Flora & Fauna

In this Unit:

This Unit has been modified by permission by the Newtown Creek Alliance from the original with assistance from the National Wildlife Federation's Greenpoint Eco-Schools Program. The original module was developed by the Gowanus Canal Conservancy.

Unit Overview

Essential Questions:

- How do native plants and animals contribute to the overall health of the Creek's ecosystem?
- How can examining or observing the plant and animal life in the Creek teach us about the health of the Creek?
- How does biodiversity support the overall health of the environment and what are humans role in protecting that diversity in and around the Creek?
- How can we develop proposals to create conditions that will encourage more native plants and animals to grow and thrive in and around the Creek?

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Lessons & Objectives:

Teachers Introduction

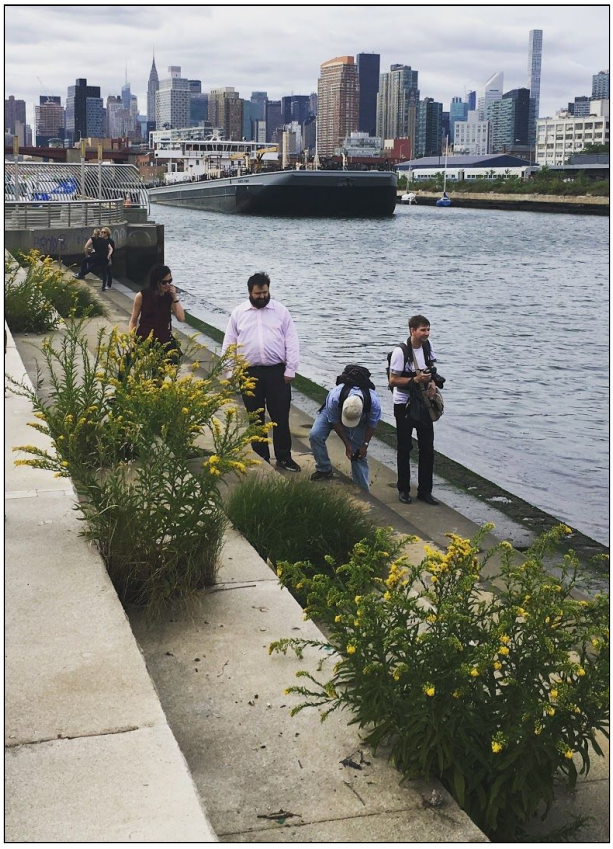
What are Flora and Fauna?

Flora and **fauna** are terms that mean plants and animals, respectively. They refer broadly to the diverse species that exist in a given **ecosystem**.

Once humans began to move goods around the world, animal and plant species came with them. Before this, ecosystems evolved in physical isolation from one another. When an **organism** is introduced to a new ecosystem, one of several things can happen: the new organism can be out-competed for resources by the **native** species and die out; it can co-exist with the native species; or it can out-compete the natives and become **invasive**. Invasive species of flora and fauna are a global problem, threatening ecosystem **biodiversity** and competing with native species for water, nutrients and space.

There are various ways to categorize flora and fauna, which are often debated by ecologists. The terms “native,” “invasive,” “exotic”, and “**introduced**” all connote particular values and goals depending on whether the goal is to restore, conserve or let an ecosystem manage itself without human intervention.

The categories used in this unit are chosen to illustrate what type of role or function particular species play in an ecosystem.



Native species (indigenous) are organisms that existed in a local ecosystem before globalization and are integrated into the ecosystem.

Introduced species are organisms that come to a new area from another place as a result of human activity.

Invasive species are introduced species that create an imbalance in the ecosystem by outcompeting native species.

Seaside Goldenrod (*Solidago sempervirens)* growing on the steps of the Nature Walk. (Source: Newtown Creek Alliance)

Why Teach It?

Many people assume that due to Newtown Creek's toxicity and **industrial** uses it is devoid of plant and animal life. As we will see, this notion is incorrect and local environmental improvements continue to allow for increased biodiversity. This unit explores some of the plant and animal species in the Creek today as well as historical species that are no longer found in the current Creek ecosystem. Each species has an impact on the health and vitality of the waterway. For some species their contribution is clearly positive or negative, but for others the story is more complicated. For instance, invasive plants can provide ecosystem services such as shore stabilization, oxygen transpiration, shading or **habitat**.

Students will gain practice closely observing the characteristics of specific plant and animal species, practice identifying the species with field guides, and have the opportunity to explore the roles these species play or played historically in the Creek urban ecosystem. It is important that we understand which species of flora and fauna we want to encourage to flourish in the Creek.

Snowy Egrets (*Egretta thula*), Great Egrets (*Ardea alba*), Laughing Gulls (*Leucophaeus atricilla*), and a Tern (*Gelochelidon nilotica*) in Jamaica Bay. (Source: NRDC Photo by Don Riepe)

Newtown Creek Flora & Fauna Background

Newtown Creek is part of the Hudson Estuary, flowing west for 3.8 miles between Queens and Brooklyn and connecting to the East River. The Creek features small branches known as: Dutch Kills, Maspeth Creek, Whale Creek, the East Branch, and English Kills. It is a tidally influenced estuary with a total surface area of 140 acres. In the early days its shores presented a beautiful sight. The Creek's natural sources were fresh water streams which flowed between wooded elevations and further along lowlands until they mingled with the salt water of the East River, which is actually a Tidal Strait. When the **tides** of these waters rose, the inundation of the sea water would cause the streams to overflow into the surrounding marshes. The Creek abounded with fish and shellfish as well as birds and various mammals that used them as a food source. The Creek would have also been a favorite stop over spot for migratory birds as well. As we will see, this landscape was dramatically altered in the 19th and 20th centuries, with valuable marshland and streams lost in the process.

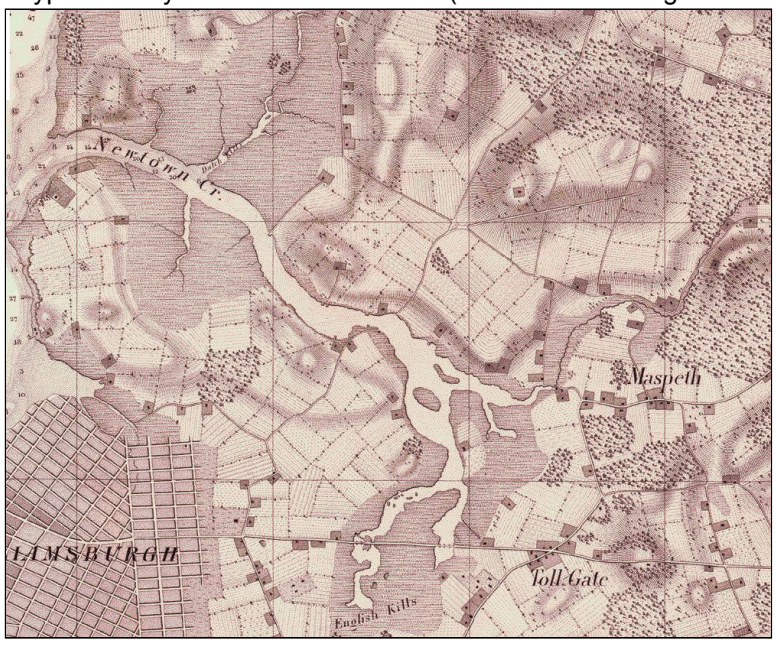
Newtown Creek has **brackish** water, or a mix of fresh water, from precipitation collected on land into streams, and salt water from the Atlantic Ocean. Brackish water has the ability to support a diversity of plant and animal species. Nutrients coming in from the tides stimulates plant growth in the marsh ecosystem and carries out organic material that feeds fish and other organisms. On the bottom of marshes is **peat**, which is decomposing plant matter that is often several feet thick, waterlogged, root- filled and very spongy.

Salt marshes are among the most productive ecosystems on Earth, benefitting the wider ecosystem through the food web. Few animals eat **salt marsh** plants, but after the plants die they become colonized by bacteria, fungi and protozoans, making a rich food source called **detritus**. Detritus is an initial step in many food webs that ultimately feeds many other important (commercially and environmentally important) species. First, worms, crabs and other invertebrates eat the detritus on the marsh bottom. At high tide, mummichogs, silversides and other small fish swim across the flooded marsh surface to feed on the detritus and invertebrates. At low tide, the small fish retreat into deeper creeks. Larger fish such as winter flounder and striped bass venture into the creeks and feed on the small fish. In turn, the larger fish swim out of the marsh, which connects the salt marshes food web with that of the Hudson River, the New York Harbor and the coastal waters beyond. Through the food-web and the export of nutrients, salt marshes play a major role in sustaining larger coastal ecosystems.

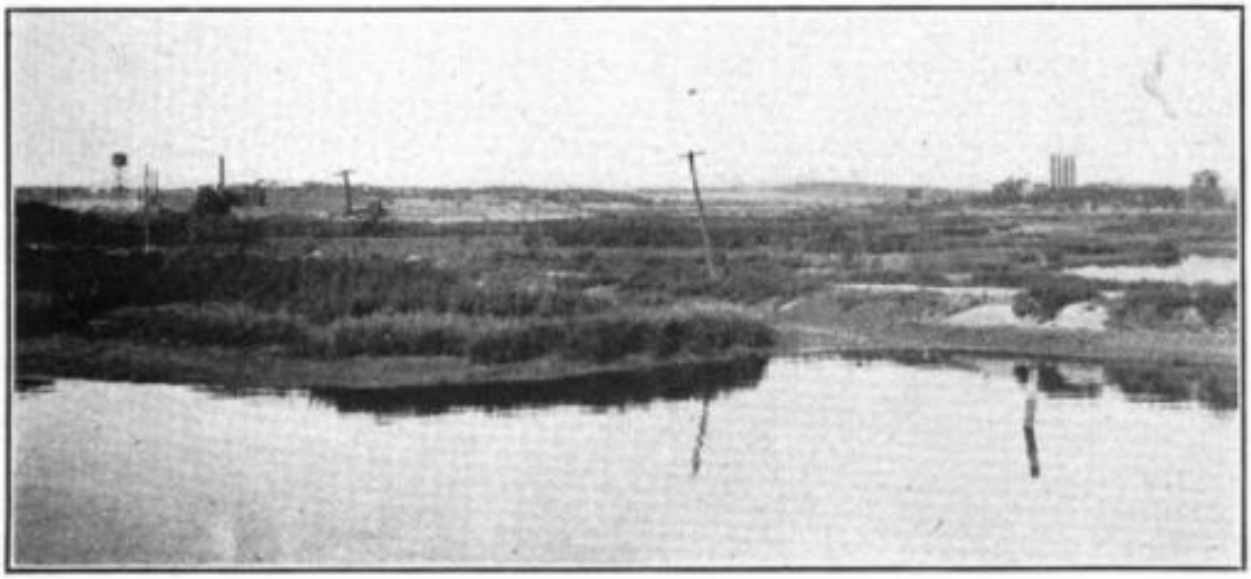
Salt marshes also serve as nurseries for the young of many organisms such as winter flounder (*Pleuronectes americanus*), tautog (*Tautoga onitis*), sea bass (*Centropristis striata*), alewife (*Alosa pseudoharengus*), menhaden (*Brevoortia tyrannus*), bluefish (*Pomatomus saltatrix*), mullet (*Mugil cephalus*), sand lance (*Ammodytes americanus*), and striped bass (*Morone saxatilis*). Other common fishes found in tidal salt marshes include Atlantic silversides (*Menidia menidia*) and mummichog (*Fundulus heteroclitus*). Many fish species reside in salt marshes for most of their life cycle, including mummichog and striped killifish (*Fundulus majalis*). Common birds of the tidal marsh

include osprey (*Pandion haliaetus*), herons, egrets, rails, swans, ducks, and marsh sparrows.

A typical tidally influenced salt marsh. (Source: www.thinglink.com)



Newtown Creek and the surrounding land - 1844 (Source: https://publiclab.org/)



MORE THAN A HUNDRED ACRES ARE HERE AVAILABLE. MANY SITES ON THE WATER FRONT. THIS TRACT IS TRAVERSED BY THE LONG ISLAND RAILROAD

Shoreline for sale in early 1900's. Native grasses and soft shorelines are still present. (Source: The Newtown Creek industrial district of New York City. By the Merchants' Association of New York. Industrial Bureau, 1921, courtesy Google Books)

Rapidly declining water quality from industrial pollution, sewage and the introduction and growth of invasive species caused many native species to disappear during the heavy industrial period in the Creek's history. Approximately 85% of former wetlands and salt marshes in the New York/New Jersey harbor **estuary** were lost over the course of New York City's development beginning in the 1700s. By the mid-twentieth century, the Creek was completely channelized and 100% of the former wetlands and salt marshes were gone.

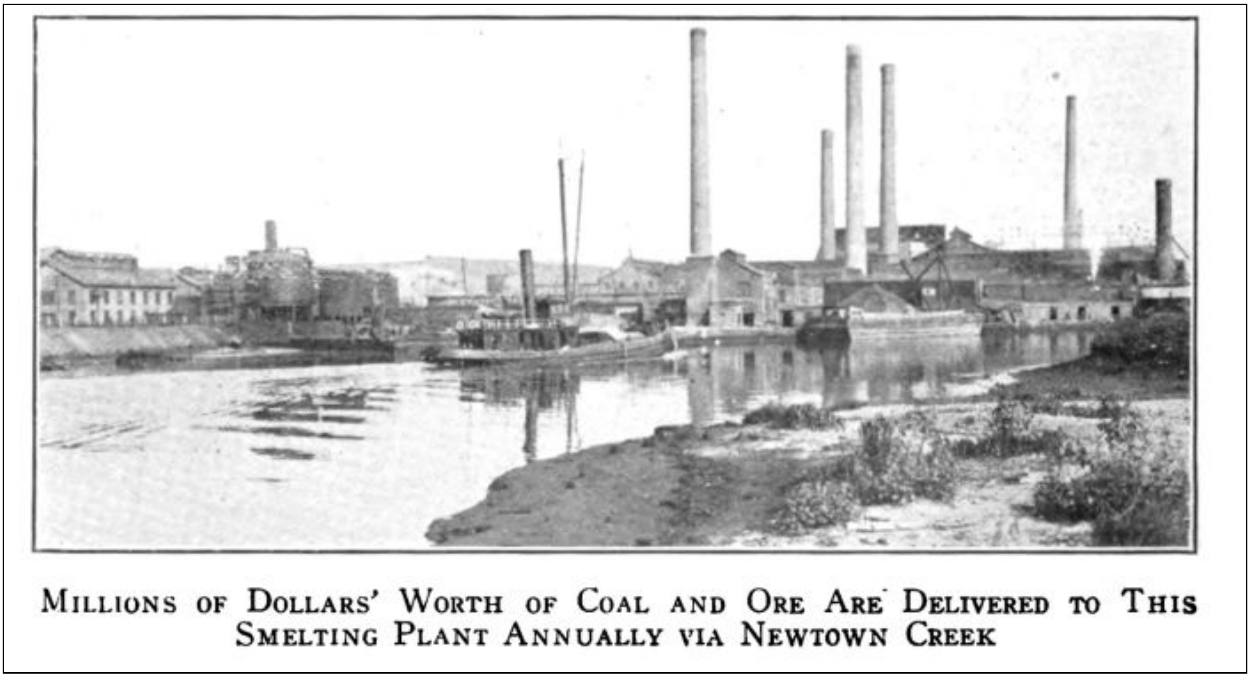
The Creek has been used by humans for hundreds of years starting with Native Americans who lived near the headwaters of the Creek, and used the whole ecosystem for food. Dutch explorers first surveyed the Creek early in the 1600's. Following skirmishes with European settlers and disease, the local Mespat tribe was eventually driven out of the area. The Dutch and English used the Creek for agriculture and industrial commerce, making it one of the oldest continuous industrial area in the nation. The country's first kerosene refinery (1854) and first modern oil refinery (1867) helped throw fuel on the fire of the fledgling industrial revolution and drastically change the nature of the Creek.

By the end of the 19th century, Rockefeller's Standard Oil, had bought up and operated over 50 distilleries on both sides of Newtown Creek. Newtown Creek was also home to such businesses as sugar refineries, hide tanning plants, animal renderers, canneries

and copper smelting plants. By the 1920s and 30s, the Creek was a major shipping hub and was further widened, deepened and bulkheaded to accommodate bigger barges.

The Creek is now a highly altered environment. Since most of the ground in the footprint of the historic salt marsh has been removed from normal tidal action, it can no longer support the historic salt marsh species. There are, however, many species that are native to the region in the Creek, both planned and spontaneous, that have found small pockets where they survive and even thrive. As we plan gardens and streetscapes around the Creek, there are many opportunities to use plants native to the region that will thrive in the area's current conditions.

(left) General View of Oil Refineries 1800's (Source: http://www.astorialic.org/) (right) The Head of Dutch Kills. (Source: The Newtown Creek industrial district of New York City. By the Merchants' Association of New York. Industrial Bureau, 1939)



MILLIONS OF DOLLARS' WORTH OF COAL AND ORE ARE DELIVERED TO THIS SMELTING PLANT ANNUALLY VIA NEWTOWN CREEK

Fossil Fuel industry activities on the banks of the Newtown Creek. (Source: The Newtown Creek industrial district of New York City. By the Merchants' Association of New York. Industrial Bureau, 1921)

The Creek still teems with both animal and plant life despite its history of neglect and before any major cleanup has taken place. Consider the presence of the Great Blue Heron (*Ardea herodias*) that frequent the Creek — they wouldn't be there unless there

were fish in the water to eat! Fish that are observed in the Creek today include Mummichog (F*undulus heteroclitus*), Atlantic silversides (*Menidia menidia*) and invertebrates including Blue Crab (*Callinectes sapidus)* and Horseshoe Crab (*Limulus polyphemus*). These aquatic vertebrates and invertebrates are hardy species that are able to withstand the extremely polluted conditions in the Creek. Oysters (*Crassostrea virginica*), once a keystone species in NY Harbor are returning to the Mouth of the Creek and there are as many as 200,000 ribbed mussels (Geukensia *demissa*) found throughout various niches and corners of the Creek. Both of these species are valuable filter feeders that actually help clean the water by removing bacteria.

With the exception of a few hardy species, there are obvious constraints to achieving a truly healthy ecosystem with a diversity of flora and fauna in the Creek today. Poor water quality, including low levels of dissolved oxygen, create stressful conditions for any type of aquatic life. Suspended **sediment** in the surface and subsurface waters prevents light from reaching the bottom of the Creek, or the **benthic** zone, which in turn prevents photosynthesis necessary for the any plants that would otherwise provide oxygen, food and habitat for aquatic animals. Sediment **contaminated** with PCBs, PAHs, heavy metals and other carcinogens also prevents most plants and animals from living in the Creek's benthic layer. Oil, pharmaceuticals, and other surface water contaminants can be highly toxic to aquatic birds, fish and insects.

On the Creek's modern **shoreline**, you will still find most of the land surrounding the waterway kept in place by bulkheads. **Bulkheads** are vertical shoreline walls that prevent erosion and act as a hard edge between water and land. These walls can be made with concrete, metal or lumber. These materials and their rigid and flat surfaces do not support habitat for the terrestrial plants that would have once populated the soft shoreline of the salt marsh.

(left) Native Ribbed Mussels (Geukensia *demissa)* clustered in the cracks in old wooden pilings. (right) A migratory monarch butterfly (*Danaus plexippus*) is attracted to native Seaside Goldenrod (*Solidago*

sempervirens). (Source: Newtown Creek Alliance)

(left) Late season Mugwort (*Artemisia vulgaris)* dominates a shoreline in English Kills. (right) Multiple Tree of Heaven (*Ailanthus altissima*) create a narrow canopy in Whale Creek. (Source: Newtown Creek Alliance)

The plants that grow on the Creek's shores are mostly spontaneous **vegetation** dominated by invasives — such as Mugwort (*Artemisia vulgaris*) and Tree of Heaven (*Ailanthus altissima*) which outcompete other plants. However, in some spots along the creek, spontaneous vegetation includes native plants, like Seaside Goldenrod (*Solidago sempervirens*), Black Locust (*Robinia pseudoacacia*), and Black Cherry (*Prunus serotina*).

This Leopard Slug (*Limax maximus*), a European invertebrate is a surprising find during restoration work.

Cormorants (Phalacrocorax auritus) perched on a boom in Maspeth Creek, egrets (*Ardea spp.*) in the mudflats behind them. A massive combined sewer outfall in the background.

The fruit of the Black Cherry tree (*Prunus serotina*), indigenous to New York, begins to ripen in early August.

Invasives, and native plants fight for space, light, water and nutrients on the edges of commercial and industrial properties or on public street ends that abut the Creek. Since local soil is mostly **landfill**, it often lacks the characteristics plants need to thrive (see Soil Quality Unit). There are several places along the Creek that are seeing **restoration** efforts by City agencies, including the Nature Walk at the Newtown Creek Waste Water Treatment Plant, Manhattan Ave. street end Park. Community groups, like the Newtown Creek Alliance, initiated and maintain several sites and, on a few private properties, workers grow vegetables or have planted break areas; aside from these few, the Creek's shorelines are mostly unmanaged and struggle in the harsh, human-made environment.

Improvements to Creek Flora & Fauna

Though Newtown Creek and the surrounding neighborhood is dominated by unmanaged vegetation, there are efforts underway to encourage native plants, street trees and **pollinators** to return to the neighborhood, while still respecting the current industrial land use.

Some projects are forged by volunteers and others by government agencies, such as NYC Department of Environmental Protection (DEP) and NYC Parks, and others by private firms and commercial businesses. Often, all of these entities work together to improve the health and environment of Newtown Creek. Included here are a handful of featured projects that have focused on the goal of restoring or increasing native species and other beneficial flora and fauna species of the Creek and its marine and terrestrial ecosystems.

Plank Road midsummer; Maspeth, Queens. (Source: Newtown Creek Alliance)

Plank Road (58th Road in Maspeth, Queens) is a revitalized street end with known historic and ecological significance on Newtown Creek. With support from the NY-NJ Harbor & Estuary Program, the New England Interstate Water Pollution Control Commission (NEIWPCC) and New York State Department of Conservation (DEC), the

Newtown Creek Alliance is working to transform Plank Road from an overgrown, muddy and littered street-end to a clean and rejuvenated public shoreline.Situated in a dense industrial area, Plank Road now offers an inviting landscape for local employees and the general public seeking respite. During our restoration project the Alliance worked with a number of city agencies including: Transportation, Sanitation and Environmental Protection. The Alliance received a generous donation of materials, labor and equipment from neighboring US Concrete to help landscape the site. The site features a path from street to the water, a native pollinator garden, mulched pathways and signage signifying the historic significance of the area.

White Pine (*Pinus strobus*), Honey Locust (*Gleditsia triacanthos*), and (not pictured) Mulberry (*Morus spp.*) trees grow where the old Penny Bridge crossing once stood.

Meeker Ave In 2017, NCA began work to clean-up and re-introduce native plantings at the Penny Bridge site in Greenpoint. Situated at the end of Meeker Avenue, this once was the location of the Meeker Avenue Bridge (or Penny Bridge) which was demolished in 1939 when the replacement, now known as the Kosciuszko Bridge, was built a block away to the east. The upland area between the street and shoreline comprises nearly 1/2 acres of city owned land which has been largely neglected for many decades, overgrown with weeds and used as a dumping ground. Newtown Creek Alliance is working with various city agencies and volunteers to transform the overlook into a valuable green space for local workers and nearby residents.

The center, open sections of the living dock are planted with native grasses (*Spartina alterniflora)* and can be extracted to reveal the marine animals that make the substrate their home. Raccoons (*Procyon lotor*) and Canadian Geese (*Branta canadensis*) frequent the dock as do students, researchers and group tours.

The **Living Dock** is a 200 square foot floating structure designed to promote marine life. The Dock provides a clean place for marsh grasses to live, shellfish to grow and small marine animals to hide and feed. Marine plant life and bivalves like mussels, oysters and clams can help filter the water of excessive nutrients and bacteria; yet many of these crucial species have limited places to grow. To offer clean habitats for native species we have incorporated various salt marsh plant species and substrates. Ropes and stone provide more protection for killifish and shrimp while other materials, like oyster and clam shells, encourage barnacles, mussels and slipper snails.

Metal frames filled with sand and native salt marsh Grasses (*Spartina alterniflora,* & *S. patens*) are thriving at the Nature Walk on Whale Creek.

Intertidal Wetland Frames Working with the environmental science department at LaGuardia community college and trained volunteers from the North Brooklyn Boat Club, Newtown Creek Alliance has reintroduced salt marsh grasses that once covered much of area surrounding Newtown Creek. Native plant species not seen on the Creek in the past 50 to 100 years are now back and thriving. The establishment of plants within the pilot frames, has successfully demonstrated the viability of reintroducing salt marsh grasses, an effort now being pursued by city and state agencies.

Tickseed (*Coreopsis spp.*) and other native perennials in full bloom on the Kingsland Wildflowers Green Roof, the Newtown Creek Wastewater Treatment Plant and the Manhattan skyline can be seen in the background.

Kingsland Wildflowers Newtown Creek Alliance has partnered with NYC Audubon, Broadway Stages and Alive Structures to build out a 20,000 sq foot green roof at 520 Kingsland Avenue in Greenpoint. The project features native wildflowers and grasses that will not only soak up rainwater but provide habitat to pollinator and bird populations. Additionally, the roof serves as outdoor classroom for local schools and the general public.

Vocabulary

Note: Some of this vocabulary is referenced in other parts of this curriculum. All vocabulary and definitions appear in the glossary of the curriculum.

Background Vocabulary:

creek
conservation
contaminate
ecosystem
estuary
food chain
habitat
invertebrate
omnivore
organism
pollutants
pollinator
species
tide
toxin
vertebrate

Essential Vocabulary:

adaptation
algae
benthic layer
biodiversity
biological indicator
brackish
decomposer
extinct
fauna
field guide
flora
industrial
introduced
introduced non-aggressive
invasive
landfill (urban fill)
native
niche
producer
propagate
remediation
restoration
salt marsh
sediment
shoreline
vegetation

Lesson I - Biodiversity

PLEASE NOTE: These lessons were purposefully written with built-in flexibility. You are encouraged to adapt the time, materials, procedures and handouts to fit your students, your teaching and your school.

Activity Overview

Blodiversity is an integral piece of a healthy and robust environment. Understanding the roles different plants and animals play in the tapestry of life allows students to make connections to their own place in the natural world. In this lesson, students will explore a resource about biodiversity and then partake in an activity or discussion designed to clarify and deepen their thinking. The students will understand the importance of biodiversity in our lives and its impact on our local waterway, Newtown Creek.

Learning Objectives

- Students will listen to and build on classmates ideas and comments
- Students will define biodiversity
- Students will describe how humans benefit from biodiversity
- Students will discuss ways to increase biodiversity in the Newtown Creek area

Time

45-60 minutes for each lesson

Vocabulary

See Flora & Fauna Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Consider using and/or modifying portions of the Flora & Fauna Introduction as a text for your students.
- Choose from one of the articles below or find another resource of your choosing about biodiversity.
- This activity is designed to clarify and deepen our thinking about content in the resource students explore, and it is meant to build on each other's thinking about the concept of biodiversity.

Materials

- Article, book or text excerpt about biodiversity
- Journals or writing notebook
- Newtown Creek Flora and Fauna slideshow
- Pens and pencils
- Chart paper
- Marker

Procedure

This activity has been adapted from the protocol "Save the Last word for Me" by Patricia Averette http://schoolreforminitiative.org/doc/save_last_word.pdf

1. Students get into small groups.
2. Class will collectively review shared resource (read aloud text, view presentation or video, etc), each student will identify what s/he considers to be the most significant idea addressed in the article, and write a word or sentence or thought about that idea.
3. When the class is ready, a student from each small group volunteers to identify the idea that s/he found to be most significant and reads it out loud to the class. This student (the presenter) says nothing about why s/he chose that particular passage.
4. The teacher records student idea on chart paper or board in a list.
5. After thinking for a moment, the other students in the small groups each have 1 minute to respond to the idea — expressing within the group what it makes them think about, what questions it raises for them, etc.
6. The same pattern is followed until all students have volunteered their ideas to be shared with the class (as time allows).
7. The class has an open dialogue about the activity and discusses the issues of biodiversity using the Discussion Questions below.
8. Class discussion then focuses on ideas for increasing the biodiversity in the neighborhood and around the Newtown Creek. Take into consideration the what already lives and thrives in Creek. (Reference Newtown Creek Flora/Fauna presentation, Newtown Creek Alliance birds and marine wildlife posters, etc.)

Discussion Questions

These questions are optional and are helpful guides. Please develop your own questions that may help guide the conversation as needed based on resource materials used.

1. What is biodiversity?
2. What are some of the benefits of an ecosystem that has a lot of biological diversity?

3. How do humans benefit from and rely on biodiversity?
4. What are some of the main causes of the loss of biodiversity today?
5. Over the past 400 years, what do you think has contributed to the loss of biodiversity in the Newtown Creek area?
6. How could we improve biodiversity in Newtown Creek and in the surrounding areas? Think about both small-scale and large-scale improvements.

Extension Lesson - Change Over Time in Newtown Creek

Create a human timeline to demonstrate the change over time in Newtown Creek. Print out images of Newtown Creek from the Teachers Introduction, Newtown Creek Flora and Fauna Background, of the unit. Have students guess what time frame the image is from (ex: before 1600s). Student volunteers will hold up the image and together create a human timeline in class where they can embody the environmental history of Newtown Creek. Students will understand the Big Idea of Change Over Time in relation to place. (Consider using the second set of Discussion Questions in Lesson II to augment this activity)

Extension Lesson - Species Exploration

Use the Flora and Fauna ID Cards and the Newtown Creek Plant and Animal Relationships Cards to show the different native, non-aggressive introduced, and invasive plant and animal species found in and around Newtown Creek. Have each student select either a favorite species or select a pair of plants and animals and explain their relationship.

Lesson II - Introduced Species

PLEASE NOTE: These lessons were purposefully written with built-in flexibility. You are encouraged to adapt the time, materials, procedures and handouts to fit your students, your teaching and your school.

Activity Overview

A healthy ecosystem is one that is balanced and in which relationships between plants and animals are interdependent. An unhealthy ecosystem is one where that careful balance has been thrown off and only a few species dominate rather than many. In this lesson, students will play an active game where they take on the roles of native and invasive species and compete for limited resources in order to see how invasive species have the ability to out-compete native species. Acting out these roles will promote deeper understanding of balance and interdependence in an ecosystem.

Learning Objectives

- Students will understand that species depend on certain resources in order to survive and these resources are often limited within an ecosystem
- Students will understand the importance of balance and interdependence in ecosystems and begin to reflect on our role as humans in relation to that balance
- Students will understand that invasive organisms can upset the balance of an ecosystem

Time

45-60 minutes for each lesson

Vocabulary

See Flora & Fauna Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Consider using and/or modifying portions of the Flora & Fauna Introduction as a text for your students.
- To create space for the game push student desks to the side or consider using the gym or school yard.
- Game pieces should be evenly distributed around playing area for each round and students should be reminded not to run, push, or grab to get their game pieces.
- In this lesson students take on the roles of native and invasive species. You could play the game where the students represent the general concept of native and invasive species. Or you could assign the students specific, locally found

native and invasive species.

- Extension Lesson - Species Exploration (found in Lesson l) is extremely helpful in understanding the specific native, non-aggressive introduced and invasive species found locally. It is recommended that you spend time with those materials before leading this activity.
- If you assign students *specific* plants or animals species you can have a more in-depth discussion of exactly how the invasive species can outcompete the native species and what adaptations each species has that helps it survive. For example, the phragmites plant that we find around the Creek today is an invasive species and has an extensive underground rhizome system that grows quickly and densely thereby making it difficult for native cordgrass to continue to grow in the area.

Why is a species invasive?

"The term "invasive" denotes the biologically aggressive and exceptionally hardy characteristics of a plant, habitually denounced for taking over natural areas and stifling biodiversity. In non-urban conditions, these plants can at times be destructive on rural ecosystems. Monocultures of Tree of Heaven (Ailanthus altissima) or Common Reed (Phragmites australis) have been known to alter radically existing landscapes and wildlife habitats. With many invasive plants dispersing seeds multiple times throughout a season and with seed counts in the thousands per plant annually, the potential for a quick colonization of rural and suburban sites is a major concern."
(Source: http://urbanomnibus.net/2011/12/profiles-of-spontaneous-urban-plants/)

How do species become invasive?

Plants and animals are not inherently invasive but become so due to human interference and human relationships with with them. Native species in some locations become invasive species in other locations.

"Plants and animals have always traveled with us. The more we travel, the more species we unknowingly transport. Our transportation methods then become pathways for invasive species. For example, birds or the wind can carry seeds from garden plants into the wild. Exotic pets escape or are released into parks, lakes, and rivers. People can carry seeds on their clothing, in suitcases, or on cars. Packets of birdseed can contain seeds of invasive plants. Solid waste and soil that have invasive plants can be dumped as fill into wetlands. Plant seeds, insects, small animals, and organisms can hide in ship cargoes or ballast water, on the outside of boats, and on planes."
*(*Source: https://invasivespecies.wa.gov/how_do_they_get_here.shtml)

Materials

- Game pieces
    - Bingo chips, poker chips, ping pong balls OR something similar in three different colors
    - Resources for animals/plants represented by different colors (any colors available are fine):
        - Blue: Water/Water
        - Green: Food/Nutrients
        - Brown: Shelter/Space
    - You need at least one game piece of EACH color for EACH student in your class. (For example a class of 30 students - 30 Blue game pieces, 30 Green game pieces, 30 Brown game pieces)
- Colored arm bands (any kind fabric strip will do), one for each student
- Chart paper and marker for making chart below

	Native Species Survivors	Invasive Species Invaders
Round I		
Round II		
Round II		

Procedure - Round I

In this round, everyone is a native species and everyone gets enough resources and survives.

1. All students are a native species.
2. Everyone lines up along the edges of the playing area. At the signal, all students enter the playing area, searches for and collects ONE of the three different colored game pieces and returns to the sideline.
3. After all of the students have returned to the sideline, repeat this process again for the second colored game piece.
4. Students return a third time for the third colored game piece.
5. All players should survive the first round.
6. Record the number of native species survivors and invasive species invaders on the chart paper.

Procedure - Round II

In this round two students are invasive species and outcompete some of the native species for resources, causing some of the native species to die.

1. Choose two students to be invasive species. Have them wear colored arm bands.
2. The invasive species are more aggressive and are allowed to collect up to THREE game pieces per trip into the playing area.
3. The native species must act the same as they did in Round I - only collecting ONE game piece during each trip into the playing area.
4. The native species will be considered a survivor if s/he collects three different colors as they had done in Round I.
5. The invasive species must also collect three different colors in order to survive.
6. Identify the survivors.
7. Compare the surviving native and invasive species.
8. Record the number of native species survivors and invasive species invaders on the chart paper.

Procedure - Round III

In this round there are even more invasive species, which will eliminate or almost eliminate the native species..

1. Native species that did not survive Round II become invasive species. Give each new invasive species an armband.
2. Play Round III the same as Round II.
3. At the end of Round III, most, if not all, of the native species should not have survived.
4. Compare and evaluate as in Round II.
5. Record the number of native species survivors and invasive species invaders on the chart paper.
6. Collect game materials and have students take a seat in the play area and prepare for discussion.

Discussion Questions

1. What was the experience of this activity like for you? How did it feel to be a native species? How did it feel to be an invasive species?
2. What happened in each round to the native species as the invasive species were introduced and increased in population?
3. How did the introduction and population growth of invasive species impact the resources represented by the game pieces?

4. Why were the invasive species allowed to collect more game pieces? (*specific species adaptations and lack of natural predators*)
5. With both native and invasive species in the game, what could humans do to help the native species thrive? Think about how we could alter the game pieces, the players or the playing area.

(Additional discussion questions if students read the background information from the Flora and Fauna Introduction or were given the slideshow lecture)

1. How does the information you read about Flora and Fauna relate to the Introduced Species Game you just played? Cite specific parts of the text.
2. How has the Newtown Creek ecosystem (and the flora and fauna that live within it) changed over time? What has led to these changes?
3. What are some of the native, introduced and invasive species found in the Newtown Creek ecosystem?
4. How do you think these changes have affected the resources available for flora and fauna?
5. How do you think these changes have affected the species found in and around the Creek?
6. How has the availability of resources affected the populations of organisms in the Creek ecosystem?

Lesson III - Relationship Observations

PLEASE NOTE: These lessons were purposefully written with built-in flexibility. You are encouraged to adapt the time, materials, procedures and handouts to fit your students, your teaching and your school.

Activity Overview

Making observations about species and their relationships reinforces concepts of interconnectivity and interdependence. This type of systems thinking is key to laying the foundations for applied learning in the field. Students will begin to learn about flora and their relationships with a few animals specific to Newtown Creek.

Learning Objectives

- Students will make observations about specific local species
- Students will understand the interdependence of plants and animals
- Students will demonstrate the interdependence of plants, animals and natural resources through an embodied activity

Time

45 minutes

Vocabulary

See Flora & Fauna Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Consider using and/or modifying portions of the Flora & Fauna Introduction as a text for your students.
- Relationships between different plant and animal species are more like complex webs that overlap and cross and weave around each other. The relationships described in this activity are limited and overly simplified. Whenever possible try to incorporate other elements to the activity that adds dimension to the complexity of real life.
- This activity can easily be split into two seperate activities, one focused on reviewing the plants/animals and talking about their relationships and the second being the actual game physically making the connections.

Materials

- Journals or Notebooks
- Printouts of Plant and Animal Relationships Images (monarch butterfly / milkweed / black cherry tree /cedar waxwing bird, ribbed mussels / spartina grasses / menhaden fish / osprey) and images of natural resources (sun, water, nutrients, shelter, space)
- Herbarium plant specimens if possible (ex: milkweed plant, black cherry, spartina grass)
- String, twine, or rope

Procedure

1. Teacher presents the **Plant and Animal Relationship Cards** and references the accompanying notes that describe the specific reciprocal relationships between the different local plants and animals.
    a. If possible, teacher will hand out specimens of the different plants and animals for students to explore and observe while the virtual information cards are being presented.
    b. Using their journals, students will make observations of the different plants/animals by sketching or tracing the species (ex: milkweed). Students can also draw an arrow between the plant and the animal it is dependent on to signify the relationship. (ex: monarch butterfly/milkweed)
2. Teacher will initiate a discussion around the importance of *interdependence* between plants and animals. (“How does the monarch butterfly depend on the milkweed?”)
3. Students will create a **Newtown Creek Web of Life** using the different plants/animals presented in the virtual information cards, to demonstrate the existence of interdependence. *(Web of Life Activity adopted from Shelburne Farms and CELF)*
4. **Procedure for Newtown Creek Web of Life Game:** Gather in a circle. Each player takes a card. The person with the Black Cherry Tree card can start. Give them the ball of yarn, they pass it to someone holding a card with a species that interacts with the Black Cherry Tree. As they pass the yarn, they can state, I am a Tree and I provide habitat for birds. The birds then take a turn, and so on. Let students help each other if they get stuck. When everyone is connected via the yarn, discuss the connections. Ask the students what would happen if one organism stepped away/the yarn was cut.
5. Students will describe the relationship with the other plant / animal or natural resource. (ex: “the monarch caterpillar is dependent on milkweed as it’s only food source and milkweed is reliant on pollinators like monarchs for reproduction

and is also dependent on the sun for survival").

6. Introduce stress into the relationships by removing some cards and having students pull on the string demonstrating the increased pressure on that species. For example, there is a loss of habitat and less space for milkweed to grow therefore less food for young monarchs, the student acting as the butterfly pulls the string harder putting pressure on the relationship with milkweed, the student acting as milkweed pulls harder on space, and so on.
7. Teacher facilitates discussion with students around what their experience was like in the Newtown Creek Web of Life and what opportunities there may be to help relieve some of the stress on these interdependent relationships.

Discussion Questions

All of these plants and animals are native to the pre-colonial salt marsh or temperate forest that covered the Creek area:

1. What was your experience playing the Newtown Creek Web of Life?
2. How do plants and animals depend on each other? Give a specific example citing something we learned today.
3. How do plants and animals depend on natural resources?
4. Do you think the plants and animals of Newtown Creek have changed over time? How have they changed? Why have they changed?
5. What are the plants and animals you depend on in your life? Why do you depend on them?

Extension Lesson

Using the Flora Observation Worksheet and replicating many of the same discussion questions in Lesson lll, take the classroom outside to make observations of Flora found around the school yard or nearby park. Use the Field Site Metadata and the Flora Observations Worksheets as a helpful aid and in order to get the students used to working with the worksheets in the field.

Field Lesson - Newtown Creek Flora & Fauna

PLEASE NOTE: These lessons were purposefully written with built-in flexibility. You are encouraged to adapt the time, materials, procedures and handouts to fit your students, your teaching and your school.

Activity Overview

This is an opportunity to bring your students outdoors and have them carefully observe the relationships between animals and plants that live within Newtown Creek. The Flora and Fauna found in and around Newtown Creek can vary tremendously depending on proximity to human activities and other plants and animals. Being able to experience, observe, and describe features of flora and fauna, as well as their specialized relationships, can help students connect classroom learning to the real world.

Learning Objectives

- Students will observe, map, and record flora and fauna data
- Students will identify different types of animal and plant species along the Creek
- Students will observe specific features and characteristics of the Creek organisms
- Students will sketch and label flora and/or fauna
- Students will begin to establish a relationship with place
- Students will learn how to make meaningful observations.

Time

Can vary from 60 minutes to several hours

Vocabulary

See Flora & Fauna Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Choose one or more of the sites listed in the Newtown Creek Field Sites Information section of the Curriculum Introduction.
- Always visit the Field Site prior to bringing your students there.
- Consider using and/or modifying portions of the Flora & Fauna Introduction as a text for your students.
- This field experience is an excellent opportunity to practice observation and inference skills with your students. Observation and inference ideally should be taught in the classroom before coming into the field.
- There are two types of observation that are worth considering when looking at

living organisms: **direct and indirect observation**. Direct observations may include observing with the naked eye, hand magnifier or via another apparatus. It may be used for any type of species. Direct observations may be made with or without collection of the organism in question. Indirect observations may include evidence of the species, such as dried plants, seeds, cast exoskeletons, feces, spent shells, tracks, feathers, or egg and larval stages.

- Observation in the field works well in pairs. This allows students the opportunity to discuss what they are seeing and what they think it means before writing it down.
- This field lesson is an excellent opportunity for students to use their phones and other electronic devices for practicing observation through taking photographs. If the use of phones is discouraged in your school, make sure you have set clear expectations and parameters with your students before asking them to pull out their phones.

Discussion Points

For each discussion point, decide which activity may work best for you and your students. They may not all work for each activity and are suggested guiding points. If needed, a field site expert can be a part of the field experience to help facilitate discussion.

1. Built vs. “Natural” environment
2. Examples of habitat for various species
3. Comparison of native, non-native, introduced and invasive species
4. Value of plants in an urban ecosystem beyond whether they’re “native” or “non-native”
5. “Stresses” on plants and animals in an urban ecosystem
6. Favorable vs. non-favorable locations for plants
7. Benefits of plants for animals and for humans
8. Permeable vs. impermeable surfaces (created by plants)
9. Different “jobs” or “niches” of plants (bioswale vs. shoreline)
10. Observed examples of food chains or food webs
11. Stewardship of flora and fauna

Journal Prompts

We recommend having students write in their journals at the *end* of the field experience; consider some or all of the following questions. Also refer to the “Journal Writing” section of the Introduction & Methodology for more suggestions about journaling.

1. Choose one plant you observed. Describe it in detail. Where did you see it? At

more than one location? How would you categorize it: native, introduced, invasive, other? Explain.
2. What features or adaptations did this plant have that makes it suitable to live along the Creek?
3. Choose one animal you observed. Describe it in detail. Where did you see it? At more than one location? How would you categorize it: native, introduced, invasive, other? Explain.
4. Choose a location along your walking tour that could be improved for plants and animals. What could you design/propose/build at that location that would help attract beneficial plants and/or animals?

Main Activity - Survey & Map the Flora & Fauna

Materials

- Clipboards
- Journals
- Flora and Fauna Field Research Survey
- Metadata Survey
- Site Map (for your chosen Field Site)
- Flora and Fauna ID Cards
- Field Guide to the Natural World of New York City, Leslie Day (optional)
- Organism collection and observation tools (optional) e.g. binoculars, ruler, magnifying glass, magnifying box, tweezers, organism collection containers, etc.

Procedure

1. In the classroom before going on the walk, teachers will review guidelines for the field visit and make sure all students have completed their permission slip forms.
2. If needed, an expert naturalist or educator from Newtown Creek Alliance is available to support the Field Lesson on site.
3. When arriving on site, gather as a group for initial discussion and orient the class to where they're located.
4. Teacher facilitates collection of metadata on site with class. Students can record data in their student journal or using Field Site Metadata worksheet.
5. If desired, separate students into small groups.
6. It may be useful to utilize the Flora and Fauna Field Research Survey and Site Map, if so hand them out to the students. Students can also record observations, drawing, notes, etc in their journals.
7. Assign each group an area to survey. (Note: if you have more than one group working in an area, have them start on opposite sides.)
8. Teachers or other educators may pause at or highlight certain locations and

provide content for student observations. All observations should be recorded in journals.

a. Students are welcome to use all their senses (except taste) touch, feel and smell plants along the walk and listen to the birds, water, or industry.
b. Students are allowed to gather plant leaves or natural items they find along the walk to add to their journal.
c. Students are not to run, go in to the water, touch the water, or pull flowers, leaves off the plants if not fallen on the ground.

9. Students can identify, label and draw a map of all the different plants in their area using the Site Map or in their journals.
10. If using them, students should fill out the entire Flora and Fauna Field Research Survey.
11. Students note the conditions in which the plants are growing (e.g. growing up through cracks in the pavement, growing in a rain garden, growing right along the edge of the water, etc.) and any other observations.
12. Teacher and expert Naturalist can facilitate a group discussion with students about their observations and any relationships they saw while on site.
13. Bring Site Map, Metadata survey, Flora and Fauna Field Surveys and all other data captured in their journals back to the classroom for the Applied Learning Lesson.

Extension Activity - Observe a Plant

Materials

- Clipboards
- Flora Notes (previously collected by students
- Flora Observation Worksheet
- Newtown Creek Field Guides
- Field Guide to the Natural World of New York City, Leslie Day (optional)
- Any other applicable field guides
- Organism collection and observation tools; like magnifying glass, magnifying box, bags, ruler (optional)
- Disposable (nitrile) gloves or hand sanitizer (optional)

Procedure

This activity helps students practice observations before drawing conclusions. It helps students to slow down their thinking so that they can base their opinions on facts. It builds on the observations and analysis of a large group, thus helping students to see the benefits of hearing other's perspectives on a topic. It can also be an excellent jumping off point for generating questions.

1. Hand out the **Flora Observation Worksheet** to each student.
2. Stand in a central area on the site with the whole class and model how to mkaed observations and inferences about the plants you see. Which plants are most prevalent in the area? Which plants (if any) seem to be competing with each other? Help students be attentive to the diversity of plants in the Creek.
3. *Note*: While looking carefully at plants and their habitat, students may also discover some fauna. They should include any observation about insects, birds, or other animals on their worksheets!
4. Students observe 2 to 4 plants in detail on their own or in pairs
    - Describe the plant in words. (Use at least three words)
    - Does it have leaves? What color are they? Are they rough or smooth? Are they clustered together or separate?
    - Does it have a stem or trunk? Is it woody or smooth? Fat or thin?
    - Does it have flowers? What color(s) are they?
    - Does it have fruit or seeds? Is it fleshy or dry? Who might eat these fruit or seeds?
    - Does it have signs of urban stress? Damage to the plant? Leaf discoloration?
    - Where is the plant growing? What kind of conditions is it growing in? What does this say about what the plant can tolerate?
    - Sketch the plant. If you are having trouble with your drawing try tracing a leaf (try not to pick the leaf off the plant!)
    - Label every part of the plant. Include the approximate size, texture and colors.

Extension Activity - Observe a Fish

Materials

- Clipboards
- Observation/Inference Chart
- Disposable (nitrile) gloves or hand sanitizer
- Small plastic fish tanks
- Marine Wildlife of Newtown Creek field guide poster

<u>Optional</u>

- Organism collection and observation tools
- Dip nets
- Magnifying glass
- Magnifying box
- Ruler

Procedure - Set Up

1. This activity ***must*** be done along with an expert from Newtown Creek Alliance (NCA) at either the Living Dock or North Brooklyn Boat Club Field Site locations. Access without assistance can be dangerous or impossible.

2. Most of the optional materials listed in the materials list will be provided for the class.
3. Confirm the trip and NCA will set up the observational experiment. For additional information refer to Field Site location guides.
4. Before the trip to the Field Site, review the Marine Wildlife of Newtown Creek field guide poster to familiarize yourself and students with the different species that can be found in the waterway. Many of the smaller fish, shrimp, and crabs are commonly seen at these locations. If time allows, talk about the different parts of the fish.

Procedure - Observe the Fish!

1. Within the Living Dock are several crates that hold various substrate; ropes, oyster and mussel shells, rocks, etc. A variety of species like to use these substrate filled crates as habitat. When a crate is pulled from the water and held over a container, fish, shrimp, crabs, and other animals of all sorts fall into the container for viewing. An experienced professional from NCA will perform this task for the class. The container will be brought to a table set up for student viewing.
2. Carefully take a few fish, leaving the shrimp or crabs, out the container with a net and put them in a small clear plastic fish tank (plastic fish tanks work better than tupperware because the sides are clear and make for easier viewing)
3. The more fish and fish tanks you have, the better. This way students can break into small groups in order to observe the organism up close.
4. Students carefully observe the fish and respond to the following prompts on their Observation Charts or in their Journals:
    - Sketch the fish. Label all the parts of the fish. Include colors, patterns and approximate size (you can use a ruler)
    - How does it move? Is it a fast swimmer? Does it sit on the bottom or hang out at the top?
    - What do its fins look like? How many fins does it have? Where are they located? What shape are they?
    - Describe what the fish's mouth looks like. Is it pointed up? Is it very small or very wide? What do you think the fish eats with this mouth?
    - Describe the fish's camouflage and coloring. What color is the fish when you look DOWN at it from above? What color is the fish when you look UP at it from below? Why do you think the fish is colored in this way? (Note: this is called "countershading" and it is a type of dual camouflage protecting the fish from predators above and below.)
5. Students can use the Marine Wildlife of Newtown Creek field guide poster to identify your fish. (Fish caught in the creek are most likely silverside, killie or mummichog.)

6. There will be other marine-vertebrates and invertebrates in the container (shrimp, crab, sea squirts, etc). Inspect them with the magnifying glass or magnifying box and students should include observations about them on the Observation Chart or in their Journals.

Applied Learning - Designing Plant Restoration

PLEASE NOTE: These lessons were purposefully written with built-in flexibility. You are encouraged to adapt the time, materials, procedures and handouts to fit your students, your teaching and your school.

Activity Overview

Applied Learning is an opportunity for students to practically use their knowledge acquired during the Flora & Fauna Unit in a design project related to improving the native plant communities around Newtown Creek. Using data they collected during their Field Lesson, students will propose and design a plant restoration plan for the Field Site. Students will exercise their ability to make a difference by proposing solutions to an authentic site in their community.

Learning Objectives

- Students will organize the data they collected in the field
- Students will synthesize the data they collected in the field
- Students will develop a plant restoration proposal to increase biodiversity, habitat or aesthetics (or other related goals determined by student input)
- Students will defend their plant restoration proposals
- Students will demonstrate their ability to make a difference in their community

Time

45-60 minutes for each lesson

Vocabulary

See Flora & Fauna Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Remind students that they do not need to be proficient artists when doing sketches. Simple line drawings will suffice.
- Consider using and/or modifying portions of the Flora & Fauna Introduction as a text for your students.
- Check out National Wildlife Federation's Gardening for Wildlife website. There are useful tools for you and your students to learn how to enhance a site to support native flora and fauna. Consider having students use laptops to research ideas. https://www.nwf.org/Home/Garden-for-Wildlife/Create

Materials

Materials from Field Lesson

- Site Map - clean copy
- Flora & Fauna Field Survey
- Observation Chart
- Journal entries
- Other student work (e.g. photographs)
- Google image of Newtown Creek Neighborhood
- Flora & Fauna Site Improvement Proposal Worksheet
- Flora and Fauna ID Cards

Procedure

1. Separate students into the small groups. Consider whether you want the students in the group to have worked on the same area in the Field or different ones.
2. Project the **Google Image of Newtown Creek Neighborhood.**
3. Review the Field Site(s) visited during the Field Lesson as a class.
4. Find, as a class, on the Google image of Newtown Creek Neighborhood the location of the Field Site(s) visited. Consider pointing out the schools location or other recognizable landmarks in relation to the Field Site (or proposed design site).
5. Each student in the group shares some observations or thoughts about the Field Site based on their completed worksheets and/or journal entries.
6. If you visited more than one Field Site during the Field Lesson, choose one Field Site on which to focus.
7. Use the Site Maps from the Field Lesson to calculate the percentage of the site covered by plants. (Younger students can use general descriptive language -- lots of plants, no plants, etc. --, calculations are not necessary)
8. Review the Discussion Questions below, referring to the information from your Field Lesson (i.e. Site Map, Flora & Fauna Field Research Survey, Flora Observation Chart, journal entries).
9. Each student gets a **Flora & Fauna Site Improvement Proposal** Worksheet. (If this worksheet is difficult to use, it is designed to be a guide; consider reading the prompts out loud or writing them out for the whole classroom to hear or see.
10. Both the Discussion Questions and the **Site Improvement Worksheet** have been developed to guide the students in their designs.
11. Use the information from the Field Lesson to complete the Site Improvement Worksheet. Consider using additional images of thriving native plantings that support animals as inspiration.
12. Each student gets a clean copy of the Site Map.
13. Each student uses the Site Improvement worksheet ideas to sketch a design for

flora and fauna restoration on the clean Site Map.

14. Each student presents and explains his/her design to their group.
15. The group members critique each others' designs and write down the best elements from each sketch.
16. The group gets a clean copy of the Site Map.
17. The group works together to create ONE final design incorporating the best elements from each individual's design.
18. The group works together to write an explanation of the final design supporting each element of their chosen design.
19. Final designs are developed into a poster for display.
20. Each group shares their final design and explains the project to the class.
21. The class chooses the best elements of each group design and creates a final project that can be developed into a poster and presented to other classes, members of the community, Newtown Creek Alliance, employees of the Parks Department, or the Community Board.

Discussion Questions

1. Describe your field site, its location and what surrounds it.
2. Describe the current use(s) of the site.
3. How do you think the use(s) of the site should change, if at all? Explain.
4. How much of the site is covered in plants?
5. How are the plants doing? How do they look? Are they thriving?
6. Would you keep any of the existing plants as part of your restoration plan? Why or why not?
7. What other organisms do you think will be attracted to your site with your restoration design?
8. Why is it valuable to attract these other organisms?
9. Once you restore the site, what will need to be done to maintain it and keep it in good condition?
10. Why is your design worth building?

Common Core Standards

Lesson I

English Language Arts Standards Science and Technical Subjects

Key Ideas and Details Grade 6-8

CCSS.ELA-LITERACY.RH.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.

CCSS.ELA-LITERACY.RST.6-8.2

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

Craft and Structure Grades 6-8

CCSS.ELA-LITERACY.RST.6-8.4 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 6-8 texts and topics.

English Language Arts Standards Writing: History/Social Studies, Science, & Technical Subjects

Texts Types and Purposes Grades 6-8

CCSS.ELA-LITERACY.WHST.6-8.1 Write arguments focused on discipline-specific content.

CCSS.ELA-LITERACY.WHST.6-8.1.B Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

CCSS.ELA-LITERACY.WHST.6-8.1.D Establish and maintain a formal style.

CCSS.ELA-LITERACY.WHST.6-8.1.E Provide a concluding statement or section that follows from and supports the argument presented.

Production and Distribution of Writing Grades 6-8

CCSS.ELA-LITERACY.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

English Language Arts Standards Reading: Informational Texts

Craft and Structure Grade 6

CCSS.ELA-LITERACY.RI.6.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

Grade 7

CCSS.ELA-LITERACY.RI.7.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.

Grade 8

CCSS.ELA-LITERACY.RI.8.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.

English Language Arts Standards Speaking & Listening

Comprehension and Collaboration Grades 6-8

CCSS.ELA-LITERACY.SL.6-8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6-8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.6-8.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
CCSS.ELA-LITERACY.SL.6-8.1.B Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.

Next Generation Science Standards MS.Interdependent Relationships in Ecosystems
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Lesson II
English Language Arts Standards Science and Technical Subjects
Key Ideas and Details Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
Integration of Knowledge and Ideas Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
English Language Arts Standards Reading: Informational Texts
Integration of Knowledge and Ideas Grade 6
CCSS.ELA-LITERACY.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
Next Generation Science Standards MS.Matter and Energy in Organisms and Ecosystems
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-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Lesson III
English Language Arts Standards Science and Technical Subjects
Key Ideas and Details Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
Craft and Structure Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.4 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 6-8 texts and topics.
Integration of Knowledge and Ideas Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
English Language Arts Standards Writing: History/Social Studies, Science, & Technical Subjects
Texts Types and Purposes Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.1.B Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
English Language Arts Standards Reading: Informational Texts
Key Ideas and Details Grades 6
CCSS.ELA-LITERACY.RI.6.1 (WQ pre lesson I) Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
Grade 7
CCSS.ELA-LITERACY.RI.7.1 Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
Grade 8
CCSS.ELA-LITERACY.RI.8.1 Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
Integration of Knowledge and Ideas Grade 6
CCSS.ELA-LITERACY.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
Next Generation Science Standards MS.Interdependent Relationships in Ecosystems
MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Field Lesson
English Language Arts Standards Science and Technical Subjects
Key Ideas and Details Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Craft and Structure Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.4 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 6-8 texts and topics.
English Language Arts Standards Writing: History/Social Studies, Science, & Technical Subjects

Texts Types and Purposes Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.1 Write arguments focused on discipline-specific content.
CCSS.ELA-LITERACY.WHST.6-8.1.B Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
Production and Distribution of Writing Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

English Language Arts Standards Speaking & Listening

Comprehension and Collaboration Grades 6-8
CCSS.ELA-LITERACY.SL.6-8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on grade 6-8 topics, texts, and issues, building on others' ideas and expressing their own clearly. Next Generation Science Standards MS.Human Impacts
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-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Applied Learning

English Language Arts Standards Science and Technical Subjects

Key Ideas and Details Grade 6-8
CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
Craft and Structure Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.4 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 6-8 texts and topics.
Integration of Knowledge and Ideas Grades 6-8
CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
English Language Arts Standards Writing: History/Social Studies, Science, & Technical Subjects
Texts Types and Purposes Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.1 Write arguments focused on discipline-specific content.
CCSS.ELA-LITERACY.WHST.6-8.1.B Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
Production and Distribution of Writing Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Research to Build and Present Knowledge Grades 6-8
CCSS.ELA-LITERACY.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

English Language Arts Standards Speaking & Listening
Comprehension and Collaboration Grades 6-8
CCSS.ELA-LITERACY.SL.6-8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6-8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.6-8.1.B Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
Grade 6
CCSS.ELA-LITERACY.SL.6.1.C Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
Grade 7
CCSS.ELA-LITERACY.SL.7.1.C Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
Grade 8
CCSS.ELA-LITERACY.SL.8.1.C Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
Mathematics Standards Standards for Mathematical Practice Grades 6-8
CSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively

Next Generation Science Standards
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Additional Resources

Texts:

- **"Scientists say the tiny heroes of the Earth's ecosystem are all around us," Washington Post**

https://newsela.com/read/frodo-nature/id/32680/

- ***Life Cycles: what is an ecosystem?* Encyclopedia Britannica**

https://newsela.com/read/elem-sci-ecosystems/id/29113/

- **"Australia builds a huge cat proof fence to save native animals," AFP**

https://newsela.com/read/elem-australia-cat-free-zone/id/31915/

Elementary ELA or Social Studies Texts

- ***Night of the Spadefoot Toad* by Bill Harley**

https://www.amazon.com/Night-Spadefoot-Toads-Bill-Harley/dp/1561456381

- ***People of Twelve Thousand Winters* by Trinka Hakes Noble**

https://www.amazon.com/People-Twelve-Thousand-Winters-Tales/dp/1585365297

- ***Earth Mother* by Ellen Jackson**

https://www.amazon.com/Earth-Mother-Ellen-Jackson/dp/0802789927

- ***Our Big Home* (poetry) by National Geographic Learning**

https://www.amazon.com/Our-Home-National-Geographic-Learning/dp/0761317767

- ***Hidden City: Poems of Urban Wildlife*** by Sarah Grace Tuttle

https://www.amazon.com/Hidden-City-Poems-Urban-Wildlife/dp/0802854591

Videos:

- **Biodiversity Bingo; PBS Learning Media**

https://ny.pbslearningmedia.org/resource/plum14.sci.life.biobingo/biodiversity-bingo/#.W3SdYehKg2w

- **A Forest in the City; PBS Learning Media**

https://ny.pbslearningmedia.org/resource/plum14.sci.life.findingforests/finding-forests/?#.W3ZEnOhKg2x

- **Why is biodiversity so important? – TED Ed**

http://thekidshouldseethis.com/post/why-is-biodiversity-so-important-ted-ed

- **What is Biodiversity? – Educational Tree of Life**

https://www.youtube.com/watch?v=iR2AyybowPc

Images and Powerpoints:

- **Flora and Fauna Introduction powerpoint**

https://docs.google.com/presentation/d/191HsSO6LS7XCmGdftk1kFoiWwCy5dLSTT3PoRW1cguE/edit#slide=id.p

- **Newtown Creek Plant and Animal Relationship Cards**

https://docs.google.com/presentation/d/153Ys8PkwbUZt7uto7G87WySOiLn7lMnDZ2Q_6HeCN3c/edit#slide=id.p

- **Newtown Creek Fauna ID Cards**

https://docs.google.com/presentation/d/1zk7pIqZ67_TEuEzXyY2MMALJsZdLyJXdo0MSZ0mGwJA/edit#slide=id.g3d5a946b76_0_0

- **Newtown Creek Fauna ID cards_“Personified Fauna "I eat…”**

https://docs.google.com/presentation/d/1j6aNhJhMKmsoq7J-4hz6owr9ZLHUuA_706jDuGyCWJk/edit#slide=id.g3d5a946b76_0_0

- **Newtown Creek Flora ID Cards**

https://docs.google.com/presentation/d/1eCgAaIDLGTfGUFIvgyIuwQ0EPsMvIF-i2l0MQJKKFNc/edit#slide=id.g3d5a946b76_0_0

- **Newtown Creek Flora ID cards_“Personified Flora - “I grow…”**

https://docs.google.com/presentation/d/1ryQLljOeq_ULoDbxczY0NpvusvEKBfxdRwEfkEukPsk/edit#slide=id.g3d5a946b76_0_0

Newtown Creek Alliance Website Resources

- **Flickr: Wildlife Photographs**

https://www.flickr.com/photos/76572518@N04/albums/72157659614598334/with/6871221421/

- **Wildlife Posters (Marine Wildlife and Birds)**

http://www.newtowncreekalliance.org/wildlife/

Handouts

Field Site Metadata

Fill in the following information about the Field Site you are visiting

Student Name:

Location:

Site Name_____

Time_____ Day_____

Year_____ Month_____

Weather Temperature:_____

Describe the weather:

Cloud Type:

Cloud Cover:

- ☐ No Clouds
- ☐ Some Clouds (Partly Cloudy)
- ☐ Lots of Clouds

Description of Site & Conditions:

Flora Observation

Choose one plant to observe. Fill in the following information about the plant. If you're not able to identify the species, you will have time to research it later in class.

Student Name: Name of Site:

Common Name:

Scientific Name:

Estimate the following:

Height: _____ Width: _____

Number of individual plants: _____

Percent cover: _____

Observation Notes:
Do you see any animals or insects interacting with this plant?

Does the plant seem damaged or disturbed?

Do you think the plant is healthy? Why or why not?

Draw the leaf:

Describe the color and texture of the leaf:

Draw the flower or fruit:

Describe the color and smell of the flower or fruit:

Flora & Fauna Field Research Survey

Fill in the the following information about the site you are surveying and answer the questions. Take photographs and sketch the species you observe. If you are not able to identify the species you will have to research it later in class.

Student Name: Date:

Plant name (Common and Scientific)	**Growing Conditions** Planted? Growing wild? In Soil? Through Cracks?	**Is this species native, introduced, or invasive?**	**Other notes** Does it look healthy? Sickly? Alone? Are there many of the same species?

What else did you see on site that may be impacting plant and animal health? Add other notes, descriptions, questions or sketches here or on the back of this sheet.

Flora & Fauna Site Improvement Proposal

Using your site observations and research, outline a plan to improve this site. Answer the following questions to explain why your choices will be an improvement over the current site conditions.

Student Name: Name of Site:

1. What benefits for the ecosystem should plants provide at this site?

2. What benefits for humans should plants provide at this site?

3. How would you improve growing conditions at this site?

4. Based on the previous questions, what plants would you install on this site, and where? Why?

5. *On a clean Site Map sketch a design for installing new plants and improving the site based on the information above.*