Name_____

Seed Set Lab

Objectives

To learn one method to measure pollinator effect by comparing the fruit set of a flower that has been isolated from pollinators to one that has been exposed to them.

Topics Addressed

Seed set, cross-pollination, self-pollination

Background

As bees forage for nectar and pollen, they perform the important job of transferring pollen from the stigma (male) of one flower to the pistil (female) of another flower. In doing so, they allow plants to reproduce sexually and produce seeds. In the absence of pollinators, many plants are still able to self-pollinate; wind can carry pollen to the pistil of the same plant, allowing fertilization to take place. But self-pollinated plants lack genetic diversity, and reproduction usually is not as successful as those that have been cross pollinated by animals. In this activity, students will investigate just how important pollinators are to seed production.

When determining the role of pollinators on seed production success, it is essential to have a 'control' plant/flower (one that hasn't been exposed to pollinators). The reason is that, in the absence of pollinators, some plants are still able to self-fertilize: wind or rain can shake the flower and move the pollen to the stigma and these plants 'tolerate' self pollen. However, seed set (seed number) and fruit size often increases when the flower is cross-pollinated (i.e. when pollinators have moved the pollen from another plant). So, when excluding pollinators from one flower and then comparing its seed set with one that has been exposed to pollinators, we can determine how much pollinators 'helped' the plant. The difference (or ratio) of seed set (or fruit size or fruit number) of exposed vs exclusion flowers is a standard estimate of pollinator effect.

Question to discuss/think: what is the advantage of cross-pollination? (it would seem easier to always self-pollinate, right?)

Question: How does preventing cross-pollination affect seed set of plants?

Hypothesis: Write a hypothesis for the lab question. Write your hypothesis in "If, then, because…." format.

Materials

- Jalapeno peppers, or other fruit-producing plants which flower/produce fruit before end of school year.
- Mesh (Paint Strainer) covering (1.5mm) to cover half of plants to prevent pollinators from visiting.
- Another option would be to cover the bottom of a fruit tree (such as cherry) with 1-1.5mm mesh covering, if fruit trees exist nearby.

Procedure

Week 1 & 2: Planting/Tending

1. To start the pollination research, each student group should plant two plants. Care should be taken to make conditions for the plants as similar as possible (same size to start with, same amount of sun, same soil, etc).
2. Cover one of the plants with mesh when the flowers form (1.5mm) to prevent pollination.
3. Water and weed the plants as needed, approximately every other day.

Week 3 -5: Observations

4. Once flowers appear (this may be sooner than week 3, depending on the plant), record pollinator data.
5. Record all pollinator visits (bee lands on flower) to the uncovered plant for 15 minutes on 3 different days (see data sheet).
6. Continue to tend plants during this time.

Week 6: Data collection

7. Once fruit has set (this may be anywhere from 4-6 weeks after planting), harvest fruit from both plants to collect data.
8. Decide as a class what data you will collect. Ideally each group would count the number of seeds produced by each plant, but for some plants, such as strawberries, counting the number of berries, or recording the number and size of the berries may be more practical.

Seed Set Lab Pollinator Data

Record pollinator data for 15 minutes each day.

Day	Pollinator Visits	Pollinator Species Seen
Date:		
Date:		
Date:		
Total Visits:		

Seed Set Data

	Fruit/Seeds From Uncovered Plant	Fruit/Seeds From Covered Plant
Your Group		
Class Totals		

Analysis:

1. Based on your results, what can you conclude about the importance of pollinators on seed set?

2. Was your hypothesis correct? Why or why not?

3. If pollinators are found in most ecosystems, why are many plants still able to self-pollinate?

4. Can you think of any examples where pollination might be prevented or reduced by natural circumstances?

5. Research indicates that many different pollinator species are in decline, from honeybees to bumblebees to smaller native bees. What kind of an impact might this have on agriculture?

6. What kind of impact might it have on wild ecosystems?

Teacher Notes

Approximate Time: 4-6 weeks, depending on how soon flowering occurs

- This activity will work best in the early spring.
- Plant options include strawberry, blueberry, raspberry, cucumber, melon, squash, and others. All of these plants can self-pollinate, but usually have more robust seed set when cross-pollination occurs. Using more than one species of plant will give better results, as long as each group uses the same species for both of their plants.
- Once fruit has set, it may be necessary to protect the plant from slugs and other pests. Crushed hazelnut shells around the plant are a harmless, effective method.
- It is important to use a fine mesh (1.5mm) to completely prevent cross-pollination. Some native pollinators such as mason bees are very small and can easily get through netting that would keep out honeybees or bumblebees.
- Option: During pollinator observations, identify type of pollinator/bee to genus level.
- Option: In addition to number of visits, record number of approaches (bee has defined orientation toward flower but doesn't land) and/or length of visit in seconds.
- Option: Consider monitoring for all types of pollinators (not just bees) for this lab, as pollinators, like the flowers they frequent, come in many shapes and sizes.
- Source: Karrenberg, Sophie, and Kai Jensen. "Effects of Pollination and Pollen Source on the Seed Set of Pedicularis palustris." *Folia Geobotanica*, vol. 35, no. 2, 2000, pp. 191–202., www.jstor.org/stable/25133782.