The NYC Department of Parks & Recreation presents

**The Natural Classroom**
urban park rangers • education program

**BOTANY**
Plant Power

Activities and lessons in these programs meet academic performance standards accepted by the New York City Department of Education, including:

- Map Reading and Making
- Critical Thinking
- Plant Identification
- Researching and Writing a Field Guide
- Graphing
- Site Evaluation
- Creating a Timeline
- Data Gathering
- Natural Science
- Measuring
- Calculating
- Social Science
- History
- Art

City of New York
Parks & Recreation

NATIONAL GEOGRAPHIC SOCIETY

The New York City Department of Education

City of New York Parks & Recreation Urban Park Rangers
The Natural Classroom is a series of educational programs developed by the Urban Park Rangers to immerse students in the living laboratory of the natural world. These programs combine standards-based education with hands-on field lessons taught by Urban Park Rangers.

Based on natural and cultural topics that are visibly brought to life in our parks, The Natural Classroom is designed to stimulate, motivate and inspire your students to apply their developing skills in English, Math, Science and History to real-life critical thinking challenges.

The activities in Botany: Plant Power!
focus on the following skills:

• Creating and Reading Graphs, Measuring, and Making Calculations
• Exploring Living Science Concepts by creating Field Guides, and Gathering Data in the field

Writing and Drawing

How to Use This Natural Classroom Program Guide

Find Your Level:
Level One = Grades K-2
Level Two = Grades 2-6
Level Three = Grades 6-8

Word Challenge:
Important vocabulary words are provided and listed in order of appearance. Let your students find the definitions and begin their adventure.

Focus on The Big Picture:
Read the teacher text to learn about the three main program concepts, introduce them to your class and get them thinking in context.

Take Action:
Have your students research, write, measure, build, and create using the pre-visit activities. Each project is designed to actively engage the group in planning for their park visit.

Prepare for Adventure:
Review the park visit description a few days before the trip so you will be aware of the day’s anticipated activities. Let your students know how to dress for the weather, the bugs, and the terrain – you will be outdoors in the “wilde” of New York City parks.

Wrap it Up:
Have your students map, graph, illustrate, chart and analyze their way to thoughtful conclusions using the post-visit activities.

On and Beyond:
Loved your park experience and the learning topic so much that you want more? We have included extension activities that expand the scope of the in-class program.

Key Botany Vocabulary Words

| photosynthesis | gymnosperms | anther | native |
| chlorophyll    | spores      | stigma | non-native |
| cellular respiration | pollinated | pollen | invasive |
| oxidizing      | germinating | fruit  |        |
| angiosperms    | seed        | dispersal |      |

*Words will be italicized throughout program
Botany is the science or study of plants

Plants, unlike animals, are able to make their own food. Plants capture energy found in sunlight through a process called Photosynthesis. Photosynthesis means “putting together” (synthesis) using “light” (photo).

The energy from the sun's rays is captured, or absorbed, by the pigment chlorophyll, found in leaves. Chlorophyll causes the plant to appear green. This energy is then used to synthesize a sugar molecule from molecules of water and carbon dioxide.

This equation illustrates the chemistry of photosynthesis:

$$\text{CO}_2 + \text{H}_2\text{O} \text{ in the presence of light & chlorophyll } \rightarrow \text{CH}_2\text{O} + \text{O}_2$$

(Carbon Dioxide + Water + sunlight -> Sugar and Oxygen)

The Mathematics of Energy

Ecologists estimate only 10% of the energy at one trophic level (such as primary producers, or plants) is passed on to the next higher trophic level (such as primary consumers, or herbivores).

By multiplying by 10 for each trophic level the energy had to pass through, we can calculate how much plant material was needed to produce an organism at a particular trophic level.

Plants do not use all of the energy captured for growth; some is expended as the plant “breathes,” which is called cellular respiration (cellular respiration is the process of oxidizing food molecules into carbon dioxide and water).

All animals rely on the energy plants have captured. When an animal, such as a squirrel, eats a plant, such as an acorn, it converts the plant to energy essential for growth. Animals cannot digest all the parts of a plant, so some energy is lost.

When a second animal (such as a hawk) eats the first animal, the second animal converts the first animal to energy, thus ultimately using energy that was originally stored in the plant. The hawk does not use all the energy stored in the squirrel. In the transfer of energy along the food chain, some of the energy is lost.

The majority of plants are called Angiosperms, meaning they have flowers. Unlike ferns (or Gymnosperms) that have spores, angiosperms produce flowers, when pollinated.

Flowering plants start life by germinating (sprouting) from a seed. The seed contains food needed to develop the roots and a shoot. The roots transport water and nutrients from the soil to the rest of the plant. The shoot grows and begins to develop leaves.

As the plant grows, it produces flowers and seeds. Some plants mature in just a few months, while trees may take many years to reach maturity.

In order to produce seeds, pollination must occur. Pollination is the process by which pollen from the male part of the flower, the anther, is transferred to the female part of the flower, the stigma. The flowers of some plants have fragrances or bright colors that attract insects, bats, or birds. These animals then transfer the pollen from flower to flower. In other plants, pollen is transported by wind.

After pollination, parts of the flower swell to form a seed and a fruit. The seed is the embryo of a new plant, packaged with a supply of food and protected by a hard coat. The fruit is the flesh surrounding the seeds that protects them and aids in dispersal. Seeds and fruits come in all shapes and sizes to facilitate seed dispersal. Seed dispersal is the transportation of the seed from its plant of origin to another location.
Seed Dispersal Methods

Some seeds are dispersed by the wind. These seeds are either light and fluffy like parachutes (such as dandelions) or have wings or blades like a helicopter (such as maples).

Plants with “discharge” seed dispersal have specialized parts that release their seeds into the environment around them. For example, jewelweed plants are sensitive to touch and release their seeds when you brush past them.

Animals help disperse seeds in three ways. Some seeds, such as burrs, have tiny hooks on them to hold onto the fur of an animal until they are brushed off in a new location. Other seeds, like those encased in a fruit, are eaten by animals. These seeds then pass through the digestive tract of the animal and are excreted in a new location. Finally, some seeds, like acorns, are buried and saved for food by animals like squirrels. Not all of these seeds will be eaten; the uneaten seeds may germinate and grow into a plant.

Plants in the City

Plants are an important part of life in a city. They are an important source of oxygen, and even help clean the air by filtering out pollutants. In addition, plants, particularly trees, provide shade from the sun, help keep noise down, and provide wildlife habitat.

Plants, such as trees and flowers, are also important because they are aesthetically pleasing and are a way for city dwellers to connect with nature. Scientific studies have shown that access to greenspace can increase self-esteem and academic performance, and decrease violent behaviors.

There are still many wild acres of parkland in New York City. You can visit these areas and see native plants growing in much the same way they have grown for centuries.

In the manicured areas of our parks, you can see many examples of non-native plants, admired and brought in from other regions and planted for our enjoyment. Occasionally, these plants do so well in their new homes that they grow out of control and spread to other areas where they are not wanted. When this happens, the plants are considered invasive.

DID YOU KNOW?
The London Plane tree is a hybrid (combination) of the native Sycamore tree and the non-native Plane tree. This tree can be found living all over New York City and although not native to this area, it was planted because it is resistant to pollution and disease.
The following pre-park visit activities will prepare your students for their trip to the park.

**Setting up a Field Journal**

*All Levels*

**Objective:** To give students the means to make a permanent record of their experience.

**Materials:** Stapler, 10 sheets of paper per student, pencils.

**What To Do:** Fold the sheets of paper in half and staple along the folded edge.

Explain that the students will be using the journals to record information and observations from the park visit. Have each student write their name on the cover of the journal, as well as the name of the park they are going to visit. Encourage them to draw a picture of what they expect to find at the park.

Make some predictions before going in the field, and have students record these in their journals. Get students thinking by asking the following questions: Based on the time of year, what do you expect to see at the park? What do you think you will learn from the visit? Have students include a few questions and answers of their own on the first page of the journal.

The information the students collect and the observations they make in the field will be dependent on many things, including the time of year, time of day, and weather conditions. As a result, it is important to include the following information for each field journal entry:

**Date:** Is it early spring? Late fall? The time of year will greatly affect what you find in the park (e.g. leaves change color in the fall).

**Time:** Is it early in the morning? High noon? The time of day will also affect what you are likely to observe (e.g. morning glories close their petals at dawn and dusk).

**Weather Conditions:** Is it pouring rain? Blistering hot? These conditions will also affect what you are likely to observe (e.g. plants may wilt in extreme heat).

**Location:** Are you standing in a forest? Looking out over a body of water? Make note of the habitat features (forest/trees, meadow/grasses, pond, playground) in the area, as this will greatly affect what you see (e.g. you are unlikely to find large trees in a meadow).

**Observations:** Are the trees just beginning to bud? Do you see many different kinds of seeds? Using the background information learned in the pre-visit activities, keep your eyes peeled and keep track of any interesting observations.

**Sketch:** A picture is worth a thousand words. Students will practice capturing specific details in the field by drawing what they see.

Don’t forget to bring the field journals with you to the park!

**Plants For Dinner**

*All Levels*

**Objective:** To have students explore where their food comes from.

**What To Do:** Ask a student to describe what they had for dinner the night before. Stop the student after he or she mentions the first food. Ask your students what animal or plant that kind of food comes from. Ask a volunteer to represent that plant or animal.

Stop the student after he or she mentions the first food. Ask your students what animal or plant that kind of food comes from. Ask a volunteer to represent that plant or animal.

Ask your students where that plant or animal gets its energy. An animal will get it from plants or other animals, and a plant would get it from the sun. Have a second student represent this energy source. Continue asking questions and form a food chain by having other students represent these plants or animals and link hands in order. Keep going until you get to the sun.
Have the rest of your students create chains, all connecting to a single sun, representing where each part of the meal came from.

**Focus Questions:**
- Where does the energy for our food come from?
- How many levels did the energy pass through on its way to us?
- What would happen to us if there were fewer plants?
- What would happen to other animals?

### Wildcards

**All Levels**

**Objective:** To learn more about plants and plant ecology.

**Materials:** Paper, drawing and writing supplies, key rings, single hole punch, research resources such as plant field guides and encyclopedias.

**Before You Begin:** Research which plants are most common in the park you will be visiting. Think about the information that will be emphasized on the Wildcards – each card needs to have the same format in order to use them to play games (e.g. plant height, range, life history, habitat requirements.)

**What To Do:** Ask each student to create Wildcards for three or more plants.

Use index cards with a hole punched in one corner for each Wildcard. Have the students fill in each side of the index card as follows:

**Side One:**
- Illustration of the plant, including its flowers, seeds and fruit.

**Side Two (this is an example, your class can decide what information is relevant):**
1. Name of plant
2. Found in: Sun/Shade/Part Sun
3. Type of plant: Tree/Shrub/Wildflower/Grass
4. How tall it gets:
5. Flowers come out in: (month)
6. Seeds come out in: (month)
7. Student’s name

Have the students pass a keyring through the holes in their cards to make a booklet and share their booklets with the class.

**Don’t forget to bring the Wildcards with you to your park visit!**

**Focus Questions:**

- Level One
  - Which plants do you expect to see?
  - Will you see many flowers on your visit? Seeds? Leaves?

- Level Two
  Questions from Level One plus:
  - Which plants grow in full sun? Full shade? Part sun?
  - Which plants are native? Non-native? Invasive?
  - Which plants do you expect to see on your park visit at this time of year?
  - Which plants do you expect not to see?

- Level Three
  Questions from Levels One and Two plus:
  - Which plants can be found together?
  - Which plants couldn’t grow together? Why?
  - Which plants are more desirable in a park?
  - Which are less desirable? Why?
Go Wild!

All Levels

Objective: To play games with the Wildcards.

Materials: Wildcards made in the previous activity.

What To Do:
Level One
Have your students sort the Wildcards into categories by their characteristics, (such as plants with the same color flower or plants with the same sun exposure requirements).

Play memory with the Wildcards, turning a group of them with the text face down (picture face up) and attempting to match up pairs based on the categories your class explored.

Level(s) Two/Three
Break your students up into small groups. Have each group create a game using their Wildcards. “Go Fish” is a good place to start. Have the students categorize the cards into groups by one of their characteristics, then attempt to collect all of a certain “suit” they already hold one of by asking the other players or “fishing” in the deck.

Have team members write down the rules to their game as a field journal entry, including strategy, variations, and props.

Prepare for Adventure

Park Visit

Read through the following park-visit activities to get a sense of what your students will be doing on the day of the trip.

Plants In The Parks

All Levels

Objective: To have students explore plants in the park.

Materials: Student Wildcards, Plants In Your Park Worksheets for each student, plant field guides.

What To Do: Explore interesting plants in the park and have the students identify them. Challenge students to find the plants on their Wildcards, and encourage them to use all their senses while they are observing and examining the plants.

All students will collect data on the plants. Use the worksheets to record all data, and the field journals to record general observations. Depending on the season, the leaves, seeds, flowers, or stems may be the most visible and interesting part of the plant(s) you are observing.

Plant Diversity

All Levels

Objective: To have students understand that park areas can have high or low plant diversity.

Materials: Plant field guides, field journals.

What To Do: Go to a site in the park with many plants, such as a forested area, a wildflower meadow, or a garden area. Have the students count the number of plants they find at the site, identify them and record their observations in their field journals.
Next, go to a second site in the park with a low density of plants, such as a lawn or ballfield. Have the students count the number of different plants they find at the site, identify them and record their observations in their field journals.

While exploring the two sites, students will take the temperature in a sunny area and in a shaded area with trees. Have students experience the difference shade (and trees) make in our lives!

Post-Visit Activities

The following post-park visit activities will help you wrap up the park visit by using data collected at the park to draw conclusions. Extension activities are also included.

Focus Questions:

Level One
• What kinds of plants did you find at each site?

Level Two/Three
• Did you find similar plants at each site?
• Did you find more of one kind of plant at one site? What was it? Why do you think this was the case?

Plants in Graphic Detail

All Levels

Objective: To analyze the data collected in the park using graphs, charts, and other graphics.

Materials: Plants in Your Park Worksheet, graph paper, pencils.

What To Do: Using the data collected on the worksheet, have your students create charts and graphs.

Level One
Work as a class to calculate the total number of plants by seed dispersal method observed while in the park. Create a numerical chart on the board. Next, work as a class to turn these totals into a bar graph.
**On and Beyond**

**It’s A Forest Out There**

All Levels

**Objective:** To understand the habitat requirements of plants.

**Materials:** Pre-cut squares of red, yellow, and blue construction paper.

**What To Do:** Have students stand about three feet apart from each other, with one foot “rooted” to the floor at all times. Scatter unevenly among the “trees” small squares of blue, yellow, and red paper, representing:
- Blue = water
- Yellow = sunlight
- Red = nutrients

Give the group 15 seconds to gather their requirements – 3 squares of each color – without moving their “root” feet.

When the time is up, have each tree report on whether or not it survived. Discuss why some trees survived and others did not.

Try altering the game: move the trees closer together (as in a forest), thus increasing competition; or limit the various resources (less water in a desert, less sunlight in a forest, etc.).

**Focus Questions:**

**Level One**
- What do plants need to survive?

**Level Two/Three**
- Were all the trees able to survive? Why were some able to survive and some not?
- What could prevent a plant from getting what it needs to survive in the real world?
- How can you change the game so more trees survive? How about fewer?
- What could happen as the trees grow bigger? (Hint: shade)

**Get Involved:**

**Green up your School!**

All Levels

**Objective:** To plant native plants and attract native animals to your school.

**What To Do:** Have students research native plants that attract birds and butterflies and investigate where these plants can be purchased locally.

Plant a garden on your school’s rooftop, in a window box, or in the playground, and watch as wild birds and other animals come to call your schoolyard home.

**Before You Begin:**
Consider the following: Permission from school principal; water source; durability of plants to survive heat associated with rooftops; appropriate and durable containers.

**Botany Field Trip**

All Levels

**Objective:** To experience plants in the city.

**What To Do:** Schedule a field trip to one of the following facilities:
- Brooklyn Botanic Garden: (718) 623-7220
- Staten Island Botanical Garden: (718) 273-8200
- New York Botanical Garden, Bronx: (718) 817-8700
- Queens Botanical Garden: (718) 886-3800

**Visit a Local Nursery**

**Level One**

**Objective:** To experience plants in the city.

**What To Do:** Contact a nursery near your school and arrange to take your class on a tour of their facility.
# Plants In Your Park Worksheet

**What To do:**
Record the following information for each plant encountered in the park:

<table>
<thead>
<tr>
<th>Species</th>
<th>Flower Y/N</th>
<th>Seed Y/N</th>
<th>Leaves Y/N</th>
<th>Invasive Y/N</th>
<th>Seed Dispersal Method</th>
</tr>
</thead>
</table>
Notes and Remarks
THE NATURAL CLASSROOM IS AVAILABLE AT THESE
NEW YORK CITY DEPARTMENT OF PARKS & RECREATION
NATURE CENTERS AND HISTORIC HOUSES

BRONX PARKS
NATURE CENTERS
1 CROTONA NATURE CENTER
2 ORCHARD BEACH NATURE CENTER
3 PELHAM BAY RANGER STATION
4 VAN CORTLANDT NATURE CENTER

HISTORIC HOUSES
1 BARTOW-PELL MANSION MUSEUM
2 POE COTTAGE
3 VALENTINE-VARIAN HOUSE
4 VAN CORTLANDT HOUSE MUSEUM

BROOKLYN PARKS
NATURE CENTERS
5 SALT MARSH NATURE CENTER
9 SALT MARSH NATURE CENTER

HISTORIC HOUSES
5 LEFFERTS HOMESTEAD
6 OLD STONE HOUSE
7 PIETER CLAesen WYCKOFF HOUSE MUSEUM
8 HENDRICK I. LOTT HOUSE

MANHATTAN PARKS
NATURE CENTERS
6 BELVEDERE CASTLE
7 DANA DISCOVERY CENTER
8 INWOOD HILL NATURE CENTER

HISTORIC HOUSES
9 DYCKMAN FARMHOUSE MUSEUM
10 GRACIE MANSION
11 THE LITTLE RED LIGHTHOUSE
12 MERCHANT’S HOUSE MUSEUM
13 MORRIS-JUMEL MANSION
14 THE SWEDISH COTTAGE

QUEENS PARKS
NATURE CENTERS
9 URBAN PARK RANGER ADVENTURE CENTER
10 FOREST PARK NATURE/VISITOR CENTER

HISTORIC HOUSES
15 KING MANOR MUSEUM
16 KINGSLAND HOMESTEAD
17 QUEENS COUNTY FARM MUSEUM
18 LEWIS H. LATIMER HOUSE

STATEN ISLAND PARKS
NATURE CENTERS
11 BLUE HERON NATURE CENTER
12 HIGH ROCK RANGER STATION

HISTORIC HOUSES
19 ALICE AUSTRON HOUSE MUSEUM
20 CONFERENCE HOUSE
21 HISTORIC RICHMONDTOWN
22 SEGUINE MANSION

NEW YORK CITY DEPARTMENT
OF PARKS AND RECREATION
URBAN PARK RANGERS
1234 Fifth Avenue
New York, NY 10029

Call 311 and ask for the Urban Park Rangers NOW to book your program.

Programs developed and written by the Urban Park Rangers
with the support of the National Geographic Society.
Graphic Design by Shalini S. Matos
all rights reserved 2004.