



Mutualism Mouthpart Engineering

Content Connections:

Life Science - Animal adaptations

Engineering - Compare different solutions to completing a task

Grades: 2nd-6th

Time: 30-60 min

Objective: Students will model and discuss animal adaptations and how adaptations impact plant-pollinator relationships.

Materials:

- Eye droppers (1-2 per group)
- Clothespins (1- per group)
- Sponges (1-2 per group)
- Pipettes (1-2 per group)
- Bendy straws (1-2 per group)
- Cups of assorted sizes (1 each per group of Dixie cups, 5 oz cups, bottle caps,)
- Bowls of assorted sizes and shapes (1 each per group of soup bowls of 3 different sizes)
- Plates of assorted sizes and shapes (1 each per group of saucer, plate, Tupperware lid)
- Test tubes (1 per group)
- Tall and narrow bottles of different sizes, such as soda bottles (1-2 per group)
- Colored water
- Colored beads

Background:

Pollination is a mutualism in which two interactors benefit from each other: a plant rewards pollinators by providing nectar and pollen in return for the service of pollination. Many plants are able to be pollinated by a variety of pollinators. Additionally, many pollinators are adapted to feed from many plants. These pollinators are known as generalists. However, some pollinators and plants are almost completely reliant on one another. These types of pollinators

are known as specialists because they are perfectly adapted to feed almost exclusively on specific plants.

Mouthpart Activity Station Prep:

- Set up activity stations as described in the instructions below for students to explore pollinator mouthparts. There should be enough stations to accommodate 4-5 students at each station (i.e., 20 students would require 4-5 stations).
- Each station should include at least one of each Pollinator Mouthpart Tool listed in the table below, as well as the materials listed under Flower Shape in the table below. Fill each Flower Shape with the corresponding materials listed under Nectar Source. These materials simulate different types of mouthparts and flowers, as well as whether these mouthparts might belong to a generalist or specialist pollinator.

Type of Pollinator	Pollinator Mouthpart Tool	Flower Shape	Nectar Source
Generalist	Eye dropper	3 cups of different sizes (i.e., Dixie cups, 5oz cups, etc.)	Cup with small amount of colored water
Generalist	Clothespin	3 Bowls of different sizes (i.e., soup bowls, tea cups, etc.)	Colored beads taped to paper (represents pollen)
Generalist	Sponge	3 Plates of different sizes (i.e., bottle caps, plates, saucers, plastic lids, etc.)	Colored water on plates
Specialist	Pipette	Test tube	Test tubes with colored water
Specialist	Bendy straw	Tall, narrow bottle (such as glass or plastic soda bottle)	Fill bottom of bottle with small amount of colored water

Procedure:

1. Ask students to share what food they like to eat and how they eat food. What tools do they need to help them eat? Can you eat spaghetti very well with a spoon? Can you eat soup very well with a fork?
2. Just like we use forks, spoons, and knives to help us eat different foods, and not every tool is good for every food, pollinators use different mouthparts to help them eat food from different flowers.

3. Because animals don't use silverware to eat food like we do, they have different adaptations to help them eat. Some animals have long noses, some have sharp teeth, some have flat teeth.
4. Pollinators have special mouthpart adaptations to help them get their food from different types of flowers. To model the close relationship between plants and pollinators, have the class complete the Mouthpart Activity Stations.
5. Before starting the activity, model to students how to complete the activity by interacting with each of the types of mouthparts and flower shapes. Explain their objective: identify which type of mouthpart works best for types of pollinators. Let the students explore the mouthparts and discover what types of flowers work best for each food source.
6. Debrief the activity with the students. Ask students to share which mouthpart worked best for each flower shape and food type. Students should identify that the eye droppers, clothespins, and sponges worked for multiple flower types whereas the pipette and bendy straws only worked for certain types of flowers.
7. Ask students to try and explain an analogy between this activity and real-life plant-pollinator relationships. Explain to students that what they observed with the mouthpart tools is similar to real life. Some pollinators are Generalists and can feed off a variety of different types of flowers. Conversely, some pollinators are Specialists with mouthpart tools that can only feed on certain types of flowers.

Extensions:

1. As time allows, provide students with an opportunity to demonstrate their understanding of mouthpart tools, mutualism, generalist and specialist pollinators by asking them to design a pollinator that would pollinate a certain flower.
2. Provide each student, or partners, with pictures of unfamiliar, oddly shaped flowers (see images in provided resources) and ask them to draw a pollinator that might like to find food in that flower.
3. As they draw, ask them to consider:
 - a. What size would the pollinator be? Would they need to be large and strong to get to the pollen and nectar, or would a small pollinator have a better chance?
 - b. What would be the best type of mouthpart for reaching the nectar? (Beak, proboscis — long or short)

Design a Pollinator

There are lots of unique flower shapes out there, and each one needs to get pollinated. Select one of these funky flowers and design the perfect pollinator for it. As you're brainstorming, think about these questions:

- What size should the pollinator should be? Does it need to be large and strong to get into the flower to the pollen and nectar, or would a small pollinator have a better chance?
- What would be the best type of mouthpart for reaching the nectar? (Beak, proboscis — long or short)

Have fun and get creative!



Heliconia (*Heliconia* sp.)



California Dutchman's Pipe
(*Aristolochia californica*)



Catalpa (*Catalpa speciosa*)



Jack-in-the-Pulpit (*Arisaema triphyllum*)



Lady Slipper Orchid (*Cypripedium* sp.)



Hairy Clematis (*Clematis hirsutissima*)



Saguaro Cactus (*Carnegiea gigantea*)



Wild Ginger (*Asarum* sp.)



Dutchman's Breeches (*Dicentra cucullaria*)



Snapdragon (*Antirrhinum majus*)



Purple Coneflower (*Echinacea purpurea*)