Climate Trouble for Trout in the Watershed

Description:

Climate change is a complex issue that is impacting humans and organisms, such as trout, around the world. This lesson will explain the impacts of climate change within New York City's drinking water watersheds and how we can have a hand in creating resilient aquatic environments for trout to survive. The hands-on activity will model the delicate balance, or equilibrium, needed in our environment as we experience the impacts of different environmental issues.

Objectives:

- Understand the impacts of climate change in New York City's drinking water watersheds
- Discover how aquatic environments can be resilient for organisms like trout
- Demonstrate the balance needed in our environment so that we can protect it for generations to come

Vocabulary:

Balance, climate change, deforestation, environment, equilibrium, eutrophication, green infrastructure, greenhouse gas emissions, pollution, rain barrels, stormwater runoff

Materials:

- Printed K-W-L Chart for each student (or complete it as a class on a whiteboard/smartboard)
- Printed and cut Environmental Equilibrium Prompt Cards
- Printed Environmental Equilibrium Worksheet for each student
- Plastic hanger (one per group of four students)
- String (two pieces per group, measured to be the same length)
- Cups (two per group)
- Cup with beads (20 beads per group)
- Scissors (if string wasn't cut earlier)
- Single hole puncher (if cups weren't hole punched earlier)

Background Information:

Climate change is directly impacting New York City's drinking water watersheds with increases to temperature and changes to precipitation patterns. Aquatic organisms, specifically trout, can be negatively impacted by these changes in the watersheds. Trout are a sensitive indicator species that require clean, clear, and cool water to survive, along with high levels of dissolved oxygen. The increase in temperature can lead to trout experiencing heat stress and require them to use more energy while searching for cool places to rest in their aquatic habitat. Additionally, increased water temperatures decrease oxygen levels, which essentially makes it difficult for trout to breathe.

The New York City Department of Environmental Protection (DEP) manages the upstate water supply system and works to maintain healthy habitats in the watersheds by partnering with other organizations, promoting

water conservation and habitat protection, educating residents about responsible landownership, and regularly testing the water quality.

The Watershed Agricultural Council also works to educate landowners about responsible fertilizer usage. However, eutrophication has been known to impact trout species. Eutrophication is when the water's nutrient levels increase and result in algae and plant growth. This growth depletes the water of oxygen, and a consequence can be a large die-off of aquatic organisms. An example of this is a harmful algal bloom (HAB).

Changes in precipitation patterns can lead to periods of drought and increased sediment and contaminants in the water due to flooding events. When areas are experiencing a drought, water levels are lower which allows them to warm faster. During heavy rain events, stormwater runoff can carry fertilizer, sediment, such as soil and sand, and even sewage into waterbodies.

Unfortunately, trout have a limited ability to adapt to become climate resilient because they are already extremely sensitive to their aquatic environment. As humans who are contributing to the impacts of climate change, we are investigating ways to improve the resilience of the watersheds and trout habitats. An example would be to protect their habitat by maintaining tree cover and shade in the watersheds and therefore keep the water temperature cooler. Maintaining appropriate trail design, such as keeping them a safe distance away from streams, and enacting fishing protections, like catch and release, can have a positive impact on our resident trout.

Method:

- Pass out a K-W-L Chart to each student and ask them to complete the K and W parts quietly. Ask them to consider what they already know about trout and how climate change might affect them.
    - What is their preferred environment? (Clean, clear, cool water)
    - Are they freshwater or saltwater species? (Fresh)
    - What are some climate change impacts? (Sea level rise, changes in temperature and precipitation, etc.)
    - How could climate change impact a trout's aquatic environment? (Increased water temperature, changes in precipitation (e.g., drought, flooding), lower amount of dissolved oxygen in the water, etc.)
- Tell students that they are now going to demonstrate the environmental balance with a hands-on activity.
- Divide the students into groups of four, and distribute one hanger, two pieces of string, two cups, and one cup with 20 beads in it to each group. Students should use a single hole puncher to punch holes into the cups directly across from each other. Then, they can tie one string to each cup and hang it on the hanger. You can use the photo below for reference.

- If this is a younger group of students, prep the cups by punching the hole and tying the string to the cups ahead of time.
- Tell the students that one cup represents the issues our watersheds are facing, and the other cup represents the steps DEP and partners are taking to relieve or correct the issues. If you think it would be helpful, you can have the students label their cups.
- As one student holds the hanger from the top, two other students from each group should work to put the beads in the cups as the remaining student reads out the prompt cards.
- After all the beads have been placed into cups, students should notice that the cup that represents the steps DEP and partners are taking is heavier and hanging lower.
- Once their group is finished, encourage the students to complete the Environmental Equilibrium Worksheet and the L part of their K-W-L Chart.
- Gather the students together to discuss the activity and their K-W-L Charts.

Discussion:

- Which cup ended up having more beads in it, and therefore hanging lower from the hanger? [*The steps DEP and partners are taking cup.*]
- What do you think this is representing? [*That DEP and their partners are working hard to make sure that NYC and the watersheds are moving towards being climate resilient.*]
- Can you remind me of some of the steps NYC DEP and their partners are taking to help relieve or reduce impacts of climate changes in the watersheds and NYC?
- What else could we do to help DEP in their efforts?

Extension:

- Give the students 14 prompt cards (eight are the climate change impacts, and six are what DEP and partners are doing to help mitigate the impacts). The cup with the impacts should hang lower than the cup with the steps DEP and partners are taking. Host a class discussion about what could happen if NYC DEP was not as aggressive with climate change resiliency plans. Additionally, students can share their ideas for more climate change mitigation in the watersheds and NYC.
- Students can create their own prompt cards with examples from their specific community for an issue of their choosing.

NYC Department of Environmental Protection
educationoffice@dep.nyc.gov
For more information visit www.nyc.gov/dep

Environmental Equilibrium Prompt Cards

Over the last couple years, you have noticed that every time it rains the streets flood with water. It takes a couple days for the water to go down.	This summer, we experienced many strong storms and a few cloudbursts. Large trees fell, and some basements and businesses flooded due to the heavy rains.
You've noticed that people have become careless and have started throwing trash in creeks and other waterways instead of putting it in trash cans.	NYC DEP is working to reduce reliance on fossil fuels. Currently, five of the reservoirs in the water supply watershed produce hydroelectricity that is then returned to neighboring towns.
NYC DEP has worked with community members to help replace or upgrade septic tanks in the watershed. This ensures that the water being released back into the watershed is clean.	The Watershed Agricultural Council (WAC) works with farmers, landowners, loggers, and foresters to implement best management practices (BMPs) on their properties and protect water quality.
NYC DEP and partners host clean up days around the watershed throughout the year. Community members are eager to join and help keep nature clean and beautiful!	Previous strong storms had major impacts to roadways and bridges. NYC DEP is working to repair, or rebuild, them so that they can withstand future storms and drivers can safely navigate throughout the watershed.

Your favorite neighborhood park, full of trees and plants, is being cleared to build a new shopping center. The building plans do not include a green or blue roof or a courtyard.	NYC DEP scientists study the annual snowpack in the watershed to understand the rate of snowmelt and travel time to the reservoirs. These data are critical as we experience changes in precipitation due to climate change.
Over the summer, we experienced two heat waves with record breaking temperatures. Energy usage among residents increased due to people staying inside and running their AC units to stay cool.	You feel disconnected from nature. So, your science teacher decides that the class will be participating in NYC DEP's Trout in the Classroom Program. You will be raising trout through the school year and releasing them in the spring!
The upstate watersheds have been experiencing a drought and stream water levels are very low. In science class, you learned that shallow bodies of water warm faster and trout need cool waters to survive.	Forests naturally filter NYC's drinking water through the use of soil, trees and plants. NYC DEP foresters and loggers use best practices to maintain the health of the forest ecosystem.
NYC DEP scientists regularly collect water samples from streams and reservoirs in the watersheds and conduct water quality tests. They do this to ensure the largest unfiltered water supply in the country remains safe and clean!	You look around the school cafeteria and notice that a lot of people are wasting food. In science class, you learned that food waste goes to a landfill and releases methane, a greenhouse gas that is contributing to climate change.

Water consumers are encouraged to be mindful of their water usage and conserve water when they can. This can be accomplished by updating toilets and turning off the sink when brushing your teeth and cleaning your dishes.	Vehicles can create harmful toxins that affect air quality and human health. To reduce greenhouse gas emissions, NYC DEP is transitioning to all electric vehicles by 2040.
You noticed that nearby waterways have been showing signs of a harmful algal bloom. You discover that local landowners have been using fertilizer on their property.	NYC DEP requires all boats to be steam cleaned by a certified steam cleaner prior to being used on a reservoir. This is to protect the reservoir from invasive plants, animals, and microorganisms that can hurt water quality and fisheries.

Name: _____ Date: _____

Environmental Equilibrium Worksheet

1. Which side of the scale was heavier (hanging lower), the environmental issues or the steps New York City's Department of Environmental Protection (DEP) and partners are taking to help correct some of the issues? Why?

   _____

   _____

   _____

2. What do you think are some of the most critical challenges our watersheds are facing due to climate change?

   _____

   _____

   _____

3. How do you think you could help DEP in their efforts to solve environmental issues?

   a. Participate in a local cleanup event

   b. Conserve water at school and home

   c. Use a reusable bag and water bottle

   d. All of the above

4. How else can you help improve our local environment?

   _____

   _____

   _____

   _____

   _____