



# Pollinator's Journey



## Goal:

Students will perform a role play about a threatened migratory pollinator that will deepen their understanding and stewardship of pollinator species and their interdependence on their ecosystem to survive.

## Objectives:

- Describe and explain the relationship and its importance between 4 different pollinators and their host plant(s).
- Use maps and graphs to track the path of migratory pollinators.
- Describe and explain at least 4 threat causes and their effects on pollinator species.
- Discover at least 4 pathways to reduce and/or extinguish the effects caused by threats on pollinator species.

**Grade Level:** 9-12

## Subject Areas:

science, language arts, and social studies

## Materials Needed:

- science notebook
- flower anatomy diagram
- pictures of monarch butterflies, lesser long-nosed bats, organ pipe cacti, and milkweed
- maps of southern Arizona, the Sonoran Desert, and Mexico (classroom map or student atlas would work).
- books on pollination, flowers, monarch butterflies, and nectar-feeding bats (check with your librarian).

## Time to Complete:

2 class periods

## Background

Flowering plants are much more common than non-flowering plants. Many people believe that the success of flowering plants is due in large part to the flower's close relationship with animals in the process called pollination.

Many flowering plants depend on animals to reproduce. Bees, butterflies, hummingbirds, bats, ants, moths, beetles and others visit flowers in search of food. In the process, animals pollinate the flowers, bringing their reproductive cells from one plant to another of the same species. Pollination leads to fertilization, the development of new seeds and, in some plants, fruit. The young seeds (either in fruit or not) may be carried by wind, water or animals to new locations where, if all goes well, they will grow into new plants.

How does the process of pollination work? Flowers contain a plant's reproductive parts, including the male anther and the female pistil. (See diagram). The structure of the flower forces the male anther, holding pollen grains, to brush up against the pollinating species while it is looking for its food, the nectar. The female pistil includes the stamen, which is sticky and collects pollen from the bodies of animal visitors, and the egg, called an ova. When pollen grains fertilize an ova, a new seed begins to develop.

Plants, rooted in one place, must face the challenge of transferring pollen to another flower of the same species. Some flowers rely on wind to carry pollen grains, while others use water. Animal pollinators, however, give plants an advantage as they may deliver pollen directly to the flower. While collecting nectar from the base of a flower, pollinators like bees brush against pollen from the flower's anther. The bee ends up carrying a load of pollen on its body. At the next flower the bee visits, some of that pollen reaches the female reproductive parts while the bee feeds. For other animals, the exact way they collect and deliver the pollen is different (hummingbirds sometimes collect pollen on their heads!), but the function is the same. The pollination relationship is mutually beneficial to flower and animal: one gets food while the other receives help reproducing.

Over time, flowers have developed adaptations to ensure that the best pollinator for their species will visit and return often to feed. In fact, flowers' fragrance, bright colors, nourishing nectar and varied shapes are considered adaptations to attract certain pollinators. For example, the bright colors of flower petals are thought to help flowers stand out against a green background. Many flowers, such as a Black-Eyed Susan, have a bull's-eye pattern of color to focus animal attention on the part of the flower with pollen and nectar. Violets have both a weak bull's-eye pattern as well as "nectar guides" - a pattern that radiates out from the nectar cup and leads animals to the part of the flower where the nectar, anther and stamen are found. Many flowers have nectar guides, which aren't always visible to the human eye.

Birds and bees find different flowers attractive largely due to differences in the animal senses. Birds have a poor sense of smell,

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but keen color vision. Bees use both color and odors to find a suitable flower. The shape of the flower also plays a role in determining the kind of pollinator who can feed from the flower. Butterflies must have a perch to land on while feeding. Hummingbirds can hover in front of the flower and so don't need a place to land. Pollinators have also adapted to ensure that they will have access to flower nectar. Animal adaptations include sense of smell, color preferences, beak shape (especially noticeable in hummingbirds) and tongue length.

Pollinators have a critical role in both agricultural and natural ecosystems. Crop plants depend on pollination to produce much of the food we eat—from wheat and oats to corn and tomatoes. In fact, scientists estimate that every third bite of food humans eat is made possible by the act of pollination. Pollinators are also key to maintaining the health and biodiversity of wildlife habitat. Many flowering plants will not produce seeds for the next generation, such as new oak trees or milkweed plants, without the aid of animal pollinators. A habitat that doesn't have young to replace the old of all species will eventually become less diverse—a few types of plants may become dominant, and in turn, the habitat will be able to support fewer animal species.

In this decade, conservation biologists discovered a disturbing trend. Pollinator populations have declined drastically. Domesticated honeybee populations dropped 25% between 1990 and 1998, mostly due to the spread of a parasitic mite. Wild bee populations face risks from pesticides and habitat loss, and other pollinators, such as birds, bats and butterflies, have also suffered declines. Migratory pollinators appear especially vulnerable to habitat loss and other threats. In the United States many migratory pollinators are in peril. For example, the lesser long-nosed bat pollinates cacti such as the organ pipe and saguaro common to the Sonoran desert landscape. The bat, along with migratory pollinators such as the rufous hummingbird, white-winged doves and monarch butterflies, must move from bloom to bloom to take in enough energy on its 2,000 mile or more journey to Mexico to survive.

Along this nectar corridor, human development, extensive planting of non-native species (that pollinators can't feed on) and the destruction of "stopover" areas by pesticides and human alterations work together to reduce the number of these migrants. For instance, monarch butterflies depend on the milkweed plant for food and a place to raise young. The milkweed is often

a target of large-scale herbicide spraying along roads and on farms.

## Preparation

1. Post pictures of pollinator species "characters" and plants for the play – long-nose bats, monarch butterflies, organ pipe cacti, milkweed plants and humans. Feel free to provide many more examples. The resources at the end of the lesson will provide you with other ideas.
2. Collect books from your school library that reference desert ecosystems, Sonoran Desert, and any of the pollinators you are highlighting for the lesson.
3. Check out **Discovery Education Streaming** at <http://streaming.discoveryeducation.com/>—there are great video segments related to pollination, bat pollinators, Arizona's desert ecosystem, bees, and monarchs. Contact your school's or school district's Discovery Education administrator to obtain your passcode if you do not have an account already.

## Procedure

### Day 1

1. Introduce at a cognitively appropriate level the main idea of pollination – flowering plants and their pollinators have adapted to each other to the point that one may have trouble surviving without the other. Show a picture of the attached flower and ask students to reproduce this image in their science notebook using proper science drawing techniques. Around the flower ask students to write or quickly sketch pollinators; see what they come up with before giving these examples, such as bees, butterflies, birds, bats, and others. Next prompt your students by asking what would happen to the pollinators without the flower? Outline the role that pollinators play in maintaining the health of an ecosystem and its biodiversity.
2. Explain some key pollinators are threatened (from honeybees to hummingbirds) are now threatened due to parasites, habitat loss, pesticides, and introduced species. Explain in a cognitively appropriate manner the effects of a major loss of pollinators could be dramatic. Ecosystems could change their character, as trees and plants once common, begin to disappear. Agriculture could also suffer huge losses, which might lead to less food being produced. Now that some information has been introduced students will

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create a circle map demonstrating what they know, then create a class circle map showing a collaborative effort from the students and allow students to make additions and ask questions before moving on.

## Day 2

3. Today students will focus on pollinators that migrate between the U.S. Sonoran Desert and tropical Mexico. Scientists are especially concerned about migratory pollinators, such as the ones on the Sonoran Desert. Use a map to point out the Sonoran Desert as well as Mexico.

These pollinators get food along their journey from flowers along what's called a "nectar corridor". Along the nectar corridor, the pollinators move north or south from one area to the next at the same times that flowers on which they feed are blooming. That means they always have something to eat on their journey. However, these corridors are suffering. Introduced (non-native) plants are outcompeting some of the plants the pollinators rely on for food. Much of the land along the corridor has been built on or converted to roads or farms. People have used pesticides in some area that kill the plants relied upon by migrants. Not having enough plants to feed on during the journey reduces the number of pollinators that can survive.

4. Read the following story to students once out loud. Next, split the students up into groups of 5. Together they will have to create a similar story that portrays pollinator's relationship with flowering plants, threats to pollinators, and ways people can help (these are the student's objectives). Give them no more than 30 minutes to prep; this is more like improv.
5. Post the objectives of the role play to help guide and focus students. Give time reminders in at after 10, 20, and 25 minutes have passed. Gather students together and watch each group's performance. They will be assessed on how well they addressed the objectives.

## Assessment

### Choice 1:

Divide a science notebook page in half or use manila paper and fold it in half. Have students draw a picture of an entire scene showing many pollinat-

ing plants and at least four pollinators i.e. long-nose bats, bees, hummingbirds, etc., on one side or part of the page. Students will then write on the other half of their page a paragraph about the relationship between pollinators and plants focusing on the importance of pollinators, at least 3 threats to pollinators and 4 human helps. Sentence and paragraph structure will be determined based on student ability, but should be evaluated based not only on conceptual understanding but grammatical competence.

### Choice 2:

Have students create a multi-flow Thinking Map demonstrating their understanding of the cause and effects associated with threats to pollinators.

### Choice 3:

Participate in a Pollinator Live citizen science project over a determined period of time. Determine your student outputs that would show the student's conceptual understanding of the objectives from the top of the lesson.

## Citizen Science

### Pollinator Live

<http://pollinatorlive.pwnet.org/teacher/citizen.php>

An extensive list of citizen science opportunities directly related to pollinators.

## Resources:

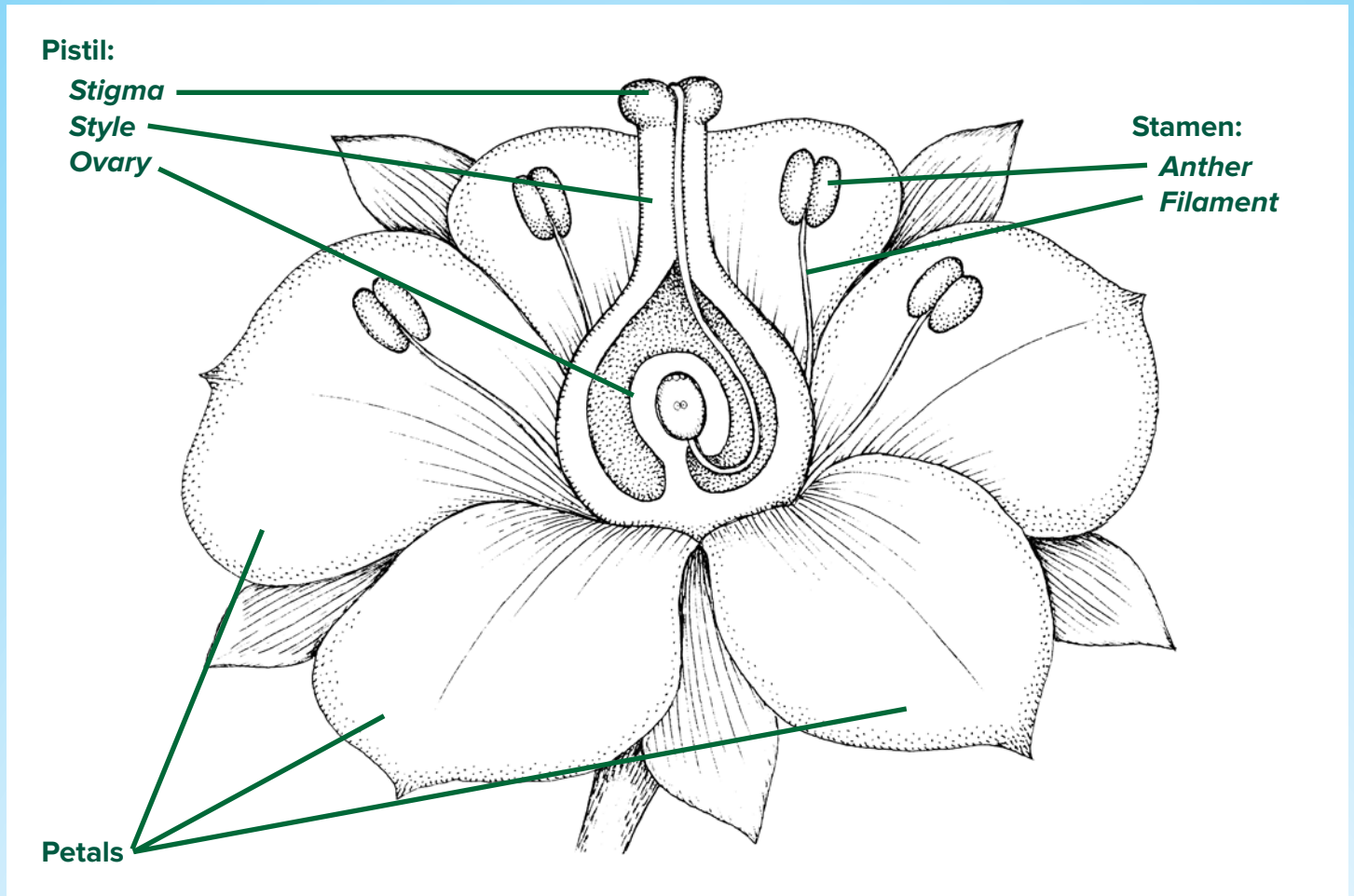
- **U.S. Fish and Wildlife Service Pollinator's Page:**  
<http://www.fws.gov/pollinators>
- **Center for Sonoran Desert Studies:**  
<http://www.desertmuseum.org/pollination/>
- **What Lives in the Sonoran Desert?:**  
<http://www.nps.gov/archive/cagr/kids%20corner/fun%20facts/What%20lives%20in%20the%20SD/What%20lives%20in%20the%20Sonoran%20Desert.htm>
- **Thinking Maps®:**  
<http://www.thinkingmaps.com/products.php>
- **Dinah Zike's Notebook Foldables®:**  
<http://www.dinah.com/>



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## Parts of a Flowering Plant



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## The Pollinator's Journey Play

### Narrator

It is early fall in the beautiful Sonoran Desert of Arizona. Long-nosed bats and monarch butterflies live here in the summer. Soon, they must start a long journey south where they live in the winter. The nights are starting to get cooler. The flowers that bats and butterflies feed on have begun to fade. It is time to begin their journey to Mexico.

### Stage Directions

*Bats pretend to fly while feeding on cacti. Butterflies will fly and land next to milkweed flowers to feed. When students hear the word "cooler" they should begin to shiver (although these animals do not shiver in reality, this is a good tool for conveying the idea of the changing season). As the bats and butterflies try to continue to feed, the cacti and milkweed flowers sit down and drop their heads. The butterflies and the bats all know it is time to begin the journey. They leave the scene. Suggestion: There is no role for humans in this scene. Perhaps have that group be wind or act as flowers just for this scene.*

### Narrator

Each year the pollinators follow the same route to Mexico, called a nectar corridor. They stop at the same places each year to rest and feed on flowers. But this year, one of the rest stops is missing! A new golf course stands where there were once hundreds of flowers to feed on and cover to hide in. A few flowers remain, but many of the pollinators have nothing to eat. Without food, some pollinators get very tired. They don't have the energy for the long trip. Some bats and butterflies die. Others move on.

### Stage Directions

*Have bats and butterflies start on one side of the room and move together across the room. The flowers stand facing each other, forming a corridor for the group of pollinators to move through. As the pollinators pass, the flowers should move to the front of the corridor line. The Humans group should form a football huddle to represent the new golf course, right in the nectar corridor (flowers nearby have died during the construction and sit on the floor with their heads dropped). One cacti and one milkweed will remain standing. Bats and butterflies feed on the flower, but all other pollinators are tired and moving slowly. One out of three of the pollinators should lie down on the floor to show they have died (they should act as humans in next scene). The other pollinators leave to continue the journey.*

### Narrator

Arriving at their winter home, there are fewer bats and butterflies than usual. New buildings and highways have destroyed some of the usual rest stops along their journey. Herbicides sprayed along highways may poison butterflies. Breaking up habitat into smaller areas makes the journey harder, as cities, houses and highways fragment wild habitat into smaller pieces. But those that have made it can live in peace for awhile.

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## Stage Directions

*The remaining bats and butterflies arrive at their winter home, where the flowers are all in bloom. As the teacher talks about the threats facing pollinators, the humans should act out the actions of: building, spraying herbicides, and cutting down trees and shoveling over wild habitat.*

## Narrator

In spring, the weather warms. It's time for pollinators to begin their return journey to Arizona. The flowers have started to fade. The bats and butterflies depart.

## Stage Directions

*Bats and butterflies are feeding on flowers. Slowly, flowers begin to sit down and drop their heads to show they are not in bloom anymore. The bats and butterflies may use human cues to show they are getting hotter, such as wiping sweat from the brow or fanning themselves (like shivering, this is a human way to deal with heat, but will help get the idea across). Humans sit out during this short scene.*

## Narrator

Near the end of the journey, the bees and bats are very tired. While some stop-over spots are still rich with nectar, others have been destroyed. If only there was a flower-filled field over the next hill. Suddenly, they see flowers in bloom. It's a rest stop lost years ago to development and it looks inviting again. The flowers sit in a garden next to a large school building. Students have been working hard to create wildlife habitat on their school grounds. They've selected the exact plants that they know these migrating pollinators are looking for, and they have added bat boxes to their habitat. Hungry, the pollinators fly down to the garden to feed on flowers. In the garden, they see children weeding around the cacti and milkweed and watering young plant seedlings. The pollinators all get enough to eat. They are ready for the final miles of their trip, well-fed and prepared to go on. Flapping their wings, the bats and butterflies flyaway, leaving the children quiet with awe and happy that they have helped to make the pollinators journey a successful one.

## Stage Directions

*Humans and flowers should all be on one side of the classroom. Flowers are in bloom, while humans are tending to the Schoolyard Habitat. The bats and butterflies are flying, obviously tired and slow, toward the garden. They swoop down to the flowers and feed on the nectar. Once they have all had a chance to feed, they move much more quickly, and fly away with much more energy. The humans stare at them in awe and smile while the bats and butterflies leave the room/area.*