The NYC Department of Parks & Recreation presents

The Natural Classroom
urban park rangers • education program

ENTOMOLOGY
Buggin Out!

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

- Map Reading and Making
- Critical Thinking
- Plant Identification
- Researching and Writing a Field Guide
- Graphing
- Data Gathering
- Site Evaluation
- Creating a Timeline
- 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 Entomology: Buggin Out! 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

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### 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 activities a few days before the trip so you will be aware of the day's anticipated events. Let your students know how to dress for the weather, the bugs, and the terrain – you will be outdoors in the “wilds” 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.

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### Key Entomology Vocabulary Words

- invertebrates
- exoskeleton
- chitin
- head
- mandibles
- proboscis
- thorax
- abdomen
- metamorphosis
- egg
- larva
- pupa
- cocoon
- chrysalis
- adult
- nymph
- molt
- queen
- worker
- drone
- migration

*Words will be italicized throughout program*
Entomology is the scientific study of insects. Insects are among the most interesting and abundant creatures on the planet. They are all around us, they come in many shapes, sizes, and colors and they have the ability to completely change their physical form.

All insects are part of a larger group known as Phylum Arthropoda, which includes spiders, horseshoe crabs, shrimp and centipedes. All arthropods are invertebrates, meaning they do not have a spine but have an external skeleton instead. They also have a segmented body and legs with joints. All insects and only insects have six legs.

The skeleton that insects wear on the outside of their bodies serves as armor. The external skeleton or exoskeleton is a tough, flexible layer made of a substance called chitin. It also helps protect the insects from water loss. Insects breathe through openings in the exoskeleton, called spiracles, allowing air to enter the body and travel to the body’s cells.

Insects have three body sections:
- The head contains the mouthparts and the sensory organs such as simple and compound eyes and antennae. Insects have specialized mouth parts relating to what they eat. Those insects with mandibles, like ants, chew their food, and those that have a proboscis, like butterflies, suck nectar.
- The thorax contains the legs and wings.
- The abdomen contains the organs.

During the course of their lives almost all insects undergo an amazing physical change known as metamorphosis. For example, the butterfly begins its life as a caterpillar and the bee starts out as a grub.

There are two types of metamorphosis, complete and incomplete.

1. Complete metamorphosis
The majority of insects (88%), such as beetles, ants, wasps, bees, butterflies, and moths, undergo complete metamorphosis, which includes the following stages:

Egg - A female insect lays eggs.

Larva - Larvae hatch from eggs. They do not look like adult insects, and usually have a worm-like shape. Caterpillars, maggots, and grubs are the larval stages of insects. Larvae molt their skin several times a year, as they grow.

Pupa - Once the larva is full-grown, it will become a pupa. Many larvae create a covering of silk to protect themselves (from enemies and the weather) during this delicate transformation. This soft covering is called a cocoon. Some insects, like butterflies, do not make cocoons, but suspend themselves from an object and are entirely exposed during metamorphosis. The pupa of a butterfly is called a chrysalis.
Adult - After a period of time (anywhere from 4 days to many months), the adult breaks through the pupa skin and emerges equipped with wings and six legs.

2. Incomplete (Simple) Metamorphosis
The minority of insects (12%), such as dragonflies, grasshoppers, crickets, cicadas, cockroaches, walking-sticks, and mantids, undergo incomplete metamorphosis, which includes the following stages:

Egg - A female insect lays eggs.

Nymph - The eggs hatch into nymphs. nymphs look like small adults, but usually don’t have wings. In order to grow, nymphs need to shed, or molt, their tough exoskeleton. Before this is done, a new skin is formed under the old one. This new skin is soft and will allow the insect to grow before it hardens. Most nymphs molt 4-8 times.

Adult - The insects stop molting when they reach their adult size. By this time, they have also grown wings.

DID YOU KNOW?
Insects aren’t the only animals who undergo metamorphosis. Most amphibians (such as frogs) undergo metamorphosis as well.

The Behavior of Insects

Migration
Many species of insects migrate, or travel long distances to take advantage of abundant food sources, or to find a mate and reproduce.

The Monarch butterfly is a champion of migration. At the end of summer, monarch butterflies begin a long journey south in pursuit of warmer weather. Some butterflies have to travel 3,000 miles to reach their wintering grounds in the mountains in Mexico. Millions of butterflies wait out the winter together only to begin the journey again as spring returns to the north.

Feeding Habits
As a group, insects will eat almost anything. Food preferences vary depending on the insect, and may include things such as seeds, fungi, paper, wood, blood, dead animals, nectar, other insects, plants, and even concrete!

Social Insects
Social insects live in colonies and have distinct divisions of labor, or castes. Bees, ants, termites, and wasps are all examples of social insects. The three basic castes found in a hive or colony are: the Queen (who founds the colony and produces the eggs); the workers (sexually undeveloped females) and the drones (fertile males).

Reproduction
Most species of insects have males and females that mate and reproduce sexually. In some cases, however, males are rare or present only at certain times of the year. In the absence of males, females of these species may still reproduce. For example, in many species of wasps, unfertilized eggs become males while fertilized eggs become females.
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.

The ten most common insect orders are listed below. This list is a great place to start when identifying an insect:

<table>
<thead>
<tr>
<th>Insect Order</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORTHOPTERA</td>
<td>grasshoppers, crickets</td>
</tr>
<tr>
<td>COLEOPTERA</td>
<td>beetles</td>
</tr>
<tr>
<td>LEPIDOPTERA</td>
<td>butterflies, moths</td>
</tr>
<tr>
<td>DIPTERA</td>
<td>flies, mosquitoes</td>
</tr>
<tr>
<td>HYMENOPTERA</td>
<td>ants, wasps, bees</td>
</tr>
<tr>
<td>HEMIPTERA</td>
<td>true bugs</td>
</tr>
<tr>
<td>HOMOPTERA</td>
<td>aphids, cicadas</td>
</tr>
<tr>
<td>DERMATOPERA</td>
<td>earwigs</td>
</tr>
<tr>
<td>ODONATA</td>
<td>dragonflies</td>
</tr>
<tr>
<td>ISOPTERA</td>
<td>termites</td>
</tr>
</tbody>
</table>

**Imitation or Mimicry**

Some insect species will imitate, or mimic, others for their protection. For example, the poisonous monarch butterfly tastes terrible to birds and its bright colors advertise “Don’t eat me!” The non-poisonous viceroy butterfly has evolved to look much like the monarch butterfly.

Other species imitate others to make better predators. For example, each species of firefly has its own blinking signal used for locating individuals of the same species. The females of one predatory firefly species take advantage of this by imitating the signal of a different firefly species, luring them in to kill them!

**HOW MANY DO YOU KNOW?**

Grouping insects is necessary because there are so many; there are about 900,000 known insect species in the world!

**Pre-Visit Activities**

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. insects migrate 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. some insects are more active 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. some insects are more active in the 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. some insects prefer grassy areas).

Observations: Is there a swarm of flies around a certain tree? Have you seen an unusual number of butterflies? 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!

Insect Field Guides

All Levels

Objective: To gather information and compile it into a reference guide.

Materials: Key rings, single hole punch, pencils, crayons or markers, index cards, insect field guides and other research resources.

Before You Begin: Select the information you want to include in the field guide (physical characteristics, behavior, habitat, etc.) so that each entry is consistent.

What To Do: Have each students research two or more insects they are likely to see in the park. Record this information on an index card with a hole punched in one corner. On one side, have the student draw the insect in its habitat. On the other, have the student describe the insect’s characteristics.

Before going to the park, collect the index cards and pass a keyring through the holes in the cards to make a booklet.

Don’t forget to bring the field guides to the park!

Know–Want–Learned (KWL) Chart

All Levels

Objective: To have students develop a better understanding of insects.

Materials: Large sheets of paper, markers.

What To Do: Create a blank chart with three columns on a large piece of paper. Label the first column Know (K), the second column Want (W) and the third column Learned (L). Hang the chart at the front of the classroom.

Establish your students’ knowledge-base about insects by asking them what they already know. Write their responses, such as “a butterfly sucks nectar with its proboscis”, under the ‘K’ on the chart with a marker. Briefly discuss each response with the class.

Have the students take turns writing what they want to learn about insects under the ‘W’ column on the chart. For example,”Why do some bees put pollen on their legs?”

As they acquire new information (through research for the other pre-visit activities or through the visit to the park), students should write what they have learned under the ‘L’ on the chart. This stage should be ongoing.

Guide students to resources that will help them find out about what they want to learn.

As a culminating activity, review additions to the chart and address any of the students’ prior misconceptions about insects. Have the students copy the chart into their field journals.
**Insects on Trial**

**Level(s) Two/Three**

**Objective:** To have students discover the benefits of insects with “bad reputations”.

**Materials:** Paper, writing utensils, research resources such as field guides.

**What To Do:** As a class, create a list of adjectives commonly used to describe insects. Not surprisingly, many students might contribute words such as creepy, crawly, gross, scary or disgusting.

Next, break the class into small groups and assign each group an insect to research. Groups should focus on the benefits of that insect, especially its contributions to humans.

Stage mock trials for each insect: Humans vs. Insects. Using the list of words commonly used to describe insects, the teacher will represent the humans while the students represent the insects.

**Some examples of insects to research are:**

| Bees |
| Maggots (Fly Larva) |
| Dung Beetles |
| Dragonflies |
| Wasps |
| Mosquitoes |
| Termites |

**Prepare for Adventure**

**The 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.

**Insect Detective**

**All Levels**

**Objective:** To have students discover evidence of local insect activity.

**Materials:** Insect Scavenger Hunt Worksheet, student field guides, field journals, bug boxes, insect field guides.

**What To Do:** Hiking with the Ranger through the park, students will visit different habitat types, record insect observations on the Insect Scavenger Hunt Worksheet, and sketch pictures of the insects in their field guides.

Use the insect field guides, or the field guide booklets, to help students identify what they find. When in doubt, ask your Ranger!

**Focus Questions:**

**Level One**
- In what parts of the parks did you find insects? The fewest?

**Level Two/Three**
- Do you think today’s weather conditions impacted what you saw? How?
- What were most of the insects doing?
- At what stages of development were the insects you found today?
- Which order of insect was the most prevalent?
- Did you find any insects that you were unable to identify?
The following post-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.

**Wrap it up**

### Insects in Graphic Detail

**All Levels**

**Objective:** To analyze the data collected in the park by creating drawings, charts and graphs.

**Materials:** Graph paper, pencil, worksheets, field guides, field journals, completed Insect Scavenger Hunt worksheets.

**What To Do:** Use the data collected on the Insect Scavenger Hunt Worksheet to create graphs and charts.

**Level One**

Work as a class to tally the total number of insect species found in each habitat type. Create a chart showing these totals on the board. Next, work as a class to create a bar graph showing the total number of insects found in each habitat (habitat versus abundance).

**Level Two/Three**

Have each student calculate the total number of insect species observed in each habitat and create a bar graph representing habitat type versus abundance. Next, work as a class to calculate the class totals and create a class bar graph. Have the students compare the two graphs.

Finally, have the students identify the order to which each species belongs.

**Focus Questions:**

**All Levels**

- Are certain types of insects more prevalent?

**On and Beyond**

### Butterfly Lifecycle

**All Levels**

**Objective:** To observe close-up the development of a caterpillar into a butterfly.

**Materials:** Caterpillars, butterfly habitat, and Observation Recording Sheet

**What To Do:** Purchase caterpillars from a scientific supply store. See Carolina Biological Supply Company at www.carolina.com/.

Before the arrival of the caterpillars, teach the class about the lifecycle of a butterfly, using a cycle diagram found in this program. Have the students identify the following stages: egg, larva, pupa and adult.

Have the students draw their own cycle diagram with arrows, illustrating and labeling each stage of development in order of occurrence.

Then have the class use the library or internet to research the duration of each butterfly lifecycle stage (since the butterflies arrive in the larval stage, and will be released in the beginning of the adult stage, the students will not witness the egg stage or the complete adult stage).

When the caterpillars arrive, determine a set time each day for the students to make butterfly observations. The students will use recording sheets to record the length of time the butterflies are in each life cycle stage while they are in your classroom.
The chrysalis (pupa) stage is the only complete stage the students will observe. After the chrysalis stage is complete, the students should compare the length of time they have recorded to the length of time the typical butterfly spends in this stage. The chrysalis lifecycle is considered complete when the majority of butterflies have emerged.

**Butterfly Migration Watch**

**All Levels**

**Objective:** To have students participate in the annual fall equinox butterfly tagging event located at Belvedere Castle in Central Park.

**What To Do:** Monarch butterflies migrate nearly 3,000 miles from their birthplaces in the Northeast to their winter homes in Mexico. You and your students can participate in this process by contacting the Urban Park Rangers at Belvedere Castle in Central Park by dialing 311 (outside New York City dial 212-New-York).

An organization called Monarch Watch tags about 70,000 monarchs every year. Monarch Watch documents migration through tagging and observation of monarchs during their journey to over-wintering sites. By tagging the adult butterflies with uniquely coded tags, scientists can associate the location of capture (Central Park) with the point of recovery for each butterfly. The data from these recaptures are used to determine the pathways taken by migrating Monarchs, the influence of weather on the migration, the survival rate of the Monarchs, and even the overall size of the migratory population. You can learn more about this process and the organization by visiting www.monarchwatch.org

**Cultivate a Butterfly Garden in Your Schoolyard**

**Level Two/Three**

**Objective:** To have students plant a school garden that will attract butterflies and serve as an observation site for the students.

**What To Do:** As a class, research plants and flowers that bloom during the school year and that will attract butterflies. The plants selected should provide a safe living environment for both butterflies and their larvae and must provide an adequate nectar supply. The garden should be placed in a sunny spot. Divide responsibilities among students and begin planting after all the materials have been acquired.

Make sure students maintain the garden with regular watering throughout the year, and provide many opportunities for the students to observe butterfly behavior.

**Suggested “butterfly” plants**

**Nectar Plants**

- **Butterfly Weed**................. Asclepias tuberosa
- **Butterfly Bush**................. Buddleia davidii
- **Common Cosmos**.............. Cosmos bipinnatus
- **Purple Coneflower**.......... Echinacea purpurea
- **Lantana**............................ Lantana camara
- **Bee Balm**....................... Monarda didyma
- **Black-Eyed Susan**.......... Rudbeckia hirta
- **Zinnia**............................ Zinnia elegans

**Host Plants**

- **Hollyhock**..................... Alcea rosea
- **Dill**............................... Anethum graveolens
- **Red Clover**................... Trifolium pratense
- **Parsley**......................... Petroselinum crispum
- **Common Milkweed**.......... Asclepias syriaca
- **New York Ironweed**....... Veronia novenboracensis
### Insect Scavenger Hunt Worksheet

**What To do:**
Try to find insects in as many different locations as possible.

<table>
<thead>
<tr>
<th>Location</th>
<th>Species</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>POND</td>
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<tr>
<td>STREAM</td>
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<td></td>
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<tr>
<td>SHORELINE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROTTING LOG</td>
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<tr>
<td>SHRUBS</td>
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<tr>
<td>LEAF LITTER</td>
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<td>AIR</td>
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<tr>
<td>SOIL</td>
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<tr>
<td>OTHER</td>
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Notes and Remarks
NEW YORK CITY DEPARTMENT OF PARKS & RECREATION

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

**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 MANSON
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 AUSTEN HOUSE MUSEUM
20. CONFERENCE HOUSE
21. HISTORIC RICHMONDTOWN
22. SEGUINE MANSION

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