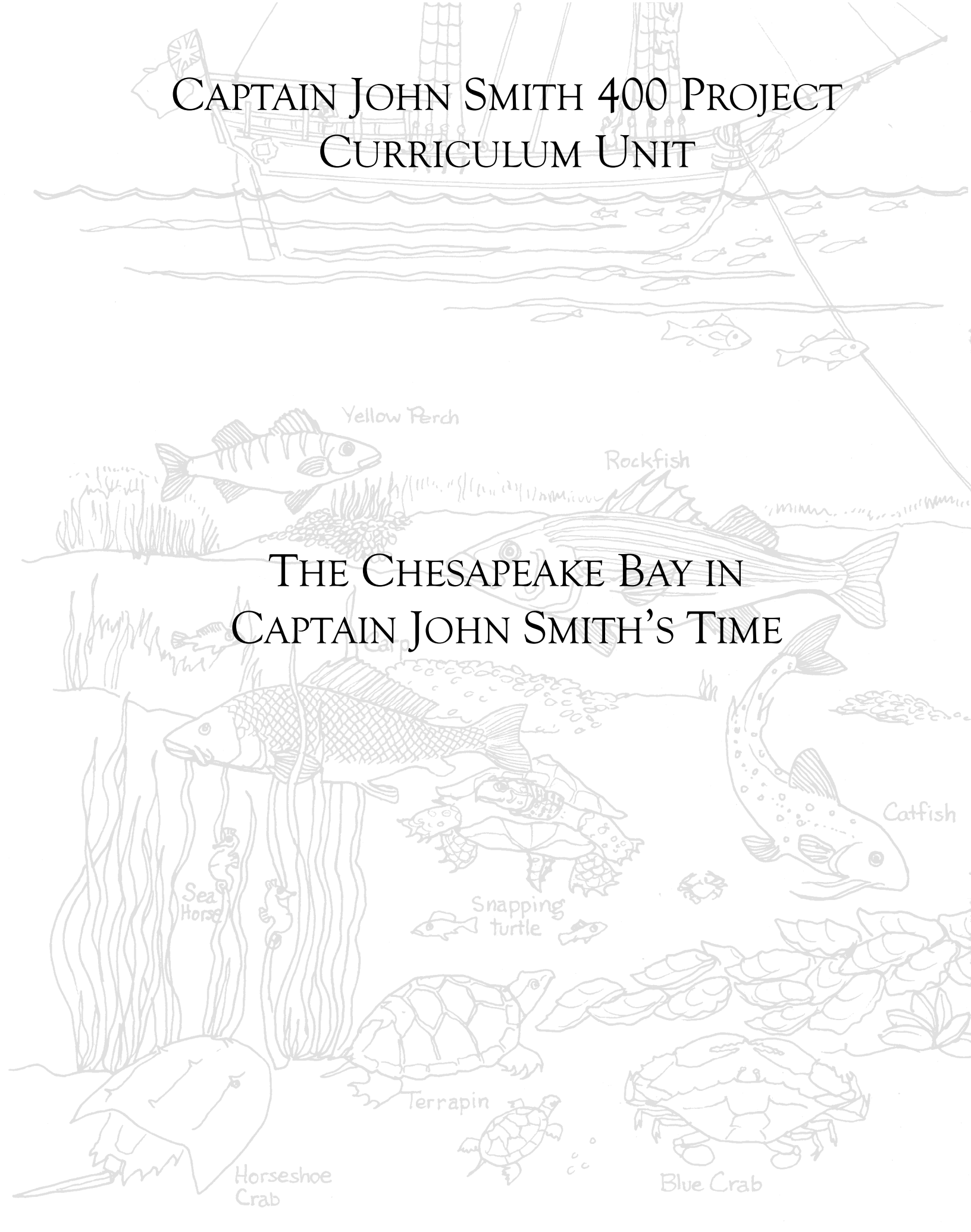
Captain John Smith 400 Project
Curriculum Unit



The Chesapeake Bay in Captain John Smith's Time

TITLE: The Chesapeake Bay in Captain John Smith's Time

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GRADE: 4

CLASS PERIOD/DURATION: 2/3

VSC STANDARDS/INDICATORS:

3.0 LIFE SCIENCE- The students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results of the interactions that occur over time.

3.F. ECOLOGY

1. Explain ways that individuals and groups of organisms interact with each other and their environment.
    a. Identify and describe the interactions of organisms present in a habitat
    b. Explain that changes in an organism's habitat are sometimes beneficial and sometimes harmful.

1.0 SCIENCE SKILLS & PROCESSES - Constructing Knowledge

1. Gather and question information from many different forms of scientific investigations including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments.
    a. Support statements with facts found in books, articles…..
    b. Follow directions carefully and keep accurate records of one's work in order to compare data gathered.

OBJECTIVES:

- Students will analyze primary sources in order to assess the presence of various animals and the quality of the Chesapeake Bay habitats in the 1600s.
- Students will compare the Chesapeake Bay of the 1600s with that of today.

VOCABUALRY

habitat	an area where a plant or animal lives that provides it with food, water, protection for survival and reproduction
SAV	(Submerged Aquatic Vegetation) rooted underwater plants that provide an important source of food and habitat for many Bay-dwelling animals
forested buffer	wooded areas which help filter polluted runoff before it enters rivers or streams
wetlands	areas such as marshes and swamps typically found along the Bay's edges in shallow areas where the water meets the land. These areas are often called "nurseries" because they provide food and shelter for small, juvenile animals.

MATERIALS/RESOURCES:

Teachers:	Transparency #1	*The Chesapeake Bay in 1608*
	Transparency #1a	*The Chesapeake Bay Today*
	Transparency #2	*Healthy Habitats*
Students:	Handout #1	*Common Animals Seen on the Chesapeake Bay by Captain John Smith*
	Handout #2	*Quotes from Early Explorers of the Chesapeake Bay*
	Handout #2a	*Student Data: Animals of the Chesapeake in the 1600s*
	Handout #3	*Healthy Habitats: Captain John Smith's Descriptions of the Chesapeake*
	Handout #3a	*Student Data Sheet*
	Handout #4	*Chesapeake Bay Report Card in the 1600s*
	Handout #4a	*The State of the Bay in 2005*

TEACHER BACKGROUND

In the summer of 1608, Captain John Smith made two voyages from Jamestown to explore the Chesapeake Bay and its tributaries. Smith documented the natural environment, features of the land and waterways, and encounters with the Native peoples he met along the way. From this he created a remarkably accurate map of the Chesapeake Bay that played an influential role in the future colonization of the region. Accompanying this map was a pamphlet guide entitled "*A Map of Virginia. With a Description of the Country, the Commodities, People, Government and Religion*" which gave readers in Europe their first comprehensive picture of the great Chesapeake estuary.

In his voyage narratives, Smith described the Bay's shorelines, rivers, and creeks and provided names for islands and other land features. He described forests along the shoreline that were "*frequented with wolves, Beares, Deere and other wild beasts* [sic]." The dense forests surrounding the Bay and its rivers slowed sediment and freshwater runoff. Some scientists believe that the Bay was actually saltier in the 1600s than it is today because so much rain water was absorbed by the massive canopies of these old growth forests. The Bay also had exceptional water clarity due to the natural filtration provided by oysters, marshes, swamps, and submerged grass beds.

Aside from the obvious changes to the region brought by four centuries of development, the most significant differences are found in the quantity and variety of animals living in the Bay's ecosystem. Though the quantity of oysters has been in sharp decline until very recently, Smith writes that oysters in the early 17th century "*lay as thick as stones*." The Bay's fish population included "*sturgeon, grampus, porpoise, seals, stingrays … brits, mullets, white salmon [rockfish], trout, soles, perch of three sorts*" and a variety of shellfish. At one point, Smith and his men were surrounded by schools of fish so massive that they attempted to catch them with frying pans!

In this lesson, students use primary sources to summarize the variety and abundance of plant and animal life witnessed by Smith and other explorers of the 17th century Chesapeake. They will use this information to make inferences about the water quality of the Bay in 1608. They will then compare the health of the estuary in Smith's time to the health of the Bay today using data from the Chesapeake Bay Foundation's 2005 State of the Bay Report.

Additional Sources of Background Information:

The following selections are included at the end of this lesson plan:

- Chesapeake Bay Watershed
- Wetlands: Food, Filter, Habitat
- Submerged Aquatic Vegetation
- The Eastern Oyster

This information has been selected from Sultana Projects' ecology workbook entitled *Chesapeake Bay Ecology Unit for Classroom Teachers*.

LESSON DEVELOPMENT:
Students will examine resources that describe the animals and plants that John Smith and his crew encountered on the Chesapeake Bay in 1608. They also will read reports about the habitats that Smith described during his travels. Students will issue a "report card" on the Bay's health in 1608, using evidence from primary sources to support their assessment. Students will compare the health of the Bay's fisheries and habitats in the 17th century with the Bay's health today. Finally, students will compare their report card grades to score/s annually issued by the Chesapeake Bay Foundation to determine whether or not the Bay has changed since 1608.

ENGAGEMENT:

1. Have students form small groups and brainstorm the names of plants and animals that live in the Chesapeake Bay. Have each group read their list to the class. Make a list of these organisms on the chalk board.
2. Project images from the transparency entitled "*The Chesapeake Bay in 1608*" (Transparency #1). Have students make observations about the living and non-living things in the environment. Instruct them to look carefully at the Bay, its rivers, plants and animals and the surrounding lands.
3. Project images from the transparency entitled "*The Chesapeake Bay Today*" (Transparency #1a). Have the students make observations about these images. How do they differ from the images on the 1608 worksheet?
4. Draw a T-chart on the board and label one side "*Chesapeake Bay in 1608*" and the other side "*Chesapeake Bay Today*"
5. Have students close their eyes and imagine they are Captain John Smith as he travels up the Chesapeake Bay. After opening their eyes, ask students to describe what they saw. Record their responses on the t-chart. (*Possible responses: Lots of clear water, forests, wetlands along the water's edge, the presence of Indians, no motorized boats, rivers entering the Bay.)*
6. Instruct students to now imagine they are on a boat in the Chesapeake Bay today. Ask them to describe what they see. Record their responses on the T-chart. (*Possible responses: lots of murky water, some forests and wetlands along the water's edge, many houses and buildings lining the shore, many boats on the water, rivers entering the Bay, and bridges.)*
7. Discuss the differences in how the Bay looked in the 1600s and today.
8. Ask students: Have the changes that have occurred around the Bay since the 1600s had an effect on the plants and animals that live in the Bay today? (Answer: *Yes - murkier waters have led to declining amounts of submerged grass beds. This loss of habitat has led to fewer crabs and fish. Also, intense fishing pressure and pollution have taken a heavy toll on the populations of fish, crabs, and oysters.)*
9. Tell students they will need to discover what the Chesapeake Bay was like in the 1600s in order to fully understand how the Bay has changed in the last four centuries. They will begin this process by reading about the animals that Captain John Smith and other explorers of 1600s found during their explorations of the Chesapeake region.

EXPLORATION:

1. As a class, read the worksheet entitled "*Common Animals Seen on the Chesapeake Bay by Captain John Smith in 1608*" (Handout #1). Ask the students if they have seen the animals in the pictures. Which animals are no longer common today? (*It is likely that many of the students will have never seen a live sturgeon, shad, or herring - despite the fact that these were once among the most common fish found in the estuary. It is also likely that they WILL have seen oysters, geese, and rockfish*). Tell the students that today they will be reading quotes from early explorers of the Chesapeake to learn about fisheries on the Bay in the 17th and 18th centuries.

2. Draw a T-chart on the blackboard like the one found on the worksheet entitled "*Student Data: Animals of the Chesapeake in the 1600s*".

3. Use the T-chart to compile student responses to the activity below:

   - Instruct students to read the quotes provided on the handout entitled "*Quotes from Early Explorers of the Chesapeake Bay*" (Handout #2) in order to create a list of names of the animals that were found and their relative numbers. Students should record their findings on the worksheet entitled "*Student Data: Animals of the Chesapeake in the 1600s*" (Handout #2a).
   - Go over the instructions for the assignment and reading strategy. Differentiate reading strategies in other ways if necessary (i.e., pair students, give one passage to a team; assign two or more of the primary resource passages to each student). The passages are quotes from the 17th and 18th centuries. Since they are written in the language of the time it may be difficult for students to read them. Provide teacher assistance as needed. *The object of the lesson is to discover the animals and the relative numbers that were found, not to get weighted down with the language***.** Since actual numbers are often not given, instruct the students to write down general observations such as "many" or "great amounts".
   - Call on students to volunteer to read the information from their data chart/s. Record student responses on the T-chart on the blackboard.

EXPLANATION:

1. Discuss the information from the T-chart and ask students to give a general description of the numbers and kinds of animals found in the Bay during the 1600s. (*In general, the students should conclude that there were large quantities of fish, birds and oysters in the Chesapeake Bay of John Smith's time.)*

EXPLORATION:

1. Discuss the following vocabulary words:

habitat	an area where a plant or animals lives that provides food, water and protection for survival and reproduction
SAV	(Submerged Aquatic Vegetation) rooted underwater plants that provide an important source of food and habitat for many Bay-dwelling animals
forested buffer	wooded areas which help filter polluted runoff before it enters rivers or streams
wetlands	areas such as marshes and swamps typically found along the Bay's edges in shallow areas where the water meets the land. These areas are often called "nurseries" because they provide food and shelter for small, juvenile animals.

2. Project the transparency entitled "*Healthy Habitats*" (Transparency #2) and read it aloud as a class. Discuss the definition of a habitat and have the students come up with habitats that are not mentioned in the reading (*student responses may include brooks, streams, rivers, meadows, etc*.) Tell the students that they are going to be reading quotes from Captain John Smith which describe habitats on the Bay in the 1600s.

3. Instruct students to read the text entitled *"Healthy Habitats: Captain John Smith's Description of the Land Surrounding the Chesapeake Bay in 1608"* (Handout #3). Add pre-reading and during-reading directions as needed.

4. Have students read the quotes and complete their *Student Data Sheet* (Handout #3a) with the name/s of the habitat and words that describe the habitat.

5. Compile the responses on a class T-chart on the blackboard.

ASSESSMENT

1. Explain to students that they will now grade the condition of the Chesapeake Bay in the 1600s. They will need to think about what they learned from Captain John Smith and other explorers of the 1600s and what they now know about the importance of healthy habitats.

2. Review the instructions on the worksheet entitled "*Chesapeake Bay Report Card in the 1600s*" (Handout #4) with students. Grades for each category are based on a scale of 0 (worst) to 100 (best). After giving a grade for each item, students should assign one overall grade to the Bay. They should support their choice of a grade with information.

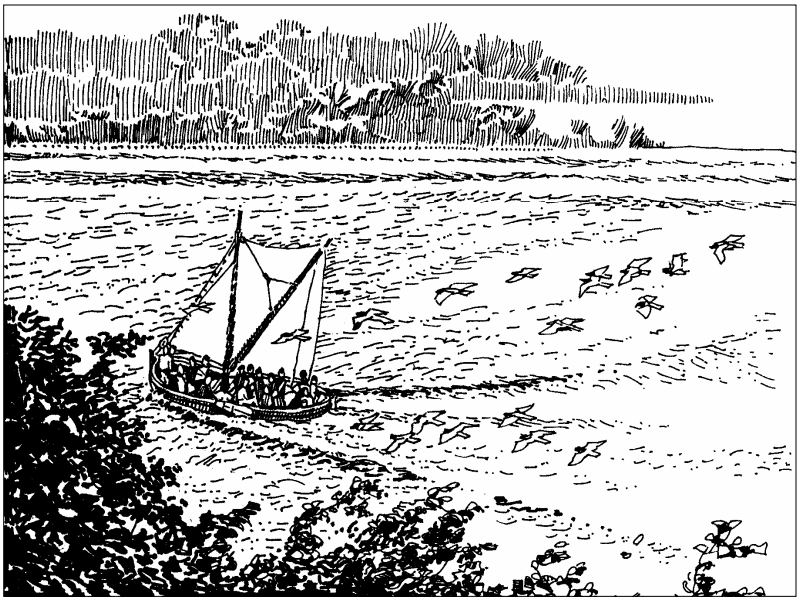
EXTENSION

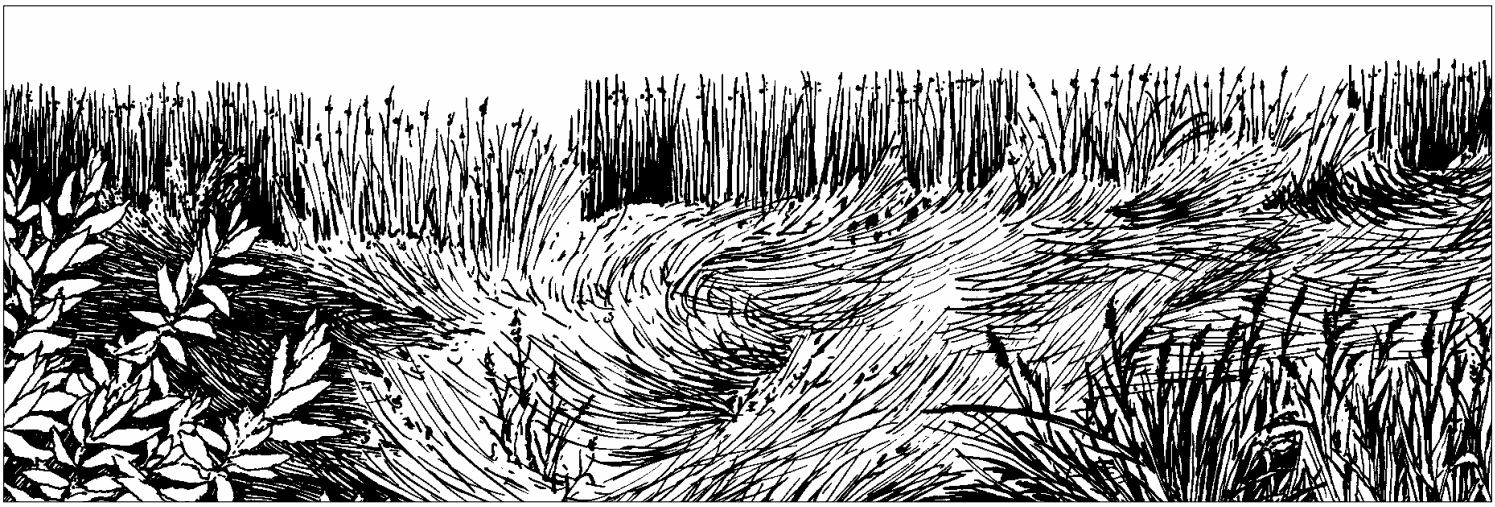
Now present students with data in the same seven categories from the worksheet entitled "*The State of the Bay in 2005*" (Handout #4a). This data is taken from the Chesapeake Bay Foundation's annual State of the Bay Report. Students should compare the two report cards and summarize what changes have occurred in the Bay since John Smith's time.

TO OBTAIN THE ENTIRE STATE OF THE BAY REPORT:

1. Visit the Chesapeake Bay Foundation's web site at www.cbf.org
2. Double click on the "State of the Bay" icon on the blue horizontal bar near the top of the page.
3. Double click on "Download". The download requires Adobe Reader 6.0 software.

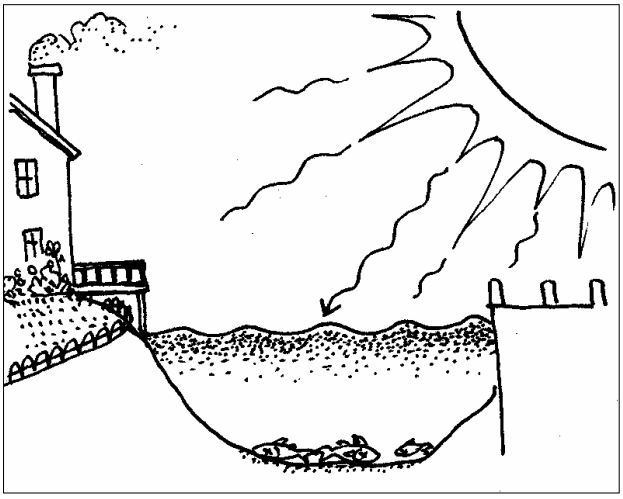
The Chesapeake Bay In 1608

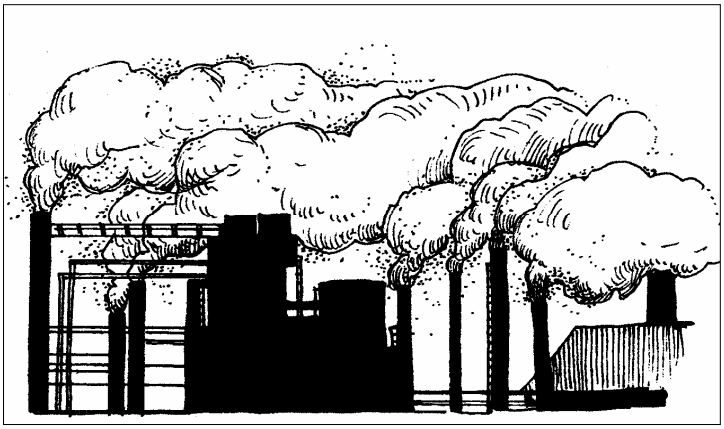


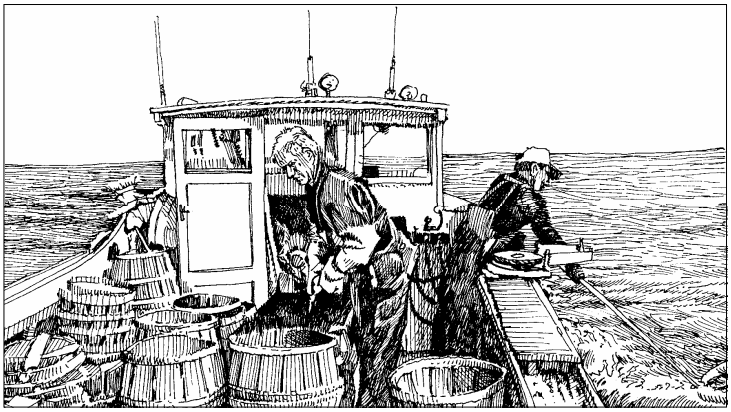


Images of shallop and “first contact” courtesy Marc Castelli
Images of marsh scenery courtesy Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition

THE CHESAPEAKE BAY TODAY

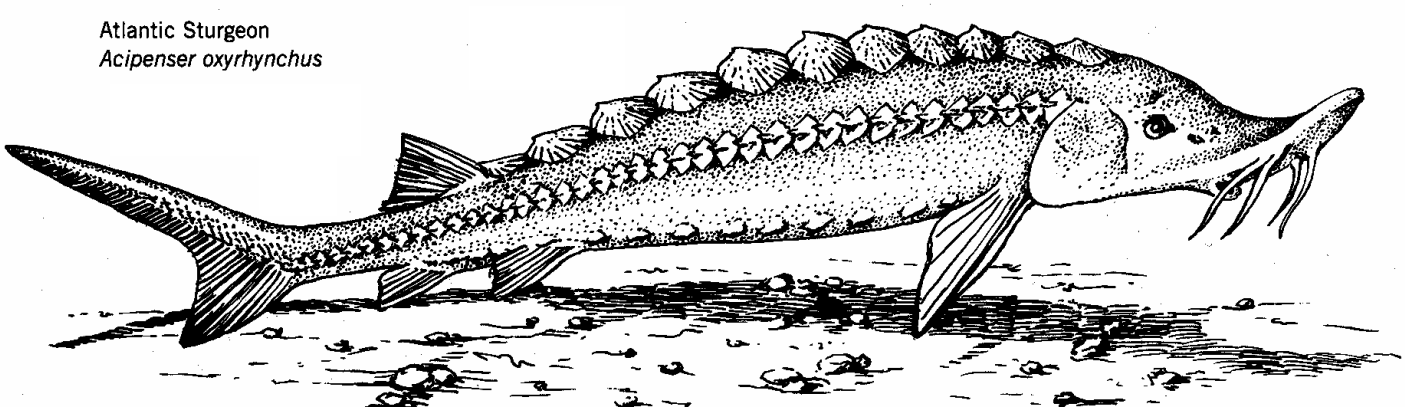




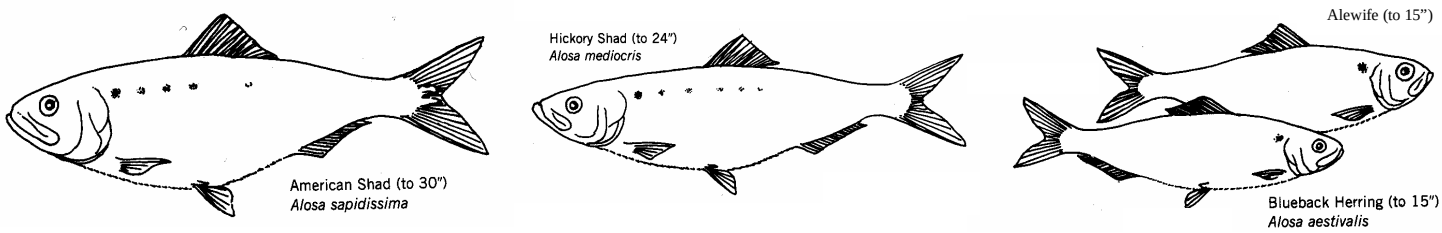


Images of farm field and waterman courtesy Marc Castelli
All other images courtesy Marcy Dunn Ramsey

Common Animals Seen on the Chesapeake Bay by Captain John Smith in 1608

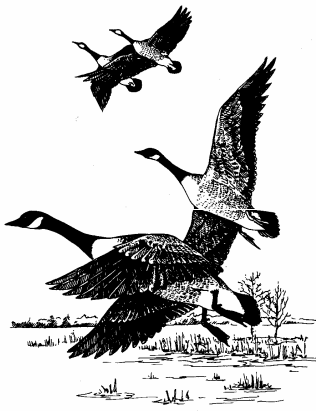


STURGEON - Giant sturgeon, some up to *14 feet long*, were a common sight in the Chesapeake of John Smith's time. These large, pre-historic fish are rarely seen in today's Chesapeake Bay.

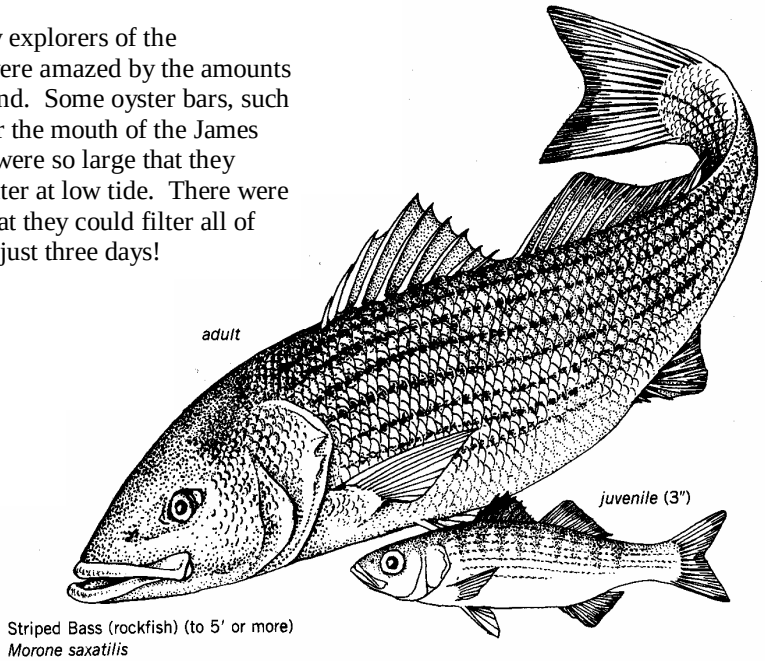


SHAD AND HERRING - In the 1600s, the Bay's rivers and streams were filled each spring by millions of spawning shad and herring. The fish swam upstream as far west as the Appalachian Mountains of Virginia and Maryland and as far north as New York state to lay their eggs. The Indians and English settlers netted these fish by the thousands.

OYSTERS - Early explorers of the Chesapeake Bay were amazed by the amounts of oysters they found. Some oyster bars, such as those found near the mouth of the James River in Virginia, were so large that they stuck out of the water at low tide. There were so many oysters that they could filter all of the Bay's water in just three days!



CANADA GEESE - In John Smith's time, hundreds of thousands of Canada Geese visited the Chesapeake each fall to feast on the submerged grass beds found in the Bay's shallow waters. These birds can still be found in large numbers today on the Eastern Shore during winter months.



STRIPED BASS (ROCKFISH) - In 1608, huge striped bass - some weighing 50 pounds or more - swam up the Bay's tidal rivers to spawn.

All images courtesy Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition

NAME: _____ DATE: _____

QUOTES FROM EARLY EXPLORERS OF THE CHESAPEAKE BAY

DIRECTIONS: Below you will find different quotes to read. These quotes were written by Captain John Smith and other early Chesapeake Bay explorers. After you finish reading, write the names of the animals these explorers discovered on the chart provided, then write a brief description of how many of these animals were seen.

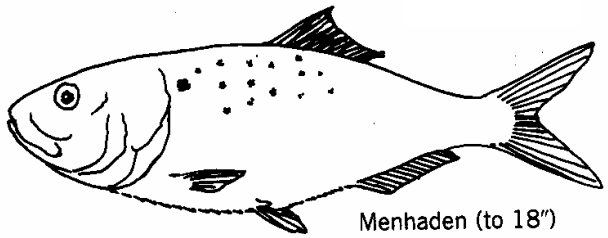
**READING STRATEGY: As you read the text, underline the names of animals and any adjectives that describe how many the explorers found.

- "Of fish we were best acquainted with sturgeon, grampus, porpoise, seals, stingrays whose tails are very dangerous, brits, mullets, white salmon, trouts, soles, plaice, herring, conyfish, rockfish, eels, lampreys, catfish, shad, perch of three sorts, crabs, shrimps, crevises, oysters, cockles, and mussels."

  Captain John Smith, 1612

- "The main river (James) abounds with sturgeon, very large and excellent good, having also at the mouth of every brook and in every creek both store and exceedingly good fish of divers kinds. In the large sounds near the sea are multitudes of fish, banks of oysters, and many great crabs rather better, in fact, than ours and able to suffice four men."

  Captain Christopher Newport, 1607



Menhaden (to 18″)
Brevoortia tyrannus

- "To the natural commodities which the country has of fruit, beasts, and fowl, we may also add the no mean commodity of fish, of which, in March and April, are great shoals of herrings, sturgeon, great store commonly in May if the year be forward. Shad, great store, of a yard long and for sweetness and fatness a reasonable food fish . . ."

  William Strachey, 1612

- "Sturgeon and shad are in such prodigious numbers that one day within the space of two miles only, some gentlemen in canoes caught above six hundred of the former with hooks . . . and of the latter above five thousand have been caught at one single haul of a seine."

  English traveler Andrew Burnaby, 1759

- "Herring are not as large as the European ones, but better and more delicious … When they spawn, all streams and waters are completely filled with them, and one might believe, when he sees such terrible amounts of them, that there was as great a supply of herring as there is water. In a word, it is unbelievable, indeed, indescribable, as also incomprehensible, what quantity is found there."

  William Byrd II (Virginia), early 1700's

Quotes from Early Explorers of the Chesapeake Bay

- "Saw a seine drawn for herring and caught upwards of 40,000 with about 300 shad fish. The shads they use but the herrings are left upon the shore useless for want of salt."

  English visitor Nicholas Cresswell, 1777

- "Here are such plenty of oysters that they may load ships with them. At the mouth of Elizabeth River, when it is low water, they appear in rocks a foot above water. There are also in some places great store of mussels and cockles (conch)."

  Thomas Glover, 1676

- "The abundance of oysters is incredible. There are whole banks of them so that the ships must avoid them . . . They surpass those in England by far in size, indeed, they are four times as large. I often cut them in two, before I could put them into my mouth."

  Explorer Francis Louis Michel, 1701

- "Rockfish were hunted on the Eastern Shore on horseback with spears. The large fish coming to feed on the creek shores, overflowed by the tide, showed themselves in the shallow water by a ripple before them. They were ridden on behind and forced into water too shallow for them to swim well, and were speared …"

  Col. T. J. Randolph of Edgehill, VA, 1875

- "Of birds, the Eagle is the greatest devourer. Hawks there be of diverse sorts as our Falconers called them, Sparrow hawks . . . Goss hawks, Falcons and Ospreys . . . In winter there are great plenty of Swans, Cranes gray and white with black wings, Herons, Geese, Duck . . . Parrots, and Pigeons. Of all those sorts great abundance, and some other strange kinds to us unknown by name."

  Captain John Smith describing the birds of the Chesapeake region, 1612

- "Of beasts the chief are Deer, nothing differing from ours. In the deserts towards the heads of the rivers, there are many, but amongst the rivers few."

  Captain John Smith, 1612

- "Their Bears are very little in comparison of those of Muscovia and Tartaria. The Beaver is as big as an ordinary water dog, but his legs exceeding short . . . His tail somewhat like the form of a Racket bare without hair . . . They have many Otters, which, as the Beavers, they take with snares, and esteem the skins great ornaments; and of all those beasts they use to feed, when they catch them."

  Captain John Smith, 1612

Illustration courtesy Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition

NAME: _____ DATE: _____

STUDENT DATA:
ANIMALS OF THE CHESAPEAKE IN THE 1600S

ANIMALS DISCOVERED	AMOUNTS OF ANIMALS DISCOVERED

1B. On the lines below summarize what the Chesapeake Bay ecosystem was like in the 1600s

_____

_____

_____

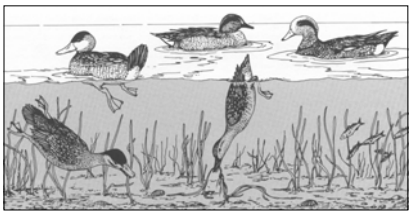
_____

_____

HEALTHY HABITATS

In order for many kinds of animals to live in the Chesapeake Bay they must have healthy habitats. Habitats are the homes of animals that provide them with food, water, and space where they can find protection and raise their young. Your home is a habitat for you; it is where you find food, water, and a safe place to live. If the Bay's habitats are in healthy condition, there will be good homes for many animals to live there. If the habitats are in poor condition, fewer animals will be live there. The Chesapeake Bay has many habitats for different kinds of animals. Some of these include:

WETLANDS (swamps and marshes)
Wetlands are the marshes and swamps found along the edges of the Bay. It is where shallow water meets the land and also where many plants grow. Wetlands are sometimes called the nurseries of the Bay because many fish live there when they are young and small.



UNDERWATER GRASSES (SAV)
Underwater grasses are also called SAV, which stands for submerged aquatic vegetation. SAV are found in shallow clear water where the sun can reach the bottom. SAV provide food for many kinds of animals and put oxygen in the water. They also provide a place for small organisms such as young fish, snails, shrimp and crabs to hide.

OYSTER BARS
Oysters live in large groups called oyster bars or shoals. Oyster shells provide habitat for many animals such as snails, worms, small crabs and young fish. Many of these animals are then eaten by larger animals. Oysters filter the Bay's water by sucking it into their shells and eating plankton. This also removes dirt and excess nutrients from the water, keeping it clean and clear.

FORESTS (forested buffers)
Forests lining the Bay's shoreline provide nesting sites for bald eagles, ospreys, blue heron, and many other bird species. They also soften the impact of heavy rains and limit the amount of runoff entering the Bay.

Today you will be reading quotes from Captain John Smith which describe some of the habitats that he found in the Chesapeake region in 1608. You will then use information from the reading to create a "Report Card" for the Chesapeake Bay in the 1600s.

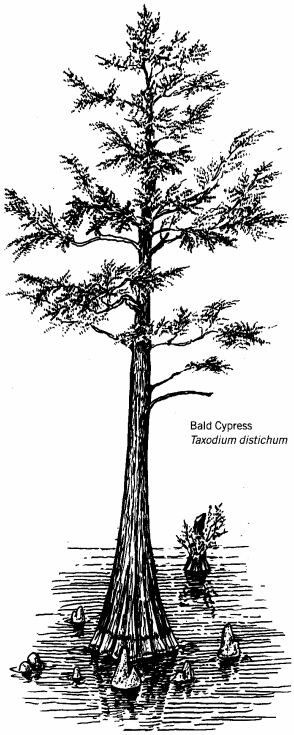
Images courtesy Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition

HEALTHY HABITATS: CAPTAIN JOHN SMITH'S DESCRIPTIONS OF THE CHESAPEAKE BAY IN THE EARLY 1600S

Read the statements below to see how Captain John Smith described the habitats surrounding the Chesapeake Bay during his voyages of 1608. You may need help from your teacher, as John Smith spoke in a style of English much different from your own! When you are finished, fill in the *Student Data Sheet* on the following page.

- "The cape on the South side is called Cape Henry in honor of our most noble Prince . . . The north Cape is called Cape Charles in honor of the worthy Duke of York. Within is a country that may have the prerogative over the most pleasant places of Europe, Asia, Africa, or America. for large and pleasant navigable rivers: heaven and earth never agreed better to frame a place for means of habitation . . ."

- "The country is not mountainous nor yet low but such pleasant plain hills and fertile valleys, one prettily crossing an other, and watered so conveniently with their sweet brooks and chrystal springs, as if art itself had devised them."



- "Here are mountains, hills, plains, valleys, rivers, and brooks all running most pleasantly into a faire Bay compassed but for the mouth with fruitful and delightsome land."

- "Thirty leagues we sailed more Northwards not finding any inhabitants, leaving all the Eastern shore, low Islands, but overgrown with woods, as all the Coast beyond them so far as wee could see."

- "The Western shore by which we sailed we found all along well watered, but very mountainous and barren, the valleys very fertile, but extreme thick of small wood so well as trees, and much frequented with Wolves, Bears, Deere and other wild beasts."

- "By the rivers are many plain marshes containing some 20, some 100, some 200 Acres, some more, some less. Other plains there are few, but only where the Savages (Indians) inhabit: but all overgrown with trees and weeds being a plain wilderness as God first made it."

- "Virginia doth afford many excellent vegetables and living Creatures, yet grass there is little or none but what grows in low Marshes: for all the Country is overgrown with trees."

Illustration of bald cypress courtesy Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition
Captain John Smith described bald cypress trees that were up to 80 feet tall before the first branch could be seen!

NAME: _____ DATE: _____

STUDENT DATA SHEET

DIRECTIONS: After reading "*Healthy Habitats*", use the information to fill in the chart and provide a short answer to the question below.

HABITATS MENTIONED	DESCRIPTION OF HABITAT

After reading John Smith's quotes on the previous page, state whether or not if the Chesapeake Bay habitats were in good condition or poor condition during the 1600s. Include information from the reading to support your answer.

NAME: _____ DATE: _____

CHESAPEAKE BAY REPORT CARD IN THE 1600S

You now have a good idea of what the Chesapeake Bay was like in the 1600s. The Chesapeake Bay Foundation makes a report card for the Chesapeake Bay each year. They grade different parts of the Bay according to how healthy they are. Now it is your job to complete a report card on the health of the Chesapeake Bay in the 1600s.

Listed below are seven categories for habitats and animals found by explorers in the 1600s. Based upon what you have learned in this lesson, assign a number grade from zero to 100 to each of the habitats and animals. Use the grading system below.

90 –100	Very Good
80 – 89	Good
70 – 79	Fair
60 – 69	Poor
50 and below	Failing

HEALTH OF THE BAY IN THE 1600S
REPORT CARD

HABITAT OR ANIMAL	GRADE
WETLANDS	
UNDERWATER GRASSES (SAV'S)	
OYSTERS	
ROCKFISH	
SHAD	
WATER CLARITY	
FORESTED BUFFERS	

OVERALL GRADE FOR THE CHESAPEAKE IN THE 1600s: _____

NAME: _____ DATE: _____

THE STATE OF THE BAY IN 2005

In their annual "State of the Bay Report", here is how the Chesapeake Bay Foundation rated the Bay's health in the seven categories that you just examined with your class:

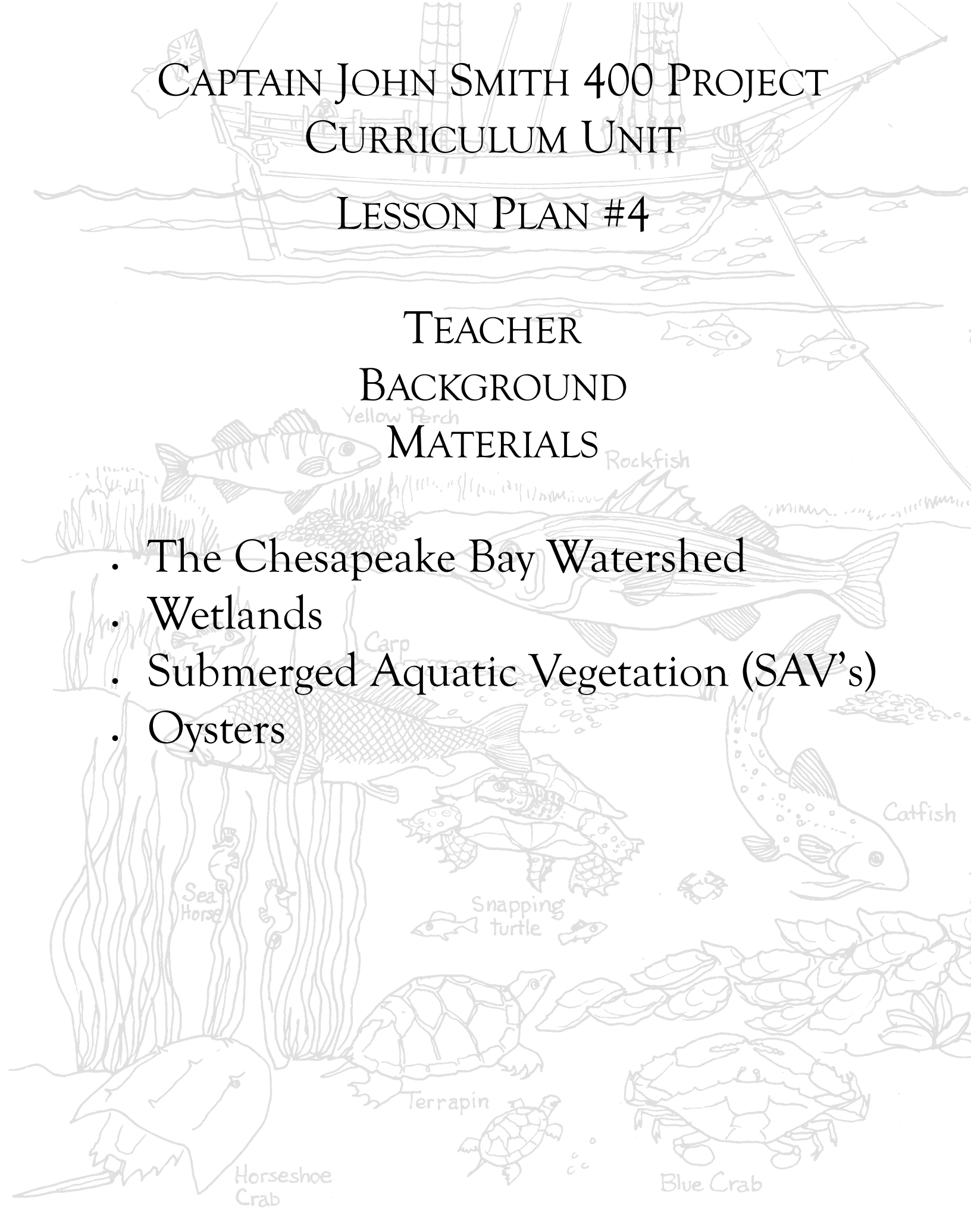
HABITAT OR ANIMAL	GRADE
WETLANDS	42
UNDERWATER GRASSES (SAV'S)	20
OYSTERS	3
ROCKFISH	71
SHAD	12
WATER CLARITY	15
FORESTED BUFFERS	55

Based upon these results, how does the health of the Chesapeake Bay today compare to the health of the Bay in the 1600s? What may have caused these changes?

Captain John Smith 400 Project
Curriculum Unit
Lesson Plan #4

Teacher
Background
Materials

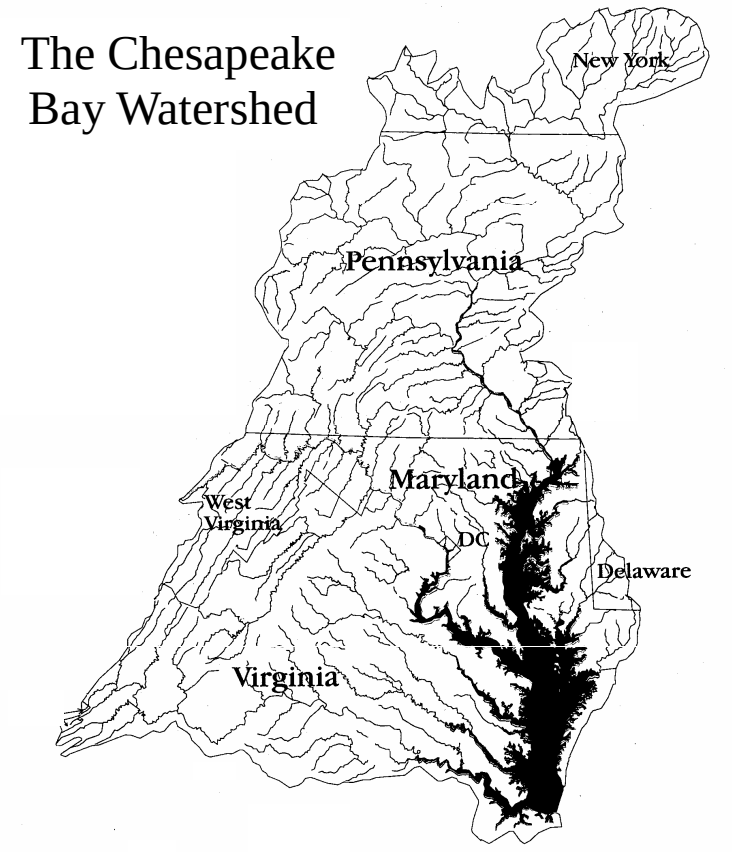
- The Chesapeake Bay Watershed
- Wetlands
- Submerged Aquatic Vegetation (SAV's)
- Oysters



The Chesapeake Bay Watershed

The Chesapeake Bay gets its **fresh water** from thousands of brooks, streams, and rivers which drain 64,000 square miles of land. The enormous piece of land which drains fresh water to the Bay is known as its **watershed**. States within the Chesapeake Bay watershed's boundaries include New York, Pennsylvania, Delaware, Maryland, West Virginia, and Virginia.

Since the Chesapeake Bay watershed covers such a large amount of land, the health of its water is affected by human activities which take place hundreds of miles upstream. Soil from tilled farm fields in Pennsylvania, human sewage from treatment plants in central Virginia, and even chemicals found on the parking lot of the Baseball Hall of Fame in Cooperstown, New York all have the potential to be washed into feeder streams which eventually flow to the Bay. If you live within the watershed's boundaries, the health of the Bay literally begins with the stream in your own back yard.



The Chesapeake Bay's 64,000 square mile watershed includes parts of six states and the entire District of Columbia. Understanding how land use on the watershed affects the water quality of environments many miles downstream is essential for preserving the health of the Chesapeake's rich ecosystem.

When fresh water reaches the Chesapeake, it mixes with **salt water** from the Atlantic Ocean to create **brackish water**. **Ecosystems** which contain brackish water are called **estuaries**. Estuaries are famous for being among the most productive ecosystems in the world. The Chesapeake Bay is the largest estuary in North America. It is also home to over 2,000 species of plants and animals! Some of the most well-known seafood products to come from the Chesapeake include oysters, crabs, striped bass (rockfish), and clams.

In the 1600's, virtually all of the land which makes up the Chesapeake Bay watershed was covered with dense, old growth forests. The canopies of these trees protected the soil from the impact of heavy rains, while the massive root systems kept **erosion** under control. As a result, fresh water entering the Bay was exceptionally clean and crystal clear. The water clarity allowed rooted plants to thrive on the bottom of the Bay, providing ideal habitat for fish, crabs, and other organisms. Early explorers of the

Illustration courtesy of the Chesapeake Bay Program

The Chesapeake Bay Watershed

Chesapeake were amazed by the amount of marine life that they witnessed in this incredibly productive environment.

As 16 million people have crowded onto the watershed in the last 400 years, many forests have been cleared to make room for housing developments, roads, and farm fields. When rain water rushes over these unprotected environments, it transports large amounts of **sediments** and pollutants to the Bay, lowering the water quality and making it more difficult for plants, fish, crabs, and other animals to survive.

Only recently have we begun to fully understand the connection between land use on the watershed and the health of the Chesapeake Bay. If people take care of the land within the watershed's boundaries, the result is a healthier ecosystem.

A close look at Captain John Smith's 1612 map of the Chesapeake Bay reveals dense forests surrounding the entire body of water as well as Native American tribes inhabiting both shores. As more and more settlers came to the Chesapeake region, thousands of acres of forests were cleared to make room for homes and farm fields. The arrival of colonists also led to the removal of tens of thousands of Native Americans from their traditional lands.

Captain John Smith's 1612 map of the Chesapeake Bay courtesy Maryland State Archives

Wetlands: Food, Filter, Habitat

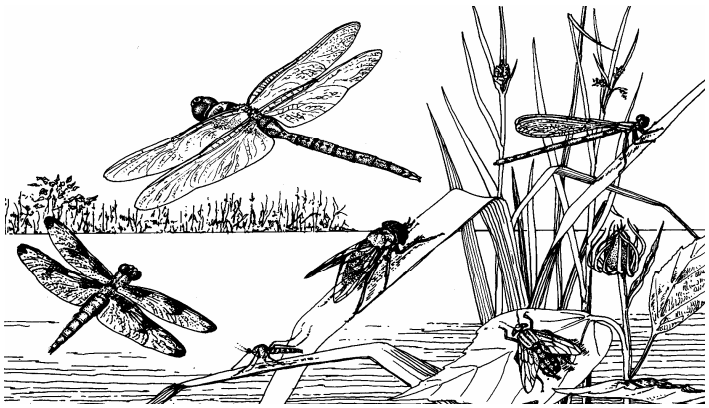
Plants in wetland areas absorb excess nutrients and filter out pollutants before they reach the Bay.

Swamps and marshes found along the coastline of the Chesapeake Bay which connect deep water and land are known as **wetlands**. These areas provide habitat for a wide variety of organisms and act as a natural filtration system for the Bay's water. In recent years, people have come to understand the important role wetlands play in preserving the health of the Chesapeake Bay ecosystem.

Wetlands act as a protective nursery area for many aquatic organisms who travel into their shallow waters seeking food and protection. Juvenile rockfish, perch, and sea trout are just a few of the fish species which take advantage of the shelter provided by plant cover found in wetland areas. Blue crabs spend much of their young life in the protective confines of the marsh; adult crabs often hide in wetlands after molting while their new shell is still soft. Wetlands also provide food and resting areas for **migratory waterfowl**. Canada geese, swans, and many species of ducks can typically be found feeding in these areas, consuming rooted plants which are abundant in these shallow water environments.

Swamps and marshes play the important role of filtering water entering the Bay. Sediments and pollutants which wash from land into the water are trapped by the tangled plant matter found in wetlands. Water that flows through a marsh or swamp is consequently much cleaner than it was beforehand. Wetlands help minimize the effects of flooding by protecting shoreline environments from erosion.

When humans fill in wetlands for waterfront development, they remove areas that are vital for improving the water quality of the Bay, as well as critical habitat for many species of plants and animals. In recent years these "critical areas" have been protected by strict environmental laws which prohibit the filling in of swamps and marshes for land development.



Wetlands are home to many insect species. Insect larvae serve as a food source for many young fish living in the marsh.

Illustrations courtesy of Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition.

Submerged Aquatic Vegetation

Submerged weed beds and sea grass meadows are among the most important habitats found in the Chesapeake Bay. These rooted plants are found in shallow water where sunlight can reach the bottom. Scientists refer to these plants as **s**ubmerged **a**quatic **v**egetation, or **SAV's**. There are sixteen different species of SAV's found in the Chesapeake Bay and its tributaries, and their distribution depends heavily on salinity levels. In the high salinity areas of the lower bay, SAV's include eelgrass and widgeon grass. Areas with fresh and low-salinity brackish water are home to several different species of SAV's including wild celery, sago pondweed, and redhead grass.

SAV's provide a rich source of food for a wide variety of animals. Snails feed on the abundance of decaying plant material found in these environments. Small fish prey upon insect larvae which hide amongst the grasses. Larger fish prey on the smaller fish, and are in turn eaten themselves by eagles, osprey, and blue heron. Other birds, such as ducks and geese, feed directly on rooted plants and rely on them as a primary food source during seasonal migrations.

SAV's also provide ideal habitat for many aquatic organisms. Small fish seek cover in the grass beds, taking advantage of the natural camouflage they provide. Crabs use the cover provided by submerged plants to hide from predators while they shed their shells. SAV's also help to stabilize the bottom of the Bay. Their root systems hold sediments in place and lessen the impact of wave action.

Prior to the arrival of European settlers, the bottom of the Chesapeake Bay was covered with hundreds of thousands of acres of submerged grass beds. Today, only a fraction of these habitats remain. Several factors have led to the demise of SAV's. Soil which washes into the Bay from construction sites and tilled farm fields clouds the water, preventing SAV's from receiving sunlight they need to grow. Nutrients from sewage treatment plants, fertilizers, and car exhaust feed small plants called algae, which grow in such large quantities at the top of the water column that they, too, prevent sunlight from reaching the bottom. Recent efforts have been made to improve these conditions, with mixed results. In parts of the Bay, SAV's appear to be making a comeback. By restoring these critical areas, we provide thousands of animals with important habitats they need to survive.

Illustration courtesy of Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition.

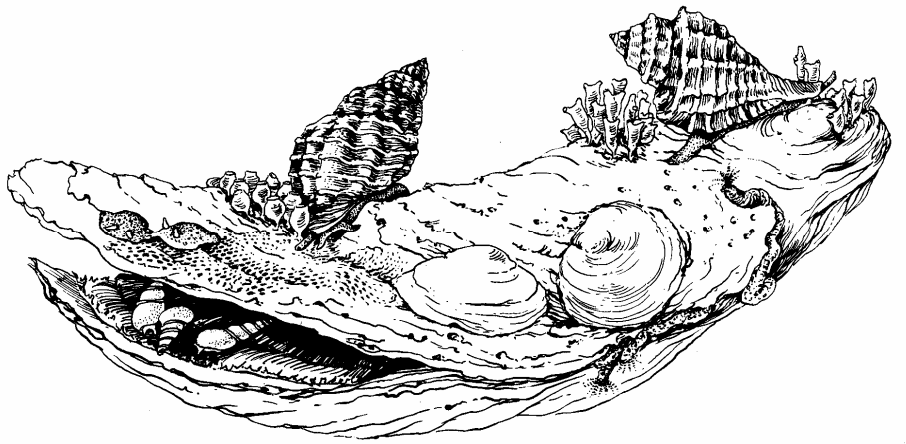
The Eastern Oyster

"The abundance of oysters is incredible. There are whole banks of them so that the ships must avoid them … They surpass those in England by far in size, indeed, they are four times as large. I often cut them in two, before I could put them into my mouth. "

Swiss explorer Francis Louis Michel, 1701

Perhaps no other living creature in the Chesapeake Bay is more well known than the oyster. Early explorers were amazed by the amount of oysters found in Bay waters, and they quickly became famous around the world for their unique flavor. Large adult oysters can filter up to sixty gallons of water in a single day while providing **habitat** for a wide variety of organisms. Unfortunately, the oyster population has been in sharp decline since the late 1800's due to over-harvesting, disease, and habitat loss.

Oysters are among the most prolific reproducers in the world. A single female can produce several hundred million eggs over the course of a lifetime. Oysters spawn near the end of June, when rising water temperatures trigger females to release eggs into the water, where they are met by sperm released from males. Fertilized eggs develop into swimming larvae which, after a few days, settle to the bottom and attach themselves to a hard surface. Usually this surface is another oyster shell. Juvenile attached oysters are called **spat**. As spat grow, their shells increase in size. Once an oyster is three inches long, it can legally be caught and eaten.



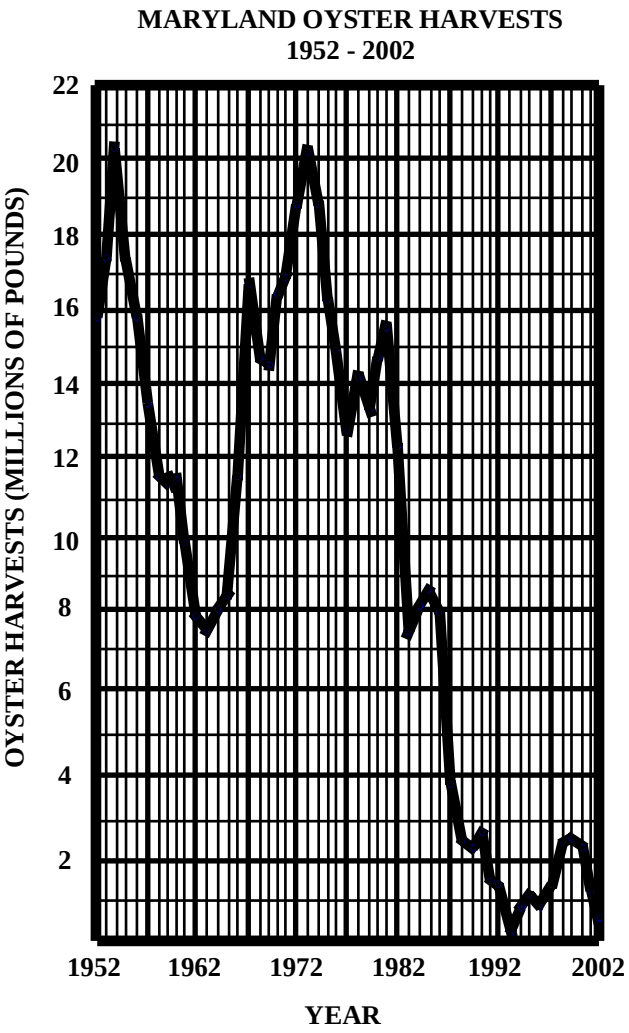
The oyster shell itself provides a hard surface for other organisms to attach to or feed upon. Creatures commonly found clinging to oysters include bryzoa, oyster drills, snails, and barnacles.

One unique characteristic common to all oyster species is their ability to change gender. At two to three months old, oysters are bisexual. At the end of their first year, most oysters spawn as males. As they grow older, however, many spawn as females, particularly after their second year.

Oysters eat by sucking water into their shells and filtering out small plants called phytoplankton. When this happens, sediments and excess nutrients are also removed from the water. This process greatly improves the water quality of the Bay. According to scientists' estimates, oysters were once so abundant that they filtered the entire water volume of the Chesapeake Bay in only a few days. Today, with only one percent of the

Illustration courtesy of Alice Jane Lippson, selected from Life in the Chesapeake Bay, Second Edition.

The Eastern Oyster



The line graph above shows the sharp decline in Maryland oyster harvests in the last 50 years. The collapse of the oyster industry has led some scientists to call for introducing a foreign oyster to the Bay.

historic population remaining, that same process takes over a year.

Several factors have led to the oysters' collapse. Years of over-harvesting greatly depleted the population. Diseases such as **MSX** and "**Dermo**", which attack young oysters, have destroyed what was left. Furthermore, sedimentation caused by land development has covered prime habitat with silt, preventing larval oysters from attaching themselves to a hard surface. Without a hard surface to grow on, juvenile oysters cannot survive.

Many efforts are being made to restore the native oyster population. Private citizens are helping by raising young oysters in specially designed "oyster gardens" which hang from their piers. Artificial oyster bars are being built in areas less susceptible to MSX and Dermo. The Maryland Department of Natural Resources plants seed oysters and shell matter on traditional oyster bars. Despite all of these efforts, the recovery process has been very slow, and in 2001-2002 a severe drought allowed the viruses to spread to the upper Bay, leading to the death of tens of thousands of oysters.

The limited success of restoration efforts has led some scientists to believe that extreme measures need to be taken. In recent years, experiments have been conducted with an Asian oyster (known to scientists as *Crassostrea ariakensis*) that may be introduced into the waters of the Chesapeake Bay in the next few years. The Asian oyster tastes similar to the Eastern oyster, grows more quickly, and appears to be resistant to MSX and Dermo. While many are excited about the promise shown by this oyster, others fear the hidden side effects that are always involved when placing an introduced species into the Bay.

The fate of the native oyster ultimately depends upon our efforts to restore habitat and improve water quality. Perhaps one day we may live to see the incredible abundance of oysters which beheld the first inhabitants of our "Great Shellfish Bay".

DATA SOURCE: National Marine Fisheries Service (www.st.nmfs.gov)