THE GOWANUS CANAL & NYC WATERWAYS

1) **How are NYC's Waterways connected?**

The Gowanus Canal is part of a much larger system of interconnected waterways called the Hudson River Estuary System. Estuaries are some of the most productive ecosystems in the world. The water in an estuarine system is brackish - the Hudson river estuary is a mix of salt water from the Atlantic Ocean and fresh water from the Hudson River.

- ❏ Use STEM Gowanus *History & Geography Unit.*
  Use lessons to get students familiar with their city's waterways, particularly:
  - *Lesson 2* - Students look up definitions of water body vocabulary words and then label them on a map of NY Harbor.
  - *Lesson 4* - Students label the land and water bodies of a blank NY Harbor map. Can incorporate the idea of tides in this lesson and have students thinking about how water flows through the Gowanus Canal system, or you can make this a different lesson (see lesson 3).

  Download STEM Gowanus for free on GCC's website:
  https://gowanuscanalconservancy.org/stem-curriculum/

- ❏ Read background information on what makes estuaries important - they are especially productive as the "nurseries of the sea", and act as a buffer between land and sea, filtering runoff pollution before entering the ocean and also decreasing the intensity of storm surges.
  https://oceanservice.noaa.gov/education/tutorial_estuaries/welcome.html

2) **How is the Gowanus Canal part of an urban ecosystem?**

An urban ecosystem consists of the following:

- Living things - including plants and animals.
- The natural environment - including air, water, and soil
- The built environment - including buildings, roads and sewers

- ❏ **"Poonami" video** of raw sewage flooding the Gowanus Canal during a storm. This is a good visual when thinking about present day pollution in the canal. We will cover CSO in more depth when students arrive for their first visit.
  https://www.youtube.com/watch?v=HzWOOqPAEgs&t=64s
  *please note this video contains language that may be inappropriate for the classroom. View on mute or chose clips at your own discretion.

- ❏ **Float through time video** Students can watch a 2 min. animated video of a "float through time" on the Gowanus Canal - What are the ecological and physical consequences of industry and urbanization along the banks of the Gowanus Canal? Helps students think about historic sources of pollution in the canal.
  https://vimeo.com/9207374

- ❏ **STEM Gowanus *Flora & Fauna Unit***
  Do plants and animals live in the polluted Gowanus Canal? Yes, and you can find a list of them in this curriculum (pg. 6)! Can lead to some discussion, such as:
  - Why do you think these animals (blue crabs, mummichogs, etc.) are still able to survive in the Canal?
  - Do you think different plants and animals lived in the canal in the past?
  - What type of animals can no longer survive in the Canal due to human impact (ex. filter feeders who would absorb toxins from the water, and the animals that prey on them).

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- ❏ **GCC's The Mighty Mussel StoryMap: *https://arcg.is/1855GS1***

- ❏ **iNaturalist - Gowanus**
  See what species of plants and animals have been documented recently in and around the Gowanus Canal by volunteers. You can see all species or search by type. Students can download the iNaturalist app for free and document plants and animals, while experts identify the species.
  https://www.inaturalist.org/places/126632

- ❏ **Gowanus Ecosystem Survey Biological Report & Gowanus Field Guide**
  See what species of plants and animals have been documented recently in and around the Gowanus Canal by volunteers and what species are commonly and historically found in and around the canal.
  Link to report **and** **Link to field guide**

3) How do we measure the health of a waterbody?

We perform water quality tests to measure the health of a water body in relation to the needs of biotic species (plants, animals and humans). When students visit, they will perform water quality tests on samples from the Gowanus Canal.

1. Temperature
2. Salinity
3. Turbidity

4. Dissolved Oxygen
5. Nitrate
6. Phosphate
7. Enterococcus

- ❏ **Water Quality Info Sheets** explain what each parameter measures, testing protocol, and why it is an important test to run in the Gowanus Canal specifically. These info sheets will also be at the testing stations for students and facilitators to reference. Check the DOE Lib Guide to view or print the WQ info sheets. https://nycdoe-stem.libguides.com/CitizenScience/Gowanus

- ❏ **STEM Gowanus *Water Quality Unit***
  Background reading on changes of Gowanus Canal water quality through time and human impact, including information about the Superfund clean up effort. More information on our testing procedures.
  Download for free on GCC's website:
  https://gowanuscanalconservancy.org/stem-curriculum/

- ❏ **GCC's Water Quality Story Map: *https://arcg.is/1jWe190***

4) How have humans had an impact on our waterways?

Students explore the concept of watersheds and sewersheds. A watershed is a basin shaped area of land enclosed by high elevation areas, or ridges. When it rains, water that falls on those ridges and drains into the lower basin-like areas of the watershed, eventually emptying into the lowest-lying body of water. A sewershed, on the other hand, is formed largely by the built environment. It describes how water flows through an area to its eventual discharge point through sewer mains below ground and a wastewater treatment plant, or to a CSO outfall that discharges into a waterway in the event of a storm. Curbs, roads, pipes and catch basins are some of the many factors that influence a sewershed.

- ❏ **STEM Gowanus *Watershed/Sewershed Unit***
  Background information on how humans altering the environment changed the Gowanus watershed over time, including how Combined Sewer Overflow (CSO) pollutes our waterways. Green infrastructure can help reduce CSO in watersheds that have lost a lot of their permeable surfaces through time. There are also interactive lessons and project ideas, such as building a model of the Gowanus watershed and sewershed, and working with a topographic map of the Gowanus neighborhood which may be useful for students' service learning projects. Download for free on GCC's website: https://gowanuscanalconservancy.org/stem-curriculum/

- ❏ **An NYC DEP interactive map of NYC's watersheds** as well as where there is green infrastructure. You can zoom into a specific watershed to explore green infrastructure, or you can type in a specific address to see what watershed it is in and if there is any

green infrastructure nearby.
http://www.arcgis.com/home/webmap/viewer.html?webmap=a3763a30d4ae459199dd01d4521d9939&extent=-74.3899,40.497,-73.3757,40.9523

- ❏ **NYC DEP Educational Resources** about green infrastructure, with lessons included. https://www1.nyc.gov/site/dep/environment/resources-for-educators.page

- ❏ **Open Sewer Atlas**
  - http://openseweratlas.tumblr.com/wetweathermap - Wet Weather Map. A map of CSO sites around the city - students can find the closest CSO to their school, home, etc…
  - http://openseweratlas.tumblr.com/dryweathermap - Dry Weather Map. A map showing the wastewater treatment plants and the sewersheds they service.

- ❏ **Gowanus Canal Conservancy Combined Sewer Overflow Poster** and **CSO Student Actions**.

The following key ideas and resources may be helpful when **students start to analyze data**:

5) How does community science help us monitor the health of NYC's waterways?
Community science is most effective when data is collected reliably and continually. Students can use several online data sets that compile water quality results through time for the same parameters students test for.

- ❏ **GCC Community Science Program**
  Results from student testing starting in 2017. Data from student collected samples includes temperature, salinity, turbidity, dissolved oxygen, nitrate, phosphate, biological oxygen demand and enterococcus. **See up to date results here.** Contact education@gowanuscanalconservancy.org with any questions.

- ❏ **NYC DEP Harbor Water Quality Data Visualization**
  This tool graphs results through several years of water quality results collected by the NYC Department of Environmental Protection for dissolved oxygen and enterococcus. https://nyc-water.shinyapps.io/nyc-water/

- ❏ **Raw WQ data collected by the DEP** for dissolved oxygen, enterococcus, and fecal coliform from 2008-2018. The Gowanus Canal Site is coded as "G2". Download data as a .csv file and read in Excel.
  https://data.cityofnewyork.us/Environment/Harbor-Water-Quality/5uug-f49n

- ❏ **NYC Community Water Quality Testing Program**
  Raw data collected by volunteers for the NYC Water Trail Association. This community science data has results for enterococcus for sites throughout New York Harbor and NYC from weekly sampling for 20 weeks of the boating and recreation season, starting in May of each year. Link to 2022 data
- ❏ GCC compiled and graphed all data from all sampling years for the Gowanus Canal here. Contact education@gowanuscanalconservancy.org with any questions.

- ❏ A map of water quality results for enterococcus in sites throughout New York Harbor, including the Gowanus Canal and Gowanus Bay. Can click through several years worth of data. Data has been collected by the NYC DEP and by citizen scientists through the NYC Water Trail Association. (Note: results are currently only available through 2016) http://openseweratlas.tumblr.com/waterqualitymap -

- ❏ A map of NY Harbor where you can get satellite imagery for information about salinity, currents, temperature and several other parameters. You can also access a chart view of these parameters by selecting "ATON Gowanus 30, NY (SIT)" OR "ATON Gowanus 32, NY (SIT)" in the Time Series box.
  http://hudson.dl.stevens-tech.edu/maritimeforecast/maincontrol.shtml

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The following key ideas and resources may be helpful **when students are deciding how they will take action** to improve water quality. Over 363 million gallons of CSO enter the Gowanus Canal each year, polluting our waterways. It is possible to get to zero CSO.

6) How can students take action to improve the water quality of the Gowanus Canal and other NYC waterways?

- ❏ **Take the Water Use Challenge!**
  Students can cut down on water use when it rains to reduce CSO. Calculate how much water you use at home every day. Use a simple calculator such as https://www.watercalculator.org/ to find out. How much water does your school use? Can your family or school reduce water use during rainstorms? Compile your classmates' results and report on how much water you saved.

- ❏ **Spread the word!**
  Teach others about CSO and ask people to commit to reducing water use during rainstorms. Check out this video of students talking about the problem and solutions for some inspiration. Post your campaign on social media with the hashtag #CleanTheCanal

- ❏ **Write a letter for cleaner waterways!**
  There are sustainable, cost effective solutions to get to cleaner waterways. Do your research on solutions, find your city council member online https://council.nyc.gov/districts/, and send a letter with your ideas.

- ❏ **GCC's Green Infrastructure StoryMap: *https://arcg.is/18mfDW***

- ❏ **Design green infrastructure for your school!**
  Create a proposal to build green infrastructure on your schoolshed. You can include a green roof, rain gardens, rain barrels, and other systems to capture, re-use or conserve water. Share it with your school principal or other school decision makers.
  Download a design guide for students on GCC's website:
  https://gowanuscanalconservancy.org/stem-curriculum/

- ❏ **Make your school or home a better sponge!**
  Plant a rain garden to capture stormwater, or add mulch and compost to street trees, which increases the amount of rain they can soak up. Measure the total square footage of tree beds and green space you stewarded to see your impact. Look at Grow NYC's Green Infrastructure Tool Kit to read about different green infrastructure options. NYC Parks offers various events and resources on tree stewardship and habitat restoration, signup to become a stewardship volunteer. And you can make a request for Trees New York to plant a new tree in your schoolyard. Apply here

Projects are not limited to this list! Encourage students to generate their own solutions for zero CSO and cleaner NYC waterways.