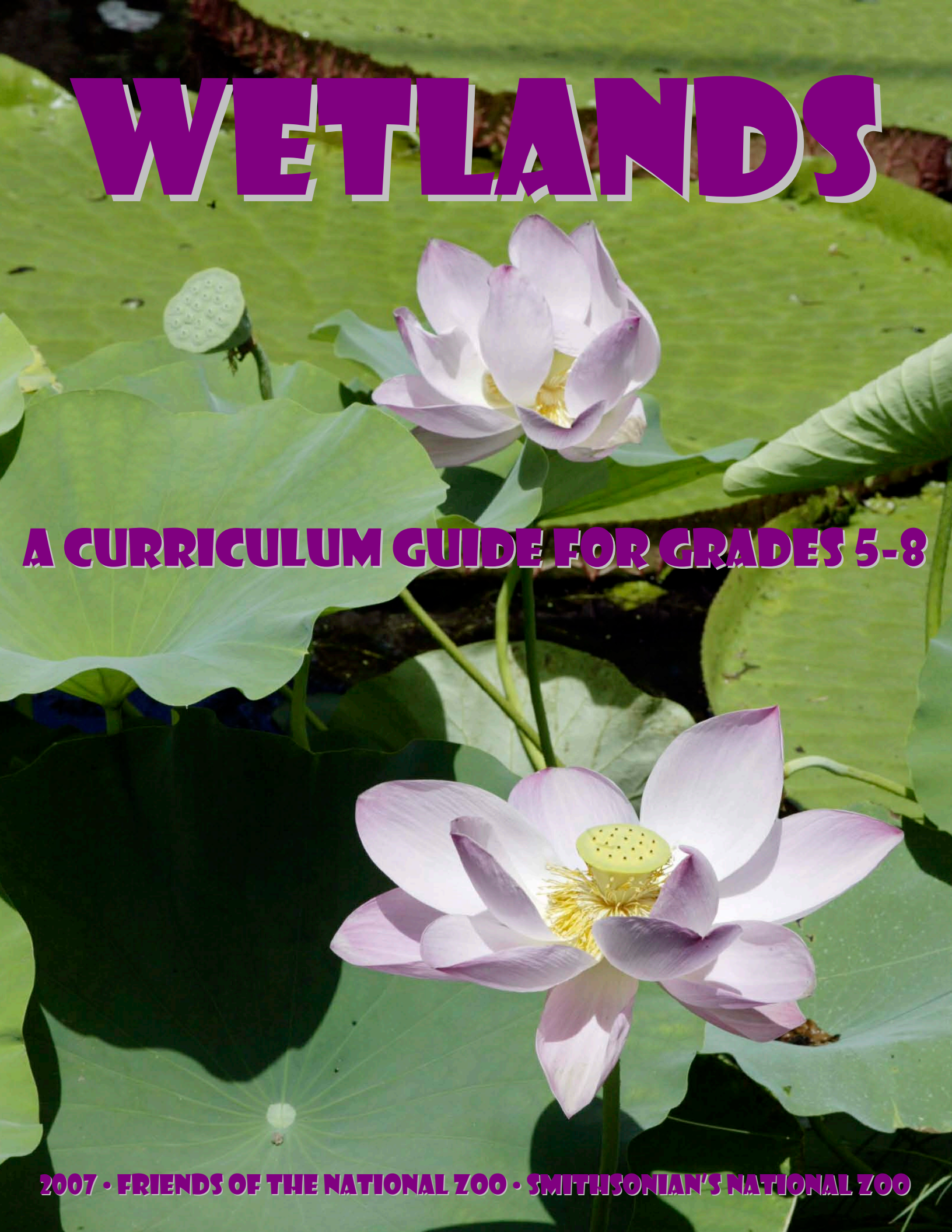
WETLANDS

A CURRICULUM GUIDE FOR GRADES 5-8



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We welcome your feedback! How did you use this curriculum guide? Did the materials meet your expectations? How can we improve this resource? Email you comments and suggestions to: **education@fonz.org**

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Smithsonian
National Zoological Park

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Objectives

At the end of this curriculum guide students will be able to:

- explain important concepts of ecology using wetlands as the main theme;
- understand and describe the different types of wetlands;
- recognize common wetland life forms and how they are adapted to living in a wetland.
- describe the threats to and ways to conserve wetlands.

The guide's text and activities also highlight the National Science Education Standards for grades 5-8 Life Science content, focusing on:

- Structure and function of living organisms
- Populations and ecosystems
- Diversity and adaptations of organisms

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Introduction

Dark, swampy wastelands or lush, beautiful habitat for intriguing animals? One way or another, people usually have strong opinions about wetlands. Because wetlands are not always the best places for humans to build homes or cultivate crops, they have frequently been viewed as wastelands. But, these 'wastelands' are quietly cleaning our water, controlling flooding, slowing erosion, and providing homes for some of the world's most unique species.

This curriculum guide is designed to teach students in grades 5 to 8 about basic ecological concepts using wetlands as the main theme. Through interdisciplinary activities, students will learn about animal and plant adaptations, food webs, ecological balance and conservation of wetlands. As part of their study, students will visit the National Zoological Park to see firsthand some wetland animals and plants. As outlined, this module can be covered in two months, but the time can be adjusted to suit any schedule. Also many of the activities can be adapted for use with older and younger students. Some students, or perhaps your entire class, may want to become more actively involved in conserving wetlands. Participating in an action project can be an important learning experience and we encourage you to support your students as they lead the way!

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Calendar (Weekly Questions)

The following calendar of weekly questions suggests how to organize your time in order to cover the wetlands module in two months. The length of time devoted to each weekly question, or theme, can vary according to the needs of students and teachers.

WETLANDS CALENDAR

WEEK 1 What is a wetland?
Activities 1, 2 and 3

WEEK 2-3 What are the common life forms of wetlands and how are they adapted to living there?
Activities 4 and 5

WEEK 4-5 How do wetlands animals and plants interact?
Activities 6, 7, and 8

WEEK 6-7 How do wetlands function?
Activities 9 and 10

WEEK 8 How can wetlands be conserved?
Activity 11 and Assessment Alternatives I and II

WETLAND ACTIVITIES: INTERDISCIPLINARY ASPECTS							
	Science	Math	Social Studies	Language Arts	Reading	Geography	Art
Activity 1	X			X		X	X
Activity 2	X			X	X		
Activity 3	X	X				X	X
Activity 4	X			X			
Activity 5	X			X			X
Activity 6	X						X
Activity 7	X		X		X	X	
Activity 8	X					X	X
Activity 9	X	X			X		
Activity 10	X				X		
Activity 11	X		X		X	X	X
Alternative I	X		X	X			X
Alternative II	X		X	X			

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Teacher Background Information

(Vocabulary words are underlined when they first appear throughout the teacher background information and activities)

I. What is a Wetland?

Wetlands are known by a number of different names including, swamps, bogs, fens, ponds, vernal pools, riparian areas and salt and freshwater marshes. Wetlands cover approximately 6% of the earth's land surface and are found in nearly every country and climate of the world.

The variety and dynamic nature of wetlands makes defining them difficult. For example, although water is present in wetlands for at least part of the time, the depth and duration of flooding vary considerably from wetland to wetland and from year to year. Using wetland species (plants, animals and microorganisms) to describe a wetland is difficult because wetland species have a range of adaptations that help them live in wet or dry conditions. The particular field of science and even the political climate can also influence how wetlands are defined.

In general, wetlands can be described as "a midway world between terrestrial and aquatic ecosystems, with some of the characteristics of each". Wetlands usually include three main attributes:

1. the presence of water in the soil, either at the surface or within the root zone – hydric soil

2. soil conditions that differ from that in nearby uplands – wetland hydrology
3. vegetation adapted to wet conditions - hydrophytes

In recent times, the need for a clear definition of wetlands has become urgent as society begins to recognize the value of these systems and laws have been required to protect against further loss of this habitat. Therefore, the Fish and Wildlife Service definition was officially adopted in 1996 as the federal standard and is used by all federal government agencies. This is the definition used for this guide and contains the above three components (water in the soil, soil conditions and vegetation adaptations).

II. What are the Different Types of Wetlands?

Wetlands are divided into two general types: coastal wetlands and inland wetlands. A description of the types of coastal and inland wetlands follows.

Coastal wetlands

Coastal wetlands are influenced by alternating flood and ebb of tides. They include tidal salt marshes, tidal freshwater marshes and mangrove wetlands.

- *Tidal salt marshes* - Salt marshes are found throughout the world along protected coastlines in the middle and high latitudes. Plants and animals in these systems have adapted to the stress of salinity, periodic flooding and temperature extremes. Salt marshes in the United States are found mostly along the eastern coast from Maine to Florida, and along the Gulf of Mexico coastline in Louisiana and Texas.

- *Tidal freshwater marshes* - are found further inland than tidal salt marshes but still close enough to the coast to experience tidal effects. Those wetlands are dominated by a variety of grasses and by annual and perennial broad-leaved aquatic plants. In the United States, freshwater marshes are found primarily along the middle and south Atlantic coasts, and along the coasts of Louisiana and Texas.

- *Mangrove wetlands* - are found in tropical and subtropical regions of the world, inland from tidal salt marshes. The word *mangrove* refers to both the wetland itself and to the salt-tolerant trees that dominate this habitat. In North America, they are found from the southern tip of Florida along the Gulf Coast to Texas. Florida's southwest coast supports one of the largest mangrove swamps in the world.

<u>Inland wetlands</u>

The greatest expanse of wetlands in the United States is inland wetlands. They are divided into Northern peatlands, Southern deep-water swamps, freshwater marshes and riparian ecosystems.

- Northern peatlands - include the deep peat deposits of the northern temperate regions of North America. *Bogs* and *fens* are the two major types of peatlands. Bogs are characterized by their nutrient deficiency and waterlogged conditions. Plants and animals have adapted to these conditions by conserving nutrients, or in the case of plants, by becoming carnivorous. Fens on the other hand, are not

as acidic or nutrient-poor, so they are able to support a more diverse plant and animal community.

- *Southern deepwater swamps* - are freshwater woody wetlands that have standing water for most, if not all, of the growing season. These wetlands are normally dominated by cypress and black gum (tupelo) trees. They can occur as isolated patches of cypress (cypress domes) fed primarily by rainwater, or as swamps that are flooded annually by streams and rivers. They are found in the southeastern United States and are one of the most widespread types of wetlands in this country.

- *Freshwater marshes* - are characterized by shallow water with shallow peat deposits. They typically have soft-stemmed aquatic plants such as cattails, arrowheads, pickerel-weed, reeds and several species of grasses and sedges. In the United States, freshwater marshes dominate the prairie pothole region of the Dakotas, the coastal region of the Great lakes, and the Everglades of Florida.

- *Riparian forested wetlands* - occur along rivers and streams. They occasionally flood, but are usually dry during some portion of the growing season. Riparian forests are another widespread type of wetlands in the United States.

III. Food Webs in Wetlands

A food web is the relationship between plants and animals in an environment. Food webs are made up of interrelated food chains. An example of a food chain is the relationship between an eagle (a predator) and a mouse (prey). But, when you

consider that an eagle might also eat fish, and mice may also be eaten by snakes, the simple food chain becomes a food web.

The roles plants and animals play within a particular ecosystem are divided into four categories: producers, primary consumers, secondary consumers and decomposers. Producers are species that are able to produce their own food. Producers are almost always plants. Primary consumers are animals that eat plants. Secondary consumers are animals that eat other animals and sometimes eat plants. Decomposers are organisms that feed on and break down dead plants and animals.

IV. Wetland Life Forms

The wetland environment can be a harsh place for animals and plants. The water often lacks oxygen, there are wide variations in salinity, and the water level fluctuates frequently. In response to this unusual environment, wetland plants and animals have developed a variety of adaptations that enable them to survive. A description of some of the ways that plants and animals have adjusted to a wetlands environment follows.

Wetland Plants

The primary way wetland plants have responded to flooding is the development of air spaces in roots and stems, which allow oxygen from the aerial portions of the plants to reach the roots. In plants with this adaptation, the roots cells no longer depend on receiving oxygen from the surrounding soil, like terrestrial plants do. Wetland trees and non-woody plants also get oxygen by producing roots that reach above water.

Many other species have evolved ways to reproduce in a changeable environment. The most common of these strategies is to produce seeds during the non-flood season through delayed or accelerated flowering. Some trees also produce buoyant seeds that float until they lodge on dryer ground, or have seeds that germinate while the fruit is still attached to the tree (as in the red mangrove).

Typical freshwater marsh plants include:

black willow	common elder	silky dogwood
weeping willow	arrowheads	marsh fern
pink oak	broad-leaved cattail	pussy willow
red maple	reed canary grass	wild rice
sycamore	rice cut-grass	smooth alder
cinnamon fern	tearthumb	nerved manna
fringed sedge	twig rush	wool-grass
eastern bur-reed	skunk cabbage	spatterdock
blue flag iris	arrow arum	pickerelweed

Typical salt marsh plants include:

groundsel bush	spike grass	rose mallow
marsh elder	sea pink	three-square
bayberry	black rush	glasswort
cordgrass	sea lavender	switch grass

Wetland Animals

Animals are exposed to the same range of environmental conditions in wetlands as plants, but show more variation in their adaptations. For example, one response to a changeable environment is to move elsewhere when conditions become difficult. In wetlands, that might mean moving from a wetter, oxygen-poor area to dry land.

However, dry land poses its own challenges. Animals that retreat to dry land are subject to temperature extremes and desiccation (drying out). Successful adaptations of wetland animals are compromises which enable them to live in a variety of conditions. Two examples of animal adaptations to wetland conditions are the long legs and beaks of wading birds, such as herons and storks, and the, moisture-retaining skin of amphibians, like frogs and salamanders.

Typical animals of freshwater marshes include:

Mammals:	Birds:
beaver	mallard
river otter	swamp sparrow
mink	wood duck
muskrat	sora
raccoon	Virginia rail
white-tailed deer	Canada goose
	blue-winged teal
Reptiles and Amphibians:	canvasback
snapping turtle	ruddy duck
mud turtle	great blue heron
spotted turtle	egret
musk turtle	snipe
painted turtle	northern harrier
ribbon snake	
garter snake	Invertebrates:
water snake	caddisfly
spring peeper	dragonfly
four-toed salamander	fingernail clam
red-spotted newt	deer fly
green frog	monarch butterfly
American toad	giant water bug
northern cricket frog	water strider
bullfrog	copper-colored beetle
pickerel frog	crayfish
	snail
Fish:	
white catfish	largemouth bass
bluegill	golden shiner
killifish	

The following are common salt marsh species:

Mammals:	Birds:
meadow vole	glossy ibis
rice rat	herring gull
raccoon	osprey
river otter	American bittern
	great blue heron
Reptiles and Amphibians:	
diamondback terrapin	Fish:
mud turtle	striped killifish
snapping turtle	hog chocker
musk turtle	spol
	striped mullet
Invertebrates:	needlefish
blue crab	menhaden
horseshoe crab	American eel
mud snail	
oyster	
ribbed mussel	

V. Conservation of Wetlands

People have long made use of wetlands. Reeds and sedges have been used for thatching, peat is used for fuel, and during drier seasons, wetlands are used for grazing domestic animals. In some cases people live harmoniously with wetlands. In the Brazilian Pantanal wetlands, "pantaneiros" have successfully raised cattle for centuries without irreversibly damaging the wetlands. The Seminole Indians of the Florida Everglades live with the limitations posed by a wetland ecosystem without disrupting its balance. However, not all human interactions with wetlands are sustainable. Dredging, filling, draining, peat mining, water pollution and water flow changes take their toll on the world's wetlands. The United States is no exception. Between 1950 and 1970, the U.S. lost more than 14,000 square miles (37,000 square kilometers) of wetlands. Most of these losses were connected to

agriculture. Since colonization by European settlers, the U.S. has lost half of its original wetland areas.

Wetlands are not only home to plants and animals, but they also perform crucial ecological functions which are important reasons for their conservation. For example, wetlands:

- often indicate the state of groundwater supplies;
- retain storm waters, preventing large-scale flooding;
- slow the flow of water because of the presence of vegetation;
- help to control coastal erosion because plant roots bind and stabilize particles and slow down waves or strong currents;
- maintain and improve water quality by removing nutrients and sediment, and by recycling chemical and organic matter (Wetlands are so effective at cleaning water that people have built wetlands to clean urban waste water.);
- and provide breeding, nursery, residence and colonization areas for many types of plants, invertebrates, amphibians, reptiles, fish and birds.

A better understanding of the importance of wetlands has promoted new state and federal laws and regulations to help protect this unique habitat. International agreements, such as the Ramsar convention and the North American Waterfowl Management Plan, are also helping to protect wetlands. Complete protection of wetlands is not always necessary. If they are kept in a relatively natural state, some wetlands can be used for agriculture and aquaculture. And if they are managed carefully, wetlands have the added benefit of enhancing fish and wildlife populations, cleaning water and controlling flooding.

Vocabulary List

1. **adaptation** - a quality or characteristic of a species that allows it to adjust to an environment. Having webbed feet is an adaptation that allows ducks to paddle in water.

2. **conservation** - taking care of our environment by managing natural resources.

3. **consumer** - higher level organisms that get their food by eating other living things.

4. **decomposer** - organisms that feed on and break down dead plants and animals. Examples of decomposers are bacteria and fungi.

5. **detritus** - decomposing plant material and animal waste.

6. **ecosystem** - a community of plants, animals and microorganisms that are linked by energy and nutrient flows, and that interact with each other and with the physical environment.

7. **endangered species** - a plant or animal threatened with extinction by natural or man-made changes in the environment.

8. **extinction** - the condition when a species of plant or animal ceases to exist.

9. **food web** - the relationships of plants and animals in an environment. Food webs are made up of interrelated food chains.

10. **habitat** - the area where an animal, plant or microorganism lives and finds the nutrients, water, sunlight, shelter and space it needs to survive.

11. **hydric soil** – soil that is saturated, flooded, or ponded long enough during the growing season to develop low oxygen levels in the soil.

12. **hydrophyte** – plants that grow in water or on a substrate that is at least periodically deficient in oxygen due to excessive water content.

13. **predator** - an animal that lives by hunting, killing and eating other animals.

14. **prey** - an animal that is hunted, killed and eaten by other animals.

15. **producer** - plants that are able to make their own food.

16. **species** - a group of plants or animals that can reproduce with each other.

17. **watershed** - an area of land that drains into a specific body of water.

18. **wetland** - a place where the soil is always moist or covered with water

19. **wetland hydrology** – the characteristics and patterns of the movement of water in wetlands. Factors that affect hydrology include climate (temperature and precipitation), soils, vegetation and landscape.

WETLANDS

Activities – Week 1

What is a Wetland?

Activity 1

Before starting this activity, make a copy of the "Eco-Cube" for each student.

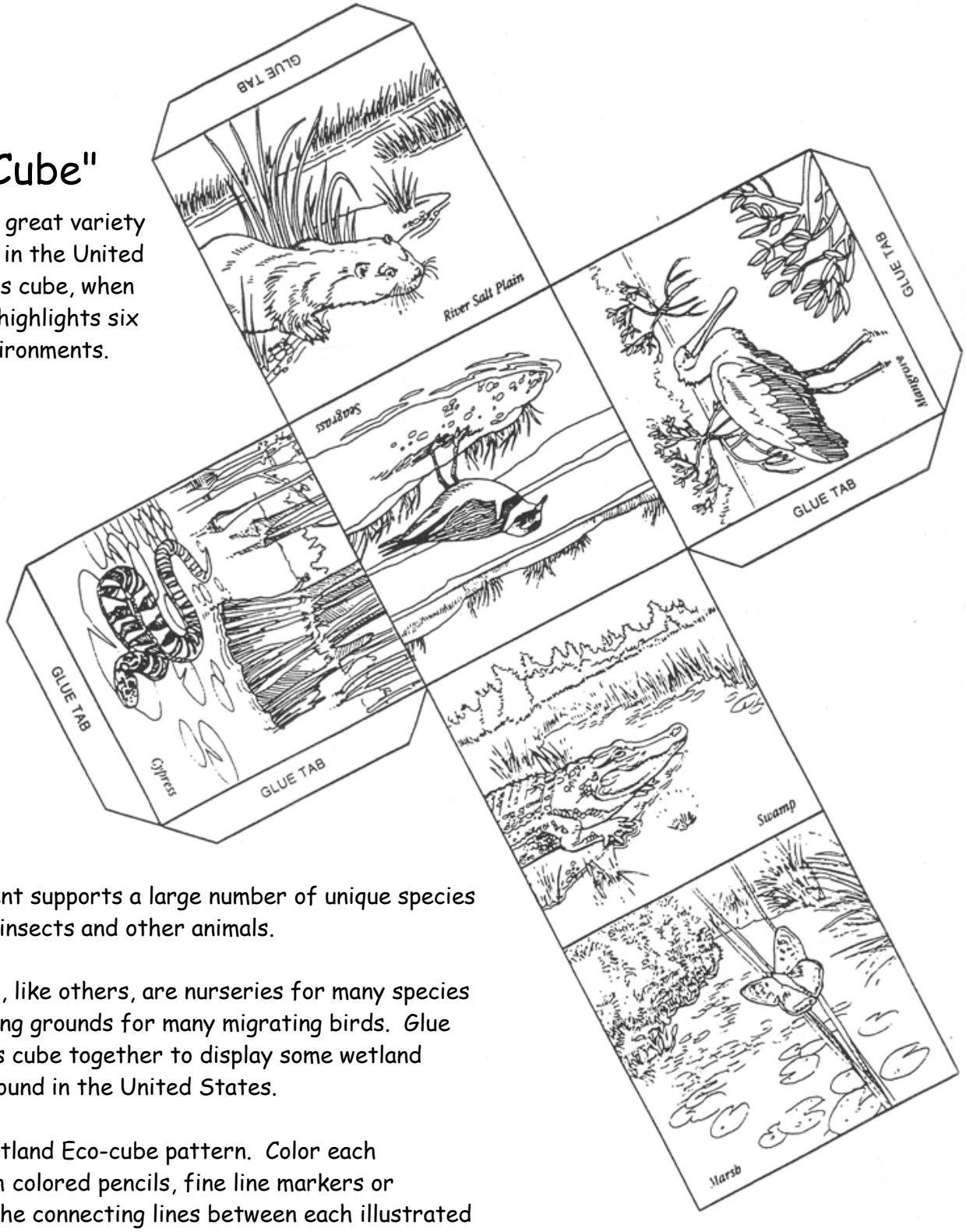
Begin the unit by asking students to write a short paragraph about what they think a wetland is and how they feel about wetlands. Answers may range from a student who has fond memories of playing by a pond to a student who thinks wetlands are scary swamps with strange creatures.

When students are finished, ask some students to read their paragraph to the rest of the class. Write key words and common themes on the board. Next, use the teacher background information to define wetlands and describe the different types of wetlands. You can use a map to show students where different types of wetlands are found in the United States.

Conclude the activity by having students color and assemble the "eco-cube". Students should keep their cubes so they can refer to them throughout the unit.

"Eco-Cube"

There are a great variety of wetlands in the United States. This cube, when assembled, highlights six wetland environments.



Each environment supports a large number of unique species of plants, fish, insects and other animals.

These wetlands, like others, are nurseries for many species as well as feeding grounds for many migrating birds. Glue the tabs of this cube together to display some wetland environments found in the United States.

Cut out the Wetland Eco-cube pattern. Color each illustration with colored pencils, fine line markers or crayons. Fold the connecting lines between each illustrated environment. Form a cube by folding the sides upward and glue the tabs together.

Activity 2

The chart titled "All About Wetlands'' is a summary of the characteristics of different types of wetlands. Make a copy for each student and ask them to use the chart to answer the questions on the worksheet. The chart is a good handout to refer to throughout the curriculum guide.

All About Wetlands

"Wetlands" are wet areas of land usually found near bodies of water. They are important habitats because of the species diversity found there. Wetlands also work as giant filters for nutrients and pollutants. There are many different types of wetlands, and each type supports different kinds of plants and animals. Use the chart to find out more about wetlands and to answer the questions below.

Kind of Wetland	Type of Water	Common Animals	Common Plants
salt marsh	salt water	blue crab fiddler crab	black rush pickleweed
inland marsh	salt or fresh water	pintail duck bullfrog dragonfly mosquito	grass sedge cattail
northern forested wetland	fresh water	woodpecker wood duck moose	black spruce tree
southern forested wetland	fresh water	raccoon opossum alligator	bald cypress tree
shrub wetland	fresh water	red-winged blackbird mouse muskrat	black willow low-growing, woody plants

Questions:

1. In what kind of wetland can you find alligators?_____
2. Which wetland is home to black willows and red-winged blackbirds?
   _____
3. Which wetland on the chart may have either salt water or fresh water?_____
4. Woodpeckers and moose are found in which kind of wetland?_____
5. Pickleweed often grows in this kind of wetland:_____
6. An inland marsh is home to bullfrogs, dragonflies and this kind of insect:
   _____
7. This kind of wetland always has salt water:_____

Activity 3

The Chesapeake Bay and the areas that drain into it (its watershed) make up a huge and diverse landscape covering 64,000 square miles and parts of six states. More than 2,300 square miles of the Chesapeake Bay watershed area is wetlands. These wetlands are a critical link between inland habitats and the Chesapeake Bay itself. Activity 3 is designed to give students a sense of how these watershed wetlands are distributed among the surrounding states. In this activity students will participate in a map reading exercise and also practice their graphing skills using real data about wetland distribution.

The Chesapeake Bay Watershed

Student Objectives:

1. appreciate the vast expanse of the Chesapeake Bay watershed;
2. use class maps to discover and label the major rivers in the watershed area;
3. construct graphs of wetland distribution in the watershed.

Background:

The drainage area, or watershed, of the Chesapeake Bay is huge, covering parts of six states! The great expanse of the watershed means that pollution even far away from the Bay often ends up there because of the water drainage. This activity combines map reading exercises with a math exercise to encourage the students to understand and appreciate the magnitude of effects we have on the Chesapeake Bay through its watershed.

Activity: Map Exploration

Materials:
- one copy for each student of the watershed area map provided
- resources showing the geography of eastern United States (i.e., large class map, atlases, road maps, Web sites)

Procedure:

1. Pass out copies of the watershed map to each student. Use a large classroom map to discuss the extent of the watershed in this area of the United States.

2. Several major rivers are part of the Bay's watershed:

River	begins in:	runs through:	ends at:
Chemung	NY	NY	Susquehanna River
Choptank	DE	MD eastern shore	Chesapeake Bay
James	VA	VA	Chesapeake Bay
Juniata	PA	PA	Susquehanna River
Patuxent	MD	MD	Chesapeake Bay
Potomac	WV	WV and VA	Chesapeake Bay
Rappahannock	VA	VA	Chesapeake Bay
Susquehanna	NY	NY, PA and MD	Chesapeake Bay
York	VA	VA	Chesapeake Bay

Divide your class into teams of two or three and give each team the name of one river. Have each team use various resources to find out the specifics of where their river begins, its course, and where it ends. Each team should report their findings to the class, using a large class map to show the course of their river from beginning to end. Students should label each of the rivers on their individual watershed maps.

Extension: broaden the scope of exploration by asking the students to discover and learn more about other large watersheds. Examples include the watershed areas of the Columbia and Mississippi Rivers in the United States, the Amazon River in South America, and the Congo River in Africa.

Activity: Graphing Wetland Distribution

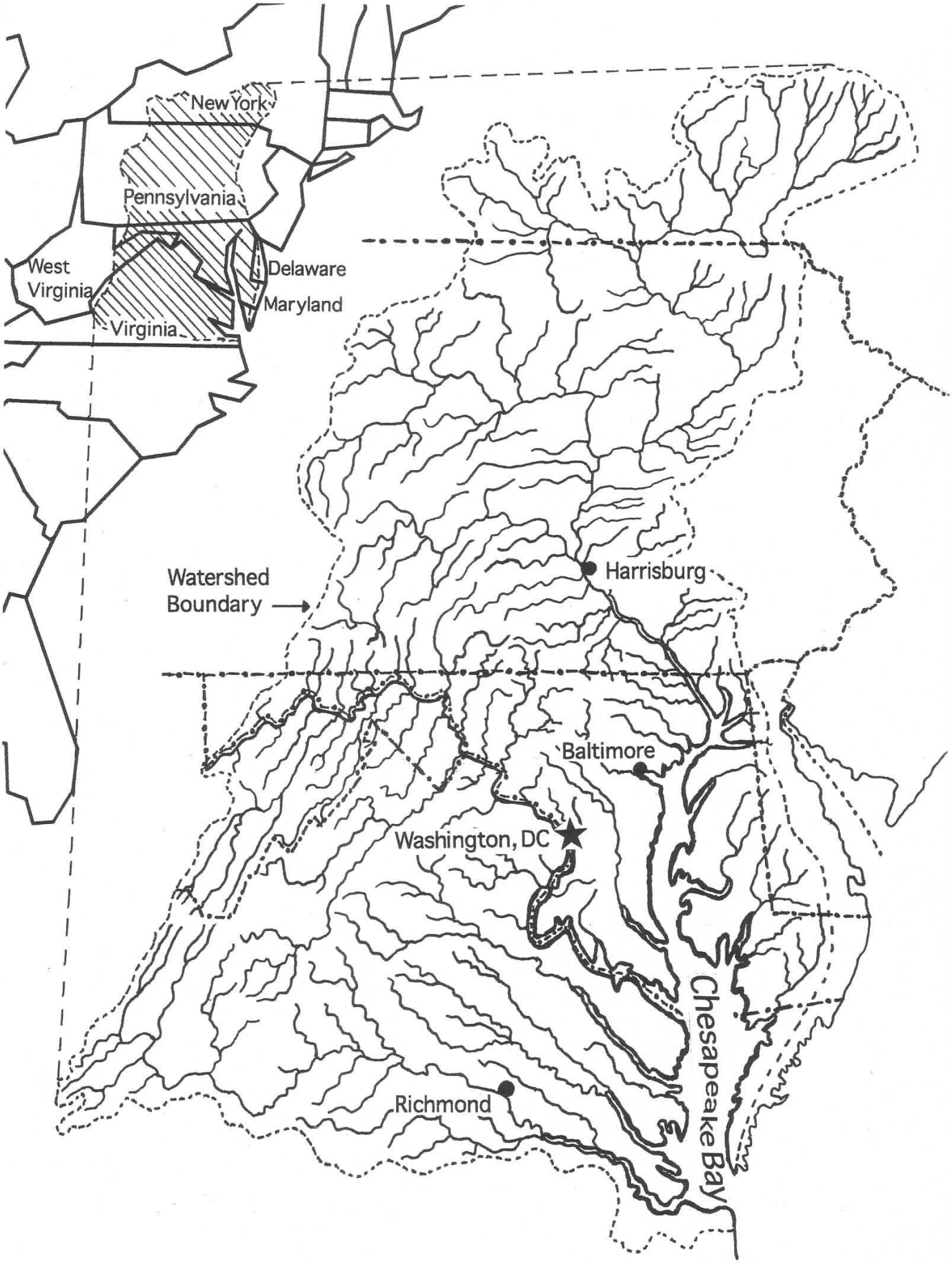
To give students a sense of how the 2,300 square miles of wetlands are distributed throughout the Chesapeake Bay watershed, and to practice their graphing skills, have them make a pie chart AND a bar graph using the information below. If necessary draw an example of the two types of graphs, but let the students figure out how to organize the information on their own pie chart and bar graph.

Distribution of wetlands in the Chesapeake Bay watershed:

Delaware	6%	Pennsylvania	14%
Maryland	28%	Virginia	40%
Now York	11%	West Virginia	1%

When students have completed their graphs ask for volunteers to draw a copy of their graphs on the board. As a class, compare the advantages and disadvantages of the two types of graphs in presenting information. Discuss ways to organize the information to make the graphs more understandable. For example, you may want to talk about labeling the graphs, using color, and organizing the bars in descending or ascending order. Based on this information, encourage the students to redraw their graphs to make them easier to understand.

Extension: Challenge your students to figure out the actual square miles of wetlands in the six different states that make up the watershed area. (For example, Virginia at 40% has: 2,300 X .40 = 920 square miles of wetlands). The students can draw new graphs based on the square mileage data.


New York
Pennsylvania
West Virginia
Delaware
Maryland
Virginia
Watershed Boundary
Harrisburg
Baltimore
Washington, DC
Richmond
Chesapeake Bay

Activities – Weeks 2 and 3

What are the Common Life Forms of Wetlands and How are They Adapted to Living There?

Activity 4

In this activity, students will be writing clues describing wetland animals and plants. Begin by having each student select a different species from the list of Chesapeake Bay plants and animals. Have students research their plant or animal to find out what it looks like and how it behaves. Next, tell them to write 5 clues, starting with a general one and becoming more specific with each clue. Clues can be written in first person. For example, clues describing a monarch butterfly might include:

1. I am a small animal that lives in the wetland.
2. I fly from flower to flower.
3. I have six legs.
4. I migrate to Mexico.
5. I have large, orange and black wings.

Choose one student to read their clues, one clue at a time, to the class. When a clue is read, let the rest of the students guess the animal or plant using the list of Chesapeake Bay species. The student who guesses the correct species gets to read his/her clues next. If a correct answer is given before the last clue is read, have the clue's author read the remaining clues so other students can learn more about the organism's characteristics.

Animal And Plant Life Of The Chesapeake Bay

Fish:
striped bass
manhaden
bluefish
flounder
sea trout
spol
mullet
croaker
shad
herring weakfish
mackerel
sturgeon
red drum
perch
alewife

(Freshwater only)
catfish
carp
trout
sunfish

Mammals:
muskrat
white-tailed deer
beaver
raccoon

Birds:
wood duck
mallard duck
canvasback duck
peregrine falcon
red head duck
black duck
bald eagle
osprey
Canada goose
red-winged blackbird
heron
egret
tern
gull
kingfisher
sandpiper

Amphibians/Reptiles
northern diamondback terrapin
eastern mud turtle
painted turtle
northern water snake
southern leopard frog
bullfrog
Fowler's toad

Invertebrates:
Insects
dragonfly
monarch butterfly
caddisfly
copper-colored beetle

Crustaceans
clam
oyster
blue crab
crayfish
shrimp

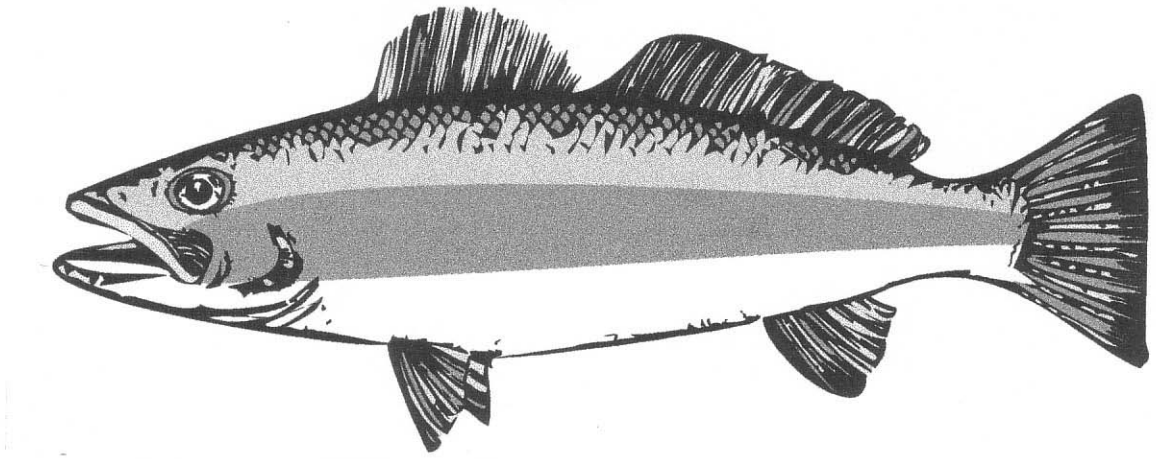
Plants:
cattail
swamp rose
coontail
eelgrass
widreon grass
wild celery
common waterweed
curly pond weed
sago pond weed
hydrilla

Did you know 2,700 species of plants and animals live in the Chesapeake Bay?

Activity 5

Introduce this activity by explaining the concept of adaptation. Tell students that wetland animals and plants have developed special adaptations in order to live in an environment that changes a lot. You may want to use the information in the teacher background section to describe some of the animal and plant adaptations. When students have a basic understanding of adaptations, use the activity "Design a Fish" to deepen their understanding.

Design A Fish



Student Objectives:

1. recognize general adaptations of fish to their environments;
2. describe how some adaptations help fish survive in their habitat;
3. discuss the general importance of animal adaptations.

Background:

Fish, like other animals, have adaptations that have evolved over hundreds of thousands of years. Most adaptations increase an animal's chance of surviving and reproducing in its particular habitat. Animals with adaptations that provide flexibility in response to changes in the environment are most likely to survive. Some animals have adapted to such a narrow range of conditions that they are unable to respond to changes in their environment. These "highly specialized" animals are much more susceptible to dramatic changes, and thus extinction.

In this activity, students design a new kind of fish. The adaptations of their new fish would actually take thousands of years to develop. As each adaptation is added to the design, the fish becomes better suited to the habitat where it lives. Different fish can live together within the same habitat because of the variety of conditions found there. Some fish adaptations are listed in the following table:

ADAPTATION	HELPS THE FISH TO….	FISH EXAMPLES
Mouth type		
sucker shaped mouth	feed on small plants and animals	carp
longer upper jaw	feed on prey it sees below	cod
longer lower jaw	feed on prey it sees above	barracuda
duckbill jaws	grasp prey	pike
very large jaws	surround its prey	grouper
Body shape		
torpedo shape	move fast through the water	wahoo
flat bellied	feed on the bottom	catfish
vertical disk	feed above or below	butterfish
horizontal disk	live on the bottom	halibut
hump backed	be stable in fast moving water	sockeye salmon
Coloration		
light colored belly	hide from predators below	tuna
dark head and back	hide from predators above	catfish
vertical stripes	hide in vegetation	croaker
horizontal stripes	hide in vegetation	yellow bass
mottled coloration	hide in rocks or on the bottom	crappie
Reproduction		
eggs deposited in nests	protect the eggs	bluegill
eggs deposited on bottom	hide eggs from predators	trout
eggs float freely	disperse many eggs all at once	striped bass
eggs deposited on plants	stabilize the eggs until hatching	yellow perch
live birth	ensure more offspring surviving	guppies

Activity

Materials:

- art materials (colored pens, pencils, crayons, paper)
- five cards for each category of adaptations listed above (master copy provided)

Procedure:

1. Divide the adaptation cards into five sets of four cards each: one card with a "mouth type" adaptation, one card with a "body shape" adaptation, one card with a "coloration" adaptation, and one card with a "reproduction" adaptation.

2. Divide your class into five groups of 4 to 6. (If your class size is larger than 30, make additional sets of the adaptations cards to keep the group size small.) Give each group a set of the adaptation cards.

3. Ask each group of students to "design a fish" from the adaptations they have in their card set. Each group should:
   - use the art materials to create a drawing of their fish
   - describe and draw the habitat of their fish
   - come up with a name for their fish

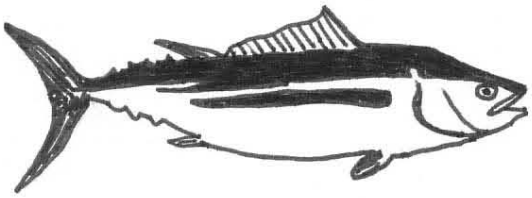
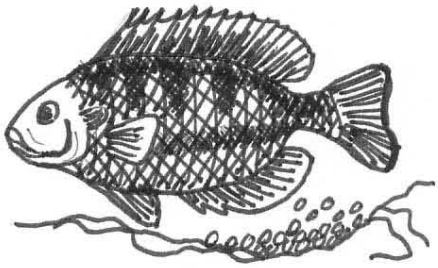
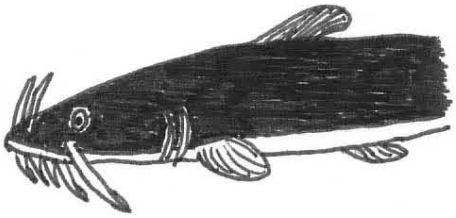
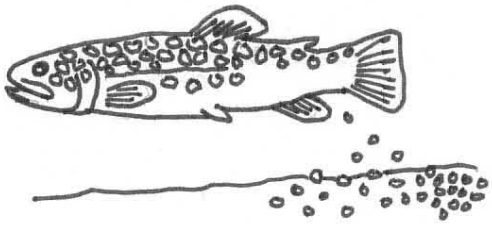
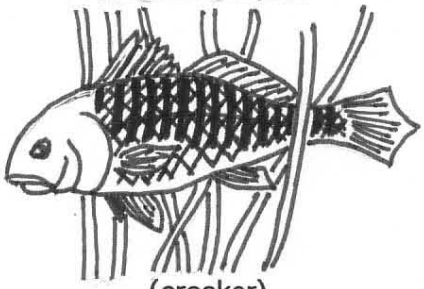
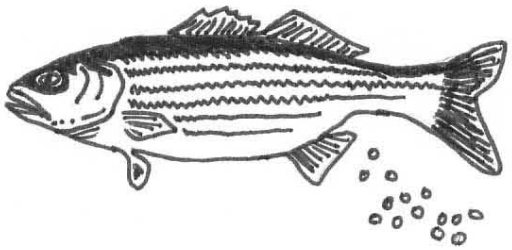
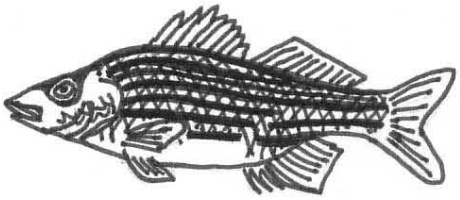
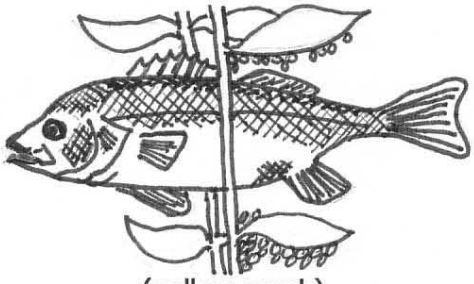
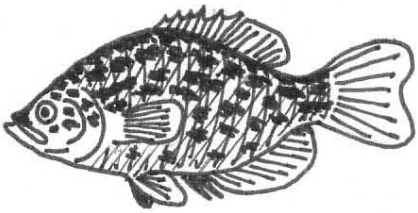
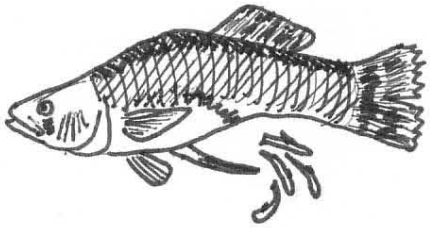
4. Each group should report to the rest of the class about their fish, including its adaptations, its habitat, and how it was named. Ask each group of students to describe how their fish might adapt to a change in its habitat.

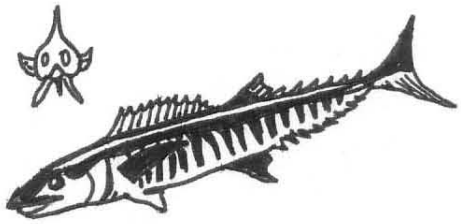
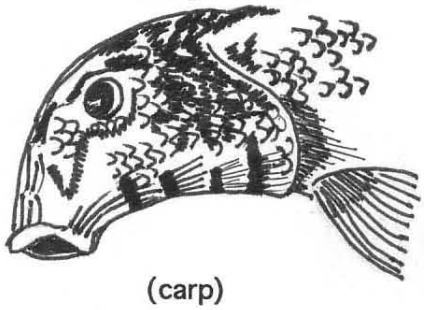
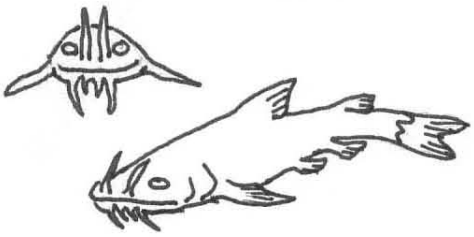
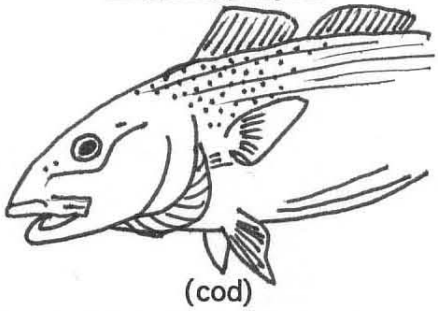
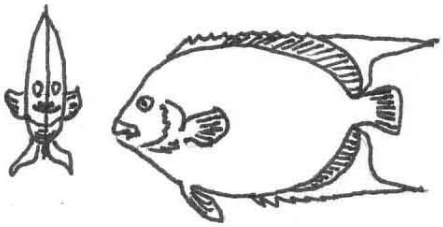
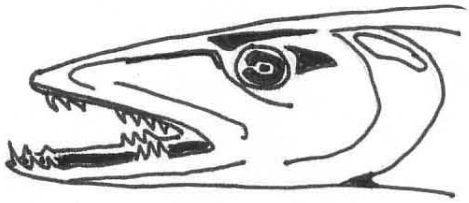
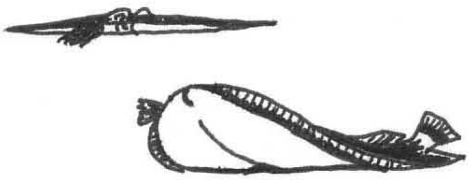
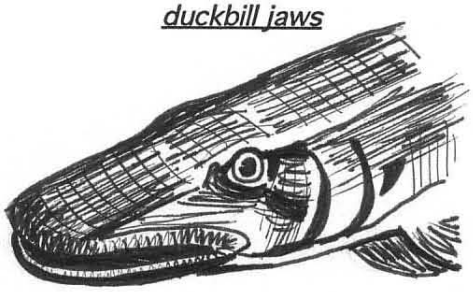
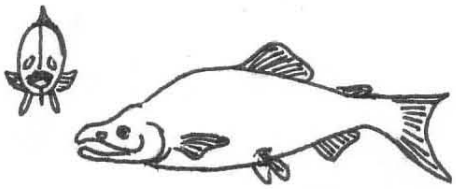
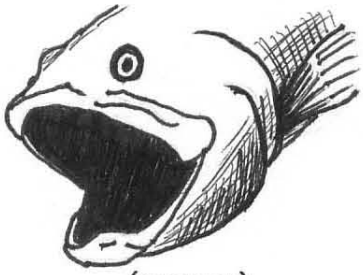
Extensions:

1. Have your students look at photos or illustrations of fish and identify other types of body shape, mouth type and coloration adaptations. Encourage the students to speculate on a fish's habitat given its adaptations.

2. Broaden the scope of investigation by asking the students to find special adaptations in other animals. Students should try to identify how the adaptation helps the animal. An example is the long neck of the giraffe, which helps it reach leaves high in the trees. Collect the students' examples, and conduct a class discussion about animal adaptations. Encourage the class to classify adaptations into general types, such as feeding, coloration, body shape and reproductive behavior.

3. Change the direction of investigation by having the students think about particular habitats, and the general adaptations an animal would need to survive there. In any habitat, an animal needs to find food, water, shelter and mates. The kind of habitat (such as a desert) determines how an animal meets those needs, based on the animal's general type (fish, reptile, amphibian, bird, mammal). Challenge your students to deduce what kinds of adaptations each general type of animal would have in a specific habitat.

light colored belly  (tuna) Coloration	*eggs deposited in nests*  (bluegill) Reproduction
dark head and back  (catfish) Coloration	*eggs deposited on bottom*  (trout) Reproduction
vertical stripes  (croaker) Coloration	*eggs float freely*  (striped bass) Reproduction
horizontal stripes  (yellow bass) Coloration	*eggs deposited on plants*  (yellow perch) Reproduction
mottled  (crappie) Coloration	*live birth*  (guppies) Reproduction

torpedo shape  (wahoo) Body shape	*sucker shaped mouth*  (carp) Mouth type
flat bellied  (catfish) Body shape	*longer upper jaw*  (cod) Mouth type
vertical disk  (butterfish) Body shape	*longer lower jaw*  (barracuda) Mouth type
horizontal disk  (halibut) Body shape	*duckbill jaws*  (pike) Mouth type
humpbacked  (sockeye salmon) Body shape	*very large jaws*  (grouper) Mouth type

Activities – Weeks 4 and 5

How do Wetland Animals and Plants Interact?

Activity 6

This activity can either be started by introducing the concepts of food chains and food webs first or by having students discover food chains and food webs as they create the food web model on the following pages.

To use the model to teach the concepts of food chains and food webs, begin by defining the following terms: producers, primary consumers, secondary consumers and decomposers. Then ask students to identify an animal or plant on their model that occupies each role in a wetland. Also, ask students to give examples of organisms that are not represented on the model that fill the same type of role. Be sure to show students how the organisms interrelate from the top to the bottom of each chain, as well as between chains. For example, a secondary consumer at the top of one food chain may eat a primary consumer on another chain in addition to the one below it. This type, of "cross-chain" relationship demonstrates a food web. You may want to put strings between connected organisms on different chains to show how these relationships form a food web.

Food Web Mobile

Student Objectives:

1. understand the terms producer, consumer and decomposer,
2. construct several food chains that include wetland producers, consumers and decomposers;
3. describe how the interrelationships between organisms in different food chains helps to define a food web.

Activity: Food Web Mobile

Materials:

- art materials (safety scissors; optional coloring materials)
- glue and cardboard
- kite string, or other type of thin string

- *for each student:*
    - one shoebox lid
    - nine pieces of yarn, each 6 inches long
    - four pieces of fishing line, each 12 inches long
    - one copy of the three pages of organisms (master copies provided)

Procedure:

1. Pass out copies of the three pages of organisms to each student. Discuss as a class some of the food chains possible between these different organisms. Each student should then choose three food chains to develop for their mobile. (If you'd like, let each student color their organisms as they see fit).

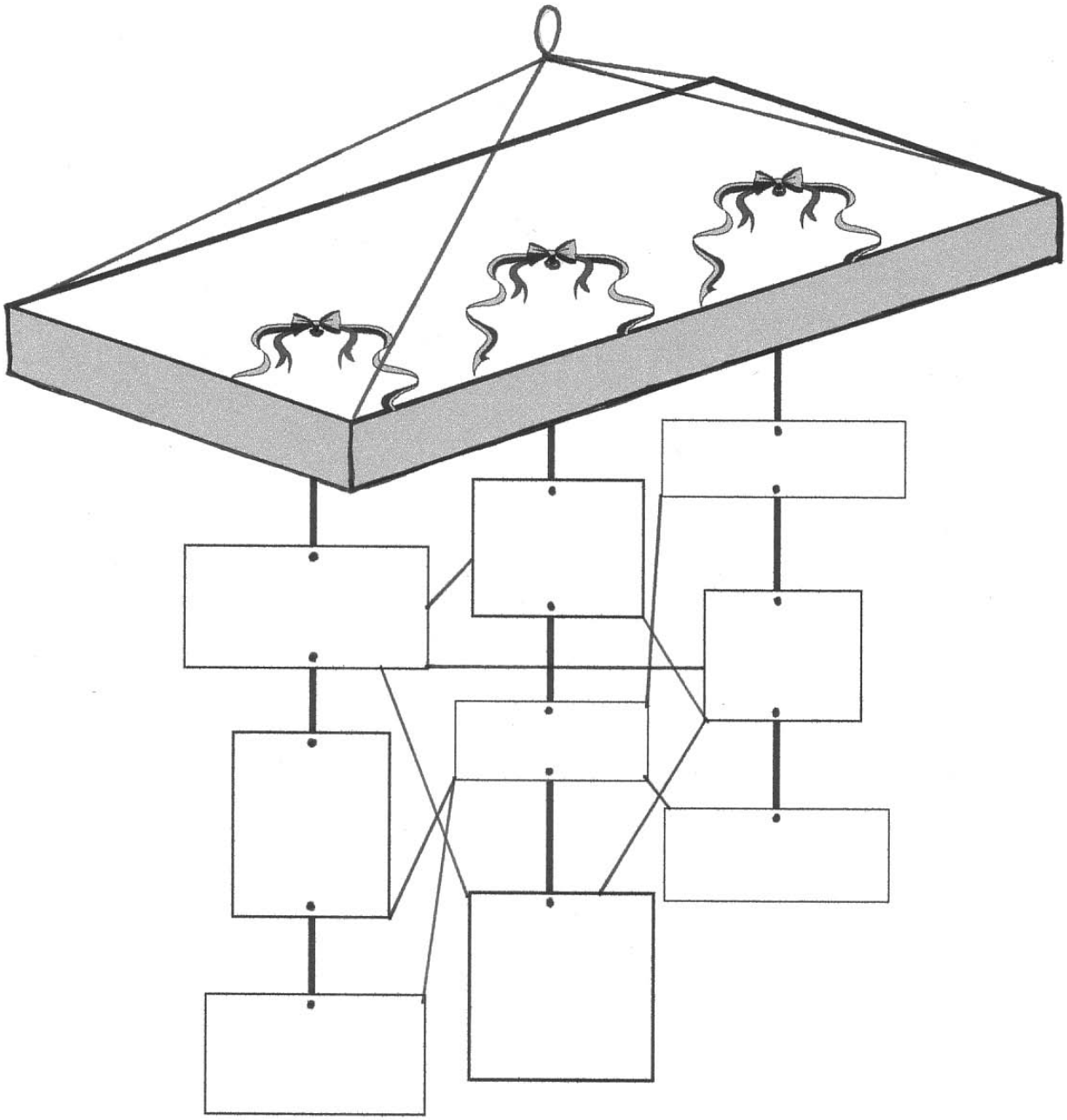
2. Have the students cut along the lines between the organism cards, and then arrange their three food chains so that the secondary consumer is on the top, then the organism it eats, and so on. Glue each organism card to a piece of cardboard to make it sturdier, then punch a hole in the top-center and bottom-center of each card. Working with one food chain at a time, the students should then tie each organism card in the food chain together in the correct order.

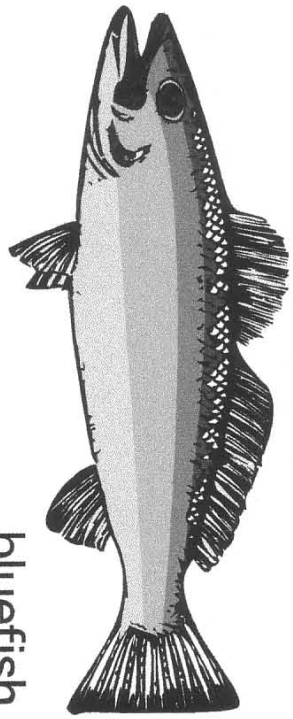
3. Next, punch three holes in the shoebox lid in a line down the long center (see diagram), and tie each food chain to the shoebox lid. Once the three chains are attached, poke small holes in each corner of the lid and tie the fishing line to the lid. Bring the four pieces of fishing line together above

the center of the lid and tie them in a knot. (You may have to help students adjust the lines so that the mobile is balanced).

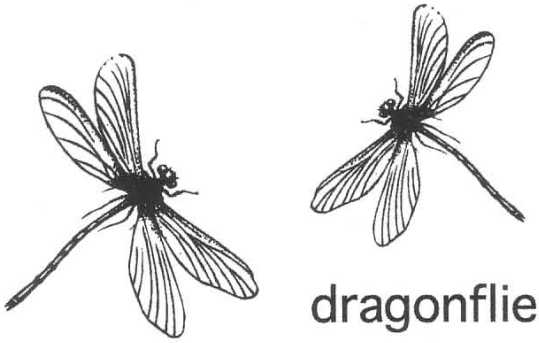
4. Each student should examine their food chains to see if there are any "cross-chain" interactions between organisms on different food chains. For example, in one chain the snake eats the frog, which eats the dragonflies, and in another chain the osprey eats the bluefish, which eats the minnows. But the osprey also eats the snake, so a connection between those chains exists. The students should link every type of cross-chain interaction they can find by gluing kite string between the organisms (see diagram; make sure the food chains still hang straight). By defining these interrelationships, the students can see their food chains truly becoming a food web!

Food Web Mobile



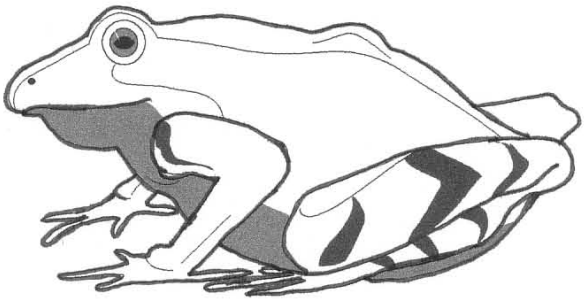


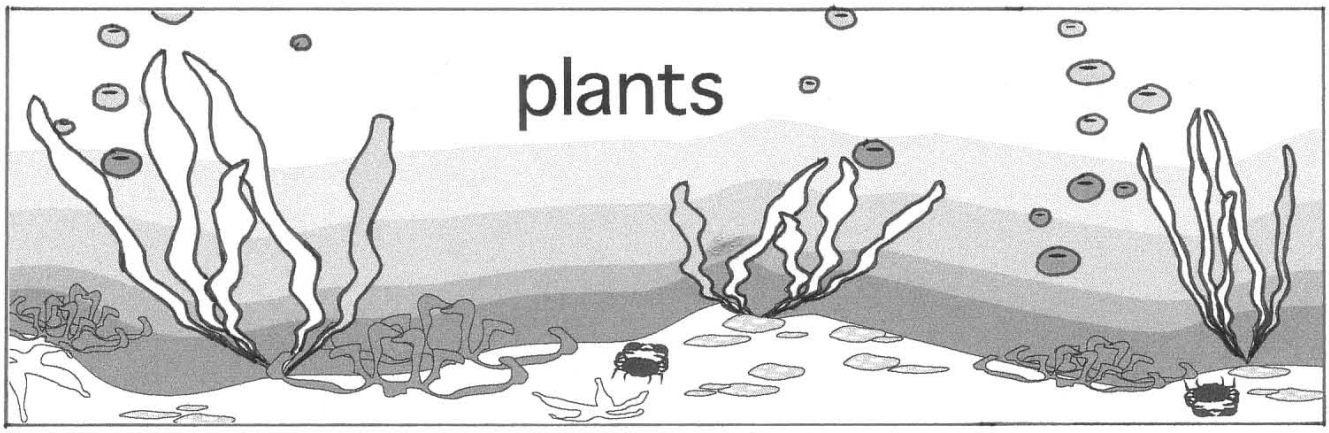
bluefish

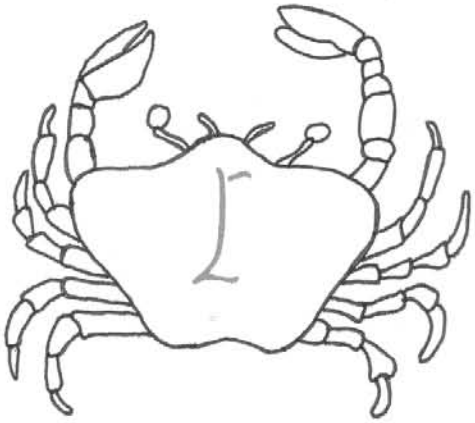


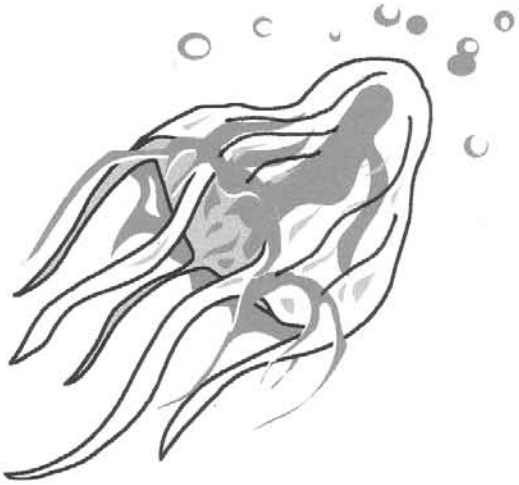
dragonflies

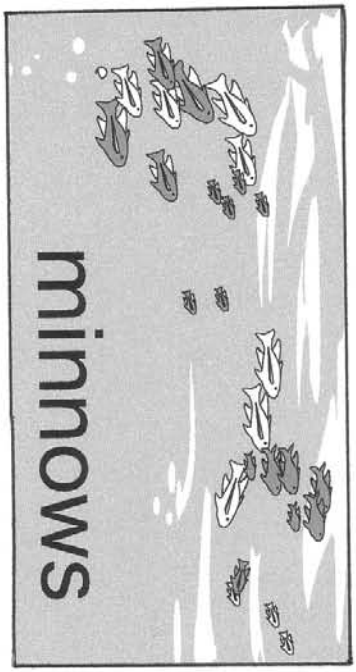
oyster

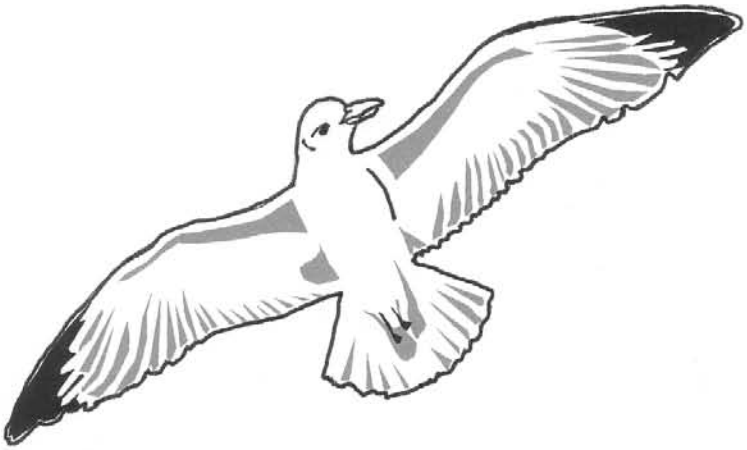


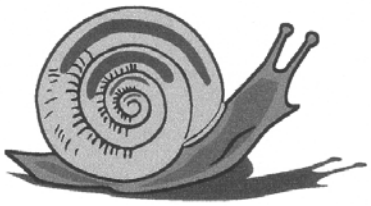


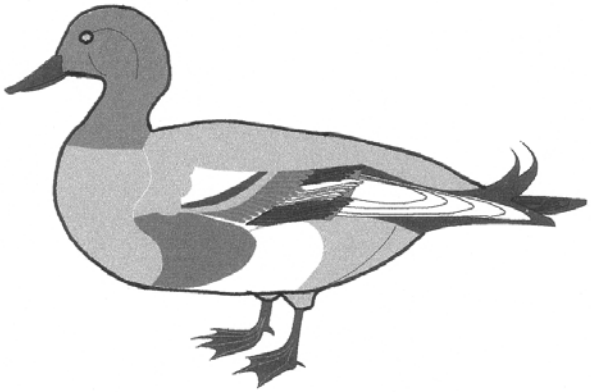


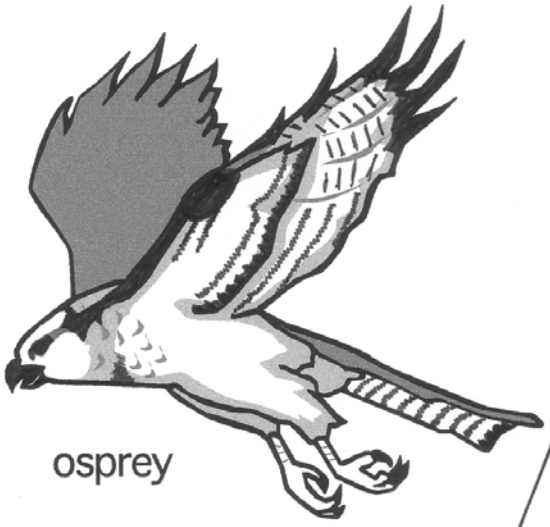



minnows

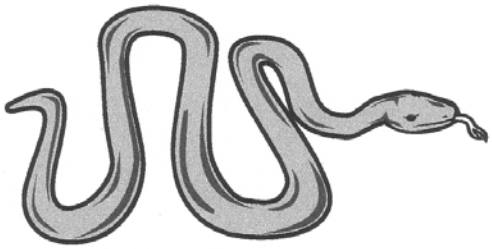


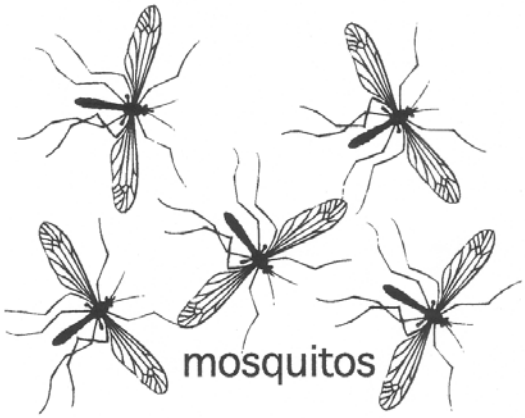






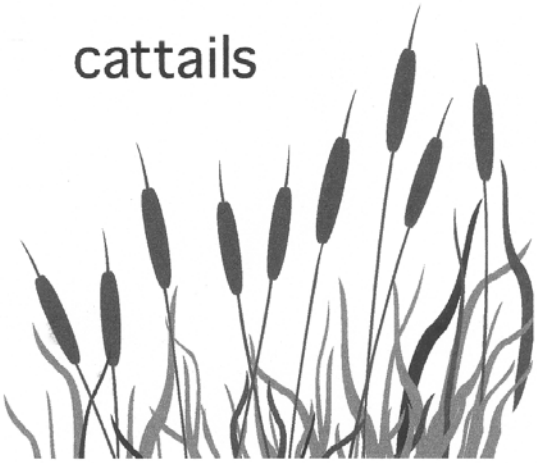
osprey





mosquitos

cattails



Activity 7

Wetlands are important feeding, breeding and nesting stops along bird migration routes. Along the East Coast is a migration route called the "Atlantic Flyway" where wetlands serve as critical "rest stops" for migrating birds. Introduce your students to this important function of wetlands through the game "What a Trip!".

What A Trip!

Bird migration refers to the regular seasonal movement of certain species of birds. Nearly all North American birds migrate between their breeding areas and their wintering areas. Since each species has its own special requirements for food and time for breeding they migrate at different times. The major stimulus for bird migration is the seasonal change in the amount of daylight. In spring, increasing daylight triggers changes in birds that prompt them to migrate north. In autumn, decreasing daylight causes similar changes that prompt birds to migrate south. The benefits of migrating include finding more food and nesting sites as well as escaping extreme weather changes.

Birds encounter many obstacles as they migrate north or south. Severe weather, lack of food, destruction of prime habitat and problems with people are some of the obstacles which affect migrating birds. Because of such obstacles, some species lose 50% of their population during migration.

Ornithologists (people who study birds) study migration in several ways. One way is just by watching: they count the number of birds that fly through an area during a specific time period. Ornithologists also study migration by banding birds. To band a bird, you catch it alive and place a small numbered band on its leg, then release it. When banded birds are recaptured or found elsewhere, scientists can find out where they went, how long they lived, and what happened to their bodies as they migrated.

Materials:

- 24 migration statements (list A)
- 10 detour statements (hot B)
- 34 3 X 5 index cards
- 3 gummed labels
- magic marker
- glue or stapler
- 24 clip-on clothespins (optional)

Pre-planning

1. Read through the entire activity first, to familiarize yourself with the process.
2. Prepare a set of migration cards. Copy the statements provided (List A). Cut and attach each to an index card.

3. Number the back of each index card with the corresponding statement number. If you are going to play the game outside, clip one clothespin to each card to prevent the cards from blowing away. These cards will be used to form a simulated migration trip.

4. Prepare a set of detour cards. Copy the statements provided (List B). Cut and attach to index cards. Mark the back of each card with "Detour". Clip the cards together with a clothespin.

5. Find an appropriate location for the game (indoors or outdoors). You will need approximately 100 feet of clear pathway for the students to follow with separate starting and ending points. The pathway does not have to be a straight line.

6. Mark each gummed label with an "X". Place them at the end of the pathway. (There are three mortality cards. The students who come to the finish line with these cards get a label stuck to their forehead.)

7. Wait until the game is about to begin before placing the cards on the pathway.

Getting the Students Ready

(Use the map provided to help orient your students.) Discuss with your students how to plan for a trip. "You are going on a trip to Boston. What are some of the things that would help you to get there?" (Fair weather, car in good condition, fuel, airplane, money for fares, food, suitcases, place to sleep along the way). "What are some things that would upset your plans along the way?" (Flat tire, breakdown, accident, no place to eat or sleep on the way, lost or stolen money, plane crash).

Once your students have started thinking about what's involved in taking a trip, explain to the students that they are going to pretend to be birds migrating up the Atlantic coast from Florida to Boston.

1. Create a trip path with the migration cards by placing each card face down at four-foot intervals along the pathway you have designated.
2. Detour cards should be set in a pile off to the side of the pathway.
3. Divide the class into three groups. Designate early, middle and late migrants as found in List C, giving each student or group the name of a migratory bird. If

the class size is larger than 15, have them travel in twos or threes and "fly" together as a single unit to each space.

4. Beginning with the first group of migrants, assign each student/unit a number from 1 to 4.

5. Start the game by sending the first group (early migrants) onto the pathway: first student/unit to card #1, second to card #2, etc.

6. Instruct your students to pick up the card, read it, replace it face down, and do what the card tells them to do. Anytime someone else is using the card they are sent to, they are to go to the detour pile and follow the instructions on the card that is picked. If a number along the migration path is missing, they should go to the next card in the path.

7. As the migration cards become vacant, more early migrants can enter the pathway. Then repeat the procedure with the middle and late migrants.

8. When most of the students have reached the finish, assemble the class for discussion (see Wrapping up the Activity).


New Hampshire
Maine
Vermont
Massachusetts
Boston
New York
Rhode Island
Connecticut
Pennsylvania
New Jersey
Delaware
Maryland
Virginia
D.C.
North Carolina
South Carolina
Georgia
Atlantic Ocean
Florida

LIST A
Migration Cards

1. WATCH OUT!!! Power lines ahead near Crystal River, FL. Don't hit them! Crawl ahead 3 spaces on your hands and knees.	5. A cat almost catches you on the Eastern Shore, but you escape. Your wing is a bit sprained though. Get it back in shape by slowly swinging your left arm around 10 times, then move ahead 1 space.
2. Many berries and insects are available in this overgrown marsh in Georgia. Smack your lips 10 times and move ahead 4 spaces.	6. Scientists at the Blackwater Wildlife Refuge in Maryland catch you for research. After putting a numbered metal band on your leg you are set free. Move ahead 3 spaces.
3. You land in a polluted marsh near Atlanta and become sick from the food you eat. Sit down, hold your stomach for a count of 30, groan 10 times, then move ahead 2 spaces.	7. You got tangled in a plastic fishing line near the Chesapeake Bay. You can't eat and are weak from hunger. A kind person cuts away the line. Hop on 1 leg in a circle, count to 40, then move ahead 4 spaces.
4. Watch out for the sharp-shinned hawk! It wants to eat you. Freeze, count to 40, then move ahead 3 spaces.	8. You find a bird feeder in a 5th grader's backyard near the Anacostia River. Spend a few days enjoying the free food. Chew 20 times and move ahead 5 spaces.

9. It's raining, it's pouring, and you don't want to fly in this rainstorm. Count to 50 while you wait for the storm to stop, them move ahead 4 spaces.	13. You are able to fly a long distance in one day because of good winds along the Shenandoah Mountains in western Virginia. Move ahead 4 spaces.
10. You can't find the spot you came to last year because a new shopping mall has been built on the site. Walk around in 3 wide circles searching for a place to rest and feed. Because you are still hungry you have only enough strength to move ahead 1 space.	14. It's hard to find caterpillars to eat because the forest was sprayed with an insecticide. Open and close your eyes 25 times while you look for food and move ahead 1 space.
11. While traveling at night, you become confused by the beam from Bloody Point Lighthouse on the Chesapeake Bay. You are tired from flying in circles and can't continue. Sit down, count to 40, and move ahead 3 spaces.	15. Strong winds from the wrong direction keep you from migrating. Go back 3 spaces.
12. You arrive on Assateague Island when the horseshoe crabs lay their eggs in the sand. Yum!! Rub your stomach 15 times and move ahead 4 spaces.	16. You become covered with oil from a spill in the Potomac River. Although rescued, you do not recover. The game is OVER for you. You're died! DON'T TELL ANYONE. Take this card with you. Go to the finish and place an "X" sticker on your forehead. Sit down and wait for the others to finish.

17. You just flew into a tall glass building in Washington, D.C. Sit down, hold your head, count to 35 and move ahead 2 spaces.	21. Oops! An unexpected freeze kills off all the insects that you usually eat. Go back 1 space as you try to find more food.
18. You find a nice resting spot in Bombay Hook National Wildlife Refuge in Delaware. Count to 20 as you get rest then move ahead 3 spaces.	22. The remnants of a hurricane blow you into the Atlantic Ocean. You rest on the water, but get eaten by a gull. The game is OVER for you. You're dead! DON'T TELL ANYONE. Take this card with you. Go to the finish and place an "X" sticker on your forehead. Sit down and wait for the others to finish.
19. You have been shot with a BB gun. The game is OVER for you. You're dead! DON'T TELL ANYONE. Take this card with you. Go to the finish and place an "X" sticker on your forehead. Sit down and wait for the others to finish.	23. Strong winds near Rhode Island blow you off course. Go back 3 spaces.
20. After flying for several days you land in the Oyster Bay National Wildlife Refuge in New York. Spend time feeding on berries in a thicket. Pretend to pick 10 berries from a bush, then move ahead 4 spaces.	24. Spend 5 days resting and feeding at McKinney National Wildlife Refuge in Connecticut. Count to 40. Because you are so strong you can fly to the finish!

LIST B
Detour Cards

Go to card #9	Go to cards #23
Go to card #18	Go to card #3
Go to card #24	Go to card #6
Go to card #5	Go to card #15
Go to card #10	Go to card #17

LIST C
Wetland Birds That Migrate Along the Atlantic Flyway

Early Migrants	Middle Migrants
(late February through mid-April)	(mid-April through mid-May)
red-winged blackbird	solitary sandpiper
ring-necked duck	least tern
ruddy duck	veery
killdeer	
northern harrier	Late Migrants
northern pintail	(mid-May through mid-June)
	red knot

Wrapping up the Activity

Here are some questions (with some possible answers) you may wish to use with your students. Consider making lists of the answers to encourage students to compare.

- What obstacles did you encounter as birds?
- Which of those obstacles were created by people? (Power lines, plastic fishing line, pollution, lighthouses, glass buildings)
- Which were natural phenomena? (Hawks, cold snaps, difficult winds, storms)
- What things helped you complete your migration?
- Which of these were created by people? (Bird feeders, wildlife refuges)
- Which were natural phenomena? (Good winds, plenty of food)
- Why didn't all of you finish at the same time? (Birds migrate at different times, birds were held back by obstacles and they were advanced by helpful events)
- What do you think happened to the "birds" with 'X's' on their foreheads? (They died.)

Extension Ideas

- Ask the students to evaluate their community. List the things that would help birds migrate and those which would interfere with migration.

- Erect and monitor a feeding station on the school grounds. Keep a daily log and make seasonal comparisons of the birds that come to feed. A feeding station can be as simple as scattered seed on the ground near a tree or bush.

- Research the birds you have seen at the feeding station. Categorize them into winter visitors and year-round residents. Why are some birds able to survive the winter without migrating? (Winters are milder, birds change their diet or have varied diet)

- Make a list of winter birds other than those seen at your feeding station. Where do they come from and why are they here?

- On a map of the area, locate all the sites mentioned on the migration cards.

Activity 8

Although there are no mangrove wetlands in the mid-Atlantic area, they are fun to investigate because of the unusual characteristics of mangrove habitats and the interesting plants and animals that live there. Each animal species uses the mangrove habitat in a different way and the mangrove trees themselves are uniquely adapted to living in a very dynamic environment. Students will enjoy learning about mangroves and the animals that live there by actually creating a mangrove model in the classroom.

Make a Mangrove

Introduction

The term 'mangrove' refers to both a type of plant and the habitat they form. Mangroves grow in tangled clumps along nearly 75 percent of tropical and subtropical shorelines around the world. Of the estimated 50 species found worldwide, three species live in the U.S. - all of them are found in southern Florida.

Mangroves are salt tolerant and thrive in an environment where most other plants would perish. In Florida, they grow along shorelines, in coastal bays and lagoons where saltwater mixes with freshwater, in tidal rivers where the presence of saltwater can be low to high, and on low islands that are occasionally flooded by tides.

In Florida, the red mangrove grows closest to the shore. Its distinct root system makes it one of the most easily recognizable Florida mangrove species. The roots look like upside down tree branches! By keeping part of the root system above the wet soil and water, the red mangrove can draw oxygen through pores on the roots. The red mangrove seeds turn into seedlings right on the tree. When they fall off the branch, they float on the surface of the water until they find a place to take root.

Leaves, bark, twigs and droppings from birds roosting in mangrove trees fall into the water below, decompose and begin a very rich food chain. The animals that feed on this detritus - such as fiddler crabs, killifish and minnows - are adapted to live in habitats with wide variations of temperature and salinity (salt in the water). These animals are eaten by sea trout, snook and other consumers at higher levels of the food chain.

Around the world, mangroves are threatened by urban development, pollution and shrimp farms (mangroves are cleared to create shrimp farms). Since they act as nurseries for so many aquatic species and they help slow erosion by retaining soil, the continued loss of mangroves can affect the health of fisheries and shorelines.

Materials:
copies of Red Mangrove drawing for each student
3 copies of Mangrove Tree Construction handout
1 copy of the Trunk Group handout
1 copy of the Root Group handout
1 copy of the Canopy Group handout
construction paper (blue, brown and black)
glue
scissors
egg cartons
pipe cleaners
green tissue paper
tape or stapler
thin cardboard
crayons or markers
reference books or access to a library

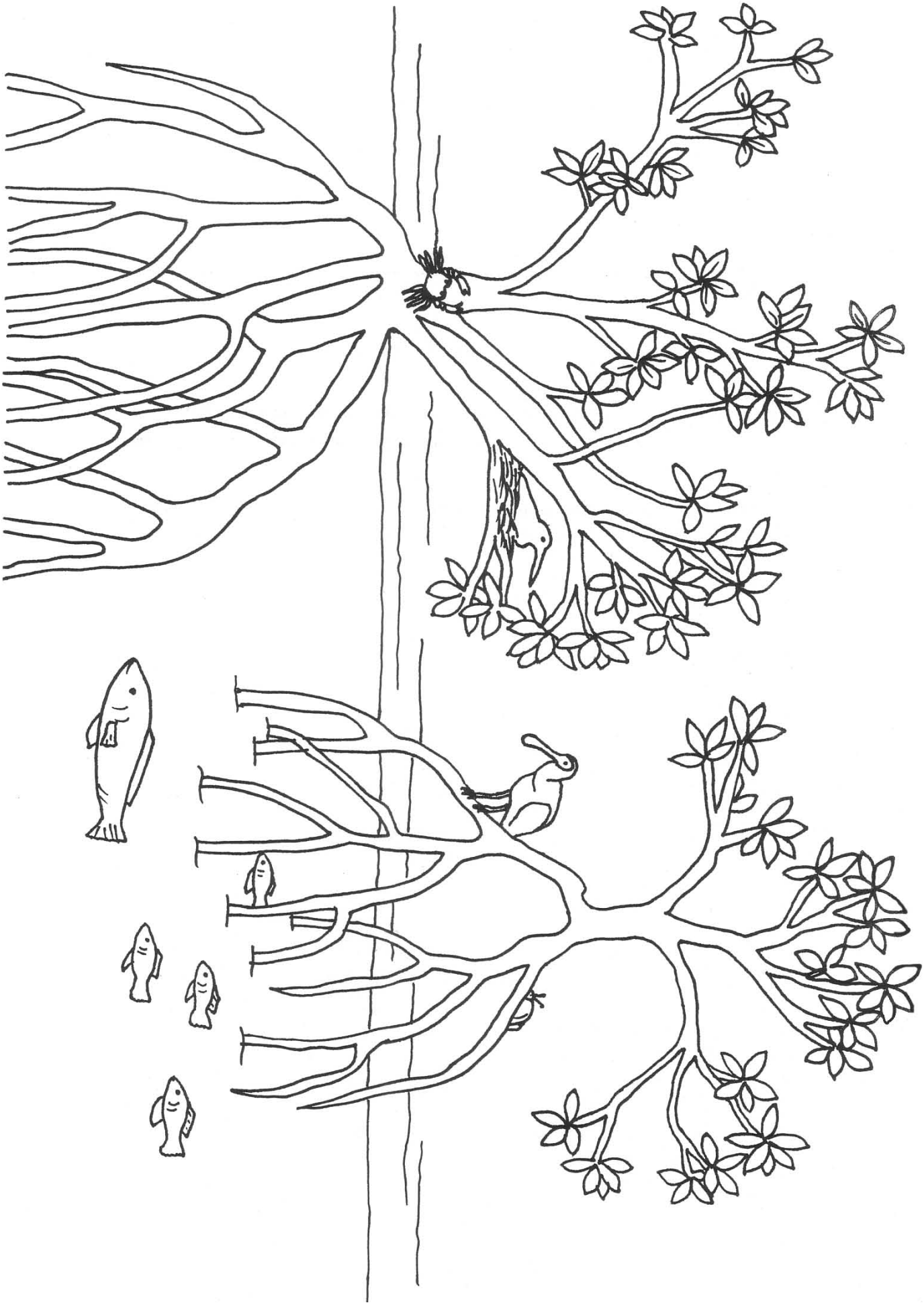
Before starting this activity, make copies of the handouts and clear a corner of your room to make way for your mangrove swamp.

1. Introduce students to mangrove, trees and mangrove ecosystems using the introduction from this activity, the map, and the handout with the drawing of the red mangroves. You may also want to view the video titled Creatures of the Mangrove listed in the Resources section of this module.

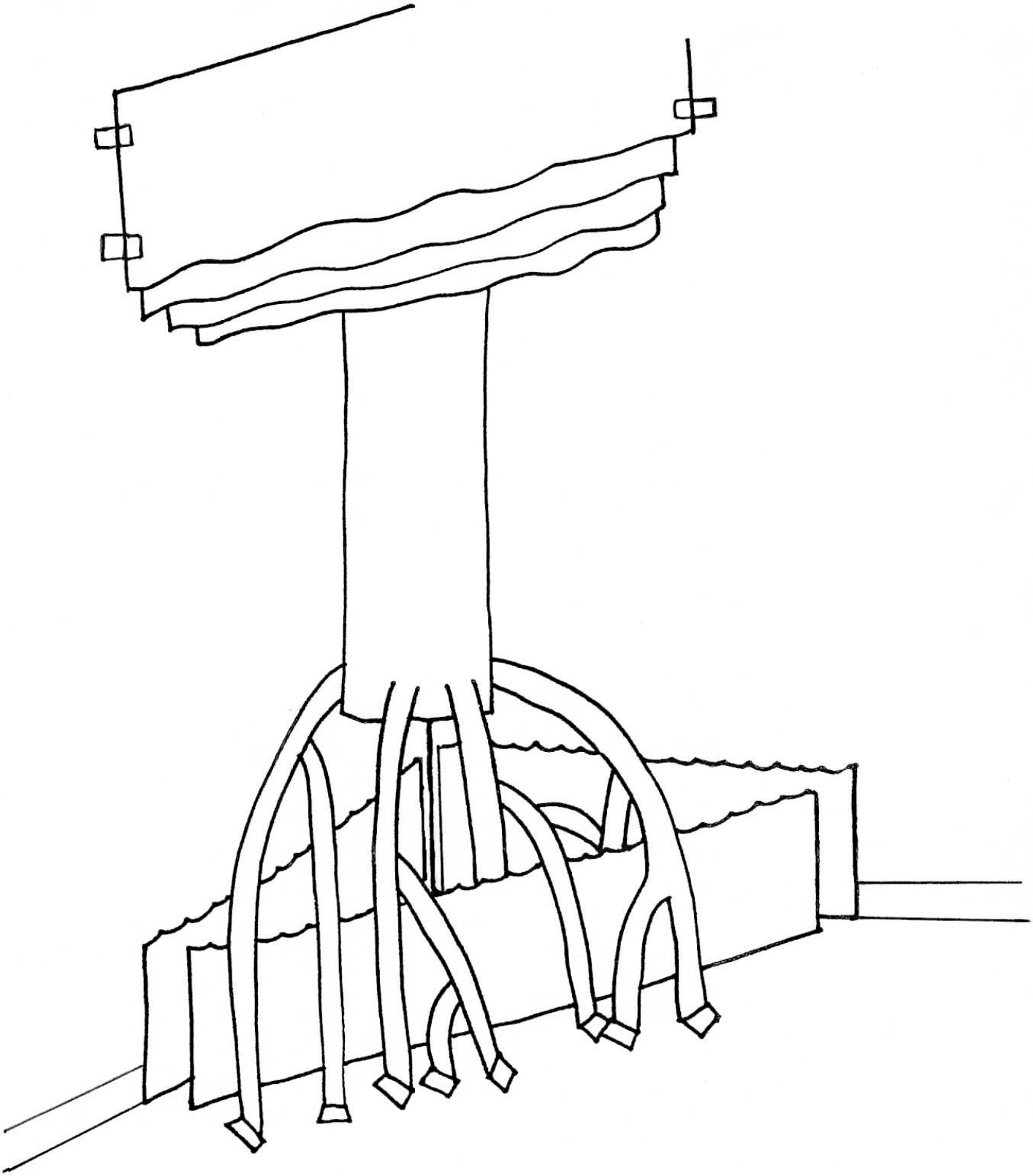
2. Tell students they will be building a mangrove tree in their classroom. Divide them into three groups - the Trunk Group, the Root Group and the Canopy Group. Each of the groups will be responsible for creating their assigned portion of the tree as well as the animals that live in that part of the tree.

   Give each group a copy of the Mangrove Tree Construction handout and a copy of the Mangrove Animals handout. Tell students they have instructions for building their part of the mangrove tree and one or two of the animals that live in mangrove trees. Students will need to find out what the remaining animals look like and decide how to draw or construct them. Be sure to give them a few days to conduct their research.
3. Bring out the art materials and begin construction. Be sure to have the Trunk Group assemble and place the trunk first, then the Root Group, and finally, the Canopy Group.

4. When the tree is completed and the animals have all been placed, have each group describe the animals they made.



Mangrove Tree Construction



Trunk Group

<u>To build the mangrove trunk:</u>

1. Tape or staple several pieces of brown or black construction paper together end to end in order to make a trunk about 1 foot wide and 3 feet long.
2. Tape the trunk in the cleared corner of the room, attaching the sides to the two walls of the corner. The base of the trunk should be about 2 feet above the floor.
3. Create water around the base of the mangrove by taping several sheets of blue construction paper to the bottom of the wall. The water should reach from the floor to the base of the trunk. Also tape or staple together several pieces of blue construction paper and tape one end to one wall and the other end to the other wall so it stands up. The construction paper 'water' should be arranged to form three sides of a triangle (see Mangrove Tree Construction handout).

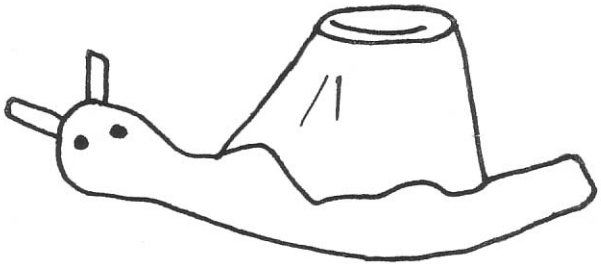
<u>Mangrove animals:</u>

Yellow Rat Snake

- climbs in trees
- eats rodents, birds and eggs
- nonpoisonous

Angulate Periwinkle Snail

- found on trunk, roots and branches
- very abundant in mangrove swamps
- eats algae and other plants



To make the snail:

1. Cut out one cup from an egg carton and turn it upside down.
2. Cut out a snail body (including head and tentacles) from construction paper and glue them to the cup.

Root Group

To build the mangrove roots:

1. Cut out black or brown construction paper (the color should match the trunk) into 1 inch strips. Also cut out some shorter strips to make the smaller roots that branch off the main roots.
2. Create a mangrove root by taping a long strip to the bottom of the trunk and continue to tape long strips end to end until they reach the floor or water below. Anchor the roots to the floor or water. Repeat this with more strips to form more roots. Some of the roots should begin higher up on the trunk. Also, attach shorter strips low down on the roots and anchor to the floor or water to form "accessory roots" (they will look like upside down branches). See Mangrove Tree Construction handout for guidance.

Mangrove Root Animals:

Mangrove snapper
- swims between submerged mangrove roots
- eats shrimp and crabs
- young snappers hide in roots to avoid predators

American crocodile
- hides in mangrove roots waiting for fish, mammals and birds to prey upon
- females build nests made of sticks and leaves
- endangered species

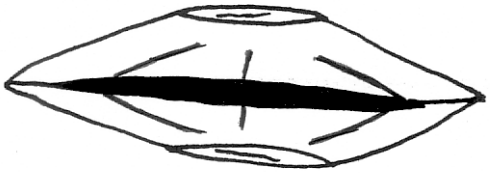
Sea horse
- uses prehensile tail to hold onto mangrove roots
- type of fish
- father sea horses carry babies in a pouch until they hatch
- eats tiny plants and animals by sucking them through a tube-like mouth

Oyster
- grow in clusters on roots
- eats by sucking water through a siphon and filtering out food

To make an oyster:

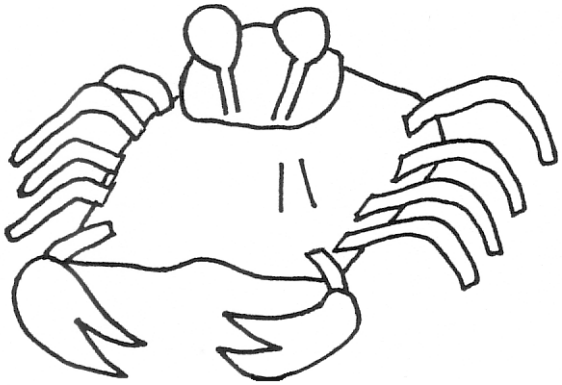
1. Cut out two cups from an egg carton. Cut some slits from the edges towards the middle so the cup opens until it is almost flat.

2. Put the two cups together so the bottoms bulge slightly away from each other. Staple or tape most of the edges of the two cups together, leaving an opening that looks like a mouth. Decorate with markers.



Blue crab
- holds on to roots during "soft shell" phase after molting
- has large fifth pair of legs to help it swim
- eats plants, shrimp, small fish, oysters, clams and dead animals

To make a blue crab:
1. Cut out one cup from the egg carton and turn it upside down.
2. Poke a line of four holes in the bottom edge on two opposing sides of the cup. Also poke two holes on a third side of the cup. This will become the front.
3. Put a pipe cleaner in one of the side holes and push it through the corresponding hole on the opposite side. Bend the ends downward to form the crab legs Repeat with three more pipe cleaners.
4. Push a fifth pipe cleaner through one of the front holes and out the other. Bend the ends forward. These will become the clawed legs.
5. Using construction paper, cut out claws and stalked eyes. Glue the eyes to the top of the cup and the claws to the ends of the fifth pipe cleaner.



Canopy Group

(Leaves and Branches)

To build a mangrove canopy:

1. Cut brown or black construction paper into 1-inch strips (the color should match the trunk and roots). Tape some strips together, attach to the top of the trunk, and anchor to the ceiling to form branches. Use shorter strips to make branches off main branches.
2. Use sheets of green tissue paper to make layers of leaves. Tape a few sheets end to end, then attach to the two walls of the corner. Repeat with more tissue paper to make layers of leaves, but make each new layer a little shorter and further from the wall.
3. If you want a different effect, cut out each leaf from construction paper separately and attach to the branches instead of using tissue paper layers.

<u>Mangrove Canopy Animals:</u>

White ibis
- builds platform nests with twigs in mangrove branches
- nests in colonies
- eats crabs and other small animals that live in mud at low tide

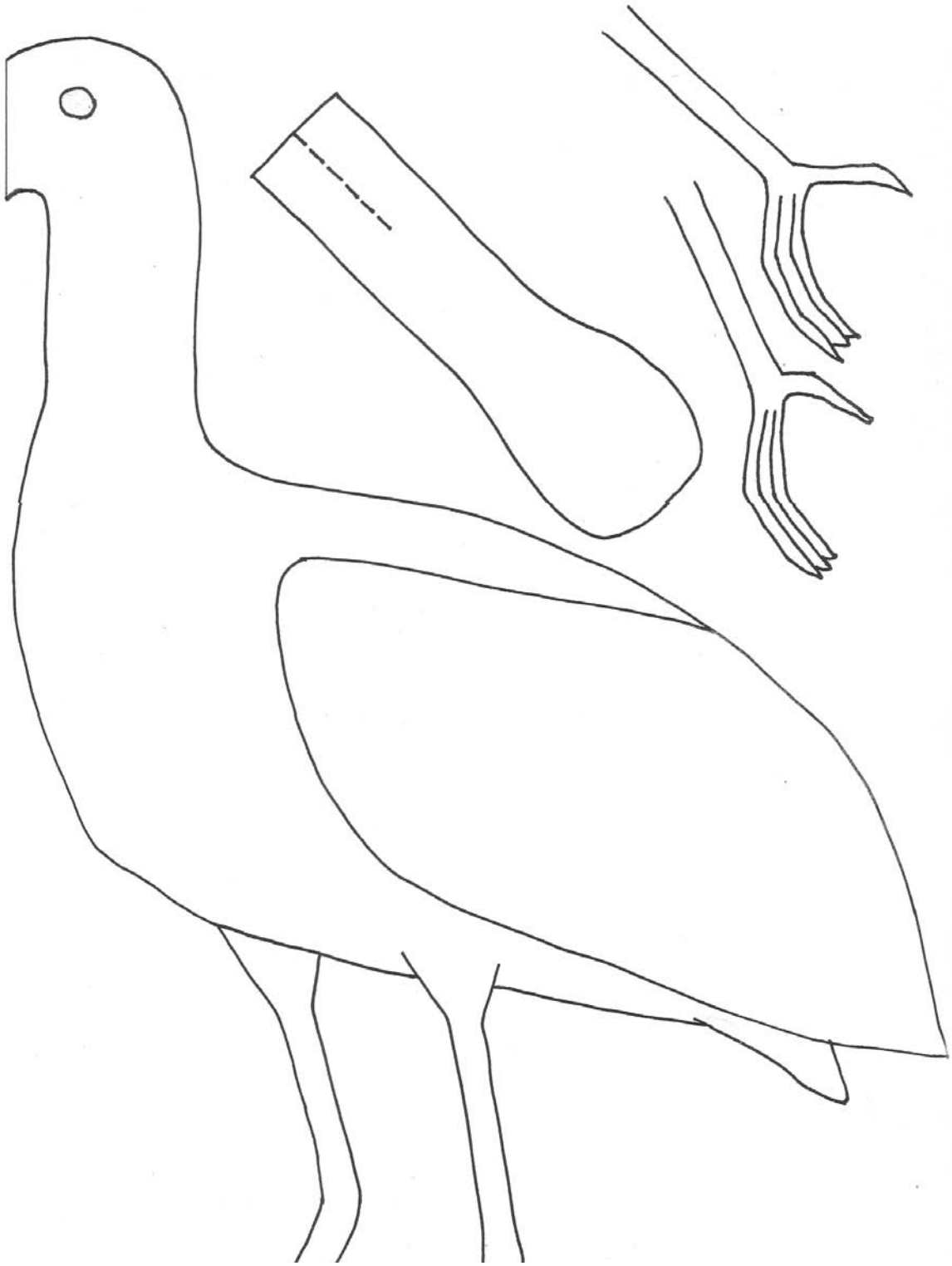
Brown pelican
- makes nests of sticks and reeds in the upper canopy of mangrove
- nests in large colonies
- dives from the sky into the water to catch fish

Roseate spoonbill
- rests in mangrove canopies and roots
- flattened tip on end of bill
- feeds on small marine life

To make a roseate spoonbill:
1. Use the pattern on the next page as a guide to draw the outline of a roseate spoonbill body onto white paper (with the feet attached). Use the outline again to trace the body and feet onto thin cardboard. Cut out the two drawings and

glue them together. The cardboard will make the drawing sturdier, and the spoonbill should stand up straight.

2. To make the bird's bill, follow the same procedure as above (white paper and thin cardboard patterns. When the glue is dry, cut an inch-long slit in the middle of the face side of the bill (see diagram). Insert the bill onto the face of the bird using the slit, and secure with tape.
3. Color the spoonbill's wings, underbelly and legs pink. Color the top of the head and the bill gray, but leave the rest of the bird white. Draw in eyes.



Activities - Weeks 6 and 7

How do Wetlands Function?

Activity 9

There are many examples of ecological balance in wetlands. Define ecological balance using examples from the teacher background if necessary. Give examples of ecological balance between predators and prey, and also explain how ecological balance is maintained within wetlands. For instance, you may want to explain that wetlands contain water that might otherwise flood a large area or that some predator species keep the population of their prey in check. Once students understand the concept of ecological balance, follow the steps for the ecological balance jeopardy game.

Ecological Balance Jeopardy

Before you begin, make copies of the wetland animal fact sheets.

1. Pass out the wetland animal fact sheets and have students read them carefully. When they are finished reading, collect the fact sheets.

2. Divide the class into teams of 4 or 5 students and assign a number or name to each group. Explain that they will be playing a jeopardy-like game that uses examples of ecological balance from the fact sheets as well as what they have been learning in class. They will be given an answer and they must respond with the correct question in order to get points. Tell students that each answer/question combination is worth a different amount of points depending on its difficulty. After you give an answer, each team should discuss quietly amongst themselves, then write down the question they think is correct. When everyone is ready, have each team read their question. Teams with correct responses (or responses that show that students understand the example of ecological balance being described) should be given points. Keep track of the points on the chalkboard or a piece of flip chart paper.

3. Use the following 'Jeopardy Answer and Question Sheet' to begin the game. When you have finished with all the answers and questions, total the points and declare a winner!

Wetland Animal Fact Sheet

Alligator

American alligators are North America's largest reptile. Unlike the crocodile, they live in freshwater and have a wide, round snout. They are important wetland animals because the burrows they dig for hibernation also collect water in pools for other wildlife to use. Alligators were once an endangered species because of over hunting, but have made a remarkable comeback in recent years.

Damselfly/Dragonfly

Damselflies and dragonflies are major players in marshes because they eat large quantities of other insects. They begin life as larvae in the water. Eventually they crawl out onto a stem or leaf and metamorphose into a flying insect.

Muskrat

A muskrat's brown coat is waterproof. It's a good thing because muskrats spend almost all their time in water. They prefer wetlands dominated by cattails because muskrats depend on cattails for food and also use cattails to build their mound-like lodges.

American bittern

This water bird lives among the cattails and bulrushes of freshwater and brackish marshes. The vegetation provides a good hiding place for bitterns since their feather color and pattern matches the plants. When bitterns are startled, they point their bills straight up and freeze so they look even more like a tall marsh plant.

Fiddler crab

Fiddler crabs live in tidal marshes from New England to Florida. They are most active at night and in the early morning when predators have a harder time seeing them. The numerous burrows they dig in the mud helps air flow through the soil and into plant roots.

Mosquitofish

Mosquitofish live along the coast in both fresh and brackish water. As their name implies, they like to eat mosquito larvae. They are so good at controlling the population of mosquitoes that people have released them in areas with mosquito problems.

Brant

This type of goose breeds as far north as Greenland - farther north than any other type of goose. In the winter they live in salt marshes along the East Coast of the United States. They are very dependent on an aquatic plant called eel grass for food. When a disease struck eel grass on the East Coast in the 1930's, the brant population declined rapidly.

Crayfish

There are over three hundred species of crayfish in the United States. They live in flood plains for their entire life cycle. Crayfish feed on dead animals and plants, helping to recycle nutrients that can be used by living plants and animals.

Cardinal flower

Cardinal flowers bloom in swamps filled with red maples. They can grow up to four feet in height and have a long cluster of red flowers. Cardinal flowers depend on hummingbirds for pollination.

Beaver

Beavers are known for the dam they build out of twigs and logs. Beaver-cut logs have been found that are 10,000 years old. As beavers build their dams, they change wetland water levels. These changes affect all the other plants and animals living there.

Jeopardy Answer and Question Sheet

1. 100 Points: They dig burrows that provide pools of water for other wetland animals.
   What are alligators?

2. 100 Points: An animal that changes the water level in wetlands.
   What is a beaver?

3. 100 Points: They eat mosquito larvae.
   What are mosquitofish?

4. 100 Points: The burrows of fiddler crabs allow this to flow through.
   What is air?

5. 100 Points: Where muskrats spend almost all their time.
   What is water?

6. 100 Points: This type of goose lives farther north than any other type of goose.
   What is a brant?

7. 200 Points: They help recycle nutrients by eating dead animals and plants.
   What crayfish do for wetlands?

8. 200 Points: They freeze and point their bills towards the sky so they blend in.
   What bitterns do to look like marsh plants?

9. 200 Points: They eat large quantities of other insects in wetlands.
   What are damselflies and dragonflies?

10. 200 Points: A grass that brants depend on for food.
    What is eel grass?

11. 200 Points: Hummingbirds help pollinate this flower.
    What to the cardinal flower?

12. 200 Points: Muskrats build lodges from this plant.

What are cattails?

13. 200 Points: Unlike its relative the crocodile, the American alligator lives only in this type of water.
What is freshwater?

14. 200 Points: Predators have a hard time seeing fiddler crabs because they are most active at this time.
What is night?

15. 300 Points: This organism starts any food chain by producing their own food.
What are plants? Or
What are producers?

16. 300 Points: Wetlands collect water and slow its rate of flow.
How wetlands control flooding? Or
How wetlands prevent erosion?

17. 300 Points: Wetland plant roots trap silt and some pollutants.
How do wetlands clean water?

Activity 10

What better way to explain how wetlands filter silt and pollutants, help prevent soil erosion and control flooding than actually showing students how wetlands function? Activity 11 describes how to construct a model wetland. You can build the model yourself or make it a team effort with students. When the model is complete, use it to demonstrate how wetlands purify water, reduce soil erosion and control flooding.

A Model Wetland

Use the following instructions to build a wetland model and demonstrate wetland functions.

Materials:
aluminum foil roasting pan
modeling clay
small piece of indoor-outdoor carpet
jar of muddy water

To make a demonstration model:

1. Spread a layer of modeling clay in half of the roasting pan. This will represent the land in your wetland. The other half of the roasting pan will be a body of water such as a lake or river.
2. Arrange the clay so it gradually slopes towards the body of water. Smooth the clay against the sides of the pan so the edges are sealed. If you want, shape the clay so a stream meanders towards the body of water.
3. Cut a strip (2-3 inches wide) of indoor-outdoor carpet so it stretches from one side of the roasting pan to the other between the modeling clay and body of water.

Using the model to demonstrate how wetlands control floods:

Tell students that the carpeting between the "land" and the "water" represents a wetland. Slowly pour some water onto the land. Have the kids describe what happens. They should see that some of the water flow is slowed by the carpeting.

Next, remove the carpeting and water. Pour the same amount of water on the model at the same location and at the same speed as before. Have students describe what happens this time. The water should move much faster. Tell students that, in reality, wetlands collect water and slow the rate of water flow, which helps reduce flooding and soil erosion. Finally, tell students that when wetlands are filled in, drained, or covered up by pavement, they can no longer reduce flooding and erosion.

Using the model to demonstrate how wetlands purify water:

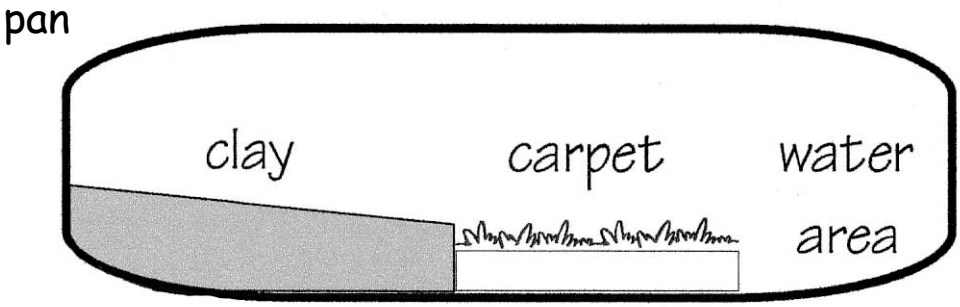
Start with no water in the pan and a fresh strip of carpeting in the model. Pour some muddy water from the jar onto the land. Have the kids compare the difference between the water in the pan and the water in the jar. (The water that passed through the carpet in the pan should look cleaner).

Next, remove the carpeting, empty the water from the model and repeat the demonstration without the carpeting. Ask the students why the water in the model is just as muddy as the water in the jar this time. Tell them that just like the carpet, plant roots in a wetland trap small particles of silt and some pollutants. Dirty water that flows through a wetland often comes out cleaner.

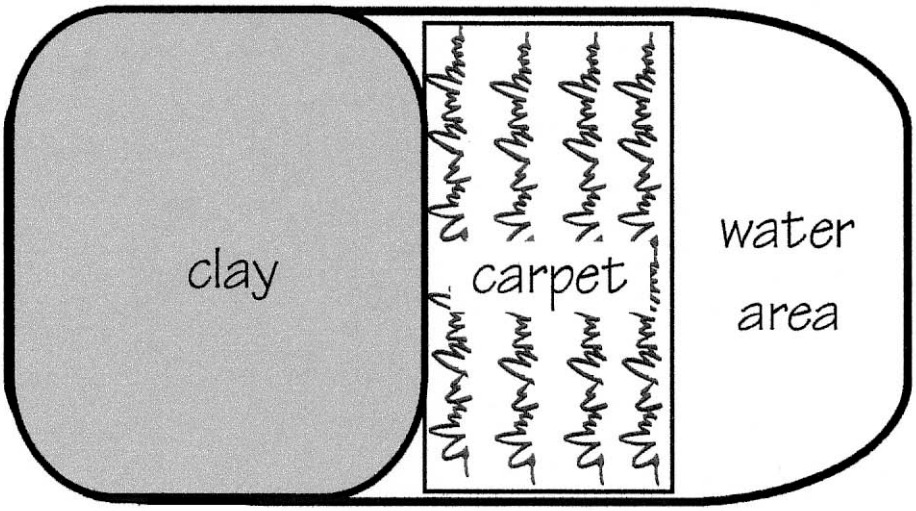
After the demonstrations, encourage your students to think about other reasons why wetlands might be important. Possible reasons might include recreation for people (boating, fishing, bird watching, etc.), providing habitat for a variety of wildlife and helping recharge groundwater supplies by filtering water slowly through the ground.

Wetland Model

Side View
(cutaway)



Top View



Activities – Week 8

How Can Wetlands be Conserved?

Activity 11

The Potomac River area of Washington D.C. provides an interesting example of how wetlands have changed over time. Before colonization, the Potomac was a broad, tidal river with marshes along its banks; now it's a narrowed water corridor bordered by a seawall and an urban environment. In this activity, students will learn about the history of this area by creating a timeline and adding features to maps that show how the area has evolved.

Washington-Potomac History Activity

1. Before you begin, create a class timeline by taping blank sheets of paper end-to-end and hanging the chain of paper (or use butcher paper) horizontally along a wall of the classroom. The timeline should be at least 12 feet long. Write the years "Pre 1800", "1800", "1850", "1900", "1950", and "2000" evenly spaced along the timeline. Be sure the numbers are large enough for all students to see and leave some space on the left side for dates earlier then 1800. Also, before starting the activity, make one copy of each of the Historical Information Sheets.

2. Using the general information in the teacher background section of this module, discuss with students how and why wetlands have been changed by people. Also introduce the idea that wetlands in the Washington area have changed as the city developed. Tell students that they will be learning about some of those changes and helping to create a class timeline to show how the Potomac River area of Washington, D.C. has evolved.

3. Divide the class into five groups and assign each a historical period (pre 1800, early 1800's, late 1800's, early 1900's and late 1900's). Give each group the appropriate Historical Information Sheet. Tell students that each sheet includes a few key events and a rough map of the Potomac River area of downtown Washington, D.C. Students will need to work as a group to research their historical period in more detail and label and draw missing features on their map. In some cases, a feature will come and go during a particular historical period. In those cases, students should include the feature and be ready to explain how it has changed during the particular period.

4. Give students a week or so to gather more information and modify their maps.* When they are ready, have each group attach their maps to the timeline. They should also write notes and add important dates to the timeline. Once every group has added information to the timeline, begin with the pre 1800 group and have a representative from each group stand before the timeline and describe the events of that particular historical period to the rest of the class.

5. Finally, ask the class how Washington, D.C.'s development has impacted the wetlands that were originally along the Potomac River. (Most of them are gone). Was it surprising to find out that water pollution was a problem last century? Do you think agriculture up river still affects the Potomac River near

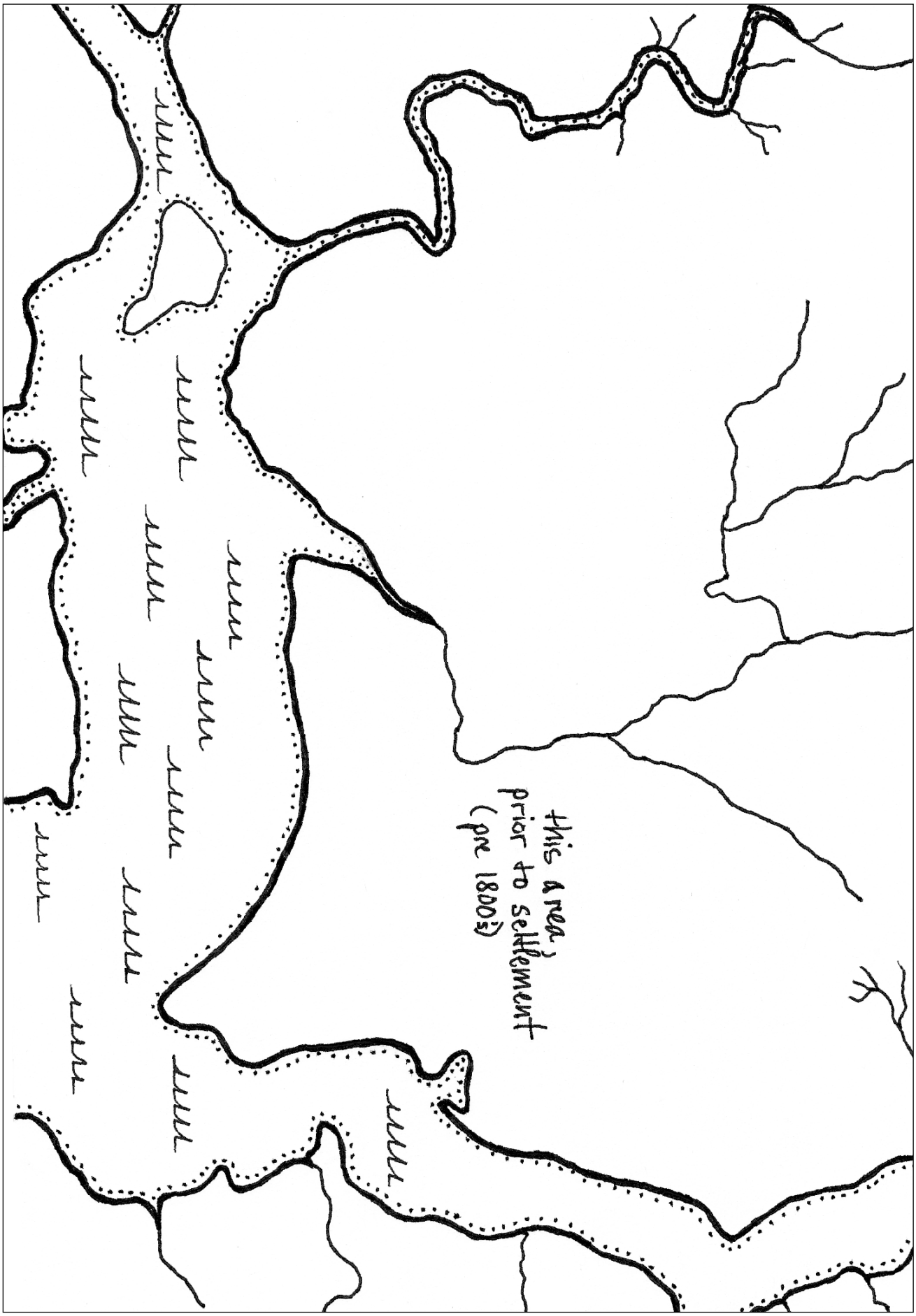
Washington? (Soil and agricultural chemicals, as well a trash from cities, washes down the Potomac, but today the river is cleaner than it has been at other times). Why isn't the Potomac River as important for commerce as it used to be? (Trucks, trains and planes have taken the place of boats). What types of changes can the students predict for the future of the Potomac River?

* A good source of Washington historical information and maps is the Washington, D.C. City Museum on K Street NW, and the book: *Washington on View: The Nations Capitol Since 1790*. 1991. John Williams Reps. University of North Carolina Press.

Historical Information Sheet - Pre 1800's

Before 1800, the Potomac River below Little Falls (the area that would become Washington, D.C.) was a tidal river where few people lived. This portion of the river had a soft bottom made up of mud, sand, pebbles, shells and decaying plants. It had deep channels running through the soft bottom and low marsh areas along the river's shores.

In the 1730's and 1740's the town of Alexandria (called Belhaven at first) grew on the Virginia side of the Potomac River and Georgetown grew on the Maryland side. Both towns became dependent on the river for commerce.

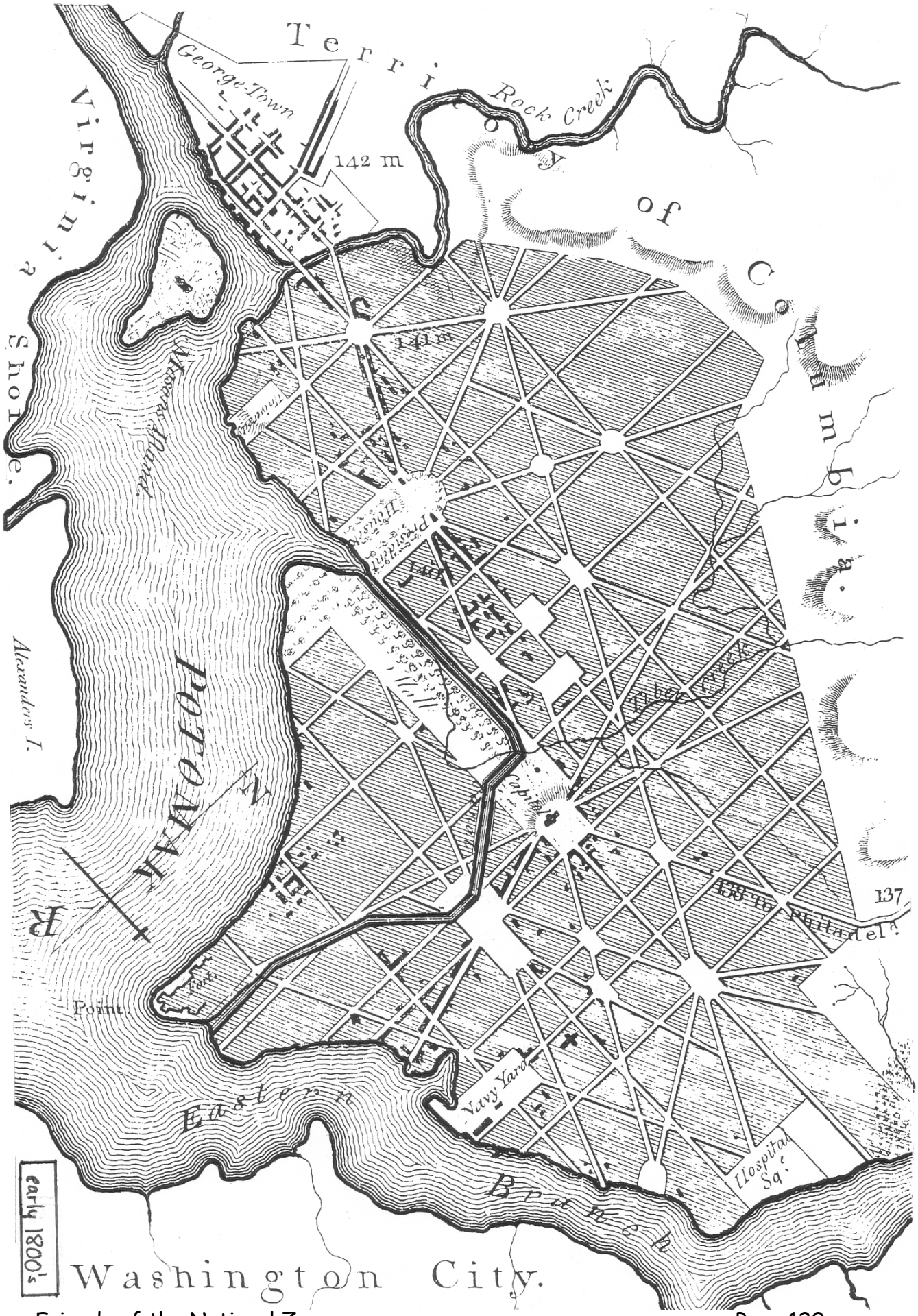

this area
prior to settlement
(pre 1800s)

Historical Information Sheet Early 1800's

- A bridge, called Long Bridge, was built across the Potomac River from what is now the end of 14th street to the Virginia side between what is now the Pentagon and Reagan National Airport. During a flood in 1831, part of the bridge was destroyed. It was rebuilt and reopened in 1835. Long Bridge was damaged by floods or river ice again in 1840, 1856, 1860, 1863, 1866 and 1867.

- A canal designed to give boats a short-cut around Greenleaf's Point was opened. The Washington City Canal started at the mouth of Tiber Creek, ran along what is now Constitution Avenue, and across to the Anacostia River.

- The Chesapeake and Ohio Canal (C&O Canal) was built along the Potomac River. It helped people transport products along the sections of the river that were too rough or shallow for big boats. The canal operated for a century.

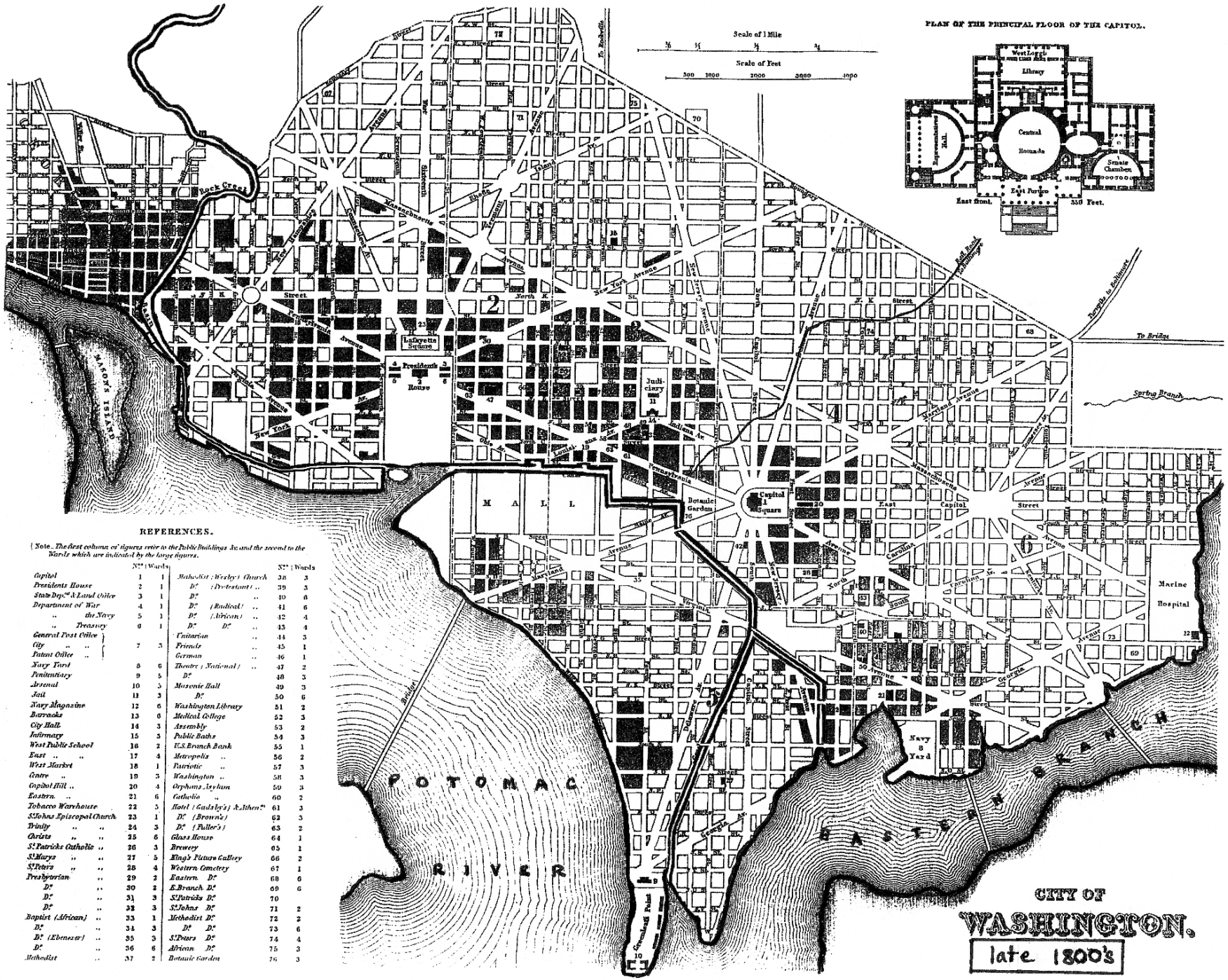

Territory of Columbia.
Virginia Shore.
George-Town
Rock Creek
142 m
141 m
140
Tiber Creek
Capitol
138 to Philadel.
137
Navy Yard
Hospital Sq.
Eastern Branch
Point
Alexanders I.
POTOMAK
Washington City.
early 1800's

Historical Information Sheet - Late 1800's

During heavy rains, soil from new farmlands along the Potomac above Washington, D.C., would wash down the Potomac and settle in the navigation channels. An 1867 report by the Corps of Engineers concluded that the Potomac was too broad and should be confined with narrower walls to help it flow faster and move debris and slit down the river.

In the early 1870's, the old Washington City Canal was converted into a sewer. Sewage from the canal came out into the tidal flats at the foot of 17th Street encouraging hundreds of acres of eel grass to grow.

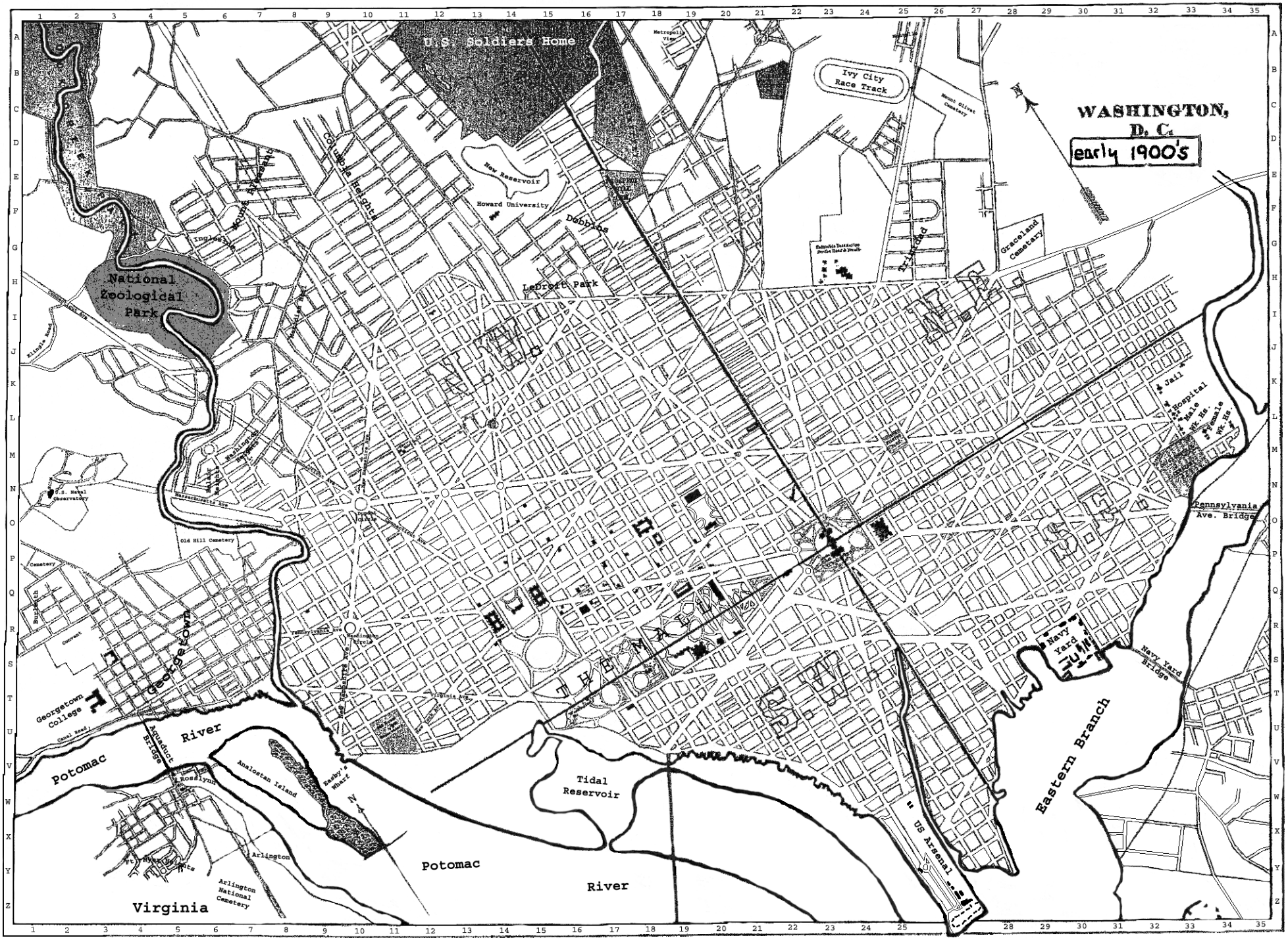
In 1881 when floodwaters reached the foot of Capitol Hill, Congress decided to fund changes to the Potomac River. From 1882 to 1891, the river was dredged to help widen and deepen the navigation channels. A seawall was built, and the material from the bottom of the river was piled onto the polluted tidal flats forming East and West Potomac Parks. The Washington City Canal was also cleaned up and finally filled in 1873.



Historical Information Sheet – Early 1900's

- An athletic field was created from part of the new land created by the dredging of the Potomac River along the south side of what is now the tidal basin. Later the site became a bathing beach and finally the Jefferson Memorial was built there.

- Also during the first part of this century, the Lincoln Memorial, the reflecting pool, the Department of Agriculture building and other buildings were added to the National Mall.

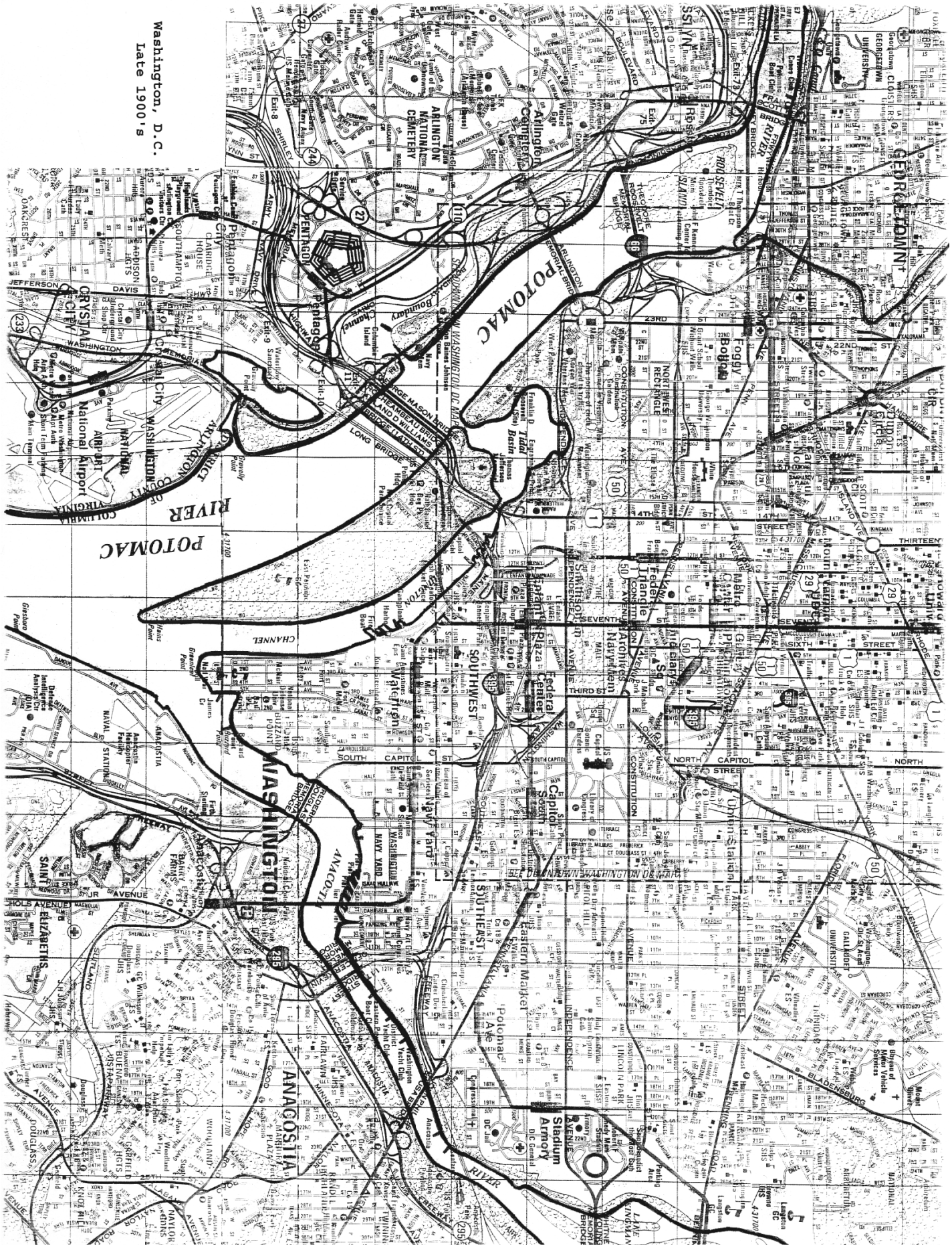

WASHINGTON,
D. C.
early 1900's
U.S. Soldiers Home
Ivy City
Race Track
Metropolis View
Mount Olivet Cemetery
New Reservoir
Howard University
Columbia Heights
Dobbins
Leipert Park
Graceland Cemetery
Railroad
National
Zoological
Park
Ingleside
Mount Pleasant
Kingle Road
Rock Creek
Washington Heights
Massachusetts Ave
Old Hill Cemetery
Cemetery
Buckeith
Convent
U.S. Naval Observatory
Georgetown
Georgetown College
Canal Road
Aqueduct Bridge
Potomac
River
Rosslyn
Fort Myer
Arlington
Arlington National Cemetery
Virginia
Analostan Island
Easby's Wharf
Tidal
Reservoir
Potomac
River
US Arsenal
Eastern Branch
Navy Yard
Navy Yard Bridge
Pennsylvania Ave. Bridge
Jail
Hospital
Male
Wk. Hs.
Female
Wk. Hs.
Pennsylvania Ave
Washington Circle
New Hampshire Ave
Virginia Ave
Connecticut Ave
Dupont Circle
Massachusetts Ave
Washington Heights
Rock Creek
Kingle Road

Historical Information Sheet Late 1900's

- Many of the museums and buildings that are now found near the Potomac were added during the late 1900's. The National Museum of American History was completed in 1964, the Kennedy Center was added in 1971, and the National Air and Space Museum was completed in 1976.

- Also added in the late 1900's was the east wing of the National Gallery, the Hirshhorn Museum, Vietnam Veterans Memorial and the Korean War Veterans Memorial. In 1997 the Franklin Delano Roosevelt Memorial was completed in West Potomac Park. In 1998 the huge Ronald Reagan federal building was added just off the north end of the National Mall.

Washington, D.C.
Late 1900's



Historical Information Sheet Early 2000's

- Congress has passed legislation for a number of new memorials, some to be built along the National Mall. Construction on the World War II Memorial has already begun between the Washington Monument and the Lincoln Memorial. Future memorials include the George Mason Memorial, the Black Patriots Revolutionary War Memorial, and the Martin Luther King, Jr. Memorial, which is currently planned along the Tidal Basin.

- In 2004 the National Museum of the American Indian opened along the National Mall and the new Capitol Visitor Center opened to the public in 2005. Other projects like a new Washington Monument Visitor Center are also being discussed.

Assessment/Activity Alternatives

Either or both of the following activities can be used as the assessment for the curriculum guide. You may want to use one as an activity and the other as an assessment or have your students choose which version to do as an assessment. Both activities rely on knowledge your students have gained while working through this guide, and both require students to apply that knowledge to wetlands conservation issues.

To use one of the activities as an assessment, tell students in advance that their work will be evaluated on organization, vocabulary choices, spelling, content and most importantly, how well they demonstrate an understanding of the concepts learned in the module.

Assessment Alternative I

While there are many problems confronting wetlands, there are also many ways individuals and groups of people can help solve those problems. Ask your students to brainstorm how wetlands can be protected or used in less destructive ways.

Using the information in Alternative I, introduce students to effective poster design. You may want to write and draw some of the information on the chalkboard or copy the information sheet and hand it out to students. Be sure to give students plenty of time to create their posters.

When the posters are complete, have students present their posters to the rest of the class, and then display them in a prominent place. You may also consider having students present their posters to other classes, parents or other groups.

Poster Design Suggestions

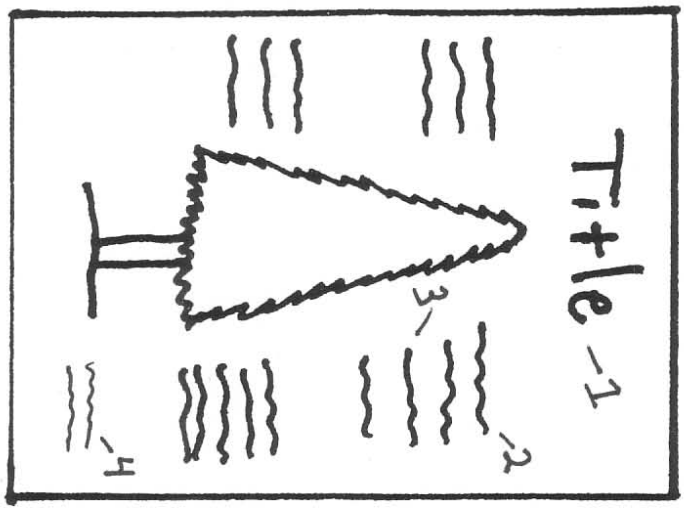
Organization is very important when you are trying to convey information through a poster. You want the poster to grab and hold your audience's attention. There needs to be enough information so your audience understands your ideas, but not so much that they are overwhelmed. Here are some suggestions for organizing information into four levels of detail (see diagram for examples):

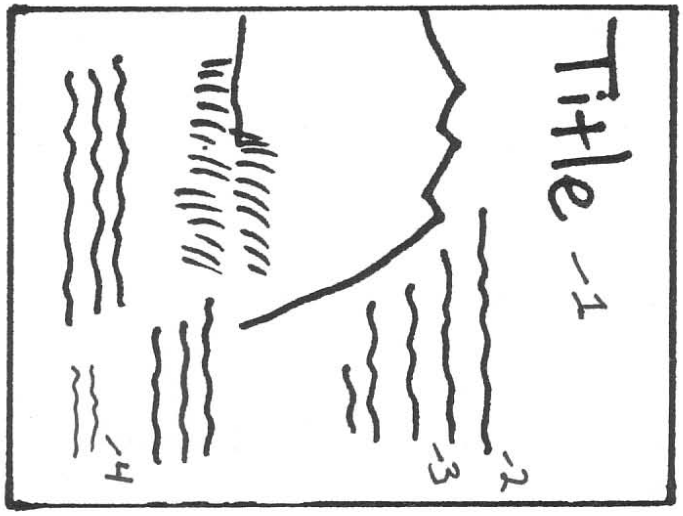
LEVEL 1: THE THEME OF THE EXHIBIT
The most important part of the poster is the theme. The viewer should be able to understand what the poster is about within a few seconds. Be sure the theme is short, clear, and prominently displayed on the poster. The artistic design should highlight the theme title.

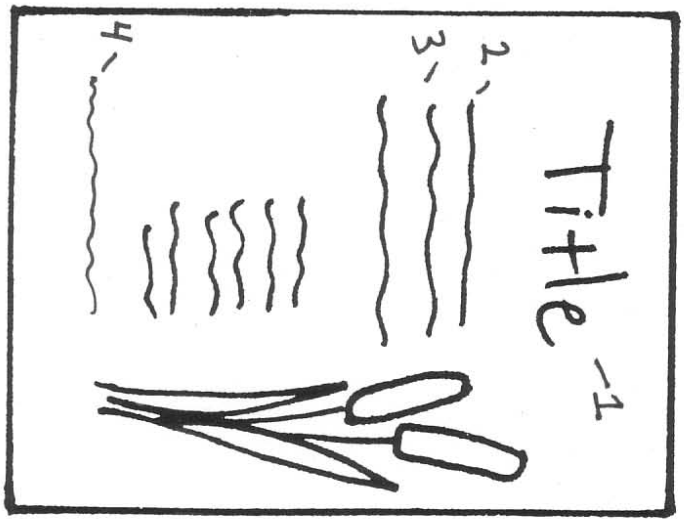
LEVEL 2: THE MAJOR DIVISIONS
There should be no more than 5 major divisions or subheadings on the poster. More than that, and most people will start to lose sight of the main message. The divisions can be shown by either using subheadings that are smaller than the main title or by separating them visually.

LEVEL 3: INFORMATIONAL DETAILS AND ILLUSTRATIONS
Facts, ideas and other information about the main theme should fall under the divisions and subheadings described in Level 2. There should be just enough detail for the audience to see how the information relates to the main theme. Illustrations can help the audience "see" what you are describing.

LEVEL 4: MAIN MESSAGE AND WHERE TO GO FOR MORE INFORMATION
Make sure your main message is stated clearly in the poster. Your audience should walk away understanding your most important point. Some people will want to know how to get more information or how to get involved once they have learned about a topic. Provide suggestions on who to call, where to write, where to visit, or what they can do to help solve a problem. Make it simple and limit suggestions to just a few.


Title -1
-2
3-
-4


Title -1
-2
-3
-4


Title -1
2-
3-
4-

Assessment Alternative II

Make and hand out a copy of the handout of Assessment Alternative II. Have students read the brief introduction to themselves. Tell students they are to write a short report to the city government explaining why this particular wetland should be protected. They should pay close attention to the specific topics that need to be included in the report. Be sure to give students plenty of time to do a thorough job.

Your Job: Protecting the Wetlands

You are a park ranger in a wetlands sanctuary in a small city. The city government wants to drain (remove the water) and sell the land to a development company that wants to build houses there. The people in the city government have asked for your opinion on their idea. Write a report for them describing:

1. What type of wetlands you are in charge of.
2. What animals and plants live there.
3. How the animals and plants interact.
4. What might happen if the wetlands are destroyed.
5. Why wetlands are important to people.

WETLANDS

Resources

Additional information and educational resources on wetlands can be obtained through the following organizations:

Chesapeake Bay Foundation
Philip Merrill Environmental Center
6 Herndon Avenue
Annapolis, MD 21403
410-268-8816
301-261-2350 (from D.C. metro)
www.cbf.org

National Audubon Society
Education Division
700 Broadway
New York, NY 10003
212-979-3000
www.audubon.org

National Geographic Society
Educational Services
1145 17th Street N.W.
Washington, D.C. 20036
800-647-5463
www.nationalgeographic.com

Smithsonian's Environmental Research Center
647 Contees Wharf Road
Edgewater, Maryland 21037
443-482-2200
www.serc.si.edu

Smithsonian's National Zoological Park
3001 Connecticut Avenue, NW
Washington, D.C. 20008
202-673-4955
www.nationalzoo.si.edu

U.S. Fish and Wildlife Service
Patuxent Wildlife Research Refuge
10901 Scarlet Tanager Loop
Laurel, MD 20708
301-497-5760
www.fws.gov

Wetlands Institute
1075 Stone Harbor Blvd.
Stone Harbor, NJ 06247-1424
609-368-1211
www.wetlandsinstitute.org

World Wildlife Fund
1250 24th Street, NW
Washington, D.C. 20037
202-293-4800
www.panda.org

Books

Brubaker, Jack and John Brubaker. Down the Susquehanna to the Chesapeake. Pennsylvania State University Press. April 2002

Cumming, David and Ewan McLeish. Wetlands. Steck-Vaughn. December 1995

Hibbert, Adam. A Freshwater Pond. New York, NY: Crabtree Publishing Company. 1999

Lisowski, Marylin and Robert Williams. Wetlands. Scholastic Library Publishing. April 1997

Niering, William. Wetlands. National Audubon Society Nature Guides. New York: Chanticleer Press, Inc. 1997

------.Wetlands of North America. Charlottesville, VA: Thomasson-Grant, Inc. 1991

Tiner, Ralph. In Search of Swampland: A wetlands sourcebook and field guide. New Jersey, Rutgers University Press. 1998

Video

National Geographic. Creatures of the Mangrove. 60 minutes. Filmed in Borneo. 1986

PBS Home Video. Journey into Amazonia. 180 minutes – two tapes. 1999

PBS. Conserving America: The Wetlands. 58 minutes. 1994