Open Spaces as Learning Places
RIVER UNIT

THE "OPEN SPACES AS LEARNING PLACES" PROGRAM

PROGRAM STRUCTURE

The Open Spaces as Learning Places program teaches environmental science through six curriculum units focused New Haven open spaces. The program takes place over 9 weeks in both the spring and fall semesters. Each year, we teach approximately 27 hours of science education to 200 New Haven 6th grade students. In addition, through teacher training workshops and on-going support, we provide professional guidance to New Haven public school teachers.

In the **Schoolyard Unit** students learn that even the schoolyard is part of the natural world. By studying New Haven's history and creating a wildlife enhancement project in their schoolyard, students recognize the role humans and nature play in shaping the landscape.

The **Greenspace Unit** raises student awareness of open space at the neighborhood level. Children learn about local stewardship efforts of neighborhood residents to restore open space by transforming vacant lots into greenspace sites, landscaping yards, and maintaining curb strips. Students note the effects of natural change on the neighborhood environment and examine the special adaptations that allow flora and fauna to thrive in their neighborhood habitats.

The **Park Unit** takes an ecological approach to open space by focusing on a nearby city park to teach students about natural communities and ecosystems within their local park. Students begin to appreciate the ecological significance of open space. They become aware of the dynamic state of nature as they observe materials cycling through the forest environment and learn about successional change.

The **River Unit** makes regional connections, showing how watersheds join together urban communities and suburban towns to open space areas. Students study stream dynamics to see how water shapes the Earth's surface. After learning that water is a limited resource, students identify sources of pollution that threaten local rivers. After a canoe trip on a nearby river, the children explore adjacent wetland habitats rich with wildlife.

The **Pond Unit** ties together concepts from previous lessons and uses the example of a local pond for the study. The children use physical, chemical and biological measurements to analyze water quality. As they sample pond life, students observe food webs, metamorphosis and adaptations to different pond habitats. The students see successional change and learn how overlapping ecosystems provide valuable edge habitat for wildlife.

The **Cemetery Unit** provides a geological overview of landscape change. Students discover that the Earth's crust, composed of rocks and minerals, moves slightly every day. At a local historic cemetery, students look for change over time on gravestones, noting differences in resistance to weathering among rock types. They also learn that cemeteries serve as wonderful habitat for urban wildlife.

To download any of these teaching materials for free, please visit www.urbanresourcesinitiative.org.

RIVER UNIT:
SUMMARY

The river unit makes regional connections, showing how watersheds join together urban communities and suburban towns to open space areas. Students study stream dynamics to see how water shapes the Earth's surface. After learning that water is a limited resource, students identify sources of pollution that threaten local rivers. After a canoe trip on a nearby river, the children explore adjacent wetland habitats rich with wildlife, gaining an appreciation for the importance of these natural areas to people, animals and the whole environment.

RIVER UNIT:
LEARNING OBJECTIVES

Journal

- Students demonstrate their writing skills through the composition of a poem about the river that they visited.

Worksheets/Reviews

- Students demonstrate understanding that water can exist in a solid, liquid and gaseous state. They will be able to identify examples of water in each of the three states.
  Review Sheet 4.1-River Review

- Students can describe the water cycle.
  Worksheet 4.1-Mobius Ring

- Students can identify and describe the way that human actions change the environment, including deforestation and erosion, pollution, the construction of dams and tide-gates.
  Review Sheet 4.2-Wonderful Watersheds

- Students demonstrate an understanding of river ecosystems and the organisms that inhabit them.
  Review Sheet 4.1-River Review

- Students demonstrate an understanding of the characteristics of the wildlife that live in New Haven (including opossums, deer, squirrels, rabbits, chipmunks and raccoons) and their interactions with their environment.
  Review Sheet 4.1-River Review

- Students describe the function of water in the process of erosion and creation of rivers.
  Review Sheet 4.2-Wonderful Watersheds

- Students will use knowledge of structures and functions of fish cohesively to produce a drawing of a fish.
  Fish Portrait Activity

Classroom Performance

- Students listen and respond to presentations by looking at the speaker and asking relevant questions.

- Students understand that freshwater is an important resource provided by the environment that meets the needs of human beings and that its supply is finite.

- Students can identify the consequences of pollution on the quality of life for all (humans and wildlife).

- Students recognize that the interconnectedness of the environment means that human actions may have unanticipated effects.

- Students use their observation skills in the classroom and out of doors.

- Students recognize the impacts that urbanization has had on New Haven's environment including the filling in of wetlands.

- Students work cooperatively with their peers to meet new challenges, including paddling together in a canoe.

- Students observe the function of water in the formation of a variety of landscape features.

- Students demonstrate cooperation and respect for peers (with like and with different skill levels) when paddling in a canoe.

- Students demonstrate competency in paddling a canoe.

- Students work cooperatively as a member of a team on challenges that include tracking wildlife in the park and creating "rivers" in the classroom.

- Students contribute to discussions on the trade-offs and consequences associated with technological solutions to human problems (such as dams) on the environment.

- Students can relate fractions to pictures and vice versa.

RIVER UNIT												
Science Standards and Curriculum Framework - Grade 6		**Classroom Activities**							**Outdoor Activities**		**Focus Activities**	**Journal**
Content Standards	**Expected Performances**	The Water Planet	The Water Cycle	Fresh water Model	Seeds on the Move	Fred the Fish	Fish Portrait	Wetland Wonders	Canoe Trip	Wetlands Walk	River Cutters	River Rhythms
Scientific Inquiry, literacy, and numeracy	**C INQ. 3** Design and conduct appropriate types of scientific investigations to answer different questions	X		X		X	X	X		X	X	
	C INQ. 5 Use appropriate tools and techniques to make observations and gather data	X		X		X	X		X	X		
	C INQ. 6 Use mathematical operations to analyze and interpret data	X										
	C INQ. 8 Draw conclusions and identify sources of errors									X		
	C INQ. 9 Provide explanations to investigated problems or questions	X		X		X		X		X	X	
	C INQ. 10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic			X						X	X	X
6.2 Matter and Energy in Ecosystems	**C 5.** Explain how populations are affected by predator-prey relationships									X		
	C 6. Describe common food webs in different Connecticut ecosystems									X		
6.4 Science and Technology in Society	**C10.** Expalin the role of septic and sewage systems on the quality of surface and groundwater resources.			X		X					X	
	C 11. Explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem	X		X		X		X	X		X	

RIVER UNIT											
English Language Arts Standards and Curriculum Framework - Grade 6		**Classroom Activities**						**Outdoor Activities**		**Focus Activities**	**Journal**
Content Standards	**Expected Performances**	The Water Planet	The Water Cycle	Fresh water Model	Fred The Fish	Fish Portrait	Wetland Wonders	Canoe Trip	Wetlands Walk	River Cutters	River Rhythms
1.1 Students use appropriate stategies before, during, and after reading in order to construct meaning	**a.** Activate prior knowledge, establish purposes for reading and adjust the purposes while reading.								X		
	e. Draw conclusions and use evidence to substantiate them by using texts heard, read, and viewed.				X				X		
	f. Make and justify inferences from explicit and/or implicit information.								X		
1.2 Students interpret, analyze, and evaluate text in order to extend understanding and appreciation	**a.** Generate and respond to questions.			X	X					X	
	e. Discuss and respond to texts by making text-to-self, text-to-text and text-to-world connections.				X						
	f. Identify and discuss the underlying theme or main idea in texts.				X						
1.3 Students select and apply strategies to facilitate word recognition and develop vocabulary in order to comprehend text.	**a.** Use phonetic, structural, syntactical and contextual clues to read and understand words.		X				X			X	
	d. Develop vocabulary through listening, speaking, reading and writing.		X	X			X			X	
	e. use content vocabulary appropriately and accurately (math, music, science, social studies, etc).									X	
3.1 Students use descriptive, narrative, expository, persuasive, and poetic modes.	**a.** use oral language with clarity, voice and fluency to communicate a message.			X	X					X	
	c. use the appropriate features of persuasive, narrative, expository or poetic writing.										X
	d. write to delight in the imagination.										X
4.2 Students seek and write using standard language structures and diction appropriate to audience and task.	**a.** use sentence patterns typical of spoken and written language to produce text.										X

RIVER UNIT

Math Standards and Curriculum Framework - Grade 6		Classroom Activities							Outdoor Activities		Focus Activities	Journal
Content Standard	Expected Performances	The Water Planet	The Water Cycle	Fresh water Model	Seeds on the Move	Fred the Fish	Fish Portrait	Wetland Wonders	Canoe Trip	Wetlands Walk	River Cutters	River Rhythms
2.1. Understand that a variety of numerical representations can be used to describe quantitative relationships.	d. (1) Estimate and find percents using benchmarks and number patterns.	X										
	d. (3) Solve problems involving ratios, proportions, and percents.	X										
2.2. Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.	a. (1) Estimate and predict reasonable answers and recognize and explain when an estimate will be more or less than an exact answer.	X										
	a. (2) Use a variety of computational strategies (mental computation, paper-and-pencil and calculator) to add, subtract, multiply, and divide multidigit numbers in the context of multistep word and practical problems.	X										
	a. (6) Create and solve a variety of provlems involving fractions, decimals, mixed numbers, money and simple percents.	X										
3.1 Use properties and characteristics of two- and three- dimensional shapes and geometric theorems to describe relationships, communicate ideas and solve problems.	a. (1) Use the relationships of sides and angles to classify sets and subsets of polygons.		X									
4.2 Analyze data sets to form hypotheses and make predictions.	a. (2) Recognize that changes in a data set can affect the mode, median, mean and range.	X										
4.3 Understand and apply basic concepts of probability.	a. (1) Explore the relationship between the number of trials in an experiment and the predicted outcomes.	X										

RIVER UNIT:
BACKGROUND INFORMATION

In the river unit, students see that the local environment is connected to distant communities by watersheds. The children use models to explore large-scale concepts, learning how water cycles through natural systems and reshapes the environment. They manipulate watershed models by introducing human factors that alter and degrade river and wetland areas. Field study reinforces watershed concepts and helps students develop an appreciation for the beauty and vulnerability of river systems. Students learn how their actions impact the natural world and recognize that they have the power to make a difference.

Earth is called the water planet because 71% of its surface is covered with water. Water exists in many different forms and in many different places. Depending on the temperature, water can be a liquid, a solid or a gas. There are two main kinds of water: **saltwater** which is found in oceans, seas and saltwater lakes and marshes; and **freshwater** which is in ponds, lakes, streams, rivers, freshwater wetlands and underground. Only 3% of Earth's water is freshwater (the remaining 97% is saltwater) with most of it frozen in ice caps and glaciers (80% of all freshwater) or unavailable because it is too far underground, polluted or trapped in soil. A very small amount (only 0.00003% of the total amount of water on Earth) represents clean, freshwater found in **surface water** or groundwater **aquifers**. The majority of our drinking water (95%) comes from **groundwater** — water that has **infiltrated** the soil and **percolated** down to the saturated zone beneath the **water table**. The average American uses 200 gallons of water per day.

Water is a finite resource and a major limiting factor for life on Earth. The water that we have today is all we will ever have. Water circulates back and forth from the atmosphere to Earth's surface. Water **evaporates** into the atmosphere, **condenses** to clouds, comes down as **precipitation** and then follows many different routes. Water **runs off** or falls directly into surface water, infiltrates and percolates down to become groundwater or is taken up by plants before **transpiration** returns it to the atmosphere. Pollution threatens water quality as water cycles through natural systems heavily impacted by humans. Construction sites, factories, paved surfaces, storm drains, lawns and farms are human-related features that degrade the aquatic environment with sediments, fertilizers, chemicals, trash, gasoline and oil.

Wetlands are natural environmental purifiers that improve water quality by acting as sediment traps and by filtering out and absorbing many pollutants. Wetlands also help recharge groundwater aquifers and provide flood control by capturing, storing, and slowly releasing storm runoff. In addition, wetlands offer coastal protection, serving as buffer zones between open water and land. Filled with nutritious food and protective cover, wetlands represent incredibly productive habitats for a wide range of plants and animals, including many endangered species.

Wetlands are delineated based on: 1) **hydric** (saturated) soils; 2) **hydrophytic** (water tolerant) plants; and, 3) a distinct hydrologic pattern in which the water level rises periodically to just above or just below the ground's surface. Historically, wetlands were

viewed as wasted lands - soggy, inaccessible, mosquito-infested areas that stood in the way of progress and development. A lot of effort went into draining, dredging and filling wetlands to transform them into "useful" property. In recent years, wetlands have started to be recognized as an asset to people, wildlife and the environment as a whole. Federal and state legislation now supports the need to protect, preserve and manage these important natural resources.

Water in wetlands, lakes, ponds, rivers, streams and underlying groundwater is connected to the surrounding landscape. The drainage area between ridges or topographic high points is called a **watershed**. Gravity forces precipitation that does not infiltrate the soil to flow downhill and run off into waterways in the watershed. Harmful human activities in the interconnected watershed can have far reaching effects that degrade surface water areas and underground aquifers.

Identifying sources of pollution is the first step in controlling pollution. Some pollution, known as **point source pollution** comes from specific sources such as outfalls (drains, pipes, industrial discharge, etc.). Other kinds of pollution arise from widespread sources and are called **nonpoint source pollution** (pesticides, road runoff).

Water reshapes the landscape as it flows through a watershed. The moving and scraping of rock and soil as water runs over land is called **erosion**. Over time, distinctive morphologic features emerge as a watercourse carves the landscape. The **source** or the beginning of a river is often associated with a spring, wetland or melting snow and ice. The **mouth** of a river or its destination might be a pond, lake, wetland, stream or ocean. Time and terrain affect the shape of a river. Faster flowing, younger streams at higher elevations tend to take a straighter **course**, while slower, older rivers on flatter terrain follow a wavy pattern made up of s-shaped curves called **meanders**. Occasionally, a river bisects a meander for a shorter, less circuitous route, creating an isolated body of water known as an **oxbow lake**. Watersheds often exhibit a **dendritic** drainage pattern with smaller waterways connecting like branches to a larger river at the heart of the watershed. These large watercourses usually flow into a bay or an ocean or join up with another river that eventually connects to the ocean. A stream or river that feeds into another waterway is called a **tributary**.

Earth's surface is continuously being reshaped by water. The **hydrologic cycle** is an integral part of stream dynamics and the changing landscape. It balances precipitation, runoff, evaporation, transpiration and groundwater recharge through percolation and infiltration. Within a watershed, water connects human communities to natural systems, creating a balance that is essential to life. Harmful human practices tip the scale, degrading the environment in ways that impact global vitality.

RIVER UNIT:
CLASSROOM ACTIVITIES

CLASSROOM ACTIVITY ONE

Title: The Water Planet
Objectives: Students will develop an understanding of the distribution of water and recognize freshwater as a limited resource.
Time: 15 minutes
Materials: Clear gallon container, clear plastic cup, clear half-cup measure, water, salt, inflatable globe, ice cubes and a thermos of hot water
Preparation: Fill the gallon container with water.
Procedure:

- Begin by explaining that Earth is called the water planet because two-thirds to three-quarters of it is covered by water. Toss the globe around to different students and have them freeze after catching it with both hands. Check to see if their fingers are touching water. Show them how much water is on the planet by pointing out that every time the globe was caught, a student's hand was on water.
- Discuss how water exists in many different forms and in many different places. Depending on the temperature, water can be a liquid (point to the gallon jug), a solid (hold up the ice cubes) or a gas (open up the thermos to let out some steam). Frozen water is found in cold places on the tops of mountains and at the polar ice caps (point to the globe) and water as a gas is all around us in the atmosphere (wave your hands). Ask the students to think of places where there is liquid water (ponds, lakes, rivers, streams, ocean, seas, underground, etc.)
- Describe how there are two main kinds of water on Earth, saltwater and freshwater. Ask the students where you find saltwater (oceans, seas, saltwater lakes, etc.). Tell them that 97% of all the water on the planet is salt. Toss the globe around again to show how much of Earth is covered by saltwater. When you check hands on the globe to see if they are on water, identify the location of the fingers and specify if they are touching fresh or saltwater.
- Show that freshwater is a limited resource by using the gallon container of water as a model for all the water on Earth. Remind the students that only three percent is freshwater. Pour one-half cup water from the gallon container into the measuring cup, telling them that the water in the measuring cup represents all the freshwater on the planet. Add some salt to the gallon jug to emphasize that most of the water is salt and only a little is fresh. Ask the students if they would like a drink of water from the gallon jug of saltwater. Explain that saltwater can only be used as drinking water when the salinity has been removed. The process is time consuming and costly.
- Point out that not only is a very small percentage of the Earth's water fresh but most of the freshwater is not easily accessible. Two-thirds of the freshwater on our planet is frozen (pour one-third of the water from the measuring cup into the plastic cup), some is in the atmosphere (remove some water from the plastic cup) and other freshwater is underground (take out a little more water). Hold up the plastic cup that

now contains a very small amount of liquid and explain that the water remaining in the cup represents the freshwater found in ponds, lakes, rivers and streams. Explain that this water is the easiest to get to as a source of drinking water but ask the students if they think it is all clean enough to drink (No!).
- Conclude by stating that freshwater is a limited resource that must be protected and conserved.

Adapted from Project Wild Aquatic, pp. 7-9

CLASSROOM ACTIVITY TWO

Title: The Water Cycle

Objectives: Students will learn that the water cycling throughout the Earth's systems is a finite resource.

Time: 10 minutes

Materials: Water cycle poster, Mobius ring worksheet (Worksheet 4.1), scissors and tape

Preparation: Make a sample water cycle Mobius ring by cutting along the two dark lines on the handout to create three strips of paper. Tape the bottom of strip #1 to the top of strip #2 and tape the bottom of strip #2 to the top of strip #3. Give the long paper strip a half twist before taping the top of strip #1 to the bottom of strip #3.

Procedure:
- Explain that our water supply is finite. What we have today is the same water we had billions of years ago and it is all we will ever have.
- Use the poster to illustrate the water cycle. Describe how water is constantly on the move, circulating back and forth from the atmosphere to Earth's surface. Discuss how water evaporates into the atmosphere, condenses to clouds, falls as precipitation and then follows many different routes (runs off or falls directly into surface water, infiltrates to become ground water, or is used by plants before transpiration returns it to the atmosphere, etc.).
- Show students the Mobius ring model for the water cycle. Explain how the twist in the ring illustrates water's continuous movement throughout Earth's systems. Challenge them to think of other natural cycles that would be well represented by a Mobius ring.
- Give each student a handout, scissors and tape. Show them how to construct a water cycle Mobius ring by connecting the three strips with a twist before making a loop.

Adapted from WetNet, pp. 24-28

CLASSROOM ACTIVITY THREE

Title: Freshwater Model

Objectives: Students will study the effects of erosion and pollution on freshwater systems as they watch precipitation run off into surface water or infiltrate to become groundwater.

Time: 15 minutes

Materials: Plastic rectangular salad trays, pea size pebbles, food coloring, spray bottles, scissors, indoor/outdoor carpet, water and topsoil.

Preparation: Cut carpet into four strips, three inches wide and long enough to fit across the width of the plastic container. Fill two spray bottles with water and add several drops of blue food coloring to each bottle.

Procedure:

- Divide the class in half and set up two models so that smaller groups of children can observe the demonstration.
- Construct a model of a hill sloped down towards a river by pouring a two-inch layer of pebbles into the bottom of the plastic container. Angle the pebbles to create a rock mound on one side and a pebble free area on the other. Explain that when it rains, water sometimes runs off the surface into rivers, ponds, storm drains, etc. If it is very hot, water evaporates into the air and when it is cold, precipitation freezes. Often water percolates down through the soil where it can be used by plants or settles into rocky areas beneath the soil to become groundwater. Tell the children that in built environments with paved roads, parking lots and sidewalks, water cannot infiltrate the way it does in more natural areas. On impermeable surfaces, precipitation forms puddles and eventually evaporates or runs off directed to one side or into a storm drain.
- Explain to the students that they will use the model to observe the movement of water underneath Earth's surface. Make it rain by squirting blue water on the rocky side of the model until there is approximately one inch of water on the bottom. Point out how water percolates down through the rocky zone by moving around the pebbles. Have the students look at the container from the side. They should see blue water filling up the spaces between the pebbles and seeping into the open river area. Be sure they understand that the water is not being absorbed by the rocks, it is moving around the pebbles downwards and sideways. The transverse movement is filling the river with water. Explain that the saturated area at the bottom of the model is the groundwater and that the line along the top of the groundwater is the water table.
- Discuss how 95% of drinking water comes from groundwater. Explain that people drill down through the ground to the water table to access freshwater beneath Earth's surface. Demonstrate the process by taking the top off the sprayer and twisting down with the long tube through the rocks to the water table. Show them how water is pumped to the surface by pressing down on the sprayer, directing the blue water towards the raised lid of the container. Describe how drinking water in New Haven comes from surface water found in reservoirs, but many towns outside of New Haven rely on underground wells and need to use the same process that was demonstrated in the model.

- Show the students how groundwater becomes polluted by adding a few drops of yellow food coloring to the model. Make it rain some more to show how pollution percolates through the model. Drill a well and ask the students what color the water will be if the groundwater has become polluted. Pump the sprayer to show that the well water is now green. Explain that it is much harder to clean up polluted groundwater than surface water.
- Now make the model more realistic by adding a thin layer of soil on top of the pebbles and placing two strips of indoor/outdoor carpeting side by side across the dirt mound. Explain that when water is sprayed on the model some of it will infiltrate the soil through the small spaces between dirt particles and continue to move down through the rocks. The rest of the water will stay on top running off the hill into the river. Remind the students of the park visit when they observed the effects of erosion on sloped surfaces (Outdoor Activities Five and Seven, Park Unit). When it rains, water takes soil with it as it flows downhill. Ask them if they remember how moss and other woodland plants helped to lock in the soil and reduce erosion. Explain that their model of a hillside with plants is similar to the park. Make it rain to show how the river gets only slightly dirty when soil is trapped by plants. Remove the carpet to demonstrate erosion on a bare slope. As the students watch the river fill with dirt, ask them how erosion impacts the animals living and breathing in the water.
- Have the students think about long-term successional change as a water area slowly fills in with sediment, becoming a wetland, a field, and finally, a forest.
- Tell the students they will explore river and wetlands during their upcoming field trip. Prepare them for the canoe trip by discussing safety concerns and logistics.

Adapted from AWRA Poster Series

CLASSROOM ACTIVITY FOUR

Title: Fred the Fish

Objectives: Students will learn about different types of water pollution and their influence on stream inhabitants as they follow the adventures of a young fish on his journey downstream through areas impacted by human development.

Time: 15 minutes

Materials: Fred the Fish handouts (Handout 4.1), scissors, tape, light colored sponges, yarn needle, metal nut, string, plastic aquariums, water, pencils, clear plastic cups, soil, brown sugar, pancake syrup, salt, colored construction paper, hole puncher, detergent, red food coloring and green food coloring

Preparation: Cut two sponges into the shape of a fish. Thread the needle with the string and push it through from the top to the bottom of the fish. Attach the metal nut to the string so it hangs below the fish. Cut the other end of the string and tie it to a pencil. Fill the aquarium two-thirds full with water, open up the plastic window on the cover and position the fish midway in the tank by rolling up the string on the pencil. Repeat with the second sponge and aquarium. Punch out one-half cup colored dots (litter) and pour into two plastic cups. Fill two sets of plastic cups one-quarter full with soil,

brown sugar (fertilizer), pancake syrup (oil) and salt. Mix one-half cup water with a few drops of detergent and pour into two separate cups. Place a red bottle of food coloring (sewage) in two plastic cups and a green bottle of food coloring (toxic waste) in two other cups. The end result should be two sets of eight plastic cups containing soil, brown sugar, pancake syrup, salt, paper dots, sudsy water, red food coloring and green food coloring. Read through the handout to become familiar with the script.

Procedure:

- Divide the class in half so that smaller groups may observe two separate demonstrations. Count the number of students, thinking through how the materials will be distributed so that every child has a chance to add pollution to the tank (doubling up students to one cup is fine). Have fun with the activity and feel free to be very dramatic!
- Start out by introducing Fred the Fish. Explain that Fred is a young fish, impatient with his life in the pristine environment of his protected stream at the nature preserve. Fred is bored and wants an adventure. He imagines that life is much more exciting downstream and wants to leave home. In fish years, Fred is a teenager and like most teenagers, Fred is about to get himself into trouble. Big trouble! Shake Fred around a few times in the tank to show how fast he can swim. Stress how clean the water is in the protected stream at the nature preserve.
- Follow the script elaborating along the way. Add pollutants according to the story, having one child at a time come forward with a cup. Divide the contents of a cup between two students as needed. Be careful to limit the drops of food coloring to three or four to avoid a huge mess. At each stop, point out how humans have degraded the environment. Explain that in some of the scenarios, polluting the stream was unintentional and the people responsible were not even aware of what they had done. Ask the students how Fred looks after each pollutant is added so they feel the impact of environmental degradation on living creatures.
- At the end when all the materials have been added, ask the students, "How is Fred?" The answer may likely be that "Fred is Dead!" Conclude by commenting on how Fred was fine in a site protected from human influence. As he ventured downstream, areas became increasingly developed and he could not escape the impact of human change. Talk about ways that people can improve the environment after it has been polluted.

Adapted from Water, Stones, and Fossil Bones, pp. 54-57

CLASSROOM ACTIVITY FIVE

Title: Fish Portrait

Objectives: Students will learn that close observation leads to a more detailed understanding.

Time: 10 minutes

Materials: Drawing paper, pencils, small plastic aquariums and live goldfish

Preparation: Place one goldfish in each aquarium.

Procedure:

- Give each student drawing paper and a pencil. Tell them they have one minute to draw a picture of a fish. After 60 seconds, ask them to turn over their paper. Bring out the containers of live fish. Explain that they should observe a live fish closely and then draw another picture of a fish. Give them at least five minutes to finish their drawings. Ask them to compare their two pictures. What differences do they notice? Did they add physical features to the second drawing that were not on their first fish (gills, fins, scales, etc.)? Point out that this activity illustrates that you see more when you take time to observe closely.

Adapted from Critters p. 101

CLASSROOM ACTIVITY SIX

Title: Wetland Wonders

Objectives: Students will learn about the characteristics of wetlands and their importance to humans and wildlife.

Time: 10 minutes

Materials: Large paper bag, sponge, pillow or bed, soap, egg beater, cradle, strainer, coffee filter, bottle of antacid tablets, small box of nutritious cereal, picture of a zoo and picture of a vacation resort

Preparation: Fill the paper bag with assorted items from the Wetlands handout.

Procedure:

- Begin by explaining that wetlands are in fact wet lands with water present at least 7 consecutive days, soil saturated within 6-18 inches of the surface during the growing season and plants adapted to wet conditions. Wetlands come in a variety of sizes and shapes, and may contain fresh, salt or brackish water. The most common wetlands are swamps, marshes and bogs. Most wetlands are highly productive habitats, rich with nutritious food, vegetative cover and water. Wetlands provide a wide range of benefits to plants, animals and humans and help keep the whole environment healthy.
- One by one, pull out items from the paper bag and describe how the objects represent specific wetland functions.
    1) SPONGE – Wetlands are storm breakers and flood-busters. They are buffer zones between inland areas and large bodies of water. They act like shallow bowls that slow down, soak up and retain water.
    2) PILLOW OR BED – Wetlands are resting places for migrating birds with a rich supply of food and cover that allow long distance travelers to refuel before continuing on their journey.
    3) CEREAL – Wetland plants absorb nutrients and help cycle them through the system. The nutritious vegetation is an important food source for other living things.
    4) CRADLE – Wetlands are breeding areas for many wildlife species. Fertile wetlands act as nurseries that shelter, protect and nourish developing animals.

5) STRAINER – Wetlands keep the water supply clean by straining out silt, sediment and debris.
6) COFFEE FILTER – Wetlands are natural filtering systems that trap small impurities to reduce concentrations of nutrients and toxins in the water.
7) ANTACID – Wetlands trap, neutralize and promote the decomposition of many toxic substances.
8) SOAP – Wetlands purify the environment by removing harmful substances and releasing oxygen through photosynthesis.
9) EGG BEATER – Wetlands help mix nutrients and oxygen into the water.
10) PICTURE OF A ZOO – Wetlands provide critical habitat for a wide range of living things including many rare and endangered species.
11) PICTURE OF A RESORT – Wetlands are winter vacation spots for migrating birds.

- Describe how in recent years, people have started to appreciate the importance of wetlands. New Haven's landscape with its three rivers and its shoreline includes many wetland areas. In the past, wetlands were viewed as wastelands – soggy, inaccessible places that were breeding areas for mosquitoes. Wetlands were filled-in, dredged and channelized. Tidegates were installed on the rivers to control the floodwaters and tidal influence that kept adjacent wetland areas fed with water. People now recognize that tidal flushing improves water quality and controls invasive plants such as Phragmites australis that tend to dominate disturbed marshy areas. In fact, wetlands benefit overall system health by filtering out sediments and removing impurities. People also understand that wetlands actually reduce flooding by slowing down storm waters and acting as buffer zones. Most importantly, wetlands provide valuable habitat for a wide range of plant and animal species. Rapid urbanization left New Haven with little open space. Most of its remaining natural areas are wetlands. Wetlands protection legislation is now in place, reinforced by public education programs designed to raise awareness of the importance of these areas to humans and wildlife. New management strategies reflect lessons learned from past mistakes.

Adapted from Wonders of Wetlands, pp. 85-86

CLASSROOM ACTIVITY EXTENSIONS

1. Who lives Upstream? Using local maps and pictures, make a list of all the towns and cities that are upstream in New Haven's watershed. Make an overhead transparency or a computerized projection if possible so that the whole class can look on. If your maps are specific enough, have students identify tributaries by name. Ask students what areas on the map are residential, commercial and industrial, defining these terms as you go. Have a class discussion, asking students to hypothesize which of these three areas most effects the health of their watershed and why.

2. Invasives: What are invasive species? Where did they come from and why do they cause so much trouble? Have students research the invasives that are most common in their neighborhoods. Use New Haven resources such as the Agricultural Experiment Station to answer questions about the particular nuisances that gardeners deal with. Some

common invasives to use in student research include Phragmites Australis, Norway Maple, Japanese Knotweed, Oriental Bittersweet, Multiflora Rose, Climbing Nightshade, Tree of Heaven, Russian Olive, Winged Euonymus, Porcelain Berry, Leafy Spurge, Japanese Stilt Grass, Japanese Honeygrass, Japanese Barberry, Garlic Mustard, Black Locust, and Autumn Olive. Discuss native plants and explain how they better support the ecosystem.

RIVER UNIT:
OUTDOOR ACTIVITIES

OUTDOOR ACTIVITY ONE

Title: Canoe Trip
Objective: Students will enjoy an outdoor adventure, experiencing first-hand the wonders of local waterways and wetlands.
Time: 45 minutes
Materials: Canoes, lifejackets, paddles and adult leaders
Preparation: Several weeks in advance, schedule a date with the New Haven Riverkeeper (including a raindate), notify the Board of Education of the trip, and obtain and have childrens' parents or guardians sign Parks Department permission slips
Procedure:

- While half of the class is hiking, the other half goes out in canoes with the New Haven Parks Department's Ranger Program after a safety talk by the Riverkeeper. While paddling, children are encouraged to observe the landscape and look for wildlife. Be sure to point out natural features and human influences that relate to program topics (introduced and invasive species, litter, construction, erosion, etc.). After the canoe trip, the group goes on a wetlands walk.

OUTDOOR ACTIVITY TWO

Title: Wetlands Walk
Objective: Students will search for signs of wildlife as they walk along a wetlands trail with hidden animal clues.
Time: 45 minutes
Materials: Nature artifacts, clay scat, partially eaten food materials, track prints, Animal Clues handout (Handout 4.2) and toy animals
Preparation: Hide wildlife evidence and descriptive clues along the trail that leads up to a hidden toy version of the real animal.
Procedure:

- While half of the class is canoeing, the other half goes on a hike along a wetlands trail. Before the walk, explain to the students that wetlands are wonderful areas for wildlife but sometimes it is difficult to spot the animals because they are hiding or not active at that particular time. Ask the students what might reveal an animal's presence even if the animal was not actually seen. Discuss different types of animal signs (tracks, scat, trails, homes, animal artifacts, sounds, feeding signs, etc.). Tell the students that wildlife evidence not only identifies an animal but also gives valuable information about the natural history of that animal. By tracking wildlife

and looking carefully at the signs left behind, it is possible to unlock the mystery of elusive wild animals.

- Tell the children that if they observe closely as they walk along the trail, they should find clues that lead to a mystery animal. Challenge them to guess each animal using the fewest number of animal sign clues. Students will work together as a group to analyze the clues and identify the mystery animal.
- Lead the group along the trail, setting the pace for the hike and giving hints as needed. Ask the children to look for live animals as well as wildlife signs. Remind them to scan up high, at eye level and down low. Wetlands offer diverse habitat at all levels for many wildlife species.

OUTDOOR ACTIVITY EXTENSIONS

1. Migration Maps: Following up on the canoe trip, lead a discussion of the birds that students observed while on the river, eventually introducing the topic of migration. Help the students come up with an example of a migrating bird that spends some time in New Haven--perhaps a bird they saw on their trip. Once students have picked a bird, have them research the bird's migration route and discover the other stops the bird makes along the way. Assign students the task of creating a migration map that details the places their bird journeys to during the year. For example, students visiting the West River in New Haven will notice the large Osprey nests. They might choose to draw a poster size map of the Osprey from its breeding grounds on the west river over the Appalachian Mountains to the tropical rainforests of Costa Rica, the coasts of Columbia and eventually to its wintering grounds in west central Bolivia, South America. Ask students to draw in correct geographical features, but also encourage students to be creative, adding details to their bird's story and its adventure along the way. Reflect together on some of the dangers migrating birds encounter along the way, including storms, airplanes, power lines, tall buildings, polluted waters, etc.

2. Human River: Make a human river in order to demonstrate to students the effects of runoff and dumping of pollutants on rivers. Ask students to choose one item (a pencil, pen, piece of paper, book, etc.) as their pollutant. Arrange students around the room in a river pattern and ask them to hold their items. Label different signs with river parts such as source, tributary, meander, fork, delta, etc., and safety pin the signs on different students. Explain that as water flows down a river it picks up loose materials and pollutants along the way. Beginning with the student labeled "source," have students pass the pollutant they are holding to the next person in line. Have students make up what their pollutant is and state something like, "I'm a Waste Water Treatment Plant and I'm dumping raw sewage into the river." Once all the pollutants have been passed to the front, have the student labeled "ocean" attempt to hold them all. Ask students how they felt at the beginning, the middle and the end of the river.

RIVER UNIT:
FOCUS ACTIVITIES

FOCUS ACTIVITY ONE

Title: River Cutters

Objectives: Students will create a river model that speeds up time to show thousands of years of change in seconds. They will see how water shapes the landscape through erosion and connects communities by watersheds. Students will identify river features and learn about the far-reaching impact of non-point and point source pollution.

Time: 90 minutes

Materials: River Features handouts (Handout 4.3), river and wetland maps, large plastic bins with covers, diatomaceous earth, half-gallon containers, wood blocks, poster board, food coloring (red, blue, yellow and green), Q-tips, water, plastic cups, plastic coffee stirrers with two holes, Monopoly houses, spray bottles, wire, clear acetate, Ziploc bags, bucket, sponge, scissors, safety goggles, mask and large spoon

Preparation:

(1) Wearing the safety goggles and mask to avoid irritation to eyes and nose, prepare the substrate for the model by mixing 14 cups of diatomaceous earth with 13 cups of water in large plastic bins. Stir well and add additional water as needed to moisten all the powder. Allow the material to settle for 15 to 30 minutes and drain off excess water before using. 2) Prepare the dripper system by cutting segments of wire the length of the coffee stirrers. Push them through one of the holes in each stirrer and then bend the stirrer slightly. Take the plastic cups and cut a small notch on opposite sides of the rim. Rest a bent stirrer over the top of one of the notches on each cup. Mix several drops of blue food coloring with water in half-gallon containers. Fill each cup with the blue water.

(2) Create 20 labels for each group of students by cutting poster board into three by three by one inch (3 x 3 x 1 inch) triangles.

(3) Make dams for the model by cutting clear acetate into three-inch by one-inch rectangles. Fold each rectangle in half and cut a small notch in the top of each fold.

(4) Set up watershed development by separating Monopoly houses into clusters of 20 and placing them in Ziploc bags, one for each group of the students.

(5) Prepare "pollution" by breaking Q-tips in half and soaking the cotton tops in food coloring to create 20 to 30 colored Q-tip halves in yellow, green and red.

(6) Get ready to simulate inclement weather by filling the spray bottles with water.

Procedure:

- Separate students into small groups of four to six children. Cluster the desks together so they are facing each other.
- Before distributing materials, introduce the activity by discussing how water shapes the landscape through erosion. The students will create a river model that speeds up

time, showing thousands of years of change in seconds. They will see a river cut through the landscape, moving materials as it flows downstream. Describe how the Colorado River created the Grand Canyon through years of erosion, moving and scraping rock and soil to slowly carve out a huge ravine. Relate the discussion to the canoe trip and explain that local rivers are changing New Haven's landscape through the same process. Explain that their models will show how the shape of a river changes over time.

- Define the term, watershed, as the entire area that drains into a river. Demonstrate by placing your knuckles together and holding your elbows up high with your hands down low. Have the students pretend that where your knuckles meet is a river. Ask them where the water would go if it rained on your hands (where the knuckles come together). Explain that any water falling anywhere from your elbows down to your hands would flow down to your knuckles. The area that drains into your knuckles is your river's watershed. Have someone else stand next to you with his/her hands in the same position and one elbow touching your elbow. Ask where water would go if it rained on the other person (where his/her knuckles meet). Now pretend it is raining on both of you and ask where the water would flow (water would drain to one side or the other depending on where it fell). Explain that you have created watersheds for two separate rivers. Have a third person stand next to you on your other side with his/her hands in the same position and one elbow touching your other elbow. Compare the three watersheds that you have created to New Haven's three rivers. Explain that the person on your right side represents the West River watershed, you are the Mill River and the student on your left is the Quinnipiac River watershed. Distribute Greater New Haven maps with the different watersheds shaded in. Point out that a watershed connects communities and different towns. Tell them its raining and point to various places on the map to show them that water runs off into different rivers depending on where it falls.
- Distribute River Features handouts and maps of the river the students visited during their canoe trip. Describe the source (start) and the mouth (end) of a river and ask the students to point out the source and the mouth of their local river. Note that the Mill River joins up with the Quinnipiac but eventually all three rivers drain into New Haven Harbor and Long Island Sound. Explain that a river that flows into another river is its tributary. Describe a meandering river by asking students if they have ever visited a water park. Compare the snake like curves of the waterslide to the meanders of a river. See if they can find meanders on the map of their local river. Explain that a young, fast-flowing river is straight but as a river gets older and slows down, it starts to meander. Sometimes a meander gets so large that the river takes a shortcut, by-passing the curve. An area of water is left behind which is called an oxbow lake. Many ponds in New Haven were created when people straightened rivers, cutting off meanders as they moved the soil. Define other river features (delta, braided pattern, etc.), referring to the handout.
- Tell the children that they will create their own rivers in a plastic tub. They will observe changes in the river and label any features they happen to see. Pass out 20 cardboard triangles to each group explaining that they will use these as labels. Each group will create a different river and no two rivers will be the exactly the same. Two features that all the rivers will have in common are a source and a mouth. Ask them

to make up labels by writing source and mouth on two separate triangles. Explain that they will stick these labels in the appropriate position in their river models.

- Distribute a bin of diatomaceous earth to each group. Tell the students that the non-toxic substrate is made from shells of diatoms that occur in nature. Diatomaceous earth is readily available at pool supply stores because it is used in pool filters. Emphasize that even though the material is safe, the students should not touch the earth. The activity is based on careful observation and they will be told when they should manipulate their model.
- Set up the models by placing a block under one side of each bin to create a slope. At the top of the slope, place a dripper system. Suck on one end of the straw to create a constant drip (also possible to submerge the straw completely, removing all air to create a siphon). Adjust the curve in the straw to slow down (straighten) or speed up (bend) the flow of the dripper system. Three drops per second is a good flow rate. Stress to the students that they should not touch the dripper system. Explain that the cup is the source of their river that might represent a spring, wetland, melting glacier, etc. Surface runoff and ground water recharge a river to keep it flowing. The entire bin is the drainage area or watershed for their river.
- Ask the students to label the features as their river develops. Be sure they have marked the source and the mouth. Monitor dripper systems closely, keeping the cups full and the flow constant. Show them erosion by pointing out earth being transported by the blue water. Encourage them to share their observations.
- After five to ten minutes, reposition the straw to the other side of the cup to start a second river. Soak up excess water with a sponge if "New Haven Harbor/Long Island Sound" starts to take over their model.
- Wait five to ten minutes and then add a dam to create a reservoir for drinking water. Bend the clear acetate into the shape of an arrow (notch-side up) and press it down firmly into an upstream section of the river. Explain that water is very powerful so they should expect to see it eventually break down or bypass their dam. Allow students to visit other groups in an orderly fashion.
- After another five to ten minutes, distribute bags of Monopoly houses to each group. Tell them that people are moving into their watershed and they should develop the area with Monopoly houses. They need to think carefully about the placement of their buildings. People like to live near water in beachfront homes and in houses near lakes. They might want to create communities with churches and schools. There may be isolated farms in upstream areas and factories closer to developed sections. Emphasize that the group needs to work together to create their special watershed.
- When the students have finished developing their watershed, explain that the people that moved in are polluting the area. Remind them of non-point and point source pollution and the different types of pollutants that affected Fred the Fish. Explain how sometimes people do not realize how their actions degrade the environment while in other cases polluters are purposefully violating the law. Tell the children that this activity will show the far-reaching effects of pollution. Rotate among the groups, adding different colored Q-tips to the watershed models. Specify the source of pollution each time you add a Q-tip (someone wants the greenest lawn and sprays pesticides, factories are dumping waste in the river, people change their car's oil and

dump it down the storm drain, etc.). Challenge the students to come up with their own scenarios.

- Warn the students that a huge rainstorm is approaching. Squirt the watershed models with the spray bottles to simulate rain. Note that pollution is seeping into the river, past homes all the way to Long Island Sound. Rotate among the groups, asking the students to point to homes that are safe from pollution. Spray water again to be sure that pollution does not flow towards the designated houses. Explain that water flows downstream so homes are affected by pollution from far away as well as in the immediate vicinity. Ask them where New Haven would be in their watershed. Remind them that the City is next to the harbor. Point out that many different towns are connected to New Haven by watersheds. Negative actions in these adjacent towns impact New Haven because it is located so far downstream. Have them look closely at the surface water areas used for drinking water that are now filled with pollution and at Long Island Sound which is multicolored. Ask them if they would go for a swim or eat fish from water that was that polluted.
- Cover and remove the bins and other materials. Ask each group to describe their watershed to the rest of the class by summarizing how they developed the area and what their reactions were to it becoming polluted. Encourage all members of a group to participate in the discussion.

Adapted from GEMS – River Cutters

****Note:** While the Rivercutters activity requires a substantial amount of preparation, it is well worth the effort. Teachers consistently comment on its success.

At the end of this lesson the teacher may choose to assign the River Review and Wonderful Water review sheets.

FOCUS ACTIVITY EXTENSIONS

1. Write a Letter: Teach students the importance of letter writing as a civic responsibility by working on a class assignment that addresses the health of New Haven's rivers. Give students the option to write to a local newspaper, the Mayor's office, a business that is located on one of New Haven's rivers, etc. Ask students to write about something they have learned about New Haven's rivers and watersheds in order to educate the city's leaders about the importance of our aquatic resources. Remind students that rivers, like the other open spaces we are studying, belong to the public and depend on the public to advocate for their health and wellbeing.

2. River of Words: Consider having students work together as a class or individually to submit some poetry or art to The Library of Congress Center for the Book's *River of Words* International Poetry and Art Contest for youth on the theme of watersheds. The contest is "designed to help youth explore the natural and cultural history of the place they live, and to express, through poetry and art, what they discover" (from their website). Go to their website at www.riverofwords.org to read instructions for the contest. Build on the students' canoeing experiences, as well as their time learning about

New Haven's rivers and watersheds in the *Open Spaces* program, to make art and poetry that speaks about their relationship with their local ecology.

RIVER UNIT:
NATURE JOURNAL

ASSIGNMENT FOUR

Title: River Rhythms
Objectives: Students will record their thoughts about the river unit and write poetry for a deeper expression of their feelings.
Time: Conducted between last day of River Unit and first day of Golf Course Unit.
Materials: Nature journal, pencil and River Poetry worksheet (Worksheet 4.2)
Preparation: None
Procedure:

Give each student the corresponding Poetry handout. In the first part of the assignment, the students are asked to brainstorm and reflect on their experiences and feelings related to the river unit. After organizing their ideas, they are asked to write a Haiku poem about the river that they visited. It may be necessary for the teacher to go over the worksheet with the students and do a short lesson on Haiku poetry.

***Note:** Facilitator/Teacher should have students put the worksheets into their nature journals on the last day of the River Unit. Assignments should be collected, corrected, and a classroom discussion should be held before the start of the next Unit.

RIVER UNIT:
HANDOUTS, WORKSHEETS & REVIEW SHEETS

RIVER HANDOUT 4.1 Fred the Fish

Script

1. Imagine a clean river flowing through a nature preserve. In this river lives Fred the Fish. HOW IS FRED? Fred is a young fish, and is impatient with his life in the pristine environment of his protected stream in the nature preserve. Fred is bored and wants an adventure. He imagines that life is much more exciting downstream and he wants to leave home. In fish years, Fred is a teenager, and like most teenagers, Fred is about to get himself into trouble. Big trouble!
2. Fred leaves home and travels downstream. He swims into farm country. He passes a freshly plowed field, when it begins to rain and some soil erodes into the river. (*Dump soil into water*.) HOW IS FRED?
3. Fred keeps swimming downstream. He nears a suburban housing development. Some fertilizer from the houses' lawns washed into the river. *(Add brown sugar to water*.) The fertilizer makes all the plants in the river grow very fast and thick. Eventually, the river water ran out of the nutrients the plants needed, and so they died and are starting to rot. Their decomposition is using up some of Fred's oxygen! HOW IS FRED?
4. Fred feels like he has to get outta there! He swims away and under a highway bridge. Some of the cars traveling across the bridge are leaking oil, although their drivers don't know it. Rain washes the oil into the river. (*Pour in the pancake syrup*.) HOW IS FRED?
5. It is starting to get very cold and ice is forming on the bridge over Fred's river. City trucks spread salt on the road to melt the ice and prevent traffic accidents. The rain is now washing salty slush into the river. (*Put salt in the water*.) HOW IS FRED?
6. Fred keeps swimming and passes a city park. Some picnickers didn't throw their trash into the garbage can, and wind blows it into the river. (*Sprinkle confetti into the water*.) HOW IS FRED?
7. There are several factories in the city. Although regulations limit the amount of pollution the factories are allowed to dump into the river, the factories don't always follow the rules. (*Pour in soapy water*.) HOW IS FRED?
8. The city's wastewater treatment plant is located along this stretch of the river. A section of the treatment plant is broken down and some raw sewage is leaking into the river. (*Squirt two drops of red food coloring into the water*.) HOW IS FRED?
9. Finally, Fred swims past a hazardous waste dump located on the bank next to the river. Rusty barrels of toxic chemicals are leaking and the rain washes these poisons into the river. (*Squirt two drops of blue or green food coloring into the water*.) HOW IS FRED?

RIVER HANDOUT 4.2 Animal Clues

My tracks fall in a straight line and look like the prints of a small dog. I have long teeth called canines that help me rip and tear apart mice, rabbits, birds and other prey. My scat is pointed at the ends and contains fur and bones from my prey. Try to spot my red fur when I'm out of my underground burrow.

?

ANSWER: RED FOX

I am an animal with no legs but I can move very quickly on land or in water when I try to catch worms, fish and frogs. I open my jaws to swallow my prey whole. I like to sun myself on warm, clear days but don't be scared if you spot my yellow and black stripes. I am not poisonous. If you frighten me, I let off a strong musky scent that will make you hold your nose.

?

ANSWER: GARTER SNAKE

My tracks show that I walk low to the ground, dragging my long tail behind me. My back paw prints look like hands with an opposable thumb just like yours. I am the only marsupial (animal with a pouch) in north america. My scat is found in segments, 1 to 3 inches long, and may contain practically any kind of food even garbage. Please don't confuse me with a rat if you see me near your trash cans.

?

ANSWER: VIRGINIA OPOSSUM

RIVER HANDOUT 4.2 Animal Clues (cont.)

I am the only hooved wild animal in the park. I have teeth designed to shred and grind plants. Look for lots of my scat (20 to 3o pellets) in one spot, usually in browsing areas with delicious trees and shrubs. My white tail is a warning flag to others that danger is approaching.

?

ANSWER: WHITETAIL DEER

My two-legged, four-toed tracks show that I am a large bird. I can be spotted running through the brush but I can fly when I need to. I am a funny looking creature but in november, many people think I look and taste just fine.

?

ANSWER: WILD TURKEY

My tracks show the sharp claws that I use to dig for food at night. I am an omnivore that eats a wide range of food items, including garbage. My scat often contains pieces of insects but it doesn't smell as bad as I sometimes do. Steer clear when you see my black and white fur and my tail sticking straight up.

?

ANSWER: STRIPED SKUNK

RIVER HANDOUT 4.2 Animal Clues (cont.)

My tracks make it look as if I only have three legs when my two small front feet land together and my large back feet push off. My self-sharpening, continuously growing front teeth are well designed for cutting the bark and twigs that I like to eat. You can find my scat (about 5 to 10 round pellets) under shrubs and in other areas with twigs, fruit, leaves and seeds. You have to look carefully for me in an open field before I hop into a thicket.

?

ANSWER: COTTONTAIL RABBIT

My tracks look like hand prints and often can be seen near water. I eat almost anything even garbage. My scat is quite large with flat ends and contains seeds, bones, insects, trash and pieces of crayfish. I may look like a masked bandit but I really try to avoid people when I wander around at night.

?

ANSWER: RACCOON

I am a large bird of prey with tufts of feathers on my head that make it look like I have two horns. I hunt silently at night, swooping down on unsuspecting animals. I have sharp talons on my feet for grabbing mice, skunks and other prey and then I use my hooked beak for tearing them apart. I cough up pellets filled with fur, bones and other animal parts that I can't digest. I may be hard to spot but if you listen carefully for my hoots, you'll know I'm nearby.

?

ANSWER: GREAT HORNED OWL

RIVER HANDOUT 4.2 Animal Clues (cont.)

My tracks show how I jump, pushing off with my back feet as I search for food. I use my sharp front teeth to crack open different types of nuts but acorns are my favorite. I often leave behind nutshells, gnawing marks and digging signs. You usually can't see my oval scat in the woods but you might find it in open areas where I've been raiding a birdfeeder. Look for me up in the treetops where I build leaf nests and jump from branch to branch using my gray bushy tail for balance.

?

ANSWER: GRAY SQUIRREL

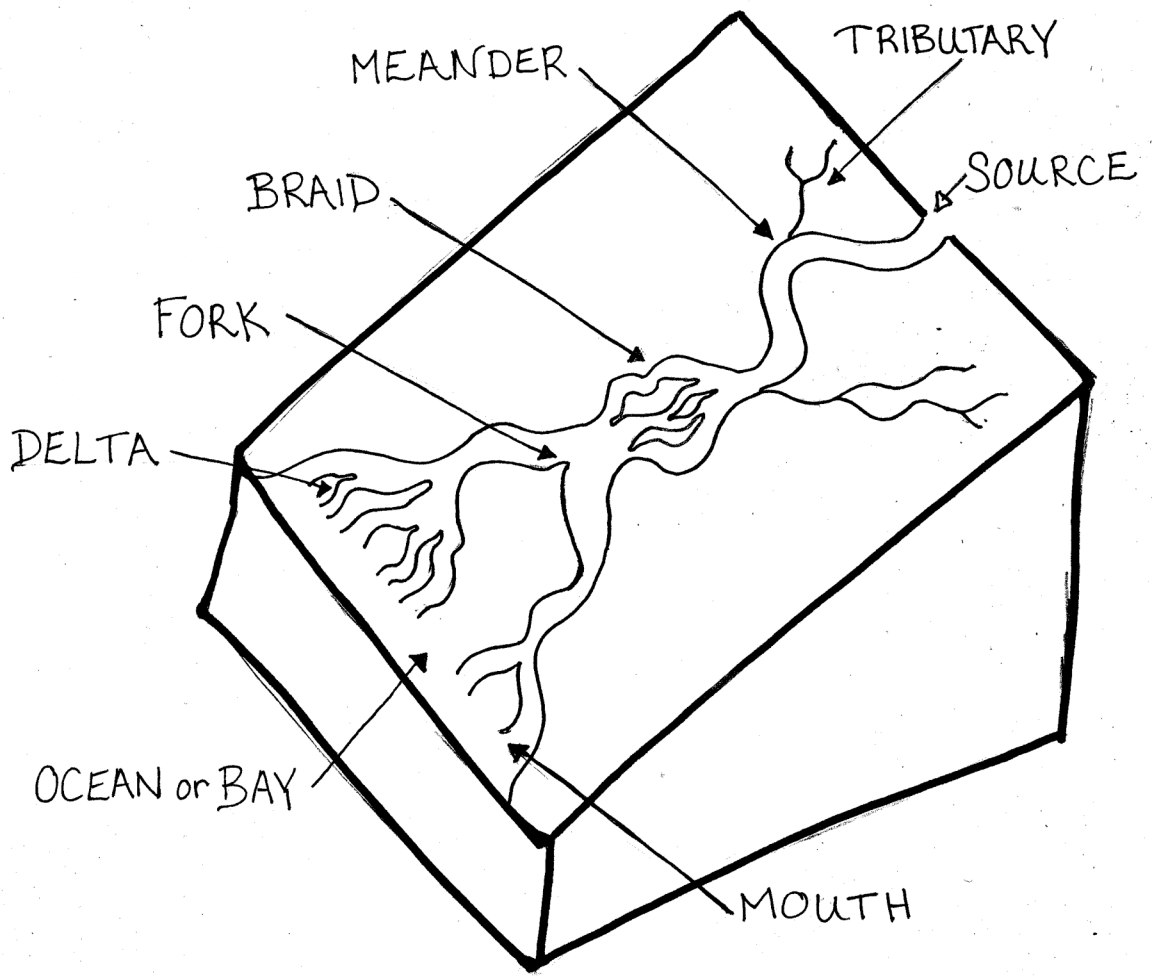
Mystery Animal Trail

Wild animals are all around you in the city but they aren't always easy to see. They often try to avoid people by running away, blending in with their surroundings or being active at times when people are asleep. Even if you don't spot them, it is possible to know which animals have been around by looking at the tracks and signs they leave behind as they move about. Wild animals leave clues that allow you to identify them and understand how they live.

Wildlife clues include the footprints or tracks of animals, their droppings or scat, feeding and movement signs, where they find shelter (nests, holes, beds etc.) and parts of animals (feathers, fur, bones, skin, eggs, etc.). These clues give details about an animal's everyday life. Tracks tell you what the animal was doing, where it was going, how fast it was moving and when it was there. Scat helps you identify an animal but it also lets you know what it was eating even when there are no feeding signs. Wildlife trackers gather all the information they can find to learn about the behavior and identity of wild animals.

The Mystery Animal Trail challenges you to use wildlife clues to recognize the presence of ten animals on the trail before spotting them. Working as a group, search for boxes of clues along the trail. After finding a box, leave it in place but open the top to see what's inside. Look carefully at all the clues and read the animal description. Try to guess the identity of the animal. Check your answer by wandering down the trail a short distance to find the mystery animal. Move on to the next box, continuing along the trail until you have identified all ten animals.

RIVER HANDOUT 4.3 River Features Handouts



RIVER WORKSHEET 4.1 Mobius Ring

1

START HERE

Water *vapor* in air cools and becomes a liquid. This is called ***condensation***.

This is how clouds are formed.

2

When there is too much condensation, the liquid water falls.

This is called ***precipitation.***

Depending on the temperature, this precipitation may be

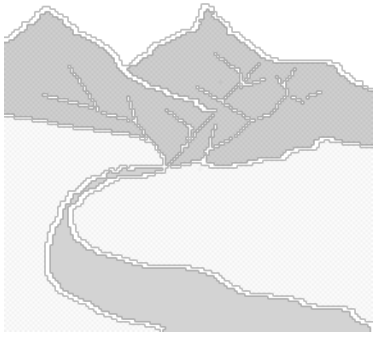
RAIN

or

SNOW

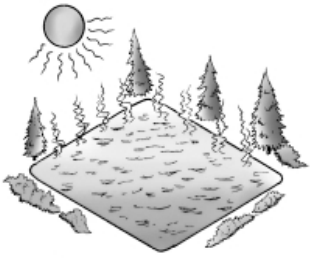
3

Water precipitation may RUN OFF ALONG THE GROUND into lakes, ponds, streams and wetlands.



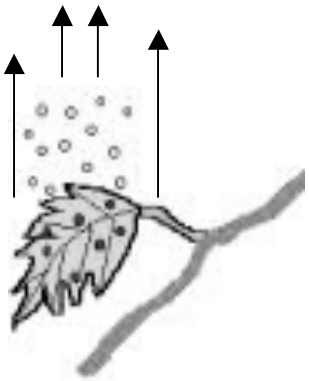
6

When surface water is exposed to the air, some of it will return to the vapor (gas) state. When water goes from liquid to *vapor*, it is called *EVAPORATION*.



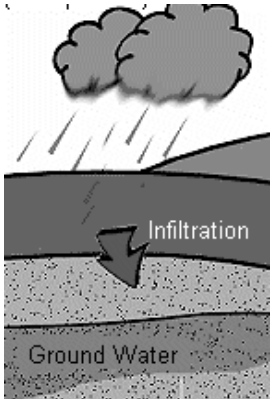
5

The water that is used by plants is also returned to ***vapor*** through *TRANSPIRATION*



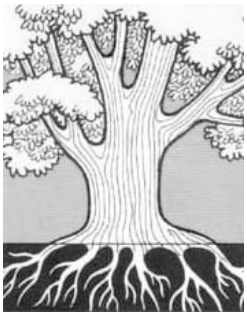
4

Water precipitation may soak further down into the water table. This water is called *GROUND WATER*



or

Water precipitation may soak into the ground and be used by plants



RIVER WORKSHEET 4.2 River Poetry

Name_____

We have spent three classes exploring rivers. We learned about how a river is formed, the effects of pollution on river ecosystems, the water cycle and much more. We also paddled on one of New Haven's three rivers.

Your nature journal assignment for this week has two parts. First, take some time to write about what you learned and how you felt about the river unit. Second, take these ideas and use them to write a poem following the directions given below.

PART 1
In your journal, write down:

(1) Your thoughts about the river unit. You can include your feelings about the canoe trip, classroom activities or any other special experiences you had.

(2) Share something new that you learned about rivers.

PART 2
Use the ideas that you just wrote about to write a haiku poem about the river that you visited with your class. Haiku is one of the most important form of traditional Japanese poetry. Haiku poems are three lines. **The first line is 5 syllables, the second line is 7 syllables and the last line is five syllables.**

Below are two examples of Haiku poems. Try counting the syllables as you read each line. Are they both 5-7-5?

A giant firefly:
that way, this way, that way, this --
and it passes by.
--Issa (1762-1826)

.
Leaves falling slowly
Red, Yellow and Orange fall
Like rain from the sky

REVIEW SHEET 4.1 River Review

Name_____

Fill in the blanks with the correct words.
Hint: there are more words than there are blanks.

oxygen	**more**	**liquid**	**less**	**solid**	**salt**

Fish breath _____that is dissolved in the water.
When we put water in the freezer it turns to ice. Ice is a _____.
The world's seas and oceans are filled with _____water.
We drink fresh water. There is _____fresh water on the planet than salt water.

New Haven Wildlife
Match the clue to the animal that it describes

Clue	New Haven Animal
I am the only marsupial (I carry my babies in a pouch) in North America.	Raccoon
I am an omnivore who often gets into peoples trash. I look like a masked bandit!	Squirrel
I am an herbivore who spends much of my time collecting nuts and burying them.	Opossum
I am a large herbivore who can run quite quickly. If I am a male I have antlers.	Skunk
When another animal threatens me, I spray them with my scent.	Deer

REVIEW SHEET 4.1 River Review (cont.)

ANSWER SHEET

Fill in the blanks with the correct words.
Hint: there are more words than there are blanks.

oxygen	**more**	**liquid**	**less**	**solid**	**salt**

Fish breath *OXYGEN* that is dissolved in the water.
When we put water in the freezer it turns to ice. Ice is a *SOLID.*
The world's seas and oceans are filled with *SALT* water.
We drink fresh water. There is *LESS* fresh water on the planet than salt water.

New Haven Wildlife
Match the clue to the animal that it describes

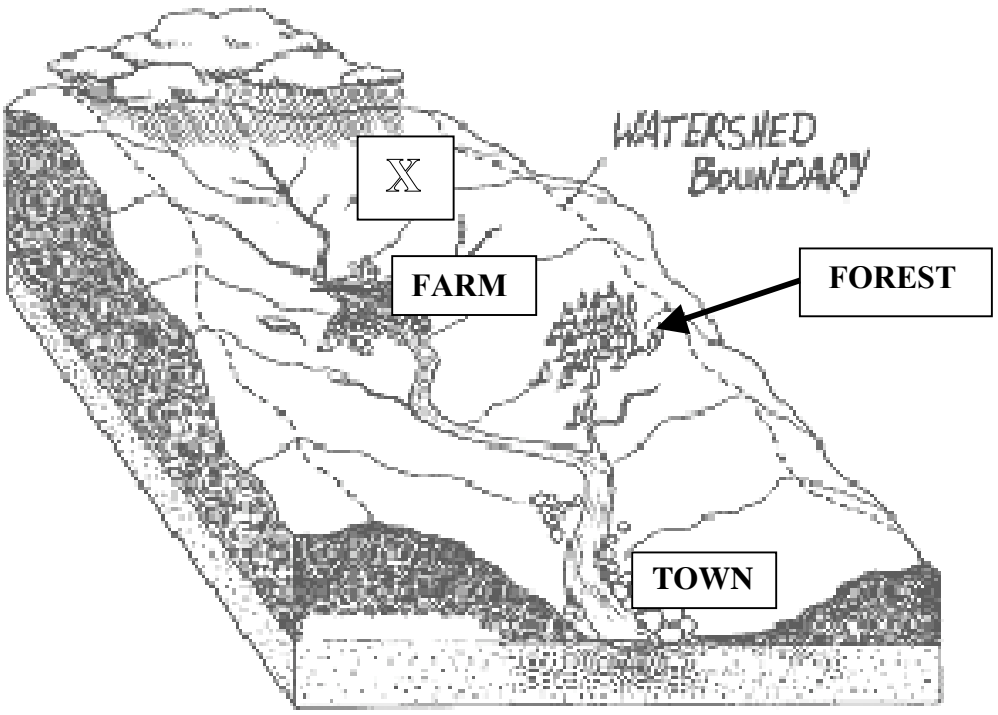
Clue	New Haven Animal
I am the only marsupial (I carry my babies in a pouch) in North America.	Opossum
I am an omnivore who often gets into peoples trash. I look like a masked bandit!	Raccoon
I am an herbivore who spends much of my time collecting nuts and burying them.	Squirrel
I am a large herbivore who can run quite quickly. If I am a male I have antlers.	Deer
When another animal threatens me, I spray them with my scent.	Skunk

RIVER REVIEW SHEET 4.2 Wonderful Watersheds

Label the Watershed

- Write a big "T" beside one of the river *tributaries*.
- Write a big "M" where there is a *meander* in the river.
- Circle the right answer:

Will the rain that falls at [X] drain [INTO] or [AWAY] from the river?



Answer the questions by looking at the drawing of the watershed.

If the farmer on the FARM pollutes the river where she is, will the pollution reach the town?

_____

What will happen to the river if the trees that are next to it are all cut down?

_____

Will the amount of water flowing into the TOWN increase or decrease if somebody builds a dam at the FARM?

_____

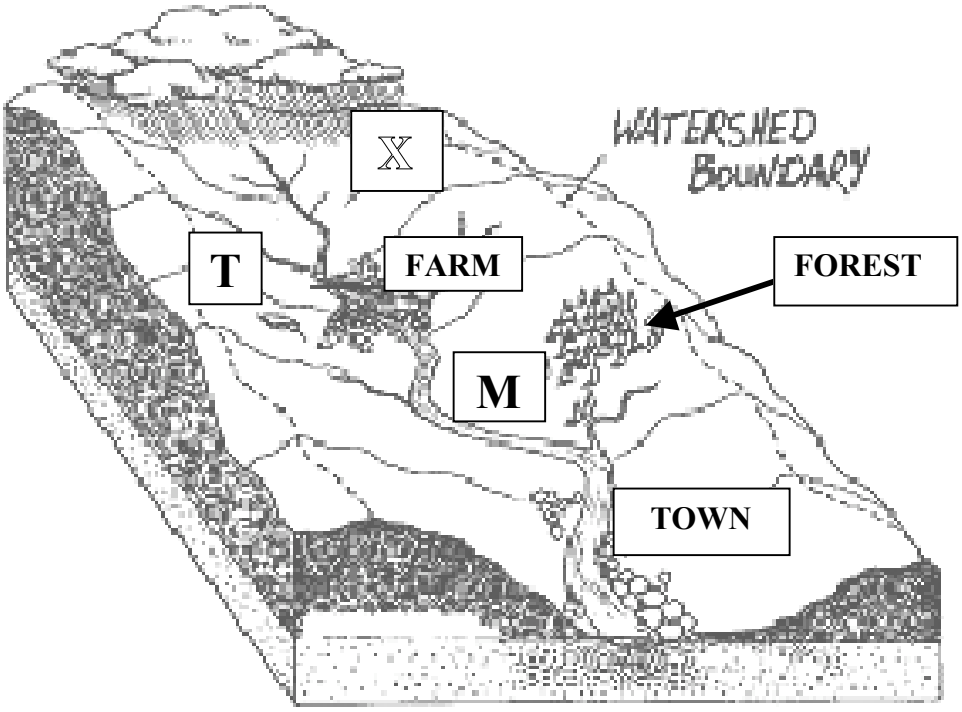
RIVER REVIEW SHEET 4.2 Wonderful Watersheds (cont.)

ANSWER SHEET

Label the Watershed

- Write a big "T" beside one of the river *tributaries*.
- Write a big "M" where there is a *meander* in the river.
- Circle the right answer:

Will the rain that falls at [X] drain [INTO] or [AWAY] from the river?



Answer the questions by looking at the drawing of the watershed.

If the farmer on the FARM pollutes the river where she is, will the pollution reach the town?

Yes, the pollution will reach the town.

What will happen to the river if the trees that are next to it are all cut down?

The river will become cloudier because the soil will erode and wash into the river.

Will the amount of water flowing into the TOWN increase or decrease if somebody builds a dam at the FARM?

The amount of water flowing into the town will decrease if somebody builds a dam at the farm.