Teaching the Environment: Activity Guide

A compilation of lessons to support teachers and educators in incorporating the environment, particularly the Hudson River and surrounding watersheds, into their practice.

SARAH LAWRENCE COLLEGE
CENTER FOR THE URBAN RIVER AT BECZAK

SARAH LAWRENCE COLLEGE
CHILD DEVELOPMENT INSTITUTE

NEW YORK STATE
Department of Environmental Conservation

Hudson River Estuary Program

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Teaching the Environment Activity Guide and Teacher Professional Programming Developed By:

Sarah Lawrence College Center for the Urban River
Christina Edsall
Kathalene Lamboy
Jason Muller
Ryan Palmer
Kinza Siddiqui

Sarah Lawrence College Child Development Institute
Kim Ferguson
Rachel Ford
Patricia Hanley

NYS Department of Environmental Conservation
Chris Bowser
Rebecca Houser

Special thanks to the contributions of collaborating organizations
Jessica Alba, Grace Romer, and Tyler Van Fleet - Watershed Agricultural Council
Elisa Caref - Billion Oyster Project
Joel Rodriguez and Jason Bonet - Groundwork Hudson Valley
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Mary Leou and Tania Goicoechea - NYU Wallerstein Collaborative for Environmental Education
Native Land Digital

Visit Sarah Lawrence College Center for the Urban River (CURB) at:
https://www.centerfortheurbanriver.org/

ABOUT THE SARAH LAWRENCE COLLEGE CENTER FOR THE URBAN RIVER AT BECZAK

Launched June 2013, the Center for the Urban River at Beczak (CURB) is an alliance of Sarah Lawrence College and the Beczak Environmental Education Center. The mission of CURB is to advance environmental knowledge and stewardship by providing high quality K-12 environmental education for the local community, establishing a regional hub for research and monitoring focused on Hudson River estuary and urban watershed issues, and serving as a welcoming open community space for a variety of civic and cultural activities.

The first academic research facility in Yonkers beyond the College's campus, the Center is located on the banks of the Hudson River at Habirshaw Park, and features a welcoming riverfront lawn, an easily accessible tidal marsh, a beach used for river exploration and seining, and a newly redesigned and outfitted field station lab.

CURB carries on the mission of the Beczak Environmental Education Center, a well-loved river exploration and interpretative center that has been offering programs for adults and children for over twenty years. Its name honors Joe Beczak, one of the Hudson River enthusiasts who taught children about the Hudson in the 1970s.

ABOUT THE SARAH LAWRENCE COLLEGE CHILD DEVELOPMENT INSTITUTE

The Child Development Institute, part of the Children, Childhood and Education Collaborative, was established in 1987 to develop programs for early childhood and elementary school teachers, administrators, child development professionals, parents and the community at large.

Through its work, the Child Development Institute provides a progressive perspective on child development and education. In this perspective, the child is viewed as an individual in the social context, actively engaged in constructing knowledge through interactions with other people and the physical environment. We believe that the child's educational experience should encompass social, emotional, and imaginative aspects of life in concert with intellectual development. Further, we are concerned that schools and other institutions be developed as communities that attend to the interests and needs of children from diverse backgrounds.

The activities of the Child Development Institute, while developed primarily as outreach programs, are part of Sarah Lawrence's Children, Childhood and Education Collaborative and as such, enhance the educational experience of undergraduate and graduate students on campus.

ACTIVITY GUIDE INTRODUCTION

Teaching the Environment is a program between the Sarah Lawrence College Child Development Institute and the Center for the Urban River at Beczak. It is a professional development program for educators working with children of all ages. During this weeklong professional development opportunity, participants collaborate in experiential workshops, engage in dialogue with experts, and connect with others who share their interests and challenges.

The Teaching the Environment: Activity Guide is a compilation of lesson plans and resources to support teachers and educators in incorporating the environment, particularly the Hudson River and surrounding watersheds, into their practice. The suggested grades for each activity are listed on the next page, however, many teachers in our workshops have been able to modify content for the grades they teach.

The Activity Guide includes lessons from various organizations, therefore representing the uniqueness of each organization's contributions.

The lessons contributed from CURB include objectives for English Language Learners based on writing, reading, listening or speaking skills. The lessons from CURB also include suggestions for engagement, representation and expression, based on the Universal Design Framework. These additions are solely ideas of how to support learners, and are not exhaustive of all individual learning needs.

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SARAH LAWRENCE COLLEGE
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Estuary Model and Watersheds

45 MINUTES, GRADES 2–12

ENGAGE

Let's look at this map/model together:

> What are we looking at? Is this the whole Hudson River? (no). This is the lower 35 miles of the Hudson River Estuary and its watershed. What is an **estuary**? What is a **watershed**?

EXPLORE/EXPLAIN

To introduce the Hudson River Estuary, if classes can't visit CURB, teachers can use the videos at this website: Hudson River Estuary Model Videos to showcase the model. Each of the three videos is between five and seven minute long and cover the following topics: estuarine literacy, local geography, brackish water, tides, storm surge, human impacts/pollution, and restoration.

ELABORATE/EVALUATE

Students can work on the worksheet questions and lab activities for each video.

Worksheets: Student Version
Teacher Version (with answers)

EXTENSION

Have students create their own watersheds using only paper, markers (non-permanent), and water! See the "Crumbled Paper Watersheds" lesson in this guide!

CLASSROOM MODIFICATION TIPS

This lesson can be done fully in the classroom, assigned as homework, or some mix of the two. There is a longer set of activities, linked below, that may need more time and/or an individual internet connection for each student.

Longer activities: Activities for model videos

VOCABULARY

Brackish Water: A mixture of fresh and saltwater that can be found in an estuary.

Bridge: A structure carrying a road or path across an obstacle such as a river.

Current: A body of water moving in a definite direction.

Estuary: Where a freshwater system meets a saltwater system.

Flooding: The covering or submerging of normally dry land with a large amount of water.

Freshwater: Water where salt content is nearly 0 ppt.

Geography: The study of physical features of the earth and its atmosphere.

Island: A piece of land surrounded by water on all sides.

Marshland: Land consisting of marshes (an area of low-lying land which is flooded in wet seasons or at high tide).

Peninsula: A piece of land surrounded by water on three sides.

Pollution: The presence or introduction into the environment of a substance or thing that is harmful or has poisonous effects.

Precipitation: Rain, snow, or hail fall to the ground from the clouds.

Runoff: The draining away of water from land into waterways; sometimes collection pollutants along the way.

Saltwater: Water found in oceans that has a salt content higher than 34 parts per thousand (ppt).

State Line: The boundary between two states.

Tide: The gravitational influence of the moon causing a rising and falling effect on water.

Tributary: A river or stream flowing into a larger river or lake.

Water Cycle: The cycle of processes by which water circulates between the earth's oceans, atmospheres and land.

Watershed: An area of land that drains flowing waters into a common outlet.

STANDARDS

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural system.

UNIVERSAL DESIGN LEARNING IDEAS

Engagement

Ask students to reflect on any experiences they had with the Hudson River. (Where were you, what were you doing, who were you with, etc..) Encourage students to provide details regarding the physical landscape when they share their experiences.

Expression

At the end of the activity, have students draw a picture of the Hudson River at CURB, at both high tide and low tide. Encourage students to depict the key differences of the two tides within their images and have them explain how the contrasting tides can affect their experiences.

Representation

Choose a few of the vocabulary words from the list above and provide images/videos that help further define the terms.

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to verbally identify 1-2 key geographic features on the map.

Students will comprehend the movement of water up and down the river by the movement of tides. Assessments for comprehension can be done by drawings, body movements, or gestures.

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Biodiversity of the River: Seining

90 MINUTES TO 2 HOURS, ALL AGES

STANDARDS

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Scale, proportion and quantity Cause and effect	Using mathematics and computational thinking	LS2 Ecosystems: interactions, energy and dynamics ESS2 Earth's Systems

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scale.

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

ENGAGE

The Hudson River is a home for different species and creates a vast ecosystem of different populations. What do you know about the Hudson? What are some creatures you know that live there? How might some of these creatures interact with their environment/each other?

EXPLORE

Go through properties of the Hudson River. Where does it begin? Where does it end? How long is it? What 3 types of water are present within the river? Estuaries act as nurseries for many species. What lives in the river estuary? (Begins at Lake Tear of the Clouds in the Adirondack Mountains on Mt. Marcy. Ends at the Atlantic Ocean. It's 315 miles long, but the estuary itself is 153 miles of that - where the ocean still influences the river by tidal changes. Tides bring salty water from the ocean at high tide and lower salinity in the estuary at low tide. Within the tidal section of the river at Yonkers we see American Eel, Mummichogs, Silversides, Striped Bass, Blue Crab, White Perch, Grass Shrimp, Moon Jellies, Comb Jellies.)

Some species are able to move throughout these waters with different salt content and some rely on this movement in order to have offspring. For example, the American Eel generally lives in freshwater rivers for most of its adult life; however, it travels out to the salty Sargasso Sea when they are ready to spawn. The mysterious adult eels never return to the shallow freshwater rivers; however, the babies find their way back to the same freshwater rivers their "parents" came from. Because American Eel live in freshwater and travel to saltwater to spawn, they are categorized as **catadromous fish**. Other fish species that live in saltwater for their lives and move to freshwaters to spawn are categorized as **anadromous fish**. Do you know of any fish that do either of these aquatic **migrations**? (Think about salmon).

There are also times where we find fish that are technically "freshwater fish" within the brackish areas at CURB. Why do you think this happens? (There are a number of reasons this can happen - fish can become sick and has been taken by the tides, large rainfalls can cause rivers to flow at high velocities taking smaller juvenile fish into the **mouth of the river** and out to an estuary, super moons can cause very low tides causing a dilution of the estuary water.)

EXPLAIN

There are a lot of ways that we can measure the health of the river. One of the ways we measure the river's health at CURB is by looking at what species are present at different times of the year. Through fishing with a **seine** net, we are able to safely collect animals and information about them. We can compare this information with past information to get a broad picture of river health.

Animals have different characteristics. Some animals are **pollution tolerant** - which means we might see more of them in waters that are not as healthy. Some animals are pollution sensitive, which means they can only survive in healthy water. A lot of times we call these **indicator species**, because their survival (or lack thereof) in an environment can give us insight into how healthy it is. Different populations may also be able to live in different conditions better than others through **adaptations**.

As we collect animals from the river, we will look at them carefully within our hands and take note of the different adaptations that help them survive in the Hudson River. What do you anticipate we will see today?

ELABORATE

Have students seine with proper adult supervision. Split them into teams of 2 and provide them with waders, if possible. Students can practice using a dichotomous key to properly identify the organisms they catch. Make sure students document the identified organisms and their accurate numbers on a chart.

EVALUATE

Why is it important for us to understand what different species are living within the Hudson River estuary? What can they tell us about the health of the river. Based on the data collected in today's seining, what do you think the conditions of the Hudson River are today?

EXTENSION

Educators leading the groups of students are able to take a copy of their seining data back to their classroom with them (this data will also become available later on our website at https://www.centerfortheurbanriver.org/research/). This data can be used to complete further analysis and study of the Hudson River's ecology.

Have students work in small groups to look at the way data is represented in four different charts, all taken from the 2019 seining spreadsheet (in the tabs at the bottom of the document): 2019 Running Totals by Month; 2019 % of top 10 Catches; Catch vs Water Parameters; 2019 Salinity and Catch.

Ask the students to try to analyze the chart and come up with some conclusions they might be able to draw from the data. Let them discuss for 8-10 minutes, and then have each group present their data and analysis to the rest of the class. After each presentation, ask the rest of the class to share any questions or ideas about other conclusions they may be able to draw.

CLASSROOM MODIFICATION TIPS

While the basis of this lesson is doing hands-on seining, it would be best if you can take your students on a field trip either to CURB or to other organizations that do similar fish surveys along the Hudson River. However, even without physically going seining, your class can review historic seining data from CURB's website to look at trends from previous seines, learn more about the fish and the water quality they prefer, and think about habitat/identification (See our Hudson River Food Web lesson with Species Cards on CURB's resources webpage).

VOCABULARY

Adaptation: The process of change in a species' behavior, physiology or structure over time.

Anadromous Fish: Fish that spend most of their lives in the ocean, but return to rivers to spawn.

Catadromous Fish: Fish that spend most of their lives in rivers, but return to the ocean to spawn.

Growing Population: a population of a specific species that gets larger over time Indicator Species: An animal or plant species that can be used to infer conditions in a particular habitat.

Migration: Seasonal movement of animals from one region to another.

Mouth of the River: The specific place where a river empties out into another body of water.

Pollution Tolerant: Organisms that can survive in poor water quality.

Seine: A fishing net that sits vertically in the water with floats at the top and weights at the bottom edge, usually attached to poles at each end which are drawn together to ensnare organisms. Generally used on coasts/shorelines.

Stable Population: a population of a specific species that is neither getting larger, smaller, nor changing the age composition over time.

Shrinking Population: a population of a specific species that is getting smaller over time.

MATERIALS NEEDED

- ❑ Seine net (2)
- ❑ Fish buckets (lots)
- ❑ Small plastic buckets or even gallon-sized ziplocs for proper fish ID
- ❑ Bubblers - make sure batteries have sufficient energy reserved
- ❑ Hand nets - various sizes
- ❑ Waders - staff and students
- ❑ Clipboard and pencil
- ❑ Data sheet
- ❑ First aid kit
- ❑ Fish measurement board, if needed

UNIVERSAL DESIGN LEARNING IDEAS

Engagement

Ask students to reflect and share their own experiences dealing with animals. Prompt the conversation by asking questions such as "Have you ever had a pet before?", "How did you take care of it?", "Were you able to play with this animal (like a dog or a cat) or was it an animal you observed (like a fish, turtle, crab, etc..)?

Expression

Prior to seining, show students photos and videos of the potential species that will be caught. Additionally, walk around the center with students and point out the different fish that have been caught in the Hudson River and answer a few clarifying questions students may have.

Representation

If some students are uncomfortable with getting in the water, ensure a few species that are caught are put in an alternate tank/bucket where students are able to closely observe them. Explain what kind of species they are, their distinguishing qualities, and their relationship with the Hudson River (are these common species we catch, do we only catch these species during certain times of the year, etc..).

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to orally identify two species that were caught in the seine net. Students with a higher level of English proficiency will be encouraged to utilize descriptive adjectives (size, color, shape, etc..) that help further identify a species.

Students will be able to identify 1-2 action verbs that were utilized during the seining process. Examples include identifying, observing, holding, measuring, etc... Students with a higher level of English proficiency are encouraged to use these action verbs in a full sentence.

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Water Quality: Chemical and Physical Properties

90 MINUTES, GRADES 9–12

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Scale, proportion and quantity Cause and effect Energy and matter System and system models	Using mathematics and computational thinking Analyzing and interpreting data	PS1: Matter and its interactions LS2: Ecosystems

HS-LS2-1. Use mathematical and/or computational representations to support explanations of biotic and abiotic factors that affect carrying capacity of ecosystems at different scales

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and(3) the extinction of other species.

HS-ESS2-5.Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

ENGAGE

The Hudson River is a dynamic system that changes every day, even hour to hour. What do you know about the Hudson? What changes? Does anything ever stay the same?

EXPLORE

Go through properties of the Hudson River. Where does it begin? Where does it end? How long is it? How do tides influence the river? How might that change some of its properties? What else could influence the river?

(Begins at Lake Tear of the Clouds in the Adirondack Mountains on Mt. Marcy. Ends at the Atlantic Ocean. It's 315 miles long, but the estuary itself is 153 miles of that - where the ocean still influences the river by tidal changes. Tides bring salty water from the ocean at high tide and lower salinity in the estuary at low tide. Many tributaries line the Hudson bringing more freshwater in, especially in rainy seasons/early spring when snow is melting from the mountains. Rain and precipitation also have an impact on the amount of salinity, and other parameters which we'll explore shortly.)

EXPLAIN

There are a lot of ways that we can measure the health of the river, and looking at the physical and chemical properties can give us a lot of information. At CURB, we generally measure the following: temperature, salinity, pH, turbidity, and dissolved oxygen. Which of those do you recognize?

Temperature: a measurement of how much heat is in a substance. The tool we generally use to measure temperature in the river is a thermometer, and the unit is Celsius (for general use) or Fahrenheit (in the US so we know what it actually means). What do you think the water temperature is right now? Will it be the same as the air temperature, or different? Higher or lower? Why?

Salinity: a measurement of how much salt is dissolved in the water. The tool we use to measure dissolved salt is a hydrometer, and the unit is parts per thousand (ppt), which basically means that if you had a thousand parts of water, how many of those would be dissolved salt ions. For reference, the ocean is generally between 34 and 36 ppt. What do you think the estuary would be? What would that depend on?

pH: a measurement of the acidity of a substance. The tool we use is a chemical test kit, and the unit is a logarithmic scale, so from 0 to 14. What is neutral? (7). What would you expect the Hudson River to be?

Turbidity: a measurement of the clarity, or really unclarity, of the water. This can also be expressed as a measurement of suspended particles. The tool we use is a turbidity tube, which relies on being able to see a secchi disk at the bottom. The unit for turbidity from the tube is centimeters, so it's basically a measurement of how far you could see if you opened your eyes underwater. What causes turbidity? What do you think the Hudson River's turbidity is? Is it low (high visibility) or high (low visibility)?

Dissolved oxygen: a measurement of how much oxygen is dissolved into the water and is available for organisms to breathe. The tool we use is a chemical test kit, using a Winkler titration, and the unit is parts per million, or ppm. Why is dissolved oxygen so important to measure? What might cause DO to go up? Down?

ELABORATE

Have students do water quality monitoring of their waterway. Split them into groups and take multiple water samples so each group can have their own bucket, if possible. Use Water Quality How-to guide to help students work on their own to do the testing. Spanish instructions here. Make sure students document their answers on the chart in their worksheet. It is helpful to have the students run through 3 different stations to keep them on time and know what they need to do next. For example, one station can be turbidity, one station temperature/dissolved oxygen, and the last station salinity and pH. They can be at each station for about 10-15 minutes.

EVALUATE

Why is it important for us to keep track of these water quality parameters? What can they tell us about the health of the river? Why would long-term monitoring be useful? Use Water Quality worksheet to have students think about some of the parameters and their fluctuations, uses, and causes.

Compare students' readings from their worksheets. Did every group get the same results? Why or why not?

EXTENSION / MODIFICATION

Although this lesson requires many different tools of measurement to conduct these water quality tests, a classroom can use the videos provided by CURB via Vimeo to take a closer look at pre-recorded water quality data collection. After taking a look at these videos students can also analyze and look at past data collected by the HRECOS sonde in Yonkers to answer questions on the worksheets.

VOCABULARY

Temperature: a measurement of how much heat is in a substance.

Salinity: a measurement of how much salt is dissolved in the water

pH: a measurement of the acidity of a substance

Turbidity: a measurement of the clarity, or really unclarity, of the water

MATERIALS NEEDED

- ❑ Buckets
- ❑ Thermometers
- ❑ Hydrometers
- ❑ pH kits
- ❑ Dissolved Oxygen kits
- ❑ Turbidity Tube
- ❑ Funnel and Small Buckets for Turbidity tube fill
- ❑ Water Quality Data Collection Sheet
- ❑ Clipboards
- ❑ Pencils
- ❑ Towels/Mop
- ❑ Waste Buckets for chemical kits
- ❑ Water Quality How To Cards

PREP

- Ensure all materials in each of the kits are complete and cleaned and ready for use
- Prepare all tables with brown paper liner, if available
- Be prepared with mop and other rags nearby in case of spills

UNIVERSAL DESIGN LEARNING IDEAS

Engagement
Ask students to reflect on their own experience at a body of water. Ask them if they thought the water quality was healthy or unhealthy. Ask them to provide detail, and see what answers are formulated to mean healthy or unhealthy. Encourage students to discuss with one another.

Expression
While a worksheet is provided in this lesson plan, consider creating a graphic organizer template more suitable for your students to record their data.

Have students choose their own media in describing each of the parameters.

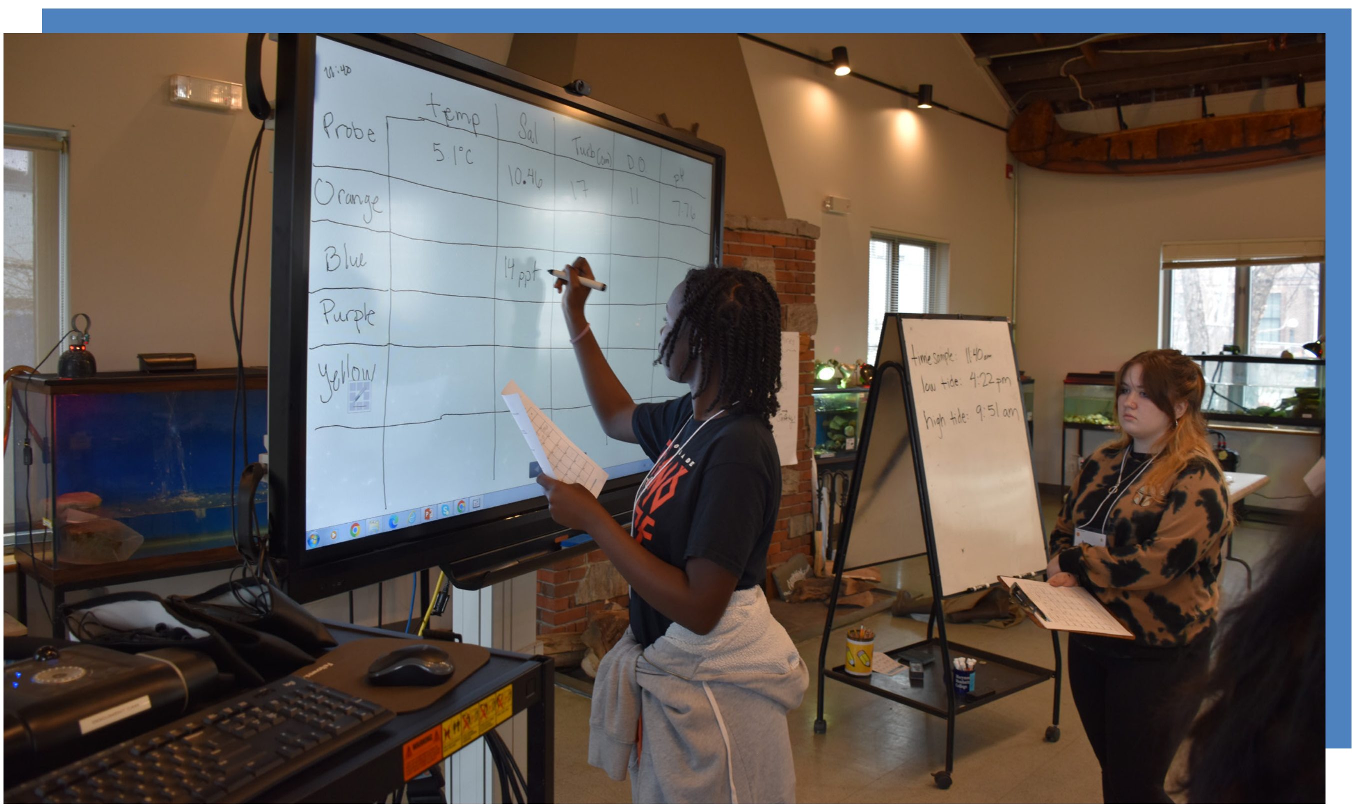
Representation
Make explicit cross-curricular connections (e.g., water quality impact to humans in the social studies classroom).

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students are given the new vocabulary at home, with pictures provided, to practice before the lesson.

Students are able to practice reading the Water Quality How to Instructions beforehand.

Students practice describing each of the parameters, written or orally, based on proficiency.



Crumpled Paper Watersheds

GRADES 6–12

GOAL

Students will be able to understand the basic geography of a watershed, how water flows through the system, and how people can impact the quality of our water by constructing a simple model of a watershed

SUMMARY

This lesson plan contains 4 activities which can be used together or separately. The first and second activity demonstrates water flow within a natural landscape with ridgelines. The third activity demonstrates the overall concept of a watershed, water flow and the interconnectedness to other bodies of water. The fourth connects watersheds with forests and pollution - asking students to design their own watershed. All activities done together

SUGGESTED DURATION

Activity 1: 5–10 minutes
Activity 2: 5–10 minutes
Activity 3: 15– 20 minutes
Activity 4: 30 minutes

STANDARDS

Next Generation Science Standards Disciplinary Core Ideas:

- LS2.A Interdependent Relationships in Ecosystems
- LS2.B Cycle of Matter and Energy Transfer in Ecosystems
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- ESS3.A Natural Resources
- ESS3.B Natural Hazards
- ESS3.C Human impacts on Earth Systems
- ETS1.A Defining and Delimiting Engineering Problems
- ETS1.B Developing Possible Solutions
- ETS1.C Optimizing the Design Solutions

Crosscutting Concepts:

- Cause and Effect
- Stability and Change
- Systems and Models

Science and Engineering Practices:

- Asking Questions/Defining Problems
- Constructing Explanations
- Arguing from Evidence
- Communicating information

Performance Expectations High School:

- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including costs, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

AP Environmental Science Topics:

Land and Water Use

- Other Land Use
- Urban Land Development
- Land Conservation Options
- Sustainable Land Use Strategies

Common Core English and Language Arts Standards for Science and Technical Subjects and Writing Grades 9–12:

- CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

BACKGROUND

A **watershed** is a geographic area in which water drains into a common body of water like a stream, creek, reservoir, or bay. As such, a watershed includes all the plants, animals and people who live in it, as well as the non-living components like rocks and soil. We are all part of a watershed, and everything we do can affect the surface and groundwater that runs through this system.

ADDITIONAL KEY TERMS:

Landform: A physical feature, such as a hill, mountain, valley, plateau, river, lake, etc.

Ridge: The high points of a range of hills or mountains

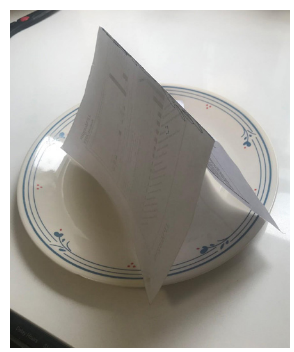
Tributary: A stream feeding into a larger stream, lake, etc.

MATERIALS

- ❑ 2 different colored washable markers
- ❑ 1 permanent marker
- ❑ 4 pieces of any light-colored paper*
  **Alternative: if paper is unavailable, use anything that crumbles that can represent topography. Ie) A shirt, scrunchie, plastic bag, leaves, aluminum can, backpack*
- ❑ Pieces of a sponge or cloth
- ❑ A surface that can get wet
- ❑ Spray bottle or access to water (optional)

PROCEDURE

Activity 1- Create this initial model to demonstrate a **ridgeline**:



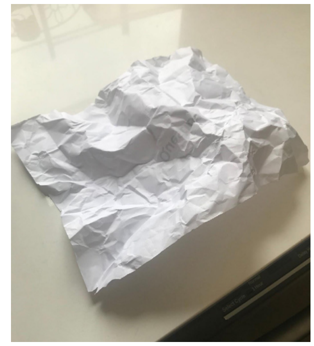
1. Fold a piece of paper in half. Flip it over so that the point of the crease faces you.
2. Color in the crease that you've just created, with a washable marker.
3. Make a prediction about what you think will happen if it "rains" on your simple landform (a single ridgeline).
4. Sprinkle droplets or spray water on your folded paper.
5. Observe what happened. Where did the water travel? Why?

Activity 2- Create this model to demonstrate a **valley**:

1. Fold a piece of paper in thirds, representing 2 mountains and a valley
2. Color in the 2 creases that you've just created, with a washable marker
3. Make a prediction about what you think will happen if it "rains" on your simple landform
4. Sprinkle droplets or spray water on your folded paper.
5. Observe what happened. Where did the water travel? Why? What happened to the color of your ridgeline?

Activity 3- Create the following model to gain a better understanding of what a **watershed** is:

1. Crumple up a piece of paper, open it but do not smooth it out. It should still be a bit crumpled, showing small ridges (high points) and valleys (low points).
2. Imagine that this paper is a section of land, and find the ridgelines (the tops of the fold-lines).
3. Use a washable marker to color along the ridgelines on your "land." (There will be many! It is not necessary for students to color all of them.)
4. You are going to "rain" on your landform. What do you think will happen to your land when it "rains?" Make a prediction about where water will flow and where it will collect.
5. Sprinkle droplets or spray water to create a "rainstorm" over your land.
6. As your "rainfall" accumulates, observe the pathways where the excess "rainfall" travels. What happened to the color of your marker? What would you identify as a river, tributary or a lake?



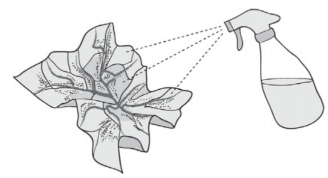


Image credit: Expedition Northwest OMSI

Activity 4- Create the following model to add **pollutants** and **forests** to your watershed:

1. Crumple up a piece of paper, then open it but do not smooth it out. It should still be a bit crumpled, showing small ridges (high points) and valleys (low points).
2. Imagine that this paper is a section of land, and find the ridgelines. Use a permanent marker to color along the ridgelines.
3. Add in two additional elements with washable markers – color in sections of your paper to represent factories (one color) and farms (a different color).
4. Using cut-out pieces of sponges, add forests to the landscape. They can be simply placed or taped to the paper. **For a higher grades, have students use their knowledge of water quality, pollutants and forest absorption to strategically plan where they would place their elements.**
5. You are going to "rain" on your landform. What do you think will happen to your land when it "rains?" Make a prediction about where water will flow and what will happen to the ink color.
6. Sprinkle droplets or spray water to create a "rainstorm" over your land.
7. As your "rainfall" accumulates, observe the pathways where the excess "rainfall" travels.

QUESTIONS TO ASK:

- Where in your watershed would YOU want to live? Why?
- What changes did you observe in your landforms once you made it rain?
- Where does most of the rain collect?
- What path does the water follow?
- Did any part of your paper collapse? What could this represent in the real world?
- What happened to the farms and factories in Activity 4?
  - Are they in the way of a raging river or crumbling hillside?
  - Would the water flowing from these areas impact any other areas?
- What happened with the forests?
- How would the flow of water through a watershed in real life affect our choice of building sites?
- What actions do you think farmers take in real life to protect the water quality?

Watershed Agricultural Council

Woods Wash Water

ALL AGES

HOW TREES FUNCTION TO FILTER AND PROTECT WATER QUALITY IN A WATERSHED.

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Structure and Function	Asking questions	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Q: How does a forest act/function like an UMBRELLA?

A: Umbrella – represents the forest canopy and how it intercepts rain, shades the ground.

- **Interception:** Rain falls on the canopy and some of it sticks to the leaves and branches and then just evaporates back up into the atmosphere. This reduces the amount of water that falls to the ground and can reduce surface runoff and flooding.
- **Interception:** Rain hits the leaves and branches of the canopy and then falls to the ground. The precipitation that falls from the canopy to the ground is called **throughfall**. The interception by the canopy reduces the force of the raindrops' impact on the ground and decreases soil erosion and runoff.
- The canopy creates **shade** that keeps the ground and streams below cooler, which reduces water loss through evaporation.
- The canopy gives off water through **evapo-transpiration**. This moisture helps maintain a humid microclimate in forests, which keeps more moisture in the ground, available for lifeforms to use during wet and dry periods.

Q: How does a forest act/function like a SPONGE?

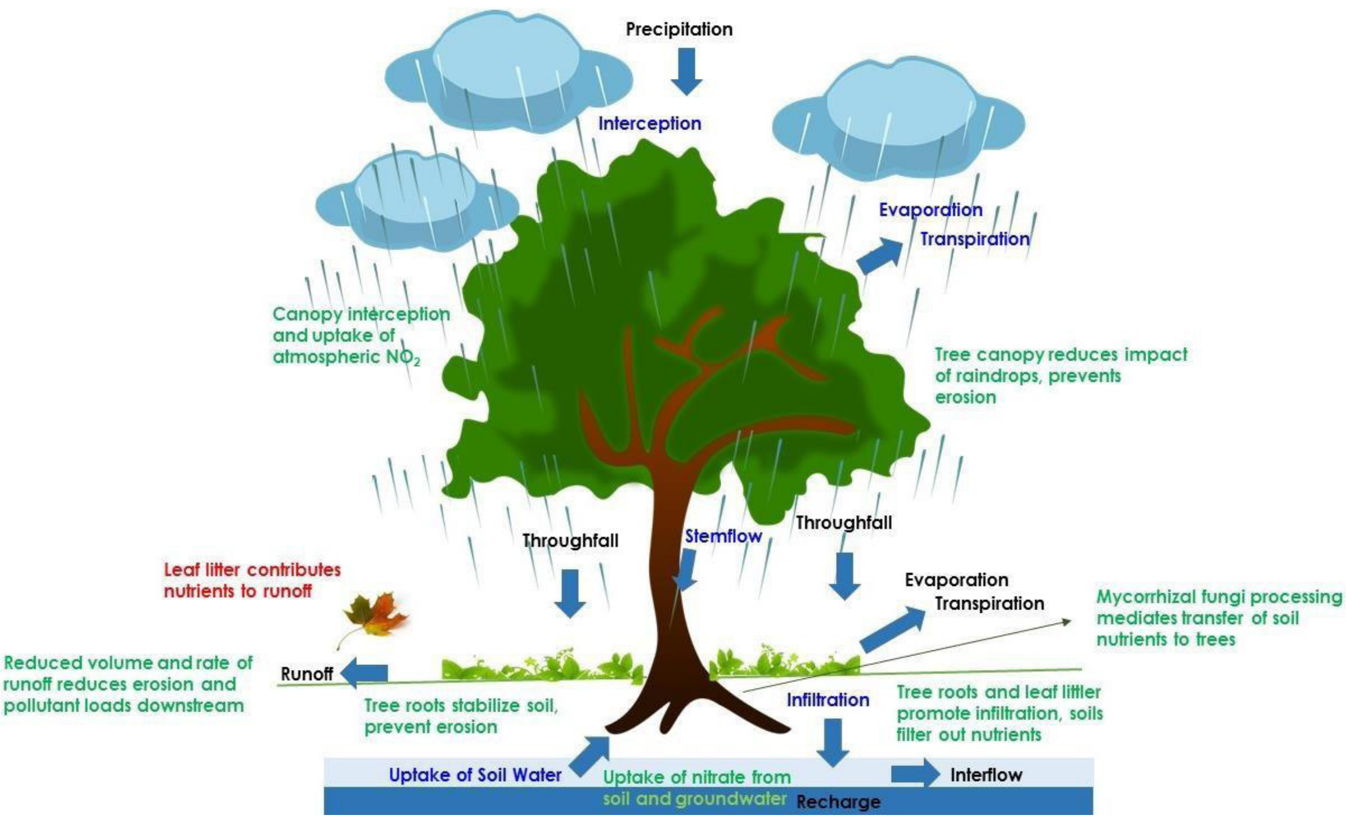
A: Sponge – represents how trees (especially the matrix of roots and soil) absorb, store, and slowly release water.

- **Absorb:** Forest soils are especially "fluffy" because of the humus it contains (decomposed plant and animal materials). Tree roots also create tiny channels that readily absorb water. Forest soils are excellent at absorbing water (compared to pavement, hard pack soil, grass, etc.)
- **Store:** Trees and forest soils store lots of water like a sponge, making it available for plants to use over time, including during periods of drought. Forests cycle and store a lot of water, which helps recharge ground water and aquifers.

Q: How does a forest act/function like a COFFEE FILTER?

A: Coffee Filter –Forest roots and soils trap loose dirt and nutrients, removing or "filtering" them out of water runoff.

- **Trap:** Roots and soil work together to trap loose dirt and other materials, filtering these materials out of the runoff that will eventually collect in streams, rivers and reservoirs.
- **Absorb:** Plant roots absorb nutrients in the soil and runoff, especially Nitrogen and Phosphorous, filtering these potential pollutants out of our streams, rivers and reservoirs.



For additional teacher resources from Watershed Agricultural Council, please visit: https://www.nycwatershed.org/teacher_resources#activitieslessons

Watershed Agricultural Council

Power of a Drop

GRADES 5–12

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Cause and Effect	Planning investigations	ESS2.A: Earth Materials and Systems

SUPPLIES

Tongue depressors/popsicle sticks and/or coffee filters or paper plates with a hole cut out of the center, an area with bare soil, an area with growing grass, and a watering can with water.

LESSON PLAN

1. Introduce yourself and explain that we will be running an experiment to see if and how plants prevent water from moving soil and causing erosion.

2. Explain to the students that trees can protect and filter water. But how do they do this? Their roots! Roots hold sediment in place, trapping dirt while allowing water to flow past it. This keeps our water clean.
   Seeing how trees filter water can be hard, so we're going to run an experiment that lets us watch this happen in real time.

3. Explain to the students how the experiment will run. There are two separate areas that each represent different types of land cover and we will be pouring water over them to simulate a heavy rainstorm. In both areas we have a tongue depressor and/or coffee filter to catch any sediment that the water moves. This way, we can see where dirt splashes up and where dirt is held in place.
   a. Bring the group to one of the test areas. Ask for the kids to make observations about that environment. What is the land cover like? What landscape features can they see?
   b. Compare this to a real-world watershed. What could a space like this represent?
      i. Bare soil could be construction zones, mining, farms during the off season, or other kinds of industry. Vegetation can represent forests and other green spaces and infrastructure like parks.
   c. Based on what they observe at this first test zone, what do they think will happen when water is poured over it? Will we see a lot of soil move? Have them make predictions.
   d. Repeat this process at the other test site.

4. Run the experiment by pouring equal amounts of water (you can time the pour or measure it out) over both coffee filters (aim for the hole cut out of the center) and around both tongue depressors.
    a. Collect the filters and sticks without disturbing too much of the soil on them. Place them next to one another so that the students can clearly compare and contrast the results of the experiment.

5. Talk about the results. Which area allowed more dirt to move? Which area held soil in place? What does this mean in relation to our watershed? Which kind of land cover prevents more erosion?
    a. We want forests in our watershed because their roots trap sediment and filter water. Why do trees do this?
        i. Trees need their roots to survive. They hold onto the ground and absorb vital nutrients and water through their roots. While doing this, trees provide us with incredible ecosystem services. Take guesses from the students of what an ecosystem service is (hint: filtering water is an example of one).
            1. Ecosystem services are the benefits healthy natural environments provide to humans.
    b. Just by existing, trees are doing work for us every day. Because forests are naturally in the Watershed, we get to benefit off of the ecosystem services they provide towards clean water. This is a good thing for us, because if the trees weren't here we would have to filter all the water ourselves, which would cost a lot of time, money, and energy. But since the water is so clean to start with it makes it easier for us to make it safe to drink. In fact, all of the drinking water that comes from the Catskill Mountains is filtered only by forests! We use technology to treat the water for germs and bacteria, but in the Catskill and Delaware Watersheds we don't use any technology to filter the water. The trees filter it for us! Next time you see a tree make sure to thank it for all the hard work it's doing!

6. Conclude by telling the students that the water they use every day comes from and is cleaned by upstate forests. Every time they use water in NYC they are connected to the trees in the Hudson Valley and the Catskill Mountains. How they use water is important because it affects what happens in other parts of New York, and how people in other parts of New York use their forests is important because it affects their drinking water down in the city. That's why it's good to take care of our natural resources.

For additional teacher resources from Watershed Agricultural Council, please visit: https://www.nycwatershed.org/teacher_resources#activitieslessons

Simple Watershed Models
ALL AGES

Note: The examples below assume the definition of a watershed has already been discussed or provided, since a basic understanding of watersheds is necessary to grasp more abstract ideas about them, like how they're nested. These lessons are ways to help students visualize watersheds, how their boundaries are formed, and the way that gravity moves water.

LEAF

SUPPLIES
At least one leaf for the students to look at either together or individually. Ideal leaves for this activity are simple and lobed to make distinct watershed boundaries. Maples and red oaks work well for this.

LESSON PLAN
1. Have the students hold their leaf flat in the palm of their hand.
2. Have them trace the outline of their leaf with their fingers, following the teeth and lobes. Ask them to point out the peaks and sinuses of the lobes.
3. Then have them find and trace the leaf veins, starting at the peaks and working down to the stem. Eventually they should notice that the veins get bigger as they join and meet together at the stem of the leaf.
4. Tell them to imagine that their leaf is a landscape on Earth and they have a bird's eye view of this space. The area they are looking at is a watershed.
    a. What features in a watershed can we see represented here?
        i. The peaks of the lobes are like mountains, the sinuses are like valleys, and the veins and stem are like streams and rivers.
        ii. As the rivers flow downhill and join together, they get bigger. Eventually all the water ends up in one common place.
    b. Ask your students how many watersheds they can count in their leaf. Since watersheds are nested, each little stream will also have its own watershed. The entire leaf is also a watershed for the big river/stem.
5. You can enhance this activity by asking the students to imagine they are building a town on their leaf landscape. Where would they want to put different types of buildings? Where would they want to collect their drinking water? Why have they chosen these locations?

HAND

SUPPLIES

Hands, spray bottles, and a space that you can spray water, like over a sink or outside. This activity can be modified to eliminate the water aspect if needed.

LESSON PLAN

1. Have students hold out their hand flat with their palms facing up.
2. Tell them to imagine that their hand is a landscape on earth and they have a bird's eye view of this space. The area they are looking at is a watershed.
3. Looking at their flat hands, ask them what type of landscape or environment this could represent. Answers should be something like plains, meadows, fields, and other flat landscapes.
    a. Ask the students where the water would go if it were to rain on this environment. Since it's relatively level, the water would settle in the cracks between fingers and then possibly drip through or off the sides of the hand. This flow could represent ground water being recharged, while any water caught on the palm or fingers is surface water.
4. Ask the students to cup their hands so their fingers are curled up and touching one another and their palm makes a bowl shape. Using their other hand, have them trace their finger along the high and low points of their cupped hand.
    a. Run through the same set of questions, asking what type of landscape is shown in their hands now and how water would interact with this landscape.
        i. Now their fingertips are mountain peaks, the cracks in between their fingers are valleys that rivers could flow through, and their palm is a bigger body of water, like a pond, lake, reservoir, or ocean. You can have them point back to these features as they list them, or trace the path they think water will take when it rains.
        ii. Pass out spray bottles so the students can make it "rain" on their cupped hands. Have them observe all the ways that water moves. Were their guesses of where it would flow, seep through, and collect correct?
    b. Looking at their hands and where the water has moved to, ask the students how many watersheds they can see. Remind them that watersheds are nested.
5. You can enhance this activity by asking the students to imagine they are building a town on their hand landscape. Where would they want to put different types of buildings? Where would they want to collect their drinking water? Why have they chosen these locations?

ARMS

SUPPLIES

At least 2-3 volunteers who don't mind getting wet, a spray bottle with water, and space that you can get wet (preferably outside on a hot day). This activity can be modified to eliminate the water aspect if needed.

LESSON PLAN

1. Ask for a few volunteers to come up and act out being a watershed for the group. Have the volunteers stand shoulder to shoulder facing the same direction. Ask each person to make a "mountain" in front of their bodies by holding their arms out so that their elbows are apart and their finger tips are touching, like an upside down V. Each person's elbows should be touching the elbows of the person next to them.

2. Ask the students what the shapes the volunteers have made represent in a landscape. Each individual is one mountain, but together they represent a mountain chain. The finger tips are the summits of the mountains and the side of the arms slope down and meet at the elbows to form valleys.

3. Once they understand the landscape they are looking at, ask the students to guess where the water would go if it rained. Have additional volunteers come up and point out the directions they estimate the water to flow in. The students should predict that the water will flow down the sides of the mountains to the low points by the elbows.
    a. Using the spray bottle, make it rain on the mountain range by spraying the tops of the mountains with water. Have the students observe where the water is moving to and where it collects. Compare the results of the test with the initial guesses the group made.

4. As a group, try to figure out how many watersheds there are in this mountain range. Each valley is a watershed, but it's possible that all of these rivers also flow to one ocean. Remind the students that watersheds are nested.

5. You can enhance this activity by asking the students to imagine they are building a town on their mountain range. Where would they want to put different types of buildings? Where would they want to collect their drinking water? Why have they chosen these locations?

For additional teacher resources from Watershed Agricultural Council, please visit:
https://www.nycwatershed.org/teacher_resources#activitieslessons

Hudson River Water Cleanup

60 MINUTES, GRADES 3–6

PROGRAM DESCRIPTION

In this fun, messy activity, students compete in groups to see which team can make the best economic and procedural decisions to best clean "pollution" from a water sample.

OBJECTIVE

Students will understand the different types of pollution affecting the Hudson River and discuss the impacts on the environment and Yonkers community.

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Cause and Effect	Asking Questions/Defining Problems Constructing Explanations and Designing Solutions	ESS3.A Natural Resources ESS3.B Natural Hazards ESS3.C Human impacts on Earth Systems ETS1.A Defining and Delimiting Engineering Problems ETS1.B Developing Possible Solutions ETS1.C Optimizing the Design Solutions

MATERIALS

Note that some of these materials are suggested to represent a type of pollution. Other materials can be used if desired.

- ❑ Store Price List Sign
- ❑ Soil or dirt. If it has perlite this can represent "trash"
- ❑ Small pieces of "litter". Can be styrofoam or
- ❑ Food coloring
- ❑ Vegetable oil
- ❑ Cotton balls

- [ ] 8 small bottles (250 mL) with water
- [ ] 8 Funnels
- [ ] 8 Eye Droppers
- [ ] 8 Screens (can use small strainers)

Each group will need the following:
$7 budget of fake money
Working bins to catch spills
2 tennis ball containers with lids

PREP

Prepare "polluted" water samples:

Add a tablespoon of soil – with perlite, 4 drops of food coloring (red preferred), and 2 tablespoons of oil to your tennis ball containers. Fill the rest of the tennis ball container space with tap water. Each group will need one of these prepared batches. Each sample bottle should have a group number written on them or on a tape on the tennis ball container.

Create your Store Price List Sign with the following information:

- Funnels ($1 each)
- Eye dropper ($2 each)
- Screens ($3 each)
- Cotton balls ($3/3 cotton balls) – Cannot be exchanged
- Fresh water in small 250 mL containers ($3 each bottle) – Cannot be exchanged

Cover table tops with brown paper:

Set-up "store" with supplies. This should be done at a centralized location under educator supervision.

INTRODUCTION

Define pollution with class (something that contaminates the water, air or soil and harms the ecosystem). Ask students what are some pollutants that they have heard of before and add their answers to a white board or large chart paper.

Explore the following commonly known pollutants of the Hudson River:

- Litter/Trash
- Oil
- Sedimentation (Soil)
- Chemicals – PCB's (Polychlorinated biphenyl's)
- Sewage Waste
- Fertilizers and Pesticides

Use the following guiding questions to guide the conversation:

- What is [pollution type]?
- Where does [pollution type] come from? What is the source?
- How does this [pollution type] influence our river? The species who call the river home?
- What are the solutions to addressing these pollutants?

CREATIVE EXTENSION

Ask students to create “Pollution Solution Machines!” Imagining a world with no restraints and where money is no option, encourage your students to design a machine aimed at reducing one of the pollutants that was reviewed. This can be done on large chart paper or in notebooks. This can be done in groups or as a solo activity. After 10 minutes of design time, students should share the name of their machine, what pollutant it is addressing and how the machine will function.

After this creative component, we will start the clean-up interactive challenge component of this activity.

WATER SAMPLE CLEAN UP CHALLENGE

Vegetable oil (representing oil in waterways), chemicals (represented by red food color), dirt (representing sedimentation and litter if it has perlite)

You will become a company and work together in groups to solve the problem of pollution on the Hudson River. We are looking for the best company to clean up our polluted water (display samples created).

Each group should receive the following supplies: $7 budget of fake money, 2 Working bins, 2 Tennis ball containers with lids – one filled with “polluted” water sample and the other empty.

1. Students should pick a company name & decide who will be the “buyer” (1 student from the group) – educators can assign the “buyer” before activity begins
2. Give budget amount (pass out money) $7 per group
3. Decide as a group what materials to buy and how to spend the money
4. Have ONLY the buyer shop for supplies
5. Provide 20 min to clean up sample best they can by transferring the “polluted” sample from one tennis ball bin into the other using the purchased cleanup tools

WRAP UP

- Emphasize teamwork and effective problem solving
- Discuss challenges / easiest method vs. hardest method
- Give students time to complete the worksheet questions found on the next page

Name ________________________________

"WATER POLLUTION CLEAN UP"
WORKSHEET QUESTIONS

1. List different examples of pollution found in the Hudson River.

____

____

____

2. How does pollution affect the Hudson River?

____

____

____

3. Circle the pollution which was the hardest to get out of your sample?

Oil Chemicals Sedimentation Litter

Describe why it was the hardest.

____

____

____

4. What would you need in order to get the sample as clean as possible? More money? More time? More materials?

____

____

____

5. What is the major source of chemical pollution that faces the Hudson River?

____

____

____

6. How can you relate this activity to a recent current event or natural disaster?

____

____

____

UNIVERSAL DESIGN LEARNING IDEAS

Engagement

Ask students to reflect on their experience at a lake or a beach. Ask them if the water was clean. If they respond 'yes' to this question, ask them to imagine their experience near the water if it was dirty. How would this have changed their experience? Would it no longer be fun? Encourage students to discuss with one another.

Expression

At the end of the activity, if there is time, allow students to draw and present alternative, potential tools they would have used to remove the pollution from the water in this activity. Encourage students to answer the 'how, what, and why' regarding the mechanisms of their tools.

Representation

Present contrasting images or clean bodies of water vs. polluted bodies of water.

Allow students to participate in a local water body trash clean up, or local park beautification project. Connect with a local organization who can support this work.

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to orally identify and describe 2 types of common pollutants that are found in water (trash, oil, etc..). Students with a higher English proficiency are encouraged to describe, in 2-3 sentences, how these pollutants get into our water.

Students will write 2-3 sentences describing significant challenges they faced during the activity and compare it to the real-life difficulties of cleaning up polluted waters. Students are encouraged to write these sentences in both their native language and in English.

SARAH LAWRENCE COLLEGE
CENTER FOR THE URBAN RIVER AT BECZAK

Marsh Filtration

45-60 MINUTES, GRADES 3–8

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Cause and Effect Stability and Change Systems and Models	Asking Questions/Defining Problems Constructing Explanations Arguing from Evidence	LS2.A Interdependent Relationships in Ecosystems LS2.B Cycle of Matter and Energy Transfer in Ecosystems LS2.C Ecosystem Dynamics, Functioning, and Resilience ESS3.A Natural Resources ESS3.B Natural Hazards

MATERIALS

- ❑ Notebooks
- ❑ Pencils
- ❑ 2L bottles, cut in half
- ❑ Small buckets or cups for pouring water
- ❑ 5 gallon bucket with river water

ENGAGE

(10 minutes): Get participants familiar with filters/concept of filters

- Ask participants to recall their last experience using filters.
    - Do you use a brita or other water filter?
    - How do you make your morning coffee? Using coffee filters?
    - When was the last time you changed the air filters in your house?
    - Does your pet have a filtered water station?
- Come up with your own definition of a filter, without using the word filter. Write down your definition in your notebook.
    - Encourage participants to use their previous experience with filters as a guide to creating their own definition.

EXPLORE

(10 minutes): Introduce marshes to participants

- Ask participants "think, pair, share" where they think examples of filters exist in nature.
- Visually introduce participants to marshes by taking everyone to CURB's marsh. If you are unable to visit CURB or another marsh area by you, we recommend using a digital visualization.
  - Encourage participants to discuss their observations.
- Let participants come up with a collective definition of a marsh.
  - Then, share a scientific definition of marshes: "An area of low-lying land which is flooded in wet seasons or at high tide. It is dominated by herbaceous rather than woody plant species."
- Allow participants to discuss their experiences with marshes by asking probing questions.
  - Have you seen other marshes?
    - Where? What else was present in the surrounding area?
- Begin making the connection between filters and marshes.
  - Ask participants why they think marshes are an example of filters.

EXPLAIN

(5 minutes): Discuss how marshes can act as natural filters

- Explain that marshes slow down runoff and absorb water.
  - As water flows into a marsh, it encounters the plants growing there, also known as the buffer zone. This buffer zone helps slow the flow of water, decreasing the likelihood of erosion while also allowing the nutrient pollutants found in the water, nitrogen and phosphorus, to be absorbed by the surrounding plants. This process is not only beneficial to the growth of the plants, but it also aids in 'cleaning' the inundating water. [1]

ELABORATE

(15 minutes): Marsh filtration experiment

- Demonstrate how to use the 2L filter system.
  - Use a plastic beverage bottle, (2 L bottle works best) it will need to be cut in half horizontally, then stacked. Students will stack the top layer with their filtration items, and the filtered water should pour out in the second half of the bottle. See diagram for an example.
  - Alternative: If bottles are unavailable, you can use 2 cups and a strainer. Have 1 cup full of the polluted water. Stack your filtration materials in the strainer. Have another cup or bowl under the strainer to catch the filtered water.
  - Distribute 2L bottles to participants
  - Instruct participants to find things they can collect on the beach and in the marsh to recreate a marsh filtration system
  - Participants can use sand, mud, rocks, leaves, roots of plants etc.
  - After 5 minutes of searching, instruct participants to pour a sample of river water through their filter and see if/ how it worked. If you do not have access to river water, you can use tap water with dirt, or other household items to "dirty" the water. See ideas in the "Water Cleanup" lesson plan.
  - Take note of how long it takes for the water to filter

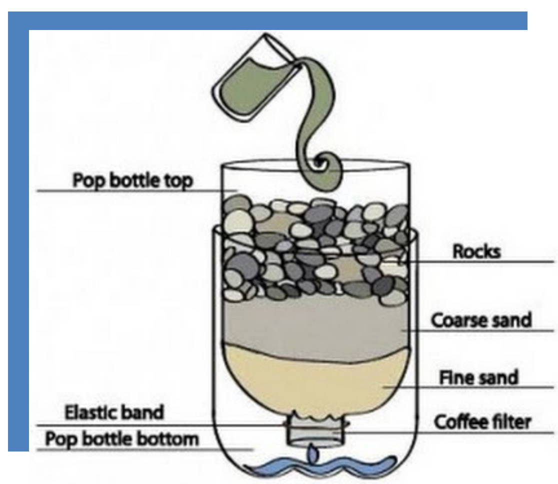


Image Credit: HomeQuicks

[1] https://www.wetlandswork.org/wetland-benefits/clean-water

EVALUATE

(5 minutes): Reflection

- Reflect on the activity with participants by asking them these reflection questions:
  - Is there anything you would change about your definition of a filter?
  - In your own 2L marsh system, what was filtered and what wasn't? Which objects do you think were the most effective in working as a filter? Why?
  - How was your filter like or unlike our marsh outside?

UNIVERSAL DESIGN LEARNING IDEAS

Engagement

If getting outside is a barrier, bring outdoor materials inside the classroom.

Ask students to reflect on their own experiences with a river, marsh or body of water. Encourage students to be descriptive and let them talk about what they saw, heard, etc...

Expression

Provide alternative requirements for timing to collect materials.

Allow students to draw materials they would add instead of collecting materials.

Representation

Present marshes and filters though audio, video and pictures.

Provide another way to access visual components of the outdoors, such as allowing children to listen for sounds or provide verbal descriptions.

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to orally identify and describe 2 landscape terms they saw while outside during the marsh filtration activity (river, beach, trees, brush...). Sentence starters or words will be introduced based on proficiency.

Students will write 1-2 sentences describing what tools they would use to recreate a filter in their own home. Students with a higher English proficiency are encouraged to create increasingly detailed instructions on how they would make a filter at home (where they would look for objects, how they would use them specifically, etc..).

Students will write the key vocabulary word "filter" with a definition that is appropriate for the student. A definition that includes the students' native language is also encouraged, since the focus is that the student identifies and conceptually understands the word "filter."

The Importance of Trees

GRADES 7–12

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Cause and effect Scale, Proportion and Quantity	Developing and Using Models Using mathematics and computational thinking	ETS1.A: Defining and Delimiting an Engineering Problem ESS3.A: Natural Resources

INTRODUCTION

A tree inventory is the gathering of accurate information on the health and diversity of the trees on your school grounds, streets, parks, and/or your community. The goal of a tree inventory with an educational focus, is to learn about the ecology of your community. Tree inventories allow students to go out into the community and ask questions like: How many trees are there in a specific area? What species of trees are there? How healthy are they? How old are they? How much carbon are they storing? What kind of wildlife do the trees support? How do they help reduce the impact of climate change?

DURATION

2-4 sessions

LOCATION

- Indoor
- ✓ Outdoor
- Virtual

Image courtesy of NYU Wallerstein Collaborative for Urban Environmental Education & Sustainability

LEARNING OBJECTIVES

Students will be able to identify the trees in their community by examining key characteristics.

- Students will be able to conduct a tree inventory and understand their importance.
- Students will be able to gain skills in tree identification and in taking key tree measurements.
- Students will be able to geolocate trees using a smartphone or a GPS tool.
- Students will be able to understand the importance of trees in their community and the ecosystem services they provide.

MATERIALS

- ❑ Clipboards
- ❑ Data collection sheet (included at the end of this activity)
- ❑ NYC Parks' Street Tree ID Guide
- ❑ Phone with compass/GPS application
- ❑ Calculators
- ❑ String
- ❑ Measuring tape (at least 60 feet)
- ❑ 12 inch ruler

DESCRIPTION OF THE ACTIVITY

Part 1: Choose a Park or Green Space

- Identify a green space with trees that you would like to study in your community.
- Take your class to that green space and be prepared to split the group up in small groups of 4-5 students each.
- Each group will have a clipboard with a data sheet, a measuring tape, a string, and a ruler.
    - If you don't have enough materials for each group to have a set, groups can share and coordinate to do different measurements and rotate. Each group will pick (or get assigned) a tree with a simple form (i.e. one single trunk, not tilted, etc).

Part 2: Conduct Tree Observations

- Students will closely observe their tree and will write down things they notice about it. Where is the tree located? How old do they think the tree is? Are there any animals on the tree? Does this tree look healthy? What kind of tree is it?
- These questions don't need to be answered accurately on the spot, it's more important for students to use their observation skills at this moment.

Part 3: Evaluate Tree Condition

- Students will evaluate the condition of their tree and will get the GPS coordinates to input in the data sheet.

  Condition Scale
  Excellent (E): Tree has no apparent disease or insect damage and good color and form to its limbs, branches and bark.

  Fair (F): A tree with minor damage to its trunk, branches or bark and very little insect damage in bark or on leaves.

  Poor (P): Significant damage to its limbs, trunk or bark with evidence of insect damage or disease.

  Dead (D): Tree presents no leaves or bark and there is damage to its limbs, trunk and bark.

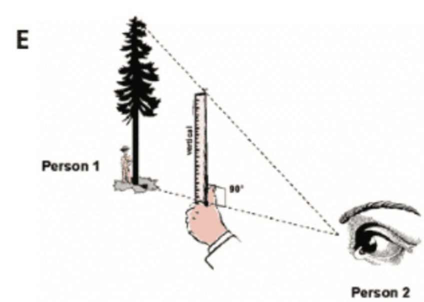
  GPS Location
  Using your compass, or if you have a general knowledge of where North lies, stand as close as possible to the north-facing side of the tree. Facing north, use any location application to look up latitude and longitude coordinates (write all numbers). Latitude is the first number and longitude is the second number.

Part 4: Conduct Tree Measurements

- Each group will be taking the following measurements of their tree: diameter at breast height (DBH), height, and crown spread.

  DBH: The diameter at breast height refers to the measurement of the diameter of the tree at a height of 4.5 feet (which is the average breast height of a human).

  1. Two students can approach the tree and measure 4.5 feet from the ground and hold the measuring tape to mark the breast height on the tree trunk.
  2. Another student (or pair of students) can use the string to measure the circumference of the tree at that height. Have the student wrap the string around the tree trunk (making sure it is straight and tight around the trunk), and mark or cut the string once it is completely around it.
  3. Measure the length of the string to get the circumference of the tree in inches. Then calculate the diameter by dividing the circumference by ϖ (3.14). *Diameter = circumference/*ϖ

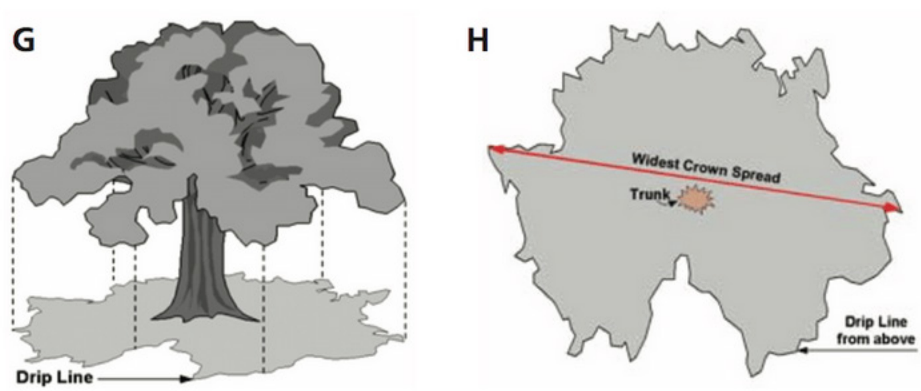


Height: Sometimes trees are so tall we can't measure them by going up, so we go sideways. For this you need a 12-inch ruler and a 60+ feet tape measure.

1. Student #1 will stand next to the tree they are measuring and will wait there for instructions.
2. Student #2 will hold the 12-inch ruler at arm's length and will (carefully) walk backwards until the entire length of the ruler covers the tree from base to top. When that happens, they will stop walking and turn the ruler 90 degrees to either side (while still holding it at arm's length).
3. Student #2 will hold the ruler there, and ask Student #1 (who is standing next to the tree) to walk from the tree trunk towards the direction the ruler is pointed, until they reach (what they see from their vantage point as) the end of the ruler.
4. Now Student #1 is at roughly the same distance from the trunk as the tree is tall. Student #1 should stand still while someone else measures the distance from the tree trunk to where they are standing. That should give us a fair approximation of the tree's height.

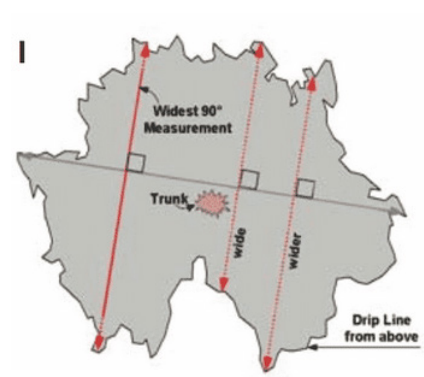
Crown Spread: The crown of the tree is the top part of it that extends from the trunk as branches and leaves. To measure this we will need the 60+ ft measuring tape, two students to hold the tape and a recorder to jot down the measurements in the data sheet.

1. Find the widest crown spread by finding the greatest distance between any two points on the edge of the crown (or the drip line). Have one student at each of the two points and extend the tape measure from one to the other to measure that distance. This will be measurement #1.



Illustrations by Pete Smith
Retrieved from: https://texasforestservice.tamu.edu
/uploadedFiles/FRDSF/Education/Tree_Trails
/3%20Tree%20Measurement%20Guidelines.pdf

2. Turn the measurement line 90 degrees, or perpendicular, from measurement #1's line, find the widest crown spread along this plane and measure the length, in feet.
3. Add the two measurements and divide by 2 to get the average crown spread. This is the number you will input in your data sheet.



Illustrations by Pete Smith
Retrieved from: https://texasforestservice.tamu.edu
/uploadedFiles/FRDSF/Education/Tree_Trails
/3%20Tree%20Measurement%20Guidelines.pdf

EXTENSIONS

- Use iTree to calculate how much carbon your trees are sequestering.
- Make a map of your trees by hand or by using Google Maps.

RESOURCES AND REFERENCES USED

(e.g. websites, books, materials, etc):

- Texas Forest Service's Tree Measurement Guidelines (PDF)
- NYC Parks' Street Tree ID Guide (PDF)
- My Maps - Google Maps
- iTree Tools
- Connecting Kids to Nature: How Big is Your Tree? (PDF)
- River Works Full Curriculum

MODULE 3: COMMUNITY SCIENCE

Lesson 6: The Importance of Trees

Tree Inventories Worksheet

Names ______________________________
____

School ______________________________

Date ______________________________

Site ______________________________

Tree #	Species	Condition	Latitude	Longitude	Circumference (inches)	DBH D=C/ 3.14 (inches)	Crown Average (feet)	Height (feet)	Observations

SARAH LAWRENCE COLLEGE
CENTER FOR THE URBAN RIVER AT BECZAK

Green Infrastructure Lesson Plan

60 MINUTES, GRADES 9–12

STANDARDS

Next Generation Science Standards

Crosscutting Concepts	Science and Engineering Practices	Disciplinary Core Ideas
Energy and Matter Cause and Effect	Asking Questions/Defining Problems Obtaining, evaluating and communicating information	ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solution

MATERIALS

- ❑ Notebooks
- ❑ Pencils
- ❑ Clipboards
- ❑ Green Infrastructure cards
- ❑ Area of Google maps ready to project on smart board

ENGAGE

(5 minutes): Introduce the concept of infrastructure

- What do the participants think infrastructure is? How would they define it?
    - Allow the group to come up with a collective definition.
- Encourage participants to reflect on the infrastructure they see in their neighborhoods.
    - What prominent forms of infrastructure make up your community?
    - Schools, offices, shops, etc...
- Ask participants if they are familiar with green infrastructure.
    - What do you think it is?
    - How does it differ from typical infrastructure?
    - Provide Definition: “the range of measures that mimic nature and earth’s natural systems to store, infiltrate, or have plants drink up stormwater and reduce flows to sewer systems or surface waters.”

PASS OUT GREEN INFRASTRUCTURE CARDS

(5 minutes)

- Pair up participants
- Allow participants 3 minutes to get familiar with their green infrastructure card, and ask any clarifying questions.

EXPLORE & EXPLANATION

(20 minutes): Infrastructure Tour

- Walk around the local neighborhood with a map to look for water and sewage infrastructure. They can also do this on their phones by saving a note in any map app they may have (Google maps etc)
- Have participants take notes of any green infrastructure they see, or of areas that they think would be appropriate to have green infrastructure (based on the card they were assigned).

ELABORATE

(20 minutes) - Green Infrastructure cards, back in the classroom

Display a map of the area using Google maps or another platform, and review the area that was just walked.

- *(Marking - 10 minutes) "Imagine that you are an urban developer."* Provide participants with a map printout of the area, or have them use their phones. Have participants mark on the map where they think their GI cards may fit in on the map based on the water and sewer infrastructure they found on their walk
- *(Presenting - 10 minutes)* Pull up the area on Google maps (on a large screen) and have participants present in pairs of where their GI cards would best fit into the map.
    - Have participants present what was on their card, where they would place the green infrastructure on the map, and why.
    - If their GI cards don't fit anywhere, ask if there is an area nearby where they might fit instead, or an area in their own community!

EVALUATE

(5 minutes) - Evaluate the importance of Green Infrastructure today. How imperative is it to have GI in neighborhoods?

- When does it come in handy the most?
- How else can green infrastructure benefit communities? (recreational, aesthetic purposes etc..)
- Is Green Infrastructure easily accessible for all people/communities?
- How can we work towards improving the accessibility/access to green infrastructure for all people/communities?

UNIVERSAL DESIGN LEARNING IDEAS

Engagement
Encourage students to verbally describe their neighborhood and the types of infrastructure they notice.

Expression
Allow students to either draw a map of their neighborhood and have them label the types of infrastructure present, or allow students to 'build' a replica of their neighborhood using small building blocks.

Representation
Present the concept of green infrastructure either through a tour of the local area where types of green infrastructure are pointed out, or present a video showing what green infrastructure is/ it's prevalence and importance in our cities.

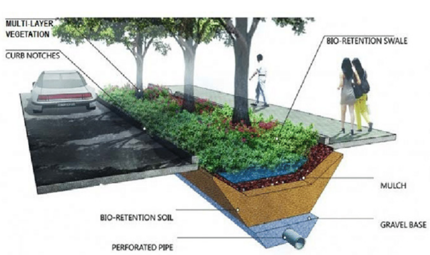
ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to orally identify and describe 2 forms of infrastructure found in their neighborhood (school, office building, bank etc..) Sentence starters or words will be introduced based on proficiency.

Students will be able to use the photos provided in the lesson to identify different types of green infrastructure (green roofs, bioswales, etc).

GREEN INFRASTRUCTURE CARDS

A rain garden is made up of local plants planted in a small depression, generally formed on a natural slope. It is designed to temporarily hold and soak in rain water runoff that flows from roofs, driveways, patios or lawns, and helps to remove most nutrients, chemicals and sediments from the runoff. Compared to a regular lawn, rain gardens allow for 30% more water to soak into the ground.



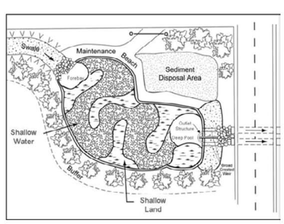
Bioswales are channels designed to collect stormwater runoff while removing litter and pollution. Bioswales can also be beneficial in filtering groundwater. Bioswales typically have plants growing in an area with gently sloped sides, with layers of mulch, soil, and gravel underneath.

A green roof (or living roof) is a roof of a building that is partially or completely covered with plants and a growing medium, planted over a waterproofing layer. It may also include other parts such as root barrier, drainage, or irrigation systems.

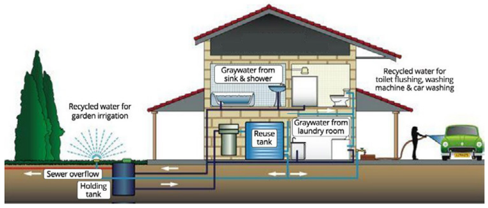
Permeable pavement is an urban surface designed to absorb water. It is usually composed of open pore pavers, concrete, or asphalt with an underlying reservoir (area for collecting water). Permeable pavement catches precipitation and surface runoff, storing it in the reservoir while slowly allowing it to soak into the soil below or drain out through a drain pipe.

A rainwater tank (or rain barrel) is a water tank used to collect and store rain water runoff, typically from rooftops via pipes.

Stormwater wetlands can have several treatment stages that include a sediment reservoir, wetland filter made up of gravel, shallow wetland system, and an outlet pool. The permanent water level is maintained just below the surface of the stone and vegetation. Stormwater is physically filtered as it passes through the stone, and biologically treated through plant uptake and soil microorganism activities. The biological treatment continues on the water that remains in the wetland even after the storm.

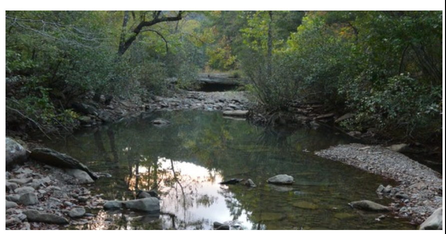


Graywater systems are onsite wastewater systems that use graywater (water from sinks, showers, and laundry) for landscape irrigation or recycling water. The graywater can be accessed through the use of mulch basins, holding tanks, or drip irrigation fields.



A garden is a planned space, usually outdoors, set aside for the display, cultivation, or enjoyment of plants and other forms of nature. The garden can incorporate both natural and human-made materials.

A stream buffer is a planted area (a "buffer strip") near a stream, which helps shade and partially protect the stream from the impact of land uses. It plays a key role in increasing water quality in associated streams, rivers, and lakes, thus providing environmental benefits.



A storm drain is infrastructure designed to drain excess rain and ground water from surfaces like paved streets, parking lots, footpaths, sidewalks, and roofs.

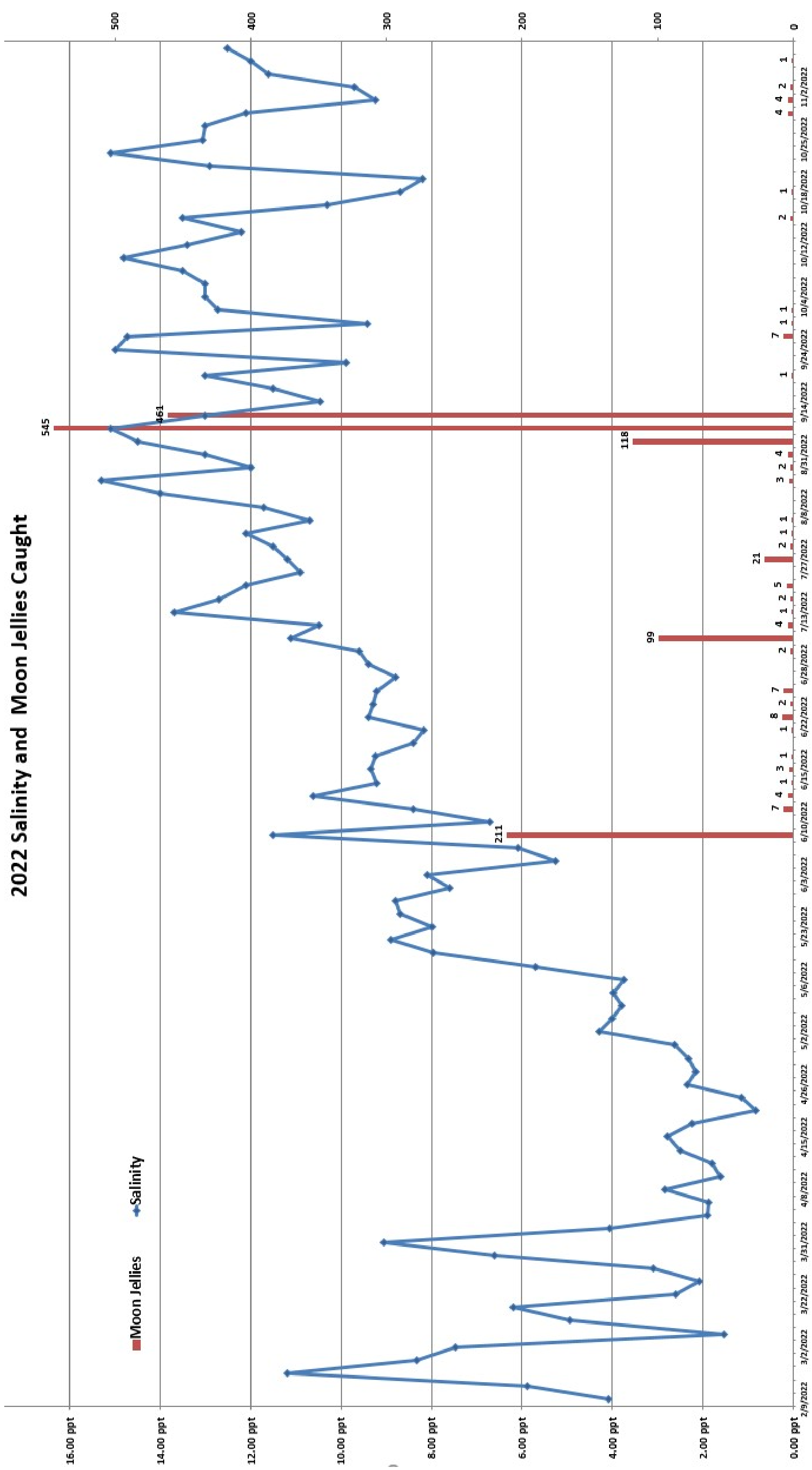
Using the I-squared strategy for data analysis

GRADES 6–8

Analyzing graphs can be overwhelming. One way to help scaffold graph analysis with your students is using the I-Squared strategy, by the Biological Sciences Curriculum Study. This strategy helps you make sense of graphs, figures, sketches and other ways of showing data.

See breakdown of the strategy here: https://media.bscs.org/icans/Icans_I2_SE.pdf

We have provided some graphs of data taken of the Hudson River, so you can practice this strategy with your students, while making connections to the watershed!


2022 Salinity and Moon Jellies Caught
Moon Jellies
Salinity
0.00 ppt
2.00 ppt
4.00 ppt
6.00 ppt
8.00 ppt
10.00 ppt
12.00 ppt
14.00 ppt
16.00 ppt
0
100
200
300
400
500
2/9/2022
3/2/2022
3/22/2022
3/31/2022
4/8/2022
4/15/2022
4/26/2022
5/2/2022
5/6/2022
5/23/2022
6/3/2022
6/10/2022
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7/13/2022
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8/8/2022
8/31/2022
9/14/2022
9/24/2022
10/4/2022
10/12/2022
10/18/2022
10/25/2022
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2 99 4 1 2 5
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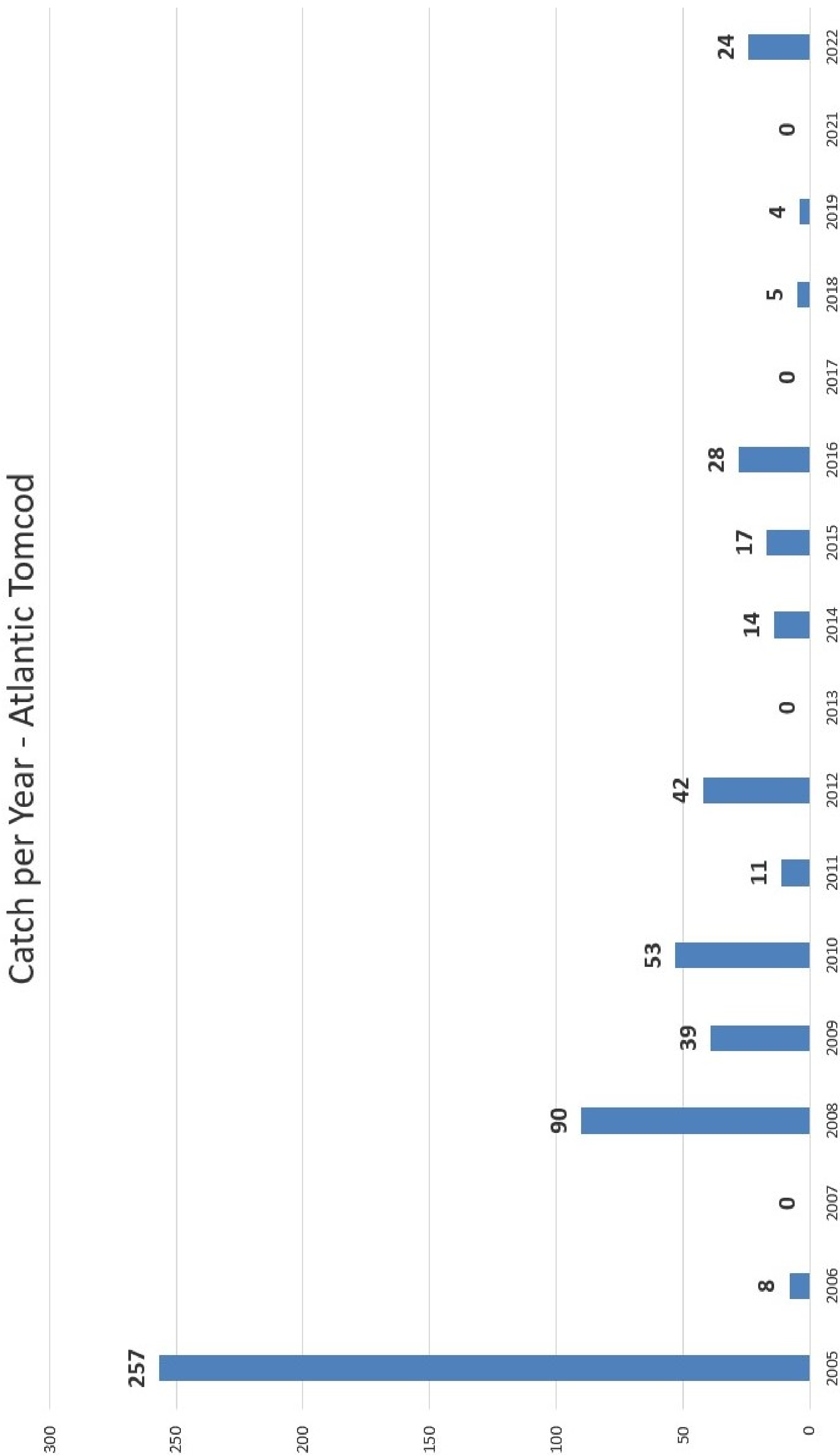
1 7 1 1
2 1
4 4 2 1


Catch per Year - Atlantic Tomcod
300
250
200
150
100
50
0
257
8
0
90
39
53
11
42
0
14
17
28
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2019
2021
2022

GROUNDWORK Hudson Valley — CHANGING PLACES CHANGING LIVES

In partnership with:

SARAH LAWRENCE COLLEGE — CENTER FOR THE URBAN RIVER AT BECZAK

Weather vs. Climate

GRADES 6–9

I.A: WEATHER VERSUS CLIMATE-OVERVIEW

Key Concepts and Web-app Resources

Every day, we dress for the weather. One day to the next, our outfits reflect if we expect mild, cold, or hot conditions, or if it is supposed to be clear, windy, or rainy outside. Weather is changeable from day to day, and sometimes a bit unpredictable, because it is shaped by even the smallest energy shifts in our atmosphere, oceans, and land masses. Our daily outfit choices are representative of the ***weather***. Still, we are unlikely to go from wearing a bathing suit on the beach to a heavy coat within a week's time. Instead, we might expect to swap out our closets on a seasonal basis. Our year's wardrobe is akin to the local range of weather conditions averaged out throughout the seasons, or in a word-***climate***. Scientists use weather averages for a period of 30 years or more to determine climate conditions, and climates can change over time, with variations of vegetation, ice cover, or atmospheric composition. However, these shifts are typically subtle and slow.

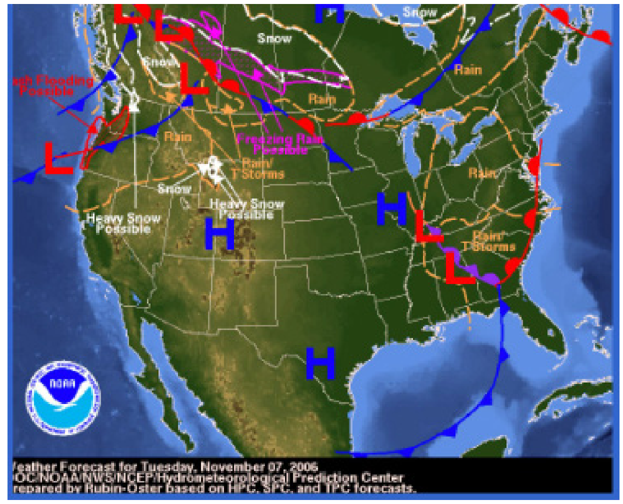
Earth's climate interacts with the regional landscape to create ***biomes*** of flora and fauna that are well-adapted to the annual temperature ranges and amount of precipitation that is expected there. When the local climate changes slowly, plants and animals either adapt or move their ranges to more suitable conditions over time. Because the climate system on Earth is so complex, it usually takes thousands or millions of years to show meaningful change. Still, ***Earth's climate has changed many times in its 4.6 billion year history***, and it has had enormous consequences to life, as evidenced by the fossil record. What would happen if Earth's climate system changed rapidly? Life as we know it depends on climate stability-from our farmlands to our coastlines, to our cities and roads. Humans can adapt, but only if given access to meaningful and accurate data, and the time and means necessary. ***Climate science*** is integral to adapting to a changing planet.

The way scientists study Earth's climate system is also changing with technology. Now, sophisticated measuring instruments are sent into our atmosphere via weather balloons, into orbit via satellites, and into the oceans on ships and buoys. Then, computers can use that real-time data to perform complex calculations, run simulations with input variables, and map out recent past, present, and predicted future conditions.

I.A: WEATHER VERSUS CLIMATE-CLASSROOM ACTIVITY

LESSON

What is the Difference Between Weather and Climate



SUBJECT / GRADE LEVEL

6th-9th grade, Earth Science

MATERIALS

Mini "fun-size" bags of M&Ms, worksheets, computer for webapp content. Alternatively, bags with different color beads can be prepared ahead of time. Optional: special event M&M packs with different, or limited colors to represent different climate regions.

NGSS STANDARDS

ESS2.C: The Roles of Water in Earth's Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-S)

ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

LESSON OBJECTIVE(S)

Students will understand the difference between weather and climate as well as how they are related. Students will learn the difference between trend and variation. Students will be able to graph the changes of weather over time and see if there is a trend within the variation. Students will be able to identify at least 3 distinct climates found around the world.

ENGAGEMENT

(5 minutes)

- Ask students to describe the current, local *weather*. Do they know what it'll be like tomorrow or the coming weekend? Are they as are sure about the forecast next week, or next month, as they are about tomorrow's?
- How much is the weather likely to change from day to day? Though it might go from rain to sun, will it go from snow to a scorcher?
- How would they define their *climate*? Are they in a temperate zone with four distinct seasons? Are they semi-tropical with plenty of rainfall, but very mild winters? Are they in an arid region, with hot summers and without much precipitation? Does their climate change from day to day or even year to year?

EXPLORATION

(20 minutes)

- Depending on your supply of M&M bags, have students work individually or group them into teams.
- Make sure each student has a worksheet with the reference key and table to chart their results.
- Ask the class as a whole to identify the colors expected in the typical M&M bags. Tell them to imagine that each color represents a different weather expectation. Have them define each color's weather (e.g.: yellow is sunny and mild, orange is warm and dry, red is hot and humid, brown is thunderstorms, green is cool and rainy, blue is cold and windy). If using any special-holiday packs to represent different climate regions, you may need to assist with those. Do not tell them how they might define their climate pack just yet.
- Distribute the M&M bags. Optionally, you can have a few individuals or teams get a special-event pack. These can be purchased seasonally in grocery stores, on amazon.com, or from the M&M on line store. (Fall Harvest pack is good for representing either arid or tropical climates, Baby Boy pack is good for representing tundra).
- Following the worksheet directions, students should pull one M&M at a time out of the bag, and record the associated weather condition as a new day each time, until they have completed 10 days on the table.
- Students can continue using the worksheet, answering questions about percentage and what climate their bag/selections may represent. They may use the **Koppen Climate Classification** map on the back of the worksheet provided for reference.

EXPLANATION

(15 minutes)

- Have students present their conclusions to the classroom about the difference between weather and climate and what particular climate they had based on the 10 M&M's they drew.

- Using the web-application, show them the following video on **Trend and Variation:**
  > **Climate Science»Climate vs. Weather»>Trend and Variation**
  (also found here: https:ljyoutu.be/e0vj-0imOLw)

- The *dog* represents the *weather* and the *owner* represents the *climate*. The dog is tethered to the owner via a leash, so while his one movement to the next may vary, his range is fixed by the leash, and his general direction over time is the same as the owner. Ask students if they can provide any additional analogies to describe weather vs. climate? E.G.: outfit vs. wardrobe; a play during the Superbowl vs. the team's entire football season averages; seashells washing onto shore vs. the whole beach.

- **Ask:** How many years of weather data do you think is necessary to reliably determine a region's climate?Hint: We need to find a trend emerging from the day to day or season to season variations.
  A: 30+ years.

ELABORATION

(10+ minutes)

- Though day to day weather is somewhat unpredictable, climate IS typically predictable. Why is climate predictability so important? If they don't offer, give them leading suggestions:

  - Agriculture: it helps farmers determine what they can grow year to year.

  - Seasonal Weather Extremes: It helps governments, communities, and emergency responders anticipate and prepare for extreme weather, like hurricanes, tornadoes, and heat waves.

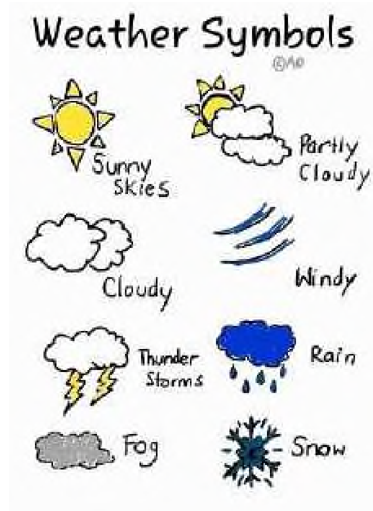
  - Economy: tourism/hobby industries rely upon this for their businesses, like skiing, beach resorts, etc.

- Using the web-application, show them the following video on Weather vs. Climate:
  > Climate Science»>Climate vs. Weather»>What is Climate? (UEN Climate Science Series)
  (also found here as Episode 2: https://www.uen.org/climate/videos.shtml)
- Re-state the complexity of our climate system: **"When energy from the Sun interacts with the atmosphere, oceans, land, ice, clouds, and living things on earth, it creates the climate."**
- **Ask:** How do you think scientists know the global climate is changing? How do you think scientists can track global changes given our climate system's complexity? Why is rapid climate change a concern?

To explore Groundwork Hudson's Valley entire Climate Change Curriculum, please visit:
https://www.groundworkhv.org/programs/sustainability-education/climate-change-curriculum/

I.A. WEATHER VERSUS CLIMATE—WORKSHEET

Name: ______________________________



Experiment (adapted from activity by Westerville School in Ohio)

1) As a class, define different type of weather for each M&M candy color.

Brown- ____________________
Yellow- ____________________
Blue- ____________________
Green- ____________________
Orange- ____________________
Red- ____________________

Optional Colors (Op):
1________-______________
2________-______________
3________-______________

2) *Each person or group will get a small bag of M&M's. (DO NOT EAT THEM… *yet*). This bag represents the different weather we can see on a daily basis.

*Each person or group will, without looking, pick one M&M from their bag and place it in front of them. That M&M current weather conditions.

The weather today, according to your M&M is

____.

3) Continue drawing M&M's one at a time and record the corresponding weather in the table below.
This represents weather… the unpredictable daily happenings of what is going on outside.

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Weather										

If you look at the weather over a longer period of time, (for example, each M&M represents a different day patterns start to emerge. You are starting to pin down the climate....

4) Next, pour out all your M&M's on the table and compute a percentage for each color for your tab (Remember… color divided by total number multiplied by 100) This is **climate**.

Conclusion:

Color/Weather	**Percentage**
Brown:________________	
Yellow:________________	
Blue:________________	
Green:________________	
Orange:_______________	
Red:_________________	
Op1_______:__________	
Op2_______:__________	
Op3_______:__________	

If you give someone a fresh bag of M&M's, you can't predict the weather—whether the next candy out of the bag will be blue or orange—but you can predict trends in the weather. You can say, with confidence, that there won't be 100% orange candies in the cup. That would be very unlikely!

5) So… The difference between weather and climate is:

____
____
____
____

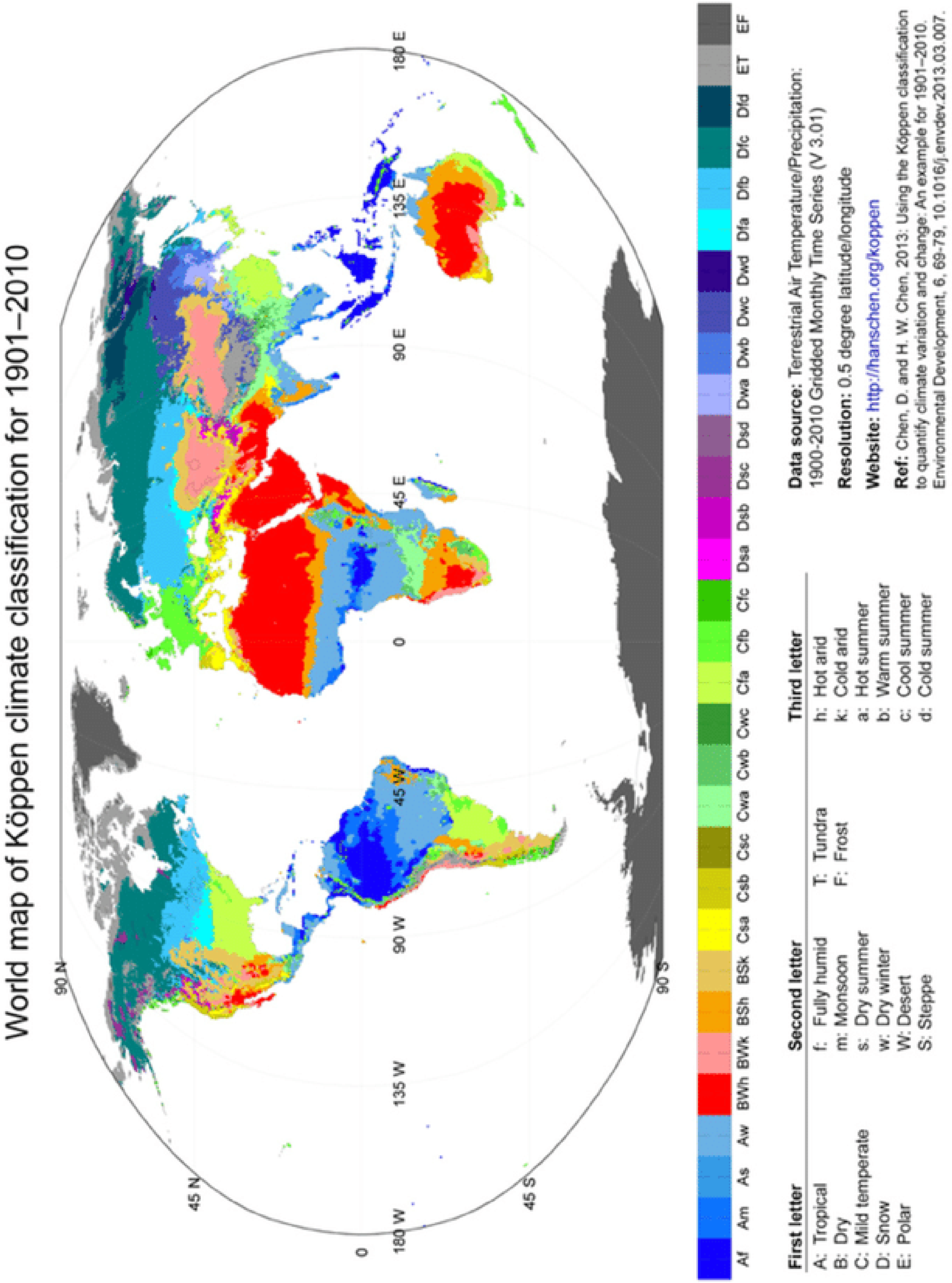
6) How would you describe your local *climate* based on the results from your particular bag of M&M's*?

____

**If some individuals/groups were given alternatives to the classic M&M bag (ie: Harvest Bag or Baby Boy) their colors will be different—and thus the range of weather conditions and climate would be different!*

I.A. WEATHER VERSUS CLIMATE—WORKSHEET

Name: ____



NEW YORK STATE | Department of Environmental Conservation

American Eels Data Trends

GRADES 6–8, OTHER GRADES AVAILABLE

Topics: Life cycle, migration, community science, adaptations, research
Grade Level: Middle School

BIG IDEAS

- Animals adapt over time.
- Organisms require a supply of energy and materials for which they are often dependent on or in competition with other organisms.
- American eels are an important part of the ecosystem.
- American eels have multiple habitat requirements throughout their life cycle.

LEARNING OBJECTIVES

Students will be able to...

- Analyze and interpret data to plot the migratory path of glass eels.
- Identify the behaviors and adaptations that allow animals to survive in their environment.
- Analyze and construct scientific explanations that changes to physical or biological components of an ecosystem affect populations.
- Model how eels use resources in their environment for every part of their life cycle.

NEW YORK STATE SCIENCE LEARNING STANDARDS

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms in a variety of ecosystems.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

KEY UNDERSTANDINGS

- Organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
- Organisms engage in characteristic behaviors that increase the odds of reproduction.
- Multicellular organisms have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
- Organisms can change their physical structures and their behaviors over their life cycle to better adapt to their environment and to meet their basic needs.
- The shapes and kinds of land and water in any area can be mapped.
- American eels use different habitats throughout their life cycle and travel long distances.

ESSENTIAL QUESTIONS

- How do animals adapt to their environment to survive?
- How does an animal's external structures help it survive?
- How can disruptions to an ecosystem lead to shifts in populations?
- How can populations change over time?
- Why do some animals migrate throughout their lives?

STUDENTS WILL KNOW…

- What a life cycle is, and the sequential life stages of the American eel.
- Key vocabulary terms.
- Eels rely on many different habitats during their life.
- The migration patterns of the American eel.
- How to read graphs and analyze trends over time.
- Scientists, including students and their teachers, contribute valuable data that helps scientists study changing eel populations.

VOCABULARY

Adaptation: a feature that allows an organism to deal with environmental conditions.

Behavioral adaptation: an adaptation involving the way an animal acts.

Physical adaptation: an adaptation involving the form of an organism.

Estuary: a body of water in which fresh and salt water meet.

Habitat: the place where a given plant or animal lives,

Life cycle: the stages of form and activity through which a living thing passes as it develops from a beginning stage to an adult able to reproduce and restart the cycle.

Migration: the movement from one place to another.

LEARNING PLAN

We recommend doing these lessons in sequential order; however they can be done as individual lessons. Lessons have multiple links (videos, songs, diagrams, activities) that can be used at the teacher's discretion depending on class time.

PRE-ASSESS

How do eels know where to migrate to? Use informational surveys/questionnaires/inventories, K-W-L or I notice/I wonder to assess students' prior knowledge, have students write or draw in response to the essential questions. Use the eel poster to show students the migration, and life stages of the American eel. Have students discuss and make a T-chart about which challenges eels might have in their migration and hypothesize what structures/behaviors could help with that migration.

PROGRESS MONITORING

Formative assessment and teacher feedback should be ongoing throughout the lessons. Teachers should develop assessments based on their individual class needs. Think-pair share, exit tickets, interactive discussions, questions and listening, informal observations, quizzes and student work samples can all be used.

LESSON 1: COMMUNITY SCIENCE IN ACTION

Students watch a video and learn about eels through a PowerPoint presentation, then complete a worksheet on eel biology.

- Hudson River Eel Project
- Migration of the American Eel Presentation & Student Worksheet

LESSON 2: MAPPING THE MIGRATION OF AMERICAN EELS

Students follow the life cycle of the American eel by mapping their migration routes. Using graphs and videos students pose questions about eels and their reliance on many aquatic habitats.

- American Eel Mapping Video & Poster
- Animation Video: The Life of an Eel
- Mapping the Migration of American Eels Student Activity, Student Worksheet & Map
- Conservationist for Kids Magazine: Explore the Hudson River
- Extra: Meet the Fish Video: American Eel

LESSON 3: EEL RELAY RACE

Students will learn about the different life stages of the American eel through an active relay race.

- Eel Relay Race Student Activity

LESSON 4: DATA TRENDS OVER TIME

Students will analyze and interpret eel data trends over time at various tributaries along the Hudson River.

- Hudson River Eel Project Data Analysis PowerPoint Activity & Data Excel Spreadsheet
- Video: The shocking truth about eels
- Extra: Eel Migration in the Hudson Estuary
- Extra: Article on Eel Poaching

Teachers: Would you like to visit us at Norrie Point environmental education center, or have an educator visit your classroom in-person or virtually? Contact us to schedule a program: hrteach@dec.ny.gov

RESOURCES

To explore the Department of Environmental Conservations Hudson River Unit, including the Eels Lesson Plan for other grades, please visit https://www.dec.ny.gov/education/25386.html.

Websites:

- The Hudson River Eel Project (NYSDEC)
- U.S Fish & Wildlife Service Eel Page
- All about American Eels Infographic (PBS Nature)
- Video: The Mystery of Eels & Eel Project (PBS Nature)
- Chesapeake Bay Program American Eel

Books:

- The Hudson: An Illustrated Guide to the Living River by Stephen Stanne, Roger Panetta, Brian Forist & Maija Niemisto
- Eels: An Exploration, from New Zealand to the Saragasso, of the World's Most Mysterious Fish by James Prosek
- The Book of Eels: Our Enduring Fascination with the Most Mysterious Creature in the World by Patrik Svensson

Environmental Justice

GRADES 4–12

WE ACT for Environmental Justice has launched a series of free online learning modules for children in grades 4 -12. These mini lessons provide students – and their parents – with an introduction to the basic concepts of environmental health and environmental justice.

Please visit WEACT's website for the mini modules.

Native Land
GRADES 6–12

Native Land Digital strives to create and foster conversations about the history of colonialism, Indigenous ways of knowing, and settler-Indigenous relations, through educational resources such as our map and Territory Acknowledgement Guide.

Please visit Native Land's website and teacher's guide.

The Built Environment
GRADES 11–12+

THE BUILT ENVIRONMENT, FAMILY PROCESSES, AND CHILD AND ADOLESCENT HEALTH AND WELL-BEING

The built environment impacts multiple components of child health and well-being through direct impacts on the child and through impacts on family interactions and processes. In this session, we focus on the impacts of the physical environment (toxins and pollutants, food and water insecurity, lighting and temperature, noise, crowding, chaos, and housing quality) on family processes and on interactions of children and adolescents within home environments and extensions of home (nearby play spaces, after-school settings, and youth centers). We also briefly discuss impacts on two extensions of home, child and sibling school and childcare environments and sibling and caregiver work environments. We focus specifically on several family processes that are known to be impacted by key aspects of the physical environment, namely parenting practices, attachment, caregiver-child relationships and interactions, sibling relationships, family routines and rituals, family conflict, interpersonal aggression, child maltreatment, and social support (including social capital and social networks). We consider both the spaces that children, adolescents, and their families inhabit and the materials that make up those spaces and are embedded within them, such as structural quality, ambient conditions, food, water, books, and play materials outside of the home. We also discuss both the opportunities and constraints (affordances; Gibson, 1979) of various spaces and materials. Following this review, we discuss needed actions for change based on the extant literature, gaps in the work to date, and potential avenues for future research. We pay particular attention to racial and socioeconomic inequalities in both exposure to adverse environmental conditions and access to positive physical resources.

OBJECTIVES

- Discuss key components of the built environment impacting child health and well-being, as well as family interactions and processes.
- Identify key opportunities and constraints (affordances) of various spaces and materials, with a focus on opportunities for action for historically underrepresented and underserved communities.
- Engage in active play with recyclable, found, and natural materials as one potential action step for underrepresented and underserved children and their families.

MATERIALS

- PowerPoint slides with images of play spaces: Ferguson_Evans_Built_environment_family_processes_TTE_2022.pptx - Google Slides
- Recyclable and other found and natural materials, including cardboard boxes, plastic containers, string, fabric, pinecones, scrap wood, chalk, scissors.

AGENDA

1. Discuss the built environment & children's health and well-being, referencing slides 2-3 .
2. Discuss family interactions and processes within a bioecocultural context, referencing slides 4-6.
3. Discuss the built environment and family processes, referencing slides 7-28 .
4. Discuss cumulative risks experienced by vulnerable families, referencing slides 29-30.
5. Discuss Community Adventure Play Experiences (CAPEs) as one potential positive intervention strategy for children and their families, referencing slides 31-34 .
6. Explore recyclable and other found and natural materials in a facilitated Community Adventure Play Experience (CAPE).

UNIVERSAL DESIGN LEARNING IDEAS

Engagement
Include interactive discussion of each key topic to engage all participants actively in the discussion.

Ask students questions throughout the session, highlighting key questions they have and key contributions they make. Help them connect their questions and comments with those of their fellow students. Add additional information, questions, and framing as the discussion unfolds.

Expression
Encourage students to share their thinking and questions throughout the session.

Highlight key take-homes throughout the discussion, verbally and in accompanying PowerPoint slides.

Conclude the discussion with an active participatory play event to enable participants to experience a potential application of the discussion.

Representation
Highlight key take-homes throughout the discussion, verbally and in accompanying PowerPoint slides.

Define key terms throughout the discussion.

ENGLISH LANGUAGE LEARNING OBJECTIVES

Students will be able to define the terms "built environment" and "children's health and well-being" and explain some of the factors that influence each.

Students will be able to define the terms "family processes" and "family interaction."