Lesson:
Where Do Bees Get Wax to Build Their Cells?

Teacher's Guide to the Honeybee Discovery Center's Lesson Plan
Developed by: HDC Staff

Grade Level: TK-K-1 and 2-3

Background: Honey bees build their cells for honey and pollen storage and to rear their young out of beeswax. When bees are between 12 and 20 days old, they develop glands that produce wax. The wax is created in flakes that extrude between the segments of a bee's exoskeleton on a bee's abdomen. Wax flakes are created using the sugar in honey for energy. The flakes are used by the bees to create their cells. The bees chew the wax and then add it to the wax foundation and "draw" out the comb. Even without a sheet of wax, also called foundation, the bees will build 6-sided cells. Making wax requires a lot of energy. It takes approximately 8 pounds of honey to make a pound of wax. Because of this, bees make wax and build onto their hive only when they have plenty of food to convert to energy. This lesson is intended to be an interactive lecture with the teacher sharing information through questions and a demonstration.

Objective: Students will be able to identify and characterize the primary anatomical functions of a honey bee and how wax cells are made.

Preparation:
- Gather materials
- "Where Do Bees Get Wax to Build Their Cells" presentation ready
- Compile supporting worksheets and diagrams
- Students complete activity

Materials: (adjust supplies to number of students)
- Presentation: Beeswax Lesson Presentation for Teachers
- Beeswax sheets
- Candle wicks
- 8 oz jar of honey
- 1 oz bar of beeswax
- Bee Anatomy Worksheet (optional)
- Members of the Colony PDF

VOCABULARY

1. Foundation: The wax or plastic sheet placed in the frame for the bees to build out with wax.
2. Abdomen: the largest part of the bee's body where wax is produced. It contains the stomachs and intestines.
3. Exoskeleton: the segmented, rigid coverings on a bee's abdomen.
4. Wax: a natural product produced by bees, which they use to build cells.
5. Wick: a braided cotton that holds the flame of an oil lamp or candle.
6. Dorsal: refers to the front part of the body.
7. Extrude: to force, press, or push out.
8. Energy: the ability to do work, to make things happen and to cause changes.
9. Mandible: two movable jaws; a pair of claws suspended from the head and part of the bee's mouth.

PROCEDURE

1. Presentation. Follow script for slide to slide guidance.
    a. Ask students "Where does beeswax come from?" Share with students that beeswax comes from bees.
    b. Slide 1: Read the slide and begin the presentation with "Are you ready to know how bees make beeswax?"
    c. Slide 2: Read "Lets learn how bees make beeswax and why they make it."
    d. Slide 3: Read "First, let's learn how do bees make beeswax."
    e. Slide 4: Read the slide and point out bees as you name them. You can explain that bees have many jobs in the hive and making beeswax is one of them.
    f. Slide 5: Refer to the bee picture and point out the wax scales on the ventral (meaning underneath) side.
    g. Slide 6: Read the slide. Share with students that energy is needed for all living things. Just like they need to eat for breakfast to have energy to play and learn, bees also need energy to create beeswax.
        i. Optional: Show the 8 oz jar of honey and point out that the process of creating wax requires that the bees have food for energy. Explain that they need to ingest 8 oz of honey to make 1 oz of beeswax. Show the 1 oz bar of beeswax.
    h. Slide 7: Read the slide and point out the hind and fore legs on the screen diagram.

i. Slide 8: Refer to the bee picture and point out the ventral side (meaning frontside) of the bee which is the underneath part of the worker bee's abdomen.
j. Slide 9: Read the slide and point out that bees don't have mouths and teeth like humans to chew. Instead, they use their mandibles to "chew" the beeswax.
    i. *Optional: Ask students to use their hands and form mandibles with their hands and pretend to use them to chew the beeswax.
k. Slide 10: Play the embedded video and ask students to watch carefully at the worker bee in the middle of the screen. Watch as it moves the scale of beeswax with her hind legs to her mandibles to chew the beeswax and add the chewed-up pieces to the cell. Point out that the video is in real time, so it takes a very long time for bees to create the cell walls.
l. Slide 11: Read the slide. Point out the walls that make up the individual cells.
m. Slide 12: Read the slide.
n. Slide 13: Read the slide.
o. Slide 14: Read the slide and propose the question. Ask for some ideas from the students. You are looking for answers such as: honey, pollen, baby bees or larva.
p. Slide 15: Read the slide and point out the image of honey in the honeycomb. Point out the pollen and say, "You can see the pollen is bright yellow."
q. Slide 16: Read the slide. Point out that the egg and larva stages of the bee do not resemble a bee until the pupa stage.
r. Slide 17: Read the slide.
s. Slide 18: Read the slide.
t. Slide 19: Read the slide.
u. Slide 20: Ask assessment questions and/or use the attached assessment worksheet.
v. Slide 21: Thank you for learning with us!
w. Slide 22: Picture sources.

ASSESSMENT

The teacher will assess student learning by presenting the following questions, with students responding in oral or written form. You may also use the assessment questions at the end of the video presentation on slide 17.

Here is the answer key Assessment for Beeswax Lesson.pdf. Check out the Member of the Colony PDF.

1. Which honeybee makes beeswax? (worker, queen, drone)
    a. Worker bees
2. Where do honeybees get beeswax?
    a. They use energy from eating honey to exude wax from wax-secreting glands on the ventral side of their abdomen.
3. What do bees use the beeswax for?
    a. To create the wax-combed cells that make up the honeycomb.
4. What is stored in the wax-combed cells?
    a. Honey, pollen, eggs, larvae
5. What things can be made from beeswax?
    a. Candles, lip balm, soap, lotion, furniture polish

Optional assessment:

1. How are the bees able to create wax? (Concept of how energy is necessary and where it's from.)
2. Students can draw and label a picture of a bee with wax extruding from between the ventral side of a
bee's abdomen.

Extension: Explore the concept of "energy" further.

a. Why is energy required in nature?
b. What are some sources of energy?
c. Where do humans get energy? (Could be as detailed as learning about mitochondria and other cellular structures.)
d. How is energy stored? What are the different kinds of energy?

ACTIVITY

Tips &/or Cautions: (If relevant, 20 or fewer students, thoughts after teaching, etc.) Rolling the candles requires adult help for younger students and is best taught in a small group. Use a direct instruction sequence; with the teacher demonstrating the process first with an “I do, We do, You do” sequence. It can be helpful to note to students that they won’t be given more wax and should follow the directions carefully because bees don’t waste wax.

Activity Steps:

1. Explain to students that you will be working with 100% beeswax to create beeswax candles. Each student will get one sheet of wax and a precut wick for 2 candles.
2. First, divide the sheet of wax in half. Carefully fold the sheet of wax in half shorter side corner to corner or “hamburger style.” Repeat, folding the wax the opposite way, back and forth. After approximately four bends, the wax will break in half. (For younger children, the teacher may want to pre-break the sheets instead of the students.)
3. Note that the “string” is a special kind used specifically for candles and is called a wick.
4. Begin by laying the wick on the straight edge of the wax foundation. Fold the wax over the wick, keeping the folded edge straight.
5. Carefully repeat this step, applying enough pressure to prevent open spaces in the wax as it’s rolled but not pressing the wax and distorting it. Continue until the wax is rolled into a candle. With the thumb, smooth the final exposed edge of the wax sheet so that it adheres to the candle. Use pressure to flatten the wax together, but don’t press so hard that the candle becomes not round.
6. Using the paper that came with the wax foundation sheets, have students wrap their candle(s). Caution them not to leave the candle in a warm place and to give it to an adult. (This is a good “gift” project for students to create and give it away.) It is important to share with the students that they are not to play with fire or light their candle, but to ask an adult to do so.

This supplemental worksheet is optional to discuss the anatomy of a honeybee. The Bee Anatomy Worksheet is provided by “The Honey Files: A Bee's Life” Teaching Guide by The National Honey Board.

Accompanied assessment worksheet: Assessment for Beeswax Lesson

Sources:

- California Foundation for Ag in the Classroom
- “The Honey Files: A Bee’s Life” Teaching Guide by the National Honey Board.
- “The Honey Files: A Bee’s Life” Teaching Guide written by Alyssa Boettcher Educational Services. Provided by the National Honey Board. Copyright ©2001 National Honey Board.

California Department of Education Standards:

Kindergarten: LS1.C: Organization for Matter and Energy Flow in Organisms: § All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)
Grade 1: LS1.A: Structure and Function: § All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)

LS1.D: Information Processing: § Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)
Grade 2-Science and Engineering Practices: Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. § Ask questions based on observations to find more information about the natural and/or designed world(s). (K–2-ETS1- 1)