Soil Quality

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. The original module was developed by the Gowanus Canal Conservancy.

Unit Overview

Essential Questions:

- How is soil important to life?
- How is soil part of an ecosystem?
- How does the diversity of life in the soil contribute to soil health?
- What is the relationship between soil ecosystem and soil health?
- What are some indicators of a healthy soil ecosystem? (What does a healthy ecosystem look like?)
- How does soil ecology change overtime?
- How can we effectively test soil?
- What can soil testing tell us about the Newtown Creek?

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Teacher's Introduction

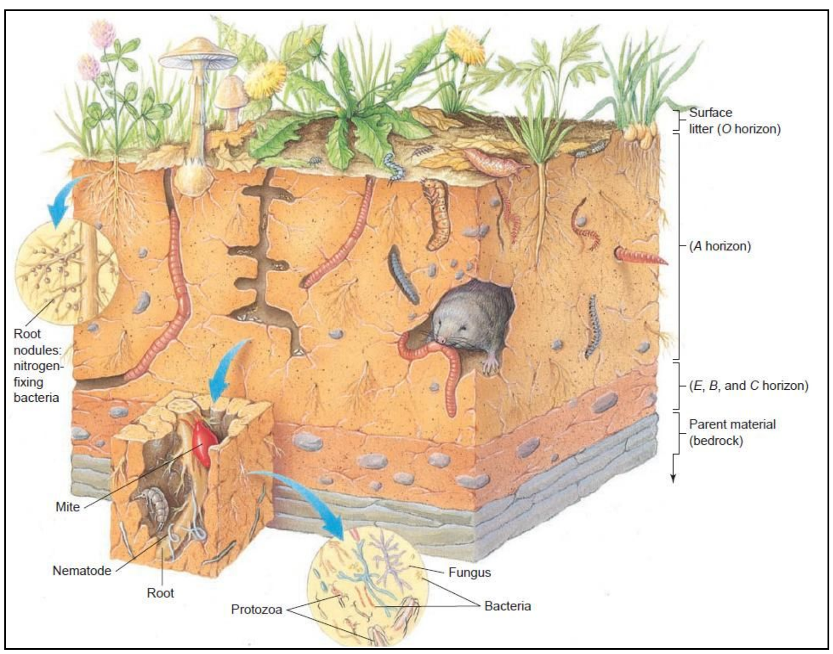
What is Soil Quality?

Soil is critical for life. It provides food for plants, animals and humans; cleans air and water; and beautifies landscape.

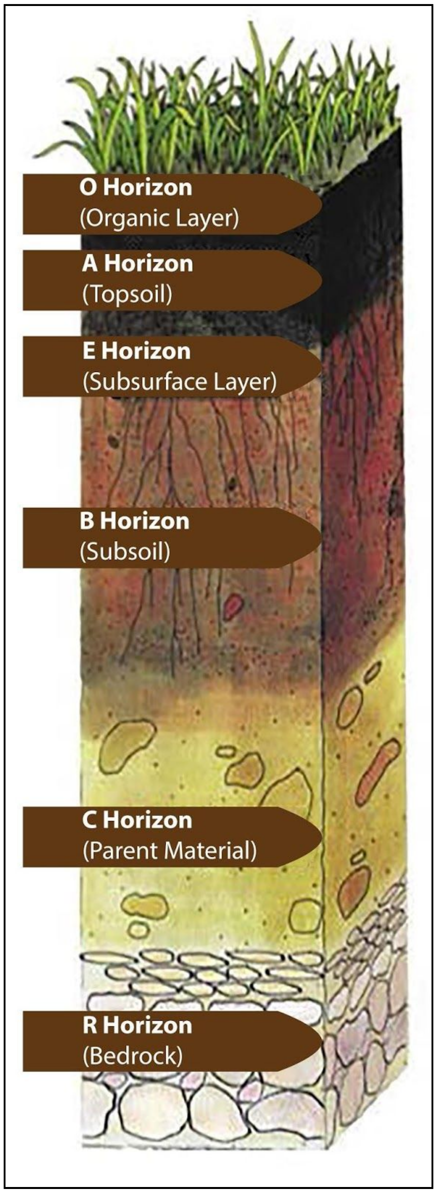
Cotyledon in rich soil.

What makes soil different than dirt? Think of soil as a thin living skin that covers the land. Dirt is misplaced soil. It is what you find under your fingernails or on your clothes; soil is what you find under your feet. It goes down into the ground just a short way. Even the most fertile topsoil is only a foot or so deep. Soil is more than rock particles. It includes all the living things and the materials they make or change.

Soil is a mix of minerals, air, water and countless microorganisms, forming at the surface of the land and coming in many types.



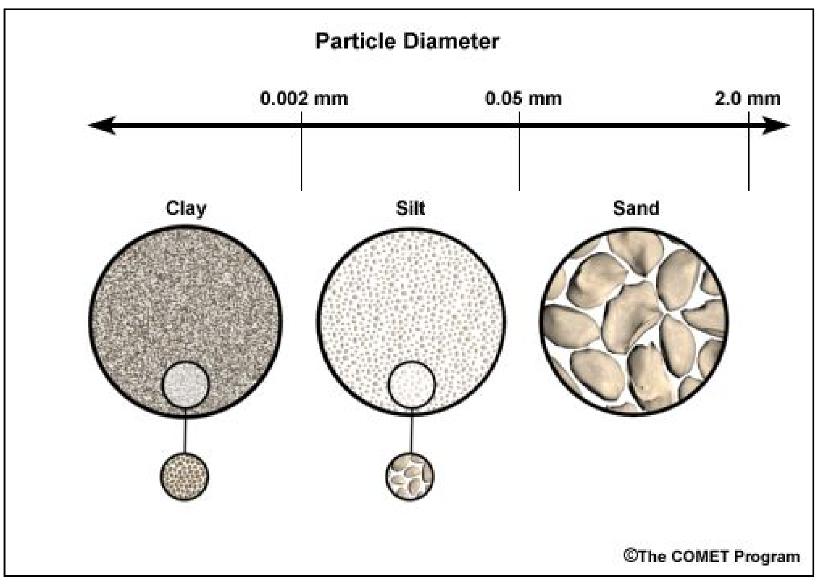
Surface soils can be home to many types of life. (Source: Permaculture Sydney South)



If you were to dig a hole a few feet down, most likely you would be able to see clearly the difference between the topmost layers (O and A layers), teaming with life and rich with organics, down to the mineral and rock based bottom layers (C and R layers) and a few others in between. Soil can take many, many years to form and it's the process of formation that creates those distinct layers. Soils in the desert will look a lot different than the soil you might see in a rainforest or on a mountain slope or in a forest. Even urban soils have their own unique characteristics.

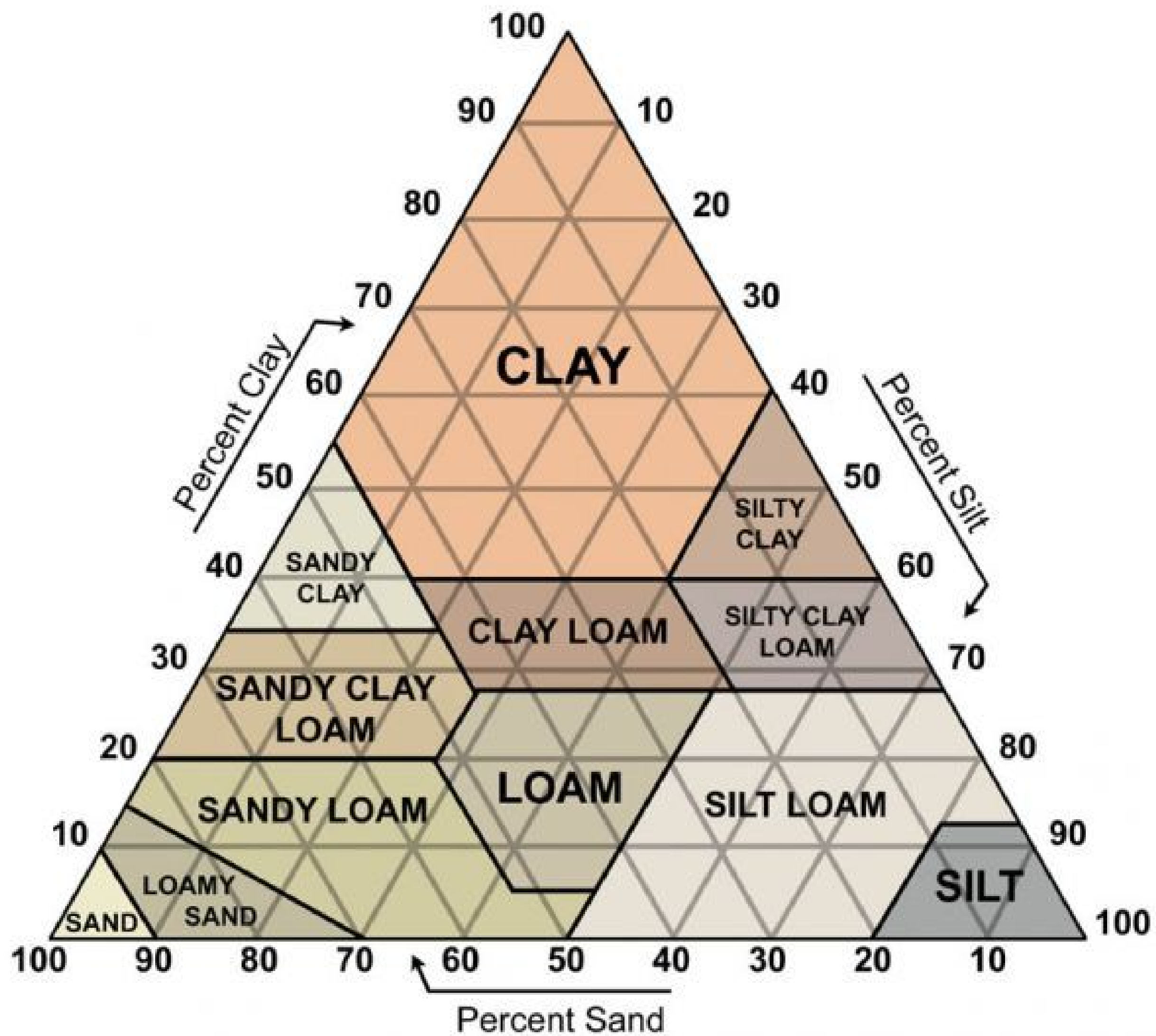
The diversity of life in fertile soil includes plants, root systems, fungi, earthworms, flatworms, roundworms, beetles, ants, spiders, mites, bacteria, algae, burrowing animals such as moles, mice and groundhogs, and much more, all depending on where you look.

In addition to being home to many organisms, soil has distinct textures, structures and colors. Sand, silt and clay describe the particle size of soil, with the largest being sand, and the smallest clay. As parent rocks break down into smaller and smaller pieces these particles are formed.



Constituent particle size determines the soil texture. (Source: COMET Program)

Soil's texture is described as the relative proportions of sand, silt and clay, for example a loamy soil has a balance of the three. Here in NYC, much of our soil can be described as either sandy loam or loamy sand. Soil structure are how these particles clump together. These clumps also have different properties; they filter water, hold nutrients, support life and provide different resources based on how they "clump". Structure can be described as balls, blocks, columns and plates. The structure of the soil is particularly important when considering it's direct impact on how water interacts with it. Sometimes resulting in rapid infiltration, other times the opposite.



Soil Texture Pyramid. (Source: Natural Resource Conservation Service (NRCS)

The spaces in between clumps create pore space for water, air and organisms. Color varies according to mineral content. A darker soil indicates more organic matter; and orangey color indicates higher iron content.

Soil provides many important biotic and abiotic ecological functions including [1]:

• **Nutrient Cycling** - Nutrients are made available to to plants as soil releases them through the water cycle process

• **Water Relations** - Soil regulates water drainage and stores nutrients. It regulates water use for plants and groundwater recharge

• **Biodiversity & Habitat** - Soil provides habitat and nutrients for plants, animals and microorganisms. The healthier the soil, the more biodiversity exists

• **Filtering & Buffering** - Soil filters air and water, buffering or degrading toxic nutrients and making them unavailable to plants and animals

• **Physical Stability and Support** - Soil structure can allow air and water to pass through pores between particles, prevent erosion, and support to hold plant roots. It provides foundation for building structures and other human made infrastructure

• **Soil Quality** - Refers to the the capacity of a soil to function and can include chemical, physical and biological characteristics, usually with respect to the needs of one or more biotic species of plants, animals, and humans. When measuring soil quality, it is important to evaluate these properties of the soil.

It can take up to 500 years to form an inch of soil – is this a renewable resource? Conversely the quality of a soil can be degraded rather quickly by: erosion, contamination, and compaction.

Soil Quality Indicators: Measures of Soil Functional State[2]		
Indicator	**Tests**	**Related Soil Function**
Biological	Respiration, Earthworms, Particulate Organic Matter	Biodiversity of Organisms (decomposers and nutrient cycling), Filtering
Chemical	pH, Electrical Conductivity (EC) and Soil Nitrate Levels	Nutrient Cycling, Water Relations, Buffering, Plant and Soil Organisms Health, Contaminant Levels and availability of uptake
Physical	Bulk Density, Water Content, Infiltration Rate, Aggregate Stability, Slaking, Morphological Estimations	Water Entry and Retention, Nutrient availability, Erosional status

[1] Soil Functions: Services Provided by Soil. Soil Quality for Environmental Health. http://soilquality.org/functions.html

[2] Soil Quality Indicators: Measures of Soil Functional State. Soil Quality for Environmental Health. http://http://soilquality.org/indicators.html

Why teach Soil Quality Testing?

Soil Quality Testing provides a window into the health and vitality of the creek. It can:

- Help to identify pollution and specific sources of pollution
- Determine whether soil is meeting specific standards
- Monitor trends over time
- Monitor impacts of disturbances such as flooding, drought or chemical spill

Exposed sediments during a low tide on Newtown Creek's Queens shoreline. (Source: Newtown Creek Alliance)

Issues related to soil quality in urban soils like that surrounding the creek may include:

- Erosion
- Compaction
- Reduced infiltration and increased runoff
- Salt or other chemical buildup
- Nutrient loss
- Reduced biological activity
- Weed or pathogen infestation

Several of these soil quality issues directly impact the water quality of the creek, including erosion, runoff, infiltration and groundwater recharge.

Since we're interested in the health and changes over time in the Newtown Creek it is important to test the soil. Soil health is directly linked to plant health — for example, if soils are degraded, how will beneficial plants and organisms thrive?

It also impacts Water Quality. Does compacted soil absorb and filter the same volume of water — and how would this affect levels of stormwater runoff? Do different testing locations along the Newtown Creek reveal different results (e.g. in a tree pit, a bioswale, or a brownfield property)?

Through testing, students will see a "snapshot" of the Soil Quality at the Newtown Creek. Most meaningful data sets emerge when the soil is tested over time. Long term monitoring reveals trends over days, months and seasons. It could also uncover the sources of previously unknown sources of pollution.

(An urban tree with heavily compacted soil. Source: Shrub Doctor)

Soil Quality testing addresses additional skills including:

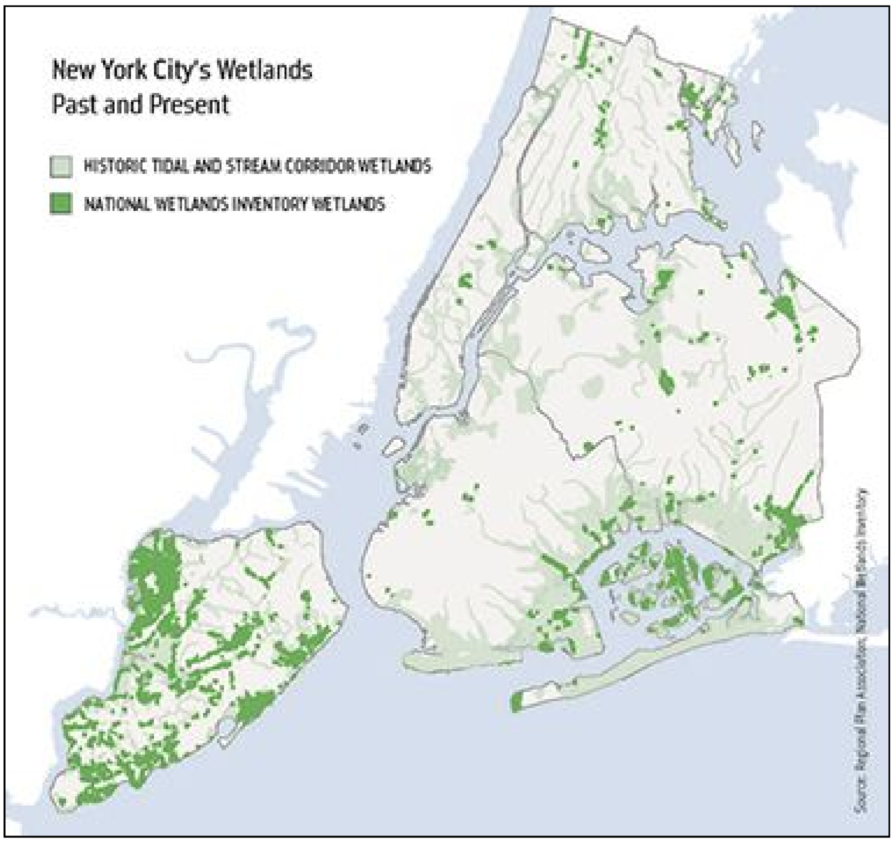
- Following safety procedures
- Making predictions and hypotheses
- Measurement and accuracy
- Data collection and recording
- Analysis and interpretation of data
- Comparison of data

Newtown Creek Soil Quality Background

All of the soil in the land surrounding Newtown Creek is imported. None of it is original to the tidal salt marshes of 400 years ago. But whether it is older landfill or new soil brought in for restoration it is important to understand the health of the soil and how it impacts life — plant, animal, and human — in the Newtown Creek Watershed.

The Phelps Dodge Copper refinery in Queens mid-1900s. (Source: Newtown Creek Alliance)

The primary issue with Soil Quality surrounding Newtown Creek today is the contaminated soil left over from polluting industry that operated along the waterfront from the mid 1800's to the mid 20th century — a period of heavy industry. Dozens of refineries, glue factories and tanneries, metal and chemical processing plants on the Creek supplied the region with goods, economic wealth and industrial power for more than a century and are the major source of poor soil health. Soil Quality suffered as industrial waste leaked or was dumped into the soil around the Creek. In particular, coal tar, the byproduct of converting coal to manufactured gas, and crude oil seeped from holding tanks into the ground from Standard Oil's progeny companies, as well as copper refining byproducts –– contamination from the Phelps Dodge Superfund site, are all still present in high quantities in the soil. Coal tar and other oil byproducts mixed in with Creek sediments is often called “black mayonnaise” for its thick, gooey consistency and color, and contains many known carcinogens. It is a highly toxic substance. These contaminants include polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), pesticides, other coal tar wastes and heavy metals such as barium, cadmium, copper, lead, mercury, nickel and silver. These pollutants pose serious health risks and prevent important soil organisms (not to mention plants and animals) from thriving.



Map showing historic wetlands, nearly all of which were filled in. (Source: Regional Plan Association, National Wetlands Inventory)

Urban soils like those surrounding the Newtown Creek have particular issues due to the nature of land use and population density. Urban soils have been disturbed in some way, by cutting out native soil, filling with other material and regrading to construct roads, buildings, and recreational areas such as parks. As a result many urban soils are likely to be compacted and contaminated, depending on previous or current land use. In NYC in particular, 85% of waterfront land and soil that was originally salt marsh was filled in and built on during the 1700 and 1800s.

In the original marsh land around the Newtown Creek, fill materials are associated with canal construction in the 1850s and 60’s and the subsequent industrialization and regrading of the area. The fill consists of silt, sand and gravel mixed with ash and fragments of brick, metal, glass, concrete, wood and other debris.

Four geologic units lie beneath the area surrounding the Newtown Creek:

- Fill (newest and most shallow)
- Alluvial/marsh deposits
- Glacial sands and silts
- Bedrock (oldest and deepest)

Today, other factors affecting Soil Quality health surrounding Newtown Creek include soil compaction and contaminated runoff from road salt, animal feces, oil and other chemicals on the streets that get washed off during precipitation.

Improvements to Newtown Creek Soil Quality

Several coordinated efforts are underway to improve Soil Quality near Newtown Creek. Larger clean ups are being led by government agencies, and volunteer groups are improving Soil Quality through smaller scale interventions.

The Superfund

After years of community advocacy and a series of lawsuits, in 2010 Newtown Creek was designated a Superfund site by the United States Environmental Protection Agency (USEPA)[4]. The Superfund program has the resources to mediate some of the nation's most contaminated areas and responds to environmental emergencies, oil spills and natural disasters. Restoration of Superfund sites are covered under the *Comprehensive Environmental Response, Compensation and Liability Act of 1980*, which forces polluters to clean up the toxic sites they created. To protect public health and the environment, the Superfund program focuses on making a visible and lasting difference in communities, ensuring that people can live and work in healthy, vibrant places. The Superfund process promises to be a lengthy investment of time and resources in achieving a thorough cleanup of toxic contaminants that pose risk to human health and ecological systems. Advocates and community volunteers play a large role in making sure Superfund is carried out correctly and they are on the ground making incremental positive steps to improve the environment around the Creek every day.

[4] *https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0206282*

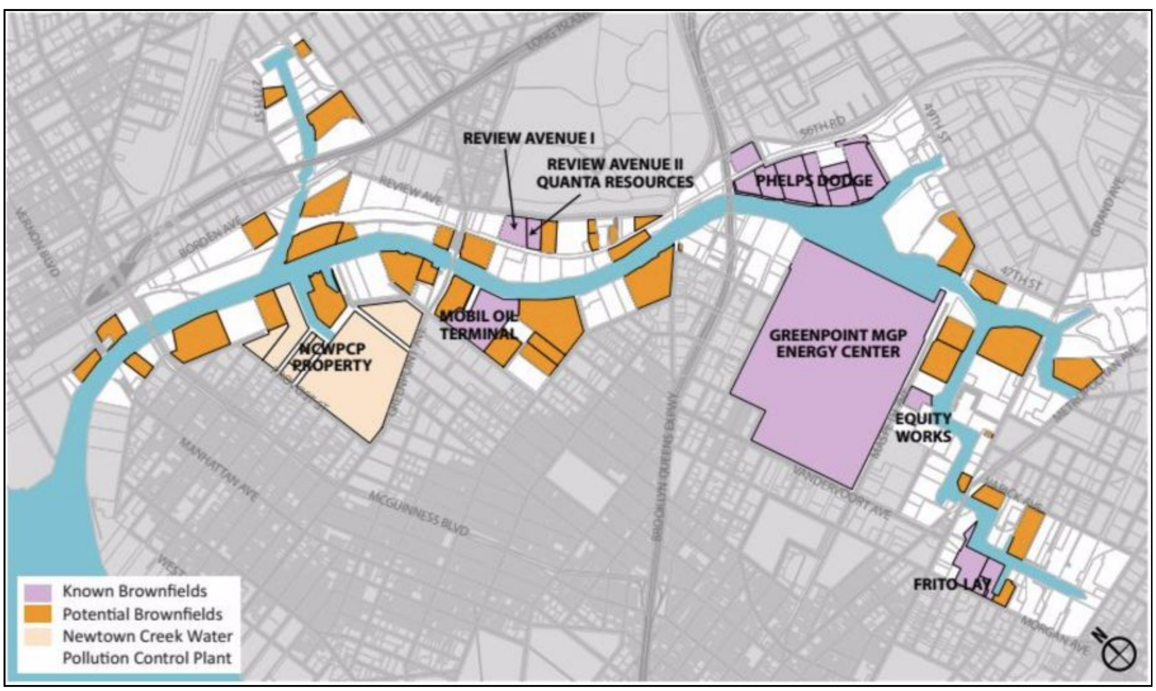
New York State Brownfield Program

The soils in properties adjacent to the Creek can be cleaned up through the New York State Brownfield Program. A site is a brownfield if the contamination levels exceed health or environmental standards.[5]

The contamination in these soils can also be attributed to toxic wastes from petroleum refining and other chemical production and storage on the Creek. Today, any time a property is redeveloped along the Creek the law requires property owners to remediate the soil, which usually involves large excavations of the most contaminated layer. Developers are provided tax incentives to do this work.

Redevelopment of Creekside properties is unlikely to take place without a larger rezoning -- or change of use -- of the area. In 2012, in a joint initiative of the Greenpoint Manufacturing and Design Center (GMDC), Riverkeeper and the Newtown Creek Alliance, the Newtown Creek Brownfield Opportunity Area (BOA) Nomination Study was initiated. The objective of the BOA was to create a 21st Century approach to enhancing and reutilizing sites within one of New York City's most important maritime industrial areas without using the tool of rezoning.

Like the Superfund cleanup process, citizens are invited to participate in the Brownfield program by providing comments on the proposed cleanup plans.



The 2012 BOA identified dozens of known and potential Brownfields around the Creek. (Source: Brownfield Opportunity Area Nomination Report)

[5] *NYSDEC Brownfield Cleanup Program http://www.dec.ny.gov/chemical/8450.html*

NYC Green Infrastructure Plan

The thousands of bioswales (Right of Way Rain Gardens) are being constructed across NYC as part of the NYC Green Infrastructure Plan. The sandy soil mix used in these street side gardens is engineered to slow down and filter stormwater runoff. Bioswales are designed with a significantly deeper soil bed than most gardens and tree beds, increasing water holding capacity. The soil elevation is lowest in the center of the swale, which allows water to pause and infiltrate.

Right of Way Rain Garden in action. (Source: NYC DEP)

Compost!

One way volunteers improve Newtown Creek Soil Quality is by promoting the production and use of compost within the Newtown Creek Watershed. Compost adds important nutrients and organisms to replenish depleted urban soil. Volunteers create healthy compost with a 1:1 mix of nitrogen-based material (mostly food scraps) and carbon material (“browns” such as dead leaves and mulch). The material should be regularly turned to aerate the pile, providing oxygen for microorganisms that break down material. The mixture cures until it becomes a rich, dark material ready to add to gardens and street tree pits. Compost can be distributed to local schools, community gardens, street trees and parks.

Compost provides these benefits to soil health[7]:

- Increases water filtration rates, reducing runoff and erosion
- Improves soil structure and porosity
- Improves water holding capacity
- Absorbs and binds contaminants, such as heavy metals
- Increases biodiversity of micro and macro organisms
- Adds nutrients to soil and stabilizes pH
- Helps prevent weed growth and some pathogens

7: Compost and Its Benefits; US Composting Council (2008)
http://compostingcouncil.org/admin/wp-content/uploads/2010/09/Compost-and-Its- Benefits.pdf

How to Test Soil Quality in Newtown Creek

Determining the soil quality in Newtown Creek requires completing a battery of tests. There are many different tests that are used by organizations and government agencies that monitor Soil Quality.

This unit will focus on the several of the most fundamental Soil Quality tests:

- **NPK (Nitrogen, Phosphorus, Potassium)**
- **pH**
- **Temperature**
- **Filtration Rate**
- **Stratification**
- **Organism Population**

Use test kits to determine these soil quality parameters. Filtration, Stratification, and Organism Population can be determined by additional tests that are explained in the field lesson.

NPK (Nitrogen, Phosphorus, Potassium)

All plants need these three basic elements to grow. Nitrogen helps plants grow leaves and shoots. Phosphorus facilitates strong root growth, and potassium promotes flower and root development. A deficiency in any of these nutrients stunts plant growth and production, also making the plant more vulnerable to insect attack. Indicators of deficiency may include discoloration of leaves. A balanced level of these nutrients allows for healthy growth and increases the plants ability to ward off pests and disease.

pH

A pH test will show whether a soil is acidic or alkaline. Plant nutrients, like Nitrogen, Phosphorus and Potassium are best absorbed from the soil when a pH is in the neutral range (6.2 to 7.2). Soil becomes acidic by erosion from rain water (which leaches away basic ions), carbon dioxide from decomposing organic matter and some strong plant fertilizers.

Temperature

Use a soil thermometer to measure the warmth of soil at specific depths. Temperature is important when planting new plants and germinating seeds, which require specific temperature ranges for different species and planting zones. Temperature will vary during the day, night and season. Taking the temperature of compost can also indicate when the pile has heated up by decomposition activity and when it has cooled down enough to be applied to the soil as fertilizer.

Vocabulary

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:

biology
biodiversity
ecology
ecosystem
environment
food chain
food web
organism

Essential Vocabulary:

absorption
bulk density
clay
compaction
contaminate
decompose
decomposer
dirt
fertilizer
filter
fill (or urban fill)
landfill
leech
loam
humus
microorganism
mineral
matter
nitrate
nutrient
organic matter
parent material
pH
phosphate
porosity
potassium
runoff
sand
sediment
silt
soil
soil horizon
soil profile
structure
subsoil
texture
topsoil

Extension Vocabulary:

abiotic
alluvial
aquifer
bacteria
bedrock
benthic zone
biotic
blocky
buffer
brownfield
compost
disturbance
drought
friable
fungi
glacial till
massive
nematodes
platy
protozoa
permeable
photosynthesis
remediation
respiration
rhizosphere
stormwater

Lesson I - Observing Sand, Silt and Clay

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

Soil is important for supporting life, filtering and storing water, growth of all plants and animals (humans included!), is a foundation and anchor for our buildings and the city we live in. In this lesson, students will work in small groups to observe samples of sand, silt and clay. The teacher will then lead students in a discussion in order for them to learn more about these particle sizes. The students will understand the importance of soils in our lives and the value of knowing it's component parts.

Learning Objectives

• Students will observe samples of soil using different senses
• Students will differentiate between different sizes of soil particles (sand, silt and clay)
• Students will explain why soil is important
• Students will determine how the soil type impacts the plants that live in the soil

Time

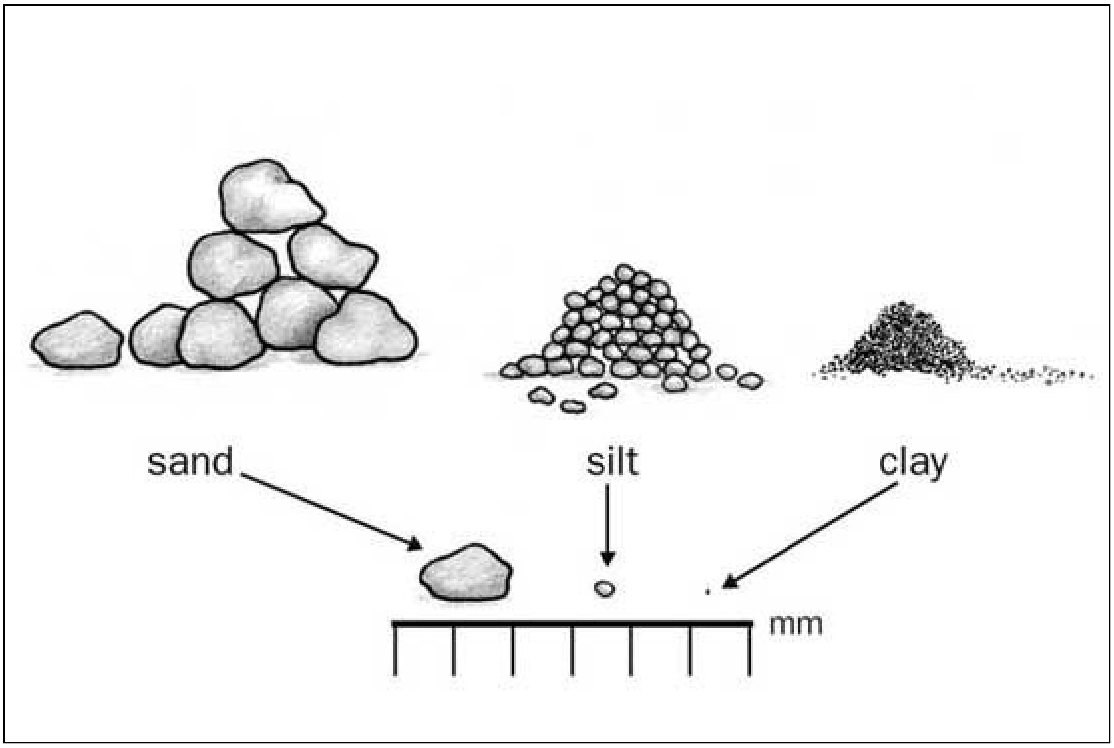
45-60 minutes

Vocabulary

See Soil Quality Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Consider using and/or modifying portions of the **Soil Quality** in Teacher's Introduction as a text for your students.
- Consider if and how you want to review the definitions of soil, sand, silt and clay before the students have an opportunity to observe the samples.
- **Sand** - feels gritty, has lots of air space, and does not hold water well.
- **Silt** - feels smooth, has some air, and holds water well. When silt soil is wet, it gets slippery.
- **Clay** - feels sticky because it is made of very small particles. It does not have much air space and does not have much room for water.
- Remember to leave sufficient time to have the students clean up at the end of class.



Texture scale.
(Source: Nelson, M. Rae. "Soil." *Experiment Central*:
Understanding Scientific Principles Through Projects)

Materials

- "Know, Want to Learn, Learned" (KWL) Worksheet
- Soil Observation Activity Worksheet
- Sand, silt and clay (can be purchased from Ward's Science or Home Depot)
- Containers for soil
- White paper
- Cleaning supplies

Procedure 1 - Introduction

1. Give students the **KWL Worksheet.**
2. Facilitate a discussion assessing students' knowledge of soil. Students write in the "K - Know" section of the worksheet during the discussion.
    a. What is soil? (Soil is a complex mix of materials: minerals, air, water, and organic matter.)
    b. What is the difference between soil and dirt, and where in your

neighborhood do you see either? (Dirt is just soil that has gotten lost. When it's on our living room floor we call it dirt. When it's in the park we call it soil.)
   c. What are some of the functions and purpose of soil? (Food, clothing, building materials, etc.)
   d. Why might soil be called "the foundation of life"? (Because nearly everything we eat, drink, use, etc. comes from soil, grows in soil, is filtered by soil, is built on soil, etc.)
   e. Are there different types of soil? (Yes: different combinations of sand, silt, and clay.)
3. Tell students that they will be observing (looking, smelling and touching) the soil.
4. Students individually fill out the "W - Want to Know" section of their worksheet based on what they want to find out during their observation/exploration of the soil. (This can be thought of as the student learning how to develop a hypothesis)

Procedure 2 - Observing Soil Textures (Sand, Silt and Clay)

1. Separate students into pairs or small groups.
2. Give each pair/group a copy of the **Soil Observation Activity Worksheet** to record their results.
3. Post or review a word bank for students to reference when making specific observations:
   a. **Look:** *sparkly, dull, shiny, multi-colored, speckled, grainy, marbled*
   b. **Smell:** *musty, earthy, pungent, odorless, sour, fragrant, grassy, sweet, moldy, rotten*
   c. **Feel:** *grainy, smooth, bumpy, soft, dry, wet, hard, malleable, moist*
   d. **Structure:** *friable, loose, crumbly, firm, clumpy, massive*
   e. **Smear color:** *feel free to combine colors (e.g. greenish-gray, reddish-brown)*
4. Give each group soil samples of sand, silt and clay OR have students rotate around to a station for each soil sample.
5. Students observe and write down all observations on the Soil Observation Activity Worksheet.each soil sample.
   - Look closely at it
   - Smell it
   - Feel it between your fingers
   - Smear on paper (color is important with soil!)
   - Grain size - space between particle sizes
   - Structure - how it holds together
6. Students draw a picture of the soil particles and include labels that indicate size

(refer to “Texture scale” graphic,) shape and color of particles.

7. Students hypothesize or predict whether each soil sample is sand, silt or clay based on the following definitions:
   a. **Sand:** *feels gritty, has lots of air space, and does not hold water well.*
   b. **Silt:** *feels smooth, has some air, and holds water well. When silt soil is wet, it gets slippery.*
   c. **Clay:** *feels sticky because it is made of very small particles. It does not have much air space and does not have much room for water.*

Discussion Questions

1. Why do we find different-sized particles in soil? Soil composition and particle size depend on the materials (rocks, plants, minerals, etc.) and processes (surf, wind, moisture, etc.) in the area.
2. How do we describe soils with different percentages of sand, silt and clay in them? (Reference “Texture Pyramid” in Teacher’s Introduction)
3. How can particle size affect filtration (water moving through the soil)? Water will flow more quickly through sand, get absorbed by silt and have a difficult time penetrating clay.
4. How might this particle size and filtration rate be important? Different amounts of water, or moisture levels, exist in soil depending on amount and regularity of rainfall and precipitation and rates of filtration through the soil. Different plants require different amounts of water and have adapted different root systems etc.
5. Why soil is important to human beings? Prompt students to think about what comes out of soil: plants make food, clothing materials, and so forth. We build our houses and schools on soil. Soil filters our water...
6. How might different soil types affect human lifestyle in that area? The soil composition determines what kind of plants and crops grow best in each area and therefore which resources are available.
7. During or after this discussion, have students fill out the “L - Learned” section of their KWL worksheet.
8. Have students write an “extended response” to the question: Why is soil important?

Extension Lesson - Porosity of Soil

To demonstrate the size of soil particles, display three jars: golf balls (sand), marbles (silt), and small beads (clay). You can use large mason jars for this activity. Pour the same amount of water into each container and observe how long it takes the water to fill the bottom of the jar. The water will filter to the bottom of the jar fastest in the golf balls (sand) container and slowest in the beads (clay) container.

Extension Lesson - Blind Test

After the above lesson, have students work in pairs and do a “blind feel” test to see if they can determine whether the sample is sand, silt or clay. Students can use all their observation skills other than sight.

Extension Lesson - Building Soil

Collect a sample of soil from the McCarren Park Demonstration Garden or another raised bed in your neighborhood. Using 1) the raised bed soil as a model, 2) the sand, silt, and clay from the Observing Soil Textures activity, 3) some compost and decomposing leaf litter (also known as humus), and 4) the Texture Pyramid, try to recreate the soil found in the garden. This is nutrient rich soil, perfect for growing food - how much sand, silt or clay, compost or other organic matter is required to achieve this type of soil quality?

Extension Lesson - Explore the soil around your school

Students will collect soil samples on and near their school. These samples will be Jar Tested and compared to the Soil Pyramid to identify different soil compositions. How to Jar Test soil: place collected sample in a jar (just a few tablespoons works well). Fill the rest of the jar with water. Shake. Leave jar overnight to settle. The next day observe how the soil has settled in the jar. The sand will settle on the bottom; the silt will settle in the middle; and the cay will settle on the top (if there is lots of clay it may take more than 24 hours to settle!). Using a marker, indicate on the jar with a line where each soil type ends. Compare ratios to Soil Pyramid to determine soil type.

Lesson II - Soil as a Filter

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

Soil acts as an important filter, removing pollutants and other contaminants. Different types of soils work differently as a filter, some types doing a better job than others. Reduced filtration increases runoff; increased runoff means increased contamination. Students will work in small groups and experiment with how sand and fine soil (a combination of silt and clay) filter different ingredients mixed with water (floatables, colored water, soap, oil).

Learning Objectives

- Students will see how soil acts as a filter
- Students will explain the concept of “filtering capacity”
- Students will discuss how the filtering capacity of soil affects pollution and contaminants
- Students will explain the benefits of soil acting as a filter

Time

45-60 minutes

Vocabulary

See Soil Quality Introduction for a list of vocabulary words from which to choose

Tips for Teachers

- Consider using and/or modifying portions of the **Soil Quality** in Teacher’s Introduction as a text for your students.
- You can model one of the experiments to save time.
- You can do many varieties of this activity with different soils. You could collect soil from the places you will visit during the field lesson or purchase soils with different make-up and sediment sizes.
- Remember: always try these experiment first, so you have an idea of what to expect before you try it with students.

Materials

- Soil as a Filter Activity worksheet
- Toothpicks or pencil
- Liquid soap or detergent
- Extra cups

- Aluminum tray
- Paper towels
- Sand - *clean with large, rough particles (stream table sand from Ward's Science or Home Depot)*
- Fine soil - *mixture of particle sizes (silt and clay)*
- "Floatables" *(like styrofoam pieces or other small pieces of plastic trash)*
- Colored liquid *(mix red and blue food coloring to make purple water)*
- Paper cups of two different sizes. *(The bigger size should be able to sit in the smaller size - 5oz and 3oz work well).*
- Cooking oil

Procedure 1 - Introduction

1. Review Lesson I and the different types of soil particles: sand, silt and clay.
2. Briefly discuss soil as a filter with the class
    a. What is a filter? (show a coffee filter to aid discussion)
    b. How can soil work as a filter?
    c. How do different soils filter differently?
3. Split students into small groups.

Procedure 2 - Cup & Sand Set-up - Soil Filter Test Preparation

1. Poke holes in the bottom of a bigger cup using the toothpick or sharpened pencil.
2. Place the bigger cup in the smaller cup.
3. Put a toothpick or pencil vertically in between the two cups so air can escape from the bottom cup.
4. Place the two cups into the aluminum tray.
5. Fill the bigger cup ½ way with sand.

Testing with Floatables, Colored Liquid, Detergent, and Oil

Procedure 3 - Filtering Water With Floatables (Trash)

1. Make **Cup & Sand Set-up**.
2. Give each group a copy of the **Soil as a Filter Activity** Worksheet.
3. Students hypothesize or predict what will happen to the sand, water and floatables when poured through the sand.
4. Pour water with floatables added to it into the bigger (top) cup.
5. Students observe and record what happened to the floatables.
6. Remove bottom cup and observe and record the results of the experiment on the water and soil.
7. Draw conclusions from the experiment.
8. Repeat experiment with fine soil.

Procedure 4 - Filtering Water With Colored Liquid (Chemicals)

1. Make a new **Cup & Sand Set-up**.
2. Hypothesize or predict what will happen to the sand and the colored liquid.
3. Pour colored liquid into the bigger (top) cup.
4. Observe, record and draw conclusions based on what happened to the colored liquid and the sand.
5. Make another **Cup & Sand Set-up**. This time fill bigger cup with 1⁄2 inch of sand and add fine soil until the cup is 1⁄2 full.
6. Predict and hypothesize what will happen to the fine soil and the colored liquid.
7. Pour colored liquid into bigger cup.
8. Observe, record and draw conclusions based on what happened to the colored liquid and the soil.

Procedure 5 - Filtering Water With Detergents

1. Make a new **Cup & Sand Set-up**.
2. Hypothesize or predict what will happen to the sand, water and the detergent.
3. Mix up the water and detergent so there are suds.
4. Pour sudsy water into the top cup.
5. Observe, record and draw conclusions based on what happens to the sudsy water and the sand.
6. Make another **Cup & Sand Set-up**. This time fill bigger cup with 1⁄2 inch of sand and add fine soil until the cup is 1⁄2 full.
7. Hypothesize or predict what will happen to the fine soil and the sudsy water.
8. Pour sudsy water into bigger cup.
9. Observe, record and draw conclusions based on what happens to the sudsy water and the soil.

Procedure 6 - Filtering Water With Oil

1. Make a new **Cup & Sand Set-up**.
2. Hypothesize or predict what will happen to the sand, water and the oil.
3. Pour oil & water into the top cup.
4. Observe, record and draw conclusions based on what happens to the oil & water and the sand.
5. Make another **Cup & Sand Set-up**. This time fill bigger cup with 1⁄2 inch of sand and add fine soil until the cup is 1⁄2 full.
6. Hypothesize or predict what will happen to the fine soil, oil & water.
7. Pour oil & water into bigger cup.
8. Observe, record and draw conclusions based on what happens to the oil & water and the soil.

Discussion Questions

1. What types of pollution/contamination could each ingredient above represent?
2. What happened with the floatables (trash)?
3. What happened with the colored liquid (chemical)? (Clay has a charge and can hold onto certain nutrients and chemicals that are oppositely charged)
4. What happened with the detergent?
5. What happened with the oil?
6. How would you describe the difference between the different types of pollutants you experimented with?
7. How would you describe the difference between the different types of filtering you experimented with?
8. What other factors in a soil ecosystem (worms, other insects, roots, organic materials, etc) could contribute to filtering?
9. How does planting plants along the shoreline of the Newtown Creek help with the issues of runoff?
10. Based on this experiment, what type of soil used in these experiments should we use along Newtown Creek? Why?
11. How could the filtering ability of soil be used in the wastewater treatment process?

Extension Lesson:

Soil Horizons - draw a Soil Profile poster or have each student represent one of the layers in the profile. The layers can be described as a lasagna, where each layer plays an important role.

NCA
NEWTOWN CREEK ALLIANCE

Field Lesson - Soil Quality

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

Soil quality in and around Newtown Creek varies depending on its current or historical use, its natural history, its location and what its made out of. This field lesson is an opportunity to bring your students outdoors and have them interact with Newtown Creek by making observations and inferences and testing the quality of the soil using several different parameters.

Learning Objectives

- Students will observe different types of land surfaces in the Newtown Creek watershed
- Students will accurately measure soil quality parameters (filtering rate, Nitrogen, Phosphorus, Potassium [NPK], stratification, organism observation)
- Students will interpret the results of each test and discuss possible factors impacting each test result
- Students will draw preliminary conclusions about the health of the soil based on the data
- Students will compare soil quality data if tested at more than one time or location

Time

Can vary from 60 minutes to several hours

Vocabulary

See Soil Quality 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. (recommended sites: McCarren Park Demonstration Garden and Manhattan Ave Street End Park)
- Always visit the Field Site prior to bringing your students there.
- Consider using and/or modifying portions of the Soil Quality Introduction as a text for your students.
- Each student group will collect a soil sample and conduct one or more tests.

Working in small groups will help these tests go smoothly and help guard against error.
- For each discussion point, decide which teaching method works best for you and your students.

Discussion Points

- Built vs. “Natural” environment
- Importance of testing procedure/protocols
- Importance of metadata (location, date, time, tide, etc.)
- Testing once vs. testing multiple times and taking an average
- Factors influencing nitrate, phosphorus, and potassium
- Bioswale (Rain Garden) soil vs. tree bed soil
- Pollutants that may influence test results (e.g. chemicals dumped at curb)
- Other factors that may influence test results
- Other observations about the site
- Human activity at the site
- Stewardship of the Creek

Journal Prompts

We recommend having students write in their journals at the end of the field experience and 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. What observations do you think are important to note on your **Soil Quality Data Sheet**? What observations did you make?
2. What are some common features of healthy soil?
3. Why do we need healthy soil for our ecosystem?
4. What factors contribute to unhealthy plant and soil life?
5. How does the diversity of life in the soil contribute to soil fertility?
6. What is a human’s relationship to the soil?
7. How is soil important to life?
8. What are the components of soil? What are some abiotic and biotic factors of soil?
9. What are the different soil types?
10. How does soil change as depth increases?
11. What are nutrients that plants need to maintain health? Explain how each nutrient is responsible for a specific plant function.
12. How does the quote, “one man’s trash, is another man’s treasure” relate to the compost ecosystem?

13. What are the benefits of composting?
14. Choose one soil quality result that you think should be improved in Newtown Creek. What could you design/propose/build within the Newtown Creek Watershed that could have a positive impact on this soil quality parameter?
15. Alternatively, what other kind(s) of stewardship could you participate in that could improve the health of the soil in the Newtown Creek Watershed? Explain.

Main Activity - Testing the Soil Quality of Newtown Creek

Materials

- Clipboards
- Journals
- Soil Quality Data Sheet
- Site Map (for your chosen Field Site)
- Soil quality test kit tools (depending on which tests you choose to do)

Procedure

1. Separate students into small groups.
2. Give each group a copy of the **Site Map** and a **Soil Quality Data Sheet**.
3. Stand in a central area on the site with the whole class and compare the boundaries on the Site Map to where those boundaries are on the actual site.
4. Students make observations and inferences on the Site Map, based on elements they notice that are degraded (e.g. litter, floatables, oil, compacted soil, dilapidated bulkheads) and other things that may impact soil quality.
5. Students collect metadata and record on Soil Quality Data Sheet; Metadata Section. You may want to collect the metadata with the whole class, or you may assign this as a task to one or more small groups. It is important to collect this information first because it sets the stage for the soil quality tests.
6. Student groups test the soil and record results on the Soil Quality Data Sheet.
7. Facilitate students sharing test results so that their data sheets are complete as possible.
8. Students calculate averages.
9. Students complete the soil quality analysis at the end of the data sheet.
10. Students clean their equipment and hands.
11. Bring all data back to the classroom for the Applied Learning Lesson.

Extension Lessons - Soil Drainage Test

To test drainage (infiltration capacity):

1. Dig a hole about 1 foot deep.
2. Fill with water and allow it to drain completely.
3. Immediately refill the pit and measure the depth of the water with a ruler.
4. 15 minutes later, measure the drop in water in inches, and multiply by 4 to calculate how much water drains in an hour.

Less than 1 inch per hour is poor drainage, indicating the site may stay wet for periods during the year. Plants that don't tolerate poor drainage will suffer. 1 to 6 inches of drainage per hour is desirable. Soils that drain faster than 6 inches per hour have excessive drainage.

Simplified Test Option: Another option is to get a coffee can and open it on both sides. Place coffee can 1 inch into soil. Pour measured amount of water and see how long it takes to absorb. Repeat this same process in different types of soil areas (e.g. tree pit, rain garden, garden, unmanaged area, etc.) and compare and contrast the results.

Extension Lesson - Soil Stratification (Jar Test)

Take soil samples from various sources, including tree beds. Stratify soil by putting each type in a mason jar with water. It will stratify into layers of sand, silt and clay. Bring back samples and compare to "pure" sand, silt and clay samples from Lesson I.

Extension Lesson - Identify Soil Organisms

Collect soil samples to look at under a microscope. Identify various microorganism that you may find (millipedes, centipedes, worms, microbes, roots)

You could purchase and bring field microscopes with you for this lesson or you could collect samples and bring them back if you have microscopes at school. (Newtown Creek Alliance has two student microscopes that can be borrowed for this activity.)

Applied Learning - Designing Soil Quality Improvements

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

Coming up with practical solutions to problems of degraded or impaired soil is a good way to demonstrate students knowledge and critical thinking. It also helps students problem solve using systems thinking. In this activity, students will either recommend a strategy for working towards improvement of the health of the Newtown Creek Watershed or design an improvement to a specific parameter of soil quality in the Newtown Creek Watershed based on the data they gathered during the Field Lesson.

Learning Objectives

- Students will review soil quality data from Field Lesson
- Students will discuss validity of results – what should be repeated or done differently next time
- Students will draw further conclusions about the health of the soil based on the data
- Students will create a plan to build something that would help improve one or more of the soil quality indicators tests at the field site

Time

45-60 minutes

Vocabulary

See Soil Quality 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 Soil Quality Introduction as a text for your students.
- Make copies of Discussion Questions sheet for small group discussions.

Materials

Materials from Field Lesson (completed)

- Site Map
- Site Map - clean copy
- Soil Quality Data Sheet
- Field Site Metadata
- Journal entries
- Other student work (e.g. photos)
- Google image of Newtown Creek Neighborhood

Design Procedure

1. Separate students into the small groups. You may choose to use the same groups they were in during the Field Lesson or new groups. Consider whether you want the students in the group to have worked on the same area in the field or different ones.
2. Give a copy of the Neighborhood Map (depending on the scale needed) and a copy of Discussion Questions and a clean Site Map to each small group.
3. Review the Field Site(s) visited during the Field Lesson as a whole class.
4. Mark on the Neighborhood Map the location of the Field Site(s) visited.
5. Each student in the group shares some observations or thoughts about their site based on their worksheets and/or journal entries.
6. If you visited more than one site during the Field Lesson, choose one Field Site on which to focus.
7. Review the Discussion Questions in small groups, referring to the information from Field Lesson (Site Map, Soil Quality Data Sheet, journal entries, etc).
8. Each student in small groups choose one soil quality parameter they would like to see improved.
9. Students revisit their observations from the field and discuss what observations might be impacting the soil quality.
10. Using clean copy of the Site Map, each student brainstorm ideas that will improve soil quality at your field site.
11. Each student uses the brainstorm ideas to sketch the design for soil quality improvements on the clean Site Map.
12. Each students share and explain his/her design to their small group.
13. The group members critique each others' designs and write down the best elements from each sketch.
14. The group gets a final clean copy of the Site Map for group design.
15. The group works together to create ONE final design incorporating the best elements from each individual's design.
16. The group works together to write an explanation and defend each element of

their design.

17. Each group presents their completed design to the class, with individuals talking about a particular element of the design.

Designing Soil Quality Improvements

Discussion Questions

1. Describe your Field Site, its location and what surrounds it.
2. What types of pollutants did you observe on the Field Site?
3. What other observation did you make at your Field Site?
4. How do the results compare to the soil quality ranges we would expect to see in the Newtown Creek? Refer to information in the Soil Quality Introduction.
5. Are there any results that are surprising? Explain why.
6. Are there any results that are questionable? (e.g. a group knows they made a mistake while performing the test.) Explain why.
7. How might one or more of the observations you made be impacting the soil quality results?
8. Which of your test results do you find most concerning? Is soil compaction an issue? Why?
9. What role do plants and animals play in the health of the soil?
10. Which of your test results do you feel you should focus on improving? Why?
11. Consider the following remediation options:
    - Excavate it
    - Cap it
    - Aerate it
    - Add mulch
    - Add compost
    - Add plants

Common Core Standards

Lesson I

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.

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

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.

Next Generation Science Standards

MS.Human Impacts

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

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.

- 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.

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.

Next Generation Science Standards MS.Matter and Energy in Organisms and Ecosystems

MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological

Field Lesson

English Language Arts Standards Science and Technical Subjects

Key Ideas and Details Grades 6-8

▪ 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.

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.

Next Generation Science Standards

MS.Matter and Energy in Organisms and Ecosystems

▪ 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 Grades 6-8

▪ 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.

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.

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:

- ***Life in a Bucket of Soil* by Alvin Silverstein**

https://www.amazon.com/Bucket-Dover-Childrens-Science-Books/dp/0486410579

- ***You Wouldn't Want to Live Without Dirt* by Ian Graham**

https://borrow.bklynlibrary.org/r1s/iii/encore/record/C__Rb11917426?lang=eng

- **The Science of Soil From the Ground Up (teacher resource) Download Lesson 2:**

http://www.thescienceofsoil.com/teacher-resources

- **Soil Quotations; USDA's Natural Resources Conservation Service**

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/college/?cid=nrcs142p2_054312

- **A Deeper Dive into Soil; The Science of Soil: From the Ground Up (teacher resource)**

https://drive.google.com/open?id=1Q4VnVzu2ipLeRHEe2mhwYYNWhL7LAlxl

- **Incredible Journey Into the Soil**

https://www.blm.gov/nstc/soil/Kids/incred.html

Videos:

- **Starting with Soil**

https://www.wholekidsfoundation.org/starting-with-soil/

- **How is soil formed?** (Scroll down to select video).

http://www.thescienceofsoil.com/teacher-resources

- **The Soil Song**

https://www.youtube.com/watch?v=GCLvZ3pffpc

- **Topsoil Dance**

https://www.youtube.com/watch?v=J6l2dMdAx5M

Lesson Powerpoints/ Teaching Guide

Lesson I Observing Sand, Silt, and Clay**:**
https://docs.google.com/presentation/d/1QLKg5YTCz33M3RnjP7IhPWlgopYsxQEdzV9DCIpjc_Y/edit#slide=id.g25a452cca0_0_122

Handouts

KWL Worksheet

Student Name: Date:

Know	Want to Know	Learned

Soil Observation Activity

Student Name: Date:

Feature	Sample 1	Sample 2	Sample 3
Look			
Smell			
Feel			
Smear Color			
Size of Grains			
Other			

Soil as a Filter Activity

Student Name: Date:

Water with Floatables (trash)

Filter	**Sand**		**Fine Soil**	
	Prediction:	**Results/Conclusion**	**Prediction:**	**Results/Conclusion**
Soil				
Water				
Floatables				
Water with Oil				
Soil				
Water				
Oil				

Soil as a Filter Activity

Student Name: Date:

Water with Chemicals (colored liquid)

Filter	**Sand**		**Fine Soil**	
	Prediction:	**Results/Conclusion**	**Prediction:**	**Results/Conclusion**
Soil				
Water				
Floatables				
Water with Detergents				
Soil				
Water				
Oil				

Soil Observation Activity

Student Name: Date:

Sample #1 Sketch (include labels)	**Hypothesis** Prediction:	Explanation:
Sample #2 Sketch (include labels)	**Hypothesis** Prediction:	Explanation:
Sample #3 Sketch (include labels)	**Hypothesis** Prediction:	Explanation:

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 Cover:

☐ No Clouds

☐ Some Clouds (Partly Cloudy)

☐ Lots of Clouds

Cloud Type:

Description of Site & Conditions:

Soil Quality Data Sheet

Student Name:

Name of Site:

Description of Site (including vegetation, contaminants, and land use)

Time

Year: __________ Month: __________ Day: __________ Local Time: __________ am/pm

Weather

Precipitation in last 48 hours? YES/NO Current Weather: ________

Description of Sample

Depth of Sample:

Smell of Sample:

Color of Sample:

Soil Structure:

Temperature

Observer Name:	Results:
1)	
2)	
3)	
	Average:

Nutrients: Nitrogen

Observer Name:	Results:
1)	
2)	
3)	
	Average:

Nutrients: Phosphorus

Observer Name:	Results:
1)	
2)	
3)	
	Average:

Nutrients: Potassium

Observer Name:	Results:
1)	
2)	
3)	
	Average:

Soil Quality Data Sheet

Student Name:

Name of Site:

pH

Observer Name:	Results
1)	
2)	
3)	
Average:	

Optional Description of Sample

Drainage Test Results:

Stratification Test Results:

Organisms Observed:

Water Quality Analysis

What do these results tell us about Newtown Creek?

Other Observations or Notes: