

FISHING FOR ANSWERS IN AN URBAN ESTUARY

James E. McGreevey, Governor
Bradley M. Campbell, Commissioner
**New Jersey
Department of
Environmental Protection**



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**New Jersey
Audubon Society**

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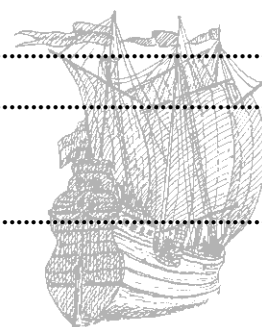
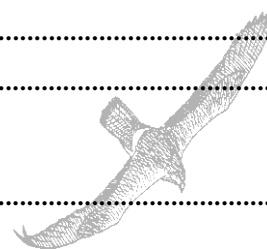
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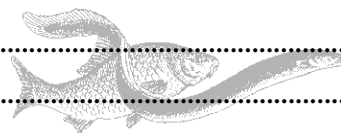
TABLE OF CONTENTS

INTRODUCTION	vii
ABOUT THIS GUIDE	ix
The Newark Bay Complex (a map)	xii
SECTION 1 - THE NEWARK BAY COMPLEX, A <i>NATURAL SYSTEM</i>	
o A Closer Look - Overview	1
o Detritus "Itis"	3
Students learn about the composition of mud. A simulation shows how sediments and pollutants mix and settle under aquatic conditions.	
o Who Belongs	10
A food web-building activity demonstrates how species from different habitats interact and how a healthy habitat can be determined by the presence or absence of a specific species.	
o You Are What You Eat	22
An active game demonstrates how toxins can accumulate in the bodies of animals in an estuary food chain.	
o The Works	29
Hands-on model building introduces students to topographic maps, their local watershed and how habitats within a regional system are connected.	
o Where in the World	36
Students become acquainted with their local waterways and watershed by reading and interpreting maps.	
SECTION 2 - THE NEWARK BAY COMPLEX, <i>RICH IN HISTORY</i>	
o A Closer Look - Overview	49
o Way Back in Time	51
Guided imagery and map reading help students understand how major geologic events helped form the landscape in the Newark Bay Complex.	
o Popular Perceptions	62
Interpreting articles, descriptions, and advertisements give a historical perspective on peoples' changing views of the Newark Bay Complex area.	
o The Art of Land Use	70
Interpreting maps teaches students about historical and present-day land use practices.	
o Once There Was a Forest	79
Reading historical excerpts and interpreting maps generate a discussion about human use of natural resources.	
o Map Detectives	90
Interpreting maps enable students to discover how changes in technology affected transportation, which, in turn, affected population distribution in the Newark Bay Complex.	



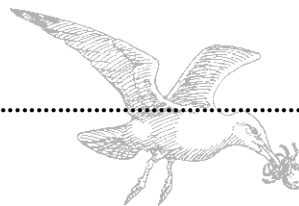
SECTION 3 - THE NEWARK BAY COMPLEX, *TEEMING WITH LIFE*

o A Closer Look - Overview	107
o Fish Puzzle Relay	109
An active game teaches students to identify aquatic animals including those listed in the Fish Consumption Advisories.	
o Drop Me a Line c/o The Estuary	119
Students are challenged to develop methods for catching fish and to design models of fishing equipment.	
o The Angles of Angling	125
An active game teaches students about fishing methods and about restrictions that regulate keeping aquatic game animals for consumption.	
o Comings & Goings	134
Students learn about life cycles of aquatic animals, their seasonal movements, and environmental and human pressures by designing maps and writing stories.	
o Cutting the Risks	141
A hands-on activity teaches fish and crab anatomy as well as techniques for cleaning and preparing fish and crabs that may have been exposed to PCBs and dioxins.	



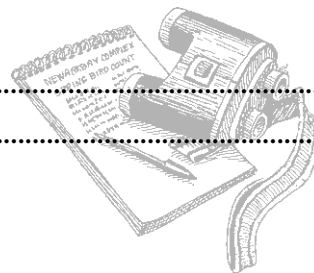
SECTION 4 - NEWARK BAY, A COMPLEX STUDY

o Newark Bay's Complexities	149
Understanding the major environmental, economic and health issues of Newark Bay.	
o Wildlife of the Harbor Estuary's Newark Bay Complex	159
A poster and accompanying brochure show what is actually living in and near the waters of the Newark Bay Complex.	



SECTION 5 - COMMUNITY OUTREACH

o Catch and Release	162
o Watershed / Water Monitoring Programs	163



SECTION 6 - APPENDICES

A. Advisories for Eating Fish and Crabs Caught in the Newark Bay Complex — Fish Consumption Advisories	169
B. Sample Community Awareness Signs	170
C. Field Trip Suggestions	171
D. Organizations to Contact for Information	173
E. Public Access Areas	177
F. Keyword Glossary	179
G. Education Resources List	183



New Jersey Department of Environmental Protection

New Jersey Department of Environmental Protection's Mission Statement

The NJDEP's mission is to assist the residents of New Jersey in preserving, sustaining, protecting, and enhancing the environment to ensure the integration of high environmental quality, public health, and economic vitality.

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The overarching goals of the Watershed Management Program are: comprehensive water resource management on a watershed basis to ensure "clean and plentiful water" for the residents of New Jersey and their descendants; the protection and restoration of the integrity of New Jersey's water resources by preventing, abating and controlling water pollution to achieve the statewide goal of "fishable and swimmable waters". However, there is an intimate relationship between the quality and quantity of surface water. Therefore, DWM must manage both the quantity and quality of the State's water resources, including groundwater, to sustain the water supply needs of the State's residents and ecology.

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New Jersey Audubon Society is a privately supported, not-for-profit, statewide membership organization. Founded in 1897, and one of the oldest independent Audubon societies, NJAS has no formal connection with the National Audubon Society.

NJAS fosters environmental awareness and a conservation ethic among New Jersey's citizens, protects New Jersey's birds, mammals, other animals, and plants, especially endangered and threatened species, and promotes preservation of New Jersey's valuable natural habitats. In order to achieve its purpose, NJAS, through its board of directors, professional staff, members, and volunteers endeavors to:

- Develop, encourage and support sound conservation practices, programs, and legislation;
- Disseminate information on the natural environment through education programs, information services, and publications;
- Advance knowledge, through field research, of New Jersey's flora and fauna and their relationship to the habitats on which they depend;
- Acquire, establish and maintain wildlife sanctuaries and education centers.

For membership information and all other inquiries about New Jersey Audubon Society contact:

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Cape May Bird Observatory Center for Research and Education

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INTRODUCTION

The Newark Bay Complex (NBC) is part of the New York/New Jersey Harbor Estuary. It includes tidal portions of the Hackensack and Passaic Rivers, the Arthur Kill, Kill Van Kull and the Newark Bay. The Complex includes five counties and more than 30 local governments with a population of more than three million. The Newark Bay boasts the third largest port in the United States. Some of the communities that touch these waters include Hackensack, Bayonne, Secaucus, Newark, Elizabeth, Lyndhurst, Perth Amboy, Woodbridge, and Jersey City.

History and Growth of the Complex

The Complex has a rich and diverse history dating back to geologic times and more recently to its earliest people - the Lenni Lenape - who lived along the shores and relied on the estuary for food and transportation. During the Industrial Revolution, the Complex became a major route for trade and commerce. At one time, an active oyster industry existed in the Complex, which was responsible for supplying oysters to many communities in the Northeast region. However, this industry collapsed in the 1800's, when the bay was closed to commercial oystering due to water pollution. Over time, much of the shoreline was developed and used for residential, commercial and industrial interests. Today, the Complex continues to provide people with jobs and recreation while still providing the habitats in which animals and plants live.

While much of the growth in the Complex has benefited society as a whole, there have also been negative consequences. Prior to 1970 when the Clean Water Act was put into law, years of municipal sewage discharges and industrial effluents - legal and illegal - caused sediments in the Complex to become contaminated by a variety of toxic and non-toxic chemicals. As a result, there was a loss of wildlife in and around the Complex's rivers, as well as limited recreational use of the water by local residents.

Today's Challenges

In 1977, the federal Environmental Protection Agency (EPA) moved to ban the manufacture of polychlorinated biphenyls (PCBs), a probable carcinogen known to produce toxic effects in the laboratory at very low doses. Due, most likely, to a discharge of well over 500,000 pounds of PCBs from a facility on the Hudson River (Barclay, 1993) these substances along with dioxins and others passed through the aquatic system of the Newark Bay Complex. They continue to build up in the bottom sediments and enter the food chain of crustaceans and finfish. (Shaw, 1994)

In 1982, research conducted by the New Jersey Department of Environmental Protection (NJDEP) in the Newark Bay Complex showed elevated levels of dioxins and PCBs in certain fish and crabs (Belton et. al., 1982). Subsequently, advisories were adopted by the state to guide citizens regarding safe consumption practices. The species under advisory include bluefish, blue crabs, American Eels, white perch, striped bass and white catfish. (Appendix A)

In addition, development pressures continue to be an issue as the region struggles to maintain the balance between growth and the need for open space and public access to the rivers.

Why a Teaching Guide?

There are many people who fish the waters of the Newark Bay Complex for recreation and to provide food for their families. Fishing organizations and environmental groups were concerned that urban recreational anglers were not receiving vital health information about consumption of contaminated fish and crabs. These groups approached the NJDEP and asked that a special outreach effort be initiated in the Complex. As a result, a program was initiated in the fall of 1993 to design education and information initiatives and tools that would explain the fish consumption advisories and health effects from consumption of contaminated fish and crabs to the people of the Newark Bay Complex. This publication is one outcome of that on-going effort.

Kerry Kirk Pflug
Project Director
2004

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- Barclay, B. *Hudson River Anger Survey*. Poughkeepsie, New York: Hudson River Sloop Clearwater, Inc. 1993
- Belton, T.J., Ruppel, B.E., and Lockwood, K., 1982, *PCBs (Anocher 1254) in Fish Tissues Throughout the State of New Jersey: A Comprehensive Survey*. Trenton: New Jersey Department of Environmental Protection, Office of Cancer and Toxic Substances Research, 36p.
- Shaw, J.A. *Risk Management Teams: State and Local Cooperation to Protect Public Health in Urban Coastal Communities*. Atlanta, Georgia: ATSDR Conference, 1994.

ABOUT THIS GUIDE

OVERVIEW

Urban estuaries offer a valuable opportunity for millions of people to explore the unique features of a sensitive and diverse environment. *Fishing for Answers in an Urban Estuary* provides teachers and their students in grades 4 to 8 the framework for such an opportunity. Although this guide was prepared for the Newark Bay region, there are urban estuaries worldwide and the lessons can be adapted easily to other sites.

All of the activities in the guide have been field tested by teachers for

- 1) grade level appropriateness
- 2) effectiveness of the hands-on activities in communicating learning outcomes and building critical thinking skills
- 3) degree of interdisciplinary application
- 4) ease of using in an established curriculum, and
- 5) degree to which the lessons address diverse learning styles.

LEARNING OUTCOMES

There is great variance in the public's understanding of estuary dynamics and how residential and commercial activities impact its health. To help teachers and students understand this dynamic more richly, it is feasible to explore concepts and develop skills in the sciences, social studies, the arts, and math with an environment-based focus. Exposure to issues surrounding the estuary will direct learners to apply their knowledge and creativity toward managing and caring for the environment in addition to minimizing impacts on human health.

Fishing for Answers in an Urban Estuary is designed to teach school-age children in grades 4 to 8 about the unique natural and historical features of the Newark Bay Complex, the importance of the estuary from economic and ecological perspectives and their role in maintaining the balance between human need and environmental protection.

Upon completion of the lesson plans, students will be able to:

- Understand the functions and value of the estuary as they relate to animals, plants and people;
- Identify the geographic areas where fish consumption is a concern;
- Cite reasons why consumption should be limited or avoided;
- Identify the six fish species in this region under state advisory;
- Identify ways to prepare fish to reduce or avoid exposure to contaminants;
- Infer ways to reduce contaminants over time and propose sound measures to help improve the ecosystem;
- Understand the links between pollution, habitat contamination, contaminated fish and human health;

- Understand how human actions can have positive and negative impacts on natural systems;
- Understand the need to protect and use resources wisely;
- Understand the need to engage in pollution prevention and non-point source pollution prevention behavior; and
- Understand the benefits of being involved in related community activities.

CORE CURRICULUM CONTENT STANDARDS

In 1996 the New Jersey Department of Education adopted the Core Curriculum Content Standards to guarantee that all students receive a “thorough and efficient” education. Each content area has standards that outline the major concepts that students should know at various stages of their education. Progress indicators for each standard further focuses on what the students should know at various levels. Since these standards change periodically, a complete list of correlations for *Fishing for Answers* lessons can be downloaded from www.njaudubon.org/education.

Copies of the Core Curriculum Content Standards can be ordered from the New Jersey State Department of Education, Office of Publications, 2225 W. State Street, P.O. Box 500, Trenton, NJ 08625-500 or online at www.state.nj.us/njded/cccs/index.html

SECTION & LESSON OVERVIEW

This guide is divided into six sections:

- Section 1 - The Newark Bay Complex, *A Natural System*
- Section 2 - The Newark Bay Complex, *Rich in History*
- Section 3 - The Newark Bay Complex, *Teeming with Life*
- Section 4 - Newark Bay's Complexities
- Section 5 - Community Outreach
- Section 6 - Appendices

Sections 1-3 provide fully developed lessons with the following format:

- Grade level, time needed, keywords and materials
- Goal of the lesson, specific student objectives and the process skills that students will use
- An “Advisory Link” that describes how the lesson content supports the goals of the Fish Consumption Advisories
- Background information for the teacher
- Prerequisites for the students
- Preparation for the teacher
- Procedure needed for the activity:
 - *Setting the Stage*: focuses the students’ attention on the activity;
 - *The Action*: a series of hands-on lessons, experiments, simulations and/or demonstrations that involve the students in learning the concepts, and
 - *Assessment*: either embedded in the lesson with direct questioning and discussion or used after the lesson to see if the students can take the information that they learned and apply it to a new situation.

- Extensions that help carry the lesson into more longer-term or broader applications
- Staying Involved can encourage students to take the knowledge they have learned into the community through suggested concrete strategies
- Related Education Resources lists other supplemental guides that have similar lessons
- Reference materials that were used for factual portions of the activity

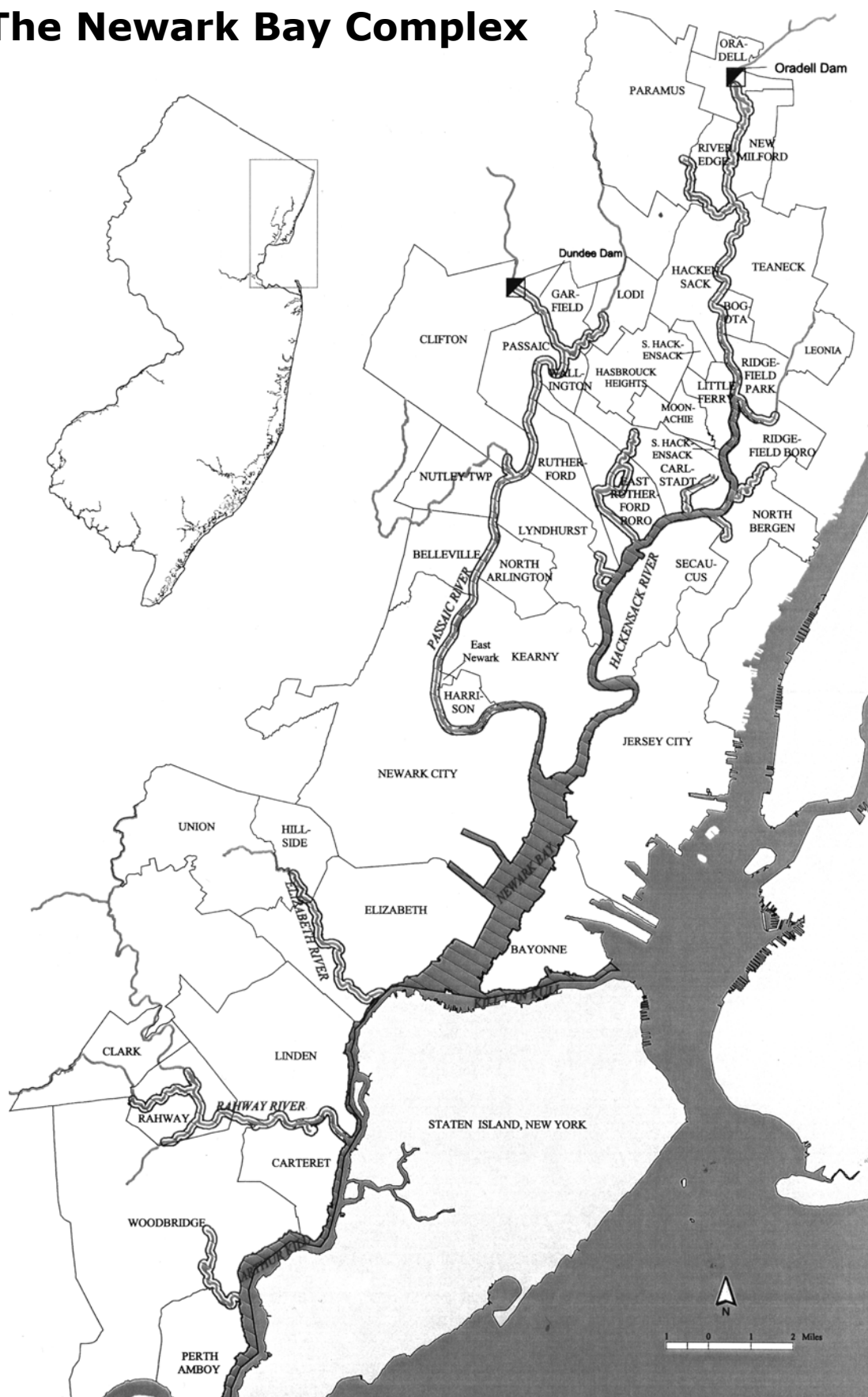
In addition, some activities include figures and diagrams that can be used to share information and “Discovery Sheets” that help students organize data, read maps, and complete their independent research.

Section 4 provides a method for students to learn about some of the major issues in the Newark Bay Complex. Using one or several of the instructional strategies provided, the teacher can facilitate his/her students’ understanding of the NBC’s complexities. It also provides information on how to receive a full color poster and accompanying information on over 60 species of animals and plants that are found within the Complex.

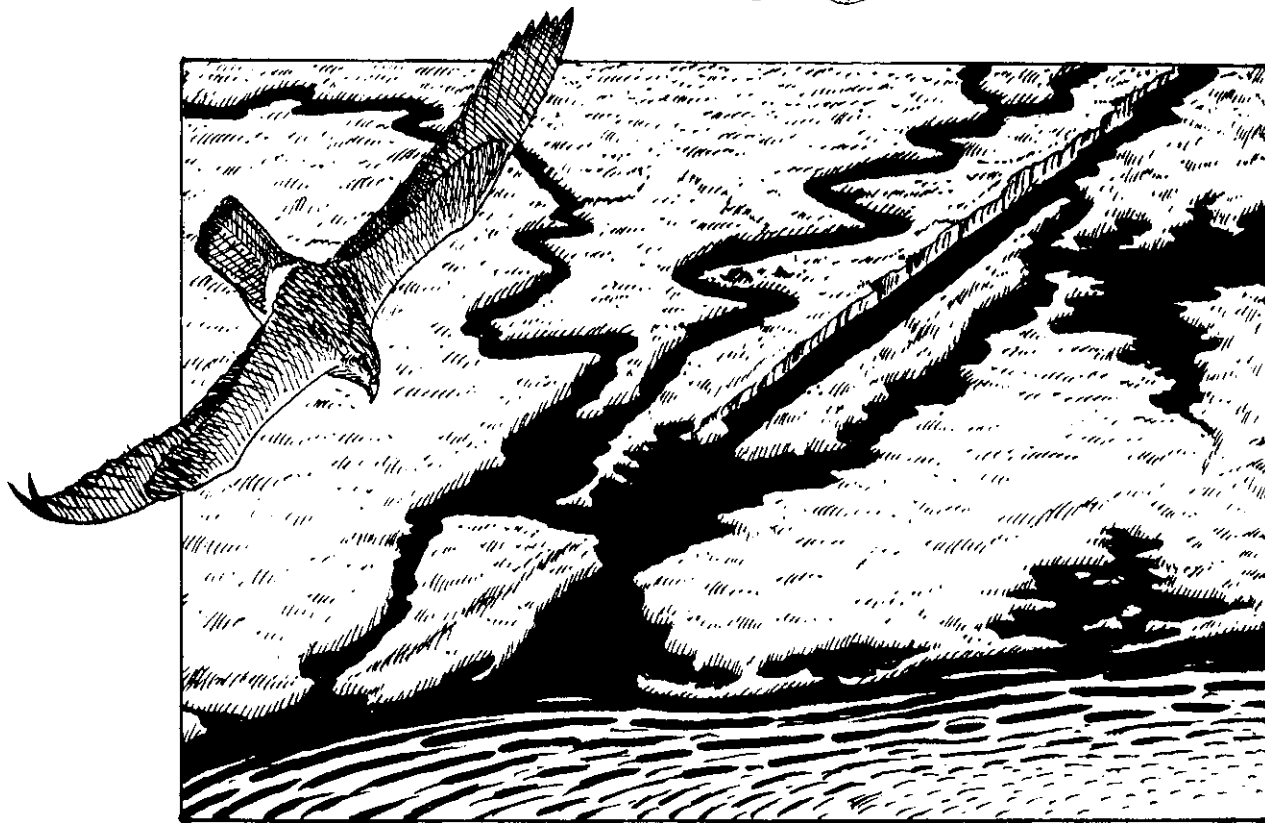
Section 5 provides information on how to “catch and release” a fish properly as well as how to get involved in monitoring your local waterway.

Section 6 is the Appendices and includes text for the Fish Consumption Advisories, samples of the Community Awareness signs in a variety of languages, suggestions for field trips in the Newark Bay Complex, public access areas for fishing, organizations to contact for more information about the Complex, a glossary, and a bibliography for the education resources mentioned in the activities.

The Newark Bay Complex



A CLOSER LOOK



SECTION 1 THE NEWARK BAY COMPLEX, *A NATURAL SYSTEM*

The Newark Bay Complex is a series of tidal waterways and open water bays in northeastern New Jersey. Included in the Complex are the lower portions of the Passaic and Hackensack Rivers, which drain into Newark Bay, the Rahway River, the Elizabeth River, the Arthur Kill, and the Kill Van Kull. The headwaters of the Passaic River are in the highlands of northwestern New Jersey, whereas the Hackensack River begins across the state line in New York. Water from the Watchung Mountains and the higher elevations of the Piedmont physiographic region channels into the Rahway and Elizabeth Rivers. These drain to the southeast into the Arthur Kill, which connects Newark Bay with Raritan Bay.

These waters, along with associated wetlands, are affected twice daily by the ocean's tides. They are rich and diverse ecosystems that contain a variety of plants and are used by countless numbers of animals. Although biologists conclude that estuaries are some of the most productive environments on earth, many estuarine systems have been and continue to be altered by the human behaviors of draining, channeling, filling, and dredging.



Estuarine wetlands follow the line of coastal tidal waters. New Jersey contains approximately 325 square miles of tidal land, which includes salt marshes and brackish waters. About 138 square miles are located along the Delaware Bay and River, while another 170 miles edges the southern Atlantic coast. The remaining 17 or so square miles extends from Raritan Bay north into Bergen and Hudson counties.¹ This last portion is included in the Newark Bay Complex.

As an ecosystem, the estuary has many functions. It creates an ecotone, or an overlap between freshwater habitats and the ocean. Nutrient-rich sediments from rivers are carried to the estuary where they mix with tidal and ocean sediments. This “nutrient soup” creates the basis for a complex food web upon which many animals depend. Plants and animals that live in the salt marsh habitat must be able to tolerate elevated salinity levels and be capable of surviving fluctuating water levels. Being broad and fairly shallow, estuaries slow both river-induced and ocean-induced floodwaters. They act also as water filtration systems, as well as natural erosion control.

An estuary’s expanse and relative shallowness, complimented by deeper channels, provide excellent habitat for aquatic creatures to spawn, lay eggs and for young animals to mature in relative safety. Higher elevation areas in the salt marsh provide tangles of dense grasses and reeds in which mammals and birds can hide and raise their young. Likewise, all these areas provide resting and feeding spots for migrant birds such as shorebirds, waterfowl and raptors.

The estuary is also part of a larger watershed system. A watershed or drainage basin is an area of land that is drained by a specific waterway. The Newark Bay Complex is the lower part of two major drainage basins (Passaic/Hackensack and Raritan) that includes 16 watersheds and many sub-watersheds. All of these watersheds are separated from each other by high relief (ridges, mountains, etc.). Even though the Complex includes only the saltwater or brackish waters of these waterways, it is influenced by the continuous introduction of freshwater from the upstream portion of the drainage basin. Anything that goes into a tributary or main channel flows downstream to be deposited in the estuary or adjacent salt marsh. Since the area of study drains the land where close to two-thirds of New Jersey’s population lives, there is a tremendous amount of pressure on these waterways and their adjacent habitats.

The lessons that follow cover basic natural history concepts regarding the function of the estuary including the importance of estuary mud; how animals and plants interact to create complex food webs; how toxins affect the health of the ecosystem; and, where the estuary fits into the regional watershed system. All of these lessons enable students to learn more about their connection with this unique area.

¹ Collins, Beryl Robichaud and Karl H. Anderson. Plant Communities of New Jersey: A Study in Landscape Diversity. Rutgers University Press, New Brunswick, NJ. 1994.



DETRITUS "ITIS"



BACKGROUND INFORMATION



Inorganic material (sand, clay and silt) and organic matter or detritus (bits and pieces of dead vegetation and decaying animals) combine to produce the mud that is an integral part of the estuary ecosystem, the world's most productive biological system. Scientists estimate that a single acre of salt marsh can produce more than 60 pounds of nutrients per day, making it more productive than any land-based acreage.

The inorganic materials carried by ocean tides and freshwater rivers supply important minerals to the system. Most of these particles settle out of the water column in calmer waters such as bays, estuary channels with slow-moving water, and coves. They also get caught in the roots of the extensive marsh vegetation. Detritus provides organic matter from which animals and plants extract nutrients. These nutrients are recycled through the food web as animals and plants live out their life cycles.

In the salt marsh habitat, decaying plants, especially *Spartina* grasses, are more nutrient-rich than living plant tissue. Microbes break down the dead plant material into tiny manageable pieces that become available for scavengers such as blue claw crabs, mussels, clams and oysters. Though plants produce the energy that

drives all food webs, detritus is the driving force behind estuarine food webs. In many estuarine food webs, humans are the highest consumers.

Many different types of pollutants enter the estuary ecosystem. Some of the most persistent and highly toxic of these are a group of man-made organic chemicals that include PCBs and dioxins. PCBs (polychlorinated biphenyls) were used widely as coolants and lubricants in electrical equipment such as transformers and capacitors. The manufacture of PCBs in the United States was stopped in 1977, but a large quantity of PCBs remains in service. Dioxins are unwanted by-products of many different processes including incineration, production of herbicides and disinfectants, and the production of paper that uses chlorine.

These compounds enter the environment through various means - improper disposal, spills, incineration and direct industrial discharge. They also adhere to suspended particles in the waterway and eventually settle to the bottom along with other bits of detritus. Although they have been diluted by great quantities of water, they remain persistent in the aquatic environment because they break down very slowly.



LEVEL

4 to 6

LENGTH

3 class periods



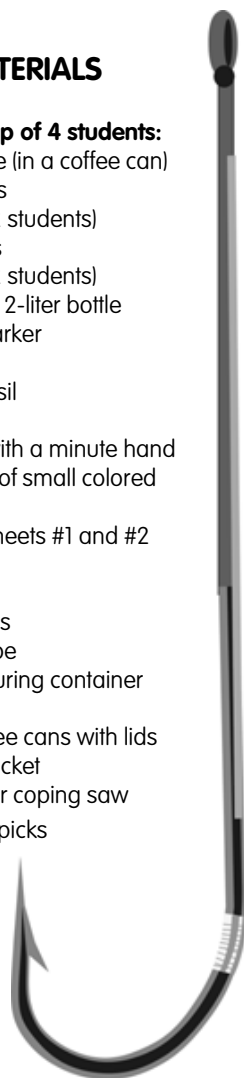
MATERIALS

For each group of 4 students:

- o mud sample (in a coffee can)
- o paper plates
(1 for every 2 students)
- o hand lenses
(1 for every 2 students)
- o clear plastic 2-liter bottle
- o indelible marker
- o spoon
- o mixing utensil
- o ruler
- o timepiece with a minute hand
- o tablespoon of small colored beads
- o Discovery Sheets #1 and #2

For the class:

- o paper towels
- o masking tape
- o water in pouring container
(1 gallon)
- o several coffee cans with lids
- o clean-up bucket
- o utility knife or coping saw
- o box of toothpicks



OVERVIEW

Students learn about the composition of mud. A simulation shows how sediments and pollutants mix and settle under natural conditions.

OBJECTIVES

Students will:



Classify the organic matter and inorganic materials found in mud;



Describe the role of detritus in the estuary ecosystem;



Observe and describe the mixing and settling of sediments in an estuarine-like setting;



Explain how some contaminants enter the estuary ecosystem.



ADVISORY LINK

Detritus is the primary component of muddy bottom sediments found in aquatic habitats. Detritus is also the basis of the estuarine food web. Organic chemicals such as PCBs and dioxins become part of the estuarine environment when they adhere to sediment particles. The Fish Consumption Advisories lists fish and crab species that are at risk of concentrating high levels of toxic chemicals in their bodies.

KEYWORDS

contaminant
detritus
dioxins
ecosystem

estuary
inorganic
non-point source pollution
organic

PCBs
point source pollution
sediment

STUDENT PREREQUISITES

A basic understanding of estuary ecology

An understanding of how food chains and food webs work

PROCESS SKILLS

classifying
investigating
experimenting
observing
collecting and recording data

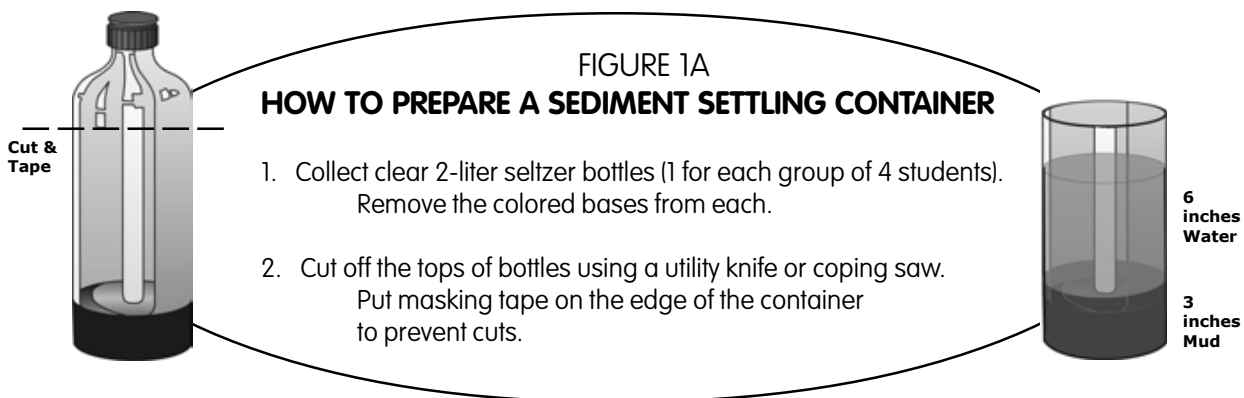
interpreting data
formulating hypotheses
analyzing
measuring
inferring



PLANNING



1. Fill several coffee cans with "bottom mud" from a lake or pond. Drain off the excess water. Keep the mud in a sealed container to prevent drying. **(Do not take mud from the Newark Bay Complex. Contamination from PCBs and dioxins prevents safe handling.)**
2. Prepare sediment-settling containers (one per four students). See Figure 1A.



PROCEDURE SETTING THE STAGE

Discuss experiences that the students have had with mud.

Ask, "Where was it"? "What was it like"? "What were you doing"? "Is all mud alike"?

THE ACTION



Period 1

1. Give each pair of students a small sample of mud on a paper plate.
2. Have the students use toothpicks to investigate the composition of the mud sample and classify its components.
3. Discuss the difference between organic materials (decaying plants and animals, bits of leaves and sticks) and inorganic materials (rocks, clay, and sand). Introduce the term "detritus" and discuss what parts of the mud would fit the definition.
4. Ask the students to explain how detritus would be important to an aquatic ecosystem. *[Detritus provides food and shelter for animals, nutrients for plants, and a place where roots can take hold.]*
5. Show the students your sample container and tell them that this sample represents estuary mud of which detritus is a major part. Tell the students that they will conduct an experiment that simulates how mud settles in an estuarine habitat.
6. Divide the class into groups of four and distribute the following materials to each group: one 2-liter clear soda bottle, a ruler, masking tape and a marker.
7. Have the students mark their containers at the 3" and 6" levels and label each container with the names of the participants in each group.

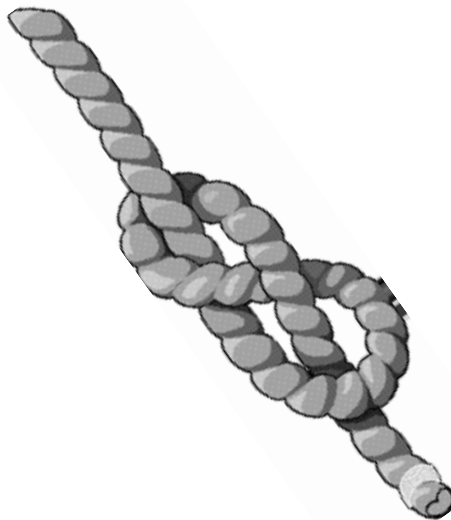


Period 2

Divide the students into their groups and distribute the necessary materials for conducting the experiment. Have the students follow directions on Discovery Sheets #1 and #2.

Period 3

1. Have the students make their final observations for the settling experiment.
2. As a whole class, create a list of different types of water pollution [e.g. *runoff from streets, chemicals from factories, sewage from boats, litter, gasoline, heavy metals, fertilizers, etc.*]. Introduce the terms point source and non-point source pollution. Categorize the list into these two types of pollution.
3. Define PCBs and dioxins. Ask the students to decide where these chemical compounds fit into the pollution categories.
*NOTE: Initially both compounds were point source pollution, originating from industrial discharge into a waterway. Today, as relatively little or none of these compounds are being discharged, they have become non-point source pollution. They are reintroduced into the environment through various means as bottom sediment is disturbed or as older equipment using these compounds fails or goes out of service.
4. Distribute a small amount of colored beads to each group. Explain that these beads represent chemical pollutants, such as PCBs and dioxins. Instruct each group to add the colored beads to the water in their container. Discuss what happens to the beads.
5. After the beads have settled to the bottom of the container, ask the students to describe what processes or activities would cause the water and sediments to mix [*rain, river water entering the estuary, ocean tides, storms, boat wakes, animal movement, dredging and clearing channels*].
6. Instruct the students to mix the sediments, and then have them explain what happens to the objects that represent the chemical pollutants. [*The beads are redistributed within the sediments.*] Discuss how some contaminants are recycled through the estuary ecosystem. [*Contaminants become available to the plants and animals in the ecosystem when natural events and human activities stir up the mud.*]



ASSESSMENT STRATEGIES

Have the students:

- ❑ Draw a cross-section of their sediment-settling container using symbols and a key.
- ❑ Draw a picture; create a diorama or computer-generated image of how a cross-section of the estuary would look. Show how plants, animals, and pollutants are connected to the bottom sediments through detritus.

EXTENSIONS

Compare the mud from different aquatic ecosystems, i.e., pond, bog, lake, swamp, freshwater marsh, river, etc. Have the students keep a journal of their observations.

STAYING INVOLVED

Have the students learn more about the species in the Fish Consumption Advisories that are detritus feeders.

RELATED EDUCATION RESOURCES

- Bottle Biology
- *Ranger Rick's Nature Scope - Wading into Wetlands*

SEDIMENT SETTLING EXPERIMENT - DIRECTIONS

Discovery Sheet #1

Names of Group Participants: _____

Date: _____

HOW TO CONDUCT THE EXPERIMENT

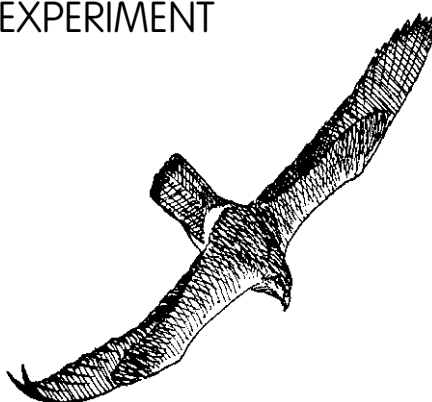
Assign roles:

Time Keeper _____

Measurer _____

Recorder _____

Materials Handler _____



PART 1

1. Add mud to the 2" level on your container.
2. Add water until it reaches the 6" level.
3. What happens? Record your observations under Part I on the data sheet.
4. Predict how your mud sample will settle after you mix the mud and water thoroughly.

PART 2

1. Stir the mud and water until everything is mixed well.
Begin recording the time on the data sheet.
2. At two-minute intervals, measure the thickness of the layer of settled mud.
Record these measurements next to the time.
3. Continue your observations for 20 minutes.
4. After your last measurement, observe the settled mud and describe what you see in your settling container. Record this under Part 3 on your data sheet.
5. Place the settling container aside. Conduct a final observation in 24 hours.



SEDIMENT SETTLING EXPERIMENT - DATA SHEET

Discovery Sheet #2

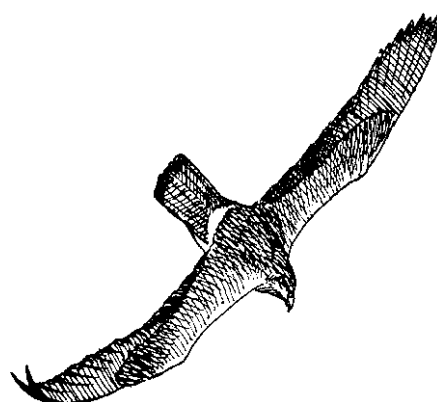
Names of Group Participants: _____

Date: _____

Part 1: Initial Observations:

Part 2: The Experiment

	Time	Layer Thickness
Start	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Finish	_____	_____
24 hours later		_____



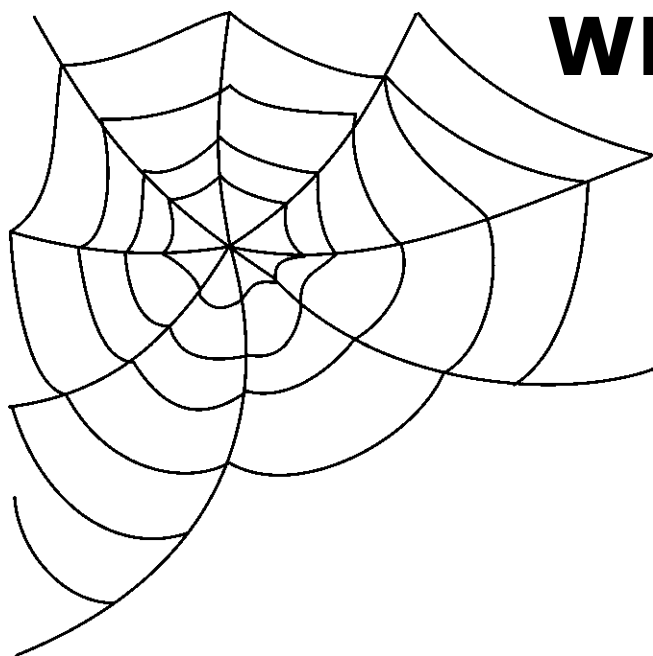
Part 3: Observations upon completion:

Part 4: Final observation (after 24 hours)

(Note the color of the sediments, the size and arrangement of particles and the color of the water.)



WHO BELONGS?



BACKGROUND INFORMATION



Ecosystem dynamics include the interrelationships between organisms. These consist of, but are not limited to, the interaction of species within a food web. All of the participants (producers, consumers, scavengers and decomposers) are involved in maintaining biological balance. When this balance is tipped for any reason, it produces a ripple effect throughout the system, which can affect various species in different ways.

Indicator species are those plants and animals that help identify a habitat or ecosystem. Skunk cabbage indicates a freshwater wetland habitat whereas blue claw crabs indicate a salt marsh habitat or estuarine ecosystem. When biologists study these natural systems, they look for the presence or absence of these indicator species to help gauge the health of a system or to determine if that system is maintaining

its biological balance. As an example, if a marine biologist studying the Newark Bay Complex found a dearth of blue claw crabs, it would raise a red flag and give an indication that the waters in the complex were unsuitable for this previously abundant indicator species. Based on this observation, research could be undertaken to determine why the species' numbers had dropped and if the cause poses any risk to human health. In this way, indicator species often act as environmental barometers.

In depth study of habitats, natural communities, and ecosystems becomes a fairly complicated matter as one looks at the myriad ways that these systems are connected. Whether through a common predator, the flow of groundwater, or a waterborne seed, no natural system exists in a vacuum. Often food chains are the common links between these systems.



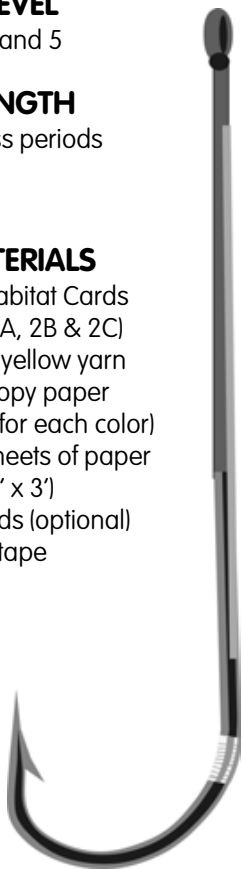
LEVEL
4 and 5

LENGTH
2 class periods



MATERIALS

- o 1 set of Habitat Cards (Figures 2A, 2B & 2C)
- o 3 balls of yellow yarn
- o colored copy paper (2 sheets for each color)
- o 3 large sheets of paper (at least 2' x 3')
- o index cards (optional)
- o masking tape
- o markers
- o string



OVERVIEW

A food web-building activity demonstrates how species from different natural systems interact and how that system's health can be determined by the presence or absence of a specific species.

OBJECTIVES

Students will:



Describe how energy flows through a food web;



Explain how organisms from different natural systems interact;



Demonstrate an understanding of why indicator species help identify specific habitats, natural communities and ecosystems;



Understand how the presence or absence of an indicator species helps monitor the health of an ecosystem.



ADVISORY LINK

The species listed in the Fish Consumption Advisories are affected by many factors from outside the boundaries of the Newark Bay Complex. To fully understand how these species are impacted by natural and human influences, it is important to understand how these animals interact with species from other aquatic natural systems within the Complex.

KEYWORDS

aquatic
consumer
decomposer
detritus
ecosystem

estuary
food chain
food web
habitat
indicator species

ocean
producer
river

STUDENTS PREREQUISITES

A basic understanding of river, estuary and ocean ecosystems
An understanding of how food chains and food webs work

PROCESS SKILLS

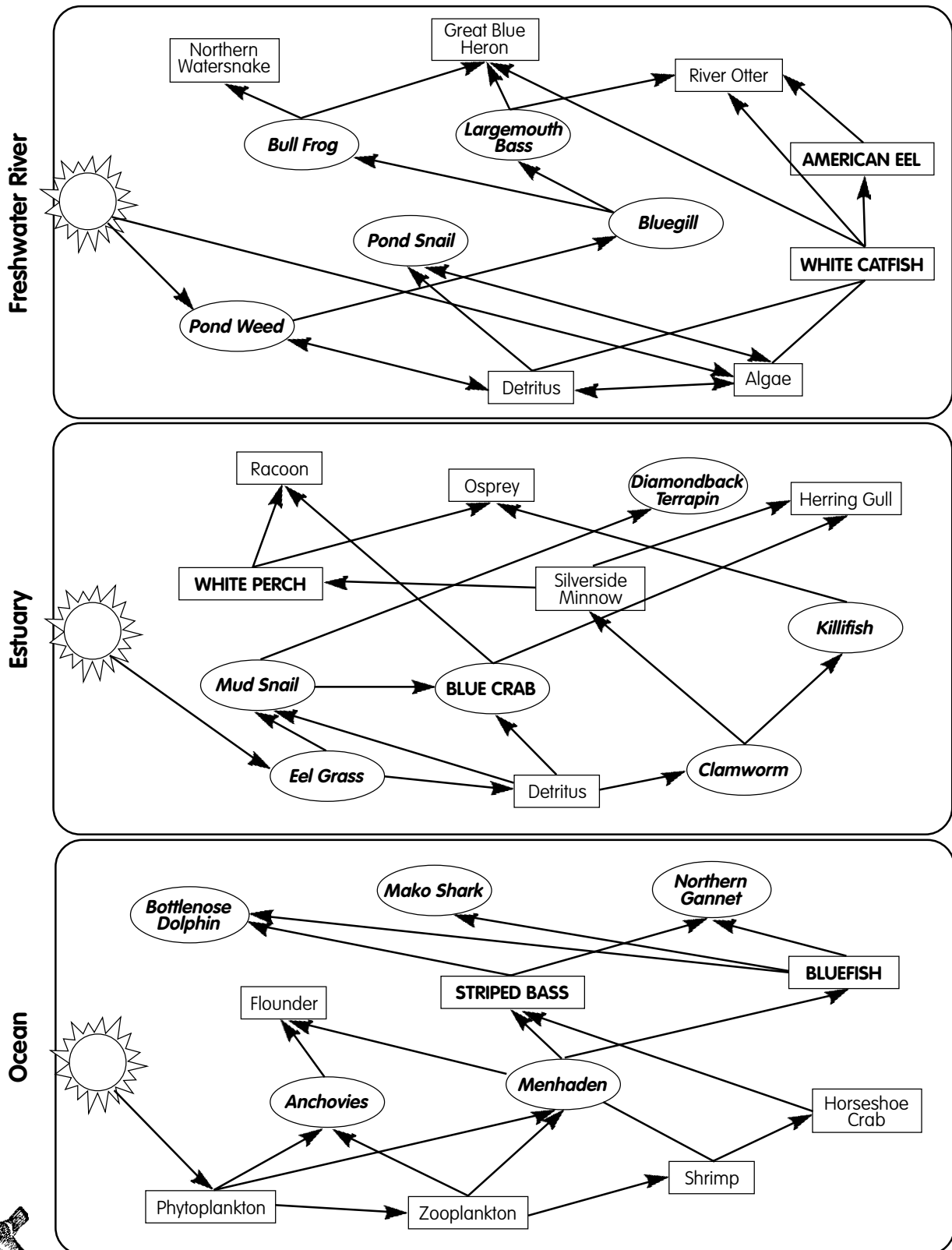
communicating
categorizing
inferring

analyzing
synthesizing
predicting

STRIPED BASS



SAMPLE FOOD WEBS



PLANNING



1. Copy the Habitat and Species Cards (Figures 2A, 2B & 2C) onto three different colored papers. On the cards, all indicator species are in ***bold italics*** and all Fish Consumption Advisory species are in **BOLD** capital letters.
2. Create a “sun” card and a “human” card for each group.
3. Cut the cards apart and mount each on an index card or other stiff paper.
4. Laminate each card or cover in clear contact paper.
5. Copy each sample food web without the arrows (Figure 2D) onto a large sheet of paper. These sheets will be used in the activity after students have created their food chains and food web. Only some of the connections that would occur in each food web are shown.

PROCEDURE SETTING THE STAGE

Ask several students to describe their favorite food. List the ingredients that are required to make the food. Create a simple food chain to show how energy flows from the sun to the human consumer.

THE ACTION



Period 1

1. Divide the class into three groups that represent the following aquatic systems: freshwater river, estuary, and ocean.
2. Designate one student from each group to be the sun, one to be the human, and another to be the yarn carrier whose job is to transport the yarn ball from person to person during the activity. Distribute a species card (from that natural system) to each additional member of the group.
3. Discuss the terms producer, consumer, and decomposer to review how each organism obtains its food.
4. Distribute a ball of yarn to each group. Tell the students that the yarn represents the sun’s energy and should be passed from person to person during the activity.
5. Have each group work together to create a series of food chains using the information given on each card. Once a food chain is complete, return the yarn ball to the sun to start a new chain (Figure 2E). Each student needs to be connected at least once before food web status is achieved.
6. Once each group is finished, have the students place the yarn on the ground and step away from it. Discuss the concept of food web.
7. Post the large species lists on the board or wall. As each habitat group explains their food web to the class, draw these connections on each of the master lists. Ask other students to contribute additional connections.

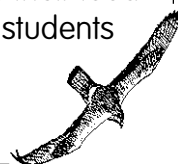
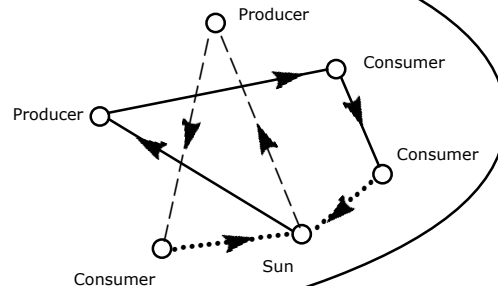


FIGURE 2E
HOW TO CONNECT THE STUDENTS

KEY:

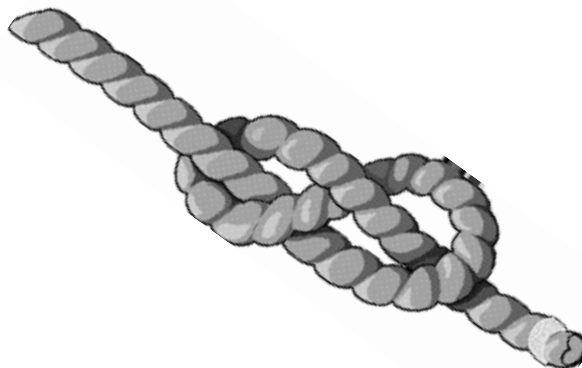
- 1st Food Chain A = —————
Reconnecting to the Sun =
2nd Food Chain B = - - - - -



8. Identify the students who represented the indicator species (**bold italics** on the cards). Ask students to speculate why these species belong to a special group. Introduce the term, indicator species, and discuss how these species are significant in determining habitat types and ecosystem health.
9. Identify the students who represented the Fish Consumption Advisory species (**BOLD** capital letters on the cards). Show an example of the Fish Consumption Advisories (Appendix A). Explain why these species have been included on the Advisory list. [*These species are either bottom dwellers or scavengers that have direct contact with contaminated detritus or they eat other animals that have contact with the contaminants.*]

Period 2

1. Tape the food web lists on a wall in order of their flow from freshwater to saltwater (river, estuary, ocean).
2. Divide the class into small groups (their original groups halved) and ask them to write down as many food chains as they can to show how species from different habitats interact. Allow the students to refer to their habitat cards.
3. Have each small group explain one of their food chains. Use string and tape to make these connections between the habitat sheets. Ask the members of each group to describe how the habitats are connected as part of a larger regional natural system.



ASSESSMENT STRATEGIES

Have the students:

- ❑ Describe what might happen to the other members of the food web when the indicator species are removed from each of the habitats.
- ❑ Determine which of the animals and plants within the food web would be more susceptible to change, less susceptible to such changes, and why.
- ❑ Write essays to complete the following newspaper headings. Include information about health effects on the animals and plants within the three habitats and what efforts are being used to remedy the situation:
 1. An oil tanker leaked crude oil into the ocean near Sandy Hook, NJ...
 2. A barge ran aground in the Hudson River and part of its waste load for the landfill was dumped...
 3. Construction along a lakeshore produced sediments that clog the channel going into a nearby river...

EXTENSIONS



Have the students research their habitat and report on other plants and animals that belong there.



Have each student illustrate his or her animal or plant from the lesson. Display these illustrations as a bulletin board in the hallway. Use yarn to show some of the connections between the animals, plants and habitats.

RELATED EDUCATION RESOURCES

- *Aquatic Project WILD - Aquatic Education Activity Guide*
- *Bridges to the Natural World: A Natural History Guide for Teachers of Grades Pre-K to Six*
- *The Biology of the Hudson-Raritan Estuary: A Teacher's Guide*
- *The Living Tidal Marsh*
- *Young People's Guide to Saltwater / Freshwater Fishing*

REFERENCE

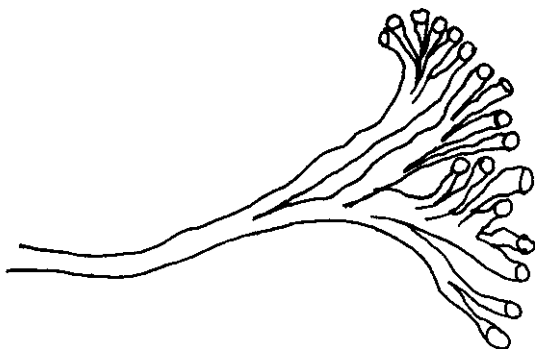
Redington, Charles B. *Plants in Wetlands, Redington Field Guides to Biological Interactions*. Kendall/Hunt Publishing Co., Dubuque, Iowa. 1994.

Reid, George K., Ph.D. *Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes*. Golden Press. NY. 1987.



FRESHWATER RIVER

FIGURE 2A



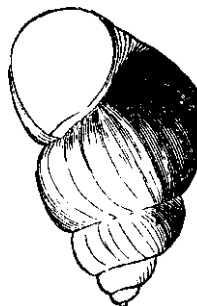
Algae: producer



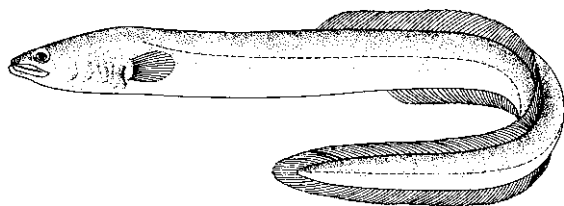
Detritus: bits of dead plant & animal matter



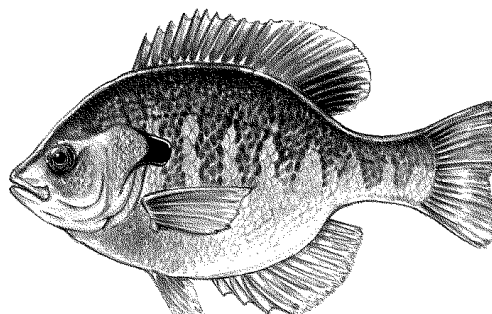
Pondweed: producer



Pond Snail: consumer, scavenger
Eats: algae, aquatic plants, detritus



AMERICAN EEL: consumer
Eats: fish, plants, crustaceans, worms

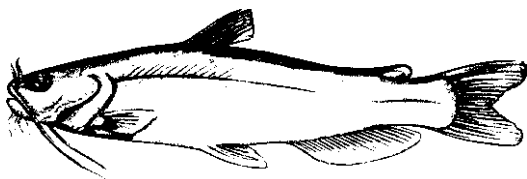


Bluegill: consumer
Eats: insects, crustaceans, small aquatic animals

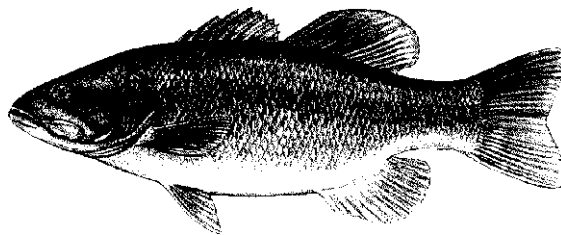


FRESHWATER RIVER

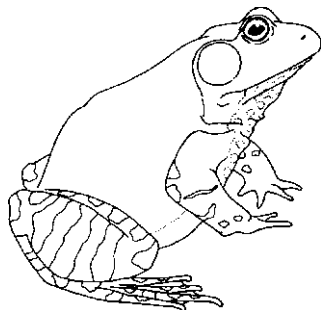
FIGURE 2A (continued)



WHITE CATFISH: consumer
Eats: detritus, plants



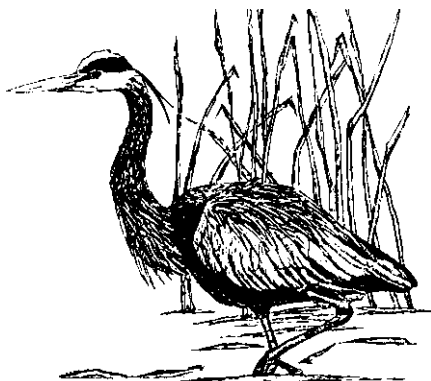
Largemouth Bass: consumer
Eats: smaller fish



Bullfrog: consumer
Eats: insects, frogs, small fish



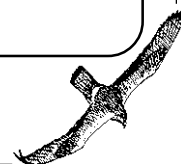
Northern Watersnake: consumer
Eats: frogs, fish, salamanders, crustaceans,
small mammals



Great Blue Heron: consumer
Eats: fish, small mammals, frogs, snakes



River Otter: consumer
Eats: fish, snakes, frogs



ESTUARY

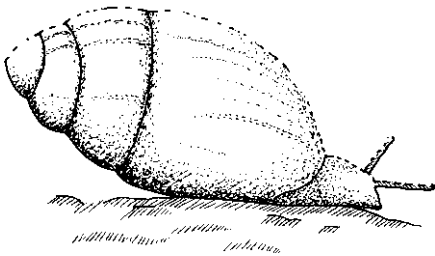
FIGURE 2B



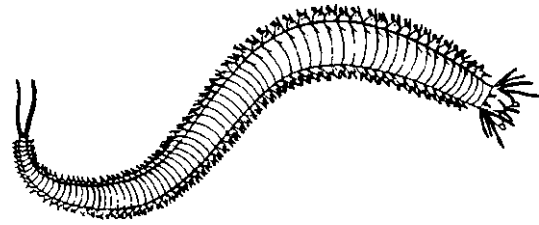
Detritus: bits of dead plants & animals



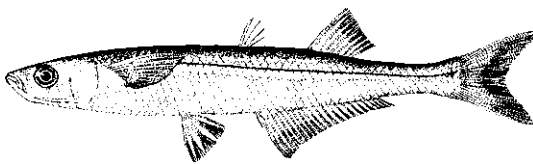
Eel Grass: producer



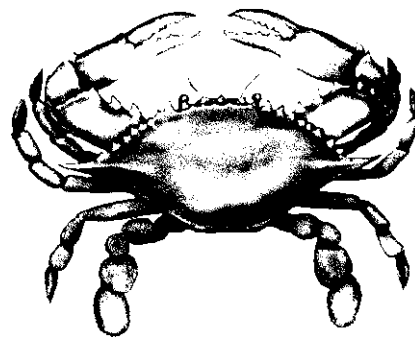
Mud Snail: consumer, scavenger
Eats: plants, detritus



Clamworm: consumer, scavenger
Eats: detritus, other clamworms



Atlantic Silverside: consumer
Eats: algae, shrimp, crustaceans, insects, worms, horseshoe crab larvae

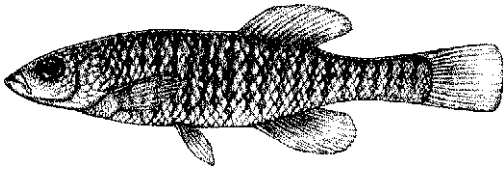


BLUE CLAW CRAB: consumer, scavenger
Eats: worms, plants, crustaceans, detritus, fish

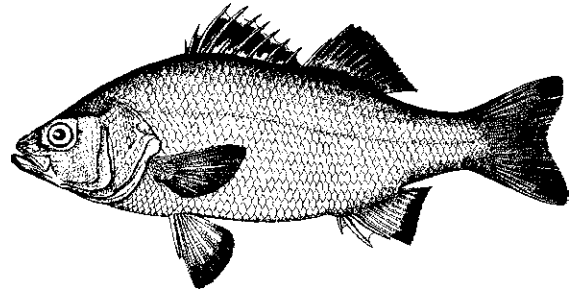


ESTUARY

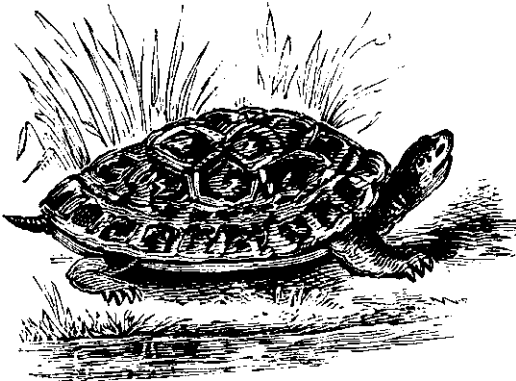
FIGURE 2B (continued)



Killifish: consumer, scavenger
Eats: vegetation, worms, detritus,
crustaceans, mosquito larvae



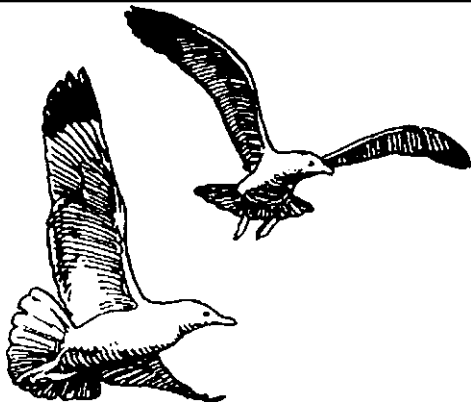
WHITE PERCH: consumer
Eats: some plant species, worms, detritus,
crustaceans, fish, crabs



Diamondback Terrapin: consumer
Eats: marine snails, clams, worms



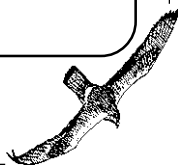
Osprey: consumer
Eats: all types of larger fish



Herring Gull: consumer, scavenger
Eats: small fish, most any type of animal

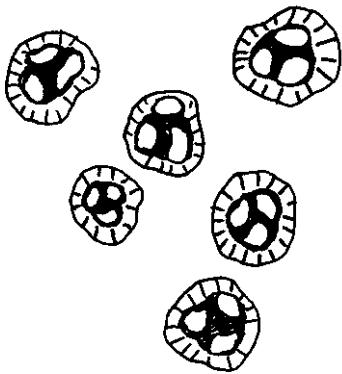


Raccoon: consumer
Eats: frogs, large insects, bird eggs, small
mammals, crabs, fish

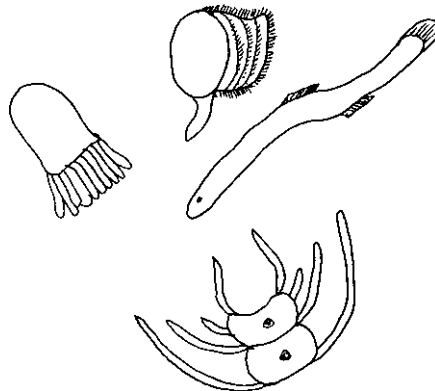


OCEAN

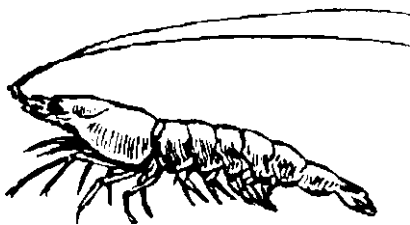
FIGURE 2C



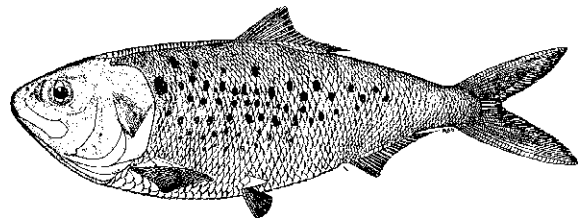
Phytoplankton: producer



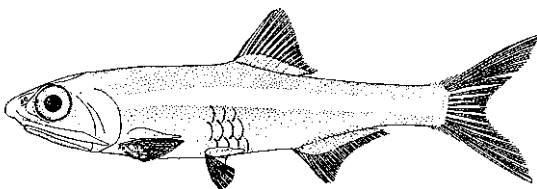
Zooplankton: consumer
Eats: phytoplankton & other zooplankton



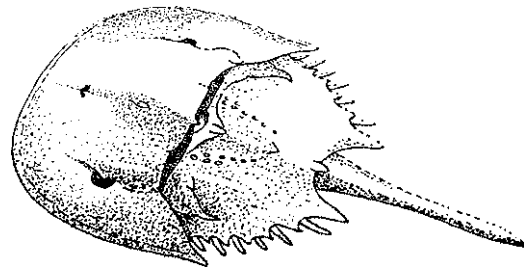
Shrimp: consumer
Eats: phytoplankton



Menhaden: consumer
Eats: phytoplankton, small crustaceans



Anchovy: consumer
Eats: zooplankton, marine worms, small crustaceans

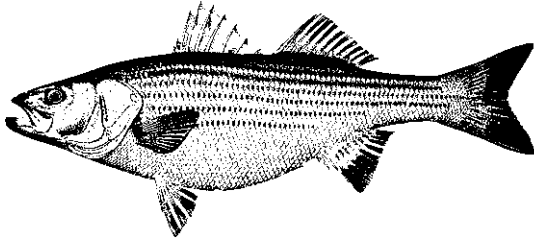


Horseshoe Crab: consumer, scavenger
Eats: worms, small crabs, shrimp, dead fish

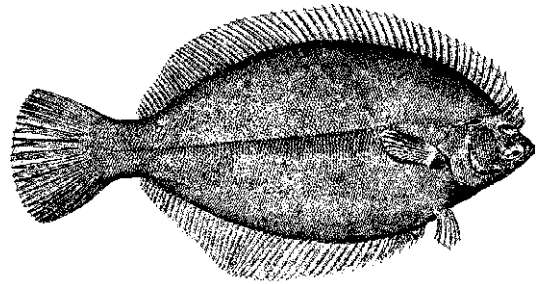


OCEAN

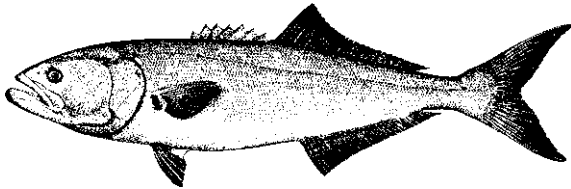
FIGURE 2C (continued)



STRIPED BASS: consumer
Eats: menhaden, silversides, blue crabs, horseshoe crab larvae, shrimp, clams



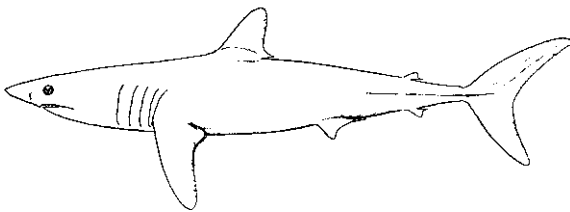
Flounder: consumer
Eats: worms, small fish, shrimp, Atlantic silversides, killifish



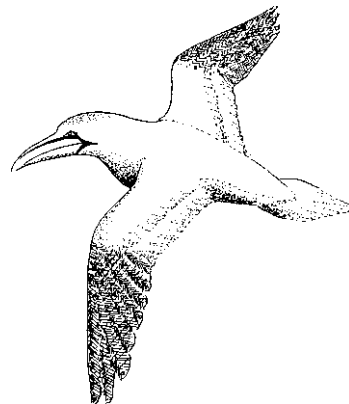
BLUEFISH: consumer
Eats: menhaden, silversides



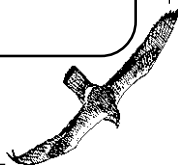
Bottlenose Dolphin: consumer
Eats: all types of fish



Mako Shark: consumer
Eats: all types of fish



Northern Gannet: consumer
Eats: all types of fish



YOU ARE WHAT YOU EAT



BACKGROUND INFORMATION



Many potentially harmful substances have been introduced into the environment. Some of these are biodegradable and, over time, have little long-term effect on the health of the ecosystem. Others, such as synthetic organic chemicals (PCBs, dioxins, chlordane) do not biodegrade to the same degree, but remain in the environment. Since these chemicals are toxic at certain concentrations and some are possible carcinogens, they are considered potentially harmful to the animals living in or depending on the affected ecosystem.

These substances are not soluble in water and tend to concentrate in bottom sediments. The chemicals may be ingested by aquatic animals that rely on the nutrients they receive from the detritus in the sediments. Once these chemicals enter the animal they are difficult to excrete and over time become stored in the animal's fatty

tissue. This process, called bioaccumulation, may not kill the animal, but, when it becomes prey to another animal, all of the original animal's "chemicals" are taken into the new animal's body. The chemical builds up in the new animal's body as it eats more and more of the affected species. During this process of biomagnification, the new animal may store enough of these contaminants in its body to elicit adverse health effects (See Figure 3C). The long term effects of small amounts of these contaminants and their possible impact on humans are not well understood, although the Fish Consumption Advisories give guidelines for minimizing risk to humans who eat the affected animals.



LEVEL

4 to 6

LENGTH

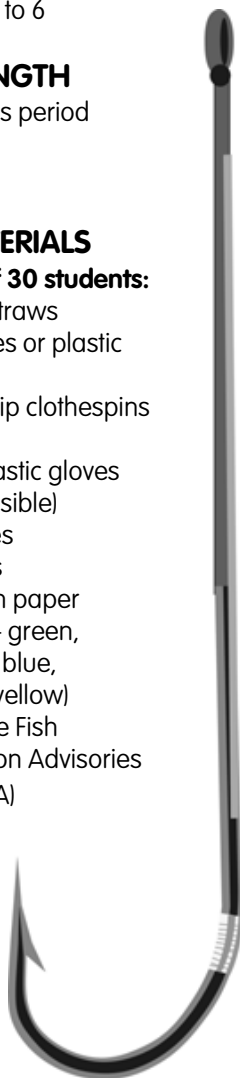
1 class period



MATERIALS

For a class of 30 students:

- o 20 plastic straws
- o 15 envelopes or plastic baggies
- o 10 spring-clip clothespins or tongs
- o 3 sets of plastic gloves (blue, if possible)
- o paper plates
- o paper bags
- o construction paper (18 pieces – green, 18 pieces – blue, 4 pieces – yellow)
- o 1 copy of the Fish Consumption Advisories (Appendix A)



OVERVIEW

An active game demonstrates how toxins can accumulate in the bodies of animals in an estuary food chain.

OBJECTIVES

Students will:



Describe how energy moves through an estuarine food chain;



Explain the processes of bioaccumulation and biomagnification;



Describe how bioaccumulation and biomagnification can affect people.



ADVISORY LINK

The New Jersey Department of Environmental Protection, Division of Science and Research found unsafe levels of dioxins and PCBs in some species of fish and crabs in the Newark Bay Complex. These chemicals are classified by the federal Environmental Protection Agency as probable cancer causing substances in humans. As these toxins move through the estuarine food chain, they become more concentrated in higher order consumers. The Fish Consumption Advisories give guidelines for anglers to follow when they consider consuming specific fish and crabs from these waters.

KEYWORDS

bioaccumulation
biomagnification
consumer

contaminant
detritus
dioxins

estuarine
PCBs
producer

STUDENT PREREQUISITES

An understanding of how food chains and food webs function
The basics of an estuary habitat

PROCESS SKILLS

communicating
measuring
counting

interpreting data
formulating hypotheses



PLANNING



1. Cut paper for food markers. For each student who represents an oyster, cut nine green markers for decaying vegetation, nine blue markers for decomposing animal matter and two yellow markers for toxins.
2. Assemble the other materials and find a site for the game.
3. Make one copy of Figure 3C for each student.

PROCEDURE SETTING THE STAGE

Display pictures of the three animals that are represented in the game (Figure 3B). Ask the students if they have seen any of these animals, and if so, in what context. Explain to the students that each of them is going to assume the role of one of these animals in a food chain game.

THE ACTION



Pre-Game

1. Write the following ratio on the blackboard 6:3:1. This explains an approximate number of oysters to crabs to gulls in the environment. Have the students determine how many of each animal should be represented based on the total number of students in the class (in a class of 30 students there should be 18 oysters, 9 blue crabs, and 3 herring gulls).
2. Discuss the significance of the ratio. (*There are more first order consumers (oysters) than second order consumers (blue crabs), and more second order consumers than top consumers (herring gulls).*)

Game

1. Assign roles to the students. Players are hereafter referred to as oysters, crabs, and gulls.
2. Instruct the students representing oysters to sit on the ground. (Oysters grow by attaching themselves to a stationary object.) Discuss how oysters feed by filtering microscopic zooplankton and phytoplankton from the surrounding water. Give each oyster a plastic straw that they will use to pick up their food markers.
3. Spread the food markers all around the oysters. Note: Do not explain the color representations.
4. On your signal have the oysters collect as many food markers as possible using their straws and without moving

FIGURE 3A

GAME RESULTS			
	GREEN MARKERS	BLUE MARKERS	YELLOW MARKERS
OYSTERS 1. 2. 3. 4. 5. etc.			
BLUE CRABS 1. 2. 3. 4. 5. etc.			
HERRING GULLS 1. 2. 3. 4. 5. etc.			



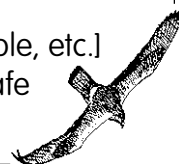
from their spots. Collected food markers should be placed on a paper plate. (Hint: In case the students do not discover how to pick up the markers, show them that they can position an open end of the straw on top of the marker, suck on the other end, and thus pull the paper off the floor.)

5. After most of the food has been collected, tell the oysters to stop. Leave the remaining food markers where they are.
6. Instruct the oysters to separate the food markers they collected according to colors, and then count the number for each color. Record the results on a chart similar to Figure 3A.
7. Have the oysters remain seated with their food plates in front of them.
8. Send the blue crabs onto the field. Using clothespins or tongs (crab claws), these students collect the markers (picking them up one by one and placing them in a baggie) from each oyster they visit. As soon as all the food from an oyster has been taken, the oyster leaves the playing field and the crab may move to another oyster.
9. After most of the oysters have been consumed, pause the game and instruct the blue crabs to count their food markers the same way as the oysters did. Record the results.
10. The blue crabs go back onto the playing field. Discuss where crabs live in the estuary [*along the water's edge, on mudflats, in vegetation, under the water*]
11. Tell the crabs that they may move around the playing field to stay away from the gulls. Gulls try to tag a crab with their gloved hands. When this happens, they put the crab's food into their paper bag and the crab is out of the game. Gulls may move freely around the field until the teacher yells WAVE. At this time every gull must freeze but crabs may continue to move. Discuss the real life parallel. [*When water flows over the crabs, it is difficult for a gull to find and eat it.*] When the teacher yells EAT, the gulls may chase the crabs again.
12. Continue until there are two crabs left, and then instruct the gulls to count their markers and record the results.

CLOSING DISCUSSION

Explain that in the game, the blue and green markers represented detritus and the yellow markers represented toxins that are present in the detritus. Discuss PCBs and dioxins as two of the contaminants affecting animals in the Newark Bay Complex.

1. What do you think happens to the nutrients that the animals get from the detritus? [*The nutrients are used for life functions, they are passed through the animals' systems, and they are transferred to another animal when it gets eaten.*]
2. What do you think happens to the toxins? [*These types of chemicals are stored in the fatty tissue of the animals; they do not pass through the animals' systems, and the toxins are passed from one animal to the next in the food chain.*]
3. Based on the game, in which animals did most of the toxins accumulate? [*the gulls*]
4. How did the gulls accumulate the toxins? [*The gulls ate other animals that were contaminated.*] To discuss how the chemicals might affect species that have them in their bodies, have the students review the results. If a gull had between 5 and 10 yellow markers it was fine, between 11 and 20, it was sick, and if it had more than 20 markers, that gull did not survive. Use Figure 3C to discuss biomagnification.
5. List other consumers of oysters and blue crabs. [fish, other birds, raccoons, people, etc.]
6. Introduce the Fish Consumption Advisories as a source for learning about the safe consumption of possibly affected species (Appendix A).



ASSESSMENT STRATEGIES

Have the students:

- ❑ Create a visual representation of the action that occurred during the game. Suggestions: Diagrams, flow charts, sketches, diorama, comic strips.
- ❑ Graph the results of the game to explain the process of bioaccumulation.

STAYING INVOLVED



Do a survey of common household products. Determine which of these are biodegradable and which are not. Discuss how the non-biodegradable products may accumulate in a natural system.



Research and/or devise alternatives to using the more hazardous chemicals. Refer to *The Clean Water Book* for suggestions.

EXTENSIONS



Have students research other food chains that would be affected by bioaccumulation and substitute these animals for the original ones.



Challenge the students to create a board game that reflects the simulation.

RELATED EDUCATION RESOURCES

- *Aquatic Project WILD: Aquatic Education Activity Guide*
- *Project WILD Elementary Activity Guide*
- *Project WET Curriculum and Activity Guide*
- *WOW! The Wonders of Wetlands*
- *Fishways, Ontario Ministry of Natural Resources 1991*
- *Delaware Estuary Issues, US EPA, US Fish and Wildlife Service*

REFERENCES

Hoffman, Kyra. *The Clean Water Book: Lifestyle Choices for Water Resource Protection*. New Jersey Department of Environmental Planning.

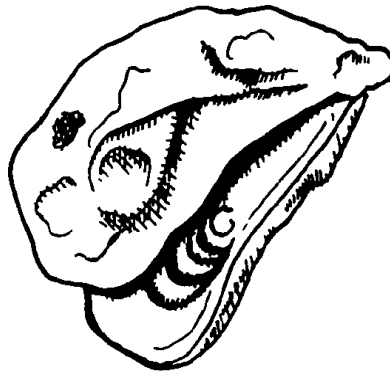
New York/New Jersey Harbor Estuary Program. Pamphlets entitled "You Can Help the Harbor"



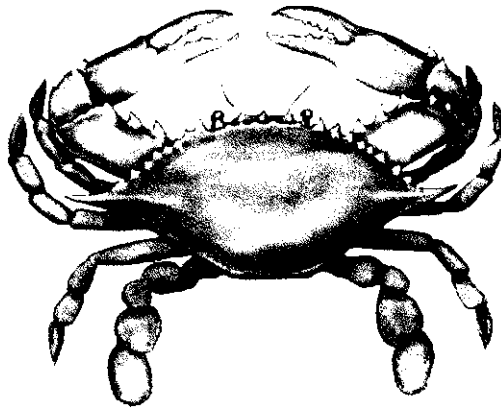
ESTUARY ANIMALS

Figure 3B

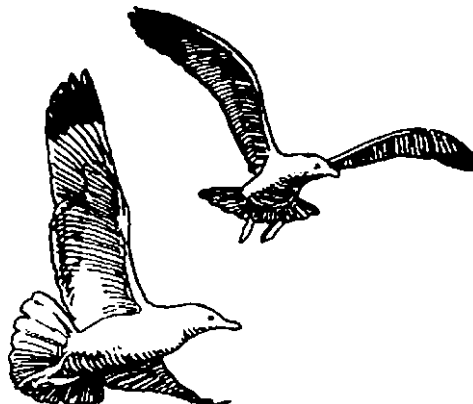
OYSTER



BLUE CLAW CRAB



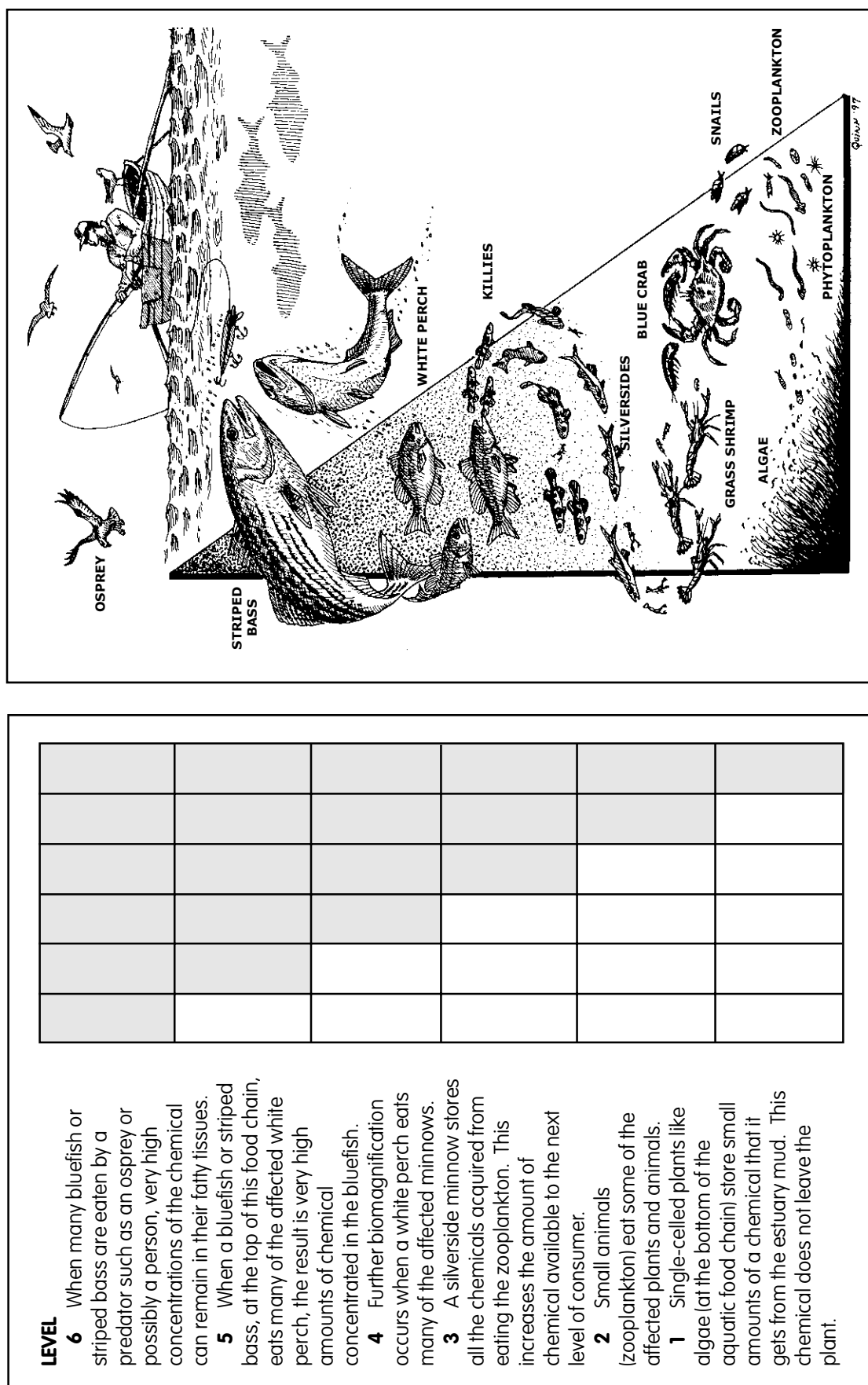
HERRING GULL



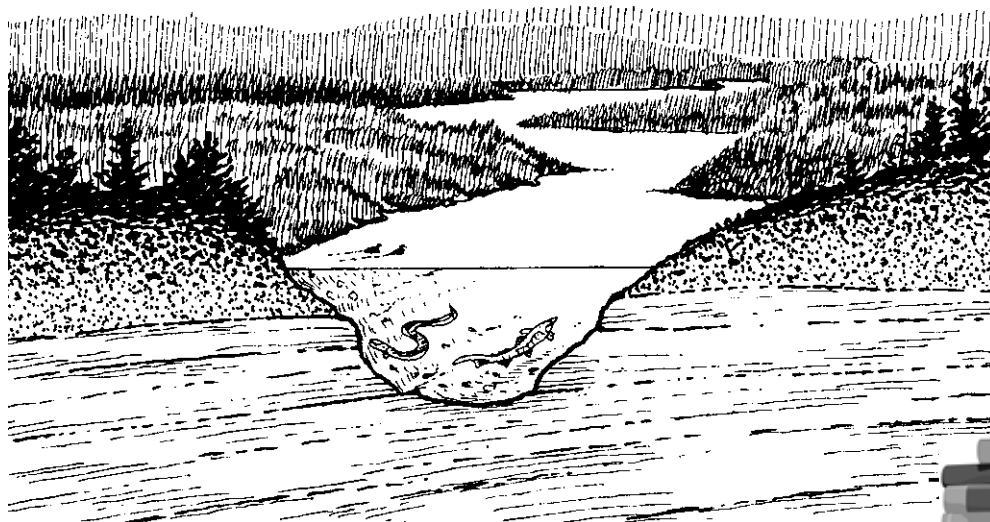


BIOMAGNIFICATION IN THE FOOD CHAIN

Figure 3C



THE WORKS



BACKGROUND INFORMATION

A watershed is defined as the land area that drains into a specific body of water such as a river, stream, lake or estuary. Watersheds come in a variety of sizes – they can be as small as the land area that surrounds a catchment basin in a housing development or as large as the land area that surrounds an entire river system. Regardless of size, any natural or human-made environment that exists within its boundaries becomes an integral part of the watershed's regional system.

To identify the boundaries of a watershed, it is necessary to read the earth's topography. Topographic maps, which show elevation as contour lines, help the map-reader visualize the watershed's boundaries. High elevations separate one watershed from another and the positions of low elevations help determine how water will drain off the land and where it will collect. Although water collection sites can be categorized into

several types of aquatic habitats (pond, lake, stream, river, estuary, bog), each site will have some of its own unique properties, depending on geology and soil type.

By looking at the topographic maps for an individual watershed, it is easy to see the continuity of river systems and how these systems are connected to lakes, ponds, marshes, estuaries, and reservoirs. Further interpretation will show how the contours of the terrestrial habitats adjacent to these waterways determine the direction of water flow. A complete study of the watershed system will help teach about human land use and how these actions contribute to water quality and quality of life issues.



LEVEL

6 to 8

LENGTH

3 class periods



MATERIALS

For each small group or pair of students:

- o one clear plastic box with clear lid (at least shoebox size)
- o several rocks or clay
- o spray mister
- o non-permanent marker
- o ruler
- o container of colored water
- o topographic map that includes the school

For the class:

- o 1 set of habitat sketches (Figures 4B & 4C)
- o food coloring
- o paper towels
- o newspapers
- o aluminum foil
- o tracing paper

OVERVIEW

Hands-on model building introduces students to topographic maps, their local watershed and how habitats within a regional ecosystem are connected.

OBJECTIVES

Students will:



Understand the basic structure of a watershed;



Identify aquatic habitats within a regional watershed;



Interpret three-dimensional models and topographic maps;



Understand how habitats within a region create an integrated ecological system.



ADVISORY LINK

The species listed in the Fish Consumption Advisories spend all or part of their life cycle in the estuary ecosystem. The estuary is part of a larger regional system called a watershed, which encompasses diverse natural and human-made environments.

KEYWORDS

bedrock
contour lines
ecosystem
elevation
estuary

freshwater marsh
habitat
landform
salt marsh
slope

tidal marsh
topographic map
topography
upland
watershed

STUDENT PREREQUISITES

Practice in map reading
An understanding of "habitat"

PROCESS SKILLS

communicating
observing
analyzing
measuring

predicting
synthesizing
comparing
formulating hypotheses



PLANNING



1. Obtain a topographic map of the area around your school.
These can be purchased at sports/camping stores, from the *New Jersey Atlas & Gazetteer* by DeLorme or by ordering through the NJ Department of Environmental Protection (DEP) Publications Catalog: Map and Publications Sales, NJDEP, PO Box 417, Trenton, NJ 08625-0417 (609) 777-1038. They can also be downloaded from the NJDEP website at <http://www.state.nj.us/dep/njgs/geodata/index.htm>
2. Make copies of Figure 5C – Watersheds of Northern New Jersey.
3. Assemble the materials for the model demonstrations and the clean-up equipment.
4. Copy Figures 4B and 4C to display to the class.

PROCEDURE SETTING THE STAGE

Ask the students to identify various locations in town that show examples of low and high elevation. Create a list of resources where the students could find more information about the elevation of these specific sites.

THE ACTION



Period 1

1. Divide the class into groups of not more than four students per group.
2. Read aloud the directions for creating a watershed model. Have the students take “step by step” notes to create their model using the materials supplied.

FIGURE 4A HOW TO CREATE A WATERSHED MODEL

- Step 1 Distribute a clear plastic container with a clear plastic lid and rocks or clay to each small group of students
- Step 2 Have the students arrange the rocks or clay to form higher elevations and lowland areas.
- Step 3 Cover the rocks and clay with plastic or foil to create indentations for lakes, marshes and other water habitats.



3. Create a class list of the various landforms represented on the models. Relate these to similar sites from around town.
4. Discuss the factors that would determine the direction water would flow [*geology, limnology, soils, topography, gravity, the path of least resistance, human land use*]. Ask the students to predict where water would collect on their models.



5. Ask the students to name the types of habitats that might be associated with these collection sites. Use Figures 4B and 4C to help the students visualize how these aquatic habitats might look. Discuss which of these water habitats would channel water [*river/stream*] and which would store water [*pond/lake, marshes*].
6. Provide each group with a spray mister filled with water. Instruct the students to place their models on newspaper, and then spray water on the model to simulate a rainstorm. Discuss the results.
7. Have the students count how many "collection areas" they have on their models.
8. Define "watershed." Discuss how a watershed's size varies depending on the amount of land that is drained.
9. Have students explain how smaller watersheds may be a part of a larger watershed.
10. Ask the students to explain how water and land habitats are connected. [*Water from rain and snow melt runs off the land into waterways. Smaller waterways are connected to larger waterways and eventually will connect to the estuary and the ocean. Streams and river travel through marshes, ponds, swamps, lakes and reservoirs.*]
11. Distribute copies of Figure 5C for the students to see. Identify the subwatershed and watershed in which their school exists.

Period 2

Have the students translate their 3-D model into a flat map by following these steps:

1. Use a ruler to mark the outside vertical wall of the container at $\frac{1}{2}$ " intervals.
2. Pour colored water into the container until it reaches the first $\frac{1}{2}$ " mark.
3. Place the clear top on the container and trace the water level line on the plastic top with a non-permanent marker.
4. Repeat Steps #2 and #3 until the container has been filled to the top mark on the outside wall.
5. Remove the container's top. As the students look at the top, explain that each line drawn is called a contour line. These continuous lines represent points on the surface of the earth that have the same elevation.

Period 3

Distribute one sample topographic map that includes your school to each small group. Refer back to the maps that the students created using the 3-D model. Ask the students to study the sample map and to write five questions about how to read the map. Use the students' questions to stimulate a discussion; include the following:

- What does a topographic map represent? [*the physical features of a region*]
- How are the gradations on different slopes represented? [*Steep slopes are indicated by closely drawn contour lines; gentle slopes have contour lines that are drawn farther apart.*]
- How is elevation shown? [*Thick contour lines have numbers that represent elevation in feet.*]
- How can you tell if there is a stream, river, or other body of water shown on the map? [*All water is drawn in blue and marshes have a blue symbol that looks like blades of grass.*]



ASSESSMENT STRATEGIES

Have the students:

- ❑ Create a flat map of their model on the computer. Include a key for interpretation.

EXTENSIONS



Plan a field trip to one of the habitats shown on the topographic maps. (See Field Trip Suggestions, Appendix C)

RELATED EDUCATION RESOURCES

- *Aquatic Project WILD: Aquatic Education Activity Guide*
- *Beneath the Shell: A Teacher's Guide to Nonpoint Source Pollution and Its Potential Impact on New Jersey Shellfish*
- *Bridges to the Natural World: A Natural History Guide for Teachers of Grades Pre-K through Six.*
- *New Jersey WATERS: A Watershed Approach to Teaching the Ecology of Regional Systems*
- *The Living Tidal Marsh*
- *Project WET Curriculum and Activity Guide*
- *Ranger Rick's NatureScope: Wading into Wetlands*
- *The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of New York City's Water Supplies*

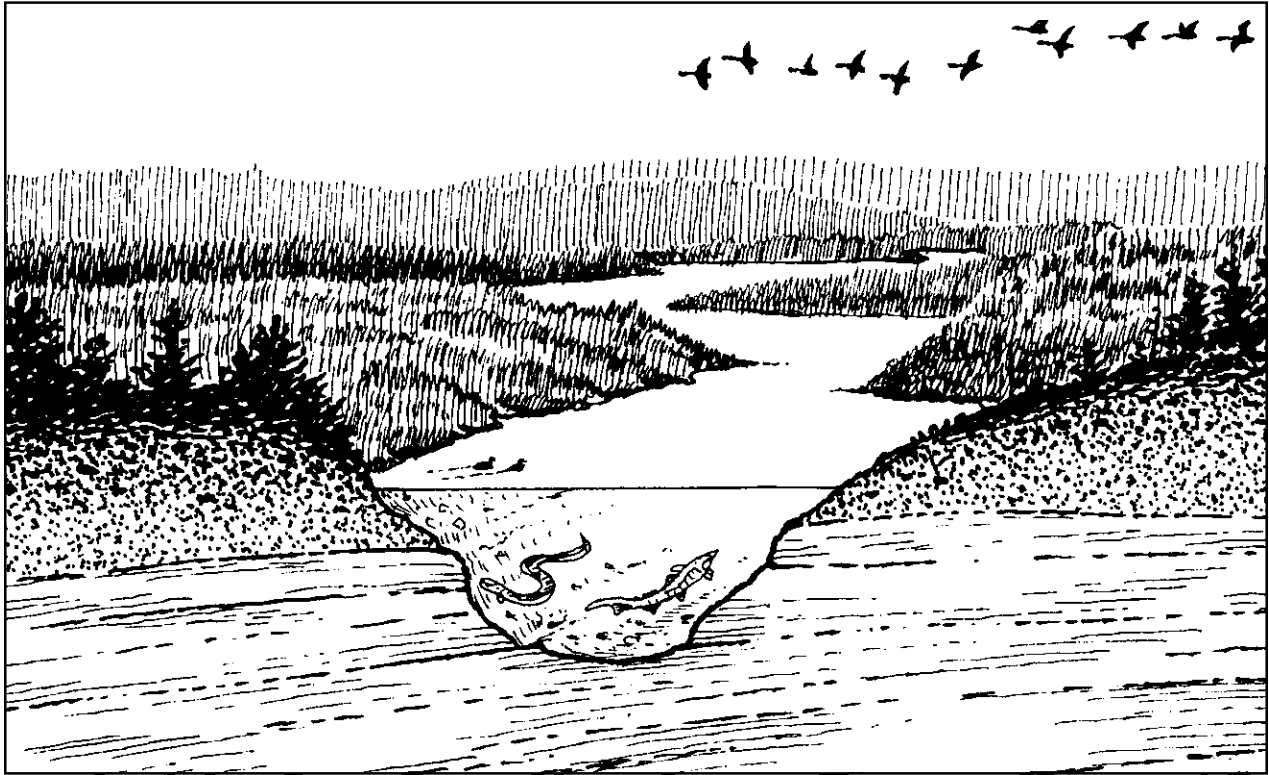
REFERENCE

New Jersey Atlas & Gazetteer. DeLorme. Yarmouth, ME. 1999.



FIGURE 4B

STREAM or RIVER HABITAT



POND or LAKE HABITAT

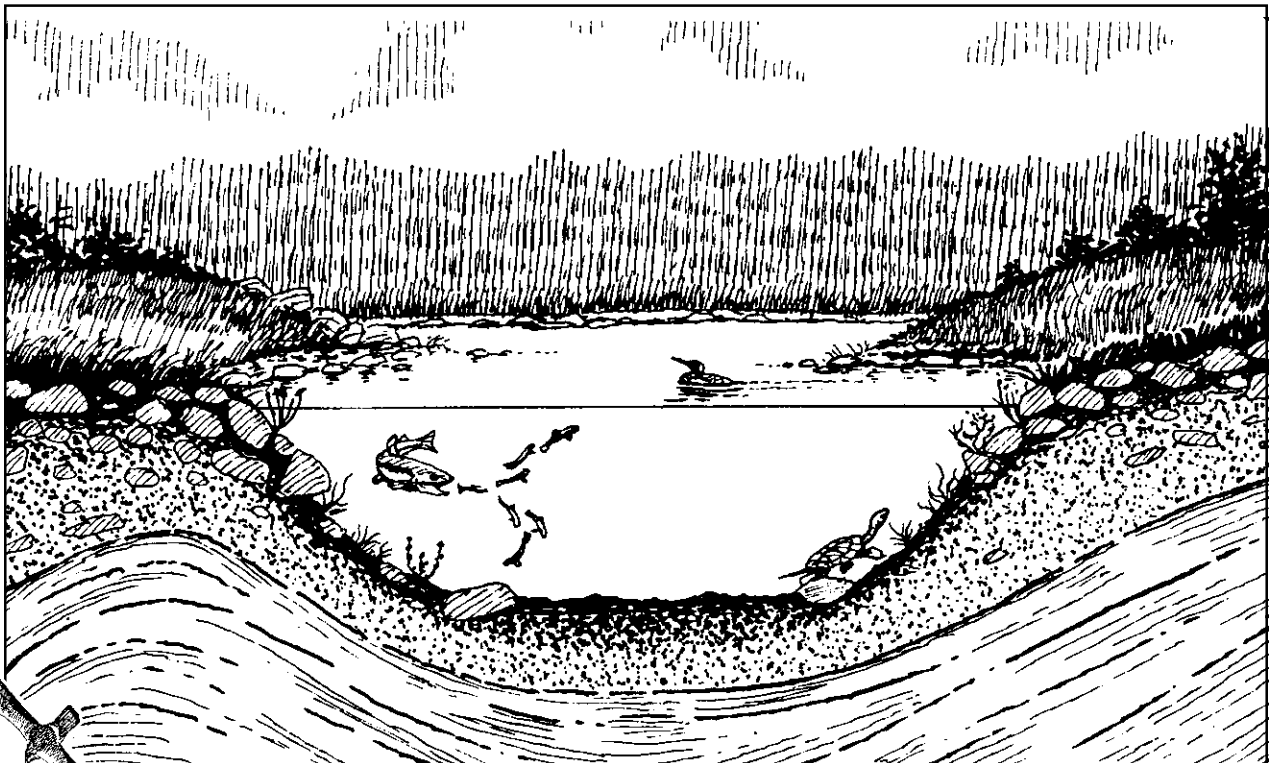
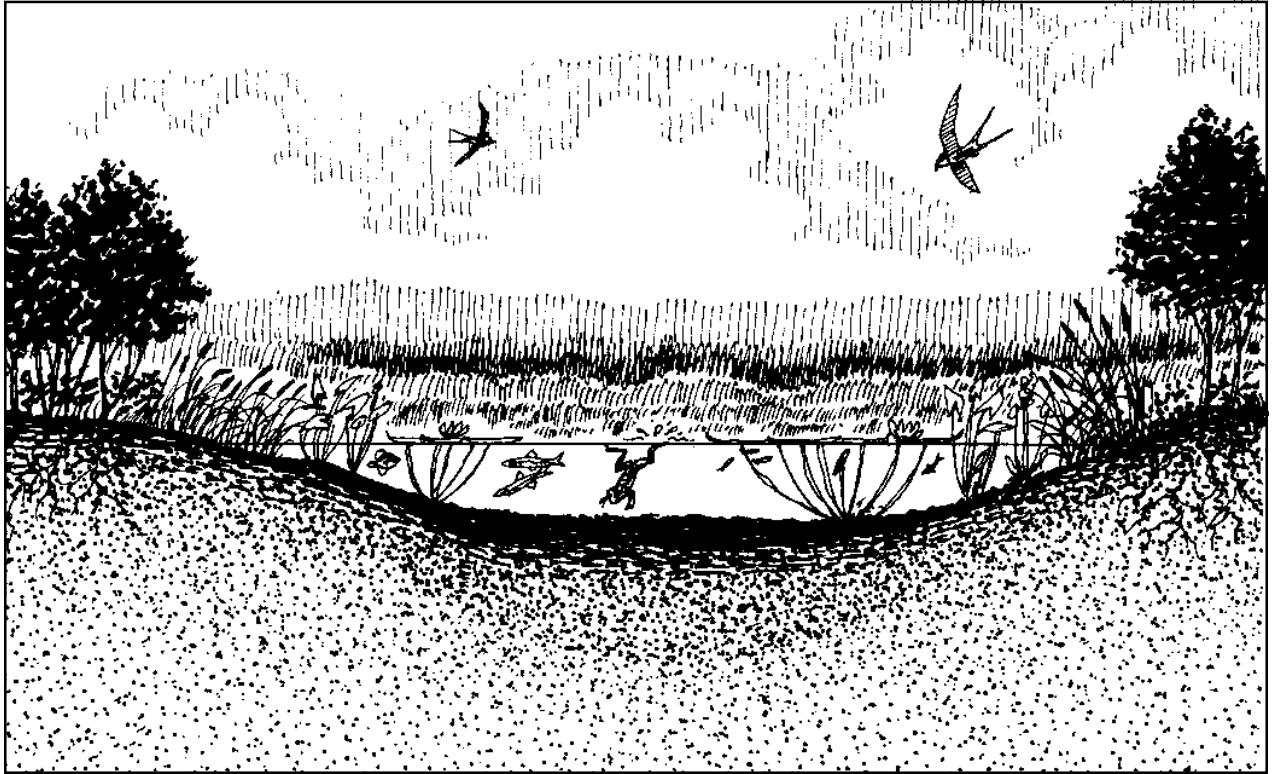
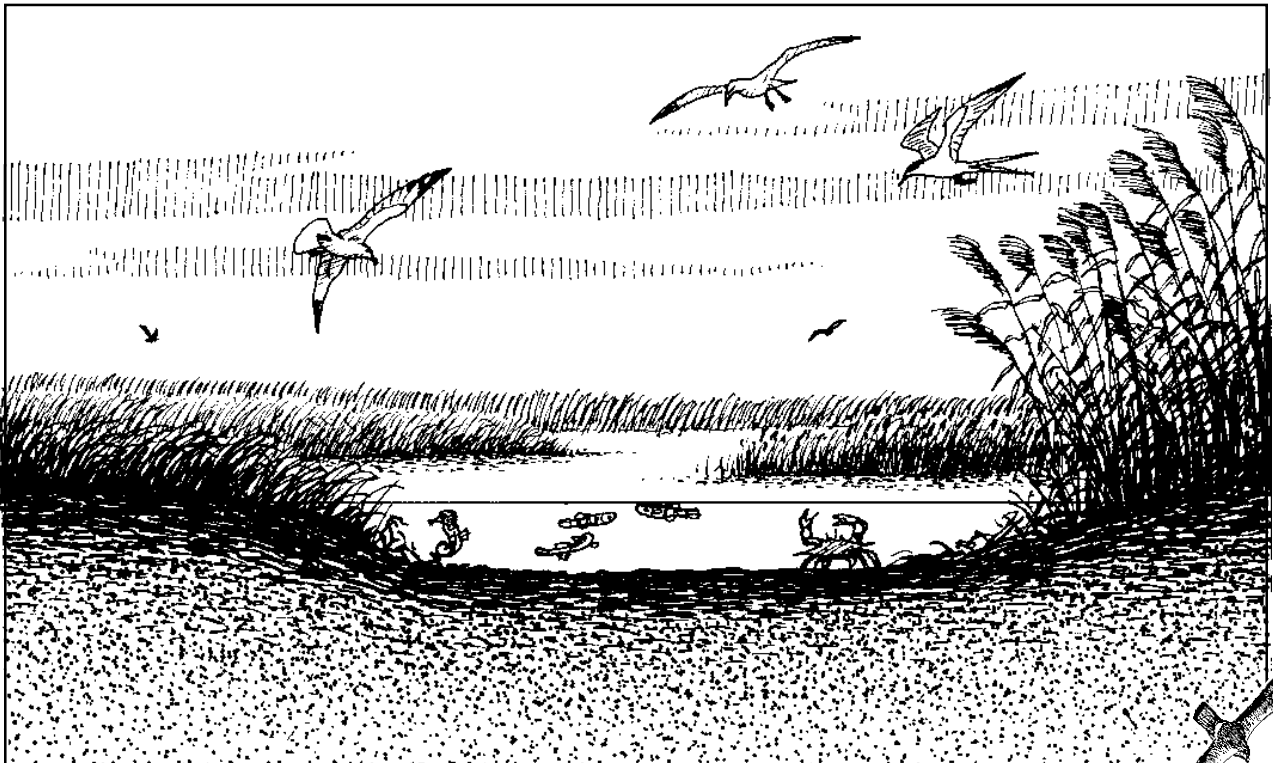


FIGURE 4C

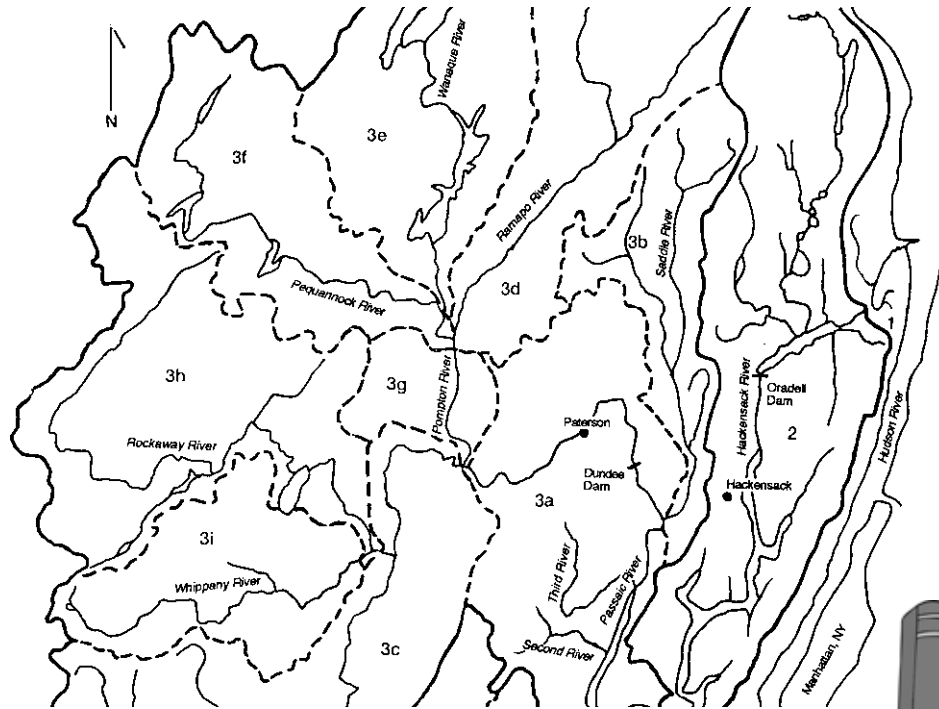
FRESHWATER MARSH HABITAT



SALTWATER MARSH HABITAT



WHERE IN THE WORLD?



BACKGROUND INFORMATION

Most natural river systems follow the same distinct pattern of flow from small streams to larger rivers, which, if traced far enough, drain into an ocean or sea. They begin at the headwaters, usually a natural spring, run-off from snowmelt, or a rain-fed pond. As these small fresh water streams merge with other streams, they produce the wider, deeper channel of a river. In most cases, these rivers will connect to estuaries influenced by ocean tides.

A river's channel is determined by many factors, including natural landforms, rock strata underlying the surface of the earth, and volume of water flow. All of the land area that drains into a specific body of water (river, lake, stream, ocean) is called its "watershed."

Like most urban waterways, the river systems of the Newark Bay Complex have provided a means for commercial transportation and growth in the area. The rivers have been dammed, channeled and filled. They are the repositories for unwanted products and by-products. They also provide a place for people to enjoy various forms of recreation like fishing, boating, bird watching, and other nature-related activities. Since rivers are not confined to one community or one demographic region, all who live in the watershed play an important role. The consumption and disposal of products as well as the use of the land determine the health of the river system.

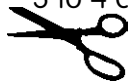


LEVEL

4 to 8

LENGTH

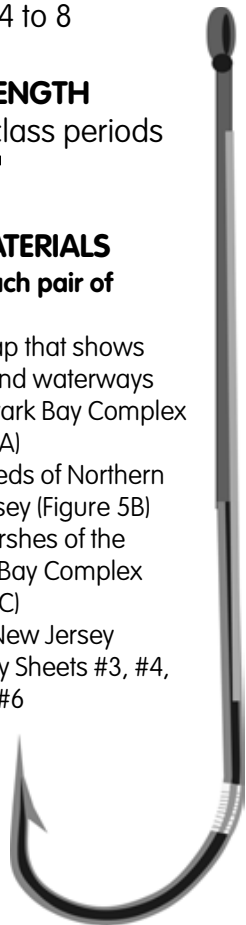
3 to 4 class periods



MATERIALS

One for each pair of students:

- o Town map that shows streets and waterways
- o The Newark Bay Complex (Figure 5A)
- o Watersheds of Northern New Jersey (Figure 5B)
- o Tidal Marshes of the Newark Bay Complex (Figure 5C)
- o Map of New Jersey
- o Discovery Sheets #3, #4, #5, and #6



OVERVIEW

Students discover their sense of place as it relates to local waterways and watersheds.

OBJECTIVES

Students will:



Interpret local and regional maps;



Demonstrate an understanding of the factors that affect their watershed;



Describe the effects of population density on a waterway.



ADVISORY LINK

The Fish Consumption Advisories covers the tidal portions of the Newark Bay Complex, but the health of the estuary ecosystem is largely dependent on the quality of the entire watershed.

KEYWORDS

brackish
cartographer
channel
drainage basin
estuary
freshwater marsh

ground truth
headwaters
landform
non-point source pollution
point source pollution
river mouth

salt marsh
tidal marsh
tributary
watershed
waterway

STUDENT PREREQUISITES

Practice in map reading
An understanding of basic river system dynamics
An understanding of the definition of watershed
An understanding of point source pollution and non-point source pollution

PROCESS SKILLS

interpreting
communicating
comparing
estimating

formulating
hypotheses
analyzing
synthesizing



PLANNING



- Obtain a copy of each of the maps listed under materials.
 - New Jersey road maps - the New Jersey Department of Commerce, Division of Tourism, PO Box 826, 20 W. State Street, Trenton, NJ 08625 (609) 292-2470.
 - Topographic maps - sports/camping stores, from the New Jersey Atlas & Gazetteer by DeLorme or by ordering through the NJ Department of Environmental Protection (DEP) Publications Catalog: Map and Publications Sales, NJDEP, PO Box 417, Trenton, NJ 08625-0417 (609) 777-1038.
- If necessary, create the town map by copying the portion that includes your school and the closest waterway. Enlarge (or reduce) it to an 8 ½ x 11-inch size.
- Make enough copies of the other maps for each pair of students or small group. (Optional: Laminate each map or cover with clear contact paper for multiple use.)
- Make copies of Discovery Sheets #3 through #6 for each pair of students or small group.

PROCEDURE SETTING THE STAGE

Ask the students to think of a river or stream they have seen or visited. Discuss what they did there and how the waterway looked. Create a list of the types of activities for which people used the waterway.

THE ACTION



Divide the class into pairs or small groups. Distribute the appropriate discovery sheets and maps in sequence.

CLOSING DISCUSSION

*Note: Read through the questions on the Discovery Sheets before using the following questions in discussion.

Discovery Sheet #3 – A Tour through Your Town (Town map)

1. List the types of information found on this map (*streets, parks, building complexes, etc.*).
2. Have each group share their directions from the school to the closest waterway with the class. Have the students decide which directions are the most complete and why.
3. Discuss how the students' directions can be verified. [*They can be verified by following the directions, confirming the directions with someone who has followed them, or looking at aerial photographs.*] Introduce the phrase "ground truth."
4. If possible, ground truth the directions to confirm map interpretations. If the waterway is not visible, look for evidence of a streambed, ask local authorities about it, or interview residents. Discuss how cartographers ground truth the maps they make.
5. Ask whether any of the students have visited the waterway. List the types of land uses they saw near the waterway, i.e. parking lot, marina, restaurant, park, roads, bridges, etc. Introduce non-point source pollution or "people pollution" and how each of these land uses contributes to water quality.

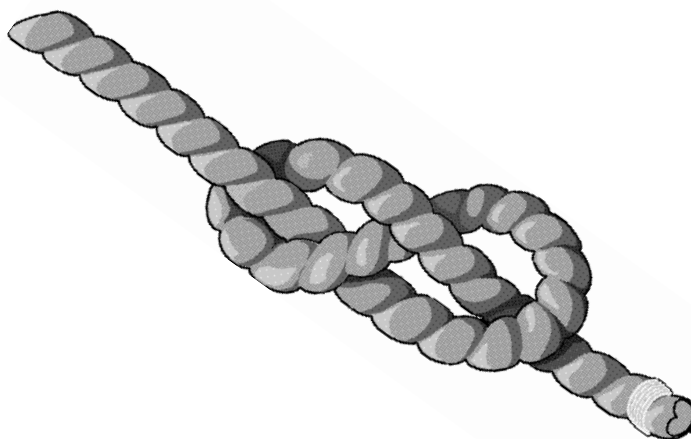


Discovery Sheet #4 – The Newark Bay Complex (Figure 5A)

1. If you were to take a boat from the river's headwaters to its mouth, what physical changes would you observe? *[The river starts out small. Other rivers join it. The river gets larger. The river may get dammed.]*
2. Starting at the headwaters of one of the major rivers, describe how the research you did on town population numbers compare. What reasons could explain the differences? *[Higher population numbers in the urban areas coincide the portion of the river that was navigable by ship and therefore more easily settled. Smaller population numbers denote more rural areas.]*
3. Based on your understanding of land use and town populations, what do you think happens to the water quality as the water flows from headwaters to river mouth? Justify your answer.

Discovery Sheet #5 – Tidal Marshes of the Newark Bay Complex (Figure 5B)

1. Ask whether any of the students have visited a tidal marsh. Describe the purpose of the visit, what the marsh looked like, the types of plants and/or animals seen, and any evidence of human activity.
2. Introduce and discuss the term brackish.
3. Compare the qualities of a tidal marsh to those of a riverside park in a city or town. Where would there more likely be ball fields, jogging trails, picnic pavilions, etc? Why? *[tidal marsh – muddy, wet, affected by the tides twice a day; park – higher land, usually grassy]*
4. What reasons could explain why the Meadowlands Sports Complex, Newark International Airport, Port Elizabeth, and Port Newark were located where they were? *[Proximity to New York City and the northern New Jersey populations, built where there was space left]*
5. What construction challenges would be encountered when building in a tidal marsh zone? *[Builders would have to deal with unstable land; they would have to use fill; and they would have to develop ways to keep the tides from affecting the development site.]*



Discovery Sheet #6 – Watersheds of Northern New Jersey (Figure 5C)

1. Look at a map of New Jersey. What is the boundary between New Jersey and Pennsylvania? [*the Delaware River, which is a natural boundary*] Trace the Garden State Parkway to the New York Thruway (Route 87). How would you know that you have crossed from New Jersey to New York? [*state line sign, which signifies a political boundary*].
2. Compare the Watersheds of Northern New Jersey (Figure 5C) and the Newark Bay Complex map (Figure 5A). Which map shows the natural landforms as boundaries and which map relies more on human made boundaries? [*Watersheds use natural landforms as boundaries (Figure 5C), people create county and state lines (Figure 5A).*]
3. What are the advantages and disadvantages to viewing the land in each of these manners? [*Looking at the land in view of watersheds connects people and habitats within a regional natural system that forces a dialogue between planners from nearby towns and states. Looking at the land using political boundaries is a traditional view, might make planning more manageable.*]
4. Complete the following in terms of how the action will affect the entire watershed:
 - A new condominium complex is built near the Pequannock River...
 - A series of new roads were built through a forested area of the Highlands...
 - A ship docking in Port Elizabeth leaked crude oil into the Newark Bay...

ASSESSMENT STRATEGIES

Have the students:

- ☐ Develop critique criteria for a verbal presentation that answers the following question: How do land use practices in northern New Jersey affect the quality of water in the Newark Bay Complex? Have the students grade each other on content, organization of presentation, and presentation style.

STAYING INVOLVED



Invite a local organization that is doing water quality monitoring to the classroom. Have the students find out how they can participate in this activity.



Organize a stream walk and clean-up. (See Organizations to Contact - Appendix D)



Do storm drain stenciling to educate the neighborhood about the significance of keeping pollutants out of the storm drain system. Visit the following websites to learn more about this activity: (<http://www.state.nj.us/dep/watershedmgt/stenciling4web.htm>) or (<http://www.cleanoceanaction.org/Stenciling/StormDrains.html>)



EXTENSIONS



Research and draw a small section of the river (divide the river's total length or town length by the number of students in your class). Include the structures built by humans as well as the wild open spaces. Connect the sections and use as a hallway display.



Research the origins of human settlements on the banks of the river and create a "settlement timeline."



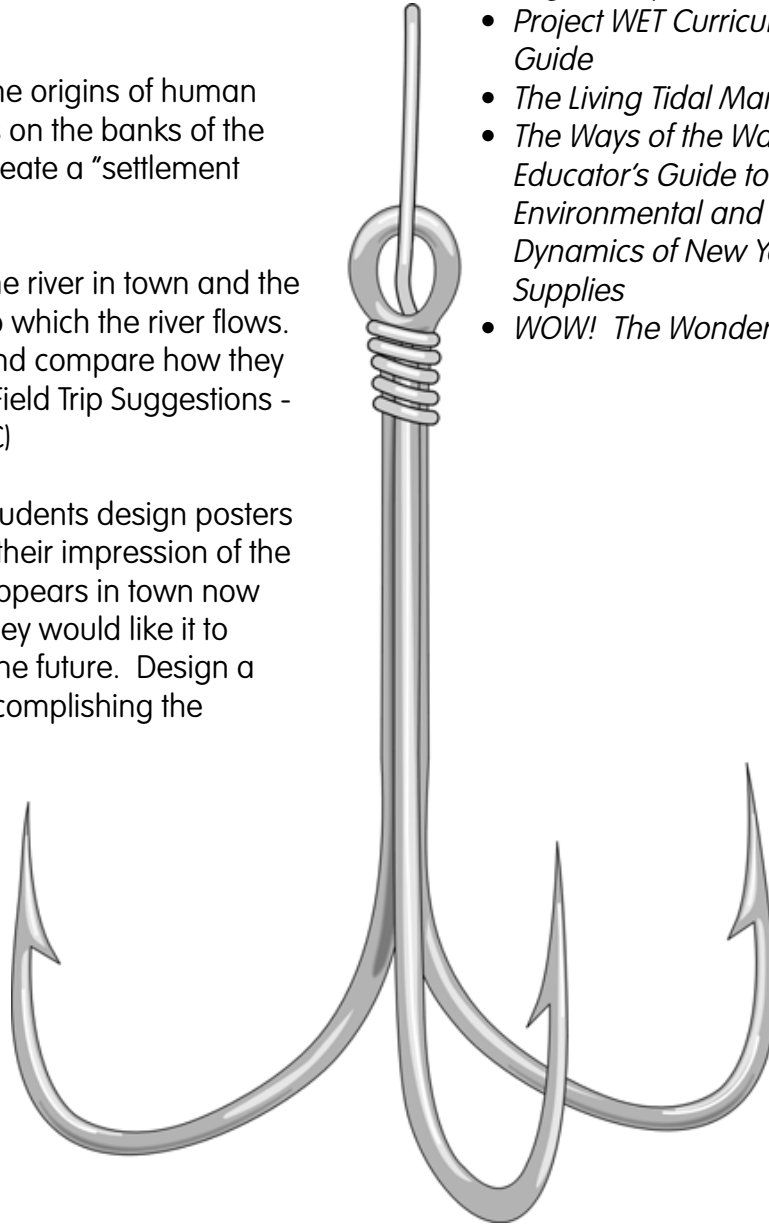
Visit both the river in town and the estuary into which the river flows. Describe and compare how they look. (See Field Trip Suggestions - Appendix C)



Have the students design posters that reflect their impression of the river as it appears in town now and how they would like it to appear in the future. Design a plan for accomplishing the change.

RELATED EDUCATION RESOURCES

- *Bridges to the Natural World: A Natural History Guide for Teachers of Grades Pre-K to Six*
- *New Jersey WATERS: A Watershed Approach to Teaching the Ecology of Regional Systems*
- *Project WET Curriculum and Activity Guide*
- *The Living Tidal Marsh*
- *The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of New York City's Water Supplies*
- *WOW! The Wonders of Wetlands*



REFERENCE

Baldi, Bruce. "The Hackensack Meadows: A Natural and Unnatural History." American Littoral Society, Highlands, NJ. 1981.



A TOUR THROUGH YOUR TOWN (Town map)

Discovery Sheet #3

Name(s): _____

Date: _____

1. Locate the following places on your town (or city's) map and circle each with pencil or marker.
 - Your school (or street)
 - The closest stream, river or waterway to your school. What is the name of this waterway?
2. Use a highlighting marker to trace the course of the waterway through your town. List the names of the roads that cross the waterway and landmarks that are near the waterway.
3. Write directions from your school to the waterway.
4. Trace the length of the waterway to determine if it is a tributary to a larger river. If so, name the larger river into which it flows.



A TOUR THROUGH THE NEWARK BAY COMPLEX

Discovery Sheet #4

Name(s): _____

Date: _____

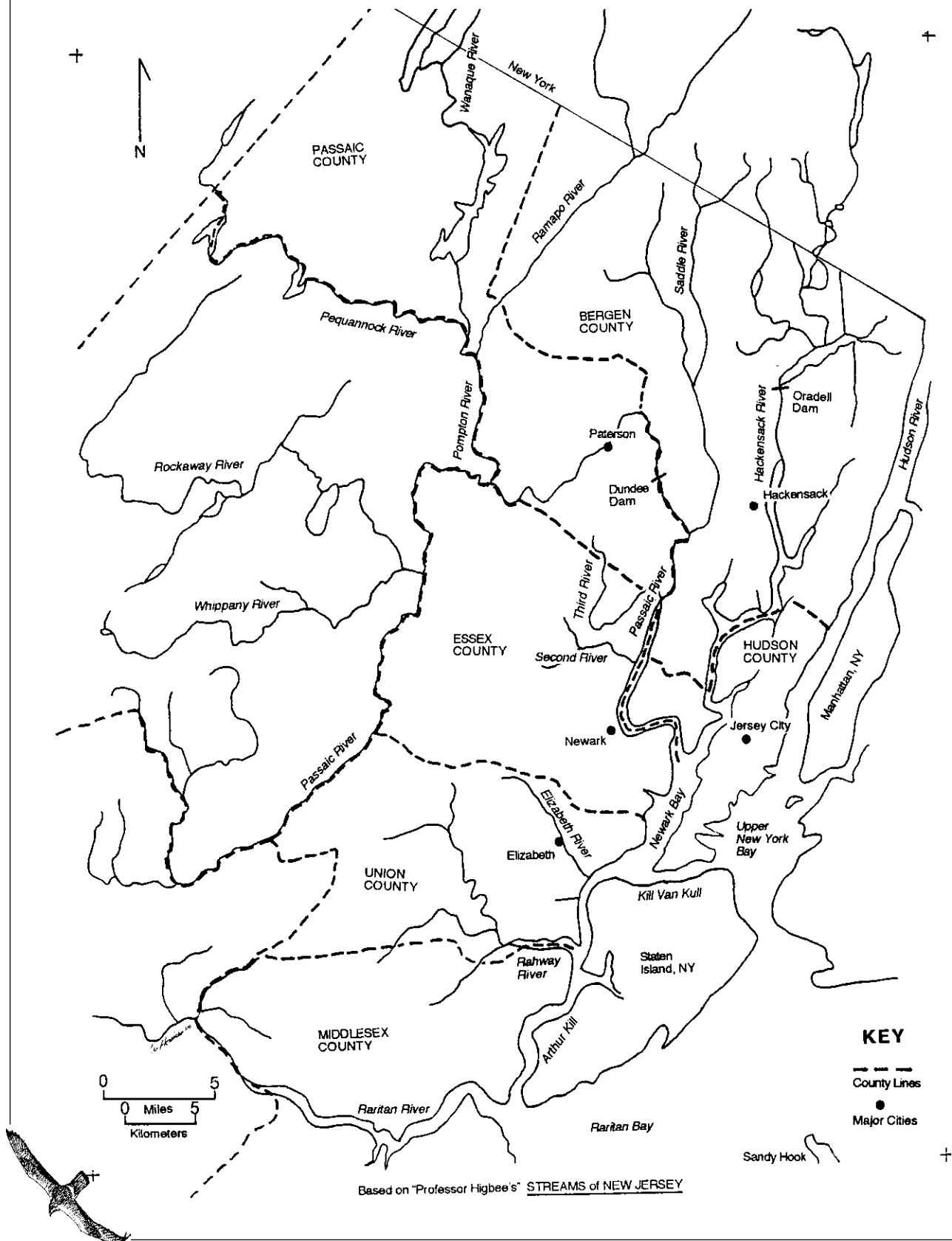
On the Newark Bay Complex map (Figure 5A)

1. Color all the waterways and water bodies on the map with blue crayon. If needed, check this against the map of New Jersey.
2. Color the waters of the Newark Bay Complex with a red crayon. (The Newark Bay Complex includes all the water south of the Dundee Dam on the Passaic River, south of the Oradell Dam on the Hackensack River, the Newark Bay, the Kill Van Kull, the Arthur Kill, a small portion of the Elizabeth River, and the Rahway River up to where it splits.)
3. Locate and mark your town on the Newark Bay Complex map.
4. Name the largest river closest to your town.
5. Locate this river on a New Jersey map. Trace the entire length of the river from its headwaters (the beginning) to the Newark Bay. Estimate how much of this length is in the Newark Bay Complex.
6. Compare your town map or the New Jersey map to the Newark Bay Complex map. Is your local waterway a tributary of the river you named in Question #4?
 - *If yes, list the name changes that the waterway takes as it flows from your town to the larger river.*
 - *If no, list the possible reasons why your local waterway does not join the larger river.*
7. Identify and list major towns along the larger river. Begin at the headwaters and end at the mouth (where it empties into another river or bay). Use the population key on a New Jersey map to list each town's population range.



Figure 5A

A TOUR THROUGH THE NEWARK BAY COMPLEX



A LOOK AT THE TIDAL MARSHES (Figure 5B)

Discovery Sheet #5

Name(s): _____

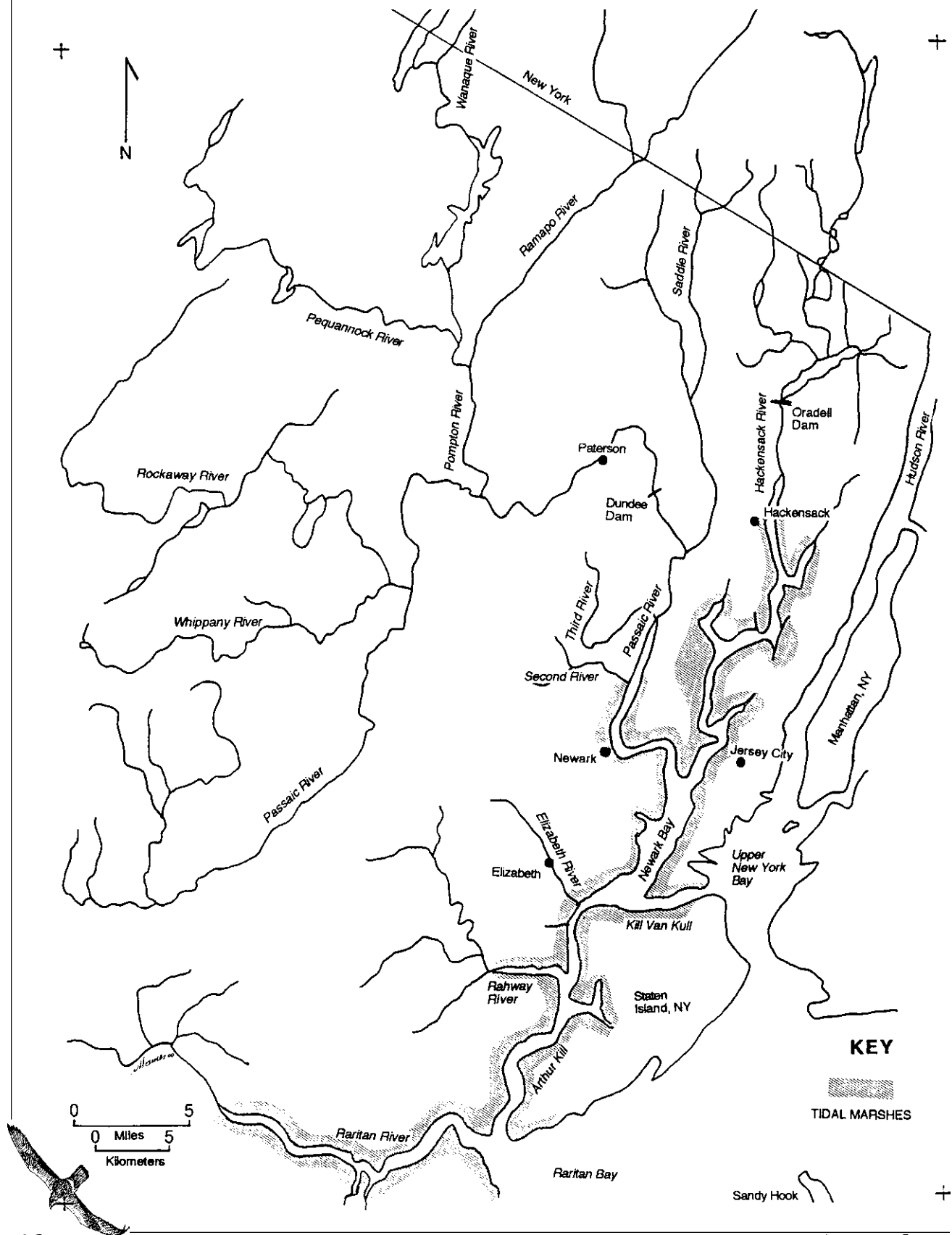
Date: _____

1. What type of water is in the ocean?
Color the following yellow: Atlantic Ocean, Raritan Bay, Upper New York Harbor, Hudson River, Arthur Kill, Kill Van Kull, Newark Bay and the length of both the Hackensack and Passaic Rivers from Newark Bay up to where the symbol for "tidal marsh" stops.
2. What type of water comes from mountain streams?
Color the following blue: Passaic and Hackensack Rivers from headwaters to Newark Bay, Whippany River, Rockaway River, Pequannock River, Wanaque River, Ramapo River, Pompton River, Saddle River, Third River, Second River, Elizabeth River, Rahway River from headwaters to the Arthur Kill.
3. If you visited a place on the map where the two colors overlap, describe the type of water you would find.
4. Create a map key that identifies the three types of waters.
5. Using other resources (first hand experience, natural history guides, the library, etc.), list the qualities of a tidal marsh.
6. Estimate how many miles of tidal marsh exist in the Newark Bay Complex, from the Raritan Bay northward.
7. Use a map of New Jersey to locate and mark the following on your map:
 - Meadowlands Sports Complex
 - Newark Airport
 - Port Elizabeth
 - Port Newark



Figure 5B

A LOOK AT THE TIDAL MARSHES



A TOUR THROUGH THE WATERSHEDS of Northern New Jersey (Figure 5C)

Discovery Sheet #6

Name(s): _____

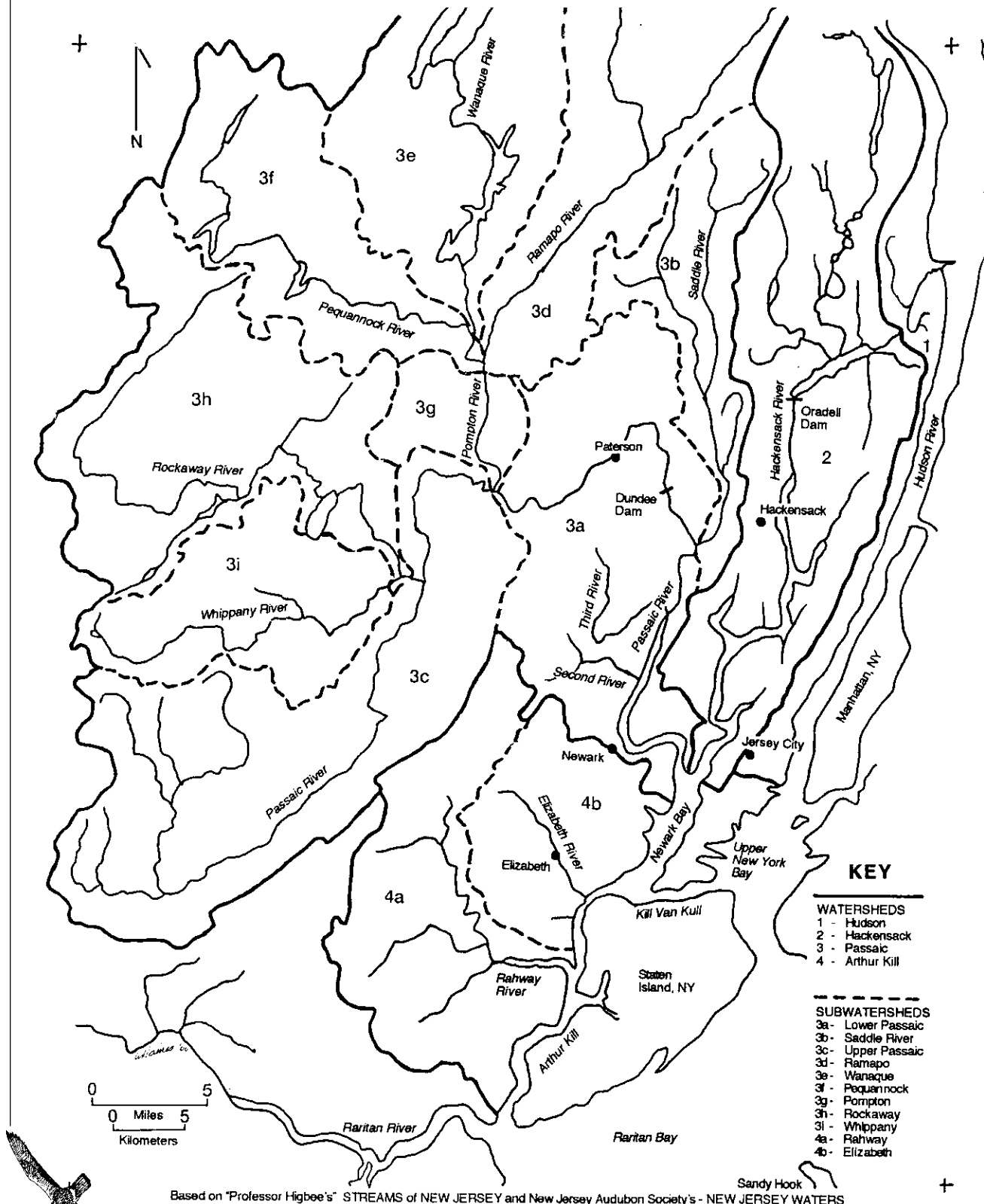
Date: _____

1. Define "watershed."
2. Locate and mark your town on the Watersheds of Northern New Jersey map (Figure 5C).
3. Outline each of the watersheds listed in the key (#'s 1 to 4) in a different color. Add these colors to the map's key.
4. Color each of the subwatersheds a different color. Add these to the map's key.
5. Where on the map is the area of higher elevation? How do you know this?
6. What landforms would create the higher elevation?
7. What creates the dividing lines between watersheds and between subwatersheds? How could you check your answer?
8. Compare the watershed map to the Newark Bay Complex map (Figure 5A). What are the similarities? What are the differences?
9. Using the town map and the Watersheds of Northern New Jersey map, write your watershed address. (Example: I live in the Saddle River subwatershed and the Passaic Watershed.)



Figure 5C

A TOUR THROUGH THE WATERSHEDS of Northern New Jersey



A CLOSER LOOK



SECTION 2 THE NEWARK BAY COMPLEX, *RICH IN HISTORY*

Ancient geologic forces and climatic changes set the stage for the diverse topography and plethora of natural resources present in the Newark Bay Complex. Sediment deposition, volcanic upwelling, continental plate drifting, and glacial scouring created the foundation for many of the physical features we see today. The Hackensack Meadowlands is the remnant of Glacial Lake Hackensack. Snake Hill is part of an ancient volcanic neck, and the red sandstones and shales of the area were deposited in shallow seas during the Triassic Period in geologic history. Global climatic changes brought about alternating periods of freeze and thaw which created continental glaciers that covered the land and affected sea level. With the retreat of these glaciers, the sea level rose to near its current level, thus helping to create New Jersey's bays, estuaries, and tidal waterways.

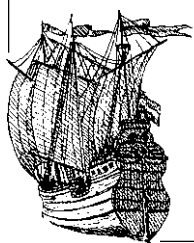


Since humans first settled on the shores of the Newark Bay and its tributaries, they have altered and manipulated the area's habitats. Prior to European settlement, the Lenni Lenape Indians (Hackensack, Tappan and Raritan tribes) inhabited the Newark Bay Complex. The food, clothing, and shelter for this scattered and transitory population was derived directly from the natural resources of the land and water. These same natural resources provided for the early colonists in the 1600's and 1700's, but due to their non-transitory nature the pressure on these resources became more acute. Copper and basalt were mined; salt hay was harvested from the salt marsh, while cedar trees were harvested from the freshwater marsh; oysters were harvested from Raritan and Newark Bays; and, clay was extracted for making bricks and other buildings. With the drastic increase in population during the 1800 and 1900's, historical records tell how the quantities of certain natural resources were depleted and that the quality of drinking water became threatened, while sanitary systems and other human related services were strained. Impact on the environment became severe.

As expansion across the United States progressed, canals, railroads and road systems were built to link industrial and agricultural producers with distant customers. The upland areas of the Newark Bay Complex became the choice relocation site of people seeking to escape the problems of nearby cities - overcrowding, poverty, and pollution were all major concerns in the more urban areas. The marshlands between New York City and these upland areas were unsuitable for residential development and therefore became the repository for all kinds of refuse disposal (including human and animal waste), as well as by-products from early industrial manufacturing processes.

Currently, the Newark Bay Complex supports one of the most densely populated areas in the country. The area's land surface has been swallowed up by all the services that people need, including residential and industrial developments, transportation routes, stores and shopping malls, office complexes, sports complexes, parking lots, airports, refineries, and commercial and industrial sites. Every year, countless plans for development are proposed, reviewed, and accepted or denied. As a result, natural habitats and open space are limited and very valuable. Yet, visiting these open spaces gives the viewer a glimpse into the past. This urban estuary, once pristine and now highly impacted by human encroachment, continues to exude beauty, inspire artistry, and provide habitat for a myriad of animal species including fish, birds, and mammals.

The Newark Bay Complex is rich in both geologic and human history. Lessons in this section help the students learn about the way the land was formed, human use of natural resources, and land use strategies employed by people throughout time, from the Native Americans to today.





WAY BACK IN TIME

BACKGROUND INFORMATION



Read Figure 6A, "Geologic History of Northern New Jersey and the Newark Bay Complex."

LEVEL

5 to 8

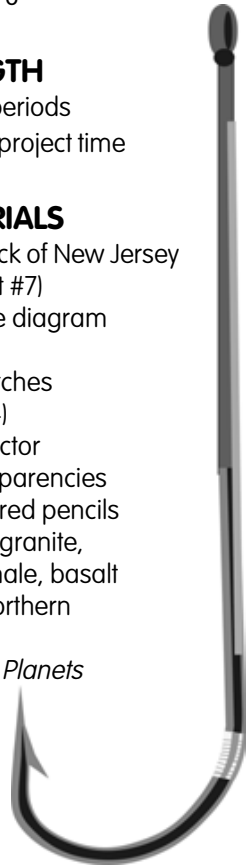


LENGTH

4 class periods
Independent project time

MATERIALS

- o Geologic Bedrock of New Jersey (Discovery Sheet #7)
- o Glacial Advance diagram (Figure 6B)
- o Envisioning sketches (Figure 6C #1 - 4)
- o Overhead projector
- o Overhead transparencies
- o Crayons or colored pencils
- o Rock samples: granite, sandstone or shale, basalt
- o Relief map of northern New Jersey
- o Tape/CD of *The Planets* by Gustav Holst



KEYWORDS

basalt	granite gneiss
conglomerate	landform
diabase	landscape
ecosystem	sandstone
erosion	sediment
geology	shale
glacial lake	terminal
glacier	moraine
granite	upland

OVERVIEW

Major geologic events helped form the landscape in the Newark Bay Complex.

OBJECTIVES

Students will:



Describe how past geologic forces and events determined the present-day landscape;



Practice reading maps to assist in their understanding of geological changes;



Interpret geologic events to create a visual presentation;



Explain how people use the natural systems formed from geologic forces.



ADVISORY LINK

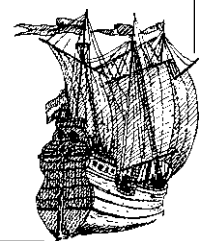
The species listed in the Fish Consumption Advisories exist within a dynamic ecological system. To understand how and why the system functions requires knowledge of the area's geologic history. This knowledge leads to an understanding of how earth forces combined to create the interdependent ecosystems of the Newark Bay Complex.

STUDENT PREREQUISITES

Basic geologic terms and processes
Map reading skills

PROCESS SKILLS

recalling, sequencing, communicating,
analyzing, interpreting, synthesizing



PLANNING



1. Make an overhead transparency of each of the following:
 - Newark Bay Complex map (Figure 5A), Geologic History of Northern New Jersey and the Newark Bay Complex (Discovery Sheet #7), Glacial Advance (Figure 6B), and each of the Envisioning Sketches (Figures 6C #1-4).
2. Copy Discovery Sheet #7 for each student.
3. Collect samples of granite, sandstone or shale, and basalt (See Resource section).

PROCEDURE SETTING THE STAGE

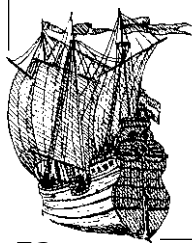
Think about how the surface of the earth looks. “What are some of the ways that the earth’s surface can be changed to look differently than it does now”? Group these according to changes made by humans and those made by natural forces. [*Human – creating hills and depressions as in constructing a golf course or housing development, creating reservoirs, blasting mountains to create highways, putting soil and fill in low-lying areas; Natural – volcanic eruptions altering a mountain shape, floods changing river bed shapes, coastal storms removing/adding sand to the beach*] Discuss the time frame for most of these events.

THE ACTION



Period 1

1. Tell the students that during these lessons they will be learning about how the surface of the earth in the northeastern part of New Jersey changed over a period of millions of years.
2. Distribute samples of granite (metamorphic rock from the Highlands), sandstone or shale (red/brown sedimentary rock from the lower-lying areas of Bergen, Passaic, Essex, Union, Hudson and Middlesex counties, used as the building material for “brownstones”), and basalt (gray igneous rock from the Watchung Mountains, also called trap rock and often used as crushed gravel in driveways).
3. Have the students study the samples and discuss the differences that they see between the three rock types.
4. Distribute the Geologic Bedrock of Northeastern New Jersey map (Discovery Sheet #7) to each student. Instruct the students to locate the area where each of the rock samples may have come from, and then color-code the map and key.
5. Ask the students to list the other types of rocks that are shown on the map. Explain what a conglomerate is and what diabase is.
6. Ask the students to cross-reference the geologic map to a relief map to discover the names of some of the landforms the different rocks created. [*Diabase – the Palisades, basalt – the Watchung Mountains, granite – the Highlands, more specifically, the Ramapo Mountains sandstone/shale – valleys, conglomerate – Hamburg Mountain, Wawayanda Mountain, Green Pond Mountain*]
7. Display the Newark Bay Complex map (Figure 5A) on an overhead projector. Have the students locate where their town would be located on this map.
8. Overlay a transparency of the Geologic Bedrock map (Discovery Sheet #7) to help students determine the general geology of where they live.



Period 2

1. Now that the class knows there are differences between the rocks and the types of landforms that these rocks created, read "Geologic History of Northern New Jersey and the Newark Bay Complex" to the class. (Figure 6A)
2. After the reading, ask the students, "According to the description, what forces helped create the landforms that we see today"? [*mountain building, volcanic activity, glacial activity, erosion, the sea covering the land*]
3. Have the students work in small groups to recall the major events and write them down in sequence.
4. Use the students' recollections to create a simplified listing of the events that reflect the following key points:
 - a. The Highlands are formed.
 - b. Seas deposited red shales and sandstones over low-lying areas.
 - c. Magma oozed from within the earth onto the surface and hardened into rock over time.
 - d. The surface of the earth lifted and eroded numerous times. This action created ridges of hard resistant rock (the Watchung Mountains and the Palisades) and valleys of softer rock (the Piedmont).
 - e. Streams and rivers helped carve the landscape.
 - f. A glacier that covered the land carried boulders and gravel from the mountains. As the glacier melted, the boulders were left behind. This created a long line of rocks that blocked the glacier's melt water from exiting to the sea.
 - g. Large lakes formed behind the boulder ridges.
 - h. When the glacier retreated, the land lifted and tilted slightly toward the sea. This allowed the large lakes to slowly drain and produce the landscape we see today.
5. Overlay the Glacial Activity map (Figure 6B) on top of the Newark Bay Complex map (Figure 5A) to show the students the extent of the glaciers. Discuss how the land where their town exists was affected by glacial activity [*glacier was directly on top of the land; boulders, rocks, pebbles, and silt were deposited by the glacier on the land*].
6. Show the Envisioning Sketches to the class (Figures 6C #1-4). Discuss each interpretation.

Period 3

1. Divide the students into small groups or pairs. Tell them that, like the artist who created the envisioning sketches, their challenge is to interpret the geologic history of the area and create a way of sharing this information and action with the rest of the class. Discuss examples of various strategies they could use: model building, dramatization, computer images or simulations, video, dance, poetry, etc.
2. Provide the students with either the guided imagery story or the geologic event listing for reference.
3. Establish a time limit for each presentation. Discuss the points that will be used in the presentations' evaluations including: originality, clarity, completeness, organization, correct sequence of events, time, etc.
4. Work with each group during this period to keep the project and presentation on task and focused.



Period 4

Have the student groups share their interpretation of the geologic history of northeastern New Jersey.

ASSESSMENT STRATEGIES

Have the students:

- ❑ Create a timeline with illustrations depicting the land and water changes from the beginning of the description (1billion years ago).
- ❑ Generate a list of ways people use the landforms and ecosystems that were created by geologic activity. [Examples: canoeing/boating because of the lakes, rivers and bay; fishing because of the estuaries, lakes, and rivers; hiking because of the mountains; quarrying because of the mountain; hunting because of the wooded and field areas of the Highlands and Piedmont; natural history study because of the diverse habitats.]

STAYING INVOLVED



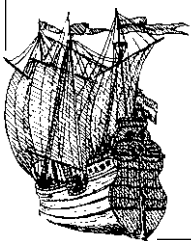
Provide a list of geologic sites where students and their families can visit. See Field Trip Suggestions, Appendix C.

RELATED EDUCATION RESOURCES

- *Geology: The Active Earth* from Ranger Rick's Nature Scope.
- *New Jersey Rocks and Sediments kit* from New Jersey Department of Environmental Protection

REFERENCE

- Collins, Beryl Robichaud and Karl H. Anderson. *Plant Communities of New Jersey*. Rutgers University Press, New Brunswick, NJ. 1994.
- Mitchell, Alison E. *The New Jersey Highlands: Treasures at Risk*. New Jersey Conservation Foundation, Morristown, NJ. 1992.
- Quinn, John R. *Fields of Sun and Grass: An Artist's Journal of the New Jersey Meadowlands*. Rutgers University Press, New Brunswick, NJ. 1997.
- Wright, Kevin. *The Hackensack Meadowlands*. An unpublished report for Hackensack Meadowlands Development Corporation Environment Center.
- Geologic Map of New Jersey



GEOLOGIC HISTORY OF NORTHERN NEW JERSEY AND THE NEWARK BAY COMPLEX - GUIDED IMAGERY

(Play *The Planets* by Gustav Holst)

We need to go back very far in time, so close your eyes, put your head down, and listen. Let the music carry you back to a time before cities, before bridges, before ships, before people, and even before the dinosaurs. I want you to see a written number. It is the number 1 followed by a comma...zero...zero...zero...comma...zero...zero...zero...comma...zero... zero...zero. We have now gone back in time 1 billion years.

You have entered a time in the Earth's history called the Precambrian Era when some of the oldest rocks of New Jersey were formed. A large shallow inland sea covered the entire area and layers of sand, silt, and clay settled to its bottom. Over time, heat and pressure from the earth's forces changed these sediments into rocks that formed mountains as tall as the Alps. Today we call these mountains "the Highlands."

Millions of years passed like the slow turning of pages – each telling a new story. The sea covered the low elevations of New Jersey many times. Each time the sea withdrew; it left behind sand, silt, and mud. Mountain streams flowed out of the Highlands washing soil and rocks down to lower-lying areas. Over many years, new rocks such as conglomerates were formed from these materials. As earth forces lifted the land again, new mountain ranges were built from these rocks.

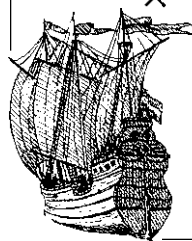
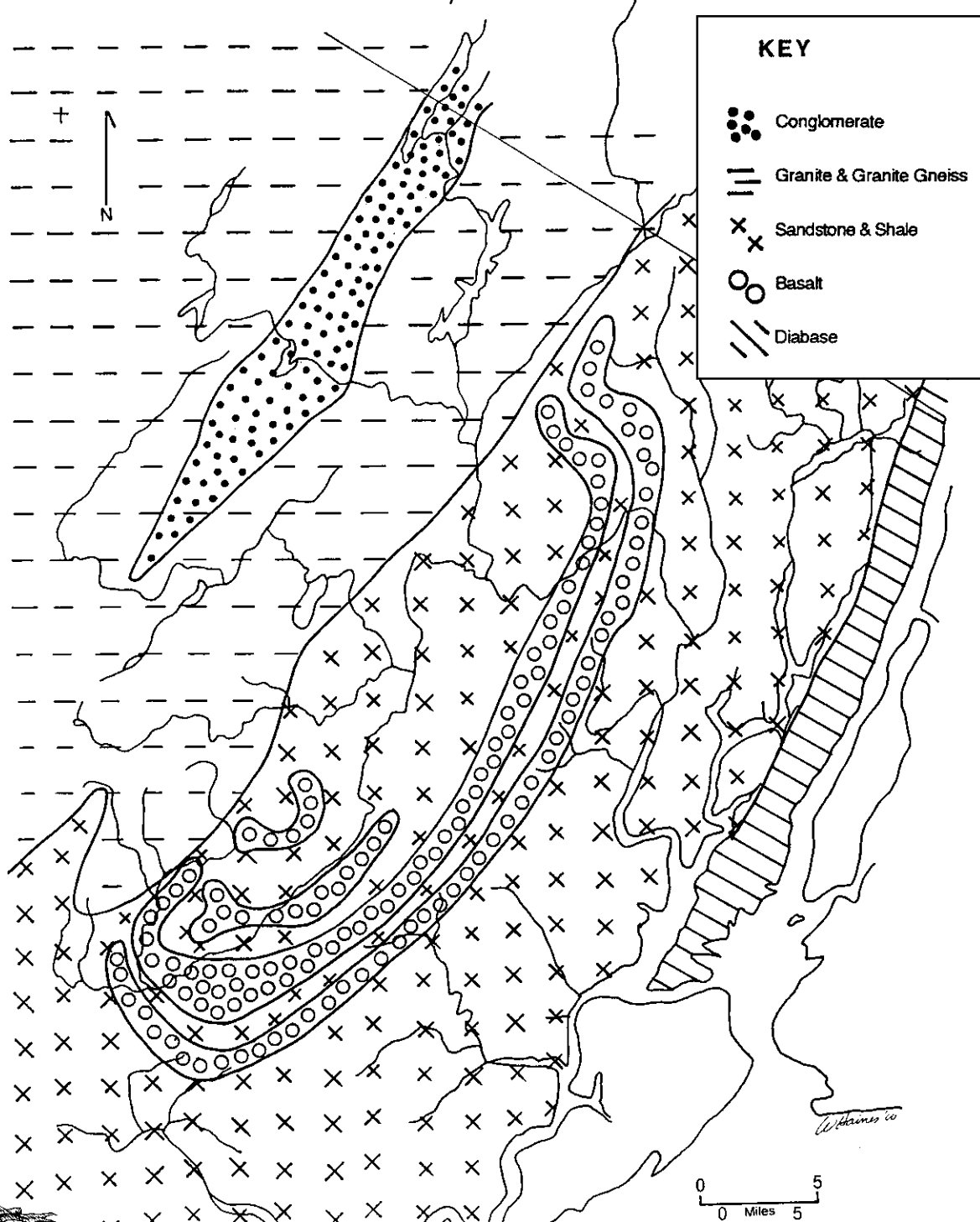
Time marches forward and we enter the Mesozoic era, when large three-toed dinosaurs roamed the land area of New Jersey. Swamps and lakes, mud flats and sandy shores covered New Jersey in the region we now call the "Piedmont." This broad band of land covers the middle of our state from the Hudson River to the Delaware River. Red-colored sediments settled to the bottom of another shallow sea and these eventually hardened into rocks called sandstones and shales. From under the surface of the earth, magma oozed through the softer sandstones and shales and it too slowly hardened to rock. Over the years, the softer sandstones and shales eroded and the harder rock made from magma was exposed to make the ridges we now call the Watchung Mountains and the Palisades.

The land continued to be lifted to form mountains and continued to be eroded by rain and mountain streams. Glaciers covered Northern New Jersey several times. At times, the glaciers were one-mile thick and so heavy that the land underneath sank as much as 2,000 feet from its current elevation. Four glaciers affected the landscape of New Jersey and the most recent one melted about 12,000 years ago. Its ice sheet extended south as far as north central New Jersey. As it moved across the northern mountains, the glacier slowly plucked, gouged, scoured and moved rocks. As the ice melted, the large boulders that rode on top of the ice flow dropped to the land in a line of scattered rocks called a terminal moraine. These walls of rock blocked the flow of streams and created huge lakes. As the glacier continued to melt, the fine sediments in its meltwater were deposited on the bottom of the lakes. These sediments formed thick beds of clay. Eventually the great weight of the glacier lessened and the land lifted. The entire northeastern part of New Jersey tilted slightly toward the sea and these great lakes were able to slowly drain. Our landscape today is a result of these historic geologic activities.



GEOLOGIC BEDROCK OF NORTHEASTERN NEW JERSEY

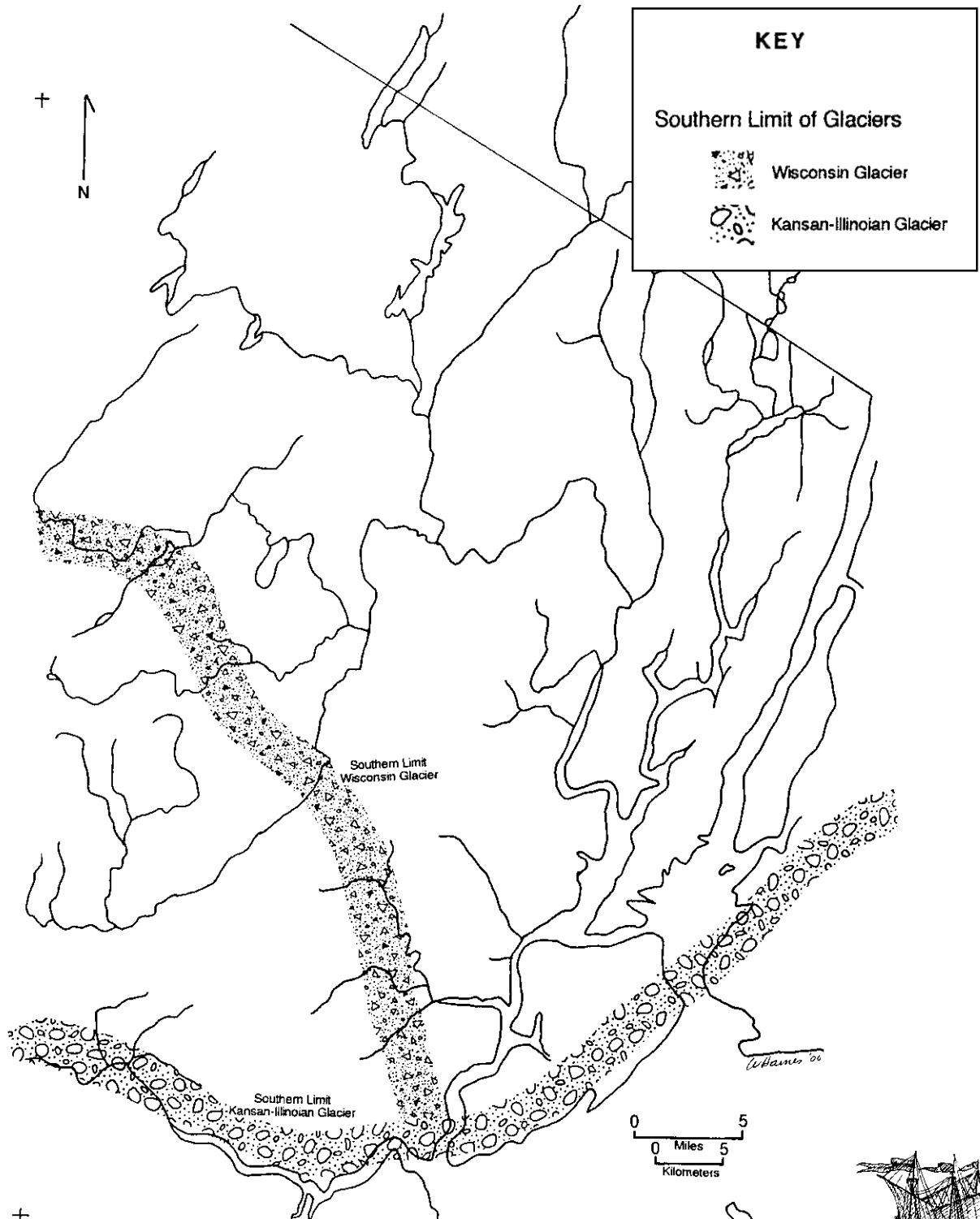
Discovery Sheet #7



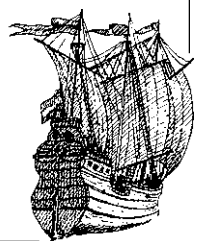
(Copied from one prepared by J.C. F. Tedrow [1962]. The source of the map key also was from Tedrow 1962, with 1993 written comments, and additional data was extracted from the official geologic map of New Jersey prepared by J.V. Lewis and H. B. Kummel in 1910-12 and revised by Kummel and others.)

GLACIAL ADVANCE

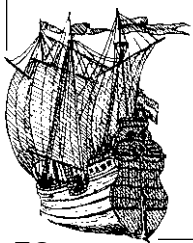
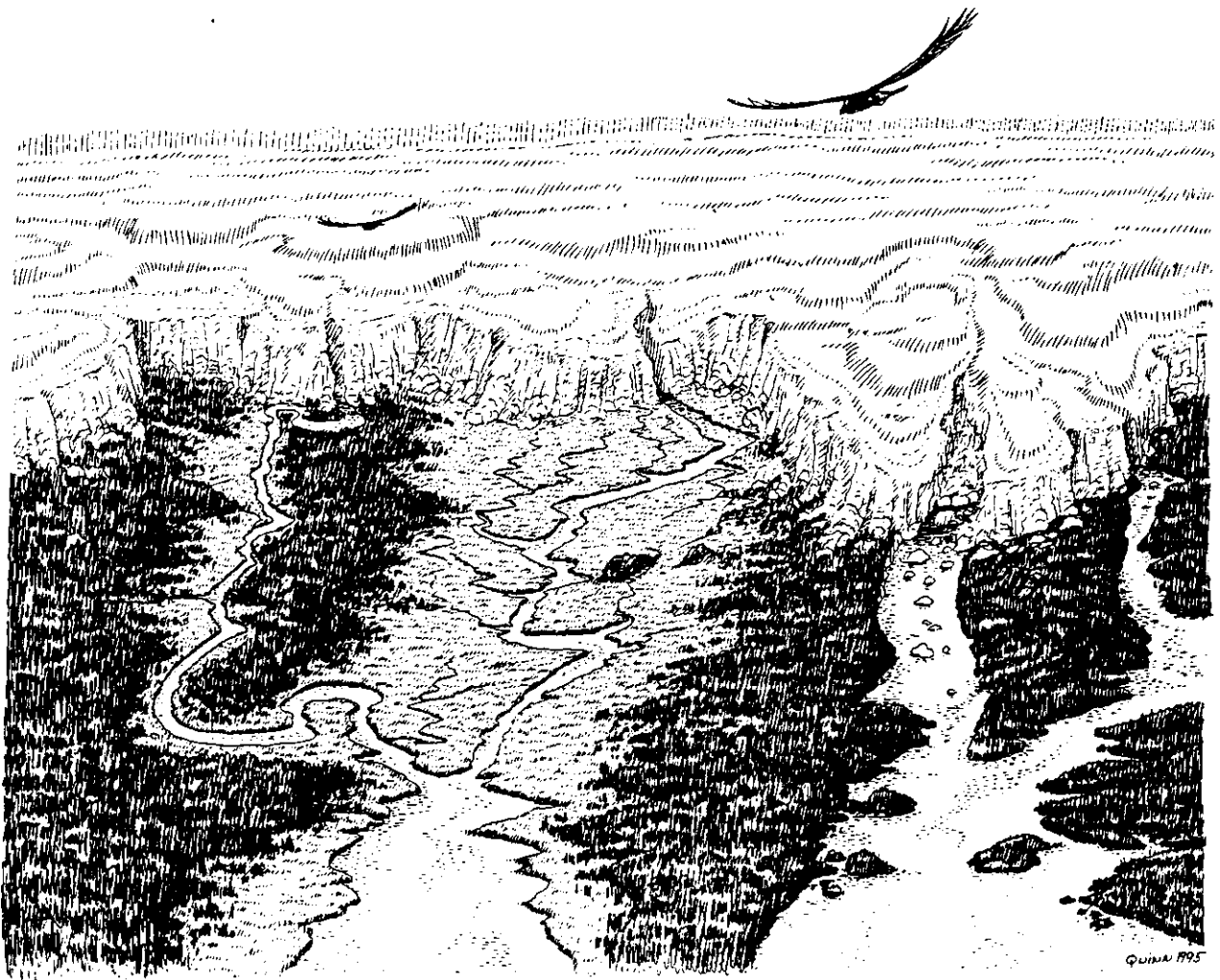
Figure 6B



Map drawn by John R. Quinn, *Fields of Sun and Grass: An Artist's Journal of the New Jersey Meadowlands*, copyright ©1997 by John R. Quinn. Reprinted by permission of Rutgers University Press.



ENVISIONING SKETCH - The Advance of the Glacier

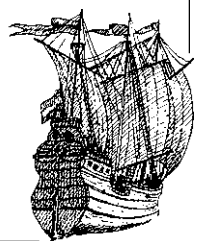


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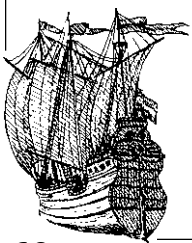
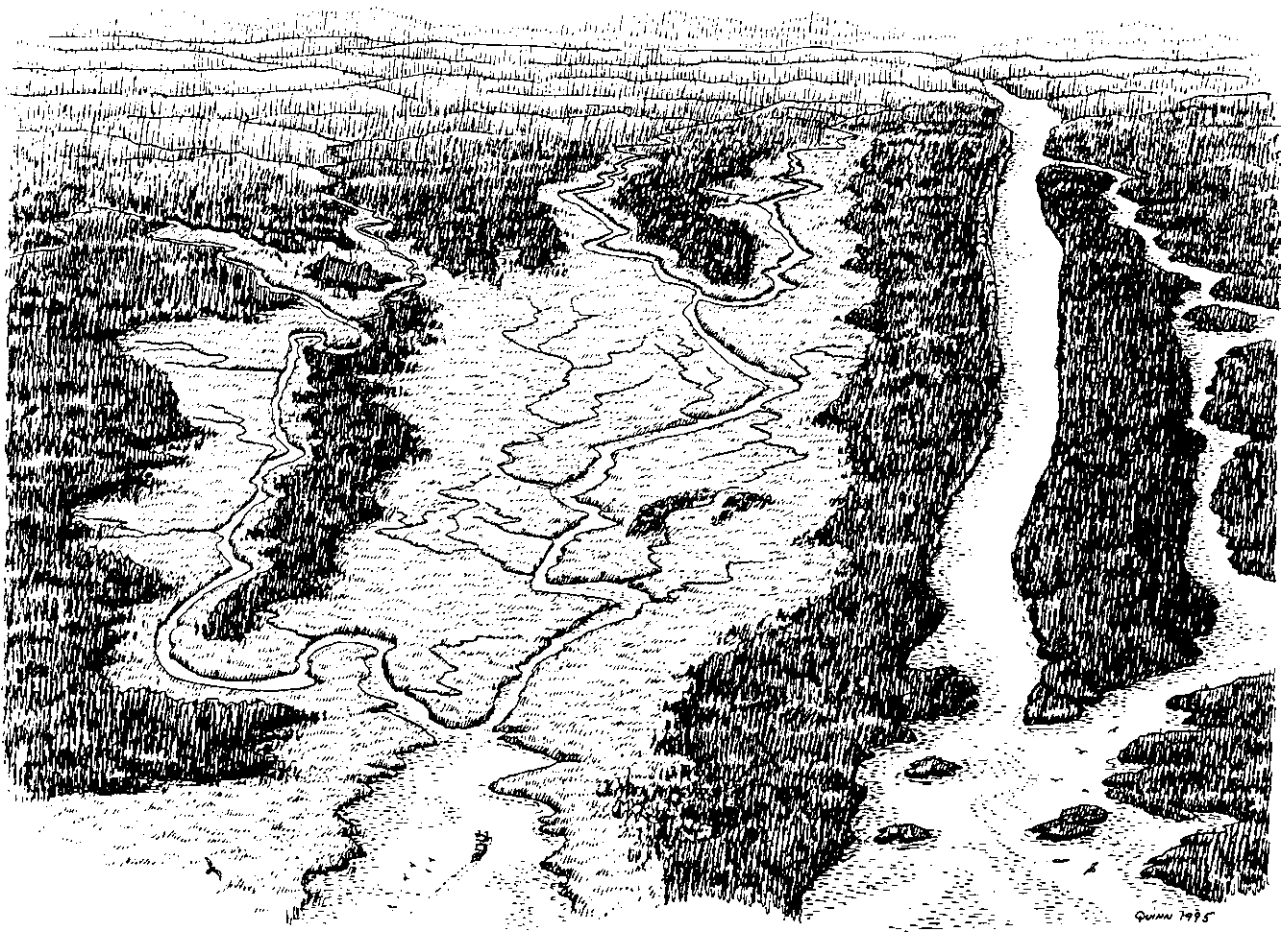
ENVISIONING SKETCH - The Melting of the Glaciers and Formation of Glacial Lakes



Sketch by John R. Quinn, *Fields of Sun and Grass: An Artist's Journal of the New Jersey Meadowlands*, copyright ©1997 by John R. Quinn. Reprinted by permission of Rutgers University Press.

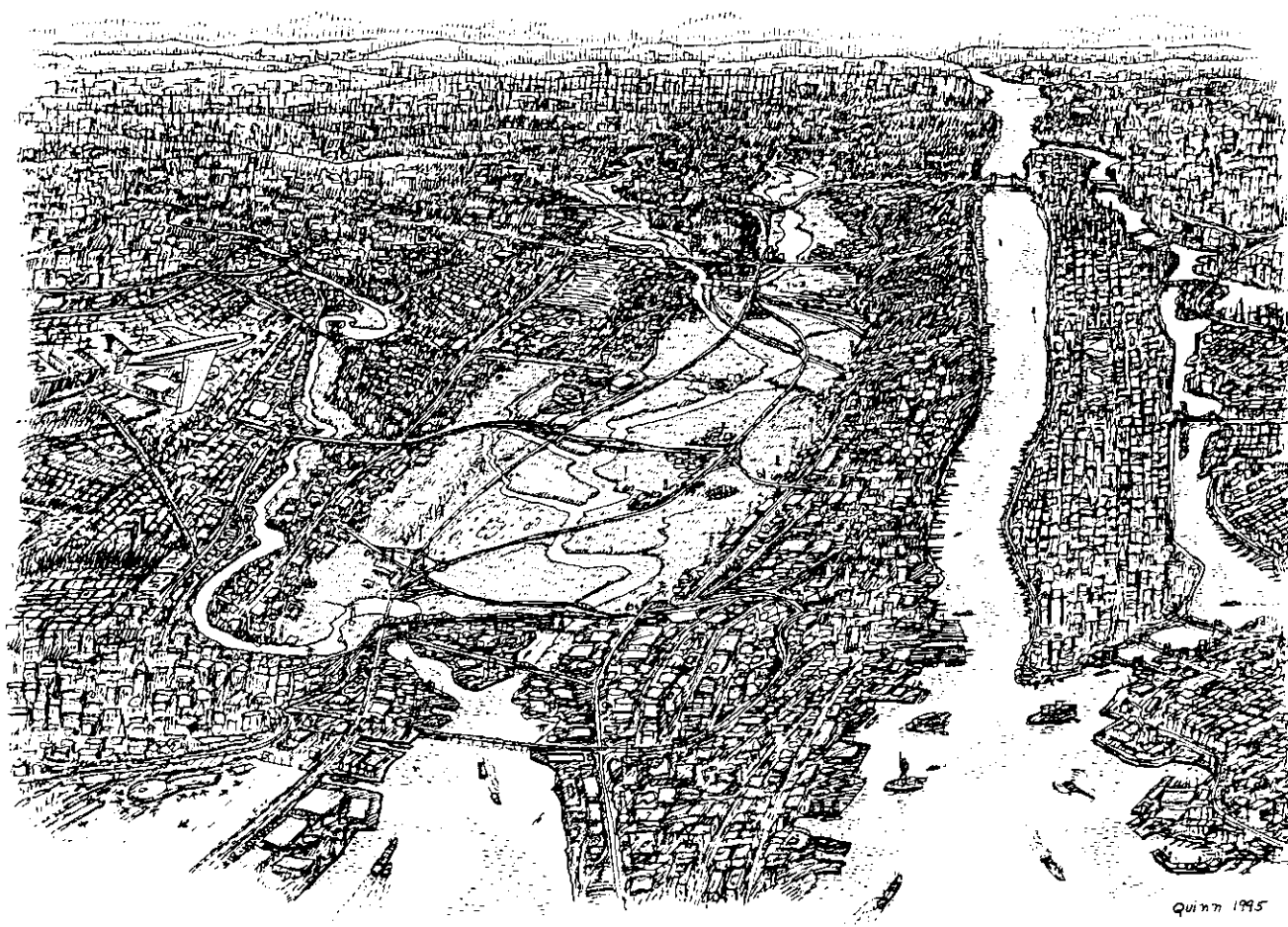


ENVISIONING SKETCH - The Draining of the Glacial Lakes



Sketch by John R. Quinn, *Fields of Sun and Grass: An Artist's Journal of the New Jersey Meadowlands*, copyright ©1997 by John R. Quinn. Reprinted by permission of Rutgers University Press.

ENVISIONING SKETCH - The Area as it Looks Today



Sketch by John R. Quinn, *Fields of Sun and Grass: An Artist's Journal of the New Jersey Meadowlands*, copyright ©1997 by John R. Quinn. Reprinted by permission of Rutgers University Press.



POPULAR PERCEPTIONS

BACKGROUND INFORMATION

Interpreting historical information has always provided a window to an earlier time. Information comes in a multitude of forms. Geologists interpret rock strata to help understand how the land was formed; while paleontologists study how plant and animal species evolved over time. Anthropologists interpret cultural or societal artifacts to piece together how past societies lived. Historians interpret text from newspapers, books, journals and maps to provide a clearer picture of the evolution of a family, community, business, town or region.

Reading and interpreting actual writings from various time periods can encapsulate the human history of the Newark Bay Complex. These writers reflect personal views, professional views, and business ventures. By compiling these, an historian is able to hypothesize what it was like to live during a specific historical period.

LEVEL

6 to 8

LENGTH

2 periods

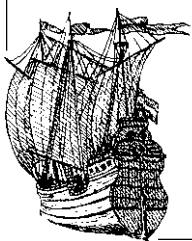


MATERIALS

- o Perceptions of the Newark Bay Complex - Figure 7A
- o assorted pictures of the Newark Bay Complex
- o poster board
- o glue or staples
- o paper for a timeline (at least 15 ft. long and 2 ft. wide), e.g. shelf paper
- o markers

KEYWORDS

perception
perspective



STUDENT PREREQUISITES

Some knowledge of the natural and built components of the Newark Bay Complex

OVERVIEW

Students gain an historical perspective on peoples' changing views of the Newark Bay Complex area.

OBJECTIVES

Students will:



Interpret historical information and summarize how the natural systems of the Newark Bay Complex were viewed during different time periods;



Describe changes that have occurred to the natural systems of the Newark Bay Complex;



Explain how people's perceptions affect land use and the environment.



ADVISORY LINK

Many of today's environmental issues are so complex that it is extremely difficult to sort through facts to decide the appropriate actions for specific issues. The Fish Consumption Advisories were developed to warn anglers of potentially harmful substances that can be found in specific species of fish and crabs. Social mores, cultural heritage, custom, socio-economic status, and religious affiliation are just a few of the factors that will determine how an individual angler reacts to the Advisory guidelines.

PROCESS SKILLS

analyzing
describing
evaluating
formulating hypotheses

interpreting information
sequencing
summarizing
synthesizing

PLANNING



1. Collect pictures of sights from the Newark Bay Complex (Examples: the New Jersey Turnpike, Newark Airport, Meadowlands Environment Center, Meadowlands Sports Complex, landfills, marshes, animals, cars, trucks, and ships). Make a collage with all the pictures.
2. Make one copy of Figure 7A. Cut quotations into separate pieces.
3. Cut a 15-foot length of paper for making the timeline. Mark the paper to show the following time periods: 1600's, 1700's 1800's, 1900's, current year, the future.

PROCEDURE SETTING THE STAGE

Show the students the collage of pictures from the Newark Bay Complex. Ask the students to write down a few sentences that describe their perception of the Newark Bay Complex based on what they know already or what they see in the pictures. Put these comments aside to use in the timeline.

THE ACTION



Period 1

1. Mix the separate quotation sheets so they are not in order. Distribute one quotation to each student. Explain that each excerpt describes what some people thought of the Newark Bay Complex area during a different period in time.
2. Have the students arrange themselves in time order starting with the 1600's. Ask each student to read aloud his/her quote.
3. Create time period groups (1600's, 1700's, 1800's, 1900's). Ask each group to write a brief summary about how some people viewed the area of the Newark Bay Complex during that time period.

Period 2

1. As each group reports on the prevailing attitude of the time period, affix their summary to the appropriate place on the paper timeline. Create a "timeline of perceptions."
2. Add the students' current views (from "Setting the Stage") to the current opinion's spot on the timeline.
3. Ask the students to write about how they would like to see environments of the Newark Bay Complex in the future. Add these to the timeline.

CLOSING DISCUSSION

1. How did peoples' attitudes change toward the Newark Bay Complex ecosystem over time? How did peoples' attitudes remain the same toward the Newark Bay Complex?
2. What methods were used to inform or influence people's attitudes during the time periods that we studied? *[newspaper articles, real estate advertisements, letters, interviews, experts]* What additional methods are used in today's society? *[television, computer, reports, books, magazines, events, music, public forums]*
3. What strategies could you use now for changing people's perception toward the area?



ASSESSMENT STRATEGIES

Have the students:

- ❑ Select a community member from the Newark Bay Complex (real estate salesperson, boat captain, developer, bird watcher, etc.) and write a persuasive article about the Newark Bay Complex from that person's point of view. Establish and use criteria for evaluating written products. Have part of the criteria reflect whether the persuasive technique was effective.

STAYING INVOLVED



Encourage the students to become the "watchdogs" of the area by keeping track of perception articles from local newspapers, advertisements, and other sources. Share findings with the class to stimulate discussion.

EXTENSIONS



Draw pictures, cartoons, etc. of their quotes to place on the timeline. Look for historical / political cartoons and satire from the area that depict the different time periods.



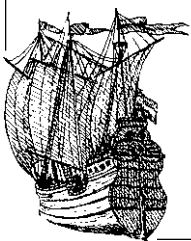
Add quotes and perceptions from the 2000s to the timeline.

RELATED EDUCATION RESOURCES

- "Jersey Journeys" by the New Jersey Historical Society, 230 Broadway, Newark, NJ 07104.
- Project WET Curriculum and Activity Guide

REFERENCE

- Baldi, Bruce. *The Hackensack Meadows: A Natural and Unnatural History*. Hackensack Meadowlands Development Commission Environment Center. 1981.
- Burger, Joanna. *A Naturalist Along the Jersey Shore*. Rutgers University Press, New Brunswick, NJ. 1996.
- Kraft, Herbert C. *The Lenape or Delaware Indians*. Seton Hall University Museum, South Orange, NJ. 1996.
- Quinn, John R. *Fields of Sun and Grass: An Artist's Journal of an Urban Wilderness*. Rutgers University Press, New Brunswick, NJ. 1997.
- MacKenzie, Clyde Jr. *The Fisheries of Raritan Bay*
- Wright, Kevin. *The Hackensack Meadowlands*. An unpublished report for the Hackensack Meadowlands Development Commission Environment Center.



PERCEPTIONS OF THE NEWARK BAY COMPLEX

1609

"There they found a river (the Kill von Kull) to the westward, between two islands, the lands... were as pleasant with grass and flowers, and goodly trees as ever they had seen, and very sweet smells came from them...So they went in about two leagues and saw an open sea (Newark Bay)."

Early Dutch and Swedish Settlers of New Jersey, Lieby, p.4, 1964

1628

"At the side of the ...little river, which we call Achter Col, there is a great deal of reedy land; the rest is full of trees, and in some places there is good soil, where the savages plant their maize, upon which they live, as well as by hunting."

Letter of Issac DeRasieres to Samuel Blommaert, Narratives of New Netherland 1609-1664, Jameson, J. Franklin (ed.), New York: Barnes & Noble, Inc., 1958.

Early 1600's

"Numerous species of waterfowl were considered 'very good and fit to eat' including swans, geese, various ducks and divers. Salt water fish harvested from local waters included codfish, weak-fish, herring, mackerel, flounders, sharks, and others 'unfamiliar to European eyes.' From the sandy and muddy bottoms came lobsters, crabs, conchs, abundant oysters and mussels, land and sea tortoises. Along the margins of the marsh and tidal creeks, there were wild turkey, plover, wood and water snipes, pheasants, heath-hens, cranes, herons, and bitterns. On the islands in the marsh or within the enclosing forests and uplands roamed mountain lions, bears, elk, deer, wolves, beavers, otters, fishers, and many other animals."

Descriptions from the early Dutch observers taken from The Hackensack Meadowlands by Kevin Wright, p. 9.

1719

"New Jersey passed a conservation law that applied to all (except Lenape Indians), 'No gathering of oysters from the [New Jersey] half of the Great Beds [Raritan Bay] should take place between May tenth and September first and none of its oysters should be taken by any vessel not owned within New Jersey."

The Fisheries of Raritan Bay by Clyde MacKenzie, Jr.



1750

"The Indians who inhabited the coast before the arrival of the Europeans made oysters and other shellfish their chief food, and at present whenever they come to salt water where oysters are to be gotten, they are very active in catching them, and in selling them in great quantities to other Indians who live further inland."

From Peter Kalm's Travels in North America. The English Version of 1770. Vol. II. Wilson-Erickson, Inc., NY 1937.

Circa 1768

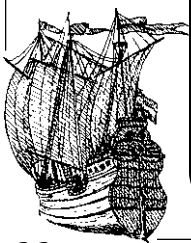
"The meadows are reckoned by those in the neighborhood, who have frequently mowed in them, not inferior to any salt meadow in that part of the country; and some parts thereof at a very small expense, may be made fresh meadow, and to yield good English grass. The timber and wood of every kind in the cedar swamp, is in great perfection as the present owner has preserved it, and prevented any wood being cut out for near upon 30 years. The conveniences of landings and easy carriage from the said cedar swamp are in no way inferior to those of any other swamp on that neck; as a great part of the swamp is bounded by Berry's Creek, and common sloops and wood-boats go up the creek to be loaded; and from the other side of the tract the timber may be brought to Hackensack River, by sledding or carting it one quarter of a mile..."

Advertisement from NJA Vol. XXXVI, Newspaper Extracts Vol. VII 1768-1769, pp 245-246.

July 10, 1868

"Drainage and Reclamation of Marsh Lands Almost every owner of these tide-marshes believes them to be valuable only for their salt hay and mosquito crops. Some few . . . have thought of draining them...to improve the quality of the hay, while others, wedded to old habits and old ideas, are of the opinion that any change from the condition in which these marshes were bequeathed to them by their fathers must of necessity be detrimental. Individuals there are who firmly believe that these marshes are only floating islands, and that once the water is drawn off the islands themselves must settle and finally sink into the bottomless pit. Others believe that subterranean passages exist, connecting these marshes with the sea, and that therefore they cannot be drained."

Excerpts from a newspaper article from the Jersey City Standard (republished in the Bergen Democrat)



1873

"Rutherford Park (37 minutes from New York by the Erie Railroad) ... Rutherford Park, being on the beautiful Passaic River, has good boating and fishing. We desire to call attention to choice building lots that are offered at very reasonable prices. Some advertised properties included a 'desirable residence' containing 11 rooms...on six acres with 75 fruit trees and two acres of gardens."

Real Estate pamphlet - "New Jersey Real Estate," A.D. Mellick, Jr. & Bro., Auctioneers, and Dealers in New Jersey Real Estate, December 28, 1873, pp. 160-161

1885

"The investigation [of Arthur's Kill von Kull at mouth of Newark Bay] found lots of empty oyster shells and in some places a problem with green slime. Although they didn't find direct evidence of 'acid waste', they were told about it as a major problem at the mouth of Newark Bay. The oystermen claim...that upon a great many days during the past season the water has been covered with acid and oil waste from the factories located along the shores, and it looks very decidedly as if we must look to this cause for the destruction of the oysters whose empty shells we found so abundantly."

Report of the U.S. Commissioner of Fish and Fisheries for 1885, Washington, DC, U.S. Government Printing Office: 157-163

1883

"The time was when the entire waters west of the channel, beginning south of Jersey City, and surrounding Ellis and Bedloes' Islands and Robbin's Reef, and a little way beyond Constable's Point, up the Kill von Kull, altogether some six miles in a straight line, was a rich bank of native oysters, and supposed to be inexhaustible."

Report of the Department of Statistics of Labor and Industry. Part VI. The Oyster Interests of New Jersey, in Documents of State of NJ, p. 225.

1896

"In its present condition all of this area [Meadowlands and other tidal marshes to the south] is unproductive. It raises a luxuriant crop of coarse sedge and salt grass having little value. It is a breeding place for mosquitoes and other insects. Owing to its trifling value, this marshy area is gradually becoming, and is likely to, in the future, become more and more a site for offensive manufacturing industries, manure piles, and other nuisances."

Vermuele, Cornelius C. New Jersey Geological Survey Annual Report. Trenton. 1896.



Circa 1927

30,650 acres of meadowland were the "logical location for the region's industrial development."

Statement from the Bergen County Chamber of Commerce

1934 near Carlstadt

"On one side were fields of celery and turnips, and on the other was the virgin forest. The birds were very numerous, there were flocks of pine finches, and it was interesting to watch them feeding on the tall reeds, and creeping around the branches of the golden rod to pick off the ripe seeds and any late caterpillar that might still be found there. The Hackensack River is still there and beautiful as ever. Except the Hudson, no stream of water pleases me so well...."

Descriptions from Joseph Rydings County Walks in Many Fields, Being Certain Choice Annals of the Paterson Ramblin Club.

1958

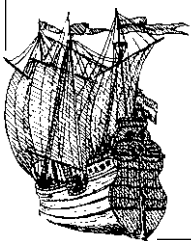
"Of 7,000 acres in Bergen County under the jurisdiction of the Meadowlands Regional Planning Board, 5% was devoted to urban uses, 10% consisted of vacant filled areas and garbage dumps, the remaining 85% being unreclaimed marshland...largely in its natural state altered only by the numerous railroads, utility and highway embankments which cross the area. Literally miles of drainage ditches lace the meadows, a great number of which have been constructed for purposes of mosquito control."

Report from the Passaic Valley Citizens Planning Association Master Plan Series, Report Number 2: Reclamation Plan, December 3, 1958, p 15.

1979

"We were among the first to recognize the enormous potential of the Hackensack Meadowlands - and to act upon it. In just seven short years we turned marshlands into a vital, beautiful, bustling world for business and pleasure...."

Statement from Hartz Mountain Industries taken from The Hackensack Meadows: A Natural and Unnatural History by Bruce Baldi. 1981.



1996

"As I grew older, the Hackensack River was for us a place to swim, crab and go row boating. It played a big part in our lives. Then came the chemical and oil plants that polluted this river with no regard for the outcome. State and local inspectors did not stop the abuse. There were some politicians who received their monthly checks to look the other way. In addition, over the years, many businesses used the river as a sewer line, as well as some towns dumping raw human sewage into the river."

Interview with Secaucus Mayor Anthony Just from the Secaucus Reporter, Volume 9, Number 14, Sunday, April 28, 1996.

1996

"The threat to this river, in one word is development," said Captain Bill Sheehan, Hackensack Riverkeeper.

The Secaucus Reporter, Volume 9, Number 14, Sunday, April 28, 1996.

1996

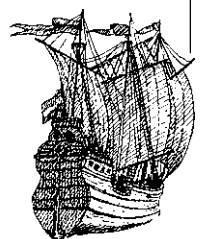
Margaret Bowman, a staff member of the American Rivers, says, "This river is on the upswing. It is in the process of recovery, but without those wetlands, the health of the river is never going to completely recover."

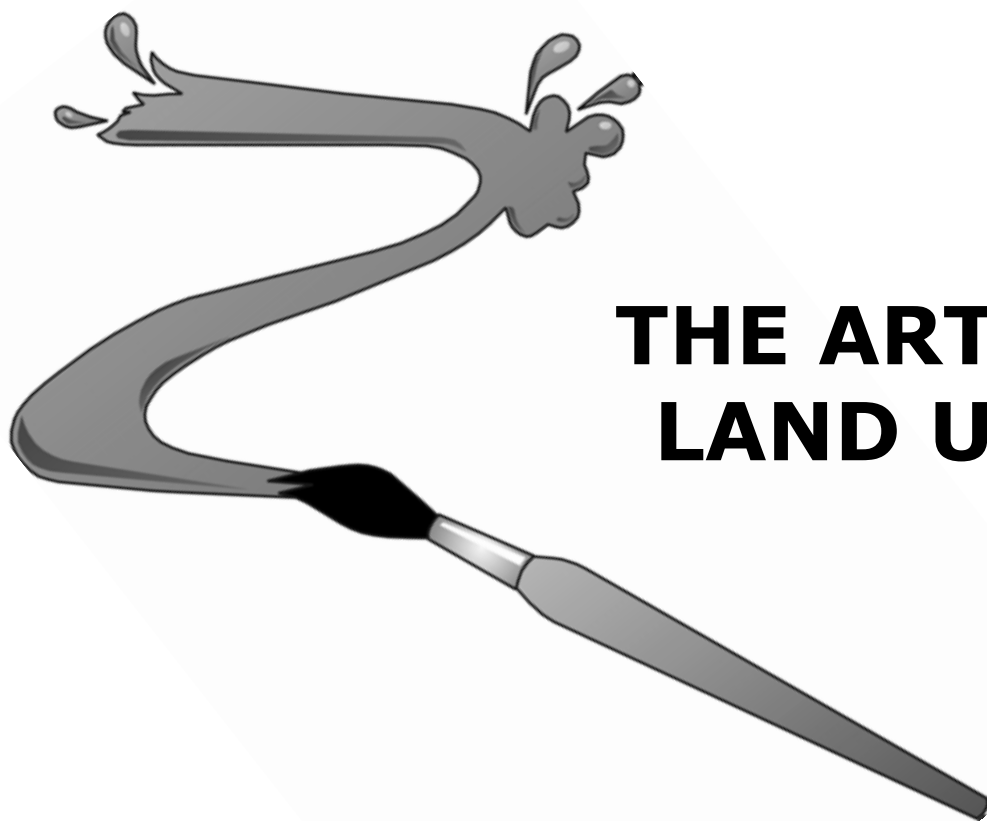
The Secaucus Reporter, Volume 9, Number 14, Sunday, April 28, 1996.

1996

"The Hackensack Meadowlands Development Commission (HMDC) was created to reverse the degradation that had been going on here - in the most assaulted wetlands in the U.S. - for almost 100 years. We have done much to reverse that negative pattern."

Statements from the Meadowlands Chamber of Commerce, October 1996



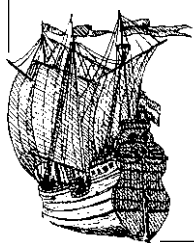


THE ART OF LAND USE

BACKGROUND INFORMATION



People have always altered the land to suit their needs. Native Americans that lived in the area cut trees to make boats and shelter and to use for fuel. They cleared patches of land for gardens, campsites, and villages. They set fire to forested lands to encourage certain game species (like deer) and to make travel easier. Our understanding of this type of land management comes from Native American stories that have been passed down through the generations and interpretation of artifacts and artwork.



As the settlers arrived in the Newark Bay Complex, they brought with them European ideas of how the land should be viewed and used. Although land was cleared for some of the same reasons as the Native Americans, the European land ethic was different as they struggled to cultivate the wilderness to emulate what they left behind in England, France, Spain, and the other western European countries. As more immigrants arrived, the land not only had to support the burgeoning population around New York City, but it also became a useful tool for increasing and encouraging trade of products made from the region's natural resources. Land use from the time of early settlement is understood by interpreting numerous written documents (land deeds, bills of sale, etc.) as well as maps.

LEVEL

5 to 8

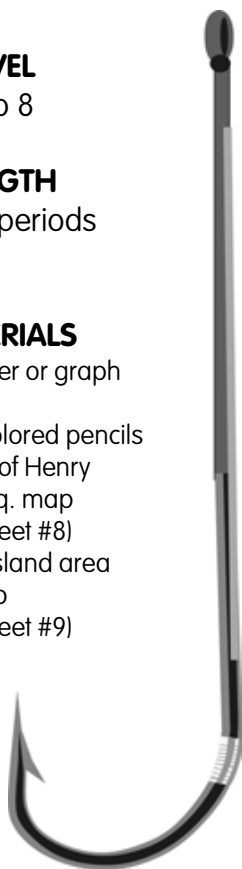
LENGTH

3 class periods



MATERIALS

- o drawing paper or graph paper
- o crayons or colored pencils
- o The Property of Henry Kingsland, Esq. map (Discovery Sheet #8)
- o Current Kingsland area land use map (Discovery Sheet #9)



OVERVIEW

Maps teach us about historical and present-day land use practices.

OBJECTIVES

Students will:



Create a graphic that illustrates present land use practices;



Interpret maps to describe land use practices;



Explain how land use has changed in a specific area over time;



Draw inferences about how land use affects environmental quality.



ADVISORY LINK

The Fish Consumption Advisories were developed to educate anglers about health risks involved with consuming certain fish and crabs from Newark Bay Complex waters. By-products from industrial, commercial and residential practices have altered the quality of the estuarine ecosystem where these animals live. By comparing historic and present day land use practices, we may better be able to understand how these practices have impacted the ecosystem over time.

STUDENT PREREQUISITES

Map reading

KEYWORDS

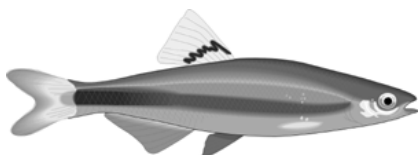
commercial
land use
residential

industrial
land use planning
zoning

PROCESS SKILLS

communicating
categorizing
classifying
inferring
formulating hypotheses

comparing
interpreting information
analyzing
synthesizing



SAILFIN



PLANNING



Make one copy of Discovery Sheets #8 and #9 for each student.

PROCEDURE SETTING THE STAGE

Have the students create a list of places in their neighborhood and what use each of the places has. Examples - supermarket/food; temple/worship; school/education; house/shelter; video store/entertainment; apartment/shelter; park/recreation; deli/food; church/worship. Discuss how these individual uses can be combined to create similar groups of uses.

THE ACTION



Period 1

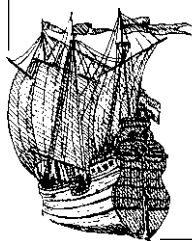
1. Duplicate the process used in "Setting the Stage" to help generate a list of places that are present on the school grounds.
2. Partner students and have each pair create a bird's eye view map of the school grounds showing all the places on their list. Discuss strategies for determining how to locate these different sites on a map (relative location, size comparisons, and directions).
3. Each map should contain a symbol key to identify the sites. Remind students that places with the same use should reflect the same symbol. Example: kindergarten playground, ball field, and blacktop playground are all recreation.
4. When the maps are finished, have the students assess each other's work for clarity, neatness and practicality (would a person be able to find their way around the school grounds using the map).
5. Discuss land use and land use planning as a way to identify, categorize, and code the ways that people use the land in the town, county, region, state, etc.
6. Ask students to describe what people, agencies, or organizations would benefit from this method of categorizing land use and why. [*developers, town planners, environmental agencies, etc.*]

Period 2

1. Read aloud "Description of an 18th Century Farm and Homestead" (Figure 8A)
2. Generate a list of the types of land these early settlers needed in order to maintain a working farm and homestead. Discuss.
3. Divide the class into pairs of students. Distribute "The Property of Henry Kingsland, Esq." (Discovery Sheet #8) to each pair and have them study this map to determine how one family (the Kingslands) used their land.

Period 3

1. Distribute the "Current Land Use" map (Discovery Sheet #9). Explain how this map covers the same area as the historic map; information on this map comes from town and government sources.
2. Compare the two maps and have students describe any changes. Ask the students to speculate how these changes may have occurred.



DESCRIPTION OF AN 18TH CENTURY FARM AND HOMESTEAD

The typical eighteenth century farm in the Hackensack valley depended upon the river for transportation of bulk commodities and therefore would have to be conveniently situated near a public dock. It might contain upwards of 150 acres, half of which would be cleared land "neatly divided into Tillage, Meadow, and Pasture." A domicile, preferably a good stone house, and a large barn serving as a granary would be situated on the upland or terraces above the river, close to the public highways that generally maintained a somewhat level gradient by following the contour of the ridges. Overland transportation was conducted by horseback, wagons and sleighs. This upland would have to provide a sufficiency of good water and a woodlot supplying enough timber for fuel and fences. Large apple orchards of about 120 trees, together with other fruit trees, would also occupy the well-drained slopes. Tidal flats [would bear] natural crops of salt grasses and reeds. Salt grass was therefore seasonally mown just before ripening and stored for animal-bedding and fodder. Most Bergen Dutch farms were oriented to the production of cereal grains, respectively, rye, corn, buckwheat, wheat and oats. Gristmills would have to be conveniently located for the conversion of kernel to flour and feed.

SUGGESTED ANSWERS TO MAP QUESTIONS

Historical Map of Kingsland Property

1. Information could be found on other old maps, in deeds and in historical descriptions of Kingsland's land.
2. 257 acres
3. All of the Kingsland family's life needs had to be provided for on their property. Transportation was primitive according to today's standards, therefore they did not travel far for their necessities. There were no supermarkets or shopping malls to visit and buy items or materials, but they may have sold part of their crops to buy things they could not produce.
4. The homestead was close to the main road to make it easier for transportation and visitors, especially in bad weather. It was also in proximity to the freshwater creek.
5. Most likely from the creek that ran behind the homestead.
6. The property contained a variety of habitat types. The orchards provided food. The trees in the woodlands could be used for fuel, the salt meadow provided salt hay for farm animals or for sale, and the property was close to the river and one of the main roads for transportation.
7. Wooded areas may have been logged for firewood and turned into fields. People plant orchards, therefore the land must have been cleared.

Current Land Use map

- 1 & 2 See key on map.
3. Similarities – land was and is used for transportation, building, industry, commercial ventures;
Differences – redistribution of natural habitats and residential areas, presence of the cemetery, no stream.
4. When a pattern is established it may be difficult to break that pattern; when an abundance of resources is recognized they may tend to be used for individual or commercial gain.
5. The surrounding ecosystems are mostly affected by the area's non-point source pollution including litter, road runoff and fertilizers.



ASSESSMENT STRATEGIES

Have the students:

- ❑ Plan an imaginary town that incorporates general land use types. Ask them to present the plans in some visual form, i.e., model, computer image, architectural drawing, etc. Have other students assess the completed maps for the degree of environmental impact.

STAYING INVOLVED



Go to the town hall and request a copy of the zoning map or tax map for your town. Explore the town's land use patterns. Create a more accurate map of the neighborhood around the school.

EXTENSIONS



Have the students create 3-D models of each map.



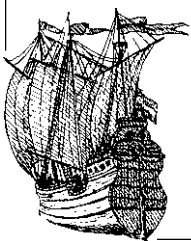
Cross-reference the current land use map with county and topographic maps of the area (Lyndhurst). Challenge the students to discover where the ridge is that separates the Passaic and Hackensack watersheds (Ridge Road) and where the wetlands are (Hackensack Meadowlands).

RELATED EDUCATION RESOURCES

- *Keepers of the Earth: Native American Stories and Environmental Activities for Children.*
- *Project WET Curriculum and Activity Guide*
- *Sustaining the Future: Activities for Environmental Education in U.S. History.*

REFERENCE

- Finkelstein, Milton et al. *Minorities: USA*. Globe Books, New York. 1971.
- US Fish and Wildlife Service, Southern New England – New York Bight Coastal Ecosystems Program. *Significant Habitats and Habitat Complexes of the New York Bight Watershed: Geomorphic Provinces and Sections*. Charlestown, RI. 1997.
- Wilson, George F. *European Settlers: Saints and Strangers*. Raynel & Hitchcock, New York. 1945.
- Wright, Kevin. *The Hackensack Meadowlands*. An unpublished report for the Hackensack Meadowlands Development Corporation's Environment Center.

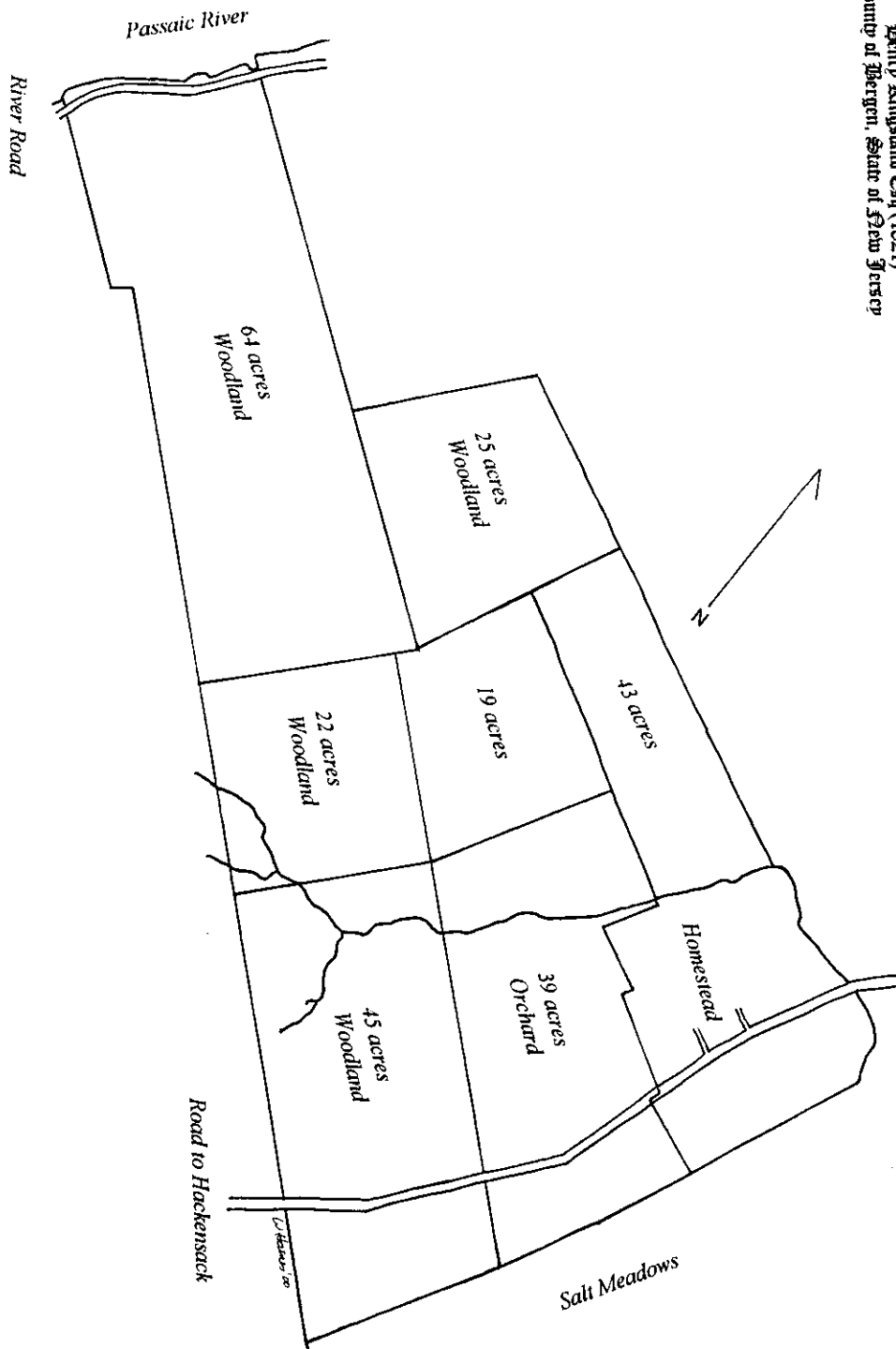


THE PROPERTY OF HENRY KINGSLAND, ESQ.

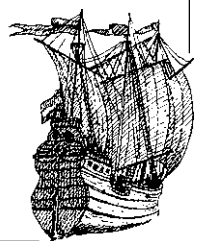
(November 12, 1821)

Discovery Sheet #8

A Map
of the
Upland and Salt Affections
the property of
Henry Kingsland Esq (1821)
County of Bergen, State of New Jersey



Map courtesy of Bergen County Administration Office, Hackensack, NJ.
(Map has been reduced, printed scale is not valid)



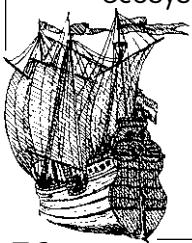
HISTORIC MAP OF THE KINGSLAND PROPERTY

Discovery Sheet #8

Name: _____ Date: _____

Color code the map according to land use types. Create a key.

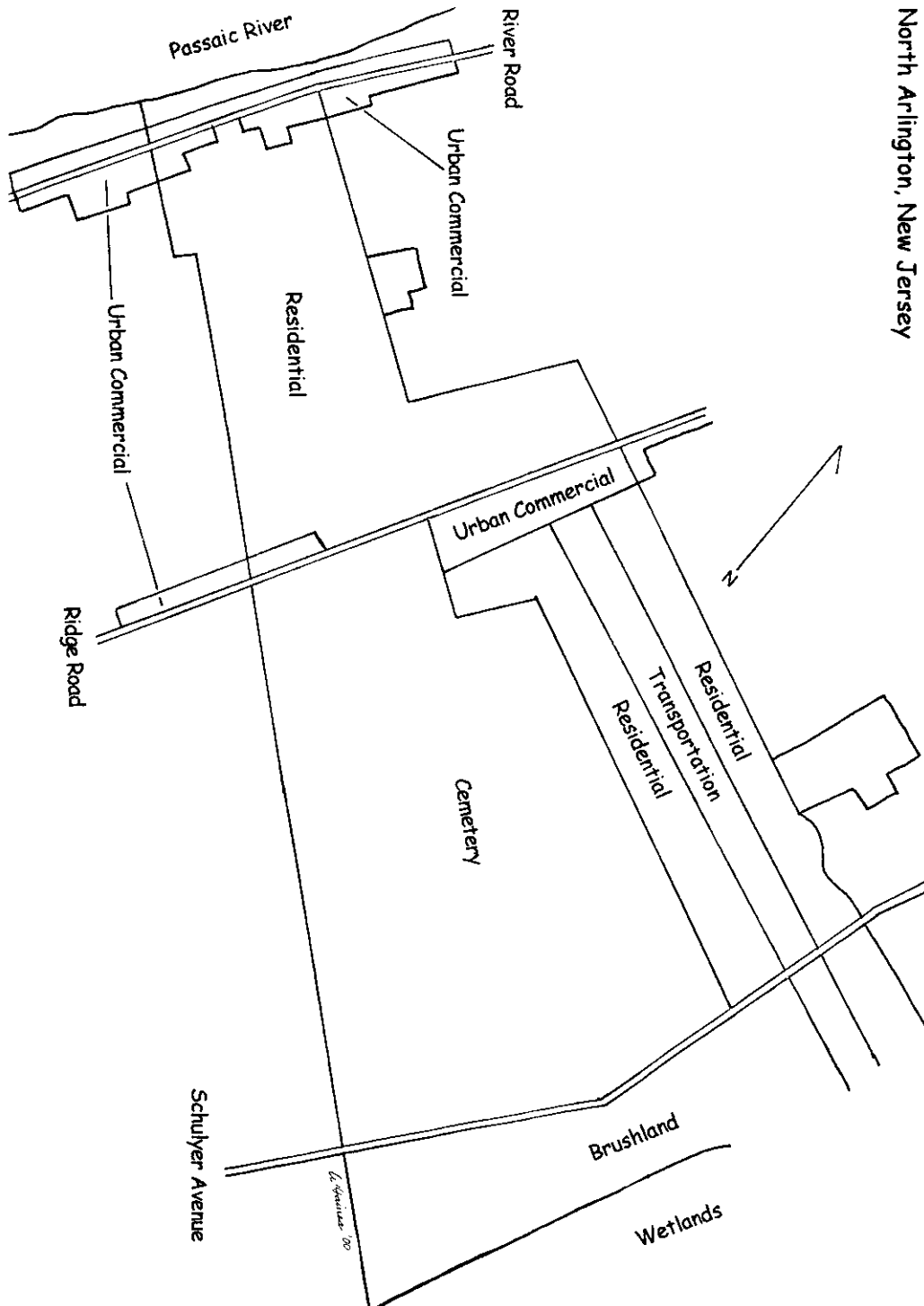
1. What should be done for areas of the map that cannot be coded? How might that information be found?
2. What was the total number of acres owned by the Kingsland family?
3. Why did the Kingsland family require that many acres of land?
4. Why do you think the homestead portion of the land was located where it was?
5. How do you think the members of the Kingsland family got their drinking water?
6. What were the advantages of where the Kingsland family settled?
7. How do you think the Kingsland farm and its land use affected the surrounding ecosystems?



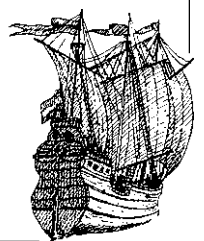
CURRENT LAND USE OF THE KINGSLAND PROPERTY

Discovery Sheet #9

Current Map for the
Kingsland Property
North Arlington, New Jersey



This information has been modified from Geographical Information System (GIS) data provided by the New Jersey Department of Environmental Protection. All information is approximate.



CURRENT LAND USE MAP

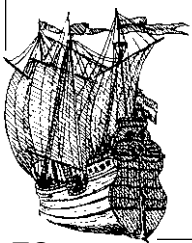
Discovery Sheet #9

Name: _____ Date: _____

Color code the map according to land use types.

Create a key. Where appropriate, use the same codes on this map as on the historical map).

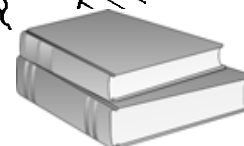
1. How might the current land use areas look if one was to visit them?
2. What are some of the present-day uses of the area that was once the Kingsland property?
3. What are the similarities and differences between historical land use and present day land use?
4. Do you think historical land use patterns led to present day land use patterns? If so, how? If not, why?
5. How do you think these present day uses affect the surrounding ecosystems?



ONCE THERE WAS A FOREST



BACKGROUND INFORMATION



The Newark Bay Complex is rich in natural resources. These resources are used for commercial, industrial and residential purposes, as well as for providing open space for recreation. These resources also are part of diverse ecosystems that function in many ways to help control flooding, filter impurities from surface water, determine drainage patterns, and provide habitat for wildlife.

In the past, Atlantic white cedar forests dotted the marsh. Cedar trees were used to create products such as shingles and wooden kegs because the wood was resistant to decay. Salt hay was harvested from the marsh for cattle; peat was removed from the marsh for fuel; and clay was extracted for making bricks. Basalt, an igneous rock, was mined from Snake Hill; there was a copper mine located in North Arlington; and oysters were harvested extensively in the Newark and Raritan Bays. Although some of these resources are still present in the Complex, most are no longer available in quantity or quality to make them profitable for human use.

The natural resources still used and enjoyed by the people of the area are not as product-oriented as in the past. Fishing the waterways continues to be extremely popular and there are numerous marinas in the area for people to launch their own boats or arrange for a charter trip. Many parks and other public access places encourage recreational fishing. Hunting of game species was historically popular and this sport continues today. People canoe, kayak, watch birds and butterflies, walk, and photograph nature throughout the Newark Bay Complex.

In order to devise comprehensive land use strategies for this pressured area, planners, officials, engineers and other involved parties draw on an understanding of historical events and review the consequences of various decisions. The case of the disappearing cedar forests in the Newark Bay Complex is a good study that shows multiple impacts on a resource.



LEVEL

5 to 8

LENGTH

4 class periods



MATERIALS

- o Historic map of Cedar Swamps (Discovery Sheet #10)
- o Current Land Types map (Discovery Sheet #11)
- o Once There Was A Forest story (Figure 9A)
- o Once There Was a Forest worksheet (Discovery Sheet #12)
- o crayons or markers
- o overhead projector
- o 2 overhead transparencies
- o pictures of Atlantic White Cedar
- o cedar boards or closet blocks of cedar

OVERVIEW

Historical information from maps and written accounts tell how our ancestors used available natural resources.

OBJECTIVES

Students will:



Describe events or forces that caused the cedar forests of the Newark Bay Complex to disappear;



Discern between substantiated fact and factual interpretation;



Explain how natural occurrences and human manipulation can affect habitats and ecosystems;



Demonstrate how learning about historical events can lead to a better understanding of current problems and their possible solutions.



ADVISORY LINK

The Fish Consumption Advisories suggests behaviors that will decrease an angler's likelihood of eating contaminated fish and crabs. This document was created after scientists conducted research and reviewed current scientific data as well as historic accounts. They were then able to determine the best course of action for dealing with an environmental health problem in the Newark Bay Complex.

KEYWORDS

brackish

land reclamation

land use management

mitigation

natural resource

STUDENT PREREQUISITES

A basic understanding of the habitat requirements of plants

A basic understanding of marsh and swamp habitats

An understanding of how people use natural resources

An understanding of land use

Map reading

PROCESS SKILLS

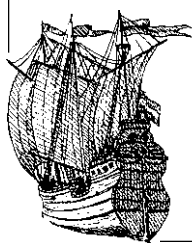
comparing

analyzing

formulating hypotheses

synthesizing

interpreting data



PLANNING



1. Make enough copies of the maps (Discovery Sheets #10 and #11), the story (Figure 9A), and the Once There was a Forest worksheet (Discovery Sheet #12) for each student or pair of students.
2. Make one set of overhead transparencies for the maps.
3. Obtain visuals or examples of Atlantic white cedar and red cedar as well as products made from their wood.
4. Obtain a photo or drawing of an Atlantic white cedar forest

PROCEDURE SETTING THE STAGE

Ask the students, "What are some events or forces that you have seen that have changed how the land is used or how a land area looks"? (Examples: development in the town, new highway, landscaping around a house or park, hurricane damage along the coast, flooded roads, wind/ice damage.)

THE ACTION



Period 1

1. Distribute a copy of the Current Land Use Map (Discovery Sheet #11) to each student or pair of students.
2. Tell the students to color code the map using the key.
3. Display a transparency of the map on the overhead projector. Have the students categorize the types of land into those that are more natural vs. those that have more built qualities. [*water, brushland, salt marsh, recreation, non-tidal marsh vs. transportation, industrial, and commercial*]
4. Discuss what types of natural resources would be present or available in the more natural habitats or land use areas and how they would be used. [*Examples: water - fishing for recreation, waterways for transportation; brushland - habitat for small animals; salt marsh - habitat for animals and plants; open space for recreation activities and, habitat for animals and plants*]
5. Distribute a copy of the Historic Map (Discovery Sheet #10) to each student or pair of students.
6. Tell the students to color code the map using the key then describe what the landscape might have looked like (i.e. include degree of moisture, types of plants present, possible animal species, etc.). Ask the students to list the types of natural resources that might have been present in each of these habitat types and speculate how early settlers may have used them. [*Examples: water - fish and shellfish for eating, the waterway for transportation and discharge of waste, habitat for aquatic animals; upland - trees for building and fuel, habitat for game animals; cedar forest trees for building, manufacturing products such as shingles, kegs, and barrels, aesthetics; marsh - salt hay production, peat production, habitat for wildlife and plants*]



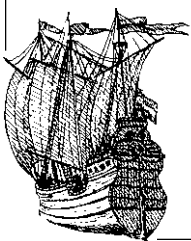
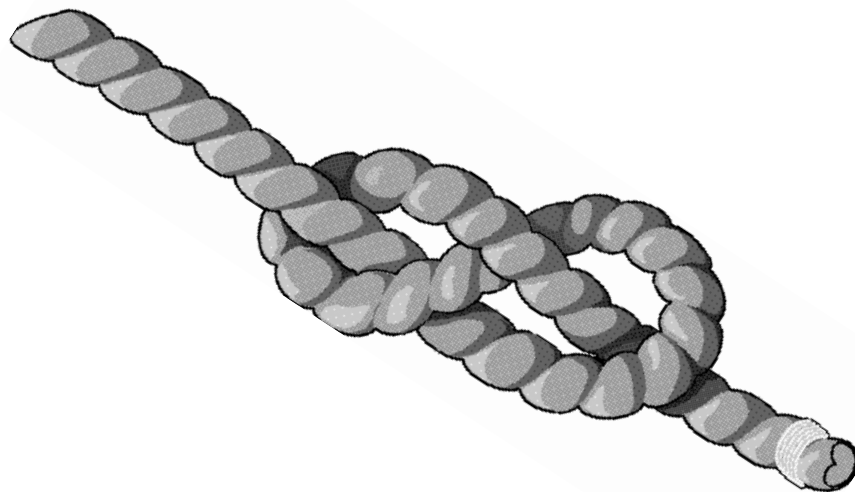
7. Ask the students, "Where could we go to verify or expand upon our habitat resource list"? [*Look through historical records from biologists, manufacturers, fishermen, hunters, etc.*]
8. Overlay the two maps. Ask the students to compare their maps. How has the area changed over time? How do you think resource use has changed? Brainstorm a list of possible events or forces that may have contributed to the changes.

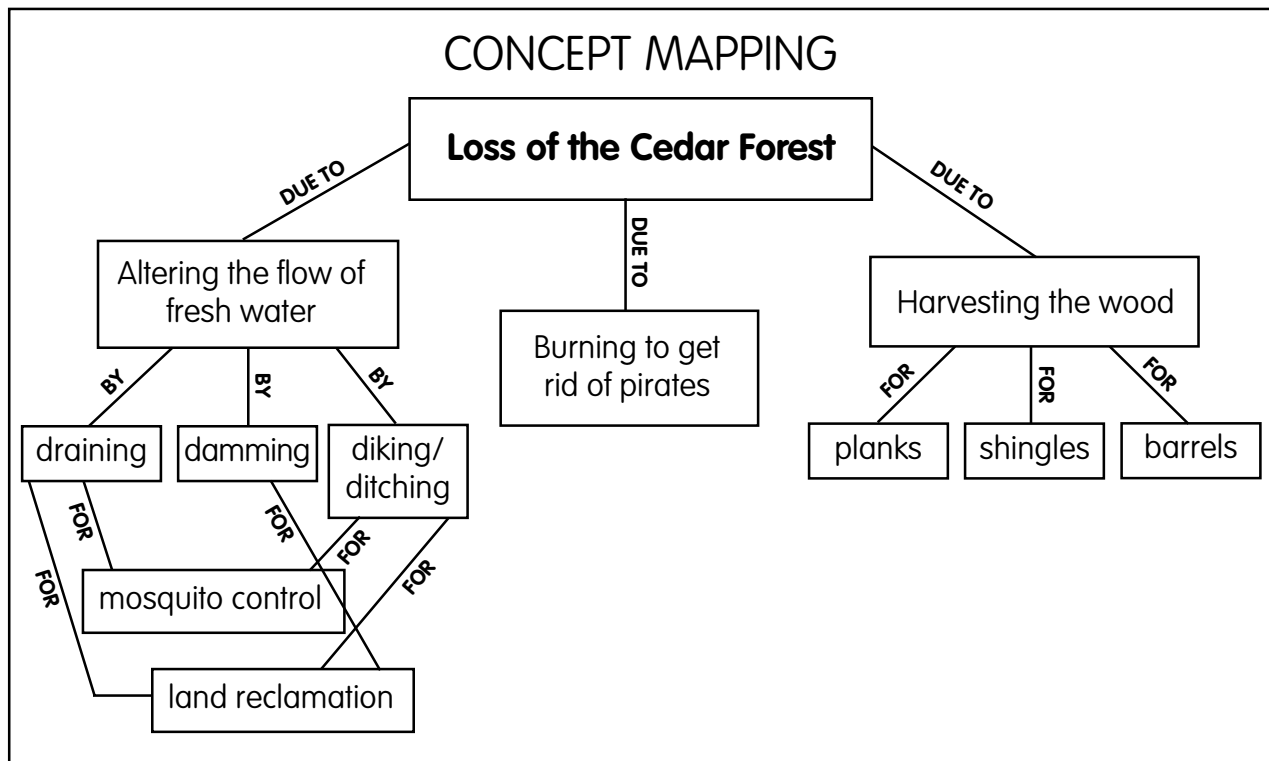
Period 2

1. Ask the students if anyone has ever been to a cedar forest or has seen a cedar tree. Or, pass out cedar blocks / boards for the students to observe. Have the students share their impressions.
2. Discuss the differences between Atlantic white cedar to red cedar. Use visuals or examples to help generate a list of each tree's characteristics and habitat requirements.
3. Discuss the uses of cedar. [*closets, water kegs and barrels, shingles, cedar chips for animals, cedar plank roads*] Use visuals or examples if possible.
4. Introduce the case of the disappearing cedar forest by telling the students that there are several theories as to why the forests disappeared. It is the students' challenge to determine what is the most likely explanation.
5. Distribute a copy of "Once There Was A Forest" (Figure 9A) to each student. Have the students share the reading of the selection aloud.

Period 3

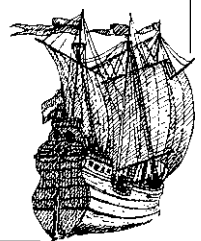
1. Distribute Discovery Sheet #12 to each student or pair of students. Have the students re-read the story and then create a concept map to illustrate what contributed to the disappearance of the cedar forests. (See Figure 9B.)
2. Discuss how each factor could be proved or disproved.





CLOSING DISCUSSION

1. What examples of disappearing forests do we have today? *[rainforests from clear cutting for farming and grazing; temperate, deciduous forests for development; hemlock forests from the woolly adelgid, an introduced insect]* What factors do you think have the most impact on forests that are disappearing today?
2. What does this story tell us about human actions towards some resources? *[purely views resources for human consumption; people sometimes do things without assessing the consequences; desire for the resources sometimes outweighs environmental impact]*
3. List human behaviors that you see pertaining to resource use in the Newark Bay Complex. *[Grassroots environmental organizations work to save habitat; creating new habitats through mitigation; informing people about potential health problems; using government funds to establish regulatory agencies; developing new ways to address environmental issues; pollution continuing in various forms; habitats are altered or degraded.]*





ASSESSMENT STRATEGIES



Have the students:

- ☐ Create a chronology of the disappearance of the cedar forests.
- ☐ Illustrate or dramatize "Once There Was A Forest".
- ☐ Write a cause and effect statement for one or more of the factors contributing to the disappearance of the cedar forests.
- ☐ Complete the following in essay form: The disappearance of the cedar forests in the Newark Bay Complex has (no, little, much) impact on me because:

STAYING INVOLVED

-  Select an environmental issue in the area, gather resource information about the issue through newspapers, television, the Internet, etc. Write a position paper on the issue, using cause and effect as the method for structuring the paper.
-  Interview people who work with the current day resources (anglers, hunters, canoeists, birdwatchers, land managers, ecotourism companies) to find out how they are used. Have the students assess whether the resources are being used wisely. (See Organizations to Contact, Appendix D.)

EXTENSIONS

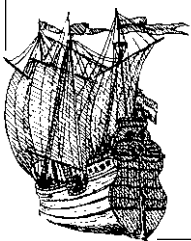
-  Compare the current land use map to GIS-generated maps available though the Internet and through the NJ Department of Environmental Protection.
-  Write a screenplay for the story; act it out for another class.

RELATED EDUCATION RESOURCES

- "The Trashy History of the Meadowlands"
- *Beneath the Shell: A Teacher's Guide to Nonpoint Source Pollution*
- *Bridges to the Natural World: A Natural History Guide for Teachers in Grades Pre-K to Six*
- *Project Learning Tree: Environmental Education Activity Guide*
- *Project WET Curriculum and Activity Guide*

REFERENCE

- Collins, Beryl Robichaud and Karl H. Anderson. *Plant Communities of New Jersey*. Rutgers University Press, New Brunswick, NJ. 1994.
- Longman, Phillip. "Pirates of the Meadowlands" *New Jersey Monthly*. January, 1983.
- Wright, Kevin. *The Hackensack Meadowlands*. An unpublished report for Hackensack Meadowlands Development Commission Environment Center.



ONCE THERE WAS A FOREST

Brom Polter's wagon creaked along the dense forest road. He was late coming home from market at the wharf, but it had been a profitable trip. He sold all the vegetables he had brought from his small farm, and his money pouches were full. The Polter farm was perched on a high table of land overlooking the wide expanse of trees and marsh, which stretched to the harbors that served the bustling city of New Amsterdam. As the wagon rolled homeward clouds drifted across a steamy summer sky and veiled the moonlight. The broad meadow halted abruptly and he entered the thick cedar forest. "Just another two miles," he thought, "my dinner will be waiting for me." His wife, Hilda, was a good cook and the thought of a tasty meal drew him along the dark lonely road distracted by thoughts of the food waiting and coins to be counted. The drone of mosquitoes was the only other sound besides the soft clip-clop of his horse's steps on the dirt road.

As the road wound through the swampy part of the cedar forest, heavy branches created a thick darkness, blotting out any remnant of moonlight. Brom slowed the wagon. The sudden rustle in the trees above did not disturb him. "It's some raccoon starting on his nighttime foray, looking for dinner, just like me." But in the next moment, three masked robbers dove down on Brom and pummeled the poor man senseless. He lay unconscious as the thieves ran off into the swamp with the bags of money. The muddy trail swallowed the robbers into the darkness without a trace.

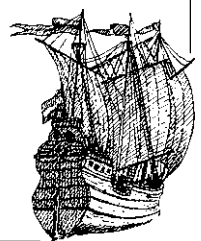
Brom lay by the side of the road. His horse, a creature of habit, trotted home to his stall and oats. "O, Gott in himmel", Hilda cried, "something has happened to my Brom!" The neighbors rallied from miles around and went out with lanterns along the lone road, across the old cedar swamp forest, toward the river

settlements. It was a familiar road that grew busier every day. Since the late 1600's, industry in the area had grown. Many were farmers, like Brom Polter, but some cut and sold the great white cedar trees. Everyone knew the single road that led through the tall trees and marshy swamps.

"I found him," shouted Will Smythe. "He's hurt, but still alive!" The small company divided. Some tended Brom, checking his wounds and listening to how robbers had stolen his earnings of the day. They bundled him into a wagon and took him home to Hilda.

"Jim Barclay, John Mason, and you lad, Pieter von Stod, come with me," ordered Will. "We worked this part of the woods just a few months ago. Let's see if we can find the trail the robbers took and get Brom's money back." The little band followed the trails they themselves had helped make through the forest as they harvested the lumber to make barrels, containers, roof shingles, planks, and poles. The ground was dry in some areas but ankle deep in water most of the time. It was easy to rob an innocent traveler on the road and escape into the wet, mosquito infested swamp without leaving a trail. Pirates of old were changing their thieving ways. The seas were well patrolled now and capture of ships was not as easy or profitable. New Amsterdam, once a safe harbor to sell and store their loot, was now a bustling seaport. Ships from many nations came here. The English were especially troublesome for these robbers of the sea. Pirates now infested the meadowlands, preying on unsuspecting travelers.

As the little band trudged through the swamp, each thought of the increasing dangers of the road to the harbor towns. Young Tom and Becky Dawson were attacked and robbed. They killed

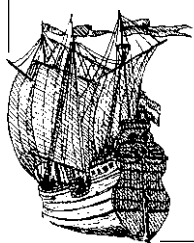


Tom and poor Becky was never seen again. A few months later a lumberman found her bonnet stuck to a branch in the woods. The Wilson boys, merchant seamen, were robbed and killed as they were making their way home. Hadn't been home in three years. The widow Wilson was so proud of her boys. She hasn't spoken to anyone since that happened. Must be five years or more. All recalled some tragedy that touched them personally.

Pink dawn brought some light to the steamy swamp, but hope dwindled in the hearts of the search party and they trudged back to the main road and home. On the way, a plan was forged. Enough! They would put a stop to this. They were not ripe fruit to be plucked and devoured by ravaging hoards. In the next few months, all the neighboring towns agreed to raid the hiding places where pirates were known to hide. For weeks, battles raged, cannons fired, and many hideouts were abandoned. The last of the bandits fled into the cedar forests of the marshlands.

"Burn the meadows and forests!" The people, now in a frenzy of rage and excitement set fire to all the meadows from the Arthur Kill to the harbor towns across from New Amsterdam. Pirates died in the blaze and some were captured, tried and executed. In the end, the roads became safe, but the fire took its toll on the cedar forests of the area.

The five-mile trek from the harbor towns to the high ground and farms in the west was now a vast open meadow. Tidal waters flowed into the fresh marshes. Brom's children of seven generations still drove their produce by wagon through the meadowlands to Hoboken and New York. Out in the marsh men stood in long lines with picks and shovels. They were digging. "Great progress going on here", said the old farmer to his son. "The ditches and dikes these folks are building will keep the tide waters out. Make room for farms and grazing lands for cattle."



"What are those old blackened posts, Papa?" asked the boy.

"Ah, the old folks tell stories about a forest that was a hideout for raiding pirates. They say the people set fire to it to chase the pirates. They say they are the stumps of the old trees. Fancy story. Don't know if it's true."

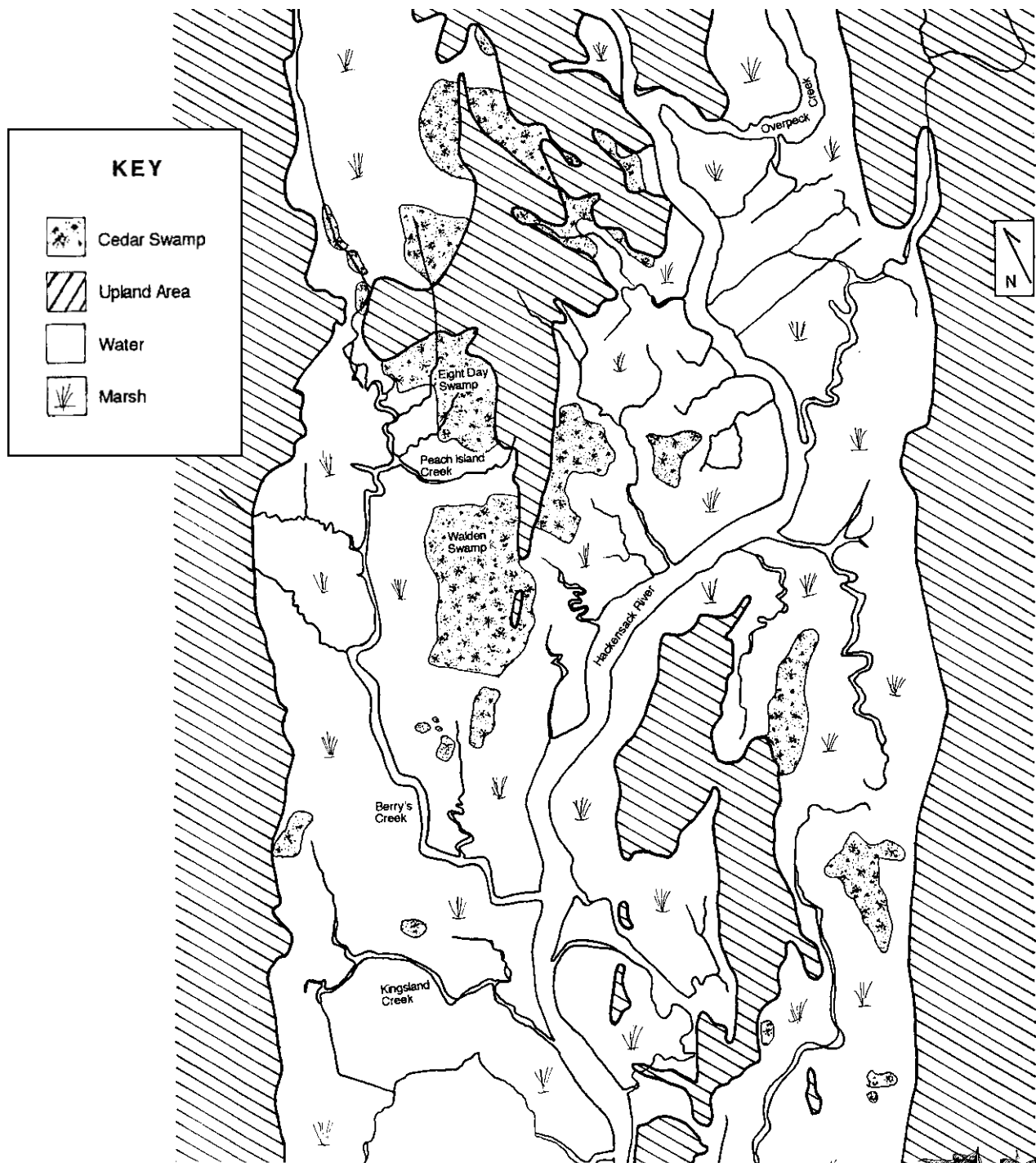
Farming and grazing in the meadowlands was somewhat successful, but by the early 1900's malaria became common to the people of the area. Mosquitoes that breed in shallow, still water carried the fatal disease. In 1904, John Smith wrote, "These dead end ditches in the meadows are one of the worst breeding places for mosquitoes in the state." The canals had no outlets through the embankments. The mosquitoes were the new raiders of neighboring communities. They were huge, came in swarms, and if they did not infect with the deadly malaria, they left itching welts on those who went beyond screened porches in the summer. From 1900 to 1950 Mosquito Commissions from various counties surrounding the meadowlands worked to drain the pools of water and repeatedly sprayed the pools and ponds with lightweight oil to prevent the mosquito larvae from becoming adults.

The flow of water through the meadowlands was greatly altered and the system became more and more brackish with saline tidal waters. Construction of Oradell Reservoir in 1922 also reduced freshwater flow downstream. The last of the great cedars finally died around 1939. But in some places, charred stumps can still be seen where once there was a forest.

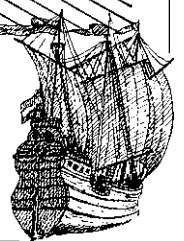
Written by Patricia F. Kane

HISTORIC MAP OF CEDAR SWAMPS

Discovery Sheet #10

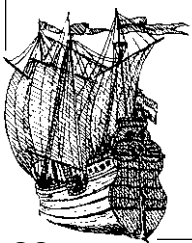
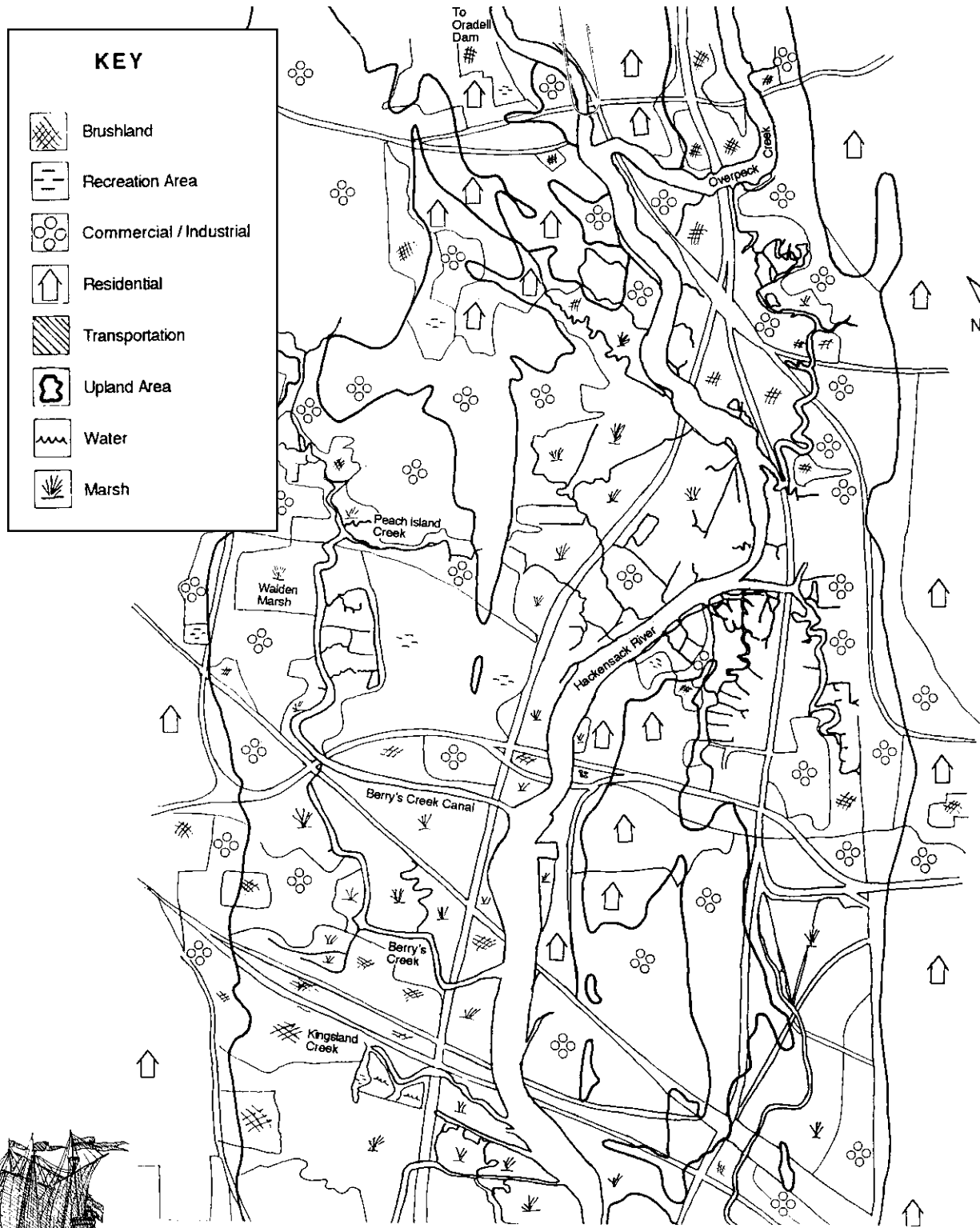


Adapted from A Cartographic Impact Evaluation of HMDC Development Alternatives on Known and Potential Prehistoric and Historic Resources Within the Hackensack Meadowlands, New Jersey. EPA Contract No. D102182QZ. Prepared by Joel W. Grossman, Principal Investigator of Grossman and Associates, Inc. for EcoSciences, Inc., February 4, 1992.



CURRENT LAND TYPES MAP

Discovery Sheet #11



This information has been adapted from NJDEP Geographic Information System data.

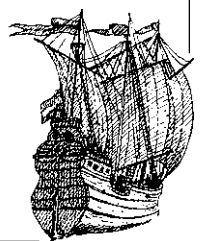
ONCE THERE WAS A FOREST

Discovery Sheet #12

Name: _____ Date: _____

Create a concept map for the story to answer the following question:
What happened to the cedar forests in the Newark Bay Complex?

Which of the factors listed do you think had the most impact on causing the cedar forests to disappear? Why?





MAP DETECTIVES



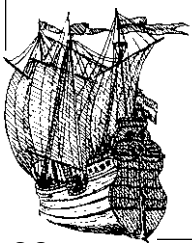
BACKGROUND INFORMATION

At the time of New Jersey's first census in 1726 the state's population was 32,442; it had grown to 149,435 by 1784. By 1900, the population had jumped to nearly 2,000,000 and by 1990 the entire state's population had increased to 7,730,000. Approximately 49% of this population (3,775,344) lives in the six counties that border New York (Bergen, Passaic, Hudson, Essex, Union, and Middlesex). It is within these six counties that the Newark Bay Complex exists.

Resource distribution and technological advances played a major part in how this population became distributed over time. At the time of the Native Americans and the early European settlers, water travel and foot or horse travel were the modes of transportation. Landform barriers such as mountain ranges, cliffs, and even some waterways prohibited mass settlement away from the cities. As the population of cities increased and more advanced technology was invented or discovered, people found opportunity to move away from industrial centers to the outlying

areas. This expansion movement blossomed in the 1800's and continues today by making rural areas more accessible.

New Jersey has 567 municipalities located in 21 counties and each municipality has, by state law, the right to plan and zone its own land use. Historically there was little discussion between town managers about how one town's projects (or growth) affected another town and its resources. Roads, commercial and industrial sites, landfills, residential development, recreational complexes and shopping malls were built without much regional planning. Many of the challenges that arise in dealing with the environmental issues of the area include providing open space habitat, clean water, and clean air. These become challenges because of people's differing attitudes towards the environment, the economy, their lifestyle, quality of life issues, and personal freedoms. Since environmental problems and concerns transcend municipal boundaries, conflicting land use is a serious concern in New Jersey.



LEVEL

6 to 8

LENGTH

3 class periods



MATERIALS

Maps:

- o Native Americans in the Newark Bay Complex Before the Dutch Settlers (Figure 10A)
- o The Newark Bay Complex (circa 1720) (Figure 10B)
- o The Newark Bay Complex (circa 1871) (Figure 10C)
- o The Newark Bay Complex, Today (Figure 10D)

Discovery Sheets:

- o #13 Native Americans in the Newark Bay Complex Before the Dutch Settlers
- o #14 The Newark Bay Complex (Circa 1720)
- o #15 The Newark Bay Complex (Circa 1871)
- o #16 The Newark Bay Complex, Today



OVERVIEW

During the last 400 years technological advances have changed the manner in which people move about the state, country and world. These changes also have affected population distribution throughout the Newark Bay Complex.

OBJECTIVES

Students will:



Describe how advances in transportation technology affected population distribution in the Newark Bay Complex over time;



Discern between life needs and life wants as they relate to the student's lifestyle.



Explain how population density affects the use of natural resources;



Describe how regional planning would affect the use of natural resources and ecosystem health.



ADVISORY LINK

The resources of the Newark Bay Complex have provided a basis for continuous population growth since the 1600's. Human ingenuity and technological advances have further developed the infrastructure to support this growth over the years. In order to fully understand why the Fish Consumption Advisories were adopted, it is helpful to understand how the region developed to become one of the most densely populated areas in our country. Associated with this are the quality of life issues that arise from population density and lifestyle patterns.

KEYWORDS

land use
landform

landform barrier
natural resource
sustainable development

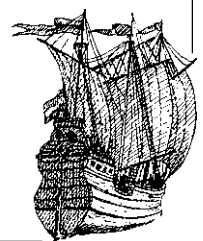
STUDENT PREREQUISITES

Map reading
New Jersey geography

PROCESS SKILLS

comparing and contrasting
interpreting information
formulating hypotheses

analyzing
synthesizing
evaluating



PLANNING



1. Make one copy of each map for every student or pair of students.
2. Make one copy of each Discovery Sheet (front and back) for every student or pair of students.

PROCEDURE SETTING THE STAGE

Tell the students that they have been invited to go into New York City for a special event. Ask them to describe how they would get to the city (by car and tunnel or bridge, by bus, using the Path, by helicopter, etc.). Discuss the variety of transportation options available to the students and their families.



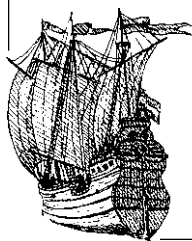
THE ACTION

Periods 1 and 2

1. Tell the students that travel was not always as easy as it is today and that by looking at a series of maps and reading short descriptions, they will discover what it might have been like to live in the area at various times throughout history.
2. Distribute one map at a time (in order from historical to current), and have the students interpret each map by reading the time period excerpt and answering the Discovery Sheet questions.

Period 3

1. Ask the students to list things that enable them to live their life the way they do, then categorize these into wants and needs.
The needs: Think about the needs of the Native Americans, the early Dutch settlers, the 1800's citizen, and your needs today. Have they changed much over time? If yes, in what way? If no, why not?
The wants: How do you think the wants of people have changed over time? What affect could the production or distribution of wants have on the resources in the Newark Bay Complex?
3. Introduce the term "sustainable development." Have the students hypothesize what this means based on the definition of each word.
4. Lead a discussion on how wants and needs and population density relate to sustainable development.



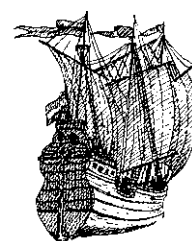
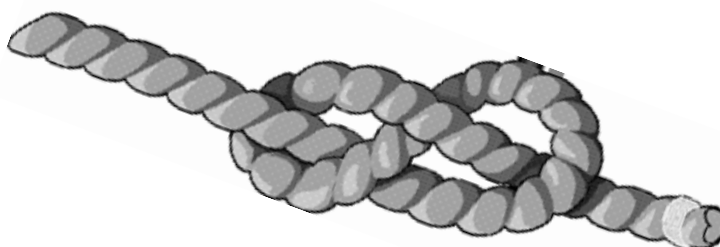
INDIGENOUS PLACE NAMES OF NORTHEASTERN NEW JERSEY

Present Day Site Names for Teacher Reference

1. Hackensack
2. Jersey City
3. River Edge
4. Watchung
5. Overpeck Creek and the Meadows
6. Hoboken
7. Manhattan
8. Moonachie
9. Part of Secaucus
10. Passaic
11. South Hackensack
12. Where the Saddle and Passaic Rivers meet
13. Secaucus
14. Teaneck
15. In Hackensack
16. Weehawken

CLOSING DISCUSSION

1. Compare the four maps. Describe your impression of the information that is shown as you look from the oldest to the most current map. *[more towns and cities, less open space between towns and cities, more types of transportation options, changes in landforms e.g. shrinking of meadowlands, alterations in Newark Bay, etc.]*
2. Discuss what effects population growth and population density may have had on the resources of the Newark Bay Complex over time.
3. How do you think a map of 2020 will look? Justify your answer.
4. What suggestions would you have for town planners concerning future development in the area to utilize/conservate existing resources?





ASSESSMENT STRATEGIES

Have the students:


- ☐ Select one of the wants from their list. Trace the "life" of the object from its current state back to its natural resource/s from which it came.
- ☐ List all the means of transportation and people that needed to produce that object and get the object to them.


STAYING INVOLVED

 Learn what provisions the town administrators have for restricting growth and/or encouraging growth or conserving natural resources.

 Find out how town administrators work with other towns/counties to work towards regional planning.

EXTENSIONS

 Trace population growth on each map by consulting census figures for the major cities and towns in the Newark Bay Complex. Have the students color code the maps to make a better visual presentation.

 Interview older citizens for descriptions of the town as it was in the past.

RELATED EDUCATION RESOURCES

- *Beneath the Shell: A Teacher's Guide to Nonpoint Source Pollution and Its Potential Impact on New Jersey Shellfish*
- *Project Learning Tree: Environmental Education Activity Guide*
- *Project WET Curriculum and Activity Guide*
- *New Jersey WATERS: Watershed Approach to Teaching the Ecology of Regional Systems*

REFERENCE

Collins, Beryl Robichaud and Karl H. Anderson. *Plant Communities of New Jersey: A Study in Landscape Diversity*. Rutgers University Press, New Brunswick, NJ 1994.

"Indigenous Place Names in Northeastern New Jersey" by Kevin Wright. 1994. (map)

Kraft, Herbert C. *The Lenape or Delaware Indians*. Seton Hall University Museum, South Orange, NJ. 1996.

"New York From a Balloon", Harper's Weekly, Supplement, May 6, 1871. (map)

U.S. Census Bureau website: www.census.gov

For specific historic population numbers:

www.census.gov/population/www/censusdata/pop-hc.html

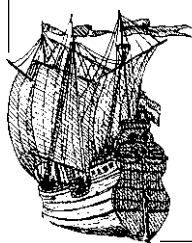
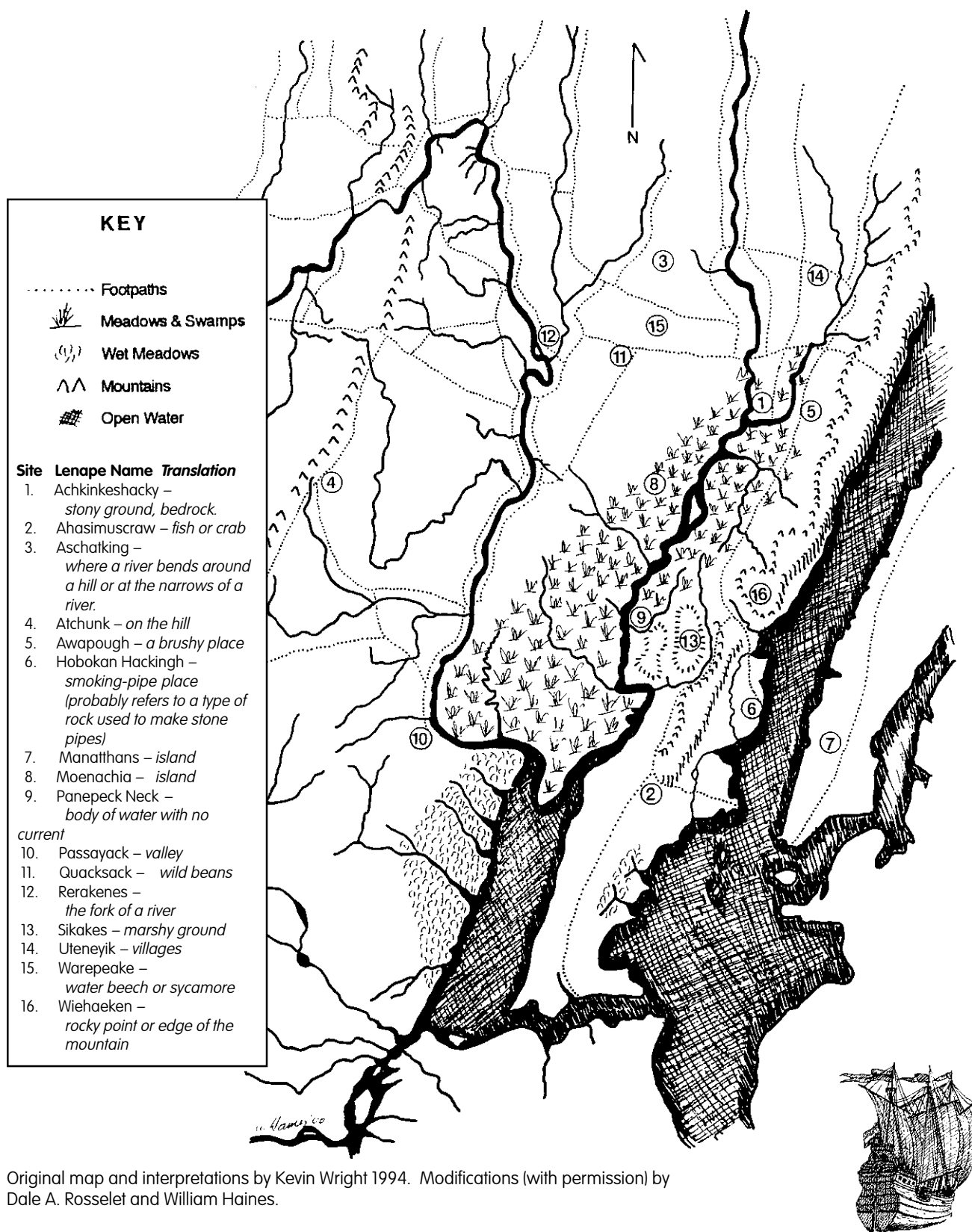


FIGURE 10A

NATIVE AMERICANS IN THE NEWARK BAY COMPLEX BEFORE THE DUTCH SETTLERS



Original map and interpretations by Kevin Wright 1994. Modifications (with permission) by Dale A. Rosselet and William Haines.

NATIVE AMERICANS IN THE NEWARK BAY COMPLEX BEFORE THE DUTCH SETTLERS' DESCRIPTION

Discovery Sheet #13

THE LENAPE INDIANS

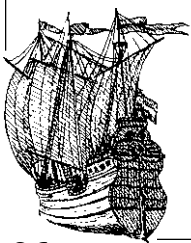
The Lenape Indians lived in small groups or bands scattered along streams and rivers. Most Lenape Indian bands had only 25 or 30 people. One or two families might live in a small wigwam, although some of the larger longhouses could house 25 or more people. The Lenape spent most of their time outdoors.

Each member of the band had his or her tasks to perform. Young girls helped their mothers and aunts gather wild plants, roots, nuts, berries, mushrooms, birds' eggs, clams and other things that were good to eat. They also worked in the garden and collected firewood. Dishes and cups were made from wood, gourds, seashells, or turtle shells and cooking pots were made from clay. Baskets were woven from reeds and roots and clothing was made from animal skins, sewn together by hand.

Men and boys cut saplings to make houses, carved dugout canoes from large trees, and cleared the forest to make fields for gardening. They also made most of the tools and weapons; hunted, fished, and trapped for food, skins and warm furs. A hunter might walk all day and not see a bird or an animal. When he was lucky enough to kill an animal, he had to carry it home on his shoulders. No part of the animal was wasted and all of the meat was eaten. The marrow and fat in the bones were cooked to make soup: the animal's skin was tanned and used for clothing, moccasins, containers, and many other items. Tools and ornaments were made from the teeth, claws, and bones; and, sinew was used as thread.

The Lenape often had to travel many days in search of food and supplies. Sometimes they would walk and the trails they used went across mountains, around lakes, and along rivers. The Lenape would carry heavy loads on their backs, for there were no horses to ride and no wagons. At times the Lenape traveled by dugout canoe that were made from tulip or cedar trees.

Taken from The Lenape or Delaware Indians by Herbert C. Kraft. 1996.

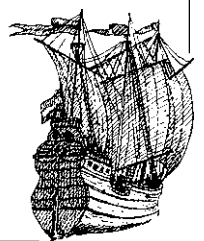


NATIVE AMERICANS IN THE NEWARK BAY COMPLEX BEFORE THE DUTCH SETTLERS' MAP AND DESCRIPTION INTERPRETATION

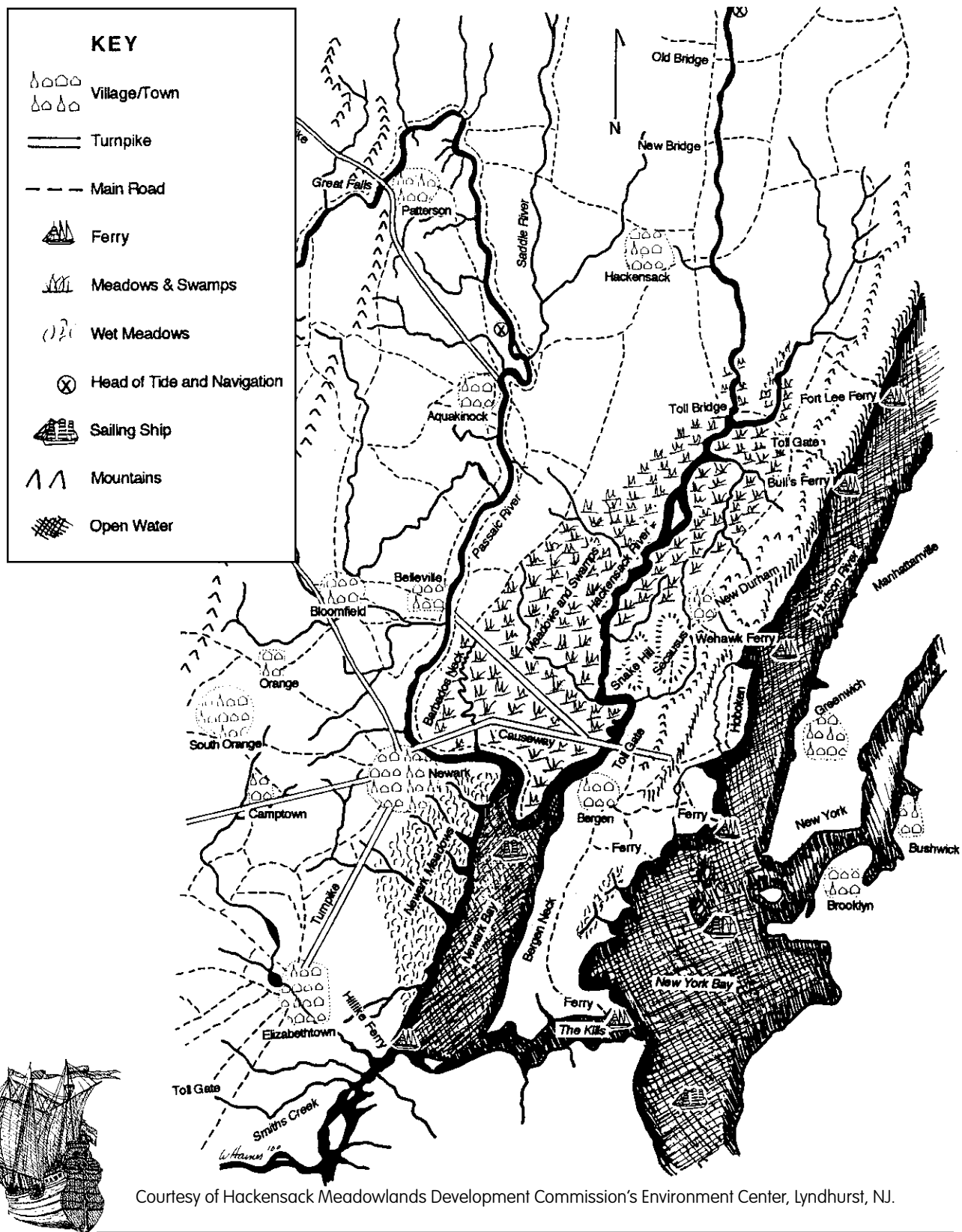
Discovery Sheet #13

Name: _____ Date: _____

1. List six (6) places on the map that were named for landforms or habitat types.
2. List the names of places on the map that refer to a natural resource that was used by the Lenape.
3. Why do you think the Lenape named these places as they did?
4. How did the Lenape travel from one place to another?
Why were the Native American's trails located where they were?
5. Based on your map interpretation and the story, what effect do you think the Lenape had on the land and its resources? Explain your answer.



THE NEWARK BAY COMPLEX (CIRCA 1720)



THE NEWARK BAY COMPLEX (CIRCA 1720) - DESCRIPTION

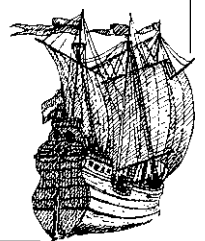
Discovery Sheet #14

THE EARLY SETTLERS

While most of the new settlers were farmers, there were also fishermen, craftsmen and merchants among them. Slowly people bought land in the Newark Bay Complex or were granted deeds to pieces of property by English nobility. Throughout these early times the settlers were making important discoveries about the resources their new home had to offer - a valuable copper mine was discovered in North Arlington, salt hay that grew in the salt marshes of the Meadowlands could be harvested to feed livestock, and cedar trees that dotted the marsh could be harvested to manufacture into a variety of products. The red/brown clay found in the Hackensack Valley was easily baked to create earthenware pottery and later became a primary source for brick making. The first substantial houses built by European settlers were made from wood, with brick chimneys that were molded and baked at their building site.

These early settlers needed to be fairly self-sufficient. Although a man's main occupation might have been building houses, he might also have had to raise crops, raise livestock, and make other products (like chairs and other furniture) to trade for some of his family's necessities. The other members of the family also had important roles in maintaining the household. The woman of the house would process and preserve food for the winter, spin yarn to make cloth and clothing, care for barnyard livestock, and school the children. Children also had chores. Young girls would help their mother with all of her jobs: as well as tend the garden and learn to sew. A boy would help with the chores around the house, as well as learn farming and other skills from his father.

Rivers remained the principal arteries of commerce and travel. Boats and sloops sailed up and down the Hackensack River going to and from New York and other regions. These boats carried wood, lumber and agricultural products. A primitive network of dirt roads followed the contours of the upland above the Passaic River and the Meadowlands. Ferries crossed the Hackensack and Passaic Rivers and short causeways across marshy areas were built of cedar trunks, lying side by side. These corduroy or plank roads helped accommodate travelers, carriages, horses and cattle moving from the country of New Jersey to the markets of New York.



THE NEWARK BAY COMPLEX (CIRCA 1720) MAP and DESCRIPTION INTERPRETATION

Discovery Sheet #14

Name: _____ Date: _____

1. List the towns and cities whose names you recognize.
2. Why were these towns located where they were?
3. What types of transportation do you think were the most common during this time period?
4. Why did these early settlers use these types of transportation?
5. Compare this map to Map 1. What are some similarities and differences between the maps?
6. What were some of the barriers to transportation that the early settlers had to overcome to transport themselves and their goods?
7. How can you tell from the map that population increased?
8. What role does transportation have in increasing population in a specific area?
9. What were some of the effects that this growth had on natural resources?

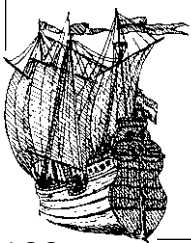
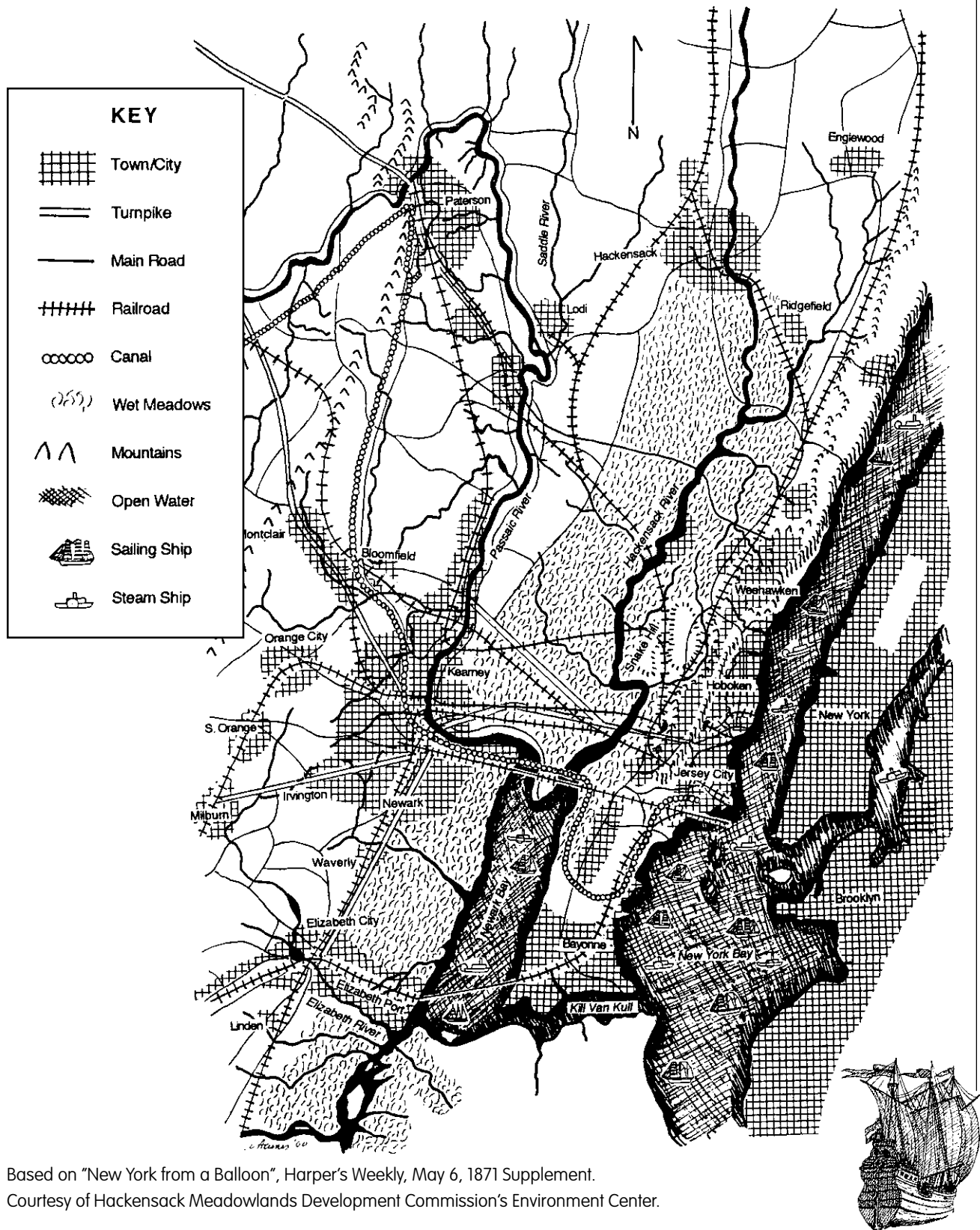


FIGURE 10C

THE NEWARK BAY COMPLEX (CIRCA 1871)

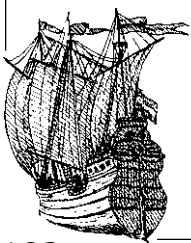


THE NEWARK BAY COMPLEX (CIRCA 1871) - DESCRIPTION

Discovery Sheet #15

Immigration into the country increased dramatically during the late 1800's and early 1900's. New York City and many of the larger cities in New Jersey (Newark and Elizabeth) became thriving metropolises. The political and economic upheaval of the American Revolution disrupted the primitive transportation system and throughout the 1800's vital improvements were made to this system. There was a great push for more permanent roads, causeways, and bridges. According to reports, the causeways across the marshes consisted of three or four layers of logs covered with earth and surfaced with gravel. Clearly, it was important to have reliable transportation to make it easier for merchants to bring their wares to New York City.

During this time river craft increased in size and schooners carrying brick and agricultural products became a common sight. Vessels and steam-tugs ran up the Hackensack and Passaic Rivers with coal, lumber and other freight. Trading, purchasing, and transporting goods were essential to the economy. The marshes remained a vast uninhabitable field of salt grasses and cedar thickets, wedged between the industrial cities and farmlands to the west and the great city of New York to the east. Every day businessmen described different plans for aiding in transportation of goods and people. The Morris Canal was dug, but soon it was made obsolete by the invention of the steam engine and the building of the railroads. Throughout this time the scull-boat was used extensively for hunting waterfowl and for trapping. Anglers also used it to catch fish and eels.



THE NEWARK BAY COMPLEX (CIRCA 1871) MAP and DESCRIPTION INTERPRETATION

Discovery Sheet #15

Name: _____ Date: _____

1. What are the similarities and differences between this map and the two previous maps?
2. What types of transportation were common during this time?
3. What new methods of transportation can you discover by studying this map?
4. How were some of the barriers to transportation solved by 1871?
5. Compare this map to Map 2. Name a town or city that you find on both maps. By looking at the two maps, explain how the town or city has changed or remained the same.
6. How can you tell that the population of the area has increased between the time periods that are shown on Map 2 and Map 3?
7. What were some of the effects that this growth had on natural resources?

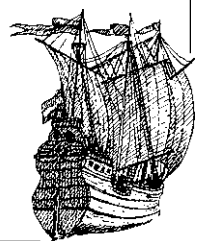
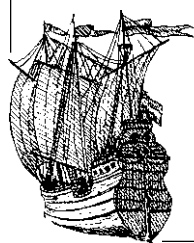
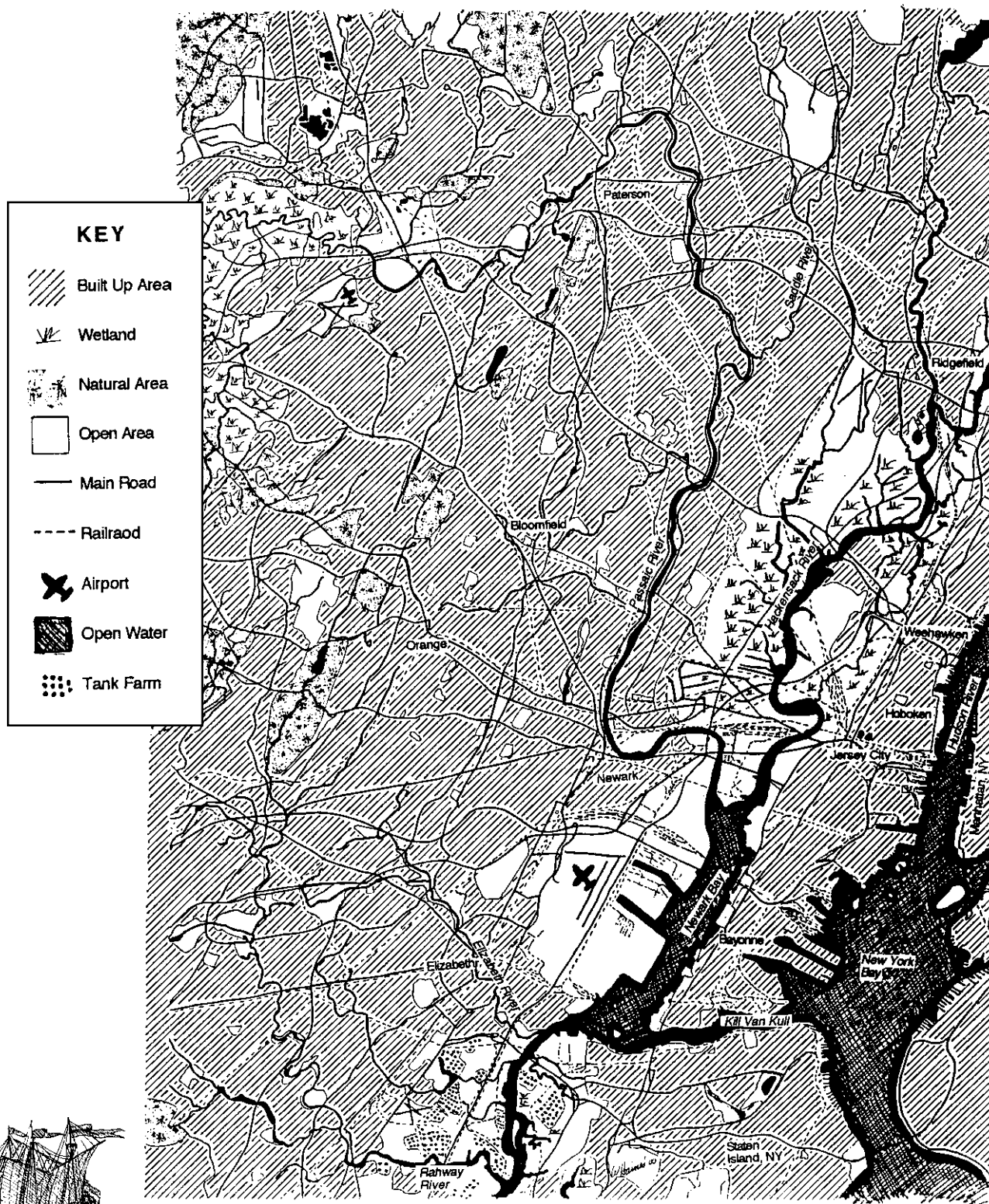


FIGURE 10D

THE NEWARK BAY COMPLEX, TODAY



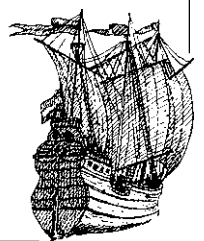
Reprinted in part from U.S. Geological Survey and the National Ocean Service, Newark, New Jersey - New York quadrangle:1:100 000-scale topographic-bathymetric map. 1986.

THE NEWARK BAY COMPLEX, TODAY MAP INTERPRETATION

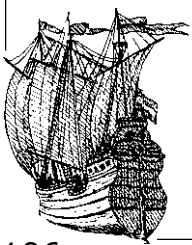
Discovery Sheet #16

Name: _____ Date: _____

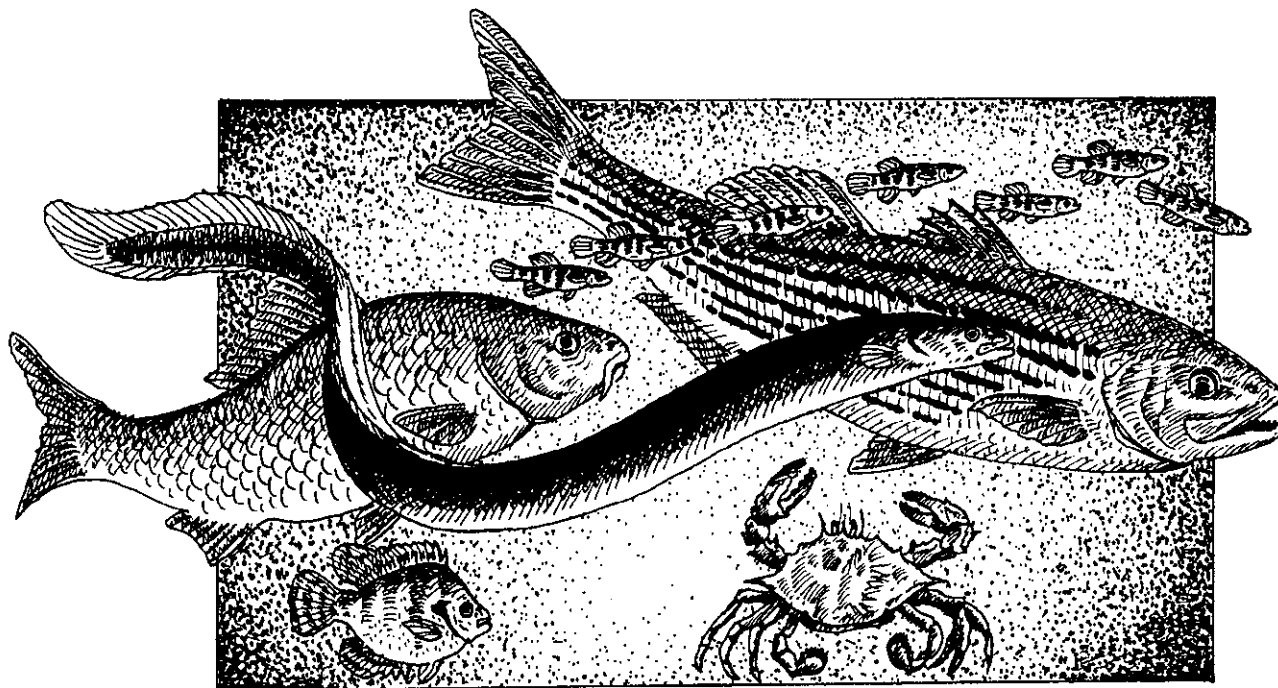
1. What new methods of transportation do you see on this map of the Newark Bay Complex compared to 1871?
2. How is this map similar to the other three maps? How is it different?
3. How has current technology dealt with landform barriers to transportation?
4. What places have been population centers since the time of the early settlers?
5. How do you think population growth affected the natural resources of the area?
6. How would you find out what type of "open space" is represented on the map?



NOTES



A CLOSER LOOK



SECTION 3 THE NEWARK BAY COMPLEX, *TEEMING WITH LIFE*

As long as people have inhabited the areas within the Newark Bay Complex, there has been a focus on the waterways and the living resources within those waterways. Fish, crabs, oysters, eels, shellfish and other aquatic animals have provided food and a livelihood for countless people. But, throughout the centuries, there has been concern about how pollution was affecting these very resources. For example, by the 1920s, the oyster industry in the New York/New Jersey Harbor Estuary was closed because of bacterial contamination from human sewage.¹

Although commercial fishing is now banned from the Newark Bay Complex waters, people continue to catch fish from these waters for sport and to supplement their diet. In 2001, the U.S. Fish and Wildlife Service estimated a total of 806,000 anglers fishing New Jersey's waters.² No matter what age you are or whether you "catch and release" or "catch and keep," the thrill of the catch is the same. But for those who catch and keep, it is important to know the waters where you fish and to be aware of state fish consumption advisories. This is particularly true of New Jersey's urban rivers and bays, where pollution has caused the water to become contaminated with toxic chemicals that are harmful to fish – and may be harmful to the people who eat them.

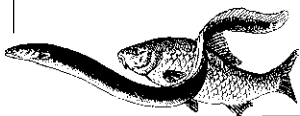


The most popular saltwater fish species sought by these anglers include fluke (summer flounder), bluefish, striped bass, sea bass, winter flounder, scup, porgy, weakfish and tautog (blackfish). From that list, bluefish and striped bass are included on the state's Fish Consumption Advisories list (Appendix A) along with white perch, American eel, blue crab and white catfish. The New Jersey Department of Environmental Protection, Division of Science, Research and Technology identified these six species as those that may contain unsafe levels of dioxins and polychlorinated biphenyls (PCBs). These man-made chemicals are classified by the U.S. Environmental Protection Agency as probable cancer-causing substances in humans.

For decades, industries and municipalities discharged wastes directly into the region's waterways. Although production and discharge of these contaminants is no longer permitted, persistent contaminants, such as PCBs and dioxins, remain in the sediments in the estuary and its tributaries. Storms and dredging continue to disturb this lower layer, and bottom-feeding organisms directly ingest the contaminants. These organisms become a food source for fish and crabs and the contaminants become accumulated in these higher order consumers in greater concentration. Despite all of this, there are thousands of people in the Newark Bay Complex who enjoy angling in its waters. In 2001, New Jersey anglers spent approximately \$841 million, and in cases where the fisheries have been managed well and resources are productive there continues to be a strong ecotourism industry.²

There are generally three categories of anglers in the Newark Bay Complex. According to Beatrice Bernzot from New Jersey Concern, the first group of anglers have traditionally fished, crabbed and eaten their catch their whole lives and their families have done the same. These people simply do not believe there is a problem with the fish because they have never gotten sick, and no one in their family is sick. The second group is those who fish and crab as part of a cultural tradition – it is a way of life for them, and the third group fish and crab to put food on the table.³ All anglers are encouraged to become familiar with the guidelines outlined in the Fish Consumption Advisories. These guidelines help anglers who eat their catch, reducing the likelihood of long-term health problems due to ingesting the contaminants found in the Advisory species. Suggestions are given as to how often one should eat these fish, who should not eat these fish (pregnant women / young children), what size the fish should be, and how to prepare the fish or crab.

The Fish Consumption Advisories are not intended to discourage anglers from fishing, but are designed to educate anglers and the general public about potential health problems associated with the regular ingestion of specific fish species. Often chemical contamination is odorless and shows no noticeable defects in the organism. The lack of any overt "problems" with an affected species makes it difficult to convince people of potential health impacts.



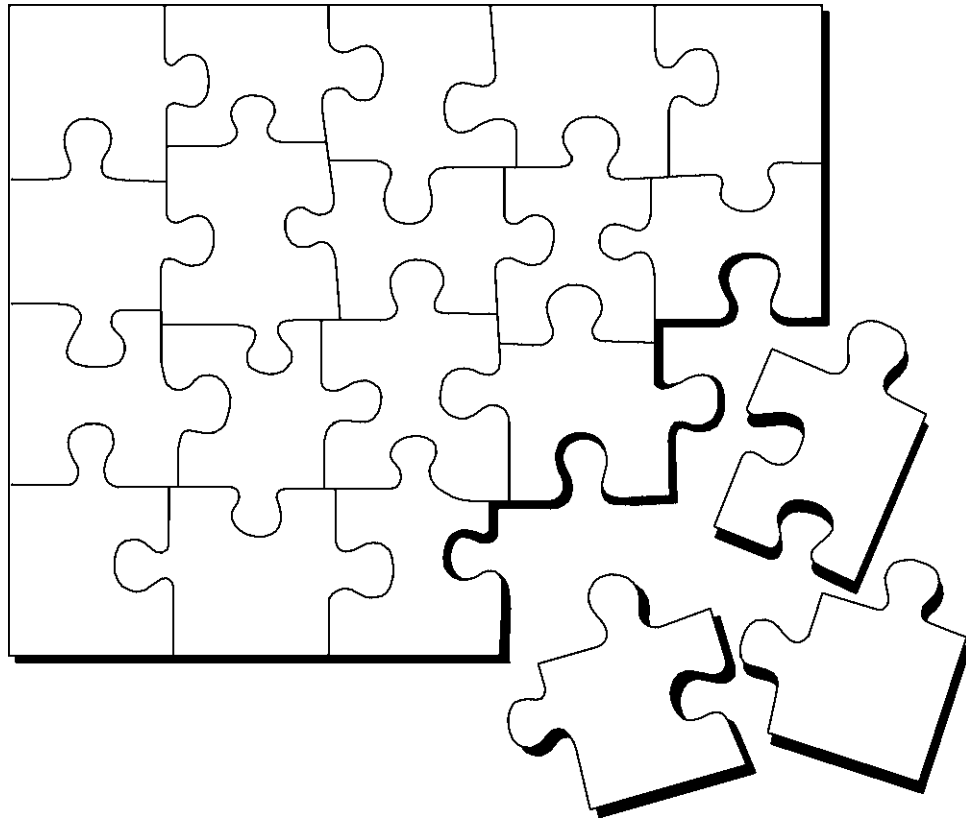
¹ NY/NJ Harbor Estuary Program newsletter.

² US Fish and Wildlife Service, 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, issued June 2002.

³ Beatrice Bernzot, director of New Jersey Concern, Linden, NJ



FISH PUZZLE RELAY



BACKGROUND INFORMATION



An animal's shape, color and markings complement its lifestyle. Coloration and markings aid in camouflage, concealment, recognition and spawning, while an animal's shape and overall manner lend insight into the animal's habits.

Most fish are dark on top and light on the belly. This combination makes it more difficult for a predator to see the fish. From above, it looks dark like the deep water and from below, it looks light like the sky.

Bottom dwelling fish and aquatic animals usually are mottled and camouflaged and look like the composition of mud or sand on which they live. Vegetation dwellers tend to be striped or splotched, which makes them blend in with dappled sunlight. Most open-water fish are more white and silver and reflect the shimmering water. Bright colors may benefit fish in finding mates and be a signal of danger to predators.



LEVEL

4 and 5

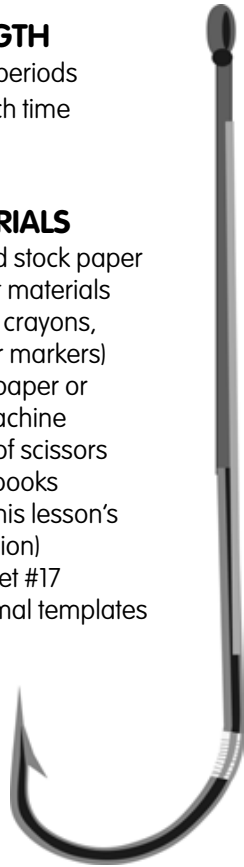
LENGTH

2 class periods
research time



MATERIALS

- o oaktag or card stock paper
- o a variety of art materials (suggestions: crayons, paints, and/or markers)
- o clear contact paper or laminating machine
- o several pairs of scissors
- o identification books (listed under this lesson's reference section)
- o Discovery Sheet #17
- o estuarine animal templates (Figures 11B-I)



OVERVIEW

Awareness of an aquatic animal's characteristics leads to an understanding of the animal's identification, behavior, and habitat.

OBJECTIVES

Students will:



Identify various species of estuarine creatures;



Identify the Fish Advisory species;



Describe how colors and patterns help animals survive in their habitat.



ADVISORY LINK

Each species of estuarine animal is identifiable by looking at the animal's shape, color, markings, and the habitat in which it is found. Recreational anglers should learn to recognize the species that are listed in the Fish Consumption Advisories because the consumption of these species may pose potential health risks.

KEYWORDS

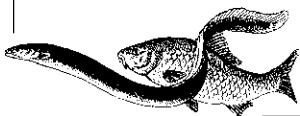
adaptation
camouflage
estuary

STUDENT PREREQUISITES

None

PROCESS SKILLS

observing
formulating hypotheses
communicating
analyzing
categorizing
synthesizing



PLANNING



1. Assemble the art materials and identification books.
2. Copy estuarine animal templates (Figures 11B-K) onto oaktag or card stock. Make enough for each student to have one.
3. Color, identify, laminate and cut at least two extra animal puzzles (or have a student do this for you).
4. Determine a site for a relay race.

PROCEDURE SETTING THE STAGE

Ask the students where they have been or what they have been doing to see different kinds of fish [*aquarium, zoo, lake, estuary, photographs, books, television, snorkeling, glass bottom boat*]. Have various students describe some of the fish they have seen. Write these descriptions on the board. Have the students explain why the listed species have different descriptions.

THE ACTION



Period 1

1. Write the names of the animals (Figure 11A) on the board. Have each student select one animal.
2. Provide students with reference materials or allow them time to go to the library to research their animals and complete Discovery Sheet #17. This research will allow them to become an "expert" on their species.
3. Distribute an oaktag outline of their animal for students to color.
4. Have the students cut out the drawings and on the back of each have the student write his/her name, the name of the animal, and the animal's habitat.
5. Laminate the drawings or have the students cover each with clear contact paper.
6. Cut the drawing into four jigsaw pieces. Set one piece from each puzzle aside in a pile and mix the rest of the pieces together.

Period 2

1. Divide the class into three teams to play a puzzle relay race.
2. Give each student one puzzle piece that is not his/her own. Place the remaining pieces (face-up) at the other end of the gym or field. *NOTE: Include your extra puzzle pieces to make it more challenging for the last few students to find their own pieces.
3. Explain the rules:
 - On your signal, the first student from each team runs to the other pieces and collects one piece that fits his or her puzzle.
 - The student runs back, tags the next student, then goes to the end of the line.
4. Continue play until one team finishes and sits down.
5. Have each student hold up his/her completed puzzle and give the name of the animal, the information from the back of the puzzle and hypothesize why the animal is colored or patterned the way it is.



CLOSING DISCUSSION

1. What characteristics (physical adaptations) do bottom dwellers have in common?
[dark on top, light on the bottom, brown and gray colors, mottling] vegetation dwellers? [stripes and splotches to simulate shadows and sun dappling] open water fish? [silver and white colors]
2. How do you think these variations help the animals? *[create camouflage, help in breeding, help predators catch their prey.]*
3. Which of these animals have you seen and in what circumstances?

EXTENSION ESTUARY GO-FISH

Cover the back of each puzzle to hide the written information. Mix all the puzzle pieces together and turn them upside down in a pile. Have each student in the small group draw five pieces. The rest of the pieces remain in a center pile. Have the students take turns asking other players for the pieces that they need or by drawing from the center pile. Needs should be based on describing the colors and patterns. If another player provides a possible puzzle piece, the asker gets to see if it fits. If it does, the asker gets to keep it to work on finishing the puzzle that, upon completion, is laid down on the table and identified. If it does not fit, the card can be kept or placed in the discard pile. The first player to use up all their cards is the winner.

FIGURE 11A

ESTUARINE CREATURES OF THE NEWARK BAY COMPLEX

BOTTOM DWELLERS

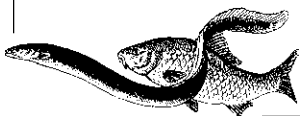
Blue Crab
White Catfish
American Eel
Winter Flounder
Fluke (Summer Flounder)

OPEN WATER FISH

Bluefish
White Perch
Striped Bass
Weakfish

VEGETATION DWELLERS

Killifish
Tautog (Blackfish) - juveniles only



ASSESSMENT STRATEGIES

Have the students:

- ❑ Demonstrate recognition of the listed species by using the puzzles as flashcards to quiz each other. (Use velcro on the back of each piece and affix to material-covered poster board.) Work in small groups to create a section of a wall mural that depicts how the animals use their adaptations to survive in the estuary ecosystem. Highlight the Fish Advisory species on the mural.

STAYING INVOLVED



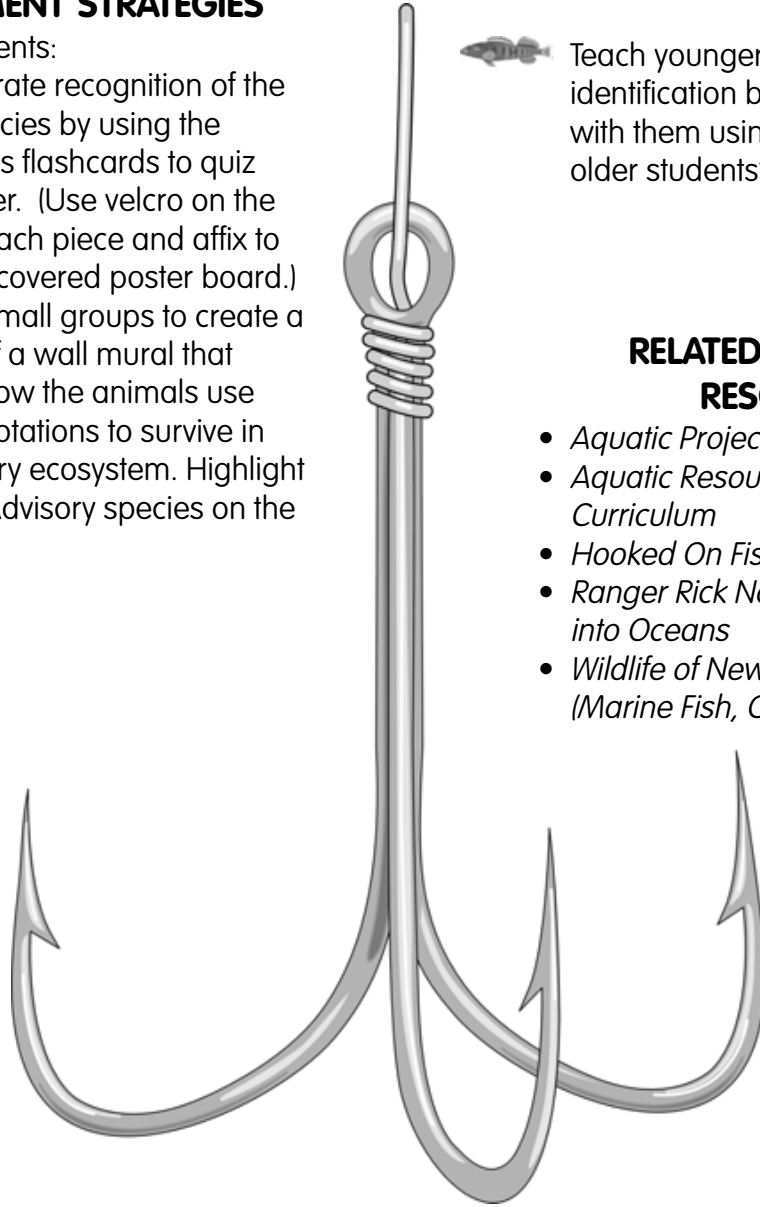
Display the students' mural (mentioned in assessment strategies) in a public place along with information about the Fish Consumption Advisories.



Teach younger children fish identification by playing the game with them using the older students' puzzles.

RELATED EDUCATION RESOURCES

- *Aquatic Project WILD*
- *Aquatic Resources Education Curriculum*
- *Hooked On Fishing - Not On Drugs*
- *Ranger Rick NatureScope - Diving into Oceans*
- *Wildlife of New Jersey Posters (Marine Fish, General Marine Life)*



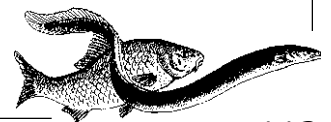
REFERENCE

AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.

McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*. Henry Holt and Company, New York. 1974.

New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*. Sandy Hook, NJ. 1987.

Robins, Ray, and Douglass. *Peterson Field Guides - Atlantic Coast Fishes*. Houghton Mifflin Company, Boston. 1986.



COLORS & PATTERNS OF ESTUARINE ANIMALS IN THE NEWARK BAY COMPLEX

Discovery Sheet #17

Name: _____ Date: _____

ANIMAL'S NAME:

Complete the following using reference materials in the library, on the Internet, or from books in your classroom.

1. Describe the animal's habitat:
2. Draw and describe the animal's life cycle:
3. Describe the animal's colors and patterns:
4. Give reasons why you think the animal is colored or patterned the way it is.

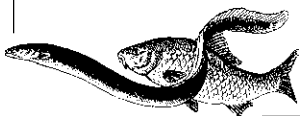


Figure 11B
FLOUNDER

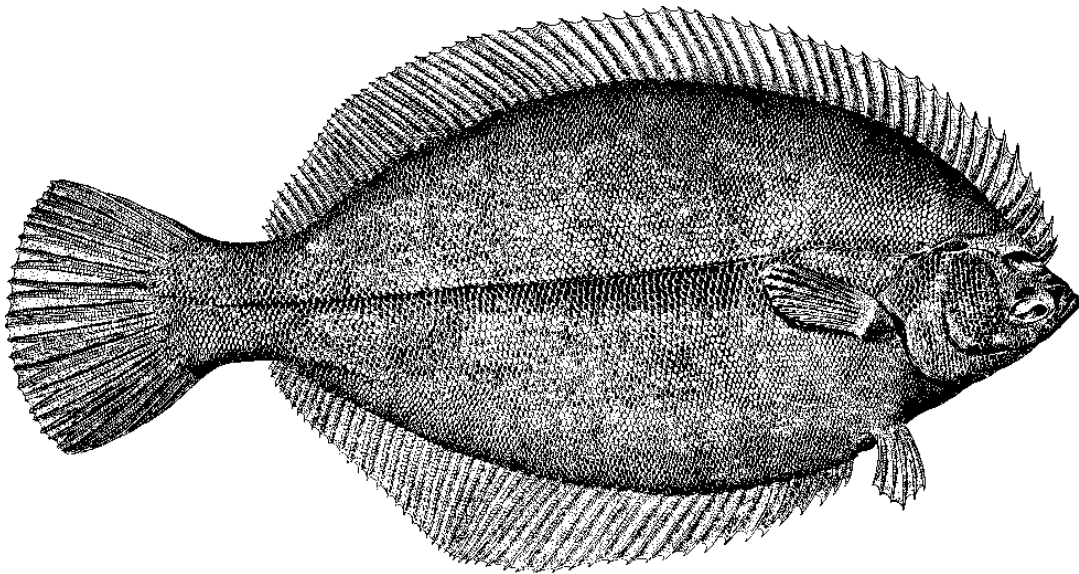


Figure 11C
STRIPED BASS

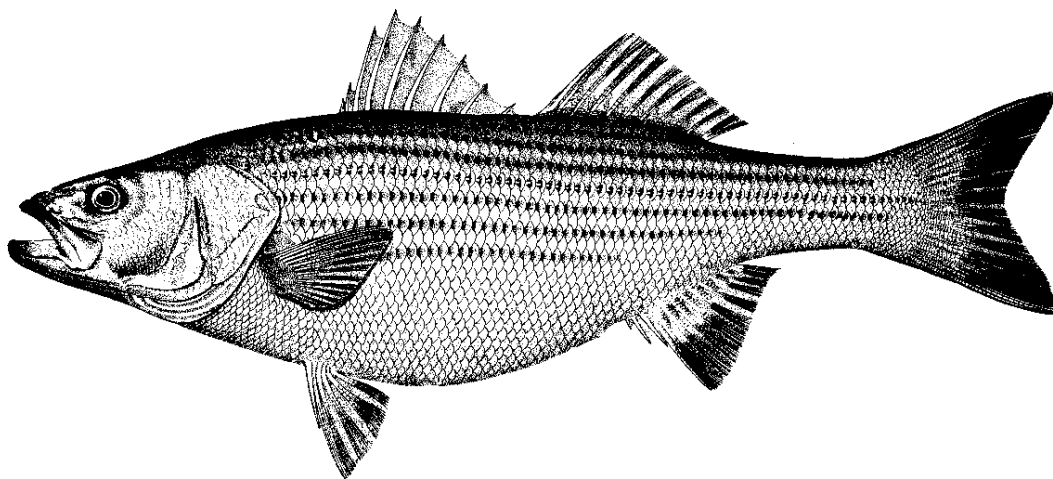


Figure 11D
BLUE CRAB

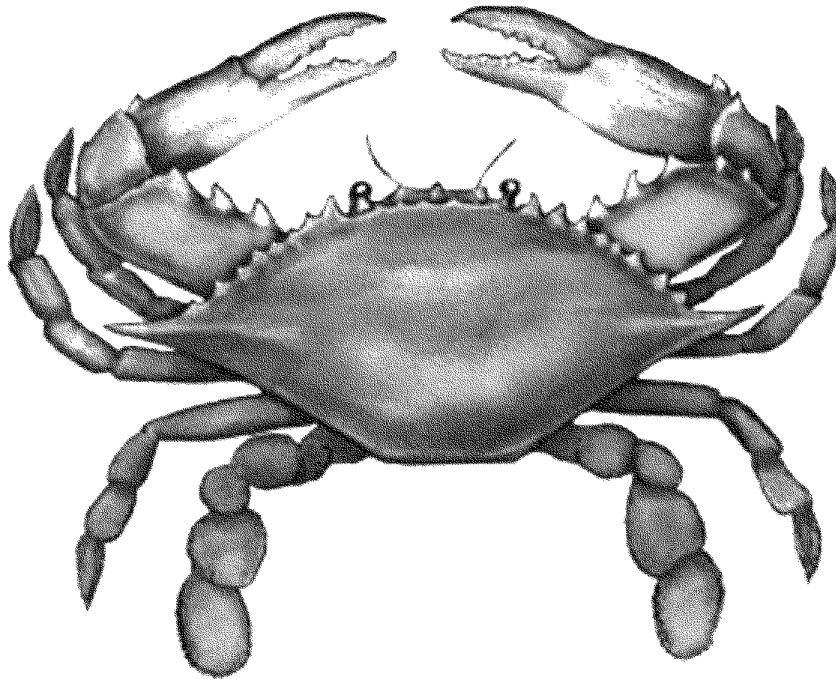


Figure 11E
KILLIFISH

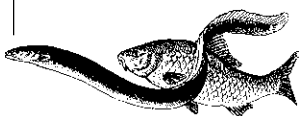
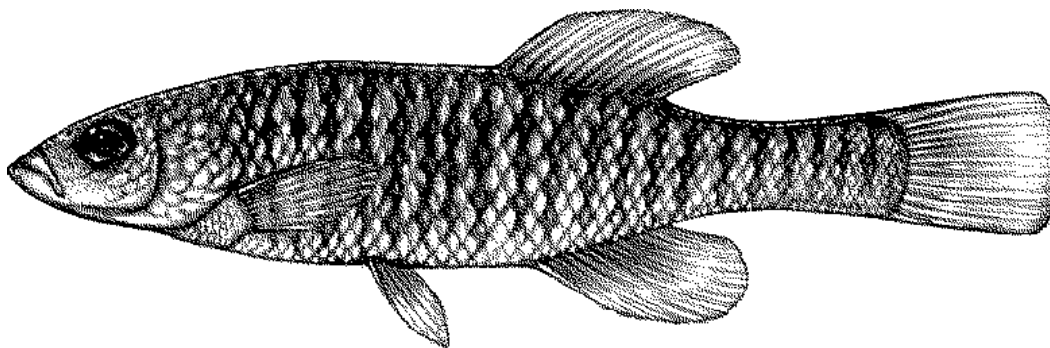


Figure 11F
WHITE PERCH

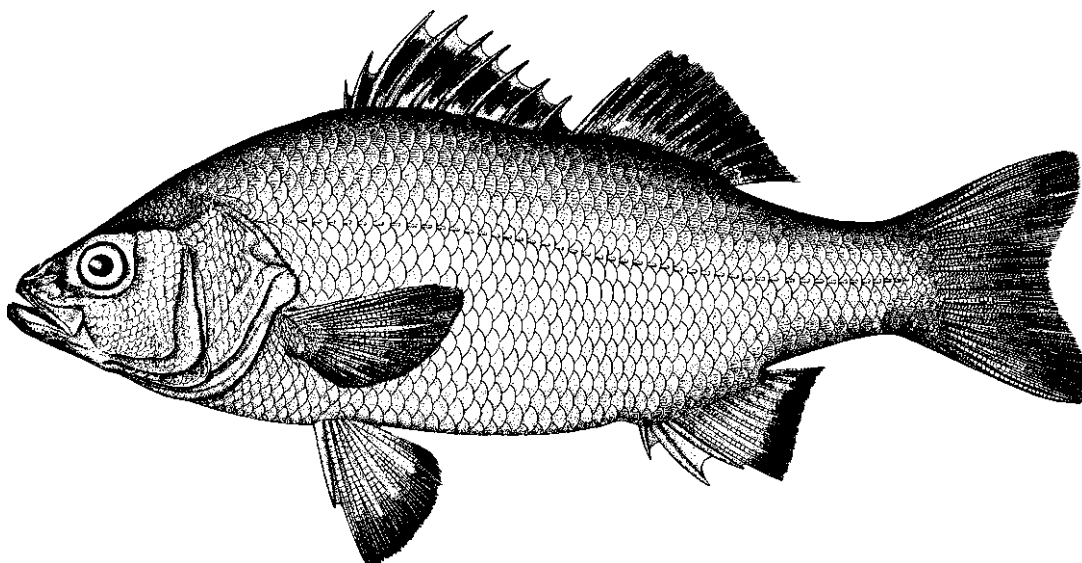


Figure 11G
BLUEFISH

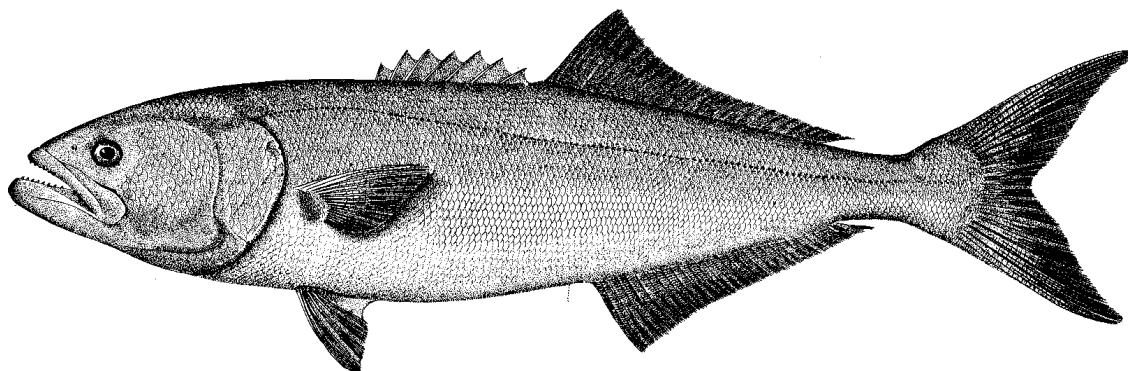


Figure 11H
WEAKFISH

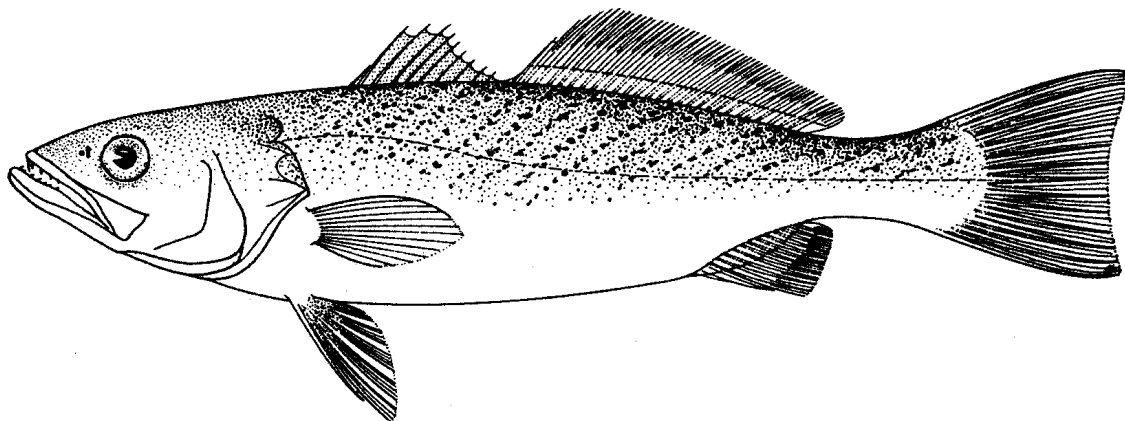
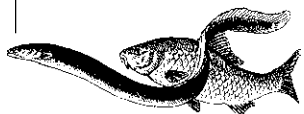
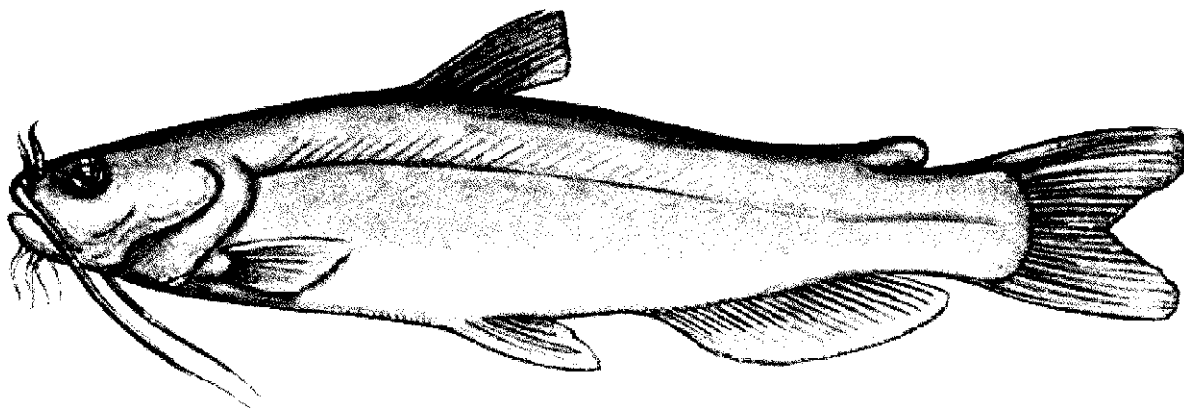
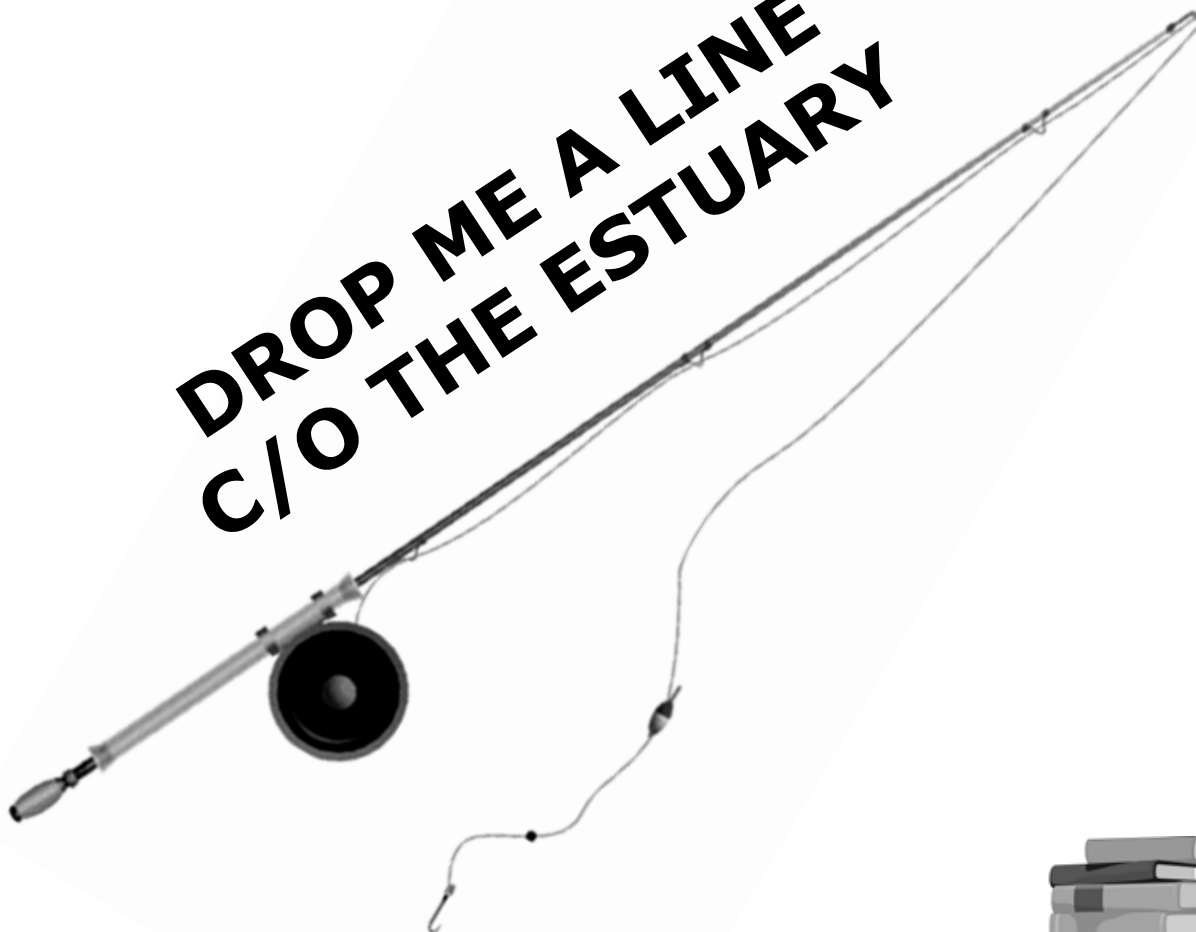


Figure 11I
WHITE CATFISH



DROP ME A LINE C/O THE ESTUARY

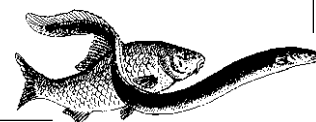


BACKGROUND INFORMATION

Recreational fishing has been documented back to medieval times. It differs from subsistence fishing and commercial fishing in that it is done primarily as a hobby and pastime activity. In recent years, recreational fishing has evolved into an extremely popular hobby upon which anglers spend billions of dollars annually.

In support of this sport/hobby, anglers buy equipment, boats, motors, clothing, books, videos and bait; they hire guides and pay for fees and licenses; they buy food, stay in motels, and pay for all the associated travel expenses for fishing trips.

Each angler has his or her preferred method of catching fish, and the choice of equipment depends on the species of fish sought. Equipment and fishing techniques can vary from simply standing on the side of a water body with a handline, hook and bait, to chartering expensive boats and using specialty rods. Many recreational anglers opt to employ a catch and release technique that allows them to continue enjoying the thrill of the sport, while ensuring that the fish are returned to their environment. See "Catch and Release Fishing", page 162.



LEVEL

Grades 4 to 8

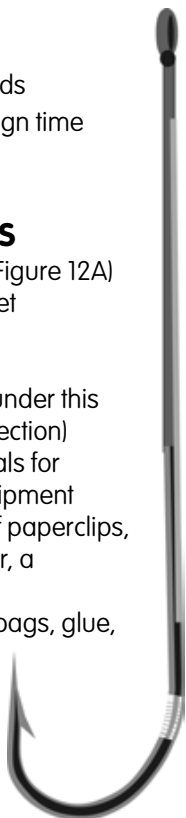
LENGTH

3 class periods
research and design time



MATERIALS

- o Species Fact sheet (Figure 12A)
- o Equipment Fact sheet (Figure 12B)
- o resource materials (suggestions listed under this lesson's reference section)
- o variety of art materials for creating fishing equipment (ball of string, box of paperclips, pipe cleaners, paper, a selection of dowels, cheesecloth, onion bags, glue, tape, etc.)



OVERVIEW

People have invented and have used many different devices for catching fish and other aquatic animals.

OBJECTIVES

Students will:



Identify food preferences for specific aquatic species;



Devise methods and equipment for catching a specific aquatic animal;



Assess and evaluate invented fishing equipment for safety and practicality;



Discuss different motives that anglers have for catching fish.



ADVISORY LINK

There is heavy use of the Newark Bay Complex by recreational anglers. The Fish Consumption Advisories act as guidelines to promote the safe consumption of various species that may be affected by contaminants in the estuary. According to the Advisories, some species should not be consumed at all. However, anglers can still enjoy fishing by participating in "catch and release," a strategy that returns the animal to its environment.

KEYWORDS

angling
catch and release
commercial fishing
recreational fishing
subsistence fishing

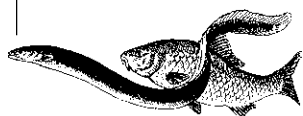
STUDENT PREREQUISITES

An understanding of the aquatic food chain
General knowledge of the estuary's habitats

PROCESS SKILLS

communicating
measuring
categorizing
comparing and contrasting

interpreting data
analyzing
synthesizing
evaluating



PLANNING



1. Write the names of the animals (from Figure 12A) on the board or a separate sheet of large paper for display. (Note: The additional information on the sheet is for teacher use, not to distribute to the students.)
2. Duplicate one Equipment Fact sheet (Figure 12B) for each student.
3. Amass art materials.
4. Make arrangements to have an angler come to the class to give a short talk on local fish.

PROCEDURE SETTING THE STAGE

Poll the class to discover how many students have gone fishing or have seen people fish. Ask the students to describe what they saw, the place where they fished, what they caught, the equipment they used, and the bait they used.

THE ACTION

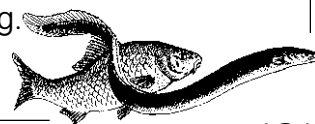


Period 1

1. Say to the students, "In the forest we see animals find food at different layers – some will find it on the ground, others on plants, and still others in the trees." Describe the layers in an aquatic habitat. What types of food are there for aquatic animals to eat? [*lotter fish, worms, insect larvae, detritus, vegetation, crustaceans*]. Where might the animals find this food? [*on the surface, among the rocks, in the mud, at different depths*]
2. Ask students to describe the kinds of food given to a variety of domestic pets. Discuss why we feed different pets different types of food. [*Each animal is attracted by different food.*]
3. If animals on land have different food preferences, what do you think about aquatic animals? Ask the students to describe types of fish bait and how they know which bait catches which fish. [*from experience, books, videos, talking to anglers, etc.*]
4. Have pairs of students select a species from the list (from Figure 12A).
5. Tell the students to use independent research time (at home, in the library, etc.) to find out about their animals' habits, habitat and food preferences. If possible, invite an angler to the classroom to help the children with this portion of the activity.

Period 2

1. Discuss the difference between catching an animal out of need (includes subsistence fishing and commercial fishing) and catching one for sport. Describe the terms subsistence fishing, recreational fishing and commercial fishing. Discuss the needs being met by each practice (Subsistence – feed self and family, Recreational – relaxation, testing skill, enjoyment, Commercial – to earn a living).
2. Ask the students, "Which of the three types of anglers needs to keep the fish? [*subsistence and commercial*]. If the angler doesn't have to keep the fish for food, what other options does he or she have to do with it? [*Mount the fish for trophy, return it to the water, or share it with other people.*]. Introduce the phrase "catch and release." Discuss the advantages and disadvantages of this technique of fishing. (See page 162.)



3. Using the materials provided, ask each pair of students to devise a method and equipment to catch the animal they have researched. Note that their design should take into consideration the following attributes: type of food the animal prefers and what that food item looks like, habitat in which one would find the animal (e.g. deep water vs. shallow marsh), whether the method focuses on bait or lures, what particular safety features should be in place on the equipment. Also note that each pair will be expected to share the method and equipment with the rest of the class.
4. Tell the students that their presentation will be critiqued on the following items:
 - The equipment and method – feasibility, ease of design, creativity, safety.
 - The presentation – clarity, degree of involvement by participants, use of visuals, ability to answer questions posed by the audience.

Period 3

Have each pair of students demonstrate their fishing equipment and method. Share with students the Equipment Fact Sheet (Figure 12B) for them to compare their method/equipment to what is already being used.

ASSESSMENT STRATEGIES

Have the students:

- ☐ Redesign their equipment based on their observations and class discussion about other types of equipment and safety.

STAYING INVOLVED



Generate a list of local sites for fishing as well as bait and tackle shops and places to obtain licenses. Plot these (and the extent of the advisories) on a map of the town or county. Have the students research how to get there and what restrictions might apply before fishing any of these sites.

EXTENSIONS



Write about a fishing experience or make up a story about “the one that got away.”



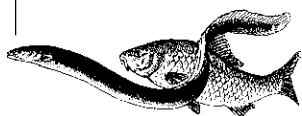
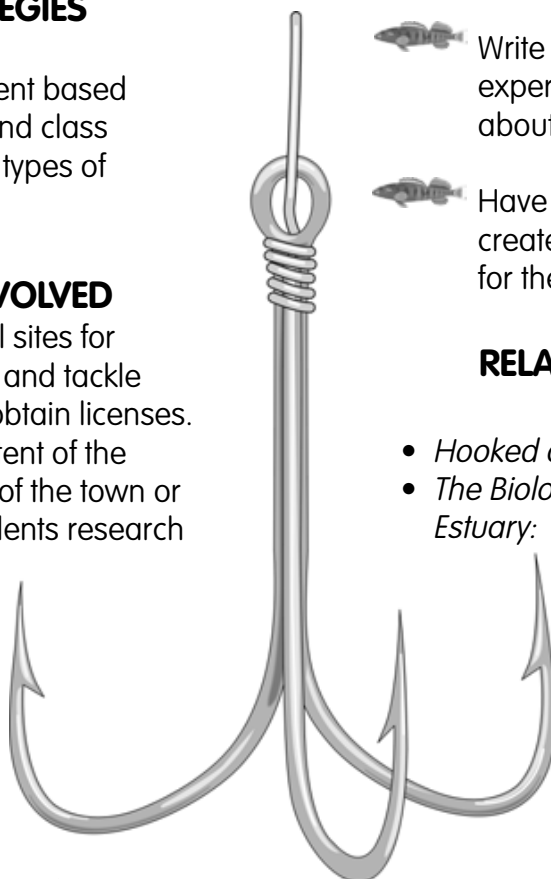
Have each pair of students create a sales advertisement for the equipment.

RELATED EDUCATION RESOURCES

- *Hooked on Fishing - Not on Drugs*
- *The Biology of the Hudson-Raritan Estuary: A Teacher's Guide*

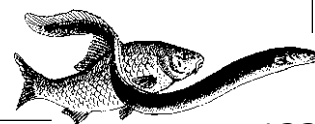
REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*. Henry Holt and Company, New York. 1974.
- New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*. Sandy Hook, NJ. 1987.



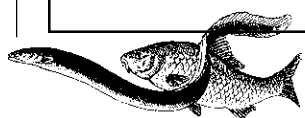
SPECIES FACT SHEET

SPECIES	WHERE CAUGHT	HOW CAUGHT	BAIT
BLUE CRAB	Tidal Creeks and Bays	Handline, Scoop Net, Various Traps	Fish Chicken Chunks
BLUEFISH	Inlets, Bays, Surf, Ocean	Trolling, Jigging, Casting, Fly Fishing	Lures, Crabs, Bait Fish, Artificial Flies
STRIPED BASS	Bays, Rivers, Surf, Ocean	Trolling, Casting, Fly Fishing	Lures, Crabs, Squid, Herring, Eel, Artificial Flies
WHITE PERCH	Bays, Brackish Rivers	Trolling, Casting, Fly Fishing	Minnows, Grass Shrimp, Spinnerflies, Lures
AMERICAN EEL	Bays, Brackish Rivers	Bottom Fishing	Most Baits - Crabs, Squid, Minnows, Grass Shrimp
WHITE CATFISH	Rivers, Streams, Lakes, Brackish Backwaters	Bottom Fishing	Worms, Minnows, Crayfish
WINTER FLOUNDER	Mud Flats in Bays	Still Fishing or Drift Fishing	Sea Worms, Clams, Mussels
BLACKFISH /TAUTOG	Among Rocks, Vegetation, Wrecks	Still Fishing	Crabs, Mussels, Bloodworms, Clams



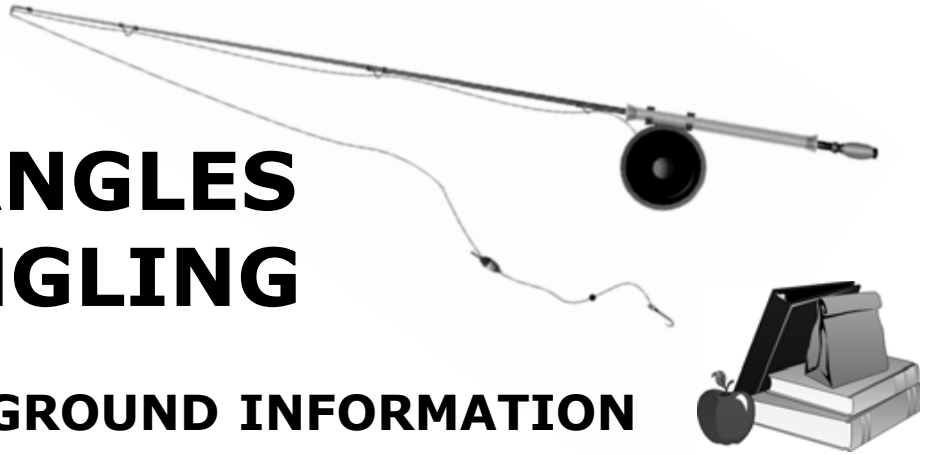
EQUIPMENT FACT SHEET

METHOD	EQUIPMENT	LOCATION	TECHNIQUE
STILL FISHING	Hand Line, Rod and Reel, Weighted Line	Fishing from a fixed site like the shoreline, a pier, a bridge, or an anchored boat	Keep bait still in the water or resting on the bottom until the fish bites
DRIFT FISHING	Weighted or Unweighted Line	Fish from a drifting boat	Trail the line behind a slow-moving boat
JIGGING	Line with a lure called a jig	Fish from a fixed site like a boat, a pier, or from the shoreline	Move the line up and down with a jerking motion
NETS	Scoop Net, Long Handled Net	Fish from the shoreline or from a boat	Scoop or skim the bottom with a net
TRAPS	Trap	Fish from a bridge or from a boat	Lower a trap with bait into the water and wait
TROLLING	Live Bait or Lure	Fish from behind a moving boat or from a bridge or pier	Tow a baited line
FLY FISHING	Fly Rod and Reel	Fish from the shoreline, a pier, a bridge, or a boat	Cast a "fly" on a line
SURF CASTING	Rod and Reel	Fish from the shoreline in the ocean's surf	Cast a baited line into the surf



THE ANGLES OF ANGLING

BACKGROUND INFORMATION



The sport of fishing has evolved over the years to reflect countless methods and equipment for catching fish. There are ample opportunities and sophisticated equipment for anglers to pursue their sport, but they must adhere to the restrictions that apply to many species.

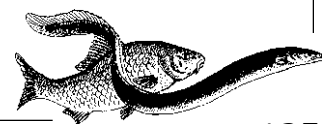
Fishery managers, such as federal and state fish and wildlife agencies, establish size limits, number limitations (bag limits) and seasonal closures. They also are involved in studying the health of the aquatic environment and how it reflects on the safe consumption of certain species. It is important that anglers are familiar with both the regulations about keeping fish as well as the guidelines on consuming fish or crabs that may contain concentrated levels of contaminants.

Size and bag limits are used to protect the spawning populations of a particular species. Size limits designate standards for keeping fish of a certain length or weight, whereas bag limits apply to the number of individual fish of a given species an angler may take at a given time. Other management tools include establishing seasons during which species can be taken and dictating the type and size of the fishing tackle permitted. These types of management strategies relieve pressure on

the animal species during a particular part of the year. During spawning season, when animals are under environmental and biological stress (such as cold water making a species sluggish and easier to catch), or when the estimated number of a species is in short supply, the population of the species needs to be protected.

Health advisories, like the ones outlined in "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" (Appendix A) were developed for species that accumulate contaminants from the environment into their fatty tissue. These guidelines suggest ways to minimize a person's exposure to potentially harmful contaminants like dioxins, PCBs, chlordane and mercury. They also recommend a maximum number of individual animals of a species that can be consumed by a person during a given time period, and include details on proper cleaning, skinning and trimming before consumption.

All of these restrictions are based on the assumption that the angler will catch and keep a particular fish. Many anglers adhere to the "catch and release" technique, which promotes the sport of fishing, but returns the fish to its habitat.



LEVEL

4 to 6

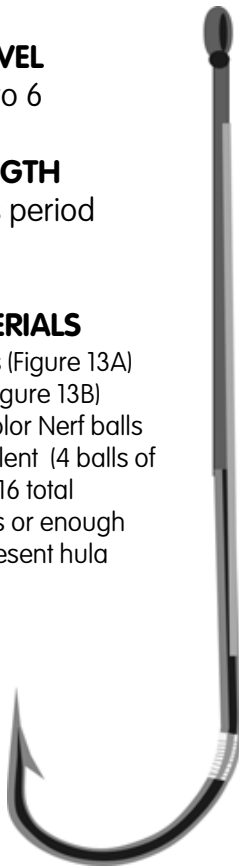
LENGTH

1 class period



MATERIALS

- o Angler cards (Figure 13A)
- o Fish cards (Figure 13B)
- o 4 different color Nerf balls or the equivalent (4 balls of each color) - 16 total
- o 4 hula hoops or enough string to represent hula hoop size



OVERVIEW

Students learn that fishing practices and methods are regulated for human health and conservation of resources.

OBJECTIVES

Students will:



Describe various methods of angling and the type of fish caught by each;



Explain the guidelines and restrictions that apply to catching fish and why they are in effect.



ADVISORY LINK

Fish and other aquatic animals that live in the waters of the Newark Bay Complex are caught using a variety of methods and according to specific regulations imposed by state and federal wildlife agencies. There are additional guidelines in place for the species listed in the Fish Consumption Advisories to warn anglers of the presence of possible cancer-causing contaminants in these animals' fatty tissue.

KEYWORDS

angler

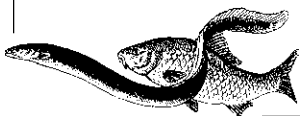
Fish Consumption Advisories

STUDENT PREREQUISITES

Basic knowledge of fishing methods

PROCESS SKILLS

communicating
analyzing
observing
formulating hypotheses
interpreting data



PLANNING



1. Make 1 copy each of Figures 13A and 13B.
2. Cut, mount and laminate the cards.
3. Obtain the Nerf balls (or an equivalent)
4. and the hula hoops (string, cones, etc.) that will designate "pails."
Set up the playing field as in Figure 13C.

PROCEDURE SETTING THE STAGE

Ask the students to describe what types of fishing (angling) they have heard about, seen people do, or have done themselves. Discuss why certain methods may be preferred over others.

THE ACTION

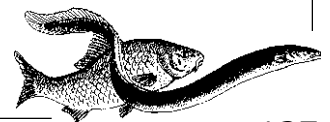


Period 1

1. Select four students to represent the anglers. Give each an angling card and four of the same color Nerf balls.
2. Distribute a fish card (Figure 13B) to each remaining student.
3. Explain that the information on the fish card tells what method of angling can be used to catch the fish, in what season the animal can be caught and any other restrictions that are placed on the species. Note: Fishing restrictions reflect those for children and high-risk individuals.
4. Explain the rules:
 - a. Students with fish cards must move around within the boundaries of the playing field (*water of the Newark Bay Complex*).
 - b. Anglers try to "catch" a fish by tossing the Nerf ball at a student holding a fish card. When a student is tagged, he/she must go to that angler and read the card with the angler to determine if the angler's method can catch the fish. If yes, the student must stand inside the area designated as the "pail." If not, the student goes back onto the field to continue play.
 - c. When anglers have used up their four Nerf balls (regardless of whether they have caught a fish or not) they must sit down in their spot.
 - d. Play the first round until all anglers are sitting down.
5. Continue the play by allowing the students to switch roles.

CLOSING DISCUSSION

1. What types of fish did each angling method catch?
2. Which fish were left in the water? Why? [*size restrictions, location restrictions, luck, good maneuvering*]
3. What would happen if the number of anglers was increased? [*anglers may not catch any fish because of competition or restrictions, more fish might be taken*]
4. What types of restrictions did the anglers encounter? [*seasonal, number of fish allowed, length of fish, weight of fish, health restrictions*] Discuss how these reflect real restrictions.
5. Why do you think regulations were developed to restrict catching certain species? [*to keep a species from being fished out, to keep a population stable enough for successful reproduction, to minimize the amounts of toxins that one person can ingest*]



ASSESSMENT STRATEGIES

Have the students:

- ☐ Describe their strategies as anglers (for catching fish) or as fish (from being caught by an angler).
- ☐ Have the students create a written version of what happened to them during the game.

STAYING INVOLVED



Interview an angler that uses one or more of the methods from the game and report back to the class about how it is done.



Accompany an angler to learn how to fish.

EXTENSIONS



Have the students redesign the game to include a "catch-and-release" component.



Have students research different species and introduce more types of fish into the game.



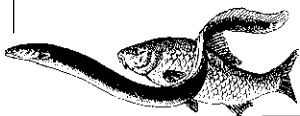
Play the game to reflect some "high risk" anglers as explained in the Fish Consumption Advisories (see Appendix A, page 169).

RELATED EDUCATION RESOURCES

- *Hooked on Fishing - Not on Drugs*
- *Future Fisherman Foundation. Aquatic Resources Education Curriculum.*

REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Marine Fisheries Administration. "Salt Water Fishing in New Jersey."
- _____. "Marine Recreational Fishing Seasons, Possession & Minimum Size Limits." 1996.
- New Jersey Department of Environmental Protection, Division of Science, Research and Technology. "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters." 2004 edition. (Appendix A)
- McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*, Henry Holt and Company, New York. 1974.
- New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*, Sandy Hook, NJ. 1987.



ANGLER CARDS

Angler 1 (A1)

Hook and Line
DEEP WATER in a Bay, Inlet or Offshore
From a Boat

Angler 2 (A2)

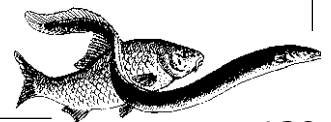
Hook and Line
SHALLOW WATER
From a Boat, Fishing Pier or From the Edge

Angler 3 (A3)

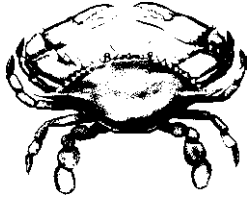
TRAP or NET
From a Bridge or Fishing Pier

Angler 4 (A4)

Hook and Line
SURF CASTING
From the Shoreline



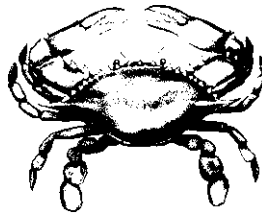
FISH CARDS

BLUE CRAB (Adult)

Angler's Method - Hook and line in shallow water

Season - March 15 through November

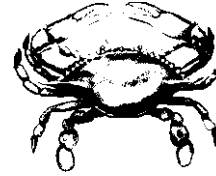
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUE CRAB (Adult)

Angler's Method - Trap

Season - March 15 through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUE CRAB (Shedder - soft shell)

Angler's Method - Net

Season - March 15 through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (5 pounds)

Angler's Method - Hook and line in deep water

Season - May through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (8 pounds)

Angler's Method - Surf casting

Season - May through November

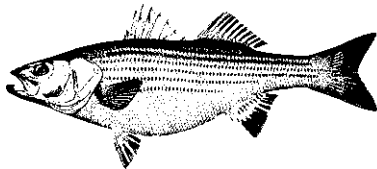
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (15 pounds)

Angler's Method - Hook and line from the surf

Season - May through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (36 inches)

Angler's Method - Hook and line from the surf

Season - March through December

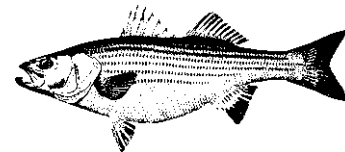
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (18 inches)

Angler's Method - Hook and line in shallow water

Season - March through December

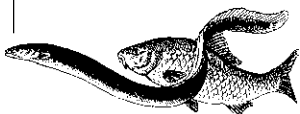
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (30 inches)

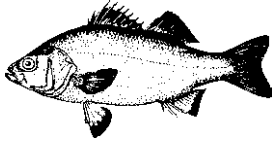
Angler's Method - Hook and line in shallow water

Season - March through December

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.



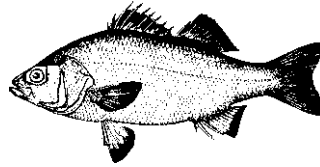
FISH CARDS

WHITE PERCH (1 pound)

Angler's Method - Hook and line in shallow water

Season - All Year

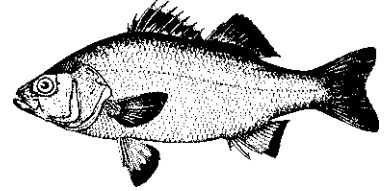
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE PERCH (½ pound)

Angler's Method - Hook and line in shallow water

Season - All Year

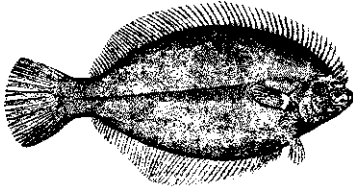
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE PERCH (2½ pounds)

Angler's Method - Hook and line in shallow water

Season - All Year

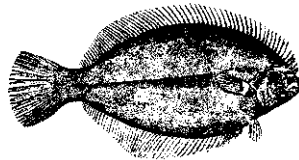
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WINTER FLOUNDER (13 inches)

Angler's Method - Hook and line in shallow water

Season - March through May; September 15 through December

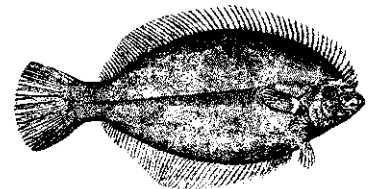
Restrictions - Must be more than 11 inches long to keep.

WINTER FLOUNDER (9 inches)

Angler's Method - Net

Season - March through May; September 15 through December

Restrictions - Must be more than 11 inches long to keep.

WINTER FLOUNDER (12 inches)

Angler's Method - Hook and line in shallow water

Season - March through May; September 15 through December

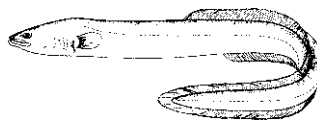
Restrictions - Must be more than 11 inches long to keep.

AMERICAN EEL (14 inches)

Angler's Method - Trap

Season - April through October

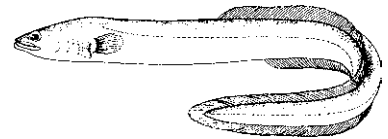
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

AMERICAN EEL (20 inches)

Angler's Method - Net

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

AMERICAN EEL (28 inches)

Angler's Method - Trap

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.



FISH CARDS

WHITE CATFISH (3 pounds)

Angler's Method - Hook and line in shallow water

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE CATFISH (4 pounds)

Angler's Method - Hook and line in shallow water

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE CATFISH (1 pound)

Angler's Method - Net

Season - April through October

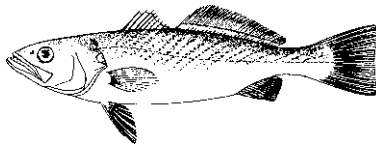
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WEAKFISH (10 inches)

Angler's Method - Hook and line in the surf

Season - All Year

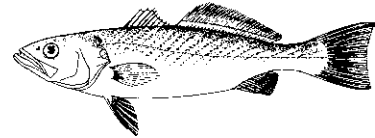
Restrictions - Must be at least 13 inches long to keep.

WEAKFISH (16 inches)

Angler's Method - Hook and line in shallow water

Season - All Year

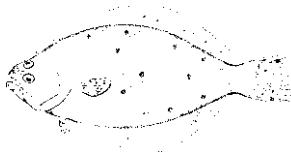
Restrictions - Must be at least 13 inches long to keep.

WEAKFISH (15 inches)

Angler's Method - Hook and line in deep water

Season - All Year

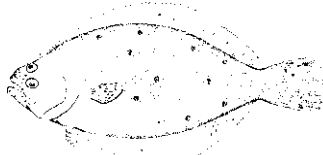
Restrictions - Must be at least 13 inches long to keep.

FLUKE (Summer Flounder) (12 inches)

Angler's Method - Hook and line in shallow water

Season - May through Mid-October

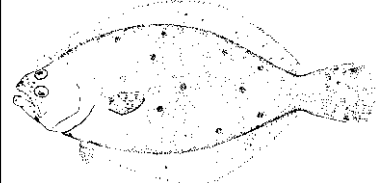
Restrictions - Must be at least 16½ inches long to keep.

FLUKE (Summer Flounder) (17 inches)

Angler's Method - Hook and line in the surf

Season - May through Mid-October

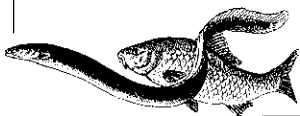
Restrictions - Must be at least 16½ inches long to keep.

FLUKE (Summer Flounder) (20 inches)

Angler's Method - Hook and line in deep water

Season - May through Mid-October

Restrictions - Must be at least 16½ inches long to keep.



FISH CARDS

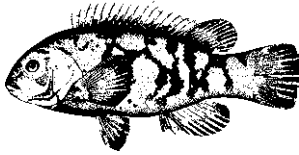
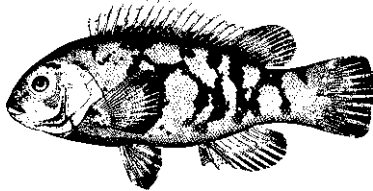
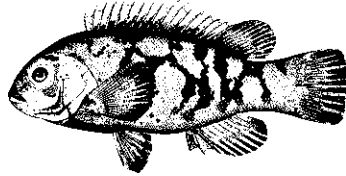
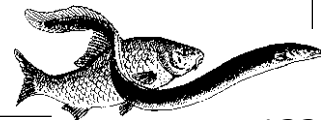
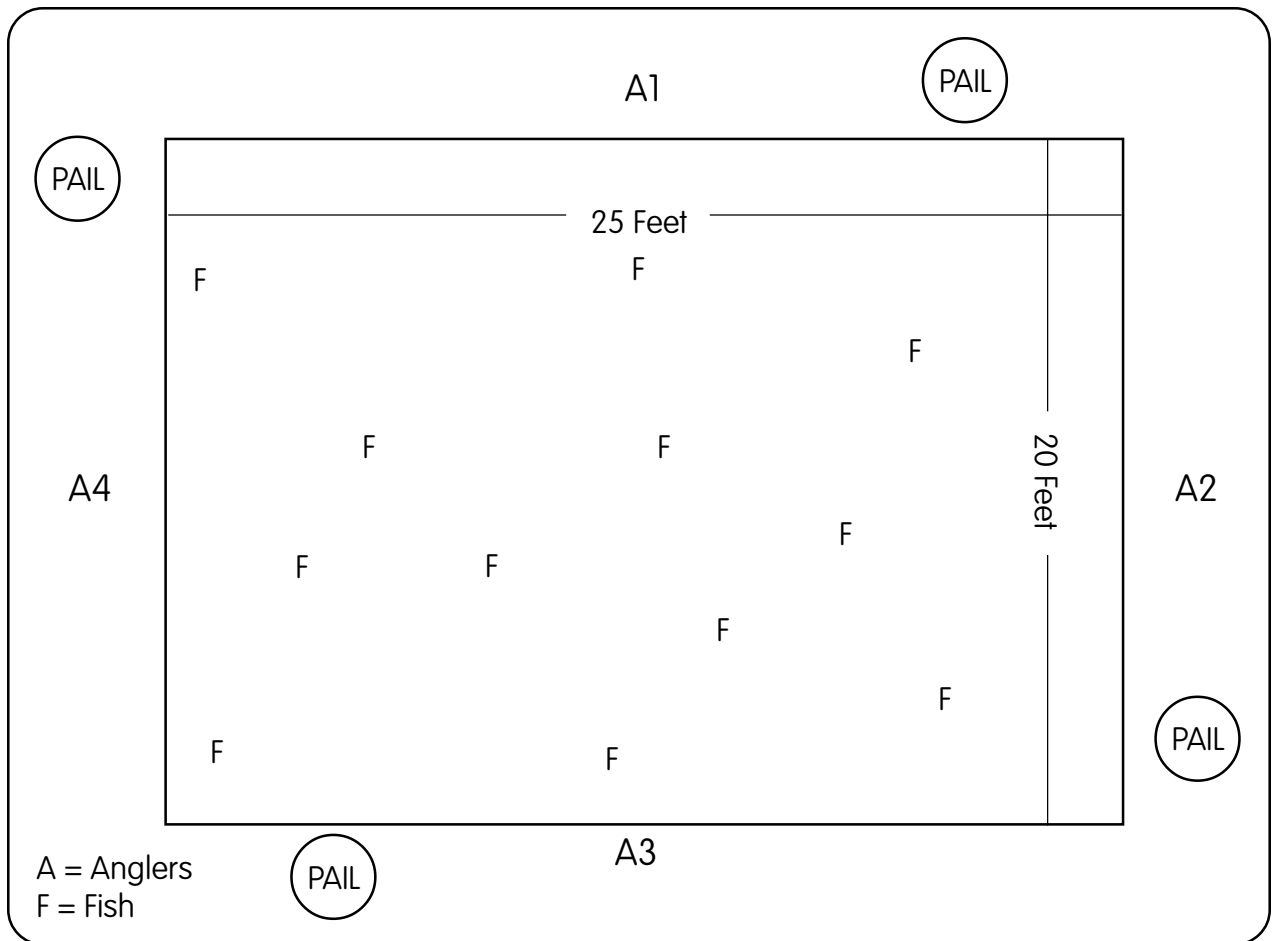
<p>TAUTOG (Blackfish) (10 inches)</p>  <p><u>Angler's Method</u> - Hook and line in shallow water <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>	<p>TAUTOG (Blackfish) (18 inches)</p>  <p><u>Angler's Method</u> - Hook and line in the surf <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>	<p>TAUTOG (Blackfish) (15 inches)</p>  <p><u>Angler's Method</u> - Hook and line in deep water <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>
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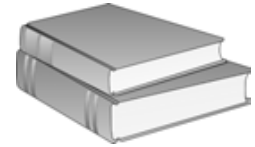
Figure 13C

SET-UP FOR THE PLAYING FIELD



COMINGS AND GOINGS

BACKGROUND INFORMATION

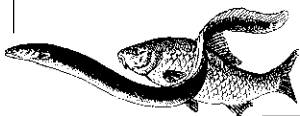


The estuary ecosystem is often described as an aquatic nursery. Many species of fish and other aquatic animals spawn in the shallow, nutrient-rich waters, and young animals spend their first few months or years feeding in these relatively safe environments. These species, along with others, may also be migratory – coming to the Newark Bay Complex during certain seasons.

Some fish respond to the changing ocean temperature by moving from cooler to warmer water or from warmer to cooler water. When schools of prey fish travel up and down the Atlantic coast, predatory fish (and anglers) follow. New Jersey is well known for the seasonal occurrence of bluefish when large numbers migrate offshore in late April and early May. Migration occurs also when it is time for fish to spawn. American eels spend most of their lives in freshwater, but return to the sea to spawn. On the other hand, striped bass and other anadromous fish such as river herring and American shad do the opposite. They spend most of their lives in the ocean and ascend freshwater streams to spawn.

Like most other animal populations, fish populations are under pressure from human interactions. Water pollution, habitat degradation and encroachment all contribute to the decline in numbers and size of fish. Additionally, some anglers pursue their hobby with such tenacity that they will go to extreme lengths to fish in even the most remote areas. Those studying fish behavior have indicated that some species of fish have changed their feeding and migrating patterns to avoid areas that are heavily fished.

Continued observation and research enables fishery managers to keep track of the numbers and types of fish taken from the fishery, both commercially and through sport fishing. Management practices take into consideration the migratory patterns of species, their life cycles, and the spawning season to ensure that the fishing industry and the sport do not negatively impact an individual species' population. They also ensure that these fish will be available for recreation and commercial use in the future.



LEVEL

4 to 8

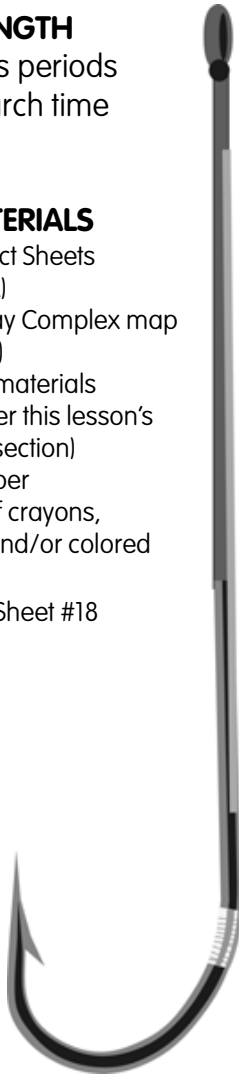
LENGTH

2 class periods
research time



MATERIALS

- o Species Fact Sheets (Figure 14A)
- o Newark Bay Complex map (Figure 5A)
- o reference materials (listed under this lesson's reference section)
- o writing paper
- o a variety of crayons, markers, and/or colored pencils
- o Discovery Sheet #18



OVERVIEW

Seasonal changes, as well as environmental and human pressures, may affect aquatic animals during their life spans.

OBJECTIVES

Students will:



Describe the life cycle and seasonal movement patterns of an aquatic animal;



Describe how natural and human-made pressures affect these animals;



Explain how the seasonal movements of aquatic animals may affect the accumulation of contaminants in their bodies.



ADVISORY LINK

The fish and crabs listed in the Fish Consumption Advisories spend all or part of their life in the estuary waters of the Newark Bay Complex. Since scientists have determined that sediments in the Newark Bay Complex contain unsafe levels of dioxins and PCBs, these species are more likely to accumulate contaminants because of their seasonal movements, spawning habits and feeding habits.

KEYWORDS

anadromous
bioaccumulation
catadromous

contaminants
estuary
spawn

fishery
migration

STUDENT PREREQUISITES

Basic map-reading skills
General fish biology as it relates to life cycles
An understanding of migration related to aquatic species

PROCESS SKILLS

communicating
comparing
evaluating
categorizing

analyzing
interpreting data
synthesizing



PLANNING



Make copies of Figures 5A, 14A (2-sided) and Discovery Sheet #18 for each student.

PROCEDURE SETTING THE STAGE

Discuss basic human needs. Ask, "If you were cold, what would be some of the things you would do to warm yourself? What would you do if you were thirsty?" Some animals move from location to location to fulfill their basic needs. Discuss migration.

THE ACTION



Period 1

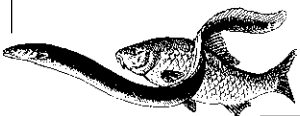
1. Distribute a copy of the Newark Bay Complex map (Figure 5A) to each student. Discuss or review the difference between fresh water, brackish water, and salt water. Determine where these might be found on the map.
2. Instruct the students to color-code the types of water (i.e. salt water, brackish water, fresh water). Refer the students to Figure 5B (Tidal Marshes in and Near the Newark Bay Complex) to estimate the extent of each type of water.
3. Distribute Figure 14A, Discovery Sheet #18 and a copy of the Fish Consumption Advisories (Appendix A) to each pair of students. Have each pair select a species and complete the research using the Fish Fact sheets or other research material as needed.

Period 2

Have each student add his/her animal's seasonal movements and life cycle information to the Newark Bay Complex map. * Note: The students may need to create a key to explain any symbols they created to explain their animal's movements and life cycle. (Example: adult = A, juvenile = J, etc.)

CLOSING DISCUSSION

1. List some of the reasons why these animals migrate [*to get food, to breed, to find warmer or cooler water*].
2. Which animals migrate from fresh to salt water (catadromous)? Which animals move from salt water to fresh water (anadromous)?
3. Which animals remain in the estuary ecosystem throughout their life?
4. Which animals eat plants or plant material? Which animals eat other animals? Which animals eat both?
5. What pressures could the animals encounter that are human-induced? What natural phenomena could affect the animals?
6. How might an animal's position in the food chain affect the long-term health of that particular animal? [*An animal at the top of the food chain has more opportunity to accumulate toxins in its fatty tissue since these contaminants increase (bioaccumulate) at each level of the food chain.*]
7. How might seasonal movements of fish affect the accumulation of toxins in the fish's body? [*A fish may not be contaminated if it is found in a contaminated area because it may not spend all of its life there. Conversely, a fish containing toxins can swim into a non-contaminated area and be eaten by a fish in that area.*]





ASSESSMENT STRATEGIES



Have the students:

- ❑ Write a story that tells the “imaginative” travels of their animals including any information they have learned about environmental or human-induced pressures.

EXTENSIONS

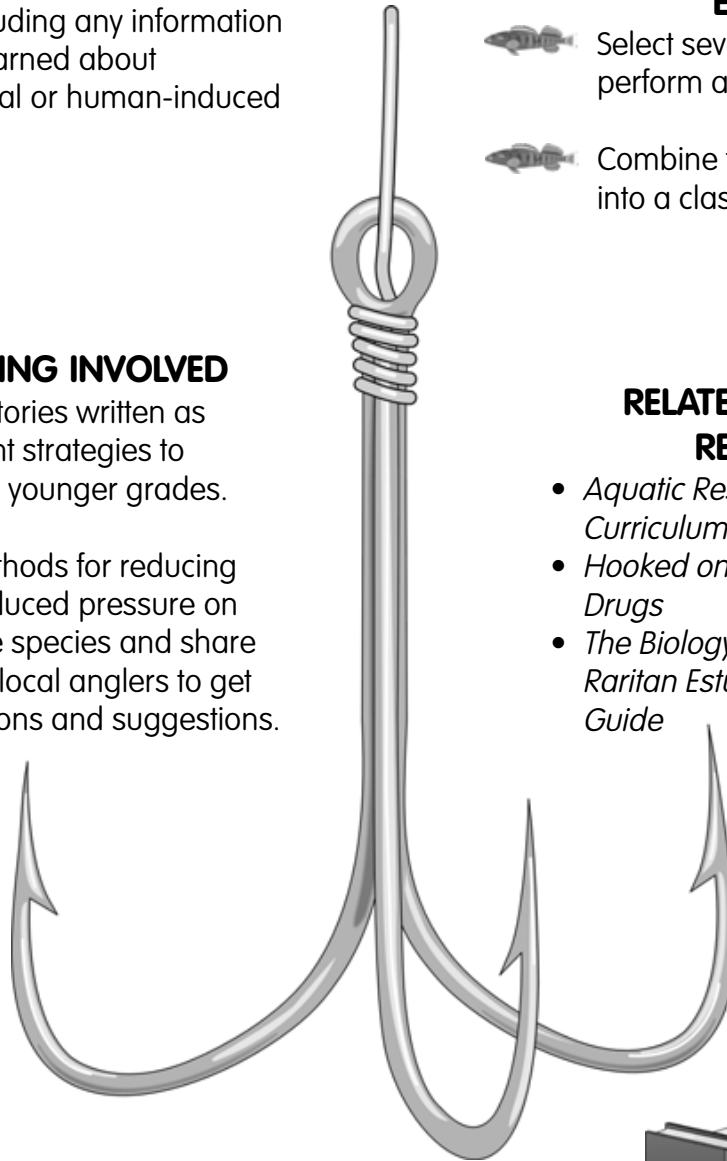
-  Select several of the stories to perform as a mini-play.
-  Combine the stories and maps into a class booklet.

STAYING INVOLVED

-  Read the stories written as assessment strategies to students in younger grades.
-  Devise methods for reducing human-induced pressure on each of the species and share these with local anglers to get their reactions and suggestions.

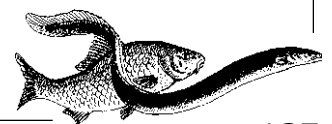
RELATED EDUCATION RESOURCES

- *Aquatic Resources Education Curriculum*
- *Hooked on Fishing - Not on Drugs*
- *The Biology of the Hudson-Raritan Estuary: A Teacher's Guide*



REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Marine Fisheries Administration. “Salt Water Fishing in New Jersey.”
- _____. “Marine Recreational Fishing Seasons, Possession & Minimum Size Limits.” 1996.
- New Jersey Department of Environmental Protection, Division of Science, Research and Technology, “A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters,” 2004 edition. (Appendix A)



FISH FACTS

BLUEFISH

SEASONAL MOVEMENT: Bluefish migrate east and north along the Atlantic coast in spring and west and south in late fall.

PRESSURES: High on the food chain, popular commercial and sport fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Young Bluefish are called Snappers. They come into the bays and estuaries in spring and feed there all summer. All Bluefish have an impressive set of teeth because they are predators. Fishermen have found that Bluefish can see almost as well out of water as in water, so use caution when handling.

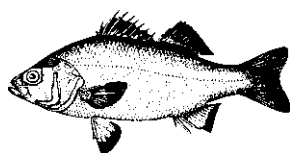
STRIPED BASS

SEASONAL MOVEMENT: Striped Bass move south in the fall to find warmer water and north in the spring. Striped Bass are anadromous, which means they move from salt water to brackish and freshwater streams to spawn in early spring.

PRESSURES: High on the food chain, popular marine game fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Striped Bass are predators that gorge themselves on smaller fish. As adults, their only predators are people. Also called Rockfish.

WHITE PERCH

SEASONAL MOVEMENT: White Perch usually stay in the brackish waters of estuaries and back bays, although during spawning season (April to June) perch may move further upstream into freshwater areas.

PRESSURES: Popular "pan" fish among sport fishermen

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: White Perch live in a variety of habitats because they are very adaptable.

WHITE CATFISH

SEASONAL MOVEMENT: White Catfish are year-round residents with only limited seasonal movements.

PRESSURES: Catfish are bottom dwellers, which means they are closely linked to bottom sediments that contain contaminants.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Of all the species listed in the Fish Consumption Advisories, the White Catfish is the least tolerant of salt water. Their characteristic whiskers help identify them.

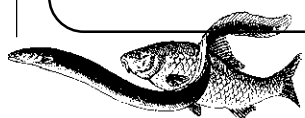
AMERICAN EEL

SEASONAL MOVEMENT: Adults migrate during winter/early spring from fresh water rivers to the deep ocean to spawn.

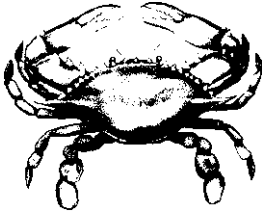
PRESSURES: Eels are bottom-dwelling omnivores that eat both live animals and dead organic material that settles into the bottom sediment.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: As a young eel changes from a larva to an elver to an adult, it migrates back from the ocean to the freshwater rivers. Many eels are caught in traps called weirs and sent to market to be bait for other fish.



FISH FACTS

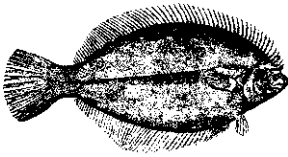
BLUE CRAB

SEASONAL MOVEMENT: Blue Crabs spend most of their life cycle in the estuary, although females move into the ocean to lay their eggs.

PRESSURES: Blue Crabs are bottom dwellers that filter feed from the detritus. Their feeding habits increase their chances of exposure to the contaminants that have accumulated in the bottom sediments.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Soft shell crabs (or shedders) are the crabs that have just recently shed their hard outer shell (exoskeleton). At this time they are vulnerable to predators while the shell hardens.

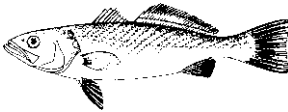
WINTER FLOUNDER

SEASONAL MOVEMENT: Winter Flounder are year-round residents that move from deep water to shallow water in the fall; they move offshore again in the spring, and spawn in the bay.

PRESSURES: Commercial fishermen take Winter Flounder offshore in the summer by trawlers and inshore in the winter by nets staked in shallow water.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: When the water gets cold in the winter, flounder bury themselves in the mud. Like Fluke (Summer Flounder), the Winter Flounder's body structure changes as it grows older.

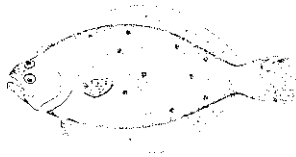
WEAKFISH

SEASONAL MOVEMENT: Weakfish have similar seasonal movements to Bluefish in that the species moves out to sea (and south) in the winter, while in the summer they move closer in to shore.

PRESSURES: Popular game fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: Weakfish are so named because they have a "weak" mouth structure that allows a hook to come out easily.

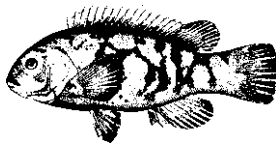
**FLUKE
(Summer Flounder)**

SEASONAL MOVEMENT: Fluke move from deeper water to shallower water during the summer months.

PRESSURES: Very popular sport fish.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: A young Flounder changes from a "normal" looking fish to a flat fish early in its life. Its skull twists and one of its eyes migrates from the side of its head to the other side, so that both eyes are on the same side.

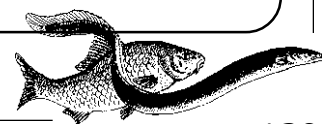
**TAUTOG
(Blackfish)**

SEASONAL MOVEMENT: Adult Tautogs move to deeper water during late fall. Here they overwinter and remain fairly inactive.

PRESSURES: Tautog is a bottom species; it is also a popular game fish.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: The male of the species is extremely territorial.



COMINGS AND GOINGS – RESEARCH GUIDELINES

Discovery Sheet #18

Name: _____ Date: _____

Name of animal:

Description (size, coloration, other):

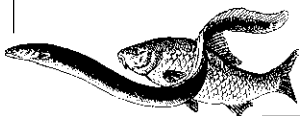
Describe seasonal movement or migration:

Life cycle information:

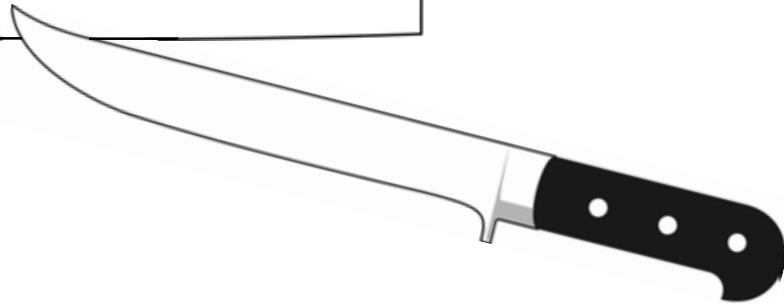
List preferred food:

Describe any pressures on the animal:

Interesting Facts:



CUTTING THE RISKS



BACKGROUND INFORMATION

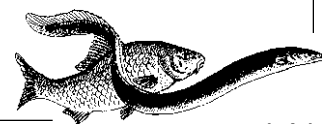


Fishing provides enjoyable and relaxing recreation. Fish are excellent sources of protein, minerals and vitamins and play a role in maintaining a person's healthy, well-balanced diet. Many people enjoy cooking and eating their own catch, but since 1982, when research began to show elevated levels of potentially harmful contaminants in certain fish and crabs in some New Jersey waters, advisories were adopted to guide anglers on safe consumption practices.

Fish that are used for food must be kept fresh until they are cooked, frozen or stored. Special cleaning methods can be used when preparing fish caught from areas that have a high incidence of contamination. These include skinning the fish and removing the fatty tissue (where contaminants concentrate) around the backbone, the belly, and the lateral line (along its side).

Blue crabs also contain these same contaminants, and in the Newark Bay Complex, it is prohibited to catch and/or harvest the crabs. As a general precaution, it is advised that crabs caught in other waters are prepared in such a way that the "green gland" or hepatopancreas is removed and not eaten. Water that the crab is cooked in should be discarded and not used in the preparation of other foods.

A popular alternative to catching and eating fish is to catch and release the animal. Anglers catch the fish, enjoy the relaxation and the thrill of the catch, but then immediately release the animal back to the water. Special equipment must be used for this type of fishing to reduce the risk of damaging the animal before it is released.



LEVEL

4 to 8

LENGTH

2 class periods



MATERIALS

- o Anatomy charts (Figures 15A and 15B)
- o Fish Preparation chart (Figure 15C)
- o modeling clay of different colors (enough for entire class)
- o a packet of pipe cleaners
- o a box of toothpicks
- o cardboard (one piece for each student or pair of students)
- o 1 fish specimen (with fatty tissue, such as bluefish or striped bass)
- o 1 fillet knife (for teacher)
- o plastic knives (one for each student)
- o newspaper
- o paper towels
- o plastic bag for disposal of the fish
- o water for cleaning up

OVERVIEW

Knowledge of fish and crab anatomy is necessary for cleaning and preparing them for human consumption.

OBJECTIVES

Students will be able to:



Identify the internal and external anatomical parts of a fish and crab;



Explain why certain parts of some fish and crabs should not be consumed;



Demonstrate preferred methods of fish/crab preparation.



ADVISORY LINK

The Fish Consumption Advisories outlines steps that an individual can take to minimize exposure to potentially harmful contaminants. By properly cleaning, skinning and trimming contaminated species, an angler can reduce the level of PCBs and dioxins in finfish.

KEYWORDS

anatomy
bioaccumulation
biomagnification
contamination

dioxins
fatty tissue
fillet
PCBs

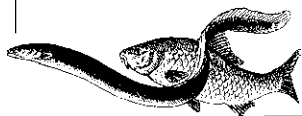
STUDENT PREREQUISITES

Safety practices when using knives

PROCESS SKILLS

communicating
observing
comparing

analyzing
synthesizing



PLANNING



1. Contact a local angler to demonstrate the proper cleaning methods to the class.
2. Obtain at least one fresh, not frozen, fish from the fish market and store it on ice for the demonstration.
3. Make copies of the Anatomy charts (Figures 15A and 15B) and the Fish Preparation chart (Figure 15C).
4. Assemble the art materials.

PROCEDURE SETTING THE STAGE

Name the parts of a chicken that you like to eat. What are the parts you don't like, but are still eaten by others?

THE ACTION



Period 1

1. Distribute the fish and crab anatomy charts to explain both the external and internal parts of each animal (Figures 15A and 15B). Discuss that blue crabs should not be caught and eaten from the Newark Bay Complex.
2. Introduce or review the concepts of bioaccumulation and biomagnification. Discuss what these terms mean with regards to fish. Identify the places where contaminants accumulate.
3. Provide each student (or pair of students) with art materials and cardboard.
4. Challenge the students to create an anatomically correct fish that includes the internal and external parts of the animal.
5. Set the models aside for the next day.

Period 2

1. Have a local angler demonstrate:
 - a. how the fish was kept fresh [*on ice*] and the importance of this step.
 - b. how to clean a fish by removing the fatty tissue that may contain the highest concentrations of contaminants. Distribute and reference the Fish Preparation chart (Figure 15C).
2. Instruct the students to practice cleaning their clay fish. Distribute plastic knives for the students to use.

CLOSING DISCUSSION

1. Describe the similarities and differences between fish and crab anatomy.
2. Why does the fish need to be prepared in a special way? [*The fish may contain contaminants from chemicals in the environment; special preparation reduces health risks.*]
3. Which parts of the animals need to be discarded to reduce the amount of contaminated food eaten? [*In fish, the fatty tissue along the backbone, the belly, its organs, and the lateral line*]



4. If a person chooses to eat a potentially contaminated fish how can he or she be sure that the animal has been cleaned and prepared properly? *[they can do it themselves; they can watch the person doing the cleaning, or a fish already cleaned can be purchased from a reliable source]*

ASSESSMENT STRATEGIES

Have the students:

- ☐ Draw a step-by-step schematic of the cleaning method.

STAYING INVOLVED



Have the students share their techniques for cleaning and preparing fish with their families or other students.

EXTENSIONS



Visit a fish market or seafood store for a guided tour.



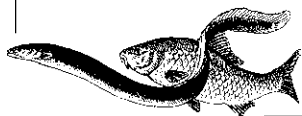
Go aboard a fishing vessel to see how the caught fish are processed and stored before going to market.

RELATED EDUCATION RESOURCES

- Aquatic Resources Education Curriculum
- *Project WILD*

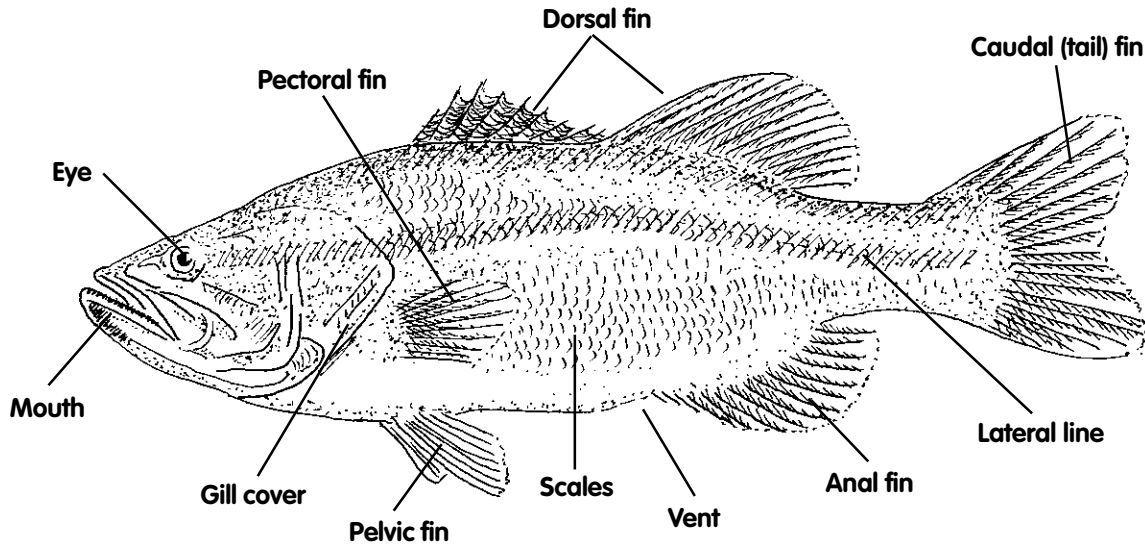
REFERENCE

New Jersey Department of Environmental Protection, Division of Science, Research and Technology. *Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters*. 2004.

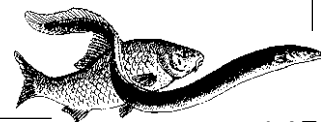
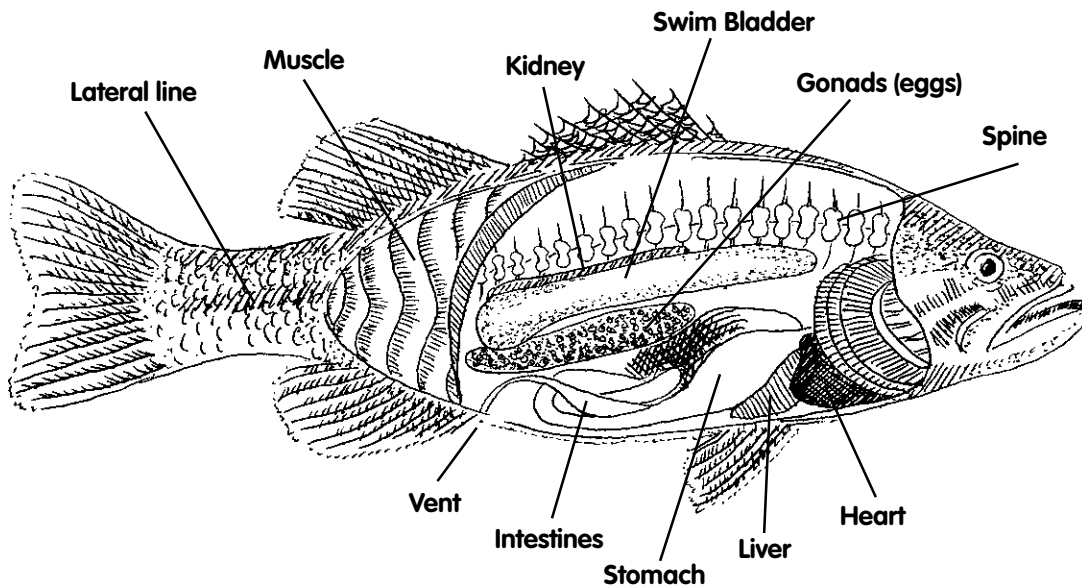


FISH ANATOMY

From the Outside:

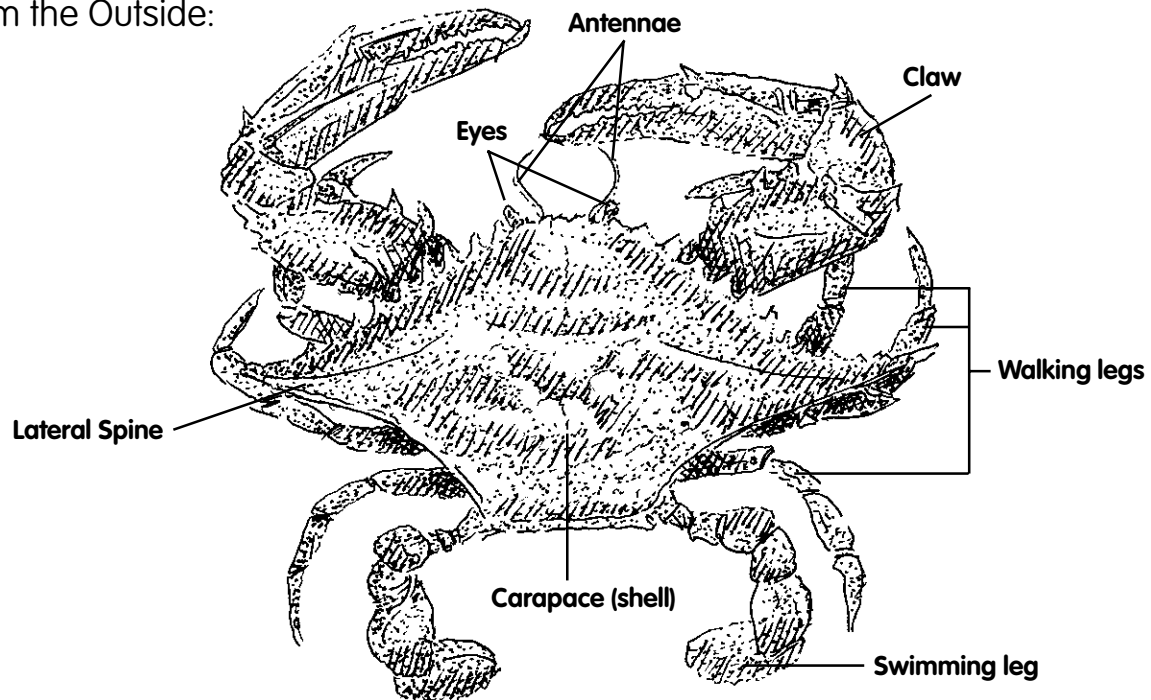


From the Inside:

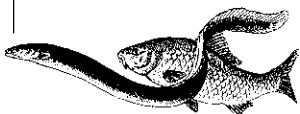
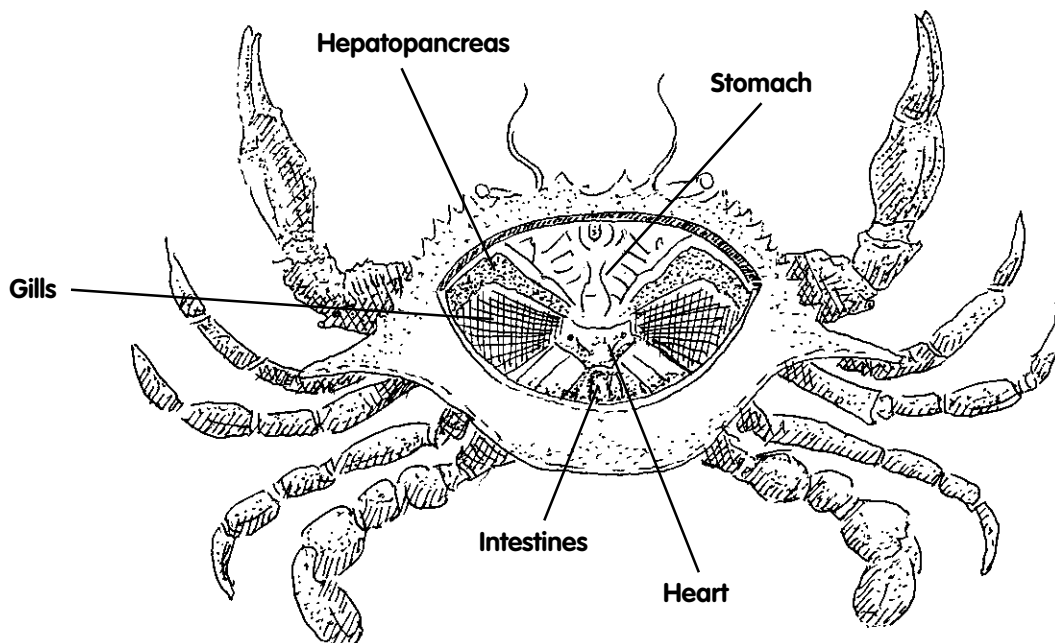


CRAB ANATOMY

From the Outside:



From the Inside:



FISH PREPARATION CHART

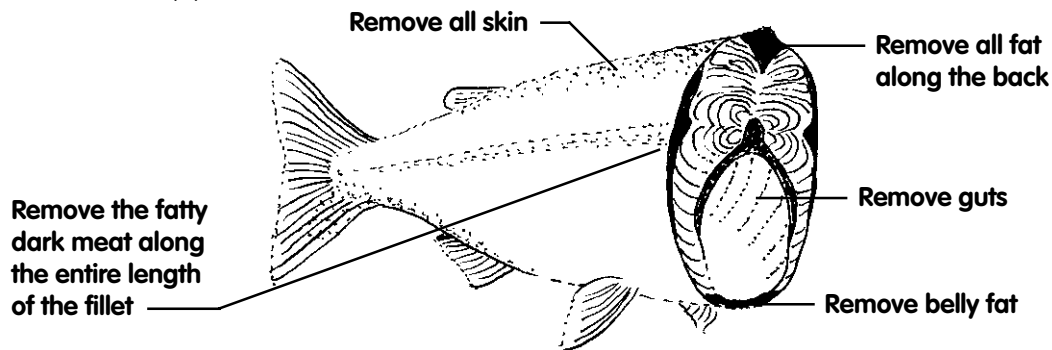
FISH PREPARATION METHODS

(From NJ Department of Environmental Protection, Division of Science, Research and Technology - <http://www.nj.gov/dep/dsr/pcb-advisories.htm>)

Proper fish cleaning and cooking techniques may reduce PCB levels approximately 50 percent when compared to raw fish fillets.

Eat only the fillet portions.

Do not eat whole fish or steak portions. Do not eat the heads, guts or liver, because PCBs usually concentrate in those body parts. Also, avoid consumption of any reproductive parts such as eggs or roe. Many chemical contaminants, like PCBs and pesticides (but not mercury), are stored in the fatty portions of fish. To reduce the levels of these chemicals, skin the fish and trim any of the dark meat (Lateral Line), back strap and belly flap. The following diagram illustrates those body portions.



FISH COOKING METHODS

Use a cooking method such as baking, broiling, frying, grilling, or steaming that allows the fats and juices to drain away from the fish. When possible, cook the fish on an elevated rack that allows fats and juices to drain to the pan below. Avoid batter, breading or coatings that can hold in the juices that may contain contaminants.

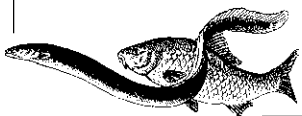
The juices should be thrown away since they contain the PCBs and other chemicals that were in the fat. Do not pour these juices over the fish as a sauce or to moisten the fish.

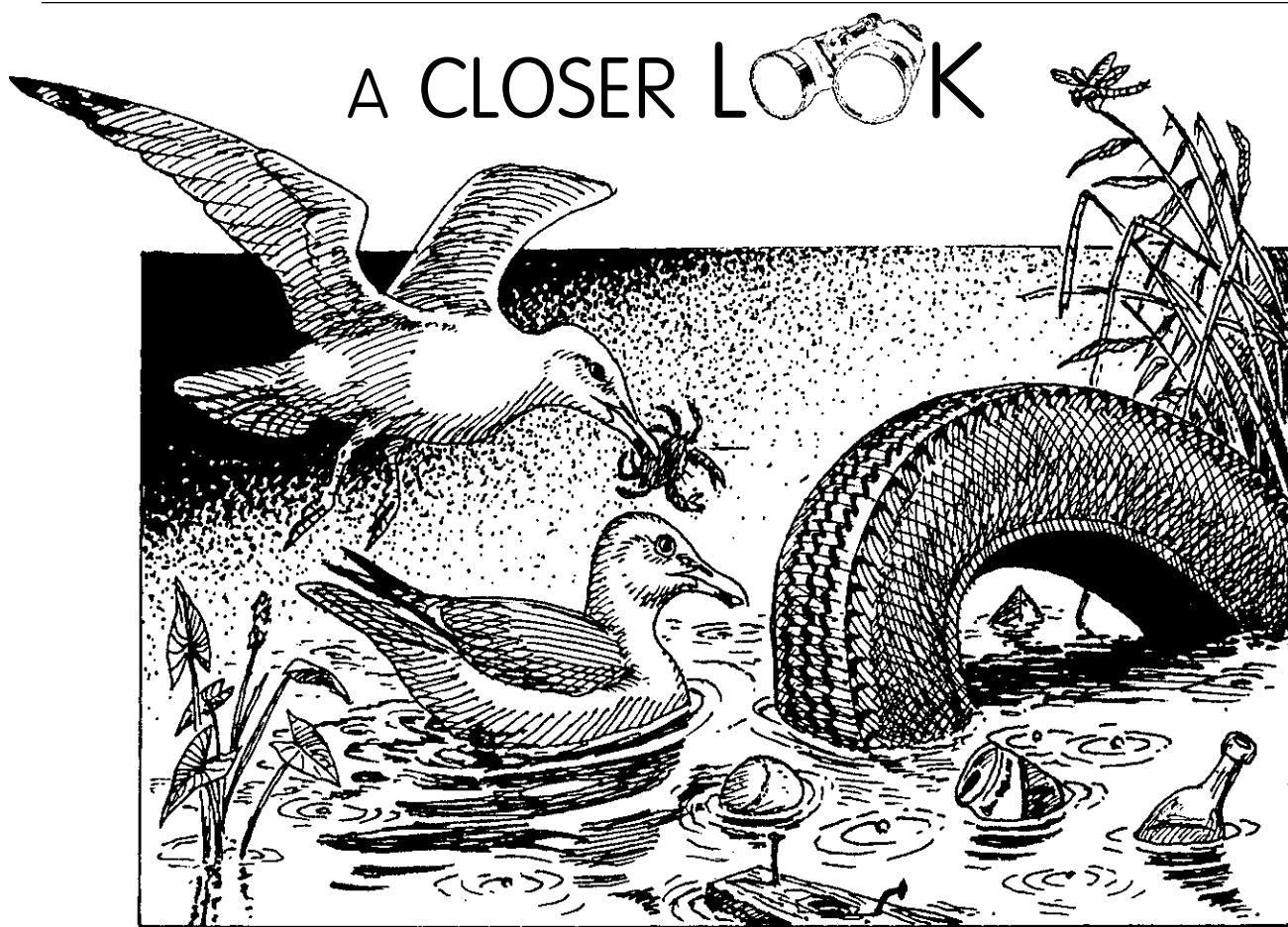
Butter, margarine or other liquids can be added to the fish for this purpose once the juices have been poured off.

After cooking, **discard all liquids and frying oils**. Do not reuse. Do not use heads, skin, trimmed fatty portions in soups, stews, chowders, boils, broth or for fish stock. If you make stews or chowders, only use skinless fillet parts. Raw fish may be infested by parasites. Cook fish thoroughly to destroy the parasites. This also helps to reduce the level of many chemical contaminants.



NOTES





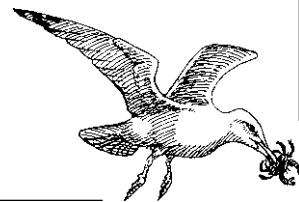
SECTION 4

THE NEWARK BAY, A COMPLEX STUDY

Newark Bay is one of the busiest ports in the world. In 1895, the value of imports and exports going through the port was 934 million dollars and in 1993 it had climbed to an estimated 56.3 billion. Port Newark currently provides 180,000 jobs and about five billion dollars are paid out in wages and salaries.¹ Newark Bay and its associated waterways are also some of the most polluted water systems in the country. Much of the sediment is highly contaminated with toxic and hazardous substances, including

heavy metals (mercury, chromium, and cadmium) and synthetic organic compounds (PCB's, dioxins, and chlordane).

Historically, the Newark Bay supported a major shellfish industry although today all commercial fishing is banned on the New Jersey side. Recreational fishing continues to be a favorite pastime for people whether they fish from boats and docks or along jetties and shorelines.

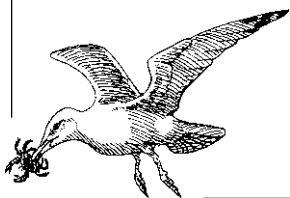


Considering the pollution concerns, the Fish Consumption Advisories were developed to warn anglers about the potential health risks associated with eating parts of various species of fish from this and other polluted waterways in New Jersey.

Even with tremendous impacts on the ecosystems of the Newark Bay Complex, it continues to be a rich and diverse area that includes salt marsh, fresh water marsh, brushland, estuary, open water, and upland habitats. Natural history enthusiasts view the area as a unique combination of wilderness in an urban setting. Under some circumstances, existing open space has been preserved, while new habitats have been created (a practice called mitigation). Many people have learned to recognize the intrinsic value of the land and water systems and "eco-tourism" is on the rise. Birdwatchers, hikers, photographers, and boaters all want a say in how the land and water are impacted. Like anglers, these people invest money and resources to pursue their hobbies.

In an area such as the Newark Bay Complex, every issue, concern, or problem involves a multitude of stakeholders. Stakeholders may represent local, regional, and/or statewide agencies and groups as well as individual citizens from the community. Each stakeholder may hold a different view concerning an issue in the region so that it becomes a challenge to sort through all the options to discover a best-use practice that is agreeable to all sides. Before most decisions can be made, stakeholders and other concerned citizens must first be made aware of the issue and given basic information about the issue; only then will stakeholders and general public be able to make informed decisions about the issue.

¹ McDonnell, Janice. "The Dredging Dilemma". Project CORE (Community Organized to Regain the Environment). Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ.



NEWARK BAY'S COMPLEXITIES

BACKGROUND INFORMATION

See "A Closer Look."



LEVEL

6 to 8

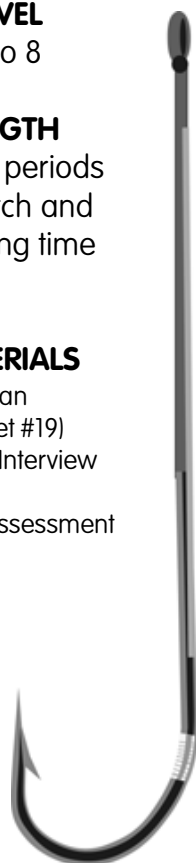
LENGTH

6 class periods
research and
planning time



MATERIALS

- o Project Work Plan (Discovery Sheet #19)
- o How To Do An Interview (Figure 16A)
- o Presentation Assessment (Figure 16B)



OVERVIEW

Students increase awareness and create education plans and products based on land use issues in the Newark Bay Complex.

OBJECTIVES

Students will:



Identify and describe current land use issues in the Newark Bay Complex;



Prepare and present a project plan to address a specific issue;



Create an awareness / education project to address the land use issue.



ADVISORY LINK

Newark Bay's ecosystem and surrounding habitats are impacted greatly by human actions. There is ongoing debate regarding environmental, economic and health concerns. Often these debates are so technical and on such a grand scale that it is difficult for the general public to be intimately involved. The Fish Consumption Advisories are a way to increase awareness about an issue in which "everyday" people can take action.

KEYWORDS

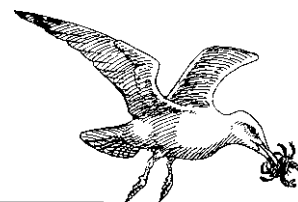
land use
stakeholder

STUDENT PREREQUISITES

A background in research skills
A background in oral presentation and evaluation

PROCESS SKILLS

gathering and interpreting information
categorizing
formulating hypotheses
analyzing
synthesizing
evaluating



PLANNING



1. Instruct students to bring to class current event articles that deal with land use issues in the Newark Bay Complex.
2. Make copies of Project Plan (Discovery Sheet #19), How to Conduct an Interview (Figure 16A), and Presentation Assessment (Fig. 16B).

PROCEDURE SETTING THE STAGE

Locate the Newark Bay on a map. Discuss the significance of its location in regards to the New York metropolitan area. Generate a list of uses around the Bay [*Newark Airport, Port of Newark, refineries, landfills, transportation, homes, wildlife preserves, fishing areas, marshes, boating areas, shopping malls*].



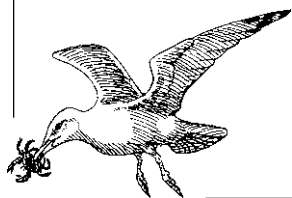
THE ACTION

Period 1

1. Have each student summarize his or her article about a Newark Bay Complex land use issue. List all the issues on the board.
2. Have the class take a vote to select one issue that interests them the most.
3. Ask the students to identify the various points of view described in the article. Example: an article on the building of a shopping mall may include points of view from retail organizations, contractors, environmental organizations, residents, etc.
4. Divide the students into small work groups. Assign each group one stakeholder point of view.
5. Explain that each student group will research their facet of the issue and design an education tool to inform their community about their issue or concern. Sample projects include: teaching younger students about the issue, creating a poster or visual display to put in the school hallway or local library, producing a video on the issue or creating a PowerPoint presentation about the issue.

Period 2

1. Throughout the project, students will be responsible for periodic progress reports as well as self and group assessment reports. Explain that after doing their research each group will explain to the class their facet of the issue, the education tool they plan to use, the audience it targets, and the method they would employ if they were going to present this tool to the community.
2. Distribute a Project Work Plan (Discovery Sheet #19) to each student in the group and discuss the outline points.
3. Have the individuals in each group complete their Project Work Plan according to group consensus.



4. Groups will be responsible for their progress with the following methods:
 - Individual Journal - each student should keep an ongoing record of his or her thoughts on the issue and how what they learned about it affects their personal attitudes and values. These are personal and are not usually read by anyone but the teacher.
 - Periodic Progress Reports - each group should be responsible for updating the class on their progress.
 - Group Evaluation - an internal periodic assessment of the group's progress - what things are going well, where the group needs improvement, and what actions can be implemented to address changes that need to be made.

Independent research time

Designate an appropriate time for students to gather their information and design a five-minute multimedia presentation. (Minimum time: three weeks because it may require that much time for organizations to respond to the students' requests for information.)

1. Discuss research guidelines with the group. Possible methods that the students could utilize would be: interviews (both phone and in-person), review of magazine and newspaper articles about the subject, internet research, meeting attendance, contacting organizations for pamphlets and other information (see Organizations to Contact, Appendix D). Note: If you want students to do phone interviews, arrange for them to use a school phone.
2. Review How To Do An Interview (Figure 16A). Distribute a copy to students and tell them that they should use a separate sheet for each interview that they do.
3. Distribute a copy of the Presentation Assessment (Figure 16B) so students will know how other students will assess their presentation.

Period 3

1. Discuss the reasons why assessment and constructive criticism are integral to an effective project [*increases input from other perspectives, people unfamiliar with the plan may see "holes" in the process, identification of resources that may not have been thought of originally*].
2. Distribute the Presentation Assessment sheet (Figure 16B) for students to complete after each presentation.
3. Have each group designate a note-taker who will keep track of the comments or concerns that other classmates offer that could strengthen their plan.
4. Have each group present their project work plan. Allow time for question and answers.

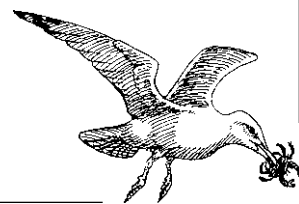
Period 4

Have each group reassess their plan and design their final product based on class discussion and assessment.

Period 5

(with independent work time, if needed)

Allow time for students to create their final product.



Period 6

Have each group present their finished product to the class. If appropriate, consider inviting appropriate local stakeholders in to observe the final presentation.

CLOSING DISCUSSION

1. What skills did you use to obtain good research information? [*general understanding of the issue, ability to find new resources, flexibility to pursue ideas/data found in initial research, an understanding of the best resources to use for the job at hand*]
2. What skills do you need to be a good presenter? [*clear speaking, organized, know your information, charismatic, utilize different presentation methods, know your audience*]
3. What skills do you need to be a good listener? [*listen for biases, be prepared to ask questions for clarification of points*]
4. What are the characteristics exhibited by the best education products? [*clarity, appeal to the audience for which they are intended*]

ASSESSMENT STRATEGIES

Have the students:

- ☐ Keep a detailed log of their work project plan including their progress reports, interview sheets, resource lists, draft copy of their presentation, observer assessment sheet, and impressions of the process.

RELATED EDUCATION RESOURCES

- *Beneath the Shell*
- *Marine Education Resource Guide*
- *New Jersey WATERS*
- *Project WET*

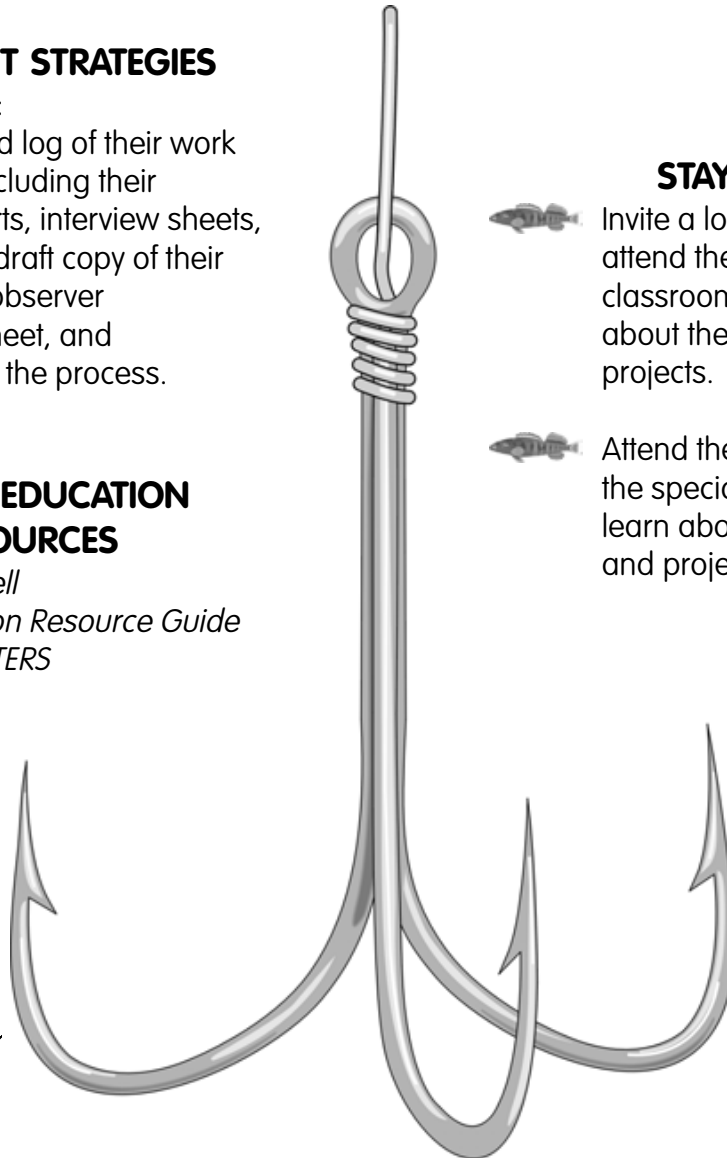
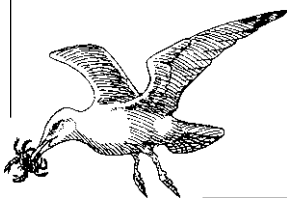
STAYING INVOLVED



Invite a local newspaper to attend the proceedings in the classroom and write a story about the students' final projects.



Attend the meeting of one of the special interest groups to learn about current problems and projects.



PROJECT WORK PLAN

Discovery Sheet #19

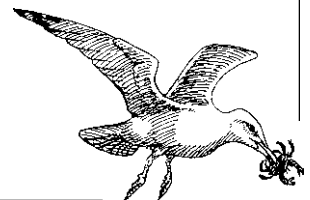
NAMES:

ISSUE:

YOUR GROUP'S POINT OF VIEW:

RATIONALE (Why is this issue important to you and to your community?):

	TEACHER INITIALS	PROGRESS REPORT	DATE TO FINISH
<p>EDUCATION TOOL – What tool(s) are you going to create to help educate people about your issue?</p> <p>Tool</p> <p>Target Audience</p> <p>What method will you use to deliver your education tool?</p>			
<p>RESOURCES – What will you need to complete your project?</p> <p>Materials</p> <p>Skills</p> <p>Outside expertise?</p>			
<p>PROJECT TASKS</p> <p>What are the steps you will take to complete your project and design your oral presentation? Who is responsible for each step?</p> <p>Use a separate sheet if necessary.</p>			



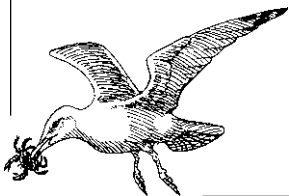
GUIDELINES ON HOW TO DO AN INTERVIEW

Date:_____ Time:_____

1. Name of organization:
2. Name and title of person you are interviewing:
3. Introduce yourself (your name, your grade, your school):
4. Explain why you are contacting that person:
5. Ask the person if he/she can speak to you now for about five minutes. If not, when is a more convenient time for you to call back?
6. Ask your questions and take notes on Figure 16A. Limit your questions to a manageable number (maximum four questions). Make sure your questions are clear. If your question can be answered by yes or no, change the wording. Show your questions to the group, friends or parents to make sure that they are clear and relevant, not confusing.
 - Question 1
 - Question 2
 - Question 3
 - Question 4
7. Request to receive printed material that the organization has which relates to your topic.
8. Spell your name and address.
9. Confirm the organization's address:

Address: _____

Town/City:_____ State _____ Zip Code _____
10. Thank the person.
11. Write a follow-up note to that person to let them know how the project progresses and that you appreciate him/her giving the time to you. Invite them to observe your final presentation (with approval of your teacher).



GUIDELINES ON HOW TO DO AN INTERVIEW

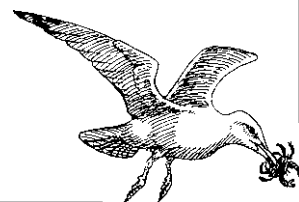
NOTES:

Question 1:

Question 2:

Question 3:

Question 4:



PRESENTATION ASSESSMENT

NAME:

NAME OF THE GROUP:

TITLE OF THE PROJECT:

Rate each aspect of the plan on a scale of 1 to 4. Circle the best response.

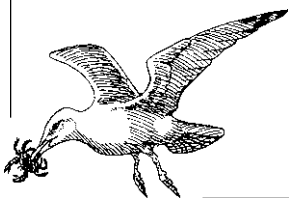
- 1 I don't think so.**
- 2 Possibly**
- 3 Likely**
- 4 Definitely**

1. Will the tool be interesting to the group's target audience? 1 2 3 4
Why or why not?
2. Will the tool help educate people about the land use issue? 1 2 3 4
Why or why not?
3. Does the tool reflect a "group effort?" 1 2 3 4

Rate each aspect of the group presentation on a scale of 1 to 5. Circle the best response.

- 1 Poor**
- 2 Fair**
- 3 Good**
- 4 Very Good**
- 5 Excellent**

- | | | | | | |
|--------------------------------|---|---|---|---|---|
| Creativity | 1 | 2 | 3 | 4 | 5 |
| Organization of Information | 1 | 2 | 3 | 4 | 5 |
| Organization of Presentation | 1 | 2 | 3 | 4 | 5 |
| Group Effort and Participation | 1 | 2 | 3 | 4 | 5 |



A detailed black and white illustration of a coastal ecosystem. The scene includes a large bridge in the background, a body of water with various fish (salmon, tuna, flounder, etc.), and a shoreline with birds (eagles, herons, seagulls), a crab, a turtle, and a snake. Numerous circular insets show magnified views of specific organisms like jellyfish, a crab, a turtle, a snake, a bird, and a fish. The artist's signature "Kathy Johnston © 2000" is in the bottom right corner.

IDEAS FOR USING THE POSTER

Create an informational display about the Fish Consumption Advisories. Identify the Advisory species, create a method for highlighting which animals are listed in the Advisories and develop information cards that explain why the animals are included in the Advisories.

Use the poster as a centerpiece for a wall mural. Have each student select an animal or plant, learn more about it, and create a "biography" for species. Connect the biographies to each species on the poster using string.

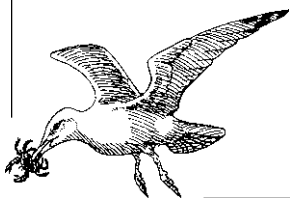
Have the students create a sample food chain and/or food web using the species on the poster. Identify each species as producer, consumer, decomposer or scavenger.

Identify the animals and plants according to species and classify them according to groups (birds, fish, amphibians, etc.). Create a Newark Bay Complex checklist to distribute to the students and their families.

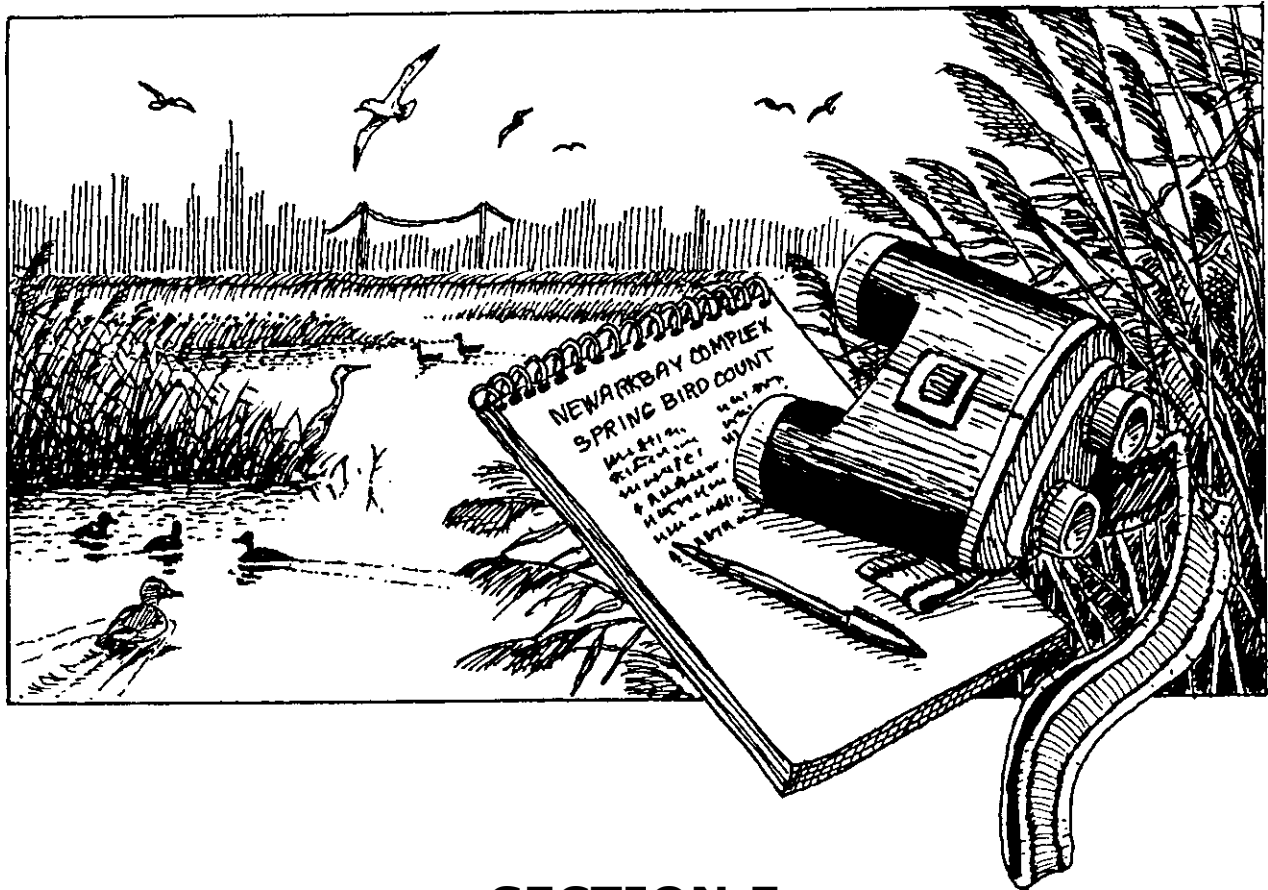
Write a poem, haiku or prose about the natural habitats and human made environments depicted in the poster and the animals and plants that live there.

To order color copies of this poster (24" x 36") contact:

New Jersey Department of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625
(609) 292-2113

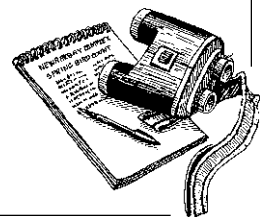


A CLOSER LOOK



SECTION 5 COMMUNITY OUTREACH

There are numerous ways in which citizens can get involved in learning more about angling opportunities in their communities and the quality of their community's water resources. The next few pages explain two ways that students can be involved by taking care of the aquatic resources by practicing "catch and release" fishing, and by learning how to monitor the quality of local waterways through a watershed program.



CATCH AND RELEASE FISHING

BACKGROUND INFORMATION

Catch and release fishing has become a popular alternative for anglers who enjoy the thrill of the catch but do not want to eat the fish. If you decide to release your catch, use special equipment such as artificial lures or barbless hooks, or crimp the barb on a standard hook. These devices make it easier to remove the hooks from the fish. Follow these tips to safely return the fish to the water:

- Time is essential, so quickly land and release the fish.
- Keep the fish in or over the water as much as possible.
- Gentle handling of the fish is essential. Hands should be kept wet at all times while handling the fish. Do not put fingers in the gills or eyes.
- Remove hooks quickly using long nosed pliers. If the fish is deeply hooked, cut the line and leave the hook.

Place the unhooked fish gently into calm water. If the fish does not immediately swim away, hold it upright in the water until it regains its strength. It may be helpful to grasp the fish by the tail and move it slowly forward and backward to “force” oxygenated water to pass over its gills to speed revival.

Organizations that provide fishing information include:

US Fish & Wildlife Service

www.fws.gov

NJ Division of Fish & Wildlife

www.state.nj.us/dep/fgw/fishing.htm

American Littoral Society

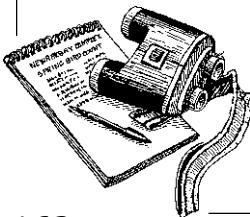
www.alsnyc.org

NJ Chapter Hudson River Fisherman’s Association

www.hrfanj.org

Jersey Coast Anglers Association

www.jcaa.org



WATERSHED / WATER QUALITY MONITORING PROGRAMS



BACKGROUND INFORMATION

Volunteer monitoring has become an integral part of the effort to assess the health of our nation's waters. Data collected in these programs must adhere to strict quality control and volunteer monitors are trained in specific methods. Students who participate in water quality monitoring as part of school projects:

- Learn about scientific data collection techniques and equipment,
- Document the effect of nonpoint and point source pollutants on water quality,
- Contribute to the broad base of scientific information on the function of an ecosystem and the effects of estuarine pollution,
- Become watchdogs for their waterway, and
- Indicate to local officials and other community members that they care about the quality of their waterway.

METHODS

According to the U.S. Environmental Protection Agency (EPA), the most important parameters to assess in an estuarine ecosystem are dissolved oxygen, nutrients and phytoplankton, submerged aquatic vegetation and bacteria. (*Volunteer Estuary Monitoring: A Methods Manual*. 1993.)

Dissolved Oxygen (DO)

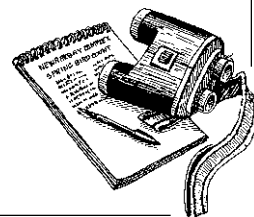
Dissolved oxygen is one of the most important indicators of the quality of water for aquatic life. Both plants and animals require oxygen for respiration and the amount of DO in the water controls the presence or absence of estuarine species.

Oxygen levels vary with the amount of chemicals present in the water, biological processes, seasonal and climatic variations and salinity.

Nutrients

Nutrient levels are closely related to the level of DO in the water. Nitrogen and phosphorus are two of the many nutrients that are needed for the survival of aquatic organisms. Nitrogen is essential for plant growth, while phosphorus is critical for metabolic processes that involve the transfer of energy.

Excessive amounts of either represent a major pollution problem. Nonpoint sources include



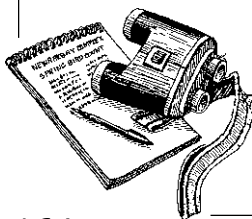
agricultural runoff and fertilizers, while point sources include sewage and industrial effluents.

Submerged Aquatic Vegetation (SAV)

Submerged aquatic plants are essential to estuarine systems. These beds provide shelter for many species as well as a nursery ground for young animals. They provide food for animals, add DO to the water, assimilate nitrogen and phosphorus, and help buffer the shoreline against erosion. Monitoring the status of these plant populations over time will help determine the health of the system.

Bacteria

The most easily monitored bacteria in an aquatic system are fecal coliform. This bacteria lives in the intestines of all warm-blooded animals, including humans. Its presence in water may indicate possible sewage contamination and the presence of pathogens. These pathogenic bacteria pose a threat to human health. Sources of bacteria into waterways include animal waste, inadequate wastewater treatment systems, leaky septic systems, sanitary landfills and storm water runoff.



VOLUNTEER MONITORING PROGRAMS

- U.S. Environmental Protection Agency (EPA), Office of Water
401 M Street, SW
Washington, DC 20460
www.epa.gov/ow/citizen.html
www.epa.gov/owow/volunteer.html

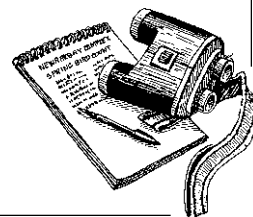
The U.S. Environmental Protection Agency (EPA) supports the volunteer monitoring movement in a number of ways. It sponsors national and regional conferences to encourage information exchange between volunteer groups, government agencies, businesses, and educators; publishes sampling methods manuals for volunteers; produces a nationwide directory of volunteer programs; and can provide some technical assistance on quality control and laboratory methods.

- New Jersey Department of Environmental Protection (NJDEP),
Division of Watershed Management
PO Box 418
Trenton, NJ 08625-0418
Phone: (609) 292-2113
www.state.nj.us/dep/watershedmgt/volunteer_monitoring.htm

NJDEP's Volunteer Monitoring Program began as a way to help interested citizens gain the skills and experience needed to monitor their local waterways. The goal is to get New Jersey citizens out in the field enjoying, learning and collecting data about the characteristics of their watershed.

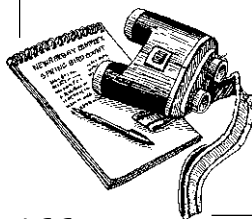
The Office of Outreach and Education in the Division of Watershed Management is responsible for the coordination of the Volunteer Monitoring Program and the Watershed Watch Network.

Watershed Watch Network is a program acting as an umbrella for all of the volunteer monitoring programs within New Jersey. The Watershed Watch Network has two advisory committees; Data Users and Water Resource Managers make up the Internal Advisory Committee and Volunteer Monitoring Program Managers throughout the State make up the Watershed Watch Network Council. A four-tiered approach has been developed to allow for volunteers to pick their level of involvement based on what the purpose of their monitoring program is, what the intended data use is and who the intended data users are. The goal of this new program is to provide acceptable protocols and QA/QC requirements for volunteers if they chose to submit their data to the NJDEP, to assist volunteers in designing and building upon their existing programs and assist data users in gathering sound data for their uses.



If you would like more information about this program please contact Danielle Donkersloot, Volunteer Monitoring Coordinator at 609-633-9241 or via email at Danielle.Donkersloot@dep.state.nj.us.

- Watershed Partnership for New Jersey
Identify your local watershed association by visiting the Watershed Education and Resource Directory on the website for The Watershed Partnership for New Jersey
www.wpnj.org



RESOURCES

Supplemental Teaching Guides

The Comprehensive Water Education Book. Grades K-6. 1994. International Office for Water Education. Logan, UT: Utah State University.

Hands On Save Our Streams. 1994. Firehock, Karen. Gaithersburg, MD: Izaak Walton League of America, Inc.

New Jersey WATERS: Watershed Approach to Teaching the Ecology of Regional Systems. 1999. Rosselet, Dale A., et.al. Bernardsville, NJ: New Jersey Audubon Society.

Project WET Curriculum and Activity Guide. 1995. Bozeman, MT: Western Regional Environmental Education Council and The Watercourse.

Sourcebook for Watershed Education. 1996. Cole-Misch, Sally, et. al. ed. Ann Arbor, MI: Global Rivers Environmental Education Network.

The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of NYC's Water Supplies. 1995. Haskin, Kathleen M. Claryville, NY: The Frost Valley YMCA.

WOW! The Wonders of Wetlands: A Educator's Guide. 1995. St. Michaels, MD: Environmental Concern Inc., and Bozeman, MT: The Watercourse.

General information on watersheds

The Clean Water Book: Lifestyle Choices for Water Resource Protection. 1997. Trenton, NJ: New Jersey Department of Environmental Protection, Office of Environmental Planning.

Communities of Place: The New Jersey State Development and Redevelopment Plan. 1992. New Jersey State Planning Commission. Trenton, NJ: Office of State Planning.

Greenways to the Arthur Kill. 1993. New Jersey Conservation Foundation. Far Hills, NJ: New Jersey Conservation Foundation.

Hackensack River Migratory Bird Report. 1997. Kane, Richard and David Githens. Bernardsville, NJ: New Jersey Audubon Society.

Raritan Bay Wildlife Habitat Report. 1994. Kane, Richard and Paul Kerlinger. Bernardsville, NJ: New Jersey Audubon Society.

Statewide Watershed Management Framework Document for the State of New Jersey. 1997. Trenton, NJ: New Jersey Department of Environmental Protection.

Watersheds: A Practical Handbook for Healthy Water. 1999. Dobson, Clive and Gregor Gilpin Beck. Buffalo, NY: Firefly Books.

Volunteer Monitoring Programs and Books

Clean Water: A Guide to Water Quality Monitoring for Volunteer Monitors of Coastal Waters. 1996. Stancioff,

Esperanza. Waldoboro, ME: University of Maine Cooperative Extension.

Citizen Monitoring Manual. 1991. Ellett, Kathleen K. Baltimore, MD: Alliance for the Chesapeake Bay, Inc.

Field Manual for Global Low-Cost Water Quality Monitoring. 1997. Stapp, William B. and Mark K. Mitchell. Ann Arbor, MI: Global Rivers Environmental Education Network.

Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools. 1996. 10th ed. Mitchell, Mark K. and William B. Stapp. Ann Arbor, MI: William B. Stapp.

Great Bay Watch: A Citizens Water Quality Monitoring Program. 1990. Meeker, Bonnie S. and Ann S. Reid. Durham, NH: UNH Cooperative Extension Sea Grant.

Monitor's Guide to Aquatic Macroinvertebrates. 1994. Kellogg, Loren Larkin. Gaithersburg, MD: Izaak Walton League of America, Save Our Streams Program.

The Monitor's Handbook. 1992. Fisher, Nina, ed. Chestertown, MD: LaMotte Company.

Plain Talk About Drinking Water. 1997. Symons, Dr. James M. Denver, CO: American Water Works Association.

Plants in Wetlands. 1994. Redington, Charles B. Dubuque, IO: Kendall/Hunt Publishing Company.

Stream Watch: Comprehensive Water Quality Monitoring Program Volunteer Monitors Handbook. 1995. Pennington, NJ: Stony Brook-Millstone Watershed Association.

Volunteer Estuary Monitoring: A Methods Manual #842-B-93-004. 1993. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

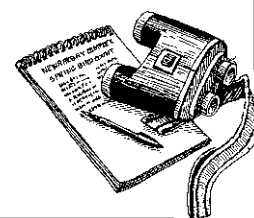
Volunteer Lake Monitoring: A Methods Manual #440/4-91-002. 1991. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

The Volunteer Monitor (newsletter). Baltimore, MD: Alliance for the Chesapeake Bay. 410-377-6270.

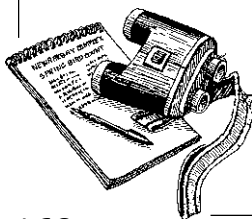
Volunteer Stream Monitoring: A Methods Manual # 841-B-97-003. 1997. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

Water Quality Monitoring Program: Leader's Handbook #ER-SP-EE-107A/93. 1985. Harrisburg, PA: Commonwealth of Pennsylvania, Department of Environmental Resources.

Water Quality Indicators Guide: Surface Water #SCS-TP-161. 1991. Terrell, Charles R. and Dr. Patricia Bytnar Perfetti. Washington, DC: United States Department of Agriculture, Soil Conservation Service.



NOTES




APPENDIX A

Advisories for Eating Fish & Crabs Caught in the Newark Bay Complex

To view these advisories on the Internet visit: www.nj.gov/dep/dsr/njmainfish.htm

FISH AND CRAB CONSUMPTION ADVISORIES BASED ON PCBs or DIOXIN CONTAMINATION

LOCATION	SPECIES	ADVISORY/PROHIBITION		
		General Population ^{1,2} Range of Recommended Meal Frequency		High-Risk Individual ^{2,3} Recommended Meal Frequency
		Lifetime Cancer Risk of 1 in 10,000	Lifetime Cancer Risk of 1 in 100,000	
		DO NOT EAT MORE THAN	DO NOT EAT MORE THAN	DO NOT EAT MORE THAN
Newark Bay Complex (for other species see Statewide advisories) ⁴				
This complex includes Newark Bay, Hackensack River downstream of Oradell Dam, Arthur Kill, Kill Van Kull, tidal portions of all rivers and streams that feed into these water bodies.	Blue crab*	Do not eat or harvest ⁵		
	Striped bass*	Do not eat		Do not eat
	American eel*	One meal per year	Do not eat	Do not eat
	White perch			
	White catfish			
Passaic River downstream of Dundee Dam and streams that feed into this section of the river.	All fish and shellfish*	Do not eat		Do not eat
	Blue crab*	Do not eat or harvest ⁵		
New Jersey Statewide - All Water Bodies (for areas without specific advisories)				
	Bluefish (over 6 lbs/24 inches)	Four meals per year	Do not eat	Do not eat
	Bluefish (less than 6 lbs/24 inches)	Once a month	One meal per year	Do not eat

* Selling any of these species from designated water bodies is prohibited in New Jersey (N.J.A.C. 7:25-18A.4).

1 Range of Recommended Meal Frequency corresponds to a cancer risk of 1 in 10,000 to 1 in 100,000 over a lifetime.

2 Eat only the fillet portions of the fish. Use proper trimming techniques to remove fat, and cooking methods that allow juices to drain from the fish (e.g., baking, broiling, frying, grilling, and steaming). See text for full description. One meal is defined as an eight-ounce serving.

3 High-risk individuals include infants, children, pregnant women, nursing mothers and women of childbearing age.

4 Advisories based on dioxin remain in effect for American lobster; and the Newark Bay Complex, except for white perch, white catfish, and American eel, which are based on PCBs.

5 No harvest means no taking or attempting to take any blue crabs from these waters.

APPENDIX B

Sample

Community Awareness Sign

Regarding Blue Crabs in the Newark Bay Complex



APPENDIX C

Field Trip Suggestions

(Get Your Hands & Feet Wet)

Edison National Historic Site

National Park Service
Main Street & Lakeside Avenue
West Orange, NJ 07052
(973) 736-0550
www.fieldtrip.com/nj/17360550.htm

Flat Rock Brook Nature Center

443 Van Nostrand Avenue
Englewood, NJ 07631
(201) 567-1265
<http://www.flatrockbrook.org>

Fort Lee Historic Park

Hudson Terrace
Fort Lee, NJ 07024
(201) 461-1776
www.fieldtrip.com/nj/14611776.htm

Hackensack RiverKeeper, Inc.

231 Main Street
Hackensack, NJ 07601
(201) 968-0808
www.hackensackriverkeeper.org

Jersey City Museum

472 Jersey Avenue
Jersey City, NJ 07303
(201) 547-4514
www.jerseycitymuseum.org

Liberty Science Center

Liberty State Park
Jersey City, NJ 07305
(201) 200-1000
www.lsc.org

Liberty State Park Interpretive Center

Freedom Way
Jersey City, NJ 07305
www.libertystatepark.com

Meadowlands Museum

91 Crane Avenue
Rutherford, NJ 07070
(201) 935-1175
www.fieldtrip.com/nj/19351175.htm

Museum of Early Trades & Crafts

Main Street at Green Village Road
Madison, NJ 07940
(973) 377-2982
www.rosenet.org/metc

Newark International Airport

Tour for grades 3-12
Port Authority of NY & NJ
Newark, NJ 07114
(973) 961-6264
www.fieldtrip.com/nj/19616264.htm

New Jersey Historical Society

52 Park Place
Newark, NJ 07102
(973) 596-8500
www.jerseyhistory.org

New Jersey Meadowlands Environment Center

2 DeKorte Park Plaza
Lyndhurst, NJ 07071
(201) 460-1700
www.meadowlands.state.nj.us

APPENDIX C (continued)

Field Trip Suggestions

(Get Your Hands & Feet Wet)

The Newark Museum

49 Washington Street
Newark, NJ 07101
(201) 596-6550
www.newarkmuseum.org

Paterson Museum

2 Market Street
Paterson, NJ 07501
(973) 881-3874
www.fieldtrip.com/nj/18813874.htm

Stueben House (historical site)

River Edge, NJ 07661
(201) 487-1739

Tenaflly Nature Center

313 Hudson Avenue
Tenaflly, NJ 07670
(201) 568-6093
www.tenafllynaturecenter.org

TurtleBack Zoo

560 Northfield Avenue
West Orange, NJ 07052
(973) 731-5800
www.turtlebackzoo.org

APPENDIX D

Who to Contact for Information



Can I Ask
You a Question?

BUSINESS / COMMERCIAL

Bergen County Utilities Authority

Foot of Mehrhof Road
PO Box 9
Little Ferry, NJ 07643
(201) 641-2552
www.bcua.org

**Public Service Electric & Gas,
The Electric Universe**

80 Park Plaza
Newark, NJ 07101
<http://pseg.electricuniverse.com>

Passaic Valley Water Commission

1525 Main Avenue
Clifton, NJ 07011
(201) 340-4300
www.pvwc.com

United Water New Jersey

200 Old Hook Road
Harrington Park, NJ 07640
(201) 767-9300
www.unitedwater.com/uwnj

Port Authority of New York & New Jersey

260 Kellogg Street
Port Newark, NJ 07114
(973) 589-7100
www.panynj.com

EDUCATION / UNIVERSITY

**Environmental & Occupational Health
Sciences Institute (EOHSI)**

Resource Center, Right To Know Information
UMDNJ
Robert Wood Johnson Medical School
Brookwood II
45 Knightsbridge Road
Piscataway, NJ 08854
(908) 463-5353
www.eohsi.rutgers.edu

Institute of Marine & Coastal Sciences

Rutgers University
P.O. Box 231
New Brunswick, NJ 08903
<http://marine.rutgers.edu>

Rutgers University

www.rutgers.edu

Fairleigh Dickinson University

www.fdu.edu

APPENDIX D (continued)

Who to Contact for Information

ENVIRONMENTAL

Clean Ocean Action

P.O. Box 505
Highlands, NJ 07732
(732) 872-0111
www.cleanoceanaction.org

Greater Newark Conservancy

303-9 Washington Street
Newark, NJ 07102
(201) 642-4646
www.citybloom.org

**The New Jersey Meadowlands
Environment Center**

2 DeKorte Park Plaza
Lyndhurst, NJ 07071
(201) 460-1700
www.meadowlands.state.nj.us

Hackensack RiverKeeper, Inc.

231 Main Street
Hackensack, NJ 07601
(201) 968-0808
www.hackensackriverkeeper.org

Hudson River Sloop Clearwater, Inc.

112 Little Market Street
Poughkeepsie, NY 12601
(914) 454-7673
www.clearwater.org

Hudson Waterfront Museum

P.O. Box 1602
West New York, NJ 07093
(201) 433-8229

Ironbound Community Corporation

51 McWhorter Avenue
Newark, NJ 07105
(201) 589-3353

New Jersey Marine Science Consortium

Sandy Hook Field Station, Building 22
Fort Hancock, NJ 07732
(732) 872-1300
www.njmsc.org

New Jersey Audubon Society

Department of Education
c/o Scherman/Hoffman Wildlife Sanctuary
PO Box 693
Bernardsville, NJ 07924
www.njaudubon.org

NY/NJ BayKeeper / Raritan Riverkeeper

Sandy Hook Marine Laboratory
Building 18
Highlands, NJ 07732
(732) 291-0176
www.nynjbaykeeper.org

Passaic River Coalition

246 Madisonville Road
Basking Ridge, NJ 07920
(908) 766-7550
www.passaicriver.org

Rutgers Environmental Law Clinic

15 Washington Street, Room 334
Newark, NJ 07102-3192
(201) 648-5576

Turtle Back Zoo

560 Northfield Avenue
West Orange, NJ 07052
(201) 731-5801
www.turtlebackzoo.org

APPENDIX D (continued)

Who to Contact for Information

FISHING

Jersey Coast Anglers Association

1201 Route 37 East, Suite 9

Toms River, NJ 08752

(732) 506-6565

www.jcaa.org

**Harbor Watershed Education
and Urban Fishing Program**

www.state.nj.us/dep/dsr/urban-fishing.htm

**The New Jersey Chapter of the
Hudson River Fisherman's Association**

P.O. Box 421

Cresskill, NJ 07626

(201) 869-7843 or (201) 837-2400

www.hrfan.org

GOVERNMENT

Fish & Seafood Development Program

New Jersey Department of Agriculture

PO Box 330, 2nd Floor, Room 204

Trenton, NJ 08625

U.S. Environmental Protection Agency

National Estuary Program

NY/NJ Harbor Estuary

www.epa.gov/owow/estuaries

New Jersey Department of

Environmental Protection

Division of Science, Research & Technology

PO Box 409

401 East State Street, 1st Floor

Trenton, NJ 08625-0409

www.state.nj.us/dep/dsr

New Jersey Department of

Environmental Protection

Division of Watershed Management

PO Box 418

Trenton, NJ 08625

www.state.nj.us/dep/watershedmgt

New Jersey Department of

Environmental Protection

Division of Fish & Wildlife

PO Box 400

501 East State Street, Floor 3

Trenton, NJ 08625-0400

www.state.nj.us/dep/fgw

New Jersey Marine Education Association

hometown.aol.com/newjerseymeag

APPENDIX D (continued)

Who to Contact for Information

REGULATORY / ENFORCEMENT

**New Jersey State Police
Patrol Support Bureau**

Marine Services Unit
P.O. Box 7068
West Trenton, NJ 08628-0068
(609) 882-2000 Ext. 6181

**New Jersey Department of
Environmental Protection
Compliance and Enforcement**

1-877-WARNDEP
www.state.nj.us/dep/enforcement

**U.S. Coast Guard
Marine Safety, Security
and Environmental Protection**

www.uscg.mil/hq/g-m

APPENDIX E

Public Access To Our Waterways

(It's Closer Than You Think)

ARTHUR KILL & TRIBUTARIES

Carteret Pier

Carteret

Elizabeth Marina

First Street

Elizabeth

Perth Amboy Marina

Smith Street

Perth Amboy

Woodbridge Boat Launch

Cliff Road and Ferry Street

Woodbridge

HACKENSACK RIVER

Hackensack River County Park

Access at Riverside Square Mall (Rt. 4)

Hackensack

Losen Slote Creek Park

Merhrhof Road

Little Ferry

Laurel Hill County Park Public Boat Launch

New County Road

Secaucus

Snipes Park

Meadowlands Parkway

Secaucus

New Jersey Meadowlands Commission

2 DeKorte Park Plaza (and end of Valley Brook Ave.)

Lyndhurst

Mill Creek Park

Mill Creek Road

Secaucus

The Alfis Tract

End of River Lane

New Milford

Overpeck Park

Fort Lee Road

Teaneck, Leonia, Palisades Park, and Ridgefield Park

Waterside Park

Behind Department of Public Works on

Industrial Avenue

Ridgefield Park

Hackensack River Greenway

Through Teaneck Access – River Road

Teaneck

River Edge Municipal Canoe Launch

Riverside Way (far end of River Edge Swim

Club parking lot)

River Edge

APPENDIX E (continued)

Public Access To Our Waterways

(It's Closer Than You Think)

KILL VAN KULL

Mayor Dennis P. Collins Park

West 1st Street

Bayonne

NEWARK BAY

DiDomenico Park

16th Street

Bayonne

Hudson County Park

Bayonne

Ahern Veterans Memorial Park

West 25th Street

Bayonne

PASSAIC RIVER

Gunnel Oval Park

Schuyler Avenue

Kearny

E.J. Vincent Waterfront Park

Bergen Avenue

Kearny

River Bank Park

Jackson Street Bridge

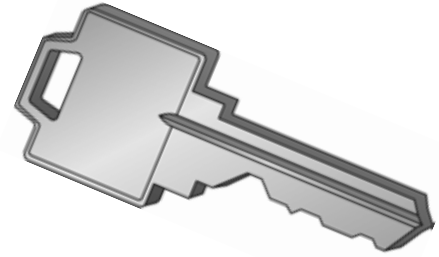
Newark

Nutley Municipal Ramp

Park Avenue

Nutley

Keyword Glossary



A

- Adaptation** 🔑 Any physical or behavioral characteristic of a plant or animal that enhances the species' ability to survive.
- Anadromous** 🔑 Migrating from the sea up a river to spawn.
- Anatomy** 🔑 The science that deals with plant and/or animal structure.
- Angle** 🔑 To fish with hook and line.
- Angler** 🔑 A person who fishes with a hook and line.
- Aquatic** 🔑 Living mostly or all the time in water.

B

- Basalt** 🔑 A dark-colored, fine-grained, extrusive igneous rock.
- Bedrock** 🔑 The solid rock that underlies unconsolidated surface materials such as soil.
- Bioaccumulation** 🔑 The storing of contaminants in living tissue, which can be transferred to other organisms, including humans, through the food web.
- Biomagnification** 🔑 The accumulation of substances in larger and larger quantities in the bodies of organisms at each higher level of the food chain.
- Brackish** 🔑 Water containing both salt and freshwater, as in an estuary.

C

- Camouflage** 🔑 Specific colors and/or patterns in an animal that enable it to blend into its surroundings and be less visible to its predators or prey.
- Cartographer** 🔑 A person who draws maps.
- Catadromous** 🔑 Migrating down a river to the sea to spawn.
- Channel** 🔑 The bed of a stream or waterway.
- Commercial fishing** 🔑 The industry of catching fish and other aquatic animals to sell for food.
- Consumer** 🔑 An organism that feeds on plants or animals, living or dead, to fuel its metabolism.
- Contaminate** 🔑 To render impure or unsuitable by contact or mixture with something unclean.
- Contamination** 🔑 The act of contaminating.
- Contour lines** 🔑 A drawn line on a map that connects all the contiguous land that is the same elevation.

D

- Decomposer** 🔑 Plants or animals (mostly fungi and bacteria) that, as a byproduct of their metabolism, reduce organic

material to simpler organic and inorganic forms.

Detritus 🌀 Dead and decomposing organic material.

Diabase 🌀 A dark-colored, medium-grained, intrusive igneous rock.

Dioxins 🌀 Chemical byproducts of the manufacture of certain herbicides; U.S. EPA lists as probably cancer-causing substances.

Drainage basin 🌀 The largest watershed management unit which generally drains into a major water body such as a large river, bay or estuary, or lake. These generally cover several thousand square miles.

E

Ecosystem 🌀 A stable and self-perpetuating ecological unit in nature created by the interaction between living organisms and the non-living physical environment.

Elevation 🌀 The height to which a landform is raised above sea level.

Erosion 🌀 The wearing away of land due to natural processes (wind and water). Human practices, including deforestation and construction, hasten the rate of these processes.

Estuarine 🌀 Of or pertaining to an estuary

Estuary 🌀 A semi-enclosed coastal body of water which connects to the ocean and within which the salt water is diluted by fresh water from land drainage (brackish water).

F

Fishery 🌀 A place for catching fish and other aquatic animals.

Food chain 🌀 The transfer of food energy from producers through a series of consumers.

Food web 🌀 A series of food chains that are interconnected.

Freshwater marsh 🌀 A permanently wet area with a cover of non-woody vegetation.

G

Geology 🌀 The science that deals with the physical history of the earth.

Glacial lake 🌀 A lake created by glacial action.

Glacier 🌀 A thick sheet of ice formed when successive snowfalls accumulate at a rate exceeding the rate of melting.

Granite 🌀 A light-colored, coarse-grained igneous rock.

Granite gneiss 🌀 A metamorphic rock that began as granite, but was changed through intense heat and pressure over a long period of time.

Ground truth 🌀 The process of comparing a map against the actual site the map represents.

H

Habitat 🌀 The natural environment of an organism where it finds enough food, water, shelter, and space to live its full life cycle and reproduce others of its kind.

Headwaters 🗝️ The uppermost reaches of a river, stream or watershed.

I

Indicator species 🗝️ A plant or animal that indicates, by its presence in a given area, the existence of certain environmental conditions.

Inorganic 🗝️ Not of, or from, living material and does not contain carbon.

L

Land reclamation 🗝️ The act of restoring land to its original state prior to human development or manipulation.

Land use 🗝️ A description of how the surface of the earth is utilized for human endeavors.

Land use management 🗝️ Directing the use of specific parcels of land for specific purposes.

Land use planning 🗝️ To create a set of regulations or guidelines that direct the use of specific land areas.

Landform 🗝️ A natural feature of a land surface, e.g., mountain, lake, ridge, plateau, etc.

M

Migration 🗝️ The seasonal movement of populations of a species from one location to another.

Mitigation 🗝️ The replacement of natural habitat lost during human development of an area.

N

Natural resource 🗝️ Any materials supplied by nature.

Non-point source pollution 🗝️ Contaminants that originate from many sources, such as lawn herbicides, road pollution, animal waste, etc.; sometimes called “people pollution.”

O

Organic 🗝️ Material that contains carbon

P

PCBs 🗝️ Synthetic chemical compounds used mostly in the production of electrical equipment such as transformers and capacitors. These toxic substances have been determined to cause a variety of health problems.

Point source pollution 🗝️ Contaminants that originate from specific place, like the end of a discharge pipe or factory.

Producer 🗝️ Organisms that do not get their energy from retain other plants or animals. Producers are primarily green plants.

Protective coloration 🗝️ Any pattern or camouflage that helps an organism blend into its surroundings and thus gives it protection from predators.

R

Recreational fishing 🗝️ The sport of fishing where individuals catch fish and/or catch and release fish for pleasure.

River mouth 🏹 The downstream end of a river where it enters an ocean or other larger body of water.

S

Salt marsh 🏹 A wet area formed wherever shallow, sheltered ocean waters meet a gently sloping coast. The ecology of these areas is ruled by the twice daily flooding by salt water at high tides.

Sandstone 🏹 A rock formed from sand.

Sediment 🏹 Mineral or organic matter deposited by water, air or ice.

Shale 🏹 Fine-grained sedimentary rock composed of clay and silt.

Slope 🏹 The angle that is created between the top of a hill and the valley floor.

Spawn 🏹 To deposit eggs or sperm directly into the water, as fish do.

Subsistence fishing 🏹 The act of fishing which provides the major source of protein for an angler and his/her family.

T

Terminal moraine 🏹 A ridge of unconsolidated boulders, gravel and sand deposited at the end of a glacier's extent.

Tidal influence 🏹 Affected by the ocean's tide.

Tidal marsh 🏹 A wet area along the edge of a river or stream that is affected by the ocean tides.

Topographic map 🏹 A type of map that uses contour lines to represent changes in elevation and landforms.

Topography 🏹 The relief features or surface configuration of an area.

Tributary 🏹 Any stream or river that flows into a major river.

U

Upland 🏹 An area of higher elevation.

W

Watercourse 🏹 A stream of water, such as a river or a brook.

Watershed 🏹 The land area where water drains into an individual stream, lake, or other body of water.

Waterway 🏹 A river, canal or other body of water used as a route or way for transportation.

Z

Zoning 🏹 Of or pertaining to the division of a town or city into land use types.

APPENDIX G

Education Resources List

Aquatic Project WILD - Aquatic Education Activity Guide. Western Regional Environmental Education Council, Boulder, CO. 1987.

Bottle Biology - Mrill Ingram Kendall/Hunt Publishing Company, Dubuque, IO. 1993.

Bridges to the Natural World: A Natural History Guide for Teachers in Grades Pre-K to Six - Patricia Kane, et al. New Jersey Audubon Society, Franklin Lakes, NJ. 1991, Revised 2003.

Delaware Estuary Issues, US EPA, US Fish & Wildlife Service

Fishways, Ontario Ministry of Natural Resources 1991.

Ranger Rick's Nature Scope - Geology: The Active Earth. National Wildlife Federation, Washington, DC. 1988.

Ranger Rick's Nature Scope - Wading into Wetlands. National Wildlife Federation, Washington, DC. 1986.

Hooked on Fishing - Not on Drugs, Aquatic Resources Education Curriculum. Sport Fishing Association, Future Fisherman Foundation, Alexandria, VA.

Keepers of the Earth: Native American Stories and Environmental Activities for Children - Michael J. Caduto and Joseph Bruchac. Fulcrum, Inc., Golden, CO. 1988.

New Jersey WATERS: A Watershed Approach to Teaching the Ecology of Regional Systems - Dale A. Rosselet, et al. New Jersey Audubon Society, Bernardsville, NJ. 1999.

Project Learning Tree: Environmental Education Activity Guide (Pre K - 8). American Forest Foundation, Washington, DC. 1994.

Project WET Curriculum and Activity Guide. The Watercourse and Western Regional Environmental Education Council, Montana State University, Bozeman, MT. 1995.

Project WILD Elementary Activity Guide. Western Regional Environmental Education Council, Boulder, CO. 1983.

Sustaining the Future: Activities for Environmental Education in US History - Jeffrey L. Brown, editor. Global Learning, Inc., Union, NJ. 1995.

The Biology of the Hudson-Raritan Estuary: A Teacher's Guide. New Jersey Marine Sciences Consortium, Sandy Hook, NJ. 1998.

The Lenape or Delaware Indians - Herbert C. Kraft. Archaeological Research Center, Seton Hall University Museum, South Orange, NJ. 1996.

The Living Tidal Marsh Teacher's Guide - Grades 7-12. Public Service Electric & Gas, Newark, NJ.

The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of New York City's Water Supplies - Kathleen M. Haskin. Frost Valley YMCA, Claryville, NY. 1995.

WET in the City: Water Education for Teachers - Curriculum and Activity Guide K-12. Council for Environmental Education, Houston, TX. 1999.

WOW! The Wonders of Wetlands. Environmental Concern, Inc. and The Watercourse, Montana State University, Bozeman, MT. 1995.

Young People's Guide to Saltwater / Freshwater Fishing - Eleanor A. Bochenek. New Jersey SeaGrant Marine Advisory Service, Rutgers cooperative Extension

"Jersey Journeys." New Jersey Historical Society, 230 Broadway, Newark, NJ 07104.

"The Trashy History of the Meadowlands" - Robert Sikora. Hackensack Meadowlands Development Commission Environment Center, Lyndhurst, NJ.

NOTES

