Project Bee Watch

Citizen Science

CITIZEN SCIENTIST MANUAL

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POINT PARK UNIVERSITY

PROJECT GOALS

Project Bee Watch is a partnership of organizations, including Allegheny Land Trust, and citizen scientists being organized and led by Point Park University professor, Matthew Opdyke. The goals of the project are to assess the diversity and population status of pollinators in southwestern Pennsylvania, provide scientific data to assist environmental organizations, local municipalities, schools and others in designing pollinator gardens and train citizen scientists to be ambassadors that promote the conservation of pollinators. Audubon Greenway, an Allegheny Land Trust property located in Sewickley Heights Borough, is serving as a model for expanding the project to other locations, where additional partners will organize their own citizen scientists and report their data to Professor Opdyke at Point Park University. Citizen scientists receive training on how to conduct stationary surveys of pollinators and submit their data for analysis.

This project is funded by Point Park University's Department of Community Engagement and Center for Inclusive Excellence through their Social Impact Grants. The project leader is Matthew Opdyke, an environmental professor at Point Park University in downtown Pittsburgh. You can forward all questions about the project to Matthew at *mopdyke@pointpark.edu*. The project website is *http://www.opdyke-environlab.com/pollinators.php*.

POLLINATORS NEED YOU. YOU NEED POLLINATORS.

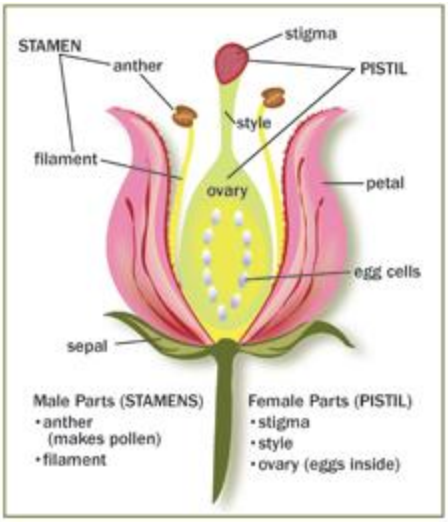
Why are pollinators important?

Somewhere between 75% and 95% of all flowering plants on earth need help with pollination – they need pollinators. Pollinators provide pollination services to over 180,000 different plant species and more than 1,200 crops. That means that one out of every three bites of food you eat is there because of pollinators. If we want to talk dollars and cents, pollinators add $217 billion to the global economy, and honey bees alone are responsible for between $1.2 and $5.4 billion in agricultural productivity in the United States. In addition to the food that we eat, pollinators support healthy ecosystems that clean the air, stabilize soils, protect from severe weather, and support other wildlife.

What do we know about their status?

Pollinator populations are changing. Many populations are in decline, and this decline is attributed to a loss in feeding and nesting habitats. Pollution, the misuse of chemicals, disease and changes in climatic patterns are all contributing to shrinking and shifting pollinator populations. In some cases, there isn't enough data to gauge a response, and this is even more worrisome.

What is pollination?



When a pollen grain moves from the anther (male part) of a flower to the stigma (female part), pollination happens. This is the first step in a process that produces seeds, fruits, and the next generation of plants. This can happen through self-pollination, wind and water pollination, or through the work of vectors that move pollen within the flower and from bloom to bloom.

Who are pollinators?




Birds, bats, butterflies, moths, flies, beetles, wasps, small mammals, and most importantly, bees are pollinators. They visit flowers to drink nectar or feed off of pollen and transport pollen grains as they move from flower to flower.

How can you help?

Pollinators need help, and we know how to help them!

Make room for pollinators on your land

You can do this by downloading the BeeSmart Pollinator Gardener app (*http://pollinator.org/bee-smart-app*), which references plants by what pollinators you want to attract, light and soil requirements, bloom color and plant type. Pollinator gardening will increase your garden yield and attract other insects that prey on garden pests – a win-win situation.

Support the science

You have received this manual because you want to support the science. Citizen science plays an important part in helping further science. If not for the help of citizen scientists, researchers would not be able to collect the necessary amount of data on pollinators to determine their status and what needs to be done for their protection. In addition, you will act as ambassadors to help others understand why pollinators need help.

SECRET LIFE OF BEES

Is this a bee?

Bees and wasps are similar in appearance. Every summer, someone is stung by a "bee" or complains about a "bee" that has invited herself to a picnic. In all cases, the insect was probably not a bee but a wasp.

The most telling differences between bees and wasps are their mannerisms. Most important among the behavioral differences is that bees are pollen eaters. Wasps are meat eaters. While both visit flowers for nectar, bees also visit flowers to collect pollen to feed their young. This dietary preference has resulted in physical differences. Bees are hairy and their bodies are bulky, which aid in the gathering of pollen. Quite the opposite of the furry bee, wasps have fine transparent hairs, skinny waists, and long spindly legs.

Are wasps pollinators?

Wasps are seen as a threat and nuisance, but they perform vital roles in pest control and pollination. Wasps are most active as pollinators in the fall when visiting flowers at Audubon Greenway; and if you look closely, they are covered by fine hairs that attract pollen.

Though not close relatives to bees the way wasps are, many flies mimic the bee look. Flies are best distinguished from bees by their short stubby antennae, fine transparent hairs, larger eyes, and they have only two wings compared to the four wings of a bee.

The bee lifecycle

A bee passes through the very same phases through which a butterfly passes. A bee moves from egg to larva to pupa to adult. Because the adult looks so different from the grub-form that characterized its youth, the growth of a bee (and butterfly) is known as complete metamorphosis.

Even as well known as they are, honey bees and bumble bees make up less than 1% of all bee species, and their life history is hardly illustrative of bees at large. Honey bees and bumble bees are highly social, meaning they live in hives with a queen and female workers that divide up the various duties necessary to keep the hive thriving. In contrast, most bee species are solitary, with each female building her own nest, gathering the food resources to feed her offspring, and laying all the eggs.

Bee names

Scientists use a system of classification known as taxonomy to group organisms together according to the way they look. At the most inclusive and highest level of classification is domain, followed by kingdom, phylum, class, order, family, genus, and species. For example, all insects fall into the same class (Insecta) because they have a hard exoskeleton (rather than a soft skin like mammals), three distinct body parts (head, thorax,

and abdomen), six legs, compound eyes, and antennae. Within that large class, all butterflies are grouped together in the order Lepidoptera, all flies in the order Diptera, and all bees in the order Hymenoptera. For most purposes, these levels of organization suffice; however, bees require some additional divisions. Tribes and subfamilies are both smaller than the level of family, but larger than the level of genus.
We use tribe and subfamily divisions when naming bees.

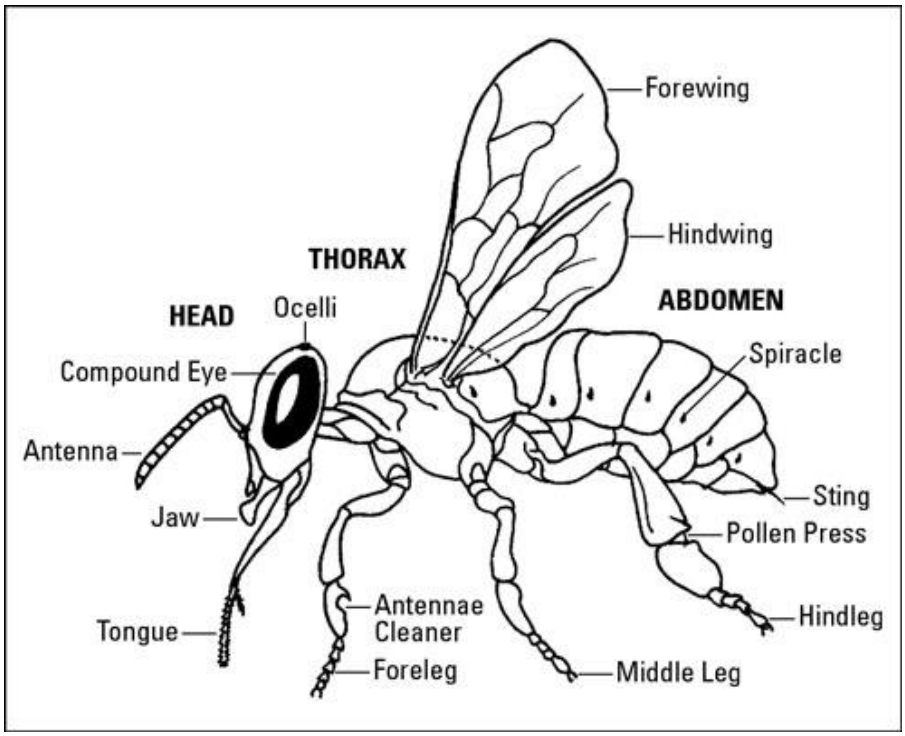
Together, the combined genus and species name of an organism is unique and no other organism shares that combination of names. These two names are usually underlined or italicized. Why don't we just use common names, the way others do for most birds and mammals? First, the common names that exist for bees may represent numerous different species. And second, there are more species of bees than there are birds and common names do not exist for most of them.

Because all bees belong to the same order, bee classification takes place at the family level and below.

Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Hymenoptera
Family: Apidae
Subfamily: Apinae
Tribe: Bombini
Genus: *Bombus*
Species: *fervidus*

Bee body

A bee's body is a creative wonder of efficiency. It is comprised of three main sections: the head, the thorax, and the abdomen. The head includes the antennae, the mouthparts, the mandibles, and two sets of eyes. Microscopic hairs and sensory pits along the antennae allow the bee to process the many chemical compounds in the air, especially the fragrances produced by flowers. The mouthparts, also called the proboscis, are used for sopping up nectar, and their tongues have chemical receptors for communicating. The mandibles or jaws are used for sparring with enemies and building nests. The two compound eyes on the side of the head are for sight and navigation, but bees also have three smaller ocelli near the top of the head. Ocelli are simple eyes used for orientation, triangulating on the position of the sun in the sky and using this information to guide them to and from their nests.



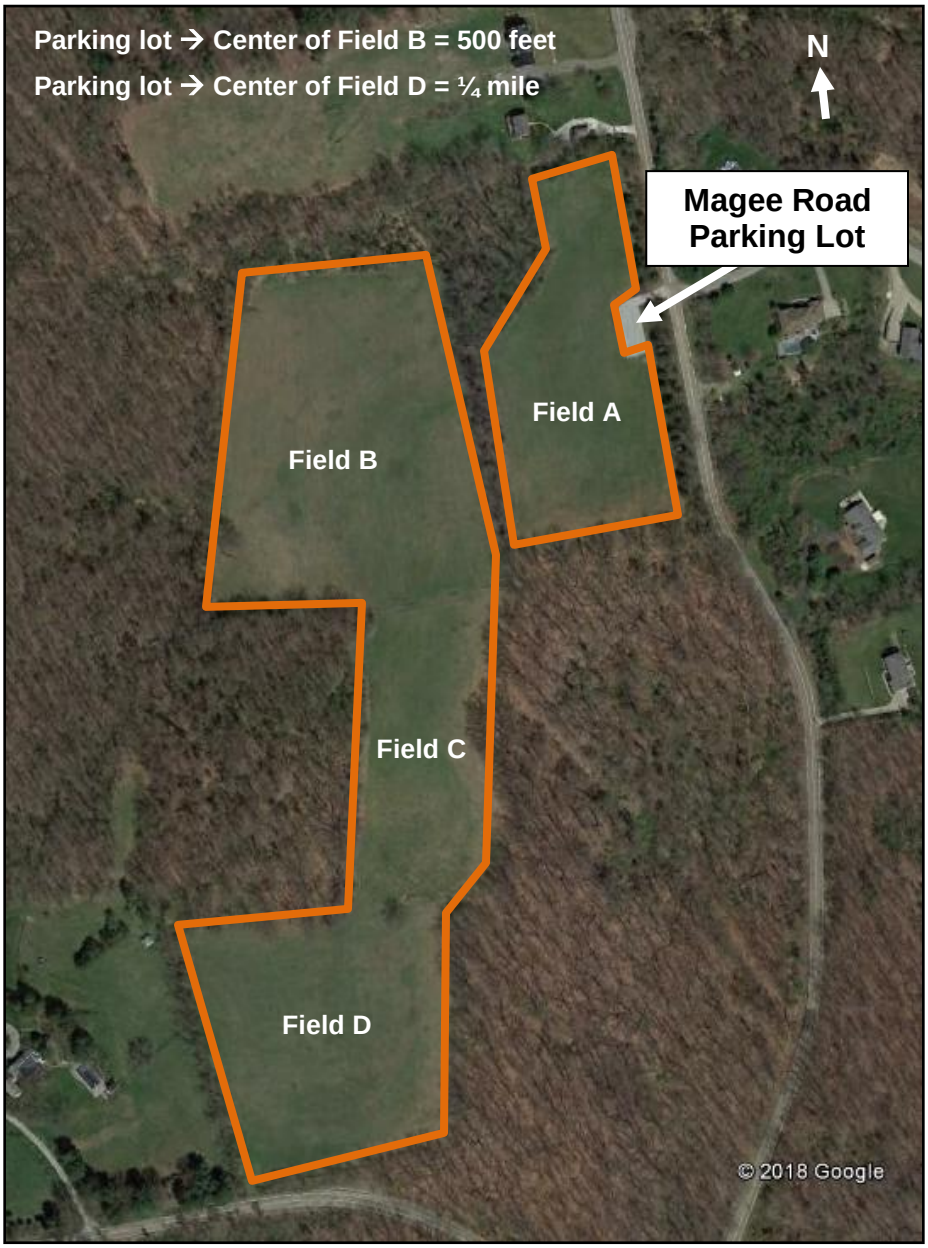
The middle section of a bee's body, complete with wings and legs, is called the thorax. The coloration patterns on the thorax and density of hair are important keys to identifying a bee. Bees have four wings that may carry a bee great distances. Medium- and large-sized bees (such as bumble bees) can travel several miles, while smaller mason bees may travel only the length of a football field or less in their lifetimes. The three pairs of legs contain electrostatically charged pollen-collecting hairs. Some bees (including honey bees) have pollen baskets, which is a concave area on the legs surrounded by curved hairs.

The coloration patterns on the abdomen are also important keys to identifying a bee. At the tip of the abdomen is the location of the sting, a highly modified ovipositor (egg-laying tube) that no longer lays eggs. Males don't have one, and therefore cannot sting. And for most bees, stinging does not mean death. Some never sting.

METHOD FOR SURVEYING POLLINATORS

Where?

The long-term goal is to involve other organizations throughout southwestern Pennsylvania who will establish their own sampling locations and coordinate their own citizen scientists. The more sampling locations and volunteers involved, the better we can assess the status of native bees and protect their habitat. For now, we are only conducting surveys at Audubon Greenway to serve as a model for future studies.



You can survey anywhere within the meadows of Audubon Greenway, which are highlighted in orange on the map.

When choosing a location, identify a random location in the meadow to sit.

Flowers must be present at your sampling location.

Avoid sampling in the same location more than once, preferably in different fields.

When?

Sampling may occur any day between May and October, between 10 a.m. and 4 p.m. Bees will be most active in the afternoon on calm, sunny days. Do not sample on rainy or windy days. The more times you visit Audubon Greenway the better we can assess the status of bees, so please try to visit at least three times a year during different times of the day and different months.

How to survey bees?

You'll be conducting surveys of bees and other pollinators using a stationary method of observation. Upon arriving at your sampling location, sit either in a chair or on the ground. It is important to not move around for the next 15 minutes. Walking around the sampling area, waving your arms or sitting and standing repetitively will scare the pollinators away. Each time you survey at a sampling location, you must commit exactly 15 minutes to sitting and recording flowers and pollinators. If you wish to spend additional time at a location, use a different data sheet for each 15 minutes.

Establishing your sampling location

Once you have chosen a location, lay out your sampling grid on the ground. The grid measures 3.3 feet by 3.3 feet (1 m^2). Settle into a chair or on the ground and prepare to remain stationary for the next 15-20 minutes.

Filling out the top-half of the data sheet

When you arrive at your sampling location, immediately answer the questions at the top of your data sheet (see examples below). The first section requires your name, number of observers, the visit number (for your first visit to Audubon Greenway, put 1; for your second visit to Audubon Greenway, put 2; etc.) and date. For the start time, put down the time you begin counting flowers and pollinators. For the finish time, put down when you stop counting flowers and pollinators.

PROJECT BEE WATCH DATA SHEET

Observer's Name: Matthew Opdyke **# of Observers:** 1 **Visit #:** 1

Date: 07/23/2018 **Start Time:** 1 p.m. **Finish Time:** _____

The second section of the data sheet requires you to circle answers about the weather. Answer to the best of your ability.

Weather (circle one choice in each category)

1. Sky: (Clear) Partly Cloudy Overcast **3. Wind:** (Calm) Light Breeze Windy

2. Rain: Overnight/Yesterday Rain (Dry) **4. Temperature (F):** 50 60 (70) 80 90 100

The third and fourth sections of the data sheet require you to circle answers about your sampling location and provide a brief description about your location. This will help us in determining the distribution of pollinators and why.

Sampling location (circle one choice in each category)

1. Field: A (B) C D

2. Proximity to edge: <20 ft. from edge (20-50 ft. from edge) center

General description of sampling location (example – northeast corner of field)

Location along eastern side of meadow, approximately halfway between the northern and southern ends straight out from large oak tree with vines hanging from it

Filling out the bottom-half of the data sheet

After you have completed the top-half of the data sheet, you are now ready to begin surveying flowers and bees. Begin by recording your start time.

Use your identification guide to record the types of flowers in your sampling grid. You may use additional identification guides in identifying the flowers, but keep in mind that your focus should be on the pollinators. If there are numerous pollinators visiting your sampling grid when you first arrive, you can always identify the pollinators first, and at the end, go back and identify the flowers. For each type of flower, record how many there are in the sampling grid.

Name of **Flower** and Number of Individuals of Each Flower	Name of **Bee** and Number of Individuals of Each Bee	Name of **Other Pollinator** and Number of Individuals of Each Pollinator
1. Mint - 3		
2. Buttercup - 1		
3. Queen Anne's Lace - 5		

Use your identification guide to record the name and number of bees, and other pollinators, visiting each type of flower. If no pollinators visit a flower, leave the spaces blank in the second and third columns. If you need more space to record flowers and pollinators, use the back of the data sheet.

Note that some of the bees, wasps and beetles are only identified to family or genus level. Identifying them to species level, often requires capture and looking at them under a microscope. For example, species of sweat bees are identified by examining the veins in the wings and minute markings on the body.

Feel free to lean over a flower to get a better look at the pollinators but avoid touching them. Their initial response to being disturbed will be to fly away. Most of the native bees you see cannot sting, and for those that can, they will only sting if they feel they have no other choice of escape. You may use additional identification guides but the pollinators will likely be moving in and out of your sampling grid, leaving you little time to flip through pages. Do the best you can in matching the pictures on the identification guide with the bees you see.

Name of **Flower** and Number of Individuals of Each Flower	Name of **Bee** and Number of Individuals of Each Bee	Name of **Other Pollinator** and Number of Individuals of Each Pollinator
1. Mint - 3	blue/green sweat bee - 5	cabbage white butterfly - 1
2. Buttercup - 1	honey bee - 2	lady beetle - 4
	bumblebee - 3	
	unknown bee - 1	
3. Queen Anne's Lace - 5		

Once you have completed your survey, record your finish time.

iNaturalist

iNaturalist is a free online resource that allows anyone to record his or her observations in nature. It can easily be downloaded to your phone so that you can take pictures of pollinators and post them on iNaturalist for later identification.

A project has been established under iNaturalist to support this study. You must first sign up to use iNaturalist and join the project. When iNaturalist is downloaded to your phone, you can "add observations to this project." The project website is *https://www.inaturalist.org/projects/project-bee-watch*. When you add an observation, include a brief description of your sampling location and upload your photo.

The iNaturalist project that supports this study is only intended for use by citizen scientists who have completed the training and are taking pictures of pollinators while surveying at Audubon Greenway.

How to submit data sheets and replace them?

You can submit data sheets by scanning or taking a photo of the sheets and sending them to Matthew Opdyke via e-mail at *mopdyke@pointpark.edu*. They can also be mailed to Matthew Opdyke, Point Park University, Department of Natural Sciences, Engineering and Technology, 201 Wood Street, Pittsburgh, PA 15222.

You can replace data sheets by downloading new ones from Project Bee Watch's website at *http://www.opdyke-environlab.com/pollinators.php*.

REFERENCES

Project Bee Watch website (extra copies of data sheets, etc.)

http://www.opdyke-environlab.com/pollinators.php

iNaturalist link to Project Bee Watch

https://www.inaturalist.org/projects/project-bee-watch

Educational website about pollinators

Pollinators by U.S. Department of Agriculture, Forest Service. *http://www.fs.fed.us/wildflowers/pollinators*

Wildflower identification guides

National Audubon Society Field Guide to North American Wildflowers – Eastern Region.

Peterson Field Guide to Wildflowers – Northeastern and North-central North America.

Bee identification guides

Bees: An Identification and Native Plant Forage Guide by Heather Holm.

The Bees in Your Backyard: A Guide to North America's Bees by Joseph Wilson and Olivia Carril.

BugGuide by Iowa State University, Department of Entomology. *https://bugguide.net*

Identification Atlas of the Vespidae (Wasps) of the Northeastern Nearctic Region by University of Guelph, Canada. *http://cjai.biologicalsurvey.ca/bmc_05/key_vespidae.html*

Butterfly and moth identification guides

Kaufman Field Guide to Butterflies of North America.

Peterson Field Guide to Moths of Northeastern North America.

Beetle identification guide

Beetles of Eastern North America by Arthur Evans.