



STEMsational Ag:
The Virtual Farm
MIDDLE TENNESSEE STATE UNIVERSITY

Module 10: Feed the Bees
UNIT 2: BEE LIFE
Grades 3 - 5



This work is supported by the Agriculture and Food Research Initiative, Education and Workforce Development Program. [grant no. 2021-67037-33380/project accession no. 1024880], from the U.S. Department of Agriculture, National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

31843 / Middle Tennessee State University does not discriminate against students, employees, or applicants for admission or employment on the basis of race, color, religion, creed, national origin, sex, sexual orientation, gender identity/expression, disability, age, status as a protected veteran, genetic information, or any other legally protected class with respect to all employment, programs, and activities sponsored by MTSU. The Assistant to the President for Institutional Equity and Compliance has been designated to handle inquiries regarding the non-discrimination policies and can be reached at Cope Administration Building 116, 1301 East Main Street, Murfreesboro, TN 37132; Christy.Sigler@mtsu.edu; or 615-898-2185. The MTSU policy on non-discrimination can be found at mtsu.edu/iec.

Materials are intended for educational purposes only. Content Contributors and the STEMsational Ag team have reviewed to ensure all content is cited. Please contact STEMsationalAg@mtsu.edu with any concerns.



STEMsational Ag—The Virtual Farm

Welcome to Module 10 Unit 2: Bee Life



3 - 5 Grade:

Introduction:

Look at the screenshots and read the narration from *“What You’d See If You Could Walk Into a Beehive.”*





What You'd See If You Could Walk Into a Beehive

<https://youtu.be/clwSy1N9BvQ>



Bees first appeared on Earth 130 million years ago,



and they outlived dinos.



What helped them survive for so long is the incredibly complex structure of their society and teamwork. Each bee has its own role and responsibility.



Some of them build and repair their home.



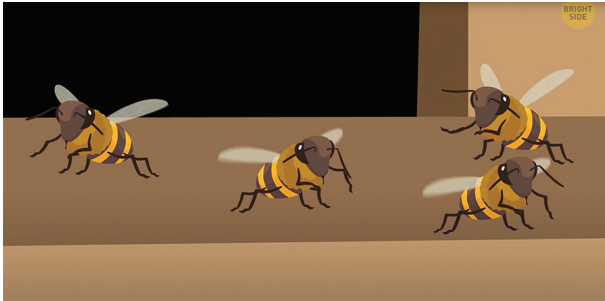
Some bees protect it.



Others clean the hive and get food.



But, what if you could sneak into a hive and figure out how this whole system works? What would you see inside?



For some mysterious reason, it's easy for you to get past the guards; but, if you were a bee from another colony, they wouldn't let you in without a fight. The guard bees look rather intimidating.



They stand on their back four legs at the hive's entrance with their front legs raised in the air. These bees inspect every insect entering the hive with their antennae and front legs.



Each hive has its own odor, and the guards can understand if a bee belongs to their colony by smelling it. Only the bees that live in the hive can get inside.



Suddenly you see something strange. One of the guard bees has detected an intruder! An alien bee must have mistakenly tried to enter the wrong hive. But, it's carrying a load of nectar, and the guard lets it in. Apparently, they don't mind accepting free gifts of food even from strangers.



You feel too curious to linger there any longer. The hive has only one entrance. You notice that the walls around it look strange. You take a closer look and understand that it's coated with a thin layer of some substance. It's **propolis** (hardened plant resin produced by bees). It helps fight infections and cures different health problems.



A bit further, you can see countless honeycombs - their densely packed hexagonal cells made of beeswax. Bees use them to store food, pollen, and honey. That's where they keep eggs, larvae, and pupae.



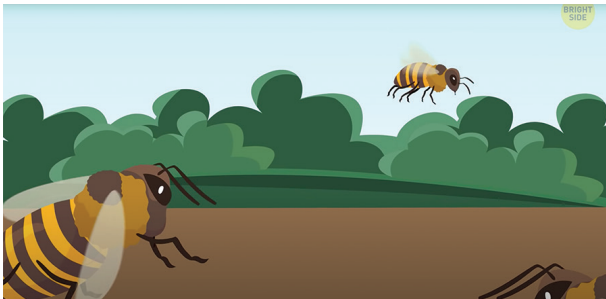
Honeycombs are fixed to the walls of the hive. They stretch from top to bottom and are even attached to the sides. But, you spot narrow passageways along the comb edges. Bees use them to move around the hive. You might also be able to squeeze through one of these tunnels.



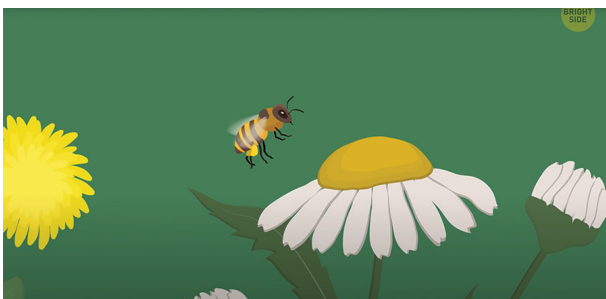
After exploring the place, you figure out that bees store honey in the upper part of the comb. Beneath there are cells that contain pollen. Then, there are cells used for keeping eggs with future worker bees. And, at the very bottom, there are drone eggs.



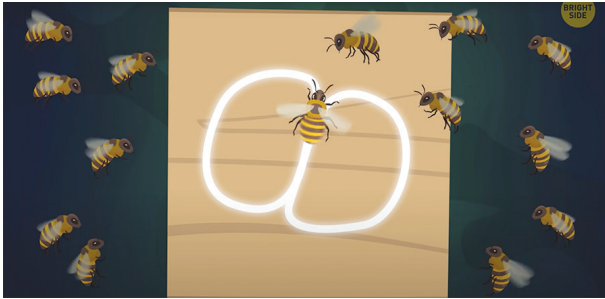
Of course, your ultimate goal is to see the queen bee, but it's not that easy to find her. First, you come across lots of other bees. Most of them are workers. They make up the largest part of the hive's population, and they're all ladies. Each of them has its own task; the most common of them is foraging.



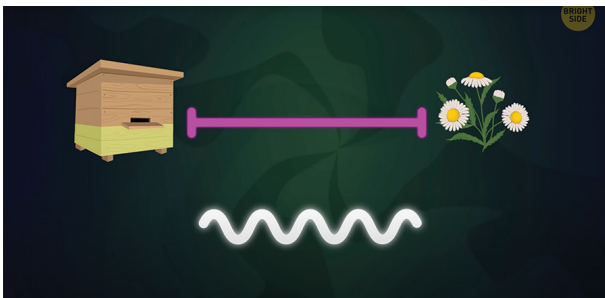
You spot a bee leaving a hive and decide to follow it. The queen can wait a bit. You want to see how bees provide food for the hive. The bee is buzzing ahead of you.



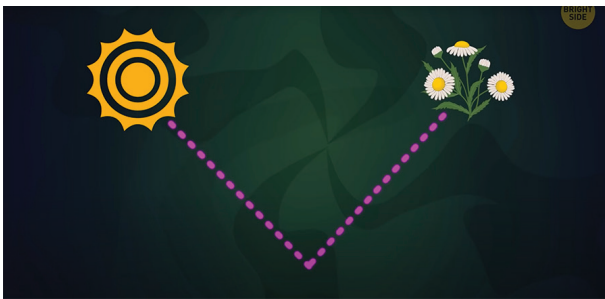
After visiting a couple of flowers, it suddenly starts wiggling while hovering in one place. Ah! That's the famous bee dance! That's how bees communicate. Once a forager finds a perfect supply of nectar, ...



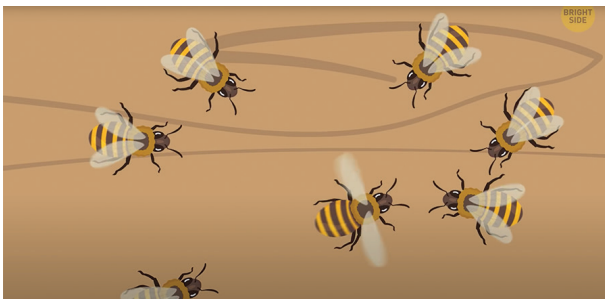
It starts to perform a very precise dance. It consists of a series of straight lines and figure eights. Throughout the dance, the bee is also shaking its wings. How long the dance lasts means how far away from the hive the nectar is.



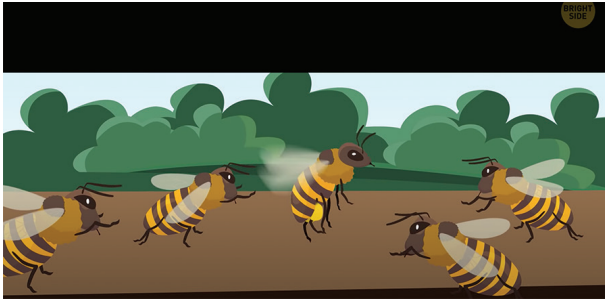
Every 75 milliseconds is another 330 feet to the distance. And, how intense the dance is, depends on the richness of the source of the nectar. The stronger the waggle is, the more nectar the bee has found.



And there's also the angle of the dance. It shows the direction of the nectar in relation to the sun.



Your bee must have found tons of nectar. It's practically vibrating. Suddenly, it starts flying back to the hive. You follow it there. The bee does a shake dance in front of the other worker bees. This is how it tells other bees they need to go foraging right away.



You decide to stay behind and just watch what will happen. Soon the bees return. They've brought back a lot of nectar that needs to be ripened into honey.



Your bee does a tremble dance this time. It's shaking its legs in a way that makes its body tremble all over. This little dance makes other workers get down to process the nectar.



It's time for you to resume your search. You dive back into the hive and begin to squeeze through small passageways. You come across the cells where worker bees begin their lives as eggs. It takes a bee 21 days to develop from an egg into a full-grown worker.



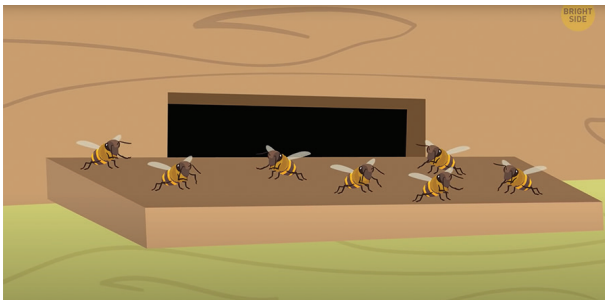
The first task of this new worker is to clean the cell where it grew.



The cell then becomes a nursery for a new egg, and the bee looks after this egg. Later, it feeds the larva and keeps it warm.

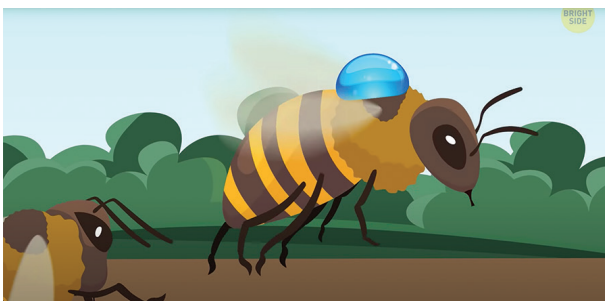


During the next stage of its life, when it's 12 to 20 days old, the bee starts doing chores around the hive. It produces wax, stores pollen and nectar, builds the comb ...



Guards the entrance ...

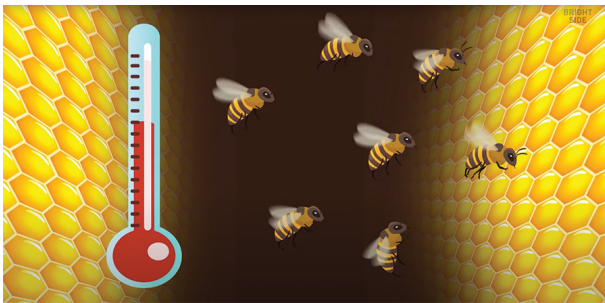
and so on.



When the bee turns 20 days old, it becomes a forager. It looks for and delivers pollen, nectar, and tree resin to make propolis. The bee also brings water. Bees need it for drinking and cooling the hive.



At one point do you see something that looks like a hospital room? There, worker bees look after those that feel unwell. The doctors bring them different types of honey depending on their infection. If there's no other way, they remove a sick bee from the hive. It helps to prevent the entire colony from getting ill.



And then there are also temperature control bees. The temperature in the hive is usually around 95 degrees Fahrenheit. It's crucial to keep it this way - not hotter - not colder. Otherwise, the eggs won't hatch. You see a group of bees and instantly understand they're temperature bees! Apparently, the temperature in the hive has dropped, and now the bees are trying to warm it up. They're vibrating in a special way which raises their body temperature, and you can feel the air around you become a bit warmer.



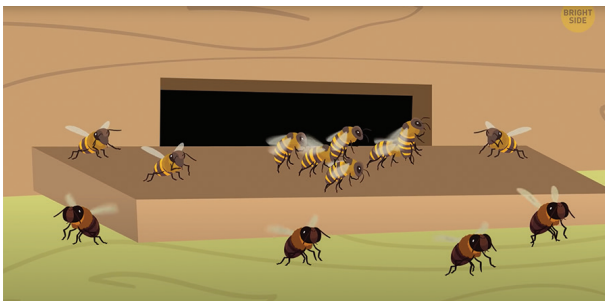
And, if they needed to cool the hive, they would go and gather some water droplets. Then they would bring this water on their backs. Once in the hive, the temperature bees would buzz their wings very fast, making the water evaporate and lowering the temperature.



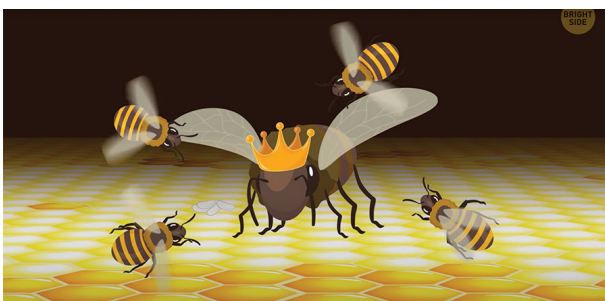
You move further and soon come across a bee you haven't seen before. It has huge eyes, a large body, and no stinger. It's a drone, the only kind of male bee in the hive. Drones don't have any foraging tools either.



Their only purpose is to mate with the queen and care for her. The drone's life isn't too long. For one thing, if this bee manages to mate with the queen, it never survives the process.



And, if there's a food shortage or winter is coming, worker bees usually kick drones out of the hive and don't let them back in. Wow, that's hard!



You keep going until you finally notice a nursery. There you spot a bee that is twice the size of a worker bee. Your quest has come to an end. That's the queen. This bee is the most important one for the hive because it's the only bee that can lay eggs.



Despite her title, the queen doesn't actually rule, and her brain is smaller than that of a worker bee.



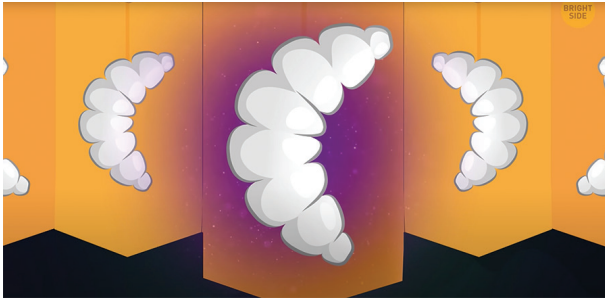
But, she produces special pheromones that influence the mood of the entire hive.



The queen also gives birth to every single bee in the colony.



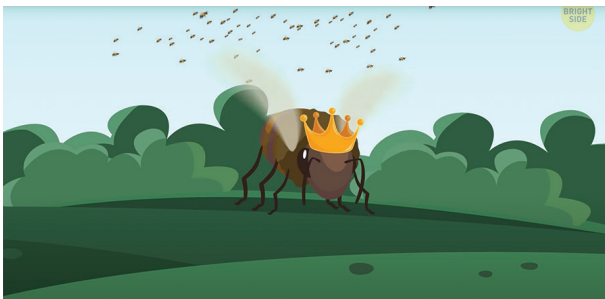
When the queen is still a larvae, worker bees feed her royal jelly. That's a goop with super high sugar content.



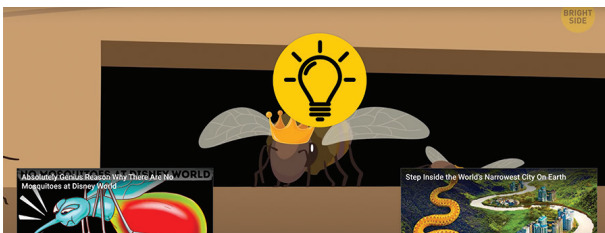
A larger cell along with such a diet leads to a bigger body and the future queen's ability to emit the pheromones.



When the queen has mated with drones she returns to the hive. Three days later she starts laying eggs and never stops. She works especially hard in the spring, laying one egg every 20 seconds. No wonder that later in the year, the colony already has a population of thirty thousand to sixty thousand bees.



But wait — something strange is happening here! A group of worker bees ... in fact, lots of them (it might be half the colony) ... leave the hive with the queen leading them. It means the colony has become too big. The queen goes outside for the first time since mating, and the whole swarm sets off in search of a new home.



Back in the hive, a new queen hatches from an egg eight days later.



Pre-Assessment:

Honey Bee Words Activity on page 16

- For educators in a classroom: Ask students to explain out loud how each word is connected to honeybees.
 - For example, most of us know a drone as a small aircraft but there are also male bees in a hive called drones.
 - A comb can be used to comb out our hair, but you will also find a structure in a hive that bees build called comb.
- For individual learners: Explain how each word is connected to honeybees by discussing your answers with a parent or another adult.



Honey Bee Words Activity

Directions: Use the table to complete this activity. In the table, there is a list of words in column 1. Use column 2 to mark which words you think apply to Honey Bees.

Word List	Place a mark in this column if the word applies to Honey Bees
Airplane	
Bacon	
Basket	
Beef	
Brood	
Brush	
Cell	
Cheese	
Circle	
Cocoon	
Comb	
Concrete	
Dance	
Doctor	
Drone	
Dust	
Flower	
Hexagon	
Hive	
Honey	
King	
Larva	
Leaves	
Nectar	
Nest	
Nurse	
Pollen	
Pupa	
Queen	
Scout	
Seeds	
Stinger	
Worker	



National Agricultural Literacy Outcomes

Agriculture and the Environment Outcomes

T1.3-5E. Recognize the natural resources used in agricultural practices to produce food, feed, clothing, landscaping plants, and fuel (e.g., soil, water, air, plants, animals, and minerals).

Culture, Society, Economy & Geography

T5. 3-5B. Discover that there are many jobs in agriculture.

Purpose:

The purpose of the lesson is to educate students about the life cycle of a honeybee and the multiple tasks a honeybee must perform to keep the hive running smooth.

Student Learning Outcomes for the Unit:

- Student will create a lifecycle of a honeybee and label the lifecycle.
- Students will be able to identify the difference between a queen, worker, and drone.
- Student will explore the many jobs honeybees perform through reading comprehension.

Vocabulary:

- **Honeybee:** a stinging winged insect that collects nectar and pollen, produces wax and honey, and lives in large communities (a bug that makes honey and lives in a hive)
- **Life cycle:** the series of changes that the members of a species undergo as they pass from the beginning of a given developmental stage to the inception of that same developmental stage in a subsequent generation (a queen bee lays an egg, a larvae hatches from the egg, this is the baby bee, a larva grows into a pupa, this is a teenager bee and finally the pupa grows into an adult honeybee.)
- **Queen:** the single reproductive female in a hive or colony of honeybees (a girl bee that lays eggs for the hive – there is only one queen)
- **Drone:** a male honeybee, does not have a stinger (a boy honeybee that does not sting)
- **Worker:** are female but are not capable of reproducing. They do all the work in the hive, and they control most of what goes on inside (a girl bee that takes care of the hive doing jobs like babysitting, cleaning, grocery shopping (foraging/collecting pollen) and door monitoring)
- **Comb:** is simply a series of interconnected cells that are used to store honey and pollen and to protect developing brood
- **Cell:** describe any type of closed space created from wax by bees
- **Larva:** legless and featureless white grub
- **Pupa:** grub begins changing, taking on features of the adult

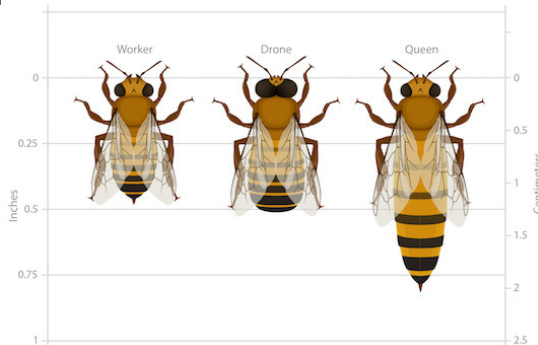


Materials Needed:

Supplies for building the honeybee lifecycle model:

- 1 piece-Construction paper
- 1-Empty toilet paper or 1 paper towel roll cut into 1/2 inch pieces (make 4 hexagons)
- 1 bottle-Clear glue
- 1-Grain of rice
- 1-Dry, C-shaped pasta noodle (example, macaroni noodle)
- 1-Small container of white play dough or modeling clay
- 1-A model, felt, or cutout of an adult worker bee

■ You can find honeybee cutouts used in the course on this website from [Arizona State University, "Bee Bonanza: The Story of Honey Bees,"](https://askabiologist.asu.edu/bee-colony-life)
<https://askabiologist.asu.edu/bee-colony-life>



■ Optional: You can purchase a **"Lifecycle of the Honey"** set on Amazon

Safari Ltd Safariology the Life Cycle of a Honey Bee
Brand: Safari
412 ratings
Amazon's Choice for "bees toys"
\$14.98
Thank you for being a Prime Member. Get \$125 off: Pay \$0.00 \$14.99 upon approval for the Amazon Business Prime Card. Terms apply.
Color: Multi
Brand: Safari
Item Dimensions LxWxH: 6 x 6 x 9 inches
Age Range (Description): 4+
Model Name: G22716
Color: Multi

About this item

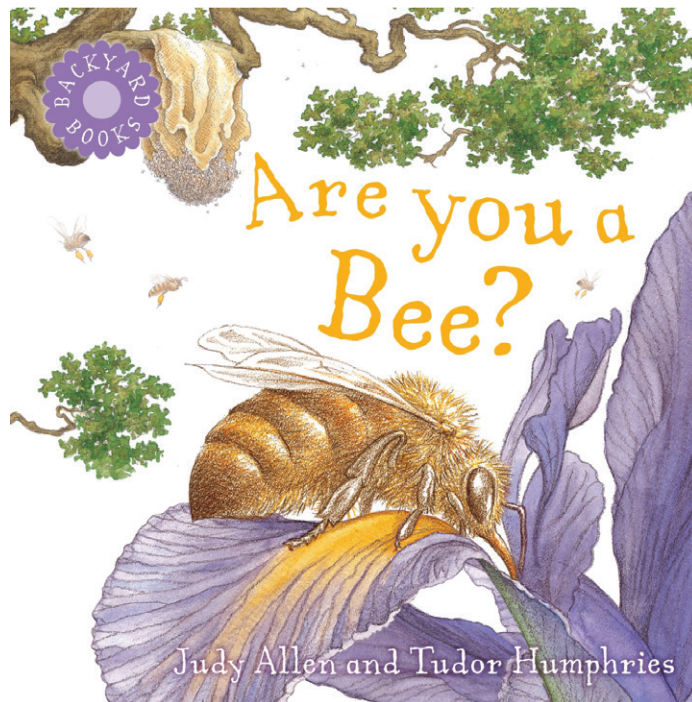
- Honey Bees are fascinating creatures which have been kept by humans for centuries. Now you can explore the life cycle of the honey bee without being stung. Watch as it grows from an egg, to a larva, and to a pupa before finally emerging as a mature adult.
- Part of Safari Ltd's Safariology Life Cycles Collection, which allows children to explore miraculous and awe-inspiring transformations in close detail. This product can be admired, displayed, squeezed, touched, and played with.
- Made with Safari Ltd's industry-leading standards, each replica in the Life Cycle Collection has been individually hand painted and features solid construction from quality, safe, phthalate-free and lead-free materials.
- Includes egg, larva, pupa, mature adult honey bee, and educational information in 3 languages.
- Complete package measures 9"L x 7.8"W x 0.5"H. For children ages 4 and up.

- 6-Labels (type them and cut them out or write them on paper and cut them out)
- 1-Pair of scissors



Read a book:

- Read the book "Are You a Bee?" by Judy Allen and Tudor Humphries.
- For Educators, while reading the book with the students, be sure pause after reading each page to allow students to see the pictures and point out important features such as the lifecycle, differences between queens, drones, and worker bees, and the jobs each bee does.
- For Students: Answer the following questions by writing them down on paper to discuss your answers with a parent or another adult.
- What did you like learning most about honeybees from the book?
 - Would you like to become a beekeeper?
 - If you were a bee, what bee would you want to be?
 - Worker, Queen, or Drone?
 - Do you or your family have honeybees?



<https://youtu.be/NdZMsNO6I-A>



"Are You a Bee?"

Book Questions

Directions:

Answer the following questions based on the video, "Are You a Bee?". Once you have completed answering the questions, view the answer key on page 25 of this document to check your answers and to access bonus information about bees.

1. Which honeybee lays eggs?
2. What does a honeybee egg hatch into?
3. What is a cell?
4. Are there more drones or more workers in a beehive?
5. Name two jobs worker bees have in the hive.
6. How do bees make bee bread?
7. What kind of food does a bee need to become a queen?
8. Where do bees find their food?
9. Can you eat the same food bees eat?
10. Bonus: Where do honeybees live?

Answer Key located on page 25



Complete This Activity: Make an Interactive Hive

- The activity will consist of exploring an interactive hive.
- The parent or teacher can create the hive with the student(s) or have it completed beforehand. Use the materials in the "Materials Needed" list at the beginning of this unit.
- Open and view the **"Creating a DIY Interactive Honeybee Display"** PowerPoint for directions on how to create the hive and to access examples of the finished product.

"Build a Honey Bee Lifecycle Instructions" PowerPoint

Build A Honeybee Lifecycle

- Hive Tools
 - Scissors
 - Glue
- Building materials
 - yellow or orange construction paper
 - toilet paper or paper towel empty rolls
 - one grain of rice
 - one macaroni noodle
 - one portion of white dough
 - an adult honeybee cutout
 - Labels

Photo by Amber Dunnaway



Step 1:

- Cut an empty toilet paper roll into four 1/2-inch strips



- Fold strips into three sections



- Once unfolded it should make a hexagon shape



- Glue into place on the construction paper



Photos by Amber Dunnaway

Step 2:

- Place each stage of the lifecycle into a cell and label correctly. Start on the left with stage 1 and move to the right with each stage after that, as follows:

- Grain of rice = egg
- C-shaped noodle = larva
- Molded playdough = pupa
- Create your own adult bee or use a bee cutout from this [website](#)

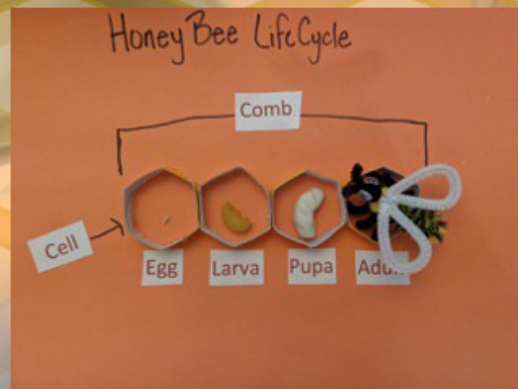


Photo by Amber Dunnaway



Lifecycle Infographic

DAYS WITHIN A STAGE BEE CASTES	WORKER	DRONE	QUEEN
EGG 	3	3	3
LARVA 	6	6½	5½
PUPA 	12	14½	7½
TOTAL	21 days	24 days	16 days

Source: *The Complex Life of the Honey Bee*, Purdue Pesticide Programs, Purdue Extension

Days Within Each Stage of the Lifecycle

(Text version)

Bee Castes	Worker	Drone	Queen
Egg	3	3	3
Larva	6	6.5	5.5
Pupa	12	14.5	7.5

Bee Type	Total Number of Days of Lifecycle
Worker	21
Drone	24
Queen	16

Source: *The Complex Life of the Honey Bee*, Purdue Pesticide Programs, Purdue Extension



Post-Assessment

- Write one to two sentences explaining the most interesting thing you learned during the lesson about honeybees.



Answer Key from page 20

1. Queen - There is only one queen in a hive and her primary job is to lay eggs.
2. Larva - Honeybee worker eggs hatch into larva, turn into pupa, and finally emerge as an adult in 21 days.
3. Room with six walls that honeybees develop in - cells are also used to store honey, bee bread, and nectar
4. Workers - The body of the hive is made up of worker bees. Worker bees are female. Drones are the male bees within the hive and are only around for a few months in the spring and summer.
5. Clean, take care of the queen, build, fan and cool the nest, guard, forage, make honey
6. Mix nectar with pollen
7. Royal jelly
8. Flowers
9. Yes, we eat honey. Humans also use multiple products found in hives to create usable products like soaps, candles, and medicine.
10. Bonus: Trees, branches, hives, empty logs