



The New
CITY THAT DRINKS THE MOUNTAIN SKY
Arm-of-the-Sea Theater

Study Guide for Educators





Ashokan Reservoir

INTRODUCTION

New York City's water supply system is one of the engineering wonders of the world. Rain and snow drain into reservoirs from watershed streams high in the Catskill Mountains. Aqueducts and water pipes then transport water by gravity to the faucets of one million people in upstate communities and more than eight million people in New York City. This new and updated version of *City that Drinks the Mountain Sky* is a docu-drama created and performed by Arm-of-the-Sea Theater which utilizes the symbolic visual language of mask and puppet theatre to tell this epic story of the New York City water supply system. You will be taken into the very heart of a watershed. You will see how forests are like kidneys, filtering water as it moves towards streams and reservoirs. You will meet the people who built the dams, reservoirs and aqueducts and you will discover how this enormous water project brought profound changes to Catskill communities and New York City.

ABOUT THE THEATER COMPANY & THE SHOW

Arm-of-the-Sea is based in the Hudson Valley town of Saugerties, NY, about ten miles east of the Catskill Mountains. The group has been creating their own style of theater for over thirty-five years. Many of their shows explore how the health of ecosystems and human communities are inter-connected.

This new and updated version of *City that Drinks the Mountain Sky* is a sequel to an earlier Arm-of-the-Sea production about water for NYC. It is performed by three puppeteers and one musician. The musician also acts as narrator and speaks all the character voices. The play begins by asking:

“Where does your water come from?

What does it take to keep it clean and safe to drink?

That most essential liquid,

Liquid of Life.

Liquid of Life.”

YOUR CURRICULUM, LESSONS AND RESOURCES

This new and updated version of **City that Drinks the Mountain Sky** will provide your students with a unique experience in the performing arts. They will also have an opportunity to observe our natural and social history unfold throughout the play's 50 minutes. This study guide can help prepare your class for the experience of live theater as well as the multi-disciplinary themes and storyline that takes us from the present-day to the historic building of the New York City water supply system and back again to current watershed protection activities.

Before you see the performance, review the attached map, *New York City's Water Story: From Mountain Top to Tap*, other New York State and water supply maps, Google Earth, or Google Maps with your students to become familiar with the region. Go to nyc.gov/dep for maps and photographs of the New York City Water Supply System and additional background information. You can use these archival and present-day photographs to provide a visual perspective of watersheds, reservoirs, tunnels, people, and other aspects of the New York City Water Supply System.



COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY IN HISTORY/SOCIAL STUDIES, SCIENCE, AND TECHNICAL SUBJECTS

The following are some examples of standards for grades 4-12 as they relate to viewing a performance of the new and updated version of **City that Drinks the Mountain Sky**. There are many relevant performance expectations for pre- and post- activities and lessons.

- Explain major differences between poems, drama, and prose, and refer to the structural elements of poems (e.g., verse, rhythm, meter) and drama (e.g., casts of characters, settings, descriptions, dialogue, stage directions) when writing or speaking about a text.
- Compare and contrast the point of view from which different stories are narrated, including the difference between first- and third-person narrations.
- Develop personal, cultural, textual, and thematic connections within and across genres as they respond to texts through written, digital, and oral presentations, employing a variety of media and genres.
- Recognize, interpret and make connections in narratives, poetry, and drama, to other texts, ideas, cultural perspectives, personal events and situations.
- Explain how a series of chapters, scenes, or stanzas fits together to provide the overall structure of a particular story, drama, or poem.
- Describe how a narrator's or speaker's point of view influences how events are described. a. Recognize and describe how an author's background and culture affect his or her perspective.
- Use knowledge of language and its conventions when writing, speaking, reading, or listening.
- Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words
- Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

It may help your students to understand the following terms used by the characters in the performance:

- **Aqueduct** – a large pipe or tunnel designed to move water from a distant source, usually by gravity.
- **Atmosphere** - the layers of gases that surround the Earth.
- **Cannonsville Reservoir** – the last reservoir (able to hold 95.7 billion gallons of water) constructed by New York City in the Catskill Mountain region.
- **Carbon dioxide** - one of the most important gases, consisting of one part carbon and two parts oxygen, on the earth because plants use it to produce carbohydrates in photosynthesis.
- **Catskill Mountains** – Formed millions of years ago by continental drift and melting glaciers, the Catskill Mountains contain the Catskill and Delaware watersheds and its six reservoirs.
- **Climate change** - changes in global and regional climate patterns caused largely by increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
- **Compost** – a mixture of largely decomposing organic matter used for improving soil conditions
- **Cow pie/Manure** - cow excrement, high in fiber, which dries out in the sun and crumbles into good fertilizer.
- **Dam** – barrier used to stop flowing water to create a reservoir.
- **Drought** – a shortage of water normally caused by unusually low amounts of rainfall.
- **Esopus Creek** – located in the Catskill Mountains, the 26-mile Esopus Creek provides rich and abundant habitats as it flows into the Ashokan Reservoir.



Catskill Aqueduct Construction 1908-1920

- **Global warming** - a gradual increase in the overall temperature of the Earth, mainly caused by increased levels of carbon dioxide and other pollutants in the atmosphere.
- **Infrastructure** - the basic physical structures that provide services essential to running a city.
- **Microorganism** – an extremely small living thing that can only be seen with a microscope.
- **New York City Department of Environmental Protection (DEP)** – government agency responsible for managing the NYC water supply, providing more than one billion gallons of water to almost 9 million people each day; also responsible for the wastewater treatment system which handles about 1.3 billion gallons of used water every day.
- **Reservoir** – a body of water created by damming a river or stream.
- **Septic systems** - underground wastewater treatment structures, commonly used in rural areas without municipal sewer systems that use a combination of nature and technology to treat wastewater from household plumbing.
- **Sewage treatment plants** –also called wastewater treatment plants, commonly used in populated areas like villages and cities, are complete systems that treat used water from our homes, schools and businesses and runoff that enters the sewers from rain and snow so it is not harmful to the environment.
- **Storm surge** – an abnormal rise of water on a coast or riverfront generated by a storm.
- **Surveying** – to collect data for analysis.
- **Ultraviolet light** – a type of light with shorter wavelengths than visible light, and therefore invisible to the human eye, used to remove microorganisms from water and wastewater.
- **Water towers** – a large elevated storage tank of water.
- **Water filtration** – the physical, biologic, and chemical processes that remove unwanted matter from water.
- **Water-borne diseases** – conditions, such as dysentery, caused by microorganisms carried in water.
- **Watershed** – an area of land that drains into a common body of water.
- **Watershed regulations** – policies, laws, and regulations to protect a specific watershed.

You may want to introduce your students to the following characters who appear in the play.

- **Claire Abacus** – a professional engineer for the New York City Department of Environmental Protection.
- **Ms. Bonaventure** – classroom teacher from P.S. 220 who inspired Claire Abacus to become an engineer.
- **Cora, Jacob, Marcus, Martha, Matilda, and Silas** – settlers of the Catskill Mountain whose lives were impacted by the building of the New York City water supply system
- **John J. Delany** – New York City Water Commissioner when the Catskill reservoirs were developed.
- **Julia, Marco, Rakella, and Thomas** – students in Ms. Bonaventure’s class studying the New York City Water Supply System.
- **Sam Shelby** – a watershed police officer for the New York City Department of Environmental Protection.
- **J. Waldo Smith** – Chief Engineer for the Board of Water Supply who devised and implemented plans to capture Catskill Mountain water.
- **Abraham Wolburn** – a sixth-generation Catskill Mountain farmer.

RESEARCH TOPICS AND LESSONS

1. Learn how to read a topographic map. Locate your school on the map. What watershed do you live in? Is it part of a larger watershed? Discuss how you and your classmates can be watershed stewards. What does this mean? A watershed is an area of land that drains into a common body of water. As an example, cup the palm of your hand and imagine the tips of your fingers are the Catskill Mountains. Mountain streams would form in the grooves between your fingers, their waters would join a larger river in the “valley” of your palm. This river would flow toward the sea. If you spray water on your fingertips, you will observe this mini watershed in motion.
2. Observe what happens when it rains on a watershed by creating your own using easily available supplies for fun small group and full class activities.
3. When you turn on your faucet, where does the water come from? Where does it go when it goes down the drain? Make a picture of the pathways that your water takes through the land.
4. Find out about non-point source pollution. How can non-point source pollution be reduced and what effect will it have on water quality in your watershed?
5. Research how forests are important in maintaining water quality within a watershed.
6. Create individual drawings of the water system and connect to create a large mural.
7. Research the people who helped to create the present day water supply system. Who are they? What was their role? How do they compare to the people who today are building, protecting and maintaining the water supply system.
8. Research news articles to learn about present day water supply issues in the New York City watersheds and on a national and international level.

ADDITIONAL IMPORTANT EDUCATION RESOURCES

- Cole, Joanna. **Magic School Bus at the Waterworks: Special NYC Edition.** Scholastic, New York (available exclusively from NYC Department of Environmental Protection).
- Evars, Alf. **Catskill Mountain Bluestone.** New York: Purple Mountain Press, 2008.
- Galusha, Diane. **Liquid Assets: A History of New York City’s Water System.** New York: Purple Mountain Press, 2016.
- Koepfel, Gerard T. **Water for Gotham: A History.** Princeton, New Jersey: Princeton University Press, 2000.
- Guillain, Charlotte. **The Street Beneath My Feet.** California: The Quarto Group, 2017.
- Locker, Thomas. **Where the River Begins.** New York: Penguin Group, 1984.
- Macaulay, David. **Underground.** New York: Houghton Mifflin Company, 1976.
- Manzano, Sonia. **The Lowdown on the High Bridge.** New York: Bronx Children’s Museum, 2015.
- Outwater, Alice. **Water: A Natural History.** New York: Basic Books, 1996.
- Sanderson, W. Eric. **Mannahatta: A Natural History of New York City.** New York: Harry N. Abrams, 2009.
- Sayre, April Pulley. **Trout are Made of Trees.** Massachusetts: Charlesbridge, 20006.
- Steuding, Bob. **The Last of the Handmade Dams: The Story of the Ashokan Reservoir.** New York: Purple Mountain Press, 1989.



- Yu, Da-jeong. **The Flow of Water**. Minnesota: Big & Small, 2015.
- Catskill Center for Conservation and Development (www.catskillcenter.org) - **The Catskills: A Sense of Place**. New York: 2002.
- Catskill Watershed Corporation (www.cwconline.org) - Provides funding for education programs and projects west of the Hudson Watershed and New York City.
- New York City Department of Environmental Protection (www.nyc.gov/dep and educationoffice@dep.nyc.gov) - Provides educational materials, field trip opportunities, staff development workshops and speakers to school and community groups.
- NYC-Watershed Educators Network (www.watershededucators.org) – Website with links to and information on classroom programs, field trips, funding opportunities and more provided by educational organizations in the New York City Watersheds and New York City.
- Trout in the Classroom (www.troutintheclassroom.org) – Join hundreds of schools throughout New York City and the watersheds raising trout from eggs to fingerlings in classroom tanks. Multi-disciplinary, STEM and humanities lessons, easily align with this 10-month hands-on program for pre-K through 12th grade students.
- Watershed Agricultural Council (www.nycwatershed.org) – Provides funding for interpretive bus trips for New York City and watershed students throughout the East and West of Hudson Watersheds; also coordinates the popular Green Connections and Watershed Forestry Institute for Teachers.
- **ARM-OF-THE-SEA THEATER** (www.armofthesea.org, P. O. Box 175, Malden-on-Hudson, NY 12453 (845) 246-7873, liveart@armofthesea.org) - Write and tell us what you liked -- and did not like --about the show.

Production of this show has been made possible through grants from the Catskill Watershed Corporation in partnership with the New York City Department of Environmental Protection and from the National Environmental Education and Training Foundation. Public performances in New York are made possible, in part, through public funds from the NY State Council on the Arts.

CITY THAT DRINKS THE MOUNTAIN SKY

Essential Questions for Pre - & Post - Performance

The New York City Department of Education's Office of Arts & Special Projects (OASP) supports student access to high-quality arts education. The *Blueprints for Teaching and Learning in the Arts, PreK-12* guide states that an arts education teaches important life skills, such as creativity, cooperation, discipline, and analysis. Students are able to grow creatively and intellectually by having positive outlets for arts learning and self-expression. The OASP created the following essential questions for students experiencing live theater performances. We are happy to share them with you in preparation for your viewing of **City that Drinks the Mountain Sky**.

BEFORE SEEING A THEATER PRODUCTION

- What do I know about the play, musical, or theatrical event? What do I know about this particular production of this piece if this is not a new work?
- What do others say about this production and what do I want to know before seeing it? What theater reviews, word of mouth, and publicity items give me more information?

BEFORE ENTERING THE THEATER

- How, if at all, does the exterior of the theater capture my attention?
- How does this theater exterior compare to other theaters I have seen or are nearby?
- Who else seems to be attending the show? What is the make-up of the other audience members (for example, age, gender, ethnicity, and race)?

AS I ENTER THE THEATER

- What is the energy of the theater space compared to the street I just left?
- What senses seem to be most activated for me? (Touch, sight, sound, smell?)
- How do I navigate the building to find my seats? Who helped me? Are my seats easy to find?



ONCE IN THE THEATER

- What strikes me about the design of the theater? The lighting? Looking up— what do I see? Looking at the frame of the stage (proscenium), does anything catch my eye?
- What do I notice about the “house” or audience seating. Are there accommodations for those who need assistance with stairs? Special seating for wheelchairs, etc.?
- What do I notice about the set design or curtain when looking at the stage? What might I understand about the production before it even starts?

OBSERVATIONS ABOUT THE PRODUCTION

- What captures my attention during the play? Is it the actors? The set? Music? Why?
- Does the plot engage me? Do I care about the characters? Why?
- What do I think about the performances? Are they believable? If not, why not?
- How do the actors seem to interact with one another? With the set and the world of the play?
- How does the director, actors and designers (costume, lights and set) stage the action to focus the drama for me? (Theater artists work to tell dramatic stories in varied and very specific ways.)
- How might I describe this work to a visually impaired person? What might a deaf or hard of hearing person understand about the play if not able to hear it traditionally?
- What questions do I have about this production? What is the meaning of the play? (This may not as easy as it seems!)
- How did it feel when the lights came up and I was brought back to the reality that I was in a theater and it is now time to leave?
- Who else in the theater audience with me?
- I took note of who entered the theater with me. Now who captures my attention before the play begins, during the production and at intermission? Why?
- How do people interact with the production? Do they seem to laugh when I laugh? Gasp when concerned about the action? Applaud? When? Why?
- What is the interaction, if any, among the cast members and the audience?

My Typical Day Water Use Calculator



Activity: Record and calculate how much water you use approximately, in one day.

Flushing the toilet

Many toilets use 5 gallons each flush. Water-saving, high efficiency toilets use 1.28 gallons each flush.

How many times do you usually flush the toilet in a day?

X

How much water does your toilet use for each flush?

gallons

=

Total gallons

Brushing your teeth

Brushing your teeth with the water running uses about 4 gallons. Turning the water off when you're not rinsing uses less than a quarter or .25 gallons.

How many times do you usually brush your teeth in a day?

X

How much water do you use each time you brush your teeth?

gallons

=

Total gallons

Washing your hands

Washing your hands or face with the water running uses about 4 gallons. Turning the water off saves 3 gallons, using only 1 gallon each time you wash up.

How many times do you wash your hands in a day?

X

How much water do you use each time you wash your hands?

gallons

=

Total gallons

Washing dishes

Washing dishes with the water running uses about 4 gallons a minute. Filling the sink or washing dishes without water running uses only 5 gallons.

How many minutes do you usually spend washing dishes in a day?

X

How much water do you use each time you wash dishes?

gallons

=

Total gallons

Taking a shower

A non-water-saving showerhead uses 5 gallons a minute. Water conserving showerheads use 2 gallons each minute.

How many minutes do you usually spend in the shower?

X

How much water does your showerhead use each minute?

gallons

=

Total gallons

+

Total gallons

Approximate total daily water use

Add up each section to calculate your total water usage for a typical day.

Answer these questions based on your daily water use calculations.

Can you think of any other ways you use water that were not included here?

Which of your daily activities uses the most water?

Were you surprised by your results?

What are some ways you can reduce your water consumption?

Is your average daily water use total higher or lower than the New York City average of 75 gallons a day?

New York City Water Cycle Rain Dance

Description:

Use this introductory activity to help your students learn about the New York City water cycle and watersheds. This interactive lesson can take place in your classroom, an auditorium or outdoors. You will want to encourage your students to close their eyes and use their imagination.

Objectives:

- To creatively help teachers and students experience the water cycle.
- To actively engage students and teachers in learning about the source of the New York City water supply.

Recommended for:

Kindergarten – 12th grade students

Method:

- Pose the question: “Where do you think your drinking water comes from?”
- Introduce the activity: As a group we are going to create a rainstorm. You will need to use your imagination.
- As some of you already know, the water that we drink comes from the sky as rain and snow. It falls far away, more than 100 miles from New York City, on the Catskill Mountains.
- Water flows downhill, moving by gravity through streams, into one of 19 reservoirs.
- Every day, one billion gallons of water is transported through aqueducts, water tunnels, and water pipes to our faucets, toilets, washing machines, and so many other plumbing fixtures.

- Then, when you flush, or brush, the used water travels through more pipes to wastewater treatment plants where it gets cleaned and released back into the NYC water cycle.
- To further celebrate your learning of, and appreciation for, NY’s precious water, we are going to create a rainstorm, right here in this room. You do not need to have an umbrella. I would like you to simply use your imagination to create rain, the source of our drinking water.
- We’re going to need each and every one of you to participate so let’s all stand up!
- To simulate or “make” this rainstorm, we are going to make 5 sounds.
- Let’s practice them first:
 1. rub hands
 2. snap
 3. 2-finger clap
 4. clap
 5. slap thighs & stomp
- Now we are ready to simulate the rainstorm so we can feel and understand what happens when it rains on the land that helps to collect our water.
- We begin by rubbing our hands for the wind.

Rub Hands: Imagine you are 100 miles away, west of the mighty Hudson River, high up in the Catskill Mountains.

- You can feel the mountain breeze flow through your hair; you can see the leaves on the trees covering the mountains starting to blow; the dairy cows from the local farms are grazing in the fields; the farmer who has just planted cauliflower seeds is finishing her chores.
- Take a deep breath with me, inhale and exhale. You can smell the forest, the air is fresh here, and it feels so good. There is even a slight smell of rain.
- Darkening clouds are rolling over the mountains in the distance.

Snap: It begins to rain lightly.

- Birds, deer, foxes, bears and other wild animals are running for cover.
- Our watershed friends are coming in from the playground; cows are herded into the barns and the farmer is washing the soil from her hands before she heads indoors.
- As the water falls lightly to the ground, it gets absorbed through the soil; tree roots also absorb the water – helping the forests stay healthy – holding the soil in place so it does not wash into streams; puddles form and streams are filling with the clean water.

2-Finger Clap: The streams fill as they flow quickly downhill into larger streams.

- Underwater, the trout are content; there is more oxygen in the water for them to breathe; the farmers are happy too; rain falls on fields where apples, corn, peaches, and other crops grow; it gets absorbed by the rich soil and nourishes the emerging seedlings.

Clap: the streams swell as the rain continues to fall.

- Trout are feeding on the insects while the eagles seek a dry place to rest; children are indoors keeping warm and dry too; streams are flowing down the mountains, into the valleys where they meander into reservoirs, brimming with water.

Slap Thighs/Stomp: Reservoirs are filling up!

Clap: Finally, the sky and rain begin to lighten

- Eager fishermen and women venture out onto the reservoirs; water continues flowing rapidly in streams and underground through the soil; an eagle leaves its perch in the tree near to the reservoir, searching for trout to eat.

2-Finger Clap: Water flows through the NYC water supply system.

- One billion gallons of water is moving -- by gravity -- from the Catskill Mountains to New York City through the Catskill and Delaware Aqueducts.
- Clean, delicious, healthy water is flowing from aqueducts into New York City's three large water tunnels.

Snap: Water is flowing under our streets in pipes leading to our homes, schools, and businesses.

Rub Hands: The sun is peeking out from behind the clouds.

- The sun shines; deer, foxes, and bears are coming back to watershed rivers to drink.
- Heat from the sun is causing water to evaporate and the cycle of water continues, *just as it always has.*
- Right now, someone is turning the tap, filling a glass and enjoying a delicious and healthy drink of NYC tap water.
- And, in the watershed, a rainbow emerges from the brightening sky, still full of moisture from the recent rain, reminding us of the never ending cycle of water.
- What a great rainstorm!

For more information contact:

New York City Department of Environmental
Protection

educationoffice@dep.nyc.gov

Also visit DEP's website at:

www.nyc.gov/dep

What is a Watershed? (Small Group Activity)

Description:

Working in small groups, students create a working model of a watershed to view its different parts, to understand how rainfall travels and collects, and to recognize human and natural impacts on this living, working, natural landscape.

Objectives:

- To introduce students and teachers to the concept of watersheds
- To understand how natural and human forces influence watersheds and water quality
- To engage students and teachers in learning about the source of New York City’s drinking water and our relationship to watersheds

Vocabulary:

Absorption, bedrock, cohesion, gravity, molecules, pollutants, precipitation, reservoirs, vapor, valley, watershed, water pressure, weathering

Recommended for:

4th – 12th grade students

Materials:

For each group of 4-6 participants:

- A plastic or metal tray (at least 4" deep)
- A spray bottle filled with water
- Six sheets of newspaper
- One large sheet of plastic
- Two paper towels
- Food coloring (optional)
- [New York City water supply map](#) (optional)

Method:

- Introduce the activity by explaining that students will create a landscape in their tray that looks very much like the area that collects New York City’s drinking water.
- Show students the water supply map and discuss landforms, geography, scale, water bodies, water cycle, etc.
- Ask students to work cooperatively within their groups and to discuss their observations.

Part I

- Instruct participants to create a mountainous landscape in the basin using pieces of newspaper. Mold the newspaper into mountains and place them in the tray.
- Give each group a piece of plastic to cover the newspaper. Make sure that it is molded to the contours and tuck ends inside the box.
- Using the fine mist from the spray bottle, explain to students that they are to rain on the landscape. Pay careful attention to what the water drops are doing: “How are they moving?” [*Downhill*] “Are they collecting?” [*Forming puddles and/or streams*] “What might the puddles represent?” [*Lakes and reservoirs*] “Did these lakes form simply by spraying directly over them?” [*They formed by streams feeding them with water*] After the landscapes have been sprayed, discuss these questions. Ask someone from each group to speak to the class about the observations their group made.
- Discuss what physical feature of the watershed the plastic wrap represents. Encourage students to explore how the water moved over the plastic. What in nature might this represent? [*The bedrock of the mountains and the rocky surface*]

Part II

- Hand out paper towels to each group. Mold to the landscape.
- Rain and observe how water moves through the landscape.
- Pose questions: “Is the water flowing in the same manner as when it rains on the plastic, or rocky surface?” [*It spreads out, does not move as quickly, still it flows downhill*] “What does the paper towel represent?” [*soil and vegetation*] “Why?”
- Discuss the role vegetation plays in the natural landscape. Trees and grasses for example help to regulate the flow of water and help to prevent flooding and erosion.

Part III (Optional)

- Add a few drops of food coloring to each landscape and rain again. Pretend the color represents a chemical (or other form of pollution) that accidentally seeped into the soil.
- What observations can you make? How does rain affect the movement of pollutants? [*It is mixed with the water and pollutes the reservoirs; it soaks into the soil*]

- “What does this mean to our water supply?” [*It is very important to protect our water supply and our watershed from pollutants, and to ensure clean water*]

Discussion:

- You have just created a watershed. Can you describe it? Why is watershed protection important to New York City?
- Can you now describe how our drinking water is collected in the watershed? Share this important information with your family and friends.
- What happens when there is not enough precipitation in the watershed? What do you do to conserve water at home and school?
- Why is watershed protection important to New York City? How do you think the natural landscape helps to maintain water quality? How else can we make sure our water is clean?
- Have your students create a “rainstorm” inside their classroom. This [activity](#) will demonstrate the cycle of water, from watershed to New York City tap.

For more information contact:

New York City Department of Environmental Protection

educationoffice@dep.nyc.gov

Also visit DEP’s website at:

www.nyc.gov/dep

What is a Watershed? (Class Activity)

Description:

In this class activity, students create a working model of a watershed to view its different parts, to understand how rainfall travels and collects, and to recognize human and natural impacts on this living, working, natural landscape.

Objectives:

- To introduce students and teachers to the concept of watersheds
- To understand how natural and human forces influence watersheds and water quality
- To engage students and teachers in learning about the source of New York City’s drinking water and our relationship to watersheds

Vocabulary:

Absorption, bedrock, cohesion, gravity, molecules, pollutants, precipitation, reservoirs, valleys, vapor, watershed, water pressure, weathering

Recommended for:

4th – 12th grade students

Materials:

- Backpacks, coats, (anything lumpy)
- Large tarp or sheet
- Large white beads (rain)
- Large red beads (pollution)
- Blue paper (reservoirs)
- Green paper or leaves (vegetation)
- Straws (aqueducts)
- Blue ribbon/ shoelaces (rivers and streams)
- Labels/pictures representing watershed
- [NYC water supply system map](#)

Method:

- Introduce the activity by explaining that students will create a landscape that will look very much like the area that collects New York City’s drinking water.
- Show students the water supply map or a map of NY State to explore landforms, water bodies, scale, communities, etc.
- Ask students to share their observations.

Part I

- Instruct participants to put their backpacks and other items in a pile.
- Cover with large tarp or sheet. Ask students: *What kind of landscape do you think this represents? Do we have mountains in our water supply system? Can you name them? How would you guess these mountains are important to our water supply system? What do you observe?*
- Have a few students add green construction paper/ leaves to their mountain range. Ask students: *What do you think this represents? How does vegetation impact water quality and our water supply system?* Discuss the role vegetation plays in the natural landscape. Trees and grasses, for example, help to regulate the flow of water and help to prevent flooding and erosion.
- Add other objects or labels to represent the different watershed features, representing this living, working, natural landscape.
- Using the beads, “rain” on the landscape. Pay careful attention to what the “water drops” are doing. Ask students: *How are they moving?* [Downhill] *Are they collecting? What might the collections of beads represent?* [lakes and reservoirs] *Did these collections of beads form simply by dropping beads directly over these areas?* [They formed where there were valleys in our mountain range].

- After the beads have been added to the landscape, ask someone to share their observations and label where they think the reservoirs are located with the blue paper or reservoir labels.
- Ask another student to label where the rivers and streams are located using the ribbon or shoelaces. *How did you know where to place the blue ribbons/ shoelaces?*
- Ask students how they imagine water travelling the more than 100 miles from the mountains to their schools.
- Lastly, ask a student to add straws to represent aqueducts. *What is an aqueduct? Where does it come from and where does it go? *Make sure that the aqueducts eventually meet*. Why do they have to eventually meet?*

Part II (Optional)

- Add some red beads to the landscape.
- Pretend these beads represent a chemical that was accidentally poured into the soil.
- What observations can you make? How does the pollution mix with the clean water (white beads)?
- What does this mean to our water supply? *[It is very important to protect our water supply and our watershed from pollution]*

Discussion:

- You have just created a watershed. Can you describe it?
- Can you now describe how our drinking water is collected in the watershed? Share this important information with your family and friends.
- What happens when there is not enough precipitation in the watershed? What do you do to conserve water at home and school?
- Why is watershed protection important to New York City? How do you think the natural landscape helps to maintain water quality? How else can we make sure our water is clean?
- Show the New York City water supply map and discuss features similar to those created in your watershed.
- Have your students create a “rainstorm” inside their classroom. This [activity](#) will demonstrate the cycle of water, from watershed to New York City tap.

For more information contact:

New York City Department of Environmental Protection

educationoffice@dep.nyc.gov

Also visit DEP’s website at:

www.nyc.gov/dep

New York City's Water Story: From Mountain Top to Tap

The water we use today is the same water that fell as rain when dinosaurs roamed the earth. In its endless cycle, water is the only substance that naturally exists as a solid, liquid or gas.



Water's journey from mountain top to tap begins when rain and snow fall on watersheds, the areas of land that catch, absorb, and carry water downhill to gently and swiftly flowing streams.



Streams provide life-cycle needs for fish and other aquatic organisms. Oxygen is trapped in the fresh water as it tumbles over rocks into deep pools. Overhanging tree branches keep water cool as fresh water continues its journey.



Water is naturally filtered by the soil and tree roots in dense forests as it travels toward reservoirs. The sun's heat energy releases some water molecules back into the atmosphere as gas, continuing the hydrologic cycle.



Thousands of skilled workers constructed dams and reservoirs to store large amounts of clean water and aqueducts to carry it great distances by gravity from watersheds to New York City.



The 4.1-mile Old Croton Aqueduct was the first to deliver a clean and plentiful supply of water to New York City. The High Bridge, completed in 1848 and hailed as an engineering masterpiece, carried the aqueduct across the Harlem River on large stone arches.



Water flowed through the Croton Aqueduct, filling reservoirs where the Great Lawn in Central Park and the New York Public Library on Fifth Avenue now stand. New Yorkers rejoiced in 1862 when another reservoir was built in Central Park to support the needs of a growing city.



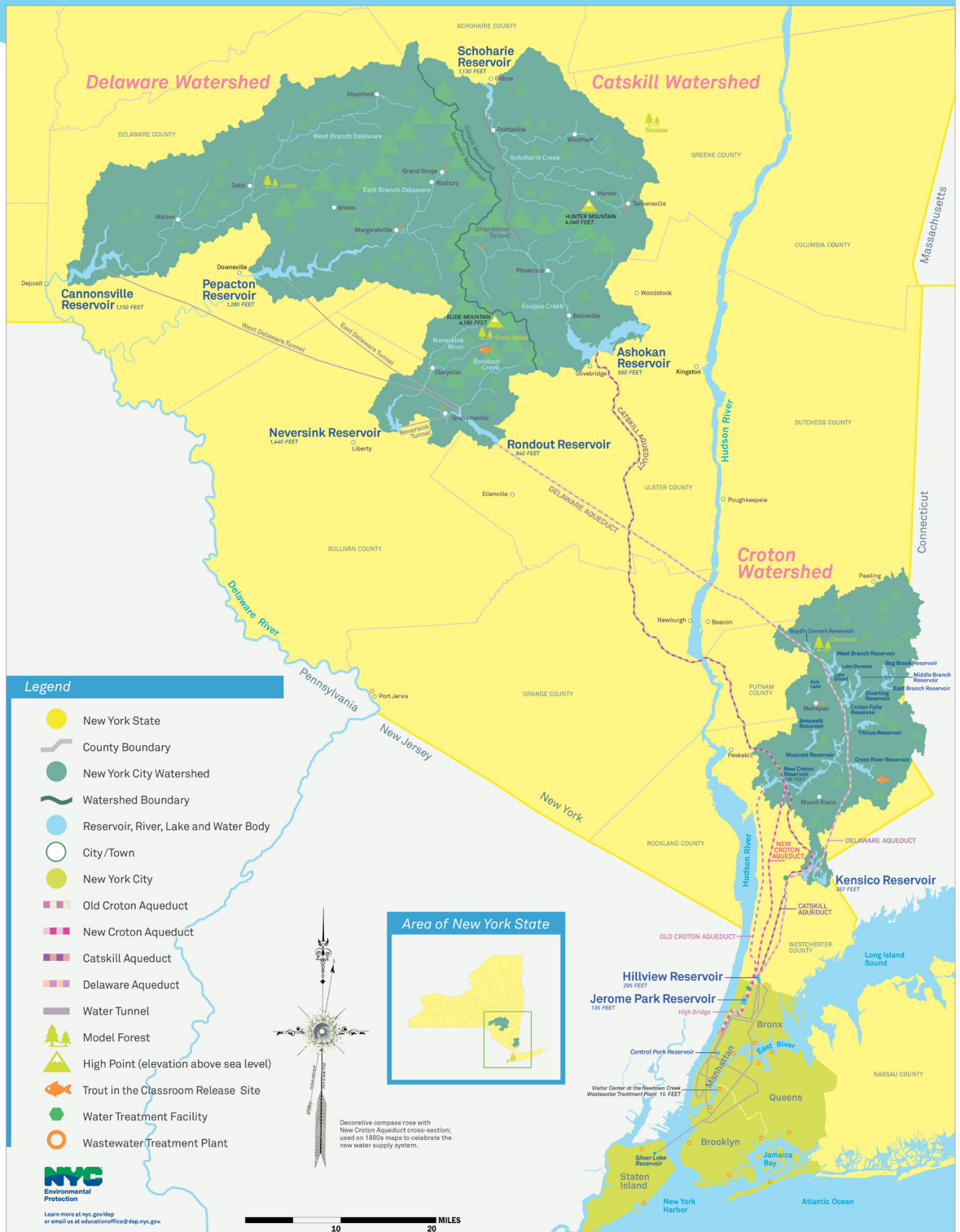
Today, thousands of miles of tunnels and pipes deliver one billion gallons of water each day from the Croton, Catskill, and Delaware watersheds to more than 9 million people. How do you use water? How much water do you think you use?



After water is used for cooking, bathing, and other activities, it travels down the drain and through sewer pipes to 14 wastewater treatment plants where it is cleaned and returned safely to the waterways surrounding New York City.



Water is all around us. We experience it in many different ways using all of our senses. As water cycles through its endless journey, we appreciate that it will continue to nourish us and all living things.



Note: A teacher guide to accompany this map is available for download at nyc.gov/dep/education

For additional education resources, please email educationoffice@dep.nyc.gov and visit:

www.nyc.gov/dep/education

www.watershededucators.org

