

## Experiment Guide

### Flowers Love Pollination

#### Objective

To explore how pollination works by constructing a basic flower and insect model using household items. Also learn about the anatomy of flowers and the importance of pollination.

#### Introduction to Kids' Lab

Welcome to the BASF Kids' Lab. BASF is the world's largest chemical company and run Kids' Lab programs like this all around the world. Can anyone think why? BASF wants children all over the world to understand and enjoy experimenting with chemistry!

Has anyone heard that word before: Chemistry? What do you think it means?

**Chemistry is the science of matter.** Have you heard the word "matter" before? What is matter? Matter is anything that takes up space and has a weight here on earth. So basically, matter is a scientific word for stuff.

Chemistry is a science that explores the composition of substances and their properties and reactions. In other words, Chemistry is a science that explores how different stuff behaves.

Matter comes in a few different forms or states: Solids, Liquids and Gases are the most common.

Chemistry is all around us. For example:

Who takes a vitamin? How do vitamins help you? (Grow big and strong, boost immunity)

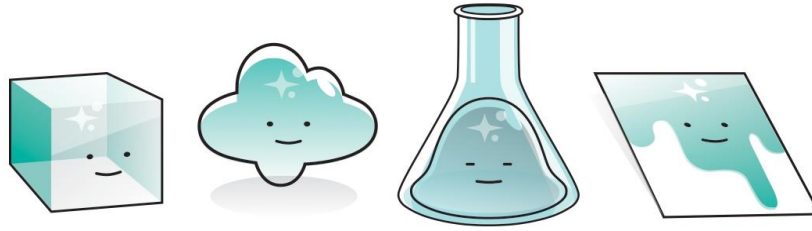
BASF makes chemicals that go into vitamins.

Raise your hand if you play a sport or ride a bike. What should you do to be safe? (Wear a helmet, pads, etc.) What materials make up the helmets that you wear? (Plastics and foam)

BASF makes chemicals that go into the plastics and foams in helmets and padding.

Besides helping you grow strong and keeping you safe when you are playing your favorite sport, BASF chemistry keeps farmers crops safe, cleans water for those in need and keeps babies clean and dry.

Let me introduce you to morph, the face of Kids' Lab. morph can move through the three states of matter with ease. Is there a substance that you know of, like morph that can easily shift from solid to liquid to gas (and back again)? Water! That's right! You know that water is usually liquid but what happens when you freeze water? Water becomes a solid ice cube. When you boil water, it becomes a gas. Water is one of the most important substances on earth. Not only does water make life possible, but it can be used to create interesting substances. We will be exploring some strange matter today!



Water is essential for all living things including plants.

**morpH and I would like you to explore the process of pollination in flowering plants.**

### Experiment Introduction

Do you know that one third of the output from agriculture in the United States depends on the work from pollinators? That equates to about 15-20 billion dollars' worth of products. Bees and butterflies are well-known **pollinators**, as are wasps, ants, flies and beetles. Bats, birds and other animals also pollinate flowers. Generally, these animals visit flowers to collect the nectar of the flower and the pollen accumulates on their bodies. As these animals visit multiple flowers, these pollen grains are spread to other flowers.

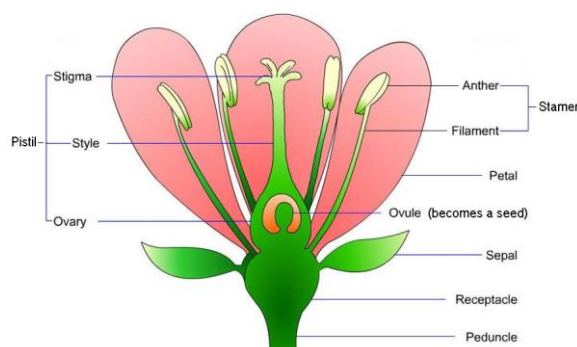
Of all pollinators, honeybees are the most significant and oftentimes farmers will add honeybee hives to their farm during a pollination period in order to maximize pollination of certain crops. Without honeybees for pollination, there would be no almonds, cherries or blueberries. It is important to protect pollinating animals like insects in order to maintain our agricultural output.

**Pollination** is the process where pollen is transferred from one flower to another flower in order to allow **fertilization**. If pollination does not occur, plants would not be able to grow seeds or fruits and new plants would not be possible.

Pollen contains genetic material and is produced by the male part of the flower called the **anther**. The anther is at the end of a **filament**. The anther and filament together are called the **Stamen**. Pollen grains vary greatly in size, shape and color depending on the plant species.

The pollen from the anthers of flowers is spread by wind, insects or other animals from flower to flower. Pollination occurs when pollen grains land on the **stigma** of a plant and the genetic material from the pollen travels to the **ovaries** and fertilizes the **ovules**.

The stigma, ovaries and ovules are all female parts of the flower. They all make up the part of the flower known as the **pistil**. If the flower is pollinated, the ovaries become the fruit and the ovules will become the seeds inside the fruit.



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## Summary of Pollination vocabulary terms:

**Pollination:** the transfer of pollen from flowers to allow fertilization.

**Fertilization:** the process of fertilizing an egg, female animal or plant ovule.

**Pistil:** the female organs of a flower, which consists of the stigma, style and ovary.

**Stigma:** the part of the pistil in a flower that will receive pollen during pollination.

**Style:** a long stalk in a flower that connects the stigma and the ovary.

**Ovary:** the hollow base of a flower that contains one or more ovules.

**Ovules:** an outgrowth of an ovary in a seed plant that encloses an embryo sac. Ovules contain the genetic material of the plant.

**Stamen:** the male part of a flower that usually consists of an anther and filament.

**Anther:** the part of the stamen where pollen is produced and shed.

**Pollen:** powdery or coarse grains produced by the anthers of a flower that contains genetic material of the plant.

### Additional Background Information

Pollination is the transfer of pollen from one flower's anthers to the stigma of the same or different flower of the same species. Remember that the anther is the part of the stamen that produces pollen, and the stigma is the part of the pistil in a flower that will receive pollen during pollination. Most flowering plants have flowers with both male and female reproductive structures (these are called **perfect flowers**) but some do not. Some plants have male flowers and female flowers where the male flower produces pollen but the female flower does not (these are called **imperfect flowers**). Flowers of cucumbers and squash are examples of imperfect flowers where the flowers are male OR female but exist in the same plant. Some plant species have individual male plants or individual female plants and the flowers are either male or female corresponding to the sex of the plant. Plant species with male or female plants are called **dioecious** and have imperfect flowers. Given all of this variation among flowering plants, the process of pollination can be complex.

Most flowering plants require **cross-pollination** where the pollen from one plant must come in contact with the stigma of another plant for successful fertilization. Some flowers can self-pollinate (**self-pollination**), where the pollen from the anther simply falls onto the stigma of the same flower or a flower on the same plant. More genetic diversity occurs when flowers are cross-pollinated because the genetic material from the pollen of one plant combines with the genetic material from the ovule of a different plant. In plants where there are male or female flowers or male and female plants, cross pollination is required. If pollination does not occur properly then fertilization is prevented and the flower will die without producing any seeds or fruit.

Pollination has to occur before fertilization can occur. Fertilization is what allows the flower to develop seeds and fruit. Thus, pollination is essential when growing fruits, nuts and vegetables to eat. Plants like corn and grasses rely on the wind to carry pollen from one plant to another but flowering plants rely on **pollinators** like insects, bats, birds, or other animals to disperse pollen.

Pollinators are attracted to flowers due to a variety of features but most visit flowers in order to collect nectar and pollen from flowers to meet their energy needs. This means that the pollinators provide a service to the plants, and the plants provide a food source to the pollinators. Some flowers require multiple visits from a pollinator to ensure proper pollination. A lack of pollination and pollinators could ultimately mean a decrease in our food supply.

What are some foods that you eat that require pollination?

Almond, apple, avocado, banana, blueberry, cashew, cherries, cranberry, cucumber, cantaloupe, eggplant, fig, grape, citrus fruits, melons, peach, pears, peppers, pumpkin, squash, strawberry, raspberry, tomato, watermelon and many others. In addition to these, many fruits, nuts and vegetables require pollination in order to produce seeds to grow more of the food.

## Safety Guidelines

**Lab safety is a must!** In order to safely explore science, we need to follow proper lab safety. How do you think we are going to do this? Scientists follow very strict procedures to protect themselves and wear protective gear like:

- Gloves
- Safety glasses (required)
- Lab aprons or lab coats

### **Before we get started:**

- Be sure everyone including instructors and helpers are wearing safety glasses. Gloves and an apron or lab coat are also recommended for this activity.
- An adult may have to poke small holes into the bottom of the cups with a toothpick or pipe cleaner beforehand. Be careful handling pipe cleaners as they sometimes have sharp ends.
- Point out any safety features in the classroom (ie. Eyewash or emergency shower; emergency exits).
- Mention housekeeping rules – NO EATING OR DRINKING.
- Mention location of bathrooms.

## The Experiment: How Pollination Works

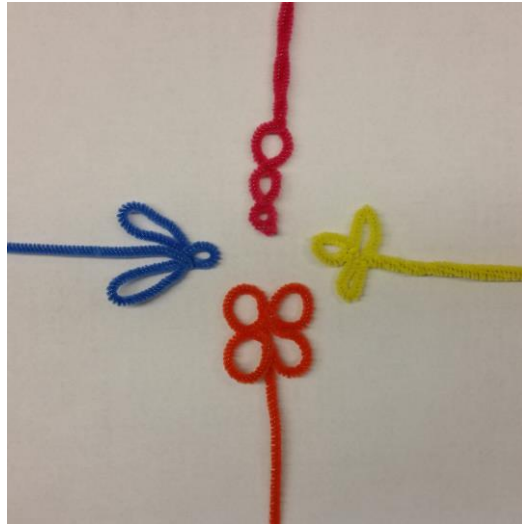
Make sure all participants have a colored pipe cleaner to make an insect in Step 1. Steps 2-4 can be completed beforehand or by a small team of students. Try to have at least one “flower” per three students and at least five colors of gelatin powder per classroom.

### **Materials**

- Colored pipe cleaners (one per student)
- 5 small paper cups (about 4 oz)
- 5 white pipe cleaners about 6 inches in length
- Masking tape
- 1 teaspoon of colored gelatin powder per cup (need at least 5 colors/ flavors)
- Water in spray bottles (one per instructor)
- Measuring tool for teaspoons (1 per instructor)

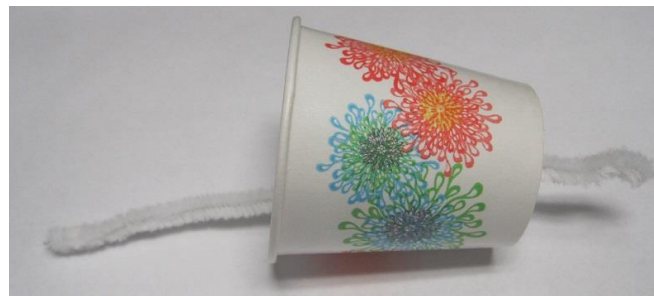
### **Step 1: Create an insect**

Take the colored pipe cleaner and bend into an “insect” shape. The insect should be small enough to fit inside the cup. Leave a few inches of pipe cleaner to serve as a handle for your insect.



**Step 2: Create a Flower Cup**

Make at least five of these “flower” cups or more depending on the number of participants. Use the tip of a pipe cleaner to carefully poke a hole in the center of the bottom of a paper cup. Insert the white pipe cleaner through the hole in the bottom of the cup and pull it through the cup to create the flower pistil.



**Step 3: Create a Flower Stigma**

Wrap a piece of tape, sticky side out, around the top of the white pipe cleaner. You might need to first wrap a piece of tape, sticky side in, to make the sticky side out piece stick to the pipe cleaner. Reposition the white pipe cleaner so that the taped end is just inside the cup and it is not touching the sides of the cup. Coil the extra pipe cleaner around the bottom of the cup and tape down the extra pipe cleaner on the underside of the cup. Tape over the hole you made if it is wider than the pipe cleaner.



#### **Step 4: Add Pollen to your flower**

Select at least five colors or flavors of gelatin- one color/flavor per cup. Add 1 teaspoon of colored gelatin powder into the bottom of each cup. Make sure there is only one color per cup and try not to get any on the white pipe cleaner. Each flower/ cup should have a different color of gelatin powder to represent the different types of pollen from different flower species.



#### **Step 5: Be an insect!**

Have the students move around the room and fly their insects in and out of multiple flower cups by touching the gelatin powder and the tape on the white pipe cleaner. Try and get as much gelatin powder into the tape as you can.



#### **Step 6: Observations**

Following several insect visits to the flower cups, you will observe that the pipe cleaner insect is covered with the gelatin powder and that each time the insect visits the flower cups, some of the gelatin powder sticks to the white pipe cleaner and the masking tape or flower stigma. Lightly spray water on the gelatin powder that is stuck to the tape and observe the colors as they brighten. The gelatin powder represents the pollen. Do you see different colored pieces of gelatin powder?



### Summary:

Next time you visit a garden or farm, look around the flowers to see what kind of pollinators are present. If you look closely, you may be able to see these animals probing the flowers for nectar and see the pollen that has accumulated in their bodies. These animals have a very important role in agriculture and are essential to the continuous production of the food we eat. More importantly, leave them to do their jobs and protect them. Remember, almost one third of the food we eat relies on the work of these pollinators.

Butterflies such as Monarch butterflies are important pollinators. The Living Acres campaign was launched by BASF to raise awareness about the declining Monarch butterfly populations and the importance of biodiversity alongside modern agriculture. Through Living Acres, BASF helps people, primarily farmers in Monarch migration areas to establish milkweed plants in non-crop areas so that Monarch butterflies will continue to thrive in North America.

See the “Start a Milkweed Habitat” Kids’ lab activity.



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