

# Bees!

## **Communication**

Students interpret visual aids, take part in group discussion, make an inference and share it with others.

## **Sustainability**

Bees are a significant pollinator and are very important to our supply of food and flowers.

More than a third of all food crops rely on pollinators, without them, our food system would collapse.

## **Nourishment**

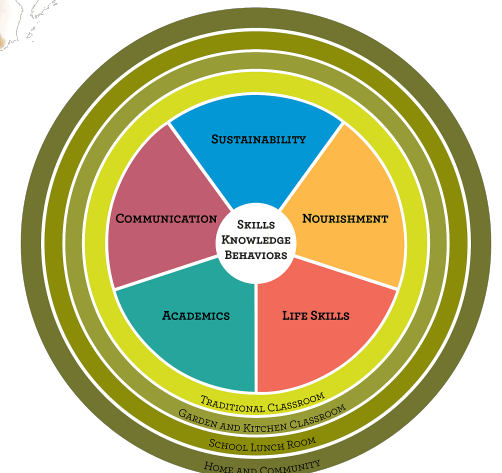
Students taste foods that are made or pollinated by bees.

## **Life Skills**

Students learn to be safe around bees and practice waiting to eat until everyone is served.

## **Academics**

This lesson fulfills Next Generation Science Standards for specialized plant structures; how environmental and genetic factors influence growth; Common Core State Standards for integrating information; following a multistep procedure; collaborative discussions; interpreting information; speaking and listening; standard English grammar; knowledge of language; and acquiring words and phrases.



## Bees! Abstract

### Summary

In this 6<sup>th</sup> grade science class, students learn the important role that bees play in pollination as they rotate through three stations in the garden: Beehive; Catch, Observe and Release; and Honey Tasting.

### Objectives

After this lesson, students will be able to:

- Feel comfortable around honeybees and native bees in the garden
- Explain the role of pollinators and their importance to our food system
- Talk about honey and how bees make it
- Explain the benefits of having a beehive in the garden

### Assessments

During this lesson, students will:

- Safely catch, observe and release honeybees and native bees
- Discuss the role of pollinators and their importance to our food system
- Discuss honey and how bees make it
- Discuss pollination, honey, and the benefits of having a hive in an educational garden

**Communication** is strengthened by interpreting visual aids, group discussion, making an inference and sharing it with others. **Sustainability** is highlighted by learning about the role of pollinators in our food system. **Nourishment** is acquired by sampling foods made by or dependent upon bees. **Life Skills** are sharpened as students learn to be safe around bees and practice waiting to eat until everyone is served.

**Academics** fulfill Next Generation Science Standards for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction; how environmental and genetic factors influence the growth of organisms; Common Core State Standards for integrating information presented in different media; following a multistep procedure;

collaborative discussion; interpreting information; speaking and listening; and acquiring words and phrases. See **Connections to Academic Standards** below for details.

*Edible Schoolyard* curriculum emphasizes developing community and personal stewardship, along with skills that will help students navigate different situations throughout their lives; and understanding the impact of **pollination** on our food supply.

This lesson follows the BEETLES Project's *Learning Cycle* (Invitation-> Exploration -> Concept Invention -> Application -> Reflection) and uses their *Discussion Routines* (Think-Pair-Share, Whip-Around). All are highlighted in **Green\*** with an asterisk for easy identification. See the documents BEETLES\_Discussion\_Routines.pdf and BEETLES\_Learning\_Cycle.pdf included in **Resources** below for more information. Games and activities from other sources are also identified in **Green**, without an asterisk.

### Connections to **Academic Standards**

Next Generation Science Standards, Middle School

Disciplinary Core Ideas:

- LS1.B: Growth and Development of Organisms
  - Animals engage in characteristic behaviors that increase the odds of reproduction.
  - Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

Performance Expectations:

- MS-LS1 From Molecules To Organisms: Structures and Processes
  - MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

- MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

#### Common Core State Standards, English Language Arts and Literacy, Grade 6

- RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
- RST.6.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on *grade 6 topics, texts, and issues*, building on others' ideas and expressing their own clearly.
  - SL.6.1.b Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
  - SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
  - SL.6.1.d Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.
- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
- SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.6.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 on page 53 for specific expectations.)
- L.6.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
  - L.6.1.a Ensure that pronouns are in the proper case (subjective, objective, possessive).
  - L.6.1.b Use all pronouns, including intensive pronouns (e.g., *myself, ourselves*) correctly.
  - L.6.1.c Recognize and correct inappropriate shifts in pronoun number and person.
  - L.6.1.d Recognize and correct vague pronouns (i.e., ones with unclear or ambiguous antecedents).
- L.6.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.

- L.6.3.a Vary sentence patterns for meaning, reader/ listener interest, and style.
- L.6.3.b Maintain consistency in style and tone.
- L.6.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### Connections to *Edible Schoolyard* Standards

Edible Schoolyard 3.0

In the Edible Schoolyard Program

- 1.0 Students work with each other and teachers to develop community and personal stewardship, along with skills that will help them navigate different situations throughout their lives.
- 1.1.1 - 1.3.12 This lesson fulfills all Edible Schoolyard Program standards, numbers 1.1.1 through 1.3.12. See *The Edible Schoolyard Berkeley Standards* for details.

In the Garden Classroom, 6<sup>th</sup> Grade

- Concepts 3.3.9: Recognize the garden as a habitat for pollinators, understand the **impact of pollination** on our food supply, develop appropriate responses to them, and consider the multitude of habitats throughout the garden.

## Bees! Lesson

### Materials

#### For the Hive Station

- Beehive
- Plexi-glass box for observation, cloth to cover box and tape to stabilize and keep box closed.
- Table for observation with umbrella, away from the beehive
- Pollen
- Bee hat
- Smoker, matches and cotton balls
- G6-13 Bee Lifecycle Visual Aid

#### For the Catch, Observe and Release Station

- Insect nets
- Large Jars for observing
- Sitting area for students
- G6-13 Bee Visual Aid
- Bee Image Cards

#### For the Tasting Station

- Honeycomb
- Two contrasting jars of honey for tasting
- Wooden stir sticks for tasting
- Toothpicks
- Bowl of sunflower seeds and serving spoon
- Bowl of almonds and serving spoon
- Sitting area for students
- G6-13 Honey Fun Fact Cards

#### For the Closing Circle

- G6-13 Closing Circle *Think-Pair-Share*\* question

### Before You Begin

- Find areas in the garden where students will be able to observe bees
- Read background material on bees
- Research how many species of bees are in your area (see 6.e)
- If you have a healthy hive, pull out a single comb and place it in plexi-glass box on table at the hive station for observation
- Create the Lifecycle Visual Aid
- Create the Bee Images Cards (photos of different types of bees)
- Create the Visual Aid Cards
- Create the Closing Circle *Think-Pair-Share*\* question
- Collect all materials
- Set up Hive Station, Catch, Observe and Release Station and Tasting Station

### Timeline Overview

Total Duration: 90 minutes

1. *Invitation*\* (10 minutes)
2. *Exploration*\* (10 minutes)
3. *Concept Invention*\* (10 minutes)
4. *Application*\* (10 minutes)
5. *Concept Invention*\* (10 minutes)
6. *Application*\* (10 minutes)
7. *Concept Invention*\*: (10 minutes)
8. *Application*\* (10 minutes)
9. *Reflection*\* (10 minutes)

### Procedures

#### At the Opening Circle

Introduce the lesson.

1. *Invitation*\*: (10 minutes)
  - a. Tell students they will be learning about bees today.
  - b. Introduce the three stations and describe briefly what will happen at each one:



- i. **Hive Station:** students will learn about the colony and observe the bees at work on the honeycomb.
- ii. **Tasting Station:** students will taste bee related foods and learn about pollination.
- iii. **Catch, Observe and Release Station:** students will learn about honey bees and native bees then go out into the garden to safely catch, observe and release bees.

2. **Exploration\***: (10 minutes)

- a. Invite students to share something they already know or think they know about bees and pollination using the **Whip-Around\*** activity.
  - i. To use **Whip-Around\***:
    - 1) Provide a prompt and quickly get a response from each person in the group.
    - 2) When it is each students' turn, they say one or two words to answer, keep it brief and fast-moving.
    - 3) Instructor can ask follow-up questions of selected students if they want to go a little deeper.
- b. Explain that Bees have three major interests:
  - i. Pollen
  - ii. Nectar
  - iii. Reproduction
- c. Clarify when and why bees sting and review the warning signs before they sting:
  - i. Fly away.
  - ii. Buzz louder.
  - iii. Emphasize that stinging is the bee's last resort.
- d. Divide students into 3 groups and rotate through the stations.

**At the Hive Station**

3. **Concept Invention\***: (10 minutes)

Students learn about the beehive and role of the beekeeper.

- a. Ask students what type of behavior is best to have when approaching the hive. (*Calm, relaxed, quiet*)
- b. Point out the flight path into the hive to students, drawing the analogy of a busy doorway, and explain the importance of keeping the flight path clear.
- c. Ask students to share observations about the hive.
  - i. Explain that this is a top bar hive. The technique originated in Kenya and it mimics the way bees build their hives in nature.
  - ii. Compare it briefly to the Langstroth method of bee keeping, largely used by commercial bee keepers.



- iii. Explain the different combs in each (one uses a foundation and the other starts with just the top bar).
- d. Ask students if they know what the beekeeper's two main priorities are:
  - i. To maintain the health of the hive by checking for parasites and intruders (other insects).
  - ii. To monitor the growth of the hive by checking in on the amount of eggs that the queen is laying.
- e. Ask students to volunteer what they think the beekeepers two main concerns are when entering the hive:
  - i. Protection - Show students the bee hat and explain how it protects the face from bee stings.
  - ii. Distraction - Show students the smoker and demonstrate its use while also explaining how the bees become distracted.
    - 1) The smoke gives bees the illusion of a fire.
    - 2) In order to survive the flight away from the hive, bees will begin gorging on honey and are thus distracted from the beekeeper's entrance.
- f. Explain that the beekeeper must work fast to avoid heat escaping from the hive.
  - i. Bees are cold blooded and need the hive to be around 95 degrees Fahrenheit.
- g. Show students a honeycomb and pass it around while encouraging students to smell it.
  - i. Explain how the bars line up and how the bees build the honeycomb on the bar.
  - ii. Open the observation window and explain how bees build the honeycomb starting with the bar closest to the entrance.

4. **Application\***: (10 minutes)

Students safely observe a honeycomb from a hive up close.

- a. Have students move to a separate table removed from the hive, where the observation comb is set up and ready for viewing.
- b. Explain that there are 3 types of honey bees in the colony:
  - i. The queen:
    - 1) She can live 3-5 years.
    - 2) It is her job to lay eggs (up to 2500 a day).
  - ii. Drones:
    - 1) The drones are the male bees.
    - 2) They mate with the queen, typically in flight, and die shortly after.
    - 3) The population of the drones in the hive is lower than worker bees.
    - 4) Drones are kicked out of the hive as winter approaches
  - iii. Worker Bees:

- 1) There are more of these than any other type of bee in the hive.
- 2) They perform all of the following jobs:
  - a) Clean the hive.
  - b) Feed the brood.
  - c) Attend the queen.
  - d) Receive nectar and process it into honey.
  - e) Build more wax comb.
  - f) Guard the hive.
  - g) Forage for nectar, pollen and propolis.
    - i) Bees forage by collecting nectar and pollen from many flowers.
    - ii) They store the nectar in their bodies and the pollen in their pollen sacs.
    - iii) Bees transform the nectar into honey by regurgitating the stored nectar and fanning it with their wings.
    - iv) Bees also collect propolis: sap from the trees that they combine with wax to seal the hive from intruders.
- iv. Bees use the comb to store nectar, lay the eggs, feed the larva, and make honey.
- v. Beginning with the area of the comb closest to the bar, point out the following:
  - 1) Capped honey storage, bees can access the honey by poking a hole.
  - 2) A bee nursery with brood cells for the queen to lay eggs into.
  - 3) Cells with nectar in them.
  - 4) Larva and drones.
  - 5) Bee pollen - point out the different colors of the pollen.
    - a) Ask students to explain why the hive has different colors of pollen in it.
    - b) Explain to students that different flowers have different colored pollen and nectar, which affects the color of the honey.
5. Explain to students how the queen bee is replaced in the hive:
  - a. The queen bee can die while mating.
  - b. When she is injured or old, the bees in the hive will pick 5-7 larvae to feed royal jelly in order to create the new queen bee.
  - c. Multiple hatched larvae can compete to be the next queen.
6. Explain to students that bees communicate within the hive by doing the bee dance:
  - a. They dance in figure 8 loops.

- b. Bees can communicate the direction of the nectar source through a defined angle from their abdomen to the sun.
- c. Bees can communicate the distance of the nectar source through the length of the dance.

### At the Honey Tasting Station

Students taste foods that are dependent on bees.

#### 7. *Concept Invention*\*: (10 minutes)

- a. Explain to students that in this station students will taste foods that are made by bees and whose production is dependent on bees.
- b. Ask students what their favorite fruit is and explain that without pollinators, those fruits would not exist.
  - i. Explain that 35% of our food crops rely on pollinators.
- c. Ask students for examples of different pollinators.
  - i. Bees are incredibly efficient pollinators.
    - 1) Briefly explain pollination.
    - 2) Define pollen as the genetic material from the male organ of the flower.
    - 3) Remind students of the three main interests of honey bees from opening circle:
      - a) Nectar
      - b) Pollen
      - c) Reproduction
- d. Taste the sunflower seeds and explain that honeybees are the primary pollinators for sunflower seed production.
- e. Taste the almonds and tell students that almonds rely 100% on honeybee pollination.
- f. Ask students to explain what honey is and how and why bees make it:
  - i. Worker bees collect nectar (sugar water or glucose).
  - ii. They store it in their bodies.
  - iii. Then carry it back to the hive where they regurgitate it.
  - iv. In the hive, the nectar becomes concentrated through a process of evaporation and transforms into honey.

#### 8. *Application*\*: (10 minutes)

Students learn facts about, taste and discuss honey.

- a. Pass out Honey Fun Fact Cards and have student volunteers read each card aloud. Allow/encourage brief discussion after each card:
  - i. An average worker bee makes 1/12 teaspoon of honey in her lifetime.
  - ii. To make a 16oz. jar of honey, honeybees have to travel 112,000 miles and visit 4.5 million flowers.

- iii. Honey is antibacterial and is 80% sugar.
- iv. Raw honey boosts the immune system and soothes burns.
- b. Pass out honey tasting to each student and explain that this honey is from a hive similar to our own hive here in the garden.
  - i. Show students the two different types of honey and ask why they might look and taste different.
    - 1) Different flowers have different colored pollen and nectar, which affects the color of the honey.
    - 2) Honey can be flower specific.
  - ii. Show students the honeycomb and ask how they think bees are able to create the wax.

### **At the Catch, Observe and Release Station**

Students learn about two types of bees, then safely catch, observe and release them in the garden.

#### **9. *Concept Invention*\***: (10 minutes)

- a. Explain to students that in this station they will learn about honey bees and native bees then safely catch, observe and release bees in the garden.
- b. Review the three main interests of bees:
  - i. Nectar
  - ii. Pollen
  - iii. Reproduction
- c. Explain that only a female bee can sting.
  - i. The bee's stinger is in its oviduct, from which eggs are released.
  - ii. Male bees do not have stingers.
- d. Delineate the difference between native bees and honeybees:
  - i. Different colony sizes.
    - 1) Bees native to the bay area are actually solitary; whereas honeybees are social.
  - ii. Different body types.
    - 1) Show the Bee Images Cards.
      - a) Ask students to share differences in they notice.
    - 2) Observe that the bees' fuzzy bellies and legs that are ideal for collecting pollen.
    - 3) Do both bees have pollen sacs?
- e. Share bee facts specific to your location:
  - i. There are 85 species of bees in Berkeley.
  - ii. There are 1,600 species of bees in California.

iii. There are between 20,000 and 40,000 species of bees in the world.

**10. Application\*:** (10 minutes)

- a. Demonstrate how to catch a bee while noting the following:
  - i. Bees can see the colors purple and blue best, so when looking for bees try plants with purple and blue flowers.
  - ii. Bees do not fly downward very well.
- b. After catching the bee look to see whether it is a native bee or honeybee and whether the bee is female or male.
- c. Release the bee.
- d. Explain to students that Bees have been around for 130 million years and have co-evolved with flowers.

**At the Closing circle**

Students summarize today's experiences with bees to answer a single question.

**11. Reflection\*:** (10 minutes)

- a. Ask students to use the *Think-Pair-Share\** process to answer the Closing Circle TPS question:
  - i. Why do we have a beehive in the garden? (*Answers could be: increase honeybee population; pollination for more flowers and more fruit; honey, education; as a teaching tool; for other bee products: propolis, wax, pollen.*)
  - ii. To use *Think-Pair-Share\**:
    - 1) Think - Give students an interesting broad question to think or write about briefly.
    - 2) Pair - Pair students, and ask them to discuss the question(s) with their partner.
    - 3) Share - Students share their discussion ideas with another pair of students or the instructor leads a whole group discussion about the topic.
  - iii. Have students circle up and discuss their findings as a group.

**Contributors**

All lessons at the Edible Schoolyard Berkeley are developed in collaboration with the teachers and staff of the Edible Schoolyard and Martin Luther King Jr. Middle School.

Learning Cycle and Think-Pair-Share discussion routine © The Regents of the University of California. All materials created by BEETLESTM at The Lawrence Hall of Science.

**Resources**

G6-13\_Lifecycle\_Visual\_Aid.pdf

G6-13\_Bee\_Visual\_Aid.pdf

G6-13\_Honey\_Fun\_Fact\_Cards.pdf

G6-13\_Closing\_Circle\_TPS.pdf

BEETLES\_Learning\_Cycle.pdf (See lesson G6-0)

BEETLES\_Discussion\_Routines.pdf (See lesson G6-1)

## The Life Cycle of a Honey Bee

life cycle

grow

growth

honeycomb

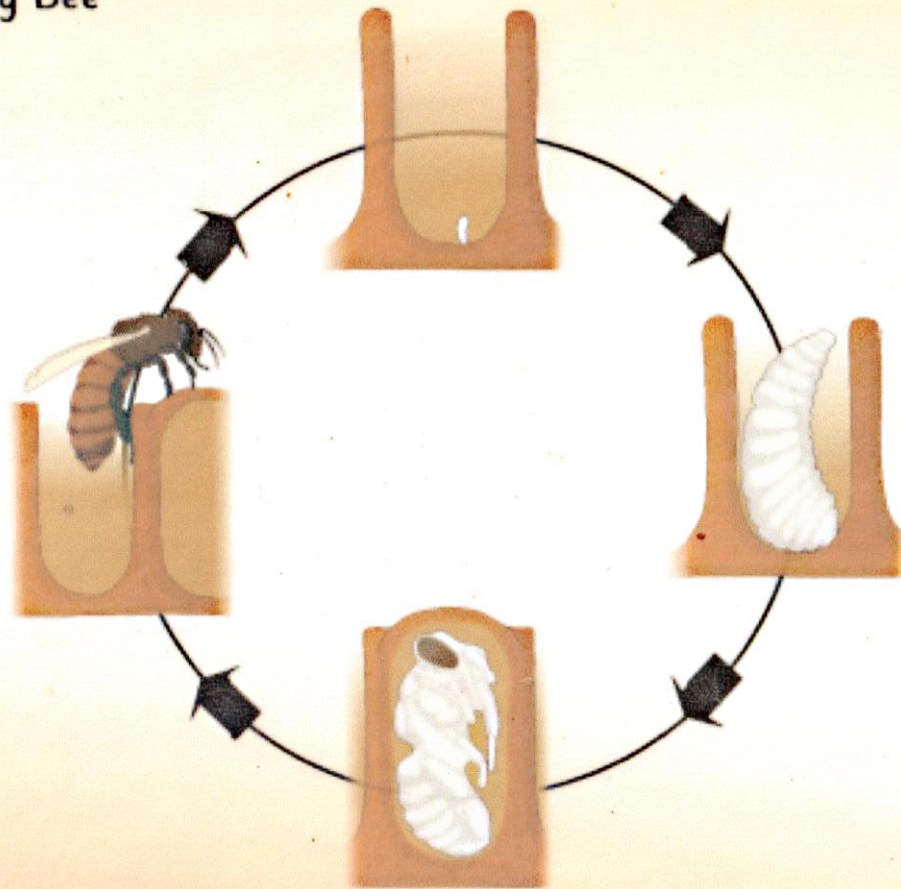
egg

larvae

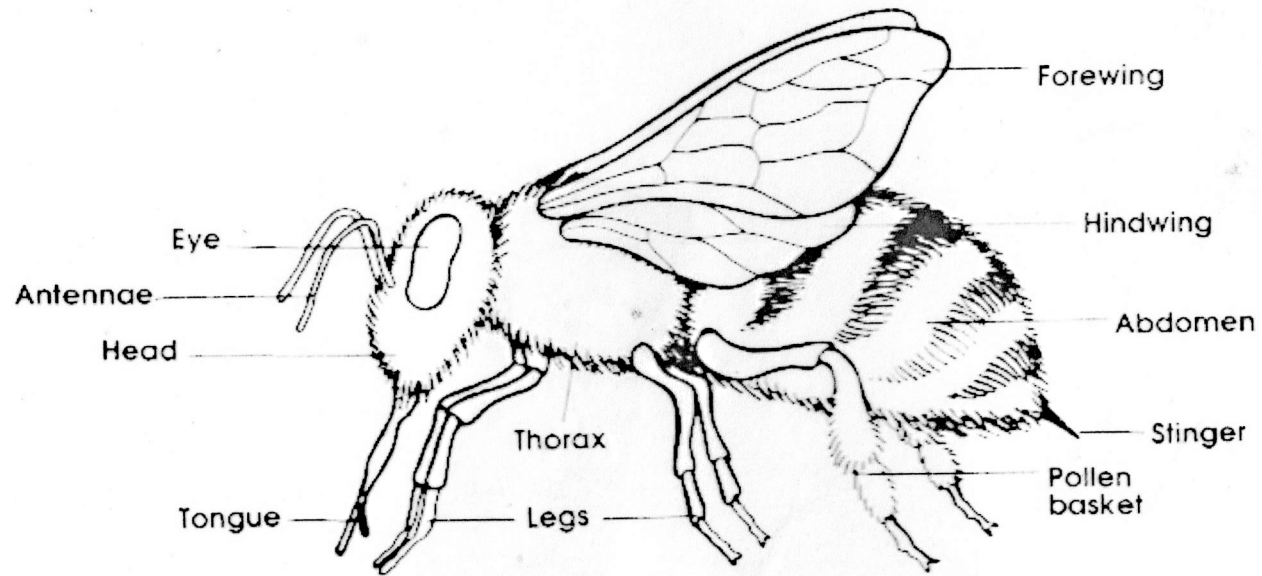
pupa

bee

emerge







The Body of a Honeybee.

## Honey Fun Facts

- An average worker bee makes 1/12 tsp. of honey in her lifetime.
- To make a 16oz. jar of honey, honeybees have to travel 112,000 miles and visit 4.5 million flowers.
- Honey is antibacterial and contains 80% sugar.
- Raw honey also boosts the immune system and soothes burns.
- Archeologists have found honey in the ancient tombs of the Egyptians.

*Why do we have a beehive in  
the garden?*