



How Sweet It Is! Explore the Roles of Color and Sugar Content in Hummingbirds' Food Preferences.

Difficulty

Time Required	Very Long (1+ months)
Prerequisites	There should be one or more hummingbirds in your yard that you can study.
Material Availability	This science fair project can only be done when hummingbirds are in your geographical region. Don't start this science fair project unless you already have hummingbirds regularly visiting a feeder in your yard.
Cost	Very Low (under \$20)
Safety	The sugar solution used to feed the hummingbirds is heated briefly. Have an adult help you perform this step, as hot liquid can cause burns.

Abstract

Do you like to watch hummingbirds? Have you ever wondered why there is specialty hummingbird food? What is it about the food that makes it so appealing? In this zoology science fair project, you will observe these remarkable creatures and learn how color and sugar concentration influence a hummingbird's selection of a food source.

Objective

The objective of this zoology science fair project is to determine whether color or sugar content is more important for a hummingbird's selection of a food source.

Credits

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- Styrofoam™ is a registered trademark of The Dow Chemical Company.
- JELL-O® is a registered trademark of Kraft Food Holdings, Inc.

Cite This Page

General citation information is provided here. Be sure to check the formatting, including capitalization, for the method you are using and update your citation, as needed.

MLA Style

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Introduction

Hummingbirds have intrigued and entertained people throughout the ages. These masters of flight can fly left, right, up, down, and even backwards. A hummingbird's average flight speed is 25 miles per hour, with wing beats up to 55 times per second. Hummingbirds must feed about every 10 minutes or so to maintain this high level of activity. They eat about 2/3 of their body weight every day, their food consisting mostly of **nectar** from flowers and from special hummingbird feeders as shown in Figure 1. They eat small insects and spiders for protein.



Figure 1. Hummingbird visiting feeder with sugar solution.

The largest hummingbird is the Giant Hummingbird. It is about 8 inches long and weighs 20 grams. The smallest hummingbird is the Bee Hummingbird, at about 2 inches long and 2 grams in mass. Most hummingbirds migrate, some of them flying thousands of miles every year.

There are approximately 330 species of hummingbirds in the world. Surprisingly, there are no hummingbirds in Europe or Asia. Hummingbirds live exclusively in South, Central, and North America. The large majority are south of the United States-Mexico border; only 17 species have ventured north of Mexico into the United States and Canada.

In the wild, hummingbirds have to be very efficient in finding food. They can not afford to waste energy returning to flowers that have low amounts of nectar. In fact, researchers have suggested that hummingbirds have very good memories, allowing them to focus their efforts on flowers that they have learned are the most likely to be good food sources.

Hummingbirds in search of nectar look for brightly colored flowers. In this zoology science fair project, you will test whether color or concentration of sugar is more important in a hummingbird's selection of a food source. You will first provide four cups (white, green, blue and red) with equal sugar content to see if they have a "favorite" color. You will then change the concentration of sugar in the cups so that one cup has nectar with a higher sugar content than the other cups. How long do you think it will take the hummingbirds to learn which cup has the most sugar? What will they do if the food source without any color (the white cup) has more sugar than a brightly colored food source? Next, you will again switch the color of the cup that has the highest sugar content. How long will it take them to change their color preference, based on the new situation? You may find that you can add a healthy respect for their ability to learn and adapt to their environment to the list of reasons to be impressed by these remarkable birds!

Terms and Concepts

- Hummingbird
- Nectar
- Co-evolution

Questions

- On what continents are hummingbirds found?
- Based on your research, what kinds of sugars are present in nectar?
- In the wild, how many blossoms will a hummingbird visit on average per day?
- Why is it bad to feed a hummingbird honey?
- A hummingbird's beak is often just the right length to drink nectar from the flowers in its environment. Is this a coincidence, or is it an example of **co-evolution**?
- Why do scientists think that hummingbirds have very good memories?

Bibliography

- San Diego Zoo. (2008). *Hummingbirds*. Retrieved September 15, 2008, from <http://www.sandiegozoo.org/animalbytes/t-hummingbird.html> (<http://www.sandiegozoo.org/animalbytes/t-hummingbird.html>)

Read this article to see why one researcher says "I think the hummingbird vocabulary is 100 percent swear words."

- Klesius, M. (2007, January). National Geographic Society. *Hummingbirds*. September 15, 2008, from <http://ngm.nationalgeographic.com/2007/01/hummingbirds/klesius-text/1> (<http://ngm.nationalgeographic.com/2007/01/hummingbirds/klesius-text/1>)

For help creating graphs, try this website:

- National Center for Education Statistics (n.d.). *Create a Graph*. Retrieved October 6, 2008, from <http://nces.ed.gov/nceskids/CreateAGraph/default.aspx> (<http://nces.ed.gov/nceskids/CreateAGraph/default.aspx>)

Materials and Equipment

Note: Start this science fair project only if you have a hummingbird feeder with one or more hummingbirds who regularly visit it in your yard.

- Styrofoam™ cups, 8 ounces, (4)
 - Small white cups or containers made of glass or ceramic will work, too.
- Permanent markers in three colors—red, blue, and green—to color the white cups
 - You can also use paint or colored paper to decorate the cups.
- Sugar
- Tap water
- Liquid measuring cup
- Dry measuring cup
- Mixing bowls, should be microwave-safe if you are heating the solution in the microwave (2)
- Pot if you are heating the solution on the stove
- Jars with a lid or 2-L soda bottles with a lid, empty and clean (2)
- Spoon
- Plastic wrap
- Stove or microwave
- Oven mitts
- Lab notebook
- Graph paper

Remember Your Display Board Supplies

(https://www.amazon.com/gp/product/B008PC1978/ref=s9_acsd_hps_bw_c_x_2_w&ie=UTF8&tag=sciencebuddie-20)

Poster Making Kit



(https://www.amazon.com/gp/product/B008PC1978/ref=s9_acsd_hps_bw_c_x_2_w&ie=UTF8&tag=sciencebuddie-20)

(https://www.amazon.com/ArtSkills-Tri-Fold-Display-Header-PA-1393/dp/B01AKR000E/ref=sr_1_1?s=arts-crafts&ie=UTF8&tag=sciencebuddie-20&keywords=ArtSkills+Trifold+with+Header)

ArtSkills Trifold with Header



(https://www.amazon.com/ArtSkills-Tri-Fold-Display-Header-PA-1393/dp/B01AKR000E/ref=sr_1_1?s=arts-crafts&ie=UTF8&tag=sciencebuddie-20&keywords=ArtSkills+Trifold+with+Header)

(https://www.amazon.com/ArtSkills-Poster-Lights-String-PA-1236/dp/B0041XS7IO/ref=lp_6913017011_1_4?srs=6913017011&ie=UTF8&tag=sciencebuddie-20)

Poster Lights



(https://www.amazon.com/ArtSkills-Poster-Lights-String-PA-1236/dp/B0041XS7IO/ref=lp_6913017011_1_4?srs=6913017011&ie=UTF8&tag=sciencebuddie-20)

(http://www.sciencebuddies.org/science-fair-projects/project_display_board.shtml#samples)

Experimental Procedure

This Experimental Procedure has two parts. In the first part, you will observe the hummingbirds to see if they have a color preference. In the second part, you will test how changing the concentration of sugar affects the hummingbird's choice of food sources. In order to obtain three independent trials, you will repeat the procedures two more times, using a different color for the cup with the highest sugar content.

Plan to observe the hummingbirds' feeding behavior over a period of two or more weeks—the longer the better.

Making the Colored Cups

1. Color three of the cups: one red, one blue, and one green. Leave one cup white. You can be creative with the coloring, but make sure that the pattern is the same for all of the cups. The only difference between the cups should be the color as shown in Figure 2. Make sure the rim is colored, too. Alternatively, you can use pre-colored cups.



Figure 2. Prepared colored cups for sugar solution.

Making the Nectars

Note: You may need to repeat this step to make more nectars if you still have more data to collect.

1. To make the 25% sugar solution, mix 3 parts water to 1 part table sugar (for example, dissolve 1 cup of sugar in enough water to yield a final volume of 4 cups).
2. Heat the sugar solution on the stove or in a microwave until it is hot, but not boiling.
 - o Do not use honey, as it may contain spores that could lead to fungus growth.
 - o Do not use artificial sweeteners, as these will not provide the energy that the birds need.
 - o Finally, do not use food coloring; it is not necessary and might be harmful to the birds.
3. Use oven mitts to remove it from the stove or microwave. Cover with a lid or plastic wrap and allow the solution to cool. Then pour the nectar in a clean jar with a lid or in a clean soda bottle with a lid to prevent contamination. You will use this solution in Part 1.
4. Now make 2 cups of the 12.5% sugar solution by mixing 1 cup of the 25% sugar solution with 1 cup of water. You will use this in Part 2.
5. Cover and store the nectar in the refrigerator. Keep the nectar in a clean jar with a lid or in a clean soda bottle with a lid to prevent contamination.

Part 1: Color Preference

Notes Before You Begin: In this part of the experiment, you will observe how the hummingbirds respond to different-colored cups. All of the cups will be filled with 6 ounces of the 25% sugar solution. You should observe until you've seen at least a total of 20 visits over all the days you are recording data. Observe them over a period of several days.

1. Fill the cups with the 25% sugar solution. Add about 6 ounces (2/3 cup) to each cup.
2. Place the cups outside, near the hummingbird feeder.
3. Put them in a line and make a note of the order in your lab notebook. For example: white, red, blue, and green. Which color do you predict will be the hummingbirds' favorite? Why?
4. Temporarily remove the hummingbird feeder so that the hummingbirds will feed from the sugar solutions in the cups.
5. Choose several times during the day to watch the hummingbirds.
6. Record the visit number (1 to 20), the time, and the cup color visited in a data table in your lab notebook. Remember, there is no "right answer"—the hummingbirds may like all the colors equally!
7. Rinse out the cups and add new 25% sugar solution nectar once every day you are recording data. Then repeat steps 1–6 of this section every day you are recording data. Keep recording data until you have recorded at least 20 total visits.
8. *Note:* If ants are a problem, try placing the cups in a "moat" of water; for example, in a large plastic container.
9. Do the hummingbirds prefer one of the colors over the others? If so, which colored cup was used the most? Graph your results. Put *Color* on the x-axis and *Number of Visits* on the y-axis. Make a graph with four columns, one for each color. The heights of the columns reflect the number of visits. Collect data for more visits (50 visits, for example) to get a more accurate result.
10. At the end of this trial, take the cups inside and put the regular feeder back outside.
 - o It is important to make sure the hummingbirds always have food available, either from the cups or from the feeder.

Part 2: Sugar Concentration Preference

In this part of the experiment, you will observe how the hummingbirds respond to changes in the sugar concentration. One cup will have twice as much sugar as the other cups. The goal is to determine how quickly the hummingbirds "learn" which food source has the most sugar. You should observe until you've seen at least a total of 20 visits over all of the days you are recording data. Hummingbirds return to feed every 10–15 minutes. You should observe them over a period of several days. Based on your observations, what is more important in the bird's choice of which cup to visit: its color or the sugar content?

1. Reduce the sugar concentration in the red, blue, and green cups to 12.5% sugar solution from the section "Making the Nectars." Keep the volume the same as before (6 oz. of nectar in 8-oz. cups).
2. Keep the sugar concentration in the white cup at 25% sugar solution. Now the white cup has *twice* the sugar content of the other cups.
3. Place the cups outside in the same order as in Part 1. It is important to keep the order the same. Only the color of the cup should change. If you also change position, it will be harder to get clear results. (The role of *position* in the hummingbird's behavior is explored in one of the variations).
4. Remove the feeder temporarily so that the hummingbirds will visit the cups.
5. Record the hummingbirds' responses to the new concentrations of sugar in the cups in your lab notebook.
6. Make a data table and record the visit number (1 to 20), the time, and the color of the cup visited in a data table in your lab notebook.
7. It is important to observe the first few visits by the hummingbird, so stick around after you've placed the cups outside. How many visits does it take for the hummingbird to "discover" which container has the highest concentration of sugar?
8. Continue observing until you have recorded at least 20 visits. Remember, they usually return to feed every 10–15 minutes.
9. Do you get the same results as in Part 1? Or have the hummingbirds responded to the changes in sugar content?

Repeating Parts 1 and 2, with a Twist.

1. Carry out the procedures in Part 1 again. That is, set out 4 cups with 25% sugar. Be careful to observe the hummingbirds' first few visits.
2. You might expect the birds to be biased in favor of the color that they have previously learned had 25% sugar. Is this so?
3. Record the visit number (1–20), the time, and the color of the cup visited, as before.
4. How did the hummingbirds respond to the change in sugar content?
5. Carry out the procedure described for Part 2 again, but this time change the color of the cup with 25% sugar. For example, add 25% sugar to the green cup, and 12.5% sugar to the others. How long does it take for the hummingbirds to find their new "favorite" color?
6. Repeat Parts 1 and 2 one more time so that you have three sets of data. Change the color of the cup with the 25% sugar in it for Part 2.
7. Graph your observations, as you did for Part 1.
8. Based on your observations, what is more important in the selection of a feeding source: color or the concentration of the sugar?

Communicating Your Results: Start Planning Your Display Board