POLLINATORS: THE PLANT PROPAGATORS

MEENAKSHI PANT

Plants court animal pollinators to ensure their survival and propagation. What traits have they evolved to attract pollinators? What roles do different pollinators play in this process?

Bees

There wouldn't be sunflowers
Wouldn't be peas.
Wouldn't be apples
On apple trees,
If it weren't for fuzzy old.
Buzzy old bees
Dusting pollen
From off their knees.
—by Aileen Fisher.

Pollination plays an important role in the survival and propagation of a variety of sexually reproducing plant species on Earth. Sexually reproducing plants have evolved to minimize self-fertilization by separating their mature male and female reproductive cells in space, time, or both. This means, for example, that the male (pollen) and female (ovules) gametes of the plant may mature in different plants, different flowers of the same plant, or at different times in the same flower. The only way fertilization can occur in such plants is through a mediator (the pollinator) that can transfer the pollen from one flower (the pollinizer) to another.

Estimates suggest that nearly 75% of all flowering plants on Earth today are pollinated by animals and more than 200,000 species of animals are known to pollinate plants. These plants have evolved a variety of mechanisms to attract their animal pollinators (see **Box 1**). By participating in this process, pollinators help increase the genetic diversity of these plants. The more genetically diverse a species, the higher the chances of its survival in changing environmental conditions.

Insect pollinators

Insects constitute the largest community of pollinators. Prominent among them are bees, beetles, butterflies, moths, wasps, flies, and ants.

Box 1. Pollination in orchids:

We know of more than 35,000 species of orchids. This family of plants has evolved a variety of structures and mechanisms to attract their insect pollinators.

Most orchid flowers have similar structures. The male and female parts of many orchid flowers are fused into a central column. Directly below the column is a modified petal that is shaped like a lip (called labellum) and acts as a landing stage for pollinators. Nectaries, when present, are found at the base of the labellum or as a nectar spur behind the flower. Pollen grains are fused into compact structures called pollinia. Pollinia are located under the anther cap and are attached to a sticky disc-like structure called the viscidium.

In many orchids, the flower is shaped in such a way that a pollinator is unlikely to be able to perch on the labellum without its head coming into physical contact with the viscidium. The labellum of orchids from *Ophrys* genus is modified to give the flower the appearance of female bees or wasps of certain species (see **Fig. 1**). Since male bees or wasps from these species emerge from their pupal stage a week or two before the females of the species, the males mistake the orchid flowers for potential mates. While they are trying to mate with the flowers, pollinia get attached to their heads.

The labellum of orchids of *Coryanthes* genus is shaped like a bucket (see **Fig. 2**). The bucket contains certain aromatic volatile secretions that are used by male euglossine bees to court females. The male bees dive into the bucket and fill pouch-like structures on their hind legs with these compounds. The only way they can escape from the bucket is by pushing against a trap-door-like structure that is lined with pollinia.

Some orchids produce chemicals with a very strong narcotic effect. These scents attract and intoxicate their insect pollinators. Once the pollinia are attached to the pollinators, the fragrance of the orchid fades abruptly. The temporarily dazed insect comes back to its senses and flies away, carrying the pollinia along with it. Orchids of the *Catasetum* genus use a hair-trigger mechanism to slap the pollinia, at high speed, onto the back of an insect pollinator. In some bog orchids, the pollinia get attached to the eyes of the female mosquitoes that pollinate them. Repeated visits blind these mosquitoes.

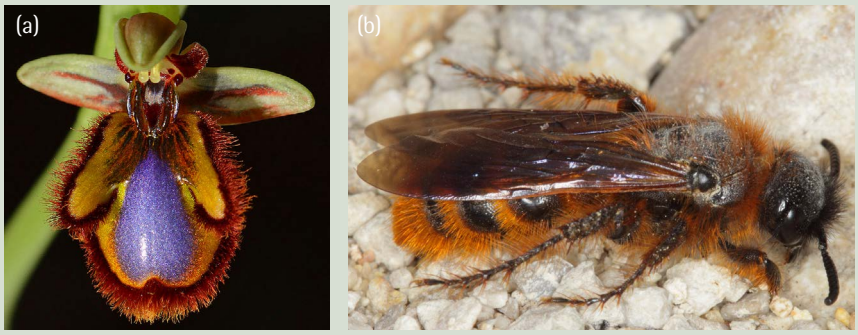

Fig. 1. The Mirror of Venus orchid (*Ophrys speculum*) is pollinated exclusively by pseudocopulation by male wasps (*Dasyscolia ciliata*). (a) The flower resembles the female wasp in many ways. For example, the band of thick reddish hair that borders the lip of the flower looks like the hair on the female wasp. The flower's scent resembles the female wasp pheromone. The bright iridescent purple or blue patch on the flower is highly reflective and can attract wasps from a distance. **(b)** This wasp species is the only known pollinator of European Mirror of Venus orchids. Male wasps mistake the orchid flower for the female wasp and copulate with it. In the process, they pick up pollen from the flower and carry it to the next flower they visit.

Credits: (a) Steve Garvie, Flickr. URL: https://www.flickr.com/photos/rainbirder/16755027492. License: CC BY-NC-SA 2.0 DEED. (b) gbohne, Flickr. URL: https://www.flickr.com/photos/51216897@N07/8707297837. License: CC BY-SA 2.0 DEED.

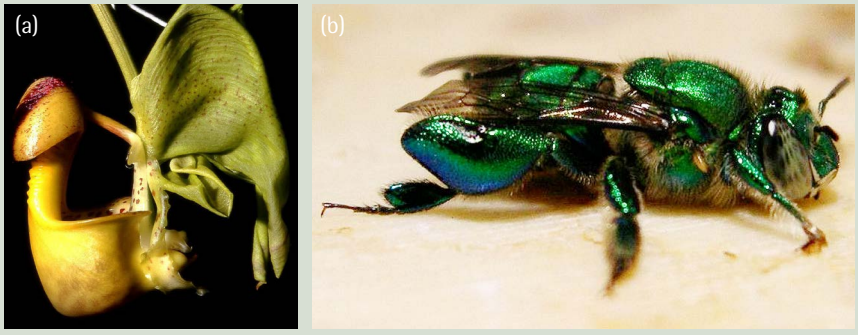

Fig. 2. The bucket orchid (*Coryanthes macrantha*) is pollinated by euglossini or orchid bees. (a) This orchid has large flowers—each flower can weigh up to 100 g. Flowers are yellow-orange in colour. The lip of the orchid is shaped like a bucket and contains a fragrant secretion that attracts its pollinator. **(b)** Only male orchid bees pollinate these orchids.

Credits: (a) Orchi, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Coryanthes_macrantha_Orchi_02.jpg. License: CC BY-SA 3.0 DEED. (b) Jacob Rus, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Male_Euglossa_sp.jpg. License: CC BY-SA 2.0 DEED.

With about 20,000 species involved in pollination, bees are some of the most important insect pollinators. Bees depend on plants not only for nectar (their main food source), but also for pollen (which is fed to their larvae). When a bee visits a flower for food, the anthers rub against the bee's body, dusting it with pollen. The bee uses its tongue to collect this

pollen, moisten it with saliva or honey, pack it into specialized structures called scopa or pollen baskets, and transport it to the next flower (see **Fig. 3**). Bee-pollinated plant species show a variety of floral traits that tend to attract these insects. Since bees rely heavily on their sense of smell, bee-pollinated flowers are often fragrant enough to attract these insects from a distance. Bee eyes have pigments sensitive to the green, blue, and ultraviolet wavelengths of light and bee-pollinated flowers are often blue or violet in colour. They also have lines or other distinct markings with special UV reflection patterns, which may function as nectar guides. While these patterns may not be visible to humans, they help ensure that bees reach the places that the flowers 'want' them to reach (see **Fig. 4**). Bee-pollinated flowers tend to offer large amounts of nectar and pollen to their visitors. The pollen collected by a single honeybee colony may amount to more than 28 kg per year.

Though bees are the most talked about pollinators, beetles are the largest set of pollinators. They pollinate about 85% of all flowering plants. Beetles frequently visit dull, white, or green coloured flowers that are dish- or bowl-shaped and have exposed reproductive organs. Since beetles rely on their sense of smell to find food and places to lay eggs, beetle-pollinated flowers often produce very strong perfumes. To us, these perfumes smell sweet, spicy, musky, or fermented, like overripe fruit. Beetles are often referred to as 'mess and soil' pollinators because they spill more pollen than they consume, eat their way through petals, and defecate in the flowers they pollinate. Beetle-pollinated flowers often have thick or leathery petals, produce copious amounts of pollen (to compensate for the amount that is spilled), and moderate amounts of nectar (see **Fig. 5**).

Although the sight of their colourful bodies perched on flowers is a treat to the eyes, butterflies are less efficient than bees at transferring pollen between plants. Not only do they not have any specialized structures to collect pollen; with their slender bodies held high on their long thin legs, not much pollen sticks to their bodies. However, they are vital to the pollination of many wild and cultivated plants. Butterflies are diurnal, foraging most actively from flowers that are open in the morning and under full sunlight. They prefer flowers with bright colours (blue, yellow, orange, but particularly red). Butterfly-pollinated plants often have small flowers, clustered together into erect inflorescences that are flat-topped, offering butterflies landing space. Many adult butterflies use their long proboscis to suck nectar from flowers (see **Fig. 6**). Nectaries of the flowers they pollinate are located at the base of their corolla tubes or spurs—locations that only an insect with a long proboscis can access.

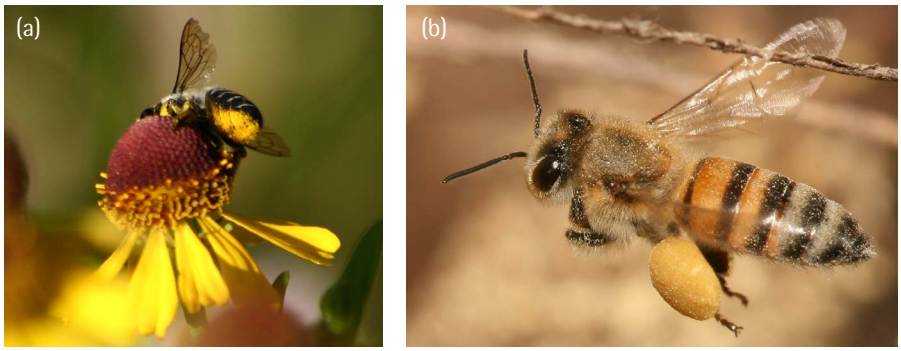

Fig. 3. Bees have evolved specialized structures to transport pollen from one flower to another. (a) In some bees, like sweat bees, these structures are in the form of a dense mass of elongated hair on their abdomen or hind legs. These are called scopa. One example is of the abdominal scopa seen on the Megachilid bee here. **(b)** In other bees, like honey bees, they are in the form of a relatively hairless cavity lined with a fringe of hair. These are called pollen baskets. One example is of the pollen basket seen on the hind leg of the European honey bee here.

Credits: (a) Dave (AKA Pollinator). URL: https://commons.wikimedia.org/wiki/File:Scopa_5948.jpg. License: CC BY-SA 3.0. (b) Muhammad Mahdi Karim. URL: URL: https://commons.wikimedia.org/wiki/File:Apis_mellifera_flying2.jpg. License: GNU Free Documentation License, Version 1.2.

Bird pollinators

About 2,000 bird species are known to pollinate plants. Birds can fly long distances and have excellent vision (this includes their ability to perceive colour and ultraviolet light). Both these traits make them good supplementary pollinators. However, birds are larger and require more energy than insects. Many of them are most active during the day. Except in a few cases, their sense of

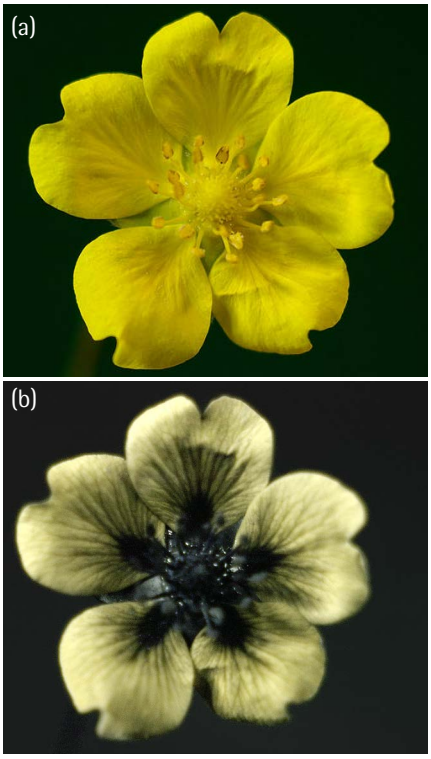

Fig. 4. Flowers of ***Potentilla reptans*** **have special UV-reflective patterns. (a)** This is how the flower looks to humans. **(b)** This is how the flower may look to bees.

Credits: (a) Wiedehopf20, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Flower_in_visible_light_Potentilla_reptans.jpg. License: CC BY-SA 4.0 International. DEED. (b) Wiedehopf20, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Flower_in_UV_light_Potentilla_reptans.jpg. License: CC BY-SA 4.0 DEED.

Fig. 5. The common milkweed (*Asclepias syriaca*) is pollinated and consumed by the red milkweed beetle (*Tetraopes tetrophthalmus*). Milkweed flowers produce huge amounts of nectar. Their pollen, like that in orchids, is in the form of pollinia. The pollinia are housed within a small chamber at the centre of each small, tightly condensed flower. It gets attached to the body of a beetle feeding on the nectar or the flower and is carried to the next flower that the insect visits.

Credits: Rbreidbrown, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Red_Milkweed_Beetle_(Tetraopes_tetrophthalmus)_Consuming_Common_Milkweed_Flower.jpg. License: CC BY-SA 4.0 DEED.

Fig. 6. Common Lantana (*Lantana camara*) pollinated by the Common Jezebel (*Delias eucharis*) butterfly. The butterfly uses its proboscis to consume nectar. When not in use, the proboscis is curled into a tight ball.

Credits: Hari K Patibanda, Flickr. URL: https://www.flickr.com/photos/krishnacolor/51433350855/in/photostream/. License: CC BY 2.0 DEED.

smell may not be much better than that of humans.

Bird-pollinated flowers tend to be brightly coloured (often red, orange, or pink), larger in size than insect-pollinated flowers, remain open during the day, and have mild or no scents. They produce much larger amounts of nectar than insect-pollinated flowers. This nectar is often at the base of tube-, funnel-, or cup-shaped flowers with numerous, brightly coloured, and protruding stamens. In getting to the nectar, the bird's head, bill, back, or breast get dusted with pollen (see **Box 2**). Since the nectar from one flower is rarely enough to meet the bird's nutritional requirements, it visits other flowers. As it does so, the pollen from the first flower is transferred to the second one.

Bat pollinators

Nectar-feeding bats (including 12 species of Old World 'flying foxes' and 36 species of American leaf-nosed bats) are found in every continent with tropical ecosystems. Most of these bat species are found in Southeast Asia, Africa, and

Box 2. Pollination by nectar-feeding birds:

In plants with specialized bird-pollinators, floral tubes are long and narrow enough to keep most insects out, but allow access to birds with sufficiently long, thin, and curved beaks. Bird species (like hummingbirds from South America and sunbirds from India) that pollinate such plants tend to have disproportionately long beaks, brush-like tongues, and bodies that are small and light enough to either hover near flowers or perch on them (see **Fig. 7**).

Plants that are pollinated by birds (like mynahs, bulbuls, and drongos) with broader, less specialized feeding habits tend to have larger and more numerous flowers.

Fig. 7. Loten's sunbird (*Cinnyris lotenius*) pollinates the Lion's Tail (*Leonotis nepetifolia*). The sunbird tends to hover over flowers for nectar, which it reaches through its long down-curved bill and brush-tipped tubular tongue. Lion's Ear produces ball-sized clusters of flowers, each of which is shaped like a slender tube and produces sweetish nectar.

Credits: Hari K Patibanda, Flickr. URL: https://www.flickr.com/photos/krishnacolor/50950412397. License: CC BY 2.0 DEED.

Fig. 8. Indian flying fox *(Pteropus medius)* feeding on the nectar of banana and pollinating it in the process.

Credits: Manojiritty, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Indian_flying_fox_cropped.jpg. License: CC BY-SA 4.0 DEED.

the Pacific islands. Bats play a vital role in the genetic diversity of tropical plant species. About 500 tropical plant species (including mangoes, litchis, bananas, and guavas) are partially or completely dependent on bats for pollination (see **Fig. 8**). Compared to insects, bats travel longer distances and can carry more pollen in their fur. They are particularly important in pollinating plant species that occur in low densities or in habitats that are far apart from each other.

Most nectar-bats are nocturnal, have good eyesight, and a strong sense of smell. Plants that rely mainly on bat pollinators tend to open at sunset or stay open at night. Their large and white- or pale-coloured flowers stand out from the foliage and the night sky in ways that bats can spot easily at night. Some bat-pollinated flowers attract these mammals by emitting fermented, musky, or rotten odours.

Unusual pollinators

The role of lizards in pollination has been recognised relatively recently. Most reports of lizard pollination are restricted to islands, where these reptiles have been observed to supplement their insect and arthropod diets with plant food like nectar, pollen, flowers, and fruit pulp. Since these plant food sources are low in protein content, it is likely that they help meet the lizards' energy and water requirements. In foraging for plant food, these lizards pollinate flowers. Lizard-pollination is rare on the mainland. This may be related to four factors that are more likely to be seen on islands than on the mainland—less stable and diverse insect populations, an excess of floral food, high population densities of lizard species, and lower predation risks to them.

For island species of plants, lizards may be more important pollinators than insects and birds. Since lizards have an acute sense of smell, they are attracted to flowers with strong scents. These flowers tend to produce copious amounts of sticky, sugar-rich nectar.

Some lizard pollinators, like *Phelsuma* geckos (commonly called day geckos), have been observed to visit plants with colourful nectar more than those with colourless nectar. Examples of oft-visited plants include *Trochetia blackburniana*, which produces orange-yellow nectar, and *Nesocodon mauritianus*, which produces blood-red nectar (see **Fig. 9**). Flowers of lizard-pollinated plants are often robust enough to support the weight of these reptiles. Inflorescences are most suited to these climbing visitors. When a lizard climbs over a flower or feeds on nectar from its base, its face and body get dusted with pollen. Grains that are out of reach of its lapping tongue are transported to the next flower it visits.

Parting thoughts

According to the evolutionary biologist Lynn Margulis and science writer Dorien Sagan (1986): *"Life did not take over the globe by combat, but by networking".* Pollination offers some of the most common and widespread examples of such collaborative networks. Many plant-pollinator associations are so highly specialized that threats to the survival of one of the partners can threaten the survival of the other.

These networks are vital to us in many ways. For example, more than 75% of food crops (vegetables, fruits, seeds, nuts, and oils) grown across the world depend at least partly on animal pollinators. Today, however, a growing number of pollinators are being driven to extinction by diverse pressures, many of which are linked to human activity. These include changes in land use, habitat degradation and fragmentation, pesticide use, pollution, pathogens, and climate change. Encouraging students to observe plant-pollinator interactions in schools and their neighbourhoods can help create awareness of local pollinators and foster appreciation for their role in sustaining life.

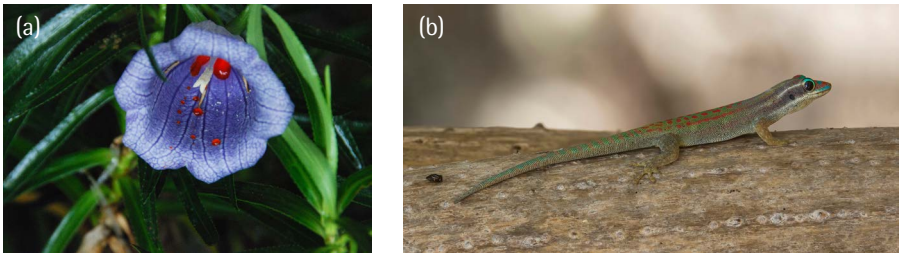

Fig. 9. *Nesocodon mauritianus* is pollinated by the Mauritius ornate day gecko (*Phelsuma ornata).* (a) Endemic to Madagascar, this is the first plant known to produce blood-red nectar. **(b)** These geckos have been observed to lick nectar, soft sweet fruit, and pollen.

Credits: **(a)** Ph. Saget, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Nesocodon_mauritianus_07_04_Philweb_(19228890139).jpg. License: CC BY 2.0 DEED. **(b)** Charles J. Sharp, Wikimedia Commons. URL: https://en.wikipedia.org/wiki/File:Mauritius_ornate_day_gecko_(Phelsuma_ornata).jpg. License: CC BY-SA 4.0 DEED.

Life in your Backyard

ACTIVITY SHEET : WHO IS THE POLLINATOR?

Aim:

Who are the pollinators in our neighbourhood? Which flowers do they visit? What features in the flowers might be attracting the pollinator(s)?

You will need:

Observation notebook

Pen/ pencil

Hand lens

What to do:

1. Your teacher will give you a list of flowering plants. Observe the flowers of the first plant. Use your hand lens to make more detailed observations. You can take about 10 minutes to do this.
2. Make a note of your observations in the format provided in the **Record your Observations** sheet. Include notes on details of any other features you think may be related to pollination. You can also record your observations as drawings.
3. If you know the local or common English name of the plant, write it down in your notebook and confirm it with your teacher. Otherwise, ask your teacher for this information.
4. Make a note of any questions and/or explanations that come to mind as you make your observations.
5. Move to the next flowering plant and repeat Steps 1-4 till you have observed all the plants that your group has been allotted.
6. Compile and share your group's observations with your classmates. Listen carefully to the presentations made by each group and make a note of anything new or different that you hear.

Think about and discuss:

Q1. Read the **Fact Sheet** that your teacher shares with you. Use this to:

- Guess possible pollinators.
- Identify differences between the information in the Fact Sheet and your observations. Can you suggest explanations for these differences?

Q2. Read the following questions, think about them, and discuss as a group.

- Did the flowers of each plant attract more than one type of visitor? In your view, what features of the flower attracted these visitors? How do you know?
- Did you notice any differences in the scents of the flowers of different plants? How is this feature related to the kind of visitors each plant attracts?
- How do you think pollination happens in flowers with dull colours and no scent?
- Do all the animals that visit the flowers of a plant pollinate it? Do you think some animals may be visiting them for other reasons? Can you think of some reasons for your answer?
- Can you think of any 'agents' other than animals that can help in pollination? What might they be?

i wonder... Rediscovering school science

Contributed by:
Radha Gopalan, who is an environmental scientist with a PhD from the Indian Institute of Technology Bombay (IITB), Mumbai. After an 18-year career in environmental consulting, she taught Environmental Science at the Rishi Valley Education Centre, Andhra Pradesh. She is a Visiting Faculty at the School of Development, Azim Premji University, Bengaluru, and a member of the Kudali Intergenerational Learning Centre, Telangana. She can be contacted at: radha.gopalan@azimpremjifoundation.org.

Azim Premji University

Life in your Backyard

ACTIVITY SHEET : FACT SHEET

Bees

Bees mostly pollinate plants that have purple, violet, or blue coloured flowers. Bee-pollinated flowers have a strong fragrance. They usually open in the day.

Beetles

Beetles usually pollinate dish- or bowl-shaped flowers in dull white or green colours. Bee pollinated flowers have strong scents, are often large and solitary with thick, leathery petals. Some beetle-pollinated flowers are small and clustered close to the ground.

Butterflies

Butterflies are attracted to brightly-coloured blue, yellow, orange, and red flowers. They often visit flowers that are flat-topped and offer landing space. Butterfly-pollinated flowers open in the morning and under full sunlight.

Birds

Birds tend to pollinate tube-, funnel-, or cup-shaped flowers in bright colours (like red, orange, or pink) and with mild or no scents. These flowers remain open in the day and are often larger in size than insect-pollinated flowers.

Bats

Bat-pollinated flowers open at sunset or stay open at night. They are large in size, white or pale in colour, and emit a fermented, musky or rotten odour.

Reference: Pant, Meenakshi (2023). 'Pollinators: the Plant Propagators'. i wonder... (10). pp.34-35. ISSN 2582-1636.

Life in your Backyard

ACTIVITY SHEET : RECORD YOUR OBSERVATIONS

Name of the flowering plant:
Location:
Date:
Time:
Weather (e.g., cloudy, sunny, warm, cool, windy, still):

Feature / Characteristic	Description	Questions/ Explanations
Flower		
Colour		
Shape (e.g., flat, open, bowl-shaped, tubular)		
Special features (e.g., lip, colourful patterns, tongue, protrusions)		
Direction of flower (e.g., facing downwards, upwards)		
Smell (e.g., strong, faint, pleasant, unpleasant, smell of overripe fruit)		
Position on the plant (e.g., close to the ground, high up on the plant, mid-way, distributed all over the plant)		
Arrangement of flowers (e.g., in an inflorescence or solitary)		
Texture of petals (e.g., thin, papery, thick, waxy, sticky)		
Reproductive organs (e.g., exposed, hidden, prominent, visible only with a hand lens)		

Feature / Characteristic	Description	Questions/ Explanations
Visitor(s)		
Types (e.g., birds, insects, spiders, bats, any other)		
More about the visitor, especially any features that may help in identification (e.g., colour, distinct markings, antennae, and eyes of insect visitors; size, colour, beak length, and beak shape of bird visitors)		
Position on the flower		
Other related questions/explanations/observations		

Contributed by:
Radha Gopalan, who is an environmental scientist with a PhD from the Indian Institute of Technology Bombay (IITB), Mumbai. After an 18-year career in environmental consulting, she taught Environmental Science at the Rishi Valley Education Centre, Andhra Pradesh. She is a Visiting Faculty at the School of Development, Azim Premji University, Bengaluru, and a member of the Kudali Intergenerational Learning Centre, Telangana. She can be contacted at: radha.gopalan@azimpremjifoundation.org.

i wonder... Rediscovering school science
Azim Premji University

Life in your Backyard

ACTIVITY SHEET: WHO IS THE POLLINATOR?

TEACHER'S GUIDE

1. This activity is designed as a group activity for middle school students. Each group can have 4-5 students.

2. Plan this as a 2-hour activity to be done over 2 consecutive days with observations on one day and the discussions on the second day.

3. This activity needs flowering plants. It could be done in the school garden, at a nearby park, a vegetable garden, or wherever there are flowering plants.

4. Flowering is a seasonal phenomenon. After selecting a suitable location, collect information about the flowering plants growing there—local and scientific names, flowering season of each plant, and whether it is an annual or perennial. Share this information with students during the activity.

5. For observations in the field:
   - Allot 3-4 flowering plants per group depending on the number of flowering plants available at the location.
   - Clearly explain each of the tasks and how they will be performed by the groups.
   - Discuss and explain each of the characteristics listed in the **Record your Observations** sheet with your students. Invite them to use a hand lens to observe each flower more carefully and make note of any extra details they find interesting or think may be related to pollination.
   - Encourage students to draw what they observe. Clarify that the drawings need not be artistic. Rather they should be an accurate representation of what they observe.
   - Invite each group to take about 10 minutes to observe the flowers of each plant allotted to them and a few minutes to make note of their observations before moving to the next plant in their list.
   - Encourage students to work as a group and clarify that this is an invitation to observe, discuss, and learn together.

6. For sharing and discussion:
   - Share the **Fact Sheet** on pollinators with each group. Take them through the information in the fact sheet clarifying any doubts they may have.
   - Clarify that students must share their findings as a group with the rest of the class and listen carefully to each group's presentation.
   - Encourage students to explore the questions in the 'Think about and discuss' section of the **Activity Sheet**.
   - Make a note of any student questions that are not addressed during the group discussion. You may consider assigning them to students to explore on their own and share their findings with the class.
   - Invite students to try this activity out at different times in a day. For example, they could try this activity early in the morning, at noon when there is bright

sunlight, and towards the end of the school day. Encourage them to also try this out on their own with flowering plants in their homes and in their own neighbourhoods.

7. Ask them to maintain a journal of pollination observations. This will help them appreciate the rhythm of plant-pollinator interactions. It may also help them observe many other patterns in a plant's life-cycle that will develop and deepen their curiosity.

Contributed by:

Radha Gopalan, who is an environmental scientist with a PhD from the Indian Institute of Technology Bombay (IITB), Mumbai. After an 18-year career in environmental consulting, she taught Environmental Science at the Rishi Valley Education Centre, Andhra Pradesh. She is a Visiting Faculty at the School of Development, Azim Premji University, Bengaluru, and a member of the Kudali Intergenerational Learning Centre, Telangana. She can be contacted at: radha.gopalan@azimpremjifoundation.org.

i wonder...
Rediscovering school science

Azim Premji University

Key takeaways

- Pollination plays a vital role in the survival and propagation of nearly 75% of all flowering plants. More than 200,000 species of animals are involved in pollinating these plants.
- Many plant traits have evolved to attract pollinators. These include flowering time, the colour, shape, size, patterns, and scents of flowers, and the amounts of nectar and pollen they produce.
- Insects constitute the largest community of pollinators, birds are good supplementary pollinators, bats are important in the pollination of tropical plant species, and lizards play a vital role in the pollination of island flora.
- While plant-pollinator associations are vital to humans in many ways, a growing number of pollinators are being driven to extinction by diverse pressures that are linked to human activity.
- Encouraging students to observe plant-pollinator interactions can help build awareness and appreciation for their role in sustaining life on Earth.

Notes:

1. This article was first published in i wonder..., January 2017, pp. 50-55. The original draft can be found here: https://publications.azimpremjiuniversity.edu.in/1273/. The version included in this issue has been reviewed and modified for school teachers. It includes new material, one activity sheet, and one teacher's guide.
2. Source for the image used in the background of the article title: Butterfly perch. Credits: Amol Mande. URL: https://www.pexels.com/photo/selective-focus-photo-of-butterfly-perched-on-flower-bud-2675714/. License: CC0.

References:

1. Waser NM & Ollerton J (Eds.) (2006). 'Plant-Pollinator Interactions: From Specialization to Generalization'. University of Chicago Press.
2. Olesen JM & Valido A (2003). 'Lizards as Pollinators and Seed Dispersers: An Island Phenomenon'. Trends in Ecology & Evolution, 18 (4): 177-181.
3. USDA Forest Service, Rangeland Management Botany Program (2006). 'Celebrating Wildflowers: Bat pollination'. URL: https://webarchive.library.unt.edu/eot2008/20090511204939/http://www.fs.fed.us/wildflowers/pollinators/bats.shtml.
4. New World Encyclopedia (2015). 'Pollination'. URL: https://www.newworldencyclopedia.org/p/index.php?title=Pollination&oldid=991213.
5. Tinbergen N (1965). 'Social Behaviour in Animals: With Special Reference to Vertebrates' (2nd Ed). Springer Netherlands. URL: https://doi.org/10.1007/978-94-011-7686-6.
6. Bayer M (2015). 'Pollinators in the Landscape II: Plants and Pollinators'. The Center for Agriculture, Food, and the Environment. URL: https://ag.umass.edu/fact-sheets/pollinators-in-landscape-ii-plants-pollinators.
7. McHatton R (2011). 'Orchid Pollination: Exploring a Fascinating World'. American Orchid Society. URL: http://staugorchidsociety.org/PDF/OrchidPollinationbyRonMcHatton.pdf.

Meenakshi Pant has been working as a science resource person at Azim Premji Foundation (State Institute, Dehradun) since December 2012. She also supports the University Resource Centre at Azim Premji University in capacity building initiatives of education functionaries. Meenakshi has a Masters in Environment Biology and a Bachelors in Education. Before joining the Foundation, she worked as a postgraduate teacher (biology and environment science) for 15 years. Meenakshi is passionate about wildlife and its conservation. She can be contacted at: meenakshi.pant@azimpremjifoundation.org.