



Three Rivers of Yonkers

A Curriculum for 4th and 5th Grades

Lesson plans, resources and maps:
An interdisciplinary approach to urban environmental
education in the classroom focusing on
the Hudson River, Bronx River, and Saw Mill River.



Sarah Lawrence College
Center for the Urban River at Beczak



YONKERS PUBLIC SCHOOLS

SARAH LAWRENCE COLLEGE

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Introduction



The “Three Rivers” curriculum was designed and developed in partnership between the Yonkers Public Schools (www.yonkerspublicschools.org) and the Sarah Lawrence Center for the Urban River at Beczak (CURB) www.centerfortheurbanriver.org.

The Three Rivers of Yonkers curriculum offers six interdisciplinary units of study that align with the New York State Common Core Learning Standards. This curriculum was created by a team of teachers from Yonkers Public Schools with support and guidance from the District's administration, and staff from the former Beczak Environmental Education Center and the Sarah Lawrence College Center for the Urban River at Beczak.

This new curriculum will help stimulate students' interest in science at an early age and will encourage students to become stewards of the Hudson, Bronx, and Saw Mill Rivers. It is hoped that it will also motivate students to develop life-long habits of environmental citizenship.

Of the six units, three are designed to be taught at the end of grade four and three at the beginning of grade five. Each unit is composed of four lessons connected to one another through an “essential question” that directs the themed investigation of the topic. Each lesson integrates English language arts, mathematics, science, and social studies as well as the usage of technology and art. Hands on activities, vocabulary, extensions, assessments, and resources are provided for each lesson.

The objectives are to increase student's awareness of the three rivers complex ecology, geology and historical significance and to teach critical thinking, problem solving, and decision making skills. Another objective is to encourage these students to share their enthusiasm and knowledge of the rivers with their fellow classmates, families, and local community.

This curriculum will be distributed to all 31 Yonkers elementary schools and be made publically available online. Up to 3,575 students will experience the curriculum in their classrooms.

This project was funded in part by Yonkers Raceway through the resolution of an enforcement action against Yonkers Raceway brought by the New York State Attorney General.

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...And to all the 4th and 5th grade students to whom this curriculum is dedicated, we wish a wonderful future filled with a clean, safe environment, a true sense of responsibility for its preservation, and the greatest pleasure in its natural beauty.

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About Sarah Lawrence College Center for the Urban River at Beczak



CURB was established in 2013 as a partnership between Sarah Lawrence College and the Hudson River Valley Environmental Education Institute, the official name adopted by the Beczak Environmental Education Center in 2011. The nonprofit educational organization, supported in part by Westchester County and the City of Yonkers, sits on the banks of the Hudson River in Harbshaw Park in downtown Yonkers, near the mouth of the Saw Mill River.

CURB's mission is to advance environmental knowledge and stewardship by providing high quality K-12 environmental education for the local community, establishing a regional hub for research and monitoring focused on Hudson River estuary and urban watershed issues, and serving as a welcoming open community space for a variety of civic and cultural activities.

In 2004 a tidal marsh was constructed at the water's edge. It is one of the few places along the Hudson River where students of all ages have direct access to the river for educational purposes. Opportunities for students include seining for fish and other river life and collecting water and sediment samples.

In 2015 CURB constructed and outfitted a working field station and lab to support academic research, monitoring, and citizen science programs, focused on the Hudson River and urban watersheds. The new center is a dynamic space with multiple uses and designed for a variety of audiences, ranging from a teaching and demonstration space for middle and high school students to a new research hub for Sarah Lawrence students, faculty and visiting scientists.

Of particular relevance to this project, CURB is now leading a comprehensive water quality monitoring program to track and identify sewage pollution sources in Yonkers' rivers, utilizing local and regional partners and a dedicated cadre of volunteer citizen scientists.

Follow us on:



Table of Contents

Grade 4 Curriculum

Unit 1: Exploration and Geography of Rivers	6
Lesson 1: Exploration by River	6
Lesson 2: River Waters	15
Lesson 3: The Three Rivers of Yonkers	21
Lesson 4: The Origin of Rivers	24
Unit 2: Balance of Nature	28
Lesson 1: River Ecosystems	28
Lesson 2: Hudson River Food Chain	35
Lesson 3: Biodiversity of Rivers	40
Lesson 4: A Case Study: The Atlantic Sturgeon	47
Unit 3: Industry and Transportation	51
Lesson 1: River Industry	51
Lesson 2: A River Story	55
Lesson 3: Steamboats of the Hudson	58
Lesson 4: Effects of Industrialization on Biodiversity	64

Grade 5 Curriculum

Unit 4: The Quality of Water	68
Lesson 1: Watersheds	68
Lesson 2: Water Pollution	73
Lesson 3: Hudson River PCB's	76
Lesson 4: Rivers and Government: The Clean Water Act	79
Unit 5: River Challenges	85
Lesson 1: Human Impact on Rivers	85
Lesson 2: New York State's Cleanup Efforts on the Bronx River	89
Lesson 3: The Great Hudson River Debate: Indian Point Power Plant	92
Lesson 4: Building Bridges: The Construction of the New Tappan Zee Bridge	97
Unit 6: Stewardship	106
Lesson 1: Cleaning up the Hudson	106
Lesson 2: Water Conservation	109
Lesson 3: The Daylighting Project: Saw Mill River	114
Lesson 4: Back to the Future: Designing an Ideal River Environment	120

Appendices/Curriculum Resources

Rivers: Water Pollution	122
Field Trip Destinations	125

Maps

Hudson River North of the Tappan Zee Bridge	131
Hudson River South of the Tappan Zee Bridge	132
Hudson River from Lake Tear of the Clouds to New York City	133
Hudson River Watershed	134
Saw Mill River	135
Bronx River	136
City of Yonkers	137



“The land is the finest for cultivation that I've ever in my life set foot upon.”

Henry Hudson

Unit 1: Exploration of Geography and Waterways

Lesson 1: Exploration by River

Objective

Students will use online resources to research explorers who traveled by water and who significantly contributed to the discovery of Canada and the United States.

Essential Question

What role do rivers play in the history of New York State?

Common Core Standards

- Science K-4 (2.1, 6.2, 7.2)
- CCSS- ELA- Literacy
 - R1.4.1 / W.4.9 / W.4.1

Skills

- Internet research
- collaborative learning
- group work
- critical thinking
- preparing presentations
- persuasive essay

Duration: 5 days

- Day 1: Introduction and Group Assignments
- Day 2 & 3: Research and Planning
- Day 4: Presentations
- Day 5: Essay-Writing

Vocabulary

river - a large, natural stream of water flowing in a definite course or channel that crosses an area of land and leads to the sea, a lake, or another such body of water

explorer - a person who investigates or searches for unknown things or places; a person who travels in search of geographical or scientific information

discovery - the act of finding or learning something for the first time

expedition - a journey or voyage undertaken by a group of people with a particular purpose, especially one of exploration, scientific research, or war

contribution - the part played by a person or thing in bringing about a result or helping something to happen or advance

commerce - the activity of buying and selling goods, especially on a large scale; trade dealings between people

development - the act or process of growing or causing something to grow or become larger or more advanced; the act or process of creating something over time

Materials

- Explorer Trading Card Worksheet
- Maps Worksheet
- Notes Worksheet
- Internet access
- coloring materials
- scissors
- poster board

Background

Rivers are an essential part of our world. Since prehistoric times, people have traveled on rivers and built cities along them. Rivers have provided food, as well as a source of commerce, for centuries.

In the fifteenth and sixteenth centuries, explorers sailed to oceans and lands that had never been discovered by their countries. Rivers played an essential part in this exploration. In their exploration of North American rivers and lands, European explorers from the late 1400s through the mid-1800s helped shape the development of Canada and the United States into the nations they are today. By following the activities below, you will be introduced to some of these explorers and their accomplishments.

Activity

Begin with an assessment of your students' knowledge about rivers and their associated explorers. For example, some questions to begin with include:

- What is a river?
- Have your students ever visited or traveled on one?
- Why are rivers important to us?
- What are the different uses of a river?
- How are rivers named?

Grade 4 Curriculum

Following this discussion, the classes will be divided into groups of approximately five students each who will work together to accomplish the following:

Day 1:

Each group will begin by being assigned one of the following explorers:

- a. Alexander Mackenzie (Mackenzie River, Canada)
- b. Simon Fraser (Fraser River, Canada)
- c. Henry Hudson (Hudson River, U.S.)
- d. Samuel de Champlain (Lake Champlain, U.S.)
- e. Meriwether Lewis and William Clark (traveled by river from the Ohio River to the Columbia River on the West Coast, U.S.)

Day 2:

Each group will research their explorer online, making sure to address the following areas on their research notes worksheet:

- f. country of origin
- g. country exploring for
- h. what they were searching for
- i. path of exploration
- j. dates of journey
- k. what they found
- l. what (if anything) was named after them
- m. three impacts of their discoveries on the world today

Day 3:

Each member of the group will fill out his or her own “Explorer Trading Card” information sheet with this data. Have each student cut out the trading card. The group will then work as a team to put together a poster board about their explorer, which they will present to the class on the last day.

Day 4:

Members of the different groups will trade cards with one another on the day of presentations to learn about a different explorer from the one they researched. Each group will have 5-8 minutes to present on their explorer.

Assessment

Once students have completed their presentations, they will use their research, presentations, maps, and trading cards to draft a persuasive essay about which explorer they felt was the most successful on their journey. Students should include at least three ways in which their explorer’s discoveries positively impacted the country as we know it today.

Research Notes Worksheet

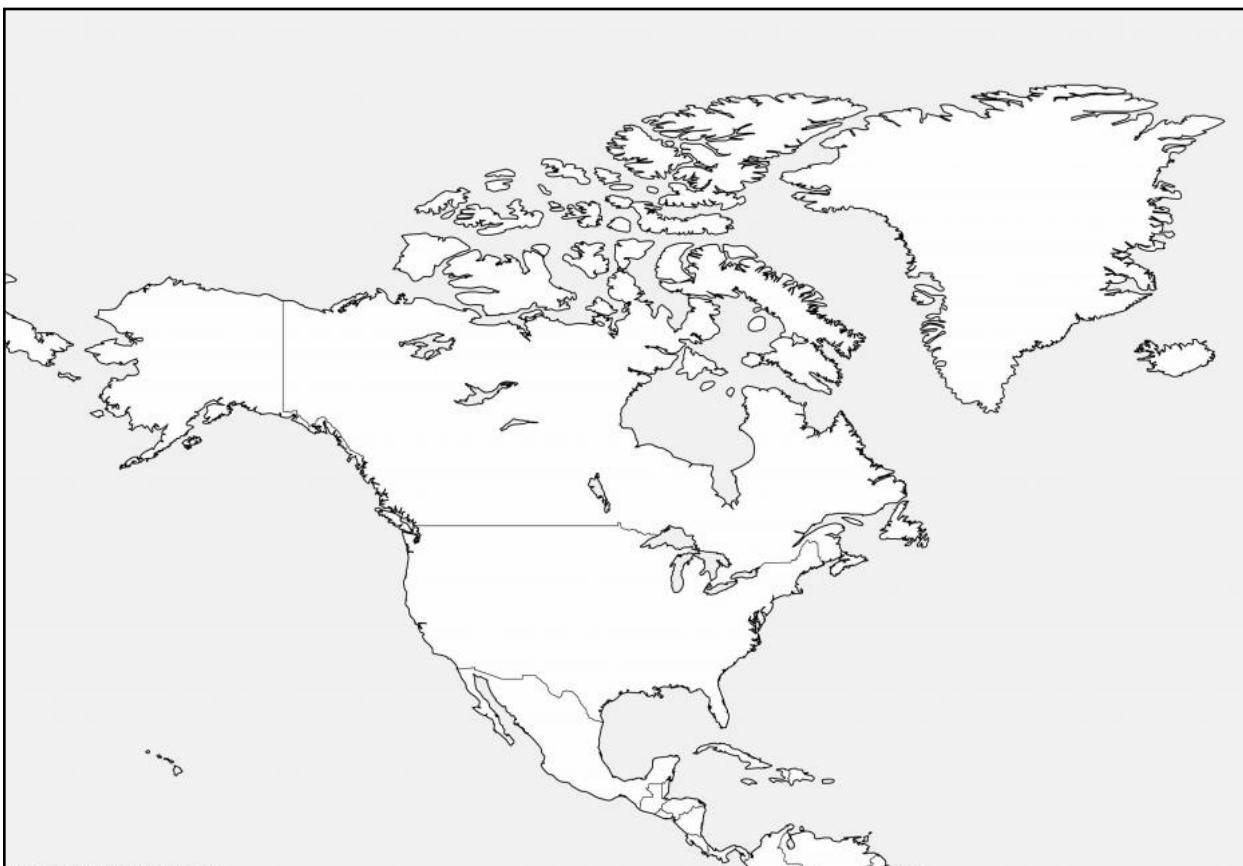
Explorer name:

Country of origin:

Country exploring for:

Searching for:

Using a map of North America, trace your explorer's path:



Grade 4 Curriculum

Dates of exploration:

Areas and landmarks discovered:

On the map below, draw and label the river(s) that your explorer discovered in the U.S. or Canada:



Grade 4 Curriculum

Was anything named after your explorer? If so, what?

List 3 ways that your explorer's discovery has helped to shape the world today:

1. _____

2. _____

3. _____

Explorer Trading Card Worksheet

Fill in the following trading card with the explorer your group has been assigned to research. For each section, use your research to answer the questions. Draw a picture of your explorer “in action” on one of his expeditions.

Explorer's Name	
Nation Explorered for	Picture of Explorer
Was Searching for	
Discovered	Two Ways This Explorer Shaped the World Today

Resources

Websites (Most descriptions provided by sources):

<http://mrnussbaum.com/explorersflash/>

A collection of interactive explorer profiles, activities and maps focused on the Age of Exploration.

<http://www.socialstudiesforkids.com/subjects/henryhudson.htm>

Find out more about Henry Hudson and his search for the Northwest Passage.

<http://www.nationalgeographic.com/lewisandclark>

Find out more about Lewis and Clark's Expedition across North America.

<http://enchantedlearning.com/explorers/indexh.shtml>

Listings of various explorers and their contributions to the world.

<http://www.britannica.com>

An online encyclopedia that can be used as a reference sources for people, places, and definitions.

http://www.cbc.ca/history/?M1val=EpContent.html&lang=E&series_id=1&episode_id=6&chapter_id+3&page_id=4

A brief history of Canadian exploration and Alexander Mackenzie.

<http://www.hrmm.org>

Hudson River Maritime Museum's website for more information on Henry Hudson and his ship, the Half Moon.

http://www.historiclakes.org/S_de_Champ/S_de_Champlain.html

Find out more about Samuel de Champlain and his discovery of Lake Champlain.

<http://lewisandclarktrail.com>

A detailed description of the trail Lewis and Clark traveled from Pittsburgh, Pennsylvania to the Oregon coast.

Books

Title: *Henry Hudson* by Ruth Manning (2001)

Call #: B Hudson

Summary: A biography of the English explorer and sea captain who explored three North American waterways later named for him—the Hudson River, the Hudson Bay, and the Hudson Strait.

Title: *The Journals of Lewis and Clark* by Bernard DeVoto (1997)

Call #: 917.804 JOU

Summary: The Rockies, the Cascades, the high plains, and the flora and fauna of the great Northwest are all described in the explorers' diaries.

Title: *The Travels of Henry Hudson* by Joanne Mattern (2000)

Call #: B Hudson

Summary: A biography of the English explorer and sea captain Henry Hudson.

Title: *Jacques Cartier, Samuel de Champlain, and the Explorers of Canada*

by Tony Coulter (1993)

Call #: 971.01 COU

Summary: Surveys the early exploration of Canada by Cartier, Champlain, and others.

Title: *Alexander Mackenzie and the Explorers of Canada* by Georgia Xydes (1992)

Call #: 971.2 XYD

Summary: Examines the explorations of Sir Alexander Mackenzie in Canada.

Lesson 2: River Waters

Objective

Students will implement prior knowledge to prepare for an exploration of rivers and the importance of water. They will observe and analyze three types of water that are found on Earth: salt, fresh and brackish.

Essential Question

What different types of water can be found in rivers?

Common Core Standards

- Science 1 M3.1a, 1 S 1.1, 1 S 1.2, 1 S 1.3, 6.4, 7.2
- CCSS- ELA- Literacy
 - R1.4.3 / R1.4.7

Skills

- Internet research
- observation and documentation
- analyzing data
- inquiry science

Duration: 45 minutes

- Preparation time: 5 min
- Discussion: 15 min
- Activity time: 20 min
- Closing activity: 5 min

Vocabulary

salinity – a measure of the salt concentration of water. Higher salinity means more dissolved salts, usually measured in parts per thousand (ppt).

fresh water – water with less than 0.5 parts per thousand (ppt) dissolved salts

salt water – water which contains a relatively high percentage of sodium chloride (high salinity)

brackish water – a mixture of fresh water and salt water

estuary – the tidal portion of a river where freshwater enters into a sound, bay or the sea and mixes with salty seawater

Materials

- 3 cups
- sticky labels (labeled #1, #2, #3)
- Student Observation Chart
- table or aquarium salt
- 10 L of water in bucket or container (3 samples)
- hydrometer – tool to measure salinity (available at pet stores)
- measuring cup

Background

Water makes up about three-quarters of the earth's surface. About 97% of that water is ocean water. The earth's oceans are made up of 96.5% water and 3.5% salt. Most fresh water (69%) is found in glaciers and icecaps (though much of this is melting because of global warming). The rest of the water is found in groundwater (30.1%) under the earth, while only 0.3% of fresh water is in our lakes, rivers, and streams.

Approximately, nearly half of the Hudson River is actually an estuary. An estuary is a portion of a river where salt water from the ocean is measurably diluted by fresh water from land drainage. The Hudson River Estuary extends from the Troy Dam to the Atlantic Ocean (153 miles).

The amount of salt in water is called "salinity" and is most commonly measured in **parts per thousand (ppt)**. "Parts per thousand" refers to how many grams of salt are in one thousand milliliters of water. (1 g of salt / 1000 ml of water)

Salt in the ocean originates from minerals dissolving in water. **Salt water** has a salinity between 32 and 36 ppt. Water that has a salinity in the range between **fresh water** (close to 0 ppt) and ocean water is called **brackish water** (mixture of salt and fresh water).

fresh water: 0 ppt

brackish water: ranges from 1-31 ppt

salt water: ranges from 32-36 ppt

Salt water enters the Hudson River during high tide, when water from the Atlantic Ocean floods the river, flowing in a northern direction. At the same time, there is a constant flow of fresh water from north to south. The source of the Hudson River to the north is Lake Tear of the Clouds, at the base of Mount Marcy in the Adirondack Mountain Range. Fresh water is also contributed to the river through fresh water tributaries (connecting streams and smaller rivers) and precipitation (rain). The average location of the "salt front" of the Hudson River (the boundary between brackish and fresh water) is located just north of the Beacon-Newburgh Bridge.

The salinity of the Hudson River can vary depending upon the time of day and the season. As the ocean tide rises, it brings salty ocean water north to cities like Yonkers. Therefore, with the rise and fall of the tides each day the salinity of the river in Yonkers may also increase and decrease. During dry periods, and seasonally in winter and summer, the salinity increases as the influx of fresh water from precipitation and runoff is reduced. Inversely, during periods of high precipitation and generally in spring and fall, the salinity of the river decreases as the salt water is diluted with fresh water.

Teacher Preparation

What you need:

1. salt water: mix 1 1/2 cup of salt / 10 liters of water
(hydrometer reading close to 35 ppt)
2. brackish water: mix 1/2 cup of salt / 10 liters of water
(hydrometer reading close to 12 ppt)
3. fresh water: mix 0 cups of salt / 10 liters of water
(hydrometer reading 0 ppt)

Notes:

- Make sure to stir the salt and let it settle before reading the hydrometer.
- Fill the hydrometer to the top for accurate reading.
- Each sample may vary depending on how much salt you add. If it's too salty, add more water; if it's not salty enough, add more salt.

Activity

1. Create a KWL chart, beginning with prior knowledge about water. Ask students to consider the following: "What do you know about water?" "Is water essential to all life?" "Where does water come from?" The teacher records the student responses on the KWL chart and reinforces the notes throughout this curriculum study. The teacher also notes important terms and vocabulary related to the study of water.
2. While working in small groups, students will conduct an experiment observing three unlabeled samples of water, utilizing their senses to determine whether the water is salt, fresh, or brackish. Students will identify and label the samples.
3. Students will record their observations on the chart. Teacher will ask students to consider the ways rivers, oceans and lakes differ from one another.

K.W.L. Chart

Topic: _____

K What I Already Know	W What I Want To Know	L What I Have Learned

Student Observation Chart

Each group will test the 3 samples of water (labeled A, B and C) using their senses and record their findings.

	SAMPLE A	SAMPLE B	SAMPLE C
What sense(s) did you use to test the water sample?			
Is the water salt, fresh, or brackish? What makes you think so?			

Follow up Questions:

1. Measure the salinity of each sample using a hydrometer and record the answers.
2. Were your observations/guesses about the water samples correct?
Explain your answer.

Assessment

- Students will share and discuss findings.

Extensions

- Research some of the different fish species that live in each of the three types of water, with a focus on adaptations.
- Carry out a “float and sink” experiment using classroom objects with fresh and salt water.

Resources

Websites (Most descriptions provided by sources):

<http://www.wisegeek.com/what-is-brackish-water.htm>

A brief and straightforward guide to brackish water.

http://www.wetwebmedia.com/ca/volume_4/V4I2/Brackish%20Systems/brackish.htm

Brackish water habitats occur where freshwater meets the sea. Discusses brackish water fish, which combine elements of both the freshwater and ocean water branches.

<http://www.ucmp.berkeley.edu/exhibits/biomes/freshwater.php>

Discussion of fresh water biomes.

http://www.geography4kids.com/files/water_intro.html

Water, water, everywhere.

http://www.ehow.com/list_6525786_different-types-water-bodies.html

Learn about the different types of bodies of water.

Books

Title: *Pond & River* by Steve Parker

Call #: 577.63 PAR

Summary: A photo essay about the range of plants and animals found in fresh water throughout the year, examining the living conditions and survival mechanisms of creatures dwelling at the edge of the water, on its surface, or under the mud.

Title: *Wonderful Water* by Bobbie Kalman & Janine Schaub

Call #: 551.48 KAL

Summary: Explores the topic of water, including the water cycle, salt and fresh water, water pollution, and water conservation.

Water, Foss Science Stories

Published and distributed by Delta Education.

Environments, Foss Science Stories

Published and distributed by Delta Education.

Lesson 3: The Three Rivers of Yonkers

Objective

To reinforce the concepts from Lesson 2 on water, students will explore the three rivers in Yonkers, NY. They will use the steps of the scientific method to identify the types of water in the local rivers: the Hudson River, the Saw Mill River and the Bronx River.

Essential Question

What are the three rivers located in the City of Yonkers?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science S1.1, S1.2, S1.3, S2 & S3
- CCSS- ELA- Literacy
 - R1.4.3 / R1.4.7

Skills

- mapping

Duration: 45 minutes

- Preparation time: 10 min
- Activity time: 30 min
- Daily observations: 5 min

Vocabulary: (review Lesson 2 vocabulary)

salinity – a measure of the salt concentration of water. Higher salinity means more dissolved salts, usually measured in parts per thousand (ppt).

fresh water – water with less than 0.5 parts per thousand (ppt) dissolved salts

salt water – water which contains a relatively high percentage of sodium chloride (high salinity)

brackish water – a mixture of fresh water and salt water

estuary – the tidal portion of a river where freshwater enters into a sound, bay or the sea and mixes with salty seawater

Materials: Each student should have:

- River Water Observation Worksheet
- Map of Yonkers, including the three rivers and map of Hudson River (see Resources)
- Three Rivers of Yonkers Fact Chart
- samples from each of the three local rivers or self-made salt water, fresh water, and brackish water samples made from a mixture of salt and tap water (see Lesson 2)

Assessment

- Discussion participation
- Mapping activity

Background

The City of Yonkers has three rivers running through it:

- The Saw Mill River is 20 miles long and lies entirely within Westchester County; it starts in Chappaqua and it empties its fresh water into the Hudson River in downtown Yonkers. The Saw Mill River was originally called the Nepperhan, which means “trap fishing place” in the language of the Wechquaescheck (Europeanized as “Wappinger”) Indians.
- The Hudson River is 315 miles long; it starts in the Adirondacks and empties into New York Bay, where it meets the Atlantic Ocean. The Hudson River was called Muhheakantuck, meaning “the river that flows both ways,” by the Leni-Lenape tribe, because of its north- and south-shifting tidal flow. The Hudson River contains fresh water in its northern locations. The lower portion of the Hudson River is an estuary, which is where salt water from the ocean and fresh water from the river mix.
- The Bronx River is approximately 23 miles long; it begins in Westchester and flows through Yonkers on its way to the Bronx in New York City, before emptying into the East River and Long Island Sound. It was originally named Aquehung, meaning “River of High Bluffs,” by the Algonkian (also known as “Algonquin”) Indians. It was once so clean that New York City wanted to use it for drinking water, but it became very polluted because people used it as a sewer. For the past 30 years people in the Bronx and Westchester have been working to clean up the river. In many places people can now use it for recreation.

Activity

1. Students will review a copy of the Yonkers map indicating the location of all three rivers. Compare and contrast the three rivers. What is the same in each of the rivers? What is different? Students complete Three Rivers of Yonkers Fact Chart.
2. Teacher will lead a discussion on the geography of the three rivers of Yonkers and focus on the types of water in each. What connections are made between geography and salinity levels in three sections of the Hudson River? What is an estuary?

Three Rivers of Yonkers Fact Chart

Fill in the chart to compare and contrast the three rivers of Yonkers.
What do you notice about the rivers that is the same? What is different?.

	HUDSON RIVER	BRONX RIVER	SAW MILL RIVER
Source:			
Length:			
Location:			
Empties Into:			
Tidal? (yes / no)			
Water Type(s):			

Lesson 4: The Origin of River Names

Objective

Based on the information learned in Lessons 1-3, students will research the origin of current river names and create a new name for one of the rivers in Yonkers.

Essential Question

What do the origin of river names signify? What is their importance?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science 2.1, 6.1, 6.2, 7.2, 3.1f, LE 7.1 a-c
- CCSS- ELA- Literacy
 - SL.4.4 / W.4.1 / W.4.9

Skills

- Internet research
- critical thinking
- creating presentations
- persuasive essays

Duration: 1 week

- Day 1: review of the three rivers in Yonkers
- Day 2: research and note taking
- Day 3: essay (draft)
- Day 4: revise and edit essay
- Day 5: publish and celebrate

Vocabulary

borough - a town or district that is an administrative unit; in particular, each of the five divisions of New York City.

settlement - a place, typically one that has been uninhabited, where people establish a community

origin - the point or place where something begins

acre - a unit of land

Aquahung - Native American (Algonkian) name for the Bronx River

Muhheakantuck - Native American (Leni-Lenape) name for the Hudson River

Nepperhan - Native American (Wechquaescheck) name for the Saw Mill River

Materials: Each student should have:

- Origin of Rivers Worksheet
- Internet access

Background

When explorers and settlers came to America, they named the rivers and other geographic landmarks after people or geographic features, or used the names they had been given by Native American tribes. For example, the origin of the name of the Mississippi River is from a Chippewa Indian word meaning “Father of Waters.” The river was initially called by many different names, but the name “Mississippi” was used on Robert Cavelier Sieur de la Salle’s map of the area in 1695 and thus was accepted as the official name.

Bronx River

Many people find it odd that, unlike most place names, and unlike the other four boroughs of New York City, The Bronx has “the” as a part of its name. The borough and the river were both named for a Swedish settler named Jonas Bronck. When Bronck bought the land, the name changed to one referring to his family’s ownership: The Bronck’s or The Broncks’ (referring to the family) was used and later became The Bronx.¹

Saw Mill River

The Saw Mill River was a very different stream when Henry Hudson and his crew found it in 1609. Known as the Nepperhan, or “rapid little waters,” by the Wechquaescheck (also known as Wappinger) people, it was an excellent spot for fishing and farming. In 1648 Adriaen van der Donck, a Dutchman, obtained a grant for it from the Dutch East India Company and purchased it from the Indians. His saw mill gave the river its subsequent name. In 1672 another Dutchman, Frederick Philipse, purchased the land and ten years later built a manor house on the site. Where Warburton Avenue is now was once the site of grist and saw mills. The family grew and prospered, but, as loyalists during the American Revolution, had their land confiscated after the war.

Hudson River

The Hudson River is named for Henry Hudson, the explorer who first traveled 150 miles up the river in 1609 looking for the Northwest Passage to China. But before he laid claim to the territory for the Dutch East India Company, the river had been named Muhheakantuck, “river that flows both ways,” by the Leni-Lenape tribe, who had long enjoyed the region’s bounty of oysters, fish and game.

Activity

1. You have been given the task of renaming one of the rivers in Yonkers (i.e. the Bronx River, Hudson River, or Saw Mill River). What would you name it, and why? Each student will create a new river name, completing the Origin of Rivers Worksheet.
2. Construct an essay providing a rationale for your name choice. In your essay, be sure to address the following points:
 - Current name of the river and what you think the new name should be
 - Location of the river
 - Historical significance of the river, and how it relates to the development of New York State
 - Reason for your name

1. DeVillo, S.P. “How the Bronx Got its Name.” *Bronx River Alliance*. 2008. Accessed July 31, 2015.

River Family Worksheet

1. Choose which river of Yonkers you would like to use as the subject of your essay.

Hudson River Bronx River Saw Mill River

2. What is the origin of your river's name? _____

3. Where is this river located? _____

4. What are some geographical features of this river? _____

5. What is the historical significance of the river you have chosen?

How does this river relate to New York State?

6. What would you like to rename the river? _____

Assessment

Students are required to submit a persuasive essay stating the rationale for their river's name. Student work will be evaluated using the 4-point ELA writing rubric.

Extension Activity

After completing the above activity, students will have an opportunity to do further research and learn how the city of Yonkers got its name. Students will use the Internet and class resources to gather more information.

Resources

Websites (Most descriptions provided by sources):

http://www.hudsonrivervalley.com/NG_TheHudson/

A history of Henry Hudson's voyage to New York and the river that became the Hudson. The site also contains a wealth of information about the history of the Hudson River Valley and historic sites along the river.

<http://bronxriver.org/?pg=content&p=abouttheriver&m1=13&m2=78#Devillo>

The Bronx River Alliance homepage provides information about the Bronx River.

<http://www.yonkerschamber.com/history.html>

Yonkers Chamber of Commerce provides everything you need to know about life in and around Yonkers.

<http://www.sawmillrivercoalition.org/about-the-saw-mill-river/slide-show-on-the-river/>

The home page of the Saw Mill River Coalition gives lots of information about the river.

<http://external.oneonta.edu/cooper/susan/hudson.html>

The origin of the early names of the Hudson River as well as other North American rivers and lakes.

Books

Yonkers: Then & Now

Yonkers Historical Society and the Blue Door Art Association. 2008

The Beautiful Bronx 1920-1950

Lloyd Ultan. 1979.

“If you’ve ever had a chance to look into the eyes of a sturgeon, there are unfathomable depths there that take you back millennia; they take you back ages and ages ago. And having looked into the eyes of a sturgeon, you can fully understand that these animals swam practically unchanged from the way they are today when dinosaurs walked the earth.”

Christopher Letts

Unit 2: Balance of Nature

Lesson 1: River Ecosystems

Objective

Students will explore the ecosystems that exist within the Hudson River watershed. The students will participate in an activity emphasizing key terms and knowledge of the local ecosystems and communities.

Essential Question

What kinds of ecosystems are found in the three regions of the Hudson River?

Common Core Standards

- Science- S 1.1 – 1.3, S 3.1 – 3.4, 2.1 / PS 3.1f
- CCSS- ELA- Literacy
 - W.4.9 / SL.4.1

Skills

- species classification and identification
- creative writing

Duration: 50 minutes

- Preparation time: 10 min
- Discussion time: 10 min
- Activity time: 30 min

Vocabulary

ecosystem – all of the organisms in a particular region and the environment in which they live. The elements of an ecosystem interact with each other, and so depend on each other either directly or indirectly.

community – a place where people or other living creatures live together

adaptation – a behavior or physical feature used for survival

estuary – The tidal portion of a river where freshwater enters into a sound, bay or the sea and mixes with salty sea water

flora – plants growing within a given area

fauna – animals living within a given area

marsh – a wetland that is seasonally flooded and is often dominated by one or a few plant species

naturalist – a person who specializes in natural history, especially in the study of plants and animals in their natural surroundings

river – a large, flowing natural waterway, originating at headwaters or a spring, flowing to its endpoint, the mouth

watershed – an area or region drained by a river, river system, or other body of water

Materials: Each student should have:

- Explorer's Ecosystem Journal
- scissors
- glue

Background

The Hudson River is 315 miles long. Since it contains many different habitats and ecosystems, there are a variety of plant and animal species found in and along the Hudson River. There are three main regions of the river. The **Upper** Hudson River Region (Lake Tear of the Clouds to Troy) is a fresh water area located within the forests and mountains of the Adirondacks. The **Mid**-Hudson River Region (Troy to Peekskill) is primarily a fresh-water river but can be affected by tides and saltwater depending on the season of the year; it contains rich marshlands and a variety of flora and fauna. The **Lower** Hudson River Region (Peekskill to New York Harbor) is an estuary; it has been the region of the greatest human impact.

The river is influenced by ocean tides to Troy, 153 miles north of New York Harbor. Diluted seawater typically ranges upriver to a point between the Tappan Zee Bridge and the Newburgh/Beacon area, depending on the amount of rain and runoff. The Lower Hudson is a productive estuary. All living things in this ecosystem have to adapt to the ever-changing conditions of the Hudson in order to survive.

From shorelines to tide pools, the Hudson River is home to a variety of species, each adapted for life in its own unique way. **Adaptations** help organisms do the things they must do in order to survive in their environments. Living things have to take in food and avoid being eaten. They need to survive the summer's heat and winter's cold. They must sense what is going on around them at all times to the best of their ability.

Activity

1. Students will research and discuss the diversity of ecosystems found along the Hudson River.
2. Students will participate in an activity about the components of a Hudson River Ecosystem.
3. Students will work collaboratively to create an Explorer's Science Journal for their assigned region.

Assessment

- Observation of ecosystem activity
- Students will share their Ecosystem Explorer's Journal

Extensions

- Make a class mural of the ecosystems of the Hudson River, with each group focusing on the specific region they explored in their journals.
- **PLAN A FIELD TRIP to the Sarah Lawrence College Center for the Urban River at Beczak (CURB)** to reinforce the concepts learned.
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - **Animal Adaptations:** How do fish swim? How do birds fly? Students discover the unique adaptations of various fish, birds, reptiles and mammals that inhabit the Hudson River watershed. Participants will view real life adaptations using our resident turtles, fish and other species.

Ecosystem Activity

Using the list of living and non-living things, complete the Hudson River Ecosystem Chart indicating the three regions of the Hudson River. Remember to keep in mind the different water types found in each region.

LIVING THINGS:

Atlantic Sturgeon
Striped Bass
Plankton
Hawk
Blue Jay
Bald Eagle
Chipmunk
Fox
Beaver
Frog
Muskrat
Great Blue Heron
Red-Winged Blackbird
Duck
Perch
Carp
Largemouth Bass
Willow Tree
Red Maple Tree

NON-LIVING THINGS:

Factory
Boatyard
Power Plant
Sawmill
Office Building
Railroad Track
Bottles
Cans
Six-Pack Rings
Nets
Fishing Line
Trash/Litter
Old Tires

Hudson River Ecosystem Chart

Upper Hudson River Region (fresh)	Mid-Hudson River Region (brackish)	Lower Hudson River Region (saltier)
Living:	Living:	Living:
Non-Living:	Non-Living:	Non-Living:

Ecosystem Explorer's Journal

Imagine you are an explorer and you have just discovered the Hudson River. You want to record information about its ecosystems. Use your chart to create a setting for a creative journal entry. Use the list to describe the river ecosystem you have explored. If you have an item that is not a natural part of the ecosystem, be sure to include its presence and a description of the impact it may have on the ecosystem. Think about plant and animal species that could survive and could not survive in your river ecosystem.

Challenge

On the back of this paper, draw a picture of what your river ecosystem would look like.

Resources

Websites (Most descriptions provided by sources):

<http://www.caryinstitute.org>

A curriculum developed by the Cary Institute of Ecosystem Studies that introduces students to the basics of ecosystems. They will also learn about the history and geography of the Hudson River, the relationship between watersheds and water bodies, measurement tools that aquatic ecologists use to understand river ecosystems (including how dissolved oxygen and temperature affect important processes like respiration and photosynthesis), and how animals and plants interact to shape ecosystem function.

<http://www.poughkeepsiejournal.com/apps/pbcs.dll/article?AID=/200812280600/NEWS04/812280319>

A December 2008 article about the work of Hudsonia Ltd., a nonprofit environmental organization, and its work on the Hudson River ecosystem.

<http://www.dec.ny.gov/lands/33596.html>

A description of the Department of Environmental Conservation's Benthic Mapping project. Have you ever wondered what secrets lurk beneath the murky waters of the Hudson? A better understanding of the benthic area—the bottom of the river—helps with the understanding of the movement of sediments, plants, animals and their habitats. The Benthic Mapping Project was developed to find out more about the bottom of the river. Aerial photos cannot penetrate the cloudy waters of the Lower Hudson, so sonar systems and sediment samples were used instead to gather various information on depth, river-bottom contours, and sediment types.

http://www.dec.ny.gov/docs/remediation_hudson_pdf/hrlpadapt.pdf

Department of Environmental Conservation: Adaptations—Designs for Survival lesson plan.

Books

The Hudson: An Illustrated Guide to the Living River by Stephen Stanne, Roger Panetta, and Brian E. Forist. 2007.

River Wild: An Activity Guide to North American Rivers by Nancy F. Castaldo. 2006.

Eco-Inquiry: A Guide to Ecological Learning Experiences for the Upper Elementary and Upper Grades by Kathleen Hogan.

Lesson 2: Hudson River Food Chain

Objective

All living things depend on one another for survival and are impacted by non-living things that surround them.

Essential Question

How does pollution impact aquatic food chains?

Common Core Standards

- Science PS 3.1f, 4.1b, 4.2a
 - LE 1.1b, 1.1c, 1.1 a, 3.1a, 3.1b, 3.1c
- CCSS- ELA- Literacy
 - SL.4.1 / SL.4.2 / W.4.2

Skills

- species classification
- sequencing
- identification of food chains

Duration: 1 day (45 minutes)

- Discussion: 15 min
- Activity time: 30 min

Vocabulary

food chain – path that energy follows as it moves from one species to another

producer – a species that makes its own food without eating other species (ex: plants)

consumer – any organism that eats other living things to obtain energy.

decomposer – an organism that recycles organic material by breaking down dead organic material to get nutrients

ecosystem – area with its own unique physical conditions and community of plants and animals

living – alive

non-living – not alive

community – all of the living things in a particular place

organism – a living thing that carries out five basic life functions on its own

habitat – the environmental setting (living and non-living) which supports an individual organism or a community of organisms.

food web – path of energy transfer among species in an ecosystem

predator – an animal that hunts and eats other animals

Materials: Each student should have:

- Hudson River Food Chain Worksheet

Background

A community of different species interacting with one another and with the non-living environment in which they all live is called an ecosystem. There are many different kinds of ecosystems. Some ecosystems are aquatic ecosystems; these include habitats located at the shore, on the surface water, or under the water. A terrestrial ecosystem exists on land, such as a desert, forest, or grassland. A river's ecosystem provides the necessary ingredients for a community of plants and animals, working as a team, to survive in different habitats. There are three types of community members in any habitat: producers, consumers and decomposers. In order for all to survive, these community members participate in an inter-related system to make and get food called a food chain. Producers (such as plants) are at the beginning of the food chain; they make their own sugar in the form of glucose. Consumers get food from producers or from other consumers. Decomposers make their food by breaking down wastes or the remains of other organisms. The food chain concept allows us to understand important aspects of organisms' roles in ecosystems.

Activity

1. Students will discuss the importance of ecosystems and how animals survive in a given habitat. What resources do they need? (food, water, space, shelter)
2. Using prior knowledge of Hudson River species, students will complete the Hudson River Food Chain worksheet.

Hudson River Food Chain Worksheet

Define **Food Chain**

What are the primary producers of a food chain?

Describe how pollution affects a food chain.

FILL IN THE BLANK using the words below:

oxygen water sugar sun carbon dioxide

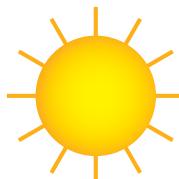
Photosynthesis is the process, energized by the _____ in which plants

convert _____ (H_2O) and _____ into _____
(glucose) and _____ (O_2).

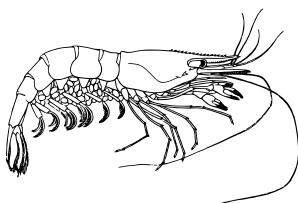
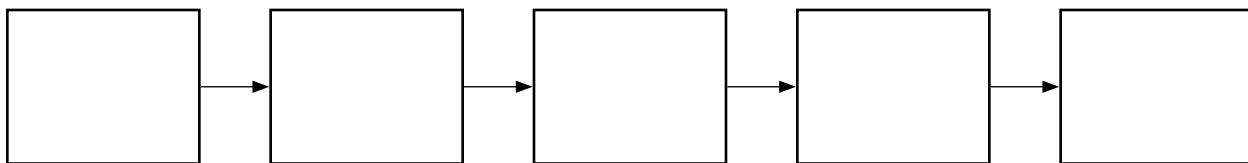
Fact: We get more oxygen from plants in the water than from plants on land.

Grade 4 Curriculum

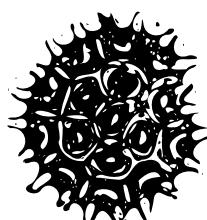
Create two separate food chains in the boxes writing the names of the Hudson River species listed below.



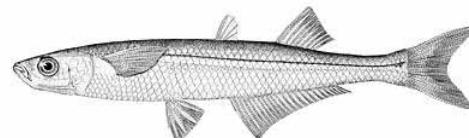
Energy Transfer →



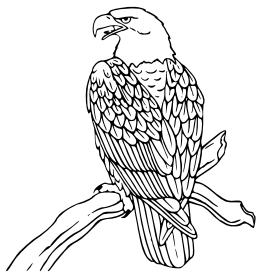
Shrimp



Phytoplankton
(plant plankton)



Atlantic Silverside



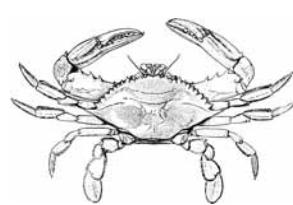
Bald Eagle



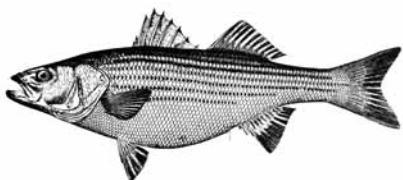
Oyster



Zooplankton
(animal plankton)



Blue Crab



Striped Bass



Amphipod



Banded Killifish

Assessment

- Completion of Food Chain Worksheet

Extensions

- Develop a food web using different animal and plant species and discuss how they differ from food chains.
- Research specific examples of food chains in the Saw Mill and/or Bronx Rivers.
- **PLAN A FIELD TRIP to the Sarah Lawrence College Center for the Urban River at Beczak (CURB) to reinforce the concepts learned.**
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - **Hudson River Food Chain** - Students role-play parts of the food chain and discover the interdependencies of plants and animals in the Hudson River watershed. See how those relationships change when pollution (PCB's) enters the system. The importance of plankton is emphasized.

Resources

Websites (Most descriptions provided by sources):

<http://pbskids.org/eekoworld/index.html?load=environment>

EekoWorld invites children to explore, experiment, and collaborate as they learn about conservation, the environment and the important role they play in taking care of the earth.

http://www.geography4kids.com/files/land_ecology.html

A website that teaches physical geography and earth science basics.

<http://www2.epa.gov/learn-issues/learn-about-water>

Discusses how careful preservation, protection and management of our natural resources will help sustain our environment for future generations.

http://www.ecostudies.org/IES_hudson_river.html

Discusses the ecological management of the natural resources of the Hudson River and promotes a broader awareness of the importance of ecological relationships to human welfare.

http://www.dec.ny.gov/docs/administration_pdf/2007jrnat5.pdf

Department of Environmental Conservation - Food chains.

http://www.primaryresources.co.uk/science/pdfs/food_chain_game.pdf

Food Chain Game.

Lesson 3: Biodiversity of Rivers

Objective

Students will define biodiversity and debate the impact that industrialization, deforestation, and pollution have had on the biodiversity of rivers.

Essential Question

How does pollution and development impact biodiversity of species?

Common Core Standards

- Science LE 5.2g, 6.1f, 7.1a, 7.1b, 7.1c
- CCSS- ELA- Literacy
 - RF.4.3 / SL.4.1 / W.4.2

Skills

- reading comprehension and writing
- collaborative learning

Duration: 45 minutes

- Preparation time: 5 min
- Activity time: 30 min
- Discussion: 10 min

Vocabulary

Biodiversity – a measure of the variety of different species or the variety of habitats and functions needed for the survival of species and biological communities

deforestation – the clearing of forests and trees

industrialization – The process in which a society transforms itself from a primarily agricultural society into one based on the manufacturing of goods and services

pollution – the presence in or introduction into the environment of a substance or thing that has harmful effects

endangered – in immediate danger of becoming extinct and needing protection to survive

extinct – no longer in existence

habitat – the environmental setting (living and non-living) which supports an individual organism or a community of organisms

species – a group of organisms having many characteristics in common

Materials: Each student should have:

- Species Sheets
- Habitat Scenario Worksheet

Background

Biodiversity refers to the large variety of plants, animals and other organisms that exist on earth. Our growing human population and increasing consumption of natural resources has had an enormous impact on natural ecosystems and the species within them, causing many species to die out (become extinct) and decreasing the biodiversity of our planet. Deforestation and pollution have also contributed to the decreasing biodiversity in our rivers and on our lands.

There are approximately 221 fish species found in the Hudson River. The estuary serves as a nursery for young fish, which includes about 50 species abundant in the tidal waters. The Hudson River estuary's diverse habitats—the wetlands, aquatic plant beds, shoreline and bottom of the river itself—are vitally important to the estuarine ecosystem and provide recreation, improved water quality, and scenic amenities to humans.

Activity

1. Write the word “biodiversity” on the board. Have the students break up the word into *bio* and *diversity* (diversity of life). List the associated words on the board and create the definition together as a class. Lead the group into a discussion about the importance of biodiversity and the impact **deforestation, pollution and industrialization** have had on biodiversity.
2. The teacher describes to the class the three scenarios that impact the environment of three different habitats. Give each group one species sheet. Each group will explain what happens to the various species on the species sheet based on the scenario selected. Give an example to start with and then give time for the students to work collaboratively.
3. Split the class into three groups and assign one species sheet to each group (marsh, river, and forest). Have each group discuss the impact of the scenario on the species' habitat. Each student can pick a specific species to write about in a paragraph and illustrate the habitat, indicating what happens to the species when the scenario occurs.

Marsh Species



Snapping Turtle



Cattails



Muskrat



Dragonfly



Great Blue Heron



Fiddler Crab



Mummichog



Mudsnail

Photo credit: NYSEC Hudson River Estuary Program Staff

Photo credit: NYSEC Hudson River Estuary Program Staff

River Species



Photo Credit: Duane Raver/U.S. Fish and Wildlife Service

Atlantic Sturgeon



Shrimp



Striped Bass



Canada Goose



American Eel



Photo Credit: Stephen Starnes/NYSDEC

Blue Crab



Herring Gull



Beaver

Photo Credit: "American Beaver" by Steve from Washington, D.C. USA. American Beaver, released under CC BY-SA 2.0 via Commons. https://commons.wikimedia.org/w/index.php?title=American_Beaver&oldid=109111117

Forest Species



Fern



Trees



Raccoon



Great Horned Owl



White-Tailed Deer



Woodpecker



Chipmunk



Gray Squirrel

Habitat Scenario Worksheet

Habitat Scenarios

1. A forest is cleared to make a parking lot. (Example: a student with a tree species card would raise his/her hand and explain that the tree would not exist anymore and what the impact of that would be. Another student may have a bird species card and would explain what would happen to the birds as a result of the trees being cleared, etc.)
2. A marsh (a wetland dominated by plants in tidal areas) is drained to build a mall.
3. A factory dumps chemicals into a nearby river.

Habitat scenario

Species name _____

How does the scenario impact your habitat and the species living within it?

Assessment

- Class participation
- Writing assignment and illustrations

Extensions

- **PLAN A FIELD TRIP** to the **Sarah Lawrence College Center for the Urban River at Beczak (CURB)** to reinforce the concepts learned.
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - **Catch of the Day Seining** - Find out what lives under the waves by dragging a 30-foot seine net through the water to catch fish and other remarkable Hudson River creatures. Students keep a tally of our catch and draw conclusions by graphing the total outcomes. We provide chest waders to help keep students dry. While waiting their turn at seining, students embark on a marsh scavenger hunt to see how many Hudson River treasures they can find.

Resources

Websites (Most descriptions provided by sources):

http://www.amnh.org/nationalcenter/kids/kids_bio/interviews.html

Learn and Teach: Interesting facts, games, and interviews with scientists from the American Museum of Natural History's Hall of Biodiversity.

<http://www2.scholastic.com/browse/article.jsp?id=3748714>

An article on biodiversity with links to other teacher resources.

<http://www.dec.ny.gov/lands/5094.html>

Department of Environmental Conservation: Habitat and biodiversity program for the Hudson River Estuary Watershed.

<http://www.dec.ny.gov/education/73131.html>

Department of Environmental Conservation: Science Lesson Plans.

Lesson 4: A Case Study: The Atlantic Sturgeon

Objective

Students will study the Hudson River Atlantic sturgeon and generate practical ideas for improving the treatment of the environment. Students will be expected to use written, visual or verbal means to communicate information to the public.

Essential Question

Why is the Atlantic Sturgeon an endangered species?

Common Core Standards

- Science LE 5.2g, 6.1f, 7.1a, 7.1b, 7.1c
- CCSS- ELA- Literacy
 - W.4.2 / W.4.7

Skills

- critical thinking
- note-taking
- reading comprehension
- creating an informational brochure

Duration: 2 days (60 minutes each)

- Day 1: Students will review articles on the Atlantic sturgeon, gather information and keep notes on the Atlantic Sturgeon Fact Sheet.
- Day 2: Using the research information, students will brainstorm ideas for what information could be included in a brochure about the sturgeon and how to convey the information.

Research should include the following:

- characteristics of the Atlantic sturgeon
- history of the sturgeon
- why sturgeon are in danger
- conservation efforts
- number of sturgeon found in the Hudson River



Vocabulary

sturgeon – a very large primitive fish with bony plates on the body, found in temperate seas and rivers and of commercial importance for its caviar (fish eggs) and flesh

endangered – in immediate danger of becoming extinct and needing protection to survive

awareness – concern about and well-informed interest in a particular situation or development

conservation – preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife.

stewardship – the action of taking care of something such as the environment

prehistoric – of, relating to, or existing in times predating written history

scute – boney plates located on the sturgeon for protection.

barbels – whisker-like appendages located near the mouth, used for sensing food

anadromous – describes fishes which live in the sea as adults but move to freshwater streams to spawn

Materials

- Atlantic Sturgeon Fact Sheet
- examples of brochures
- 11 x 17 white paper
- markers
- Internet access

Background

Author Eileen Stegemann asks us to “Imagine going fishing on your favorite lake or river and hooking a 300-pound monster. Or perhaps, while boating, you see a 7 to 10-foot “floating log” suddenly dive beneath the water’s surface. Or imagine not being able to take your boat out on the river because the channel is so full of huge spawning sturgeons that navigation is dangerous. Scenes like these were commonplace occurrences as people came into contact with our once plentiful sturgeon.”

People have long valued the sturgeon for its eggs, used for caviar. The Hudson River south of Troy was once full of Atlantic sturgeon, which could grow to 6 to 14 feet in length and weigh more than 200 pounds; they were one of the main “crops” of the river’s commercial fishing industry. But sturgeon populations have decreased drastically over the last 200 years because of over-fishing and the industrial pollution of their spawning grounds in the Hudson. Today, in spite of a 1996 moratorium against fishing for sturgeon in New York State, the Atlantic sturgeon, the largest of New York’s sturgeons, is at its lowest population level in 120 years.

There are two species of sturgeon found in the Hudson, the Atlantic sturgeon (*Acipenser oxyrinchus*) and the shortnose sturgeon (*Acipenser brevirostrum*). They are very primitive fish and in evolution fit somewhere between sharks and bony fishes. They have a dinosaur-like appearance, featuring rows of armor plates called **scutes**, which protect the sturgeon when they are small and vulnerable. As it grows, the fish needs less protection due to its rather ominous presence and size. Sturgeon can live up to 60 years or more. The sturgeon are benthic fish, living life along the river bottom, smelling and feeling for food using **barbels** located near the mouth. When the barbels detect food, the mouth protrudes to form a vacuum-like tube that sucks smaller invertebrates and fish up off the bottom.

Sturgeon are slow-moving fish and often swim solitarily along the bottom. On occasion, they can be seen skimming the surface waters.

The Atlantic sturgeon is the largest fish in the Hudson River. They can weigh up to 500 pounds at an average of 11 feet long. They are **anadromous** fish, meaning they spend most of their life in saltwater, only entering the Hudson River estuary each year to spawn.

Activity

1. You have been given the task of renaming one of the rivers in Yonkers (i.e. the Bronx River, Hudson River, or Saw Mill River). What would you name it, and why? Each student will create a new river name, completing the Origin of Rivers Worksheet.
2. Construct an essay providing a rationale for your name choice. In your essay, be sure to address the following points:
 - Current name of the river and what you think the new name should be
 - Location of the river
 - Historical significance of the river, and how it relates to the development of New York State
 - Reason for your name

Activity

Ask students to think about the different types of advertisements they have been exposed to. Discuss how organizations get messages out to the public (e.g. radio ads, presentations, television ads, music videos, newspaper ads, posters, and brochures). Show different examples.

After students have researched and organized notes on the Atlantic sturgeon, they will create a brochure. Each student will be given one piece of 11x17 white paper. The student will have to measure the length of the paper and divide it into three equal sections. The tri-fold brochure must include the following criteria:

- Organize the information collected from their research notes in written draft form.
- Design brochure using software programs on the computer, if available.
- Include online images or personal drawings of sturgeon.
- List websites and books as references

Resources

Websites (Most descriptions provided by sources):

<http://news.nationalgeographic.com/news/2007/02/070207-sturgeon.html>

National Geographic: “Once endangered sturgeon rebounding in the Hudson River”.

<http://www.dec.ny.gov/lands/66626.html>

Department of Environmental Conservation: Information and slideshow on the sturgeon.

<http://www.dec.ny.gov/animals/7025.html>

Department of Environmental Conservation: Sturgeons in New York State.

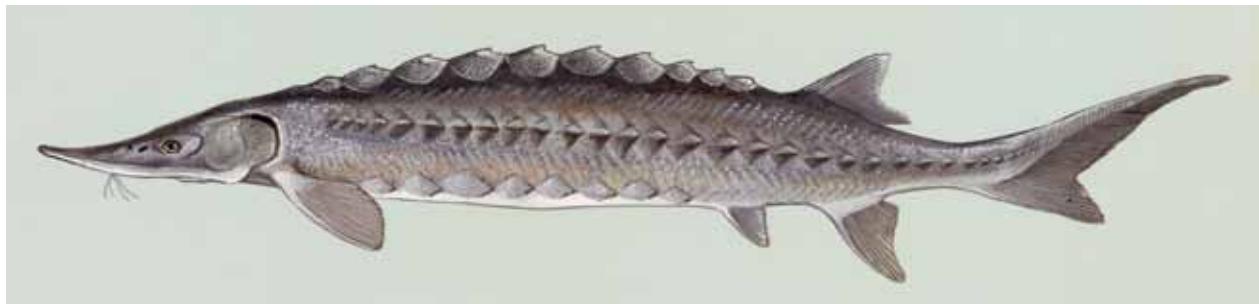


Photo credit: Diane Povet, U.S. Fish and Wildlife Service

Hudson River Atlantic Sturgeon Fact Sheet

Scientific name _____

Diet _____

Habitat and distribution _____

Adaptations/Physical Features _____

Why are they in danger? _____

Conservation efforts _____



“Accident is the name of the greatest of all inventors.”

Mark Twain

Unit 3: Industry and Transportation

Lesson 1: River Industry

Objective

Students will learn about rivers, railroads, and their roles in the industrial revolutions of New York and the United States. Using the knowledge gained they will write a creative story depicting the industrial growth of the Hudson River by developing an illustrated journal.

Essential Question

How does industrialization affect rivers?

Common Core Standards

- Science
- CCSS- ELA- Literacy
 - R1.4.1 / L.4.1 / RF.4.4

Skills

- critical thinking
- note-taking
- reading comprehension
- journaling
- creative writing

Materials

- *The Great Railroad Race: The Diary of Libby West* by Kristiana Gregory (1999)
- writing rubrics
- story element posters (5)
- graphic organizers (1 per group)
- story booklets (10 pieces of paper stapled together in a book format)
- art materials for illustration and publication (markers, colored pencils, etc.)

Duration: 10 days (40 minutes each day)

The class reads *The Great Railroad Race: The Diary of Libby West* and discusses the plot, characters, and problem the story addresses.

- Day 1: Begin class with discussion of the elements of a story. Make posters for each element (i.e. setting, characters, events, problems, solutions). Read 25 pages.
- Day 2: Read 25 pages and fill in posters.
- Day 3: Read 25 pages and fill in posters.
- Day 4: Read 25 pages and fill in posters.
- Day 5: Read 25 pages and fill in posters.
- Day 6: Read 25 pages and fill in posters.
- Day 7: Read 25 pages and fill in posters.
- Day 8: Read 25 pages and fill in posters.
- Day 9: Sharing Ideas (prewriting/brainstorming): Review the different elements of Libby's story and lead the class in a discussion planning for the students' stories. Students will work in groups to make a plan on paper using a simple 4-square graphic organizer for their own group story: a piece of paper folded into 4 parts to show a story's setting, character(s), problem, and solution—the story elements.
- Day 10: Students will use their graphic organizers to create their own stories in the booklets provided to them which will be 'published' for their classmates to read. Students are expected to use capital letters and punctuation correctly and illustrate where possible. Students will refer to their writing rubrics to help them evaluate their writing. The group will choose a title for their story.

Vocabulary

Industrial Revolution – the rapid development of industry that occurred in Britain in the late 18th and 19th centuries, brought about by the introduction of machinery. It was characterized by the use of steam power, the growth of factories, and the mass production of manufactured goods.

shipping – the movement of goods by sea or some other means of transportation

railroad – a permanent road having a line of rails fixed to ties and laid on a roadbed that provides a track for train cars or equipment drawn by locomotives or propelled by self-contained motors; a system of railroad tracks

cargo – goods, freight, or merchandise carried on a ship, aircraft, or motor vehicle

factory – a building or group of buildings where goods are manufactured or assembled chiefly by machine

bricking industry – the business of making bricks out of clay and shale that were fired in a kiln. Bricks were the new building material of the Industrial Revolution because they lasted longer and were safer than wood materials for businesses and homes.

Gilded Age – The period from 1870-1900 in the United States defined by a rapidly expanding economy, population growth, booming industry, and increased wealth. This term was coined by Mark Twain.

bridge – a structure carrying a road, path, railroad, or canal across a river, ravine, road, railroad, or other obstacle

Background

In America, as in most other countries, rivers have always been considered free for anyone to use for fishing or travel. Rivers cannot be owned by one person or company, and anyone can fish in them or use them for travel. Before there were many roads, rivers were the primary means of transportation, carrying people and goods from place to place. The very first law passed by the United States Congress after the Revolutionary War said these "navigable waters," as well as "the carrying places between the same, shall be common highways, and forever free" to the public, "without any tax, impost, or duty."

This meant that rivers became the primary way to move people and goods, and the towns and cities that were located along big rivers grew into major commercial centers. When the Erie Canal, which connected the Hudson River to Lake Erie—and thus the cities of Albany and Buffalo to one another—opened in 1825, it cut the cost of transporting goods from New York City to the Midwest by 95%. The 363-mile-long canal encouraged a lot of people to move to the middle part of New York State along the route of the canal and made New York City the chief United States port.

Unlike farmers, fishermen do not have to own land or water in order to harvest their 'crop.' Fishing became an important industry on rivers because fishermen were free to keep any fish they caught, unless a fish was protected by government regulations. The Hudson River, for example, became important for striped bass, shad and sturgeon fishing, but as the river became increasingly polluted, these fish almost disappeared. As a result of sustained efforts to clean the river over the last 30 years, shad and striped bass have now returned to the river to live and spawn, but sturgeon are still protected because of over-fishing.

Many river towns became major industrial centers because industries were founded on the banks of rivers to take advantage of the river for transportation. For example, Cold Spring—on the Hudson River across from West Point—was the home of the West Point Foundry. President Madison established by the foundry during the War of 1812 as one of just four to manufacture metal parts needed to supply the war, including engines, engine parts, and cannonballs. After the war's end the foundry continued to thrive because of its location on a primary transportation route, and the Erie Canal helped things along by connecting the Hudson to the rest of New York state.¹

When railroads started connecting the country in the 19th century, many rivers and river towns lost their place as the country's major transportation routes. The first transcontinental railroad, built from 1863-1869, became a vital link for commerce, trade, and migration for many Americans. The story read in this unit will provide greater detail on this transition.

1. Haynes, Rebecca. "A Region Steeped in History Preserves its Past." *Historic Hudson River Towns*. Accessed July 31, 2015. <http://www.hudsonriver.com/hudson-river-history>

Activity

1. Read the book *The Great Railroad Race: The Diary of Libby West*. As you read, take time each day to fill in the story element posters, which will be reviewed at the end of the book. Put up a poster entitled “Setting,” explain that the setting is where and when the story takes place. Ask the students to identify the setting of the book. For each response, refer back to the book, asking “How does it tell us that?” and help the students remember a passage or a phrase. Write down what the students give you for the setting. Repeat the process for “Characters,” “Events,” “Problem,” and “Solution.”
2. Review Libby’s story elements and lead the students in groups to create their own stories of the Industrial Revolution in a journal style similar to Libby’s, but focusing on the Hudson River rather than the Utah territory. Students will fill out their own elements in a graphic organizer which will be used the following day to write out their story for publishing.
3. Students work together to create their own story, which will be displayed for their classmates to read. Students will be evaluated as follows—

Assessment: Good writing has:

- ideas that are interesting and important
- organization that is logical and effective
- voice that is individual and appropriate
- word choice that is specific and memorable
- sentence fluency that is smooth and expressive
- conventions that are correct and communicative

Teacher will evaluate the students’ writing based on the writing rubric and the above criteria.

Resources

Websites (Most descriptions provided by sources):

<http://www.history.com/topics/inventions/transcontinental-railroad>

Transcontinental Railroad (History Channel video).

<http://www.catskill.net/purple/bricks.htm>

The Great Hudson River Brick Industry.

<http://www.scenichudson.org/news/release/scenic-hudson-receives-two-awards-work-west-point-foundry-preserve/2014-12-05>

Describes the West Point Foundry, its place in the development of commerce along the Hudson River, and its current role as a public park.

<http://www.poughkeepsiejournal.com/hudson/stories/sb900.shtml>

Describes former thriving industries on the Hudson River.

<http://www.hudsonriver.com/hudson-river-history>

Information about historic Hudson River Towns.

Lesson 2: A River Story

Objective

As an entry point into the study of steamboats, students will read *River Boy: The Story of Mark Twain*. Students will be able to identify various aspects of life on a river with a focus on shipping and transportation.

Essential Question

What impact does shipping and transportation have on rivers?

Common Core Standards

- Science
- CCSS- ELA- Literacy
 - 4.1.D / W.4.3 / W.4.4 / W.4.5

Skills

- listening comprehension
- collaborative learning
- creative writing
- critical thinking
- note-taking

Duration: 6 days (45 minute lessons)

- Day 1: Read aloud (whole class)
- Day 2: Class discussion of life along the river/note taking
- Day 3: Graphic organizers to plan stories
- Day 4: First draft
- Day 5: Edit and revise drafts
- Day 6: Publication and celebration

Materials

- *River Boy: The Story of Mark Twain*, by William Anderson
- graphic organizers
- construction paper
- crayons
- computer/Internet access

Background

Mark Twain was the pen name of Samuel Langhorn Clemens, born November 30, 1835.

Twain is best known for the novels *The Adventures of Tom Sawyer* and *The Adventures of Huckleberry Finn*. In addition to being a writer, he also worked as a riverboat pilot, journalist, lecturer, business man and inventor.

Clemens was raised in the city of Hannibal, Missouri, a Mississippi River town that inspired the locales in his famous novels. As a child, he saw violence, alcoholism and poverty in his hometown along the river and even witnessed two murders, including a master killing a slave. These experiences were to influence his most famous works. At the age of twelve, his father died of pneumonia, so he left school and went to work. He began as an apprentice printer at a local newspaper, the *Hannibal Courier*, in exchange for a bit of food. He later moved on to the newspaper owned by his brother Orion, the *Hannibal Western Union*, where he began learning the writer's trade.

When he was 21, Clemens at last pursued a childhood dream and became licensed as a steamboat pilot. He enjoyed a brief career exploring the Mighty Mississippi until the Civil War interrupted life on the river and pleasure boats stopped running. So Clemens set out for the west coast, where he honed his craft as a newspaperman and established his reputation as a great storyteller. He wrote everything from fiction to nonfiction social commentary, poking fun at people he felt were too full of themselves. He soon became famous for his quick wit and cutting commentary. It was during this time that he took his pen name, Mark Twain, a steamboat term for a depth of 12 feet of water. He was well on his way to becoming one of America's great writers.

Mark Twain died April 21, 1910, at the age of 74 in Redding, Connecticut, and was buried in Elmira, New York. He is considered one of the great American writers, called "The Father of American Literature" and "America's First Celebrity." In his time, he was one of the most famous and celebrated Americans in the world. His novels are taught in schools and colleges nationwide. Scholars and writers consider *The Adventures of Huckleberry Finn* to be one of the most important American novels, and the great American writer Ernest Hemingway famously wrote, "All modern American literature comes from one book by Mark Twain called *Huckleberry Finn*." In all, Twain wrote 28 books and numerous articles and short stories.²

Activity

1. The students will be asked to take notes while reading *River Boy: The Story of Mark Twain*. The students will use a 'story elements' graphic organizer to record their notes. As a class they will discuss various aspects of life on the river based on the boy's experiences in the story. The discussion will focus on the development of the steamboat
2. Students will be given the task to create their own river story experience incorporating what they learned about rivers and steamboats. Students who require additional support will be provided with a pre-writing graphic organizer to plan their first drafts. *Student stories should include a title, beginning, middle and end. Their stories should discuss the importance of steamboats as it relates to their character(s).*

2. "Mark Twain." Bio. A&E Television Networks, 2015. Web. 29 July 2015.

Assessment

- Evaluate student graphic organizers to see if students included all story elements (i.e. characters, setting and plot) based on the story of Mark Twain.
- Student stories will be evaluated based on the New York State English Language Arts (ELA) 4-point writing rubric.

Extensions

- Research another autobiography of an influential person involving rivers and industry.
- Create a Hudson River mural depicting Hudson River industry. Research information on the Hudson River School of Painting.

Resources

Websites (Most descriptions provided by sources):

<http://www.pbs.org/marktwain/learnmore/chronology.html>

Mark Twain, a timeline.

<http://www.pbs.org/marktwain/learnmore/activities.html>

Mark Twain classroom activities.

<http://www.marktwainmuseum.org>

Mark Twain Museum site.

<http://www.williamandersonbooks.com>

Author's webpage includes bibliography, a biography, and a personal interview.

<http://www.biography.com/people/mark-twain-9512564#heading-out-west>

Article and video on A&E about Mark Twain.

Books

Hudson River Pilot: From Steamboats to Super Tankers. Captain John G. Hamilton. 2001.

The Ghost Belonged to Me. Richard Peck. 1983

Steamboats: The Story of Lakers, Ferries, and Majestic Paddlewheelers. Karl Zimmermann; photography by the author. 2007.

Lesson 3: Steamboats of the Hudson

Objective

Students will learn about Robert Fulton's 32-hour steamboat trip from New York City to Albany and the role the Hudson River played in its success. Students will discuss the connection between Fulton-Champlain and the celebration of the Hudson River 400th anniversary.

Essential Question

What vital role do steamboats have on the Hudson River?

Common Core Standards

- Science
- CCSS- ELA- Literacy
- 4.1.D / R1.4.3 / R1.4.3

Skills

- collaborative learning
- critical thinking
- note-taking
- reading comprehension

Duration: 3 days (45 minute lessons)

- Day 1: Story and Note Taking
- Day 2: Quadricecentennial Poster Contest (Groups of 3)
- Day 3: Poster Presentation and Celebration

Vocabulary

bicentennial – relating to or celebrating a 200th anniversary

quadricentennial – relating to or celebrating a 400th anniversary

commerce – the buying and selling of goods, especially on a large scale, as between cities, states, or nations

exploration – the act or an instance of exploring or investigating

viability – the degree to which something is capable of existence and development as an independent unit

steamboat – a boat propelled by a steam engine, especially a paddle-wheel craft of a type used widely on rivers in the 19th century

Materials

- *A Head Full of Notions: A Story About Robert Fulton*, by Andy Russell Bowen
- Steamboat Fact Sheet
- Steamboat Worksheet
- poster board
- crayons/paint/brushes/markers
- Internet access



Background

In 1787, inventor John Fitch designed the first 45-foot steamboat and launched it on the Delaware River. Many other engineers and inventors were also working around this time to design a successful boat run by steam that could transport goods and people long distances no matter what the weather. The most successful steamboat was designed by Robert Fulton, who is credited with making the steamboat a commercial success. Robert Fulton was born in 1765 at Little Britain, Connecticut. Originally an artist, he became an inventor and engineer. His first boat, the *Clermont*, traveled from New York City to Albany on August 7, 1807, in 32 hours, and in 1811 his boat the New Orleans became the first steamboat to transport people and freight up and down the Lower Mississippi. Throughout the east, steamboats transported supplies for farms and industry, thereby helping the economy grow.

The year 2007 marked the 200th anniversary of Robert Fulton's historic, 32-hour steamboat trip from New York City to Albany, which demonstrated that steamboat travel on the Hudson was attainable. This historic event took place just two years before the 400th anniversaries of Champlain's exploration of the lake that now bears his name and Henry Hudson's voyage up the Hudson River.

Activity

1. As a class, students will have a turn at reading sections of *A Head Full of Notions: A Story about Robert Fulton* by Andy Russell Bowen. The students will use the Steamboat Fact Sheet to record their notes. After the reading, the class will discuss the advantages of travel by steamboat. The discussion will focus on the role Robert Fulton played in the development of commerce along the Hudson.
2. Students will complete the Steamboat Worksheet which will be incorporated into a poster commemorating the 400th celebration of the Hudson River and its history. (The quadricentennial took place in 2009.) Students will be required to include one aspect of the progression of transportation along the Hudson.

Steamboat Fact Sheet

Use this table to keep track of the many facts you have learned today about steamboats.

IMPORTANT DATES	IMPORTANT PEOPLE	IMPORTANT WORDS	FUN FACTS
<i>Example: 1807</i>	<i>Robert Fulton</i>	<i>steamboat</i>	<i>It took Fulton 32 hours to travel from NYC to Albany by boat, which would have taken 72 hours by horse!</i>

Steamboat Worksheet

Using the list of living and non-living things, complete the Hudson River Ecosystem Chart indicating the three regions of the Hudson River. Remember to keep in mind the different water types found in each region.

1. _____ were large, box-shaped boats that could move up to 100 tons of cargo downstream. They were usually _____ after their trip and their wood was sold.

2. Name one of the steamboats you learned about today: _____

3. The average lifespan of a steamboat was only _____ years. Why was this?

4. List two ways that the steamboat made life better for people in the 1800s:

5. Compare and contrast the features of a flatboat and a keelboat:

Flatboat _____

Keelboat _____

6. What year did the first steamboat go into regular service on the Hudson River? _____

7. In 1817, there were 17 steamboats in service in the Americas, which had increased to _____ steamboats by the 1860s.

8. Why did steamboats begin to vanish from rivers in the late 1800s?

Steamboat Worksheet Answer Key

1. a. flatboats
b. broken up

2. Possible Answers:

- a. Alfred T. Lacy (one of the steamboats Mark Twain piloted)
- b. Rufus J. Lackland (another steamboat Mark Twain piloted)
- c. Clermont (first steamboat piloted by Robert Fulton)
- d. New Orleans (first steamboat piloted by Fulton to carry people and freight)

3. a. average lifespan of a steamboat: 5-6 years

- b. reasons for short lifespan:

- accidents and wreckages
- fires and boiler explosions
- wooden materials that the boats were made of wore out quickly

4. Possible answers:

- a. faster travel for people and freight
- b. larger amount of cargo because the boats could carry more weight
- c. increased the number of towns and river industry
- d. the linkage of major cities along rivers
- e. entertainment: Steamboat races were popular attractions.

5. Flatboat

- a. large, box-like vessels
- b. made out of rough lumber
- c. nearly 100 feet long

- Keelboat

- a. moved upstream with the use of oars made
- b. up to 80 feet long

6. 1808 (following Fulton's maiden voyage in 1807)

7. 700

8. Possible answers:

- a. the invention and popularization of trains, which moved people and goods more quickly and more safely
- b. their replacement by boats with iron bottoms rather than wood

Assessment

- Evaluate student fact sheet to check for understanding and comprehension of the story.
- Student posters will be evaluated and graded based on the New York State English Language Arts (ELA) and arts 4-point writing rubric.

Resources

Websites (Most descriptions provided by sources):

<http://www.nysl.nysed.gov/mssc/steamboats/timeline.htm>

A Timeline of Steamboats on the Hudson.

<http://www.exploreyny400.com>

Commemoration of the past while celebrating the present – Hudson, Fulton and Champlain.

http://www.hudsonrivervalley.org/themes/hudsonfulton_champlain_quad.html

The Hudson River Valley Institute: Gateway to Historic Hudson River Valley.

http://www.accessgenealogy.com/newyork/hudson/hudson_steamboats.htm

An accurate history of the growth and development of steam navigation on the Hudson, from the building of the Clermont by Robert Fulton to the building of the superb steamers of the Hudson River Day Line.

http://thehistorybox.com/ny_city/nycity_transport_hudson_river_steamboats_article00586.htm

Famous Hudson River Steamboats.

<http://www.nypl.org/research/hudson/search/steamboats1.html>

Travel along the Hudson River in photos.

http://academickids.com/encyclopedia/index.php/Robert_Fulton

Life of Robert Fulton.

<http://inventors.about.com/library/inventors/blsteamship.htm>

The History of Steamboats and the inventors John Fitch and Robert Fulton.

Books

Robert Fulton: From Submarine to Steamboat by Steven Kroll; illustrated by Bill Farnsworth, 1999

Robert Fulton: Inventor and Steamboat Builder by James M. Flammang, 1999

Robert Fulton by Jennifer Blizin Gillis, 2004

What got you started, Mr. Fulton?: A Story of James Watt & Robert Fulton by Robert Quackenbush, 1982

Lesson 4: Effects of Industrialization on Biodiversity

Objective

Students will explore how industrialization has affected the biodiversity of the Saw Mill River.

Essential Question

How does industrialization affect biodiversity of rivers?

Common Core Standards

- Science
- CCSS- ELA- Literacy
 - R1.4.7 / R1.4.6
- Math

Skills

- graphing
- comparing/contrasting

Duration: 45 minutes

- Discussion: 10 min
- Part 1: Activity: 15 min
- Part 2: Graphing: 20 min

Materials: Each student should have:

- an ample supply of beans of different types (e.g. pinto, black, lima)
- graph paper (2 pieces)
- Biodiversity Activity Worksheet

Background

The Saw Mill River extends 20 miles from Chappaqua to Yonkers. It is one of the smallest tributaries of the Hudson River as well as the southernmost. Originally called the “Nepperhan,” which means “trap fishing place” in Wechquaescheck, the name of the river changed to the Saw Mill during the Age of Industrialization, with the first saw mill appearing in Yonkers by the Philipse Manor Hall.

The city of Yonkers developed in the 1800s and 1900s primarily as a result of the rise of waterfront industries on the Saw Mill River. The river was most commonly utilized as a power source. Improved methods of transportation, mechanization, and steam power during this time period allowed for the permanent placement of saw mills and other factories. The use of land along the river for factories and other industries, the dumping of sewage into the river for industrial waste disposal, the use of the Saw Mill as a roadway transportation corridor, and a growing urban population all have affected the river's ecosystems since the 1800s.

The Saw Mill River is considered healthy in Northern Westchester, but in Yonkers, it has been redirected into a rectangular concrete-lined channel with the final mile of the river in downtown Yonkers buried from Chicken Island to Dock Street. There have been many attempts to clean up the polluted river since its rerouting underground in the 1920s.

The Saw Mill River daylighting project was completed in 2012. Now the river is accessible to the public for viewing and educating themselves on the history and ecology of the Saw Mill River. For more information go to <http://daylightyonkers.com>.

Activity

1. As a class, complete KWL Chart about the Saw Mill River.
2. Discuss how industrialization in Yonkers affected the Saw Mill River.
3. Complete Saw Mill River Biodiversity Activity Worksheet.

Assessment

- Compare and contrast the before and after charts of the Saw Mill River biodiversity.

Extensions

- Make illustrations of the Saw Mill River before and after industrialization.
- What does the Saw Mill River look like today? Research the Daylighting project.

K.W.L. Chart

Topic: _____

K What I Already Know	W What I Want To Know	L What I Have Learned

Biodiversity Activity Worksheet

Part 1: Students will list different species that live in a forest habitat (see list in Lesson 3 as a start). Students will assign a specific bean type to represent each of the species from the student-generated list. Scatter the cup of beans randomly around this sample habitat. Count the beans/species in each of the sample spaces.

1.	2.	3.
4.	5.	6.
7.	8.	9.

How many beans/species are within each sample space?

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____

Now draw a river across the sample spaces and remove any woodland beans/species from the river. Consider what species would be at home in the river habitat (again, see the list for river habitat species in Lesson 3. Add different types of beans to represent species in the river.

How many species did you lose? _____ How many did you gain? _____

As a class, how many species are within the ecosystem? _____

Add/draw industrial factories/areas and remove any species that would be impacted.

How many species are now within the sample area? _____

As a class, how many species are within the entire ecosystem? _____

Part 2: Using graph paper, students will transfer class data from the total number of species from sample space charts representing the ecosystem to graph the number of species living in the habitat before factories were located in the area compared to how many species still lived in the habitat after the factories were built.

Be sure to include the following for each chart:

- title
- proper scale
- label each axis
- accurate representation of data



“Government cannot close its eyes to the pollution of waters, to the erosion of soil, to the slashing of forests any more than it can close its eyes to the need for slum clearance and schools.”

Franklin D. Roosevelt

Unit 4: Quality of Water

Lesson 1: Watersheds

Objective

Students will understand watersheds and how the water quality of rivers can be altered by pollution within the watershed. They will also be able to identify the sources of land pollutants that may cause the deterioration of a river's water quality and illustrate the concept of runoff, how water flows from higher elevations to lower elevations.

Essential Question

How does pollution affect the water quality of rivers?

Common Core Standards

- Science K-4 (2.1, 6.2, 7.2)
- CCSS- ELA- Literacy
 - SL.5.1

Skills

- mapping
- observation and documentation
- data analysis

Duration: 55 minutes

- Preparation time: 10 min
- Activity time: 30 min
- Discussion: 10 min
- Closing activity: 5 min

Vocabulary

watershed – an area or region drained by a river, river system, or other body of water

pollutants – chemicals or wastes that have a harmful effect on the environment

runoff – the draining away of water from the surface of an area of land

water quality – the degree of purity of a body of water

permeable – allowing liquids or gases to pass through

impermeable – not allowing fluid to pass through

valley – a low area of land between hills or mountains, typically with a river or stream flowing through it

mountain – a large natural elevation of the earth's surface rising abruptly from the surrounding level

hill – a naturally raised area of land, not as high or craggy as a mountain

urban – relating to or characteristic of a city or town

suburban – characteristic of an outlying residential district of a city

agriculture – the science or practice of farming, including the growing of crops and the rearing of animals

forested – covered with forest; planted with trees

Materials: Each student should have:

- poster board
- water-based markers
- plastic tray
- spray bottle
- topographical map of the Hudson River Watershed

Background

The Environmental Protection Agency, or EPA, offers a comprehensive definition and description of watersheds: "The land we live on is divided into watersheds. A watershed is a land area whose runoff drains into any river, stream, lake, or ocean. Small watersheds, such as the watershed for the creek behind your house, or the watershed for the pond down the road, drain into small bodies of water, and cover small land areas. The runoff from small watersheds join together, and their combined areas become a new, larger watershed. Large watersheds, such as the Mississippi Basin and the Chesapeake Bay watershed, drain into large bodies of water, and cover immense land areas. Despite their differences in sizes, all watersheds share common properties. They all perform the same function of transporting water over the Earth's surface. The watersheds encompass suburban lawns, parking lots and city streets. Water seeps down through the soil to aquifers, which are underground formations in rock and soil that contain enough ground water to supply wells and springs."

"Many human activities have an effect on watersheds. Construction projects like dams can limit the flow of water; construction of roads and buildings can divert and even increase the flow of water. Agricultural fertilizers can run off of crop fields and inadvertently fertilize harmful microorganisms in rivers and lakes, having an adverse effect on water quality and marine life. The irresponsible disposal of household and industrial chemicals can be harmful because these chemicals travel through the watershed, poisoning life and damaging natural ecosystems."¹

Watersheds are also important for humans. Many communities use rivers, streams and aquifers as their source of drinking water. For example, New York City brings its water from reservoirs in the Catskill Mountains and makes sure that this water remains safe to drink. Water is often treated to make it safe for human consumption, but if there are chemicals and harmful microorganisms in the water, it can be difficult to treat effectively.²

"Floods are one of the major events in a watershed. Homes built on flood plains, low lying areas adjacent to rivers, are susceptible to flooding conditions when heavy precipitation exceeds the watershed's capacity to absorb water. Rivers, streams, and lakes overflow, threaten human lives, and damage or destroy roads, buildings, and flood-control measures. Watersheds can also become dry, causing water shortages for those who depend on their lakes and rivers for drinking water.

"It is clear that humans have a close relationship with watersheds. The responsible planning of watershed use and development is important to ensure that the ecosystems sustained by the watersheds are not destroyed, and to protect the health and safety of our communities."³

1. "Build Your Own Watershed." *Environmental Protection Agency*. June, 1998. Accessed July 28, 2015. http://water.epa.gov/learn/kids/drinkingwater/activity_grades_9-12_buildyourownwatershed.cfm

2. Ibid.

3. Ibid.

Activity

1. Discuss the definition of **watershed**. Activate prior knowledge of surfaces which are permeable and impermeable to water. Then review the concept of water runoff.
2. Show a topographical map of the Hudson River and brainstorm what pollutants are likely to be on the land in an urban area that would run off when it rained. After students generate a list of pollutants, assign each pollutant a color marker.
3. Have students draw the pollutants with water-soluble markers on crumpled poster boards (shaped into hills, valleys and mountains in the plastic tray which will represent a watershed area).
4. Have the students spray the pollutants with water and have the students observe the runoff in the watershed area. Examine the path of the pollutants as well as the color of the water in the tray.
5. Discuss the observations and the results of the demonstration. Also, challenge the students to relate the runoff experiment to other types of watershed areas (suburban, agricultural, forested).

Assessment

Students will share and discuss findings with the class.

Extensions

- Students investigate a pollutant near their home which could runoff in a watershed.
- Look for storm drain markers on local streets.
- **PLAN A FIELD TRIP to the Sarah Lawrence College Center for the Urban River at Beczak (CURB) to reinforce the concepts learned.**
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - Hudson River Start to Finish – Students learn about Hudson River geography, estuaries, watersheds, tides, wetlands and pollution by participating in demonstrations using a one-of-a-kind Hudson River Estuary Model. They test water samples with **hydrometers** to compare **salinity**. Hudson River floor puzzle and mapping activity included during the wrap up.

Resources

Websites (Most descriptions provided by sources):

<http://water.epa.gov/aboutow/owow/>

Wetlands, Oceans and Watersheds – General site about wetlands and watersheds with links to specific sites dealing with local watersheds.

<http://ga.water.usgs.gov/edu/index.html>

USGS – Information about water and water quality produced by the U.S. Geological Survey.

<http://planning.westchestergov.com/environment>

Westchester County Government – Reviews, resources and activities in the county.

<http://www.dec.ny.gov/lands/26561.html>

Department of Environmental Conservation – Information about NYS watersheds.

<http://www.dec.ny.gov/lands/48019.html>

Department of Environmental Conservation – Information about the Hudson River watershed.

http://planning.westchestergov.com/index.php?option=com_content&view=article&id=834&Itemid=1461

Westchester County Land Use information.

http://planning.westchestergov.com/index.php?option=com_content&view=article&id=1394&Itemid=100017

Westchester County – Watershed Education Program.

<http://www.hudsonwatershed.org/hudson-riverwatershed.html>

Hudson River Watershed Alliance – Hudson River watershed information.

Lesson 2: Water Pollution

Objectives

Students will develop an understanding of water pollution and how it impacts plants and animals within watersheds and local communities. They will identify different forms of water pollution, create a slogan and an artistic representation for pollution prevention, and use the information learned to advocate for stewardship within the community.

Essential Question

How does pollution affect water quality of rivers?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science
- CCSS- ELA- Literacy
 - SL.5.1 / SL.5.4

Skills

- group work
- poster presentations

Duration: 1 hour

- Discussion about pollution: 15 min
- Group work: 30 min
- Poster presentations: 15 min

Vocabulary

pollution – the presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects

human impact – the effect or influence of human beings

point source pollution – pollution released via a pipe from a specific factory, treatment plant, or similar facility; for example, a sewage leak

Materials: Each student should have:

- pencils, paper, crayons, markers
- photographs/illustrations of different types of river pollution

Background

Plants and animals that live in rivers can be impacted by pollutants. Four common types of pollution are chemical pollution, organic pollution, thermal pollution, and ecological pollution. There are both natural reasons for pollution to occur as well as human actions that result in pollution. The Missouri Botanical Garden describes these well:

Toxic Substance – A toxic substance is a chemical pollutant that is not a naturally occurring substance in aquatic ecosystems. The greatest contributors to toxic pollution are herbicides, pesticides and industrial compounds.

Organic Substance – Organic pollution occurs when an excess of organic matter, such as manure or sewage, enters the water. When organic matter increases in a pond, the number of decomposers will increase. These decomposers grow rapidly and use a great deal of oxygen during their growth. This leads to a depletion of oxygen as the decomposition process occurs. A lack of oxygen can kill aquatic organisms. As the aquatic organisms die, they are broken down by decomposers which leads to further depletion of the oxygen levels.

A type of organic pollution can occur when inorganic pollutants such as nitrogen and phosphates accumulate in aquatic ecosystems. High levels of these nutrients cause an overgrowth of plants and algae. As the plants and algae die, they become organic material in the water. The enormous decay of this plant matter, in turn, lowers the oxygen level. The process of rapid plant growth followed by increased activity by decomposers and a depletion of the oxygen level is called eutrophication.

Thermal Pollution – Thermal pollution can occur when water is used as a coolant near a power or industrial plant and then is returned to the aquatic environment at a higher temperature than it was originally. Thermal pollution can lead to a decrease in the dissolved oxygen level in the water while also increasing the biological demand of aquatic organisms for oxygen.

Ecological Pollution – Ecological pollution takes place when chemical pollution, organic pollution or thermal pollution are caused by nature rather than by human activity. An example of ecological pollution would be an increased rate of siltation of a waterway after a landslide which would increase the amount of sediments in runoff water. Another example would be when a large animal, such as a deer, drowns in a flood and a large amount of organic material is added to the water as a result. Major geological events such as a volcano eruption might also be sources of ecological pollution.”⁴

4. "Water Pollution." Missouri Botanical Garden. 2006. Accessed July 28, 2015. <http://www.mbgnet.net/fresh/pollute.htm>

Activity

1. Divide the students into small groups and provide pictures of a river region suffering from pollution. Each group should look for as many sources and types of pollution as possible. On a piece of paper the students will record the different types of pollution found. After 5-10 minutes the groups will reassemble as a whole group and discuss the types of pollution found.
2. Deliver information about other types of pollution which the students did not explore/ identify. Discuss pollution and human impact and brainstorm ways to prevent pollution in river regions.
3. Students will create a poster based on their experience and knowledge of pollution. The illustration should also represent a way to prevent the pollution or dispose of pollutants. Students should also create a slogan to discourage pollution.

Assessment

Students will present their posters to the class.

Extensions

- Just because water may look clean and clear does not mean that it is. Have students collect a water sample to view under the microscope. Have them record what they see and discuss the visible organisms and other non-living things they observe.
- Schedule a visit to a local water treatment plant.
- **PLAN A FIELD TRIP to the Sarah Lawrence College Center for the Urban River at Beczak (CURB) to reinforce the concepts learned.**
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - Water Cleanup – In this fun, messy activity, students compete in groups to see which team can make the best **economic** and procedural decisions to best clean “pollution” from a dirty water sample (made with food coloring, vegetable oil and dirt).

Resources

Websites (Most descriptions provided by sources):

<http://www2.epa.gov/urbanwaters>

Environmental Protection Agency – Information on water conservation.

http://thewaterproject.org/water_conservation

Water Conservation, facts statistics and ways to save.

<http://www.dec.ny.gov/lands/313.html>

Department of Environmental Conservation – Water conservation.

<http://eschooltoday.com/pollution/water-pollution/effects-of-water-pollution.html>

Cool facts and tips about water pollution.

http://www.encyclopedia.com/topic/water_pollution.aspx

Encyclopedia: Water pollution information.

<http://environment.nationalgeographic.com/environment/freshwater/pollution/>

National Geographic: Water pollution.

http://epa.gov/safewater/kids/flash/flash_aquifer.html

How to Build your own Aquifer – A lesson and slides about aquifers and how they can become polluted.

Lesson 3: Hudson River PCBs

Objectives

Students will research information on PCBs to discuss their impact on the Hudson River watershed and understand the role of public participation in dealing with local environmental issues and how groups of local citizens have helped clean up the Hudson River.

Essential Question

What affect do PCBs have on the water quality and ecosystem of the Hudson River?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science
- CCSS- ELA- Literacy
- SL.5.4 / W.5.7

Skills

- research
- critical thinking
- note-taking

Duration: 2 days (45 minutes each)

- Day 1: Research PCBs in small groups.
- Day 2: Share poster presentations with class.

Vocabulary

PCBs – a chemical pollutant known as polychlorinated biphenyls (major issue for the Hudson River)

EPA – Environmental Protection Agency created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress

Clean Water Act – the cornerstone legislation of surface water quality protection in the United States

protection – a legal or other formal measure intended to preserve civil liberties and rights

quality – the standard of something as measured against other things of a similar kind

pollution – introduction of unwanted/harmful substances or products into the environment

toxins – harmful substances that affect living organisms

carcinogen – a substance capable of causing cancer in living tissue

Materials

- paper and pencil
- Internet access
- poster board and markers

Background

For 30 years, ending in the late 1970s, the General Electric Company (GE) discharged as much as 1.3 million pounds of PCBs into the Hudson River from its capacitor manufacturing plants in Hudson Falls and Fort Edward, New York. In February 2002, the federal government ordered GE to conduct targeted environmental dredging of PCB-contaminated sediment in a 40-mile stretch of the Upper Hudson.⁵

Polychlorinated biphenyls, or PCBs, were widely used as a fire preventive and insulator in the manufacture of electrical devices, like transformers and capacitors, because of their ability to withstand exceptionally high temperatures. In 1984, 200 miles of river between Hudson Falls and the Battery in New York City were placed on EPA's National Priorities List of the country's most contaminated hazardous waste sites.⁶

According to the EPA: "Today the Hudson River exists as one of the most extensively studied rivers in the country, having been monitored almost continuously for a period of more than 25 years. Ongoing evaluations of water quality, sediment, air quality, fish, and wildlife by the federal government and the State of New York have demonstrated that the river is not cleaning itself and PCBs in the sediment pose a serious risk to human health and the environment. Studies conducted to evaluate the extent of the problem revealed that most of the contaminated sediments were in "hot spots" situated in a 40-mile stretch of the river between the town of Fort Edward and the Troy Dam.

"PCBs build up in the environment (bioaccumulate), increasing in concentration as they move up the food chain. The primary health risk associated with the site is the accumulation of PCBs in the human body through eating contaminated fish. Since 1976, high levels of PCBs in fish have led New York State to close various recreational and commercial fisheries and to issue advisories restricting the consumption of fish caught in the Hudson River. PCBs are considered probable human carcinogens and are linked to other adverse health effects such as low birth weight, thyroid disease, and learning, memory, and immune system disorders. PCBs in the river sediment also affect fish and wildlife."⁷

5. "Hudson River Cleanup." Environmental Protection Agency. Accessed July 31, 2015. <http://www.epa.gov/hudson/cleanup.html>

6. Ibid.

7. Ibid.

Activity

Day 1:

In small groups, students research the history of PCBs in the Hudson River, taking notes using the following guided questions:

- What are PCBs?
- What environmental impacts do PCBs have on the Hudson River ecosystem?
- How do PCBs effect the Hudson River food chain?
- What are the environmental health impacts for humans? Can we eat fish from the Hudson? Why or why not?
- Is dredging the best solution to the problem?
- What role does government play in this issue?

Day 2:

Students will present their research to the class illustrating their findings on poster board, which should include pictures, facts, impacts of PCBs and any other information.

Assessment

Students will share and discuss findings with the class.

Extensions

- **PLAN A FIELD TRIP** to the **Sarah Lawrence College Center for the Urban River at Beczak (CURB)** to reinforce the concepts learned.
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - **Hudson River Food Chain** – Students role play parts of the food chain and discover the interdependencies of plants and animals in the Hudson River watershed. See how those relationships change when pollution (PCBs) enters the system. The importance of plankton is emphasized.

Resources

Websites (Most descriptions provided by sources):

<http://www.epa.gov/hudson/>

A summary of EPA's oversight of General Electric and its cleanup of the PCBs in the Hudson River.

http://www.epa.gov/hudson/pdf/cleaninghudson-brochure_4-2011.pdf

Cleaning up the Hudson Brochure.

http://www.health.ny.gov/environmental/outdoors/hudson_river/protecting_public_health_during_dredging.htm#how

New York State Department of Health: Protecting Public Health.

<http://swimfortheriver.com/pdf/pcbs.pdf>

Swim for the River: History of PCBs.

<http://www.hudsondredging.com>

Hudson River Dredging Project.

<http://www.dec.ny.gov/lands/66657.html>

Department of Environmental Conservation - Cleaning up pollution in the Hudson River.

<http://www.riverkeeper.org/campaigns/stop-polluters/pcbs/>

Riverkeeper: Hudson River PCBs.

Lesson 4: Rivers and Government: The Clean Water Act

Objectives

Students will construct a timeline highlighting specific milestones that led to the passing of the Clean Water Act. Students will design a bumper sticker stressing at least one of the benefits of the Clean Water Act in a creative way.

Essential Question

What is the role of government on environmental issues?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- CCSS- ELA- Literacy
 - R1.5.2 / SL.5.1

Skills

- collaborative learning
- group work
- critical thinking
- note-taking

Duration: 3 days (45 minutes per day)

- Day 1: Discussion of branches of government
- Day 2: Clean Water Act timeline
- Day 3: Creation of CWA bumper sticker and slogan

Materials

- Internet access (YouTube Schoolhouse Rock songs)
 - “I’m Just a Bill” <https://www.youtube.com/watch?v=FFroMQLKiag>
 - “Three Ring Government” <https://www.youtube.com/watch?v=N0vPwxu3x58>
- Schoolhouse Rock “Three Ring Government” lyrics
 - <http://www.schoolhouserock.tv/ThreeRing.html>
- Schoolhouse Rock “I’m Just a Bill” lyrics
 - <http://www.schoolhouserock.tv/Bill.html>
- index cards
- Three Branches of Government Worksheet
- markers, crayons, colored pencils
- white construction paper (11 x 17)
- examples of different historical timelines

Vocabulary

government – the governing body of a nation, state, or community; the group of persons in office at a particular time

executive – a person or a group of persons having administrative or supervisory authority in an organization

legislative – having the function of making laws

judicial – pertaining to judgments in courts of justice

Congress – the national legislative body of the U.S. It was established by the Constitution in 1787 and is composed of the Senate and the House of Representatives

Senate – the smaller upper legislative assembly in the U.S. Congress and most U.S. states

House of Representatives – the lower house of the U.S. Congress and other legislatures, including most state governments

bill – a draft of a proposed law presented to a legislature for discussion but not yet passed and made law

law – the system of rules that a particular country or community recognizes as regulating the actions of its members

legislation – laws, considered collectively

committee – a group of people appointed to perform a specific function; a body appointed by a legislature to consider the details of proposed legislation

veto – a constitutional right to reject a decision or proposal made by a law-making body

civics – of or relating to the duties or activities of people in relation to their town, city or local area

election – the selection of a person or persons for public office by a formal and organized process

citizen – a legally recognized subject or national of a state or country; an inhabitant of a particular town or city

vote – a formal expression of opinion or choice made by an individual or by a specified group

Background

In order for a law or an amendment to be passed, it must be considered and voted upon by both houses of the legislature. At the federal level the legislative branch is the United States Congress—the Senate and the House of Representatives. In New York State, the two houses are the Senate and the Assembly. Senators and representatives (or senators and assemblymen in New York) study, discuss and vote on bills; the versions passed by each House must then be combined into one bill and passed by the members of both Houses. A bill becomes law when it is signed by the President (at the national level) or by the governor (at the state level).

Three Branches of Government Worksheet

Using the Schoolhouse Rock “I’m Just a Bill” and “Three Ring Government” videos and lyrics, complete the following activities to learn about the three branches of the US government and the process of how a bill becomes a law.

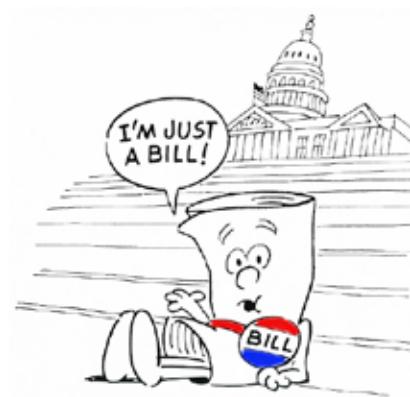
1. Write each word under the branch it best represents.

Senators	President	Justices	Vice President
Representatives	Supreme Court	Cabinet members	Congress

Legislative	Executive	Judicial

1. Can you put these steps in order to show how a bill becomes a law? Number them beginning with one (1) as the first step and ending with seven (7) as the last step.

- _____ Committee votes on the bill.
- _____ Next, House and Senate committees consider the bill.
- _____ First, Senators and Representatives propose the bill.
- _____ The bill is debated in the House and in the Senate.
- _____ Finally, the President either signs the bill into law or vetoes it!
- _____ A last vote is taken in the House and in the Senate.
- _____ The bill travels from the House and Senate to a conference committee.



The Clean Water Act

Background

The Federal Water Pollution Control Act of 1972—known more commonly as the Clean Water Act—was passed by Congress in 1972, in response to growing concern over pollution of rivers and streams throughout the United States. At the time, many rivers, such as the Potomac River in Washington, DC, and the Hudson River in New York, were too dirty for swimming.⁸ Lake Erie, which borders New York, Pennsylvania, Ohio and Michigan as well as the Canadian province of Ontario, was so polluted by the dumping of factory pollutants, farm fertilizers, and sewage that large quantities of dead fish were washing ashore, newspapers were declaring the lake dead, and the people of Toledo were left without fresh drinking water. The Cuyahoga River, which flows into Lake Erie, was so polluted it burst into flames.⁹ By the end of the 20th century, more than 25 years after the passage of the 1972 Act, water quality was much improved, but there was still a long way to go: 40 percent of the country's waterways were still too polluted for fishing or swimming; beaches were closed or warnings issued over 2,500 times in 1996 because of contaminated water; and excess runoff of pollutants caused a 6,000 square mile zone of oxygen-starved water in the Gulf of Mexico.¹⁰

The Clean Water Act signaled a new way of ensuring water quality. In 1948, Congress had determined it was in the “national interest” to protect water quality throughout the nation. Additional water pollution control laws were passed five times in the 1950s, 1960s and 1970s. These acts became progressively stricter, yet they all relied on the states for enforcement, seeing water quality as within their local area of responsibility. The federal government merely assisted the states financially, in the realm of water research and in preserving interstate waters. But the standards themselves, as well as their enforcement, were left up to the states.”¹¹

The 1972 Act represented an important shift in responsibility, oversight and enforcement. Relying on the states had proven ineffective. The federal government became responsible for ensuring water quality. It became illegal to pollute without first receiving a government permit. Congress created a new federal agency, the Environmental Protection Agency (EPA) and charged it with ensuring that all United States waters would be safe for swimming and fishing by 1983, 10 years after the act’s passage.¹²

The Clean Water Act has been amended, or changed, by Congress many times over the years to strengthen or clarify the legislation. For instance, recognizing that the original timeline for cleanup was not achievable, timelines were expanded and made more flexible.¹³

The goal of the Clean Water Act was to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” To accomplish this, the act aimed to assure a level of water quality that “provides for the protection and reproduction of fish, shellfish, and wildlife, and provides for recreation in and on the water” and to eliminate the discharge of pollutants into navigable waters. The definition of “navigable waters” has been expanded to mean all “the waters of the United States,” including streams, sloughs and wetlands.¹⁴

8. “President Clinton Announces the Clean Water Action Plan (EPA Press Release).” Environmental Protection Agency. February 19, 1998. <http://www2.epa.gov/aboutepa/president-clinton-announces-clean-water-action-plan>

9. Rotman, Michael. “Lake Erie.” Cleveland Historical. Accessed 31 Jul. 2015. <http://clevelandhistorical.org/items/show/58>

10. “President Clinton.”

11. Clarke, Jeanne Nienaber. “Clean Water Act.” Water:Science and Issues. 2003. *Encyclopedia.com*. Accessed 31 Jul. 2015. <http://www.encyclopedia.com>

12. “Clean Water Act.” *Water Encyclopedia*. Accessed July 31, 2015. <http://www.watencyclopedia.com/Ce-Cr/Clean-Water-Act.html>

13. Ibid.

14. “Clean Water Act: Section 101 (a): Declaration of Goals and Policy.” Environmental Protection Agency. Accessed July 21, 2015. <http://water.epa.gov/lawsregs/rulesregs/101a.cfm>

Clean Water Act and Major Amendments

Year	Act
1948	Federal Water Pollution Control Act
1956	Water Pollution Control Act of 1956
1961	Federal Water Pollution Control Act Amendments
1965	Water Quality Act of 1965
1966	Clean Water Restoration Act
1970	Water Quality Improvement Act of 1970
1972	Federal Water Pollution Control Act Amendments (Clean Water Act)
1977	Clean Water Act of 1977
1981	Municipal Wastewater Treatment Construction Grants Amendments
1987	Water Quality Act of 1987

Activity

Day 1:

After listening and discussing the lyrics to the Schoolhouse Rock songs, students complete the Three Branches of Government Worksheet with an emphasis on how an idea becomes first a bill, then a law, and then gets put into effect.

Day 2:

Following a discussion on historical timelines and the history of the Clean Water Act (CWA), students will transfer the information to create a timeline highlighting the milestones leading up to the passing of the CWA and its subsequent amendments.

Day 3:

Students will design a bumper sticker advocating the benefits of the CWA and create a slogan indicating their stance on the CWA.

Assessment

- Evaluate student timeline to check for understanding and sequence of the events leading up to the CWA and its later amendments.
- Review bumper sticker creation and slogan.

Resources

Websites (Most descriptions provided by sources):

<http://bensguide.gpo.gov/3-5/lawmaking/laws.html>

Who makes laws? This is an interactive kid-friendly website that uses graphics to teach students about Congress and the process of making laws.

<http://www.waterencyclopedia.com/Ce-Cr/Clean-Water-Act.html>

Water Encyclopedia – An overview of The Federal Water Pollution Control Act of 1972, its importance and its limitations.

<http://www.epa.gov/lawsregs/laws/cwa.html>

A summary of the Clean Water Act and the role of the Environmental Protection Agency.

<http://www.pbs.org/now/science/cleanwater.html>

PBS: A brief history of the Clean Water Act.

<http://www.dec.ny.gov/lands/77105.html>

Department of Environmental Conservation: How is the Hudson doing?

<http://www2.epa.gov/laws-regulations>

This site describes how the EPA goes about developing regulations.

<http://water.epa.gov/action/cleanwater40/milestones.cfm>

Interactive environmental timeline.



“Justice and power must be brought together, so that whatever is just may be powerful, and whatever is powerful may be just.”

Blaise Pascal

Unit 5: River Challenges

Lesson 1: Human Impact and Rivers

Objective

Students will be able to list pollutants that contaminate our local rivers and understand the effects of human pollution and its impacts on our local rivers. They will become familiar with the environmental laws and policy against pollution and write an essay about river pollution, including the appropriate consequences for people who pollute our rivers.

Essential Question

How do development and human impacts affect rivers?

Common Core Standards

- Science
- CCSS- ELA- Literacy
 - W.5.2

Skills

- observation and documentation
- persuasive essay writing

Duration: 10 days (15 minutes per day)

- Week 1: daily observations and discussion
- Week 2: daily observations and discussion

Vocabulary: (refer to Unit 4 lesson 2)

pollutant - something that contaminates water, air or land with harmful or poisonous substances

human impact - the effect caused by individual or group action, in this case, on the environment

stewardship - the responsible overseeing and protection of something considered worth caring for and preserving

Materials

- fish tank or large basin for tap water
- pollutants (e.g. cans, paper, food, plastic, cleaning solutions)
- Three Rivers Pollution Chart
- Observation Chart

Background

There are many human and industrial sources of pollution that impact our rivers and other water sources. People flush chemicals, pesticides, fertilizers and other substances down their drains; companies dump chemicals on the ground which then seep into the ground water or directly into rivers or drains; and people drop plastic bottles, litter and other waste products down storm drains which lead to rivers. Many of these pollutants kill aquatic plants and animals and pollute the water we make use of.

The Hudson River has been affected by the chemical pollution of PCB's, the Saw Mill River faces the challenges of sewage runoff and the Bronx River faces dumping of trash and other debris.

Activity

1. Students work in groups to list sources of pollutants found in the three rivers of Yonkers, completing the Three Rivers Pollution Chart.
2. Create a "river" in the classroom. Use a fish tank or basin and fill it with tap water. Each group will choose 2-3 items from their list to use to "pollute" the river in the classroom.
3. Have students observe and record what is happening to the river as a result of the pollutants over the course of two weeks. Use the Observation Chart below.
4. Lead a discussion on the effects of pollution in rivers over time. What did they observe? What happened to the water over time? What would the survival rate be for plants and animals?

Observation Chart

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Week 1					
Week 2					

Three Rivers Pollution Chart

After researching about the different kinds of pollution below, fill in the chart with the types of pollution that you think can be found in each river. Is any of the pollution the same in two or more of the rivers, or do they all have different types of pollution? Use the chart to share your answers.

- **Litter:** trash such as paper, plastic, cans, bottles, wrappers, grocery bags, etc.
- **Chemicals:** medicine, fertilizer, pesticides, food, cleaning solutions, sewage, PCBs
- **Sediment:** dirt, rocks, mud, sand, gravel
- **Oil:** petroleum, gasoline

Hudson River	Bronx River	Saw Mill River

Where do you think the different kinds of pollution come from for each of the rivers?
List your answers in the blanks below.

Hudson River: _____

Bronx River: _____

Saw Mill River: _____

Assessment

- Students will write about what they observed and how human pollution affects a river.
- Students will research and write about the relevant laws and policies and how they are enforced.

Extensions

- Children can explore the school property to look for signs of pollution and locate storm drains.
- Children can organize a school cleanup day and make posters.
- **PLAN A FIELD TRIP to the Sarah Lawrence College Center for the Urban River at Beczak (CURB) to reinforce the concepts learned.**
 - 35 Alexander St., Yonkers, NY 10701 / email: vgarufi@sarahlawrence.edu
 - **Water Cleanup program** – In this fun, messy activity, students compete in groups to see which team can make the best **economic** and procedural decisions to best clean “**pollution**” from a dirty water sample (made with food coloring, vegetable oil and dirt).

Resources

Websites (Most descriptions provided by sources):

http://www.nycgovparks.org/sub_about/parks_divisions/nrg/bronx_river_epa/water_quality/table_water_quality.html
NYC Parks – Information about water quality problems in the Bronx River.

<http://www.epa.gov/p2/pubs/laws.htm>
Environmental Protection Agency – Laws and Policies regarding the Pollution Protection Act.

<http://bronxriver.org/?pg=content&p=abouttheriver>
Bronx River Alliance – Information about the Bronx River and pollution issues.

Lesson 2: New York State's Cleanup Efforts on the Bronx River

Objectives

Students will research and become familiar with the various lawsuits that have been filed and won by the New York State Attorney General against municipalities and organizations for illegal dumping in the Bronx River. They then will write an editorial for the “Yonkers Public School Journal News” informing concerned faculty, staff and students of these decisions and why they were important.

Essential Question

What are the environmental implications of the Yonkers Raceway sewage dumping on the Bronx River?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- CCSS- ELA- Literacy
- SL.5.1 / W.5.1

Skills

- critical thinking
- note-taking
- reading comprehension
- responding to short answer questions
- writing a persuasive essay

Duration: 2 days (60 minutes each)

- Day 1: Students will review the Yonkers Raceway Case and gather information.
- Day 2: Using this information, students, will write their first draft of their newspaper editorial.

Vocabulary

Attorney General – chief law officer and legal counsel of the government of a state or nation

plaintiff – a person, as a complainant or chief witness, instigating prosecution in a criminal proceeding

defendant – a person against whom a claim or charge is brought in a court of law

charges – an accusation brought against a suspected perpetrator of a crime

allegedly – according to what is or has been alleged but not yet proven

settlement – an agreement between two parties to end the dispute in a court of law

penalties – a punishment incurred for a violation of law or rule

verdict – a judgment or decision

sewage – the untreated waste matter that passes through sewers

manure – excrement, especially of animals, or other refuse used as fertilizers

Materials

- a copy of the Yonkers Raceway Corporation Raw Sewage Settlement
- copies of articles about the various lawsuits and settlements
- Reporter's Notepad Worksheet

Background

The New York State Attorney General filed charges against the City of Yonkers, Yonkers Racetrack, the New York Botanical Garden, the Bronx Zoo, and four other Westchester municipalities—the cities of White Plains and Mount Vernon, the Town of Greenburgh, and the Village of Scarsdale—for allegedly flushing raw sewage into the Bronx River. The Department of Environmental Conservation found that all the plaintiffs had been flushing human and animal waste into local storm sewers, which flow directly into the river. Under the settlements, Yonkers Raceway paid \$6 million for projects to help clean the river and \$2 million in civil penalties to New York State and donated \$1 million to *Beczak Environmental Education Center* in Yonkers. The other plaintiffs paid fines to New York State and agreed to pay for cleanup activities to make sure they would no longer pollute the river.

Activity

Day 1:

Following a class discussion on the Yonkers Raceway Settlement, students complete the Reporter's Notepad Worksheet.

Day 2:

As junior editorial writers their job will be to prepare newspaper editorials and inform us about local and state events. They will be required to present points of view on current issues and report on the actions of public officials and others who exercise power.

Assessment

- Evaluate student reporter's notepad to check for understanding.
- Evaluate the student's editorial using the 4-point rubric.

Reporter's Notepad

Keep track of notes and other important information regarding the Yonkers Raceway case.

What events occurred in the Yonkers Raceway case? _____

What type of pollution was dumped into the Bronx River? _____

Who was affected by the impact of the pollution? _____

What was the outcome of this case? _____

Other information: _____

Lesson 3: The Great Hudson River Debate: Indian Point Power Plant

Objectives

Students will discuss a variety of issues up for debate. They will list various people with a particular stake, play the role of one of the stakeholders, and assess their own and/or their peers' performances in a debate.

Essential Question

How do development and human impacts affect rivers?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- CCSS- ELA- Literacy
- SL.5.1c / W.5.9

Skills

- critical thinking
- note-taking
- reading comprehension
- communication skills
- exploring different points of view
- presenting information as role-play

Duration: 3 days (60 minutes each day)

- See activity below

Vocabulary

debate – a formal discussion on a particular topic in a public meeting or legislative assembly, in which opposing arguments are put forward

role play – the acting out or performance of a particular role

affirmative (pro) – agreement with a statement or topic in a debate

negative (con) – the opposing or contrary side of a topic in a debate

cross-examine – to interrogate or question a witness or an opponent

summarize – give a brief statement of the main points

opinion – a view or judgment formed about something, not necessarily based on fact or knowledge

controversy – disagreement, typically when prolonged, public, and heated

stakeholder – a person with an interest or concern in something

Materials

- copy of the debate rules
- index cards
- Pro and Con Indian Point Worksheet

Background

Indian Point is a nuclear power plant located on the banks of the Hudson River twenty-four miles north of New York City in Buchanan, New York. The plant opened in 1962 as a three-unit nuclear station, though one of the nuclear reactors is out of commission and licenses for the other two are set to expire in 2013 and 2015. Indian Point produces electricity for around ten percent of New York State.¹

Riverkeeper,² an environmental non-profit organization dedicated to the Hudson River and clean water advocacy, is just one of many environmental groups and activists who are fighting to deny relicensing to Indian Point in favor of safer energy initiatives for New York. Such groups and related studies have shown that Indian Point is detrimental to the river ecosystem, especially because of the way the plant operates by using cooling water directly from the Hudson River. This process often kills fish who get pulled into the water filtration systems,³ which is just one of many safety concerns about the plant more generally. Other issues include oil and chemical spills into the Hudson and the forest area surrounding the plant.⁴

Nuclear power plants themselves tend to be a particularly controversial source of energy. Although environmental organizations and other concerned citizens argue that the plants are unsafe, there are many people who are in favor of nuclear power as a form of clean energy because they do not produce carbon or other emissions.

Activity

Role Play Debate Strategy – Many topics lend themselves to different forms of debate. In the role play debate, students examine different points of view or perspectives related to an issue. The class will conduct a role-play debate on the pros and cons of allowing a nuclear power plant to remain in operation at Indian Point on the Hudson River.

Day 1:

Students identify the stakeholders (key people) in the debate. Stakeholders include community residents, corporate executives, environmentalists, and government regulators. Students will read and review articles about the Indian Point nuclear power plant and the advantages and disadvantages of keeping it open. They will gather information and record their notes on the **Pro and Con Indian Point Worksheet**. The teacher writes the roles of the stakeholders on index cards (one stakeholder per card; one card per student) then places them in a basket. Students randomly draw an index card from the basket. Students then find classmates holding the same stakeholder cards. Those small groups of students are responsible for putting themselves in the position of their assigned stakeholder and formulating the arguments they will present in a classroom debate.

Day 2:

Students will use various resources (Internet, primary sources) to formulate strong arguments to support their points of view. They will provide evidence to try to convince their peers to change their opinions.

1. <http://www.nei.org/CorporateSite/media/filefolder/Policy/Papers/Economic-Impacts-of-the-Indian-Point-Energy-Center.pdf?ext=.pdf>

2. <http://www.riverkeeper.org/>

3. <http://westfaironline.com/74361/dec-hearings-address-forced-outages-at-indian-point/>

4. http://www.nytimes.com/2015/05/13/nyregion/fire-prompted-renewed-calls-to-close-the-indian-point-nuclear-plant.html?_r=0

Day 3:

Debate time! Each group selects a spokesperson to present the opinion of the group. The spokesperson will have three minutes to present the group's arguments. After the presentations, students will have an opportunity to ask questions of the individual stakeholders (question and answer portion—three minutes). In the end, the teacher, using the debate rubric, will assess the groups and decide which stakeholder presented the strongest case.

Assessment

Students will be evaluated using the attached debate rubric to assess their debating skills.

Resources

Websites (Most descriptions provided by sources):

<http://www.nydailynews.com/new-york/explosion-closes-indian-point-nuclear-power-plant-new-york-city-no-danger-radiation-leak-article-1.452514>

New York Daily News articles and blogs about Indian Point.

<http://www.riverkeeper.org/campaigns/stop-polluters/indian-point/>

Riverkeeper's view on the power plant controversy – Close Indian Point.

http://topics.nytimes.com/top/reference/timestopics/subjects/i/indian_point_nuclear_power_plant_ny/index.html

New York Times article and related news pieces about Indian Point.

<http://www.dec.ny.gov/chemical/61837.html>

Department of Environmental Conservation – Information on Indian Point.

Classroom Debate Rubric

The Rules

- No put downs.
- You must raise your hand if it's not your turn to speak.
- No interruptions. You must wait your turn to speak.
- No whispering while another speaker is talking.
- Have fun!

Breaking the rules may result in automatic disqualification.

Criteria	LEVELS OF PERFORMANCE			
	1	2	3	4
1. Organization and Clarity: Viewpoints and responses are outlined in a clear and orderly fashion.	Unclear in most parts, not well-organized	Somewhat clear and organized	Mostly clear and organized	Completely clear and organized
2. Use of Arguments: Reasons are given to support viewpoint.	Few or no relevant arguments provided	Some relevant arguments provided	Many relevant arguments provided	Solid and convincing use of highly relevant arguments
3. Use of Examples and Facts: Examples and facts are given to support reasons.	Few or no relevant supporting examples/ facts	Some relevant examples/ facts given	Many examples/ facts given, most of them relevant	Many relevant supporting examples and facts given
4. Use of Rebuttal: Arguments made by the other teams are responded to and dealt with effectively.	No effective counter-arguments made	Few effective counter-arguments made	Some effective counter-arguments made	Many effective counter-arguments made
5. Presentation Style: Tone of voice, use of gestures, and level of enthusiasm are convincing to audience.	Few style features used, none of them convincingly	A few style features used convincingly	All style features used, most of them convincingly	All style features used convincingly

Pro and Con Indian Point Worksheet



PRO

1. _____

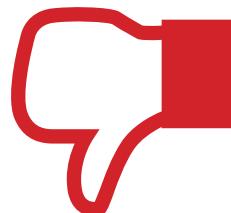
2. _____

3. _____

4. _____

5. _____

6. _____



CON

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Lesson 4: Building Bridges: The Construction of the New Tappan Zee Bridge

Objectives

Students will explore the many bridges that cross the Hudson River, facilitating movement, one of the main themes of geography. Students will also learn a brief background of how environmental monitoring came into being and will then explore its modern interpretation through researching the construction of the New Tappan Zee Bridge. After breaking up into groups, students will explore the various environmental monitoring aspects of bridge-building and will present their findings to their classmates through poster board presentations.

Essential Question

What are the environmental implications of the building of the new Tappan Zee Bridge?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science, Math and Technology
- CCSS- ELA- Literacy
- SL.5.1 / W.5.8

Skills

- critical thinking
- note-taking
- reading comprehension
- communication skills
- presenting information

Duration: 3 days

- Day 1: (30 minutes) Teacher presentation of background material and Government Worksheet.
- Day 2: (60 minutes) Exploration of the Hudson Valley Bridges through handouts and research of the New Tappan Zee Bridge through the worksheet and website.
- Day 3: (60 minutes) Poster-making and presentation of findings.

Materials

- Government Worksheet
- Hudson Bridges Handouts
- New Tappan Zee Worksheet
- access to Internet for research
- poster boards and markers for presentations

Vocabulary

government – a branch or service of the supreme authority of a state or nation, taken as representing the whole

executive – a person or a group of persons having administrative or supervisory authority in an organization

legislative – having the function of making laws

judicial – pertaining to judgments in courts of justice

Congress – The national legislative body or the U.S. consisting of the Senate and the House of Representatives

Senate – an assembly or council of citizens having the highest deliberative functions in a government

House of Representatives – the lower legislative branch in many national and state governing bodies

bill – a draft of a proposed law presented for approval to a legislative body

law – any written or positive rule prescribed under the authority of the state or nation, as by the people in the Constitution

Environmental Protection Agency (EPA) – a government agency created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress

environmental monitoring – the processes and activities that need to take place to characterize and monitor the quality of the environment

Clean Water Act – the primary law governing water pollution in the United States

Activity

Day 1:

In order to understand the origins of government-mandated environmental monitoring, students will review how laws and government agencies are formed, using the Government Worksheet. Discuss how the Clean Water Act became an environmental law. What are some ways that this environmental monitoring occurs in our three rivers? Review how environmental monitoring occurs through laws and agencies like the EPA, such as water quality standards, zoning permits, emissions limits, and wildlife protection.

Day 2:

Discuss the different ways that rivers promote movement, which is one of the five themes of geography, such as transportation (especially across bridges), water, and life. What are some ways living things interact with this movement? What kinds of animals and plants live around bridges? (For an example, check out these falcons that live on the Tappan Zee: <http://www.newnybridgegallery.com/falconcam.php>) Take a closer look at the Hudson River Bridges handouts, paying attention to how many bridges there are, when they were opened, and what kinds of different constructions there are.

Turn specifically to the Tappan Zee Bridge, which was only built to last for 50 years but is still in active use today, 70 years later. If possible, have students watch the video showing the new bridge plans: <https://www.youtube.com/watch?v=jW-mZ02oWZI>. In addition, check out the webcam that the construction firms have put in place to provide monitoring footage of their work: <http://newnybridgegallery.com/webcam.php>.

Students will now research the New Tappan Zee Bridge currently under construction and set to open in 2018. How is the new bridge different from the old one? What do the builders have to take into account when constructing this new bridge over the Hudson River? Students will use various resources (Internet, primary sources) to research several of the environmental monitoring systems set up during the building of the New Tappan Zee to protect the river and all of its inhabitants.

Split the class into groups to gather more information. (You can use some of the links in the resources section to get them started.) Students will use the Research Handout for their notes. Group topics include:

- Group 1:** What is an environmental impact statement (EIS)?
- Group 2:** What is sturgeon telemetry and how does it work?
- Group 3:** How does dredging affect the river?
- Group 4:** How does noise pollution affect the river?
- Group 5:** How does construction impact water quality?

Day 3:

Students will have 30 minutes to use their research notes to make a poster to present their findings to their classmates. Each group will showcase their topic for five minutes to the rest of the class. Wrap up by discussing the importance of protecting the environment and what the students can do.

Background

The role of Congress is to pass laws; the President must then approve those laws before they can be enacted. Congress also authorizes government agencies to create and enforce regulations in order to put those laws into effect. The Supreme Court and other federal and state courts are sometimes asked to decide if agencies are carrying out the laws correctly or if the laws themselves are legal under the terms of the original United States Constitution.

After the Clean Water Act was passed by Congress in 1972 and approved by the President, it became the responsibility of the newly formed Environmental Protection Agency (EPA) to establish the rules and regulations needed to carry out the CWA.

By the 1960s many Americans were becoming increasingly concerned about the health of their rivers and lakes. Fishermen were finding that the fish they caught were contaminated with high levels of pollutants. Lake Erie became so polluted that it started to die, and the Cuyahoga River was so polluted it even burst into flames. This rising public concern about the condition of the environment and its impact on human health culminated in the first Earth Day celebration on April 22, 1970. That same year the President established the Environmental Protection Agency, the federal agency charged with protecting the nation's environment. The EPA quickly expanded in response to new environmental laws, which assigned it new responsibilities and powers during the 1970s.

The EPA is led by an administrator nominated by the president and confirmed by the U.S. Senate. The administrator reports directly to the president. EPA regulations cover a range of environmental and public health protection issues, from setting standards for clean water to specifying cleanup levels for toxic waste sites to controlling air pollution from industry and other sources. One of the biggest effects of the creation of such an agency and environmental laws is an increase in environmental monitoring of public projects, which requires local governments to take an active role and to provide environmental impact statements.

Assessment

- Students will showcase their research to the class in the form of a poster board presentation.

Resources

Websites (Most descriptions provided by sources):

<https://www.youtube.com/watch?v=OtbumI6WIQP0>

“How a Bill Becomes a Law” (Schoolhouse Rock).

<http://www2.epa.gov/laws-regulations/summary-clean-water-act>

Summary of the Clean Water Act.

<http://www.newnybridge.com>

<http://newnybridgegallery.com/noise/>

Tappan Zee Bridge.

Books

Crossing the Hudson River: Historic Bridges and Tunnels of the River (2010), Donald Wolf

Government Worksheet

Fill in the blanks to understand how laws and government agencies come into effect and how these played a role in the creation of environmental monitoring.

HOW LAWS AND AGENCIES ARE MADE:		
passes laws and authorizes government agencies to create and enforce regulations once laws go into effect.	approves laws so they can be enacted.	decides if laws are legal under the US Constitution and if government agencies are carrying out laws correctly.

1. The _____ was passed in 1972 by Congress and approved by the President to regulate pollution discharges into US waters and to establish quality standards for surface waters.

2. This act was to be enforced by the _____ (EPA), which was a government agency formed to care for and safeguard the environment of the United States.

3. When public projects are begun, the EPA requires the local and/or state government to provide an environmental impact statement that shows how the project will implement _____ in order to protect the local ecosystem.

Hudson River Bridges

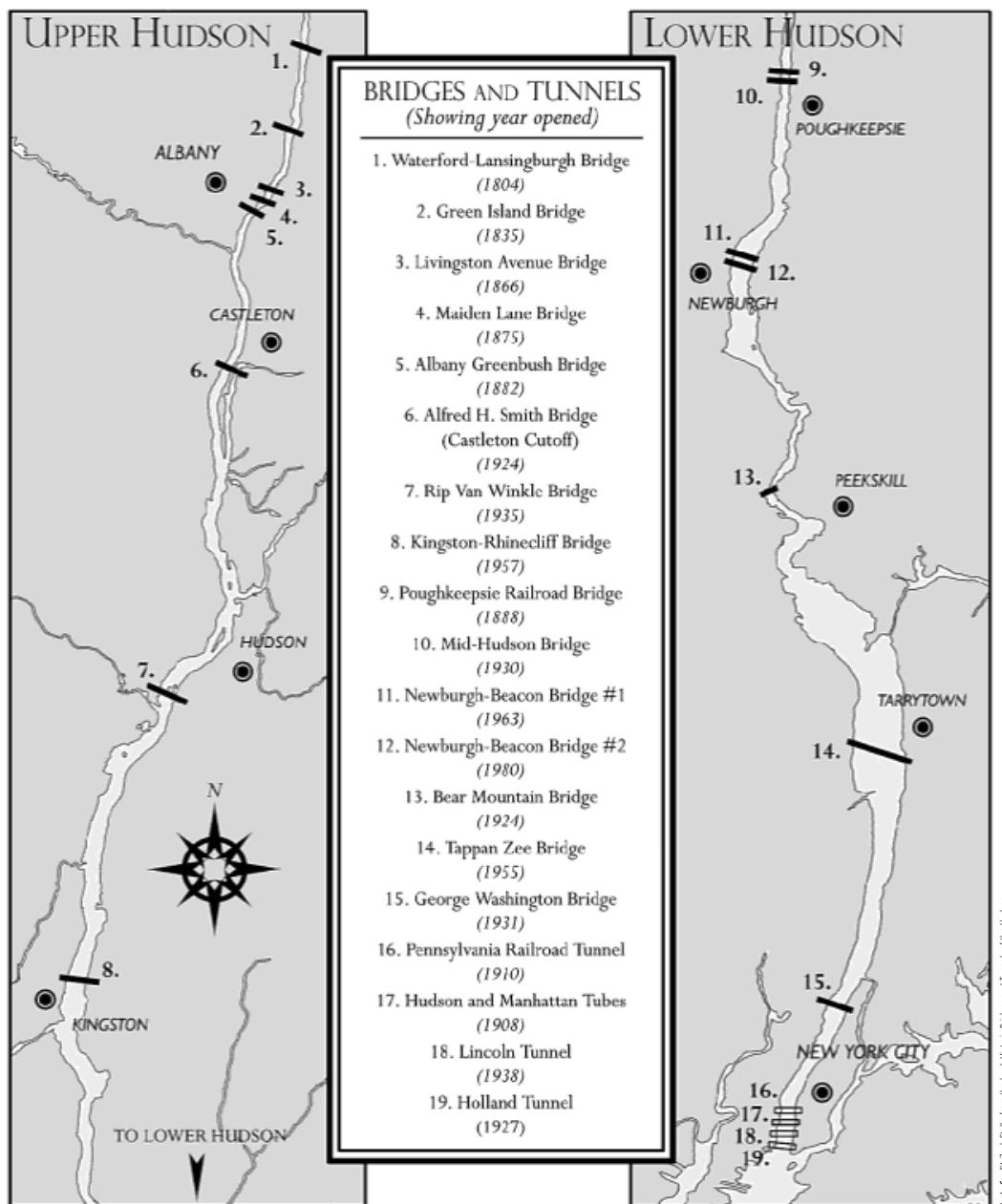


FIGURE 1 Historic Bridges and Tunnels of the Hudson, Showing Where They Cross (or Have Crossed) the River. Drawn by Zack Stella.

Hudson River Bridges

Tappan Zee Bridge (cantilever bridge, opened 1955)



Bear Mountain Bridge (suspension bridge, opened 1924)



Newburgh-Beacon Bridge (truss bridge, opened 1963)



Hudson River Bridges

Mid-Hudson Bridge (suspension bridge, opened 1930)



Kingston-Rhinecliff Bridge (truss bridge, opened 1957)



Rip Van Winkle Bridge (cantilever and truss bridge, opened 1935)



The New Tappan Zee Bridge: Research Worksheet

Keep track of notes and other important information regarding the New Tappan Zee Bridge.

Group Topic: _____

Research for your poster board:



“It is better to debate a question without settling it than to settle a question without debating it.”

Joseph Joubert

Unit 6: Stewardship

Lesson 1: Cleaning Up the Hudson River

Objective

Students will devise a plan to preserve and conserve the Hudson River, protecting it from pollution, and engage in cleanup activities.

Essential Question

Have environmental efforts and advocacy protected our water planet?

Common Core Standards

- Science
- CCSS- ELA- Literacy
- W.5.1

Skills

- problem-solving
- critical thinking
- team work
- coordination and implementation of an event

Duration: Approximately 1 Class (45 minutes)

- Preparation time: 5 min
- Activity time: 25 min
- Discussion: 10 min

Vocabulary: (Review Lesson 1 vocabulary)

pollution – the presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects

stewardship – the activity or job of protecting and being responsible for something

conservation – the careful use of natural resources (such as trees, oil, etc.) to prevent them from being lost or wasted

preservation – to keep something in its original state

restoration – the act or process of returning something to its original condition by repairing and/or cleaning it

Materials: Each student should have:

- paper and pencil
- clipboard

Background

Over the course of the last three decades, there has been growing concern about pollution and its effects on our environment. CURB is concerned about the pollution of the three rivers that run through Yonkers. Everyone has a role in the protection of our environment, including our rivers. Students need to learn what they can do as well as what other people in the community can do to continue to protect our environment.

Activity

1. Brainstorm ideas to protect the Hudson River from pollution.
2. Plan a cleanup day for the Hudson River.
3. Make a list of items that would be needed as part of the cleanup day.
(e.g. gloves, garbage bags, pronged sticks, boots)
4. Discuss what steps the group would have to take in order to organize a cleanup day.
(e.g. contact school administration and local government, get the word out to the community)

Assessment

Write a letter to the Mayor of Yonkers explaining why you would like permission to clean up an area of the Hudson River. Be sure to include the conservation reasons that were discussed in class.

Extensions

- Organize a school cleanup.
- Conduct a poster contest about the protection and conservation of the Hudson River.
- Contact a local environmental center or community non-profit to coordinate cleanup efforts.
 - Sarah Lawrence College Center for the Urban River at Beczak (CURB)
www.centerfortheurbanriver.org
 - Groundwork Hudson Valley
<http://www.groundworkhv.org>
 - Saw Mill River Coalition
<http://www.sawmillrivercoalition.org>
 - Bronx River Alliance
<http://bronxriver.org>

Resources

Websites (Most descriptions provided by sources):

<http://www.swimfortheriver.com/pdf/things.pdf>

Swim for the River: Things we can do.

<http://www.epa.gov/hudson/cleanup.html>

EPA: Hudson River Clean up.

<http://www.hudsondredging.com>

Dredging the Hudson.

<http://www.riverkeeper.org/campaigns/stop-polluters/pcbs/>

Riverkeeper.

Lesson 2: Water Conservation

Objectives

Students will define water conservation and describe how water is used in their everyday lives. They will discuss estimated water use in their homes and schools, brainstorm water conservation ideas that they can help implement, and create posters to hang around the school to help their peers be more water conscious.

Essential Question

What are effective ways that students can conserve water individually and collectively in their everyday routines?

Objectives: Students will:

- Be able to identify the three rivers in Yonkers, NY on a map.
- Be able to identify the types of water found in the three rivers.

Common Core Standards

- Science, Math and Technology
- CCSS- ELA- Literacy
 - R1.5.7 / SL.5.1

Skills

- problem-solving
- critical thinking
- teamwork
- coordination and implementation of an advocacy campaign
- research skills

Duration: 2 days (45 minutes each day)

- Preparation time: 5 min
- Activity time: 25 min
- Discussion: 10 min

Vocabulary

conservation - the preservation and careful management of the environment and of natural resources

gallon - a unit of volume for liquid measure equal to four quarts or 3.79 liters.

groundwater - fresh water stored under the Earth's surface in aquifers, layers of sand, gravel, or porous rock

water ethic - the concept that humans must protect the quality and availability of water for all species that depend on it, now and in the future

sustainable - meeting current needs without losing the ability to meet future needs

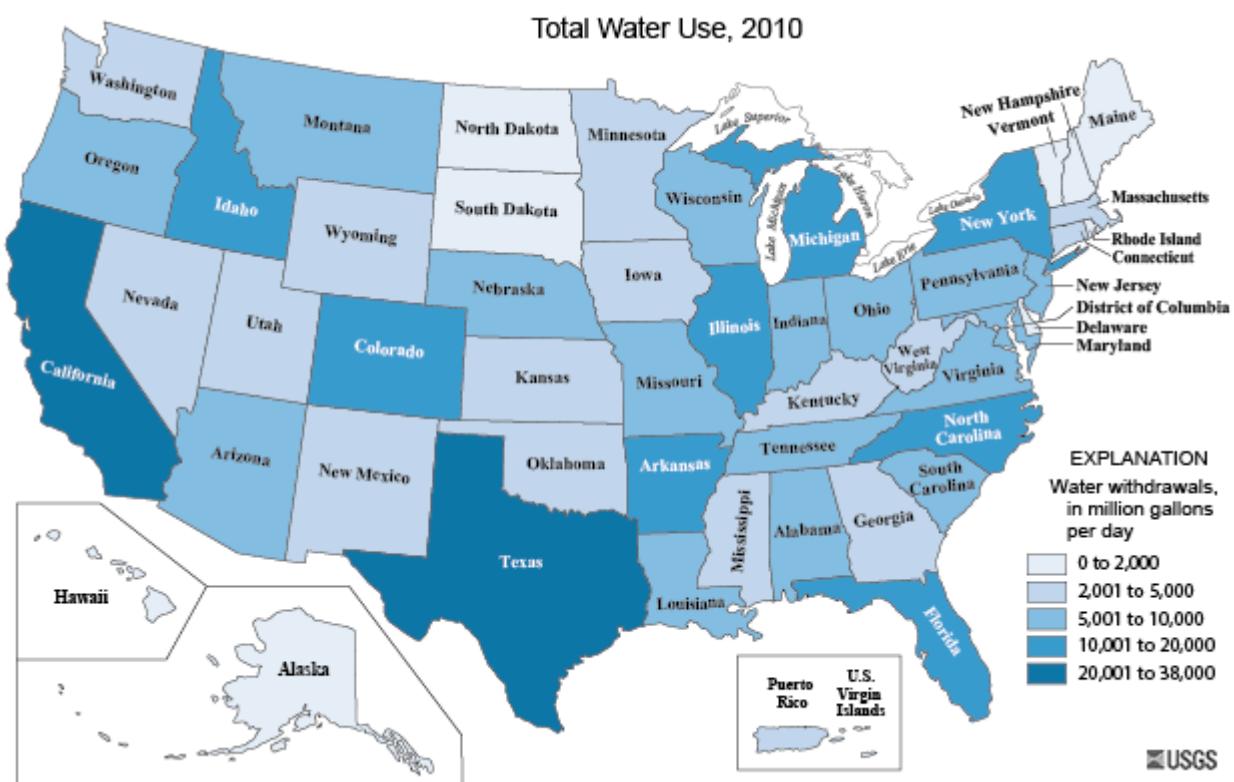
Materials: Each student should have:

- paper and pencil for brainstorming
- one poster board per student group
- art supplies for decorating the poster boards

Background

Through our knowledge of the water cycle, we know that water is a renewable resource, but many people don't realize just how much water they are actually using. Amidst weather change patterns related to climate change and issues of access, water is being used much too quickly to maintain sustainable fresh water supplies around the world. Water conservation refers to the preservation, control and development of water resources and the prevention of water pollution.

One way conservation can be broken down is into three areas: reduce, reuse, and repair. Picture a gallon of milk and how much liquid is contained inside. On average, each person in the United States uses around 100 gallons of water a day.¹ Some of the most typical uses and amount of water in US households can be found in the chart below.



<http://water.usgs.gov/watuse/wuto.html>

1. <http://water.usgs.gov/edu/qa-home-percapita.html>

Typical Water Use at Home

What are ways that we can help conserve water to not only lessen our water usage, but also help keep our water cleaner?

Bath	A full tub varies, of course, but 36 gallons is good average amount. Tip: Taking a shower instead of a bath should save a good bit of water.
Shower	Old showers used to use up to 5 gallons of water per minute. Water-saving shower heads produce about 2 gallons per minute. Tip: Taking a shorter shower using a low-flow showerhead saves lots of water.
Teeth brushing	<1 gallon. Newer bath faucets use about 1 gallon per minute, whereas older models use over 2 gallons. Tip: Simply turn the faucet off when brushing teeth.
Hands/face washing	1 gallon. Tip: Simply turn the faucet off before drying your hands and face. If you don't mind a brisk wash, don't run the faucet until it gets hot before using it. Installing a faucet-head aerator will also reduce the water flow rate.
Face/leg shaving	1 gallon. Tip: Simply turn the faucet off shaving.
Dishwasher	6-16 gallons. Newer, EnergyStar models use 6 gallons or less per wash cycle, whereas older dishwashers might use up to 16 gallons per cycle. Tip: EnergyStar dishwashers not only save a lot of water but also save electricity.
Dishwashing by hand	About 8-27 gallons. This all depends on how efficient you are at hand-washing dishes. Newer kitchen faucets use about 1.5-2 gallons per minute, whereas older faucets use more. Tip: Efficient hand-washing techniques include installing an aerator in your faucet head and scraping food off, soaking dishes in a basin of soapy water before getting started, and not letting the water run while you wash every dish. And it's best to have two basins to work in—one with hot, soapy water and the other with warm water for a rinse.
Clothes washer	25 gallons/load for newer washers. Older models might use about 40 gallons per load. Tip: EnergyStar clothes washers not only save a lot of water but also save electricity.
Toilet flush	3 gallons. Most all new toilets use 1.6 gallons per flush, but many older toilets used about 4 gallons. Tip: Check for toilet leaks! Adjust the water level in your tank. But, best to install a new low-flow toilet.
Glasses of water drunk	8 oz. per small glass (not counting water for Fido or your cats). Also note you will be using water for cooking.
Outdoor watering	2 gallons per minute, depending on the force of your outdoor faucet. This may not sound like too much but the large size of lawns and yards means outdoor water use can be a significant use of water.

Activity

Day 1: (45 minutes)

1. Start by discussing all the ways that students use water during the day outside of school, and then proceed to talk about the ways in which students use water together at school. Some ideas include washing hands, cleaning, flushing the toilet, drinking water, etc. Create a list that you can use as a class of all the ways water is consumed or wasted.
2. Have each student utilize the Water Footprint Calculator² to get a better idea of how much water their families actually uses every day—the results are astounding! Have a class discussion on the uses of water in their homes.
3. Write the word **conservation** on the board. Create the definition of water conservation from the students' brainstorming. Next to your class list of all the ways that water is used by them each day, begin drafting a new list detailing all the ways that they can start conserving water. See this list of 100+ ways to conserve water³ for a large compilation of ideas if you need them to help the student generate their own thoughts. Keep in mind to discuss conservation at home and at school.
4. Save this list for Day 2, where students will choose an aspect of conservation or tips for conversation with their school community.

Day 2: (45 minutes)

1. Start the class with a review of the ideas the class came up with the day before for ways to conserve water, specifically focusing on ways this can occur at school. Come up with a class plan for how you will all work to conserve water collectively during the school year.
2. Divide the class up into groups of four and ask them each to pick one aspect or tip for conservation that they would like to share with their peers at school. Help them develop their ideas by framing their tips through the concepts of reuse, reduce, and repair. Examples can include: reusing by saving rainwater from school gutters and using this for watering plants or cleaning inside, reducing by turning the water off when soaping your hands or using reusable water bottles, or repairing by asking the school to inspect its plumbing systems for leaks.
3. Once they have chosen a tip to share, give each group a poster board that they will use to make their peers at school more aware. Have them fill in formation about their tip on the poster, as well as including illustrations so that all ages can interpret their work. Also have them consider where they think their tip would be most useful to post. While they work on their posters, you can make a small poster outlining your class plan to post where everyone can see.
4. In the last five minutes, have each group share their tip with the class. If time is available, take the class to post their tips around the school in their desired locations

Assessment

Students will present their posters to the class.

2. <http://www.gracelinks.org/1408/water-footprint-calculator>

3. <http://wateruseitwisely.com/100-ways-to-conserve/?view=list>

Extensions

- After discussing ways for conserving water in each home, have each student come up with a plan for how they can share tips about water conservation with their own families.
- Write a letter as a class to the school principal about enacting water conservation at school using some of the ideas that they brainstormed in discussion; for example, students could petition the use of rain catching barrels at each gutter spout to reuse caught rainwater, or students could request the schoolwide use of environmentally-friendly cleaners.

Resources

Websites (Most descriptions provided by sources):

<http://www.epa.gov/watersense/>

Environmental Protection Agency - Water Sense: Revolve to Save Water in 2015: How kids can get involved in water conservation!

www.ciese.org/curriculum/drainproj/

How much water do you use every day in your home? Introduces students to the topic of water use, and to data gathering and analysis. From the Center for Improved Engineering and Science Education (CIESE).

<http://wateruseitwisely.com/kids/index.php>

Water Use it Wisely: It all starts with you. A site for kids with information and games about water and water conservation.

http://www.thirteen.org/h2o/educators_lesson4.html

Planet Water: Lesson plans on water conservation.

<http://www.dec.ny.gov/lands/67073.html>

Department of Environmental Conservation - Information on water use and conservation.

<http://www.amnh.org/exhibitions/past-exhibitions/water-h2o-life>

American Museum of Natural History: Lesson plans for Water = Life Exhibit.

Lesson 3: The Saw Mill River Daylighting Project

Objectives

Students will learn about the pros and cons of the Saw Mill River daylighting project in downtown Yonkers, discuss its environmental impact on the community and Hudson River ecosystem, and write an essay arguing their position on the project.

Essential Question

How has the Saw Mill River daylighting project impacted the Yonkers community?

Common Core Standards

- Science, Math and Technology
- CCSS- ELA- Literacy
- W.5.1 / SL.5.4

Skills

- critical thinking
- exploring different points of view
- writing a persuasive essay
- political decision making

Duration: 50 minutes

- Discussion: 15 min
- Activity time: 35 min

Vocabulary

daylighting – the term daylighting is used to describe the restoration of rivers that have been covered up with concrete, usually as a result of past public works in urban areas

flume – a deep narrow channel with a stream or river running through it

confluence – the junction of two rivers joining together

(example: Saw Mill River empties into the Hudson River in Yonkers.)

revitalization – the act of making something active, healthy, or energetic again

ecological impact – the effect(s) on living organisms and their non-living environment of human activity or natural phenomena

riffle – a short, relatively shallow and coarse-bedded length of stream where the stream flows at slower velocity but with a higher turbulence than it normally does in comparison to a pool (an implementation used in the Saw Mill River daylighting project to aid eel migration).

fish ladder – a series of pools built like steps to enable fish to bypass a dam or waterfall (another implementation used in the Saw Mill River daylighting project to aid eel migration; version used is an Alaskan steeppass).

Materials: Each student should have:

- paper
- pictures of daylighted area before and after

Background

For more than a decade the Saw Mill River Coalition and its parent organization, Groundwork Hudson Valley, have led the effort to bring the Saw Mill River to daylight. Part of the revitalization of downtown Yonkers, this project has enormous ecological, economic and cultural significance. On November 15, 2011, after many years of community organizing, waters began to flow aboveground in downtown Yonkers for the first time in 90 years—a major achievement for both the coalition and the city.

With the aboveground riverbed, 13,775 square feet of aquatic habitat have been re-created, including a tidal pool and two freshwater pools. The new natural river flows parallel to the preexisting underground flume, which now serves as an overflow channel to protect the integrity of the new park and the downtown area from floods.

The old Larkin Plaza, including the parking lot that sat on top of the underground river, has been transformed into a public park. The grand opening occurred during Riverfest on September 8, 2012. The Saw Mill River Coalition and Groundwork Hudson Valley have worked with local partners—including the City of Yonkers, the Project for Public Spaces, Inc., the Public Library, the Beczak Environmental Education Center, the Friends of Phillipse Manor Hall, and area businesses—to develop the interpretive elements for this new space. Through educational exhibits, residents and visitors will be able to investigate the river's history and the various ways in which human activity has affected its ecology over the past 400 years.

Several other cities in the US—mostly notably San Antonio, TX, and Providence, RI—have developed the rivers that run through their downtowns into “river walks,” where pedestrians can walk and sit along the river. In both cities these river walks have become major amenities, drawing tourists and residents back to downtown and to the restaurants and shops that have sprung up beside the rivers. This is the idea behind this project for Yonkers.

The Saw Mill River was buried beginning at Chicken Island in 1917, and in the 1920's the Army Corps of Engineers built a large flume beginning at that site and continuing underground for about one-half mile underneath Getty Square, North Broadway and Larkin Plaza, until the river emptied into the Hudson River. There has long been talk about diverting the river from this underground flume and building a new natural riverbed that will flow through the center of Yonkers, opening the river to daylight and creating a major urban amenity for the city and its citizens. After many public meetings the decision was made to move ahead with the project, and the groundbreaking took place in December 2010; phase one of the daylighting project was completed in 2012.

The daylighting created two dynamic pools that connect to a tidal basin. Between each of these are natural stone riffles or sloped areas to allow for fish passage. At the western edge of Larkin Plaza there is a tidal gate with a pre-fabricated fish ladder installed. This will allow the salt water from the Hudson River to fill the basin and fish to migrate up the Saw Mill River. The habitat restoration also includes a wetlands area with submerged aquatic vegetation, plantings along the riparian buffers as well as at street level and installation of permeable surfaces to allow water to run through and eliminate runoff. At the eastern, inland edge of Larkin Plaza there is a water quality netting chamber, which captures an estimated 177 tons of solid waste annually to prevent it from entering the restoration area. A pedestrian bridge is installed over the river, affording yet another way to enjoy this restored habitat. Prior to European settlement, the mouth of the river was known as the “fishing trap” by Native Americans, and tidal wetlands provided habitat for countless birds and river-dependent species. The project's goal was to recapture—to the extent possible—the river's ecological significance at this spot.

Culturally, the hope for the new river park was for it to become the corridor around which the city's culture once again revolves, with the park, trails, offices, retail, entertainment space, and an integrated interpretive story of Saw Mill. When the river was underground, very few citizens were aware that it was lurking underneath the parking lot, nor of its past history. The site was surrounded by public amenities, much like a town square in Europe. The new park now has pulled these elements together with walkways, overlooks, plantings, and kiosks. It has enlivened the area, creating a compelling public space for the entire community, as well as a destination for visitors from across the region. It has been both a unifying force and the catalyst for future growth.

Daylighting Timeline

Phase 1:

Ground Breaking: December 15, 2010

Official Opening: September 8, 2012

Phase 2:

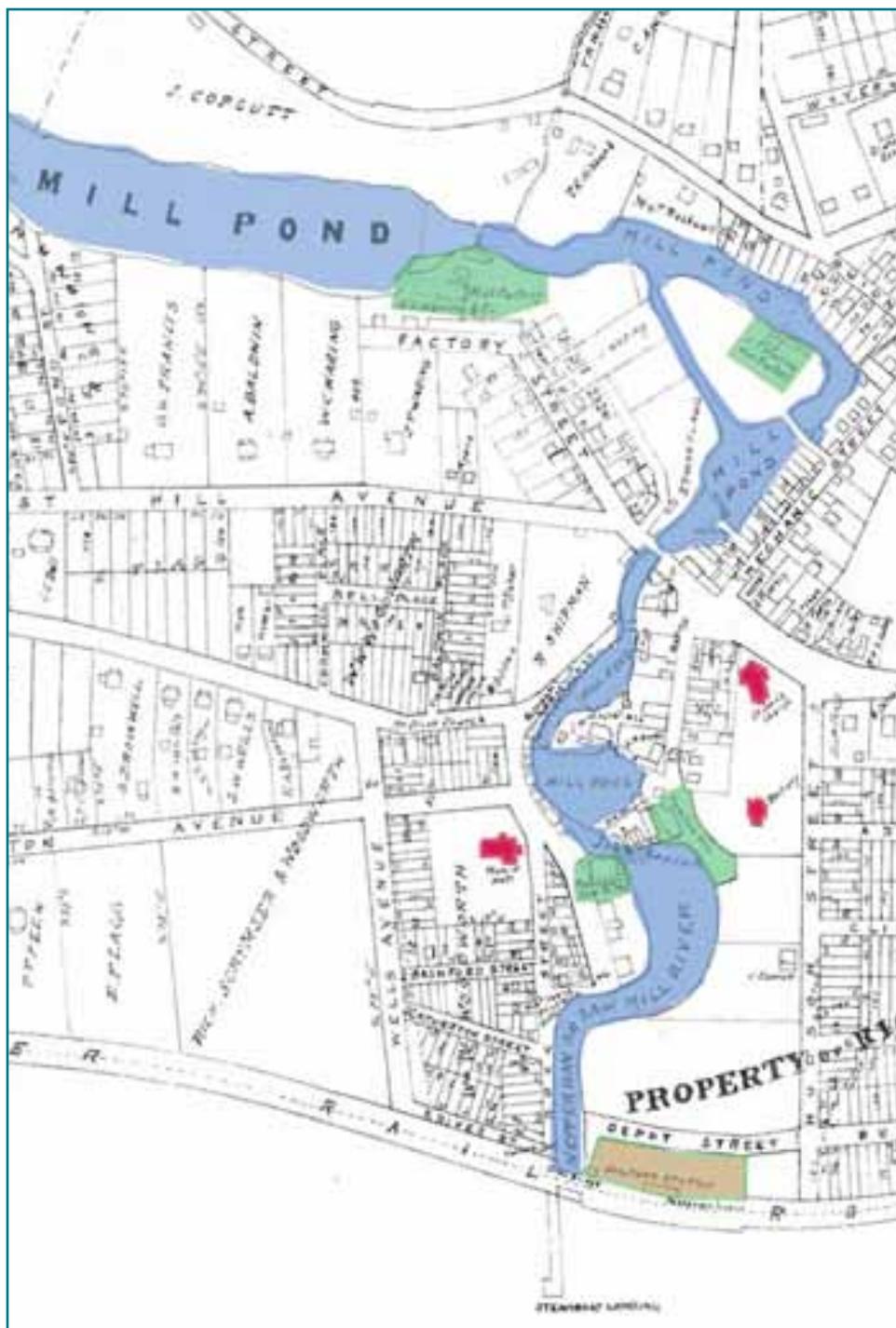
Mill St. connection to Van Der Donck development—completed 2013

Phase 3:

Chicken Island development—ongoing

Go to <http://daylightyonkers.com/plans/> for more current information.

Map of the Village of Yonkers, 1851



The Flume



Daylight Project Plan



Activity

1. After students have learned about the daylighting project, have them brainstorm the pros and cons of this project. Students should be able to defend their position and discuss it with the class.
2. Each student will write a four paragraph letter to the editor of a Yonkers newspaper on whether they support or oppose the daylighting project and its effect on the river environment. In your answer be sure to include:
 - a description of the project
 - an explanation of your position
 - details that support your position
 - check your writing for correct grammar, spelling, capitalization and punctuation

Assessment

Students will share their essays.

Extensions

- Take a field trip to see the daylighted river. Contact: Groundwork Hudson Valley.
- Find out more information about the Citizen Science American Eel Research project and learn how the school can get involved. See website below.
- Students can research the river walks in other US cities and see how they have impacted those cities. (example: San Antonio, TX)

Resources

Websites (Most descriptions provided by sources):

<http://daylightyonkers.com/daylighting-facts/>

Facts about the daylighting project in Yonkers.

<http://www.sawmillrivercoalition.org/whats-happening/daylighting-the-saw-mill-river-in-yonkers/>

The history and current status of the project.

http://www.nytimes.com/2007/07/01/nyregion/nyregionspecial2/01mainwe.html?_r=1&adxnnl=1&fta=y&adxnnlx=1295107247-kU9EgsKYnYfRwfGhxkYHqQ

An article from the *New York Times* about the possibility of daylighting the Saw Mill River.

<http://activerain.com/blogsview/827104/clean-up-grant-of-900k-form-epa-for-saw-mill-river>

Summary of the components of the \$900,000 EPA grant for the Saw Mill and the surrounding area.

<http://www.dec.ny.gov/lands/49580.html>

Department of Environmental Conservation – Citizen Science American Eel Research.

<http://www.ideo.columbia.edu/edu/plus/Westchester/WHAT%20EVER%20HAPPENED%20TO%20THE%20NEPPERHAN.pdf>

Whatever happened to the Nepperhan River?

http://wn.com/nepperhan_river

Video of the Nepperhan River?

Lesson 4: Back to the Future: Designing an Ideal River Environment

Objectives

As the culminating lesson of this unit of study on the three rivers of Yonkers, students will bring together everything they have learned about the environmental and social impact of rivers on communities, with the goal of designing an ideal river community in the year 2030.

Essential Question

What can we do to live in a more sustainable environment and community?

Common Core Standards

- Science, Math and Technology
- CCSS- ELA- Literacy
- W.5.1 / SL.5.4

Skills

- critical thinking
- reading comprehension
- communication
- political decision making
- debate skills

Duration: 3 Days (60 minutes each day)

Vocabulary

city planner – a person who plans and controls the construction, growth and development of a city or town

industrialist – a person involved in the ownership and management of industry

developer – a person who develops property or buildings

mitigate – make less severe or serious.

consequence – a result or effect of an action or condition

Materials

- mural paper
- colored pencils and/or markers

Background

Students will use any resource materials from earlier lessons to help them decide how to design a community that helps the river environment. Explore the resource links below to see information and predictions from SUNY College for Environmental Science and Forestry, The Cary Institute and Riverkeeper regarding the future state of the Hudson River.

Activity

Day 1:

Students identify the key components in a river community, including transportation, parks, housing, industry/commerce, energy, government, and schools. They will discuss what impact each of these has on the river environment—both negative impacts such as sewage, storm drain run-off, pollutants (bottles, cans, chemicals), or warm water from power plants—and positive impacts such as beaches, fishing and sewage treatment plants. Students will discuss how negative impacts can be stopped and the role of each component in the community. They will list all of these factors to aid in deciding how to design the best river community.

Day 2:

Students form three stakeholder groups: local government officials/city planners, environmentalists, industrialists/developers. The teacher writes the three roles of the stakeholders on index cards (one stakeholder per card; one card per student) then places them in a basket. Students randomly draw an index card from the basket. Students find classmates holding the same stakeholder cards. Each group will discuss what they need to do to make an ideal community, such as where to place parks and roads to avoid run-offs into the river or wetlands, where to build housing or factories in order to minimize river pollution, and what residents can do to stop people from dumping in the river.

Day 3:

All three groups will come together to design an ideal river town. Taking a long roll of paper, students will trace the course of a river down the middle. They will then decide where to put roads, bridges, houses, industry, stores, parks, and public buildings and how to mitigate any possible negative environmental consequences.

Assessment

Students will be evaluated based on their active participation.

Extensions

- Students create a PowerPoint presentation for their school.
- Interview a scientist, professor or other professional on their thoughts of the future state of the environment in which we live.

Resources

Websites (Most descriptions provided by sources):

<http://www.caryinstitute.org/events/lecture-videos/future-hudson-river>
The Cary Institute for Ecosystems Studies.

<http://www.esf.edu/outreach/k12/edunits/units/hudson/Lesson10.pdf>
SUNY College of Environmental Science and Forestry.

<http://www.riverkeeper.org/news-events/news/get-involved/the-future-of-the-hudson/>
Riverkeeper.

Water Pollution

General Electric Plant, Hudson River



Appendices/Curriculum Resources

Litter around Rivers

Hudson River



Bronx River

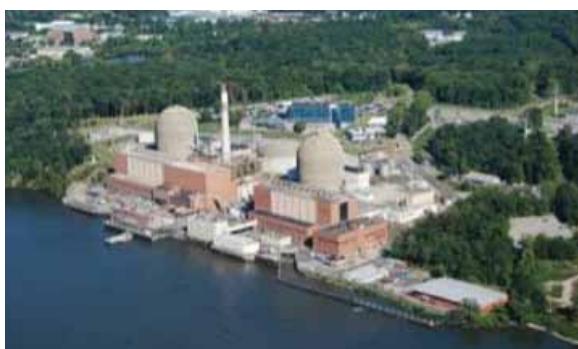


Appendices/Curriculum Resources

Water Runoff



Indian Point Power Plant, Hudson River



Resources and Field Trip Destinations

The resources provided support and enhance the *Three Rivers of Yonkers* classroom curriculum designed for the 4th and 5th grade students with a focus on the Hudson River, Saw Mill River, and Bronx River. It is encouraged that the teachers research these destinations to take advantage of professional development programs offered and field trip opportunities for the students. Many of the sites offer hands-on inquiry-based educational programs that support New York State Common Core and other curriculum mandates. These field trip experiences will foster and connect the students to learn naturally while exploring the natural world.

Hudson River

Constitution Marsh Audubon Center & Sanctuary

Garrison, NY

<http://constitutionmarsh.audubon.org>

Managed by Audubon as a wildlife sanctuary since 1970, the Constitution Marsh Audubon Center & Sanctuary is a unique and beautiful 270-acre tidal marsh that welcomes school groups of all ages for hands-on investigations of the Hudson River using scientific tools and methods in programs that focus on species identification, ecosystems, food chains, and canoe trips—most of which can also be brought to your classroom if an on-site trip isn't possible for you!

Croton Point Nature Center & Park

Croton-on-Hudson, NY

<http://parks.westchestergov.com/croton-point-nature-center>

Located within the 500-acre Croton Point Park, the Croton Point Nature Center features exhibits about the Hudson River, local history, and flora and fauna, including Hudson River specimens, local and Native American history, hands-on activities, and a 4-mile stretch of Hudson shoreline to explore.

Department of Environmental Conservation (DEC)

Albany, NY

<http://www.dec.ny.gov>

The DEC combines in a single agency all NY state programs designed to protect and enhance the environment with a mission to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being—learn more about their educational resources here: <http://www.dec.ny.gov/26.html>.

Appendices/Curriculum Resources

Greenburgh Nature Center (GNC)

Scarsdale, NY

<http://greenburghnaturecenter.org>

GNC is a 33-acre nature preserve with trails, a pond, and gardens that act as a significant wildlife habitat refuge including 30 acres of woodland, two significant wetland sites, and a wildflower meadow, which are accessible to educators through programs on a wide range of environmental topics, either on-site or at off-site locations.

Hudson River Maritime Museum

Kingston, NY

<http://www.hrmm.org>

Dedicated to the preservation and interpretation of the maritime history of the Hudson River, its tributaries, and related industries, the Hudson River Maritime Museum features a collection of exhibits and artifacts that are presented to school groups of all ages through a number of themed tours on ecology, history, and landscape, as well as brand new school-outreach programs.

Hudson River Museum

Yonkers, New York

<http://www.hrm.org>

Located of the banks of the Hudson, the Hudson River Museum is your gateway to the Hudson Valley with its Hudson Riverama, the historic site of Glenview, exhibition tours and workshops, planetarium shows, musical productions, lectures, and programs for teaching and learning.

Hudson River Sloop Clearwater

Beacon, NY

<http://www.clearwater.org>

Clearwater's "Sailing Classroom" provides students with powerful, dynamic experiences that connect them to their communities and to their environment through educational programs that inspire hands-on learning to engage students and promote "learning by doing" with the intention of transforming students of all ages into the environmental stewards of the future, including sailing, shore-based, youth empowerment, and in-class programs.

Kingsland Point Park: Kathryn W. Davis RiverWalk Center

Sleepy Hollow, NY

<http://scenichudson.org/parks/davisriverwalkcenter>

Focused on river-based education and exploration, the Kathryn W. Davis RiverWalk Center is a stop in Kingsland Point Park on the planned 51-mile Westchester County RiverWalk that features a picnic pavilion, bird watching and nature study areas, kayaking and canoeing sites, and a number of walking and hiking trails.

Appendices/Curriculum Resources

Lenoir Nature Preserve

Yonkers, NY

<http://parks.westchestergov.com/lenoir-preserve>

Lenoir Nature Preserve is a 40-acre nature preserve comprising woodlands, field habitats, and a multitude of nature exhibits, all boasting a number of unusual specimen trees and shrubs imported from around the world as well as native species that provide shelter for many kinds of wildlife, including woodpeckers, owls, and bats.

Palisades Interstate Park

Alpine, NJ

<http://njpalisades.org>

This National Historic Landmark on the Palisades encompasses 2500 acres of wild Hudson River shoreline, uplands, and cliffs, featuring hiking trails, cliff-top overlooks, a scenic riverside drive, picnic areas and playgrounds, a nature sanctuary, and several historic sites—all just minutes from Manhattan.

Riverkeeper

Ossining, NY

<http://www.riverkeeper.org>

Riverkeeper is a member-supported watchdog organization dedicated to protecting the environmental, recreational, and commercial integrity of the Hudson River and its tributaries, and safeguarding the drinking water of nine million New York City and Hudson Valley residents with the hope that residents and visitors will care for and help protect these ecosystems.

Sarah Lawrence College Center for the Urban River at Bczak (CURB)

Yonkers, NY

www.centerfortheurbanriver.org

(CURB) is an alliance of Sarah Lawrence College and the Hudson River Valley Environmental Education Institute formed to advance environmental knowledge and stewardship by providing high quality K-12 environmental education for the local community, featuring a welcoming riverfront lawn, an easily accessible tidal marsh, a beach used for river exploration and seining, and a newly redesigned and outfitted field station lab.

Scenic Hudson

Poughkeepsie, NY

<http://www.scenichudson.org>

The largest environmental group focused on the Hudson River Valley, Scenic Hudson is dedicated to protecting and restoring the Hudson River, its riverfront, and the majestic vistas and working landscapes beyond as an irreplaceable national treasure for America and a vital resource for residents and visitors—all of Scenic Hudson’s parks and preserves provide ideal “outdoor classrooms” for families, school and community groups of all ages to learn about the valley’s natural resources, how they’ve shaped the region’s culture, and the importance of protecting them.

Appendices/Curriculum Resources

The Science Barge

Yonkers, NY

<http://www.groundworkhv.org/programs/science-barge/>

The Science Barge is a prototype sustainable urban farm developed by NY Sun Works and acquired by Groundwork Hudson Valley operating as a floating environmental education center on the Hudson River, where it features a hydroponic greenhouse that grows fresh produce with zero net carbon emissions, zero pesticides, and zero runoff—it is the only fully functioning demonstration of renewable energy supporting sustainable food production in New York.

U.S. Environmental Protection Agency (EPA)

Washington, D.C.

<http://www.epa.gov>

Under the mission of protecting human health and the environment, the EPA develops and enforces regulations, gives grants, studies environmental issues, sponsors partnerships, teaches people about the environment, and publishes information—learn more about their educational resources here: <http://www.epa.gov/students>.

Wave Hill

Bronx, NY

<https://www.wavehill.org>

Wave Hill is a 28-acre public garden and cultural center in the Bronx overlooking the Hudson River and Palisades that celebrates the artistry and legacy of its gardens and landscapes, preserves its magnificent views, and explores human connections to the natural world through programs in horticulture, education and the arts.

Bronx River

Bronx River Alliance

Bronx, NY

<http://bronxriver.org>

The Bronx River Alliance serves as a coordinated voice for the river and works in harmonious partnership to protect, improve and restore the Bronx River corridor so that it can be a healthy ecological, recreational, educational and economic resource for the communities through which the river flows with an education program that brings together teachers, community-based educators, and scientists to use the river as a classroom, educate the public about the river, and train volunteers to monitor the river's conditions through programs like "Wade in the Water", Bronx River Stewards, and on-water interpretive canoe trips.

Bronx River—Sound Shore Audubon Society

Scarsdale, NY

<http://brssaudubon.org>

The Bronx River—Sound Shore Audubon works to increase the numbers and influence of those who believe in the value and need of the conservation of our wildlife, plants, soil and water resources, and of the relations to public welfare of their intelligent treatment and wise use, offering free programs and field trips to all birder levels from beginner to expert.

Appendices/Curriculum Resources

Bronx Zoo / Wildlife Conservation Society

Bronx, NY

<http://bronxzoo.com>

The Wildlife Conservation Society's Bronx Zoo is the world's largest urban zoo, featuring thousands of exotic species in naturalistic habitats, which educators can utilize through field trips, outreach programs, on-site and webinar professional development, a teacher advisory council, conservation education fellowships, an urban advantage partnership program, and an array of educational materials accessible online for a variety of age groups.

The New York Botanical Garden

Bronx, NY

<http://www.nybg.org>

An iconic living museum, The New York Botanical Garden covers 250 acres and supports over one million living plants in extensive collections with more than 300,000 people—among them Bronx families, school children, and teachers—learning about plant science, ecology, and healthful eating annually through NYBG's hands-on, curriculum-based programming that focuses on a school of professional horticulture, adult education classes, school/teacher programs, and a children's gardening program.

Rocking the Boat

Bronx, NY

<http://rockingtheboat.org>

Rocking the Boat empowers youth who are challenged by severe economic, educational, and social conditions to develop self-confidence and skills through wooden boatbuilding and environmental education in the Bronx with both on-water group programs and youth development programs, which create water classrooms for students, educators, the public, and businesses to revitalize the community while creating better lives for themselves.

Westchester County Park: Kensico Dam Plaza

Valhalla, NY

<http://parks.westchestergov.com/parks-and-destinations/kensico-dam-plaza>

Forming the Kensico Reservoir, Kensico Dam Plaza is a part of the Bronx River Parkway Reservation that provides a unique setting for a wide variety of activities including cultural heritage celebrations and concerts, fitness classes and a fitness course, as well as areas for picnicking, in-line skating, walking and nature study.

Appendices/Curriculum Resources

Saw Mill River

Groundwork Hudson Valley

Yonkers, NY

<http://www.groundworkhv.org>

For more than a decade, Groundwork Hudson Valley has been a dynamic force for change in distressed communities in the lower Hudson Valley in their work to make neglected neighborhoods more livable and sustainable through an array of on-the-ground environmental projects that directly involve local residents, especially youth, who can get involved through programs related to community food, community revitalization, the Saw Mill and Hudson Rivers, and education and job training.

Philipse Manor Hall

Yonkers, NY

<http://nysparks.com/historic-sites/37/details.aspx>

Attributed as Westchester County's oldest standing building, Philipse Manor Hall is a historic house museum located off Getty Square that belonged to the Dutch-born carpenter and trader Frederick Philipse—infamous for his signature on the “Declaration of Dependence” and his ownership of all of modern-day Yonkers—which now serves as a museum of history, art, and architecture, as well as acting as host to community organizations, meetings, educational programs and special events.

Saw Mill River Audubon

Chappaqua, NY

<http://www.sawmillriveraudubon.org>

This Westchester County, New York chapter of National Audubon works to maintain environmental quality for all living things by protecting natural ecosystems through education, advocacy and habitat conservation, offering field trips, workshops and programs to explore birds, other wildlife, and their habitats.

Saw Mill River Coalition

Yonkers, NY

<http://www.sawmillrivercoalition.org>

The Saw Mill River Coalition is program of Groundwork Hudson valley that facilitates a dynamic partnership of nonprofit groups, government agencies, municipalities, and businesses dedicated to revitalizing and protecting the Saw Mill River through projects such as water quality monitoring, river clean-ups, Adopt-a-Site, the Saw Mill River daylighting, and initiatives like “Be Tick Free”.

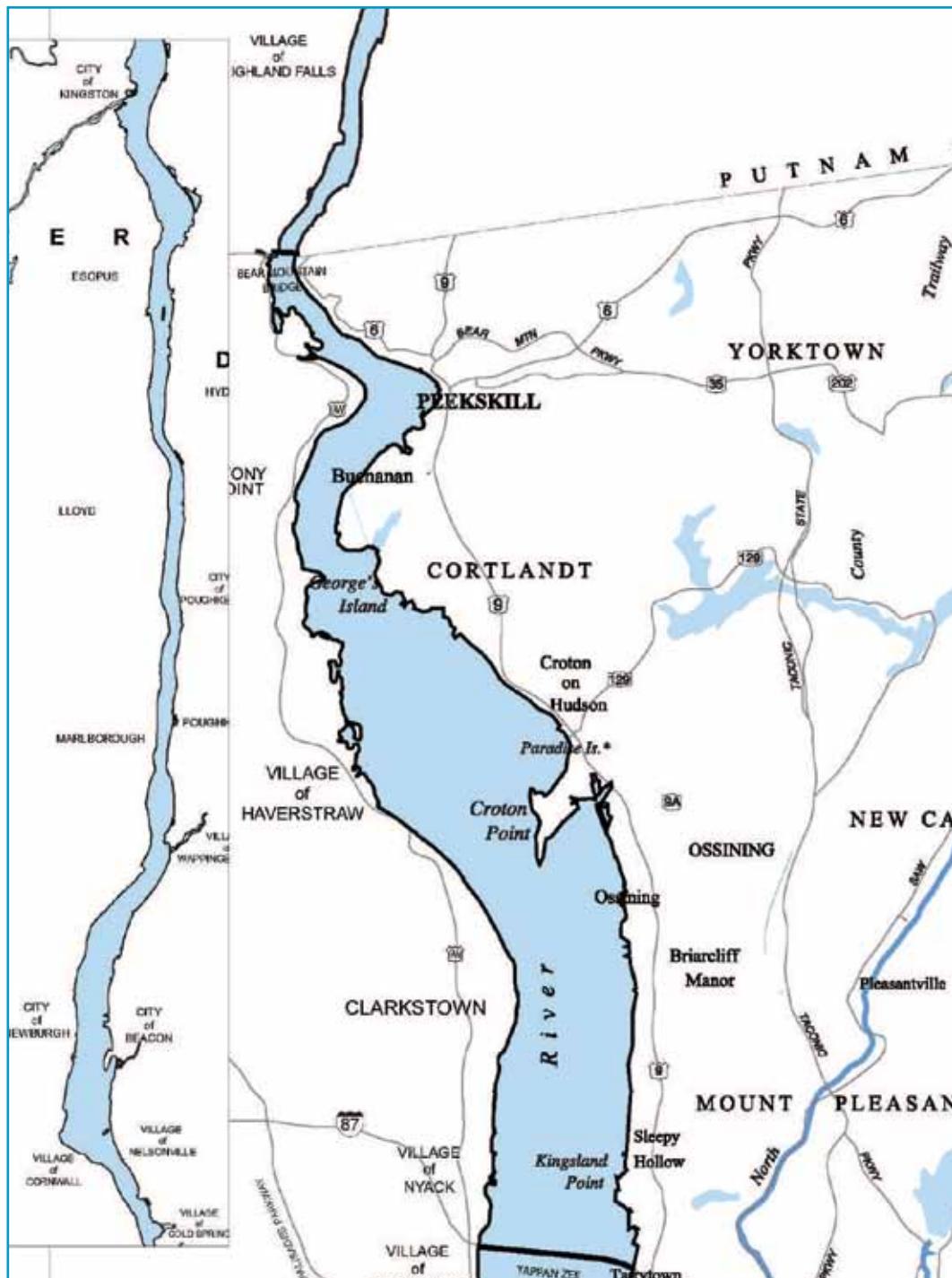
Tibbett's Brook Park

Yonkers, NY

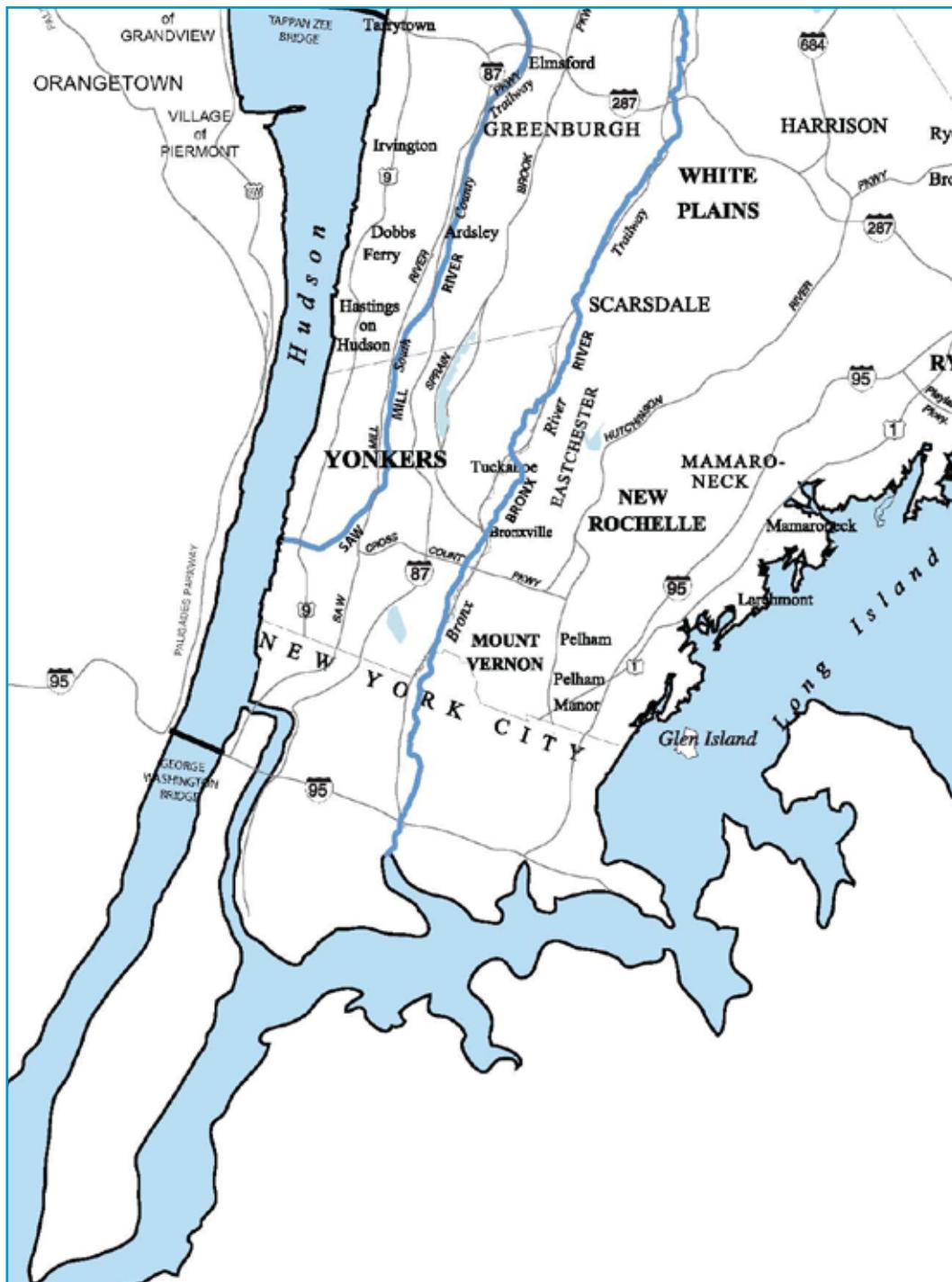
<http://parks.westchestergov.com/tibbetts-brook-park>

One of the first parks developed by Westchester County, the 161-acre Tibbett's Brook Park is the home of a number of recreational activities, ethnic celebrations, fairs, and festivals, offering nature watching, fishing, hiking, woodlands, lakes, playing fields, playgrounds, a swimming complex and a major activities lawn.

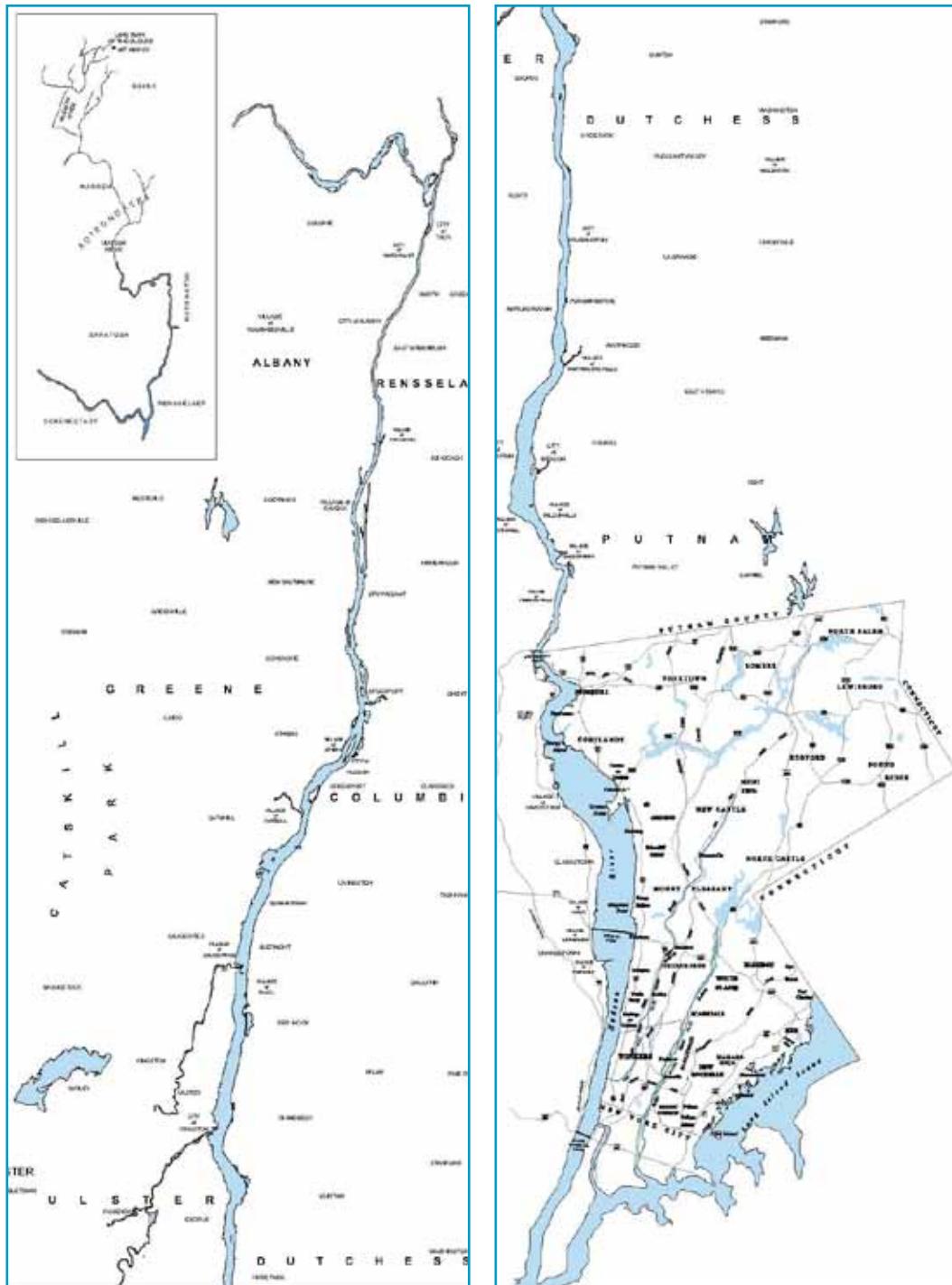
Hudson River North of Tappan Zee Bridge



Hudson River South of Tappan Zee Bridge



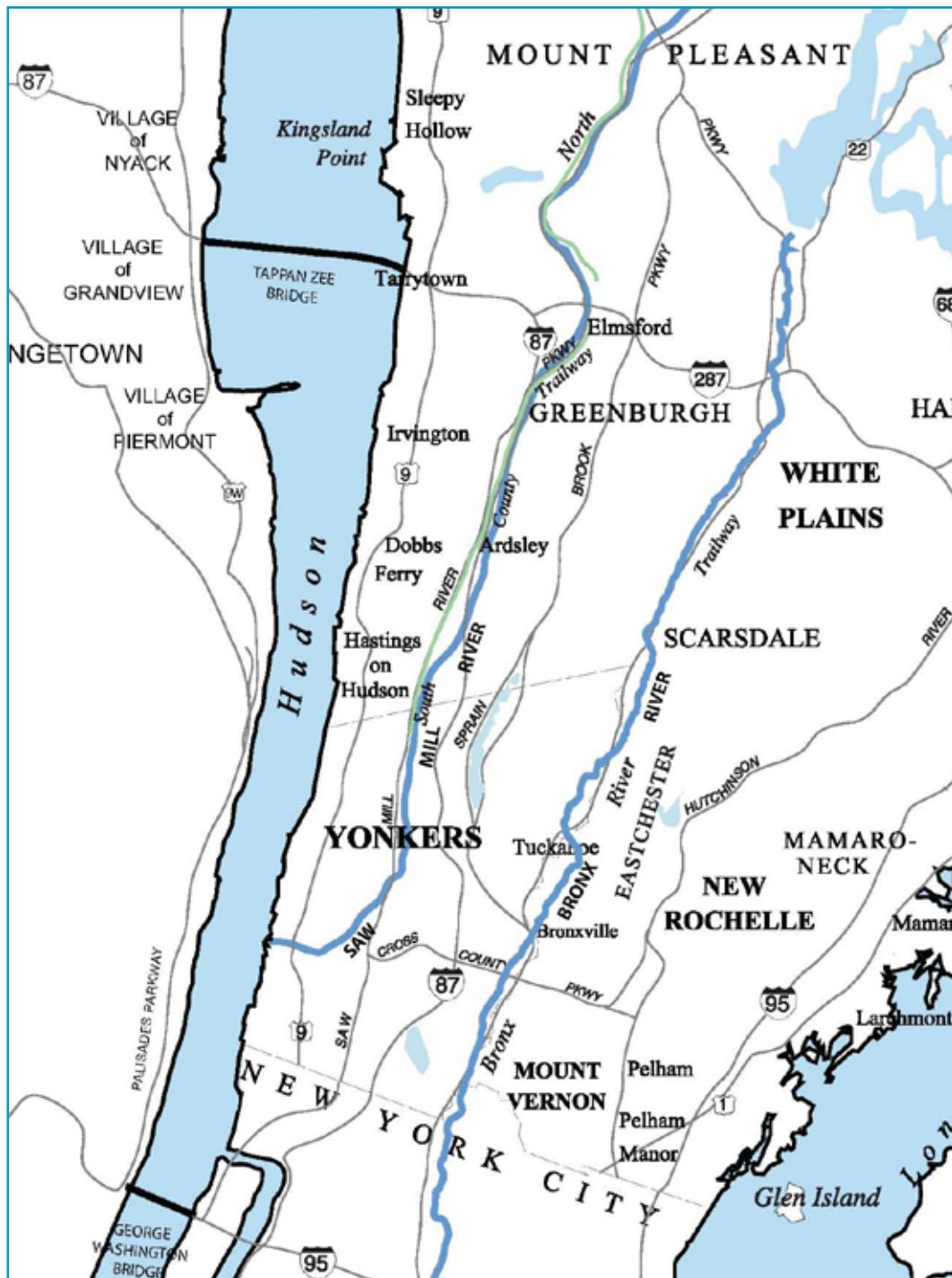
Hudson River from Lake Tear of the Clouds to New York City



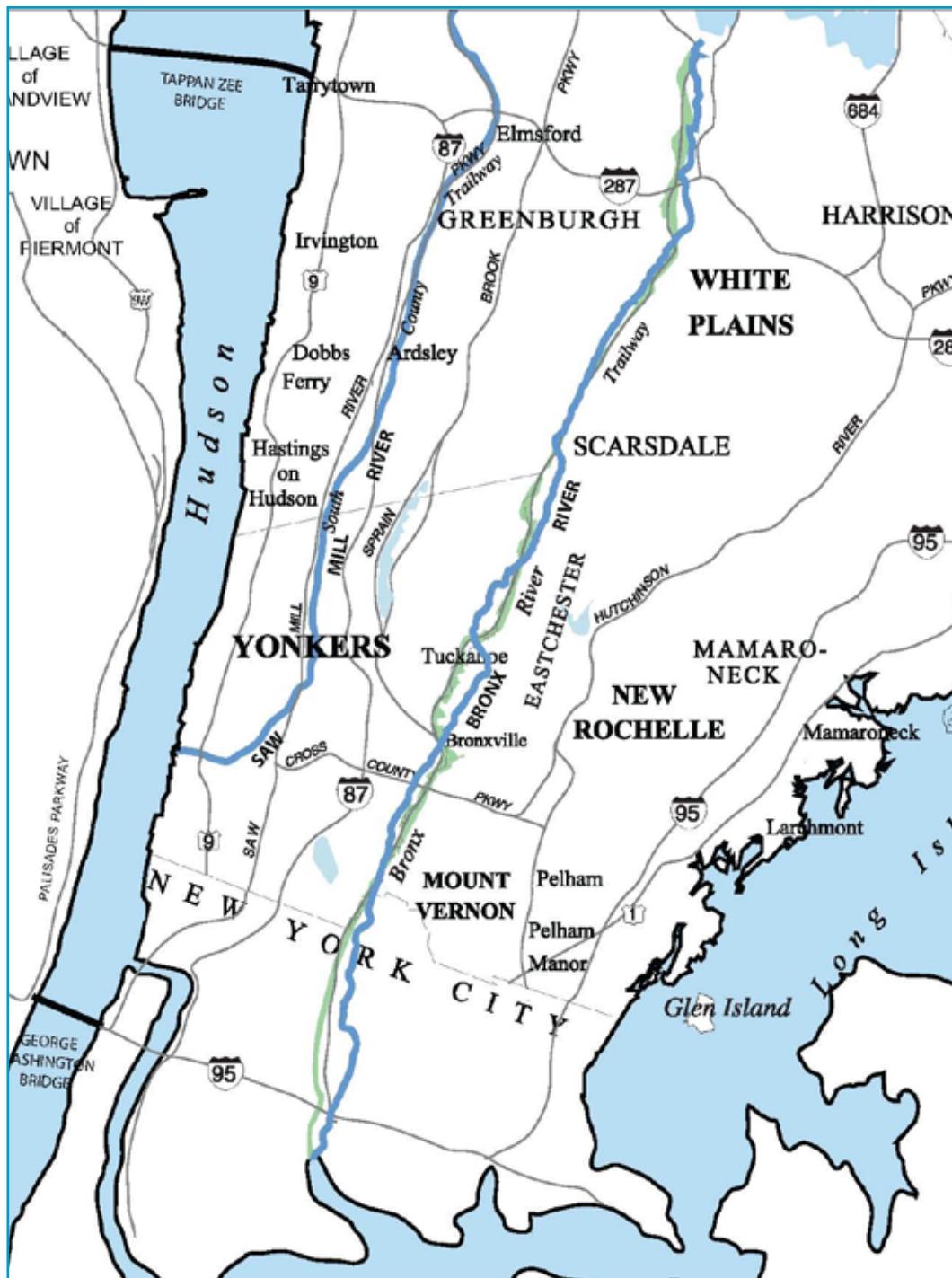
Hudson River Watershed



Saw Mill River



Bronx River



City of Yonkers

