

Honey Bee Behavioral Ecology
“Does floral color or size influence pollinator visitation?”

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Targeted Grade Level: High School

Observations:

Honey bees (*Apis mellifera* L.) forage on a wide variety of species of flowers (Fig. 1) in order to collect pollen and nectar for food. Pollen is the primary protein source for bees, while nectar is the primary energy source for bees and provides them with energy for worker tasks (foraging, taking care of young, cleaning out the hive) and queen reproduction. Nectar is produced by plants in order to attract specific pollinators. It is important that pollinators are attracted to the flowers to ensure successful bee visitation to the flowers.

Question:

Does floral color or size influence pollinator visitation?

Hints:

There are a wide variety of flowers on the landscape that honey bees use for foraging throughout the year. The nectar present in the floral resources is not always the same. Some nectar has a higher sugar concentration than others, and some nectar is even toxic to honey bees! However we also see so many different sizes and shapes and flowers that may influence honey bee visitation to the floral resources. Think about the colors of the flowers that you commonly see honey bees foraging, or go on a walk to a garden and observe with the class what you see!

Hypothesis:

Part 1 (flower color): With equal concentration of sugar in our artificial nectar and the same size of our floral cut-out with different colors, more bees will visit one color of flower over the others.

Part 2 (flower size): With equal concentration of sugar in our artificial nectar and the same color of our floral cut-out, the number of visits by the honey bees will be the same, despite changes in flower cut-out size.

Materials:

1. Honey bee hive or apiary- you are NOT required (or encouraged) to get close to the hives, however a hive or apiary in close proximity is best for frequent visitation. (Alternatively, you can set up experiment near a garden with frequent pollinator visitors)
2. White poster board (used to cut out flowers)

3. Red, blue, yellow, and white acrylic paint
4. Small bowls (~2 inches in diameter) that can be used to hold artificial nectar
5. Artificial nectar- 1:1 sugar to water solution
6. Small table to support feeders at your experimental site.
7. Glue/tape

The Experiment:

Step 1: Prepare flower cut-outs (Figs. 2 & 3):

1. Prepare floral cut-outs for **color** experiment by cutting poster board into 4 identical flower shapes, ~ 5-6 in. in diameter.
2. Paint each cut-out flower either yellow, red, blue, or white (Fig. 2).
3. Prepare floral cut-out for **size** experiment by cutting poster board into 4 flower shapes, starting with 3 inches in diameter, and increasing by 1.5 inch intervals (3 in., 4.5in., 6in., and 7.5 in.)
4. Paint each of the four different size flower shapes yellow (Fig. 3).
5. Allow flower cut-outs to dry overnight.

Step 2: Acclimate feeders to experimental site (Fig. 4).

Note: Results best if sunny and greater than 65° F outside.

1. Adhere your 2 inch clear bowls to the center of your floral cut-out from step 1 with glue or tape.
2. Mix your 1:1 sugar to water artificial nectar solution by mixing 2 cups of sugar with 2 cups of water.
3. Place your feeders out at your experimental site at noon.
 - a. If you have access to a honey bee hive or apiary, set up your feeders for part 1 of your hypothesis approximately 25-30 feet away from bee hives (Fig. 4).
 - b. If you do not have access to a honey bee hive, find a frequently visited flower patch (undisturbed by people) and place your feeders for part 1 of your hypothesis approximately 10 feet away from the flowers.

Caution: Be careful around foraging bees, especially if you have a known allergy to bee stings.

4. Line your four different color feeders on the table and fill each floral feeder half full of your artificial nectar solution. Tape to table to prevent experiment from blowing away.
5. Allow your feeders to sit outside until the following day, allowing the bees to successfully locate and utilize your floral feeder and nectar resources.

Step 3:

Record data on floral feeder visitors (Fig. 5).

1. Travel out to your field site in the early afternoon (peak foraging time).

2. Observe each floral cue for 1 minute, recording the number of honey bees that landed.
3. Repeat this observation at least 3 times for each of the four floral cues.

Step 4:

Repeat steps 2 and 3 above for part 2 of your hypothesis, now looking at floral cut-out size instead of color. Once complete, clean up your experimental site of all supplies and bring back to your classroom.

Note: Depending on your class size or group, you can split into two groups and run the color and size experiments simultaneously.

Results:

Average the number of visits for each floral feeder and present the results in a bar chart (Fig. 6 & 7).

Discussion:

Present whether the results of your experiment confirmed or rejected your hypothesis. Why do you think you arrived at these conclusions?

References:

No specific references needed.

If interested in learning more about honey bee biology, you can check out [The Biology of the Honey Bee](#) by Mark L. Winston.

Estimated Time for Experiment:

1 week (1-1.5 hours per day depending on the proximity of your experimental site)

1. Day 1- Paint floral cut-outs and allow to dry.
2. Day 2- Acclimate feeders for part 1 of your hypothesis (color) at your experimental site.
3. Day 3- Travel to experimental site and collect measurements, set up part 2 of your hypothesis (size) at your experimental site.
4. Day 4- Travel to your experimental site and collect observations, clean up your experimental site and bring supplies back to the classroom.
5. Day 5- Formulate data and present to the group or class. Depending on the size of your group class, you can perform the color and size experiments simultaneously between the two groups.

Estimated Cost:

The cost for this experiment is roughly \$20-40 dollars dependent on group size, materials already owned, and whether your experimental supplies survive from one year to the next.

Contact: For help with this project or for questions concerning the project, please contact the author- Daniel Schmehl at drs335@psu.edu

Figures:

Fig. 1. The honey bee (*Apis mellifera* L.) forages on a wide number of different species of flowers.



Fig. 2. Floral cut-outs of identical size, but different color.

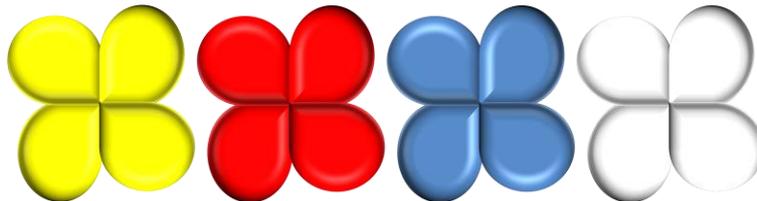


Fig. 3. Floral cut-outs of all of the same color, but of different sizes.

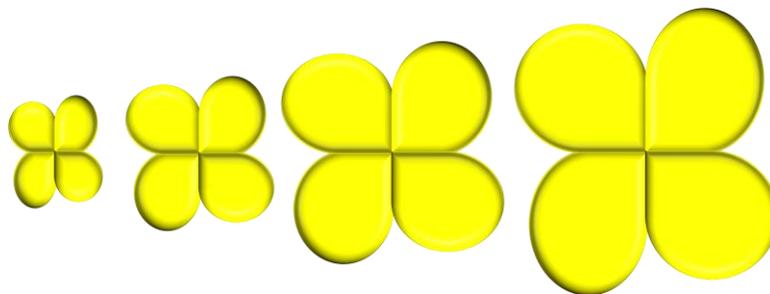


Fig. 4. Diagram of the set-up near a bee hive (if available)



Fig. 5. Sample data from the two parts of the experiment.

VISITS/FLOWER COLOR					VISITS/FLOWER SIZE				
	YELLOW	RED	BLUE	WHITE		3 IN	4.5 IN	6 IN	7.5 IN
TRIAL 1	5.0	1.0	3.0	4.0	TRIAL 1	4.0	5.0	9.0	8.0
TRIAL 2	9.0	2.0	2.0	6.0	TRAIL 2	8.0	6.0	5.0	6.0
TRAIL 3	8.0	0.0	4.0	6.0	TRAIL 3	7.0	8.0	6.0	4.0
AVERAGE	7.3	1.0	3.0	5.3	AVERAGE	6.3	6.3	6.7	6.0

Fig. 6. Visits/Flower Color 3-D bar graph made in Windows Excel (but it is fine to simply draw a graph).

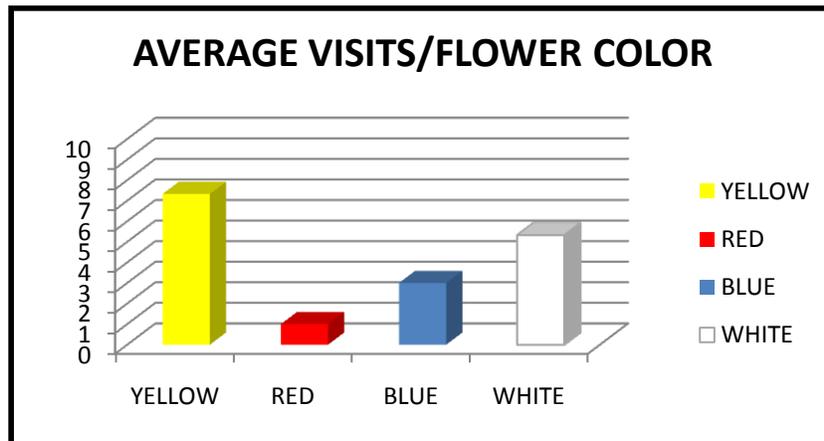


Fig. 7. Visits/Flower Size Color 3-D bar graph made in Windows Excel (but it is fine to simply draw a graph).

AVERAGE VISITS/FLOWER SIZE

