Gateway

Gateway National Recreation Area
Jamaica Bay Unit
New York

US Department of the Interior
National Park Service

Habitats by Land and Sea:
Restoring Resiliency

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Introduction

Program Goals

The primary goal of this program is to observe and document information about plant and pollinator species at Gateway National Recreation Area. To do so, students will monitor which types of pollinators we currently see at the Jamaica Bay Unit of Gateway, document changes in individual plant species over time, and test various habitats to determine which native plants are suitable to be planted there. The data collected will allow students to discover how to construct restoration projects and design pollinator gardens to increase the biodiversity and resiliency of the park and adjoining areas.

Program Objectives

- Promote greater diversity of the native plant populations in the Gateway National Recreation Area.
- Test specific areas within Gateway NRA for the physical and chemical parameters of the soil required by native plant species that attract pollinators.
- Analyze the data collected on the physical and chemical conditions of the habitats to determine native plant sustainability.
- Identify the native plants that can be planted.
- Observe weather conditions, phenology, and monitor and report pollinator activity.

Overview

Habitat stressors, (e.g. fragmentation, pollution, and climate change, among others), can leave ecosystems more vulnerable to invasion by exotic species (both plant and animal) and possible collapse. Conserving biodiversity has been shown to increase habitat resiliency. Thus, especially for urban ecosystems to be resilient to effects associated with climate change and other habitat stressors, it is essential to promote greater diversity of native plant populations in critical refuges near dense urban centers.

In this program, students become scientists whose role is to test a specific area for the parameters required by various native plant species. Each class will be divided into three groups and rotate through these stations: 1) pollinator or phenology monitoring and weather observations (depending on the season) 2) physical attributes of soil (i.e. texture); and 3) chemical attributes of soil (pH, Nitrogen, Phosphorus, and Potassium).

By exploring the living requirements for plants, students will begin to understand the importance of native plants, pollinators, and associated ecosystem services in various habitats throughout the Jamaica bay Unit of Gateway NRA. The data produced by the students will help the professional scientists and natural resource managers at Gateway to determine how to design garden areas to attract native pollinator species.

Activities Rundown

(10 mins) Habitats by Land and Sea: Restoring Resiliency PowerPoint presentation

(60 mins) Break into groups and walk to stations
Station 1: Pollination Monitoring and Weather Observations OR Phenology
Station 2: Physical Soil Testing
Station 3: Chemical Soil Testing

(15 mins) **What plants will grow here?** Students use the data they collected to determine which native plant will grow best in the area they tested. Students then stake in a picture of the native plant they have selected explain how they came to their decision based on the data they collected.

Eastern red cedar (or juniper tree)
Photo credit: Jane Chan

Science Scope & Sequence

The following are listings of skills, and standards and key ideas in accordance with the New York City Department of Education *Science Scope & Sequence*, which corresponds with the old NYS Science Core Curriculum, both Elementary and Intermediate. The exact source of each element is listed on the bottom of the page.

Inquiry Skills*	Example of activity, task, or concept skill is demonstrated in this program
Communicating – giving oral and written explanations or graphic representations of observations	**Communicating** – recording data on weather observations such as wind speed and sunlight availability
Comparing and contrasting – identifying similarities and differences between or among objects, events, data, systems, etc.	**Comparing and contrasting** – comparing and contrasting soil particle sizes and the difference in how fine and coarse particles feel
Gathering and organizing data – collecting information about objects and events which illustrate a specific situation	**Gathering and organizing data** – counting pollinators and recording number of different pollinators
Generalizing – drawing general conclusions from particulars	**Generalizing** – drawing a general conclusion of what the soil quality is like at specific location
Interpreting data – analyzing data that have been obtained and organized by determining apparent patterns or relationships in the data	**Interpreting data** – analyzing the "What Plants Can Live Here?" datasheet and seeing what conditions have been met or unmet
Manipulating materials – handling or treating materials and equipment safely, skillfully, and effectively	**Manipulating materials** – using soil core sampler, graduated cylinder, light meter, anemometer, etc.
Measuring – making quantitative observations by comparing to a conventional or nonconventional standard	**Measuring** – measuring the volume of each different soil particle size, and measuring volume of liquid in test tube
Observing – becoming aware of an object or event by using any of the senses (or extensions of the senses) to identify properties	**Observing** – weather observations, pollinator monitoring; determining soil moisture by touch; determining pH level by looking at color

Drawn from the NYC K-8 Science Scope & Sequence and based on NYS MST Standards 1, 2, 6, and 7. (Kindergarten -8)

Process Skills*

General Skills

i. **Follow safety procedures in the classroom, laboratory, and field.**
ii. **Safely and accurately use scientific tools.**
iii. **Develop an appreciation of and respect for all learning environments (classroom, laboratory, field, etc.).**
iv. **Manipulate materials through teacher direction and free discovery.**
v. Use information systems appropriately.
vi. **Select appropriate standard and nonstandard measurement tools for measurement activities.**
vii. **Estimate, find, and communicate measurements, using standard and nonstandard units.**
viii. **Use and record appropriate units for measured or calculated values.**
ix. Order and sequence objects and/or events.
x. Classify objects according to an established scheme.
xi. Generate a scheme for classification.
xii. **Observe, analyze, and report observations of objects and events.**
xiii. **Observe, identify, and communicate patterns.**
xiv. **Observe, identify, and communicate cause-and-effect relationships.**
xv. **Generate appropriate questions (teacher- and student-based) in response to observations, events, and other experiences.**
xvi. Observe, collect, organize, and appropriately *graph* data, then accurately interpret results.
xvii. **Collect and organize data, choosing the appropriate representation:**
- **Journal entries**
- **Graphs**
- **Drawings/pictorial representations**

xviii. Make predictions based on prior experiences and/or information.
xix. Compare and contrast organisms/objects/events in the living and physical environments.
xx. Identify and control variables/factors.
xxi. Plan, design, and implement a short-term and long-term investigation based on a student- or teacher-posed problem.
xxii. Communicate procedures and conclusions through oral and written presentations.

***In grades 5-8 the process skills are content-specific and are integrated into the units of study.**

***Skills that are more applicable to this program are highlighted by a darker color. Skills that are in lighter color are either not present, slightly present, or not as relevant.**

Drawn from the NYC K-8 Science Scope & Sequence and based on NYS MST Standard 4 (Kindergarten-4)

Excellence in Environmental Education: Guidelines for Learning (K–12)*

Environmental education builds from a core of key principles that inform its approach to education. Some of these important foundations are:

Systems: Systems help make sense of a large and complex world. A system is made up of parts. Each part can be understood separately. The whole, however, is understood only by understanding the relationships and interactions among the parts. The human body can be understood as a system; so can galaxies. Organizations, individual cells, communities of animals and plants, and families can all be understood as systems. And systems can be nested within other systems.

Interdependence: Human well-being is inextricably bound with environmental quality. Humans are a part of the natural order. We and the systems we create— our societies, political systems, economies, religions, cultures, technologies— impact the total environment. Since we are a part of nature rather than outside it, we are challenged to recognize the ramifications of our interdependence.

The importance of where one lives: Beginning close to home, learners forge connections with, explore, and understand their immediate surroundings. The sensitivity, knowledge, and skills needed for this local connection provides a base for moving out into larger systems, broader issues, and an expanding understanding of causes, connections, and consequences.

Integration and infusion: Disciplines from the natural sciences to the social sciences to the humanities are connected through the medium of the environment and environmental issues. Environmental education offers opportunities for integration and works best when infused across the curriculum, rather than being treated as a separate discipline or subject area.

Roots in the real world: Learners develop knowledge and skills through direct experience with the environment, environmental issues, and society. Investigation, analysis, and problem solving are essential activities and are most effective when relevant to the real world.

Lifelong learning: Critical and creative thinking, decision making, and communication, as well as collaborative learning, are emphasized. These skills are essential for active and meaningful learning, both in school and over a lifetime. Environmentally literate students possess the knowledge, intellectual skills, attitudes, experiences, and motivation to make and act upon responsible environmental decisions.

Environmentally literate students understand environmental processes and systems, including human systems. They are able to analyze global, social, cultural, political, economic, and environmental relationships, and weigh various sides of environmental issues to make responsible decisions as individuals, as members of their communities, and as citizens of the world. (Adapted from Maryland Partnership for Children in Nature, April 2009)

Drawn from the NYC Department of Education K-5 Science Scope & Sequence 2015-2016

Corresponding Education Standards*

Note to teacher/educator: Below is a list of corresponding (not inclusive) education standards for Grade 4 only. Grade 5 is included in the *NYC DOE K-5 Science Scope & Sequence 2015-2016*. For grades 6-12, please refer to the *NYC DOE 6-12 Science Scope & Sequence 2015-2016*.

Grade 4

UNIT 1: Animals and Plants in their Environment

Key Ideas represented:
LE. Key Idea 4: The continuity of life is sustained through reproduction and development.
LE. Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.
LE. Key Idea 6: Plants and animals depend on each other and their environment.
LE. Key Idea 7: Identify ways in which humans have changed their environment and the effects of those changes.

Standards represented:
NYS Science Standards:

- Plants manufacture food by utilizing air, water, and energy from the Sun.
- The health, growth, and development of organisms are affected by environmental conditions such as the availability of food, air, water, space, shelter, heat, and sunlight.

MST Standards:

- Standard 1: Analysis, Inquiry, and Design
- Standard 6: Interconnectedness: Common Themes
- Standard 7: Interdisciplinary Problem Solving

UNIT 4: Interactions of Air, Water, and Land

Key Ideas represented:
PE. Key Idea 2: Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Standards represented:
NYS Science Standards:

- Extreme natural events (floods, fires, earthquakes, volcanic eruptions, hurricanes, tornadoes, and other severe storms) may have positive or negative impacts on living things.

MST Standards:

- Standard 1: Analysis, Inquiry, and Design
- Standard 6: Interconnectedness: Common Themes
- Standard 7: Interdisciplinary Problem Solving

Drawn from the NYC Department of Education K-5 Science Scope & Sequence 2015-2016

Links for Teachers

New York State Elementary Science Core Curriculum Grades K-4
http://www.p12.nysed.gov/ciai/mst/pub/elecoresci.pdf

New York State Intermediate Level Science Core Curriculum Grades 5-8
http://www.p12.nysed.gov/ciai/mst/pub/intersci.pdf

New York City Department of Education K-8 Science Scope & Sequence
http://schools.nyc.gov/Documents/STEM/Science/K8ScienceSS.pdf

New York City Department of Education K-5 Science Scope & Sequence 2015-2016
http://schools.nyc.gov/NR/rdonlyres/949E0441-ADAF-445C-A915-E9F8123E1387/0/K5ScienceScopeandSequence_Updated.pdf

New York City Department of Education 6-12 Science Scope & Sequence 2015-2016
http://schools.nyc.gov/NR/rdonlyres/49FC3DAF-2A6A-42B5-80DC-9587487B0243/0/sciencescopeandsequence612_WEB81415.pdf

Station 1: Pollination/Seasonal Changes

At this station we are going to:

- ✓ Observe weather conditions
- ✓ Monitor pollinators
- ✓ Observe seasonal changes depending on the time of year

Supplies Needed:

- Thermometers
- Wind speed meters
- Watch/Timer
- Datasheets
  - Weather Data Sheet
  - Pollinator Identification Sheet

Observe Weather Conditions

Weather conditions must be accounted for in order to give context to the pollinator/seasonal changes data you collect.

1. Begin by observing current weather conditions using your senses. Check all boxes that apply to current weather conditions on the data sheet.
2. Recall yesterday's weather conditions and enter them into the data sheet.
3. Record the air temperature by holding the thermometer by the string for a minute. Record your finding in both Celsius and Fahrenheit on the data sheet.
4. Record the wind speed by holding the wind meter directly into the direction the wind is blowing from. You may need to take several recordings to get an accurate reading.

For this step you are going to need your data sheet that looks like:

Name _____ **Location** _____ **Date** _____ **Time** _____

Just like us pollinators are affected by the weather. Scientists can use this weather data to help predict how weather effects pollinators.

Scientists use observation data to help them better understand the world around us. Can you make observations like a scientist, too?

1. **Current weather conditions** (indicate all that apply):

rainy ☐ windy ☐ calm ☐ sunny ☐ cloudy ☐ cold ☐ warm ☐ hot ☐

2. **Yesterday**, the **weather** was mostly (indicate all that apply):

rainy ☐ windy ☐ calm ☐ sunny ☐ cloudy ☐ cold ☐ warm ☐ hot ☐

Air Temperature _____ °C _____ °F

Wind Speed _____

Monitor Pollinators

Pollinators play an important role in resiliency. By monitoring pollinator visits the data you collect will help us to determine the health of pollinators at this location.

1. Write down the name of the plant within the observation ring in the left column as well as the number of flower clusters on the plant.

2. Designate a recorder to enter observed data onto the data sheet. Each time an observer sees an insect land on a flower cluster, the observer will call out the name of the insect type visiting the flower cluster. The recorder will tally the insects visiting each flower cluster for 5 minutes per plant.

3. After 5 minutes, move on to the next plant observation ring. Enter the plants name and number of flower clusters and begin tallying pollinators.

Site Name: _____ **Date:** _____ **Start time:** _____

School: _____

Pollinators play an important role in resilliency. By monitoring pollinator visits the data you collect will help us to determine the health of pollinators at this location.

Instructions: Write down the name of the plant in the observation ring in the left column.
Each time the observer spots an insect landing on a flower cluster, the observer will call out the name of the insect type visiting the flower cluster. The recorder will tally the insects visiting each flower cluster for **5 minutes** per plant. After five minutes go to the next plant in an observation ring. Write down the name of the plant below and continue.

	Carpenter Bee	Honey Bee	Bumble Bee	Green Sweat bee	Small dark native bee	Fly	Butterfly/ moth	Wasp	Humming bird	Other pollinating insect
Plant (Write name) Number of flower clusters										
Plant (Write name) Number of flower clusters										
Plant (Write name) Number of flower clusters										
Observation notes										

If you need help identifying pollinators turn to the next page or ask a Ranger!

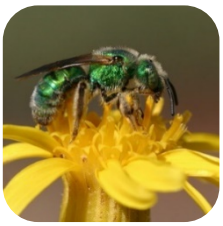
Types of Bees

Bumble Bees

Usually large, furry and often have yellow hair. Their abdomen's are more rounded at the end than the honey bee.

Honey Bees

Usually smaller and less hairy than bumblebees. Their abdomens are orange or honey colored and come to a point at the end.



Green Sweat Bees

Some of the most noticable bees with their metallic green or blue-green coloring and black and white banded abdonmen. These bees are much smaller compared to Carpenter or Bumble bees.

Small Dark Sweat Bees

Look exactly as their names specify. They also have pale hairs at the abdonimal that gives the appearance of stripes.

Carpenter Bees

These bees resemble bumblebees but their abdomen lack hairs and is shiny black in color. The male bee is unable to sting and has a white mark on its face.

Non-Bee Pollinators

Hummingbirds

Birds pollinate too! Hummingbirds are a good example of birds that pollinate. The Ruby Throated Hummingbird is common in our area most recognized by the patch of red feathers on its throat.

Butterflies

Butterflies rest with their wings folded and are usually more colorful, while most moths rest with their wings out and are different shades of brown or gray.

Flies

Flies do not have long antennae, bees and wasps have long antennae. Bee wings rest on the back when not in use. Fly wings stick out at an angle when not in use.

Wasps

Wasps can have black and yellow, brown and red, or black and white color patterns. When a wasp has landed on a flower its wings are pulled in and close to their body. Finally, wasp's waist is thinner than the rest of it's body.

Spiders

Some spiders pollinate flowers as well (i.e. goldenrod crab spiders). If you see a spider on a flower remember to record it as well!

Beetles

Other bugs could act as pollinators as well (i.e. soldier beetle), so remember to record any other bug or beetle you see on a flower!

Observing Seasonal Changes

The scientific term for seasonal changes is the word phenology. Just like people change the clothes they wear during different seasons, plants and animals do the same. The changes in weather impact the way plants and animals act throughout the year. Flower blooming is affected by weather patterns. For example when it is cold outside a flower will not open, this delays flower blooming so pollinators such as bees won't be able to pollinate them.

1. Record the weather on your data sheet. Make sure to include: temperature, state whether it is humid, sunny, cloudy, or windy, and if there is fog, rain, or snow.

2. You are then going to decide if the tree you are observing has a large number of berries or a few numbers of berries. Come up with an approximate numerical value based on your observation. The tree that has the smallest number of berries has a sparse number of berries. The tree that has the greatest number of berries has an abundant number of berries.

3. Make observations about the amount of leaf fall, colored leaves, and berries that you find on the first tree.

4. In groups make observations about the amount of color you see, based on the color charts. Draw two circles on your phenology worksheets. You are going to create two pie charts of colors using crayons.

   Your 1st color pie chart is for the first trail and the 2nd color pie chart is for the second trail. Each color seen can be expressed as a percentage or as a "slice" of pie. Student groups can just do one chart if time is limited.

5. This information will help scientists figure out if plants are changing in a way that will negatively affect the ecosystem due to climate change.

Make sure to repeat these steps for each species of

tree you are looking at.

Station 2: Physical

At this station we are going to test:

- ✓ Sunlight
- ✓ Soil Moisture
- ✓ Soil Texture
- ✓ Soil Temperature

Supplies Needed:

- Lux light meter
- Thermometer
- Soil core sampler
- Sieves
- Trowel(s)
- Datasheets:
  - Data Collection Sheet
  - "What Plants Can Live Here?"

Sunlight Measurement

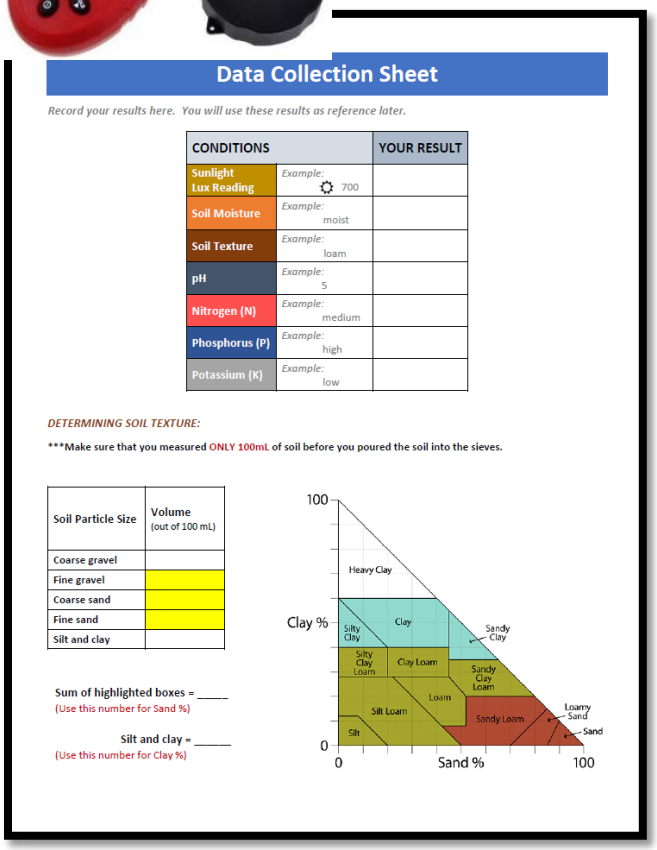
1. Begin by turning on the meter by pushing the power button once, uncapping the sensor (to reveal the white ball), and holding it upwards at waist level. Make sure you are facing the sun, not casting your shadow across the meter.

2. The display will give you a few numbers as the sunlight hits the meter. Wait a few seconds and then use the number you see most often.

3. Take turns taking measurements all over the area in at least three spots around where you are sampling. (Why 3? Remember in math class that at least three values are required to take an accurate average.)

4. Record this value in the first box under "Your Result" on the **Data Collection Sheet**. Draw a figure to indicate if it's fully sunny, or partly sunny, etc.

Plants need sun to make their food. This test shows us how much sun the plants receive.



Data Collection Sheet

Record your results here. You will use these results as reference later.

CONDITIONS		YOUR RESULT
Sunlight Lux Reading	*Example:* ☼ 700	
Soil Moisture	*Example:* moist	
Soil Texture	*Example:* loam	
pH	*Example:* 5	
Nitrogen (N)	*Example:* medium	
Phosphorus (P)	*Example:* high	
Potassium (K)	*Example:* low	

DETERMINING SOIL TEXTURE:

***Make sure that you measured ONLY 100mL of soil before you poured the soil into the sieves.

Soil Particle Size	Volume (out of 100 mL)
Coarse gravel	
Fine gravel	
Coarse sand	
Fine sand	
Silt and clay	

Sum of highlighted boxes = _____
(Use this number for Sand %)

Silt and clay = _____
(Use this number for Clay %)

Make sure you fill out the data.

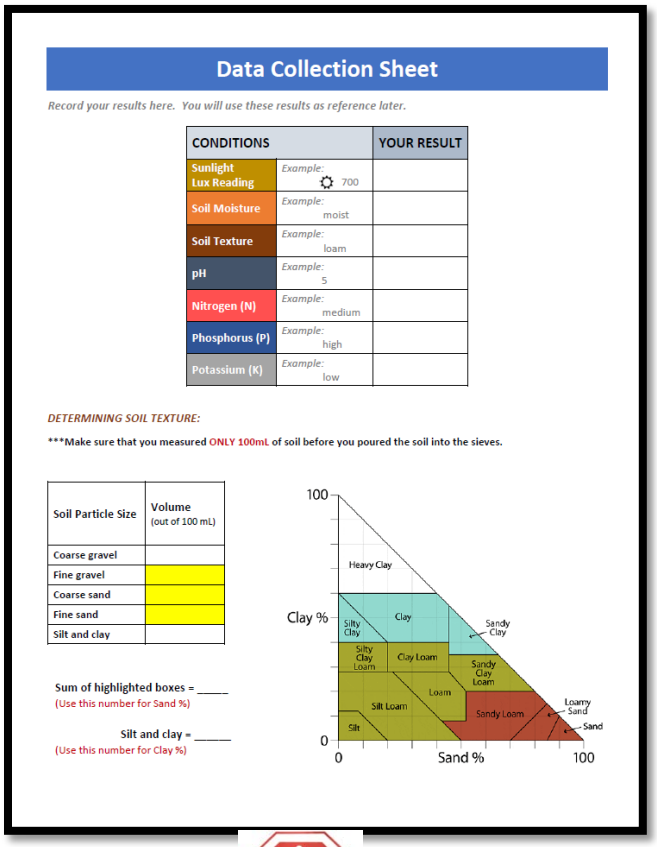
Soil Moisture

Since plants drink through their roots, the amount of moisture in the soil is very important. This test will tell us the amount of water in the soil.

1. Begin by taking a soil sample using the silver core sampler. Twist and push down carefully into the soil until you can't push it down any farther.

2. Remove core and look at the layers you see in the sample. Touch the different layers to feel how dry or wet they are.

3. Record your observation in the second box under "Your Result" for *soil moisture*.



Data Collection Sheet

Record your results here. You will use these results as reference later.

CONDITIONS		YOUR RESULT
Sunlight Lux Reading	*Example:* ☼ 700	
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Nitrogen (N)	*Example:* medium	
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Potassium (K)	*Example:* low	

DETERMINING SOIL TEXTURE:

***Make sure that you measured ONLY 100mL of soil before you poured the soil into the sieves.

Soil Particle Size	Volume (out of 100 mL)
Coarse gravel	
Fine gravel	
Coarse sand	
Fine sand	
Silt and clay	

Sum of highlighted boxes = _____
(Use this number for Sand %)

Silt and clay = _____
(Use this number for Clay %)

Make sure you fill out the data.

Soil Texture

Plants make their home in the soil. Some like hard-packed soil, while others prefer loose, sandy soil. This test helps us find out what kind of soil we have.

1. Make sure that the sieves are stacked together from largest mesh size on the top, down to the smallest mesh size on the bottom. It should read in order from **top down**:

    a. Coarse (large) gravels
    b. Fine (small) gravels
    c. Coarse sand
    d. Fine sand
    e. Silt and clay

2. Use the soil core sampler to get soil from the ground and put the soil into the large graduated cylinder until it reaches 100 mL. Then pour the soil into the top sieve.

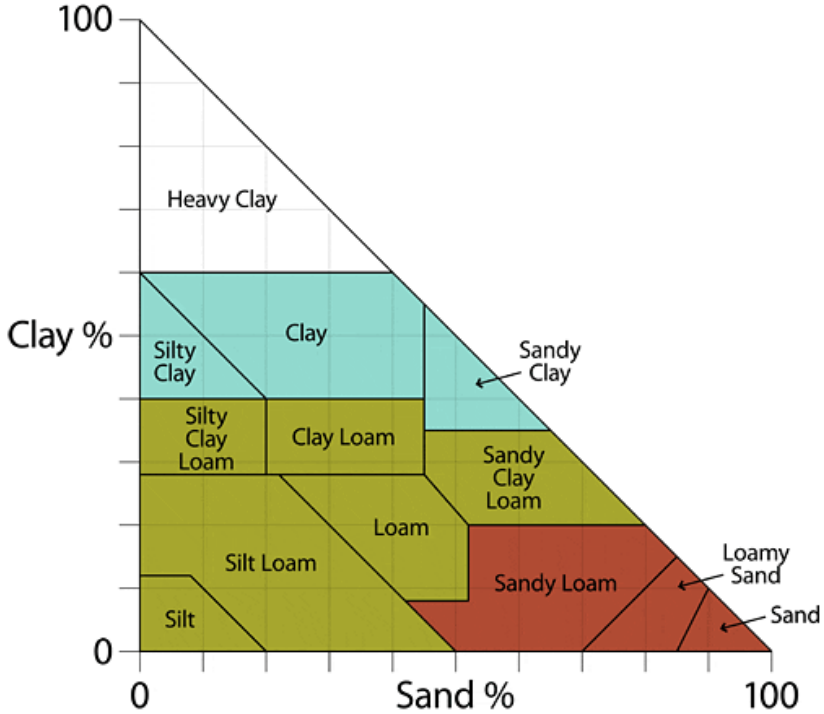
3. Next, place the cap on the top sieve. With one hand on top and one hand underneath, **hold the sieves upward** and begin to shake side to side without tilting the sieves. Take turns shaking the sieves. What do you hear?

4. Once everyone has had a turn shaking the sieves, separate the layers and feel the different soil sizes. Does it feel the same in each layer? Be careful not to dump any out, since this is our scientific data!

5. Using a funnel or measuring cup, pour each sieve into a graduated cylinder. Tap the bottom on a flat surface (or your palm) to help the soil settle. See where it lines up and record the volume in the second chart on the **Data Collection Sheet** under the correct size (e.g. fine sand). **Repeat for each sieve**.

6. **On the Data Collection Sheet**: Add the numbers in the highlighted boxes (fine gravel, coarse sand, and fine sand), the total sum will be used for the percentage of sand (Sand %). The number for silt and clay will be used for the percentage of clay (Clay %).

7. Using the percentages for sand, and silt and clay, follow the values on the texture triangle until they meet. Record the soil texture under "Your Result."



Station 3: Chemical

At this station we are going to test:

- ✓ Soil pH
- ✓ Soil Nutrients
  - Nitrogen (N)
  - Phosphorus (P)
  - Potassium (K)

Supplies:

- Soil thermometers
- pH test kit
- Nutrient test kits
- Datasheets
  - Data Collection Sheet
  - "What Plants Can Live Here?"

Soil pH Testing

Just like us (and Goldilocks), plants don't like it too acidic (e.g. lemon juice) or too alkaline (e.g. bleach), but prefer it to be *just right*, or neutral (~7).

1. Fill a square test tube to the **10 mL line** with water. Make sure that the **bottom of the meniscus** is at the 10mL line. *(see Figure a)*

2. Add **1 soil pH tablet** into test tube.

3. Fill the cap of the test tube with soil and pour into the tube.

4. Cap the tube and mix by inverting **10 times**. *(see Figure b)* Pass the tube around so each person can have a turn.

5. After mixing 10 times, turn the tube so the cap is up and the soil can settle for at least **1 minute**.

6. When most of the soil has fallen to the bottom, hold the test tube against the white part of the soil pH color chart. Match the color of the liquid above the soil to a color on the chart. What number is it? Record this number as pH on the **Data Collection Sheet.**

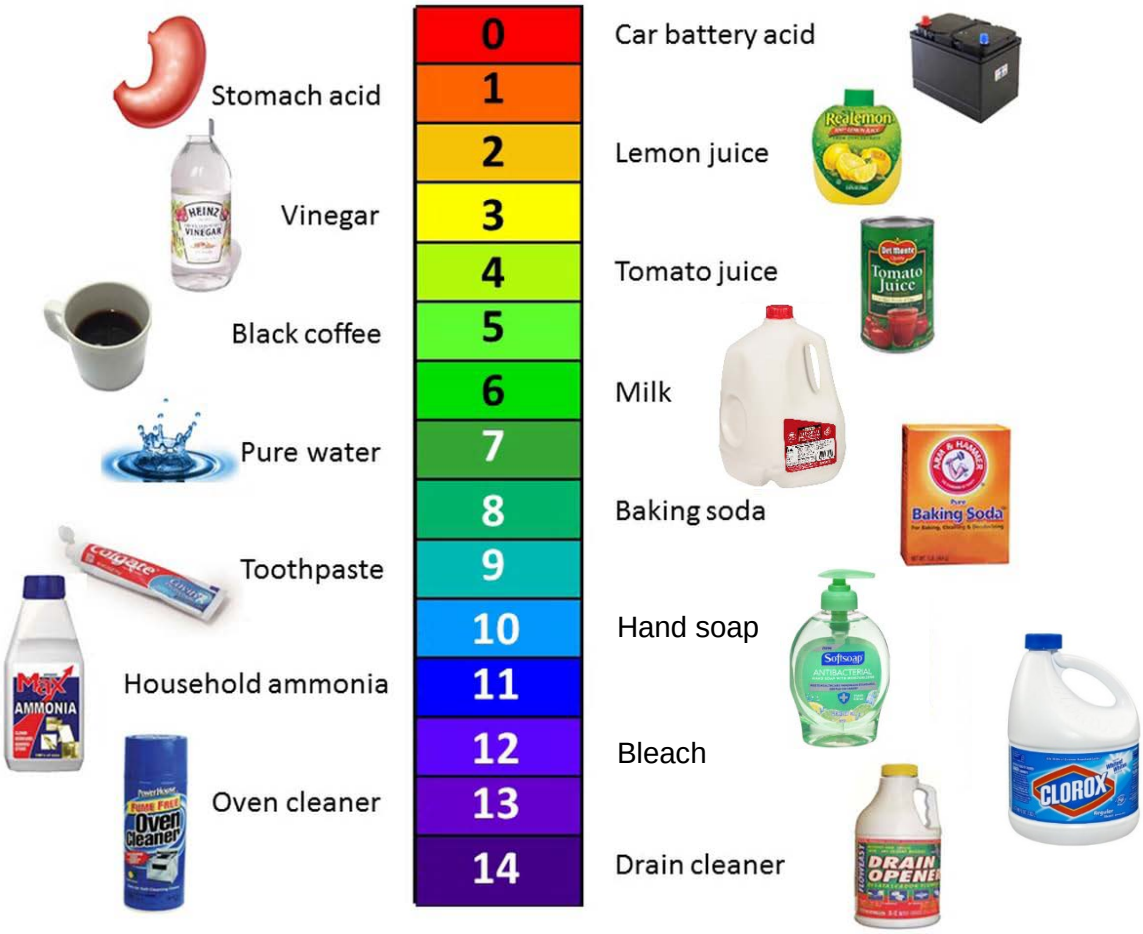
   (Note: if it looks like it is between two colors, record as 0.5. So between 7 and 8 would be 7.5.)

Make sure you fill out the data.

Figure a. How to read the meniscus

Figure b. Invert tube 10 times

pH scale


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Car battery acid
Stomach acid
Lemon juice
Vinegar
Tomato juice
Black coffee
Milk
Pure water
Baking soda
Toothpaste
Hand soap
Household ammonia
Bleach
Oven cleaner
Drain cleaner

Soil Nutrient Testing (N, P, K)

Nutrients found in the soil are important for determining plant growth. Some (like *groundsel bush* and *rose mallow*) cannot grow without certain nutrients, while others (like *Russian olive* and *milkweed*) can make their own (accumulate) nutrients. Follow these simple steps to learn the levels in the garden's soil.

PREPARATION

1. Follow these 5 simple "Extraction" steps to prepare your sample for nutrient testing. Fill the round test tube to the **30 mL line** with water. Make sure that the **bottom of the meniscus** is at the line.

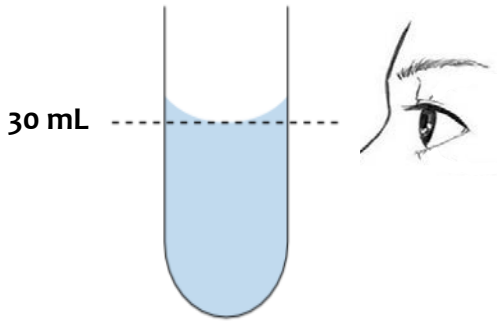
2. Add **2 soil Floc-Ex tablets**. Cap the tube and mix until the tablets have dissolved (mixed completely).

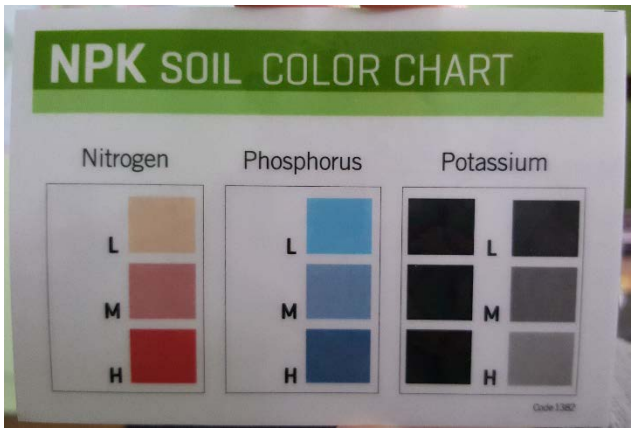
3. Remove the cap and fill with soil from sample area. Pour soil into test tube.

4. Cap the tube and shake for **1 minute**.

5. Turn the tube upright and let the tube sit until the soil settles out.

Your sample is now ready to use for **nutrient testing**!





Soil Nitrogen (N) Testing

1. Use the pipet (pronounced "pie-pet"), or medicine dropper, to transfer the liquid above the soil to a square test tube until it is filled to the shoulder.

2. Add **1 Nitrate tablet,** then put the square test tube into the silver protective sleeve.

3. Cap the tube and mix by inverting for **2 minutes** until the tablet is dissolved. Make sure to pass the tube around for everyone to take a turn mixing the contents.

4. Wait **5 minutes** for the color to fully change. Remove the tube from the silver sleeve and compare to the pink color on the Nitrogen Color Chart. *(see Figure c)*

5. Record the nitrogen value (low, medium, or high) on the **Data Collection Sheet** under "Your Result."

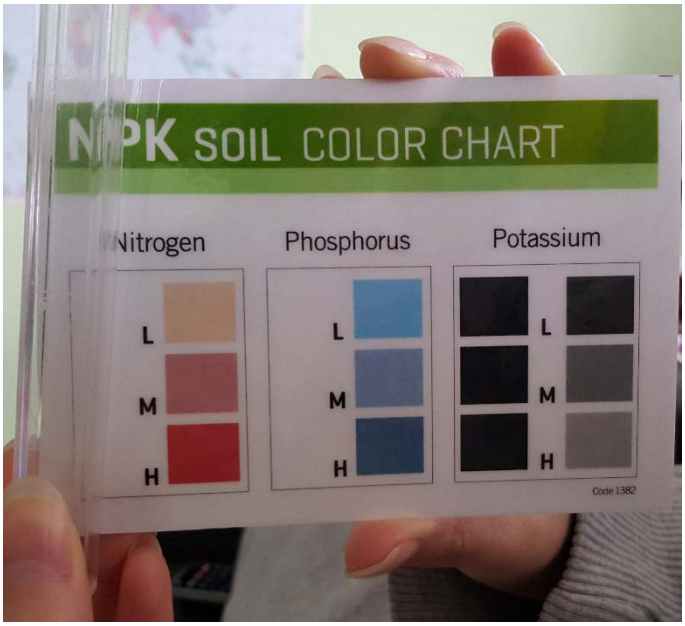


Figure c. Compare tube with pink column

Make sure you fill out the data.

Soil Phosphorus (P) Testing

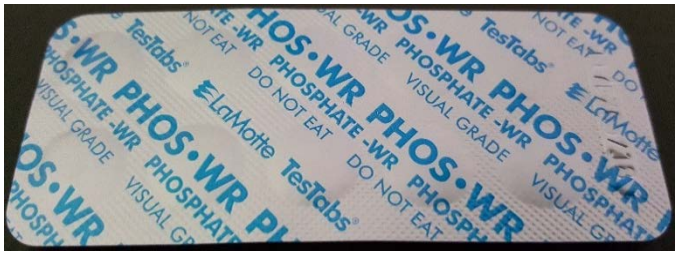
1. Use the pipet (pronounced "pie-pet"), or medicine dropper, to transfer the liquid above the soil to a square test tube. Be very careful to only transfer **25 drops** into the tube. Have your classmates help count the drops. (**Note:** If they can't, you might be squeezing the pipet bulb too much. Start over if you need.)

2. Fill the tube the rest of the way to the shoulder with the water provided.

3. Add **1 Phosphorus tablet**. Cap and mix until it dissolves completely.

4. Wait **5 minutes** for the color to fully change, then compare the blue color to the NPK Soil Color Chart. *(see Figure d)*

5. Record phosphorus value (low, medium, or high) on the **Data Collection Sheet** under "Your Result."



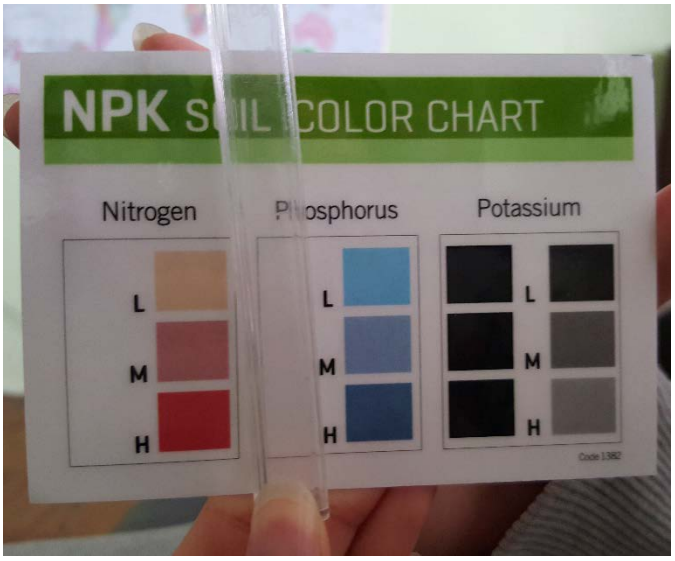


Figure d. Compare tube with blue column

Make sure you fill out the data.

Soil Potassium (K) Testing

1. Use the pipet (pronounced "pie-pet"), or medicine dropper, to transfer the liquid above the soil to a square test tube until it is filled to the shoulder.

2. Add **1 Potassium** tablet.

3. Cap and mix until it dissolves completely. This may take a while, so be sure to pass it around so everyone gets a turn.

4. Compare the cloudiness of the solution in the test tube to the NPK Soil Color Chart by holding the tube over the black boxes on the left and comparing to the shaded boxes on the right. *(see Figure e)*

5. Record potassium value (low, medium, or high) on the **Data Collection Sheet** under "Your Result."

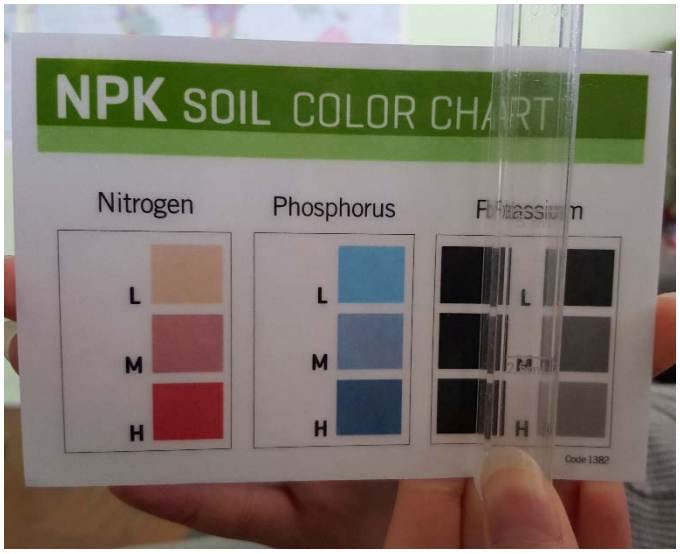


Figure e. Compare tube to gray/black column

Make sure you fill out the data.

Wrap-up: What Plants Will Grow Here?

Now that we have finished making observations and recording data, it is time to analyze the results. Take a look at the "Your Result" column on the Data Collection Sheet. These results represent the physical and chemical conditions we have at this particular location. Which means, **in order for a plant to grow here, it must have ALL of these conditions.**

Look at your second datasheet "What Plants Can Live Here?"

What Plants Can Live Here?

		CONDITIONS														
	Plants	Sunlight Lux Reading	*circle one*	Soil Moisture	*circle one*	Soil Texture	*circle one*	pH	*circle one*	Nitrogen (N)	*circle one*	Phosphorus (P)	*circle one*	Potassium (K)	*circle one*	Can this plant live in this habitat? If all conditions are "yes," put YES, otherwise, put NO
NATIVES	Common Milkweed	800 - 1000+	yes no	dry - moist	yes no	loam sand	yes no	5.8 - 7.2	yes no	accumulates	yes no	low - medium	yes no	accumulates	yes no	
NATIVES	Throroughwort	400 - 1000+	yes no	dry	yes no	sand	yes no	5.8 - 6.8	yes no	high	yes no	high	yes no	medium - high	yes no	
NATIVES	Evening Primrose	400 - 1000+	yes no	dry - average	yes no	gravel sand	yes no	5.0 - 7.0	yes no	accumulates	yes no	low - medium	yes no	accumulates	yes no	
NATIVES	Canada Goldenrod	800 - 1000+	yes no	dry	yes no	loam	yes no	4.8 - 7.5	yes no	low	yes no	high	yes no	low - medium	yes no	
INVASIVES	Virginia Creeper	0 - 1000+	yes no	dry - moist - wet	yes no	loam, sand, sandy loam, clay loam, clay	yes no	5.1 - 7.5	yes no	low-medium	yes no	medium - high	yes no	low - medium	yes no	
INVASIVES	Oriental Bittersweet	0 - 1000+	yes no	dry - moist - wet	yes no	loam sand	yes no	4.9 - 6.5	yes no	low	yes no	medium	yes no	medium - high	yes no	
INVASIVES	Common Mugwort	400 - 1000+	yes no	dry - average	yes no	wide range (sand typically)	yes no	6.6 - 8.5	yes no	low	yes no	low	yes no	low	yes no	
INVASIVES	Russian Olive	0 - 1000+	yes no	average - moist - wet	yes no	sand loam clay	yes no	> 6.0	yes no	accumulates	yes no	low	yes no	low - medium	yes no	

Start with the first plant and go down the row, circling YES or NO for each condition.

YES = what you recorded for "Your Result" is the same (or similar).

NO = what you recorded for "Your Result" does not match.

For example: you recorded "dry" for Soil Moisture in "Your Result," and it says "dry" for Soil Moisture for the first plant. It matches! So you would circle YES.

Do this for all of the conditions.

Once you reach the last column, it will ask you "Can this plant live in this habitat?" If ALL of the conditions were YES, then the answer would be YES. If there is one NO or more, the answer would be NO.

Repeat this process for all of the plants.

Once you or your group have completed this datasheet, the teacher or Rangers will lead a discussion and ask some questions.

Discussion Questions (for teachers/educators)

- **According to your results, which plants were able to grow in this habitat?**
- **If none of the native plants are able to grow here, what does that tell you about the soil conditions here? What can we do to change this?**
- **If we don't have any native plants and only invasive plants, what does that tell you about the biodiversity? What can we do to increase biodiversity?**
- **How is biodiversity related to *resiliency*?**
- **How does planting native plants help restore/increase the environment's resiliency?**

Vocabulary List

Accumulate: to gradually gather and increase in number.

Distillation: the boiling of water and then condensing the steam into a clean container.

Distilled water: water that has many of its impurities removed through distillation.

Extraction: the action of taking out something.

Invasive species: an organism that causes ecological or economic harm in a new environment where it is not native.

Inverting: to put upside down or in the opposite direction.

Loam: soil that is made up of about equal parts of clay, sand, and silt where most plants tend to thrive.

Native plants: plants that have developed, occur naturally, or existed for many years in an area (typically for thousands of years or longer).

Native pollinators: pollinator species that have developed, occur naturally, or existed for many years in an area (typically for thousands of years or longer).

Nutrients: ingredients that provide food for growth or development.

pH: a measure of how acidic or basic (alkaline) a substance is.

Phenology: the study of plant and animal life cycle events that are influenced by seasonal and climate changes.

Pipet: a slender tube attached to a bulb for transferring or measuring out small quantities of liquid.

Pollinator: a biotic agent that moves pollen from the male anthers of a flower to the female stigma of a flower to accomplish fertilization.

Resiliency: the ability to bounce back after a disturbance or extreme event.

Sieve: a utensil consisting of a wire or plastic mesh held in a frame, used for separating coarser particles from finer particles.

Soil fertility: a measure of how well the soil supports plant growth.

Soil: loose, weathered material on Earth's surface in which plants can grow.