where would we BEE without pollinators?

An educators' guide to pollination and pollinator conservation, aligned to South Carolina 1st-6th grade academic standards

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Where Would We BEE Without Pollinators?

Pollination refers to the transfer of **pollen** grains from the male part of a flower, the stamen, to the female part of a flower, the pistil. Nearly 80% of all flowering plants, including more than a third of the agricultural crops that produce our food, depend upon animal pollinators to facilitate this process. However, the animals that pollinate are in trouble, and there is not a clear Plan BEE. In this activity guide, students will learn about the process of pollination, the animals that make it all possible, and the environmental challenges our pollinators face.

SC Science Standards Correlations

Grade 1:
Standard: 1.L.5
Conceptual Understanding: 1. L. 5A.
Performance Indicators: 1. L. 5A. 1, 1. L. 5A. 2
Conceptual Understanding: 1. L. 5B.
Performance Indicator: 1. L. 5B. 1

Grade 2:
Standard: 2. L. 5
Conceptual Understanding: 2. L. 5A.
Performance Indicator: 2. L. 5A. 2
Conceptual Understanding: 2. L. 5B
Performance Indicators: 2. L. 5B. 1, 2. L. 5B. 3

Grade 3:
Standard: 3.L.5
Conceptual Understanding: 3. L. 5A.
Performance Indicators: 3. L. 5A.1, 3. L. 5A. 2
Conceptual Understanding: 3. L. 5B.
Performance Indicators: 3. L. 5B. 1, 3. L. 5B. 2

Grade 4:
Standard: 4. L. 5
Conceptual Understanding: 4. L. 5A.
Performance Indicators: 4. L. 5A. 1, 4. L. 5B. 2
Conceptual Understanding: 4. L. 5B
Performance Indicators: 4. L. 5B. 2, 4. L. 5B. 3

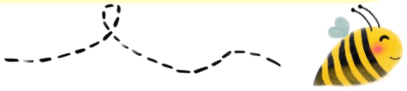
Grade 5:
Standard: 5. L. 4
Conceptual Understanding: 5. L. 4A.
Performance Indicators: 5. L. 4A. 2
Conceptual Understanding: 5. L. 4B.
Performance Indicators: 5. L. 4B. 1, 5. L. 4B. 2, 5. L. 4B. 3, 5. L. 4B. 4

Grade 6:
Standard: 6. L. 4
Conceptual Understanding: 6. L. 4A.
Performance Indicators: 6. L. 4A. 1
Conceptual Understanding: 6. L. 4B.
Performance Indicators: 6. L. 4B. 1, 6. L. 4B. 2, 6. L. 4B. 3
Standard: 6. L. 5
Conceptual Understanding: 6. L. 5B.
Performance Indicators: 6. L. 5B. 1

OBJECTIVES

- Students explain the process of pollination and the basic anatomy of a flower
- Students learn about the animals that pollinate and what physical **adaptations** they have to help them
- Students understand what environmental threats pollinators face and what can be done to help pollinators

BACKGROUND



Pollinators are animals such as bees, butterflies, beetles, birds, and bats that play a key role in the life cycle of many flowering plants. By carrying **pollen** from flower to flower, pollinators enable plants to produce fruits and **seeds**. These seeds, in turn, allow for new generations of plants to grow.

Three-fourths of the world's flowering plants depend on pollinators to reproduce, and humans and animals alike depend on these plants for survival. Many fruit, vegetable, and **seed** crops—and other plants that provide fiber, medicines, and fuel—are pollinated by animals. In fact, nearly one out of every three bites of food we eat exists because of animal pollinators!

Pollinators also play important roles in terrestrial (land-based) **food webs**. For example, some 96% of terrestrial birds—including species that eat seeds and fruits as adults—raise their young on insects, including insect pollinators.

Pollinators have a significant economic impact. Between $235 billion and $577 billion worth of annual global food production relies on animal pollinators. Honeybees—which are not **native** to North America—support more than 22,000 jobs in the US alone!

Pollinators face challenges such as **habitat** loss, **pesticide** exposure, **competition** with **non-native** species, **parasites**, **pathogens**, and climate change. But, there are many things we can do to help pollinators! Adding **native**, pollinator-friendly plants to the landscape to provide pollen and **nectar**, reducing the use of pesticides, and leaving areas for native grasses and shrubs to grow are all **conservation** practices that will help support pollinator survival.

GETTING READY

Activity A: Pondering Pollination

Before students learn about the animals that facilitate pollination, they should understand why pollination is important and how it works. Pollination must take place for flowering plants to reproduce. **Pollination** is the process of pollen being moved from a flower's male part, the **stamen**, to a flower's female part, the **pistil**. Each grain of pollen is a male **gamete** that fertilizes the female **ovules**. Unlike animals, plants cannot move around to find mates (or transfer pollen) on their own. Instead, they rely on the wind or animal pollinators to complete the process.

During pollination, pollinators pick up the pollen from the **anthers** of one flower, and carry the pollen to another (or, sometimes, the same) flower's **stigma**. Without this process of pollination, flowers would not be able to produce fruits or seeds. To better visualize floral anatomy, provide students with large, simple flowers with obvious features. (*Alstroemeria* flowers or stargazer lilies are good candidates and are available in most grocery store bouquets.) Being able to identify the basic parts of the flower will allow students to better understand pollination.

DO NOW

In small groups, have the students identify the flower parts on the diagram below on their flower "models." The students can describe the color, shape, and size of the flower, as well as count the stamen, **petals**, and sepals.

MATERIALS

Activity A

- 5-8 artificial or real flowers

Activity B

- 2 different colors of yarn
- Printer, paper, scissors, laminator, hole punch

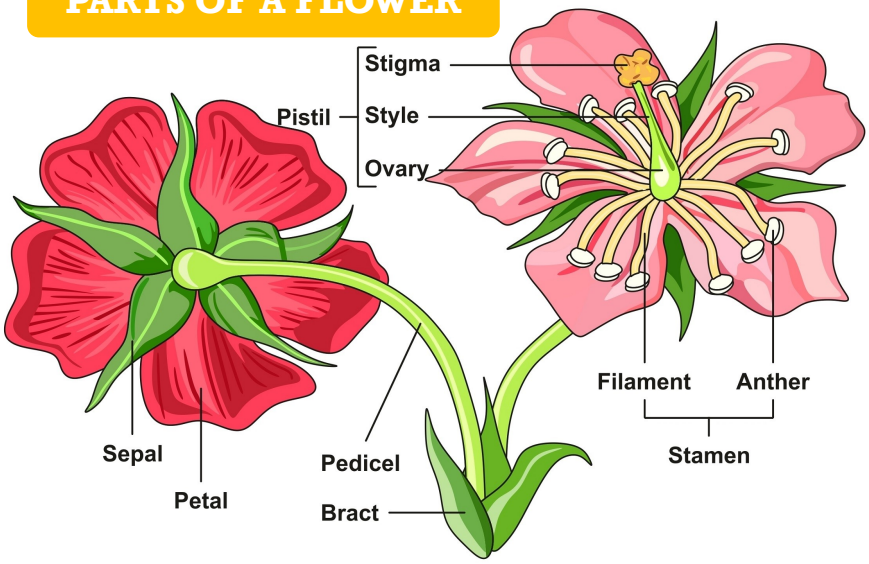
Activity C

- 30-40 plastic eggs, ping pong balls, or pom-poms
- 4 plates, bowls, or boxes
- 4 plastic spoons
- Floor tape

Activity D

- 4-sided die or random number generator
- Printer, paper, laminator

PARTS OF A FLOWER



Where Would We BEE Without Pollinators?

Activity Guide

GETTING READY

Activity BEE: Popular Pollinators

Now, it's time to meet the pollinators! While some plants—including conifers, grasses, and grains—are pollinated by wind, most plants require the assistance of an animal pollinator. Honeybees are a popular animal pollinator, but they are only one of more than 200,000 species of insects, birds, mammals, and reptiles that pollinate Earth's plants.

This activity is designed for up to 40 students to learn about different types of pollinators, while identifying certain biological adaptations both pollinators and flowering plants have that make pollination easier.

DO NOW

In this think-pair-share activity, students will receive a necklace with a pollinator flashcard. The pollinator flashcard template can be found in Appendix B. Each flashcard features a different pollinator, with a photo on one side and fun facts on the other. Use two sets of flashcards so that two students in the class receive the same card (make sure to count and sort the cards ahead of time so each student has a match). Twenty flashcard templates are included—enough for a group of up to 40 students.

Once students receive their necklaces, have them move around the room to find another student with the same pollinator. As a pair, they should discuss the pollinator and read the fun facts. Then, have each pair introduce their pollinator and their favorite fun facts to the class. This will allow the students to learn about several different pollinators.

When preparing for this activity, make two copies of the pollinator flashcard template in Appendix B. You may laminate the cards for longevity. To turn the cards into necklaces, punch two holes in each flashcard in the top right and top left corners. To make it easier to count and sort the cards, make one copy of flashcards a different color from the other, and lace the yarn through the flashcards to tie them into necklaces.

CAN YOU *BEE*-LIEVE?

- One way honeybees communicate with each other is through dancing. Dances, including the waggle and round dance, indicate distance and direction to food.
- It takes one honeybee's entire life to make just 1/12th of a teaspoon of honey. That means it takes 12 honeybees to make one teaspoon of honey!

EXTENSION

To reuse materials for this activity, consider turning the cards into a memory card/ matching game. Lay out one set of flashcards with the picture face-up and lay out the other set with the facts face-up. See if students can match facts about the pollinator to their pictures! This will help students recognize pollinators in the wild.

TIPS AND TRICKS

When facilitating the activity, it is helpful to know ahead of time how many students will participate and to match and count out the pollinator flashcards before students arrive. For example, if there will be 20 students total, count out 10 green necklaces and 10 blue necklaces, and make sure they depict the same 10 species! Shuffle these necklaces before distributing so students will have to move around the room to find their match.

Encourage students to sit with their partners after finding their match, and help the remaining students find their matches. Remind students to read over all of the facts with their partners, but only choose one or two facts to share. Come back together as a class, and have each pair introduce their pollinator and share their facts. Students may need help with some new vocabulary words — most of which can be found in the Glossary.

As students share their facts, point out, when appropriate, if a pollinator has a physical **adaptation** that facilitates pollination. For example, sphinx moths have tongues as long as their bodies that help them to drink the nectar from tube-shaped flowers. This adaptation allows them to serve as effective pollinators of a particular type of flower that other, short-tongued species may not visit!

Take time to discuss the interdependency between certain species and plants, such as the monarch butterfly, the large milkweed bug, and the milkweed plant.

BEE CREATIVE

As a follow-up activity, have students invent their own pollinators. Students should name and illustrate their creature. This pollinator could be a type of insect, bird, mammal, etc. Have students note their creatures' preferred plants/habitats and any bodily features or adaptations that help them survive, obtain nectar, or transfer pollen. The pollinators should at least make biological sense; for example, a tiny ground-dwelling ant probably will not pollinate a tall plant with large flowers. Ask students to identify environmental challenges their pollinator may face, as well as potential solutions to the challenges. This allows students to apply information they learned through this activity in a creative way.

Have students share their pollinators with classmates, and to add a competitive twist, have everyone vote on their favorite potential pollinator.

SCHOOLYARD SAFARI

Take students on a walk around the schoolyard to look for pollinators and flowering plants. Have them bring a notebook to collect data about what they see.

Can you find any plants in bloom? They could be plants in a school garden or weeds in a field. These plants probably need animal pollinators! Do you see any pollinators? Count the number and type. What flowers are they pollinating?

As a follow-up, ask students to write about their Schoolyard Safari and research the plants and animals they found. Make charts or graphs of the number and type of flowers and pollinators seen.

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GETTING READY

Activity C: Pollinator Pass-Off

Now that the students have been introduced to the pollinators and the process of pollination, it is time for them to do the "pollinating." This relay-style activity allows students to review floral anatomy and the pollination process, and to explore physiological adaptations that make the process easier for pollinators.

DO NOW

This activity will be set up like an egg-in-the-spoon relay and is easy to perform in the classroom or in a hallway. Before class begins, use floor tape to establish a starting line and finish line approximately 10' apart. The lines should be long enough to accommodate two teams of students completing the relay in parallel.

Place two plates, bowls, or shoeboxes (these will represent flowers, so you may decorate them accordingly) on the starting line and two on the finish line. Count out enough plastic eggs (or large pom-poms, ping-pong balls, etc.) for each student to have one. These eggs represent the pollen grains. Put half of the eggs into each of the two starting line "flowers."

At the start of the activity, divide students into two teams. If you've just completed Activity B, have students form teams based on the colors of their pollinator necklaces. Have each team line up behind their "flower" on the relay starting line. Give the first student in each line a spoon and explain that they have become pollinators: it is their job to transfer the pollen (eggs) from the stamens of one flower (on the starting line) to the pistils of another flower (on the finish line). Make sure to establish rules about not touching the pollen grains with their fingers, and about what to do if they drop their pollen grain (egg) before depositing it at the finish line. (Younger students may simply pick the egg up and resume the relay from where it dropped; older students may have to return to the starting line before resuming the relay.)

The team that transfers all their pollen from the stamens on the starting line to the pistils on the finish line fastest can be declared the winner!

Debrief the activity by saying "in this activity, you pretended to be pollinators and used spoons to transfer pollen from one flower to another. Animal pollinators don't have spoons, so what structures and adaptations do they use to transport pollen?"

- Hairs on their legs, bodies, heads, etc.
- Feathers on hummingbirds
- **Corbicula** or pollen baskets (honeybees)

Some pollinators have adaptations that allow them to be more efficient pollinators than others, but that does not mean that any pollinator is more important than another. Each pollinator serves a specific purpose, and it is important to conserve all of them!

GETTING READY

Activity D: Pollinators in Peril

Students should now understand the importance of pollinators. In this final activity, students will learn about the environmental challenges pollinators face, and how these challenges threaten populations of pollinators and of the plants they pollinate. Some of the major threats to pollinators include habitat loss, pesticide exposure, competition with non-native species, parasites, pathogens, and climate change.

DO NOW

This "four corners-style" activity will allow students to learn more about the variety of challenges pollinators face every day. Print the four Pollinator Habitat examples found in Appendix B and tape one in each of the four corners of a classroom space (or on trees outdoors). Each corner represents a habitat where pollinators may be found.

When the game begins, have students stand from their desks, push in their chairs, and move quickly and quietly to any of the four corners. Once all students have chosen a corner, roll a four-sided die (or put slips of paper numbered 1-4 in a cup and choose one at random, use a random number generator, or any other method to select one of the four corners at random) and read out one of the prompts included in Appendix B for the chosen corner.

Each of these prompts describes an environmental impact that results in the elimination of all pollinators (students) at that corner. Students from that corner must sit down for the rest of the round. Students remaining in the game will then choose a new corner and, on your cue, will move there quickly and quietly. Students may re-visit corners that have already been called. Roll the die to select the next corner, read out one of the corresponding prompts in Appendix B, and continue the round until there is only one surviving pollinator.

SHOW AND TELL

To take this activity a step further, assign each student a crop and have the students research the crop, where and how it grows, and what pollinators (if any) it depends upon. Students can either write a short report or simply choose a few facts to share with the class about the crop.

Have students find a recipe featuring their crop and prepare a dish (either at home or in the classroom) to taste and share! Students and their families will "bee sure" to appreciate our pollinator friends after tasting the yummy food they provide for us!

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Activity Guide

WRAPPING UP

While pollinators certainly face many challenges, the good news is there are several actions we can take to protect and conserve these amazing creatures. In this final section, help students identify simple ways they can promote pollinator conservation as individuals and as a class, at school, at home, and in their community. Students should interpret pollinator conservation as a personal and community responsibility.

How Can We Help Pollinators?

- Plant native trees, shrubs, and flowers to provide food and shelter for pollinators. Even a simple potted plant on a balcony can provide nectar and pollen for local pollinators!
- Encourage parents and school groundskeepers to minimize the use of toxic pesticides by following the practices of **Integrated Pest Management**.
- Identify and remove **invasive** species at home or at school. Invasive plants provide lower-quality habitat for native pollinators.
- Provide a water source for pollinators. A shallow basin filled with stones for butterflies, bees, and other pollinators to perch upon while they sip can be a great addition to a pollinator garden!
- Go wild! Identify an area of your schoolyard or lawn that can be left unmown for most of the year. This "wild patch" can provide essential habitat for pollinators. If there are concerns about the appearance of an "untidy" area in the lawn, create signage with messages such as "Excuse the weeds—we are feeding the bees" or "No-Mow-Zone" to make the patch appear more "intentional."
- Make nesting blocks for bees, such as mason bees, that nest in wood. Nesting blocks can be made with bamboo or paper straws, or by drilling at least 10 holes 4 to 8 inches deep and 5/16" in diameter in a block of untreated wood. Hang your bee "condo" with the holes set horizontally at least 3 feet off the ground and facing as close to southeast as possible.
- Educate others about the importance of pollinators and the steps they can take to conserve these important creatures. Commercials on the school news show, posters in the hallway, newsletters which are sent home to parents, and "pollinator parties" are all great ways to allow students to raise awareness about pollinator conservation.

Glossary

Adaptation — Special body features or behaviors that help an organism survive and reproduce.

Anther — The top of a stamen in a flower which contains the pollen.

Chrysalis — The pupal stage of a butterfly.

Competition — The rivalry between or among living things for limited resources such as food (animals) or sunlight (plants).

Conservation — The wise use, care, or protection of natural resources such as soil, water, and air.

Corbicula — Also called a "pollen basket," this structure on the hind legs of honeybees is used to harvest and carry pollen back to the hive.

Food Web — A group of interlinked food chains that includes producers, herbivores, omnivores, carnivores, scavengers and decomposers.

Gamete — An organism's reproductive cells.

Habitat — Place where an organism lives which provides the resources it needs to survive.

Integrated Pest Management — A process used to control pest populations while minimizing harmful impacts on people and the environment.

Invasive — Species (especially non-native species) that grow and spread quickly, causing harm to native organisms or ecosystems.

Migration — The seasonal movement of animals from one habitat to another to obtain resources or avoid unfavorable climatic conditions.

Native — Occurring naturally in a particular area or habitat without human introduction.

Nectar — A sugary fluid produced by flowers to attract animal pollinators.

Non-Native — An organism that has been introduced to an area by human activities.

Ovule — A plant structure that develops into a seed when fertilized.

Parasite — An organism that lives on or in another organism (called a host), obtaining food and/or shelter from the host while providing no benefits in return.

Pathogen — An organism such as a virus, bacterium, or fungus that causes disease or illness.

Pesticide — A chemical used to destroy "pest" organisms (such as insects, weeds, or fungi) that cause harm to cultivated plants or animals.

Petal — Colorful flower parts that surround a plant's reproductive structures.

Pistil — The collective female floral reproductive parts including the stigma, style and ovary.

Pollen — A fine powdery substance, often yellow, produced by the male parts of flowers. Each pollen grain contains a male gamete that can fertilize a female ovule to produce seeds.

Pollination — The transfer of pollen from the male parts to the female parts of a flower, resulting in the production of seeds and fruits.

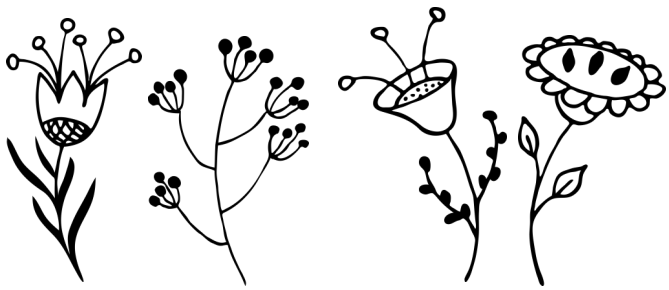
Pollinator — An animal that carries pollen from the male parts of flowers to the female parts, fertilizing plant "eggs" with plant "sperm."

Seed — The fertilized, matured ovule of a flowering plant that is capable of growing into a new plant.

Stamen — Name for the male floral reproductive parts, including the anthers and filaments.

Stigma — The part of a flower's pistil (female reproductive part) that receives pollen during pollination.

Threatened — Species likely to become endangered without special protection and management efforts.



Appendix A:

pollinator flashcards

Fold Line
(do not cut)

Honeybee

- Honeybees are not native to North America.
- Honeybees communicate the location and quality of food sources through dances.
- Only female bees sting.
- Over the course of her lifetime, a honeybee worker will produce 1/12 teaspoon of honey. That means it takes 12 bees to produce one teaspoon!
- Honeybees have special structures on their legs called "corbicula," or pollen baskets, to help them carry pollen back to their hives.

Ruby-Throated Hummingbird

- Only males have bright red throats; females are less colorful. This adaptation helps protect female birds from predators.
- Hummingbirds can beat their wings 53 times per second. They can hover, fly upside down, and fly backwards!
- Hummingbirds use their long needlelike beaks to reach deep into tubular flowers for nectar. The tips of their tongues are forked and covered with hairs to help them lap up nectar.

Fold Line
(do not cut)

Eastern Tiger Swallowtail

- This species is SC's official state butterfly.
- Young caterpillars of this swallowtail are camouflaged to resemble bird droppings.
- This butterfly's caterpillars eat the leaves of several native trees, including tulip poplar, black cherry, and sweet bay magnolia.
- A shrub called the flame azalea depends on these large butterflies for pollination: in an azalea flower, the pollen-containing stamen are too far from the pistils for smaller pollinators to reach!

Blue Bottle Fly

- Blue Bottle Flies feed on animal carcasses, manure, garbage, and decaying plants. Adult flies also consume flower nectar (which contains sugar) for energy.
- Some flowers have adapted stinky blossoms that smell—and *look*!—like rotting meat to attract fly pollinators such as the Blue Bottle Fly.
- Flies have patches of short hair on their bodies. Pollen grains stick to these hairs when a fly visits a flower, and the grains are then transported to other flowers.

Mexican Long-Tongued Bat

- Bats are important pollinators in tropical and desert climates.
- Bats are nocturnal (active at night), and the flowers they visit are also night-blooming.
- These flowers have several adaptations to make them easier for bats to locate, including a large size, pale- or white-colored flowers, and strong fragrance.
- Bats pollinate several valuable commercial crops, including figs, dates, mangoes and peaches.

Bumblebee

- Bumblebees nest in small colonies underground. They often make their nests in old rodent burrows.
- Bumblebees are larger and hairier than honeybees. Because of this, they can tolerate cooler temperatures and can forage in cool, unfavorable weather better than other bees.
- Bumblebees forage for nectar and pollen earlier in the spring, earlier in the day, and during cloudy weather when honeybees would still be hunkered down in their hives to keep warm.

Hoverfly

- Young hoverfly larvae are predators of plant pests such as aphids, scales, thrips and caterpillars.
- As adults, hoverflies drink nectar and pollinate flowers.
- The hoverfly gets its name from its ability to hover and fly backwards—something only a few other insects can do.
- Hoverflies, which cannot sting, closely resemble bees, which can! This mimicry helps protect hoverflies from predators.

Carpenter Ant

- Flowers that are pollinated by ants are usually low-growing and have small flowers which are easy for ants to reach.
- Because they cannot fly, ants can only pollinate plants over short distances.
- Ant bodies are smooth and mostly hairless, which makes it difficult for pollen to stick.
- Plants that rely on ant pollinators often grow in harsh, dryland areas where few other pollinators survive.

Red-Necked False Blister Beetle

- Beetles were among the first insects to become pollinators more than 200 million years ago.
- Flowers pollinated by beetles are often pale or white, open during the day, and may be large and have a strong fruity odor.
- Red-Necked False Blister Beetles eat pollen. While they feast, some pollen sticks to their bodies and is transported to other flowers.

Potter Wasp

- Most adult wasps are predators that eat other insects, including garden pests.
- Wasps also consume plant nectar. Pollen sticks to their bodies when they visit flowers for this purpose and can then be transported to other flowers.
- Wasps are less hairy than bees. Because of this, pollen cannot stick to wasps as easily, and wasps are less efficient pollinators.
- "Potter" is a name for one who works with clay. Potter wasps make small vase-shaped nests from clay and lay their eggs inside.

Sphinx Moth

- Many moths are nocturnal (active at night) and therefore pollinate night-blooming flowers which often have white or pale-colored flowers. This flower coloration reflects moonlight, making it easier for moths to find the flowers from a distance.
- Sphinx Moth tongues are longer than their bodies! Because of this adaptation, they are able to sip nectar from—and pollinate!—plants with long, tube-like flowers.
- Sphinx Moth caterpillars are called hornworms.

Blue Orchard Mason Bee

- Orchard bees are especially good at pollinating fruit trees like apples, pears, and peaches. These trees are commonly grown in orchards—hence the bee's name!
- Blue Orchard Mason Bees nest in holes and tunnels. They seal the nest entrance with mud, much like a bricklayer (called a mason) might!
- You can add artificial nests called "bee blocks" to your garden to create habitat for these pollinators.

Carpenter Bee

- Carpenter bees are the largest native bees in the US and can live up to three years.
- Some people consider carpenter bees pests because they drill holes for nests in the eaves of houses, barns, and other wooden structures. However, their importance as pollinators outweighs the damage they cause!
- Adult bees feed on nectar and collect pollen to feed to their babies. As they visit flowers and feed on nectar, they pick up and transfer pollen.

Gulf Fritillary Butterfly

- Gulf Fritillary caterpillars eat the leaves of the maypop (also called passionflower), which is a common wildflower in SC.
- The pupal phase of this butterfly (also called a **chrysalis**) resembles a dead leaf—an excellent camouflage that protects it from predators!
- The Gulf Fritillary butterfly range surrounds the Gulf of Mexico, and the butterfly can sometimes be found flying over the Gulf…hence its name.

Goldenrod Soldier Beetle

- Soldier beetles resemble lightning bugs but do not have light-producing organs.
- Adult soldier beetles feed on the nectar and pollen of a wide variety of flowers. They may also eat small insects such as caterpillars and aphids.
- Goldenrod is a showy fall-blooming wildflower that is a favorite food of the Goldenrod Soldier Beetle. Populations of these soldier beetles are largest in the fall, coinciding with the bloom time of the goldenrod.

Large Milkweed Bug

- Milkweed bugs feed on the seeds, sap, and nectar of milkweed. While the bugs feed, pollen becomes attached to their legs and can be transported.
- The sap of the milkweed plant contains toxic chemicals. Some insects, such as the Milkweed Bug, can tolerate these toxins and actually concentrate the toxins in their bodies. This makes the Milkweed Bug taste bitter and protects it from predators!
- These insects can't survive cold winters, so they migrate south in the fall.

Sugar Glider

- Sugar gliders are small marsupials (related to opossums) native to Australia.
- They are opportunistic eaters and will consume almost anything, from pollen and nectar to insects and small birds.
- While they eat pollen and nectar, pollen grains stick to their fur (especially their tails) and can be transported to other plants.
- They sleep for 12 hours a day. They are nocturnal, so they wake up before dusk and go to sleep at dawn.

Blue-tailed Day Gecko

- This pollinating lizard lives on the island of Mauritius [MUH] + [RISH] + [UHS] in the Indian Ocean.
- The blue-tailed day gecko drinks the nectar of the Trochetia [TRAH] + [SHEH] + [SHAH] plant, which is a native **threatened** flower. While the gecko drinks, pollen sticks just behind its head or on the gecko's throat and chest. When the gecko travels to another flower, some of the pollen is transferred.
- The Trochetia plant's survival relies heavily on the gecko's pollination.

Black and White Ruffed Lemur

- The Black and White Ruffed Lemur is considered the largest pollinator.
- It is native to Madagascar and is endangered due to hunting and habitat loss.
- This lemur is the primary pollinator of the traveler's palm, or traveler's tree, which has large flowers. When ruffed lemurs reach into the flower to snack on its nectar, they get pollen all over their furry snouts. This is distributed to the next flower they visit.

Monarch Butterfly

- Monarch butterfly caterpillars eat only one thing: the leaves of the milkweed plant. Loss of milkweed habitat results in the loss of monarch caterpillars, which means no adult butterflies can develop!
- As adults, monarch butterflies feed on the nectar of many different types of flowers. While they feed, they also carry pollen from flower to flower.
- Monarchs have an annual **migration**. They fly south to overwinter in Mexico and California, then fly north in spring.

Appendix B:

pollinators in peril

	Prompt 1	Prompt 2	Prompt 3	Prompt 4
1: Cocoa Farm	To help with production, the cocoa farmer plants a new hybrid variety of the cocoa plant. The hybrid version produces much less nectar and very little pollen. The pollinators now have limited food. Everyone at corner 1: sit down!	Cocoa trees grow best with lots of sun, so the farmer removes all of the other trees around the cocoa orchard. Unfortunately, these bordering trees provided habitat for pollinators. Without habitat, the pollinators have nowhere to live. Everyone at corner 1: sit down!	A disease infects the chocolate midges at the cocoa farm, and their immune systems aren't strong enough to fight against the disease. As midges are the primary pollinators of cocoa, the farm takes a big loss this year. Everyone at corner 1: sit down!	An **invasive** mite is introduced to the cocoa farm and infects all pollinators there with a virus. Because their immune systems are weak, many do not survive. Everyone at corner 1: sit down!
2: Apple Orchard	Just as the apple orchard was about to bloom in March, an unseasonable snow storm froze the apple blossoms. Without the apple blossoms, the pollinators have nothing to eat. Everyone at corner 2: sit down!	An infestation of ambrosia beetles causes a fungus to develop in weak apple trees. The fungus overwhelms the apple trees and causes them to die off, leaving the pollinators scrambling for food. Everyone at corner 2: sit down!	The soil in the apple orchard experienced so much foot traffic during apple picking season that it became compacted, and now ground-nesting pollinators cannot build their nests to reproduce. Everyone at corner 2: sit down!	Climate change makes the summers too hot for apple trees to grow. Without the apple orchard, the pollinators have nowhere to live. Everyone at corner 2: sit down!
3: Melon Patch	Honeybees are frequent pollinators of this watermelon patch. Invasive varroa mites infect the honeybees with various diseases that weaken their immune system, and many die. Everyone at corner 3: sit down!	Neighbors living near the melon patch have their yards sprayed with insecticides to kill mosquitoes. Unfortunately, these insecticides also kill the pollinators visiting the watermelon patch. Everyone at corner 3: sit down!	The watermelon patch is bought by a developer and paved to make a parking lot for a new store. Without the melon patch, the pollinators lose their habitat. Everyone at corner 3: sit down!	After the melon patch has been converted into a parking lot, bright street lights are installed. Moth pollinators are attracted to these lights and can now easily be preyed upon by bats and birds. Everyone at corner 3: sit down!
4: Broccoli Field	The farmer finds caterpillars eating her crop. She sprays the field with a strong pesticide which kills ALL the insects in the field, including the pollinators. Everyone at corner 4: sit down!	An unusually wet spring means the broccoli farmer is unable to plant her crop. Without the broccoli flowers, there is no nectar or pollen for the pollinators! Everyone at corner 4: sit down!	Needing more land to plant more broccoli, the farmer removes hedgerows around her field and plants these areas with broccoli. These hedgerows once provided extra food and cover for pollinators; without it, pollinators suffer. Everyone at corner 4: sit down!	The farmer plants an exotic plant that is attractive and pest-free. This plant is invasive and begins to outcompete nearby wildflowers which provide important food and cover for pollinators. Everyone at corner 4: sit down!

1

Cocoa Farm

2

Apple Orchard

3

Melon Patch

4

Broccoli Field

Appendix C:

exit quiz

1. **Match the letter to the box that represents that part of a plant on the diagram below.**

A. Sepal

B. Petal

C. Pistil

D. Bract

E. Anther

F. Stamen

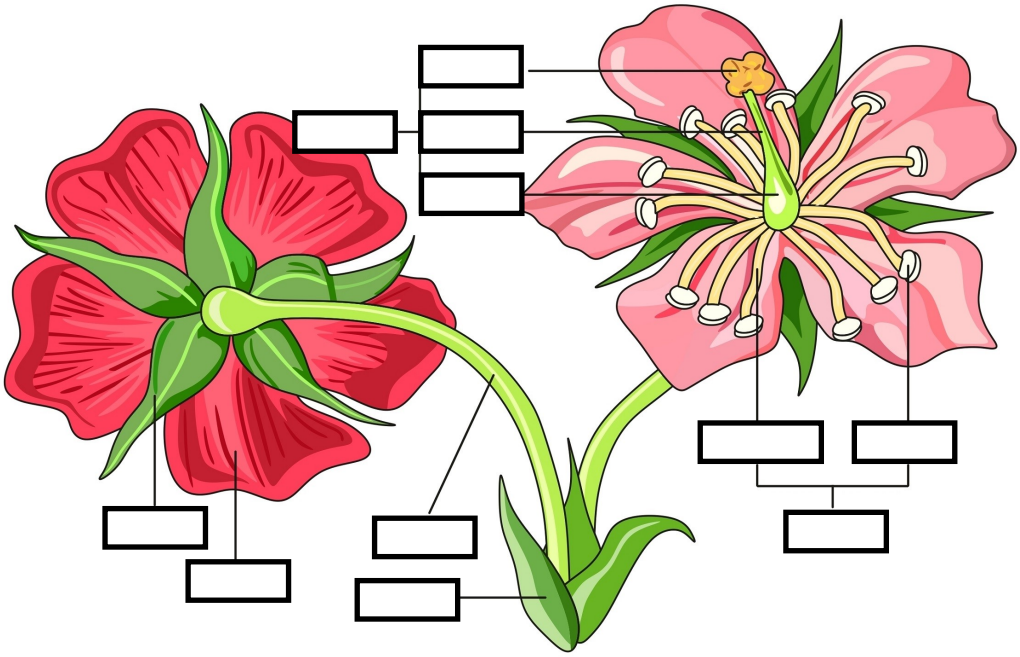
G. Ovary

H. Stigma

I. Pedicel

J. Filament

K. Style



2. FILL IN THE BLANK. In order to pollinate, a pollinator must carry pollen from the male part of the flower, called the _____ to the female part of another flower, called the _____.

3. Identify and explain one physical adaptation that helps a pollinator gather and transfer pollen.

_____

_____

4. Name four reasons why pollinators are in danger.

1. _____
2. _____
3. _____
4. _____

5. What is one way to help pollinators?

_____

_____

_____

About RSWCD

The Richland Soil and Water Conservation District (RSWCD) promotes the wise use and care of natural resources for long-term sustainability. Conservation districts are political subdivisions of state government under the local direction of a five-member board of commissioners. Three commissioners are elected; two are appointed by the South Carolina Department of Natural Resources. These commissioners volunteer their time and services to help improve natural resources conservation. There are 46 conservation districts in SC whose jurisdictions conform to county boundaries.

History

In 1937, following the ecological and economic disaster of the Dust Bowl, President Franklin D. Roosevelt urged state governors to pass legislation allowing local landowners to form soil conservation districts (SCDs). South Carolina responded by passing the Soil Conservation Districts Law, which was signed by Governor Olin D. Johnston in April of 1937. This law stated that "the farm lands of the State are among the basic assets of the State and the preservation of these lands is necessary to protect and promote the health, safety and general welfare of its people." It also allowed SCDs to be organized as subdivisions of State Government to take positive action toward this goal.

As conservation districts were first organizing in South Carolina, multi-county jurisdictions were common. In fact, 18 of the original 26 conservation districts in the Palmetto State included more than one county. However, the advantages of working within smaller districts soon became apparent, and in 1947, districts began to re-organize themselves into single-county jurisdictions.

The Congaree SCD was formed in 1939 and included Calhoun, Lexington, and Richland Counties. D.C. Bryan and W.L. Morris were this district's first supervisors. In 1951, the Lexington SCD broke away from the Congaree SCD; by 1953, the Calhoun SCD had been organized and the former Congaree SCD was renamed the Richland SCD.

In 1965, the General Assembly re-designated all SCDs as Soil and Water Conservation Districts, and so the Richland Soil and Water Conservation District (RSWCD) took on its current shape.

Today, the RSWCD works to conserve the natural resources of Richland County by providing landowner education and technical assistance, supporting local and sustainable agriculture, and engaging K-12 teachers and students in conservation through environmental education.

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Resources & References

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