

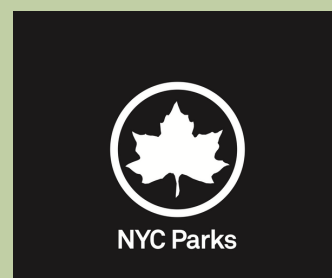
# SPARKS!

A STEMteachersNYC and  
NYC Parks partnership



## LESSON PLAN

# WATER EXPLORATION AND CONSERVATION





# Water Exploration and Conservation

**Developed by:** Dr. Grace Sanvictores and Michelle Velho

## **WILDLIFE, STEWARDSHIP, RESTORATION, RESILIENCE!**

The STEM in Parks (SPARKS) project is a unique opportunity for teachers to collaborate in small local STEMteacherNYC teams with research scientists and education staff at NYC Parks and learn to use a local park as a local outdoor lab, to help students and colleagues connect to, understand, and care for local ecosystems and their communities. Participating Parks divisions include Environment & Planning; the Wildlife Unit; Sustainable Facilities; and MS4 Compliance. Participating SPARKS teachers will collaborate with Parks colleagues and will together produce place- and/or research-based, standards and curriculum integrated lessons, focused on the ongoing, dynamic, research projects of Parks Divisions.

## **TEAM OVERVIEW & HISTORY**

Our school's integration of STEAM (Science, Technology, Engineering, Art, and Math) in the curriculum has resulted in numerous wonderful accomplishments that have had a profound impact on both our students and the wider community. Through a multidisciplinary approach to learning, our students have been able to develop skills that will enable them to thrive in the ever-changing world. The integration of STEAM in our curriculum has enabled students to learn beyond the boundaries of traditional academic subjects and has allowed them to develop a more comprehensive understanding of the world around them.

Our Elementary and Middle School STEAM program partners each year with local and regional organizations that support conservation and revitalization in the local and global community.



# About the Wetlands Team

The Wetlands Team is part of the Natural Resources Group in NYC Parks Division of Environment & Planning. NRG's work encompasses natural areas restoration projects and pre/post monitoring. Naiyiri's project portfolio includes Salt Marsh Restoration Assessments in NYC salt marshes and Stormwater Discharge Research in the streams of Arden Heights Woods, Staten Island. Both projects use Naiyiri's expertise in Benthic Ecology and Benthic Invertebrate Identification.

## POTENTIAL RESEARCH TOPICS INCLUDE:

- Freshwater benthic invertebrate assessment, which includes benthic invertebrate samples taken from a freshwater body of water (Pond, River, Stream) and identified in a lab or classroom setting.
- What do specific freshwater species say about the environment that they live in (Pollutant tolerant/Pollutant sensitive)? How does this data help NYC Wetlands in the long run?
- What importance do benthic invertebrates have on their ecosystem and environment
- Virtual water consumption and Food production
- Rivers of the world - World Water Day and Food World Day (SDG's)
- Cold Water Conservation (Trout in the Classroom)
- A Day/Week in the Life of the Hudson River (chemical, biological, physical properties of the Hudson)
- Exploring Human Impact
- Effects of Climate Change

**Naiyiri-Blu Brooker, Wetlands Project Associate**



# Goals and Outcomes

## **IMPROVE UNDERSTANDING OF WATER ECOSYSTEMS**

Water is connected to nearly every aspect of our planet's ecosystems and is a major factor in many other serious environmental issues such as deforestation, pollution, and climate change. As our planet's population continues to rise, one of the most pressing environmental crises is our global supply of fresh water. Our middle school students researched global water scarcity and related topics. By delving into the Global Water Scarcity Issue, they gained a deeper understanding of the challenges faced by people around the world. Their research on water footprint helped them identify ways to reduce water consumption and develop practical solutions to this complex problem. The videos they created highlight the importance of sustainable food choices and the role of individuals in reducing their water footprint. The posters they presented to elementary students showcase blue, green, and gray water, which are important concepts in water conservation. By sharing their knowledge and insights, the middle school students are making a positive impact on the world and inspiring others to take action on this critical issue.

## **IMPROVE UNDERSTANDING OF RIVER SYSTEMS**

Rivers are a vital component of the earth's ecosystem, providing numerous benefits to both humans and the environment. One of the most significant contributions of rivers is their role in supplying food to the world's population, as they support the growth of crops and provide a source of fish and other aquatic life. Throughout history, rivers have been essential to human settlements and have played a critical role in the development of many civilizations. However, many rivers are facing threats such as pollution, habitat destruction, and over-extraction of water, which can have severe impacts on their health and the ecosystems they support. It is crucial to keep rivers flowing and healthy to maintain their essential functions and ensure the sustainability of the planet's ecosystems. By protecting rivers, we can ensure that future generations continue to benefit from their many valuable contributions.





# Goals and Outcomes

## CREATING COMMUNITY AWARENESS AND OUTREACH

The Microplastic exhibit highlights student's research on microplastics and the ways to reduce their presence in our waters is both timely and relevant.

Microplastics, which are tiny particles of plastic that have accumulated in the oceans and waterways, pose a significant threat to marine life and human health. By examining the different ways to reduce microplastics, the students demonstrate a commitment to finding sustainable solutions to this critical issue. This research involved exploring methods such as reducing plastic usage, proper waste disposal, and the use of alternative materials. By taking a proactive approach, the middle school students help contribute to the development of sustainable practices that will protect the environment and promote a healthier planet.

## COMMUNITY PARTNERS

New Jersey Department of Environmental Protection (Liberty State Park), New York State Department of Environmental Conservation, BOP, NY/NJ Harbor Estuary, and New Jersey City University.





# Lesson Plan: Water Exploration and Conservation

## Standards linkages

- Ecosystems: MS-LS2-5
- Earth and Human Activity: MS-ESS3-2, 4, 5
- Engineering Design: MS-ETS1-1
- Earth's Systems: MS-ESS2-5; MS-ESS3-5

## Materials

- <https://www.watercalculator.org/>
- <https://www.fao.org/world-food-day/en> <https://www.fao.org/world-food-day/contest/en>
- Plastic Free Lunch Day
- <https://www.troutintheclassroom.org/docs/lesson-plans/stem-learning/>

## Essential Questions

- How do I/we use water?
- How does food consumption impact global water availability?
- What are the differences between salt, fresh, and brackish water?
- How does climate change affect each type of water?

## Resources

- [Rivers of the World Display](#)
- [Rivers of the World Sample Newsletters](#)
- [Google Photos \(SS FAIR\)](#)
- [Virtual Water Food Videos \(Grade 6-7\)](#)
- [Virtual Water Infographic Posters](#)
- [Rivers of the World Infographic Posters](#)
- [Threats to Trout infographic posters \(Climate Change\)](#)



# Lesson Plan: Water Exploration and Conservation

## Engage (15 mins)

Students will be estimating the proportion of portable (ask students what potable means) water in the world and compare it to the rest of the water on Earth. Students can work in small groups. Provide students with a large circle, this will represent their planet Earth. Students will be tearing up 2 sheets of different colored paper into 100 pieces in total. Ask students to estimate using the pieces to represent potable water and the rest of the water on the planet.

## Explore (25 mins)

Have students calculate and estimate how much potable water 1,000 ml of water to represent all the water on Earth. Using a globe, ask students where they believe most of the water on Earth is located. Ask students to pour 30ml of the water in a 100ml graduated cylinder (this represents Earth's fresh water. Pour sal on the remaining 970 ml to simulate the salt water found in oceans, not available for human consumption (non potable). Ask students to locate the Earth north and south poles on the map or globe. 80% of freshwater is frozen. Pour 6 ml of fresh water into a small dish and place the rest (24ml) in a nearby freezer or ice bucket. The water in the dish is 0.6 of the total. 1.5 ml of this water is surface water and the rest is underground. Use a dropper or a stirring glass to remove a single drop of water into a metal bucket. Make sure students are quiet so that they may hear the drop in the bucket. This represents the clean fresh water that is not polluted. This is 0.003 % of the total! This is what they need to manage properly.

## Explain (20 mins)

Have students complete a water availability table to calculate the actual amounts. Students may go back to their engage activity and reconstruct their estimates. One half of the pieces of small paper represent available water or 0.5 %. Only one small corner of the half piece is potable water or 0.003 percent.





# Lesson Plan: Water Exploration and Conservation

## Extend (25 mins)


Have students research on water use in the United States. Refer to USGS (United States Geological Survey) data to understand how much water is used by diverse water users in the United States, then compare with the Global Crises. Use the Global Crises article. Have students do an internet search to determine the current world population for 2025 and 2050. Based on these projected population growth, have students discuss the impact that this growth will cause and possible solutions.

## Evaluate (35 mins)

Have students create infographic posters on how to conserve water. Refer to the [Water Calculator](#) website on ways to save water. Students may also develop a TV commercial outlining reasons why water is limited and also a renewable source.

[A Drop in the Bucket by Project Wet \(Curriculum and Activity Guide 2.0\) p. 257 - Elementary/MS](#)





# Lesson Plan: Water Exploration and Conservation

## Fieldwork and Outdoor Connections


Students may not realize that a river and lake must meet certain health standards if its waters are to be used for particular activities, such as swimming, fishing, or boating. Testing and measuring water quality are required to determine whether bodies of water meet specified water quality standards. These activities examines quality of water body (local or regional) through data collection.

- Water parameters include salinity, dissolved oxygen, turbidity, water temperature, and tide observations.
- Measuring macroinvertebrate population - Water Quality? Ask the Bugs! Project Wet pg. 421

## Understanding Sustainability

In 2015, the United Nations General Assembly adopted the Sustainable Development Goals. 193 member states committed themselves to monumental global change by 2030. Goal 14 focuses on protecting and strengthening the reliance on biodiversity of fish producing ocean ecosystems by reducing production waste while promoting more sound forms of energy development (ESS3). Many of the development practices focused on sustainability; finding balance between the needs of societal progress and the environments that support humans.

Our whole school launched the Cafeteria Culture, Plastic Free Lunch initiative. Students explored and reflected their personal habits and how they contribute to the disruption of marine ecosystems. MS-ESS3-3: Addressing plastic pollution in our oceans. Each of the classrooms counted their single use plastics as our middle school students produced graphs to analyze and make predictions. They learned 8 million tons of plastic ends up in our ocean every year and by 2030, there will be more plastics (by weight) than fish. This lead our students to research alternatives to these products that are more sustainable and perform the same function. A compost bin was built and installed.



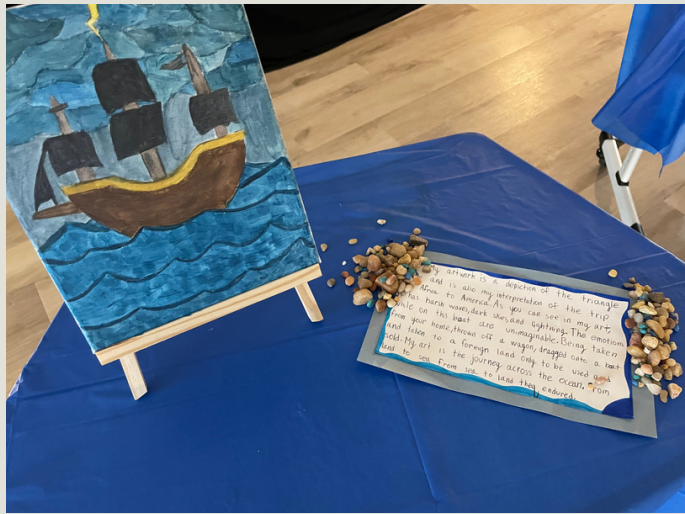
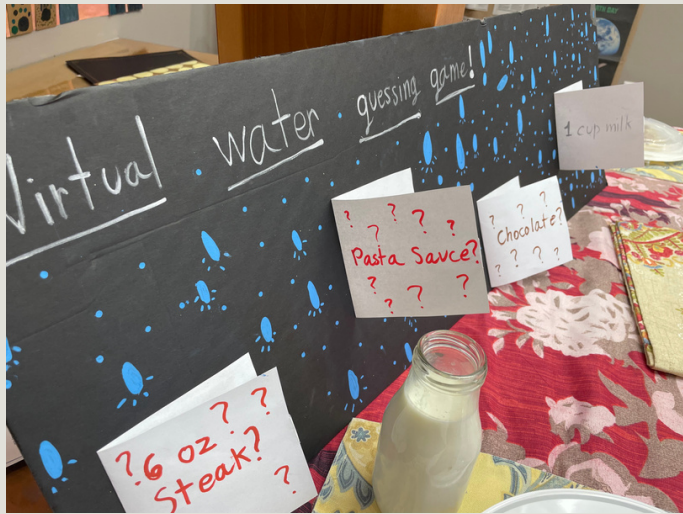
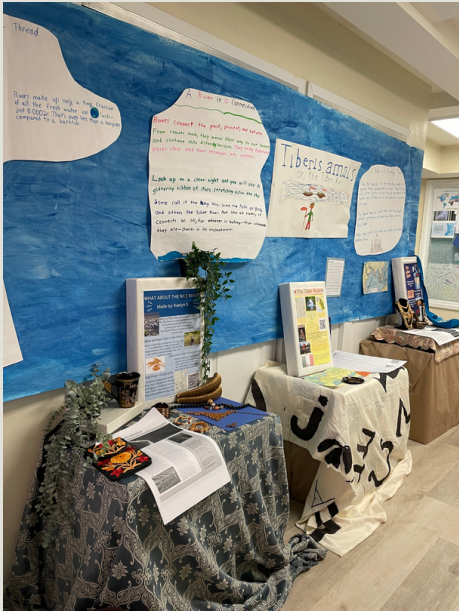
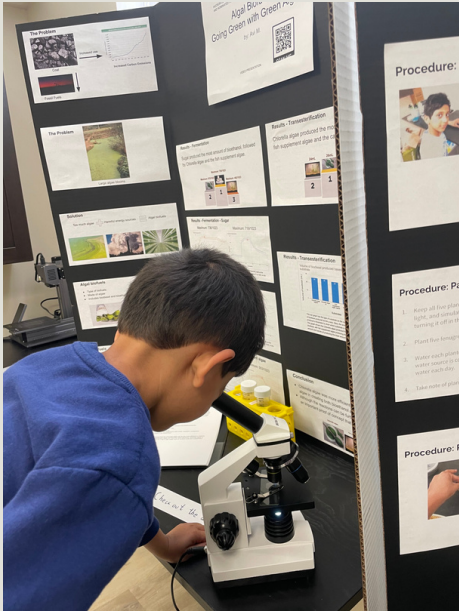
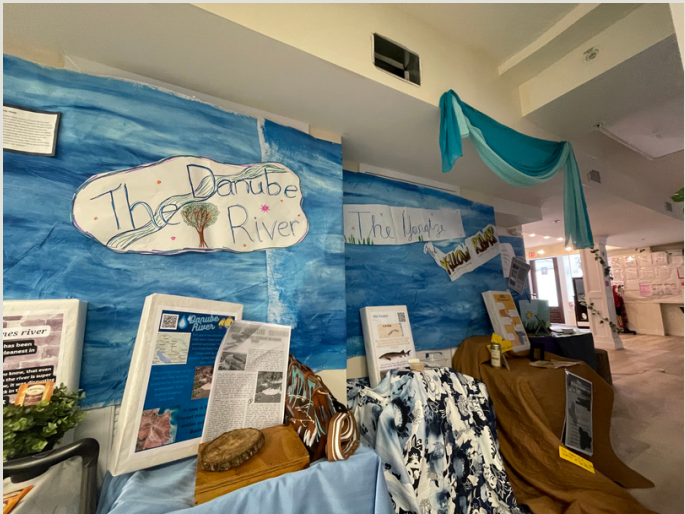




# Resources



# Rivers of the World Display and Fair 2023





# CLIMATE CHANGE V.S. TROUT

What are trout? What is their relevance to climate? Why do I in particular need to know this?

Trout are important species in our ecosystem. Let's talk about ways to protect them

Now that you know the correlation of the two topics, we should move onto the topics individually, starting with trout themselves.

As said, trout are vital species in the food chain, as most other animals. Trout are very sensitive about the temperature they can survive in, and are not very adaptable, such as other fish like mummichogs. Climate change is slowly increasing the temperature in the homes of trout, decreasing mortality rates. As climate change is mainly caused by humans, we should make our best efforts to help trout survive.

1. Rainbow
2. Cutthroat
3. Golden
4. Brown
5. Lake Trout
6. Brook
7. Dolly Varden
8. Bull
9. Tiger Trout
10. Splake
11. Palomino
12. Gila Trout
13. Apache
14. Marble



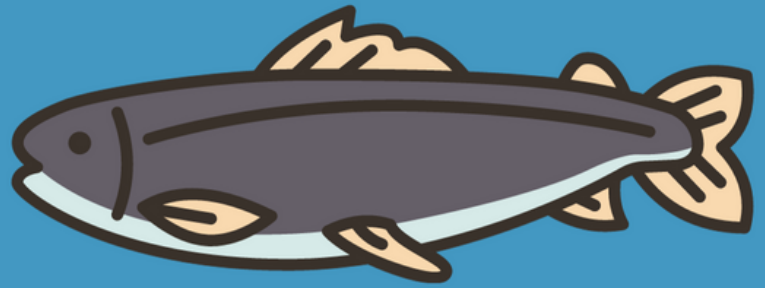
Trout need cold, clear water to survive and grow. The ideal temperature for trout is between 40°F and 68°F, but can still survive temperatures as low as freezing and as high as 77°F. Trout like to live in snow melt, underground springs, and rainfall feed streams and use trees and vegetation as shade, in which they can cool off and hide. The trout consume leaves that degrade from the vegetation and other insects. As there are many habitats in a stream, trouts change their home as they grow; young trout live in shallow waters near banks, and slowly shift to deep pools. Another popular place for trout are ripples, areas with running water filled with reliable food supply and oxygen, along with excellent hiding spots (in rocks) for trout.

Climate Change... In simple words, it's the world heating up due to human interactions. But how? We tend to exhaust certain chemicals, known as greenhouse gases, into the atmosphere. Some of the main gases are Carbon Dioxide and Methane. These are released from factory production (the ones with big smoke), agriculture (animal excretions and deforestation), and fossil fuel use (electricity, fuel, etc.). What can we do? Start by using more eco-friendly products and transportation methods! Raise Awareness! Research! Cut down meat consumption! Everything helps!

Wow, the different species of trout are so interesting, but what about climate change? And what can we do to help?

By: Seher Khetpal

# How does acid rain affect Trout?



## About Trout

Trout need cold, clear and fresh water to live. The vegetation that borders the banks make the river stable and shady. Trout stay in small riffles which is shallow and quick water. The fast current oxygenates the water.

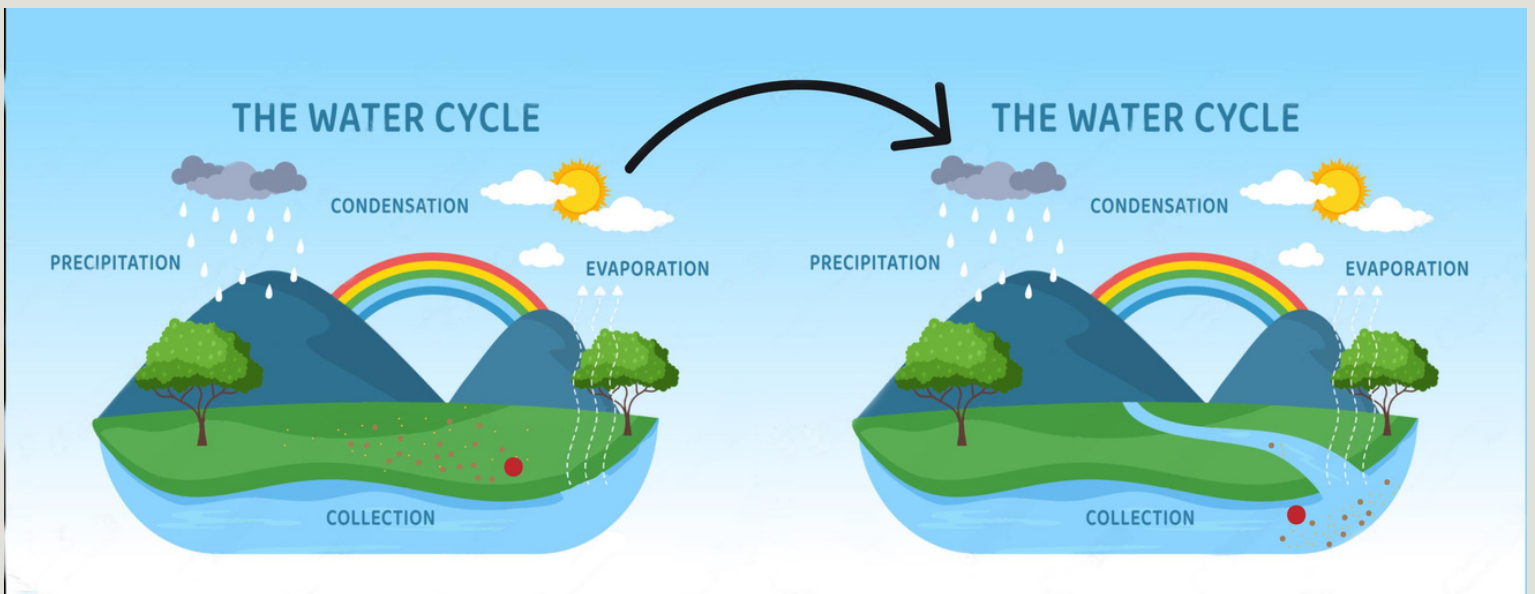


## What is acid rain?

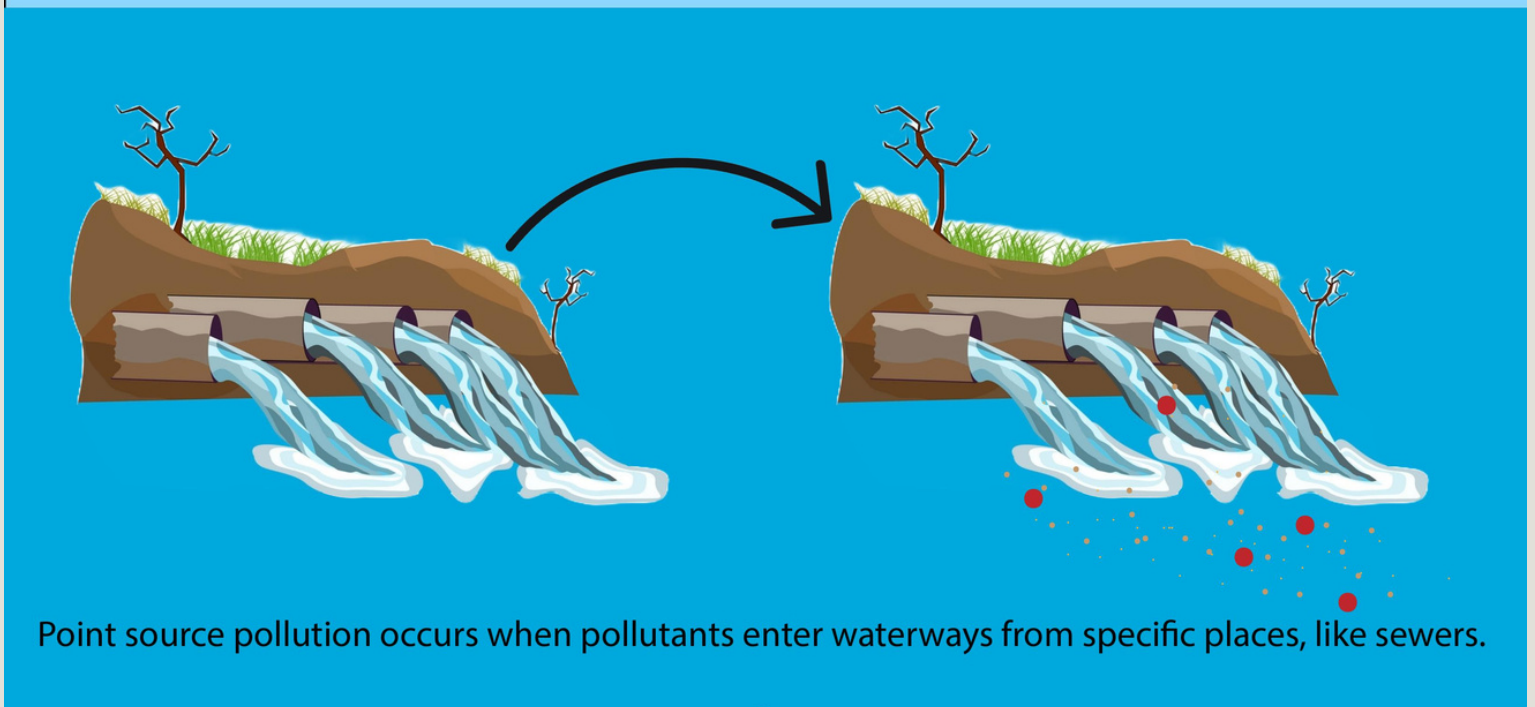
Acid rain is a big problem for trout. factories burn fossil fuels which is poisonous for the environment. When that is mixed with rain water and snow it becomes acid rain. The acidity in the water leads to high pH which is very deadly.



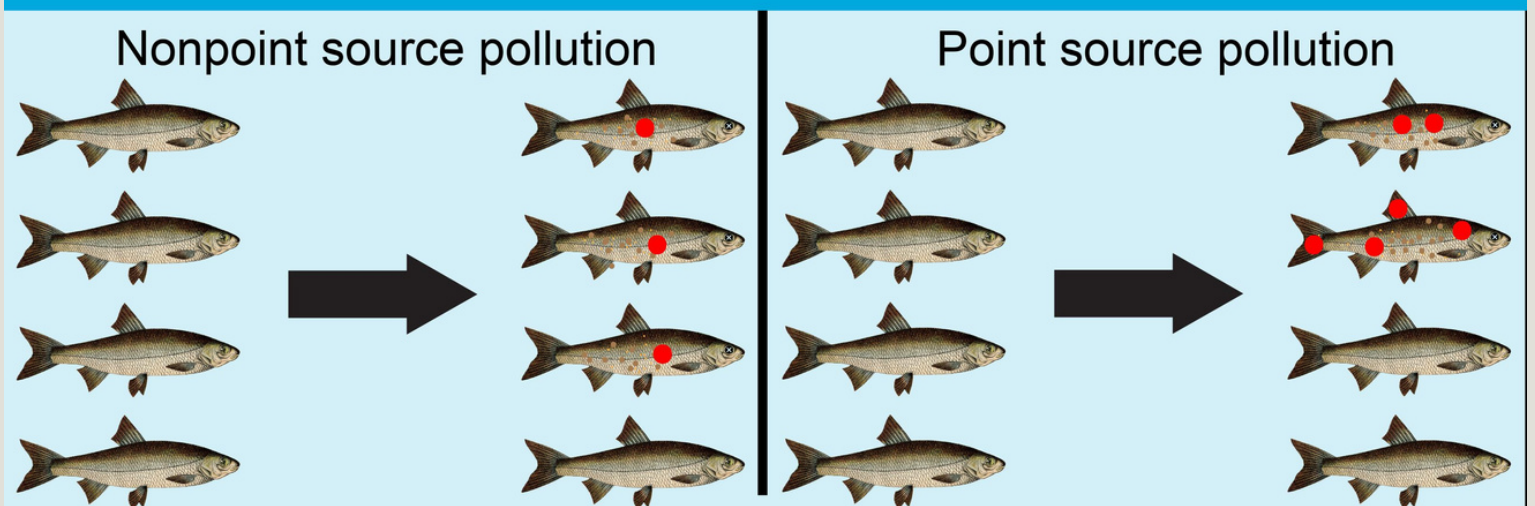




Nonpoint source pollution occurs when pollutants on the ground enter the waterways by runoff.



Point source pollution occurs when pollutants enter waterways from specific places, like sewers.



Both are harmful for marine life, but nonpoint pollution is more dangerous as there is more of it.



# TROUT VS DAMS

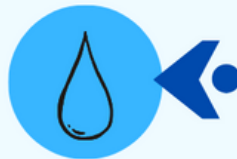
HOW TROUT ARE BEING AFFECTED BY DAMS



**BROWN TROUT**

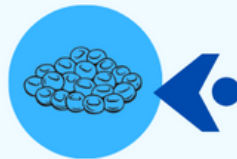
There are about 58,000 large dams (dams with foundations about 15m) around the world.

## HOW ARE TROUTS AFFECTED BY DAMS?



### WARM WATERS

Trout have a very specific temperature of water, and when that temperature is surpassed, they can easily die. Dams impound water, and impounded water is more susceptible to warming, therefore warming waters at the impounding site and downstream.



### SILT AND SEDIMENT

The silt and sediment that builds up behind the dam is also decreasing trout populations by smothering spawning sites and killing macroinvertebrates, which is important food for the trout that live there.



Dams also alter the way a river flows regularly, such as timing, duration, frequency and magnitude. This can change where prey hides as well as where trout can hide from predators.



It's not only man-made dams affecting trout. Beaver made dams are also causing blockages that leave trout unable to travel and spawn.

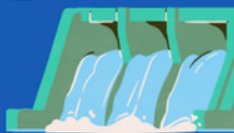


**Trout in the Pequannock River are dying due to warm waters from dams upstream.**

## DAM BUILDING

Fortunately, dam building per year has dropped from the peak of 1500 in 1970 to about 50 per year in late 2020. Hopefully the use of dams continues to decline in the next 20 years.

1500  
TO  
50



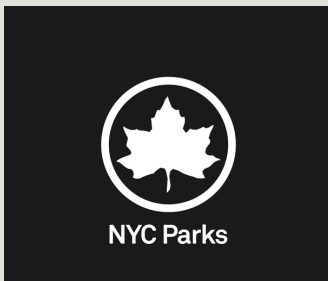
**RAINBOW TROUT**

WRITTEN BY MIRA S.

# ABOUT SPARKS!

With the twin goals of engaging students in the dynamic research taking place in their local parks, and of bringing the STEM in Parks into classrooms, in the early spring of 2021, six teams of STEMteachersNYC teachers, from across all boroughs and from K-12 public and independent schools, partnered with six teams of researchers and educators from across NYC Parks Department divisions, to collaborate on diverse ways of integrating the outdoor, highly place-based work of NYC Parks with K-12 STEM teaching and learning. Products of the partnership will include a set of free lessons and units that support teachers and schools in bringing students outside and into their local parks, to think critically and engage as stewards with the environment around them.

## PARTNERS



NYC Parks is the steward of more than 30,000 acres of land — 14 percent of New York City — including more than 5,000 individual properties. Our vision is to create and sustain thriving parks and public spaces for New Yorkers.



STEMteachersNYC is a nonprofit organization dedicated to supporting a community of STEM teachers across the NYC region. Our mission is to cultivate excellence in STEM teaching and to promote deep understanding and success for students through innovative, teacher-led professional development.

## JOIN US

Learn more about upcoming opportunities online at [stemteachersnyc.org/sparks/](https://stemteachersnyc.org/sparks/)  
Contact [info@stemteachersnyc.org](mailto:info@stemteachersnyc.org) with any questions!