Name_____

Floral Color Variation Lab

Objectives

Learn one method to collect ecological data and use this method to test for bee preferences toward flower color

Topics Addressed

Pollination, Adaptation, Generalist/Specialist Species, Mutualism

Background

Pollination is the transfer of pollen (which carries the male gametes) from the anthers of a flower to the pistil (where the female games are) of the same flower or of another flower of the same species. It precedes fertilization, which is required before the flower can develop seeds. Some plants self-pollinate, which means the pollen and pistil are from the same plant and sometimes even the same flower. Others require cross-pollination, that is, fertilization is only possible if the pollen comes from a different plant (of the same species!). Cross-pollinating plants require the assistance of either the wind or animal pollinators (for example, bees, butterflies, hummingbirds, bats, etc) to move the pollen from one plant to another.

A mutualistic relationship exists between pollinators and plants because the plants benefit from the pollination by now being able to set seeds, and pollinators get nectar and/or pollen in return which allows them to survive and reproduce as well. As a result of this mutualistic interaction, flowering plants and their animal pollinators have thus co-evolved, that is, plants and pollinators have acted as a strong selective pressure upon one another. Some plants have evolved to be specialists, and thus have flower features that allow pollination by only few animal species (in extremely rare cases, only by one species). Other plants have adopted more generalized adaptations and thus attract and are able to be pollinated by a wide variety of pollinator species.

Lab Question: What are the advantages and disadvantages of each of these strategies (specialist vs generalists)?

The color and shape of the flowers determines the type and quantity of pollinators that will be attracted. For example, red and nectar-filled flowers tend to attract birds and butterflies while bees tend to be more attracted by white and blue flowers with ultraviolet nectar guides and scents.

In this lab you will observe flower visitation by different pollinators and determine if there is variation for visitation the preference depending on color.

Hypothesis

In the space below, write your hypothesis for the lab question. Be sure to include a justification.

Approximate Time: 1 week

Materials

- Potted flowering plants of the same species of three different colors (e.g., red, yellow, purple, white)- at least 3 replicates of each color per observer/group. Primroses are a good option for numerous flower colors in early/mid spring, though they are more likely to attract beeflies rather than bees

  In lieu of purchasing flowers, you might visit a nearby community garden for the source of your flowers—just be sure to make observations at the same flower color and type in order to control for flower shape and scent.

- Notebooks/data sheets for tallying observations
- Pollinator identification guides

Procedure

1. To begin data collection, each student group should sit next to a group of potted plants or flowering plans in a garden. Each "station" should be similar in having the same number of plants, arranged in a similar pattern, each with approximately three different colored flowers.

2. Using your data sheet, record all pollinator visits during a 5 minute observation period. A visit is defined as the pollinator landing on the flower, not just flying near it. Record the specific color that the pollinator visits each time. It is possible for the same pollinator to visit more than one type of flower.

3. At the end of your first trial, rotate to another station, and repeat the procedure. You will record data at a total of three different stations.

4. Data will be recorded on three different days.

Data

Day 1	Flower Color:		Flower Color:		Flower Color:	
Trial 1	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 2	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 3	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Total Visits						

Day 2	Flower Color:		Flower Color:		Flower Color:	
Trial 1	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 2	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 3	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Total Visits						

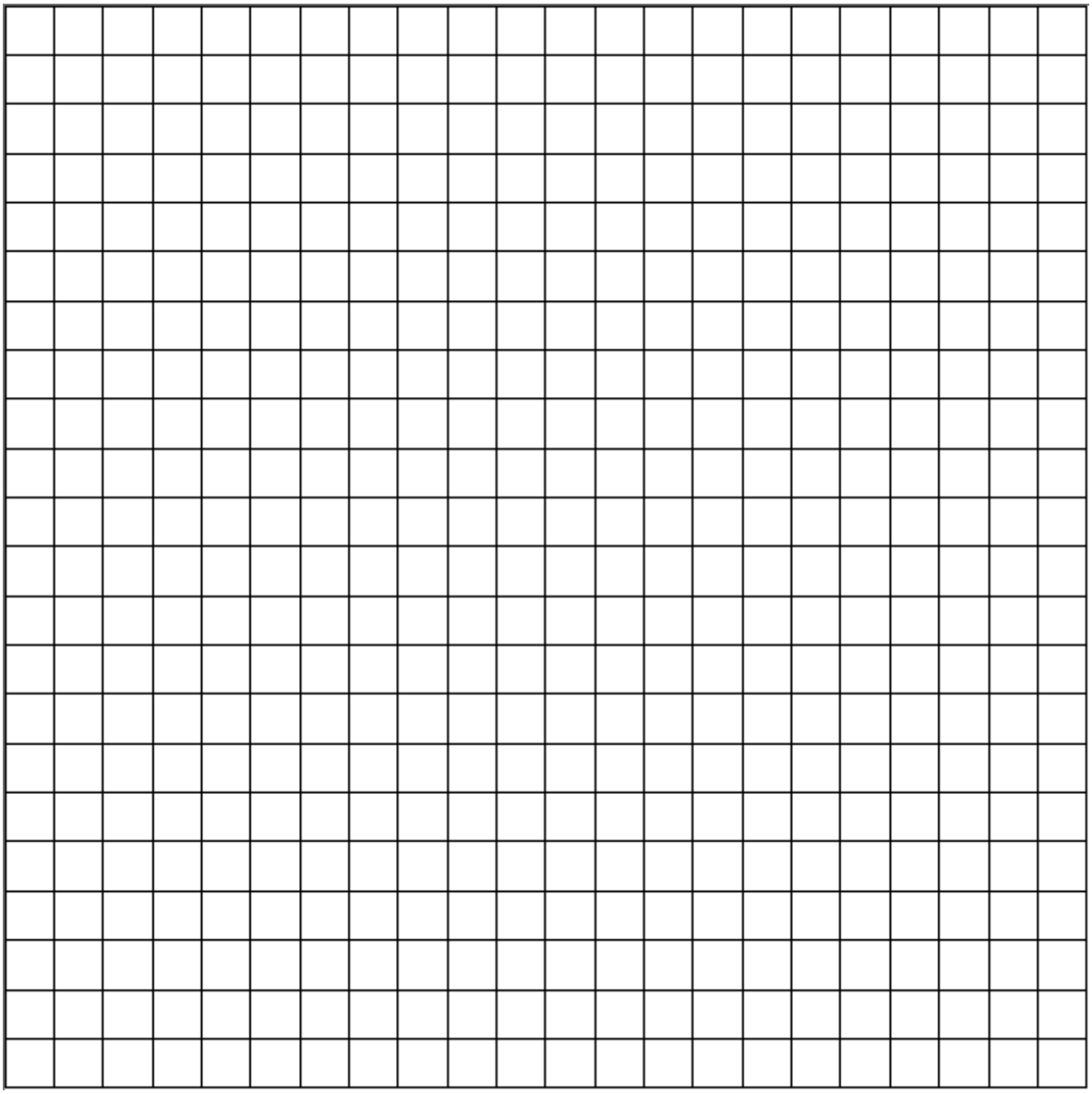
Day 3	Flower Color:		Flower Color:		Flower Color:	
Trial 1	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 2	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Trial 3	Pollinator visits	Species seen:	Pollinator visits	Species seen:	Pollinator visits	Species seen:
Total Visits						

Data Summary

Color	3 Day Total Visits (Group)	3 Day Total Visits (Class)

Graph

Use the grid below to graph the total visits for your group and the class. Be sure to title your graph, your x and y axis, and include a key.



Analysis Questions

1. Using the class results, write a one paragraph conclusion to the lab question "Do pollinators have a specific preference toward flower color?" Use data to support your answer. Explain *why* you think you got these results.

2. Were you surprised by these results? How were they different/similar to your expectations? Why?

3. What other factors might play a role in pollinator flower selection? (describe several)

5. Do you think it would have made a difference if the class had used a different type of flower, even if they were the same colors? Why or why not?

6. Why was the data collected over several days, instead of just one day? Would your results have been different if the lab was stopped after day 1?

7. Did you have more than one kind of pollinator visit your flowers? Why is this significant?

8. What would happen if pollinator populations in the area declined to the point where most flowers were not getting visited by pollinators?

Teacher Resources for Floral Color Variation Lab

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

Materials needed for activity

- Potted flowering plants of the same species of three different colors (e.g., red, yellow, purple, white)- at least 3 replicates of each color per observer/group. Primroses are a good option for numerous flower colors in early/mid spring, though they are more likely to attract beeflies rather than bees.
- Data sheets (attached)
- Clipboards
    - It may be helpful (but not necessary) to use a pollinator identification guide to familiarize students with the different types of pollinators by sight.

https://www.portlandoregon.gov/parks/article/585770

Other notes

- While outdoors, each group will sit next to a group of potted flowering plants with a mixture of colors for 15 minutes for 3 days in a row and record number of visits (bee lands on flowers) to each color flower. Pay attention to how the pots are arrayed to make sure you are testing for flower color only and not other factors (spatial arrangement of flowers, shade vs. sun, etc)
- Placing the plants outside where you will be using them the day before beginning the activity may increase your success on the first day.

Option: While observing over multiple days will improve your data, this can be done as a one-day lab. You might compare the data between different class periods to have more data points.

Option: Adapt the number of stations and length of time at each station depending on the amount of time you have, but it is important to use the same protocol each day you collect data.

Option: Identify type of pollinator/bee to "honey, bumble, mason, etc." level for each floral visit.

Option: If you are not getting very many actual visits, but do have pollinators present, you could have students record number of approaches (bee has defined orientation toward flower but doesn't land) and/or length of visit in seconds.

More background information

Sutherland, S. D., and Vickery, R. K. 1993. "On the relative importance of floral color, shape, and nectar rewards in attracting pollinators to *Mimulus.*" *Great Basin Naturalist,* 53 (2).