

Pollinator Services

Introduction (~5 minutes)

Just like humans and all other living things, plants need to reproduce to survive. In *A Plant Primer*, you learned how plants reproduce through two-gamete reproduction. In case you forgot, here's a quick review.

Petals are often brightly colored and scented. Some flowers also have nectaries. These traits have changed over generations to help attract pollinators.

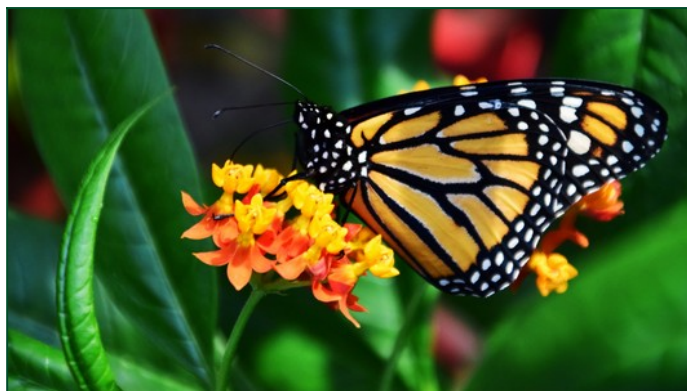
The plant's sex organs are inside the flower. Complete flowers have both male and female organs. Incomplete flowers have either male or female organs.

In flowers, the male organs are the filament and anther. The anther makes pollen, and it is held high by the filament. The filament length maximizes the chances of pollination. This is especially true of tube-shaped flowers.

The female part of the flower that receives the pollen is the stigma. It is a sticky platform in the center of the flower. The stigma is held up high by the style. When pollen lands on the stigma, it travels down the style to the ovary.



Which pollinators might we see in our field?



In *A Plant Primer*, you also learned that it is better for the next generation if pollen is moved between plants. Flowers can't move to mate with another flower, so they rely on pollinators.

Pollinators are usually animals (mostly insects, birds, and bats). They move pollen from the anther of one flower to the stigma of another. They are vital for plant reproduction, but pollinators don't help plants just to be kind. Plants and pollinators have a mutualistic relationship. They both benefit from pollination.

We know how the plants benefit. They get to reproduce with another plant. But how do the pollinators benefit? Pollinators are interested in the flower's nectar or sometimes the pollen itself.

Nectar is a sugary liquid found at the very bottom of flowers. If you like candy, cake, or other sweets, you can understand that nectar is an appealing food source! When the pollinator goes to the bottom of the flower to get nectar, they are sure to touch pollen along the way. (See the cute bee covered in pollen to the left.) When they visit another flower, some of that pollen will brush against the new flower's stigma.

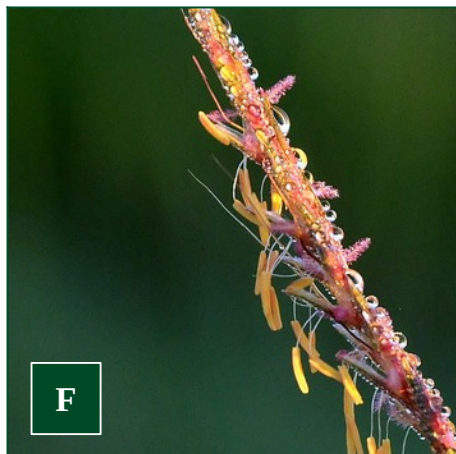
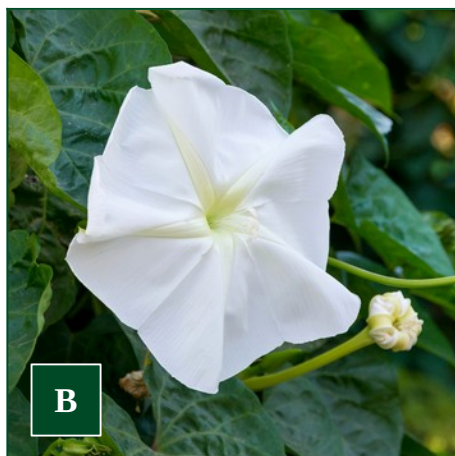
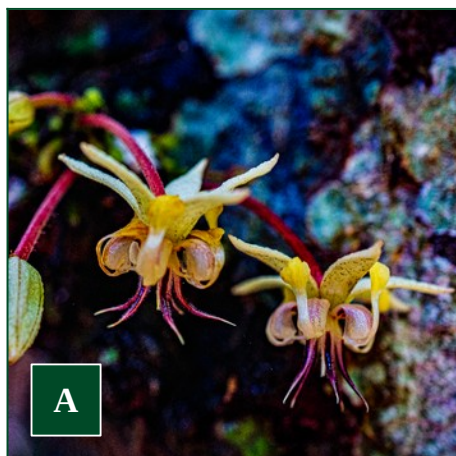
Pollen is also a food source: it contains sugars, starches, fats, proteins, vitamins, and minerals.



Explore (~40 minutes)

In this activity, you will work to find what pollinators like about flowers. Plant ecologists watched different flowers (see below). They counted how many pollinators visited each flower over the course of an hour.

Their results are in the table on the next page. Sadly, they left out some data about the flowers. Use the images to complete the "Traits" column in the data table. These traits could be a key way flowers attract pollinators.



Number of visits by each pollinator						
Traits	Bats	Bees	Birds	Butterflies	Flies	Moths
A	Color:					
	Size:					
	Shape:					
	Smell: foul or odorless	7	0	0	72	20
	Other: blooms during the day, must be pollinated within 24 hours					
B	Color:					
	Size:					
	Shape:					
	Smell: strongly sweet	11	5	0	0	34
	Other: delicate landing pad, flowers open around sunset					
C	Color:					
	Size:					
	Shape:					
	Smell: subtly sweet	0	17	0	43	8
	Other: blooms during the day throughout the summer					
D	Color:					
	Size:					
	Shape:					
	Smell: none	0	0	0	3	5
	Other: smaller flowers are complete and can self-pollinate, blooms in spring					



Number of visits by each pollinator						
Traits	Bats	Bees	Birds	Butter- flies	Flies	Moths
E Color: Size: Shape: Smell: subtly honey-like Other: blooms during the day throughout the summer	0	63	0	15	9	0
F Color: Size: Shape: Smell: none Other: blooms in late summer through early fall	0	3	2	4	0	0
G Color: Size: Shape: Smell: none Other: no landing pad, flowers point down	0	0	38	9	0	4
H Color: Size: Shape: Smell: sweet and musky Other: sturdy landing pad, flowers open at night, must be pollinated within 24 hours	23	0	4	0	0	13



After you complete the tables on the previous pages, figure out what flower traits each

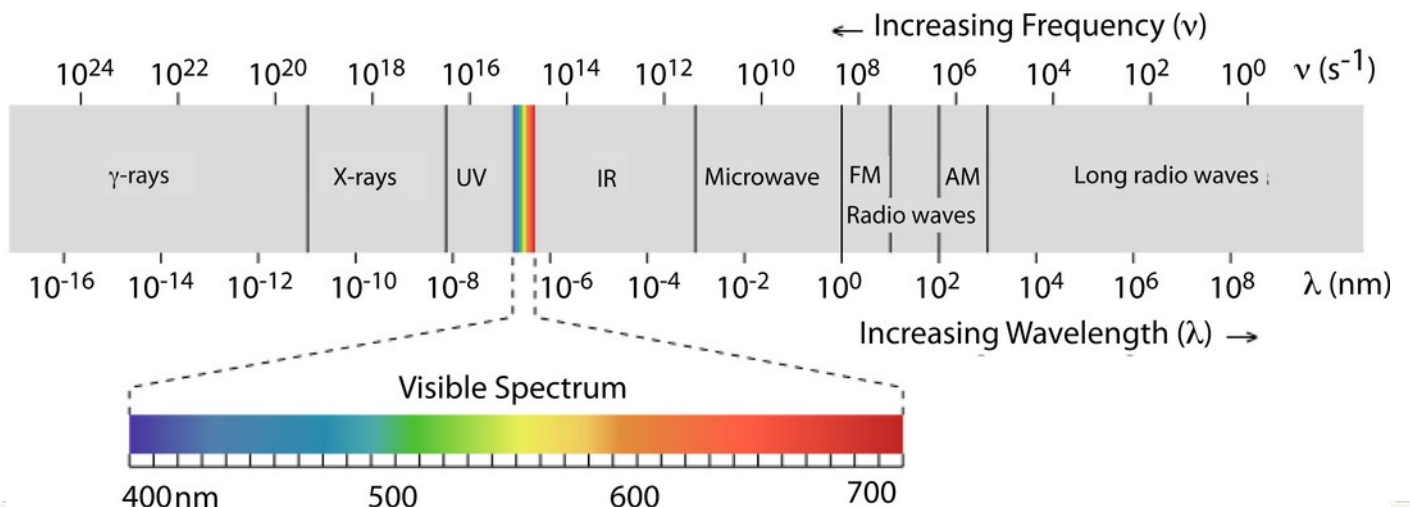
pollinator likes. Use the data to find the traits that you think each pollinator prefers!

Pollinator	Color	Size	Shape	Smell	Other
Bats					
Bees					
Birds					
Butterflies					
Flies					
Moths					

Explain (~30 minutes)

You may have learned about electromagnetic radiation (EMR) before. In the diagram below,

you can see everything from gamma rays, x-rays, and ultraviolet light through radio waves.



Visible light is the part of EMR spectrum that humans see as color.

Of course, humans aren't the only species that can see color. Some species can see parts of the electromagnetic spectrum we cannot. Use the images on page 2 and the descriptions of pollinators below to check your table. While you do so, answer the questions.

Bats

Most bats in North America are insectivores. Many bats in subtropical and tropical regions consume fruit and nectar instead. Bats can hover, but they will also land on flower petals that are sturdy enough to hold their weight. Contrary to popular myth, bats are not blind but can see quite well, even in low light. They also have good senses of smell. They visit and pollinate flowers at night.

Think about being outside at night. What colors (including black and white) are most visible outside at night?

Bees

Bees can see light from about 300–650 nanometers, and UV light. They are attracted to sweet smells and land on flower petals to gather pollen.

Look at the electromagnetic spectrum. What colors do bees see? What flower colors do you think they're most attracted to?

Birds

Birds can see very well. They can see UV light and the entire visible light spectrum. Birds are most attracted to bright reds and oranges. However, they have poor senses of smell.

Hummingbirds have long beaks that house an even longer tongue. Their tongue is used to reach deep into tube-shaped flowers and suck up sweet nectar. Birds do not rest on the flower petals or sepals to consume nectar. They typically hover by the flower.

Consider birds' senses of sight and smell. Which do you think they use to locate flowers and feed on nectar?

Butterflies

Humans have three types of color receptors in their eyes. Butterflies can have up to 15 different color receptors. Generally, butterflies can see the entire visible light spectrum and UV light. Like birds, they have a poor sense of smell.

Butterflies have a long, hollow proboscis that unfurls to drink nectar from flowers, like using a straw. Many butterflies are able to hover, although some rest on the flower petals to eat.

Think about how big butterflies are. What size flowers do you think they are most likely to feed on and pollinate?



Flies

Flies have a strong sense of smell and are often attracted to foul odors. Flies that pollinate flowers often lay their eggs on plants. When larvae hatch, they have a ready food source. Many fly larvae are insectivores, eating plant pests like aphids. Since aphids will eat the plants, even young flies are helping the plants.

Flies usually pollinate flowers that are pale in color with dark brown or dark purple patches. They land on flower petals to gather pollen and typically visit flowers that are on trees or close to the ground.

Flies are smaller insects. Fruit flies, for example, are only about $\frac{1}{8}$ of an inch long. What size flowers do you expect them to pollinate?

Moths

Moths are nocturnal relatives of butterflies, so they are active at night. They also have a long proboscis to drink flower nectar and tree sap. Moths can see UV light and white light but not colors. Moths have a strong sense of smell and are attracted to sweet smells. Like butterflies, many moth species can hover.

Moths and butterflies are physically similar; for instance, they both have a long proboscis. What

type of flower shape does this proboscis allow them to feed on and pollinate?

Moths and butterflies look similar, but they differ in the types of flowers they prefer to pollinate. Think about moths' and butterflies' senses of sight and smell. How do these senses affect the type of flowers they prefer to pollinate?

Look back at the images on page 2. Are there any plants that don't seem to have a dominant pollinator? How else can pollen be spread?

Extend (~30 minutes)

You now know some pollinator preferences! Let's look at some cover crops.

Can you figure out what types of pollinators visit these crops? In the table on the next page, fill out the predicted pollinators column.



Cover Crop	Predicted Pollinators	Actual Pollinators
<p>Rapeseed (<i>Brassica napus</i>)</p> 		
<p>Common Buckwheat</p> 		
<p>Red Clover (<i>T. pratense</i>)</p> 		
<p>Lady Phacelia or Purple Tansy</p> 		
<p>Pennycress (<i>Thlaspi arvense</i>)</p> 		



Go to your favorite search engine, and then find each plant's pollinators. University, park service, or USDA web sites are usually reliable.

Fill in the actual pollinator(s) column.

You probably found that bees pollinate many cover crops. You may have seen a lot about native bees. You already know cover crops help prevent soil erosion and help soil retain nutrients. Now you know that they are also important for pollinators!

We can thank native bees for nearly one third of the mouthfuls of food we eat. Wild bees have three basic habitat needs. They need access to food, protection from pesticides, and areas to nest in. (As we know, food comes in the form of pollen or nectar. Pesticides come in many forms, but they are all chemicals used to kill unwanted insects, fungi, or other pests.)

Cover crops can meet all three habitat needs! Research suggests that having diverse pollen and nectar sources improves bees' health. This increases their chances of surviving exposure to pesticides. Cover crops also have nesting sites in

their stems and in larger flowers. Cover crops are a great way to make a habitat for bees when cash crops like corn are not in season. This increases the chances that they'll be there to pollinate cash crops when they grow later in the summer.

Pennycress can be a very useful cover crop. Many bees hibernate in the winter. When they wake up in the spring, most flowers have not bloomed, so food is hard for them to find. Pennycress flowers early in the spring. It can provide both pollen and nectar to bees before other crops begin to flower. Pennycress is visited by over a dozen species of flies and small bees, with up to 68 insect visits per minute!

If there is an area near you that has cover crops or wildflowers, take a walk there with a trusted adult. This may be in a park, near a planted field, or even in your own backyard! Open the iNaturalist app that you used for *A Plant Primer*. Enter the flowers that you see on your walk. Remember, the more you enter, the more you are helping research the Earth's biodiversity!

Reflect (~20 minutes)

Pennycress produces both pollen and nectar for bees. However, it doesn't make as much as some other cover crops. How could scientists help pennycress make more pollen and nectar? (Hint: Think about how plants change over time.)

If you took a walk to find flowers in this module or when completing the *Plant Primer* module, look at the pictures you took.

a. What do you think pollinates these plants? (If you look close, you may see pollinators in your picture!)



b. Does it seem like the same type of insect pollinates most plants, or is there a variety?

c. Are there any pollinators that you see fewer of in your community? Look up that pollinator. What does it like to pollinate?

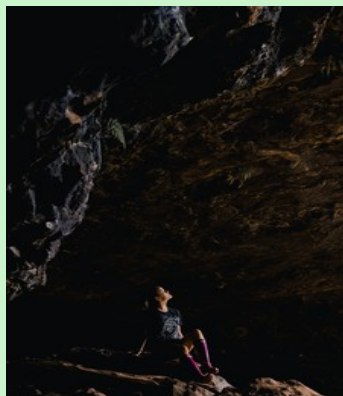


Why are cover crops important for pollinators?

What pollinators didn't you know about before?
What did you learn that surprised you?

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Career Connection: Chiropterologist

Chiropterologists (or bat biologists) are scientists who study bats. As you've learned, many bats are pollinators! Bats are studied for lots of reasons. They are unique creatures. They are also model organisms for studies on hearing, echolocation, and even fighting disease!

Most bat biologists begin with a 4-year degree in a field of biology. They will then earn a master's degree in an area like wildlife biology. They will learn common biology methods and how to use technology. Tools make up for humans' poor sight and hearing in bat habitats.

