



The Book Planter

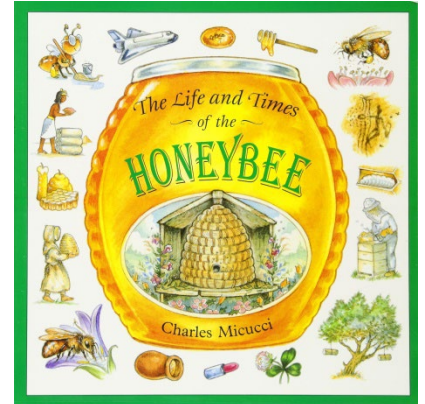


Ag in the Classroom

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August 2019: *The Life and Times of the Honeybee*
Written by: Charles Micucci

Why do beekeepers use smoke machines when collecting honey? Can a bee really sting only once? Why do bees “dance?” In concise, detailed text and abundant illustrations that range from the humorous to the scientific, Charles Micucci offers a wide-ranging and spirited introductions to the life cycle, social organization, and history of one of the world’s most useful insects. He includes information on how bees make honey, what a beekeeper does, and products that contain beeswax—everything from lipstick to waxes for buffing surfboards. Micucci’s rare gift for making science enjoyable and accessible is again revealed in this remarkably witty, rich salute to the honeybee.¹



Fun Facts

- The honeybee is the state insect for North Carolina, and 15 other states.
- Honeybees have 170 odorant receptors, compared with only 62 in fruit flies, and 79 in mosquitoes.²
- Honeybee’s wings stroke incredibly fast, about 200 beats per second, thus making their famous, distinctive buzz.²
- A honeybee can fly for up to six miles, and as fast as 15 miles per hour.²
- The scientific name for the honeybee is *Apis mellifera*.³
- Honeybees pollinate many North Carolina crops, such as apples, watermelons, and broccoli to name a few.³

Discussion Questions—Have students use *The Life and Times of the Honeybee* to source their answers.

1. What is beeswax?
2. How do honeybees help farmers?
3. Have honeybees evolved over time?
4. How did early humans get honey?
5. How long is it estimated that honeybees have been on earth?
6. What year were honeybees brought to America?
7. What are the three types of adult bees that make up a honeybee colony? Explain their roles.
8. Which bee is responsible for laying all the eggs?
9. What is the sole job of a drone?
10. How does a worker bee know when to perform each of her many duties?
11. When does a worker bee first leave the hive?

12. List three things worker bees gather.
13. What does foraging mean? Does it have a different meaning when it does not pertain to honeybees?
14. How many trips will a single worker bee make in one day?
15. Why do you think honeybees are interesting to scientists?
16. After the Ice Age, what did man use to hunt bees?
17. What helps calm bees?
18. Who were the first beekeepers?
19. What did the Romans use in the first century B.C. to paint pictures?
20. In what did beekeepers keep bees during the Middle Ages?
21. Approximately how many years did it take the honeybee to migrate across the American Continent?
22. Why did pioneers trap bees in boxes?
23. What was invented in 1852 that helped the honey business to boom?

Background Knowledge⁴

More than 25,000 species of bees have been identified around the world. In the continental United States, scientists believe there are approximately 3,500 species of bees. Bees known as honey bees are represented by eight to ten species in the genus *Apis*, a name from which comes the word for beekeeping (apiculture) and the word for a bee yard (apiary). The species of honey bee commonly found today in the Americas is *Apis mellifera*, which means honey carrier. This name is not technically correct as the bees carry nectar from flowers, which they then use to produce honey back in the hive. Races of *Apis mellifera* have different physical and behavioral characteristics such as body color, wing length, and susceptibility to disease.

As insects, honey bees pass through four distinct life stages: the egg, larva, pupa and adult. Complete metamorphosis takes between 16 and 24 days depending on the sex of the developing bee. A queen bee lays an egg in an individual wax cell. The egg hatches into a white legless larva on the fourth day. The larva feeds on royal jelly and beebread (a mixture of nectar and pollen) until it reaches mature size and then spins a cocoon around itself. The cell is capped with wax and the larva transforms into the pupa. The pupa develops into a mature adult bee inside the capped cell. When fully developed, the mature bee chews its way out of the cell. Adult worker bees live approximately 45 days during the summer months.

There are three types of adult bees that make up a honey bee colony. The great majority (about 99 percent) of adult honey bees are sterile female worker bees. Worker bees develop from fertilized eggs. Worker bee larvae are fed royal jelly for only three days. Then they are fed beebread (a mixture of nectar and pollen) for the remaining larval stage. Passing through the immature stages (complete metamorphosis) takes 21 days for worker bees.

The male members of the colony are called drones. Drones (male bees) develop from unfertilized eggs that are laid in larger cells. Drones are also fed royal jelly for three days and are then fed bee bread. Drones remain in the pupal stage for 15 days and emerge as adults on day 24. Drones have wider bodies than worker bees, rounded abdomens, and no stingers. Queen bees develop from fertilized eggs in the largest cells in the hive. Larva destined to become a queen bee is fed royal jelly for the entire larval stage. Queen bees develop in only 16 days.

Vocabulary⁴

Abdomen: the rear body region of a honey bee composed of nine segments and contains many organs including those for digestion, reproduction and respiration.

Antenna(e): the moveable, sensitive feelers on an insect's head which detect odor and movement.

Cocoon: the silk chamber a larva spins around itself just prior to the pupal stage of development.

Compound eye: an eye made up of thousands of tiny lenses that allow a honey bee to see ultraviolet light, which is invisible to the human eye, as well as visible light (except red).

Exoskeleton: the hard outer covering which forms a bee's body.

Head: the forward body region of the honey bee's three sections that contains the compound eyes, simple eyes, antennae, mandibles, and proboscis.

Honey sac: the stomach-like organ that is connected by a funnel shaped valve to the digestive tract.

The nectar stored here will be unloaded into empty hive cells or passed on to house bees for food.

Legs: a honey bee has three pairs of segmented legs used not only for walking but also to dust off antennae, brush pollen out of the thousands of branched hairs that cover the body, and to store pollen.

Mandible: located on either side of the honey bee's head, these jaw-like structures are used to chew honey and pollen, and to knead wax.

Midgut or ventriculus: the stomach section in the abdomen which digests food.

Ocellus: simple eye with a thick lens that can sense changes in the brightness of daylight.

Proboscis or tongue: a straw-like structure used for sucking nectar or honey.

Pollen basket: a smooth, somewhat concave surface of the outer hind leg that is fringed with long, curved hairs that hold the pollen in place.

Stinger: found in a chamber at the end of the abdomen (in female honey bees only) and is used to defend against intruders.

Thorax: the middle section of the honey bee's three sections that contains the flight muscles, the wings and six legs.

Wax gland(s): four pairs of glands that are specialized parts of the body wall. During the wax forming period in the life of a worker, they become greatly thickened and take on a glandular structure. The wax is discharged as a liquid and hardens to small flakes or scales.

Wing(s): the honey bee has two sets of flat, thin, membranous wings, strengthened by various veins.

The fore wings are larger than the hind wings.

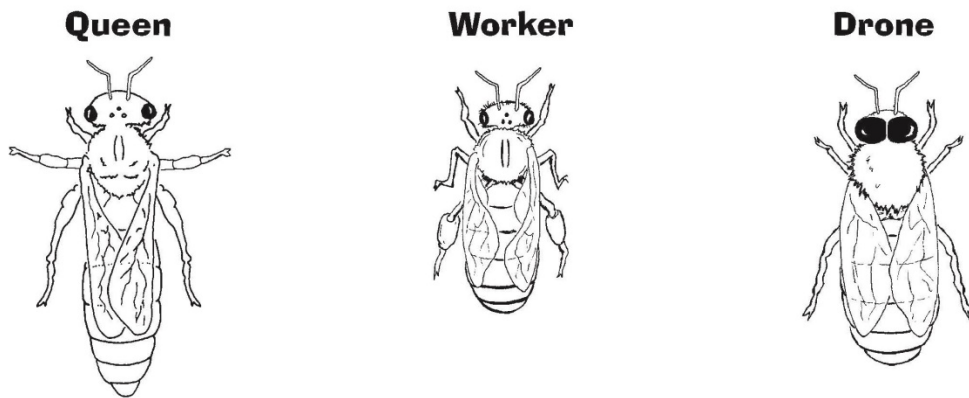
Honeybee By Design⁴

Review the basic bee body parts, using the *Anatomy of a Worker Bee worksheet* (see **Links** section, and also attached to this activity sheet). Discuss the importance of various body parts of worker bees and how these function for hive survival. Ask hypothetical questions about the life of the hive without certain body functions. For example, what if worker bees couldn't produce wax?

Have students construct worker bee models using various classroom/household materials and art supplies (you can ask students to bring recyclable items for a week ahead to collect items for them to use). Make sure each model includes the basics: head, thorax, abdomen, wings, legs, antennae. Instruct them to add as many body features as possible and to be able to explain their functions. Give students an opportunity to share their models with the class or in small groups.

Types of Honeybees^{4, 5}

Honeybees are social insects and live in groups called **colonies**. Within each colony are three types of honeybee: a queen, worker bees, and drones. Members of each type have a slightly different body depending on the tasks performed.



The queen bee is the largest of the honey bees. She has a longer abdomen, a shiny thorax, and does not have pollen baskets on her legs. The queen has a stinger, which she uses to fight off other queens. She may sting multiple times without dying.

Worker bees are the smallest of honey bees. They have long proboscises used to suck up nectar from flowers. Worker bees' hind legs are fringed with stiff hairs that form pollen baskets. Workers have a stinger and a poison gland at the tip of their abdomen. Typically, worker bees

can only sting once because their stingers and internal organs are pulled out when they sting and they die.

Drones, the male members of the colony, are somewhat larger than the workers. They have rounded abdomens, huge compound eyes, and powerful wings. Drones do not have long proboscises and must be fed by worker bees. They also do not have stingers and therefore cannot defend themselves. Drones do not have wax secreting glands. The drones' only purpose is to mate with the queen. Mating takes place in the air.

1. Have students answer the following questions:

Name three distinct features of each type of honeybee.

Why can't drones gather their own food?

Why can't drones defend the colony?

Why can worker bees usually only sting once?

What would happen to a honeybee colony if there were no queen?

What would happen to a honeybee colony if there were no drones?

2. Next, give students a copy of the *Honeybee worksheet* (in **Links** section and attached to this activity sheet). Discuss the roles of the three types of honeybees and have the students complete the worksheet. Integrate the following facts into the discussion:
 - Bees live in groups called colonies.
 - Each colony has one **queen**. The queen has a longer body than all of the other bees in the colony.
 - **Drone** bees are smaller than the queen. They are male bees and their only job is to mate with the queen so she can lay more eggs. One colony will have about 100 drone bees.
 - **Worker** bees are the smallest bees in the colony. They are all female and have lots of different jobs including feeding the larvae, cleaning the hive, creating wax and using it to make new cells, grooming and feeding the queen, guarding and protecting the hive, and leaving the hive to collect pollen, nectar and water. There are thousands of worker bees in the colony.
3. Use the information on the *Amazing Bees Online Poster* (**Links** section) to help students discover the ways in which bee colonies work together as a community.
4. Use a Venn Diagram to compare and contrast how bees in a hive and students in a classroom work together as a community. Examples include:
 - a. The bees in a hive live in large groups called colonies. In our school, our class is a large group of students.
 - b. In the hive, there is one bee who is the leader—the queen. In our classroom, the teacher is the leader.
 - c. In the hive, the worker bees have special jobs—take care of the young bees, guard the hive, create wax to build the honeycomb where eggs are laid, forage or find pollen and nectar to feed the bees in the hive, and make honey. In our classroom, we all have jobs. (Students can list jobs specific to their classroom.)

- d. If a bee doesn't do his/her job, the whole hive is affected. For example, if the bees that are supposed to look for pollen and nectar decide not to, some or all of the bees will not have the proper nutrients. In our classroom, if someone doesn't do their job, it affects the entire class. For example, if one person does not put away their books in our library, other students won't be able to read those books

Pheromones⁴

Introduce students to the idea that honeybees have senses, but that they are much different than human senses. For example, bees can see many colors, but they cannot see red. Humans on the other hand can't see ultraviolet light, but honeybees can. Humans and bees also perceive body odors differently. Humans use their noses to smell, while honeybees use their antennae to detect **pheromones**, which are chemicals they emit in certain situations. Ask students what honeybees "smell." Lead the students to an understanding of individual hive smells: the odor a queen uses to attract drones for mating, the alarm pheromone that signals hive members to defend the hive, and the "queen substance" pheromones that maintain behavioral control of the colony.

Materials:

- Jars with lids
- Oil or extract of the following: peppermint, vanilla, lemon, banana
- Cinnamon sticks
- Vinegar
- Honey sticks (one for each team)
- Blindfolds

Instructions:

1. Place each scent in a different jar and close the lid to keep the odors from escaping. Make a maze in the classroom out of tables, desks, and chairs. Hide honey sticks around the room.
2. As a class, come up with navigational instructions for each of the scents. For example, a scent of lemon could mean "Turn right." Vanilla could mean "Back up" or "The honey is here!" The students should take careful notes on the meaning of each scent.
3. Divide students into teams of 4-5 students. Each team represents a colony of bees.
4. Construct a maze in the classroom.
5. For each team:
 - a. Hide a honey stick.
 - b. Place the scent jars along the maze route where they would lead to the honey.
 - c. Blindfold one member of the team to search through the maze for the honey using only the scents as clues. The other members of the team should guide the bee for safety reasons but cannot tell the blindfolded team member where to go.
6. Have other teams take notes of each team's successes or failures in finding the honey.
7. After all teams have participated, discuss the difficulties each team experienced.

Polygons for Everyone⁴

Materials:

- Strips of construction paper 2"x9" (students can help prepare these using rulers and scissors)
- Rulers
- Long balloons (the kind used for making animal shapes)
- Tape

Discussion:

Ask students to define **polygon**, **diameter**, and **circumference**. Ask for examples of polygons, and list them on the board. Also, on the board, write the number of sides of each polygon and what the length of each side would be if the total circumference were 9" and all sides were equal.

Example:

- Triangle 3 sides 3" x 3 sides = 9"
- Square 4 sides 2.25" x 4 sides = 9"

Instructions:

1. Give each student at least 5 strips of construction paper.
2. Instruct the students to properly measure the dimensions listed on the board for each type of polygon and to fold each strip on the measurement lines in order to form a polygon. Students can use tape to connect the ends of the strip to complete the polygon.
3. Have students construct their triangles as you demonstrate the measuring, folding and taping of a triangle.
4. Have the students then construct the 4 remaining polygons on their own. Have plenty of extra paper strips on hand for mistakes.
5. Once everyone has completed all the polygons, put students in groups of 4-5 to build structures of like polygons.
6. Give each group a few balloons to blow up for diameters of approximately 1", 1.5", and 2" to represent developing bees. Students should then see how balloons fit inside each polygon.
7. Have groups discuss the benefits/drawbacks of each structure in terms of how they fit together, strength of structure, if there is any wasted space between the polygons, if there is any wasted space within the polygon when the balloon is inserted, etc.
8. Come together as a class to discuss group findings.

Links

- Anatomy of a Worker Bee worksheet
https://naitc-api.usu.edu/media/uploads/2015/01/20/AnatomyofaWorkerBee_Answers.pdf

- Amazing Bees Online Poster
<http://www.todayifoundout.com/index.php/2010/12/10-amazzzing-bee-facts-infographic/>
- Honeybee worksheet
https://naitc-api.usu.edu/media/uploads/2018/09/14/Honeybee_Worksheet.pdf

Sources

1. <https://www.hmhc.com/shop/books/The-Life-and-Times-of-the-Honeybee/9780395861394>
2. <https://www.ciintonc.com/news/photo-gallery/12734/20-amazing-honey-bee-facts>
3. <https://www.nczoo.org/wildlife/animals/honey-bee>
4. <http://www.browningshoney.com/wp-content/uploads/2013/02/honey-files-a-bees-life.pdf>
5. https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=686&search_term_lp=bees

K-5 Subject Areas

Reading, Speaking and Listening, and Science

Common Core/Essential Standards

Reading

- **RL.K.1** With prompting and support, ask and answer questions about key details in a text.
- **RL.1.1** Ask and answer questions about key details in a text.
- **RL.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of **key** details in a text.
- **RL.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the **basis** for the answers.
- **RL.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RL.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RI.K.1** With prompting and support, ask and answer questions about key details in a text.
- **RI.1.1** Ask and answer questions about key details in a text.
- **RI.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
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- **RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

Speaking and Listening

- **SL.K.2** Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
- **SL.1.2** Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
- **SL.2.2** Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
- **SL.3.2** Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.4.2** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.5.2** Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

- **SL.1.3** Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.
- **SL.2.3** Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.
- **SL.3.3** Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
- **SL.4.3** Identify the reasons and evidence a speaker provides to support particular points.
- **SL.5.3** Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.
- **SL.K.4** Speak audibly and express thoughts, feelings, and ideas clearly.
- **SL.1.4** Produce complete sentences to describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.
- **SL.2.4** Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent and complete sentences.
- **SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly in complete sentences at an understandable pace.
- **SL.4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; adjust speech as appropriate to formal and informal discourse.
- **SL.5.4** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; adapt speech to a variety of contexts and tasks.

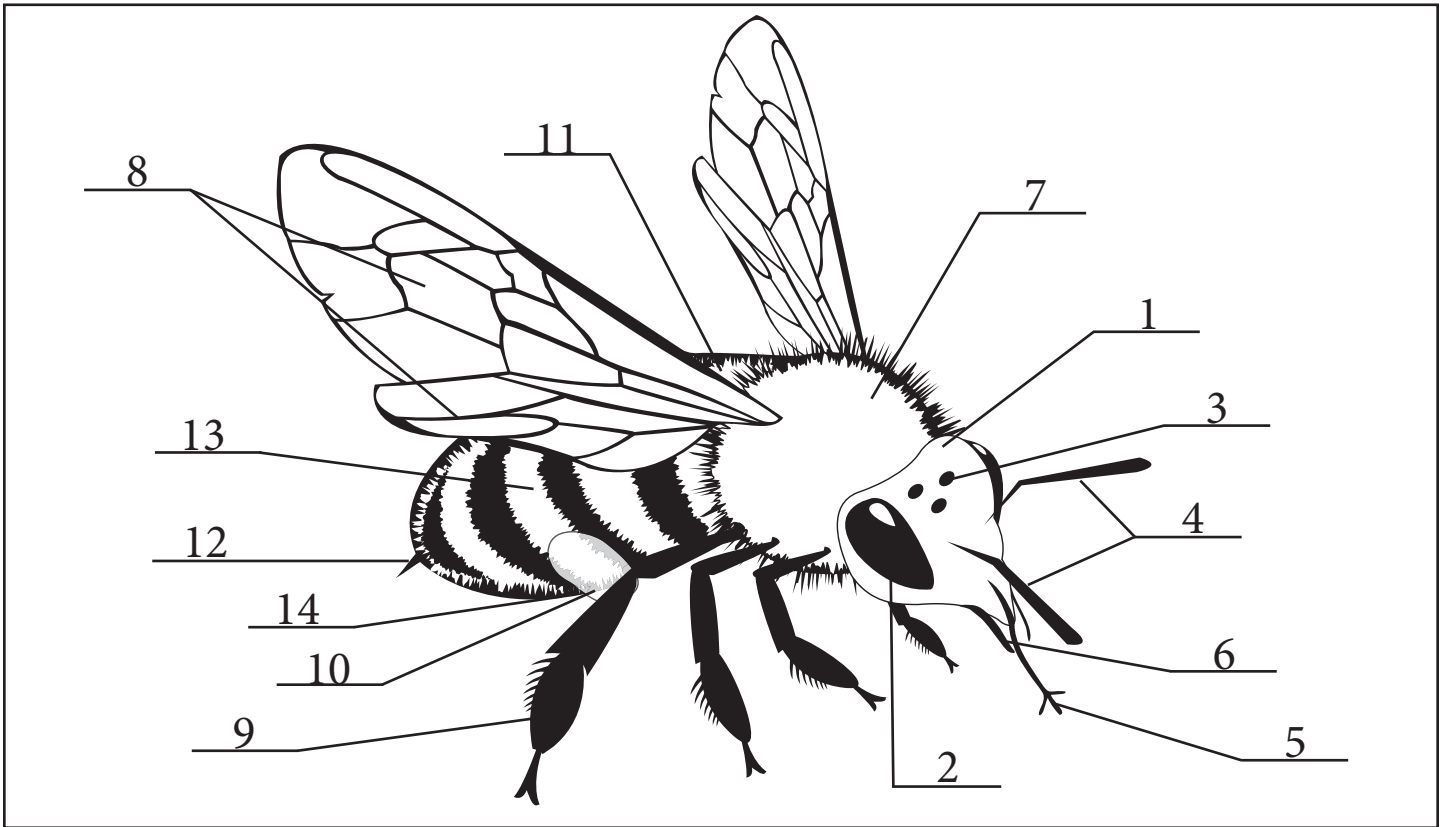
Science

- **K.P.1.2** Give examples of different ways objects and organisms move (to include falling to the ground when dropped):
 - • Straight
 - • Zigzag
 - • Round and round
 - • Back and forth
 - • Fast and slow
- **4.L.1.1** Give examples of changes in an organism's environment that are beneficial to it and some that are harmful.
- **4.L.1.2** Explain how animals meet their needs by using behaviors in response to information received from the environment.
- **4.L.1.4** Explain how differences among animals of the same population sometimes give individuals an advantage in surviving and reproducing in changing habitats.

Mathematics

- **NC.K.G.2** Correctly name squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres regardless of their orientations or overall size.
- **NC.K.G.3** Identify squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres as two-dimensional or three-dimensional.
- **NC.K.G.5** Model shapes in the world by:
 - • Building and drawing triangles, rectangles, squares, hexagons, circles.
 - • Building cubes, cones, spheres, and cylinders.
- **NC.1.G.1** Distinguish between defining and non-defining attributes and create shapes with defining attributes by:
 - Building and drawing triangles, rectangles, squares, trapezoids, hexagons, circles.
- **NC.1.G.2** Create composite shapes by:
 - Making a two-dimensional composite shape using rectangles, squares, trapezoids, triangles, and half-circles naming the components of the new shape.
- **NC.3.MD.8** Solve problems involving perimeters of polygons, including finding the perimeter given the side lengths, and finding an unknown side length.

Anatomy of a Worker Bee



Directions: Match the description with the correct part of the bee by writing the corresponding letter on the appropriate line below. Label the number of each bee body part in its correct location on the bee diagram above.

- | | |
|-------------------|---------------|
| 1. head | _____ c _____ |
| 2. compound eye | _____ j _____ |
| 3. simple eyes | _____ l _____ |
| 4. antennae | _____ e _____ |
| 5. proboscis | _____ m _____ |
| 6. mandibles | _____ k _____ |
| 7. thorax | _____ b _____ |
| 8. wings | _____ i _____ |
| 9. legs | _____ h _____ |
| 10. pollen basket | _____ d _____ |
| 11. abdomen | _____ f _____ |
| 12. stinger | _____ n _____ |
| 13. honey sac | _____ a _____ |
| 14. wax glands | _____ g _____ |

- | | |
|----|--|
| a. | a stomach-like organ used to store nectar |
| b. | the middle region of the bee that contains the flight muscles, 4 wings, and 6 legs |
| c. | the front region of the bee that contains 2 compound eyes, 3 simple eyes, 2 antennae, mandibles, and the proboscis |
| d. | a collection of hairs where pollen is stored for transport |
| e. | movable feelers that detect smells and movement |
| f. | the rear region of the bee that contains organs for digestion, reproduction, and respiration as well as the stinger and wax glands |
| g. | glands that form and excrete wax |
| h. | used for walking, dusting antennae, brushing pollen off body hairs, and storing pollen |
| i. | beat 250 times per second allowing the bee to fly |
| j. | made up of tiny lenses that allow the bee to see ultraviolet light and visible light with the exception of red |
| k. | jaw-like structures used to knead wax and to chew honey and pollen |
| l. | have a thick lens that can sense changes in brightness |
| m. | a straw-like tongue used to suck nectar or honey |
| n. | barbed and has an attached venom pouch; used for defense |

Name

Honeybee Worksheet

What Do Bees Do?

The queen, workers and drones look very different and have different jobs in the hive. Identify each bee (queen, worker or drone) pictured below and then list the jobs of each bee.



| Which Bee? | Which Bee? | Which Bee? |
|------------|------------|------------|
| Job? | Job? | Job? |