1. Unit: Marine Biology **Time:** 2 class periods
2. Topic: Chesapeake Bay

3. Objective: Student will be able to compare and contrast biological, chemical, and zoological environment of the Chesapeake Bay.

4. Correlation: Earth science standards of learning. Ocean Literacy Principle 1: The Earth has one big ocean with many features (a, b, and c). Ocean Literacy Principle 5: The ocean supports a great diversity of life and ecosystems (a, b, c, and d).

5. Materials Needed: Overhead projector, Notes, Student Worksheets, and Questions

6. Content Instructions: Lecture notes

7. Student Work:

1. Globe Toss Activity – 30 minutes
2. Lecture Notes – 45 minutes
3. Note Questions – 15 minutes
4. Annual Freshwater Inflow to the Bay Data Activity – 15 minutes
5. Chesapeake Bay Quiz – 15 minutes
6. Worksheet "What Do You Know About the Chesapeake Bay?"

Lab: Globe Toss

Objective: Student will be able to understand:

1. The ocean, and how it comprises a significant portion of the earth's surface.
    a. Scientific investigation process

Correlations:

2. Virginia Science SOL's and National Science Education Standards (Grades 9-12)
3. Ocean Literacy Principles and Fundamental Concepts

Introduction:

The ocean occupies more than 70% of the earth's surface and has a large impact on the earth and its inhabitants. Ocean-weather-climate interactions, transportation, fisheries, and recreation are just a few of many things that are influenced by the ocean. In this introductory exercise, participants will determine the percent of the surface area of the earth occupied by the ocean.

Materials:

- 16" inflatable globe
- partner
- worksheet
- graph paper
- a writing utensil

Procedure:

1. Form a hypothesis.
2. Inflate the globe.
3. With your partner, toss the globe back and forth a total of 10 times with each person catching the globe 5 times. Keep a distance of about 6ft.
4. On the worksheet provided, record how many of your 10 fingers touch ocean each time you caught the globe.
5. Reduce distance to 4ft and repeat step 2 and 3.
6. Reduce distance to 2ft and repeat step 2 and 3.
7. Record your data on the data worksheet provided.

Questions:

1. Was your hypothesis correct?
2. What was your independent variable?
3. What was your dependant variable?
4. Conclusion; what can you summarize from this activity?
5. Create a line graph for your three data tables on the back of your data worksheet.

Globe Toss Data Worksheet

Toss Number (6ft distance)	Number of fingers (out of 10) that touch the ocean
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total:	%

Toss Number (4ft distance)	Number of fingers (out of 10) that touch the ocean
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total:	%

Toss Number (2ft distance)	Number of fingers (out of 10) that touch the ocean
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total:	%

Lecture Notes: Chesapeake Bay

The Chesapeake Bay is the largest estuary in the North America.
The Chesapeake Bay contains both fresh water and salt water.

Freshwater Tributaries

The Chesapeake Bay gets its fresh water from thousands of brooks, streams, and rivers, which drain 64,000 square miles of land. Within the Chesapeake Bay watershed, five major rivers, the Susquehanna, Potomac, Rappahannock, York, and James, provide almost 90% of the freshwater in the bay. These rivers and other smaller rivers, along with hundreds of creeks and streams that feed into them, provide habitats necessary for the production of many fish species. Anadromous fish spend their adult lives in the ocean but must spawn in freshwater. Anadromous fish species in the Chesapeake Bay include striped bass, blue back herring, alewife, American and hickory shad, short nose sturgeon and Atlantic sturgeon. Semi-anadromous fish, such as white and yellow perch, inhabit tidal tributaries but also require freshwater to spawn.

While all species have different habitat requirements, all must have access to freshwater spawning grounds. However, due to dams and other obstacles, many historical spawning grounds are no longer available to fish. The fish not only need access to spawning grounds but also require good stream and water quality conditions for the development and survival of eggs and juvenile fish. Nutrients, chemical contaminants, excessive sediment and low dissolved oxygen degrades spawning and nursery habitat.

Shallow Water

The shallow water, or littoral zone, provides key habitats for many life stages of invertebrates, fish and waterfowl. Shrimp, killifish, and juveniles of larger fish species use submerged aquatic vegetation, tidal marshes, and shallow shoreline margins as nursery areas and for refuge. Vulnerable, shedding blue crabs find protection in the SAV beds. Predators, including blue crabs, spot, striped bass, waterfowl, colonial water birds, and raptors forage for food here. Along shorelines, fallen trees and limbs also give cover to small aquatic animals. Even unvegetated areas, exposed at low tide, are productive feeding areas. Microscopic plants cycle nutrients and are fed upon by crabs and fish.

Open Water

Striped bass, bluefish, weakfish, American shad, blue back herring, alewife, bay anchovy, and Atlantic menhaden live in the open, or pelagic waters of the Chesapeake Bay. Although unseen by the naked eye, microscopic plants and animal life, plankton, float in the open waters. These tiny organisms form the food base for many other animals. More than 500,000 wintering ducks, particularly sea ducks, like scoters, oldsquaw, and mergansers, depend on open water for the shellfish, invertebrates, and fish they eat during the winter months. Open water also supports oysters and other bottom-dwellers. Oysters and other filter feeders help maintain water quality, by filtering suspended organic particles out of the water. The oysters reef itself is a solid structure that supports other shellfish, finfish, and crabs.

Biological Communities

Within every habitat, communities of organisms exist in close relationship to each other. Communities may be as small as an oyster bar or as large as the entire bay. The relationships among species form a complex web. Some organisms produce food and others serve as prey. Some communities, like submerged aquatic vegetation (SAV) provide both food and cover. Many organisms fit into more than one of these categories. The functions within a given community are almost endless, and the Chesapeake supports countless communities both large and small.

Change is a characteristic of ecological systems, including the Chesapeake Bay. Germination of plant seeds, birth of animals, growth, local movement, and migration affects the species composition of each community as does changes in water quality, loss of habitat or over-harvesting.

Some variations, such as seasonal changes in abundance, follow a predictable pattern. Every year waterfowl migrate to the bay to spend the winter feeding in uplands, wetlands, and shallow water areas. Then, each spring, they return to northern parts of the continent to breed. After mating each summer, female blue crabs migrate to the mouth of the bay to spawn, while the males remain in the upper and middle part of the bay. Anadromous fish, like shad and herring, spend most of their lives in the ocean, but each spring enter the bay and migrate into freshwater to spawn. These are just a few of the seasonal variations that occur.

Some bay communities are prone to rapid population fluctuations of one or more species. This is particularly true of plankton. Rapid changes in plankton diversity and abundance may occur hourly or daily due to the interaction of biological, physical, and chemical factors.

Many species exhibit long-term patterns in population abundance and distribution. For example, croakers suffer high mortalities during exceptionally cold weather. This fish was abundant in the bay during the late 1930s and early 1940s. It is believed that relatively mild winters in the late 1930s and early 1940s promoted the high numbers of croakers. Human induced pressures can affect long term patterns. Striped bass declined rapidly in the late 1970s and through the 1980s due to over-harvesting and subsequent reproductive failure.

Individual species may belong to a variety of communities and use different habitats throughout their life cycles. Habitats are connected and communities often overlap. Changes in a particular habitat may not only affect the communities it supports but other habitats and communities as well.

In the Chesapeake, wetlands, SAV beds, plankton, fish, and bottom dwellers are biological communities supported by the bay's diverse habitats. Wetlands are transitional areas between uplands and water. SAV beds range from mean low tide to a depth of about 2 meters or where light becomes limiting to plant growth, although some freshwater species thrive up to 3 meters deep. Open water supports the plankton community, composed mostly of miniature creatures that float and drift with the movement of the water, and the nekton community, the fish and other swimmers who move freely throughout the bay and its tributaries. The bottom sediments support benthic organisms.

Annual Freshwater Inflow to the Bay
One factor which determines the salinity of the bay's water is the weather. When there is a lot of rain, the salinity of water in the bay's main stem decreases. During very dry years, salinity levels rise. The amount of rainfall is highly unpredictable, so the salinity of the Chesapeake Bay is constantly changing from year to year, season to season, and even day to day. Below is the bay's average freshwater inflow from 1953 through 2003 measured in cubic feet per second.

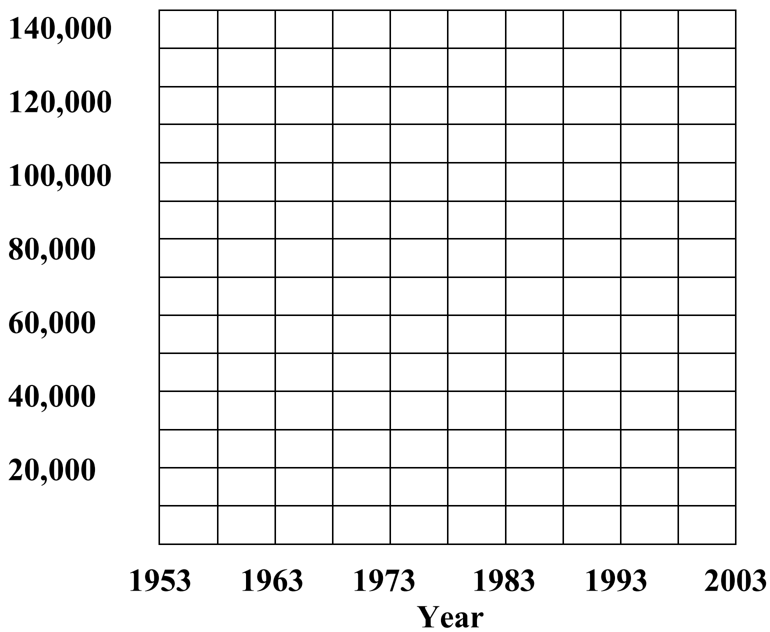
DATA

Annual Freshwater Inflow to the Chesapeake Bay
1953-2003

YEAR	CU FT/SEC.	YEAR	CU FT/SEC.	YEAR	CU FT/SEC.
1953	70,000	1971	76,000	1989	77,000
1954	55,000	1972	130,000	1990	89,000
1955	74,000	1973	90,000	1991	60,000
1956	75,000	1974	75,000	1992	73,000
1957	62,000	1975	105,000	1993	100,000
1958	76,000	1976	80,000	1994	99,000
1959	62,500	1977	77,000	1995	62,000
1960	75,500	1978	89,000	1996	135,100
1961	76,000	1979	112,000	1997	64,300
1962	70,000	1980	62,000	1998	97,700
1963	50,000	1981	51,000	1999	53,500
1964	60,000	1982	74,000	2000	65,300
1965	49,000	1983	88,000	2001	48,700
1966	51,000	1984	100,000	2002	57,800
1967	75,500	1985	70,000	2003	133,692
1968	60,000	1986	71,000	2004	75,000
1969	51,000	1987	74,000	2005	90,000
1970	75,500	1988	51,000		

Use the data provided above to make a line graph of the average annual freshwater inflow to the Chesapeake Bay. Use sample graph. You have 30 minutes to complete this.

Annual Freshwater Inflow to the Bay (1953-2005)
Sample Graph



Name: ____________________
Date: _____________________
Block: ____________________

Interpreting Your Data
Salinity

Directions: Use the data from your line graph to answer the following questions in complete sentences. Please copy and answer the questions on your own paper. You have 15 minutes to complete this assignment.

1. What are the three "wettest years on record"? How would the large volume of stream flow entering the bay have affected its salinity levels?

____
____
____

2. What would the weather have been like during each of those years?

____
____

3. Using your data, find two years when the Chesapeake Bay would have had unusually high salinity levels. Explain why you chose those years.

____
____
____

4. Using your data, predict what type of salinity levels you might have found in the Upper Bay in the spring of 1975. Give reasons which support your prediction.

____
____
____

Quiz: Chesapeake Bay

Directions: Match the following terms to the correct definitions. You have 15 minutes to complete this quiz. Please use your own paper.

______ 1. Estuary

______ 2. Salinity

______ 3. Dissolved Oxygen

______ 4. Non-point Source Pollution

______ 5. Algae

______ 6. Food Chain

______ 7. Sediment

______ 8. Watershed

______ 9. Food Web

______ 10. Plankton

______ 11. Marsh

______ 12. Waterman

______ 13. Point Source Pollution

______ 14. Nutrients

______ 15. Turbidity

a. Particles which accumulate on the bottom of a waterway.
b. Semi-enclosed body of water open to the sea where fresh and salt water mix.
c. Wild rice > Duck > Man
d. Nitrogen, phosphorous
e. Pollutant coming from a large area that cannot be pin-pointed.
f. Saltiness.
g. Oyster tongs are one of the tools of this trade.
h. Cloudiness of the water.
i. Drifting or weakly swimming aquatic organisms, often microscopic.
j. Interwoven network of food chains describing the feeding interactions of the species in an area.
k. Definable source of pollution, such as an outfall pipe.
l. Amount of oxygen gas in the water, it is essential for aquatic life.
m. Primitive, aquatic plants including seaweed and phytoplankton.
n. Area of land that is drained by a river or other body of water.
o. Low, grassy wetland without trees.

Name: ____________________
Date: _____________________

What Do You Know About the Chesapeake Bay?

Hampton Roads	Baltimore	Blue Crabs	Underwater Grasses
Invasive Plants	Population	3 Billion	6
Spot	20 miles	Development	Air
30 Feet	Zebra Mussel	Great Shellfish Bay	Land Use
Sediment	Groundwater	Bacteria	Striped Bass
PCB's	200 Miles	Diseases	Oysters
64,000	Croaker	16	
19 Billion	Nutrients	Oysters	

1. The main channel of the bay is ________ long.
2. On average, the bay is _______ wide and _______ deep.
3. The entire drainage basin of the bay covers _______ square miles.
4. There are ______ states and the District of Columbia that form the bay watershed, home to nearly __________ people.
5. The bay's original Indian name, Chesapoike, means __________________.
6. The five major rivers that flow into the bay are the ______________, ______________, ______________, ______________, and ______________.
7. The bay's two largest harbors are _________________ and ________________.
8. The Chesapeake Bay once produced half of all the ___________ in the U.S.
9. More than 90% of the ___________ ____________ have disappeared from the bay.
10. Only 1% of the original population of __________ remain in the bay today.
11. The only sport finfish not regulated in the bay are the ________________ and the ________________.
12. Each day, the bay must absorb more than ________ gallons of treated sewage.
13. Phragmites, Milfoil, and Hydrilla are introduced ___________ that are impacting the bay.
14. Mercury, creosote, and ________ are some of the toxic substances found in the bay.
15. Dermo and MSX are ___________ of oysters.
16. More than 25% of the nitrogen entering the bay comes from the ____________.
17. It will cost more than __________ dollars to upgrade sewage plants and city sewers in the bay watershed to remove nutrients from wastewater.
18. The ____________ ____________ is causing tremendous problems in the Great Lakes and has found its way into the Chesapeake Bay watershed.
19. One of the most controversial issues facing he Chesapeake Bay is the regulation of the __________ ___________.
20. Excess ______________ and ___________ are the most widespread types of pollution entering the bay.
21. Uncontrolled _____________ growth and ___________ in the future may cancel most of the gains we make in the bay improvement.

22. _________________ is a major contributor of nutrients to the bay.
23. Maryland has just issued a PCB advisory for this sport finfish: _________________.