Name

Petal Shape Variation Lab

Objectives

Learn one method to collect species observation data and use this method to test for bee preferences toward flower shape.

Topics Addressed

Generalists/Specialists, Bee Physiology, Flower Morphology

Background

Plants and their pollinators can have specialist or generalist associations with each other. Specialist plants can be only pollinated successfully by a small group of pollinators (in extremely rare cases, by one species) while generalist plants can be pollinated by a wide group of pollinators. Likewise, specialist pollinators visit only a small variety of plants while generalists visit a variety of plant species to get pollen and/or nectar. Specialist pollinators have evolved a specific relationship with a few or even just one plant species (very rare). For example, these specialists emerge from their nests at the same time their host plant begins to flower. [Question to discuss: what are the advantages and disadvantages of being a specialist vs a generalists plant/pollinator?]

Flower shape, petal arrangement, and length of the corolla are plants' adaptations to ensure that only the 'right type' of pollinators gets attracted and rewarded with pollen and nectar ('right pollinators' are the ones that are more likely to be carrying conspecific pollen). That is because nectar and pollen are "expensive" (plants spend lots of resources making them) and thus it is very disadvantageous for the plant to reward 'wrong pollinators'. In this way plants and their pollinators have co-evolved for millions of years.

Some specialist bees forage for pollen that can only be found on one plant species. Since generalist bees are less picky about the flowers they visit, they often visit a wide range of flower types and species when seeking out pollen. One way in which we see this expressed is in flower shape and petal arrangement.

Lab Question: Which flower shape (see page 2) will attract the most pollinators?

Hypothesis

Record your hypothesis for the lab question below. Be sure to include a justification.

Materials

- Art paper and/or tissue paper to construct artificial flowers in various shapes (see back)
- Scissors
- Glue and/or tape
- Wire, pipe cleaners or wooden skewers for mounting the flowers

Procedure

- 1. Choose three shapes from the options on the next page, such as "Trumpetshaped/Funnel-form," "Saucer-shaped," and "Cruciform". Each group should make three of each flower shape to observe (Nine flowers total).
- 2. While outdoors, each group will sit next to a group of the constructed artificial flowers with a mixture of petal-shapes for 15 minutes for 3 days in a row and record number of visits (bee lands on flowers) to each flower shape.
- 3. Pay attention to how the flowers are arrayed to make sure you are testing for flower shape only and not spatial arrangement of flowers.
- 4. Make sure the flowers are roughly the same size and height, so the only variable is the shape.

<u>Campanulate</u>	<u>Funnelform</u>	Trumpet	<u>Salverform</u>	<u>Tubular</u>	<u>Urceolate</u>
	\bigvee	Â.	Ţ	1	$\sum_{n=1}^{n}$
Bowl-Shaped	Saucer -Shaped	<u>Stellate</u>	<u>Cruciform</u>	<u>Labiate</u>	<u>Papilionaceous</u>
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Floral Shapes

Questions

- 1. According to the data, did the shape of the flower have an influence on pollinator visits? Was your hypothesis correct? Why or why not?
- 2. What shape was the most successful at attracting pollinators for your group? For the class?
- 3. Why do you think flower shape matters for pollinators?
- 4. Were any of the pollinators that visited generalists (visited multiple types of flowers? If so, which ones?
- 5. Were any of the pollinators that visited specialists (visited only one type of flower)? If so, which ones?
- 6. What are other factors besides shape that might influence pollinators to visit a flower?

Teacher Notes for Floral Shape Variation Lab

Approximate time: 1 week (can be done as a one-day lab)

- Different materials can be used to construct the flowers. Construction paper, tape, and wooden skewers are a low-cost, easy to use option.
- If you are not getting many actual visits (bee lands on flower), you might record number of approaches (bee has defined orientation toward flower but doesn't land) as well.
- Option: Also identify type of pollinator/bee.
- Option: Try this experiment again with different flower shapes. Some of the examples might be difficult to construct by hand, however.

Sources

- On the relative importance of floral color, shape, and nectar rewards in attracting pollinators to *Mimulus*, Sutherland and Vickery in *The Great Basin Naturalist*
- http://www.helpabee.org/specialists-vs-generalists.html?lang=en
- http://theseedsite.co.uk/flowershapes.html).

Shape	Name and Description	Example
S	Cruciform (Cross-shaped) A flower with four petals at right angles to one another. Typical of members of the Cabbage Family (<i>Brassicaceae</i>). The example is an unknown tropical species.	
	Labiate (Lipped) A flower divided into an upper 'hood' and a lower flat or pouched lip , typical of members of the Deadnettle/Mint Family (<i>Lamiaceae</i>). The example is <i>Salvia texensis</i> .	
	Papilionaceous (<i><u>Pea-family</u>)</i> The flower shape typical of members of the Papilionaceae, The example <i>is Parochetus communis.</i>	
$\left(\right)$	Ligulate (Strap-shaped) A flower with one large, long, thin petal, typical of ray- florets of the Aster/Daisy Family (Asteraceae). These look like single petals but are all individual flowers, each one capable of producing seed.	
X	Stellate (Star-shaped) A flower with many narrow petals arising separately from a central point. The example is Sisyrinchium bermudianum album.	

	Campanulate (Bell-shaped) A flower with a wide tube and flared lobes typical of the Bellflower family (Campanulaceae). The example is Campanula cochlearifolia.	
	Funnelform (Funnel-shaped) A flower that widens gradually from the base, ending in an open or flared shape. The example is Cyrtanthus elatus.	
V	Trumpet-shaped A flower that starts as a narrow tube, but widens into a flared mouth <u>, where</u> <u>the petals often turn back.</u> The example is Petunia grandiflora.	
Ţ	Salverform A flower with a long, thin tube, that widens suddenly into a flat-faced flower. The example is Plumbago auriculata.	

	Tubular A flower with a long, thin, straight- sided tube formed of united petals, often separating at the mouth into a flared shape. The example is a Kniphofia hybrid.	
L L	Urceolate (Urn-shaped) A flower in which the petals are fused into an almost enclosed globe shape, separating at the mouth into individual flared petals. The example is Erica tetralix.	
\bigvee	Bowl-shaped A flower with a deepdish shape, roughly hemispherical, with straight sides or with a very slight flare at the tips. Much the same as cup-shaped. The example is Argemone mexicana.	
	Saucer-shaped A flower that is almost flat, with slightly upturned petal tips. The example is Geranium wallichianum.	