

Okay, Bloomer

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Field(s) of Interest: Biology, Environmental Science

Brief Overview (1-3 sentences):

Mentees will learn the importance of capillary action, and how that supplies plants with nutrients and water. Mentees will also explore the anatomy of a flower by building a 3D model, leading to an activity that reenacts pollination.

Agenda:

- Introduction (5 min)
- Module 1: Capillary Action (5-10 min)
- Module 2: Anatomy of the Flower (15-20 min)
- Module 3: Pollination (10-15 min)
- Conclusion (5 min)

Main Teaching Goals/Key Terms:

- **Capillary action** is the process of liquid flowing through a narrow space without any external forces acting on it.
- **Adhesion** is the tendency of water to stick to itself
- **Cohesion** is the tendency of the material to stick to others unlike itself
- **Petals:** Modified leaves that surround and protect the reproductive parts of the flower
- **Stamen:** Male fertilizing organ of a flower
- **Pistil:** Female reproductive part of a flower
- **Pollination:** Transfer of pollen grains from stamen to ovules to allow for fertilization.
- **Cross Pollination:** One plant pollinating another plant of a different variety.
- **Insect vs Wind Pollination:** Pollination facilitated by insects transferring pollen versus the pollination via the wind blowing pollen around

Background for Mentors

Module 1 <ul style="list-style-type: none">• Capillary action• Adhesion• Cohesion	<p>Capillary action (sometimes called capillarity, capillary motion, capillary rise, capillary effect, or wicking) is the process of a liquid flowing in a narrow space without the assistance of, or even in opposition to, any external forces like gravity. The effect can be seen in the drawing up of liquids between the hairs of a paint-brush, in a thin tube, in porous materials such as paper and plaster, in some non-porous materials such as sand and liquefied carbon fiber, or in a biological cell. Capillary action is seen in many plants, and plays a part in transpiration. Water is brought high up in trees by branching; evaporation at the leaves creating depressurization; probably by osmotic pressure added at the roots; and possibly at other locations inside the plant, especially when gathering humidity with air roots.</p> <p>Several factors are involved in capillary action. The first is cohesion, the tendency of molecules of a substance to stick together. Water is a cohesive element, with a level of cohesion that creates a high degree of surface tension. When water is spilled on a table, it tends to stick together in a puddle, rather than spreading out, because it is cohesive.</p> <p>The second factor is adhesion, the tendency of some substances to be drawn to unlike substances. In the example of a tree and the water in the ground, the liquid is drawn to the cellulose fibers in the tree trunk, which form small capillaries known as xylem. As the fluid adheres, it creates a meniscus, a small curve, along the edges of the xylem. The surface tension in the water causes the water to climb up as the meniscus forms, because of the adhesion force between the wood and water molecules, and a new meniscus will form as the water is drawn further up into the tree. Without any effort on its part, the tree can draw the water all the way up into its top branches.</p>
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Background for Mentors

Module 2

- Petal
- Stamen
- Pistil

When looking at a flower, our eyes are automatically drawn toward the **petals**. Flower petals are modified leaves that come in all different shapes and sizes to give different flowers a unique quality. These petals draw the attention of bugs and insects who are looking for a new flower to land on, hence contributing to the pollination cycle for flowers.

All flowers have a reproductive system located directly in the center from where the petals bloom. The first part of this system is the **stamen** which acts as the male fertilizing organ of a flower. The two major parts of the stamen consists of the anthers and the filaments. Anthers are found at the head of the stamen and produce the pollen. Filaments are stems which connect the flower and the anthers.

The second major part of a flower's reproductive system is the **pistil**. The pistil acts as the female reproductive part of a flower in which it contains the eggs. The three main parts of the pistil are the stigma, style, and ovary. Located at the tip of the pistil, the stigma receives and collects pollen as insects and bugs land on the flower. The ovary of the pistil contains the flower ovules which later fertilize into seeds. Lastly, the stigma and ovary are connected by a tube called the style.

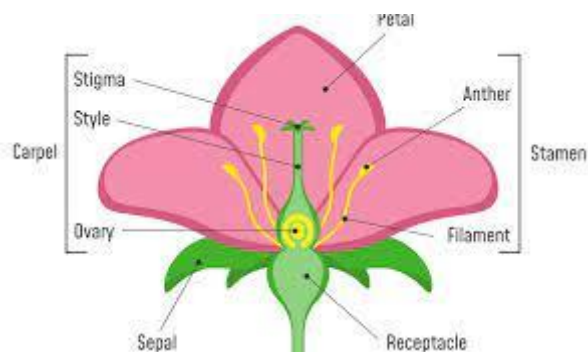
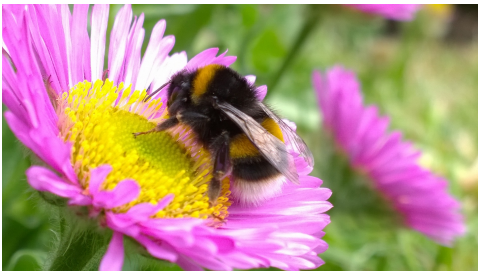


Figure 1. Diagram of flower

Background for Mentors

<p>Module 3</p> <ul style="list-style-type: none">• Nectar• Pollination• Cross Pollination• Insect vs Wind Pollination	<p>Nectar is produced in glands known as nectaries. Nectaries can be located on any part of a plant, but the glands are most commonly found in flowers. Nectar is what attracts pollinators to flowers and serves as a reward, but it also causes pollinators to come into contact with the pollen to be transferred.</p> <p>Pollination is the transfer of pollen grains from a plant's stamen to ovules and is absolutely vital to the creation of fruits and seeds, allowing for the creation of more plants.</p> <p>Most pollination is achieved through cross pollination which entails the egg cell of one plant being fertilized from a sperm cell from a pollen grain from a different plant, either of the same variety or different. This is generally achieved via insect pollination. Insect pollination is generally characterized by the insect, usually a bee, getting covered in pollen as it takes in a flower's nectar, which is then transferred to the next flower it decided to visit and feed off of.</p> <p>In addition to insect pollination, plants can also be pollinated via the wind in what is called wind pollination. Although inefficient and not very commonly seen in most flowering plants, the wind can help carry pollen from one plant to another one, although it is unlikely that the receiving plant will get more than a grain or two of pollen.</p> <div data-bbox="764 1262 1239 1530"></div> <p>Figure 1. A bumblebee doing her pollination</p>
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Introduction

Plants are very important for the environment! Pollination is how plants reproduce, and therefore, the reason why we have green, colorful parks, the source of our materials, and lots of the produce we see in stores.

Concepts to Introduce <ul style="list-style-type: none">• Capillary action• Different parts of a flowers body• Pollination• Bees = bee movie	Questions to Pique Interest <ul style="list-style-type: none">• What country is named after a tree? Brazil- Terra do Brasil (“Land of Brazil”), a reference to the brazilwood tree.• The California redwood (coast redwood and giant sequoia) are the tallest and largest living organism in the world.• Carrots were originally purple in color.• Have you ever been stung by a bee?
Scientists, Current and Past Events <ul style="list-style-type: none">• Bees are dying at an alarming rate due to a combination of factors including habitat loss, pesticide exposure, disease, and climate change. These factors have led to declines in bee populations worldwide, with some species facing the risk of extinction. Bees are crucial for pollinating flowers, fruits, vegetables, and nuts, which are essential for human food production, making their decline a significant threat to global food security and ecosystem stability.• https://www.mprnews.org/story/2021/06/23/honey-bees-are-still-dying-at-high-rates	Careers and Applications <ul style="list-style-type: none">• Bees are important because they are vital pollinators, helping to fertilize flowers, fruits, vegetables, and nuts, which contributes to the production of much of the world's food. Without bees, many crops and ecosystems would suffer, leading to potential food shortages and ecological imbalances.• Careers related to bees and flowers include beekeepers, who manage honeybee colonies for honey production, pollination services, and other hive products; entomologists, who study bees and their behaviors; horticulturists, who work with flowers and plants to create and maintain gardens and landscapes; and floral designers, who create floral

	<p>arrangements for various events and occasions. Additionally, there are opportunities in research, conservation, education, and policy-making related to bees and flowers, as their importance in agriculture, ecology, and culture continues to be recognized.</p>
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Module 1: Capillary Action

We intend to show and explain the capillary action in trees and plants. How the water travels up from the roots through the stem/trunk. They will see this property through water traveling up the wipes.

Teaching Goals

List and explain/define the 1-3 main concepts you want to focus on *for this specific module*. For example...

1. **Capillary action** is the process of liquid flowing through a narrow space without any external forces acting on it. This happens in plants and trees, with evaporation causing a depressurisation.
2. **Adhesion** is the tendency of water to stick to itself, high levels of cohesion lead to high surface tension.
3. **Cohesion** is the tendency of the material to stick to others unlike itself, water being sucked up a tissue.

Materials

- 2 different colored water
- 4 clear cups
- Wipes

Procedure

1. Pour the dyed water into two different cups. This represents the water in the soil, the color allows for a better visualization. The empty ones represent destinations in the plant.
2. Connect the cups with super absorbent wipes. One side in a dyed water cup the other side in an empty one. The water will travel upwards defying gravity, this is because of adhesion between the water and the wipes (cellulose fibers).
3. As the water travels up these relate this back to the capillary action. It will drip into the empty cups. The water travels up the roots of the plant to a different destination in it, petals, leaves, etc.



Figure 2: Paper towels in the dyed water

Classroom Notes

Group activity if they are behaving well, demo if not.

Module 2: Anatomy of a Flower

This module will explore the anatomy of a flower, and mentees will get to create a 3D flower to take home and to use to explore pollination in module 3.

Teaching Goals	Materials (for each student)
<ol style="list-style-type: none"> 1. Petals: Modified leaves that surround and protect the reproductive parts of the flower 2. Stamen: Male fertilizing organ of a flower. The anther produces pollen and is held up by the filament. 3. Pistil: Female reproductive part of a flower. The pistil consists of three parts: stigma, style, and ovary. The style is a tube that connects the stigma (pollen receptive tip) to the ovary (contains ovules/seeds). 	<ul style="list-style-type: none"> • 1 plastic straw • 4 construction paper • 2 piper cleaners • Small ball of play-do • Tape • Scissors

Procedure

4. Draw a diagram of a flower on the board, showcasing the different parts. Introduce the parts as how a pollinator would interact with a flower.
 - a. Start with how the petals and how its vibrant colors attract pollinators
 - i. Analogy - Trader Joes uses bright, colorful signs to attract its customers to different products
 - b. The pollinators reaches for the nectar, which is found at different locations (petals, anthers, stamens, sepals, pistils, styles, ovaries) based on the species of the flower
 - c. Explain how the pollen sticks onto the pollinators, and how it travels down the stamen to fertilize the eggs
5. Next, we are going to be building a 3D model of a flower.
 - a. Grab your straw and cut incisions on the lines of where the straw bends. This will result in 4 bands → cut 2 of the 4 bands. This will create a “pocket,”

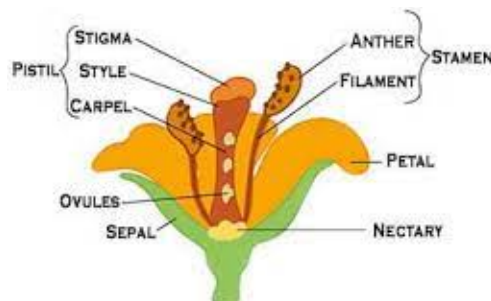


Figure 1: Parts of a flower

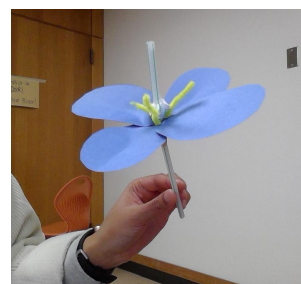


Figure 2: DIY flower

which mimics the ovaries, and will serve to hold a ball of play-doe in a future step.

- b. Cut out 4 petals in total in the shape of tear drops (or to whatever shape the mentees desire).
- c. Tape the petals one by one onto the straw and equidistant to each other so that it surrounds the ovaries.
- d. Roll a small ball of play-doe, insert it into the pocket. This will be the ovaries of the flower.
- e. Cut pipe cleaners to about 2 inches long, gathering 4 in total. Insert the pipe cleaners in the space between the ovaries and the petals. These will be the filaments of the flower.

Module 3: To Bee or Not to Bee

We are showing how pollination works by using the flowers from module 2 and creating bees to visually represent pollination

Teaching Goals <ol style="list-style-type: none">1. Pollination: Transfer of pollen grains from stamen to ovules to allow for fertilization.2. Cross Pollination: One plant pollinating another plant of a different variety.3. Insect vs Wind Pollination: Pollination facilitated by insects transferring pollen versus the pollination via the wind blowing pollen around	Materials <ul style="list-style-type: none">• Construction paper flower made in Module 2• 1 black & 1 yellow pipe cleaner per student• Baby powder
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Procedure

6. Prior to starting the activity, mentors should have mentees get into groups with other mentees that have the same flower color as them & explain that the color of the mentee's flower represents being a certain flower variety, and that different colors imply different flower varieties
7. Have mentees wrap their pipe cleaners around one finger in order to make a little bee
8. Each mentor will then go to one of these groups and hold all of the mentees' flowers from that group in a bouquet of sorts, and add baby powder to the stamens of each flower
9. To represent cross pollination, have mentees rub their bees on the pollen from their own flower variety and then go to a flower of a different variety and pollinate there
 - a. Sprinkle more baby powder on the flowers as you see fit/as necessary
10. Have mentees also "pollinate" other flowers of their same plant variety
11. To represent wind pollination each mentor should blow on their "bouquet" and have mentees see the baby powder blow from



Figure 1: Crafting the pipe cleaner bee

flower to flower. You can have the mentees try this too!

Classroom Notes

Any additional tips for mentors to make their lives easier? A hint about a certain way to build something? A shortcut? What to do if a student is struggling with something?

Conclusion

Capillary action, anatomy of the flower and pollination are all crucial parts of the ecosystem. We want mentees to take away that flowers have complicated systems but can ultimately be broken down into smaller parts. We also wanted to highlight the importance of bees into the ecosystem.

References

- Add references in case your mentors want additional information!
- Title of Source, Author, Organization. <http://www.example.com/>

Summary Materials Table

Material	Amount per Site	Expected \$\$	Vendor (or online link)
Food color dye	2		Bechtel
Clear cups	4		Bechtel
Wipes	2		Bechtel
Construction paper	15		Bechtel
Play-doh	7 jars	\$8	Amazon
Plastic straw	1/student (~22 total)	\$7	Amazon
Pipe cleaner	4/student (~88 total)	\$18.50	Amazon
Tape	1		Bechtel
Scissors	11		Bechtel
Baby powder	1	\$6.29	Amazon