Honey, I Shrunk the Mentees!

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Field of Interest: Mellitology, Apiology, Organismal Biology

Brief Overview: Mentees will learn a few concepts about bees and pollination and conclude with a crafts project teaching them about bee anatomy and hive structure.

Agenda:

- Introduction (5 min)
- Module 1: The Spice of Life (15 min)
- Module 2: Mixed Signals (15 min)
- Module 3: The BEAM Movie (20 min)
- Conclusion (5 min)

Main Teaching Goals/Key Terms:	**Mentor Development Goals:**
➔ Agriculture ➔ Pollination ➔ Waggle Dance ➔ Pheromone ➔ Beehive ➔ Bee Anatomy	➔ **Connecting to the Real World** ➔ **Adapt to the Classroom** ➔ **Support Mentees** ➔ **Encourage Creativity**

Background for Mentors

Module 1

- Pollen
- Pollination
- Agriculture
- Genetic diversity

Agriculture includes the production of crops and livestock for consumption and is an important industry for making sure there are a variety of foods available for the population. More than 80% of flowering plants are pollinated by bees and would be difficult to grow without them. Imagine a world without apples, avocados, chocolate(!), coffee, grapes, or vanilla...

Bees orchestrate an important process called **pollination**, which is the transfer of **pollen** from one flowering plant to another. Pollen is one of the components of a seed, the other being the ovule/egg. When bees land on flowers to collect nectar, they dislodge pollen from the flower and it sticks to pollen baskets on their legs. When they move to other flowers, some of the pollen falls off, entering the flower through pollen channels in the stigma and fertilizing the ovule.

Because of the actions of bees, pollen from one flower can end up fertilizing ovules miles away, allowing seeds to be **genetically diverse**. This in turn allows plants to adapt to a variety of environmental conditions, lessening the chance they will go extinct due to disease or pests.

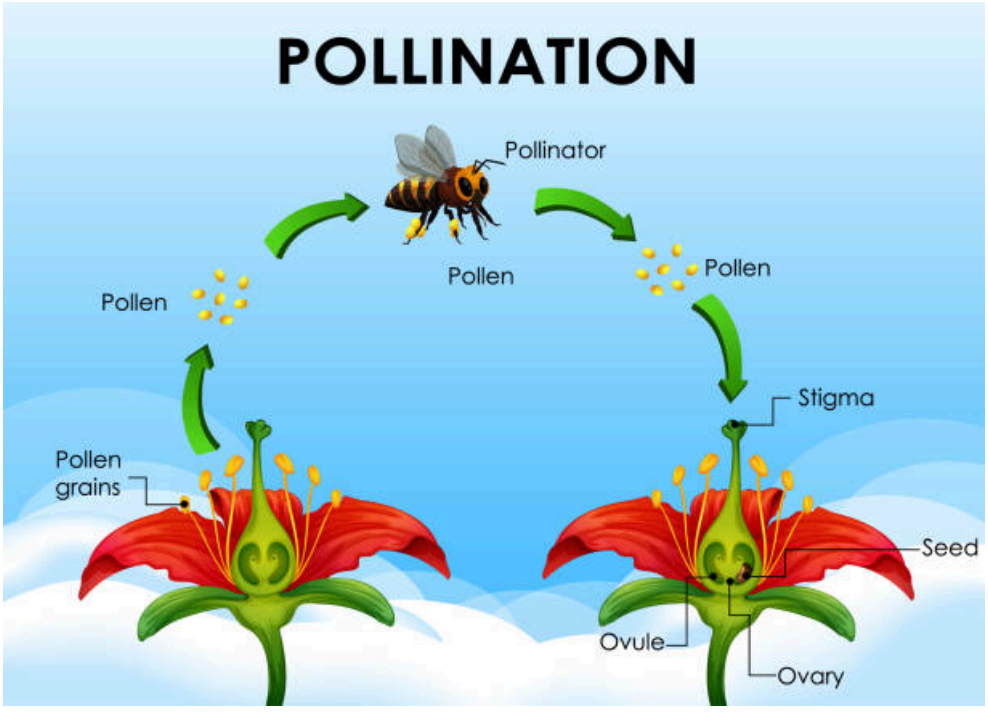


Figure 1: Pollination

Module 2

- Pheromones
- Waggle dance
- Tremble Dance

Bees use a few forms of nonverbal communication that are essential to their lives.

Pheromones are chemicals secreted and sensed by special organs on bees that signal many actions including swarming, foraging, defense, development, and reproduction. Some pheromones, mostly those secreted by the queen, are so powerful as to impact the developmental cycles in other bees. Another, secreted when a bee dies, signals other bees to remove the corpse from the hive to prevent a potential parasite or disease from spreading further.

The **waggle dance** is a flight pattern used to communicate the location of the hive, flowers, and other important landmarks to other bees. It usually occurs along pheromone secretion and is important for pollination.

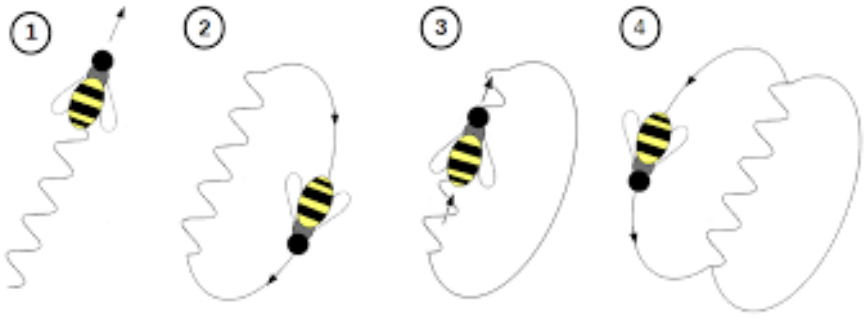


Figure 2: The waggle dance

The **tremble dance** is a vibration that forager bees engage in when they return to the hive to recruit more receiver bees to offload their nectar.

Module 3

- Beehive
- Cell
- Bee anatomy
    - Antennae
    - Eyes
    - Mandible
    - Head
    - Thorax
    - Abdomen
    - Stinger
    - Wings
    - Legs
    - Pollen baskets

Bee anatomy includes, but is not limited to:

- **Antennae**: used for sensing the environment
- **Eyes**: also used for sensory purposes
- **Mandible**: used for biting food and working with wax
- **Head**: housing the antenna, eyes, and mandible
- **Thorax**: connecting the bee's many parts
- **Abdomen**: used in communication and houses the stinger
- **Stinger**: used for defense
- **Wings**: used for flight
- **Legs**: used for landing on flowers and moving around the hive
- **Pollen baskets**: collects pollen from flowers

Bees live in **beehives**, which can be built anywhere but are usually found in tree branches, tree trunks, sheds, and other sheltered locations. Apiaries (bee farms) will usually build their hives in fields with access to sunlight, flowering plants, and a water source.

The individual component of a beehive is a **cell**, a hexagonal/circular chamber that can house larvae, nectar, eggs, pollen, and honey.

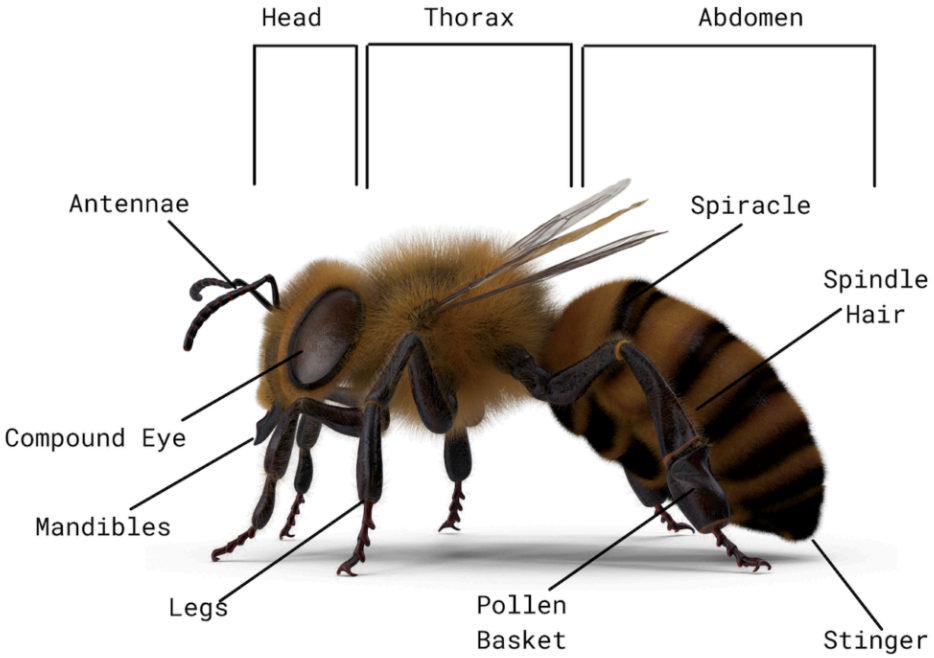


Figure 3: Bee anatomy

Introduction

Concepts to Introduce	**Questions to Pique Interest**
● Bees! ○ Mentees probably know what bees are and that they sting, but they might not be aware of the important role bees play in agriculture and genetic diversity ● Insect anatomy ○ Introduce mentees to some of the important organs in insects such as the wings and stinger ● Bees vs wasps ○ Mentees may have had scary experiences with wasps, so explain that wasps are more aggressive while bees are helpful! Feel free to bring this up again during Module 3 when discussing anatomy	● Where do you usually see bees? ○ Flowers ○ Plants ○ Around school if there are planter beds ● Have you ever seen a beehive? ● What do you think bees want when they land on flowers?
Scientists, Current and Past Events ● Colony Collapse Disorder ○ Fairly recent phenomenon where worker bees will leave the queen and immature larvae, “killing” the hive ● Abnormal quantities of bees are dying on a yearly basis - a product of mites, disease, pesticide, monocrop agriculture, and climate change	**Careers and Applications** ● Mellitologists study bee ecology, anatomy, etc. in general, while apiologists specifically study honey bees ● Honey! ○ Common sweetener in drinks and desserts

Module 1: The Spice of Life

Mentees will be learning about the purpose of pollination in agriculture and complete a drawing activity to demonstrate it. This module should be a small group activity.

Teaching Goals

1. **Pollen:** Particles released by a flower that can fertilize another flower, allowing it to produce fruit and contributing to genetic diversity.
2. **Pollination:** Bees transferring pollen from flower to flower when it sticks to their legs.
3. **Agriculture:** The process of growing plants on a large scale, supported in large part by pollinators like bees.
4. **Genetic diversity:** A variety in the genes of plants that makes them more resistant to dying out.

MD Goals

1. **Connecting to the Real World:** Tie in concepts and vocabulary surrounding pollination to the field of agriculture as a career. Agriculture is a prominent aspect of the state of California, so emphasize its importance as a field for us and the bees! In addition, use real-world examples, such as the flowers blooming during spring, to illustrate the role flowers play for pollination and bees.

Materials

- Per mentee
  - 1 marker
  - 1 piece of printer paper

Different Methods for Teaching

1. Pollen: You can explain that the pollen and the ovule are like peanut butter and jelly and combine to form something new (a seed) like a PB&J sandwich!
2. Pollination: How would mentees feel if they could only eat one food for the rest of their lives? It would probably not be healthy for them and they might feel sick! Likewise, pollination helps flowers get a variety of genetic material so they can have the best chance of survival!

Procedure

1. Give each mentee in a group a piece of paper and a different color of marker.
2. Have each mentee make 1 line/curve and then have all mentees in the group get up and rotate one chair to their right/left.
3. Each mentee will make another mark on the paper they have in front of them and repeat.
4. Once mentees have made a mark on every paper in the group, check in on mentees' progress. If they would like to continue for more rounds, allow them to. Otherwise, mentees can move on to another activity or start new drawings.
5. **Note**: mentees can draw whatever they want, but if they are stuck, suggest something related to bees or nature (ex. flowers, trees)!

Figure 1: *Round 1 mark made by Mentee 1*

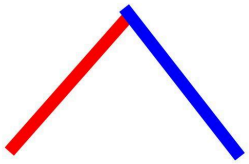


Figure 2: *Round 2 mark made by Mentee 2*

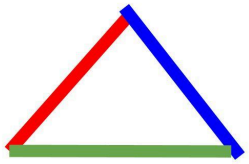


Figure 3: *Round 3 mark made by Mentee 3*

Classroom Notes

You may have issues with mentees being unhappy with the marks other mentees make on their paper. If other mentees are intentionally ruining their drawings, step in and tell them to be more considerate of everyone else in the group. Separate mentees who may have this problem beforehand.

Module 2: Mixed Signals

Mentees will learn how bees communicate with other bees about the location of flowers and the hive and then play a game of charades, mimicking nonverbal communication.

Teaching Goals

1. **Pheromone:** Chemicals released by bees to guide other bees in defense, swarming, pollination, and other activities.
2. **Waggle dance:** A dance where bees perform a back and forth flight pattern to guide other bees to food.
3. **Tremble dance:** When forager honey bees vibrate their bodies and legs to signal the need for more receiver bees to collect their nectar.

MD Goals

1. **Adapt to the Classroom:** Other mentees might get jealous if one mentee gets to act out all of the charades. Alternatively, some groups might enjoy the activity more if one mentee acts out all of the charades. Try to get a feel for which option your mentees want and adapt to their needs!
2. **Support Mentees:** Some mentees might get embarrassed and freeze when it comes to their turn to act out their location. Before site, think of ways to move the game along without placing the spotlight on that mentee, or some things you can say to them to help them through it!

Materials

- Location cards

Different Methods for Teaching

1. Use charades and other forms of nonverbal communication like pointing and waving to have mentees think about how they would do the jobs of bees.

Procedure

1. **Option 1**
    a. Mentees will get into groups and choose one mentee to be the “leader.”
    b. The mentor will show the card with a location to the leader and the leader will try to act out the location while the other mentees guess it.
2. **Option 2**
    a. Mentees will get into groups, each with a location card.
    b. Mentees must act out their location for other mentees in their group to guess. When one mentee’s location is guessed, it will be the turn of the mentee to their right/left and so on.
3. Both of these options can be done competitively or not, depending on what your mentees prefer.

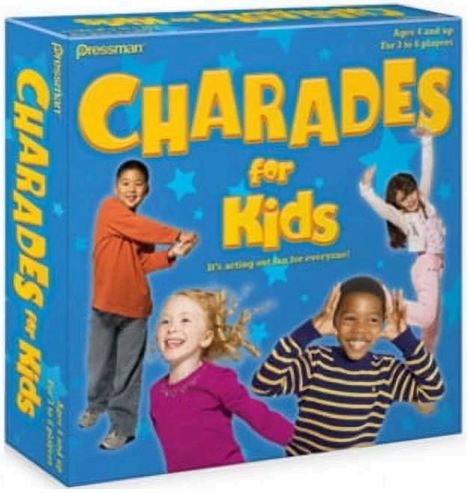


Figure 1: *Idk it’s charades*

Classroom Notes

The first option might be faster but the second option allows all mentees to have a chance to act out a word. Choose whichever you think works best for your site!

Module 3: The BEAM Movie

Mentees will be learning about bee anatomy while building a bee and constructing/decorating a cell to give their bees a home.

Teaching Goals

1. **Beehive:** The large structure that bees make out of wax to live in.
2. **Cell:** A hexagonal section of a beehive used to store honey, nectar, or larvae.
3. **Bee Anatomy**
    a. **Antenna:** The organ that gives bees smell, taste, and touch.
    b. **Eyes:** Used for vision.
    c. **Mandible:** Used for cutting food and working with wax
    d. **Head:** Houses the eyes and brain.
    e. **Thorax:** Midsection of the bee that attaches the legs to the head and thorax.
    f. **Abdomen:** Houses the stinger.
    g. **Stinger:** Bee's defense mechanism against invaders.
    h. **Legs:** Movement inside the hive.
    i. **Wings:** Allows the bee to fly.
    j. **Pollen baskets:** Allows the bee to collect pollen when it lands on flowers.

MD Goals

1. **Encourage Creativity:** After going over all of the parts of a bee and their beehive, encourage mentees to have fun with their creations and create unique stories and homes for them!

Materials

- Yellow Play-dough (1 container split between 4 mentees)
- Black pipe cleaners (1 per mentee)
- Construction paper
    - Yellow (2 per mentee)
    - Blue (½ per group)
- Googly eyes
- Markers
- Crayons
- Tape
- Scissors
- Bee diagram

Different Methods for Teaching

1. Have mentees compare their own anatomy to that of bees and think of reasons for the differences!

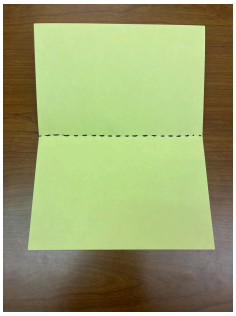
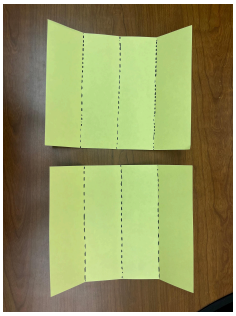
Procedure

1. Mentees will create and decorate a beehive cell with two pieces of construction paper
    a. Fold both pieces of paper in fourths
    b. Overlap one segment of each paper and tape/glue
    c. Decorate
    d. Overlap the two segments at the ends of the papers and create a hexagonal prism
2. Make a bee out of the provided materials
    a. Suggestions: playdough for abdomen and thorax, pipe cleaners for legs, stinger, antennae, construction paper for wings, googly eyes for eyes, markers to make stripes.
    b. Let mentees be creative with this part!
3. Optional: Connect everyone's cells to each other to make a "beehive"
4. Encourage mentees to be creative and personalize their cells with a bed, kitchen, etc.

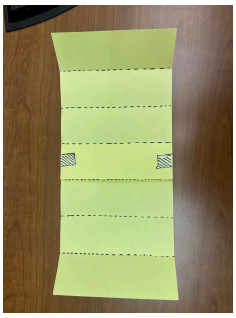
How to make a hexagonal prism

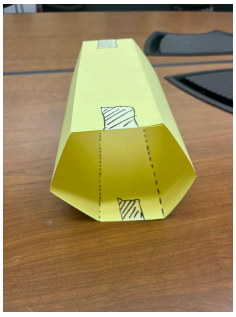
dotted lines=folds
stripes=tape

x2

x2

Classroom Notes

The craft may take some time so consider explaining the lesson content while passing out materials and/or while mentees are building their bees. It's probably easiest to decorate the cells before the final connection is made

Conclusion

If the teacher approves of it, please pass out honey sticks to each mentee and instruct them **not to give it to any infant siblings they may have.** If you have time, talk about the environmental impact of bees and the fact that it takes a bee's entire lifetime to make 1/12th of a teaspoon of honey!

References

- https://askabiologist.asu.edu/honey-bee-anatomy
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8396518/
- https://www.ncbi.nlm.nih.gov/books/NBK200983/