FLORIDA Wildflower FOUNDATION

Unit 3

Pollination

Overview

This unit introduces students to pollination and the vital role pollinators play in plant reproduction and ecosystem health. Students will learn that pollination is not a deliberate action by animals, but a result of their search for food such as nectar and pollen.

This section includes description pages that explain different types of pollinators and their specialties. Print and distribute these pages to students at the beginning of the unit. Allow time for students to read the descriptions and discuss them as a class before starting the activities. Students may keep the description pages as a reference as they work through the unit.

Emphasize that while insects such as bees and butterflies are common pollinators, some plants rely on wind, birds or bats. This helps students understand the diversity of pollination strategies and reinforces the idea that different species play different roles in natural systems.

Activities

1. Pollination Game
2. Flower Dust
3. Wandering Pollen
4. Why Wind?
5. The Perfect Fit

Vocabulary

anther
cross-pollination
fertilization
flower
nectar
nectar guide
petal
pollen
pollination
pollination syndrome
pollinator
proboscis
self-pollination
stigma

Vocabulary words are italicized within the introduction text and activities.

Standards

Grade 3: SC.3.N.1.1, SC.3.N.1.2, SC.3.N.1.6, SC.3.N.1.7, SC.3.N.3.2, SC.3.N.3.3

Grade 4: SC.4.E.6.5, SC.4.L.16.1, SC.4.N.1.1, SC.4.N.1.2, SC.4.N.1.4, SC.4.N.1.5, SC.4.N.1.7, SC.4.N.1.8, SC.4.N.3.1

FLORIDA Wildflower FOUNDATION

Unit 3

Pollination

Introduction

Why do ***flowers*** make ***nectar***? Why are some flowers bright red while others are pale white? The answer is ***pollination***!

Pollination is the first step in a plant's reproductive cycle. It involves the transfer of ***pollen*** from one flower to another flower of the same species. Pollen is a fine, powder-like material that covers the ***anthers*** within a flower. It is often yellow, but can be white, black, orange, green or many other colors. Pollen is what bees and other ***pollinators*** collect and carry. Plants need pollen to make seeds.

Why Pollinators Matter

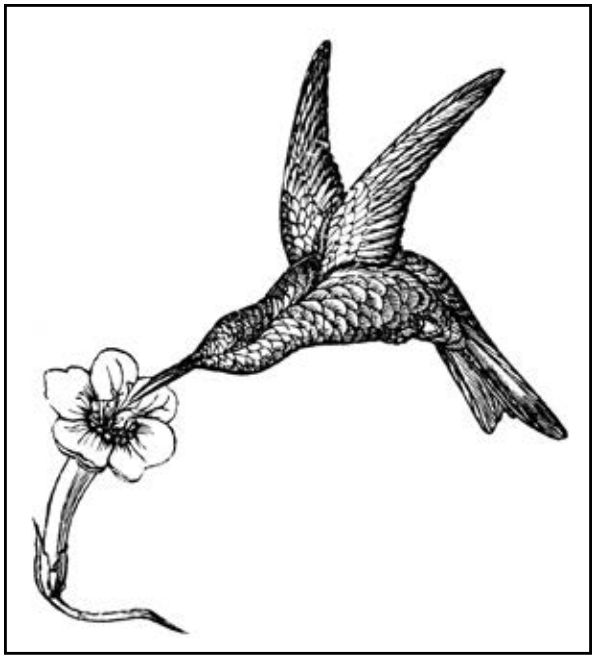
Many different insects and animals act as pollinators. These "work horses" of the natural world help ensure the continuation of plant species. But these pollinators do not get up in the morning and "go off and pollinate." Pollination is actually a lucky result of each pollinator's search for food. When a pollinator visits a wildflower in search of nectar (a sugary liquid made by the flowers), ***pollen*** or even other insects, it brushes up against the flower's anthers and ***stigmas***, picking up and depositing pollen with each visit. This process leads to ***fertilization*** and the production of seeds.

Pollination is important because most flowering plants cannot reproduce or produce seed without help from pollinators. Many fruit trees would also not produce fruit without them. Common pollinators include bees, butterflies and other insects. Some plants rely on wind, birds or bats instead. Insects are attracted to flowers by nectar, scent and colorful ***petals***.

In this unit, you will learn about different types of pollinators and the special roles they play. You'll play pollination games, become a pollinator yourself, explore how pollination works, and discover why it is essential for plants, wildlife and people.

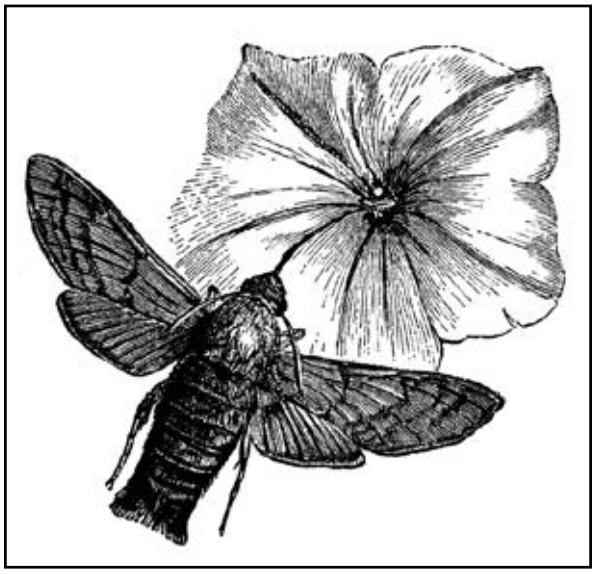
Pollination Specialties

Hummingbirds: Hummingbirds have keen eyesight and are attracted to tubular-shaped flowers that are red, orange or bright pink. The color red is not visible to most insects, but it is very visible to hummingbirds, so red flowers have evolved specifically to attract these tiny birds! ***Nectar*** is produced at the base of the deep flower tubes and is not accessible to most insect ***pollinators***. Hummingbirds hover in front of flowers and use their long, needle-like bills and even longer tongues to reach deep inside for nectar. While feeding, pollen sticks to their heads and throats, which they then carry to the next flower. Hummingbirds do not have a good sense of smell, so the flowers they visit tend to have little or no fragrance. Coral honeysuckle (*Lonicera sempervirens*), Crossvine (*Bignonia capreolata*) and Coralbean (*Erythrina herbacea*) are examples of hummingbird-pollinated flowers.



Hummingbird on Crossvine

Butterflies and moths: Butterflies are lazy pollinators and prefer flowers that provide a sturdy place where they can sit while they sip nectar. They feed on flower nectar for energy and lay their eggs on ***host plants*** where their caterpillars will later feed. Like bees, they are attracted to flowers that are sweetly scented and brightly colored. However, unlike bees, butterflies can see the color red, so they tend to visit red, blue, purple and yellow flowers. They also look for flowers with long, slender tubes that can fit their long tongues. Some flowers even have special markings called ***nectar guides*** — lines or patterns on the ***petals*** that direct the butterfly's tongue to the rich nectar at the flower base. Butterfly-pollinated flowers include Milkweeds (*Asclepias* spp.), Blazing star (*Liatris* spp.) and Firebush (*Hamelia patens*).



Hawkmoth on Moonflower

Moths, like their butterfly cousins, are also attracted to fragrant flowers, but because they forage at dusk and night, they prefer white or light-colored flowers that stand out against the darkness. Night-blooming flowers often produce very strong, sweet fragrances that guide moths from far away. Many moths have even longer tongues than butterflies, allowing them to reach nectar in extremely deep flower tubes. Moonflower (Ipomoea alba), is a perfect example of a moth-pollinated plant.

Pollination Specialties

Bees and wasps: Bees and wasps may nest in the ground, near clumps of native grass, or inside hollow plant stems. They visit ***flowers*** to feed on the ***nectar***, and also to collect ***pollen*** to feed their larvae. They eat the nectar with a tongue that extends out through a sucking tube. Body hairs on their legs and abdomens act as brushes that pick up the pollen, which they comb out and force into pollen baskets on their third pair of legs.

Furrow bee on Fleabane

Bees can see color, although in a different light spectrum (ultraviolet) than humans. Bee-***pollinated*** flowers are generally showy and brightly colored, usually in shades of blue or yellow (the color red appears black to them). Flowers tend to be sweet-smelling and often have special markings — called honey guides or nectar guides — that only bees can see. Nectar guides are designed to lead the bees straight to the nectar. They also are associated with landing platforms that provide a place for bees to sit. Bee-pollinated flowers include Spiderwort (*Tradescantia ohiensis*), Helmet skullcap (*Scutellaria integrifolia*), Toadflax (*Linaria canadensis*) and most members of the daisy family.

Some of the more unusual bee-pollinated flowers have spring-loaded traps or complex passageways that force the bee to follow a particular route. This ensures the bee will collect and deposit pollen in the proper locations. For example, the ***anthers*** of Beardtongue (*Penstemon* spp.) are arranged so they tap the bee's back as it moves into the flower in search of nectar.

Sap beetle on Magnolia

Beetles: Beetles prefer flowers that are large, greenish, white or dull in color, and give off a strong fruity, yeasty or spicy fragrance. Most beetle-pollinated flowers are flat or disc-shaped with pollen that is easy to access. Southern magnolia (*Magnolia grandiflora*) and Saw palmetto (*Serenoa repens*) are good examples of beetle-pollinated flowers.

Flies: Flies are attracted to rotting food on which to lay their eggs, so they tend to visit flowers with a similarly nasty smell. The plant provides the flies with no rewards, and so they typically leave quickly unless the plant has traps that delay or slow them down. Many orchids are fly-pollinated.

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Unit 3 Activity 1

Pollination Game

Objective

Students will be able to explain how wildflowers and insects interact in the process of ***pollination***.

Materials

- two antenna headbands for "bees" (optional)
- two boxes or tubs for "beehives"
- Post-it notes (minimum of four per student)

Standards

Grade 3: SC.3.N.1.1, SC.3.N.1.7, SC.3.N.3.2, SC.N.3.3

Grade 4: SC.4.N.1.1, SC.4.N.1.4, SC.4.N.1.7, SC.4.N.1.8, SC.4.N.3.1

Discussion

- Ask students to name some ***pollinators*** (e.g., bees, hummingbirds, moths, bats, butterflies, beetles, flies). Write the different types of pollinators on the board and discuss the preferred characteristics of each (e.g. flower color, odor and shape, ***nectar*** content, ***pollen*** type, etc.).
- Discuss how the ***flower's*** job is to attract pollinators, while the pollinators are simply looking for food.
- Ask students if plants and animals want to help each other. (Answer: No, but it works out well that they do. Explore what happens.)

Directions

1. Place the two beehives at one end of the field or classroom.
2. Select two students to be bees and have them wear antenna headbands (if available).
3. Tell the rest of the students they will be wildflowers.
4. The teacher will be the "Queen Bee" to keep order and monitor the game.
5. Give four or more small Post-its (all the same color) to each wildflower and have wildflowers write their initials on each note before putting them on the front of their shirts.
6. Upon a signal from the Queen Bee, the bees run to a wildflower, pick up two Post-its and run back to the hive.
7. Have the bees leave one Post-it in their hive, and run with the other Post-it to another wildflower.
8. Bees will then leave the Post-it with the new wildflower and take two of that wildflower's Post-its.
9. Have the wildflower put the new Post-it on his/her shirt, while the bee runs back to the hive and again deposits one Post-it.
10. Have the bee take one Post-it back to a new wildflower, and repeat the process of giving one, taking two, depositing one until the Queen Bee calls time.
11. Have the wildflowers look at their Post-its:
    - If they have at least one Post-it with someone else's initials on it, they will survive. (The more Post-its with different initials each wildflower has, the greater chance for the wildflower to reproduce.)
    - Those who have no Post-its are not likely to survive because there was no pollen deposited to start the reproductive process.
    - Wildflowers with the same four Post-its they started with will not survive.
12. Draw the students into a summary about pollination and how it might work in nature by reflecting on the results of the game.
13. Have them hypothesize scenarios or actions that might increase or decrease the chances of pollination.

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Unit 3 Activity 2

Flower Dust

Objective

Students will be able to observe and compare the characteristics of different native plant pollens.

Directions

Students should work in pairs.

1. Give each student pair a blank piece of white paper. Have them tape it to a notebook, clipboard or other hard, portable surface. (Sheets of white foamcore or sturdy cardboard can also be used.)
2. Take students to an outdoor area where ***flowers*** are present and where pollen can easily be collected. (See note.)
3. Tell students they will be collecting and studying ***pollen***. Explain that flowers and pollen have a job to do, so students must not pick any flowers; instead, they will simply collect some pollen. Demonstrate by gently bending a blossom over and shaking the pollen free onto a piece of paper.
4. Tell students not to disturb any insect or bird ***pollinators*** that are visiting a flower; instead, they should go to flowers that do not have visitors.
5. Give students 15-20 minutes to collect pollen from several different species. Be sure to point out flowers and flowering grasses with pollen.
6. Have students gather together to examine their pollen samples with hand lenses. Some of the pollen will be larger, some stickier, and some might even be different colors.

Discussion

- Ask students if there was a difference in size of the pollen grains in different flowers.
- Why might some flowers have larger pollen grains than others?
- Do all of the flowers have available pollen, or is it only present on some?
- Are there special areas or structures that hold the pollen?
- Discuss why plants need pollination to survive.

Materials

- hand lens (one per student pair)
- white paper (one per student pair)
- hard surface such as notebook, clipboard, cardboard or foamcore

Standards

Grade 3: SC.3.N.1.1, SC.3.N.1.6, SC.3.N.1.7

Grade 4: SC.4.E.6.5, SC.4.L.16.1, SC.4.N.1.1, SC.4.N.1.4, SC.4.N.1.5, SC.4.N.1.7

Note: Prior to doing this activity, locate an area in the schoolyard where pollen can easily be collected from flowering plants.

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Unit 3 Activity 3

Wandering Pollen

Objective

Students will be able to identify and demonstrate different methods for how pollen is transported.

Directions

Students should work in groups of four.

1. Give each group a cup, six marbles, 12 pom-poms and a Velcro wand.
2. Explain that the cups represent ***flowers***; the marbles and pom-poms represent different types of ***pollen***; and the Velcro wand represents ***pollinators*** (bees, beetles, butterflies, flies, bats, hummingbirds and other birds) that visit the flowers to feed on their ***nectar***.
3. Instruct the group to place the marbles in the cup, and to place the cup on the tabletop.
4. Explain that pollen can be sticky or non-sticky.
5. Ask:
   - Why might some pollen be sticky and some not?
   - How would pollen that is not sticky be carried away?
6. Explain that pollen that is not sticky depends on wind to be carried away.
7. Have one student in each group simulate a pollinator visiting a flower by stirring the wand in the cup and pulling it out.
8. Now have another student in each group simulate the blowing wind by gently tipping the flower cup and allowing the marbles to flow out and travel away.
9. Ask:
   - Which method was more effective in carrying away the non-sticky pollen? Why?
   - What about sticky pollen? What do you think will be the best method for carrying away pollen that is sticky?
10. Explain how plants with sticky pollen depend on pollinators such as insects and other animals to carry away their pollen.
11. Have students replace the marbles in the flower cup with pom-poms.
12. Again, instruct one student to simulate the blowing wind by gently tipping the cup.

(*Continued on following page*)

Materials

- cups (one per group)
- marbles (six per group)
- 5mm pom-poms* (15± per group)
- Velcro "wands" (one per group) (see note)

Standards

Grade 3: SC.3.N.1.1, SC.3.N.1.6, SC.3.N.1.7, SC.3.N.3.2, SC.3.N.3.3

Grade 4: SC.4.E.6.5, SC.4.L.16.1, SC.4.N.1.2, SC.4.N.1.7, SC.4.N.3.1

Note: Velcro "wands" can be made by adhering 2 pieces of velcro (hook side) to the ends of a large craft stick. Self-adhesive velcro hook dots are available at most office or home supply stores.

If 5mm pom-poms are not available, felt dots may be substituted.

13. Point out that the pom-poms (i.e. sticky pollen) stay inside or very near the cup, illustrating that the wind cannot carry away sticky pollen.
14. Ask:
    - Which method was more effective in carrying away the sticky pollen?
    - Why would one method be more effective?
15. Explain to students how the pom-poms grip the wand in the same way that sticky pollen grips visiting insects and other animals, and is then carried to the next flower.
16. Point out that some of the pollen falls off, and ask students to consider how that might be a good thing. (This illustrates how pollen is transferred from one flower to the next.)

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Unit 3 Activity 4

Why Wind?

Objective

Students will be able to explain why wind-pollinated plants produce large amounts of pollen and evaluate how distance and density affect pollination.

Materials

- cup(s)
- marbles

Standards

Grade 3: SC.3.N.1.1, SC.3.N.1.6, SC.3.N.1.7, SC.3.N.3.2, SC.3.N.3.3

Grade 4: SC.4.E.6.5, SC.4.L.16.1, SC.4.N.1.2, SC.4.N.1.7, SC.4.N.3.1

Directions

1. Have students sit in a semi-circle on the floor and place their hands on the floor in front of them.
2. Fill a cup with marbles. (Depending on how many students you have, you may want to fill two or three cups.) Explain that the cup will represent a ***flower*** and the marbles will represent its ***pollen***.
3. Explain that wind-dependent wildflowers must produce huge amounts of pollen for the species to survive.
4. Sit in front of the students and tell them that each student will represent a flower that needs to be pollinated.
5. Tip the flower cup(s) full of pollen marbles onto the floor. Tell students that they are to "collect" any pollen that comes in contact with them. Remind students that flowers can't move quickly or with a purpose, so to be fair, they should close their eyes.

Discussion

- How many of the pollen marbles actually reached another flower?
- What would happen if students sat farther apart?
- What if they sat closer together?
- Can they think of other things that might change the odds of the pollen reaching the other flowers?

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Unit 3 Activity 5

The Perfect Fit

Objective

Students will observe pollinators at work and be able to compare and contrast the characteristics of the flowers that various pollinators visit.

Directions

Students should work in pairs.

1. Give each pair (or each student) a "Pollinator Observations" worksheet.
2. Take students outside to an area where wildflowers and other flowering plants are in bloom.
3. Have student pairs spend about 10 minutes observing pollinators and the types and characteristics they see at work. Remind students not to disturb the pollinators they see.
4. Have students record their observations on the worksheet.
5. Have students regroup for discussion.

Discussion

- What types of pollinators were observed?
- Were individual flowers visited by two or more kinds of pollinators?
- What do the different pollinators hang on to when collecting their food?
- How many kinds of flowers were pollinated by butterflies?
- Do the butterfly-pollinated flowers have any special characteristics, such as scent, color or shape?
- How many kinds of flowers were being pollinated by bees?
- Do the bee-pollinated flowers have any special characteristics, such as scent, color or shape?

Materials

- "Pollinator Observations" worksheet (one per student pair)

Standards

Grade 3:SC.3.N.1.1, SC.3.N.1.2, SC.3.N.1.6, SC.3.N.1.7

Grade 4: SC.4.L.16.1, SC.4.N.1.1, SC.4.N.1.2, SC.4.N.1.4, SC.4.N.1.7

Note: This activity requires access to wildflowers or plants in bloom.

Pollinator Observations

Spend about 10 minutes observing pollinators and the types and characteristics you see at work. Record your observations below. **Do not disturb the pollinators you see; just observe them.**

1. What types of pollinators were observed? Indicate how many of each type below.

_____ Butterflies _____ Bees _____ Wasps

_____ Flies _____ Beetles _____ Birds

_____ Other insects (list them) _____

_____ Other animals (list them) _____

2. Were individual flowers visited by two or more kinds of pollinators? If yes, explain.

3. What do the different types of pollinators hang on to when collecting food?

4. How many kinds of flowers were pollinated by butterflies?

5. Do the butterfly-pollinated flowers have any special characteristics such as scent, color or shape?

6. How many kinds of flowers were pollinated by bees?

7. Do the bee-pollinated flowers have any special characteristics such as scent, color or shape?

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Glossary

anther: yellow, pouch-like part inside of the flower that holds pollen grains, usually located on top of a long stalk that looks like a fine hair

cross-pollination: when pollen from one flower is transferred to the stigma of a different flower

fertilization (in plants): joining of pollen with an ovule to form a seed

flower: part of a plant containing petals and sepals, often marked by a distinctive color or fragrance, where fruit or seeds are generated; part of a plant that ordinarily contains the reproductive organs

Note: Flowers can be male, female or bisexual. A male flower has only stamens. A female flower has only pistils. If a flower has both pistils and stamens, it is bisexual or both male and female.

host: in a symbiotic relationship, an organism that supplies nutrients, support or additional resources to another organism

nectar: a sweet liquid made by flowers to attract pollinators; provides food energy for insects, birds and bats

nectar guide: a pattern, line or spot on a flower petal that shows pollinators where to find nectar, like a runway guiding a plane to land

petal: the colorful parts of the flower that often attract pollinators

pollen: fine, powder-like material that covers the anthers within a flower

Note: This is what bees and other pollinators collect. Pollen is needed by plants to make seeds.

pollination: the movement of pollen from the anther to the stigma, or from the male parts to the female parts of a flower

Note: Pollination occurs when birds, bees, bats, butterflies, moths, beetles, other animals, water or wind carry pollen between flowers, or when it is moved within flowers.

pollination syndrome: a set of flower traits (color, shape, scent, nectar) that attract specific types of pollinator

pollinator: an organism (usually an insect, bird or small mammal) that moves pollen from the anther of one plant to the stigma of another

proboscis: a long, tube-like mouthpart that butterflies, moths, and some other insects use to drink nectar from flowers

self-pollination: when pollen from a flower fertilizes the stigma of the same flower or another flower on the same plant

stigma: one of the female parts of the flower; the sticky bulb in the center of flowers where the pollen lands to start the fertilization process

Tip

Turn the vocabulary words into a Jeopardy-style game for a fun, interactive way to review with your students. Free online templates are available at JeopardyLabs.com, or you can download templates for PowerPoint or Google Slides.

Pollination Definition Match

Match the vocabulary words in the Word Bank to their definitions.

Word Bank

anther	flower	pollen	pollinator
cross-pollination	nectar	pollination	self-pollination
fertilization	nectar guide	pollination syndrome	stigma

_____ the movement of pollen from the anther to the stigma, or from the male parts to the female parts of a flower

_____ joining of pollen with an ovule to form a seed

_____ a sweet liquid made by flowers to attract pollinators; provides food energy for insects, birds and bats

_____ when pollen from a flower fertilizes the stigma of the same flower or another flower on the same plant

_____ a pattern, line or spot on a flower petal that shows pollinators where to find nectar

_____ fine, powder-like material that covers the anthers within a flower

_____ a set of flower traits (color, shape, scent, nectar) that attract specific types of pollinator

_____ part of a plant containing petals and sepals, often marked by a distinctive color or fragrance, where fruit or seeds are generated

_____ when pollen from one flower is transferred to the stigma of a different flower

_____ one of the female parts of the flower; the sticky bulb in the center of flowers where the pollen lands to start the fertilization process

_____ an organism (usually an insect, bird or small mammal) that moves pollen from the anther of one plant to the stigma of another

_____ yellow, pouch-like part inside of the flower that holds pollen grains, usually located on top of a long stalk that looks like a fine hair

Pollination Definition Match

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anther	flower	pollen	pollinator
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fertilization	nectar guide	pollination syndrome	stigma

pollination	the movement of pollen from the anther to the stigma, or from the male parts to the female parts of a flower
fertilization	joining of pollen with an ovule to form a seed
nectar	a sweet liquid made by flowers to attract pollinators; provides food energy for insects, birds and bats
self-pollination	when pollen from a flower fertilizes the stigma of the same flower or another flower on the same plant
nectar guide	a pattern, line or spot on a flower petal that shows pollinators where to find nectar
pollen	fine, powder-like material that covers the anthers within a flower
pollination syndrome	a set of flower traits (color, shape, scent, nectar) that attract specific types of pollinator
flower	part of a plant containing petals and sepals, often marked by a distinctive color or fragrance, where fruit or seeds are generated
cross-pollination	when pollen from one flower is transferred to the stigma of a different flower
stigma	one of the female parts of the flower; the sticky bulb in the center of flowers where the pollen lands to start the fertilization process
pollinator	an organism (usually an insect, bird or small mammal) that moves pollen from the anther of one plant to the stigma of another
anther	yellow, pouch-like part inside of the flower that holds pollen grains, usually located on top of a long stalk that looks like a fine hair

Resources

Literary connections

Bugs in the Garden by Beatrice Alemagna

The Flowers are Calling by Rita Gray

From Flower to Flower: Animals and Pollination by Patricia Lauber

From Flower to Fruit by Anne Ophelia Downden

From Seed to Plant by Gail Gibbons

The Garden Next Door by Collin Pine

The Great Pollinator Count by Susan Edwards Richmond

Insects and Flowers by Oda Hidetomo

The Life Cycle of a Flower by Molly Aloian

Max and the Milkweed by Auggie Grand

The Milkweed and Its World of Animals by Ada and Frank Graham

Mysteries & Marvels of Plant Life by Barbara Cork

The Nature And Science Of Flowers (Exploring the Science of Nature) by Kim Taylor and Jane Burton

On One Flower: Butterflies, Ticks and a Few More by Anthony Fredericks

Pollination by Mary King Hoff

Seeds, Bees, Butterflies, and More! Poems for Two Voices by Carole Gerber

What Is a Plant? (Science of Living Things) by Bobbie Kalman

Reference books

Complete Guide to Florida Wildflowers by Roger Hammer

Florida Wildflowers in Their Natural Communities by Walter Kingsley Taylor

Websites and other web resources

The Beauty of Pollination video by Louie Schwatrzberg
www.youtube.com/watch?v=MQiszdkOwuU

Biology of Plants (Missouri Botanical Garden)
www.mbgnet.net/bioplants/main.html

Florida Wildflower Foundation (plant profiles, photos and other resources on Florida natives)
www.FlaWildflowers.org

Florida's Wildflowers and Butterflies (Florida Museum of Natural History)
www.FloridaMuseum.ufl.edu/wildflowers/wildflower-search

iNaturalist SEEK (image recognition app for identifying plants and animals)
www.iNaturalist.org/pages/seek_app

Lady Bird Johnson Wildflower Center (national database; search by state, family or habitat)
www.Wildflower.org/plants-main

Selecting Plants for Pollinators (Pollinator Partnership)
Pollinator.org/PDFs/Guides/OuterCoastalrx7FINAL.pdf