

Exploring the Chesapeake Bay



Smithsonian Environmental
Research Center

EXPLORING THE CHESAPEAKE BAY is designed to support the lead classroom teacher with materials and background information to be used before and after the field trip to the Smithsonian Environmental Research Center (SERC). The more students, parent volunteers, and other teachers know beforehand, the more successful the field trip to SERC will be.

This booklet includes:

- An introduction to SERC.
- Information about the physical and biological components of the Chesapeake Bay and its watershed
- Detailed background information for the hands-on stations students will visit during their day at SERC
- Instructional guide for teaching students about the stations and how to answer the five key questions before arriving at SERC:
 1. What is a watershed?
 2. Why are oysters important to the Bay?
 3. Why is the Chesapeake Bay estuary important to people, animals, and plants?
 4. What is the importance of plankton in the food chain or pyramid?
 5. In what ways do you and your community impact the health of the Bay?

Through this experience, students will develop skills in gathering scientific information and gain an awareness of and appreciation for the environment surrounding our own Chesapeake Bay.

For more information, visit www.serc.si.edu/education/programs.

Credits: Sara Sherman, Sarah McNaboe, Jane Holly, Mark Haddon, Barbara Zelley, Barbara McGarry

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Welcome to SERC!

What is SERC?

"SERC" is the acronym for the Smithsonian Environmental Research Center. SERC is part of the Smithsonian Institution, the same institution that is famous for its museums in Washington, D.C. It started in 1965 as a place for environmental research. Today more than 125 scientists conduct research at SERC.

Where is SERC?

SERC is comprised of 2,650 acres located on the Rhode River seven miles south of Annapolis, Maryland.

Environmental Research at SERC

Scientists at SERC study ecosystems such as wetlands, forests, creeks, and rivers that surround the Chesapeake Bay and the plants and animals that live there. Scientists are trying to solve some important puzzles about our environment. For example they are trying to answer:

- Why do certain kinds of plants and animals live where they do?
- How do plants and animals respond when an ecosystem such as a forest or estuary changes?
- How will human activities affect the environment?

Research always begins with a question. Some of the questions, we at SERC, explore are...

- How do crabs find food?
- How do vines change a forest?
- How will changes in the atmosphere affect plants?
- How does farming affect the Chesapeake Bay?

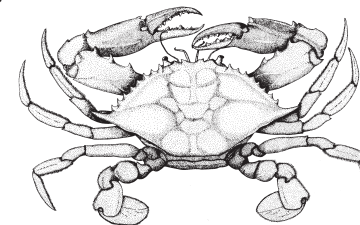


What do SERC Scientists study?

Go to the SERC website to learn more about the research in each of these labs.

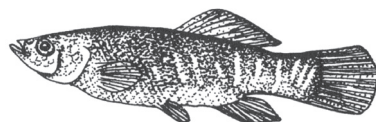
www.serc.si.edu/research/labs.aspx

Fish and Invertebrate Ecology



Trace Element Biogeochemistry

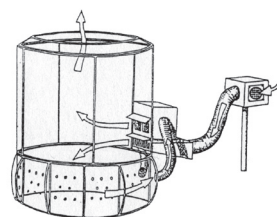
Marine and Estuarine Ecology



Nutrient Lab

Protistan Ecology

Biogeochemistry



Marine Invasion Research

CO₂ and Plant Physiology

Photobiology and
Solar Radiation

Animal-Plant Interaction

Benthic Ecology

Ecological Modeling

Phytoplankton Ecology



Forest Ecology



Microbial Ecology

Terrestrial Ecology

Plant Ecology



The Chesapeake Bay Watershed

What is a Watershed?

A **watershed** is an area of land that drains into a specific body of water such as a lake, stream, river, or estuary.

Most rivers in the U.S. eventually drain into the oceans, Gulf of Mexico, or the Great Lakes. During a storm a portion of the precipitation runs off the land. When it rains, some of the water runs along the street into a storm drain, and some water runs into a small creek, river, or pond or below the ground as ground water.

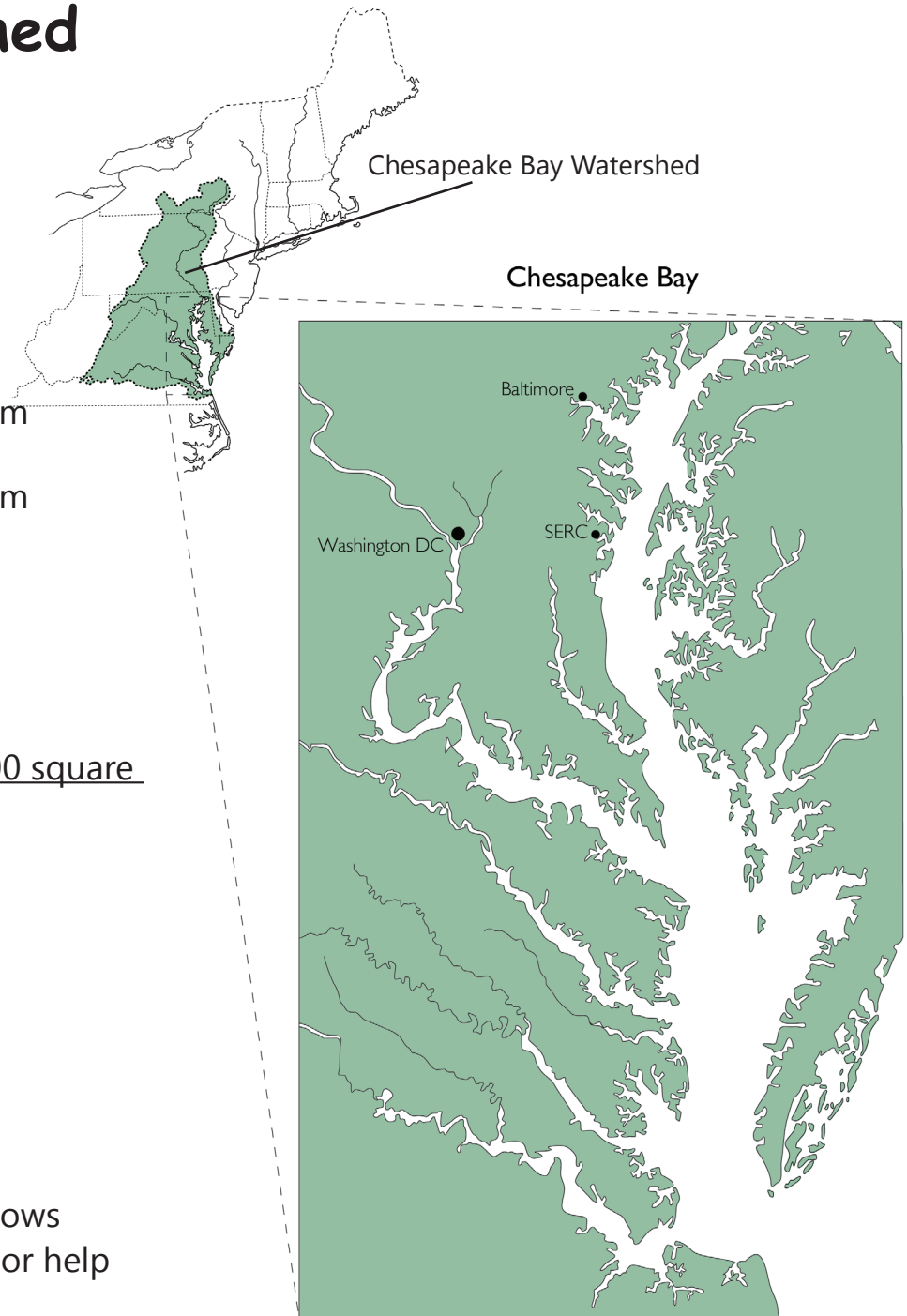
The Chesapeake Bay Watershed

The Chesapeake Bay Watershed is an area of 64,000 square miles and includes parts of six states:

1. Maryland
2. West Virginia
3. Virginia
4. Delaware
5. Pennsylvania
6. New York

and the entire District of Columbia!

You probably live in the watershed of a river that flows into the Chesapeake Bay. You have the power to pollute or help preserve the Chesapeake Bay!



The Chesapeake Bay



The Chesapeake Bay was formed 10,000 years ago during the last ice age when the Susquehanna River Valley flooded.

The Bay is over 195 miles long and ranges in width from 3.4 miles near Aberdeen, MD to 35 miles near the mouth of the Potomac River.

The Bay has 150 rivers and streams that provide spawning and nursery grounds for several important species of fish.

The Chesapeake Bay is the largest estuary in the United States and is a very complex and sensitive ecosystem that includes many different habitats and food webs.

Fish of all types and sizes live either in the Bay and its tributaries or use the waters as they migrate along the East Coast. Young crabs hide from predators in underwater grasses while oysters filter water as they feed on plankton.



What is an Estuary?



Aerial view of Rhode River

An **estuary** is a semi-enclosed body of water where freshwater from rivers and streams mixes with saltwater from the ocean creating **brackish** water. Estuaries are among the most productive environments on earth. They create organic matter and provide a variety of habitats that support diverse animal and plant communities.

Estuaries also have tidal wetlands, shallow mudflats, and submerged aquatic vegetation. Much of the water in an estuary rises and falls due to the ocean tides.

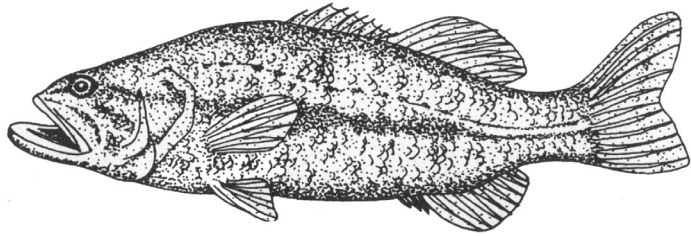
Of the fifty major tributaries that flow into the Chesapeake Bay, just three deliver about 80 percent of the Bay's fresh water. They are:

- the Susquehanna River (48%)
- the Potomac River (19%)
- the James River (14%)

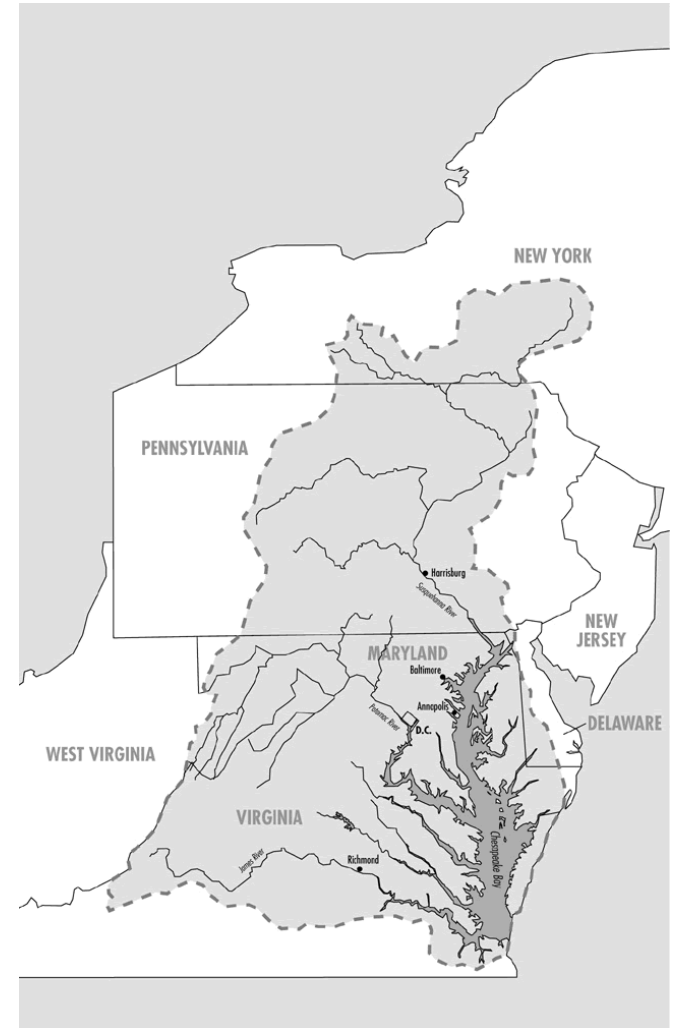
Try to locate these rivers on a Chesapeake Bay map.

Fun Facts about the Chesapeake Bay

- The Chesapeake Bay is North America's largest estuary and the world's third largest estuary.
- The watershed is home to more than 16.6 million people and is expected to grow to 20 million people by 2030.
- The Bay supports 2,700 species of plant and animal life including 200 species of fish.



- From north to south the Bay is 195 miles long.
- The shoreline of the Chesapeake Bay and its tidal tributaries is over 11,600 miles. That's more shoreline than the entire west coast of the United States.
- The Bay has an average depth of 21 feet.
- The deepest "hole" in the Bay is 174 feet deep. That's about the same length as the Chesapeake Bay bridge is high.



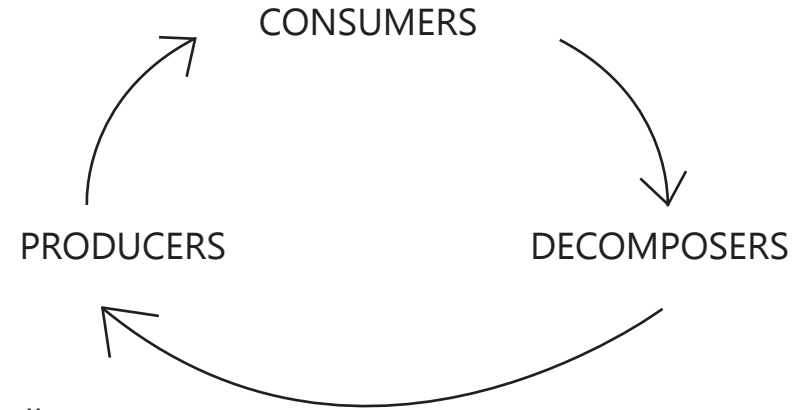
Chesapeake Bay Watershed

Animals and Plants in the Rhode River

The Chesapeake Bay has a very complicated food web. We can learn about the Bay food web by identifying producers, consumers and decomposers of a smaller ecosystem, the Rhode River.

COMPONENTS OF A FOOD WEB

There are three major components of a food chain in any ecosystem. They are the **producers**, **consumers** and **decomposers**. **Producers** are able to use the sun's energy to produce or make food. Aquatic plants and phytoplankton are the producers in the Chesapeake Bay. Animals that eat or consume plants or other animals are the **consumers**. **Decomposers** are the bacteria that feed on dead plants and animals. They break down the cells so the materials (nutrients) are returned to the system and can be used by the producers.



THE FOOD "PYRAMID"

Humans, large fish,
ospreys, eagles,
herons, large crabs

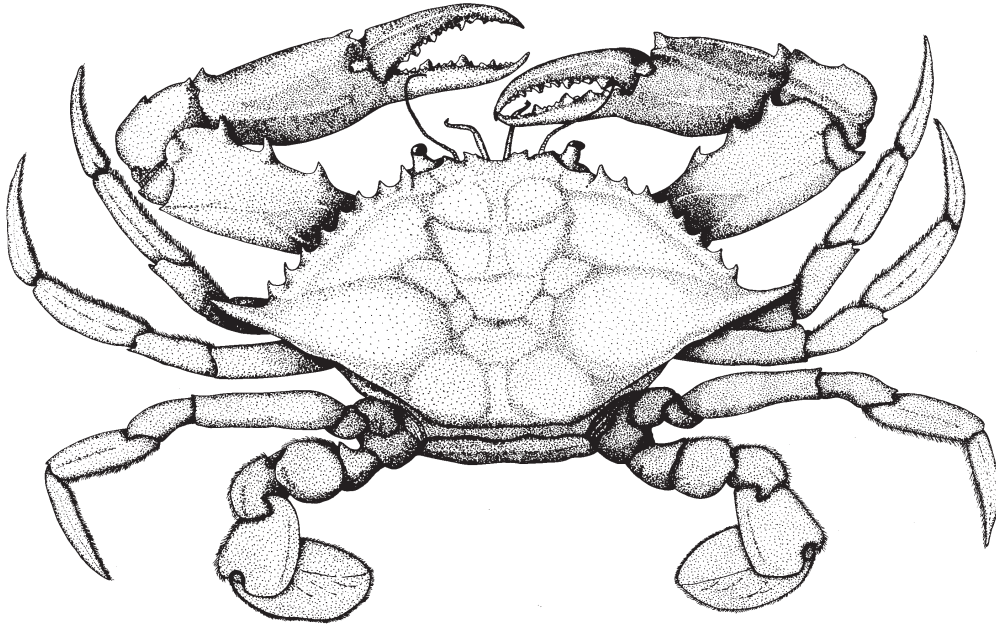
Fish,
birds, large
invertebrates

Zooplankton,
invertebrates, small
fish, clams and other
filter feeders

Phytoplankton, aquatic plants

The food "pyramid" shows the transfer of energy through the interactions of plants and animals in an aquatic ecosystem. The lower you go in the pyramid, the more living things are needed to feed the level above it. For example, millions of plankton are needed to feed a clam buried in the mud. In turn, hundreds of clams are eaten by a blue crab. Then, a person might eat a dozen crabs for dinner. Consequently, the number of animals at the top of the food pyramid is dependent on the number of plants at the bottom.

Estuary Chesapeake Station: About Crabs



The animal that most people associate with the Chesapeake Bay is the blue crab, *Callinectes sapidus*. Blue crabs are well-suited to the ever-changing salinity of the estuary and can tolerate water ranging from ocean to fresh. Blue crabs are found along most of the Atlantic Coast, from New York to Florida and into the Gulf of Mexico.

Because crabs are abundant and popular food, watermen have been able to make a living catching them in large numbers and selling them to seafood markets and restaurants.

Other names for blue crabs:

Sooks-mature females

Jimmies-males

Peelers-crabs close to shedding their shell

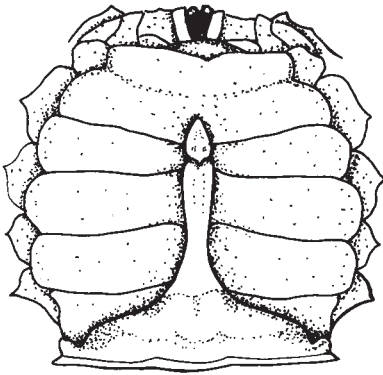
Crustaceans-class of arthropods

Doubler-mating pair

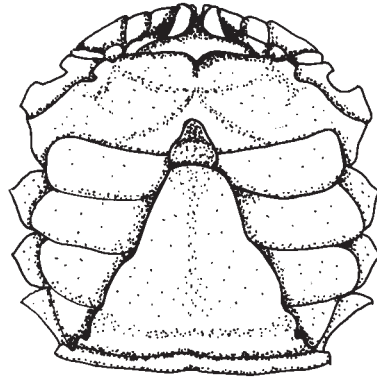


Blue Crab: Male or Female?

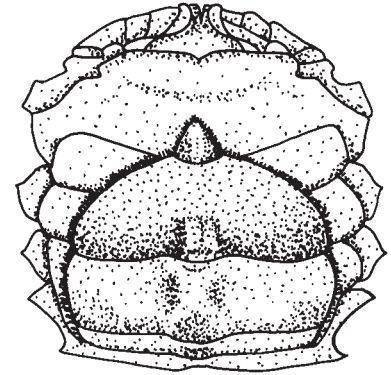
When we look at the shape of the abdomen on the underside of a blue crab we can tell whether the crab is a male or female. We can tell whether other species of crabs in the Chesapeake Bay and the ocean are male or female by looking at the shapes of their abdomens, also.



Male



Immature Female



Mature Female

LOOKS LIKE:

The Washington Monument

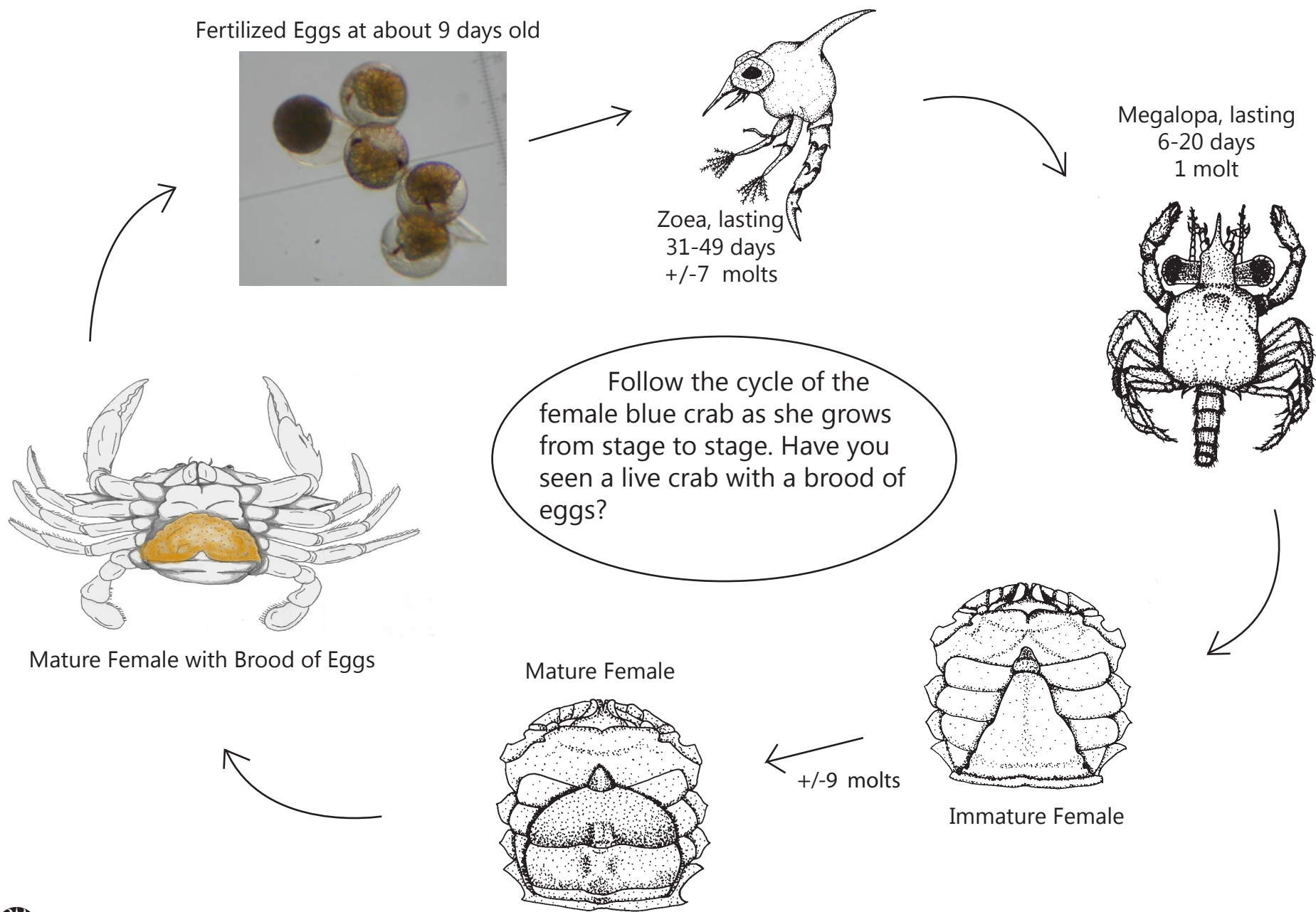
A Pyramid

The Capitol Dome

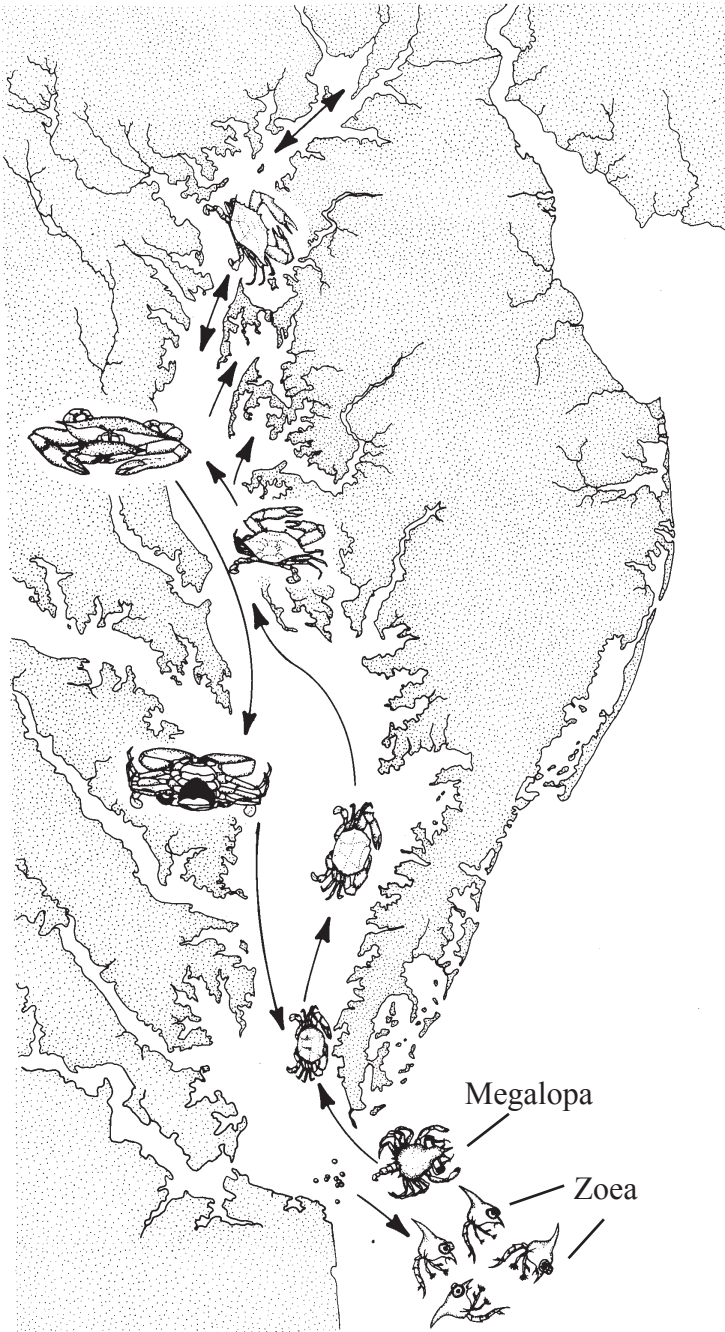
Mating

Large, mature female crabs are called **sooks**, and large males are called **jimmies**. Immature female crabs become mature female crabs after their **terminal (final) molt**, which is also the only time in a female crab's life that she can mate. The male crab will stay with the soft female crab after they mate for the seventy-two hours it takes for her to harden again. Mating takes place in all portions of the Chesapeake Bay usually during August and September. The female must then travel to the mouth of the Bay where the salinity level is very high when she is ready to produce her brood of eggs.

Life Cycle of the Female Blue Crab



Molting and Migrating



For Crustaceans, Molting = Growing

Crabs belong to the group of animals called Crustacea, which includes lobsters, shrimp, crayfish, and many other animals. For a crab to get bigger, it has to shed its exoskeleton or shell. This process is known as **molting**. A crab will molt many times during its life. A crab that is ready to molt is commonly called a **peeler**, and the discarded shell is called **sluff**. During this time the crab is vulnerable to predators such as eel, large fish and other crabs so it must find a place to hide until its shell is hard again, usually within seventy-two hours.

A blue crab molts approximately **27 times** during its life: 7 times during the zoea stage, 1 time during the megalopa stage, and 19 times as a adult blue crab.

Migrating Blue Crabs

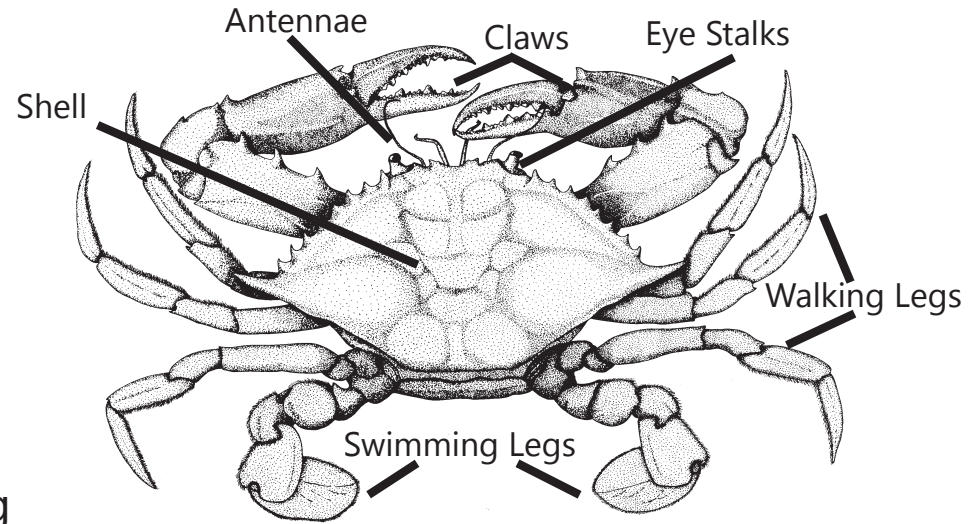
After mature females mate, they are filled with newly developed eggs and begin migrating down toward the higher salinity of the ocean. Females will produce an average of **two million to three million eggs** that will hatch into zoea in late fall and early winter.

Blue crabs hatch at the mouth of the Chesapeake Bay. Microscopic **zoea** are pushed out of the Bay by the tides into the Atlantic Ocean near the coast where they feed and grow. The zoea molt into **megalopae** that depend on the tidal currents to move them back into the Bay. Here the megalopae molt into the first crab stage.

At this point they are still in the southern part of the Bay. They begin migrating north along the many rivers and inlets. There they feed and molt in the Bay's submerged aquatic vegetation.

Amazing Crab Facts

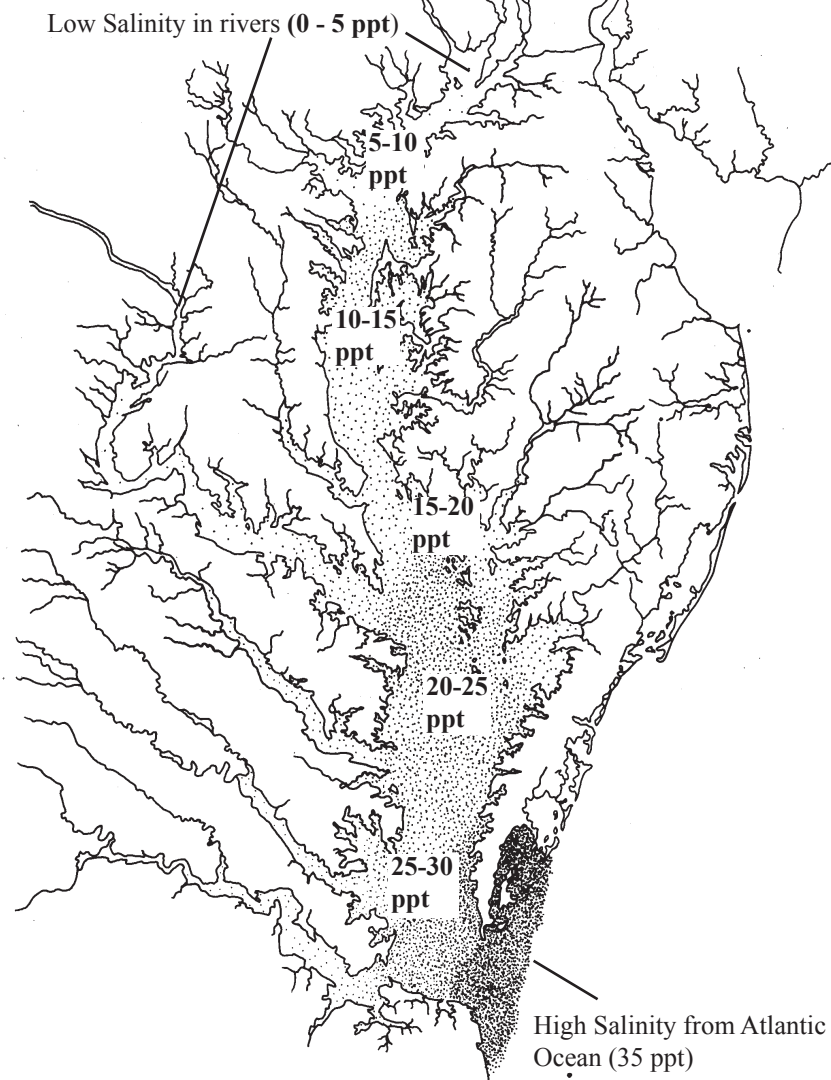
- *Callinectes sapidus* translates to "beautiful swimmer that tastes good."
- Blue crabs are decapods, a term that means having 10 legs. They have:
 - 2 swimming legs
 - 6 walking legs
 - 2 claws for protection and food gathering
- Crabs have the capability to drop an appendage if necessary to get away from a predator. It can regenerate another one to replace it.
- Crabs walk and swim sideways rather than forward and back.
- On the average, about ten crabs out of a brood of several million make it to maturity!
- A major predator of the blue crab is another blue crab.
- Blue crabs use the dropping water temperature in the fall as a cue to migrate to deeper channels. They bury themselves in the mud at 45 degree angles with only eyes and antennae exposed.
- It takes over 200 bites for a crab to eat one clam (one of its favorite foods).



Estuary Chesapeake Station: Water Testing

You can discover the physical characteristics of water by measuring salinity, pH, depth, turbidity, and water temperature. Scientists at SERC collect water samples every week and perform more than thirty tests on the water in an effort to determine the water quality of this portion of the Chesapeake Bay and the watershed.

General salinity patterns in the Chesapeake Bay



SALINITY

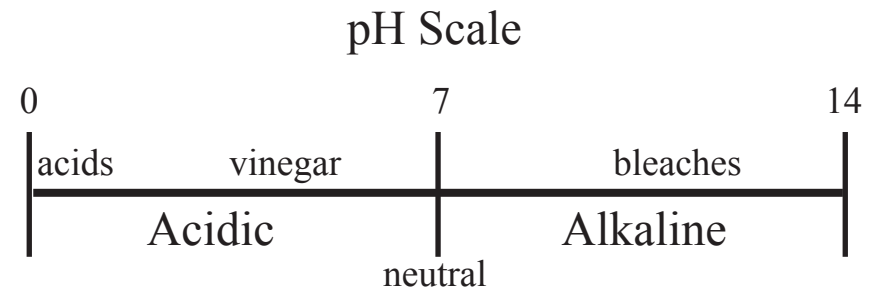
Salinity refers to the amount of salt in water. Freshwater has almost no salt, and ocean water has quite a bit.

Salinity has a scale that we use when we measure salt in water. This scale always starts at zero and can continue up past 100. The units are measured in **parts per thousand (ppt)**, a term meaning parts of salt for every thousand parts of water. For the water testing station, you will need to know that freshwater has *zero ppt* or "no parts of salt per thousand parts of water." Ocean water, on the other hand, has a salinity around *35 ppt* or 35 parts of salt per thousand parts of water.

When salt and fresh water mix, **brackish** water is created. Look at the map of the Chesapeake Bay on the left and see how low the salinity is in the upper portion of the Bay. In the lower portion of the Bay near the Atlantic Ocean are higher salinities. Most of the Bay is a mixture of brackish water ranging from 5 ppt to 30 ppt.

TESTING pH

You use a pH kit to measure the **acidity or alkalinity** of water. Pure water measures seven on the pH scale of zero to fourteen. Acids measure less than seven and alkaline substances measure greater than seven. A weak acid like vinegar measures three or four, while a strong acid like hydrochloric acid (often added to swimming pools) may measure between zero and one. Alkaline substances like bleach feel slimy and if concentrated enough can cause burns.



In the rivers, creeks, lakes, estuaries, and oceans, many animals and plants are very sensitive to changes in the pH level. The ideal pH for estuarine and ocean water is a pH of 8. If the water becomes too acidic or too alkaline, it stresses plants and animals and can become toxic to the organisms. Scientists at SERC measure the pH of rain water as well as the water in creeks, rivers, and the Bay.



A pH test kit uses an indicator chemical that is added to the water sample. In the picture on the right students are using a pH test kit to add the chemical to a water sample. The water sample then turns a color which can be matched against the color samples in the comparator, pictured to the left.



DEPTH

In an estuary, water depth changes with **high and low tides**. During high tide water rises and floods marshes along the edge of the Bay. This allows fish, shrimp, and crabs to travel throughout the marsh to look for food and shelter they cannot find in a deeper river. When high tides flood the marshes, wetland grasses have a chance to use the excess nutrients in the water, helping to keep the water healthy for plant and animal life.

Tides determine how water moves in and out of an estuary. Tides are caused by the gravitational attraction of the earth, moon, and sun. All surfaces on the earth are pulled toward the sun and the moon, but only water can move. Since the **moon** is closer than the sun, it exerts more influence. Low tide follows a high tide by about 6 hours.

TURBIDITY



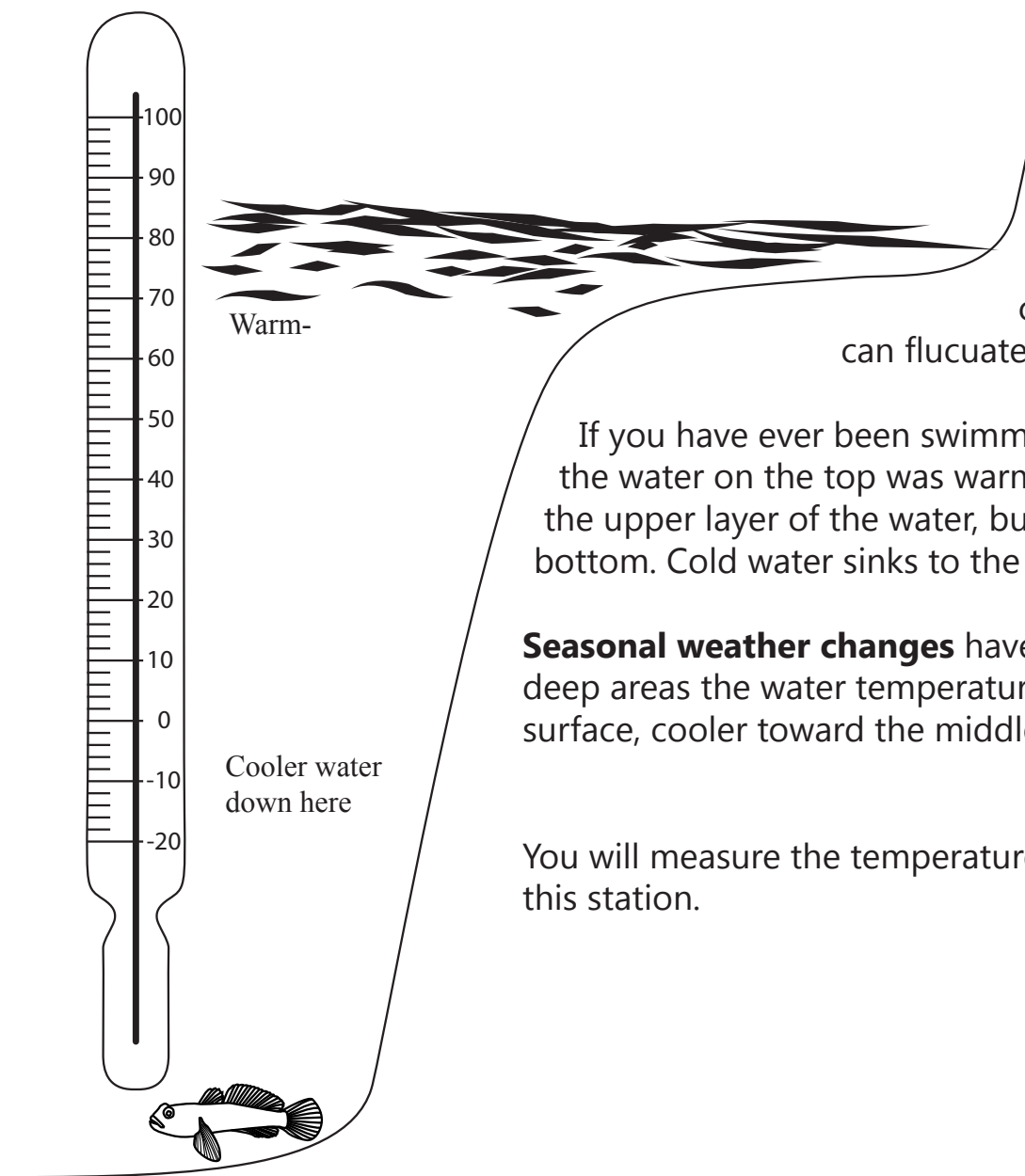
Turbidity refers to the **cloudiness** of water. The cloudiness can be caused by different kinds of materials such as sediment, plankton, or algae suspended in the water column. Often after storms with strong winds or a lot of rain, the turbidity increases due to sediment being washed from the land or stirred up from the muddy bottom. The increased turbidity can be a problem for water plants that are not close to the surface.

Since all plants need light, the ability of the light to penetrate into the water determines where aquatic plants can live. These aquatic plants provide essential food, shelter, and habitat for many organisms.

At the Water Testing Station, you will use a **Secchi (seh-key) Disk** to measure how deep light penetrates into the water. This same instrument is used by scientists who study water quality around the globe.



TEMPERATURE



Temperature is easy to measure and very important. Because the Chesapeake Bay and its creeks and rivers are so shallow, the temperature can fluctuate a lot.

If you have ever been swimming in a lake or pond, you may have noticed that the water on the top was warmer than the water around your legs. The sun warms the upper layer of the water, but the sun's energy does not reach all the way to the bottom. Cold water sinks to the bottom while warm water rises.

Seasonal weather changes have the greatest effect on the water temperature. In deep areas the water temperature changes from top to bottom. It is warmer at the surface, cooler toward the middle, and colder on the bottom.

You will measure the temperature at about half of the depth of the Rhode River at this station.



Estuary Chesapeake Station: Oyster Bar Community

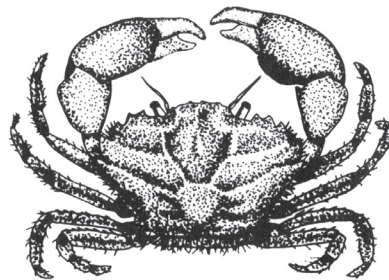


Most of the **invertebrates** that you will see at SERC live in a special type of community known as an **oyster bar**. Here, oysters and their shells provide a place where thousands of organisms land, hide and search for food. Oysters are **filter feeders**, which means they take in water and pass it over their gills. During this process, the plankton and other food materials in the water are captured on the gills and passed into the stomach. Looking at the history of the Bay, scientists know that if there were enough live oysters filtering the water in the Bay, the water would be much clearer (less turbid) than it is now.

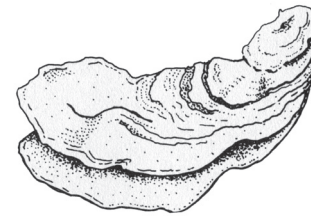
Invertebrates that share a community on the bottom of the Bay:



Barnacle



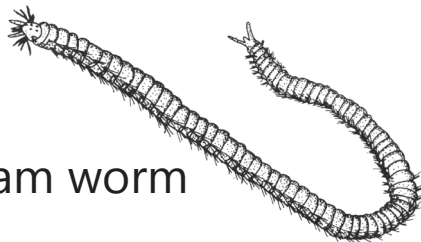
White-fingered
mud crab



Oyster



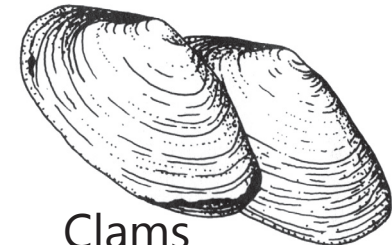
Sea
anemone



Clam worm



Amphipod

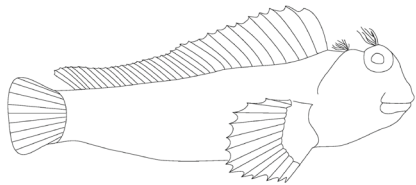


Clams

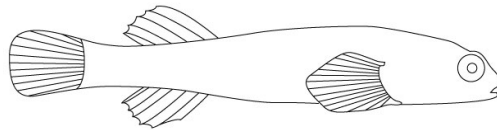
Fish and Shrimp on the Oyster Bar

There are some fish that like to live around an oyster bar. They hide under and inside oyster shells to avoid predators. They eat mostly small animals (invertebrates) and some plant material. Notice the placement of the mouth is toward the lower part of the head.

Blenny

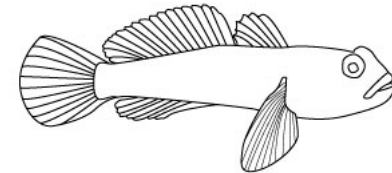


Clingfish

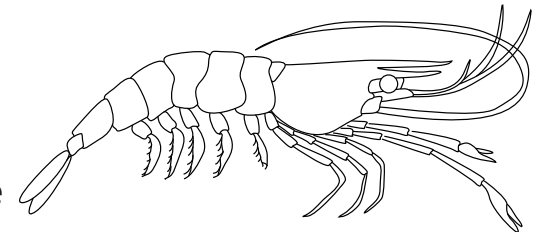


Suction area

Naked Goby



Grass shrimp are invertebrates that frequently visit the oyster bar community. These animals are hard to see when they hide along rocks, plants, pilings, and other debris on the bottom of the shallow rivers and marshes because they are almost transparent. Grass shrimp are food for some of the fish that you will see in the Rhode River.



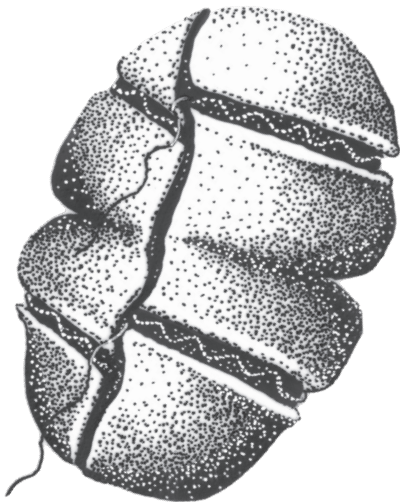
Estuary Chesapeake Station: Investigating Plankton

You can explore the microscopic world of the plants and animals that live in the Chesapeake Bay.

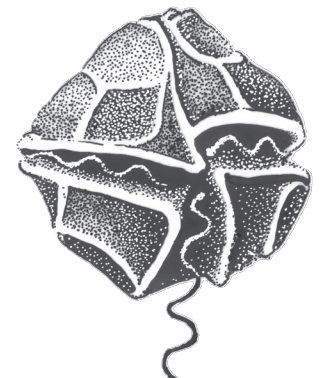
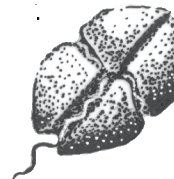
Plankton, which are plants and animals that float in and on the water, are divided into two groups: *phytoplankton* and *zooplankton*.

Phytoplankton are microscopic plants that are the basis of the food chain for aquatic organisms. They grow and live by themselves, or they can hook up to each other and form chains or large colonies. **Zooplankton**

are microscopic animals that hatch from eggs and feed on phytoplankton and other zooplankton. There are two types of zooplankton: ones that stay plankton all their lives (full-timers) and ones that grow up to be larger animals (part-timers). For example, a copepod will remain part of the plankton community all its life. An oyster starts out as planktonic larvae, but as it grows bigger, it settles on a hard surface and begins growing a shell. The adult oyster looks nothing like the larval form.



These are all **dinoflagellates** that are made of only one cell and have tiny flagella (tails) to help them move up and down the water column. Dinoflagellates range from 15-65 microns. (The period at the end of the last sentence is about 100 microns wide!)



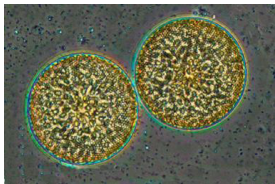
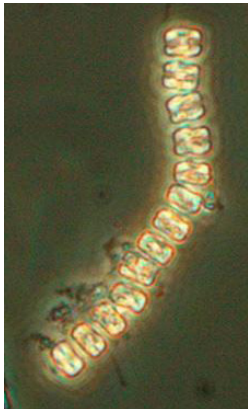
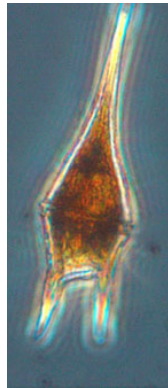
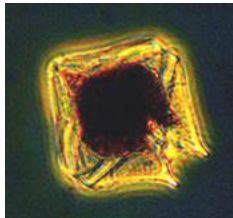
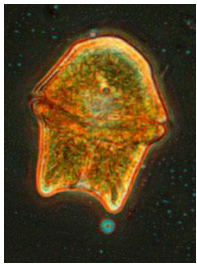
Learning More About Plankton

Remember plankton include large and small organisms. Some, like the barnacle and jellyfish, start out small and grow into large adults. Others, like rotifers and copepods, stay small their entire lives. Crabs and barnacles begin their lives as tiny, microscopic plankton but grow to be the size of the organisms we see in the About Crabs and Oyster Bar Community Stations at SERC.

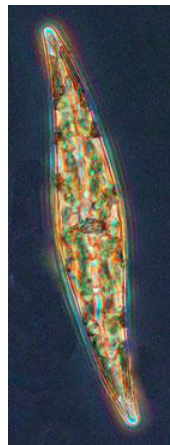
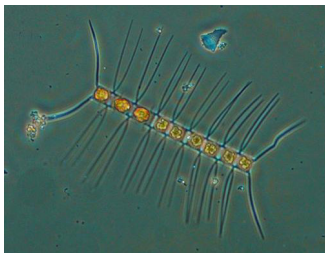
For more phytoplankton photos go to our website: www.serc.si.edu/labs/phytoplankton/guide/index.aspx.

Phytoplankton

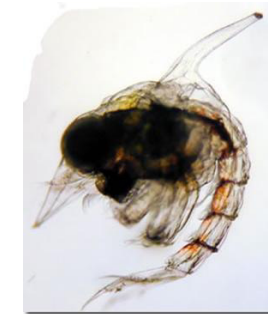
Dinoflagellates



Diatoms



Zooplankton



Crab Larvae



Crab Larvae



Copepod



Barnacle Larvae



Rotifer



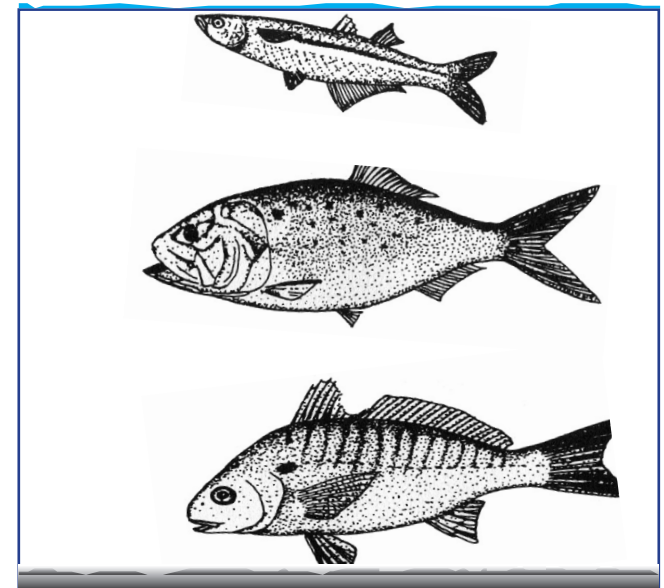
Estuary Chesapeake Station: Going Fishing

Seining is a way you can catch and sample fish along the shoreline. This is how local Native American tribes such as the Piscataway fished the Bay hundreds of years ago by seining. Scientists at SERC use seine nets to monitor fish populations.

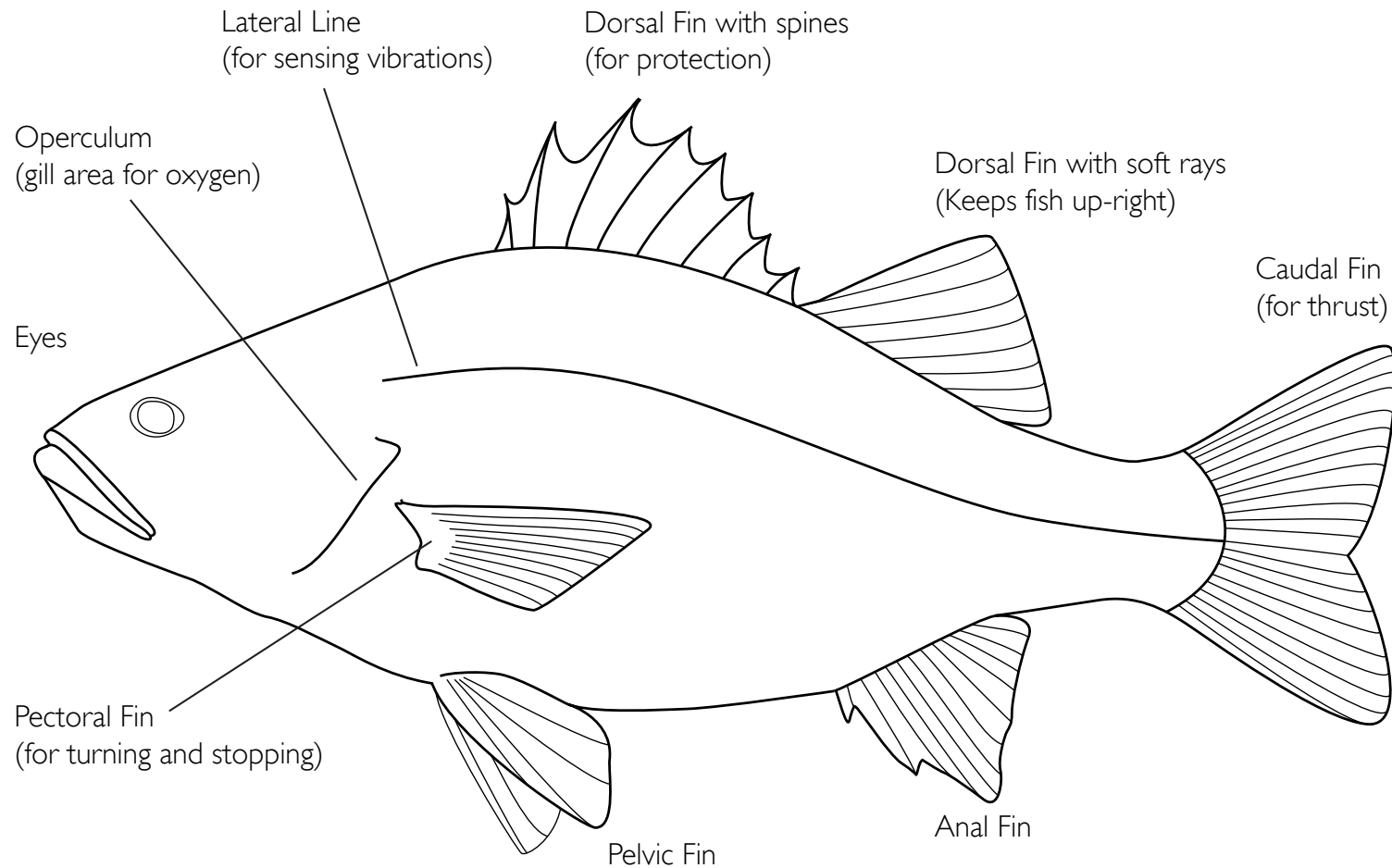
There are many kinds of fish in the Chesapeake Bay. Some, like striped bass and bluefish, live in deep waters, while others like mummichogs and silversides live in shallow areas near the shore. You will be using a seine net to catch small fish in the shallow waters of the Rhode River.



Just by looking at the location of a fish's mouth, you can tell a lot about where it lives in the water column.



External Anatomy of a Fish

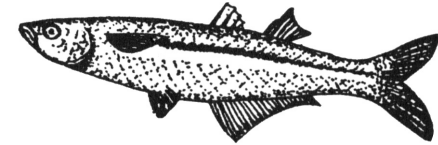


Turn the page for a closer look at most of the fish you will see at SERC.

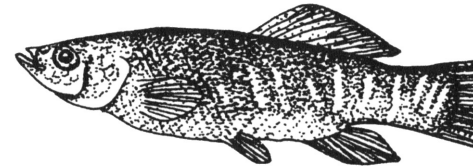
What Kinds of Fish are in the Rhode River?

SERC scientists in the Fish and invertebrate Ecology lab monitor over 50 species of fish. All fish are vertebrates. The most abundant ones are mummichog, menhaden, silversides, sheephead minnow and Norfolk spot. Pictured here and on the next page are just a few of the many species of fish that use the Rhode River at different times in their lives. White perch, for example, migrate from the saltier waters in the Bay to spawn in fresh water, while others like the menhaden and spot use the river as a nursery during the warm summer months. The mummichog, killifish, sheepshead minnow, and other small fish are year-round residents. Look at the illustrations to learn what each fish looks like. The **shape of the tail and mouth** can help you identify the fish you catch on your field trip.

SMALLER FISH (1 - 3 inches)



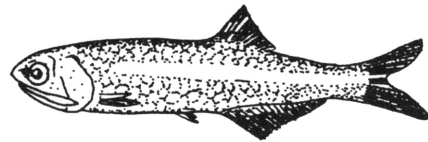
Silverside



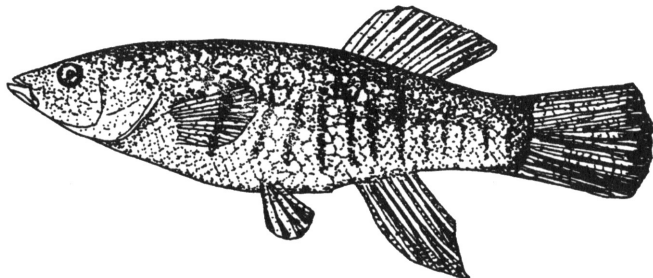
Mummichog



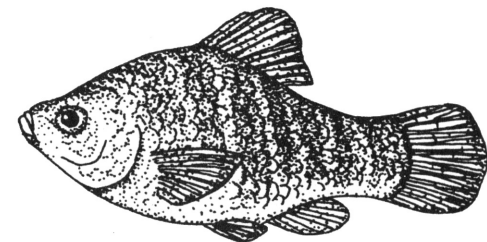
Stickleback



Anchovy



Striped Killifish

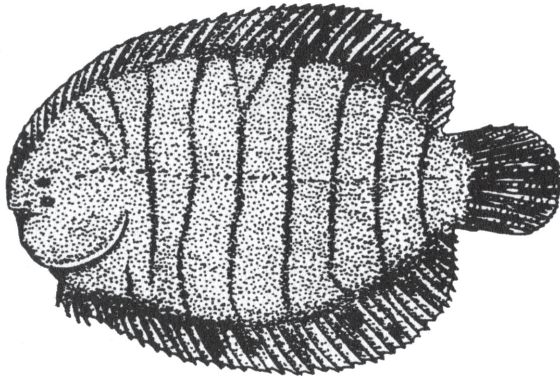


Sheepshead Minnow

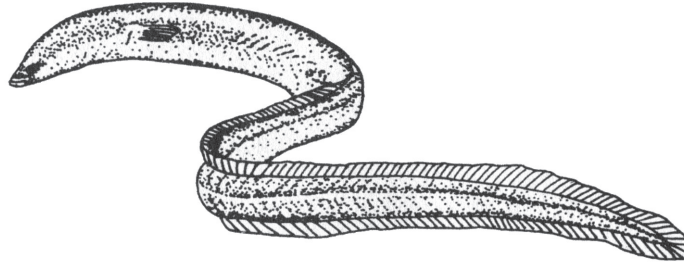
(6-12 inches)

LARGER FISH

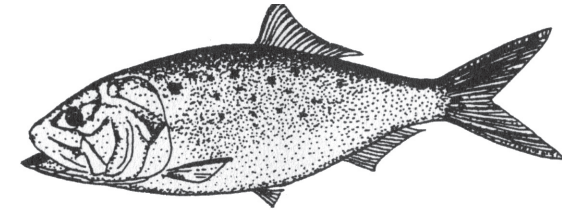
(12 - 30 inches)



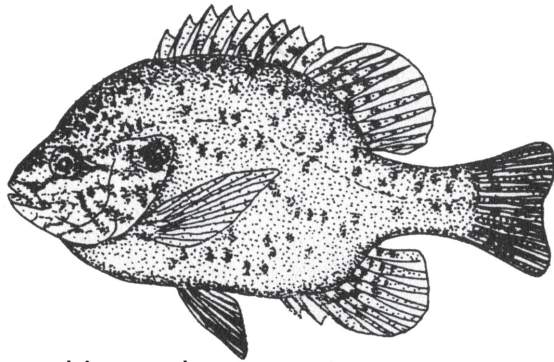
Hogchoker



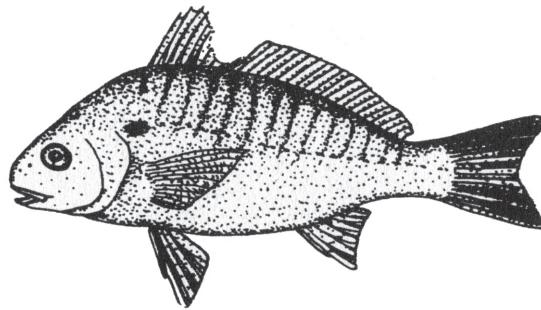
American Eel



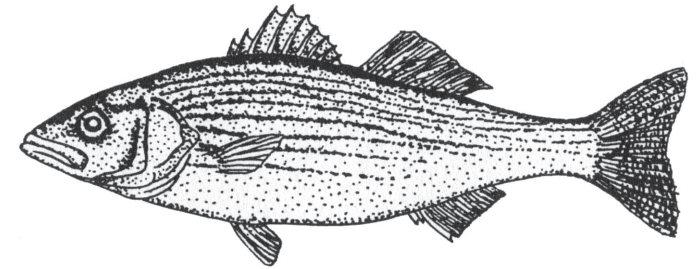
Menhaden



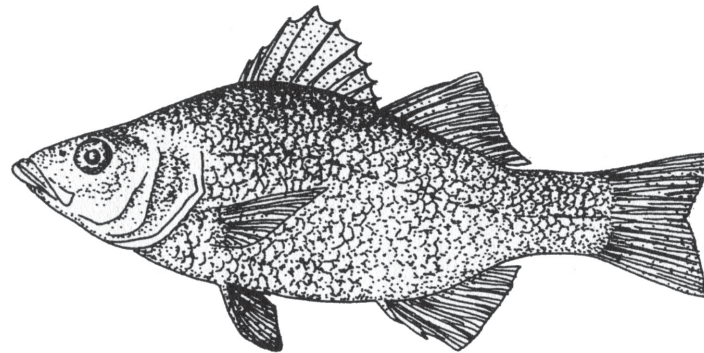
Pumpkinseed



Norfolk Spot



Striped Bass



White Perch

To learn more about how scientists are monitoring fish populations in the Rhode River go to:
http://www.serc.si.edu/labs/fish_invert_ecology/index.aspx



Have FUN When You Visit SERC!



Key Questions

To help you focus on the major points to emphasize when you are preparing your students for their field trip, below are five questions that they should be able to answer before they visit SERC. Websites that provide additional information are listed, also.

1) What is a watershed?

Activities

Give 3 or 4 facts about watersheds.

<http://tinyurl.com/chesapeakeescience>

<http://tinyurl.com/ActivityWatershed>

<http://tinyurl.com/WatershedConnections>

2) Why are oysters important to the Bay?

<http://tinyurl.com/chesapeakeoysters>

3) Why is the Chesapeake Bay estuary important to people, animals, and plants?

<http://www.gma.org/katahdin/estuary.html>

<http://www.eoearth.org/article/Estuary>

4) What is the importance of plankton in the food chain or pyramid?

<http://seagrant.gso.uri.edu/factsheets/foodweb.html>

<http://tinyurl.com/planktonfoodwebs>

<http://tinyurl.com/planktonfoodchain>

5) In what ways do you and your community impact the health of the Bay?

Activity

What is your watershed address?

<http://tinyurl.com/watershed-activities>

<http://cfpub.epa.gov/surf/locate/index.cfm>

<http://www.watersheds.org/kids/printsheds.htm>



Vocabulary

Brackish - water that is a mixture of fresh and saltwater.

Consumer - an animal that eats plants or other animals.

Decomposer -an organism that breaks down dead plants and animals for food.

Ecosystem - a system formed by the interaction of a community of organisms with their physical environment.

Estuary - a semi-enclosed body of water where freshwater from the rivers and streams mixes with saltwater from the ocean,creating brackish water.

Filter Feeder - an animal, such as an oyster that cleans (filters) the water as it feeds.

Invertebrate - an animal that does not have a backbone.

Molt - to shed an exoskeleton (shell).

pH - measures the acidity or alkalinity of water.

Photosynthesis - the process by which plants create energy using sunlight, water, and carbon dioxide.

Plankton - plants and animals that float in and on the water. They are divided into two groups: phytoplankton (plantlike) and zooplankton (animal-like).

Producer -an organism that makes food using the sun's energy.

Runoff - rainfall not absorbed by soil or the substances with it.

Salinity - refers to the amount of salt in water and is measured in parts per thousand (ppt).

Secchi Disk -flat, round device to measure the turbidity of water.

Seining - method of catching fish along a shoreline using a 3' - 4' high net with a pole on each end.

Turbidity - the cloudiness of the water.

Watershed - area of land that drains into a specific body of water such as a lake, stream, river, or estuary.

Vertebrate - an animal that does have a backbone.

Getting Ready:

Teaching ideas to prepare students for a successful SERC trip

| Idea | Description |
|-----------------------|---|
| Building Vocabulary | <p>Create a word splash. The teacher chooses several key words that are found in the text to be read. These words are "splashed" or placed around the page often in different sizes and font styles. Students brainstorm to predict the words' meanings and how they relate to the topic. Some words may be more common and will give clues about the content. As students learn more about the Chesapeake Bay, they refine and revise their predictions. Once they have completed their studies, encourage them to quiz each other on the correct information.</p> <p><i>For an example, see page 35. For a website that can create a word splash go to www.wordle.net</i></p> |
| KTWL | <p>In small groups have students brainstorm about all of the things they they know, think they know or want to know about the Chesapeake Bay. Then have them create a personalized three-column chart with headings "I Know", "I Think I Know", and "I Want to Know" and completing it for themselves. After the trip they can add a fourth column "What I Learned".</p> |
| ABC Brainstorm | <p>Following the KTWL brainstorming, continue with small teams. Have each team write the letters of the alphabet in vertical columns on a sheet of paper. The columns should be wide enough for a word to be written next to each letter. Using a set time, ask the teams to write a word which relates to the Chesapeake Bay and begins with the appropriate letter of the alphabet (a - acid, b - bay, c - crab, etc.) When time is called, the teacher provides one word in round robin to create a class list. When a team does not have a response, another team may provide it or the letter remains to be researched at a later time.</p> |
| Jigsaw | <p>Small teams are set up. Each team member is assigned some unique material to learn and later teach to his or her team members. Students working on the same material get together to decide what is important and how to teach it. After practice in these "expert" groups, the original groups return, and students teach each other. Tests or assessments follow.</p> |
| Inside/Outside Circle | <p>Students write each Chesapeake Bay question on a separate card. On the back side they write any notes to help them remember important facts and responses. The class forms two circles, one inside the other. Students face each other to form a pair. The inside student begins by asking one of the questions of his/her choice. The outside student responds with as much information as he/she can in thirty seconds. The inside student has ten seconds to correct or provide additional information. Then the student in the outside circle selects a question to ask but must not repeat the same question. The thirty/ten timing is repeated. When each pair has responded, the outside circle students move one position to the right and the process is repeated with new partners. Repeat several times giving students an opportunity to answer each question at least once.</p> |

Useful Websites

Smithsonian Environmental Research Center www.serc.si.edu

SERC's Labs offer many websites to help you prepare for your visit. Sample a few to begin your planning. Tinyurl.com, a website that allows large web addresses to be shortened, has been used to assist you.

AQUATIC LABS

http://www.serc.si.edu/labs/estuarine_ecology/index.aspx

(<http://tinyurl.com/2dltdtx>)

http://www.serc.si.edu/labs/protistan_ecology/index.aspx

(<http://tinyurl.com/26olpqj>)

<http://www.serc.si.edu/labs/phytoplankton/index.aspx>

(<http://tinyurl.com/2d73jfx>)

http://www.serc.si.edu/labs/fish_invert_ecology/index.aspx

(<http://tinyurl.com/247hzsf>)

http://www.serc.si.edu/labs/marine_invasions/index.aspx

(<http://tinyurl.com/29s62gs>)

TERRESTRIAL LABS

<http://www.serc.si.edu/labs/co2/index.aspx>

(<http://tinyurl.com/23d4vmg>)

<http://www.serc.si.edu/labs/nutrient/index.aspx>

(<http://tinyurl.com/2fpw764>)

<http://www.serc.si.edu/labs/biogeochem/index.aspx>

(<http://tinyurl.com/29cyu7u>)

http://www.serc.si.edu/labs/forest_ecology/index.aspx

(<http://tinyurl.com/2bx65hz>)

http://www.serc.si.edu/labs/terrestrial_ecology/index.aspx

(<http://tinyurl.com/23r3pdz>)

http://www.serc.si.edu/labs/plant_ecology/index.aspx

(<http://tinyurl.com/27qu4mx>)

There are many organizations researching, providing educational information and encouraging environmental action to address the health of the Chesapeake Bay.

Below is an alphabetical sampling of other organizations and their home websites:

1. Chesapeake Bay Foundation
<http://www.cbf.org/>
2. The Chesapeake Bay Program: A Watershed Partnership
<http://www.chesapeakebay.net/>
3. ChesSIE: Chesapeake Science on the Internet for Educators
<http://www.bayeducation.net/>
4. Environmental Concern
www.wetland.org
5. Institute of Marine Science
<http://www.forsea.org/LIWTOC.html>
6. Maryland Sea Grant
<http://www.mdsg.umd.edu/>
7. The Maryland State Department of Natural Resources Fisheries/Fish facts
www.dnr.state.md.us/fisheries/fishfacts/index.asp
8. New Hampshire Public Television's Natureworks
<http://www.nhptv.org/natureworks/>
9. Smithsonian Environmental Research Center
www.serc.si.edu
10. The Sultana Projects, Inc
<http://www.sultanaprojects.org/chesapeakeecologyunit.htm> (<http://tinyurl.com/28lcv5c>)



Pre-field Trip Activities

What do scientists study at SERC?

Unscramble the words to list some of the topics studied.

RATEW _____

SIFH _____

IAR _____

SLDTEWAN _____

STAPLN _____

RETEPONACY _____

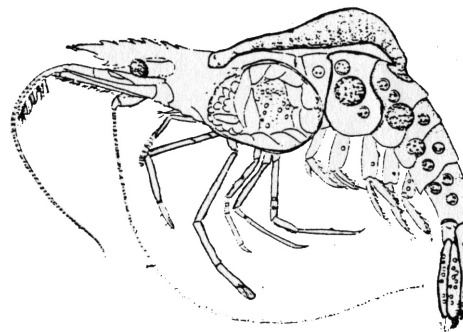
EGALA _____

SIVEN _____

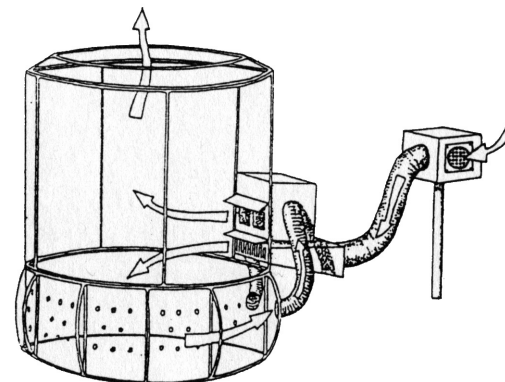
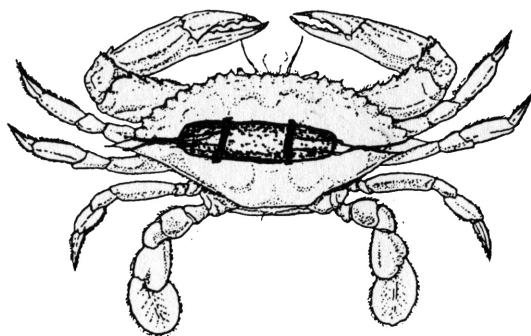
THEREWA _____

BRACS _____

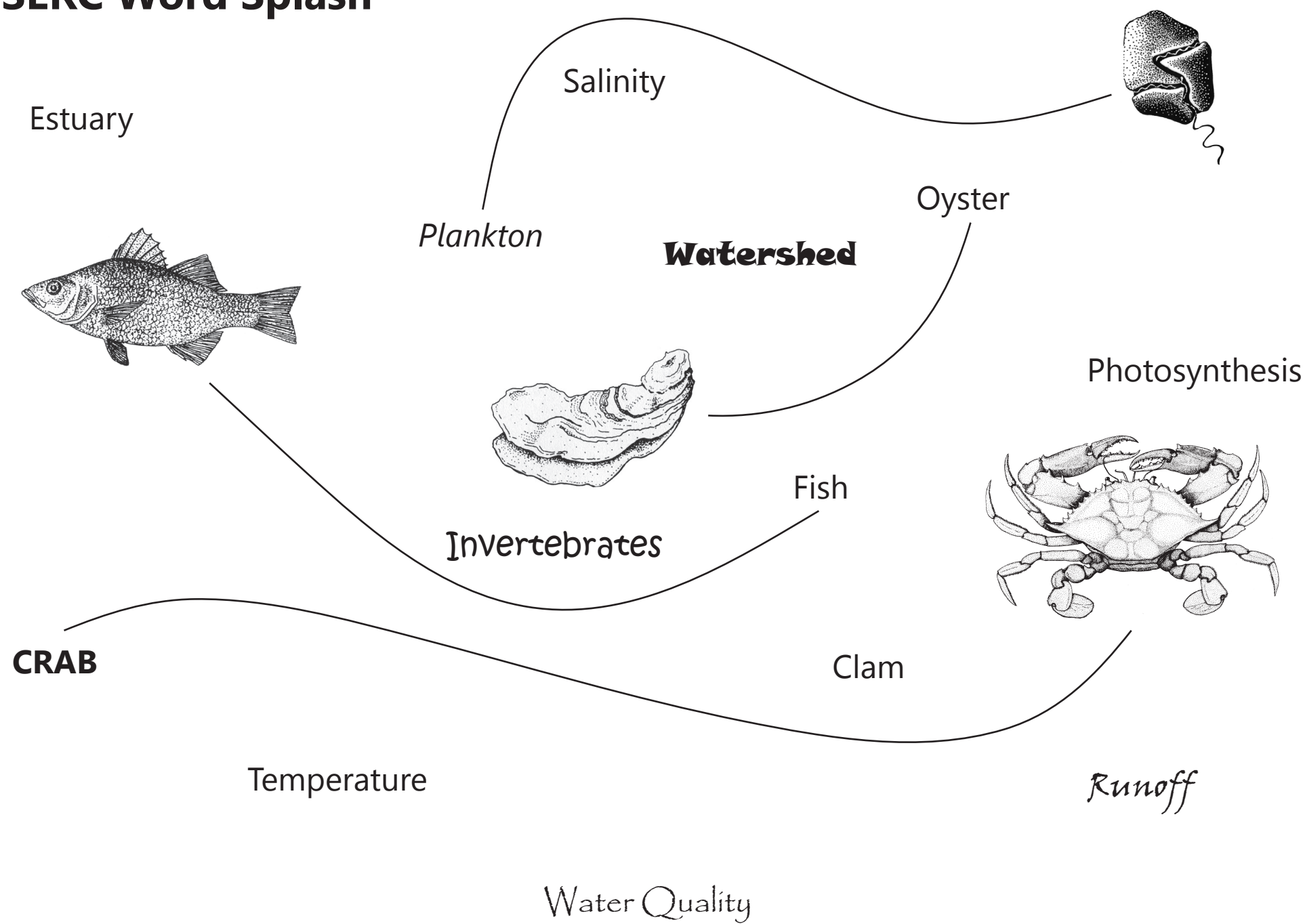
TROSSEF _____



Take the bold and underlined letters on the left and make a word that sums it up!



SERC Word Splash



Field Trip Scavenger Hunt for the Bus

As you ride the bus today, look out the window and see if you can find and check off the following items on your trip.

When there is an * write the name, place or number if you can.

Hay bale _____

Sign that is red _____

Mailbox _____

Airplane _____

Motorcycle _____

Flowering tree _____

Dog _____

Sailboat _____

License plate from Canada _____*

Double tandem truck _____

Hotel _____*

Barn _____

Cow _____

Sign that is green _____*

Weather vane _____

Bridge _____*

Fast food place _____*

School bus _____

Person riding a mower _____

House being built _____

Men working sign _____

Bank _____

Doghouse _____

Seafood restaurant _____*

Camper/RV _____

River _____*

Moving truck _____*

Coke or Pepsi truck _____

Ruins of an old house _____

Firehouse or fire truck _____

License plate for a state west of the Mississippi
_____*

Tanker truck _____

Church, synagogue, temple, or mosque _____

Sheep _____

Grocery store _____

Gas station _____

SERC sign _____

Post-field Trip Activities

PLANKTON REVIEW

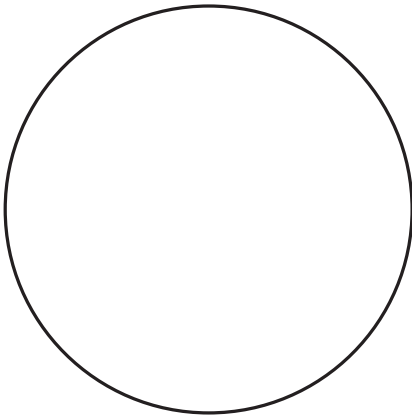
List below the plankton you saw under a microscope in the Investigating Plankton Station.

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Name three plankton that remain microscopic their entire lives:

| |
|-------|
| _____ |
| _____ |
| _____ |

Draw one of the
three you listed above



WATER TESTING REVIEW

Now you can answer some questions about the quality of water in the Rhode River on the day you visited SERC.

1. How salty was the water? Give your answer in ppt. _____

2. What causes salinity to change?

3. What was the pH reading? _____

4. Can acid rain that falls on the watershed change the pH in the Rhode River? _____

5. How deep was the river? _____

6. Will the depth of the river change throughout the day? _____

7. You measured the turbidity or how far down light can travel.

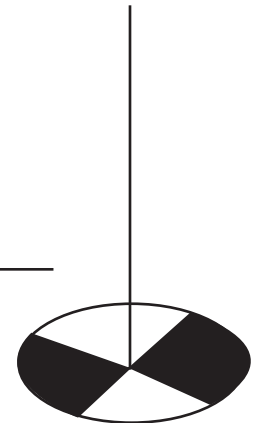
What measuring device did you use? _____

8. What was your reading when you used this tool? _____

9. Did any light go down to the bottom where you were standing on the dock? _____

10. What was the temperature of the water? _____

11. Explain why you think the Rhode River is a healthy place for plants and animals to live.



FISH REVIEW



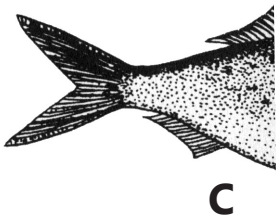
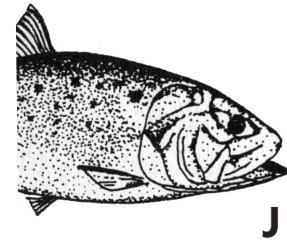
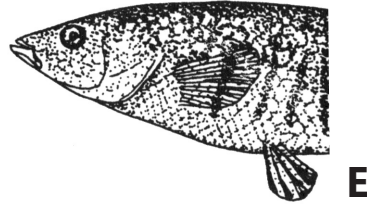
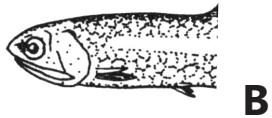
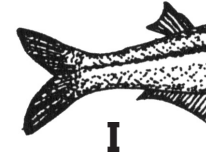
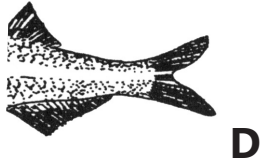
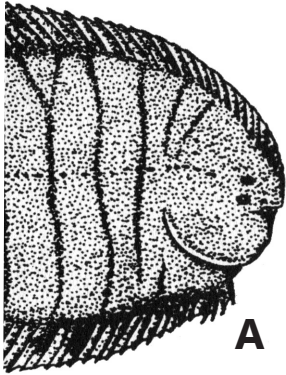
The depth in the Rhode River is fairly shallow, around 5-12 feet. The shallow depth makes the river a nice place for fish and other aquatic organisms to seek shelter when they are small.

Draw some of the fish you saw in the Rhode River during seining at the Going Fishing station or the Oyster Bar Community Station. Underneath each fish write its common name. Explain what you learned about the food chain.

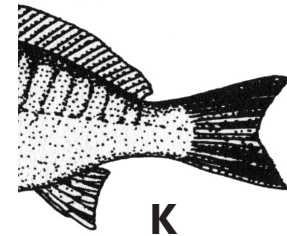
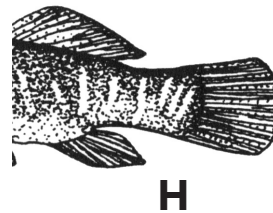


FISH HEADS AND TAILS

Try to match the heads and tails of these fish with the names listed below. Some names have more than one answer.

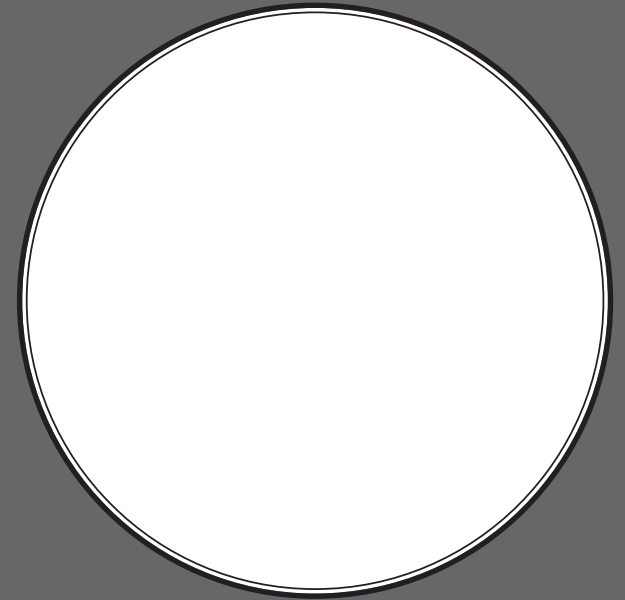
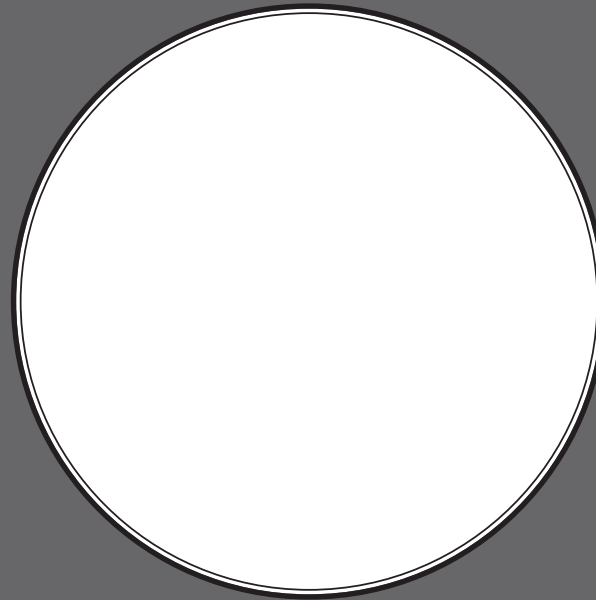
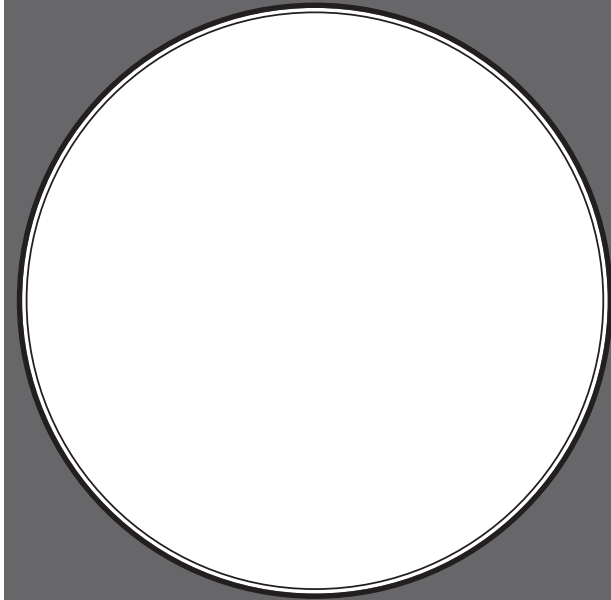
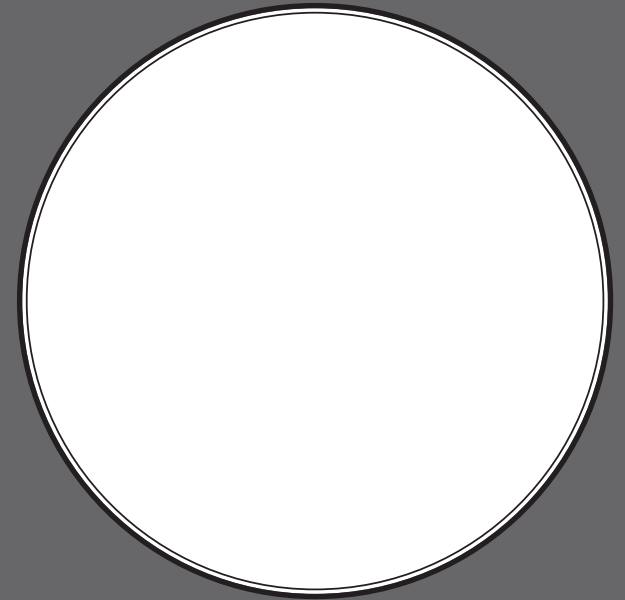
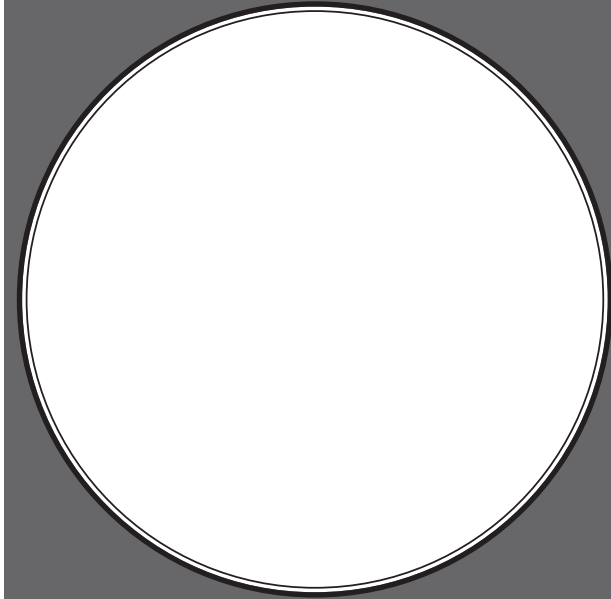


- _____ Anchovy
- _____ Menhaden
- _____ Spot
- _____ Hogchoker
- _____ Silverside
- _____ Mummichog
- _____ Killifish



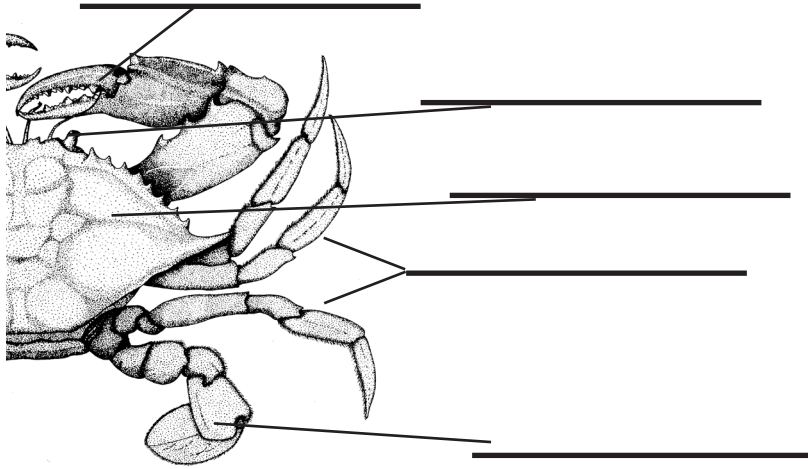
INVERTEBRATE REVIEW

Draw as many different invertebrates as you can from the Oyster Bar Community Station. Use these "petri dishes" to contain your animals. Label each specimen.

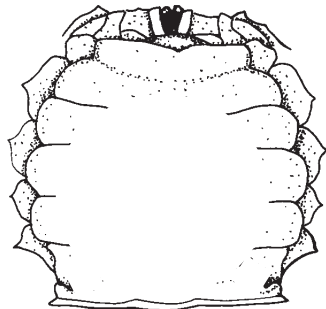


BLUE CRAB REVIEW

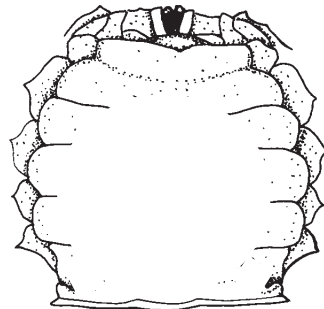
Identify parts of the crab



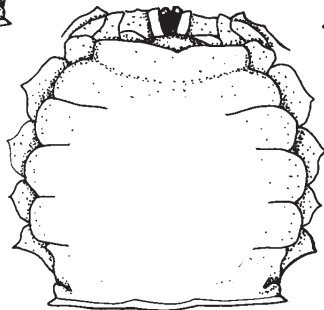
Draw my abdomen



MALE



IMMATURE
FEMALE



MATURE
FEMALE

Write the word on the line that correctly matches the phrase.

Claws

Eyestalks

Crustaceans

Shell

Megalopa

Zoea

Waterman

Scavenger

Molting

Decapod

Outer covering of crab _____

Person who crabs for a living _____

Group of animals having an exoskeleton

First larval stage of blue crabs _____

Eyesight structure in blue crabs _____

Second stage in blue crab life cycle _____

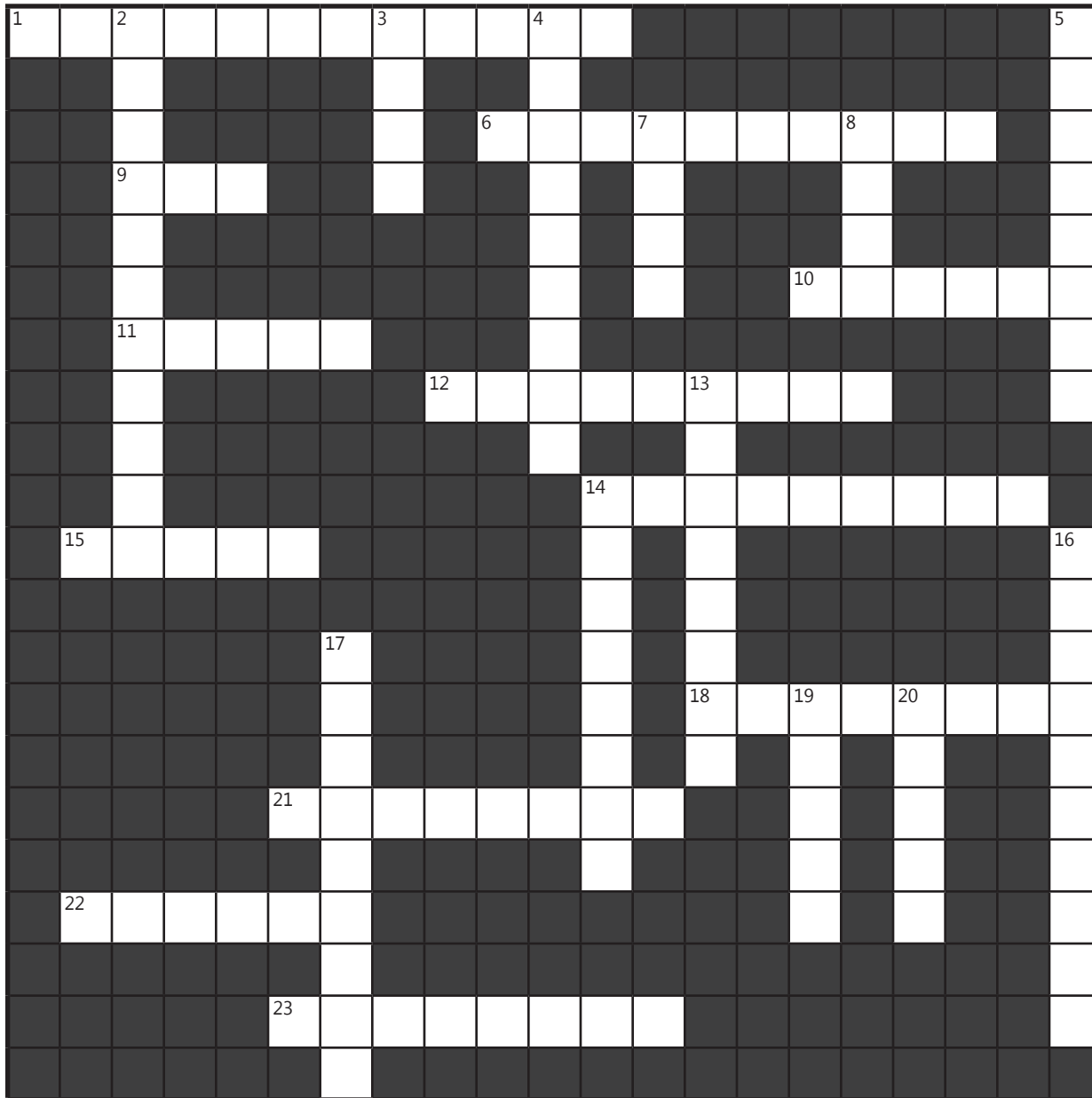
Equivalent to "growing" for crabs _____

Means "ten-legged" _____

One that feeds on dead or decaying material

Used by crabs for catching prey _____

WATER AND WORD TESTING



ACROSS

1. Temperature, pH, turbidity and salinity, will tell you about the _____ (2 words).
6. Describes a body of water with salinity of zero ppt.
9. "Parts per thousand" abbreviated.
10. Disk used to measure turbidity.
11. Phytoplankton that may cause blooms.
12. Land surrounding a lake, river, pond, or bay.
14. Has a salinity of 34 ppt.
15. Neutral on the pH scale.
18. Parts per _____.
21. Describes a substance with a pH greater than 8.
22. What you use to determine the acidity of a liquid (2 words).
23. Highest point on the pH scale.

DOWN

2. Celsius scale is used to measure this.
3. A liquid very low on the pH scale.
4. Measured by a Secchi disk.
5. A mixture of saltwater and freshwater.
7. Initials of the Smithsonian Center.
8. Either ebb or flood.
13. Measured in ppt.
14. When this is stirred up, light cannot penetrate to the bottom of the Bay.
16. Where scientists conduct aquatic research at SERC (2 words).
17. This can be made by humans or nature. Either way, it can destroy the water, land, or air.
19. Source of saltwater for the Chesapeake Bay.
20. A list of numbers measuring something.



Name that Animal!

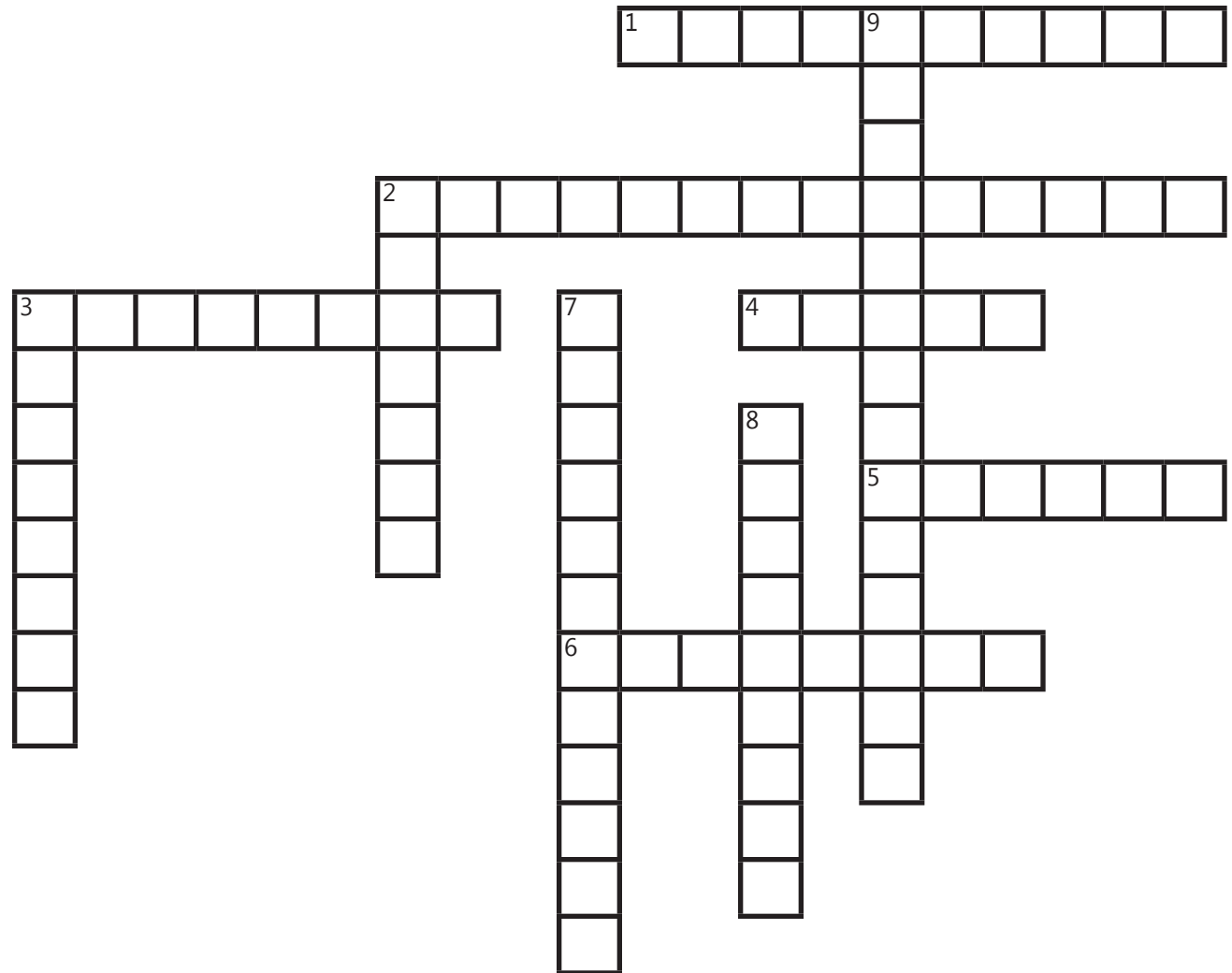
Using the hints provided, can you name the animal described? Your choices are: **blue crab, oyster, egret, bluefish, winter flounder, hooked mussel, periwinkle, menhaden, blue heron, seagull, and snapping turtle.**

Across:

1. Crawl along rocks and seaweed, scraping off algae with their file-like tongues.
2. Bury themselves in bottom mud or sand.
3. Crustacean like its cousins, the shrimp and crayfish; has ten legs.
4. White with S-shaped neck.
5. Once harvested in millions of bushels.
6. Found eating algae in large schools near water's surface.

Down:

2. Found almost all over the world nesting, hovering, and flying along shorelines.
3. Predator with a jaw full of piranha-like teeth.
7. Found attached to rocks.
8. Blue with wingspan over six feet.
9. Flat with two eyes on one side.



WHAT I LIKED MOST ABOUT THE ESTUARY CHESAPEAKE TRIP

Test your Bay I.Q.! **Circle your best guess.**

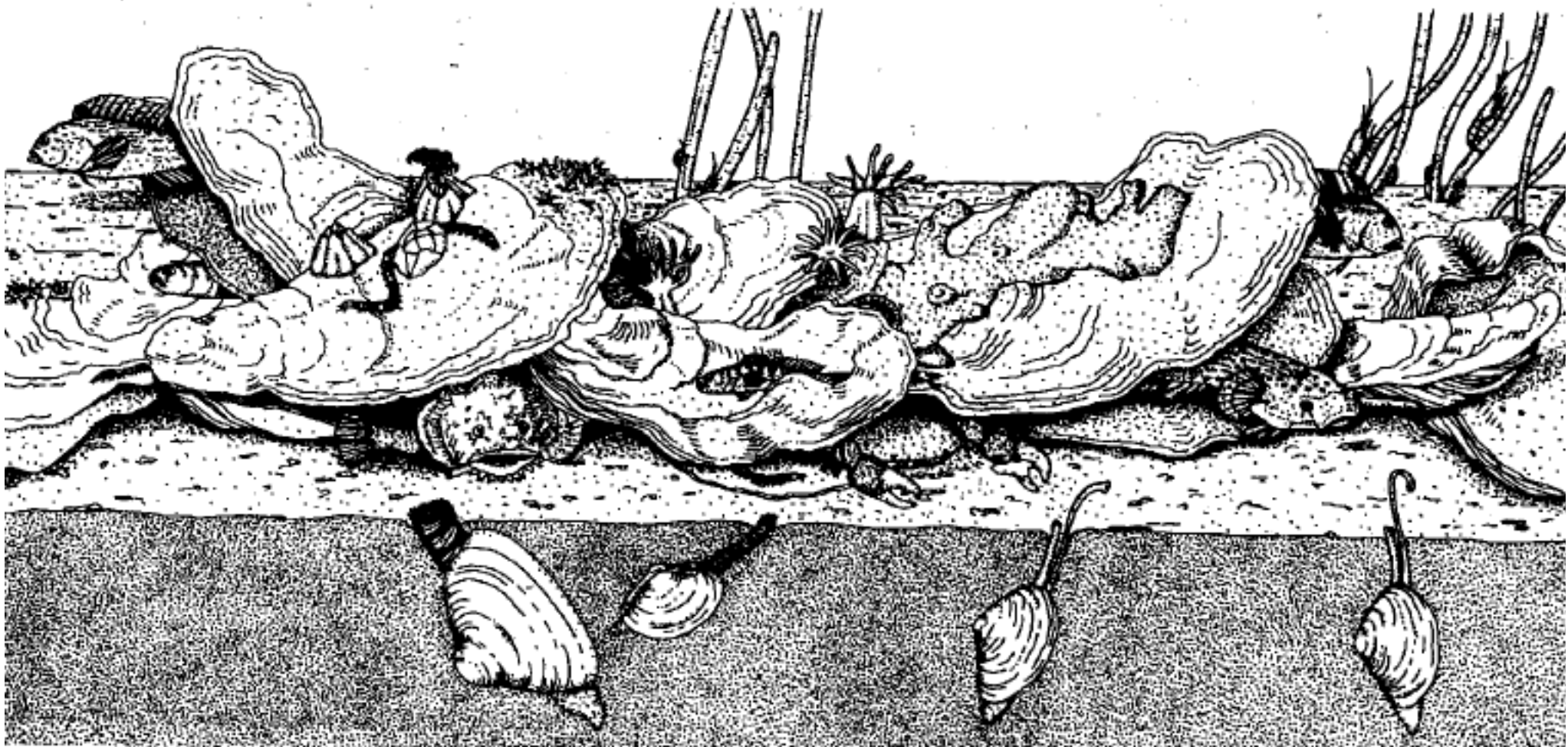
1. The Bay is home to more than (1,700 or 2,700) plant and animal species.
2. The Bay is also home to more than (100 or 600) toxic substances.
3. Approximately (100,000 or 500,000) Canada geese spend winter by the Bay.
4. (More or less) coal is shipped from harbors in the Bay than is shipped from any other harbor in the U.S.
5. The average depth in the Bay is about (25 or 75) feet.

(Answers on the back cover)



Oyster Bar Community

Circle and label at least ten organisms you see in this oyster bar community.



Smithsonian Environmental Research Center
Education Dept.
P.O. Box 28
647 Contees Wharf Road
Edgewater, MD 21037

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p. 36 Answers

1. 2700. This is due to the many different habitats within the Bay, the length of its shoreline, and the abundance of nutrients flowing into the Bay.
2. 600. People have historically dumped waste products into the Bay.
3. 500,000. Many species of waterfowl winter on the Bay. Many more use the Bay for resting, nesting, and feeding at various times of the year.
4. More. The ports of Baltimore, MD and Hampton Roads, VA are important to commercial shipping.
5. 25. One of the important characteristics of the Bay is that it is very shallow.