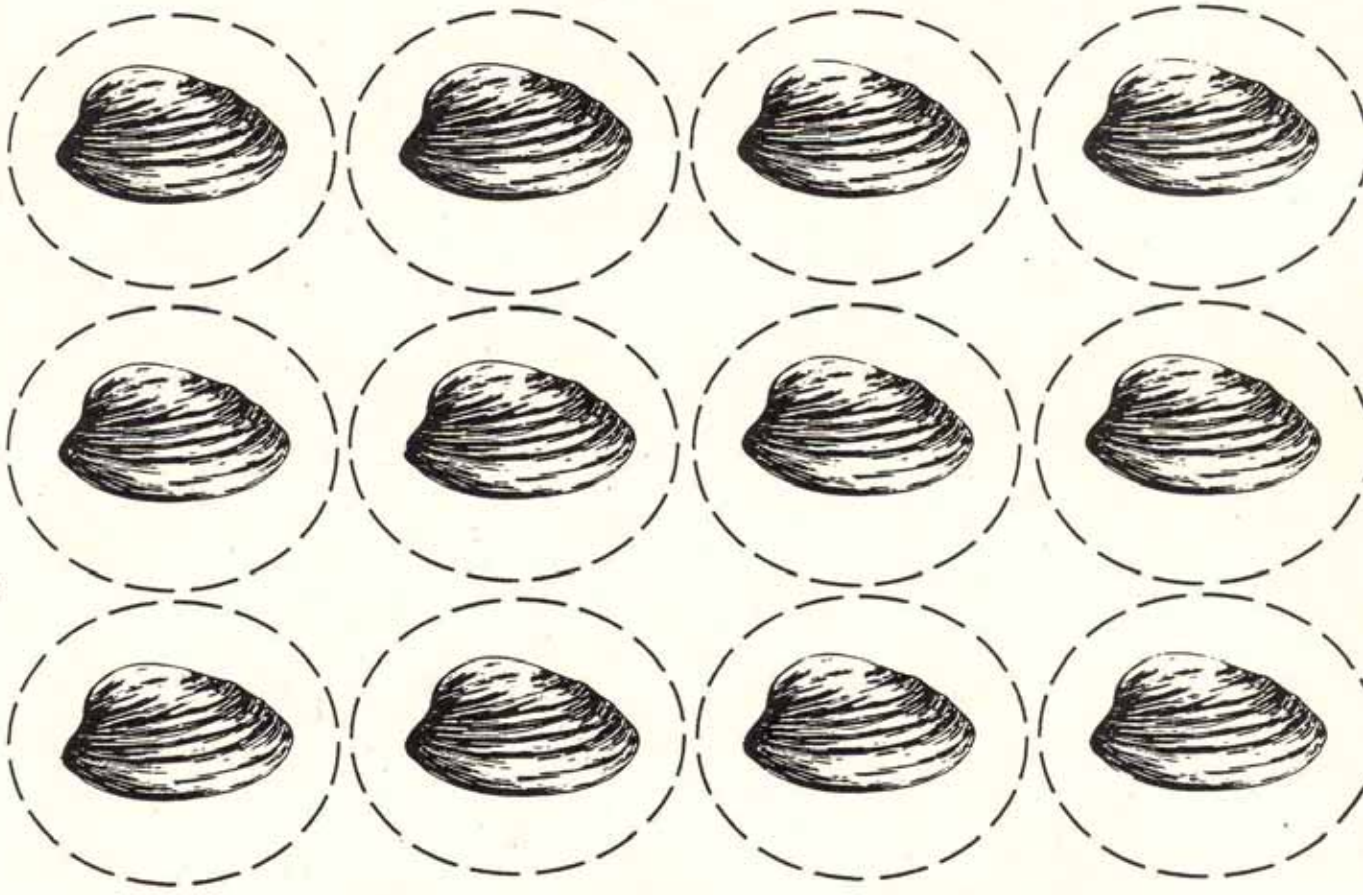
2) Obtain a simple shellfish recipe, such as clam dip or clam chowder, and create it in the classroom for a light snack.



"Shellfish and People" Worksheet

Clam Chowder	Shell Collecting	Indicators of Water Quality	Source of Food for Starfish
Food for Oyster drills	Bedding for Marine Aquarium	Ash Trays and Dishes for small Objects	Clams Casino
Bracelets	Oysters on Half-Shell	Fried Clams	Fertilizer
Buttons	Wampum (Money) Used by Indians	Food for Gulls	Steamed Clams
Form of Recreation for Harvesters	Earrings	Source of Income for Harvesters	Shells Crushed and Used to Make Roads
Revenue for State from Sales of Supplement Shellfish	Oyster Stew	Source of Protein in Diet	Source of Calcium; Dietary

"Clam Chips" Worksheet



S	H	E	L	L
		 Free Space		

SECTION FOUR

WAVES OF CHANGE

Perhaps the most valuable result of all education
is the ability to make yourself do the things you have to do,
when it ought to be done, whether you like it or not.
- Thomas Henry Huxley

KEY WORDS:

Each morning, more than 7 million New Jerseyans wake up and begin to make decisions: What should be worn? What should be packed for lunch? Does the car need a tune-up? Each decision made is based on knowing just how that particular decision and action will affect that person's life. In order to reduce and eliminate nonpoint source pollution (NPS), it is also just as important to understand how these daily decisions and actions affect the environment.

Personal Values

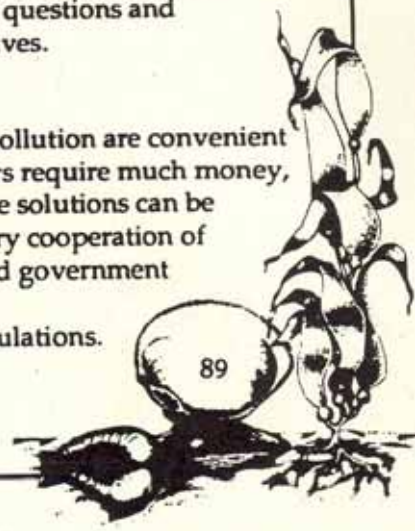
This guide provides teachers and students with information and activities focusing on the water cycle, water movement, examples of nonpoint source pollution and its impact on the state's waterways and shellfish populations. Knowledge has been gained and, hopefully, personal values exhibiting a greater respect and appreciation for water and the environment, have been demonstrated. So, if one would like to take positive action for the environment and encourage others to do so, how does one begin?

Making Decisions

Preventing nonpoint source pollution begins with proper decision-making. A homeowner, commercial landscaper and a golf course owner should each gather information on which fertilizers are safest for the environment and how they are to be applied. A dog breeder, farmer or horse owner should learn how to safely store and dispose of animal waste. A mayor should be concerned with upgrading his or her municipality's stormwater system. The owner of a home, a carwash or a commercial fishing fleet should be familiar with environmentally safe cleaning materials and their proper disposal. Making an environmentally responsible decision requires accurate and current information. This information can be obtained by contacting related organizations, researching, attending meetings, asking questions and getting involved with local groups and initiatives.

NPS Solutions

Many of the solutions to nonpoint source pollution are convenient and cost little or nothing to implement. Others require much money, planning and time to fund and develop. Some solutions can be accomplished by individuals and the voluntary cooperation of families, businesses, schools, communities and government agencies. Others require the passage and/or enforcement of local ordinances and state regulations.



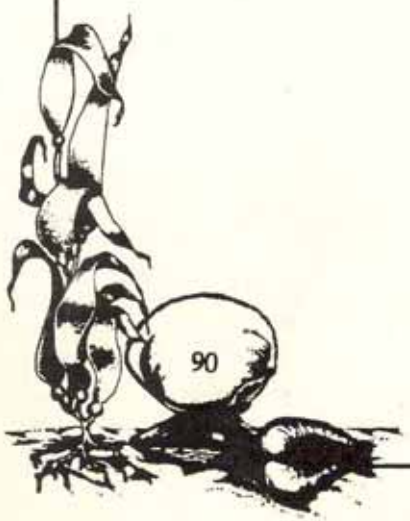
In response to the growing national concern for nonpoint source pollution, Section 319 of the Federal Clean Water Act directs each state to develop programs for controlling NPS. The Department of Environmental Protection and Energy has developed a Nonpoint Source Pollution Assessment and Management Program Plan which describes New Jersey's NPS concerns and explains what the state intends to do to address these concerns. The program stresses the need for the cultivation of public and legislative support for NPS solutions. An additional need is the obtaining of better information regarding the specific origins and impact of nonpoint source pollution. Also necessary is the need for the DEPE to prepare regulations and guidelines for the development and implementation of NPS control programs. These programs can then be carried out with the support and involvement of state, county and municipal government agencies.

Environmental Action

Once students begin to understand how their lifestyles depend and impact upon the environment they, too, can initiate nonpoint source pollution prevention measures. Halting NPS at the source begins with the individual in the classroom and at home and can focus on personal habits and behaviors. NPS prevention efforts can expand into district and community programs, networking with other groups and interfacing with parents, administrators, municipal employees, political leaders, business and industry and representatives from other organizations.

It is important that students of all ages realize that they can, and do, make a difference. The prevention of nonpoint source pollution provides students and student environmental groups with a focus that has a purpose, requires direct involvement and serves to strengthen skills related to group dynamics, research, leadership, public speaking, writing and public relations. Students are also provided with an opportunity to learn how to gather information, make responsible decisions and work cooperatively to plan, implement and evaluate an effective NPS program or project.

By the year 2010, the state's population is estimated to climb to more than 8.5 million people. Clearly, a balance must be achieved between the proper maintenance of New Jersey's waterways and the daily actions of its people. There is much that can be accomplished through the participation of teachers and students. Let this guide be only the beginning.



SOME SOLUTIONS TO NPS

(Refer to "Examples of Nonpoint Source Pollution," pages 36 & 37, for additional information.)

SEDIMENT:

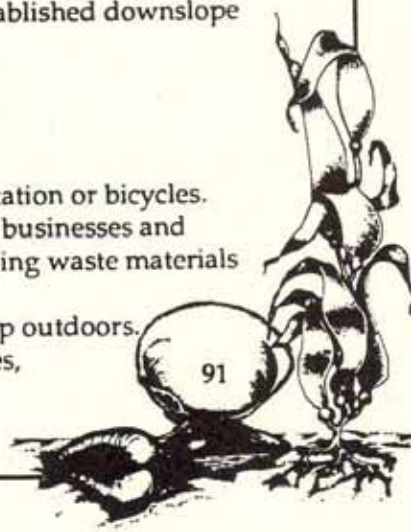
- Check the property regularly for signs of erosion and runoff; explore following a rainstorm and look for gulleys, cloudy streams, low, mushy areas, soil piles, etc.
- Make it a regular practice to sweep the walkways, driveways, sidewalks, roads and storm drains free of clutter, and dispose of materials properly.
- Put gravel or grass along driveways, parking lots and sidewalks to collect and absorb the rainwater runoff and prevent soil from eroding; use bricks and stones instead of cement when in need of a hard, porous surface.
- Build steps or a ramp between the top and bottom of a bank or hill, if it is traveled upon often.
- Place a splash block under gutter downspouts to prevent splashing and erosion. Keep gutters clear and channel rainwater to grass or gravel where it will be absorbed.
- Plant trees and bushes wherever possible to encourage water infiltration into the soil.
- To prevent erosion on hills and along ditches and streambanks, plant low-growing plants, bushes or trees; "terracing" is a good landscaping technique to hold the soil in place.
- When storing piles of soil or sand, do not pile on paved areas where it will wash away in a rain; store on soil or gravel and cover with plastic tarps.
- When building, sediment ponds work well in hilly, sloped areas to trap runoff and sediment; these can later be converted into ponds for wildlife or even an ice skating rink.
- When building, use staked hay bales, fabric and plastic to trap sediment that moves with the wind and rain on the downhill side of a construction site.
- When farming, plant crops and orchards on the contour of the land (not up and down the slope) to reduce erosion and increase water absorption in the soil.
- When farming or gardening, leave "crop residue" after harvesting when the ground is usually bare; this aids in keeping the soil in place.

EXCESSIVE NUTRIENTS:

- Substitute natural products and mechanical and biological techniques for chemical fertilizers, whenever possible; research the options; in small areas, pull weeds by hand and remember that a few weeds are fine.
- Use fertilizers only when necessary and do not use more than what is needed. Test the soil before purchasing a fertilizer and purchase what is right for your needs. Apply according to directions, at the proper time of year, and store in the original container. Dispose of all containers properly. Avoid getting fertilizers on paved surfaces and never apply them near a waterway unless it is allowed for such use.
- Do not dump leaves, sticks or grass clippings into storm drains, streams, ditches, etc. and do not leave them at the curb unless they are picked up immediately.
- Try composting leaves and clippings or mixing them with sawdust, hay and other materials to apply the mixture as a mulch.
- When farming, landscaping and building, keep a strip of vegetation established downslope of a field to reduce pollutants from entering a waterway.
- Monitor septic tanks to make sure that they are operating properly.
- Do not use detergents and cleaning materials that contain phosphorus.

TOXIC METALS:

- Cut down on car use by carpooling, walking and using public transportation or bicycles.
- Support the mapping of storm drains in your municipality; pipes from businesses and industry that are illegally tied into the storm drain system or are dumping waste materials into the drains can then be detected.
- Dispose of old batteries at a hazardous waste pick-up day; do not dump outdoors.
- Purchase rechargeable batteries and plug in appliances that use batteries, whenever possible.



ANIMAL WASTE:

- Support and enforce "Pooper Scooper" laws in your local area.
- Do not let pets defecate near water or on paved surfaces; walk pets in grassy areas or undeveloped areas. Collect animal waste and dispose of it in the garbage or toilet.
- Do not feed waterfowl in an area where they can become overpopulated.
- Manage large amounts of animal waste by constructing a temporary structure where it is properly stored, composted or treated.
- Collect runoff from roofs and maintain the roof to prevent rainwater from carrying untreated animal waste out of barns and holding areas. Clean pens regularly.
- Enclose sensitive areas of water with fencing to control access by animals and people.
- When on a boat, never discharge raw, untreated sewage directly into the water.

PESTICIDES:

- Substitute biological methods in place of chemical pesticides, whenever possible; research options.
- When purchasing, read the labels and know what you are buying; "Warning" indicates a higher toxicity than "Caution;" those without either are least toxic.
- Keep containers properly labeled and stored. Share excess pesticides with neighbors, churches or offices so that they will be used up. Dispose of pesticides containers properly, such as on a "Hazardous Waste Clean Up Day." If such a day is not available, wrap empty containers in newspaper and place them in the trash, unless labels specify another means of disposal.
- Create pest barriers around plants to keep them out; dislodge some pests with sprays of water.
- Applying pesticides at a time when winds are low and there is no impending rain.
- Consult your local forester, Soil Conservation District Office or the Cooperative Extension Office to find out more about your options and to determine if treatment is necessary.
- Choose a pesticide with the shortest half-life, which will be less likely to cause environmental damage. Choose pesticides that require fewer applications.
- Never apply pesticides near a well or waterway unless stated in directions.
- If spilled, do not rinse with water; absorb with soil or kitty litter and dispose of properly.

ACIDIC DEPOSITION:

- Cut down on car use by carpooling and walking or using public transportation and bicycles.
- Conserve electricity; use appliances and lights only when necessary.
- When burning wood or coal, make sure that the proper equipment is in place to control emissions.

MOTOR OIL:

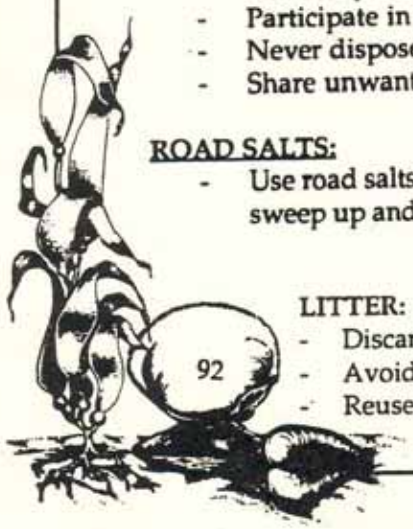
- Never dump oil into the ground, water, storm drain or ditch; take it to an auto repair garage, car dealership or filling station and make sure that it will be recycled.
- Check cars, boats, motorcycles, lawnmowers etc., to avoid leakage.

HOUSEHOLD HAZARDOUS WASTE:

- Read labels of hazardous substances before buying; be familiar with potential hazards.
- Use and purchase less harmful substances as much as possible; research the options.
- Participate in efforts to create a "Hazardous Waste CleanUp Day" in your county.
- Never dispose of such waste in the ground, water, storm drains, ditches, toilets or sinks.
- Share unwanted household hazardous materials with others; buy only what you need.

ROAD SALTS:

- Use road salts only when necessary, do not use excessively; use sand or other substitute and sweep up and reuse, if possible.



LITTER:

- Discard all trash, recyclables, and non-reusable items properly; do not dump.
- Avoid excessively-packaged purchases; cut down on the trash you dispose of.
- Reuse and share containers, bags, clothing, shoes, etc.; donate items to groups who can use them.

Water and You

Connect the dots of each of these figures. Color the things that need water to live. Add to the picture by drawing other living things that need water.

TITLE: Bringing Values to the Surface

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Cite personal values related to water;
2) Recognize that personal behaviors can impact on water quality and quantity;
3) Recall a number of nonpoint source pollution solutions that can be performed as a part of their daily activities.

KEY WORDS: Personal Values, Making Decisions, NPS Solutions

SUBJECTS: Science, English, Art

BASIC SKILLS: Analyzing, applying, drawing, identifying, listening, listing and prioritizing

MATERIALS: Paper, copies of the "Bringing Values to the Surface" Worksheet (one per student), crayons or markers, pencils, a tape or record of water or ocean sounds or a quiet piece of classical music, and a tape or record player

BACKGROUND INFORMATION: Introduction to Section Four

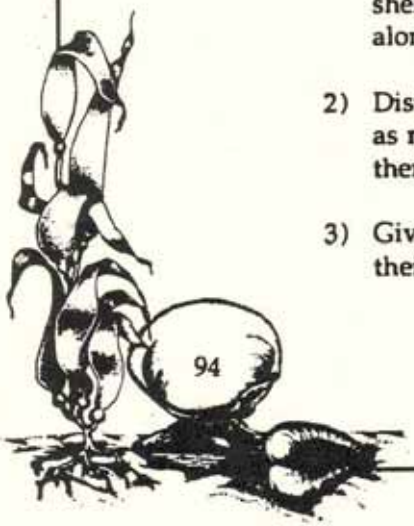
PROCEDURE:

1) Turn off the lights in the classroom. Have the students assume a comfortable position and close their eyes. Ask them to take a few deep breaths, relax and be as quiet as possible. Turn on the music and play it softly as background music. Ask them to quietly imagine the scene that you are about to create. After a few moments, read the following narrative in a quiet voice:

   My trip began one morning after a long night of strong, gusty winds and rain. Leaves have not grown on me for a couple years now and water has long since left my wood. Having become a dry, brittle and dead branch, I fell from the tree with a loud crack and landed in the stream below. I was quickly drenched and moved swiftly with the strong current. During the morning I floated by deer drinking at the shoreline and herons hunting for fish. I passed the backyards of many homes and meandered through parks, farms and small towns. Roads crossed over me and sometimes a small boat would travel near me. The stream emptied into a river. As I floated on its water I saw factories and cities along its distant shoreline. Pipes emptied water into the river and barges and ships traveled up and down its channel. Soon it widened into a bay. By this time I was soaked with water and was so heavy that I sank. I movedslowly along the bottom, mingling with fish, crabs, aquatic plants and shellfish. It was quite some time before I felt the air again when I was washed up along a stretch of sandy beach. The warm sun dried my wood.

2) Distribute pencils and the blank paper. Ask the students to focus on water and list as many phrases as possible that describe why they value water in their lives. Give them a few moments to work on the list.

3) Give each student a copy of the "Bringing Values to the Surface" Worksheet. From their individual lists, have them choose the <u>two</u> that they feel are the most



4) Have the class again create individual lists, this time describing ways in which their daily behaviors have some type of impact on the quantity and/or quality of New Jersey's water. Examples could include washing the car or brushing teeth, consuming items containing water, and using items whose production requires water, such as a newspaper or electricity. From their individual lists, have the students choose <u>two</u> behaviors that they feel have a great impact on water. Pictures of these two behaviors should be drawn into sections 3 and 4 of the clam shell.

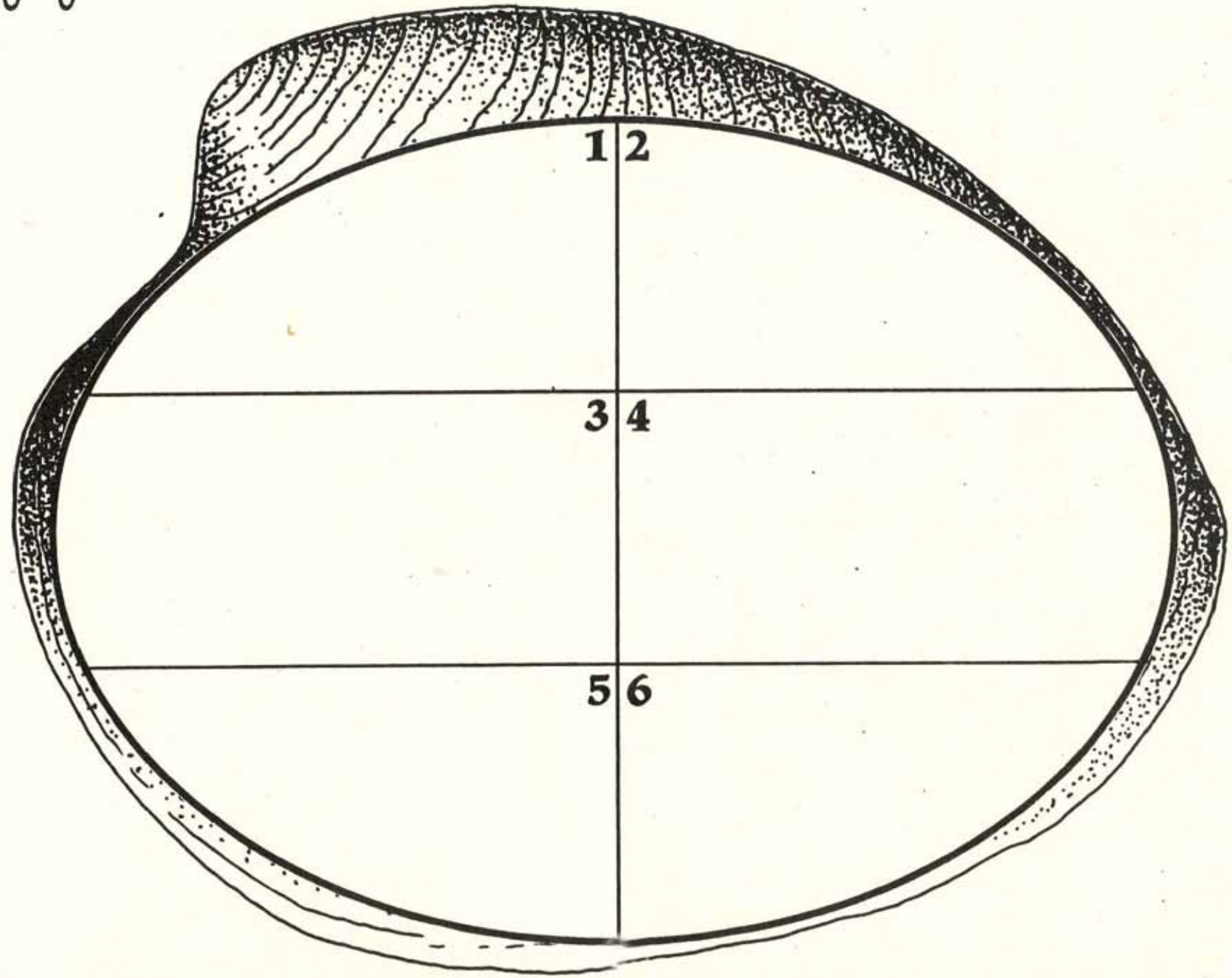
5) Using the pictures in sections 3 and 4 as references, have the students draw <u>two</u> behavior changes in sections 5 and 6 that, when implemented, would conserve and/or preserve the quantity and/or quality of New Jersey's water. Examples could include conserving electricity or water, not littering and recycling newspaper. Ask individual students to share their "clam shell" findings with the class.

6) Create a list on the board of everyone's behavior changes. Write each one down only once. Place a check next to those that are duplicated. The list should contain a number of solutions to nonpoint source pollution (NPS). Discuss:
   - Which behavior changes can be made by individuals? Families? Communities?
   - Which behavior change is the easiest for an individual?
   - Which is the cheapest for an individual?
   - Which behavior change is the hardest for an individual?
   - Which is the most expensive for an individual?
   - Go down the list and ask the students to raise their hands for the changes that they each feel they can realistically make in their own life.
   - If the class had to choose one behavior change that would be the most important one for everyone to make, which one would it be? Debate this with the class.

EXTENSIONS:

1) Have the students research why water is important to the human body.
2) Instruct the students to write a short story beginning with one of the following sentences:
   - ***If it did not rain here for one year . . .***
   - ***If my drinking water became contaminated. . .***

"Bringing Values to the Surface" Worksheet



TITLE: **Nonpoint Source Pollution - Live!**

AGE LEVELS: P, I

OBJECTIVES: After performing this activity, students should be able to:

1) Recognize six examples of nonpoint source pollution (NPS);
2) Explain how these six NPS examples affect the environment;
3) Suggest ways that these examples of NPS could be prevented.

KEY WORDS: Making Decisions, NPS Solutions, Environmental Action

SUBJECTS: Science, Drama

SKILLS: Analyzing, dramatizing, formulating, observing and recognizing

MATERIALS: One copy of the "Storm Drain Watch" activity, page 46 & 47. These stories should be cut into separate pieces of paper.

BACKGROUND INFORMATION: "Some Solutions to NPS" on pages 91 & 92 and the Introduction to Section Four

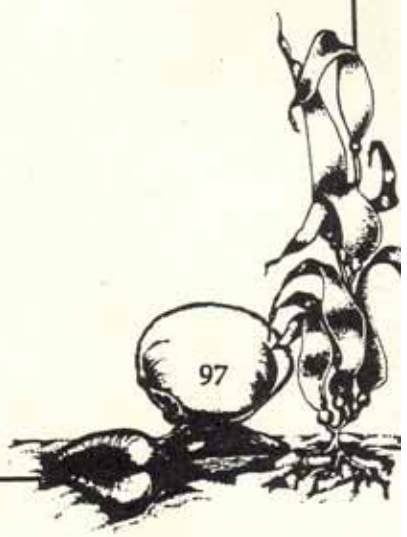
PROCEDURE:

1) Divide the class into groups of three or four students and place the groups around the room. Give each group a piece of paper with a story on it (whisper it to them, if necessary), and announce that each group will act out their story for the rest of the class. When performing, the students are not allowed to speak, but they can make noises to simulate their actions. Let them discuss and rehearse their performance for 5 - 10 minutes.

2) When all are ready, have the groups perform, one group at a time. After each performance, the class must determine the following:
   - Describe the scene and determine the example of nonpoint source pollution;
   - Discuss who and what might be affected by this type of pollution;
   - List ways in which this example of nonpoint source pollution can be prevented.

EXTENSION:

1) Perform these skits and tie them in with a presentation to other classes.



TITLE: **Wheeling and Dealing**

AGE LEVELS: I, JH

OBJECTIVES: After performing this activity, students should be able to:

1) Identify examples of and solutions to some forms of nonpoint source pollution;
2) Recognize factors in the home setting that challenge or support NPS reduction and prevention measures.

KEY WORD: NPS Solutions

SUBJECT: Science

BASIC SKILLS: Applying, comparing, constructing, deducing, identifying and interpreting

MATERIALS: Scissors, brass fasteners (1/2", one per student), gummed reinforcements (4 per student), glue, transparent tape, writing materials, mural paper, markers and the following information per student: one copy of worksheet #1, worksheet #2 and the "NPS at Home" Survey sheet and two copies of worksheet #3

BACKGROUND INFORMATION: Introductions to Section II and Section IV, "Some Solutions to NPS" on pages 91 & 92 and "Examples of Nonpoint Source Pollution" on pages 36 & 37

PROCEDURE:

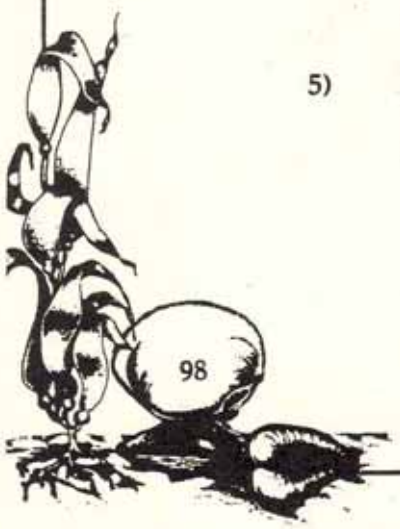
1) Distribute the "NPS at Home" Survey sheets. Ask the students to complete this survey with other members of their household. The purpose of the survey is to gather information regarding what the family is doing at home that prevents or contributes to, nonpoint source pollution. Allow the students about one week to complete the survey.

2) Review their answers as a class. Divide the chalkboard into two sections. On one side list the survey answers that would prevent NPS. On the other side list the answers that contribute to NPS. Discuss reasons why the answers vary from family to family.

3) Distribute the glue, scissors, tape, fasteners, reinforcements and worksheet copies to the students. Announce that they will construct an NPS information wheel.

4) Instruct the students to cut out the pieces in worksheets #1 and #2. Have them dribble a thin strand of glue around the edge of one of the circles and press the circles together. The writing on each piece should be facing outwards. Make sure that the six written sections on one piece are lined up with the sections on the other.

5) Next, have the students cut out both pieces from worksheets #3. Cut out the "windows" on these pieces. Make a small central hole on each of the four pieces and place a gummed reinforcement surrounding each hole.

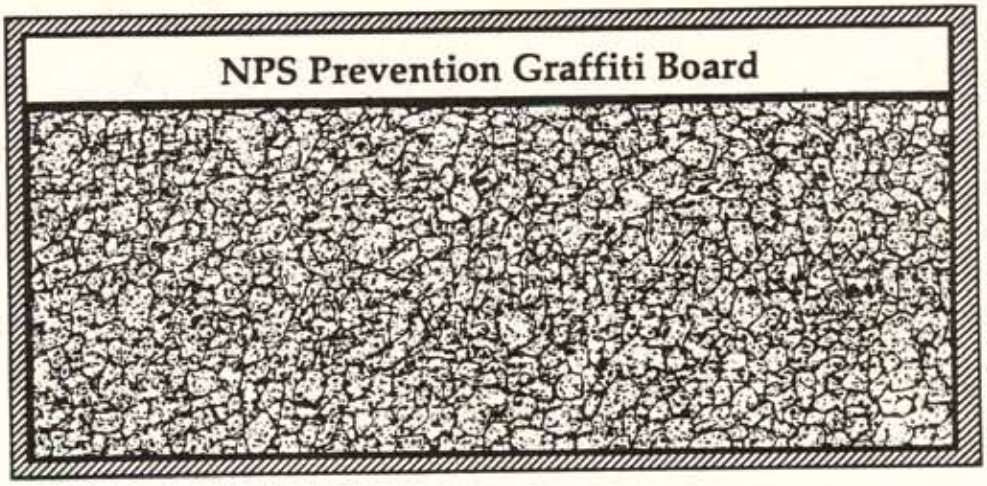


6) Place the glued circles between the two larger pieces, making sure that the writing on #3 and #4 is facing outward. Push the brass fastener through the center of the four pieces. Bend the arms of the fastener so that the four pieces are secure. Finally, line up the tops of the larger pieces and tape the corners together. The "wheel" in the center should rotate freely and the information in each section of the wheel should be visible through the windows. Allow them time to become familiar with their wheels.

7) Ask the class the following questions:
- What are pathogens?
- What example of NPS contains them?
- Which example of NPS should be taken to a gas station to be recycled?
- What carries NPS from one location to another?
- How can you prevent household hazardous waste from becoming nonpoint source pollution?

8) Ask the students to take their NPS wheels and completed surveys home to their families. Have them discuss the reasons why some of what is being done is good while other activities are harmful to the environment.

9) Create an "NPS Prevention Graffiti Board" in the classroom. Enlarge the chart shown below on a piece of mural paper and hang it in the classroom. Announce to the students that they will participate in a contest to reduce NPS in the school district. Over the next two months (or any assigned time period), the students are to encourage and promote positive NPS solutions that would take place by them or by their family members. On the mural paper, have the students begin to express the positive actions that already take place in their households or new ones that begin to take place during the two month time span. They can express their NPS solution with words, pictures, drawings or poetry. Have them sign their names by their family's accomplishments. Discuss whatever is added to the mural paper at the end of every week.



EXTENSION:

1) Work with another class to make "NPS Wheels" in their classroom. Have the students explain nonpoint source pollution to the new students by using the information provided in this guide.

"NPS AT HOME" SURVEY

1) How many people live in your home? _____ Describe your residence (Check 1 per column):

Inner-city	____	Apartment complex	____	Do not have yard/property	____
Urban	____	Townhouse/condo	____	Have yard/do not maintain it	____
Suburban	____	Duplex	____	Have yard/do maintain it	____
Rural	____	Single family home	____		

2) What do you think should be done with used motor oil?

Drain directly into grass	____	It is not my concern; mechanic's decision	____
Drain directly into soil	____	Motor oil should be recycled at a gas station,	
Dump into storm drain	____	auto repair garage and car dealership	____

3) What information can be gained by reading the labels of household cleaners, fertilizers and pesticides prior to purchasing? _____

_____

4) Check the materials in your possession that you consider to be harmful to human health:

Latex paint	____	Bleach	____	Floor/furniture polish	____	Other:	
Turpentine	____	Glass cleaner	____	Moth balls	____		____
Fertilizer	____	Oven cleaner	____	Rat/mouse poison	____		____
Furniture		Tub/tile cleaner	____	Air fresheners	____		____
stripper	____	Drain cleaner	____	Batteries	____		____

Choose three that can be substituted with less harmful choices or solutions: _____

_____

_____

How would you dispose of these if you no longer needed them? _____

_____

_____

5) Whether you have a pet or not, what do you think should be done with pet waste?

Leave pet waste on grass or soil	____	Pick up waste; dispose in toilet/trash	____
Leave pet waste near water source	____	Leave pet waste along curb or in street	____

6) Are fertilizers used on your lawn and/or garden? ____ What do you consider to be optimum conditions for fertilizing? _____

_____

7) What materials do you recycle?

Newspaper	____	Cardboard	____	Aluminum	____	Motor oil	____
White paper	____	Glass	____	Tin	____	Antifreeze	____

Why is recycling beneficial? _____

8) List items that are re-used in your home (clothing, containers, bags, etc.) _____

_____

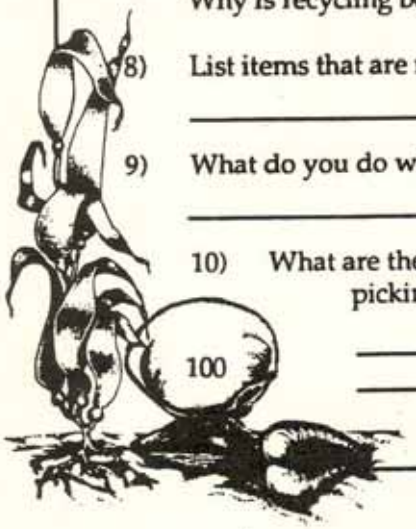
9) What do you do with grass clippings, leaves and sticks/branches picked up around your home?

_____

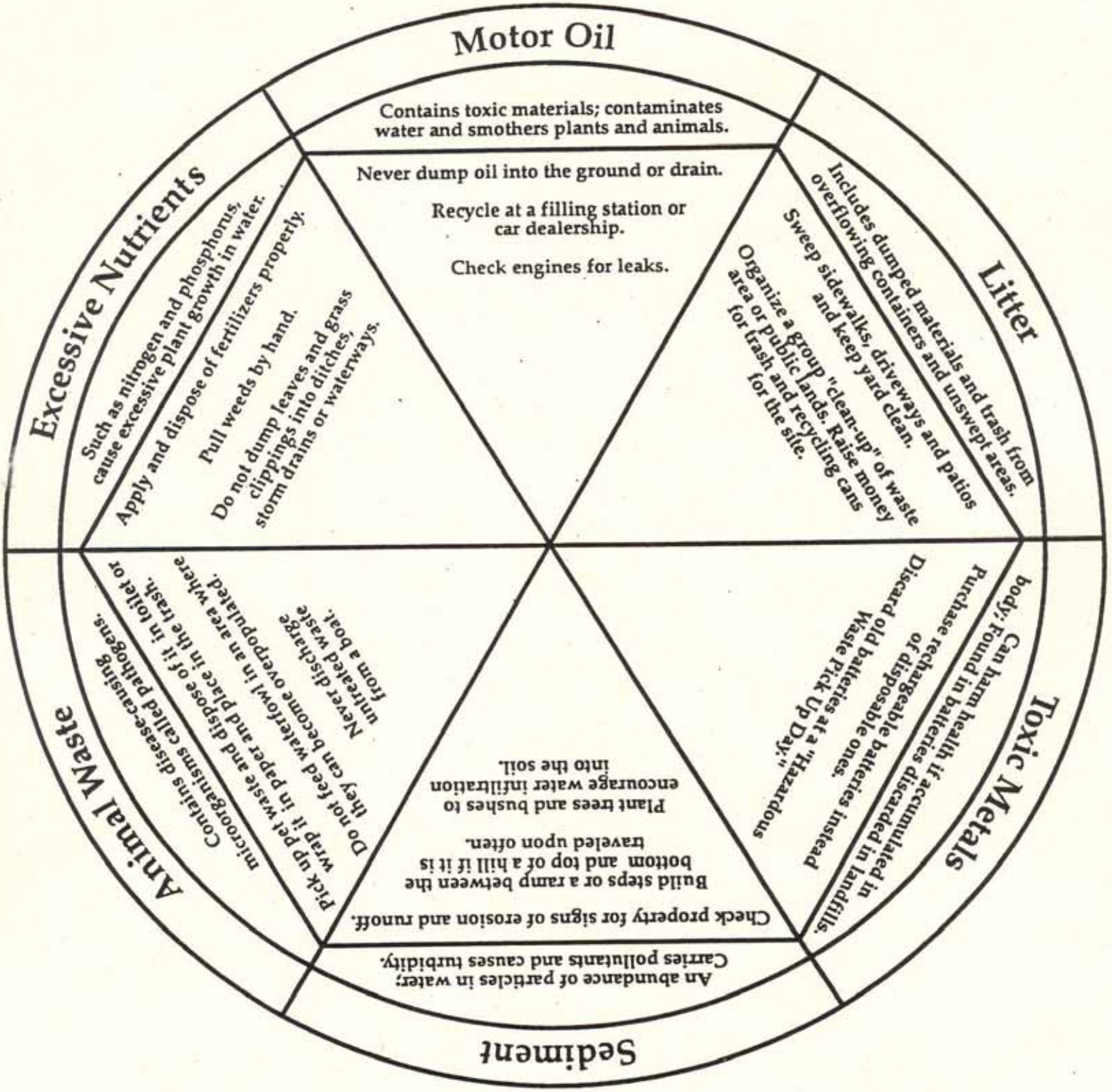
10) What are the benefits of sweeping your driveway, walkways and patio regularly and picking up litter? _____

_____

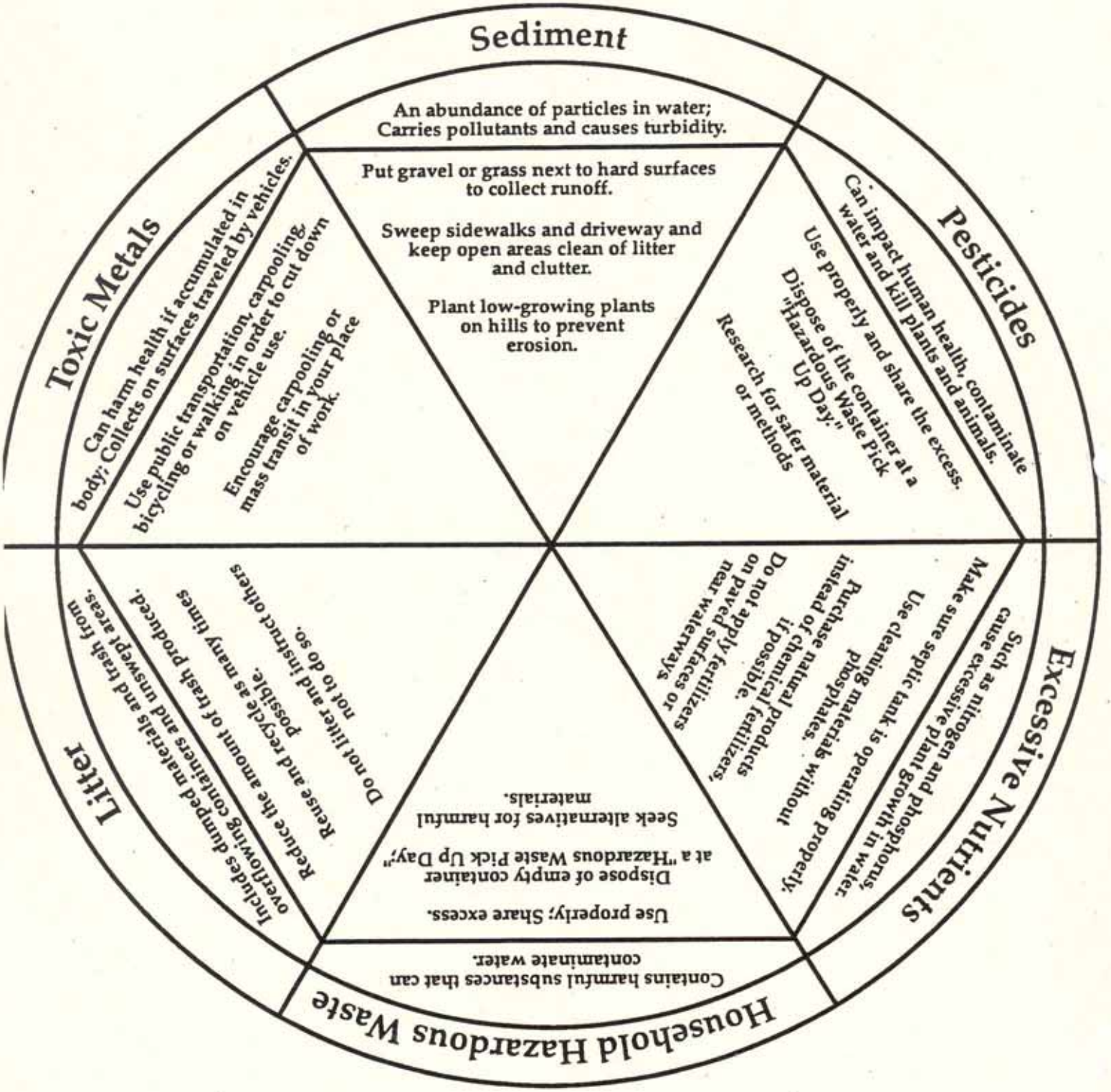
_____



"Wheeling and Dealing" Worksheet #1



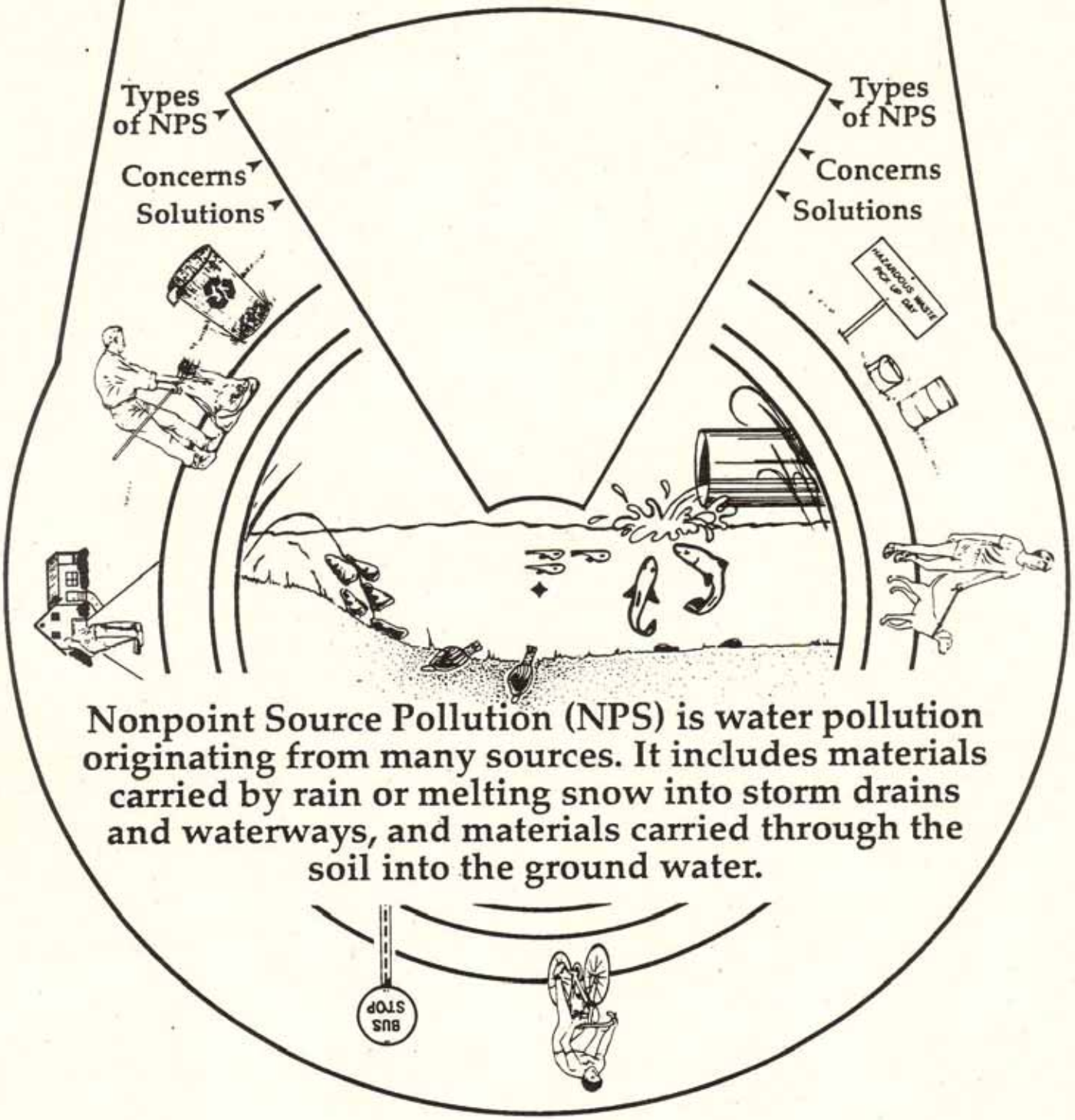
"Wheeling and Dealing" Worksheet #2



"Wheeling and Dealing" Worksheet #3

Your Guide to Nonpoint Source Pollution Prevention

The NPS Wheel



Nonpoint Source Pollution (NPS) is water pollution originating from many sources. It includes materials carried by rain or melting snow into storm drains and waterways, and materials carried through the soil into the ground water.

TITLE: Options

AGE LEVELS: JH, SH

KEY WORDS: Making Decisions, NPS Solutions

OBJECTIVES: After performing this activity, students should be able to:

1) Identify examples of nonpoint source pollution and related solutions;
2) List considerations needed when developing a plan that would involve the volunteer efforts of many people in a large area;
3) Devise a plan for a given area, when provided with the necessary information.

SUBJECT: Science

SKILLS: Analyzing, comparing, debating, developing, evaluating, identifying, problem solving and role playing

MATERIALS: Copies of the "The Navaho River " Story (1 per student), "Description of Characters" (2 copies, cut up into individual slips of paper), "Some Solutions to NPS" on pages 91 & 92 (1 per student) and writing materials

BACKGROUND INFORMATION: Introductions to Sections One, Two, Three and Four

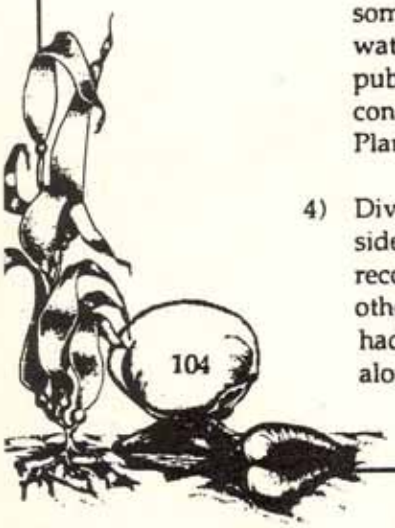
PROCEDURE:

1) Have the students read "The Navaho River" Story. Write on the board the three objectives that the Navaho River Pollution Control Board's plan hopes to accomplish. Tell the students that this situation could happen and reflects the concerns and difficulties of managing New Jersey's water resources.

2) Tell the students that the public hearing is now going to be conducted in the classroom. First, choose three students to represent the Navaho River Pollution Control Board. The rest of the class will attend as "concerned citizens." The individual descriptions from the "Description of Characters" should be folded and placed into the bag or hat. Pass the hat around and have each student choose one description from the hat. Having two or three of the same characters is fine. Give them time to read the description and ask appropriate questions.

3) Distribute copies of "Some Solutions to NPS" to the class and have one of the Board members assigned to read them aloud. Before he/she begins, remind the class that these solutions are not options to be voted on. These are actions that must be taken sometime within the next one to six years by the residents of the Navaho River watershed, if its quality is to be restored and then maintained. The purpose of the public hearing is to introduce these solutions to the citizens. Their feedback and concerns are important to the development of the Navaho River's Pollution Control Plan.

4) Divide the chalkboard into two sections. Assign a second board member to one side of the board. He/she must write down the "well-received" NPS solutions and record who approved of it and why. The third board member is assigned to the other side. He/she will record the "controversial" NPS solutions, along with who had a concern with it and why. Have the first board member read each solution aloud. After each is read, ask any citizen who will be affected by this NPS



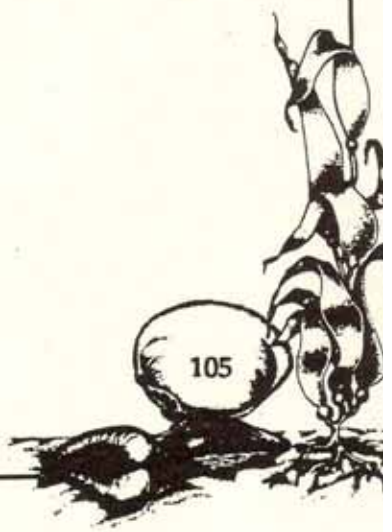
solution to raise his/her hand. Encourage discussion. Facilitate debate whenever possible and record comments for each solution on the board. Go through the entire list.

5) When finished, have the three board members rejoin the class. The public hearing is over and the entire class is now made up of various agency representatives on the Navaho River Pollution Control Board. Their task is to review the citizen's comments and concerns and, based upon the citizen's feedback, devise the plan. Remind the class that their intention is to work cooperatively with the citizens, not against them. Many of the NPS solutions require voluntary action to be taken by the citizens. Before beginning, review the three objectives of the plan that are listed on the board.

6) Distribute paper and pencils. Allow students time to jot down their own ideas before working together as a full board. They must answer these three questions:
   - What should be done in one to two years?
   - What should be done in two to four years?
   - What should be done in four to six years?

7) Approach the plan according to the general consensus of the group. Things can be prioritized in a number of ways, with the following considerations:
   - Which solutions seemed easy to accomplish and well-received?
   - Which solutions aroused the most controversy?
   - Which require marketing and advertising?
   - Which require public education programs and seminars?
   - Which can be introduced in the schools?
   - Which require additional data and research?
   - Which require the development of a project, construction, additional staff, etc.?
   - Which require substantial funding?
   - Which may require the passage and enforcement of local and/or state regulations?

8) Work together to devise the plan. When finished, discuss:
   - Which "concerned citizen" did you relate to the most? With whom did you disagree?
   - Will the plan meet its original three objectives?
   - How does the plan assure that NPS will never be a problem again in the future?
   - If some of the solutions were very controversial, how might the board members deal with them so that they will be positively achieved?
   - Does the final plan reflect much "compromise" between the board and the citizens?
   - Is the reduction and elimination of NPS in a given, local area a simple or complex process? If it seems complex, why?
   - Do you think it might be different in a real situation? Why or why not?



THE NAVAHO RIVER

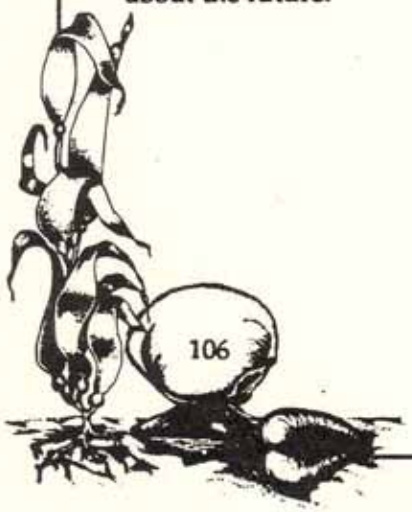
The Navaho River is currently experiencing a problem with nonpoint source pollution (NPS). This river's watershed is located in a New Jersey coastal county and receives water from many farms and small towns. Over 2,500 acres in the estuaries of the Navaho River watershed have been closed to the harvesting of clams, oysters and mussels for more than twenty years. Only commercial shellfishermen are allowed to remove shellfish that will undergo the necessary purification processes in cleaner waters. The waters have been closed because of high bacterial levels, higher than the limits set for shellfish harvesting in New Jersey. It is assumed that the sources of bacteria are NPS-related, since any known pollution sources in the area, such as small sewage treatment plants, have been eliminated. The findings of the Navaho River Pollution Control Board indicate that most of the bacteria is from animal, rather than human waste, which drains from horse farm operations upstream of the Navaho River. Other contributing NPS sources include runoff and stormwater drainage from urban and rural areas, oil, sediment and much boat and marina-related pollution.

The Navaho River Pollution Control Board represents various levels of government working to develop ways to reduce and prevent nonpoint source pollution in the Navaho River watershed. The groups represented on the Board include the Department of Environmental Protection and Energy, the local health department, the U.S. Food and Drug Administration, the local soil conservation district and the cooperative extension service. The Board hopes to develop a plan that will:

1) Restore the water quality of the Navaho River;
2) Upgrade and open the waters currently closed to shellfish harvesting; and
3) Continually monitor the water's quality in order to guard human health and to protect the water from nonpoint source pollution in the future.

Members of the Navaho River Pollution Control Board recognize that restoring and maintaining the water's quality and renewing the shellfish industry will take many years. The plan will require much research, testing and gathering of information. The Board members will need to work closely with each other, local organizations and county and town officials regarding the development of community programs, the strengthening of local ordinances and the search for funding sources. The plan also will require the voluntary cooperation of the residents that contribute to NPS - the homeowners, farmers, builders, horse breeders, boaters and business persons, to name a few.

A public hearing has been organized by the Navaho River Pollution Control Board to introduce NPS solutions and strategies to the local citizens. These solutions already face opposition by some in the area who are concerned with what the solutions will cost them and the possibility of local taxes going up, since state and federal funding is limited. Also, in an effort to limit the amount of stormwater discharged into the watershed and to upgrade the quality of the stormwater, development will have strict regulations and growth of the towns may be limited. Finally, land and homeowners might be charged a fee to treat the stormwater from their area in order to cut down on the pollutants entering the river. As a result, the public hearing is attended by a number of individuals curious and frustrated about the future.



DESCRIPTION OF CHARACTERS

Town Mayor - is responsible for managing the needs of the community and formulating the policies that will affect it. He/she is an elected official (every four years) who must heed the demands of the businesses and revenues associated with the community. He/she must balance the needs of a growing community and a clean environment; one consideration is to upgrade present stormwater systems, but this is costly and state funding is limited. The mayor would like to help but the budget for extra staff and new programs is limited. Additionally, beach tourism is still the town's largest source of income, while the shellfish industry continues to decline. As a long-time New Jersey resident, the mayor would love to see the industry thrive again.

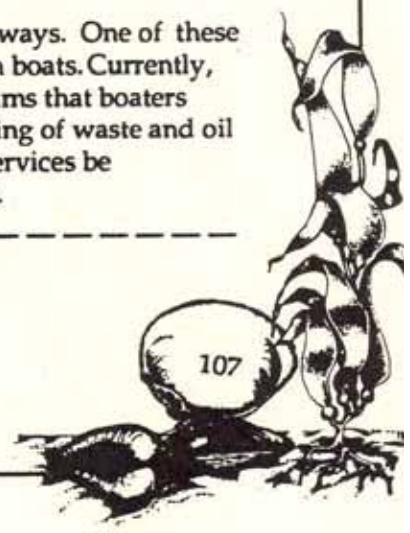
Commercial Clammer - harvests clams from local estuaries and sells catch to seafood wholesalers. The operating expenses have been increasing as a result of harvesting from waters requiring that the clams undergo a costly and laborious purification process which purges them of any contaminants. The operating expenses associated with this process continue to rise while adhering to strict health guidelines is difficult. Consequently, he and many other commercial clammers are unsure as to whether they should keep or close the business.

Local Housing Developer - constructs family homes and condominiums in the county. The upward increase in population shift to the coast is beneficial to business. Measures to reduce and improve surface runoff and stormwater would increase building costs. Curtailing development in the county in order to decrease stormwater discharge amounts would be detrimental to the housing industry in the area. Consequently, some construction workers would not have jobs.

President, New Jersey Waterfowlers - is concerned with protecting and restoring the quality of the watershed and estuaries for prime waterfowl habitat, both for hunting and observation. Undeveloped wetlands also serve as purifiers of water by filtering out toxins in the water before they enter back into the waterways. The President supports any NPS efforts that would serve in upgrading and protecting the Navaho River watershed.

Chairman, local residents group - is concerned with growth of the local community. Older residents of the area are upset to have not been able to recreationally harvest shellfish for more than 20 years. The group is also supportive of the construction of a new shopping mall, needed by local residents. Unfortunately, its construction might contribute to the stormwater and erosion problems in the area. Finally, the local residents welcome new businesses to the area - new businesses mean more families in the community.

Marina Owner - provides various services to boat owners who use the local waterways. One of these services involves the pumping out of holding tanks in certain sanitation devices on boats. Currently, this liquid is transferred to a water treatment facility for treatment. The owner claims that boaters sometimes discharge their wastewater into the river or estuary because the dumping of waste and oil is convenient. The owner is concerned about costs, should additional pump-out services be required. He is supportive of NPS solutions and would like to educate his boaters.



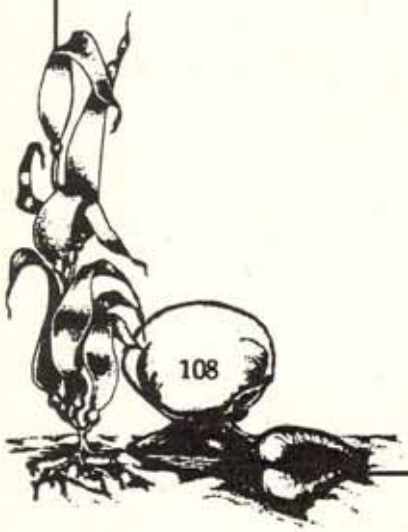
Commercial Farmer - raises feed crops like corn and hay, along with dairy cattle. Soil conservation, manure management, improved fertilizer application and alternative planting and tilling methods will raise the operating costs of the farmer but will reduce NPS sources. Additionally, the farmer has not been made aware of the technology to effectively implement these measures. He is very concerned about costs and has a hard time trusting these government officials who are asking him to change practices that have worked for him for years.

Horse Farmer - breeds and boards horses for recreational and sporting purposes. The runoff from the farm's manure piles contains bacteria, which then enter the waterways. The farmer is being asked to properly store and dispose of the horse manure. The current technology to resolve this problem is expensive and the farmer must bear some of the costs. The farmer is interested in making changes that are not as costly, such as not allowing the horses to graze near the stream running through the property.

Vice President, local boating club - would like to know why boaters are being forced to use expensive pump-out services or asked to upgrade sanitation devices that discharge waste directly into the water after chlorination. These are time-consuming and costly ventures that some boaters haven't practiced before - why now? The Vice President has been reading much publicity on these topics, along with proper washing and disposal of boat cleansing materials, and is concerned that these methods might discourage people interested in taking up boating. He/she would like to see more evidence that NPS is a problem in the Navaho River.

Dog breeder and pet owner: - is concerned with recent publicity of municipal dog control ordinances regarding the clean-up of animal waste in urban areas. He/she feels that fining negligent pet owners would discourage persons from keeping pets and may encourage their release, resulting in an abundance of strays. He/she feels that it is the municipality's job to keep the streets clean, not the citizens'. He/she is also disturbed by the plans that may require a breeder to build animal waste holding areas on the property. He/she is not located near a waterway and feels that piling it atop the sandy ground is fine until it is disposed of.

President, Student Environmental Club - represents over 40 active 10th - 12th grade club members. The high school club is anxious to get involved with remedying this local situation and is attending the public hearing for information, contacts and ideas on how to get involved. The club, as a whole, has a hard time understanding why there might be concerns or problems when it involves cleaning up local waters.



TITLE: Growing Together As A Group

AGE LEVELS: I, JH

KEY WORD: Student Environmental Action

SUGGESTIONS FOR FORMING AND MAINTAINING AN ENVIRONMENTAL GROUP:

1) Draw up a proposal with a mission statement and set of objectives. Consider how the group can benefit the environment, the students involved, the school, the school district and the community.

2) Draw support from the administration, faculty, other student groups, student leaders and parent/teacher associations.

3) Establish local and statewide environmental and community contacts (See "Additional Resources;" also consider religious affiliations, the YMCA and YWCA, County Extension programs, etc.) Find out what resources are available through the school, local libraries and the Chamber of Commerce.

4) Define your role as the group's leader. Consider how the leadership, communication, planning, research, participation and cooperation skills can be developed in the student members as a result of your support, guidance and facilitation. What will make the group successful? Who is responsible for the group's success? Monitor your role as the group matures. Define the roles of student officers in the group.

5) Advertise the first club meeting through school newspapers, posters, announcements and bulletins. Invite a school reporter (and local reporters) to attend. Take pictures and write a follow-up article.

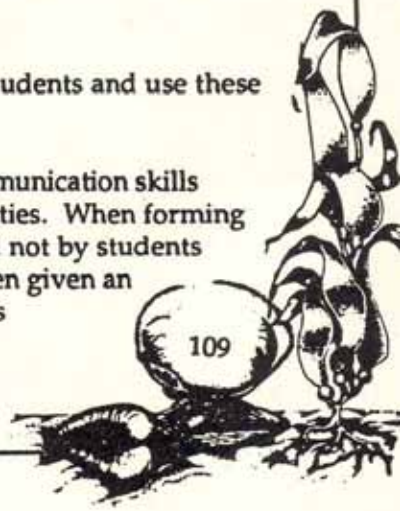
6) At the first meeting, come to a group consensus regarding the mission of the group. Focus on the current state of the environment by inviting a guest speaker, showing a short video or reading aloud excerpts from current environment-related newspaper and magazine articles. Highlight local environment-related issues, as well as national and international ones, to make the students more aware of the variety of issues that require attention and action.

7) Rely on student knowledge and values by finding out what is important to them. Brainstorm additional environmental concerns. Discuss why they feel it is important to protect the environment and maintain its health. Record their responses for future reference.

8) At the first meeting, share a number of "success stories" with the group. This information could include the number of active environmental student groups in New Jersey and other areas, along with their accomplishments and projects. This information can be obtained from some of the resources given in the last section of this guide.

9) Find out what special interests, hobbies and skills exist among the students and use these in carrying out the group's initiatives.

10) Group dynamics are important. Practice group cooperation and communication skills through group mixers, role playing, discussion and simulation activities. When forming smaller groups, do it by "similiar hair colors" or "favorite foods" and not by students forming "cliques." Vote for group officers after the students have been given an opportunity to become familiar with each other and with the duties of each position.



11) Guide the group in choosing its first initiative. To approach this, ask the members of the group to attend the next meeting with one issue that they feel the group should address. Have them be prepared to discuss why this issue should be addressed and how students can become involved with it. At the meeting, list their ideas on the board and discuss them. To prioritize the issues on the list, try the following: If each student had one dollar to spend on these issues, how would their dollar be spent? Have the group vote on their first initiative. Record the list for future reference.

12) Encourage the group to choose a group initiative that is specific and measurable, especially if the students are young or if the group is newly formed. Create a clear goal or purpose for the initiative, as well as a set of objectives. Remind them that some things cannot change overnight. Copy this information for student members to develop a "common ground."

13) Devise a strategy. What needs to be done? What can be accomplished by the group? Brainstorm ideas and outcomes. Which are realistic and most effective? List "large" desired outcomes like changing consumer habits within the community or influencing the passage of legislation, as well as "small" desired outcomes, like project deadlines, publication dates, the sponsoring of events and newspaper coverage. Create a work plan, calendar and budget. Do you need permission for anything? Funding? Equipment? Facilities? Materials?

14) If establishing committees, organize according to tasks. Utilize the strengths and interests in the group when appointing persons to a committee. Rotate persons from committee to committee to expose them to a variety of skills but keep committee tasks the same to provide the committee with an identity and with continuity.

15) Encourage the students to develop proper research techniques. Gather accurate and current information from all involved through interviews, data collecting, letter writing, news articles, visitations, phone calls and library visits. If the initiative involves a controversial issue, become familiar with all viewpoints. Find allies and work with them. Discuss how to work positively with any opposition. Build on the "common ground" shared by all involved. Invite speakers to make presentations to the group. Have the group attend public hearings.

16) Focus on desired outcomes as they occur within the work plan, to keep enthusiasm high and to prove to the students that they can work together effectively. Their spirits will then be less dampened if the "large" desired outcomes do not occur quickly or do occur in such a way that they cannot be measured.

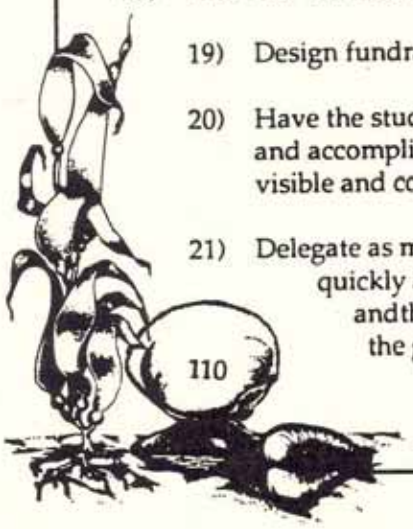
17) Analyze the initiative as the work plan progresses. Discuss any negative outcomes or incidents with the students, why they occured and if they could have been avoided. Evaluate the work plan and the final outcomes. Were the objectives accomplished? The goal? Thank all who were involved and celebrate!

18) Mix "fun" environmental field trips and parties with the meetings. Hold meetings outdoors.

19) Design fundraisers that complement the group's mission and benefit the environment.

20) Have the students work with the media to cover meetings and to announce initiatives and accomplishments. Design a logo, newsletter and shirts or hats. Keep the group visible and continue to establish its identity both within and outside the school.

21) Delegate as much as possible and be patient. Though the project may not get done as quickly as possible, the development of pride and "ownership" in the project and the experience gained by the students are almost as valuable as the goal itself.



Some Suggested Student Environmental Action Initiatives That Would Serve To Reduce Or Eliminate Nonpoint Source Pollution (NPS)

WORK WITH THE ENVIRONMENTAL GROUP TO:

1) Interact with outside entities related to nonpoint source pollution and water. Have group members arrange tours of such places as the local wastewater treatment facility, a nearby dairy farm, a protected watershed or reservoir or a construction site, to name but a few.

Gathering Information

Invite into the classroom guest speakers with expertise in municipal stormwater management, roadway maintenance, commercial landscaping, urban planning and development or solid and hazardous waste disposal. Approach tour representatives and speakers with a prepared list of NPS-related questions and concerns and encourage group interaction.

2) Contact local newspapers and discuss the possibility of having the students submit for print an article about nonpoint source pollution or submit a number of NPS-related "tips" that can be printed regularly by the newspaper in a daily/weekly/seasonal fashion.

Spreading the Word

3) Develop a NPS solutions "checklist" for the school. Begin with the school property. Take at least two excursions outdoors (one following a good rain) to look for "symptoms" related to erosion, poor drainage, clogged drains, litter, leaking faucets or pipes, leaking automobiles, buses, equipment, etc. Observe/monitor any streams or other water bodies that may be within school boundaries. Meet informally with the school's cafeteria, janitorial and maintenance staffs regarding the use of fertilizers and pesticides, recycling efforts, cleaning procedures, cleaning materials purchased and disposed of, used oil, antifreeze and tires, grass clippings, leaves, etc. Develop a list of observations and school practices that already serve to reduce and/or eliminate NPS. Also develop a list of other NPS solutions that the school can undertake. Have the group make a formal NPS presentation to the school administration that would define and describe nonpoint source pollution, as well as introduce both lists. Encourage that these solutions be considered. Monitor them and follow up on the group's efforts. Be patient and persistent. Encourage media coverage of the school's positive support.

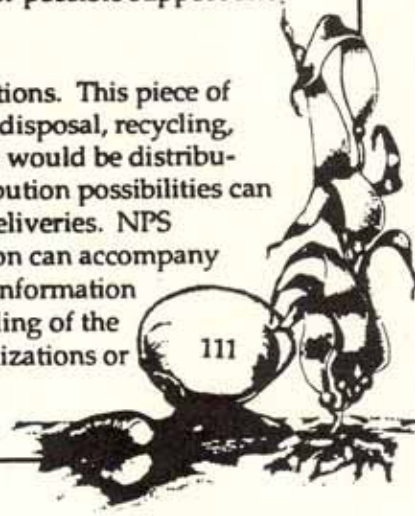
Solutions at School

4) Research, design and construct a spring/summer flower and vegetable garden on school or municipal property. Demonstrate the use of non-chemical alternatives available for weed control, fertilization and pesticides, as well as sound gardening practices related to erosion, water conservation, soil management, planting and harvesting. Encourage both students and parents to become involved with maintaining the garden, advertising the gardening methods used and selling the produce, flower arrangements or dried flowers as a fundraiser throughout the summer and autumn. Investigate the possibility of a compost pile that would utilize food waste from the cafeteria. Contact the local garden club, Parent/Teacher Association, Soil Conservation District, County Extension Office, commercial nurseries, gardening stores and the local Sierra Club and Audubon Chapters for possible support and assistance.

Producing and Harvesting

5) Develop a fact sheet, brochure or flyer explaining NPS and NPS solutions. This piece of information could focus on solutions in the yard, in the home, waste disposal, recycling, anti-litter, consumerism, septic system maintenance, etc. Copies of it would be distributed to all of the families and individuals in the school district. Distribution possibilities can be pursued through the schools, the post office or local newspaper deliveries. NPS displays can be created for local libraries and copies of the information can accompany the display. Have the students seek permission to distribute the information in malls and outside of business establishments. Seek support/funding of the printing costs through fundraising or donations made by local organizations or businesses.

Reaching Out



6) Arrange to make formal NPS-related presentations at the meetings of local civic groups and special interest organizations that are active within the community. Suggest ways in which their group and the student environmental group can work together to support each other's interests and efforts.

Speaking Out

7) Organize an "Exchange Fest." This can be done on a small scale among group members or a class, or it can involve the entire school, along with parents. This social and educational event encourages the trading, exchanging and re-use of family and household items that are still usable by others. Money is not necessary. Items to "trade" include toys, sports items, clothing and shoes, working or fixable small appliances, albums, tapes and CD's, partially full or unopened household products such as paints, cleaners and landscaping products, tools, usable tires, etc. The list is endless. Photographs and written descriptions of larger items, such as bicycles, swing sets and sewing machines can also be exchanged. Those that participate should be given a list of "rules" in advance. For instance, all items should be clean, properly marked or labeled and brought home by the participant when the event is over. If organized for students, a permission slip signed by the parents should list and accompany the items. The fest can be held in the classroom, school gym or school parking lot. Tables or blankets can be brought by the participating families. A small donation can be charged as a fundraiser.

Use It Again, Sam!

8) Contact the municipal or county solid waste coordinator to explore the possibility of assisting with the coordination of a community or county "Hazardous Waste Collection Day" in which individuals have the opportunity to drop off household hazardous waste materials and containers that will be then be properly disposed of. Help to promote the filling stations and auto repair garages that recycle used motor oil.

Bye, Bye, Waste

9) Become familiar with local NPS-related ordinances that exist in the municipality or county that address stormwater, construction and development, farming practices, animal husbandry, pets and solid and hazardous waste. Find out what state regulations apply and if proposed legislation addresses NPS. Encourage the group to communicate regularly with legislators and other decision-makers by writing letters of support and interest and arranging for meetings. (This is an extensive and time-consuming task but it does provide the group with solid information that they can collect, add to and become involved with.)

Play by the Rules

10) Develop, organize and implement a school or district wide science fair, Environment Day, Earth Day or Environmental Education Week program or event that would focus on nonpoint source pollution and its reduction or elimination. Guest speakers, projects, exhibits, plays and activities would focus on water and various NPS concerns and solutions.

In Any Event...

11) Create a list of local businesses/industries whose processes or products include some type of hazardous waste material. Have the students arrange to meet with the management at the facility to discuss the process, product and cleanup/disposal procedures, ask questions and possibly receive a tour. Prepare questions and research information in advance. Evaluate your findings and thank them for their cooperation.

It's Everyone's Business

12) Adopt a nearby waterway, whether it be a stream, lakeshore, marsh or beach, and monitor it on a regular basis for signs of pollution. Activities could include water testing, direct observation, the collection and study of aquatic plants and animals, trash pick-ups and the research of possible NPS contributors "upstream." See DEP's "Additional Resources" for further information regarding its statewide "Water Watch" Program.

Water Watching

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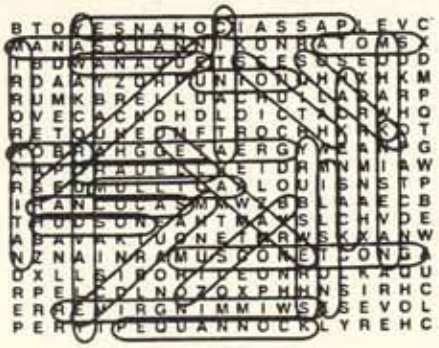
Waters in New Jersey

*There are 25 bodies of water hidden in the puzzle below. They are printed on horizontal (left to right and right to left) and vertical (top to bottom and to top). The words ocean,river and lake do not appear as part of the -only the words in bold. (Example-*ATLANTIC).

BONUS: Six words are on the diagonal (backwards or forwards).

ATLANTIC Ocean
BATSO River (Burlington)
COHANSEY River (Cumberland,Salem)
DELAWARE River (Sussex,Warren,Hunterdon, Mercer,Burlington,Camden,Salem,Gloucester, Cumberland)
GREAT EGG HARBOR River (Camden,Atlantic, Gloucester)
HACKENSACK River (Bergen,Hudson)
Lake HOPATCONG (Morris,Sussex)
Lake Mohawk (Sussex)
MANASQUAN River (Monmouth,Ocean)
MAURICE River (Cumberland,Salem)
MILLSTONE River (Somerset,Middlesex, Monmouth)
MIRROR Lake (Burlington)
MULLICA River (Burlington,Atlantic,Camden)
MUSCONETCONG River (Hunterdon,Morris, Warren,Sussex)
NAVESINK River (Monmouth)
ORADELL Reservoir (Bergen)
PASSAIC River (Essex,Union,Morris,Somerset, Bergen,Passaic)
PEQUANNOCK River (Passaic,Sussex,Morris)
RANCOCAS Creek (Burlington)
RARITAN River (Somerset,Hunterdon,Middlesex)
ROCKAWAY River (Morris)
ROUND VALLEY Reservoir(Hunterdon)
SHARK River (Monmouth)
SHREWSBURY River (Monmouth)
SOUTH River (Middlesex)
SPRUCE RUN Reservoir (Hunterdon)
SWIMMING RIVER Reservoir(Monmouth)
TOM'S River (Ocean)
UNION Lake (Cumberland)
WANAQUE Reservoir (Passaic)



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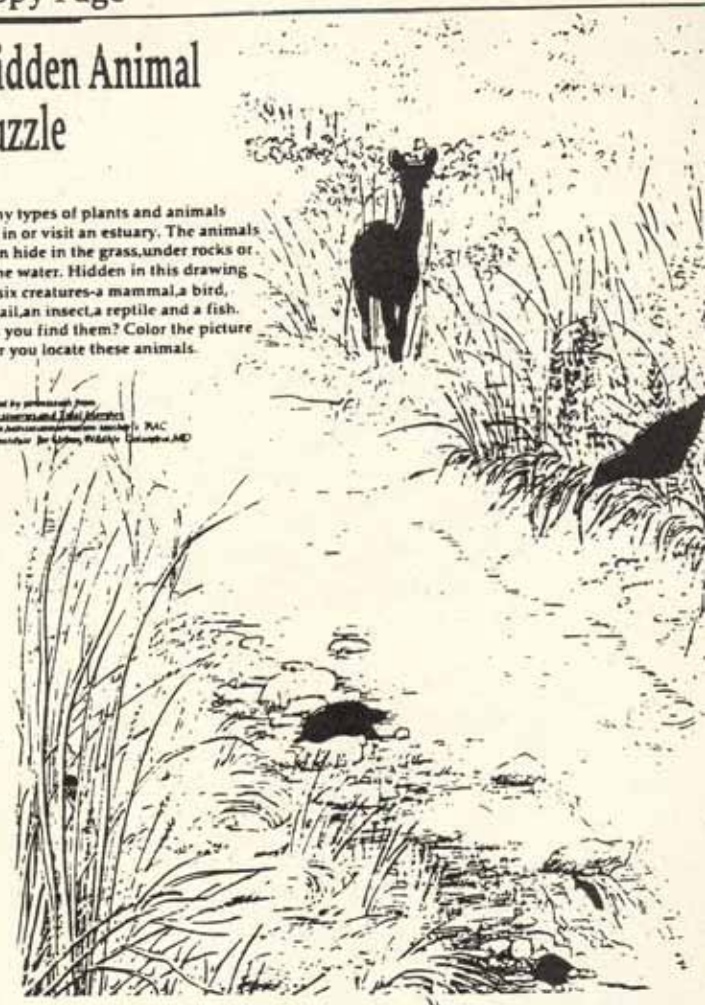
Hidden Animal Puzzle

Many types of plants and animals live in or visit an estuary. The animals often hide in the grass,under rocks or in the water. Hidden in this drawing are six creatures-a mammal,a bird, a snail,an insect,a reptile and a fish. Can you find them? Color the picture after you locate these animals.



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Harvest Ho!

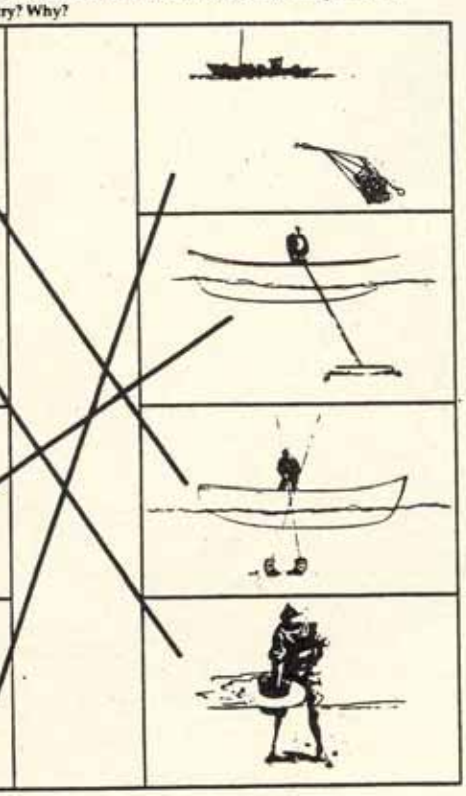
After reading the descriptions on the left,draw a line to the method of harvesting that each describes. Which would you like to try? Why?

I use a boat when I harvest shellfish,along with a pair of hand tongs. The tongs move like scissors. When I squeeze them together,I can lift them up into my boat.

I wear shorts and old socks to harvest shellfish. My toes can feel their shells buried in the mud and sand. After I pick up the clam,I place it in my "Floating basket" in an innertube.

From my boat I use a rake to dig up the shellfish,pull them towards me and lift them up into the boat. When the rake is full,it is very heavy.

use my boat to pull a heavy metal frame,to which is attached a metal bag. The "teeth" along the bottom pick up the oysters. When the bag is full,I hoist it into my boat.



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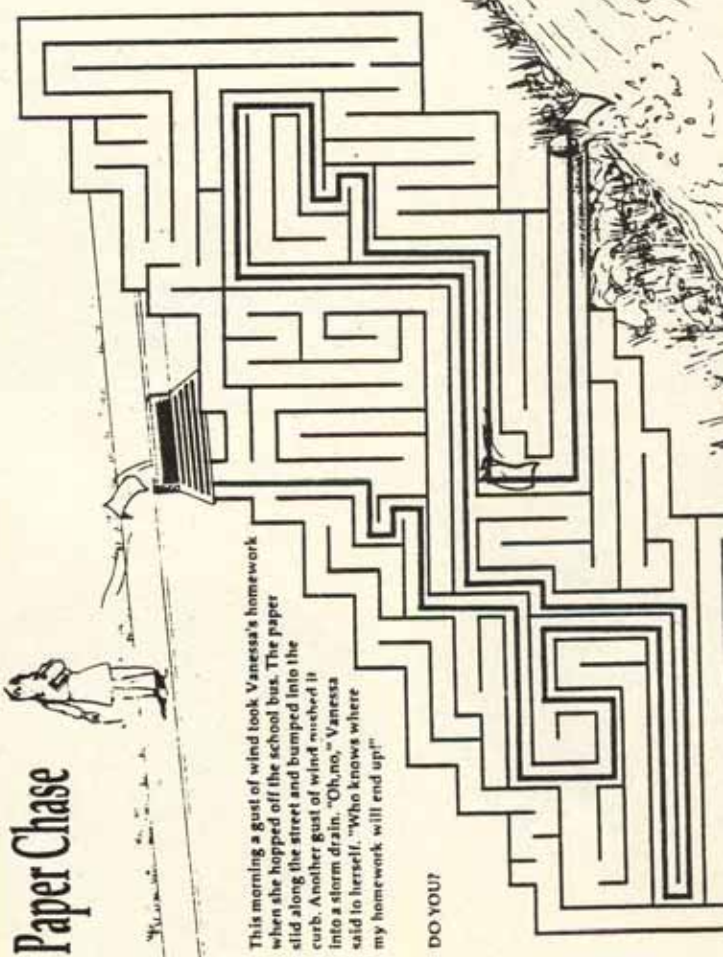
Paper Chase

This morning a gust of wind took Vanessa's homework when she hopped off the school bus. The paper slid along the street and bumped into the curb. Another gust of wind pushed it into a storm drain. "Oh,no," Vanessa said to herself. "Who knows where my homework will end up!"

DO YOU?



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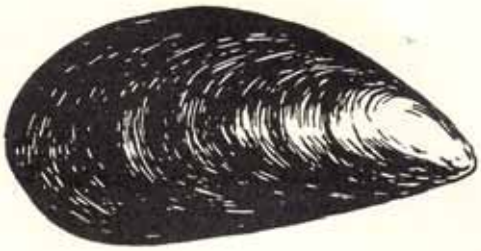
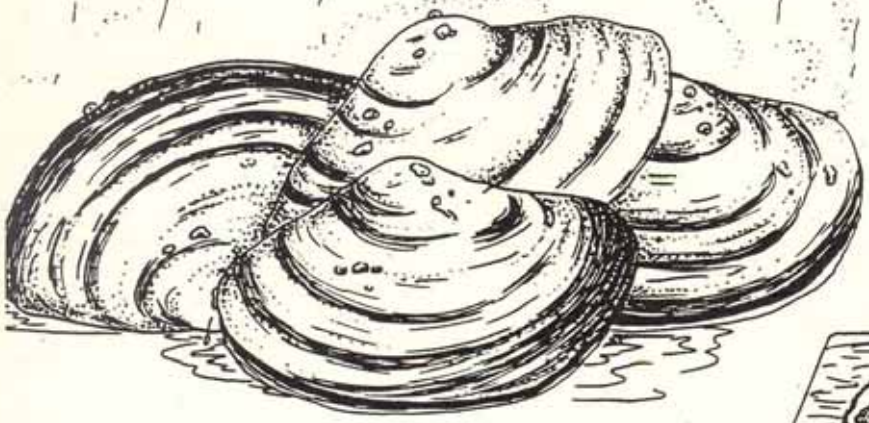
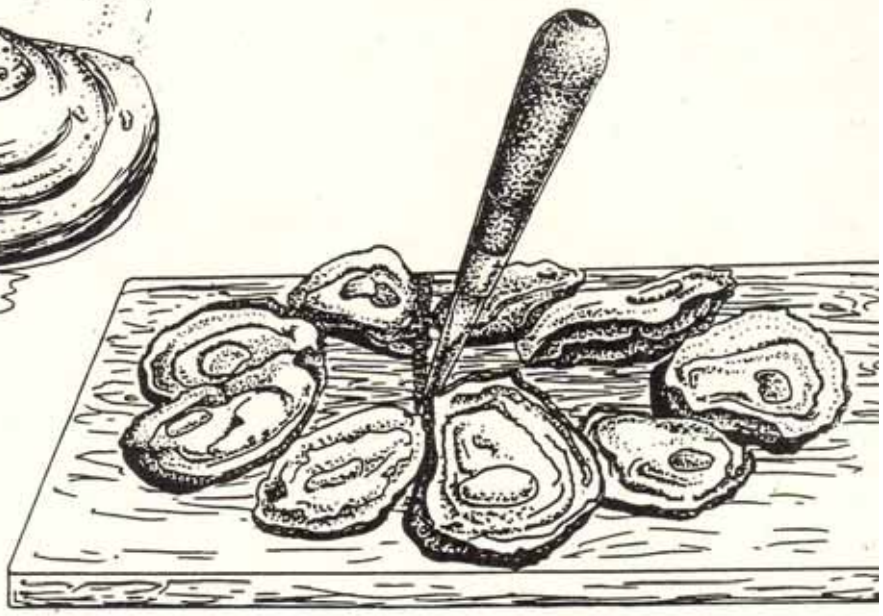
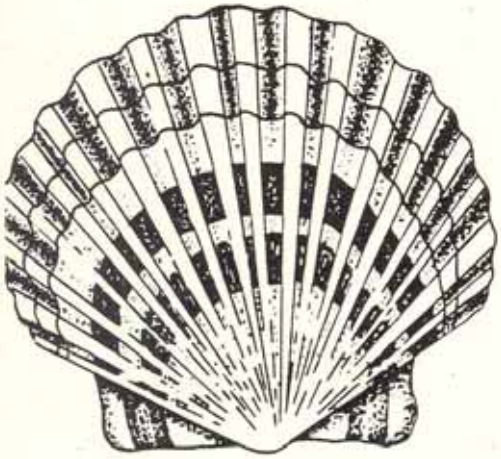








Glossary

Algae - any of numerous chlorophyll-containing plants, ranging from unicellular to multicellular forms, occurring in fresh or salt water

Acidic Deposition - the settling or lying of acid particles (sulfur dioxide and nitrogen oxides) by means of precipitation or as dry particles drifting to earth, like acid rain

Adductor (Anterior and Posterior) - two muscles that adduct or close the shells of the bivalve; oysters have a single adductor muscle

Approved Area - waters meeting the sanitary standards for approved shellfish harvesting, as recommended by the National Shellfish Sanitation Program which is administered by the Federal Food and Drug Administration

Aquifer - an underground geological formation, or group of formations, containing usable amounts of ground water that can supply wells and springs

Attenuation - the process by which a compound is reduced in concentration over time through adsorption, degradation, dilution and/or transformation

Bacteria - any number of microscopic spherical, rod-shaped or spiral organisms which are concerned with fermentation, putrefaction and the production of disease

Bay - a part of a sea or lake indented at the shoreline; a wide inlet not as large as a gulf

Bivalve - a class of mollusks having a shell that has two parts (valves) hinged together

Byssal Cement - a glue secreted by a young oyster's byssal gland; once deposited, the larvae can cement itself to any hard surface, such as other shells

Byssal Gland - part of the bivalve which secretes the byssal threads and cement

Byssal Threads - a bundle of small threads secreted by the byssal gland; used by juvenile clams to anchor to rocks or sand grains; used by mussels to attach themselves to other objects

Condemned Area - waters not meeting the established sanitary standards as recommended by the National Shellfish Sanitation Program which is administered by the Federal Food and Drug Administration

Condensation - the act or process of reducing a gas or vapor to a liquid or solid

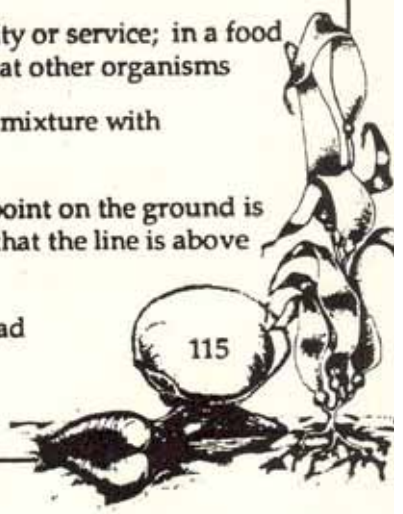
Conservation - wise use of natural resources that ensures their continuing use for future generations

Consumer - a person or thing that consumes, uses something up or uses a commodity or service; in a food chain, it is an organism which cannot make its own food, therefore it must eat other organisms

Contamination - the act of rendering something impure or unsuitable by contact or mixture with something unclean, bad, etc.

Contour Line - features on a map, seen as a line on the ground, along which every point on the ground is the same height above sea level. Some of the lines note the number of feet that the line is above sea level

Decomposer - bacteria and other non-photosynthetic organisms which consume dead material and causes this matter to break down or decompose



Depuration Program - the process of removing bacterial contamination from live shellfish taken from moderately contaminated waters. This method involves the placing of contaminated shellfish in tanks in a "controlled environment" which creates optimum conditions for purification

Detritus - freshly dead or partially decomposed organic matter which serves as a base for the food chain and is a vital part of an estuarine ecosystem

Discharge - a sending or coming forth, as of water from a pipe; ejection; emission

Distillation - the act of purifying liquids through boiling, so that the steam condenses to a pure liquid and the pollutants remain in a concentrated residue

Drainage Basin - the area of land drained by a river system and usually comprised of one or more watersheds

Effluent - any substance that enters the environment from a specific source; these flows typically pertain to sewage or liquid industrial waste

Elevation - the altitude or height of a place above sea level or ground level

Environment - the aggregate of surrounding things, conditions or influences

Erosion - the process by which a surface is gradually worn away, eaten into or disintegrated by water, wind, glaciers, waves, etc.

Estuary - a water body where salt and fresh water meet (e.g. mouth of river it empties into ocean)

Evaporation - the process by which liquid is converted to a vapor or gaseous state; the process by which water becomes vapor in the atmosphere

Fecal Coliform - the aerobic bacillus (bacteria) normally found in the colon of most animals; a fecal coliform count is often used as a water quality indicator

Filter Feeding - the act of filtering small organisms from the water or air

Food Chain - a series of organisms interrelated in their feeding habits, each being fed upon by another

Food Pyramid - a triangular-shaped drawing that depicts the energy transfer and loss between plants, herbivores, carnivores and possibly, omnivores. In the pyramid, plants make up the wide base

Foot - a bivalve's muscular, fleshy organ of locomotion

Foot Retractor - muscles in a bivalve which are used to pull its body downward toward the anchored foot

Gill - a bivalve's organ which extracts oxygen from water

Ground Water - water located beneath the surface of the ground in porous rock or sand which consists mainly of surface water that percolated into the ground

Growth Lines - concentric shallow ridges on the outer surface of a shell which mark its growth; newest growth lines are on the outside edge of the shell

Habitat - the place, or native environment, where a plant or animal species lives

Harvestingv - the act of gathering shellfish for commercial or recreational purposes

Hazardous Waste - any waste which poses a present or potential threat to human life, living organisms or the environment

Heart - a tubular, thin-walled blood- pumping organ in shellfish. In an oyster it also functions as a kidney because it serves as a reservoir for urine

Hinge Teeth - small teeth on each valve (shell) that lock together when the valves are tightly closed

Infiltration - the act of passing or filtering through small gaps or openings

Intestine - eliminates the residue of digestion

Larvae - the immature, free-swimming form of a bivalve that changes structurally when it becomes an adult

Ligament - a flexible structure in a bivalve which serves as the axis on which the shell pivots in opening and closing; it keeps the two shells slightly open when necessary to do so

Mantle - the skin-like tissue that lines each shell and secretes the new layer of shell

Marsh - a tract of low, wet, soft land that is temporarily or permanently covered with water and characterized by aquatic flora and fauna

Mollusk - any of a large number of invertebrate animals, including chitons, gastropods, cephalopods, scaphopods and bivalves, which are characterized by a soft body, gills and foot, and enclosed wholly or in part by a mantle and shell

Monitoring - the act of observing, recording, collecting or detecting an operation or condition, with instruments or tests

Mouth - the opening through which a bivalve receives its food; the entrance to a bay or river

Nutrient - a substance used by living things that promotes growth; applies to essential and trace elements

Nonpoint Source Pollution - pollution sources which are diffuse and do not have a single point of origin or are not introduced into a receiving stream of water from a specific outlet

Palps - a pair of folds, on each side of a bivalve's mouth which sort food

Percolation - the gradual passing of liquid through a porous substance; filtration

Permeability - the rate at which liquids pass through soil or other materials in a specified direction

Pesticide - substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Also, any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant. Pesticides can accumulate in the food chain and/or contaminate the environment if misused

Photosynthesis - the process by which green plants convert carbon dioxide and water into simple sugar and oxygen; chlorophyll and sunlight are essential to this process

Plankton - marine or freshwater plants and animals that drift with the movement of the water

Porosity - the state of being permeable by water, air, etc.; the percentage of the volume of the pores of a substance to the total volume of its mass

Precipitation - water received on earth directly from clouds in the form of rain, snow, sleet, hail, etc.

Predator - animals or plants that live by feeding upon other animals

Prey - an animal hunted or seized for food; the action of seizing and devouring

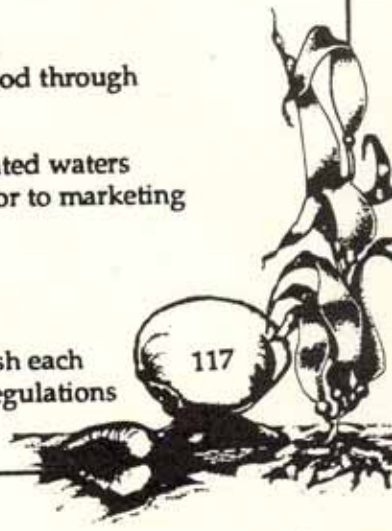
Producer - one who produces goods or services; an organism that makes its own food through photosynthesis

Relaying Program - the taking of market size shellfish from moderately contaminated waters or replanting in approved waters for purposes of bacterial purification prior to marketing

Runoff - water that drains or flows off of the land

Salinity - the saltiness of water; the concentration of salt in water

Seasonal Area - waters which are condemned or opened for the harvest of shellfish each year automatically by operation or regulation. Factors influencing such regulations are tourist visitation and seasonal use of boats and septic systems



Sedimentation - the deposition and formation of sediment, usually consisting of layered soils, along with plant and animal life

Shellfish -any mollusk or crustacean including oysters, mussels, whelks, clams, lobsters, crabs and shrimp. NJ regulations vary according to species

Shellfish Bed - a generally productive area where significant populations of shellfish may be found due to natural recruitment or shellfish management techniques.

Siphon (incurrent and excurrent) - a tube-like extension of the neck of a bivalve, which extends from the mantle and consists of one tube to bring water in and one to expel it

Spat - refers to a young oyster newly attached to a hard surface

Spawning - the reproductive process of bivalves in which fertilization occurs when the female releases eggs to the surrounding water and they are randomly joined by sperm released by the male

Special Restricted Areas - mildly to moderately contaminated areas. Shellfish removed from these areas must undergo some type of purification process before being consumed.

Stomach - an organ which stores, dilutes and digests food

Storm Drain - a system of pipes, including the entrance opening, that carry water runoff from building and land surfaces

Stormwater - water resulting from rain, snowmelt, ice, etc.

Surface Water - a body of water exposed to the atmosphere

Tide - the periodic rise and fall of the waters of the ocean and its inlets, produced by the attraction of the moon and sun and occurring about every 12 hours

Tidepool - a pool usually left in a rock basin by an ebbing tide

Topography - the science of using maps and charts to represent the relief and manmade features of a given region

Toxic Substance - a chemical or mixture that may present an unreasonable risk of injury to health or the environment; anything harmful to living organisms

Transpiration - the process by which water evaporates from plant tissue

Treading - using one's feet to feel for clams in the sand or mud; lifting the clam up with one's foot or hand

Valve (interior and exterior of) - one of the shells enclosing the bivalve

Water Cycle - the natural movement of water from the atmosphere to the earth and its return to the atmosphere through such actions as condensation, evaporation, precipitation and transpiration

Water Movement - the movement of water within the water cycle

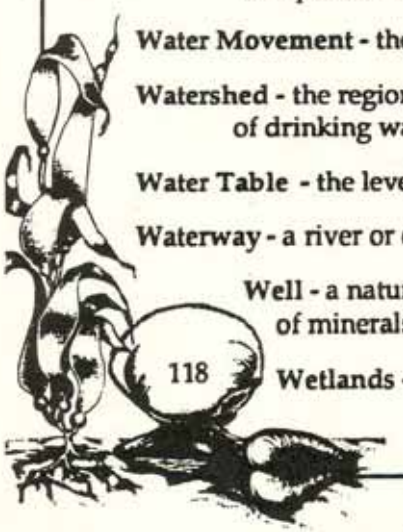
Watershed - the region or area drained by a river, stream, etc.; a drainage area; usually a source of drinking water

Water Table - the level or depth below which the ground is saturated with water

Waterway - a river or other navigable channel as a route or way of travel

Well - a natural or man-made hole that is used to obtain water; a holed drilled for the extraction of minerals or fossil fuels, such as oil

Wetlands - an area of land that is marshy or is frequently wet or flooded



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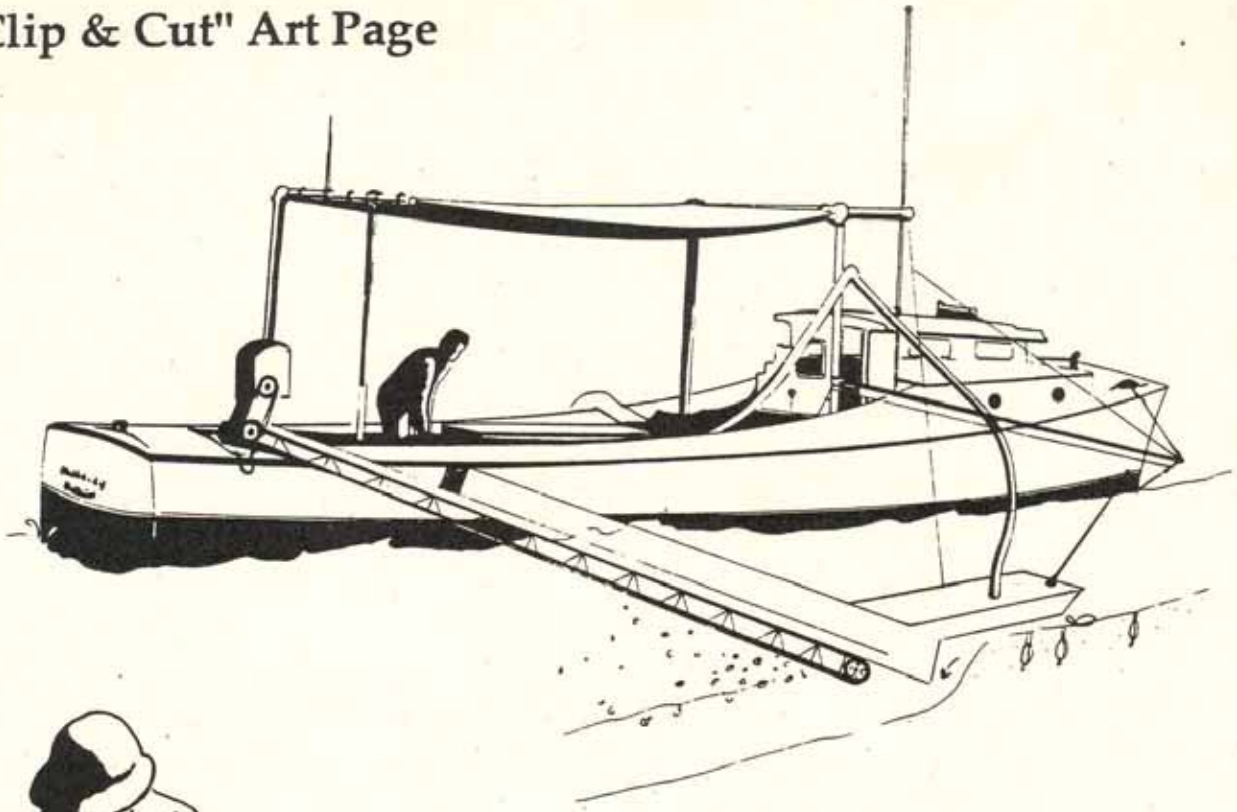
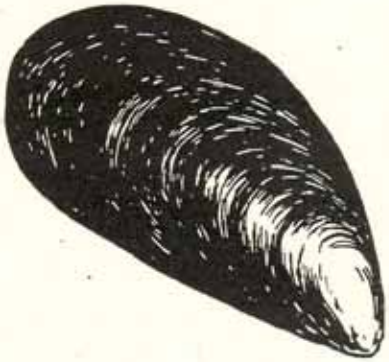
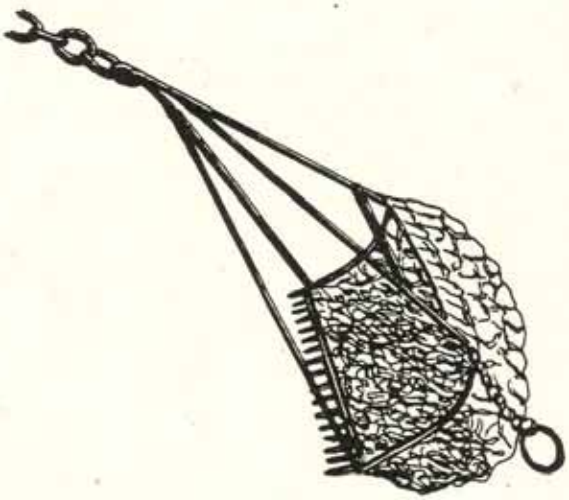






Additional Resources
for Watershed Educators

Watershed Partnership for New Jersey (www.wpnj.org)
Watershed Education and Resource Directory

NJ Department of Environmental Protection (www.nj.gov/dep)
State's Environmental Education Directory Website (www.nj.gov/dep/seeds)
Division of Watershed Management (www.nj.gov/dep/watershedmgt)

- NJ Watershed Ambassadors Program
- Project WET (Water Education for Teachers)
  - Teacher Workshops
  - Watershed Stewards Program
  - Water Festival Program
- Urban Fishing Program
- Clean Water Raingers Program
- Watershed Watch Volunteer Monitoring Program
- Publications

Soil Conservation Districts of New Jersey
(www.state.nj.us/agriculture/rural/natrsrc.htm)

Partner List - NJ
by name
by region
by Web Site

Partner Search

Watershed Links

Executive Board

Site Map

Partner Listing

Click the name of the partner for more information.

- Alliance for a Living Ocean
- American Littoral Society
- Arthur Kill Watershed Association
- Association of Environmental Authorities
- Association of New Jersey Environmental Commissions (ANJEC)
- Barnegat Bay Estuary Program
- Barnegat Bay Watershed and Estuary Foundation
- BEES (Building Environmental Education Solutions)
- Bergen County Soil Conservation District
- Bergen County Utilities Authority
- Bergen Save the Watershed Action Network (SWAN)
- Burlington County Soil Conservation District
- Byram Township Environmental Commission
- Cape May County Health Department
- Center for Environmental Communication
- Citizens United to Protect the Maurice River and its Tributaries
- Clean Ocean Action
- Clifton Environmental Protection Commission
- Cumberland County, Department of Planning
- Delaware and Raritan Greenway
- Delaware Bay Schooner Project
- Delaware River Basin Commission
- Delaware Riverkeeper Network
- Educational Information and Resource Center (EIRC)
- Environmental Commission of Camden County
- Federation of Gloucester County Watersheds
- Freehold Soil Conservation District
- Friends of the Rockaway River
- Great Egg Harbor Watershed Association
- Great Swamp Watershed Association
- Green Township Environmental/Heritage Commission
- Greenwood Lake Watershed Management District, Inc.
- Hackensack Meadowlands Development Commission
- Hackensack Riverkeeper Inc.
- Institute of Marine and Coastal Sciences
- Lake Topanemus Commission
- League of Women Voters
- Mantua Creek and Woodbury Creek Watershed Association
- Middletown Environmental Commission
- Monmouth County Planning Board
- Musconetcong Watershed Association
- New Jersey Audubon Society Department of Education

- New Jersey Coalition of Lake Associations
- New Jersey Community Water Watch
- New Jersey Department of Environmental Protection
- New Jersey Sierra Club
- New Jersey Water Association
- New Jersey Water Resources Research Institute
- New York / New Jersey Baykeeper
- Newton Creek Watershed Association
- North Jersey Resource Conservation and Development Council
- Ocean County Soil Conservation District
- Ocean Institute
- Oldmans Creek Watershed Association
- Partnership for the Delaware Estuary
- Passaic River Coalition
- Pequannock River Coalition
- Pompeston Creek Watershed Association
- Project U.S.E. (Urban Suburban Environments)
- Raccoon Creek Watershed Association, Inc.
- Revitalizing Science Teaching Using RST
- Richard Stockton College of NJ, Environmental Studies Program
- Rockaway Watershed Partnership
- Rutgers Cooperative Extension of Ocean County
- Salem County Watershed Task Force
- Soil Conservation Districts
- South Branch Watershed Association, Inc (SBWA)
- Stafford Township Environmental Commission
- Stony Brook - Millstone Watershed Association
- Sussex County Municipal Utilities Authority
- Ten Towns Great Swamp Watershed Management Committee
- The Watershed Institute
- The Wetlands Institute
- Third River Watershed Characterization Project
- Trout Unlimited, New Jersey State Council
- United States Geological Survey (USGS)
- United Water New Jersey
- Upper Maurice River Watershed Group
- Upper Raritan Watershed Association
- Woodbridge River Watch
- Youth Environmental Society (YES)

This site made possible by a grant from the NJ DEP

METRIC CONVERSION CHART

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	2. 5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6\	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.08	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 pounds)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtract - ing 32)	Celsius temperature	°C

METRIC CONVERSION CHART

LENGTH

symbol	unit	number of meters
km	kilometer	1.000
hm	hectometer	100
dkm	decameter	10
m	meter	1
dm	decimeter	0.1
cm	centimeter	001

AREA

symbol	unit square	number of square meters
km^2	kilometer	1,000,000
ha	hectare	10,000
a	are	100
ca	centare	1
cm^2	square centimeter	0.0001

VOLUME

symbol	unit	number of cubic meters
cm^3 (or cc)	cubic centimeters	0.000001

CAPACITY

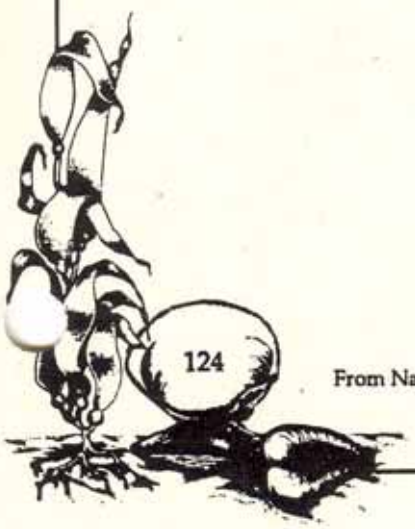
symbol	unit	number of liters
kl	kiloliters	1,000
hl	hectoliter	100
dkl	decaliter	10
l	liter	1
dl	deciliter	0.1
cl	centiliter	0.01
ml	milliliter	0.001

TEMPERATURE
Celsius scale

°C	degree Celsius
0°C	freezing point of water
100 C	boiling point of water

MASS
(weight)

symbol	unit	number of grams
t	metric ton or tonne	1,000,000
kg	kilogram	1,000
hg	hectogram	100
dkg	decagram	10
g	gram	1
dg	decigram	0.1
cg	centigram	0 . 01
mg	milligram	0.001



From National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. (Special Publication 365)

Evaluation

Your feedback will provide us with valuable information regarding the guide's effectiveness and usefulness. This information will be applied to future revisions and considered in the development of other guides. Please retain this original form and mail completed copies to the address given on the reverse side. Your comments and suggestions are appreciated as you continue to use the guide and work with different student groups.

OVERALL RATING (SCALE)

Please rate and comment on the following:	poor	unsatisfactory	satisfactory	good
1) Clarity of the guide's goal	1	2	3	4
2) Execution of the guide's goal	1	2	3	4
3) Sequential progression of sections and activities	1	2	3	4
4) Development of practical skills	1	2	3	4
5) General background information	1	2	3	4
6) Background information specific to New Jersey	1	2	3	4
7) Sufficient amount of activities available for grades 1 - 8, in each section	1	2	3	4
8) Format of activity	1	2	3	4
9) Correlation between activity outcome and objectives of the activity	1	2	3	4
10) Activity outcome vs. personal expectations	1	2	3	4
11) "Additional Resources," pages 119 - 122	1	2	3	4

ADDITIONAL COMMENTS

Please provide comments or suggestions related to the ten questions above:

Question # ____:

Question # ____:

Question # ____:

SPECIFIC ACTIVITIES

List titles of the activities used, along with comments, suggestions and any alterations made:

Title: _____ Comments: _____

Title: _____ Comments: _____

Title: _____ Comments: _____

Title: _____ Comments: _____

TAKING ACTION

Please comment on the suggestions given in "Growing Together As A Group," listed on pages 109 and 110. How have these inspired you to begin or strengthen a club in your school/center?

The Department would like to know if your class or club developed one of the "NPS Student Environmental Action Initiatives," listed on pages 111 and 112, or if your group developed an initiative of its own. If so, please provide us with a complete summary and any relevant attachments.

STAYING IN TOUCH

Would you like to receive a brochure listing other DEPE services and materials?

Would you like to be placed on the DEPE's "education" mailing list?

How guide was obtained: _____

Subjects/grades taught: _____

PLEASE RETURN THIS FORM, ALONG WITH ANY OTHER INFORMATION, TO:

NJ Department of Environmental Protection and Energy
Office of Communications
CN 402
Trenton, NJ 08625 - 0402
(609) 984-9802

PERSONAL INFORMATION:

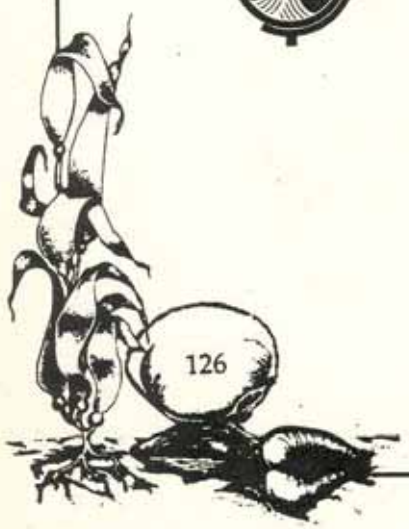
Name: _____

Address: _____

_____

Phone(day): _____

County: _____



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION • NON-POINT SOURCE POLLUTION • CLEAN WATER RANGERS • NEW JERSEY GEOLOGICAL SURVEY • RADON • PROJECT LEARNING TREE • GROUNDWATER • FISH & WILDLIFE • LANGUAGE ARTS • BENEATH THE SHELL • SMOKEY BEAR • VOLUNTEER IN PARKS • CLEAN AIR • PROJECTWET • STATE HISTORIC SITES • BIOLOGY • HIKING • WILDLIFE CONSERVATION CORPS • CRAFTS • GEOGRAPHY • WETLANDS • ENVIRONMENTAL EDUCATION PROGRAM • STATE PARKS • PROJECTWILD • PROJECT • RELIEF • EARTH DAY • WATERSHEDS • PUBLIC ACCESS CENTER • SUSTAINABILITY • PARKS & FORESTRY • CLEAN WATER • RECYCLE • AQUATIC WILD • SEEDS • REDUSE • NEW JERSEY OUTDOORS • MAPS & PUBLICATIONS

SEEDS

- Environmental Education
- Data and Information
- Field Trips
- In - Class Programs
- Enrichment and Training Opportunities
- Classroom Materials
- Events and Contests
- Volunteer Programs
- Grant Opportunities
- and more!

QUESTIONS ?

Where can I find environmental information and materials that I can use in my classroom ?

How can environmental education enhance my curriculum ?

Are professional development opportunities in environmental education available to me as a teacher ?

ANSWER !

THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION'S

SEEDS

www.state.nj.us/dep/seeds

THE STATE'S ENVIRONMENTAL EDUCATION DIRECTORY WEBSITE

WWW.STATE.NJ.US/DEP/SEEDS

An online catalog of environmental education resources available through the New Jersey Department of Environmental Protection

NJ Department of Environmental Protection
Division of Watershed Management
Education and Outreach Programs

Kerry Kirk Pflugh, Manager
NJDEP Division of Watershed Management
Outreach and Education Office
PO Box 418
Trenton, NJ 08625-0418
609-292-2113
Kerry.Pflugh@dep.state.nj.us

Why educate about stormwater, nonpoint source pollution and watersheds?
Whether they know it or not, every citizen of New Jersey may contribute to polluted stormwater runoff through his or her daily activities such as fertilizing the lawn, throwing litter down storm drains or not cleaning after pets. As a result, polluted stormwater runoff from the surrounding watershed is one of the greatest threats to many of our ponds, creeks, lakes, wells, streams, rivers, bays, ground water, and the ocean. Simple changes in daily lifestyle can make a tremendous difference in the quality of New Jersey's water resources.

How can we help you conduct outreach and education about water?
The DWM has many tools to assist you in your stormwater, nonpoint source pollution or watershed education effort. These include newsletters and brochures for the community at-large as well teacher workshops, free classroom presentation through out NJ Watershed Ambassadors Program and free publications for students and teachers. In addition, the DWM works in partnership with many outside organizations such as the Watershed Partnership for New Jersey (WPNJ), the Watershed Institute, and the watershed associations, government agencies, environmental groups involved in watershed activities across the state.

Resources available through the NJDEP Division of Watershed Management

- NJ Watershed Ambassadors Program
- Project WET (Water Education for Teachers)
    - Teacher Workshops
    - Watershed Stewards Program
    - Water Festival Program
- Urban Fishing Program
- Clean Water Raingers Program
- Watershed Watch Volunteer Monitoring Program
- Publications

NJ Watershed Ambassadors Program

The New Jersey Watershed Ambassadors program is a community-oriented AmeriCorps environmental program designed to raise awareness about water issues in New Jersey. Through this program, AmeriCorps members are placed across the state to serve their local communities. Watershed Ambassadors monitor the rivers of New Jersey through Visual Assessment and Biological Assessment volunteer monitoring protocols. The members train community volunteers on how to use these two volunteer monitoring techniques. Watershed Ambassadors also make presentations to community organizations and schools. These interactive presentations provide information about water and watershed issues in New Jersey. The presentations can be tailored to the interests of the audience. Members educate students and citizens about water issues and empower them to get involved in their watershed.

Contact: Christine Hirt

Project WET (Water Education for Teachers)

Project WET is a nationally renowned program that offers teachers a better understanding about the world's water resources through hands-on, multi-disciplinary lessons. Project WET is the only program that teaches about the importance and value of water in our every day life with formal and non-formal educators while offering specialized programs about New Jersey's water resources and watersheds. NJ Project WET is a well-rounded program that focuses on water supply, water quality, water conservation, watershed management, land use planning and wetlands. Project WET provides educators with accurate insight into critical water issues while offering a large selection of creative teaching strategies.

In addition to workshops, NJ Project WET reaches another 5,000 students annually and an estimated 12,000 parents, volunteers, educators and administrators through its Water Festival Grant Program. A Water Festival is a one-day celebration of water with a focus on a school's watershed. Students participate in a series of learning stations that examine water use over time, water's role in shaping our country, what a watershed is, how water is cleaned and used again, how a molecule travels through the water cycle and much more. The festivals involve the community and attract positive media attention that reaches thousands of people across the state.

NJ Project WET offers a unique learning opportunity for high school students and teachers through its Watershed Stewards Program. This program focuses on a weekend leadership workshop for a high school team of four or five students. They are provided instruction and training in watershed topics and team-building experiences that prepare them to focus on a watershed service project that will address an environmental concern.

Each Watershed Steward Team must work with three community organizations and solicit another 20 volunteers to assist with the project. Participants receive a small grant to conduct an Watershed Stewardship Project.
Contact: Kyra Hoffmann

Harbor Watershed/Urban Fishing Program

The goal of the Urban Fishing Program is to educate young students living in the Newark Bay Complex about the hazards of eating contaminated fish and help them to discover the beauty of the great natural resource. Students who participate in the program sample recreational opportunities that the bay has to offer while learning how to be responsible citizens within the estuary. The students experience 4 days of intense yet enjoyable instruction related to the Newark Bay Complex. Throughout the four days students are given hands on experiences, which will endure with them over a lifetime. The program also includes a storm drain marking program than can help municipalities fulfill their stormwater permitting requirements. The program is currently offered in Newark, Jersey City, Bayonne and Elizabeth.
Contact: Eileen Thornton

Clean Water Raingers Program

This program offers educators a number of teaching materials for their students as well as background information on watersheds and nonpoint source pollution. Educators who participate in the Clean Water Raingers program are provided with free booklets and associated materials for their elementary school age students. The *Clean Water Rainger Coloring Book, How to be a Clean Water Rainger Booklet* and the Clean Water Rainger stickers are also popular give-aways at family oriented events and festivals. These publications are also available on-line on the Department's environmental education web page http://www.state.nj.us/dep/
Contact: Kyra Hoffmann

Watershed Watch Network

The Division has begun to implement a Volunteer Monitoring Program over the last several years. The Division is now taking a tiered approach to Volunteer Monitoring . This approach recognizes the different purposes for collecting volunteer data: Education, Stewardship, Community Assessment and Indicators. Each of these has a different level of scientific rigor associated with them. With the assistance of the Watershed Watch Network Advisory Committee, the Division is working to better coordinate volunteer

water monitoring programs across the state and provide a forum for discussion of pertinent topics. The Division also provides training on its biological assessment and visual assessment protocols.
Contact: Danielle Donkersloot

Publications
The DWM produces a number of publications that are available for free distribution by municipalities, watershed associations, environmental groups or other organizations. These include *What's A Watershed?* Brochure, *New Jersey's Watersheds Poster*, and Clean Water Raingers publications.

The Division also publishes a newsletter entitled *Watershed Focus*. The free newsletter includes articles of interest to municipal officials, environmental groups, concerned citizens and water professionals on watershed management, stormwater, nonpoint source pollution and water education. To subscribe, please email a request to kyra.hoffmann@dep.state.nj.us
Contact: Kyra Hoffmann or Erin Brodel

June 2003

Publications Available from NJDEP Division of Watershed Management

January 2004

Please indicate quantity needed.

_____ What's A Watershed? Brochure
_____ Landscaping for Water Conservation
_____ Earth Day 2000 Poster
_____ New Jersey's Watersheds Poster (18" X 24")
_____ New Jersey Watershed Management Area Map (11" X 17")
_____ Watershed Focus Newsletter
_____ NJ Watershed Ambassadors Brochure

Clean Water Raingers Publications (Grades 1 through 6)
for students and educators

_____ CWR Coloring Book *(Grades 1-3)*
_____ How to be a CWR Booklet *(Grades 4-6)*
_____ CWR Stickers
_____ CWR Activities
_____ CWR Evaluation Form
_____ Beneath the Shell: A Teacher's Guide to Nonpoint Source Pollution and its Potential Impact on Shellfish

For more information or to place an order, please contact:
609-292-2113
609-292-0687 FAX
kyra.hoffmann@dep.state.nj.us

Kyra Hoffmann
NJ Dept of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625-0418

Name: _____

Organization: _____

Address: _____

Town: _____ State: _____ Zip Code: _____

Phone Number: _____

Email Address: _____ Date needed: _____

Many of our publications are online at our website at www.state.nj.us/dep/watershedmgt

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700 Kinderkamack Road, Suite 106
Oradell, NJ 07649
201-261-4407
201-261-7573 (fax)
973-538-1552*

BURLINGTON
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2615 Route 38 - RD 2
Mount Holly 08060
609-267-7410
609-267-3347 (fax)
609- 267-0811*
burlsoil@bellatlantic.net

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403 Commerce Lane, Suite 1
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609-625-7360 (fax)
609-205-1225*
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capeatlanticscd@comcast.net

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856-205-1225
cumberland-soil.deeweb.com
csc123@jnlk.com

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211 Freehold Road
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info@freeholdscd.org

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North Caldwell 07006
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hepscd@bellatlantic.net

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Hunterdon County Soil Conservation
687 Pittstown Road, Suite 1
Frenchtown, NJ 08825
908-788-1397
908-788-0795 (fax)
908-782-3915*

MERCER
508 Hughes Drive
Hamilton Square 08690
609-586-9603
609-586-1117 (fax)
732-462-1079*
http://mercerscd.com/
mercersoil@aol.com

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Court House, PO Box 900
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Morris Township
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mcscd@ibm.net

OCEAN
714 Lacey Road
Forked River 08731
609-971-7002
609-971-3391 (fax)
609-267-0811*
www.ocscd.org/index.htm
info@ocscd.org

SALEM
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856-769-1124
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856-769-2790*
http://cumberland-soil.deeweb.com
csc123@jnlk.com (shared district)

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Somerset County 4-H Center
308 Milltown Road
Bridgewater 08807
908-526-2701
908-526-7017 (fax)
908-782-3915*
thurlow@co.somerset.nj.us

SUSSEX
186 Halsey Rd, Suite 2
Newton 07860
973-579-5074
973-579-7846 (fax)
908-852-5450*
http://community.nj.com/cc/sussexcountyscd
sussex@nj.nacdnet.org

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224 Stiger Street
Hackettstown 07840
908-852-2579
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State Soil Conservation Committee
New Jersey Department of Agriculture
PO Box 330, Trenton, New Jersey 08625
609-292-5540
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www.state.nj.us/agriculture/rural/natrsrc.htm
james.sadley@ag.state.nj.us

*Natural Resources Conservation Service
Field Office

The New Jersey Watershed Watch Network Council Members

Crafts Creek Spring Hill Brook Watershed Association
WMA 20
ccshb@hotmail.com

Delaware River Basin Commission
WMA 1, 11, 20, 19, 18, 17
(609) 883-9500
www.nj.gov/drbc/drbc.htm

Delaware Riverkeeper Network
WMA 1, 11, 20, 19, 18, 17
(610) 469-6005
www.delawareriverkeeper.org

Federation of Gloucester County Watersheds
WMA 15, 17, 18
contact@sjwatersheds.org
www.sjwatersheds.org/watershedorgs/oldmans.htm

Great Swamp Watershed Association
WMA 6
(973) 966-1900
www.greatswamp.org

Hackensack Riverkeeper
WMA 5
(201) 968-0808
www.hackensackriverkeeper.org

Pequannock River Coalition
WMA 3
(973) 492-3212
www.pequannockriver.org

Pohatcong Creek Watershed Association
WMA 1
(908) 835-1323
www.pcwa.org

Pompeston Creek Watershed Association
WMA 18
(856) 235-9204
www.pompestoncreek.org

South Branch Watershed Association
WMA 8
(908) 782-0422
www.sbwa.org

Stony Brook-Millstone Watershed Association
WMA 10
(609) 737-3735
www.thewatershed.org

Upper Raritan Watershed Association
WMA 8
(908) 234-1852
www.urwa.org/index/html

Wallkill River Watershed Management Group
WMA 2
(973) 579-6998
www.wallkillriver.org

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Rutgers Cooperative Research and Extension Water Resources Program
statewide
(732) 932-2739
www.water.rutgers.edu

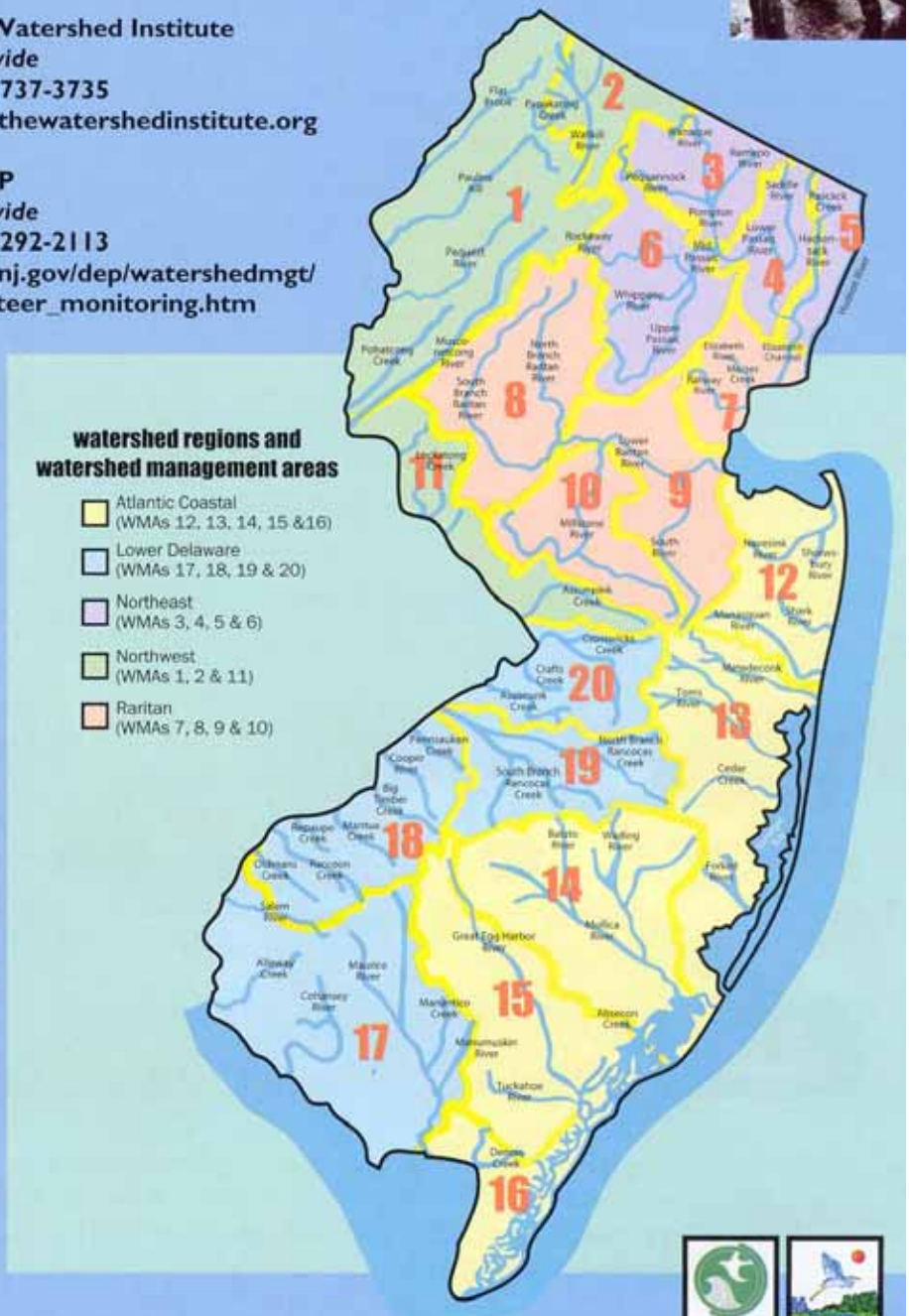
US Environmental Protection Agency Region 2 Volunteer Monitoring Program
statewide
(732) 321-4456
www.epa.gov/region02/monitor/volun/

The Watershed Institute
statewide
(609) 737-3735
www.thewatershedinstitute.org

NJDEP
statewide
(609) 292-2113
www.nj.gov/dep/watershedmgt/volunteer_monitoring.htm







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