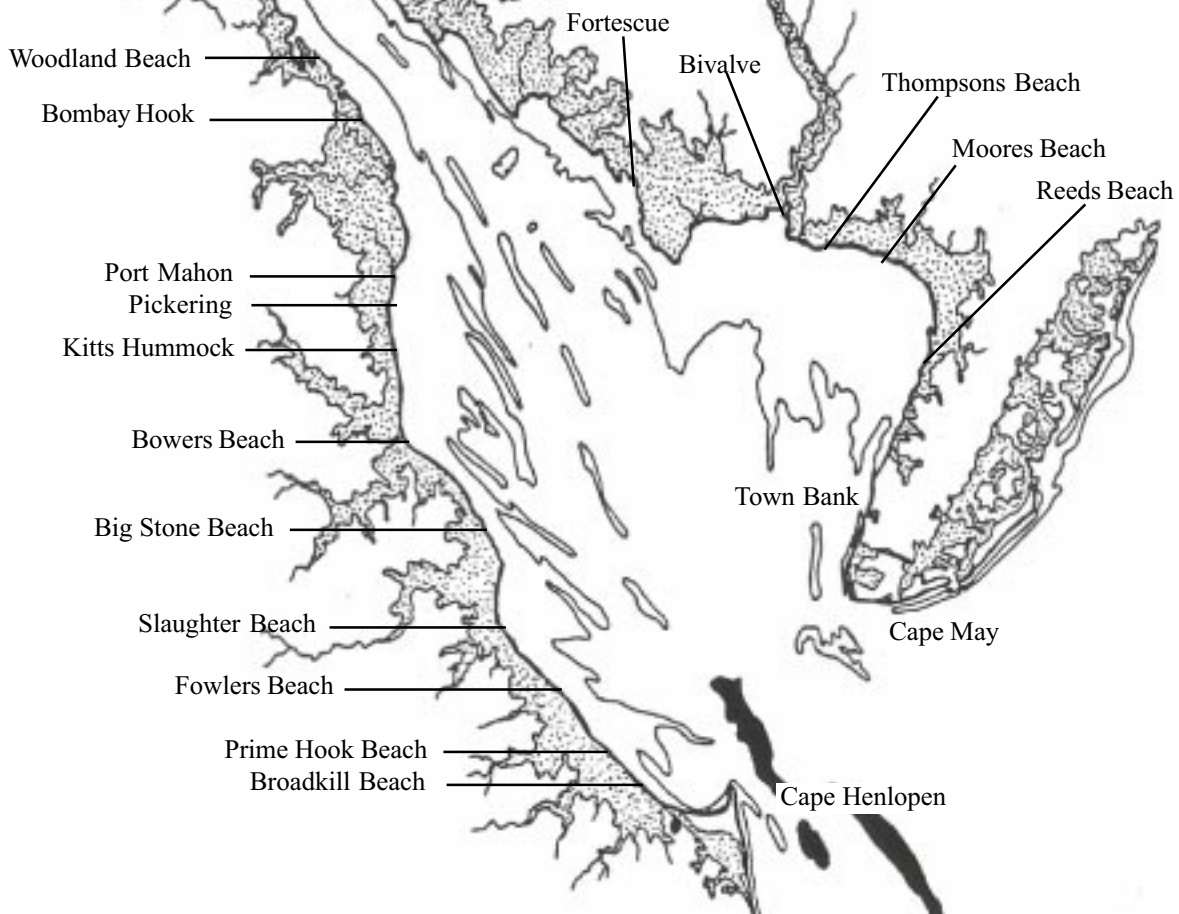




Beaches of the Delaware Estuary

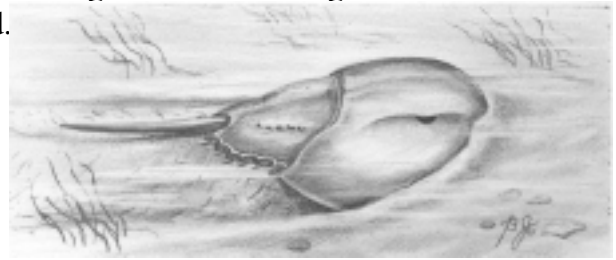


Lesson Plan 3:

Delaware Bay Estuary Investigation

Select a Delaware Bay beach to study. This lesson plan was designed with Pickering Beach and Fowler's Beach in mind, although other beaches may be substituted.

Activity 1: **Observing the Bay Environment**

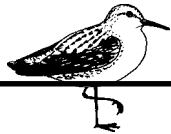


Look around you. What do you see that is:

Natural:

Man Made:

What do you hear?



Natural:

Man Made:



What do you smell?



Natural:

Man Made:



Activity 2: **Measuring the Bay Environment**

How did the driftwood, horseshoe crabs, shells, etc. reach the shore? _____

Does the tide seem to be coming in or going out? _____ How might you determine this? (Place a stake at the water's edge. Check in one hour. Has the tide come in or gone out? If a tide chart is available, check for high tide.

Using the wind speed instrument, determine the speed and direction of the wind.

Direction: _____ Speed: _____

Measure the air, water, and soil temperature. Are they all the same? _____

Air Temperature: _____

Water Temperature: _____

Soil temperature: _____

WHY? _____

What direction are the waves coming from? What is the angle of the waves from the shoreline? (use the protractor provided)

Direction: _____

Angle: _____

Using food coloring powder, dip a stick in it and toss the stick about 3-5 feet out. Determine in which direction the wave currents are moving - right or left? _____ Measure the distance in feet the dye moves in 1 minute. Distance in one minute: _____

Using the water test kits, determine the **dissolved oxygen, salinity, and pH** of the water. Is this fresh, salt, or brackish water? What other ways might you determine this? (use the chart provided)

Dissolved Oxygen (DO): _____

Salinity (parts per thousand): _____

pH: _____

Fresh? Salt? Brackish?

Activity 3: **Collecting and Observing Aquatic Life**

There are 10 aquatic nets and one seine net. According to the number of students in your class, divide into teams of 2-5 students, with each team receiving a **dip net and jar**. Have students dip for organisms and try to identify them using the picture keys provided. List the specimens on the chart below.

What's in your Dip Net?

Common Name	How many individuals?	Description of where you found it/them

Select two students at a time to use the seine net (wear hip boots provided - 2 pairs). Floats on the net go at the top, weights at the bottom. Poles should be carried at a slight angle, with the top of the pole angled behind the student and the bottom of the poles forward of their feet. Walk along the water with net pulled taut as possible. Come toward the shore and lift the net onto the beach. Have students place organisms in the white bottomed pan and list the names of specimens on the chart. Specimens collected with dip nets should also be emptied from jars into the white bottomed pan. Have a sharing and discussion session. At the end of this activity, return all specimens to the water.

What's in your Seine Net?

Common Name	How many individuals?	Description of where you found it/them

Table 1: Approximate Salinity in parts per thousand (ppt) for Fresh, Brackish, Salt, Estuarine, and Ocean Water with Possible Plant and Animal Species Present.

Water Type	Plant and Animal Species
<i>Fresh Water:</i> 0 - 5 ppt	frogs, tadpoles, painted turtles, beaver, pond lilies, cattails, fish, water bugs
<i>Brackish Water:</i> 6 - 10 ppt	overlapping of species from fresh and salt water (particularly from salt)
<i>Salt marsh water:</i> 11 - 25 ppt	cordgrasses (spartina species), crabs (blue, marsh, fiddler), diamondback terrapin, killifish, shore shrimp, mosquito fish, perch

Delaware Estuary salinity can range from 0 - 35 parts per thousand (ppt). The Atlantic ocean averages 35 ppt, but salinities change with depth and latitude. The salinity of Delaware Bay can vary depending on the weather; for example, the bay will contain more fresh water after much rain, and saltier after a drought.

Some animals can be found in either freshwater or saltwater marsh areas. For example, muskrats, otters, ducks, geese, northern water snakes, snapping turtles, and raccoons can tolerate a wide range of salinity. ***Animals which are strictly freshwater species would not be found in salt water because their bodies cannot tolerate salt; for example, amphibians (frogs and salamanders).***

What's a Watershed?

Describe what YOU think a watershed is: _____ _____	
Find your location of this stream (pond, lake) on the map. Where does the water come from? _____ _____	
Where does it go? _____	
Draw lines around the boundaries of the watershed: We are in the _____ watershed.	
What activities in this watershed might change the characteristics of this water or affect water quality?	
Activity	Ways the activity might change the water quality:

Activity 4:

Studying the Horseshoe Crab/Shorebird Connection

Background Information: In late spring, during the spawning season for horseshoe crabs, hundreds of thousands of shorebirds stop along the Delaware Bay to feed on billions of horseshoe crab eggs. The birds take advantage of this concentrated protein source during their annual flight from their wintering grounds in South and Central America to their northern breeding grounds in the Arctic.

In observing horseshoe crabs, notice the differences between the male and female crabs. First, males are smaller than females. The male horseshoe crab also has boxing glove-like claws on the first pair of legs. These claws are used to grasp the rear of the female's shell. The top portion of the male's shell is concave for this purpose. The females deposit greenish eggs and then drag the male behind them, who in turn fertilize the eggs. At times you may see more than one male crab attached to the female. Sometimes a second male will attach itself to the first male already attached to the female.

Using a **1 meter quadrat**, count the number of horseshoe crabs within the quadrat, and repeat every 10 meters for at least 5 samples. Tabulate the information in the chart below:

Beach Location:	Date:	Time:	Tide:	Wind dir:	Weather:
	How many females?	How many males?	Total no. of HS crabs	No. of Tags Record info.	Remarks:
Quadrat 1					
Quadrat 2					
Quadrat 3					
Quadrat 4					
Quadrat 5					
Average Number per quadrat					

There are 1,000 meters in 1 kilometer. If your average number of crabs per quadrat is 30, how many crabs per kilometer would you estimate on the beach? _____

Substitute the average number of crabs per quadrat you found. How many horseshoe crabs (per 1 kilometer) are on the beach today: Number of Horseshoe crabs _____

Are the crabs stranded on the beach, (e.g. turned over on their backs?). _____

Is the tail straight up or laying down in the sand? _____

(Overturned live crabs will have their tail up and in, to protect the soft parts from drying in the sun. Hopefully the next tide will return them to their aquatic environment. You may turn them face down to help them along).

How many horseshoe crabs are moving around looking for a mate? _____

How many are returning to the water? _____

How many are engaged in the fertilization process? _____

Measure some of the horseshoe crabs (from eye to eye) and the width of the crab's carapace.

What is the average size of a male? _____ A female? _____

Use the ID key provided, try to identify some of the shorebirds. Try to estimate number of shorebirds by counting by tens or one hundreds if necessary. (This is not easy to do!) No. of birds: _____

Determine the angle of the waves approaching the shoreline.

NOTE: If a pier is used for an observation platform: place 0 - 180 line on the rail parallel to the centerline of the pier, site along the crest of the breaking waves and record the angle observed.

