

Pollination Discovery Course

Essential Question:

Why do plants have different adaptations?

At a Glance: Teams of learners visit different location on their site investigating some of the mechanisms and adaptations that are important in the process of pollination using a map with locations marked on their Pollination Discovery Course.

Background Information:

Scientists have discovered many correlations between characteristics of a certain flower and the type of pollinator that is attracted to it. These correlations are accurate, but they are not absolute. There are some flowers that are pollinated only by one specific type of pollinator, such as the yucca and the yucca moth. There are other plants with nectar at such a depth as to require a butterfly with a tongue of equal distance for pollination. For the most part though, pollinators get their nectar wherever they can, and that is usually in many places.

Some of the ways flowers advertise their nectar (and subsequently their pollen and genetic information) is with brightly-colored petals and color patterns that stand out against a background of green foliage. Some pollinators have limited vision, but an excellent sense of smell. Flowers produce volatile chemicals that diffuse into the air and are carried on a breeze.

The shape of the flower also plays a large part in determining which insects are capable of visiting it. The shape can make the flower more attractive to pollinators, but can also inhibit certain predators. Insects that land when they eat need a landing platform or perch that can support their weight. Flowers pollinated by hovering pollinators generally hang down and have long styles and filaments. A beetle-pollinated flower needs to be sturdy and have an easy entrance as beetles are clumsy in flight.

In addition, the flower must offer a “reward” to get the pollinator to visit. This reward needs to be good enough to get the pollinator to visit another flower of the same species.

Nectar is a carbohydrate rich droplet that is used as an energy source for pollinators. Hummingbirds require mass quantities of nectar to maintain their movement. It is also the only food source for most butterflies. Bees collect the nectar and use it to make honey for their hives. Nectar is rich in carbohydrates, but is a weak source of most other nutrients.

Pollen contains protein, starch, oil, and other nutrients. It is far richer than nectar in vitamins and minerals too. For beetles and bees, pollen is their basic protein supply. Sticky pollen that collects

Location: outdoors in an area with common weeds or in a cultivated garden

Objectives:

Learners will:

- 1) use a map to locate specific sites on the school grounds.
- 2) determine the value of special adaptations of plants in the process of pollination.
- 3) analyze interactions of plants and animals and their co-adaptations.

Skills: compares physical attributes, uses tools, asks questions that lead to investigations and finds answers; communicates findings

Supplies:

- map with orienteering sites marked on it
- task cards
- string or brightly colored survey tape to hang task cards on trees and at other locations
- a cardboard clipboard for each team
- a pencil for each team

Time: 35 minutes

on the bodies of pollinators is transferred from one flower to another as a pollinator arrives at a second flower with lots of pollen from the first flower.

Behavior (?) can also be a reward that gets a repeat visit by a pollinator. The pollinators must like the experience and come back for more; hence, achieving pollination. (Not sure what this means—clarify, or remove...)

The following is interesting information regarding different pollinator groups:

Bees are the most important group of flower pollinators. They live on the nectar and feed it to their larvae. With special mouth parts, hairs, and other body adaptations, they are especially suited to collect and carry these materials. Bees are guided by sight and smell. They see yellow and blue, but do not see red. They see ultraviolet light as a distinct color and are able to detect the ultraviolet markings that many flowers have to direct pollinators to their nectar and pollen. They are able to smell, so the flowers they visit, such as snapdragons, usually have a sweet smell as well as a landing platform.

Butterflies are diurnal and have good vision, but a weak sense of smell. They can see red. Butterfly-pollinated flowers are brightly-colored and sometimes odorless. These flowers are often in clusters and/or are designed to provide a landing platform. Butterflies typically walk around on a flower cluster, probing the blossoms with their tongues. Examples of butterfly-pollinated flowers would be many members of the Composite Family, where many small flowers are arranged into a flat-topped head, and other plants, such as the milkweeds, where the flowers occur in large clusters. The individual flowers are typically tubular with a tube of suitable length for butterflies.

Most **moths** are nocturnal and have a good sense of smell. Moth-pollinated flowers typically are white or pale colors so they will be at least somewhat visible on a moonlit night. Often, moth-pollinated flowers only open at night. They typically use a strong, sweet perfume to advertise their presence in the darkness, and this odor is only exuded at night (evolutionarily, it doesn't make sense to waste energy producing attractant in the daytime when it is useless). Moths are hover-feeders, so these flowers have deep tubes to precisely match the length of a specific moth's tongue.

Birds, especially **hummingbirds**, have good eyes and seem to be especially attracted to red and yellow. However, a lot of birds have a poor sense of smell. Thus, bird-pollinated flowers are brightly-colored, but lack odor. Their petals are curved outward and out of the way of the pollinator. Pollen does not readily stick to the bill, but does to the feathers. Since birds lap up the nectar with their tongue, bird-pollinated flowers produce nectar that is more fluid and in greater quantity than insect-pollinated flowers. Hummingbird-pollinated flowers usually have a long, tubular corolla suited to their long beak. Hummingbirds are hover-feeders, so the flowers are designed to dust the bird's head or back with pollen as the bird probes the flower for nectar. Flowers such as Columbine, Red Salvia, and Fuchsia are favorite nectar sources for hummingbirds.

Bats are nocturnal with a good sense of smell. While many bats depend on echolocation rather than sight to navigate, those species which serve as pollinators do have good vision. Also, bats which pollinate flowers have long, bristly tongues to lap up nectar and pollen. Since these flowers are open at night, they are white or light-colored, so they'll be visible in moonlight. Bat-pollinated flowers have a musty smell like the smell of bats. These flowers are large and sturdy to withstand insertion of the bat's head as it licks the nectar and pollen.

Beetles and **flies** are more attracted to the smell of the flower rather than the color. The flowers they pollinate are often white, green or brownish-red and have a strong smell, sometimes an unpleasant one.

Wind-pollinated flowers are small in comparison to animal-pollinated flowers. The pollen grains are light, small, and are not sticky. The stamens are exposed to the wind, so that the pollen can easily blow in the wind; the stigmas are feathery and exposed to the wind, so that they can catch the pollen.

Getting Ready:

Locate appropriate plants to use in this school site activity (*see attached list of common plants*). Set up the task cards in advance (*see attached task cards*). Choose tasks that are appropriate to the school/garden site and season. Six to eight is the optimal number of tasks. Task cards should be secured close to targeted plants, and in full view. Brightly-colored flagging tape or surveying flags can be used to aid children in locating the cards.

Determine how long it will take to complete the course. Walk the entire course and add time for reading the map and answering questions.

Procedure:

1. Describe an orienteering course. Has anyone participated in one before?

An orienteering course is an interesting and motivating way to learn. This activity requires students to use a map and work in small groups to locate several sites. Upon arrival at these sites, students will complete a Question or Task related to pollination. This activity will reinforce concepts learned about the Pollination Department workers and pollination techniques.

2. Orient the students with the following instructions:

- *For our next activity, you will participate in an activity called an orienteering course.*
- *Orienteering requires a team of people to work together to locate several sites on a map.*
- *You will be provided with a map of this area, and on the map there will be eight marked sites.*
- *While locating these sites, you must stay together as a team. When you arrive at the site, you will complete questions or tasks.*
- *Each team will have just one map.*

3. Divide students into teams with three to four students per team. Have students gather with the other members of their teams.
4. Pass out the maps to students. (Do not pass maps out sooner or students may study their map and forget to listen to you!)

5. Provide the orientation and reinforce map skills with the following questions and instructions:
- *Orient students to the map (Where are you now? Point to the direction you would have to go in order to get to the road, bus pick-up area, gym, etc.).*
 - *Locate the eight dots on the map. Ask additional questions to assure that the children know how to use the map such as “Point to the direction you would have to go to find #4” or “What is the clue for #5”*
 - *Tell children, “Locate the section on your map entitled ‘Proofs of Discovery’. When you locate each site there will be a card tied to a tree or to another feature at the site. On this card will be a question or task for you to complete. Enter the answer on your map as the ‘Proof of Discovery’.”*
 - *You can visit orienteering sites in any order.*
 - *Remember, this is a team activity; you must stay with your group at all times.*
 - *Everyone will return in (# of minutes) by (state return time).*
6. When all students return, discuss their answers. If orienteering was conducted as a competitive activity, acknowledge the winning team.

Discussion/Assessment:

Name an adaptation that a plant has to help it attract pollinators.

Sites and Tasks for Pollination Discovery Course

Site: A plant with flowers blooming at different stages

Task: This plant opens up only a few of its flowers each day. This insures that flowers are there when water, food and pollen are available for making seeds. It also gives the pollinators food for a longer period of time. Look closely at the flower.

Are the flowers that are open located at the top, middle, or bottom of this flower stalk?

Site: Grasses

Task: Grass flowers have no scent or color. They have many stamens with lots of pollen that is almost lighter than air.

What non-living Pollination Department worker would move this pollen from plant to plant?

Site: Low-growing plants

Task: Plants that are low to the ground are often pollinated by beetles, the first insects to ever pollinate flowers.

Draw a picture of an imaginary crawling insect that can pollinate low, ground cover plants.

Site: Honeysuckle vine in hedgerow or edge of woods

Task: Honeysuckle is an exotic vine that is pollinated by night-flying moths. Have you ever pulled out the pistil of this plant to get a taste of the sweet nectar? Its flowers are strongly scented in the evening, but only have a slight scent in the day. Color is also important to night pollinators.

What flower color do you think creatures that fly at night would be attracted to first?

Site: Hummingbird feeder or red tubular flower

Task: This pollinator has a two-parted tongue that it rolls up to make a tube to suck the nectar out of long tube-shaped flowers. It likes red the best. It is not an insect, but it can fly real fast. It goes to Mexico for the winter. Can you roll your tongue into a tube?

What Pollination Department worker are you mimicking?

Site: Holly bushes

Task: Most flowers have both the male and the female parts on the same flower. These holly bushes are different. They are like people. One plant can be male and make pollen and another plant can be female and makes seeds and fruit.

Do the red berries that you see on the holly bushes at Christmas time grow on a male or female plant?

Site: Composite flower (dandelion, marigold, zinnia, sunflower, etc.)

Task: This flower is actually made up of many different flowers. The flowers in the center are called “disk flowers” and they do not have any petals, but make sweet nectar

for insects. The flowers on the outside have long beautiful flowers but no nectar. They are called the “ray flowers”. The ray flowers help the disk flowers attract insects.

Name two insects that you think would come to this flower for nectar.

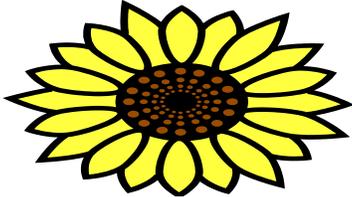
Site: Tubular-shaped flower or leaves that caterpillars like

Task: Long tube-shaped flowers can be pollinated by an insect that has a long tongue but no teeth. This insect cannot chew so it gets its food by drinking nectar out of the flowers. Before it had wings to fly from flower to flower, it was a caterpillar that ate leaves for food.

This Pollination Department worker can be very colorful. What is it called?

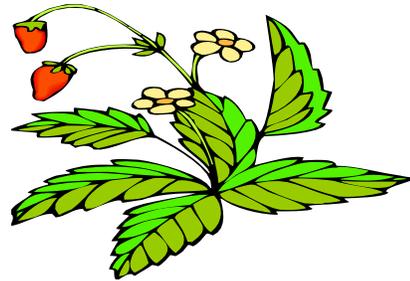
Discovery Course Task Cards – Cut, punch a hole for string and tie each card to a plant or other item at an appropriate location on your site.

1 This flower is actually made up of many different flowers. The flowers in the center are called "disk flowers" and do not have any petals but make sweet nectar for insects. The flowers on the outside have long beautiful flowers but no nectar. They are called the "ray flowers". The ray flowers help the disk flowers attract insects. **Name two insects that you think would come to this flower for nectar.**



2 Plants that are low to the ground are often pollinated by beetles, one of the first insects to ever work in the Pollination Department.

Draw a picture of an imaginary crawling insect that can pollinate low, ground cover plants.



3 Most flowers have both the male and the female parts on the same flower. These holly bushes are different. They are like people. One plant can be male and make pollen, and another plant can be female and makes seeds and fruit.

Do the red berries that you see on the holly bushes at Christmas time grow on a male or female plant?



4 This pollinator has a two-parted tongue that it rolls up to make a tube to suck the nectar out of long tube-shaped flowers. It likes red the best. It is not an insect, but it can fly real fast. It goes to Mexico for the winter. Can you roll your tongue into a tube?

What Pollination Department worker are you mimicking?



5 This plant opens up only a few of its flowers each day. This insures that flowers are there when water, food and pollen are available for making seeds. It also gives the pollinators some food for a longer period of time. Look closely at the flower.

Are the flowers that are open located at the top, middle or bottom of this flower stalk?



6 Honeysuckle is an exotic vine that is pollinated by night-flying moths. Have you ever pulled out the pistil of this plant to get a taste of the sweet nectar? Its flowers are strongly scented in the evening, but only have a slight scent in the day. Color is also important to night pollinators.

What flower color do you think creatures that fly at night would be attracted to first?



7 Long tube-shaped flowers can be pollinated by an insect that has a long tongue, but no teeth. This insect cannot chew so it gets its food by drinking nectar out of the flowers. Before it had wings to fly from flower to flower, it was a caterpillar that ate leaves for food.

This Pollination Department worker can be very colorful. What is it called?



8 Grass flowers have no scent or color. They have many stamens with lots of pollen that is almost lighter than air.

What non-living Pollination Department worker would move this pollen from plant to plant?



Pollination Discovery Course

Pollinators work hard making sure that flowers are pollinated so that the animals can have plenty of fruits and seeds to eat. In this activity you will be investigating some of the different mechanisms and adaptations that are important in the process of pollination. Good luck and have fun!

Clues to Each Station	Proof of Discovery
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8

Map of Pollination Discovery Site:

(Note: The plants used in this version of the Pollination Discovery Course were chosen based on what was available at a sample site. The course can easily be adapted to your site and the plants found there.)

Answer Key

1. Bees and butterflies both like these types of flowers (the Composite Family) due to their color and sufficient landing surface, in addition to there being many flowers to drink from at one stop. However, every type of insect may be found here.
2. Beetles come in many interesting shapes and sizes. They are attracted by smell and not color. Often the flowers they pollinate are white or green, and they are not always on the ground. Ants can also be pollinators of low-growing plants.
3. Fruit is defined as “the ripened seed-bearing ovary of a plant.” An ovary is a female flower part. If male and female flower parts are on separate flowers, the fruit will come from the female flower. If male and female flowers are on separate plants, fruits are on the female plant.
4. Hummingbirds have long tongues to get the nectar at the base of long tubular flowers. They are curious birds and are interested in bright colors, especially red.
5. This answer depends on the actual flower stalk of the plant on your course. These flowers are great food sources for pollinators since they last a long time, and people enjoy their color.
6. White flowers reflect the most moonlight, so they would be the easiest to see. White flowers are also usually the most fragrant to help pollinators on dark nights.
7. Butterflies are colorful, have wings only as adults, and love tubular flowers.
8. The wind is also a very important pollinator. In fact, it was the first pollinator. Insects weren't needed until flowering plants came into the picture.

Common Flowers and Weeds

These native and naturalized plants are commonly found in cleared fields or on the edge of woods and can be integrated into a pollination orienteering hunt.

Fall

Black-Eyed Susans
Mums (Chrysanthemums, Daisies)
Goldenrod
Joe Pye Weed
Ironweed
Kudzu
Bindweed or Morning Glory
A variety of Asters
Queen Anne's Lace
Pepperweed
Wild Grape
Smilax
Sumac
A variety of grasses and sedges

Spring

Clover
Dandelion
Sneezeweed
Redbud
Dogwood
Magnolia
Cherry
Wild Geranium
Henbit
Buttercup
Pennywort
Chickweed
Creeping Charlie
Wood Sorrel
Partridge Pea
Lespedeza
Vetch
Grasses and sedges

Preparing a School Site Base Map for GEN Activities

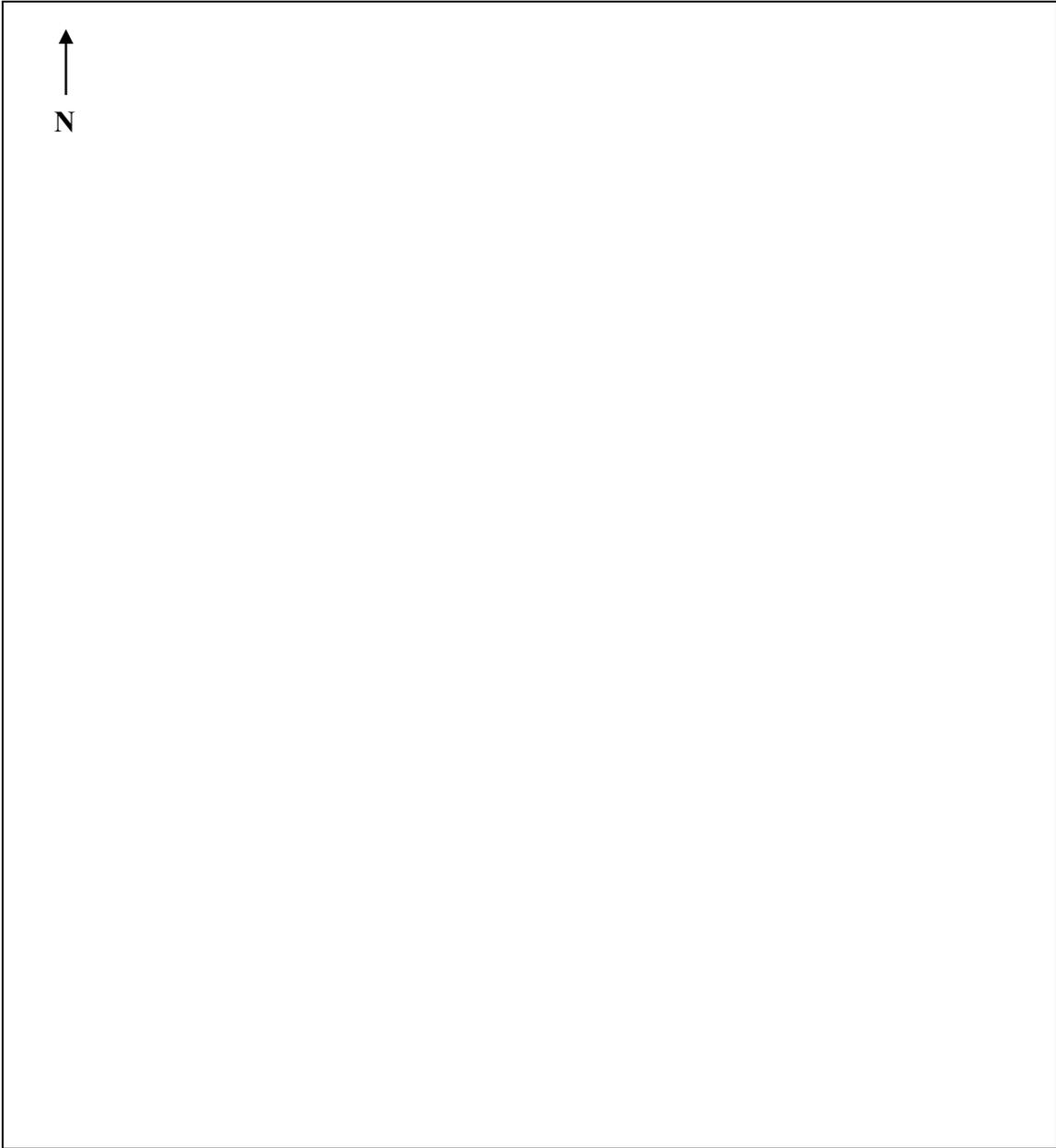
1. Designate one member of your team* to create a simplified base map of your site (11" x 17"). If you have a copy of your school site plat, use it to develop your map by tracing major features onto suitable paper. Leave off contour lines and other busy lines from your school plat. Be sure to include all buildings and existing features. This map will be used for creating several GEN activities. (see below, CHECKLIST FOR CREATING A SCHOOL SITE BASE MAP)

** Alternately, the map could be drawn by a parent, or other volunteer.*

2. Ask school administration if there are future plans for expanding the school site that should be taken into consideration as you begin your plan.

CHECKLIST FOR CREATING A SCHOOL BASE MAP:

- Name of school, date
- Scale, north point arrow
- Tract boundary lines. Names of abutting parcel owners (if known).
- Names and locations of existing streets on or abutting the tract.
- Position of buildings and other structures, including foundations, outdoor classrooms, covered walkways, underground rooms, piers, bridges, culverts, wells and cisterns.
- Location of all site construction, including walls, fences, roads, drives, walks, trails, paved areas
- Location of playground equipment, benches, boardwalks, and other features specific to the school.
- Location of water bodies, streams, springs, swamps, or boggy areas and drainage ditches or swales.
- Outline of wooded areas (if any).



Legend:

Scale: