ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

ECOS Inquiry

1. **Contributor's Name:** Sarah Bisbing and Jen Marangelo

2. **Name of Inquiry:** Busy Little Bees: Insects Working Hard In Your Schoolyard

3. **Goals and Objectives:**
   - **a. Inquiry Questions:** How are the plants and insects in your schoolyard interacting? How do the shapes of flowers impact which insects you might see in your schoolyard?
   - **b. Ecological Theme(s):** Plant-animal interactions, form and function, mutualisms
   - **c. General Goal:** Introduce students to the idea that plants and insects rely on each other
   - **d. Specific Objectives:**
     1. Students will be able to name four common insect pollinators and their mouthparts
     2. Students will be able to match basic flower shapes to insect pollinators and their mouthparts
     3. Students will determine which flower shapes are present in their schoolyard
     4. Students will graph their results (using a bar graph) and make hypotheses about which insects pollinators are likely to be in their schoolyard
   - **e. Grade Level:** 1-2
   - **f. Duration/Time Required:**
     - → **Prep time:** 1-2 hrs
       - print out worksheets/photos/flashcards (flashcards must be cut out) and find areas with blooming plants
       - Gather materials (cheerios, cups, popsicle sticks, glass jars, etc.)

       → **Implementing Exercise During Class:** 1 – 1.5 hr(s) (or one class period)
     - → **Assessment** Worksheets and class discussion act as form of assessment

4. **Ecological and Science Context:**

Background

When animals such as bees, butterflies, moths, flies, and hummingbirds pollinate plants, it's accidental. They are not trying to pollinate the plant. Usually they come to the plant to get food, the sticky pollen or sweet nectar available at the base of the petals. When feeding, the animals accidentally rub against the stamens and get pollen stuck on their bodies. When they move to another flower to feed, some of the pollen can rub off onto this new plant's stigma.

Plants and pollinators have co-evolved physical characteristics that make them more likely to successfully interact. The plants benefit from attracting a particular type of pollinator to its flower, ensuring that its pollen will be carried to another flower of the same species and hopefully resulting in successful reproduction. The pollinator benefits from its relationship with a specific flower type by eating nectar and/or pollen. Such relationships are considered mutualistic.

The most common insect pollinators belong to four families: bees, flies, butterflies and moths, and beetles. These four families have distinct body shapes and mouthparts that make them best suited to feed from different types of flowers. One important characteristic that determines which insect can obtain food from the flower is its shape. Flower shape can restrict access to pollen and nectar to only those insects that have the appropriate tools or abilities. For example, the nectar at the base of a long tubular flower may only be accessed by insects that have long mouthparts, such as butterflies or moths that have long lapping 'tongues'.

Below is a description of the four common families of insect pollinators and the types of flowers they feed from.

Bees (Mouthpart = short proboscis; flower type = short tube or round flower):

The most important pollinators are bees. Active during the day, bees visit flowers to get nectar and pollen for themselves and their developing larvae. They use their senses of sight and smell to lead them to flowers. They prefer sweet-smelling flowers and blossoms that are yellow, blue or purple (red looks like black to them). They land on the flower to collect the food.

Butterflies (Mouthpart = long proboscis; flower type = long tube):

Active during the day, butterflies visit flowers to get nectar for food. They use mainly their sense of sight to lead them to flowers. They prefer blossoms that are yellow, red or orange. Butterflies are not strong enough to hover over a flower and must land to feed. They have a long tongue called a proboscis they use as a straw to sip nectar out of a flower.

Moth (Mouthpart = long proboscis; flower type = long tube):

Active during twilight or night, moths visit flowers to get nectar for food. They use mainly their sense of smell, and some sight, to lead them to flowers. They prefer blossoms that are white, off-white, or yellow. Moths are attracted to strong, sweet, vegetable-like odors. They usually hover above the flower to feed. Like butterflies, moths have a long tongue called a proboscis they use as a straw.

Beetle (Mouthpart = chewing; flower type = flat or bowl-shaped):

Beetles were among the first insects to visit flowers and they remain essential pollinators today. Beetles have chewing mouthparts that make them well suited to eat pollen from white, yellow, blue, or green flat or bowl-shaped flowers with exposed anthers. They also prefer flowers that have a strong fruity scent to them.

Flies (Mouthpart = spongy sucker; flower type = flat or bowl-shaped, or short tube):

Flies are the second most important pollinators due to their sheer numbers. Flies mouthparts are diverse and there are three types of flower feeders: pollen eaters with short, thick proboscis and a broad tip (labella), which they can use to pick up pollen and eat from flat or bowl-shaped flowers; nectar feeders with a long proboscis and narrow tip

who can eat from short tubular flowers; and mixed feeders who have intermediate mouthparts.

Hover flies and bee flies are the most important fly pollinators and may mimic bees. To tell the difference, look at the antennae. The antennae on flies will be very short whereas bees have long antennae. Another way to tell the difference between fly mimics and bees is how they fly. Both hover flies and bee flies can remain stationary in the air. In fact, some nectar feeders can hover over a flower while feeding rather than landing. Bees cannot hover and appear to bob up and down if flying but not moving forward.

A fourth group of flies come to flowers but not to get nectar or pollen. The come because the flower smells like decaying flesh. These are the carrion and dung flies that are looking for a place to lay their eggs. Darkly colored flowers that smell like decaying protein attract these flies that will then transfer pollen from flower to flower.

For the purposes of this inquiry, we are only focusing on the flies that eat pollen.

5. Motivation and Incentive for Learning: Students are given the opportunity to explore their schoolyard to find flowering plants and look more closely at the insects on-site. And, students LOVE insects!

6. Vocabulary:

Anther = part of the stamen which produces pollen

Pollinator = an animal/insect that carries pollen from one plant to another

Pollination = the transfer of pollen from a stamen to a pistil, starting the production of Seeds

Stamen = composed of filament and anther, pollen is found on the anther – at the tip of the stamen

Stigma = part of the female reproductive structures on a flower, collects pollen

7. Safety Information: Remind students not to touch or harass pollinators and to stay away from plants with thorns/spines.

8. Materials List (including any handouts or transparency masters):

- Cheerios
- Dixie cups (1 per student)
- Popsicle Sticks (1 per student)
- Short glass jar with liquid,
- Long glass bottle with liquid, can decorate both jars to look like a flower
- Two straws (one long, one short)
- Pliers
- Sponge (slice in the center so it can be used to pick something up
- Silk Flower (with obvious stamens)

- Worksheets (attached)
- Plant pollinator flashcards

- Plant pollinator pictures
- Pencils
- Nature Journals
- Hand lenses

9. Methods/Procedure for students:

a. Pre-investigation work: Can anyone tell me what pollination is? How does pollen from one plant get moved to another? Use the silk flower to show students where the pollen is on a flower. Can you name a few pollinators (should at least end up with bee, fly, beetle, butterfly, moth)? What is the end result of pollination? Can anyone tell what type of mouthpart a bee has? Butterfly? Moth? Beetle? Fly?

What does a pollinator get out of the deal? What draws a pollinator to a plant? Let's think about it this way: what draws you to the food you eat? Why do you eat what you eat? Answers should include: scent/smell, appearance/color, accessibility (mom cooked it for me). Well, pollinators are also drawn to their food for specific reasons. The four main characteristics pollinators take into account are scent, color, platform presence, and flower shape/length. Each of these plant characteristics plays a role in determining a plant's specific pollinator.

b. Investigation work:

1. Part 1: Mouthparts Demonstration

Pass out a Popsicle stick and a few pieces of cereal in a small cup to each student. Tell the students that the first thing they need to do is eat a snack. But the one rule they need to follow is that they can only eat their snack with the stick provided – they can't use their fingers. If you'd like to make this even harder, ask students to put one hand behind their back. When they are done ask them how it went. Could they eat the food with the stick? Why or why not? Would another tool have worked better? Which one? Point out that just as there are different utensils that work best with certain types of foods, insects have different types of mouthparts and can only eat certain types of foods. Tell them that you will show them some examples.

Have the jars, straws, pliers, sponge, some cheerios and the silk flower ready to go. Begin by talking about the types of food insects might be able to get from a flower (nectar and pollen). Use the flower again to remind students where the nectar and pollen is on a flower. Then get out the straws and ask what kind of food we consume with a straw. Ask if they know what kind of insects have a mouthpart like a straw (butterflies and bees) and what they eat. Use both straws (the short one represents the bee, the long straw represents the butterfly) and the 2 jars that represent a long and short tubular flower to demonstrate that the short mouthpart can't reach the nectar of the long tubular flower.

Show the students the pliers and ask them what kind of mouthparts they think pliers represent (chewing). Ask students what kind of insect has that type of mouthpart (beetles are the pollinators with chewing mouthparts but ants, wasps, grasshoppers, etc. are all correct answers). Ask students if they think an insect with chewing mouthparts could suck up nectar. Point out that chewing mouthparts are ideal for picking up solid objects like pollen (pick up some

cheerios with the pliers). Get out the flower again and point out that the pollen would have to be exposed for a beetle to be able to eat it.

Show the students the sponge and ask what we use sponges for. Ask what type of insect has this type of mouthpart (flies). Point out that sponges can easily lap up fluid with their sponge-like mouthpart but show them that the sponge has a slit in it that also allows the fly to pick up solid objects like pollen (pick up pollen with the slit in the sponge).

Point out that the way a flower is shaped will determine what insect can eat from it.

2. **Part 2: Matching Game**

Print out flashcards and photos. Divide students into groups. Select two types of insects for each group to look at. Divide insect mouthpart flashcards and corresponding photos. Each group should receive all of the photos and flashcards corresponding to their insects. Each group should also receive a complete set of the flower shape flashcards.

Tell each group to match the flower shapes to their pollinators. There should be a discard pile, because some of the flowers will not match their chosen pollinators. For example, if students have a bee and a butterfly as their pollinators, their discard pile will include all the flat and bowl-shaped flowers (used by beetles and flies).

After students finish the exercise, ask them again about the pollinators, their mouthparts, and the flowers they pollinate. To instill these ideas in their minds, it's best to do this throughout and at the end of the exercise.

3. **Part 3: Who's Using Our Schoolyard?**

Select one student to be the writer for the group and give students the worksheet to fill out. Give students 15-20 minutes and have them wander around the schoolyard (or, if possible, assign them to specific areas/habitats) to look at the flowers in bloom. Students should tally the flower shapes they see.

Bring students back into the classroom. Ask them to add up each column and read the numbers of each to you. Draw a bar graph on the board to illustrate the distribution of flower shapes. Ask students who (according to the data they collected) is the dominant pollinator on the schoolyard. Again, go over the insect types, mouthparts, and the flower types they pollinate. Lead students in a discussion about these interactions. Ask them if the types of flowers and insects will change over time.

10. **Assessment:** Worksheets and class discussion act as form of assessment

11. **Extension Ideas:** Data collection can occur throughout the rest of the year. Have students monitor the changes in flowers on the schoolyard over time and continue to make graphs. Students should be able to witness shifts in flower types, and thus pollinators, found on the schoolyard.

12. Scalability: A more advanced inquiry for 3-5 is also available on this website (see http://www.bioed.org/ecos/Inquiries/inquiries.aspx), having students generate their own hypotheses.

13. Science Standards Accomplished:

- Characteristics of Organisms
- Organisms and Environments

14. References

Mouthparts demonstration adapted from Feeding Frenzy published by Flying Rhinoceros, Inc.

Proctor, M. Yeo, P. and A. Lack. 1996. The Natural History of Pollination. Portland: Timber Press.

Shepard, M., Buchmann, S. L., Vaughan, M and S. H. Black. 2003. Pollinator Conservation Handbook: A guide to understanding, protecting, and providing habitat for native pollinator insects. Portland: The Xerces Society.

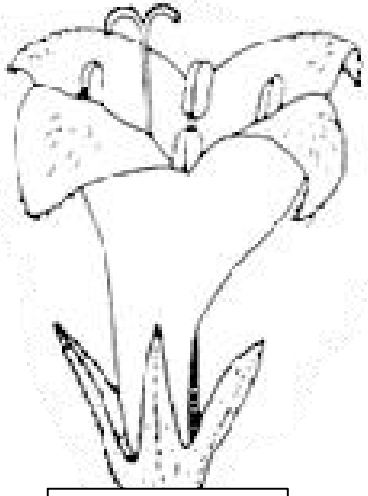
15. List of Experts and Consultants:

16. Evaluation/Reflection by Fellows and Teachers of how it went:

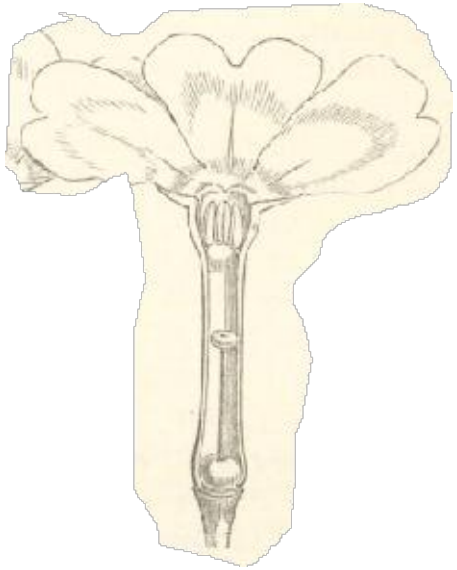
The teachers loved the activity and even asked for their own copies of the material. Yeah! A success! And . . . we even inspired a birthday party . . . insects and plants! Yay!

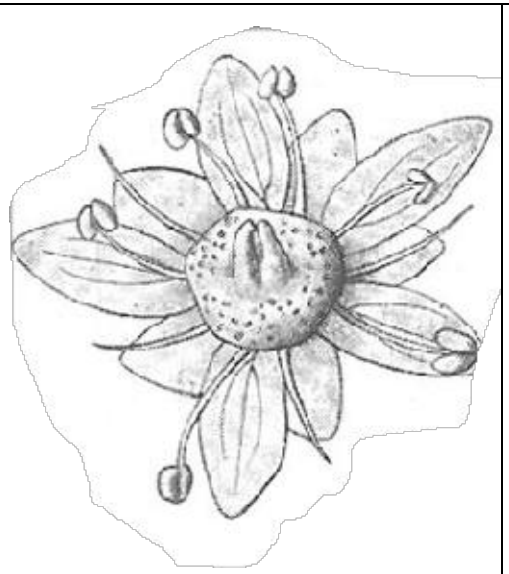
I think the different activities built on one another nicely. I would like to find a better way to explain and show fly mouthparts. In the end the students understood what type of flower a pollen-eating fly would eat, but I don't know if they really understood what type of mouthparts the fly actually has.

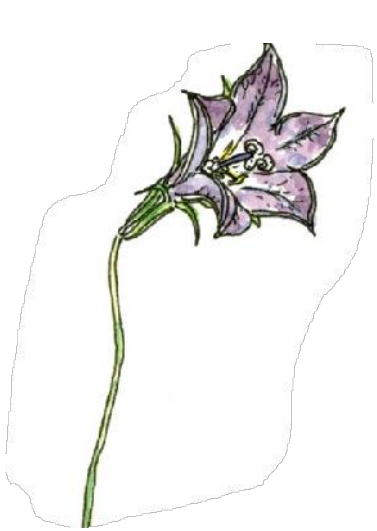
Flashcards



Short Tube

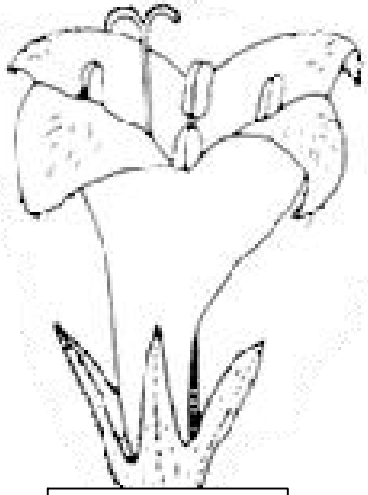
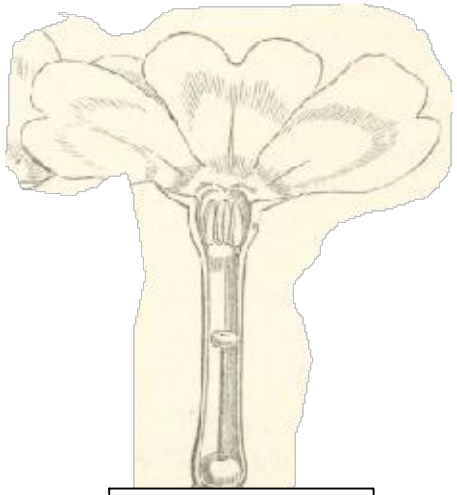






Summary Sheet

Collectors: _____

 Short Tube	 Long Tube	 Flat	 Round

Photos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