Swim for the River

Study Guide

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Introduction

Near the end of *Swim for the River* an environmental educator, Kathleen Savolt, observes that the children she works with in Yonkers, New York, "touch the Hudson River; … the kids are always astonished to learn this water is connected to other places, and connected to people in other places." In other words the river can, and often does, link learners to a much wider world of knowledge and experience.

The *Swim for the River* DVD, which includes not only the documentary but nine additional short films and this teacher's guide, works the same way. Starting with a voyage down the Hudson River as seen through the eyes of swimmer Christopher Swain, learners can branch out into "tributaries" of knowledge provided in the media package. These tributaries are connected, via carefully researched hyperlinks (***in boldface text***), to 170 additional "streams" of information that contain primary source documents and in-depth articles.

Science and Social Studies are the broad curriculum areas of *Swim for the River*. Earth/Environmental Sciences and Social History are the main subjects. Specific areas of concentration include industrialization, ecosystems, aquatic ecology, environmental law, and the environmental movement. High school teachers may visit the ***resource*** section of the Web site for a correlation between study guide content and mandated curriculum standards.

HOW TO USE THIS GUIDE

Teachers may screen the whole documentary and engage students in a general discussion, or they may choose to teach a class based on one or more of the nine short articles in the guide that best fits their curriculum. Both the guide and the DVD are designed for selective use.

Articles can be photocopied and given to students. Alternatively, students can view the articles online at ***www.swimfortheriver.com/pdf***.

At the end of each article are teaching tools to help prepare and structure the learning experience.

- **Learning Objectives** describes, in broad terms, what students should know as a result of studying the material in the article.
- **Suggested Viewing** lists sequences in the documentary and DVD Extras most related to the article.
- **Teacher's Quick Reference** provides a bulleted outline of information in the article.
- **Key Facts** is a short list of names, places, things, and events discussed in the article.
- **Content Review** is a series of questions designed to test students' knowledge. Ask these questions in the classroom or incorporate them into a written quiz.
- **Discussion Questions** are designed to help students to think and/or write analytically about each topic. They can be the basis of an in-class discussion, or they can be assigned as essay questions.

For college undergraduates or advanced high school classes, you can direct students to the online version of the study guide at ***www.swimfortheriver.com/pdf*** and instruct them to use the guide's hyperlinks to research and write about topics in greater depth.

NAVIGATING THE DVD

The film *Swim for the River* is divided into chapters that can be individually accessed through the chapter menu.

Chapters Menu

The Source Chris Swain hikes to the source of the Hudson. Nineteenth century hunters, trappers, tourists and poets discover the Adirondacks. (3 mins. 22 secs.)

The Culvert Swain encounters the first barrier across the river. He tries to convince people it should be removed. (4 mins. 18 secs.)

Whitewater Swain shoots the rapids. Whitewater rafting replaces mining and logging on the upper river. (3 mins. 0 secs.)

Devastation and Preservation Nineteenth century logging has dire consequences. Adirondack Park is created. (3 mins. 49 secs.)

Battle in Corinth Citizens band together to stop the building of a huge trash incinerator. (4 mins. 31 secs.)

Hometown, USA Glens Falls pays a price for prosperity. (8 mins. 4secs.)

History of PCBS The most persistent pollutant. (9 mins. 33 secs.)

Clearwater A floating classroom with over 1 million students. (5 mins. 44 secs.)

Indian Point The most dangerous place on the Hudson River. (1 min. 34 secs.)

A Salt Marsh in Yonkers Urban kids discover the Hudson. (2 mins. 41 secs.)

River's End America's biggest oil spill, on Brooklyn's Newtown Creek. Swain reaches the Atlantic. (5 mins. 12 secs.)

Participation The choices we make for and against a sustainable environment. (3 mins. 3 secs.)

Extras Menu

In addition to *Swim for the River*, there are nine video sequences accessible from the Extras Menu. These videos range from two to nine minutes long. Each is a separate short film on a specific topic.

Forever Wild
Loggers and the Adirondacks (4 mins. 26 secs.)

Mohicans are Still Here
The Native Americans river (4 mins. 27 secs.)

Everything's Connected
The watershed (2 mins. 0 secs.)

Invasive Species
Bivalves that ate the Hudson (4 mins. 21 secs.)

Bird Banding
Birds at Constitution Marsh (2 mins. 6 secs.)

Cleaning Up PCBs

PCBs, G.E. and dredging (8 mins. 24 secs.)

Nowhere to Run
Indian Point nuclear power plant (8 mins. 17 secs.)

A Creek in Brooklyn
Cleaning up the dirtiest waterway (9 mins. 7 secs.)

Tipping Point
Small things make a difference (6 mins. 14 secs.)

WEB-LINKED GUIDES

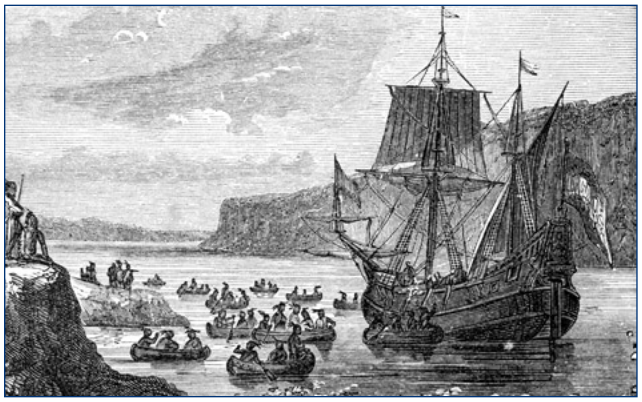
If you are reading this on paper you do not have access to the Web links in the guide. To access the Web links put the DVD in a computer with an Internet connection, select GUIDE from the main menu, and follow the onscreen instructions.

You may also access the guide directly at ***www.swimfortheriver.com/pdf***.

Also available at this location is the *Directory of Hudson River Environmental Organizations,* compiled in association with the *Swim for the River* project.

A Brief History

Four hundred years on the river, from Henry Hudson to the Superfund Law
(U.S. History)



Henry Hudson's ship, the Half Moon

The Hudson River begins in the shadow of New York state's highest mountain and flows 315 miles to the sea. For half its length the Hudson is a tidal ***estuary***; one of the longest in the world.

The explorer ***Henry Hudson*** was the first European to visit the river, in 1609. He was looking for a fabled water route to Asia through the North American continent. For thousands of years prior to Hudson's "discovery," the banks of the river had been populated by Native Americans. ***Tribes*** relied on the river as an abundant source of food and as an artery for canoe transportation. Native societies thrived along the banks until the mid-1700's. The Mohican tribe offered a gift of land to the first ***Dutch settlers***. What we now call the Hudson River they referred to as the *Mohicanituck*, which translates as "the river that flows two ways" – describing the effect of tidal action in the estuary.

Indians from Samuel Champlain's Voyages

Painting of Dutch trading post, 1615, by L. F. Tantillo

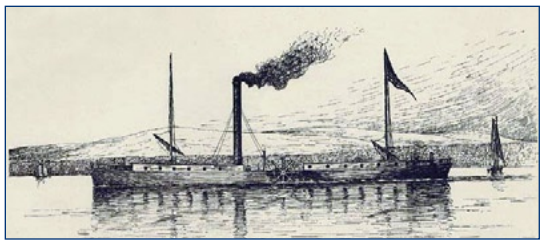
In 1635 the demand for furs, especially beaver pelts, which were used to make hats in Europe, led to the establishment of the first permanent Dutch trading post near present-day Albany. Trappers and traders were followed by farming settlers. Over time the Mohicans were persuaded to cede much of their land to the Europeans. Epidemics, a war with the Mohawks and the depletion of fur resources contributed to the decline of indigenous society, which all but disappeared by the 1800's.

American colonists in the Revolutionary War recognized the strategic value of the Hudson and built fortifications along the river. The most famous of these is West Point, where, in 1778, General George Washington's men stretched a huge ***iron chain*** across the water to prevent the British fleet from occupying the Hudson River valley. Had they done so, the colonies' supply lines crossing the river

would have been cut off. In 1802 West Point was converted into a military academy. It is the oldest point of continuous military occupation in the United States.


Hudson River sloop

The Hudson River was a major trade avenue. For nearly two hundred years its waters were dominated by a distinctive sailing craft known as the Hudson River sloop. These single-masted boats (usually 65 to 75 feet long) were the main method of transport on the river until the launching of the first commercially successful steamboat, the ***Clermont***, by Robert Fulton in 1807.


Robert Fulton's steamboat, the Clermont

The steamboat increased the quantity and reliability of commerce on the river. In the 1820's the completion of the ***Erie Canal*** made it possible to ship goods by water from New York City all the way to the Great Lakes and Canada. The Hudson became America's principal transportation artery and, at its peak, carried thousands of boats, day and night.

New York's first railroad was built to augment its river and canal system by linking the navigable waters of the Hudson and Mohawk rivers. Completed in 1831, it connected Schenectady and Albany. The transportation of freight on railcars allowed steamboats to forgo the Erie Canal and save valuable time. Steamboats remained a common sight on the river for more than a hundred years, tapering off in the mid-1900's. Railroads continued to expand and still run along the Hudson today.

Logging, mining, brick making, cement manufacture, and forging were among the ***early industries*** that blossomed along the river. Timber and wood products had been exported from the Hudson River Valley since the 1600's, but in the 19th century the need for paper, lumber, and charcoal grew exponentially. This resulted in extensive clear-cut logging and deforestation along the Hudson's upper reaches. The impact on the local environment was catastrophic.

The Adirondack forest had acted as a natural sponge, storing rainwater and gradually releasing it into the river system. As it disappeared the river became prone to a seasonal cycle of flash floods and droughts. Often, in the summer and fall, the Hudson's water level was too low to float the barges and boats that serviced its towns. In the winter it was jammed with ice. The river as a lifeline between cities was threatened.

Meanwhile some Americans began to advocate for the preservation of scenic land for the purpose of public recreation and renewal. Writers such as ***Ralph Waldo Emerson***, ***Walt Whitman***, and ***Henry David Thoreau*** wrote about the possibility of man's spiritual renewal in contact with unspoiled natural places. Painters such as Asher Durand, Albert Bierstadt, Robert Cole, and Frederick Church embraced the luminous beauty of the Hudson River Valley and the Adirondacks. Collectively they came to be known as the ***Hudson River School***, and the art they created made nature visually accessible to a receptive public.

Inspired by the romantic landscapes of the Hudson River School and the relative comfort of steamboat and railroad travel, tourists enjoyed the scenic vistas of the ***Hudson Highlands***, where the river passes through the foothills of the ***Catskill Mountains***. More intrepid adventurers went farther north to the Adirondack forests even as they were being systematically destroyed by logging.


Adirondack logs

View from Fishkill to West Point, William Guy Wall, 1821–1825

The newly popularized idea of conservation, combined with concerns about the damage to river navigation caused by forest clear-cutting, led New York state lawmakers to pass the famous "forever wild" amendment to the state constitution, creating ***Adirondack Park*** in 1892. It was, and remains, the largest protected park in the United States. At approximately six million acres, it has ensured the safety and rejuvenation of the upper Hudson and its surrounding area.

The lower Hudson, however, remained in jeopardy. As America's 19th century industrial revolution gathered momentum, towns that once relied on the river for commerce and transportation now turned their backs on it. Railroads and the invention of the automobile rendered river transport obsolete. Untreated sewage from rapidly growing population centers, as well as industrial effluent from mills and factories, made the ***Hudson a toxic waterway***, endangering the abundant life that flourished in it. Until the 1960's there was little public or political will to stop the desecration of the river.

In 1963 the Consolidated Edison Company proposed to build the world's largest hydroelectric plant on ***Storm King Mountain*** at the northern end of the Hudson Highlands region, made famous by the painters of the Hudson River School. The plan was met with strong civil resistance. The result was a seventeen-year legal battle. The proposed plan was finally withdrawn, and the case set legal precedent for what would become the ***National Environmental Policy Act***.

In the 1970's the toxicity of PCBs, or ***polychlorinated biphenyls***, was established. At the same time the chemical was discovered in large concentrations in Hudson River fish, ending most commercial fishing on the river. The source of the PCBs was two General Electric factories that spent more than thirty years dumping 1.3 million pounds of the chemical into the river. A thirty-year battle continues, in an attempt to force GE to remove the nondegradable toxic substance from the Hudson.

In 1980 Congress passed the federal ***Superfund Law***, which mandated the cleanup of heavily polluted sites and made it possible to hold major industrial polluters accountable for damage to the environment. Commercial and government organizations joined the ranks of civil groups like ***Riverkeeper*** in their efforts to restore and maintain the Hudson and bring legal actions against scores of polluters.

General Electric plant at Hudson Falls, N.Y.

Significant progress has been made, and the Hudson River is much cleaner than it was in the 1960's. However serious problems remain, and the protection of the river will require the ongoing concern and vigilance of successive generations.

Riverkeeper patrol boat

The following chapters in this guide deal with past and present challenges to the Hudson River ecosystem, the work of scientists to understand it, and the efforts of activists to preserve it.

A BRIEF HISTORY
Concepts and Discussion

Learning Objectives

This chapter is designed to give students an introduction to four hundred years of history on the Hudson River. Subsequent chapters explore specific issues in greater depth. For this chapter students should gain a basic knowledge of the early interactions between Europeans and Native Americans, the nature and consequences of industrialization in the Hudson River Valley, and the damage to the environment that led to twentieth century environmental laws.

Suggested Viewing

- Video Chapters: All.

Teacher's Quick Reference

- Henry Hudson's arrival
  - Mohicans use river as a source of food, artery for canoe traffic.
  - Dutch fur traders settle near Albany in 1635.
  - Mohicans cede land to Europeans, fall prey to epidemics.
- Hudson as strategic waterway
  - Fortifications are built on the river during the Revolutionary War.
  - Washington stretches a chain across the river in 1778 to keep out the British.
  - A military academy is established at West Point in 1802.
- Transportation along the Hudson
  - Europeans introduce single-masted sloops.
  - Steamboats expand trade. Timber and wood products are exported.
  - Industry grows to include mining, brick-making and cement manufacture.
- Environmental consequences
  - Logging increases, to satisfy the need for paper, lumber and charcoal.
  - Deforestation of the river's banks leads to flash floods and droughts.
  - Water levels of the river drop in summer and fall, preventing navigation.
- Conservation movement
  - Emerson, Whitman and Thoreau praise the virtues of nature.
  - Hudson River school painters inspire tourists.
  - Public support results in the creation of Adirondack Park.
- Political battles
  - Plans for a Storm King Mountain hydroelectric plant in 1963 meet resistance.
  - General Electric is challenged over PCB pollution in the Hudson in 1970's.
  - The 1980 Superfund Law allows for cleanup costs to be shifted to polluters.

Key Content

Mohicans
fur trade
Hudson River School
Storm King
Henry Hudson
sloops and steamboats
Adirondack Park
PCBs
estuary
industrialization
sewage and effluent
environmental laws

Content Review

- Who "discovered" the Hudson River? What was he looking for?
- How did the river benefit Native Americans?
- Why did the Mohicans call it "the river that flows two ways?"
- What caused the decline of Native American societies on the river?
- Name three types of transport along the river.
  How did they affect development?
- What early industry caused significant environmental damage?
- What was the Hudson River School?
- What is Storm King Mountain?
- What are PCBs?
- What laws were passed to help protect the environment?

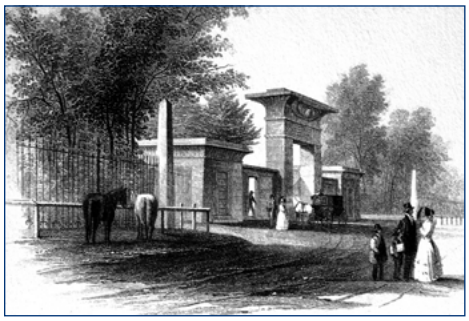
Discussion Questions

- Think of the Hudson River as a waterway that runs through both space and time. In what ways do you think it has remained the same, and in what ways has it changed? How has the landscape it runs through changed in the past four hundred years?
- By studying the river what might we learn about ourselves and our society?

Adirondack Park

Adirondack Park and the National Parks Movement
(U.S. and New York State History)

The Hudson River begins in the shadow of Mount Marcy, in the heart of New York state's immense Adirondack Park. The story of the river is linked inextricably to the story of the park, and the park is part of a national epic that played out over the nineteenth century, when most of the United States was mapped, settled, and populated.


Mount Auburn Cemetery and Park, 1847

The idea of a park, or land set aside for health and recreation, emerged in the 1800's. As urban populations increased, so did pollution, epidemics, and the stress of fast-paced city life. Travelers returning from Europe saw a potential solution in the public gardens of Vienna and London. The idea that nature was essential to humanity's physical and mental well-being took root and resulted in the creation of ***city parks***. The earliest parks in American cities were in cemeteries, where the available space served a dual purpose.

The boldest expression of the movement was the conception of New York's Central Park. In 1844, ***William Cullen Bryant***, a poet who was also the editor of the New York Evening Post, observed that "commerce is devouring inch by inch … the island [Manhattan], and if we would rescue any part of it … it must be done now." The horticulturalist ***Andrew Jackson Downing*** lobbied for a park, which local businesses began to see as a way to raise the value of adjacent real estate. The pressure from these commercial interests eventually swayed the legislature, and in 1858 a partially completed ***Central Park*** opened in New York City with great fanfare.


Central Park opening ceremony


George Catlin

Meanwhile the idea of national parks was gaining acceptance. They had first been proposed by the intrepid artist and adventurer ***George Catlin***, who spent several years on the Western frontier painting landscapes and Indians in native regalia. Catlin envisioned a national park to showcase the wilds of the West and hold them in trust for future generations. At first Catlin was both literally and metaphorically a voice in the wilderness, but his idea grew in the hearts and minds of Americans.

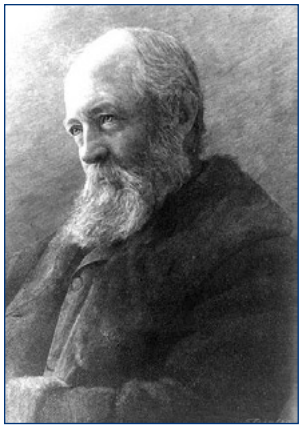
In 1860, due largely to the new science of ***wet-plate photography*** and grandiose landscape paintings by ***Albert Bierstadt*** and ***Thomas Moran***, Yosemite Valley captured the public's imagination. A bill was introduced

in the U.S. Senate designating the area as a national park. After assurances that the land was unsuitable for development and that the bill would not cost the

Yosemite Valley, by Albert Bierstadt

government money, it was signed into law by President Abraham Lincoln on June 30, 1864.

The first national park was created near the end of the Civil War. Perhaps Lincoln and the men who had pushed for the legislation conceived of Yosemite (and parks in general) as a place of respite from death and devastation.



Frederick Law Olmsted

The unofficial chairman of the first commission overseeing Yosemite Park was ***Frederick Law Olmsted***, one of the architects of Central Park. He wrote a ***report*** that would influence how Americans thought about parks. He maintained that parks should be created for two purposes. The first was the commercial value the government gained through preservation of a natural wonder. The second reason was more controversial. Olmsted wrote:

> It is the main duty of government…to provide means of protection for all its citizens in the pursuit of happiness against the obstacles, otherwise insurmountable, which selfishness of individuals or combinations of individuals is liable to interpose to that pursuit.

He went on to explain the healing qualities of nature and the dignity with which it should be maintained. Olmsted believed that intrusions into the landscape should be minimal. He proposed to build only structures that were absolutely necessary. Anything that detracted from the natural landscape he viewed as an act of destruction.

The ***national parks movement*** gained momentum. Within ten years Yellowstone Park had been created in Montana.

Meanwhile, in New York State, an adventurous cartographer named ***Verplanck Colvin*** fell in love with the Adirondack Mountains and made the first proposal for an Adirondack Park. Colvin understood that if the region were to be protected, the commercial benefits of preservation had to be demonstrated. His report to the New York Museum of Natural History in 1870 showed how deforestation was affecting water levels in the Hudson River and, consequently, commercial navigation. He concluded:

> The remedy for this is the creation of an Adirondack Park or timber preserve, under the charge of a forest warden and deputies. The "burning off" of mountains should be visited with suitable penalties; the cutting of pines under ten inches or one foot in diameter should be prohibited.

Verplanck Colvin

In 1872 the New York legislature appointed Colvin superintendent of a state topographical survey of the Adirondacks. ***Traveling over uncharted territory,*** he traced the Hudson River to its source on Mount Marcy. There he discovered a small body of water he referred to as "a minute unpretending tear of the clouds … shivering in the breezes of the mountains." Colvin called this place Summit Waters. It was later renamed Lake Tear of the Clouds in accordance with his romantic description.

Lake Tear of the Clouds

That same year New York created a commission to examine the possibility of a park in the Adirondacks. Among its members were Colvin and ***Franklin Hough***, a proponent of scientific forestry. The commission's first report, demanding that land be purchased and protected immediately, was widely ignored.

But by the early 1880's the idea of the park was being taken seriously because, as Colvin had predicted, the Hudson River was indeed running dry. Businesses that relied on river water for power started clamoring for a timber preserve upstream. Hunters who saw their favorite game dying out rallied behind the periodical *Forest and Stream*, which pushed for the protection of the Adirondack hunting ground. Farmers and tourists watched sportsmen pursue game to the edge of extinction and demanded other restrictions. People wrote to *The Nation* and *The New York Times* lamenting the desolation of the northern wilderness.

Demand for charcoal and lumber continued to devour the forest. Train engines sparked fires that ravaged the Midwest. New Yorkers worried that a railroad built through the Adirondacks could cause equivalent or worse damage. The legislature reviewed many park proposals but enacted none.

It took a serious drought in 1883 to propel the passage of a law prohibiting the sale of state-owned land in the Adirondacks. Ten thousand dollars was set aside to purchase adjoining lands under disputed title, and $15,000 was given to finance Colvin for locating and surveying detached state lands in those counties. But victory was short-lived. Unrestricted logging and hunting continued. The land wasn't sold, but it wasn't saved. Small committees set up by the legislature promoted the idea of a timber preserve, but conflicting ***political currents*** impeded progress.

On May 15, 1885, a law was passed stating: "The lands now or hereafter constituting the Forest Preserve shall be forever kept as wild forest lands. They shall not be sold, nor shall they be leased or taken by any person or corporation, public or private."

Nevertheless, illegal logging continued and local townspeople refused to acknowledge the preserve. Wardens, commissioners, and inspectors often looked the other way or were unable to stop what they saw. Public officials were complicit in undermining forest preservation. In 1893, New York ***Governor Roswell P. Flower*** gave the Forest Commission permission to sell wood from the park. In 1894 17,468 acres of spruce were sold for $53,400.

Effects of logging in the nineteenth century

That same year there was a convention to revise the New York State Constitution. Proponents of the Forest Preserve saw an opportunity to set the land beyond reach of politicians. A reworded "forever wild" clause was submitted as part of the new constitution. After extensive debate and testimonials, the clause was approved by a vote of 112 to zero.

What became Article VII, Section 7, of the new constitution read: "The lands of the state, now owned or hereafter acquired, constituting the Forest Preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold, or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed."

The final two sentences gave the park protection that cannot be overruled by any elected official, agency or legislation. Only a constitutional amendment can change it. The revised New York State Constitution, containing the ***"forever wild" clause***, was approved by the people and went into effect January 1, 1895.

Adirondack Park

More than a hundred years later there are almost no traces of the human depredations the land once endured. Plant and animal life flourishes. Some industry continues in the privately owned sections of the park but is overseen by a state-funded planning and management committee.

Adirondack Park now contains nearly six million acres, almost half of which belongs to the people of New York. The Forest Commission expanded to include a staff of sixty and eleven board members. The park is protected by rangers and forestry staff.

The idea of a park is now widely accepted: whether a small patch of grass sprouting among acres of asphalt or a stretch of majestic landscape pushing the boundaries of your vision, nature has been invited back into many cities and states. The degree of preservation, however, remains a swinging pendulum pushed by restraint and exploitation.

Do you have a local park? Find out what's going on there and how you can become involved. Take a walk or go camping and imagine what it was like for early Americans to be enveloped in a world largely unshaped by humans. Nature sustains, feeds, and clothes us, and the more we understand it, the more we appreciate what we lose if we destroy it.

ADIRONDACK PARK
Concepts and Discussion

Learning Objectives

Students learn about historical events leading up to the establishment of Adirondack Park and the arguments for its creation. The narrative of Adirondack Park should also be understood in the context of the larger story of parks in the United States.

Suggested Viewing

- Video Chapter: *Devastation and Preservation*
- DVD extra: *Forever Wild*

Teacher's Quick Reference

- The idea of parks in the United States
  - A response to urban overcrowding inspired by city gardens in Europe.
  - The first parks in the U.S. were in cemeteries. Land served a dual purpose.
  - Consider parks in your own neighborhood. How did they come to exist?
- New York City's Central Park
  - Poet and editor William Cullen Bryant and horticulturalist Andrew Jackson Downing lobby for Central Park. Businesses support the idea.
  - Frederick Law Olmsted is the main architect of Central Park, which opens in 1858.
  - Who uses Central Park today? Can you imagine New York City without it?
- National Parks Movement
  - George Catlin suggests the idea of National Parks.
  - Paintings and photographs of Western landscapes capture public imagination.
  - Yosemite Park is created in 1864 at the end of the Civil War.
  - Yellowstone is created within 10 years.
  - Frederick Law Olmsted proposes the protective role of government for parks.
- Adirondack Park
  - Lumbering leads to deforestation, which affects river water levels.
  - Verplanck Colvin advocates for an Adirondack preserve.
  - In the 1880's laws are passed designating an Adirondack timber preserve. The first laws are ineffective for a variety of reasons. Deforestation continues.
- "Forever wild" clause
  - NY's governor sells wood from the park and illegal logging continues.
  - In 1894 the "forever wild" amendment to the state constitution is passed.
  - How is Adirondack Park used today? What benefits does it provide?

Key Content

reasons for first parks
Frederick Law Olmsted
Verplanck Colvin
causes of deforestation
reasons for Adirondack Park
Central Park
Yosemite Park
Lake Tear of the Clouds
effects of deforestation
"forever wild" clause

Content Review

- What led to the creation of New York's Central Park in 1858?
- What are two purposes Frederick Law Olmsted argued that parks should serve?
- When and where was the first U.S. National Park created?
- What art inspired people to support the creation of Yosemite Park?
- What principal industry threatened the Adirondack region?
- Who first proposed the creation of an Adirondack Park?
- What convinced legislators to take the idea of the Adirondack Park seriously?
- Why were the first laws protecting the Adirondack region ineffective?
- What is the "forever wild" clause? How is it different from earlier legislation?
- How big is Adirondack Park?

Discussion Questions

- Consider the quotation of Frederick Law Olmsted on "the duty of government." In what way was he applying this to parks? Do you agree or disagree?
- The creation of Adirondack Park stopped development and put some people out of work. Mining and logging industries suffered. Is this a necessary price to pay for preservation? What alternative sources of income resulted from the establishment of the park?
- The United States has several land designations for federally owned land. These include national parks (completely protected), national forests (subject to some tree harvesting, mining, and development), and many other agricultural designations. Why are all lands not treated the same? Is it important to make these designations?
- Some members of Congress want to open up the Arctic National Wildlife Reserve in Alaska for oil drilling. Find out what protections the wildlife reserve has and compare them to the protections for Adirondack Park. Should there be drilling in the Arctic Reserve? What are the alternatives?

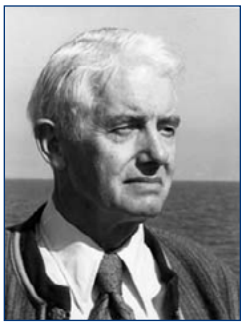
Dams

Reasons for and against dams, on the Hudson and elsewhere
(Environmental Science)

A few miles below the town of Corinth, New York, the Hudson River runs through a deep, forested canyon. Birch and oak trees populate the banks and, on a summer day, one can hear the chatter of the blue jay and the gentle riffle of water around partially submerged boulders. The scene seems primeval, untouched by the activities of humankind. Yet nothing could be further from the truth. One quarter of a mile upstream, just around a bend in the river, roars a 90-foot wall of water, the spillway from the Curtis/Palmer hydroelectric dam. A few miles downriver, the Hudson is blocked and funneled again, this time over the ***Spier Falls*** dam.

Glens Falls

Dams, chutes, spillways, canals, weirs and piers came to the river almost as soon as the first Europeans put down roots. The rushing stream provided power long before electricity or the internal combustion engine. Flowing water turned wheels that ran gristmills, sawmills, and a wide variety of early "power tools." Important cities, such as ***Glens Falls***, were built near large rapids or waterfalls that provided ready and renewable sources of energy.


David Brower

Dams are controversial. ***David Brower***, the first executive director of the ***Sierra Club***, devoted his life to opposing the construction of dams that would obliterate some of America's most scenic canyon lands, including sections of the ***Grand Canyon***. For Brower and other conservationists dams are an insult to nature. Author John McPhee, in *Encounters with the Archdruid,* muses that Brower's unqualified opposition to dams was driven by a sense that "rivers are the ultimate metaphors of existence, and dams destroy rivers. Humiliating nature, a dam is evil – placed and solid." To stand up for a river and against a dam is to stand up for nature.


Floyd Dominy

In McPhee's book an opposing point of view is expressed by ***Floyd Dominy***, commissioner of the ***U.S. Bureau of Reclamation***, the federal agency devoted to building and maintaining dams. As its name suggests, the bureau's mandate is *reclaiming* arid land by using water from dams for irrigation and other purposes. Defending the damming of the Colorado River to create 186-mile long ***Lake Powell*** in Arizona and Utah, Dominy said: "Reclamation is the father of putting water to work for man – irrigation, hydropower, flood control, and recreation. Let's *use* our environment. Nature changes the environment every day of our lives – why shouldn't we change it? We're part of nature."

Conklingville Dam under construction

There are more than ***350*** dams in the ***Hudson River watershed***. Each has its own history. Some make a huge difference in the way we use and live with the river. Others are vestiges of a bygone industrial age. Brower and Dominy would have very different things to say about each of them.

In the documentary *Swim for the River*, Christopher Swain encounters his first barrier across the Upper Hudson, in the form of a gravel mine road crossing the river. It causes upriver water to pool and warm up, compromising the coldwater habitat in which trout thrive.

A few miles downriver Swain shoots through dangerous-looking whitewater. Though it is not obvious in the film, he is helped through these rapids by a surge of unnaturally high water. This is caused by a release of water from a dam on a tributary that feeds the Hudson. ***Rafting*** companies pay the town of Indian Lake, New York, to have water released from Abanakee Dam into the Hudson. For three months a year each release creates a "***bubble***" of water that rafters can ride through rapids that would normally be too shallow. The bubble also keeps Swain from getting banged up on the rocks.

These bubbles, or surges of water, disrupt the river habitat with their repeated flushing. But the bubbles also provide local jobs in the tourist rafting business, in a region that has been hit hard by the decline in forest and mining industries. For vacationers a raft trip provides an experience on the river, which could build support for preserving it from more serious injury.

Eighty-five miles from the source of the river Christopher Swain walks around a dangerous waterfall. Just below Rockwell Falls the Sacandaga River flows into the Hudson. This is a welcome development for Swain. From this point on there is enough water to swim in.

Yet the Sacandaga River, and therefore the level of the Hudson below it, are also controlled by a dam. Called the ***Conklingville Dam***, it was built in the 1920's, primarily for flood control. Severe floods on the Hudson in 1913 drowned parts of Troy, Albany, Rens-

Flood in Waterford, N.Y.

selaer, and Watervliet beneath several feet of water. When the dam was completed, several small upstream towns were permanently submerged beneath the waters of the 42-square-mile reservoir that was created.

Conklingville Dam serves as the Hudson's main "faucet." Residents of the towns of Hadley and Lake Luzerne, where the Sacandaga empties into the Hudson, speak of the river being "turned on" or "turned off" at the dam, five miles away. To conserve water during the summer months the river is generally turned off at night. Only a trickle can be found in the shallows at the junction of the two rivers.

Loggers with peaveys

About ten miles below the Sacandaga confluence, a much-enlarged Hudson begins its rapid descent in altitude, from 1,600 feet above sea level at Corinth, New York to 367 feet above sea level at Glens Falls. The precipitous fall of the river was a challenge to ***19th century loggers*** attempting to float timber downstream. They built weirs (small wooden dams) to raise the water level at strategic points. Timber chutes channeled the water and carried logs over steep, rocky rapids. Log jams were dreaded. Men sometimes died trying to break them up with dynamite or long-handled poles called peaveys.

The stretch of the Hudson between Corinth and Glens Falls was completely changed by a series of small hydroelectric dams that take advantage of the river's drop. Each dam creates a small elongated lake. Water from these lakes and others is drawn by gravity to power electric turbines that generate 300 ***megawatts*** of electricity, enough to provide power for about 20,000 homes.

The final regulated stretch of the Hudson River is from Fort Edward down to Troy, New York. Here the river is a ***canal system***, designed to provide a waterway deep enough for navigation. From Fort Edward, which is the northernmost point for navigation on the Hudson, a 63-mile man-made canal veers northeast to Lake Champlain, making it possible to go by boat all the way to Canada.

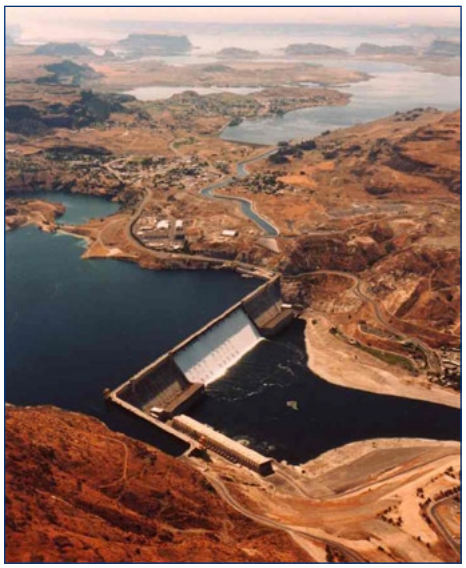
The canal system works by locks. A lock consists of two gates used to raise and lower the water between them. The two gates serve as a transition or boat "elevator" that moves vessels from one water level to another. Locks are often placed next to a low dam that backs up the river on the upstream side, keeping it deep enough for navigation. In this way the river is broken into a series of ascending pools, or steps.

One can think of the dams and locks along the Hudson as components in a vast plumbing system. These man-made faucets control the river and its water level more than natural precipitation.

The Hudson is not unique in this regard. There are more than 75,000 dams in the United States that are more than five feet high, and almost 80 percent of large rivers in the northern third of the world are regulated. Rivers and river valleys now bear very little resemblance to what they were 500 years ago. Dams are a prime example of how human settlement and livelihood are deeply entwined with an environment that we have shaped over hundreds of years.

Giant hydroelectric dams such as the ***Hoover Dam*** in Nevada and the ***Grand Coulee Dam*** in Washington generate a large amount of clean, renewable power. The Grand Coulee Dam, like many others, makes possible the irrigation of a vast agricultural region where farming would otherwise be impossible.

All dams regulate the flow of water and are used to prevent flooding and drought. A return to natural free-flowing rivers would make us more vulnerable to natural disasters. Some of our clean power would be lost, and irrigated land would once more become barren or infertile.



Grand Coulee Dam

But dams have their drawbacks. They cause a decrease in the biodiversity of a river. Fish have a hard time moving past dams, even when aided by ***fish ladders***. Fish that are too large or too small to use the ladders fail to spawn, or spawn in less hospitable areas, with a higher mortality rate.

Dams also trap sediment that is rich in nutrients. Rivers need those nutrients to maintain plant and animal life. Sediment also prevents erosion by accumulating along the shore. Some earth is washed away; more washes up to replace it. The fresher sediment feeds plants, whose roots help hold sections of the bank in place. When dams are built, riverbank erosion accelerates.

Dams affect temperature. Exposed to the sun, the surface of the slow-moving upstream reservoir becomes much warmer. Below the dam the water temperature falls. This limits biodiversity on both sides of the barrier.

In recent years there has been a ***movement to remove some dams*** from rivers in North America. The dams selected for removal were built for purposes they no longer serve or that are no longer economically viable. Often it costs less to remove a dam than to repair it.

Of the 350 dams now in the Hudson River watershed, 196 are obsolete. Many of these were built by industries that have disappeared. These smaller dams impede the flow of water and fish migration but provide neither power nor flood prevention.

Dams are a measure of how wisely we interact with nature. What is "right" or "wrong" depends on the situation.

Fish ladder

Hadley's Falls of the Hudson River, by William Guy Wall, 1821–1825

DAMS
Concepts and Discussion

Learning Objectives

Students learn about the different purposes that dams serve and their effect on river ecosystems.

Viewing Suggestions

- Video Chapters: *The Culvert, Whitewater*

Teacher's Quick Reference

- Opposing views of dams
  - Brower: "A dam is evil, placed and solid."
  - Dominy: "Reclamation is the father of putting water to work for man."
- Dams in the Hudson River watershed
  - More than 350.
  - The swimmer, Chris Swain, encounters first "dam" on the Hudson, a gravel road.
  - The Abanakee Dam is used to create a surge or "bubble" for whitewater recreation.
  - Conklingville Dam, built in the 1920's for flood control, is the Hudson's main faucet.
  - The descent of the river from Corinth to Glens Falls was a challenge to loggers and a boon to hydroelectric power.
  - From Fort Edward to Troy locks make navigation possible.
- General facts about dams
  - There are more than 75,000 dams in the United States that are over five feet high.
  - Dams are a prime example of how human livelihood and settlement are deeply intertwined with the environment.
  - Giant dams, such as the Hoover and Grand Coulee Dams, generate a lot of hydropower and make irrigation possible.
  - Dams reduce biodiversity, block sediment, and affect temperature.
  - Many dams are obsolete.

Key Content

water power
Glens Falls
David Brower
Floyd Dominy
the bubble
flood control
Conklingville Dam
hydroelectric dams
locks and canals
dams' effect on biodiversity

Content Review

- What were the reasons the first dams on the river were built? How was water power used?
- Why was the city of Glens Falls built where it is?
- What are the functions and benefits of modern dams?
- Who was David Brower, and what were his arguments against dams?
- Who was Floyd Dominy, and what were his arguments in favor of dams?
- How is the Conklingville Dam a "faucet" for the Hudson River?
- What is the purpose of locks?
- How many dams are in the Hudson River watershed? How many are obsolete?
- In what ways do dams change the river habitat for fish?
- What measures can be taken to sustain biodiversity?

Discussion Questions

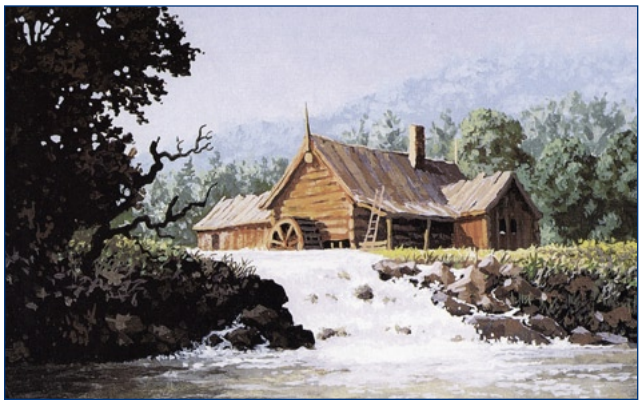
- What do you think John McPhee meant when he wrote: "Rivers are the ultimate metaphors of existence?"
- Floyd Dominy said "Nature changes the environment every day of our lives – why shouldn't we change it?" What do you think he meant by this? Do you agree or disagree?
- Create a scenario in which a dam is proposed (or use a real example if you prefer). Split the class or group into two advocacy groups and assign each side a position, *for* or *against* the dam. Debate the issue.
- Do you live near a dam? Do you know why it was built? Does it still serve a purpose? Would there be benefits if it were removed?
- Do you live somewhere that could benefit from the hydroelectric energy, flood control, and irrigation that a dam might provide?

Water Power and the Mill Town

From grist mills to paper mills, and the rise and fall of an American mill town
(History of industry)

Imagine living 350 years ago in the Hudson River Valley. There is no shower, no air conditioner, and no toilet. You could swear there was a light switch, but your fingernails scrape candle wax. You can't find the thermostat. There's a block of ice in the closet, and your refrigerator is missing. Welcome to the ***New World***.

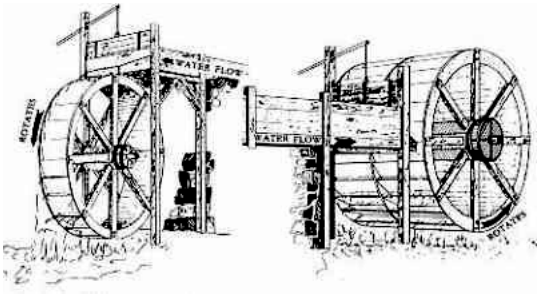
Empire builders, audacious entrepreneurs, and victims of religious persecution fought the elements, each other, and Native Americans to claim a piece of land to call their own. They brought with them tools and the modern technology of their day.


Bradt's sawmill, 1660 , by L.F. Tantillo,

Dutch settlers building camps along the Hudson in the 1600's used hand tools made of wood and iron, plows pulled by oxen, and the water wheel. ***Water power***, older than Roman civilization, was the driving force behind rudimentary industry.

Imagine that you immigrated to ***Beverwijck*** (the settlement that would become Albany) in the 1650's. You decide to build a house and you need lumber. You buy planks cut at ***Bradt's sawmill***, situated on a fast-moving stream that empties into the Hudson just south of town. The mill is powered by an upright water wheel turned by the river flowing beneath it. The wheel's axle is a driveshaft that meshes with cogs and cams to power a long saw blade with a spring-loaded arm. Water power cuts lumber from logs.

Now you need tools. A ***blacksmith*** hammers red-hot iron to make shovel heads, horseshoes, hinges, hasps, nails, knives, axes, adzes, and metal fittings for animal harnesses. To heat the metal to the point where it can be bent, hammered and shaped, the blacksmith needs a ***forge***, or special furnace. To get hot enough, a forge needs a bellows, or air pump, that forces air into the fire to make it burn super-hot. The bellows is driven by a water wheel powered by the rushing stream. Water power helps shape your tools.



Waterwheels

When water wheels stop, you feel the effect. You are hungry but you discover the baker is out of bread; he ran out of flour because the gristmill is broken. A big rainstorm has flushed debris down the stream, driftwood has caught in the water wheel, and the millstones have ground to a halt.

Water power was everything in those days. Mills sprouted on dozens of small tributaries that fed the Hudson, and on the Hudson River itself, where it cascaded from the Adirondacks. Water power was used to turn millstones, drive saws and lathes, spin yarn and thread, press paper, pump bellows, and to *full* cloth.

Fulling mills cleaned woolen cloth and shrank it to make it thicker. In a fulling mill a water wheel powered a pair of wooden mallets to beat cloth in soapy water, often for days. This process shrank the cloth to about half its original size, making it more compact and durable. By the late 1800's such mills were productive enough to export fulled cloth to other states and countries. The Hudson was the perfect conduit for shipping the goods.

On fast-running tributaries, competing mills fought for the right to dam their sections, storing water to generate more power for water wheels. North of Beverwijck, a stream named ***Wynants Kill*** (*kill* is the Dutch word for a stream or small river) offers a good example.

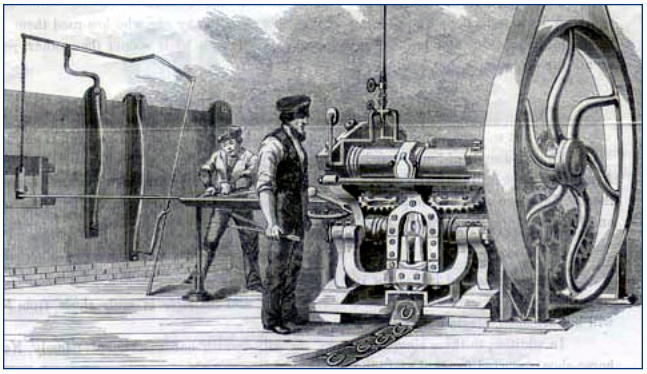
Glass Lake, 1866, headwaters of Wynants Kill

The steep descent of Wynants Kill, 850 feet in 14 miles, attracted many mills. Damming increased the water flow to individual mills, but deprived others downstream of power. Disputes arose. During the unusually dry summer of 1815, John Brinkerhoff, the owner of an ironworks on the kill, built a 28-foot dam to create a millpond. This drastically reduced the amount of water and water power available to the Merritt brothers' gristmill below. The Merritts sued Brinkerhoff and won $700 in damages, a significant sum in 1820.

Merritt vs. Brinkerhoff created a precedent for the sharing of a natural resource. This was a turning point in the history of settlement and industrialization. When Europeans first came to North America they perceived the wilderness as limitless, filled with an inexhaustible supply of timber, water, game, minerals, and other natural resources. As the population grew and towns and cities were established, it became evident that resources were not unlimited and that arrangements for sharing were necessary.

Merritt vs. Brinkerhoff led to the formation of the Wynants Kill Association of mill owners. The association shaped and controlled the stream to optimize mill operations. Each mill was responsible for river maintenance in proportion to the water power it used. The mill owners built dams that made lakes, negotiated with farmers for reservoir levels, and turned the river on and off using gates.

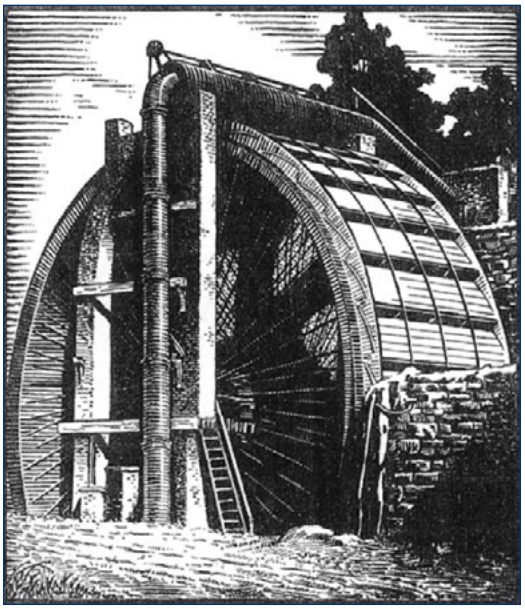
The city of Troy, New York, was founded in 1816 just to the north of where Wynants Kill flows into the Hudson. In 1822 a brilliant Scotsman named ***Henry Burden*** arrived to oversee an ironworks on the kill. It was here that Burden invented machines to make nails, railroad spikes, and horseshoes. The ***horseshoe machine*** stamped out 60 horseshoes a minute, or 51 million a year, allowing a few laborers to replace thousands of blacksmiths. Burden's designs were so successful they were adopted around the world. During the Civil War every horse in the Union Army was shod with Burden horseshoes.



Henry Burden's horseshoe machine

To drive his machines Burden built the world's most powerful water wheel. It stood 62 feet tall and 22 feet wide and generated 1,200 horsepower. It operated day and night for almost 50 years.

Troy also became the ***shirt-collar capital*** of the



Henry Burden's big waterwheel

United States. The detachable shirt collar was invented by Troy resident ***Hannah Lord Montague*** after she grew tired of washing her husband's shirts to get out the "ring around the collar." She cut off the collars and washed them separately (and more frequently) than the rest of the shirt. Then she reattached the collar with string. Local merchants embraced this labor-saving innovation. By 1897, 25 manufacturers in Troy were producing a total of eight million dozen collars and cuffs a year. Starched linen collars, offered in a variety of styles, become the status symbol for office workers – who came to be referred to as "white-collar" workers.

Hannah Lord Montague

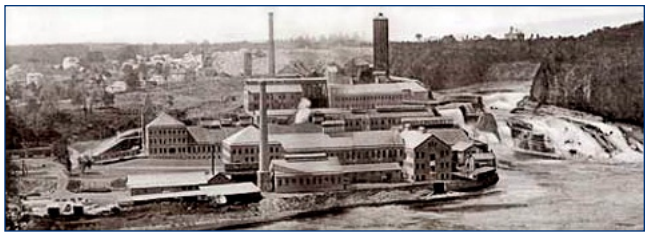
As industry grew along the Hudson in the nineteenth century, so did demand for lumber, wood fuel, and charcoal. The Adirondack forest became essential to New York state's economy. Logging companies cut millions of trees, stripped them, sawed them into 13-foot lengths, and branded them with distinctive mill marks. The logs were dragged and skidded to the Hudson River and floated downstream to be sold.

The logs wound up in Glens Falls, where they were trapped by the ***Big Boom***, a system of huge chains stretched across the river, anchored in stone piers. Here they could be sorted by the mill marks and sent on to designated mills. In 1872 more than 60 companies drove 200 million logs down the river, filling the Big Boom from shore to shore.

Just as the logging industry was reaching its peak, the paper industry was getting started. Again the river was indispensable: it brought logs for pulp and provided water power for the mills and water for slurry, the key ingredient in making paper.

The ***Hudson River Pulp and Paper Company***, the first modern paper mill on the river, was built by the Pagenstecher family in 1869 at Jessup's Landing, later known as Corinth, New York. Until the 1850's paper had been made from cotton and straw; the Pagenstechers recognized the potential of wood-based paper. With the power of the Hudson and the logs from the Adirondacks, this company quickly became one of the most successful in the United States.

The Pagenstechers imported the latest paper-making technology from Europe. The Keller-Voelter wood grinder was made in Germany. Patented in the 1840's, it was the first machine to make paper pulp from wood. Wood pulp was combined with water in machines called "beaters" to create slurry. The French ***Fourdrinier*** machine evenly distributed the slurry across a moving screen and suctioned water from the bottom to create a continuous sheet of paper. The paper was

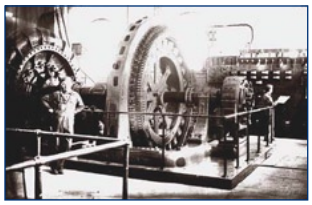


Hudson River Pulp and Paper Company, 1901

fed through felt, pressed, dried, and spooled on a roll at the end of the machine. The high-speed production of continuous sheets of paper made possible by the ***Fourdrinier process*** revolutionized the printing and publishing industry: For the first time it was possible to produce inexpensive newspapers and periodicals. Previously paper had been made in smaller sheets that

were dried individually, a time-consuming and labor-intensive process.

The Pagenstechers expanded their Hudson River mill, adding steam boilers fueled by firewood and oil.



Turbine generator, Hudson River Mill

In 1898 the business was included in a merger that created ***International Paper***. It became the largest paper company in the world, producing 60 percent of the newsprint used in the United States and owning 1.7 million acres of forest. Between 1902 and 1914 water wheels at the Corinth Mill were replaced by ***water-powered turbines***. The turbines produced electricity that powered a new generation of equipment and lit homes in the region. Today ***hydroelectric dams*** from Corinth down to Glens Falls still produce enough electricity to power a small city.

Corinth became an example of the American mill town in which an entire community was dependent on, and supported by, a single industry. For more than a hundred years, beginning in the 1870's, the mill was the ***economic and social hub of the community***. It sponsored dances, built a community center, funded school programs, supported sports teams, and published a company newspaper. The mill hosted banquets, visits from Santa Claus, and Ladies' Day, when the women of Corinth could tour the mill so they might understand the importance of their husbands' jobs.

Paper Mill Workers

Technology improved and production increased. By 1964 the paper mill at Corinth was making 175,000 tons of paper a year. It was the first International Paper mill to make ***coated paper,*** used for products such as can labels and wallpaper.

The omnipresence of the mill seemed good to the citizens of Corinth – so long as the business was expanding and the needs and demands of workers did not exceed the largesse of the company.

Paper machine

In the 1950's and 1960's Corinth was a good place to live. But prosperity came with extremely high levels of pollution. David Mathis, interviewed in *Swim for the River*, recalls swimming in the Hudson as a boy, downriver from the mills in Corinth and Glens Falls.

> We had this great-looking beach until you really looked at the water. All the paper mills dumped their untreated sludge in the river. The volume that was being dumped, the number of paper mills, it was just accepted. Sometimes it was a big oil slick. A game we'd play is to see who could hold their breath and swim all the way underneath the oil slick and get out the other side, because if you didn't, you'd get the oil all over your hair and face. Sometimes we'd complain to our parents about the oil and they'd say, "Well, that's just the barges pumping out the oil." Their tone of voice indicated that that was okay and we were to accept it.

A lot has happened since the 1960's and '70's. An environmental movement was born in response to the wholesale fouling of air and water, and a lot of manufacturing has gone to other countries where labor is cheaper and environmental regulation is weaker. The mill at Corinth closed in 2002.

Water power is no longer king. Yet not all polluters have left the river. The ***Finch Pruyn paper company*** is still in Glens Falls about 10 miles downstream from Corinth. In the documentary the swimmer and the film crew stumble across the mill's outfall pipe, which spews tons of pollutants into the river. During the 1990's Finch Pruyn repeatedly violated pollution laws and was one of the top polluters on the Hudson River. The damage peaked in 1998, when 2,800 tons of toxic ***nitrates*** were released into the Hudson.

Finch Pruyn continues to discharge pollutants under the terms of its SPDES state permit. SPDES stands for State Pollution Discharge Elimination System; it sets maximum amounts of pollutants that the permit holder is allowed to put into the water. Since 2001 Finch Pruyn's SPDES permit has let it discharge into the Hudson, in any 24-hour period, up to 15 pounds of cyanide, 21 pounds of zinc, 4 pounds of phenol, and various amounts of copper, chloroform, sulfate, aluminum, titanium, molybdenum, and methanol, as well as 63,000 pounds of unspecified waste solids.

The purpose of SPDES is *elimination* of industrial pollution of air and water, as cleaner, more efficient technology becomes available. In New York state, SPDES permits are renewed every five years. One might expect that with each renewal the pollution levels allowed by the permit would be reduced.

In recent years it has become feasible to modify paper mills to increase environmental efficiency. Recycled waste paper breaks down more easily than wood pulp, using fewer chemicals and less energy. Waste water can be recycled in ***closed-loop filtration systems***, preventing toxic effluent from being released into the river. Dangerous ***chlorine bleaches*** that are used to make white paper can be replaced by more environmentally friendly chlorine dioxide.

But so far Finch Pruyn has declined to voluntarily reduce its output of toxic effluents. There is no short-term economic incentive and little pressure from either citizens or government to get the company to reduce its toxic impact.

In August 2006 the New York State Department of Environmental Conservation gave notice that it would renew Finch Pruyn's SPDES permit for another five years with "no significant changes" – i.e., no reduction in allowed pollution levels. Under the law, citizens can comment on, and object to, the renewal of a permit. The state agency could hold a public legislative public hearing if "a significant degree of public interest exists." As this study guide went to press the deadline for public comment had not yet passed. Will citizens of Glens Falls take a stand? Or is Finch Pruyn to Glens Falls what International Paper was to Corinth – an unassailable economic pillar of the community?

Toxic effluent from Finch Pruyn outfall

WATER POWER AND THE MILL TOWN
Concepts and Discussion

Learning Objectives

Students learn about the basic history of water power on the Hudson River, the development of the paper industry at Corinth and Glens Falls, New York, and their environmental impact.

Suggested Viewing

- Video Chapters: *Battle in Corinth, Hometown, U.S.A.*

Teacher's Quick Reference

🗝 Water Power

- Dutch settlers use saw mills powered by water wheels to cut lumber.
- Water wheels power bellows for forges and grindstones for gristmills.
- Fulling mills clean and shrink woolen cloth.
- Henry Burden invent water-powered machines that make horseshoes, railroad spikes and nails.

🗝 Industrial cooperation

- During a drought in 1815, a dispute arises between mill owners on Wynants Kill. The dispute is about damming the creek to store water for water wheels.
- The ensuing lawsuit, Meyer vs. Brinkerhoff, creates a precedent for the sharing of a natural resource – water power.
- Wynants Kill Association is formed to facilitate cooperation on reservoir levels and river management.

🗝 Inventions from Troy

- The detachable shirt collar is invented by Hannah Lord Montague.
- Henry Burden's horseshoes are used by the Union Army in the Civil War.
- Another of Burden's creations is the world's most powerful water wheel.

🗝 The First Paper Mill

- The Hudson River Pulp and Paper Co. at Jessup's Landing, later known as Corinth, uses wood from the Adirondacks to make paper pulp.
- The Fourdrinier process, which produced a continuous roll of paper, revolutionizes the paper-making industry and the publishing business that depended on it.

Corinth, a mill town

- The mill at Corinth becomes part of International Paper, the world's largest paper company, in 1898.
- Water wheels are replaced by water-powered turbines between 1902 and 1914. The turbines generate electricity.
- In Corinth the entire community is dependent upon, and supported by, a single industry – making it a good example of a classic American mill town.

Current-day pollution

- Finch Pruyn in Glens Falls has become one of the worst polluters of the river.
- SPDES pollution discharge permits are intended to eliminate industrial pollution as new technology emerges, but Finch Pruyn's five-year permit will be renewed without changes in allowed pollution levels.
- Recycled waste paper breaks down more easily than wood pulp, using fewer chemicals.
- Wastewater can be recycled in closed-loop filtration systems.
- Chlorine used to bleach paper is being replaced by the less toxic chlorine dioxide.

Key Content

water wheels
Wynants Kill Association
Hannah Lord Montague
Hudson River Pulp and Paper Mill
mill towns
Finch Pruyn Company
early uses of water power
Henry Burden
Big Boom
Fourdrinier process
industrial pollution
SPDES permits

Content Review

- What were water wheels used for in early colonial settlements?
- Why and how did mill owners on Wynants Kill share water power?
- Why did Henry Burden invent the world's most powerful water wheel?
- Who invented the detachable collar and why?
- What made the Hudson River Pulp and Paper Mill so successful?
- Before wood grinders were invented, what was paper made from?
- How did the Fourdrinier process change the paper industry?
- What environmental impact does Finch Pruyn have on the Hudson River?
- What is an SPDES permit? What is its purpose?
- How can paper plants reduce their pollution?

Discussion Questions

- Imagine that you have a good job working in a mill town. The paper mill that you work for provides everything – a pay check, day care, a sports team, holiday parties, and more. Then you learn that it is polluting the air and water. How should you and your fellow citizens respond? What are your options? Which option would you choose?
- Find out where the paper that you use comes from. Consider the different kinds: writing paper, paper towels, toilet paper, newspapers, paper containers, etc. How much of that paper is made from recycled material? Did the manufacturer of the paper use a closed-loop filtration system? Discuss recycling and the importance of choosing how and why to support a company.
- Henry Burden's machines put thousands of blacksmiths out of work in the 1800's. Today the outsourcing of labor by large companies is putting a lot of people out of work. What are the similarities and differences between these situations?
- Do you know people who believe that "Pollution is the price of prosperity"? How can you work to change that perception?

Finch Pruyn on the Hudson, 1900

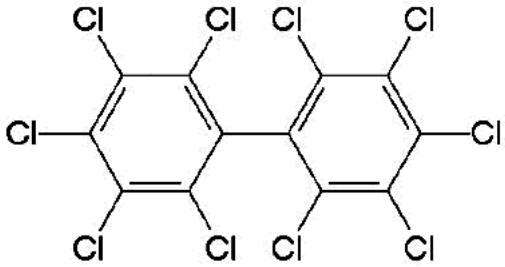
History of PCBs

The long battle over the most persistent pollutant
(Environmental Science and Social History)

Most people who live in towns along the upper Hudson River have heard about PCBs, or polychlorinated biphenyls. These ubiquitous industrial pollutants have been the focus of a thirty-year battle between the General Electric Company and assorted environmental groups, with state and federal agencies often in the role of reluctant policeman and prosecutor. Local citizens have been the target of a GE media campaign to persuade them that an attempt to clean up the Hudson would do more harm than good.

Yet few people know the history of PCBs – how they were discovered, their role in the development of energy technology, and the extraordinary lengths to which manufacturers avoided acknowledging that PCBs are a highly toxic, non-degradable pollutant.

The battle with GE on the Hudson River is part of a much larger story. PCBs were discovered in the late 1890's. Automobiles had just been invented and the process for refining crude oil into gasoline was being perfected. Waste by-products from the refining process were analyzed by scientists to determine possible uses. Among these was benzene, which became a ***key ingredient*** in PCBs. It was discovered that two benzene molecule rings could be heated, joined together, and chlorinated using chlorine gas. With variations in the process, 209 new molecular compounds could be created. These are referred to collectively as polychlorinated biphenyls and have shared characteristics. Condensed into a syrupy liquid, they possess a chemical stability that makes them highly resistant to fire, and thus an excellent insulator. This chemical stability also makes PCBs very difficult to break down.



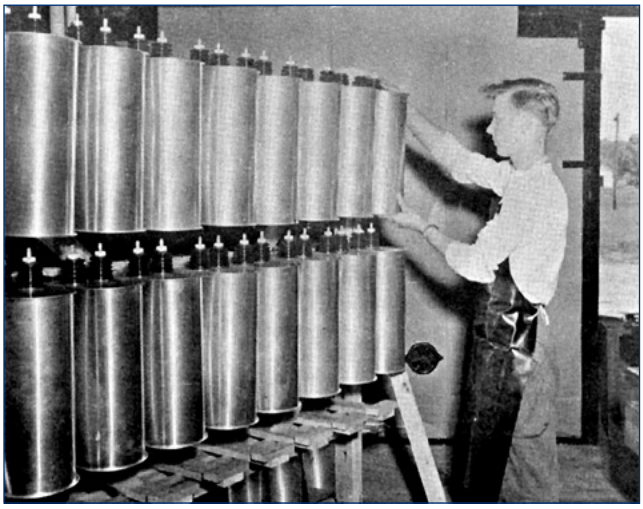
PCB molecule


PCBs do not dissolve in water

Monsanto, an innovative chemical company based in St. Louis, began producing PCBs commercially in the 1930's. Initially mixed into the plastic coating on electrical wire, they became an essential insulating fluid in capacitors and transformers. PCBs were also mixed into adhesives, inks, dyes, asphalt, paper, paints, rubber, heat-transfer fluids, hydraulic fluid, and lubricating oil. They were even mixed with sludge and sold to farmers as fertilizer.

Harmful side effects of PCBs were first recognized in 1937. *The Journal of Industrial Hygiene and Toxicology* published an article about a disfiguring skin condition called ***chloracne***. The condition was characterized by painful pustules and was observed in workers who had been exposed to the chemical. The article

quoted General Electric official F. R. Kaimer describing the reactions of GE executives on discovering these effects: "We had 50 other men in very bad condition as



Transformers at GE's Fort Edward plant, 1948

far as the acne was concerned. The first reaction that several of our executives had was to throw it out – get it out of our plant. They didn't want anything like that for treating wire. That was easily said but not so easily done. We might just as well have thrown our business to the four winds and said, 'We'll close up,' because there was no substitute, and there is none today, in spite of all the efforts we have made through our own research laboratories to find one."

Ten years later General Electric began manufacturing PCB-filled capacitors along the Hudson River at a factory in Fort Edward, New York. In 1952 it began production at a second factory, just downriver in Hudson Falls. Both factories pumped PCB-laden waste into the river. GE also donated ***contaminated fill*** that was used in the construction of homes and schools. Some executives were aware of the risk involved but found the evidence to be inconclusive. Electricity was the fastest-growing source of energy, and PCBs were the most effective electric insulator available.

The big problem with PCBs, unlike many other pollutants, is that they do not break down or dissolve. Some have found their way into groundwater. Others sank into the sediment along the river bottom, to be occasionally churned back to the surface by boats, animals, weather, and erosion. Even more dispersed into the atmosphere.

Atmospheric PCBs travel long distances. When they encounter cold air they condense and fall to the ground. PCBs followed the prevailing global air currents, settling out of the atmosphere in northern climates. This became an international problem.

Cloracne

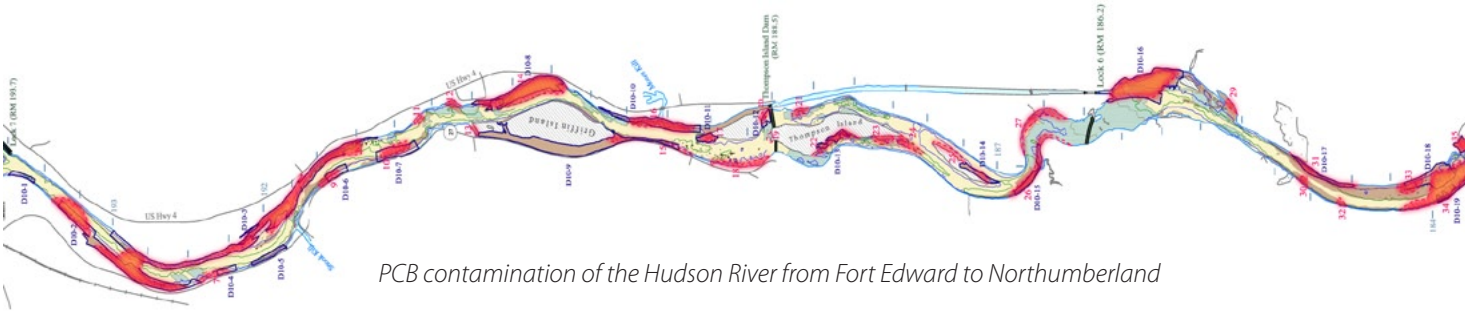
In 1964, while examining specimens in Sweden for the toxic pesticide DDT, scientist ***Soren Jensen*** discovered what he believed to be a previously unknown molecular structure permeating the environment. At the same time scientists in ***Canada*** encountered the mysterious molecule in fish and fish-eating birds. In 1966 it was identified as PCBs.

In 1968 PCBs leaked into a batch of rice-bran oil in Japan. More than 1,800 people were exposed, many showing immediate symptoms, including chloracne, respiratory problems, and failing vision. This became known as the "***Yusho incident***."

One year later, at the University of California at Berkeley, Dr. Robert Riseborough demonstrated the existence of widespread PCB contamination in the United States' food chain. He found PCBs in peregrine falcons that had eaten contaminated fish. An article citing Riseborough's work, entitled "A Menacing New Pollutant" appeared in the *San Francisco Chronicle* on February 24, 1969. The next day the manufacturer, Monsanto, denied that the chemicals found in falcons were PCBs, saying "it will take extensive research, on a worldwide basis, to confirm or deny the initial scientific conclusions."

Peregrine falcon

Meanwhile Monsanto secretly drafted its "***Pollution Abatement Plan***." The plan was a masterpiece of rationalization, placing corporate profit above public safety while minimizing potential liability. Regarding PCBs, the plan states:



PCB contamination of the Hudson River from Fort Edward to Northumberland

> The problem involves the entire United States, Canada, and sections of Europe, especially the United Kingdom and Sweden. Other areas of Europe, Asia, and Latin America will surely become involved. Evidence of contamination has been shown in some of the very remote parts of the world.

The plan outlined three choices:

> Option one, doing nothing, would cause Monsanto to face increased liability and potentially declining profits.
>
> Option two, ending the manufacture of PCBs, would result in the loss of all profits while maximizing liability, because "we would be admitting guilt by our actions."
>
> Option three, called the "responsible approach," would acknowledge aspects of the problem while continuing the manufacture of PCBs.

Monsanto chose the third option with the assumption that it would maintain profits and reduce liability in the event of any unfortunate outcomes.

Medical reports about PCBs in the 1970's documented increasing global contamination and brought government attention. Then in 1973 a dam at Fort Edward was dismantled. Built across the Hudson long before General Electric pumped PCBs into the river, it was now obsolete. No one realized that many tons of PCB-infused sediment were lodged behind the dam. When the dam was demolished the toxic sludge poured downriver, clogging navigation channels near Fort Edward and spreading PCBs along 200 miles of river, all the way to New York Harbor.

Dredges were used to clear the navigation channels. Workmen wore no protective gear while disposing of the dredged sediment. This eventually led to ***degenerative back and nervous system disorders***, now commonly associated with high exposure to PCBs. The PCB-infused sediment was put in a landfill in ***Moreau, New York***, where it leached into nearby wells, creating further health problems.

In 1976 the government ***declared PCBs a health risk*** and banned their production under the Toxic Substances Control Act. The same year, fish in the Hudson River were found to have dangerously high PCB counts. This led to a ban on commercial fishing. The ***Clean Water Act*** of 1977 made it illegal to flush PCBs and other harmful chemicals into public waterways. By then General Electric had already dumped more than 1.3 million pounds of PCBs into the Hudson River.

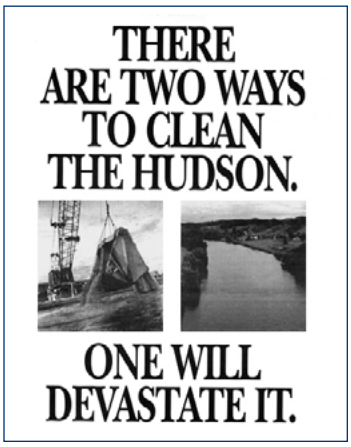
In 1980 Congress passed landmark legislation known popularly as the ***Superfund Law***. A key provision of that law allows the government to hold corporate polluters responsible for cleaning up their mess. General Electric could now be required to dredge and filter PCBs out of the Hudson River. Three years later the entire river below Fort Edward, stretching two hundred miles to the Atlantic Ocean, was designated a ***Superfund site***.

An ***Environmental Protection Agency Record of Decision*** ordered General Electric to cap sections of shoreline that contained dangerous levels of PCBs, but the EPA stated that no safe technology existed to remove the chemicals from the river sediment. Dredges normally used on rivers and harbors featuring clamshell-type buckets could stir up and resuspend PCBs in the river water without effectively removing them. Instead of dredging, GE covered small stretches of heavily contaminated river shore with a clay liner and a layer of soil, which was planted to minimize erosion.

Between 1991 and 1993, additional highly concentrated contamination was discovered seeping into the river from beneath the General Electric plant at Hudson Falls.

Meanwhile the EPA reassessed the possibility of dredging the Hudson, as new suction-dredging technology was designed and tested. In response General Electric launched a $120 million advertising campaign to convince the public that dredging was unnecessary and would damage the river. Why? If forced to clean up the Hudson, GE would have to acknowledge a degree of responsibility. This would make it liable for the cleanup of other contaminated sites around the country. At the same time, General Electric ***challenged the Superfund Law*** in court as unconstitutional. (The verdict is still pending.)

GE's television and newspaper ads misleadingly used pictures of old clamshell dredges and underscored the damage they could do. GE also funded studies that ***showed***, or were ***altered to show***, that PCBs were not a health risk. While concerned citizens and environmental groups demanded the removal of PCBs, others now opposed dredging, convinced by GE's disinformation campaign.



GE's ad campaign used images of old technology

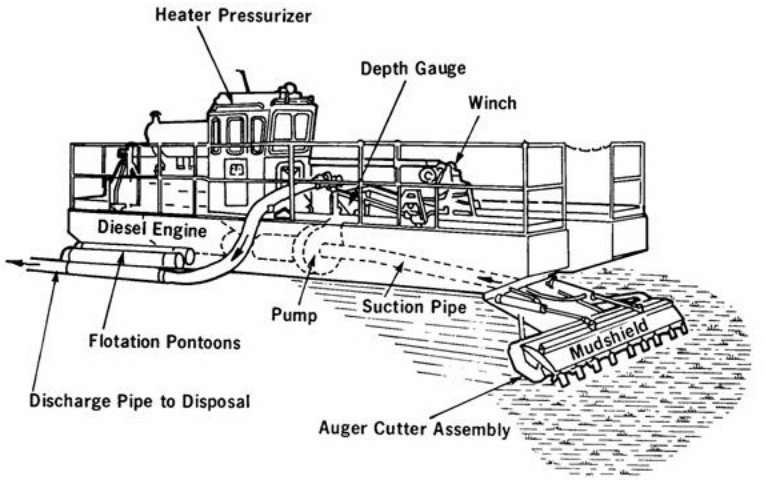
Negotiations between GE and the EPA continued. How much would be spent? How much would be dredged? Where and how would the waste be processed? Could the company be forced to dredge?

Lawsuits were filed against Monsanto, General Electric and Westinghouse (another major user of PCBs) alleging that the companies knew PCBs were a serious health risk years before the information was made public. This was confirmed by records and memos revealed in the course of litigation. One memo from a Westinghouse corporate lawyer advised the company to destroy all PCB-related records predating 1974, or risk self-incrimination in the event of a trial.

What came to light was not an orchestrated conspiracy so much as a series of individual decisions reinforced by a corporate culture of secrecy and deception in the service of shareholder profits. All those who contributed to the legacy of willful ignorance, deception and denial concerning the dangers of PCBs may have seen themselves as simply "doing their job" – the right thing for business, the company, and their own careers. Once the juggernaut of deception was in motion, each individual risked taking responsibility for the decisions of a predecessor. Production continued, studies were conducted and repressed, and electric technology advanced, made ostensibly safe by the dangerous chemicals in transformers and capacitors: PCBs.

The EPA issued a new Record of Decision for the Hudson River site in 2002. General Electric was ordered to decontaminate 2.65 million cubic yards of sediment from portions of the upper river, using suction dredges and a dewatering plant. This would filter out an estimated 150,000 pounds of PCBs. The cost to GE would be approximately $460 million. The company stalled, exceeding the estimated time for design and construction of the dewatering plant, which none of the surrounding towns welcomed. Eventually a site in Fort Edward was agreed on and dredging was scheduled for 2005. It was then rescheduled for 2007.

In January of 2006 a ***ten-year initiative*** by an organization of Christian shareholders at General Electric came to fruition. In 1996 it had begun pressuring the company to acknowledge its resistance to cleaning up its PCB pollution. Finally GE disclosed that it had



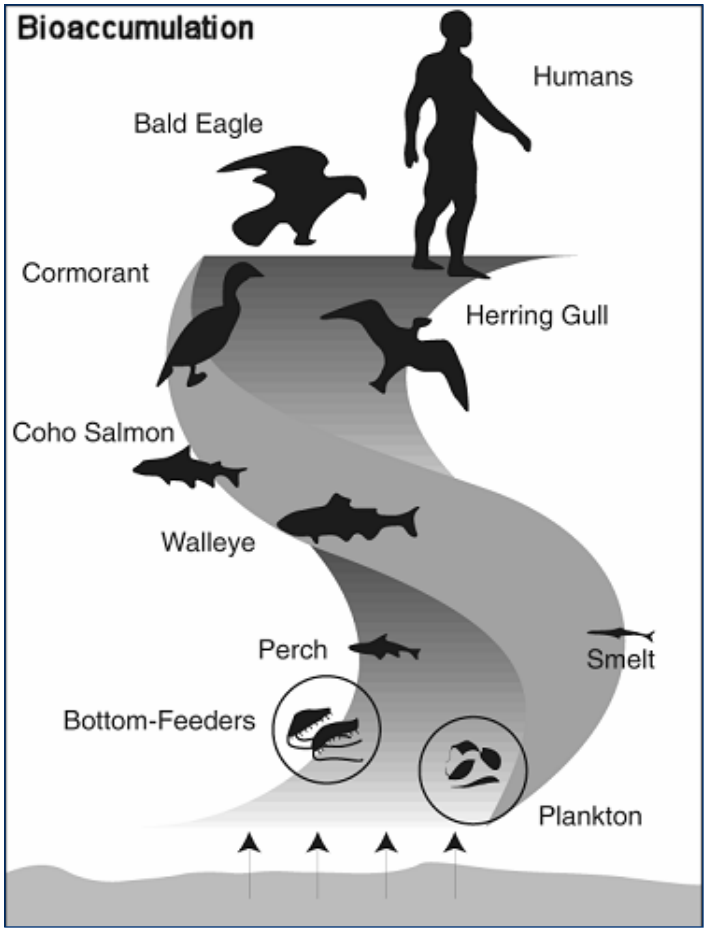
Suction dredge

pent the astounding amount of $799 million to delay cleanup of the Hudson and two other major contamination sites.

Civil, commercial, and government studies have now implicated PCBs in breast cancer, brain cancer, soft-tissue sarcomas, non-Hodgkin's lymphoma, and malignant melanomas. Even at low levels they can disrupt the body's immune and reproductive systems. They impede physical and mental development in children. PCBs are linked to spinal and joint degeneration as well as blood diseases and liver problems. Virtually all human beings on the planet are now carrying some amount of these man-made chemicals in their body.

More than 1.5 billion pounds of PCBs were manufactured in the United States between 1929 and 1977. Forty percent to 60 percent are still in use. Approximately one percent made their way into the ocean, and the rest are unaccounted for. As a result PCBs have circled the globe, affecting animals in every part of the food chain.

The high concentration of PCBs in the Hudson River is a small piece of the picture, but General Electric is still struggling to decontaminate it. Difficulties in obtaining parts for the construction of the Fort Edward dewatering facility may push dredging back further to 2008.



Consumed by microorganisms and accumulating in animal fat, PCBs concentrate as they move up the food chain

HISTORY OF PCBS
Concepts and Discussion

Learning Objectives

Students should come to understand PCB pollution of the Hudson River as part of a larger historical narrative that begins more than one hundred years ago and has global repercussions.

Viewing Suggestions

- Video Chapter: *History of PCBs*
- DVD extra: *Cleaning Up PCBs*

Teacher's Quick Reference

Chronology

- PCBs are discovered in 1890's. They prove useful as an insulator..
- PCBs are used in capacitors, transformers, dyes, asphalt, paper, paints and more.
- Harmful side effects are noted in 1937 in workers exposed to the chemicals.

Pollution on the Hudson

- From 1947 GE uses PCBs in the manufacture of capacitors and transformers.
- GE's factories on the Hudson pump PCB-laden waste into the river.
- GE donates contaminated fill to build homes and schools.

Spread of PCBs

- Atmospheric PCBs travel northward, where they fall to the ground as cold air condenses. Studies in Sweden and Canada identify toxic pollution there in the 1960's.
- In Japan people fall ill after PCBs leak into a batch of rice bran oil.
- PCBs are found in peregrine falcons that had fed on contaminated fish.

Reaction to scientific findings

- Monsanto created its "Pollution Abatement Plan" to address the problem of potential lawsuits.
- PCBs are declared a health risk in 1976, production is prohibited.
- Commercial fishing on Hudson is banned; Clean Water Act prohibits dumping of PCBs.

New limits on pollution

- Under the 1980 Superfund Law, 200 miles of the Hudson are declared a cleanup site.
- GE is ordered by the EPA to cap shoreline polluted with PCBs.
- Dredging in Hudson is proposed. GE launches a campaign to persuade the public it is unnecessary.

Harmful effects of PCBs

- PCBs are implicated in a wide range of illnesses.
- The chemicals can compromise the physical and mental development of children.
- Human immune and reproductive systems can be disrupted by PCBs.

Key Content

PCBs
Monsanto's pollution abatement plan
the "Yusho incident"
effects of early dredging for PCBs
GE's anti-dredging ad campaign
health risks of PCBs
how PCBs got into the Hudson
atmospheric migration of PCBs
Superfund Law
current situation

Content Review Questions

- How were PCBs discovered?
- How were PCBs used?
- When were the health risks of PCBs first noticed?
- How were PCBs discovered in the food chain?
- What was the "Yusho incident?"
- What were the unforeseen consequences of removing the Fort Edward dam?
- What legislation was used to order GE to clean up its contamination?
- How and why did GE attempt to sway public opinion against dredging?
- What are the arguments for and against dredging?
- What is the current status of the PCB cleanup?

Discussion Questions

- Executives and employees of General Electric and Monsanto who denied evidence of PCB health hazards probably felt they were "just doing their job" in the interests of the company and shareholders. Have you ever been a situation where you witnessed a crime or an abuse that you felt was wrong but were afraid to speak out? Discuss a range of different ways in which such a dilemma might be resolved. What option would you choose?
- In economics, pollution is considered an "externality," or a negative consequence that is not necessarily borne by the producer. Instead, the cost of pollution is often borne by society as a whole, in terms of medical costs and harm to other industries. How have the citizens of New York state borne the cost of PCB contamination? What other industries have been affected by this contamination? Should GE be held accountable for these costs to society?

The Law

Key environmental laws.
Why they were enacted and what's happened as a result
(Environmental Science and Social History)

The Hudson River Valley is one of the first places where citizens experienced the environmental consequences of unregulated industrial expansion and chose to do something about it.

The first modern environmental battle was fought over ***Storm King Mountain***, which stands at the northern end of the river's scenic Hudson Highlands. In 1962 the Consolidated Edison Company (Con Ed) proposed to excavate the mountain to install the largest pumped-storage hydroelectric plant in the world. A small group of citizens filed a suit to contest it.

Early Storm King Mountain protest

At first there were only six members of the group. Led by ***Carl Carmer***, a writer and local historian, and Leo Rothschild, an attorney and chairman of the New York-New Jersey Trail Conference, they called themselves the Scenic Hudson Preservation Conference. They fought Con Ed's plant on the grounds that it would do irrevocable harm to the environment.

The suit was initially dismissed, but an appeal in federal court won ***Scenic Hudson*** the right to sue for *potential* environmental damages. A 17-year battle ensued. The case created a ***legal basis*** for preventing environmental destruction rather than simply offering redress for damage already caused.

Elsewhere on the river, factories making automobiles, wire cable, and electrical components were causing systemic damage with their pollution. Industry saved millions of dollars in waste-disposal costs by using the Hudson as a sewer. General Electric discharged PCBs into the river, contaminating aquatic life. Paint from the General Motors plant in North Tarrytown colored the water. Chemicals and metal filings from the Anaconda Wire and Cable Company in Hastings-on-Hudson were pumped straight into the river. Dozens of other factories added their waste to the mix. Oil and sewage were common ingredients in the Hudson.


Contaminated fish

In the mid-1960's, before the sale of most Hudson River fish was banned for health reasons, buyers in New York City fish markets complained of stripers and shad that smelled and tasted like the pollutants they swam in. Angry fishermen led by Robert Boyle, a writer for *Sports Illustrated*, formed the Hudson River Fishermen's Association (HRFA) in 1966. Boyle suggested the association prosecute polluters using a little-known nineteenth-century law. The ***Rivers and Harbors Act of 1886*** made it illegal to alter the condition of a navigable water-

way without government authorization. Offending parties could be fined $500 to $2,500.

Using this law, the fishermen had their first small legal victory in a battle against the Pennsylvania Central Railroad. The railroad was forced to stop dumping oil into a Hudson tributary, while the fishermen's association won a $2,000 bounty for blowing the whistle. The group changed its name to ***Riverkeeper*** and continued to win small cases until the Harbor Act was superseded by more effective environmental legislation.


Rachel Carson

Nationwide, the 1960's brought new environmental awareness. Rachel Carson's book ***Silent Spring*** described the deadly effect of chemical pollutants in the environment. Companies exposed for using these pollutants tried to have the book banned. It went on to become a cornerstone of the environmental movement.

In 1968 the spacecraft Apollo 8 took the first ***picture*** of Earth from space. This famous image depicted


Earth from space

the world as a delicate blue-and-white orb. The picture seemed to confirm an idea environmentalists were expressing: that the world, home to nature's diversity, was a delicate thing, in need of human protection.

One year later there was a massive ***oil spill*** off the coast of California, and hundreds of dead seals and dolphins washed up onshore. Several months later Ohio's ***Cuyahoga River*** caught fire from industrial pollution and burned for several days. The national media featured images of both disasters. Americans were appalled.

President Richard Nixon, spurred by broad public support for environmental action, signed the ***National Environmental Policy Act*** (NEPA) on January 1, 1970. It was the dawn of a new era.


Fire on the Cuyahoga River

The purpose of the act was to "encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the nation; and to establish a Council on Environmental Quality." The act acknowledged the global impact of environmental problems, started a recycling initiative, and made provisions for environmental advisors to the president. It led to requirements that developers prepare environmental impact assessments and that agencies seek public review on new proposals affecting the environment.

On April 22 a grassroots movement spearheaded by Senator Gaylord Nelson organized the first ***Earth Day***. Intended as an environmental "teach-in" for schools across the country, it attracted widespread public interest. An astounding 20 million people in cities


1970 Earth Day in Washington, D.C.

across the United States joined together to participate in Earth Day events.

In July the president and the United States Congress worked together to establish the Environmental Protection Agency (EPA) to enforce the directives of the National Environmental Policy Act. They also passed the ***Clean Air Act***, which revised prior ineffective laws and set strong goals and guidelines for reducing air pollution.

The Clean Air Act identified six of the ***most toxic pollutants*** and required the EPA to find and set *primary* and *secondary health standards*. Primary standards are the level at which pollutants are considered harmful to humans. Secondary standards are the level at which they damage resources, such as livestock, crops, and other vegetation. The Clean Air Act also required the EPA to look for other potentially harmful toxins in the air and mandated that gasoline be lead-free by the mid 1980's.

In 1972 the ***Federal Water Pollution Control Act*** set standards for American water quality. The act's goals were "the elimination of the discharge of all pollutants

Air pollution

into navigable waters of the United States by 1985" and an "interim level of water quality that provides for the protection of fish, shellfish, and wildlife and recreation by July 1, 1983."

The Water Act governed what could be discharged into any regulated body of water. Industry was required to use state-of-the-art technology to reduce emissions. But a loophole existed. In cases where technology was not yet available, industries could get temporary permits that allowed them to continue polluting. It was assumed that these permits, and the pollution they allowed, would be phased out by 1985.

The Water Pollution Control Act was an environmental milestone. It went beyond the idea of pollution *abatement* to pollution *prevention*. It also provided citizens with the right to sue any party, corporate or governmental, that violated its provisions. The act even prohibited discrimination against anyone who instigated or testified in a case. Revised and amended in 1977, the law came to be known as the Clean Water Act.

The United States finally had a system for determining and regulating pollutants that posed serious threats to public health. It also had, in the EPA, a federal agency dedicated to the research and regulation of these threats. Public awareness was high, "the environment" had entered the political vocabulary, and pollution prevention had become a national priority. At the same time the long-term consequences of unrestricted industrial dumping were, quite literally, surfacing.

In the 1960's, residents of a working-class neighborhood in the city of Niagara Falls, New York, complained of odors and chemical residues leaching into their basements and lawns. The problem got worse but was given little attention until 1978, when Michael Brown, a Niagara Gazette reporter, wrote a series of articles about the horrors in a suburb known as ***Love Canal***. Brown showed that Love Canal was built over a landfill containing 21,000 tons of chemical waste.

The Health Department began collecting samples. Blood from Love Canal residents showed chromosome damage, indicating an increased risk for cancer and reproductive ailments. Between 1974 and 1978, 56 percent of children born in Love Canal were found to suffer from a birth defect.

In 1978 President Jimmy Carter declared a state of emergency for Love Canal. The government moved 239 families out of the most dangerous area. In 1980 the entire region was permanently abandoned.

Love Canal evacuation

Love Canal was not an isolated incident. In 1979 the EPA found thousands of sites across the country that posed threats to public health. It became obvious that pollution didn't just need to be regulated; in many places it had to be eliminated.

The federal authorities could not afford a thousand Love Canals, and taxpayers could not be expected to

shoulder the high price of cleanups. Prior laws allowed the EPA to sue responsible parties, but in many cases, where sites had been abandoned for decades, it was difficult to locate the culprits.

New legislation was needed. On December 11, 1980, the ***Comprehensive Environmental Response, Compensations and Liability Act***, also known as CERCLA, or the ***Superfund Law***, was enacted. The Superfund law allowed the EPA to clean up threats to public health immediately and bill the polluter later. When no responsible parties could be identified, the EPA was authorized to cover all costs. A fund was created for cleanup, containment, litigation, and reimbursement. It was financed by a tax of 9.7 cents a barrel on domestic crude oil and imported petroleum products. Two additional taxes, levied on companies using dangerous chemicals, added to the revenue. Finally a small environmental tax of 0.12 percent was levied on the profits of corporations earning more than $2 million a year.

The year the Superfund law was enacted the long legal battle over Storm King Mountain on the Hudson River came to an end. Con Ed agreed to scrap its plans to build its hydroelectric plant, reduce power-plant-related fish kills, and start a fund for environmental studies along the Hudson. In exchange the Hudson River Fishermen's Association agreed not to sue Con Ed for thermal discharge violations at its existing power plants. Though victory came at a price, the settlement stands as one of the most successful civil environmental actions. A handful of concerned citizens started a legal and political avalanche that wiped Con Ed off the mountain, preserving a part of the scenic Hudson River valley.

The legal framework was complete. Environmental law became a recognized specialty with three pillars to support it: the Clean Air Act, the Clean Water Act, and the Superfund law.

For almost two decades environmental legislation enjoyed broad bipartisan support. Although funding, standards, and enforcement varied with each administration, the essential structure remained intact.

The quality of our environment has improved since the 1970's. The EPA has facilitated the cleanup of more than 900 dangerous sites. The complete phaseout of leaded gas was accomplished in 1995, and the average amount of lead in human blood has dropped more than 50 percent nationwide. Superfund fees were expanded under President Ronald Reagan and renewed under President George H. W. Bush.

In 1995 Congress balked at renewing the industrial taxes that supported Superfund. President Bill Clinton tried to reinstate them but was unsuccessful. The fund survived on its surplus until 2002. Since then it has been supported by general tax revenues, shifting the cost of cleanup from industry to individual taxpayers.

George W. Bush is the first president to attempt to roll back the enforcement of environmental law. He has appointed EPA administrators who cut back on spending and play down financial problems rather than asking for ***reauthorization of the Superfund taxes***.

Today, according to the EPA, there are 44,000 potentially hazardous sites nationwide. The total Superfund budget has decreased in constant dollars from $1.8 billion in 1993, primarily from polluter-related taxes, to $1.2 billion in 2005, all of which is paid by individual taxpayers.

Under George W. Bush the EPA has also rolled back the ***New Source Review***, a 1977 amendment to the Clean Air Act that required plants to receive EPA approval before they could expand operations that generate additional pollution.

In its report *Rewriting the Rules, 2005,* the environmental watchdog organization the National Resources Defense Council demonstrates, step by step, how the current Bush administration has led "the most thorough and destructive campaign against America's environmental safeguards in the past 40 years."

National policies are created and administered by the people we elect. The best way to improve and enforce environmental standards is to vote for people who are educated, aware, and care enough to make these issues a priority.

Your vote makes a difference. So do your ideas. The case at Storm King started with a small group of concerned citizens. If you want to change environmental policy, get organized, get involved, and educate your community.

THE LAW
Concepts and Discussion

Learning Objectives

Students should understand the purpose of the most important U.S. environmental laws, as well as the historical events leading to their enactment.

Suggested Viewing

- Video Chapters: *Hometown U.S.A., The History of PCBs, River's End*
- DVD Extras: *Cleaning Up PCBs, A Creek in Brooklyn*

Teacher's Quick Reference

- Storm King Mountain
  - In 1962 Con Ed's plans to install a pumped-storage hydroelectric plant are contested by the Scenic Hudson Preservation Conference.
  - The ensuing seventeen-year legal battle creates a basis for preventing environmental damage rather than simply responding to damage already caused.
- Destruction of the river
  - General Electric discharges PCBs into the Hudson.
  - General Motors dumps paint from its auto plant into the river.
  - Anaconda Wire and Cable Co. discharges chemicals and metal filings.
  - Many other polluters add oil, chemicals and raw sewage to the river.
- Riverkeeper
  - The Hudson River Fishermen's Association invokes the 1886 Rivers and Harbors Act in a lawsuit against Pennsylvania Central Railroad.
  - A court ruling fines the railroad for polluting a Hudson tributary.
  - The fishermen's group successfully brings further suits.
- Beginnings of the environmental movement
  - Rachel Carson's *Silent Spring* (1962) draws awareness to chemical pollution.
  - Public response to an oil spill off California and the Cuyahoga River fire in Ohio fuels support for the 1970 National Environmental Policy Act.
  - The first Earth Day is held on April 22, 1970.
- 1963 Clean Air Act
  - Required the Environmental Protection Agency to set health standards for air.
  - Mandated that gasoline be lead-free by the mid-1980's.

- 1972 Water Pollution Control Act
  - Governed what can be discharged into any regulated body of water.
  - Required state-of-the-art technology to reduce pollution and thermal discharges.
  - Provided for citizens the right to sue those who violated it.
- 1980 Superfund Law
  - Allowed the EPA to clean up threats to public health and bill the polluter.
  - Was partially financed by a tax on domestic crude oil and imported petroleum and on the profits of corporations earning more than $2 million a year.
  - Established a fund for cleanup (about 900 sites so far), as well as for containment, litigation, and reimbursement.
- Setbacks under President George W. Bush
  - Rollback of the New Source Review, an amendment to the Clean Air Act that required EPA approval for expansion of industrial operations that pollute.
  - EPA administrators have cut back on spending and have not sought reauthorization of Superfund taxes.
  - The Superfund budget has decreased from the equivalent of $1.8 billion in 1993, paid by taxes on polluters, to $1.2 billion today, paid by individual taxpayers.

Key Content

Con Ed and Storm King Mountain
Hudson River Fishermen's Association
Rivers and Harbors Act
Rachel Carson's Silent Spring
Cuyahoga River fire
Earth Day
Environmental Protection Agency
Clean Air Act
Clean Water Act
Love Canal
Superfund law
EPA rollbacks

Content Review

- What was the Storm King Mountain legal dispute about?
- What important legal precedent did the Storm King case establish?
- How did industries treat the Hudson River before environmental laws were enacted?
- What is the Rivers and Harbors Act, and how did the Hudson River Fishermen's Association use it?
- How was Rachel Carson's *Silent Spring* influential?
- What did the National Environmental Policy Act do?
- Why was the EPA formed?
- What is the Clean Air Act and what does it do?
- What is the Clean Water Act and what does it do?
- How is the Superfund Law different from the other federal legislation?
- How have presidents, past and present, affected environmental policy?

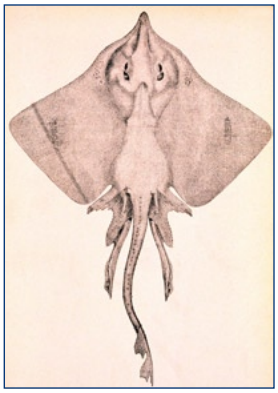
Discussion Questions

- Why did industries on the Hudson River dump waste into the waterway? Why was this tolerated for so long?
- What role did private citizens play in changing the status quo of polluting on the Hudson River? What groups were a part of this? How did these actions affect change on a national level?
- Representatives of polluting industries frequently argue that complying with EPA emission standards is too costly, undermining their industries and the economy that they help sustain. Should the federal government continue to relax pollution standards, as it has done in recent years?
- The ***Kyoto Protocol*** is an international agreement to combat global warming caused by the emission of carbon dioxide and other "greenhouse gases" from automobiles and a wide range of industrial processes. Since the Protocol was drafted in 1997, 162 countries have signed it. The United States, which is responsible for about 25 percent of the world's greenhouse gas emissions, has not. Our government claims it would be too costly for industry and that other countries would not be subject to strict enforcement. Despite these drawbacks, should the United States sign on? Why or why not?

The Estuary

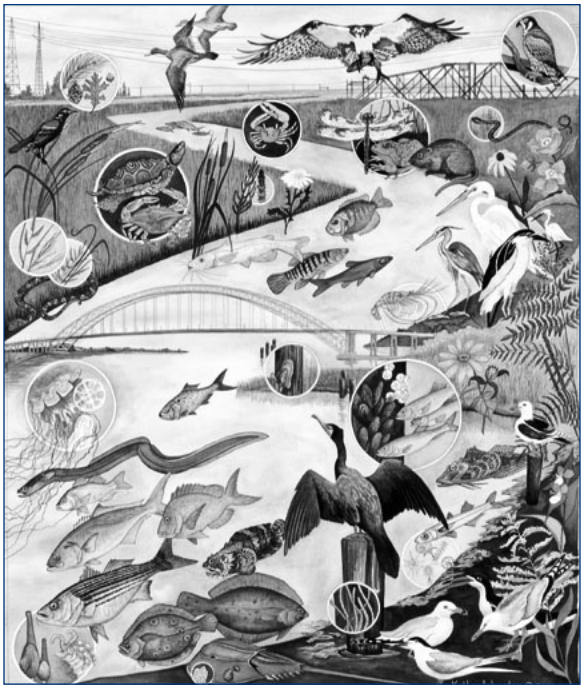
Biodiversity and alien species
(Environmental Science)

If you visit the Hudson River exhibit in the state museum in Albany, you can see a preserved sea creature called a barndoor skate. The really odd thing about this ocean fish is that it was caught near Albany, 150 miles inland. Other saltwater animals, notably ***dolphins and porpoises***, were seen in the central Hudson in the 19th century. Blue claw crabs are still found near Albany. How can saltwater species survive so far from the ocean? Because the lower Hudson is a saltwater estuary.



Barndoor skate

Estuaries are bays, harbors, river deltas or marshes in which freshwater from rivers mixes with salt water from the ocean. Protected from the big waves of coastal storms, estuaries are an ideal home for fish, crabs, plants and other aquatic organisms. Estuaries are often important fish nurseries or spawning grounds.



Estuaries are home to diverse species

Being long and narrow, the Hudson estuary is different from other big estuaries like Boston Harbor, ***Puget Sound***, or ***Chesapeake Bay***. Geologists sometimes refer to the Hudson as a "drowned river." Visualize it as a long narrow valley that was inundated 14,000 years ago when the oceans rose at the end of the last Ice Age. The sea flooded the valley bottom, creating a long fjord or finger of ocean reaching far inland.

Fresh water draining from the Adirondack Mountains and the surrounding watershed mixes with salt water. Ocean tides reverse the flow of the river every six hours, all the way to Troy, which is 153 miles inland but only two feet above sea level.

Plankton are microscopic organisms

The widest point of the Hudson estuary, about three and half miles across, is at Haverstraw Bay. Striped bass, American shad, white perch, tomcod, and Atlantic sturgeon can be found there, 45 miles from the ocean. The bay is large and shallow. It is a major producer of ***plankton***, which forms the base of the food chain. Blue claw crab and a variety of clams also make their home in the bay. Atlantic fisheries are supplied by stocks that spawn and grow there.

In the mid-twentieth century the Hudson River was seriously compromised by industrial pollution. Then in 1972 the ***Clean Water Act*** mandated a cleanup. Over

time species that had almost disappeared from the bay returned. In 1987, the New York Department of Environmental Conservation classified Haverstraw Bay as a "***Significant Coastal Fish and Wildlife Habitat***," resulting in close monitoring and regulation.

The ratio of salt water to fresh water in an estuary determines the kind of species that live in it. As one would expect, the Hudson gets less salty as one travels inland, away from the ocean. Salt disappears from the river around the city of Newburgh, about 56 miles inland. The salinity in the river changes with the season and the amount of rainfall. In the spring, fresh water from rain and melting snow pushes the salty river water closer to the ocean. Catfish, carp, and black bass thrive on the nutrients in the outer fringes of this tidal "***salt wedge***."

Fish commonly found in both fresh and salt water are ***anadromous*** species that mature in the ocean and then swim into fresh water to spawn. Drive over any of the highway bridges crossing the lower Hudson or its tributaries and you will see a sign with the bony blue outline of a fish, reading "Hudson River Estuary." The fish is an ***Atlantic sturgeon.*** Selected as the symbol of the Hudson River, the sturgeon is a living relic from the age of dinosaurs. The fish has bony plates instead of scales. Its semi-reptilian appearance is due to the

Atlantic sturgeon

fact that it hasn't changed much in a hundred million years. Sturgeons can weigh from 70 to 500 pounds and grow to about six feet long. It takes 15 to 20 years for a sturgeon to become sexually mature, and it can live for 60 to 80 years.

During most of the year sturgeon live in the ocean, swimming 50 to 100 miles offshore. Tagging studies have found Hudson River sturgeon as far north as the Gulf of Maine and as far south as the Chesapeake Bay. In the spring, when the river is flushed with fresh water, sturgeon swim upstream to spawn.

When Europeans colonized New York in the seventeenth century, sturgeon were so plentiful during their spring spawning run that they would clog the river's main channel, creating a navigational hazard. They were considered trash fish, but gradually tastes changed. By the late nineteenth century, smoked sturgeon was a delicacy. The residents of New York's capital, Albany, ate so much sturgeon steak they affectionately called it *Albany beef.*

Sturgeon eggs or roe were even more sought after than sturgeon steaks. ***Caviar*** from Hudson River sturgeon was served in the best New York City restaurants, and was a competitor to prized Beluga and other imported varieties from Russia and Iran. Thousands of pounds of Hudson River caviar were exported to Europe every year.

American caviar

The popularity of "Albany beef" combined with the profits to be had from caviar led to overfishing and the subsequent collapse of the fishery. Most commercial sturgeon fishing ended around 1900, but the population did not recover. The sturgeon's long life cycle made it particularly vulnerable to pollution, which increased during the twentieth century. When the cleanup of the river began in the 1970's, the sturgeon started to return, but it will take many generations for them to reach their former numbers. Sturgeon are now a protected species, and it is illegal to catch them.

One species that is thriving is the ***zebra mussel***. Zebra mussels are like marine blue mussels but much smaller, with black and white stripes. They are not native to the Hudson but were brought there, unintentionally, in the 1980's. The little mussel was an aquatic stowaway in the ballast water of a ship. (Ballast water is seawater pumped into special tanks in a ship's hold to provide ballast – or extra weight – to give the ship a safer, steadier ride when it is not laden with cargo.)

Zebra mussel

Only an inch to an inch and a half long, zebra mussels feed by filtering microscopic food particles out of the water. In the Hudson River they have done very well. According to aquatic biologist David Strayer

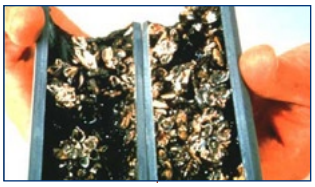
Ballast water release

(interviewed on-camera in the *Swim for the River* DVD), "There's enough zebra mussels in the Hudson right now to filter all the water in the river in every one to four days during the summertime."

Thanks to all the zebra mussels, water in the lower Hudson River is much clearer than it was. You might think that water clarity is a good thing until you consider this: Zebra mussels consume most of the suspended food particles (***phytoplankton, zooplankton***) that other organisms rely on. If you could put all the zebra mussels in the Hudson River on one side of a balance and all the other consumers in the river – fish, shellfish, plankton, worms, bacteria, etc. – were on the opposite side, the zebra mussels would outweigh everything else combined. They are crowding out other species. Some native shellfish are disappearing; some fish populations are declining. Strayer concludes: "The Hudson may look the same as it did before the zebra mussel invasion, but to an ecologist it's a completely different river."

Zebra mussels are crowding out other species

Zebra mussels also wreak havoc on man-made structures. They attach to boat hulls and clog the water intake pipes for cities and power plants. Since they first appeared in North America, $250 million has been spent to scrape them from intake pipes, to chlorinate water to discourage mussel larvae and to replace damaged equipment.



Water intake pipe blocked by zebra mussels

There is no lasting solution, no chemical or biological agent that could be used to eradicate the species without doing grave collateral damage to the ecosystem. The mussels let loose in the waterways of North America are unstoppable.

What can be learned from our experience with zebra mussels? David Strayer laments that many people, including environmental policy makers, think of zebra mussels or other invasive species as simply "bad luck" – like getting struck by lightning. Something that just happens without warning or prediction and cannot be avoided. This is not true.

Zebra mussels are part of a man-created global phenomenon. They are what scientists call an "***invasive species***," life forms introduced to the environment by man – sometimes on purpose, sometimes not. Dozens of alien species are transported from one continent to another every year – in the ballast water of ships, in wooden shipping pallets that are home to wood-boring insects, in animal and agricultural products, and in human passengers. We never hear about most of these organisms because they are relatively benign or do not adjust to their new environment. But occasionally an invasive species such as the zebra mussel asserts itself in a spectacularly destructive way. Other invaders that have made headlines are water chestnuts, ***gypsy moths***, starlings, ***chestnut blight***, ***West Nile virus***, ***SARS***, AIDS, and ***avian flu***.

Some epidemics and invasive species can be stopped by regulating global transportation. Zebra mussels would not be in North America if ships had been required to sterilize their ballast tanks. If wooden shipping pallets were replaced with recycled plastic ones, a medium for the transport of wood-boring insects would be removed. Quarantine during a potential epidemic could save hundreds of thousands of lives.

Although we may not be able to stop invasive species once they are let out of the bag, we can take preventative measures. What we need is the public awareness and political will to make these measures possible.

THE ESTUARY
Concepts and Discussion

Learning Objectives

Students learn the principal characteristics of the Hudson River as an estuary and the history of its sturgeon. They also learn about one of the river's invasive species, zebra mussels.

Viewing Suggestions

- Video Chapters: *Clearwater, Indian Point, A Salt Marsh in Yonkers*
- DVD Extras: *Invasive Species*

Teacher's Quick Reference

Estuaries

- Estuaries include bays, harbors, river deltas, and marshes.
- Protected from coastal storms, estuaries are rich in marine life.
- Estuaries are often spawning grounds.

Formation of the Hudson

- At the end of the last Ice Age, the ocean flooded a valley bottom, creating a long finger of salt water reaching far inland.
- Ocean tides reverse the flow of the river every six hours.

Haverstraw Bay

- In this wide part of the Hudson, 45 miles from the ocean, species include striped bass, American shad, white perch, tomcod, and Atlantic sturgeon.
- A cleanup under the 1972 Clean Water Act brought back many fish species.
- In 1987, monitoring and regulation of the area was mandated and an *aggregate value* was assigned to the bay.

Atlantic sturgeon

- A living relic from prehistory, the sturgeon has bony plates instead of scales.
- It can weigh from 70 to 500 pounds, grow to six feet and live from 60 to 80 years.
- The sturgeon, which spawns in fresh water, takes 15 to 20 years to mature.
- Overfishing and pollution greatly reduced the sturgeon population. The fish is now a protected species.

Zebra Mussels

- The zebra mussel was an aquatic stowaway in the ballast water of a ship. It came to the Hudson River in the 1980's.
- These bivalve filter feeders have cleared up the water in the lower Hudson but are crowding out other species.
- Attaching to underwater structures, the mussels are causing millions of dollars of damage that could have been prevented.
- Zebra mussels are an invasive species and, as such, are part of a global phenomenon for which humans are responsible.

Key Content

estuary	Sturgeon
drowned river	Albany beef
Haverstraw Bay	Caviar
plankton	zebra mussel
anadromous fish	invasive species

Content Review

- What is a drowned river?
- What kind of water is in an estuary?
- How is the Hudson different from most other estuaries?
- Why is Haverstraw Bay important to fisheries?
- What is an anadromous fish?
- What characteristic makes sturgeon different from other fish?
- What is an invasive species?
- What is a zebra mussel and why is it considered harmful?
- What measures can we take to stop the spread of invasive species?

Discussion Questions

- The sturgeon is just one kind of anadromous fish. Name other common anadromous species and consider how our management of rivers affects them.
- Read about another invasive organisms, such as water chestnuts, the gypsy moth, starlings, chestnut blight or West Nile virus. Compare it to zebra mussels. In what way was the introduction and spread of the organism similar to, or different from the spread of zebra mussels?
- In the documentary sequence "Clearwater," Sa'-kiera Hudson talks about "all the plankton that's dying due to factories that are putting hot water [in the river]." What is she talking about? Hint: Look at the "Indian Point" sequence. Why should we "save the plankton"? Using the links provided in the text, find out about plankton. What is it? What purpose does it serve?

Sewage and Sprawl

A history of waste disposal
(Environmental Science and Social History)


Sewage outfall

If you have ever thought about swimming in the Hudson River, August 14, 2003, would not have been a good day for it. On that date half a billion gallons of raw New York City sewage poured into the Hudson River and adjacent waterways.

Raw sewage is everything you wash down the sink and flush down the toilet plus waste water from appliances and commercial industries. Disease-carrying bacteria and viruses, or ***pathogens***, thrive in raw sewage, causing diarrhea, skin rashes, increased risk of cancer and impairment of the nervous, circulatory, and reproductive systems. Some of the more severe medical problems are linked with sewage from industrial sites.

The main threat to the environment is elevated levels of nitrogen, which feed excessive algae growth. As algae die and decompose, oxygen in the water is depleted, choking fish and other marine life.


Rain can overload sewers

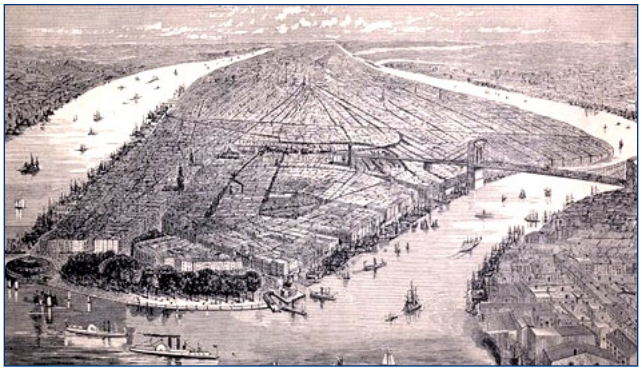
The sewage release on August 14 was caused by a ***citywide blackout***. Sewage treatment plants lost power, back-up generators failed and, as a result, untreated sewage poured into New York City's waterways.

Although blackouts are rare, sewage spills are not. In New York City spills can be triggered by as little as one-tenth of an inch of rain. Twenty-seven billion gallons escape into the city's waterways every year. Imagine 10,000 football fields covered nine feet deep in stinking sludge.

The problem stems from New York City's ***combined sewer system***. This outdated disposal method combines wastewater from residences and commercial buildings with rainwater that flows into street drains. During even a mild rainfall, excess water from the streets can overload sewers and treatment plants. To prevent raw sewage from backing up, blowing manhole covers, and spewing into the streets, floodgates and outfall pipes are activated, releasing wastewater from the main sewers into nearby waterways. These discharges are called ***combined sewer overflows***, or CSOs.


A New York street, 1861

New York's combined sewer system is the result of decisions made more than 150 years ago. In the 1800's the city's ***population*** grew exponentially. As the city expanded so did its sanitation problems. Waste from outhouses, gutters, and open trenches spread illness and disease. Deadly outbreaks of ***cholera*** finally forced the city to develop an efficient method for removing waste. Construction began on a ***sewer system*** and by the early 1900's sewers serviced most of the city. In Manhattan, the main sewer pipes ran east-west beneath cross-town streets. On the West Side they discharged into the Hudson River. On the East Side they poured into the East River. When it rained, the additional water flowing into the sewers helped flush out the waste. In 1850, when there were only ***590,000 people*** living in New York City, this probably seemed like a good solution. Waste was carried away and flushed into the rivers, where it appeared to pose no immediate problem – unless, of course, you went swimming.



Manhattan Island between the Hudson and East Rivers

One hundred and thirty years later, in 1980, the population of New York City had grown to more than seven million. What once seemed like a good idea was no longer working. Manhattan was an island floating in its own filth, and it was obvious that river currents and tides could no longer wash away the city's waste. In 1986 New York City's ***first modern sewage treatment plant*** went into operation.

Modern treatment plants use several steps to separate waste and clean the water. Sewage is strained through a series of poles that block large pieces of refuse. Then the water enters settling tanks where remaining solids sink to the bottom. The collected sediment is refined into sludge and the water is filtered, chlorinated, and released into local waterways. The sludge is put in landfills or treated and sold as fertilizer. New York City now has ***fourteen sewage treatment plants*** that filter 1.4 billion gallons of wastewater a day.

New York City's North River Treatment Plant

Treated water, called *effluent,* is relatively clean. Unfortunately, large amounts of raw sewage, or CSOs, still escape into public waterways. To solve this problem New York City would need to build a new sewer system. The cost would be astronomical. Imagine shutting down and tearing up four square blocks of Manhattan just to redirect rainwater. The lives of thousands of people would be affected. Now imagine doing this for the whole city, piece by piece.

As an alternative, city officials agreed to a ***CSO abatement program*** in 1992. Instead of a separate sewer system three underground reservoirs would be built to hold excess waste created during periods of rainfall. The stored sewage could be filtered when the rain stopped and treatment plant capacity returned to normal.

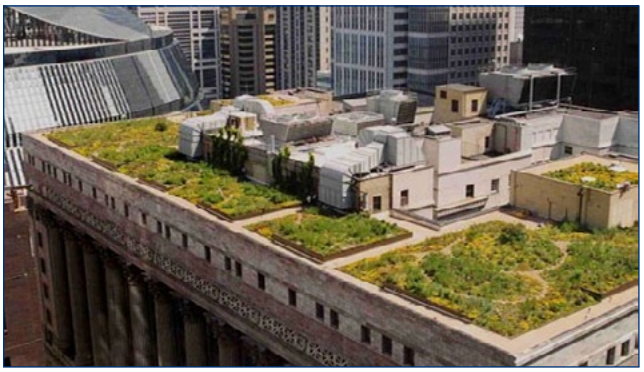
Only one of the three reservoirs is near completion. The ***Flushing Bay*** holding facility is scheduled to begin operating in November 2006, fourteen years after its initial approval. Years of delays have left the city with $2 billion worth of uncompleted runoff reduction programs, including reservoir construction and solid waste containment nets under outfalls. A recently recommended eight-year extension would complete the reservoirs by 2022, unless the city manages to push through its proposal to lower water standards, thereby avoiding the cost of renovations.

New York City is not alone in dealing with these issues. Nearly ***800 cities and towns***, mostly older municipalities on the East Coast and in the Great Lakes region, use combined sewer systems. Many are on the Hudson River. CSOs from Troy, Albany, Yonkers,

and Poughkeepsie mingle with CSOs from New York. When it rains there are swimming advisories on the river, but children play in the water anyway.

Though CSOs are a large problem within affected areas, more than 20,000 cities nationwide use separate waste and storm sewers to successfully avoid overflow.

One solution for cities with overflow problems is to build water-absorbing rooftop gardens to reduce runoff. Chicago landscaped the roof of its City Hall in 1999. Seven years later there are more than 200 green



Green roof in Chicago

rooftops in Chicago; together they cover 60 acres. Chicago has more rooftop gardens than the rest of the country combined. Architects can go a step further by designing buildings that recirculate rainwater into toilets, air conditioners, industrial cooling towers, and irrigation systems.

The problem of CSOs is often exacerbated by ***urban sprawl***. Defined in the dictionary as "the unplanned, uncontrolled spreading of urban development into areas adjoining the edge of a city," sprawl damages the environment by covering vast pieces of land with solid surfaces such as concrete and asphalt. As a result less land absorbs rainwater and there is more runoff or ***non-point source pollution***, in streams and rivers.

The lower Hudson River Valley from Poughkeepsie down to New York City has been especially prone to sprawl. As the cost of living in the city continues to rise, people look for alternative housing. Many people have moved north of the city because it allows an affordable lifestyle and a bearable commute. Real estate developers have purchased large tracts of land and turned them into environmentally hazardous bedroom communities and shopping centers.

One familiar feature of urban sprawl is the shopping mall, situated outside city centers. The mall is convenient for shoppers with cars because of ample parking lots placed on previously open land. Imagine these lots filled to near capacity. A bit of antifreeze drips here, a bit of oil there. Pesticides sprayed on an adjacent lawn

Giant parking lots: a feature of urban sprawl

get onto the asphalt; there are piles of trash and cigarette butts. The detritus builds up. Then it rains, creating a foul soup that typically includes trash, animal excrement, petroleum products, heavy metals, cleaning solvents, pesticides, and herbicides. Acting like a giant funnel, acres of asphalt direct the toxic mixture into storm drains. The drains empty directly into the Hudson River or overflow the municipal sewage plant. Either way, urban sprawl poses an environmental threat that extends beyond the land it covers.

Storm sewers concentrate water that was once dispersed, flooding rivers during rainstorms but depriving the land of groundwater during dry periods. Wetlands and aquifers which would be fed by groundwater, disappear; and with them nature's ability to counteract both flood and drought. Urban sprawl also removes tree cover that can otherwise moderate rainfall. The combined effect is an increase in flash flooding, drought, and pollution.

The best way to prevent or alleviate urban sprawl is through conscientious city planning. "***Smart growth***" means designing, or redesigning, neighborhoods to take advantage of existing resources and infrastructure to maximize the preservation of undeveloped land. Smart growth also works to maximize use of public transportation to reduce auto emissions and the need for widened highways and expansive parking lots.

Another aspect of smart growth is the reclamation of abandoned riverfront and urban space known as *brownfields*. There are many brownfields along the Hudson. These plots of land are vacant and unused because of soil contamination from former industries. In recent years the EPA has offered ***grants*** to developers and municipalities willing to pay part of the cost of cleaning up these sites. Decontaminated brownfields have been turned into waterfront parks, art galleries, and living spaces. One example is the former Anaconda Wire and Cable factory (once notorious for its pollution of the river), slated to be transformed in waterfront condominiums.

The population of the United States is still increasing. Urban growth won't stop, but development can be directed to reduce destructive social and environmental effects. Going further, visionary urban planners are beginning to talk about "***ecocities***" of the future, designed for people, not cars – urban places designed for long-term sustainability, cultural vitality, and the health of the Earth's biosphere.

How much water do you use a day? What do you pour down the drain? Have you ever tossed anything into the street instead of putting it in the garbage? Do you use biodegradable detergents, soaps, and shampoos?

The best way to prevent sewage overflow and runoff is to think carefully about your actions. Use less water, learn about and advocate technology that recycles rainwater, and get involved in city planning. Find out whether your neighborhood is part of a Combined Sewage Overflow system. If it is, find out how you can help change it. Otherwise, your next trip to the beach might leave you swimming with the contents of your toilet.

An ecocity of the future, by Richard Register

SEWAGE AND SPRAWL
Concepts and Discussion

Learning Objectives

Students learn the causes and affects of combined sewage overflows and urban sprawl and about strategies to combat these problems, including New York's sewage abatement program, smart growth, and brownfield reclamation.

Viewing Suggestions

- Video Chapters: *River's End*
- DVD Extras: *A Creek in Brooklyn*

Teacher's Quick Reference

- Dangers of human waste
  - Illnesses caused by disease-carrying bacteria and viruses.
  - Elevated nitrogen levels encourage algae growth, depriving marine life of oxygen.
- New York's sewer system
  - In the nineteenth century, a sanitation system is set up to channel waste from Manhattan.
  - In 1986, New York builds its first modern sewage treatment plant.
  - Sewer overflows can occur even after a mild rainfall.
  - An overflow abatement program to construct three underground reservoirs is proposed in 1992.
- How urban sprawl increases pollution
  - Parking lots collect and funnel toxic effluent to sewer systems and rivers.
  - Wetlands and aquifers disappear as groundwater is eliminated.
  - Tree cover is reduced, encouraging flash floods and droughts.
- "Smart-growth" city planning
  - Rooftop gardens used to absorb rainwater.
  - Undeveloped land is preserved.
  - Public transportation is developed to discourage individual automobile use.
  - Contaminated brownfields on riverfront property are reclaimed.

Key Content

pathogens
combined sewer overflows
NYC population growth, 1850–1980
NYC's original sewer system
sewage treatment plant
effluent
NYC's CSO abatement program
urban sprawl
smart growth
brownfields

Content Review

- What illnesses do pathogens from sewage cause?
- What causes combined sewage overflows?
- How much did New York City grow between 1850 and 1980?
- What was the problem with New York's first sewer system?
- Give some examples of urban sprawl.
- How does urban sprawl cause water pollution?
- Give some examples of smart growth.
- What is a brownfield?

Discussion Questions

- Find out about your town's sewage system and arrange a tour of your local sewage treatment plant. Is it a combined system? Does it produce CSOs when it rains? Is there a CSO abatement plan? How can you help?
- Americans consume an average of 75 gallons of water per person per day. A ***report*** from the John Hopkins School of Heath on world water consumption concludes a person only requires 26 gallons (100 liters) for drinking, bathing, cooking and sanitation. Study your family's water bill. Divide the gallons per day by the number of people in your household to get a figure for the amount of water each person is using. Are there ways for your family to cut down on water use and reduce the amount of sewage you produce?
- Is there an example of urban sprawl in your area? How did it happen?
  Is there an example of "smart growth" near you? What was the initiative behind it? Compare the two.
- Find a brownfield near where you live. Research its history.
  What industry was situated there? What contaminants are in the ground?
  What would it take to clean it up?
  What could the space be used for if it was decontaminated?

Things We Can Do

Getting involved

Often when people read an article or watch a television program about environmental disaster they feel helpless. What difference can one person make? The answer is: more than you think!

Included in the *Swim for the River* DVD and on the Web site is the Directory of Hudson River Environmental Organizations. It lists 50 national, state and local organizations that are working on environmental issues that affect the Hudson River Valley. Use the directory to contact a group in your area. Find out what they are doing and how you can help.

Even without joining an organization there is a lot you can do. Consider the end of the documentary film *Swim for the River*: There's a scene in which people make a symbolic gesture, signifying a pledge of action on behalf of the environment, by pouring a cup of white sand onto a gigantic scale. The scale was inspired by John Cronin, who spent thirty years building legal cases against major polluters. Interviewed in the DVD extra *Tipping Point*, Cronin tells us:

> The language that we've used over the past thirty years about the Hudson River and its problems has been the language of war, "good guys" versus "bad guys."
>
> Now we have to appeal to a higher sensibility … of changing hearts and minds, of slowly coming to that tipping point where public opinion slides so far in one direction, there is no place else to go but in that direction. Because the things that needs correcting are not just the things that are done by bad guys. The things that need correcting, a lot of them, are things done by all of us, every day.

We built the scales on the bank of the Hudson River at Croton Point. Next to the scales we placed a large banner inviting people to participate. It asked people to make a pledge to do at least one thing, one personal action, for the environment. To signify their pledge they put a cupful of white sand on the balance. It was obvious that a single action, a single cupful would not tip the scales. But in just a few hours more than 400 people made their contribution and the scales tipped.

Here is a list of some things people pledged to do that you can do too. Nothing is too small to make a difference.

TWENTY TIPS

Tip the Scales for a Cleaner River and a Greener World

1. **Slow the pace of your life.** Our hurry-up, multi-tasking lifestyles take a toll on our emotions and actions, causing unnecessary stress, thoughtless consumption, speeding cars, and erratic, poorly considered choices. Leave a cushion of time to arrive early at appointments.
2. **Walk, bike or take public transportation** whenever, wherever you can.
3. **If you must drive, increase fuel efficiency** by driving more slowly, maintaining air pressure on your tires, carpooling whenever possible and bundling your errands. Drive the most fuel-efficient vehicle you can. If you're in the new car market, think hybrid.
4. **Be a thoughtful consumer** by posing the following questions for every purchase: Do I need it? Can I afford it? Can I borrow one? How was it made? How will I dispose of it? Reduce impulse buys by delaying purchases whenever possible.
5. **When buying new appliances, select energy-efficient and water-conserving models,** especially ones bearing the EPA's Energy Star label. Wait till you have a full load before running a washing machine or dishwasher. Use large appliances – dishwashers/washers/driers – in the early morning or evening to reduce demands on the energy grid.
6. **Buy used.** If you determine that you need an item, consider buying used. This will save money, packaging, and the materials and energy needed to produce the item new. It will also help keep used items in use and out of the landfill.
7. **Eliminate unnecessary disposables.** Use cloth rags, cloth napkins, cloth towels, ceramic dishes and glass glasses etc. Think reusables – not disposables.
8. **Reuse paper,** such as paper towels, and paper napkins. Keep the back side of office paper handy for printing out e-mails and as scratch paper.
9. **Use green cleaning agents** in your home and office that are environmentally friendly and non-toxic. Consider old standbys like baking soda, vinegar and lemon juice. Avoid putting pesticides on your lawn and garden, to reduce contaminated runoff.
10. **Reconnect with nature** – our precious environment – by spending as much time outdoors as possible. Hike, walk, or prepare a picnic!

11. **Buy locally whenever possible,** especially food. Organic food – if available – is your best choice, as there is no after-trail of fertilizers or pesticides. It tastes better too, and less fossil fuel is needed for its transportation and delivery.
12. **Organize a campaign to clean up litter off a roadside.** Be sure to separate out recyclables like aluminum, glass, cardboard, etc.
13. **Consider living in a smaller space:** the "not-so-big" home. Your heating and cooling costs will decline and, with less space to fill, you're less likely to buy unnecessary things.
14. **Conserve water by employing water-saving techniques** such as taking shorter showers; installing water-conserving showerheads; and using a low-flush toilet. Try not to keep the water running continuously while brushing your teeth, washing dishes, etc.
15. **Conserve energy by disconnecting appliances that are not in use,** such as microwaves, coffeemakers, televisions, etc. Turn off your computer at the end of your work day. Replace incandescent light bulbs with compact fluorescents. Add or subtract clothing rather than adjusting the thermostat.
16. **Reduce your personal waste stream** (the average American throws out 4.5 pounds of waste per day) by composting your organic waste. Don't waste food.
17. **Look for paper products with recycled or post-consumer waste content.** Ask your local paper supplier to sell chlorine-free paper products. They are available, but suppliers need to know there is a demand for them.
18. **Get involved with local government** planning issues to ensure that your community uses its land and natural resources in a sustainable way.
19. **Work with teachers and school officials** to make sure that your child's curriculum includes environmental education.
20. **Share your ideas with others.** Start a simplicity circle, a group of people meeting regularly to share ideas and take steps to simplify their life. For information see *The Circle of Simplicity* by Cecile Andrews, and visit ***www.seedsofsimplicity.org***. Or check out the book *Nothing's Too Small to Make a Difference* by Wanda Urbanska and Frank Levering (Blair, 2004).