project PORTS

Promoting Oyster Restoration Through Schools

An Oyster-focused Outreach Initiative of the Haskin Shellfish Research Laboratory, Rutgers University

Curriculum & Activity Guide for Grades 3 through 8

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The Delaware Estuary

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Curriculum Guide

Seeding the future: Inspiring youth to care for the environment

How to use the guide.

The Curriculum Guide is divided into three main volumes, each presenting lessons on one of three themes: the Delaware Estuary, the history of the Delaware Bay oyster fishery, and oyster biology and ecology. Each volume contains a Primer, which presents in depth background information for the educator, and a series of classroom activities and lessons. Most activities included within are written in a class-ready form; however, some activities may require specialized materials. Please contact the Project PORTS coordinator for assistance with material acquisition and technical support.

The eastern oyster ***Crassostrea virginica*** is one of, if not the most important species of the Delaware Estuary. Dating back thousands of years the oyster has served as a keystone organism in the estuary, promoting water quality and providing food, habitat, and refuge to countless organisms. The oyster has also served as a principle Delaware Bay fishery holding both social and cultural significance to Bayshore communities.

Project PORTS: Promoting Oyster Restoration Through Schools is a community-based oyster restoration and educational program focusing on the importance of oyster populations in the Delaware Bay ecosystem. The goal of the program is to: increase an awareness and understanding of the oyster as a critical species and an important natural resource of the Bay; to promote an understanding of basic scientific concepts and stewardship values; and to contribute to the revitalization of Delaware Bay oyster populations.

Project PORTS presents the oyster resource of Delaware Bay as an ideal vehicle for problem-based, experiential learning in the K-12 educational setting. The oyster serves as a focal point for the integration of interdisciplinary scientific topics, the local environment, and local history. The strategy of Project PORTS is to promote hands-on activities and to emphasize the local significance of the issue. The Project has three main components. (1) Workshops offer educators an opportunity to learn about the Delaware Bay and its oyster resource directly from scientists and resource managers. (2) “Oyster-focused” classroom curriculum materials enable teachers to extend these lessons to their students. (3) A community-based oyster restoration project gives school communities the opportunity to contribute to the revitalization of Delaware Bay oyster populations. The restoration component is central to Project PORTS as it offers educators, students, and their families an opportunity to experience the Delaware Estuary, oyster ecology, and environmental stewardship first hand, while at the same time enhancing critical oyster habitat in the Delaware Bay. Project PORTS educational resources are designed to supplement current school curricula and to address NJDOE Core Curriculum Content Standards.

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Primer 1. Discovering the Delaware Bay

The Delaware Estuary is the region where waters from the Delaware River and the Atlantic Ocean meet. Estuaries are dynamic systems where tidal and river currents mix fresh river water with salty ocean water. As a result the salt content, or salinity, of estuarine waters vary from fresh to brackish to salt water.

The Delaware Estuary is about 75 miles long extending from Trenton, New Jersey and Morrisville, Pennsylvania south to Cape May, New Jersey and Cape Henlopen, Delaware. The major source of fresh water flow into the Delaware Estuary is the Delaware River, which stretches about 200 miles north of Trenton. The Delaware River watershed drains an area of 13,500 miles that includes parts of Pennsylvania, New York, and New Jersey. The Delaware River watershed is comprised of some 216 smaller tributaries, which include the Schuylkill, Maurice, Cohansey, Mispillion, Broadkill, and Smyrna Rivers among others. These tributaries receive rain and snowmelt waters from surrounding lands. The water that flows across the land surface is termed runoff. The Estuary also receives direct flow from surrounding land and marshes; much of which is ground water (water located below the land) that percolates up as the tide ebbs.

Estuaries serve as vital habitats and critical nursery grounds for many species of plants and animals. The Delaware Estuary is home to more than 130 species, including, finfish, crabs, clams, and oysters. The Delaware Estuary is also well known for the large populations of migratory shorebirds that utilize its shores and its large population of horseshoe crabs. The Estuary has the second largest concentration of migratory shorebirds in the Western Hemisphere and the largest population of spawning horseshoe crabs in the world.

Estuaries are also important to humans as we rely on them for food, drinking water, industry, and recreation. More than 5 million people live in the Delaware Estuary region. The three major cities located on the Estuary, Philadelphia, Pennsylvania, Wilmington, Delaware, and Camden, New Jersey represent the main population centers as well as sites of significant ports and industrial activities; including major petrochemical refineries. The Delaware River is the largest freshwater port in the world. The estuary is also important for its commercial fishery production of oysters, crabs, weakfish, bluefish, shad, and other finfish. In addition to these species important recreational fisheries include striped bass, flounder/fluke, black drum, perch, and many others.

Contents:

Related Vocabulary

Estuary—an area partially surrounded by land where fresh and salt water meet.

Watershed—an area of land drained by a river or other body of water.

Salinity—the salt content of water. Estuarine waters vary from fresh (no salt) to marine (salty ocean water).

Habitat—the place where a plant or animal grows or lives in nature.

Nursery ground—habitats of young-fish and shellfish. Such areas provide food and protection for the young animals.

Fishery—the business of catching fish and shellfish, or the population of fish or shellfish that are being targeted for catching.

Figure 1: Map of the Delaware Estuary. By David Barczak. Courtesy of the University of Delaware, Sea Grant College Program. Reprinted from *The Delaware Estuary.* T.L. Bryant and J.R. Pennock, Editors.

Activity 1.1

An Estuary Nearby: A Scavenger Hunt Mapping Exercise

- Grade Level
  3-5
- Subject Areas
  Science, Social Studies
- Duration
  1 class period
- Setting
  Classroom, computer lab
- Skills
  Mapping, interpreting, computing
- Vocabulary
  Estuary, Salinity, Watershed, Runoff
- Correlation with NJ Core Curriculum Content Standards
  5.8.2B, 5.8.4B, 5.8.4C, 5.8.4D, 5.8.6D, 6.6.4B

Materials:

- ☐ Copies of Delaware Estuary watershed map, New Jersey, and county road maps
- ☐ Student Worksheet-Activity 1.1
- ☐ Transparency films
- ☐ Marking pens
- ☐ Computers with internet-access
- ☐ Stick on stars or other symbols

Charting the Course

In this exercise students will learn about estuaries and watersheds and become familiar with the geography of the Delaware Bay region. They will gain their sense of place within the area by locating and mapping their school in relation to the geography of the Bayshore region. This lesson has two parts. In Part 1 the activity takes shape as a mapping scavenger hunt. In Part 2 students employ computer skills to conduct a mapping exercise using the internet.

Objectives / Students will be able to:

1. Describe what an estuary is.
2. Locate the Delaware Estuary on a map.
3. Recognize that many tributaries and streams flow into the estuary.
4. Locate their "space" (school) and other major geographical features in relation to the estuary.

Procedure / Warm Up

Open a class discussion about what estuaries and watersheds are. ***Ask: What is the nearest bodies of water are and if they lead to a bay. What bay?*** Review the basic features of a map.

The Activity [Part I]

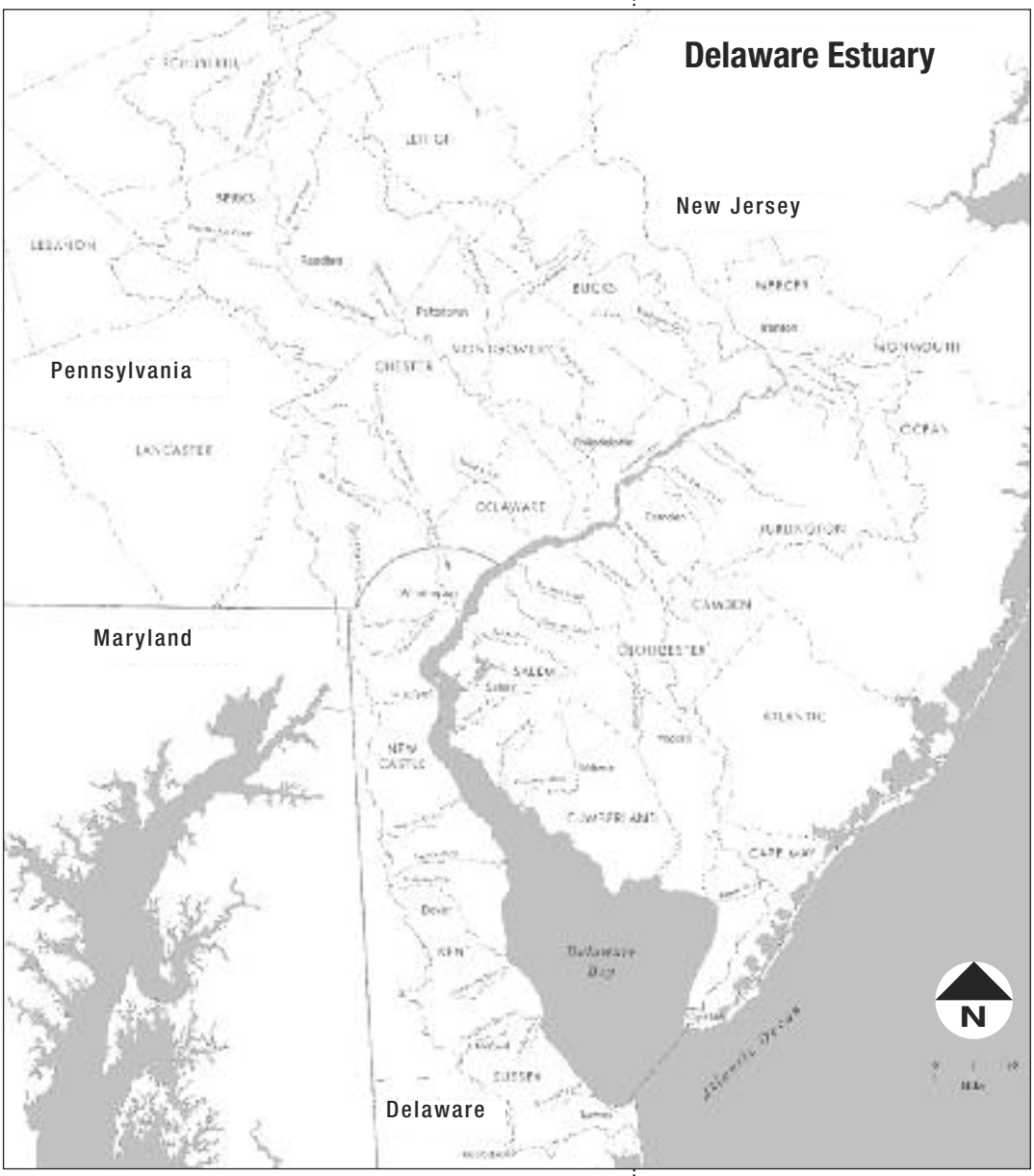
1. Divide class into groups of 2 to 3 students.
2. Hand out transparency films and original or copies of road maps of your area (map should include Delaware Bay).
3. Ask students to locate their school on the map (or have a star on map designating the location of your school).
4. If not already marked, have students place a stick-on-star on location.
5. Now students should trace on the transparency the outline of the land/bay margin and mark the location of the school.
6. Using the Scavenger-Map Activity hand out, students should find, trace on the transparency and label the following items:
   1. The Atlantic Ocean
   2. North, south, east and west
   3. The major body of water located west of your school
   4. The largest river on the map
   5. The river closest to your school that flows into the Delaware Bay
   6. Two other rivers
   7. Two states bordering the Delaware Bay
   8. The capital of New Jersey
   9. A city located on the Delaware Bay/Delaware River
   10. The source of salt water that enters the Delaware Bay
   11. The major source of fresh water that enters the Delaware Bay (largest river)
   12. A place where they would like to explore, fish, or just hang-out.
   13. Locate their school (approximately) and the tributaries that they identified as being nearest to their school.
   14. They should identify the other tributaries that they traced.
   15. Follow the Bay to the Delaware River, and follow the River as far as it goes. ***Ask: Where does it begin?***

The Activity [Part II]

1. Have students log on to http://maps.google.com/. (For more advanced classes have students work with Google Earth, which can be downloaded for free)
2. Search the map for their school (eg. D'Ippolito School, Vineland, NJ).
3. Change the format to hybrid (this will combine satellite image with overlaid road drawings).
4. Have students point out rivers, creeks, and streams on the map.
5. Follow the most prominent waterway as far as it will go. (Students will likely see creeks, moving toward rivers, ponds, and lakes; many will ultimately lead to the Delaware Estuary).
6. Based on the previous exercise can they identify the water body?

Wrap Up / Have students discuss what they learned through this exercise.
Ask: Can you name any creeks, rivers, or bays that are located near our school, within our county, or in Southern New Jersey?

Extensions / Introduce the concept of non-point source pollution. Participate in storm drain mapping activities available through state agencies and other organizations. More advanced students can be asked to investigate fresh water diversion issues, the use of water outside the watershed. For instance, New York City draws a huge volume of water from the Delaware River for drinking water. This can significantly impact the estuary.



Activity 1.2

Going with the Flow: Constructing a Watershed Model

- Grade Level
  3-4
- Subject Areas
  Science, Social Studies
- Duration
  1-2 class periods
- Setting
  Classroom
- Skills
  Modeling, constructing, describing
- Vocabulary
  Watershed, Runoff
- Correlation with NJ Core Curriculum Content Standards
  5.8.4B, 5.8.6B, 5.8.6C, 6,6.4C, 6.6.8B

Materials:

- ☐ Modeling clay or dough
- ☐ Small paint trays or tray liners
- ☐ Paints and other materials to construct landscape features (ie. Coffee, or sand may be used for dirt, small pieces of felt or scrubbing pads can be used for marshes)

Charting the Course
In this exercise students will construct a model of a watershed.

Background
The Delaware River and the Delaware Bay receive water draining directly from surrounding land through ground (underground wells) and surface water, as well as from many smaller rivers, lakes and streams. The entire area of land that drains into a particular water body is called a watershed. Watersheds are separated from one another by elevations in the area such as slopes and hills. The Delaware River, which is the main source of fresh water into the Delaware Estuary originates in New York. The River receives water from some 200 smaller rivers and the entire Delaware River watershed encompasses about 13,500 square miles.

Objectives / Students will be able to:
1. Describe what a watershed is.
2. Describe the many ways that water enters the Bay.
3. Construct a model watershed.

Procedure / Warm Up
Open a class discussion about estuaries and watersheds by asking how does water enter the bay? Define what a watershed is and talk about how human activities can affect the quality of the water in the bay.

The Activity

1. Have students work individually or in teams of two-four students.
2. Distribute materials.
3. Instruct students to construct their own model of a watershed with the main criteria being that water must flow from higher lands to lower lands and flow into a bay. Students may model the adjacent lands for any use, but they should be prepared to describe how the land use might affect the body of water in their model. Encourage students to name the main features of their models

Wrap Up / Have students present their models to the class and discuss the impact of the associated land use.

Extensions / Introduce the concept of non-point source pollution.
Storm drain mapping activities are available through the state and other organizations. Invite the Watershed Ambassador for your region to visit the class for additional lessons on watershed issues (A written invitation presents a great writing exercise for students). See www.state.nj.us/dep/seeds/njwap.htm for more information.

Activity 1.3

Life in the Estuary

Charting the Course
In this exercise students will become acquainted with the many plants and animals of the Estuary as they search for information about the appearance and life history of a particular species. Students will prepare reports and share information with their classmates orally and via a field guide, which the class constructs.

Background
The Delaware Estuary provides important habitat to a variety of plants animals. More than 130 species live in the Estuary. The Delaware Estuary is noted for being a vital habitat for migratory shorebirds and for having the largest population of spawning horseshoe crabs in the world.

Objectives / Students will be able to:
1. Name important animals and plants of the Delaware Estuary.
2. Relate key life history characteristics of prominent estuarine species.

Procedure / Warm Up
Open a class discussion about how estuaries support a diverse suite of organisms. Ask students if they can name an animal that lives in the bay.

The Activity

1. Have students select a plant or animal from the species list in Table 1.
2. Have students conduct research/report on their species finding information indicated on the student report worksheet.
3. Have students orally present their research.
4. Construct class "Field Guide of Delaware Estuary Plants and Animals" by compiling student reports.

TABLE 1

Animals of the Delaware Estuary

Fish	Shellfish
American Shad	Eastern Oyster
Striped Bass	Channeled Whelk
Spot	Oyster Drill
Clearnose Skate	Blue Mussel
Winter Flounder	Ribbed Mussel
Atlantic Sturgeon	Blue Crab
Summer Flounder	Atlantic Horseshoe Crab
Bay Anchovy	Black Fingered Mud Crab
Weakfish	Common Razor Clam
Atlantic Menhaden	Hard shell Clam
Angel Shark	
Black Drum	

Wrap Up / Share knowledge through oral presentations. Conduct a class discussion about which animals/plants students found most interesting.

- Grade Level
  3-5
- Subject Areas
  Science, Language Arts
- Duration
  1-2 class periods plus independent work time
- Setting
  Classroom
- Skills
  Reading, research, writing
- Vocabulary
  Habitat, Ecosystem
- Correlation with NJ Core Curriculum Content Standards
  5.4A, 5.6.2A, 5.5.2B, 5.5.4.C, 5.5.6C

Materials:

- ☐ Delaware Estuary animals list
- ☐ Student Worksheet-Activity 1.3
- ☐ Reference materials (books, internet, others information sources)
- ☐ Binders and materials for compilation of reports/Field Guide construction

Activity 1.4

- Grade Level
  6-8
- Subject Areas
  Science, Social Studies, Mathematics
- Duration
  1-2 class periods
- Setting
  Classroom
- Skills
  Modeling, constructing, describing
- Vocabulary
  Salinity, Gradient, Euryhaline, parts-per-thousand (ppt)
- Correlation with NJ Core Curriculum Content Standards
  5.18A, 5.3.4C, 5.6.2D, 5.8.4D. 5.8.6D

Materials:

- ☐ Beads (large and small), and string for stringing beads
- ☐ Cards with salinity of a particular site and time
- ☐ Map of the Delaware Estuary with sample sites marked (Student Handout-Activity 1.4/5)
- ☐ Monthly salinity data set

Taking it with a Grain of Salt

Charting the Course
In this exercise students will explore how salinity varies in space and time in the Estuary. Students will construct bead necklaces with beads representing the salinity for a particular bay location and time.

Background
Perhaps the most distinguishing feature of an estuary is its ever-changing salinity. Salinity, the dissolved salt content in the water is the single most important factor effecting the distribution of organisms in the estuary. Unlike the ocean where salt content varies little over large areas the salt content of the estuary varies greatly, changing from nearly full strength salt water at the mouth of the bay to fresh water at its uppermost point.

The salts present in seawater include sodium chloride, magnesium chloride, potassium chloride, calcium chloride, and a number of minor constituents. One-quart of seawater contains about 1 ounce of salts. The salts in seawater originate from land and are the result of the weathering and erosion of landforms by surface waters.

Salinity is typically expressed in units of parts-per thousand (ppt), the salt content in 1000 parts of water. In the Delaware Estuary salinity is 0 ppt at the fall line near Trenton, New Jersey. The fall line is the geologic boundary of the Delaware River and the Bay. Salinity gradually increases downstream to about 15 ppt about midway down bay. The salinity continues to increase downstream averaging about 32 ppt at the mouth of the Bay. In comparison the average salinity of ocean water is 35 ppt. The entire salinity gradient in the Bay will shift under high flow conditions and salinities will decrease bay wide. Likewise under conditions of low flow, which typically occurs during periods of drought, bay wide salinities will increase.

Estuaries with their widely variable salinities host both freshwater species in the upper reaches and saltwater species in the lower reaches. Only those species able to tolerate a wide range of salinities, euryhaline species, are able to successfully inhabit the portions of the estuary with widely fluctuating salinities.

Objectives / Students will be able to:
1. Define salinity.
2. Describe how salinity varies spatially and temporally in the estuary.
3. Show how salinity effects the distribution of animals in the estuary.

Procedure / Warm Up
Open a class discussion about the definition of an estuary and the importance of the salinity gradient in the distribution of organisms living in the Bay. Explain that salinity in the bay can change depending on how much river flow enters. In dry years flow is low and salinity increases and in wet years flow is high and salinity decreases. Within the year salinity tends to be lowest in the spring as a result of melting snow and rain.

The Activity

1. Each student should be given a salinity card (containing salinity measure for a particular site and time), beads, and string.
2. Instruct student to construct a necklace containing 10 large beads each representing 100 parts water, and smaller beads indicating the salinity for the sample on the card.
3. Each student should then be given the opportunity to show their site location on the map.

Wrap Up / Students should discuss how salinity changes from location to location in the bay and how the distribution of animals changes as a result. What other things might affect the distribution of animals in an area? How might changes in weather affect the salinity and animal distribution in the Bay.

Extensions / Visit Maryland Department of Natural Resources website Eyes on the Bay (http:/www.eyesonthebay.net) for excellent activities relating to salinity. Give students a list of bay animals and have them research the animal's salinity requirements.

Activity Prop:

Data Cards (below) show salinity in parts per thousand (ppt) at three oyster bars Arnolds, Cohansey, and New Beds. Salinity was determined on water samples collected mid-month, once each month.

Site locations are shown in Student Handout-Activity 1.4/5

Arnolds / April 2005 6 ppt	**Cohansey / April 2005 6 ppt**	**New Beds / April 2005 9 ppt**
Arnolds / May 2005 12 ppt	**Cohansey / May 2005 15 ppt**	**New Beds / May 2005 17 ppt**
Arnolds / June 2005 14 ppt	**Cohansey / June 2005 16 ppt**	**New Beds / June 2005 19 ppt**
Arnolds / July 2005 11 ppt	**Cohansey / July 2005 13 ppt**	**New Beds / July 2005 17 ppt**
Arnolds / August 2005 13 ppt	**Cohansey / August 2005 16 ppt**	**New Beds / August 2005 20 ppt**
Arnolds / September 2005 15 ppt	**Cohansey / September 2005 18 ppt**	**New Beds / September 2005 21 ppt**
Arnolds / October 2005 9 ppt	**Cohansey / October 2005 14 ppt**	**New Beds / October 2005 18 ppt**
Arnolds / November 2005 11 ppt	**Cohansey / November 2005 13 ppt**	**New Beds / November 2005 15 ppt**

Activity 1.5

Seasons of Change

- Grade Level
  6-8
- Subject Areas
  Science, Mathematics
- Duration
  1-2 class periods
- Setting
  Classroom
- Skills
  Graphing, interpreting describing
- Vocabulary
  Salinity, Gradient, Euryhaline, parts-per-thousand (ppt)
- Correlation with NJ Core Curriculum Content Standards
  5.1.8A, 5.1.8B, 5.1.8C, 5.3.4D, 5.3.8D, 5.8.2B, 5.8.4B, 6.6.8B, 6.6.8C

Materials:

- ☐ Map of the Delaware Estuary with sample sites marked (Student Handout-Activity 1.4/5)
- ☐ Monthly salinity data set
- ☐ Graph paper, or computer software for creating graphs
- ☐ Student Worksheet-Activity 1.5

Charting the Course
In this exercise students will construct and interpret graphs comparing monthly salinity measurements for a 1-year period for three oyster bars located along a salinity gradient, demonstrating how one environmental variable changes seasonally. This activity follows the same concepts as Activity 1.3 and can be conducted as an extension, or instead of Activity 1.3.

Background
Activity 1.3 Taking it with a Grain of Salt presents relevant background information about salinity and its importance in defining the estuary and the distribution or organisms in the Bay. Salinity, the dissolved salt content in the water is the single most important factor effecting the distribution of organisms in the estuary. Unlike the ocean, where salt content varies little over large areas the salt content of the estuary varies greatly, changing from nearly full strength salt water at the mouth of the bay to fresh water at its uppermost point. This activity expands on the concept and focuses on spatial and temporal changes in salinity throughout the estuary.

The salinity at a particular place in the estuary can fluctuate greatly with in a year through the seasons as well as from year to year. Typically the spring yields high fresh water inputs as melting snow and springtime rainfall increase fresh water flow into major rivers. This results in decreases in salinity in upper estuary locations. The salinity gradually increases through the summer and fall, as rainfalls typically are lower than in spring. On an annual basis a dry or drought year will result in relatively high salinities through out the bay where as wet years will cause a reduction in bay-wide salinities. For oysters this can greatly impact survival, as disease and predation tend to be higher at higher salinities.

Objectives / Students will be able to:
1. Define salinity.
2. Describe how salinity varies through space and time in the estuary.
3. Show how salinity affects the distribution of animals in the estuary.

Procedure / Warm Up
Open a class discussion about the definition of an estuary and the importance of the salinity gradient in the distribution of organisms living in the Bay. Or follow up with the **Taking it with a Grain of Salt Activity.** Explain that salinity in the bay can change depending on how much river flow enters. In dry years flow is low and salinity increases; in wet years flow is high and salinity decreases. Within the year salinity tends to be lowest in the spring as a result of melting snow and rain.

The Activity

1. Distribute salinity data set and materials for constructing graphs.
   Instruct students to plot the salinity data presented. The x-axis should be time (month) and the y-axis should be salinity in parts-per-thousand (ppt). Students should draw two lines, one for each site.
2. Have students interpret the graph, answering the following questions.
   Does the salinity at each site remain constant or change through time?
   Does the salinity differ between sites?
   Overall which site has the higher salinity?
   What is the highest and lowest salinity for each site?
   What is the range of salinity for each site?
   When did the highest and lowest salinity occur for each site?
   How would salinity change if a drought occurred and river flow was below average for the next 12 months?

Wrap Up / Students should discuss their interpretations of the salinity graph. Be sure to emphasize that there is great variability in the environment. Factors such as salinity in the estuarine environment are constantly changing. What trends do they observe? What other factors might similarly change? Also, have students speculate on how this information would be used in real life.

Extensions / Visit Maryland Department of Natural Resources website Eyes on the Bay (http:/www.eyesonthebay.net) for excellent activities relating to salinity.

Table 1:

Monthly salinity data at three sample locations, Arnolds, Cohansey, and New Beds. The data is for the year 2005 and all three sites are oyster bars–shown in Student Handout-Activity 1.4/5

TABLE 1

Salinity parts per thousand (ppt)

	Arnolds	Cohansey	New Beds
March	10.8	13.6	18.0
April	5.9	6.1	9.2
May	11.8	15.0	17.1
June	14.1	15.7	19.2
July	11.0	13.4	17.0
August	13.0	16.4	19.8
September	14.8	17.9	20.7
October	8.5	13.7	17.7
November	10.0	12.9	15.4

Student Worksheet Activity 1.1 — An Estuary Nearby: A Scavenger Hunt Mapping Exercise

Name_____**Date** _____

1. Locate your school on the map provided.
2. Mark the location with a sticker.
3. Trace on the transparency the outline of the land/bay margin and state and mark the location of the school.
4. Trace on the transparency and label the following items:
    a. The Atlantic Ocean
    b. North, south, east and west
    c. The major body of water located west of your school
    d. The largest river on the map
    e. The river closest to your school that flows into the Delaware Bay
    f. Two other rivers
    g. Two states bordering the Delaware Bay
    h. The capital of New Jersey
    i. A city located on the Delaware Bay/Delaware River
    j. The source of salt water that enters the Delaware Bay
    k. The major source of fresh water that enters the Delaware Bay (the largest river)
    l. A place where you'd like to explore, fish, or just hang-out.
5. How far is your school from the Bay?

Challenge question.

What path of creeks and rivers would rain falling on your school follow to get to the Delaware Bay?

Student Worksheet Activity 1.3 — Life in the Estuary

Name_____**Date** _____

TABLE 1

Animals of the Delaware Estuary

Fish
American Shad
Striped Bass
Spot
Clearnose Skate
Winter Flounder
Atlantic Sturgeon
Summer Flounder
Bay Anchovy
Weakfish
Atlantic Menhaden
Angel Shark
Black Drum

Shellfish
Eastern Oyster
Channeled Whelk
Oyster Drill
Blue Mussel
Ribbed Mussel
Blue Crab
Atlantic Horseshoe Crab
Black Fingered Mud Crab
Common Razor Clam
Hard shell Clam

1. Name of Animal

2. Scientific name of Animal

3. Describe appearance

Draw or place illustration of your animal here

Student Worksheet Activity 1.3 — Life in the Estuary

Name_____**Date** _____

4. Life History and Characteristic

a. Habitat

b. Life cycle

c. Food

d. Predators

Fun Fact:

Student Handout **Activity 1.4/5 — Oyster Bed Locations Map**

Student Worksheet Activity 1.5—Seasons of Change

Name_____**Date** _____

A. Using the charts on the following page and the data in Table 1. draw a graph to compare the salinity at the oyster bars known as Arnolds, Cohansey, and New Beds. Be sure to put a title and labels on your graph.

TABLE 1

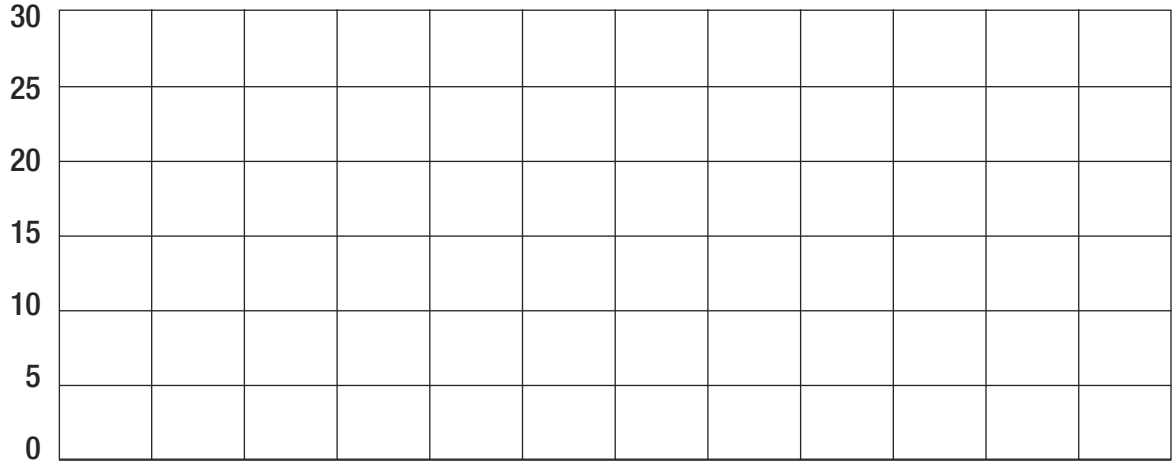
Salinity parts per thousand (ppt) in Oyster Bars and New Beds

Month	Arnolds	Cohansey	New Beds
March	10.8	13.6	18.0
April	5.9	6.1	9.2
May	11.8	15.0	17.1
June	14.1	15.7	19.2
July	11.0	13.4	17.0
August	13.0	16.4	19.8
September	14.8	17.9	20.7
October	8.5	13.7	17.7
November	10.0	12.9	15.4

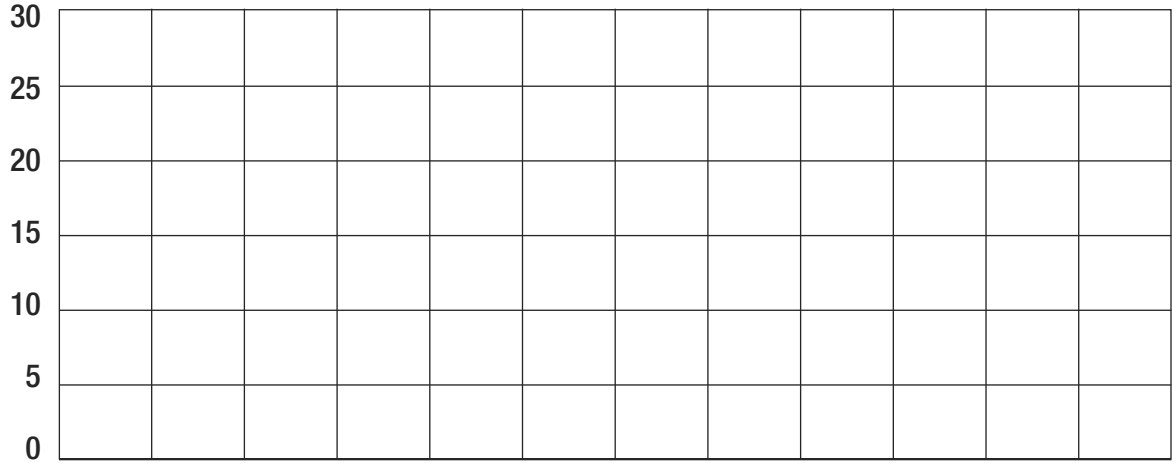
Student Worksheet Activity 1.5—Seasons of Change

Name_____Date _____

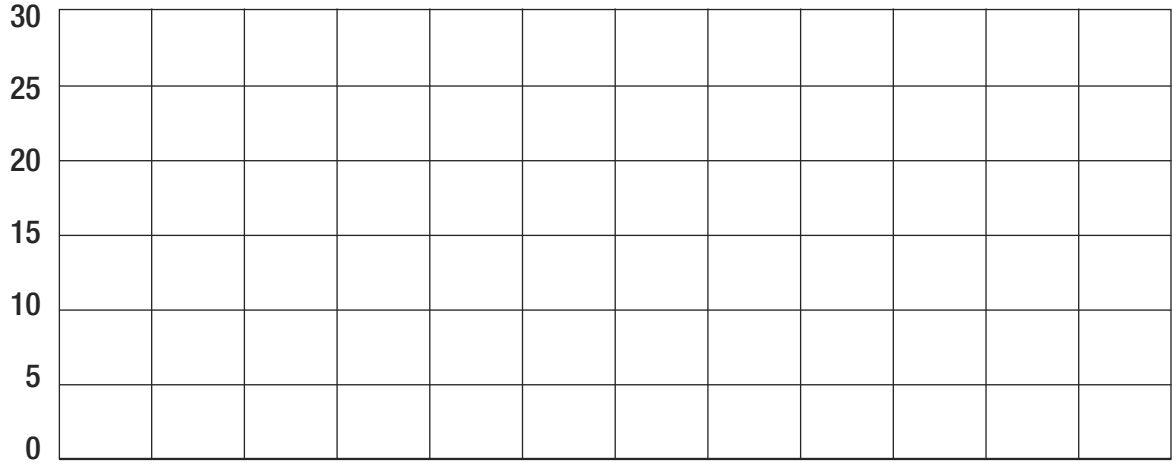
Arnolds



Cohansey



New Beds



B. After completing your graph answer the following questions.

1. Does the salinity at each site remain constant or change through time?

2. Does the salinity differ between sites?

3. Overall which site has the highest salinity?

4. Overall which site has the lowest salinity?

5. What is the highest and lowest salinity for each site?

6. What is the range of salinity for each site?

7. When did the highest and lowest salinity occur for each site?

8. How would you expect the graph to look the next year if there is above average rainfall all year long?

9. How would this information be used in real life?