PURDUE UNIVERSITY | Extension - 4-H Youth Development

4-H-1057-W

Learning About Beekeeping

The 4-H Beekeeping manuals are for youth interested in learning about honey bees and beekeeping.

This manual, *Learning About Beekeeping*, introduces bees and beekeeping and is intended to prepare learners to set up their own hive. The next manual, *Working with Honey Bees*, guides learners to set up their first hive and learn how to keep records. The final manual in this series, *Advanced Beekeeping*, provides information on how to increase the size of the **apiary**, seasonal management, and troubleshooting problems.

Beekeeping can be a lifetime hobby for lifelong learners. A master beekeeper who worked with honey bees for more than 50 years said, "Every time I look into a **beehive**, I learn something new about the bees, and I see another reason why I like the bees so much." We hope that you, too, will enjoy beekeeping throughout your life and realize that you are providing a valuable service to others.

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Notes:

- The 4-H Beekeeping project manuals are not activity-based; rather they are a guide to help young people learn while working with a facilitator. These manuals contain a lot of text, so we recommend the facilitator read with level 1 members, pausing to discuss the questions and checking that the members understand the answers.
- Words in **bold** are defined in the glossary at the end of this manual.

Some of this information has been adapted from *Starting Right with Bees,* a publication by the editors and staff of *Gleanings in the Bee Culture* and the standard in learning about beekeeping for many years. Although the book is out of print, a wealth of information is available at their website, Bee Culture (www.beeculture.com/us/), where you can also sign up for Bee Culture Magazine.

CONTENTS

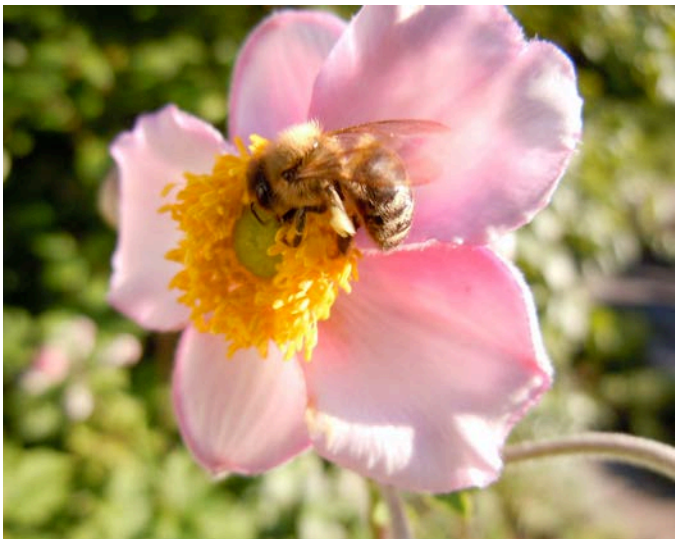
The Value of Honey Bees

People and animals enjoy the honey that honey bees provide. You may have heard about or read *Winnie the Pooh* and know how much Pooh loves honey. Bees make **bee bread** out of honey to feed their young but often make more than they need so we can enjoy it too.

Honey bees make **perennial** nests of wax and have large populations. They pollinate many crops when collecting **nectar** to make honey, so they are important to gardeners and farmers. Honey bees pollinate about one-third of the food you eat and about 75% of all crops. Bees *must* pollinate some crops to produce the food we eat, including almonds, apples, blackberries, blueberries, cantaloupes, cherries, cucumbers, peaches, pears, persimmons, plums, pumpkins, raspberries, squash and watermelon. Clover must also be pollinated by bees. Some crops such as eggplant, grape, lima beans, peppers, soybeans and strawberries have higher yields if the honey bee visits them.

Honey bees are excellent pollinators for several reasons:

- They are hard workers. An individual bee may visit as many as a thousand flowers in one day. Their large, hairy bodies easily pick up and hold many tiny **pollen** grains.



- Honey bees visit only one type of flower on a nectar-collection trip.
- Honey bee beehives can be moved to areas where flowers need to be pollinated.

Because of these special bee qualities, American crop producers rent millions of colonies of honey bees each year to pollinate their crops.

Bee Stings

The only experience most people have had with bees is stepping on one when running barefoot through the grass. You already know that bees provide much more than stings, or you wouldn't be learning about honey bees. However, a "bee in the grass" experience teaches a fact about honey bees: They sting if they think they are in danger. Bees do not want to sting because they die after stinging something. However, they sting if they feel threatened.

A bee sting causes momentary discomfort for most people. It reminds us to slow down, be more careful and show greater respect for bees. It's important that you do not open a hive alone until you know your reactions to bee stings. Although a serious reaction is unusual, a few people have them, including difficulty breathing. See a doctor immediately if you or anyone you are with has a reaction to a bee sting. If you are highly allergic to stings, you must be particularly careful when working with bees.

A Brief History of Apiculture

Bees and beekeeping (**apiculture**) originated in Europe, Asia and Africa. Drawings on rocks found in Spain that date back 9,000 years show women taking honey from wild bee colonies. Early people took honey from hollow-tree hives that they found in the forests. In the autumn these early bee-hunters killed or chased the bees away from their homes so they could take all of the honey. Honey was important at that time as the only source of concentrated sugar.

As humans learned more about bees, they found that they didn't have to kill the bees to collect honey. They found ways of controlling their bees and taking only some of the honey so colonies could survive from year to year and produce enough honey for both the bees' and the beekeepers' needs. Early beehives were made of clay pots, straw baskets and hollow logs capped with straw or clay roofs.

Europeans brought *Apis mellifera, the* species of bee that produces honey, to North America in the 1600s. The continent had some native bees. However, of the 20,000 bee species worldwide, only the honey bee produces honey, except for the *Melipona* (commonly called stingless) bee. (Native species of these stingless honey bees had been cultivated in the Americas for thousands of years and are still cultivated today in tropical and subtropical regions.)

Scientists began studying the habits of honey bees, hoping to find new ways to control them. Equipment that we use today was developed in the 1850s, when an American minister, Lorenzo Lorraine Langstroth, helped make moveable **frames** popular. He revolutionized beekeeping by using **bee space** in his hives to keep the bees from cementing the frames. Bee space is an open space of about 3/8 inch that the bees leave between their **honeycombs** so they have room to move and work. Based on his bee space idea, Langstroth built the first modern beehive with frames of combs that could be easily removed from a wooden box. His invention led to many improvements in beekeeping equipment since that time.

Quiz Yourself

- Honey bees pollinate about _____ of the food we eat and about _____ % of all crops.

- Honey bees are excellent pollinators because

  _____

  _____

  _____

  _____

  _____.

- Bee space is an open space of about 3/8 inch that the bees leave between their honeycombs so that

  _____

  _____

  _____

  _____

  _____.

- Another term for beekeeping is

  _____.

Races of Honey Bees

Bees from a particular place are called a **sub-species**. A bee sub-species is commonly called a **race.** One race of honey bees that evolved for a particular habitat often look and act differently than other races of bees. Variations in color, size and habits are the bees' way of adapting to an area's climate and geography.

All honeybees were originally brought to North America from other countries. Most bees in this country have been **hybridized** for desirable traits and particular uses. Hybridized queens are more expensive than non-hybrid queens but can be used to improve a **colony**. If your bees replace a hybridized queen, however, she may not have desired characteristics.

Six races of honey bees are commonly found in the U.S. Each has some characteristics that are useful to understand.

Italian bees: The Italian bee is light-colored with yellow and tan stripes. They were imported from Italy, as their name implies. They are the most popular bees in the U.S. because they are usually gentle and less likely to **swarm** (leave the hive in a group to start a new colony) as other races of bees. They generally maintain a high colony population from early spring until late fall and produce beautiful white wax cappings on their honey. However, they are more likely to rob honey from weaker hives than the other two races, are not as winter hardy and may be more susceptible to **brood** diseases.

Carniolan bees: The Carniolan bee is gray/brown and sometimes almost black. This race originated in Austria, Bulgaria, central Europe, Hungary, Romania and Yugoslavia. They are the second-most popular honey bees in the U.S. Carniolans are quiet and gentle. They tend to increase their colony population rapidly in the spring, but this increase in colony size can make them more likely to swarm.

Caucasian bees: The Caucasian bee is light gray. They originated in the Caucasus mountains between the Black and Caspian Seas. They are also quiet and gentle. These bees overwinter poorly and build their colony slowly in spring, so they're less likely to swarm than some races. They are susceptible to **Nosema** disease and tend to **propolize** (glue up) inside their hive.

German black bees: The German black bee originated in northern Europe and was the first honey bee brought to the U.S. They are brown or black and overwinter well. German black bees are nervous and aggressive and build the colony up slowly in spring, so they're not a good choice for the beginning beekeeper.

***Russian bees*:** The Russian bee is more resistant to Varroa and tracheal mites than other honey bees. They also tend to produce as much honey as standard bee stocks, if not more. Russian bees also are well suited to climates with long and/or cold winters such as Colorado. These bees are considered moderately gentle. Russian bees have good grooming habits, which helps reduce the overall mite population.

Africanized honey bees: Africanized bees are golden yellow with brown bands and a little smaller than the others. They are a hybrid from an African race of bees imported into Brazil in South America in 1956. These bees are highly defensive and often considered aggressive. They are much more likely to sting than other bees and once disturbed, chase people and animals that come near their hive. They are not likely to sting when foraging on flowers away from the hive. Africanized bees are now present in some of the southern U.S. but are not well adapted to the cold winters so have not moved

north. Some traits make them well adapted to the tropics, such as a tendency for the colony to grow very rapidly and to swarm often. We do not know if Africanized bees will adapt to our climate by mating with our European races of bees. If this happens, they may become less aggressive. Africanized bees have been found in the United States, and most bees probably have some African bee genetics. Africanized bees are sometimes transported to northern states in packages that beekeepers have purchased from the south.

Quiz Yourself

- Bee sub-species are commonly called a _____ .
- The original bee races have been hybridized for desirable traits and particular uses. A hybrid is

_____

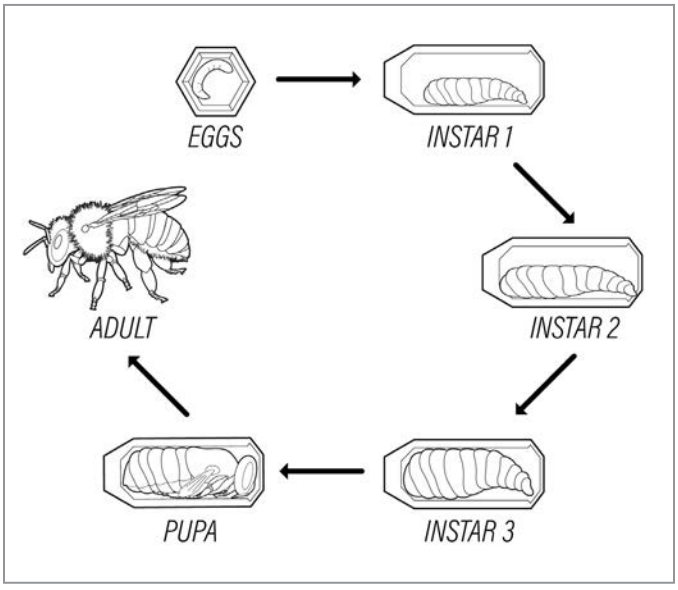
_____.

Bee Growth

Bees go through complete **metamorphosis** — four stages — as they grow. None of the stages look at all like the others. These stages are **egg**, **larva**, **pupa** and **adult**. As shown in the drawing, an instar is a stage between two periods of molting, when the developing bee casts off its exoskeleton.

Fleas, flies, beetles and moths also belong to this group. Some insects such as grasshoppers and termite go through gradual metamorphosis with just three stages of gradual metamorphosis: egg, nymph and adult.

Note: Eggs hatch, but adult bees emerge.



Honey Bee Castes

Note: Much of the following information has been adapted from *Starting Right with Bees*.

Bee colonies include a queen mother (female), some **drones** (males) and many workers (females). The different types are called **castes**. The queen and worker bees are females, and the drones are males. The queen lays all the eggs for the colony, one per honeycomb **cell**. Drones mate with a virgin queen to fertilize the eggs. The worker bees do many jobs.

- ***Queen:*** A colony has one queen whose sole duty is to lay eggs. Queens produce a variety of pheromones that regulate behavior of workers and help swarms track the queen's location during the swarming. Bees raise a new queen when the old one starts to fail or is injured, lost or killed, or to provide a queen for a swarm. A queen egg develops (through metamorphosis) into a **larva**, which is fed a large amount of **royal jelly** for five days. Worker bees then seal the cell and the larva spins a cocoon, becoming a pupa. She remains in the pupal state for seven or eight days. The new queen then works her way out of the pupae with her mandibles and the help of worker bees.

  She is now an adult bee. The new queen roams over the combs for five or six days seeking and destroying other virgin queens or queen cells that may be in the hive. She then flies out of the hive and mates with 10 or more drones. She does this only once in her life and can then lay eggs for several years. She begins to lay eggs two to three days after mating. The queen lays all the eggs in the hive and determines if they will be worker bees or drones. **Unfertilized** eggs become drones. Fertilized eggs become worker bees.

  During the busy season a queen can lay over 1,000 eggs per day. The **honey flow** and strength and needs of the colony regulate her laying. There must be enough young worker bees to feed the larvae and incubate the eggs at a constant 95°F (34.6°C). The queen must lay many eggs in the summer because the workers only live for six weeks. The population must reach over 40,000 individuals to have enough bees to collect ample honey stores for winter survival. The queen can be the mother of 75,000 workers in one season and may have as many as 500,000 offspring in her lifetime. In temperate regions the usual laying season is February to October. Queens can lay either worker or drone eggs. Although queens may live for three to four years, queens over one year of age usually do not reproduce as well, so many beekeepers replace their queens annually.

- ***Drone.*** A drone is an unfertilized male honey bee. It has half the number of chromosomes as a worker or queen. Drones do not have organs for gathering nectar or secreting wax or a stinger. They do not work; worker bees even feed them. A drone's entire function is to mate with the virgin queen so she can lay fertile eggs that develop into worker bees who build a colony. Drones that mate with a queen die soon after. Once the honey flow and mating seasons are over, any remaining drones are pushed out of the hive to die.

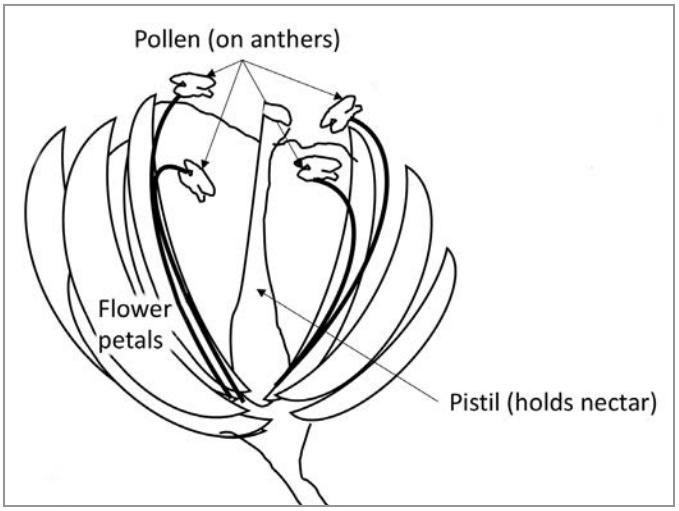
- ***Worker bees.*** Worker bees collect, store and cure flower nectar to make honey. They collect and store pollen and secrete **beeswax** to make the honeycombs. They are also the guards, nurses and cleaning crews of the hive. Age regulates each job that a worker performs:

  - *Cleaners.* Young worker bees clean cells in the brood.

  - *Nurses.* A worker's next job is to take care of larvae, secrete food and help keep the brood warm. These nurse bees may also help feed and lick the queen, ventilate the hive and help ripen honey. They secrete wax and begin comb-building if it is needed. Beeswax is produced only by young worker bees.

- *Field bees* (also called foragers). At three weeks of age, the worker bee begins to move out of the warmer brood nest to the honey **supers** and soon begins gathering nectar and pollen. Pollen is produced in the male part of a flower called the anthers. Nectar is held in the pistil, as shown in the drawing below. Field bees collect pollen from flowers in the form of tiny pellets and carry it back to the hive in small, basketlike pouches on their back legs. This pollen varies in color depending on the type of flower it comes from. Field bees also collect water, nectar and **propolis**. Water is used to cool the hive. Workers gather propolis from resinous buds, pine sap, and other gummy substances to use as a varnish or glue. It cements things together and fills in cracks or uneven surfaces inside the hive.
- *House bees.* House bees patrol the comb and remove debris and litter, usually depositing it outside. If something too large to move, like a mouse, dies in the hive the bees cover it with a layer of propolis.
- *Guard bees.* Guard bees check each bee that enters the hive to make sure it belongs to the colony and alert the other bees if an intruder tries to enter.

Mature worker bees rule the colony. They direct the queen's life and drive out drones when the honey flow is over. Most worker bees live six weeks or less, except for worker bees born in the fall. These bees have more fat cells than others, rarely leave the colony and do little foraging so they can take care of the hive over winter. They live from four to six months.



Quiz Yourself

- The castes of honey bees are

_____

- The queen's only job is

_____

- A drone is an

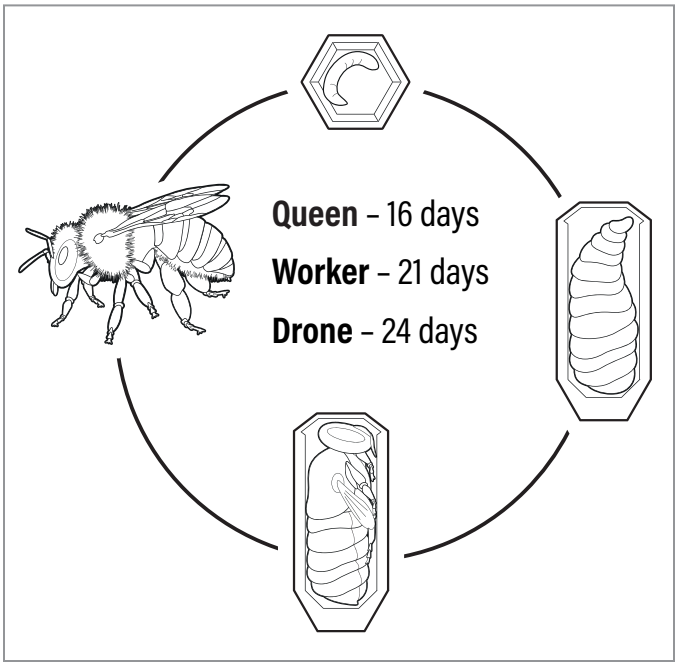
_____

- Which caste collects, stores and cures flower nectar and pollen; secretes beeswax; and serves as the guards, nurses and cleaning crews of the hive?

_____

Bee Development

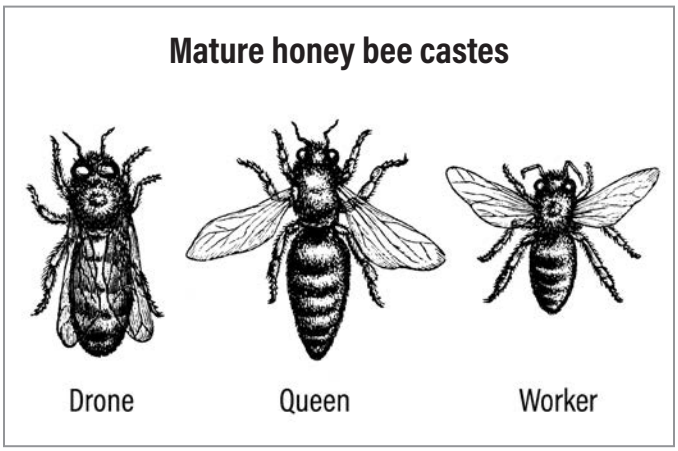
The three castes of bees — queen, drone and worker — each take a different length of time to develop from egg to adult stage. The queen lays a single egg in each wax cell. Queen bees hatch as an adult 16 days later; drones, 24 days after the egg is laid; and worker bees, 21 days after the egg is laid.



The next drawing shows mature honey bees. **Drones** vary in size, but they are shorter and heavier than the queen and larger and clumsier than worker bees. A drone has large eyes used to locate queens during mating flights. His wings extend the entire length of his body.

The honey bee **queen** is the biggest caste member in a honey bee colony when fully developed and laying 15,000 eggs a day! Her abdomen is larger than the worker bee's but not as large around as a drone's. The queen's stinger is different than that of a worker bee (drones have no stinger). It is not barbed like a worker's stinger and is curved. The queen only uses her stinger against another queen. She collects no honey so does not have a pollen basket.

Worker bees are the smallest bees in the hive with bodies specialized for pollen and nectar collection. They cannot reproduce.



Quiz Yourself

- A queen bee emerges as an adult _____ days after the queen egg is laid.
- Drones emerge _____ days after the egg is laid.
- Worker bees emerge _____ days after the egg is laid.
- Which bee caste has the longest body? _____
- Which bee caste is shorter and heavier than the queen but larger and clumsier than the workers?

_____

How Bees Make Honey

Worker bees make honey from nectar, a sweet liquid secreted in flowers. Nectar is composed almost entirely of sugar and water. Plants produce it to attract insects. Pollinators visit flowers to collect nectar and transport pollen grains as they move from plant to plant. Pollen grains must be transferred from the male parts of flowers to the female parts to make a seed. While collecting the nectar, a bee's body hair picks up pollen. As the bee visits another flower for more nectar, some of this pollen rubs off. This transfer of pollen causes fertilization of the second flower, which results in seeds. This benefit to the flowers and the pollinators is called a **symbiotic** relationship; the bees get nectar for making honey, and the flower is pollinated so it can produce seeds. Nectar is, in a sense, the flower's "pay" for being pollinated.

Nectar usually pools inside the flower. The amount of nectar the flower produces depends on the type of flower, weather, time of day and amount of recent rainfall. The visiting (field worker) bee sucks up as much of this nectar as she can, using her **proboscis** (long tongue). The field worker bee has two stomachs, a honey stomach and a real stomach. The honey stomach is only used to temporarily store nectar. It is in front of the real stomach, where digestion takes place. The nectar sucked up by the honey bee's proboscis is held in the bee's honey stomach while she flies back to the hive.

At the hive, the field worker transfers the nectar she has collected to three or more house bees, who suck the nectar from the mouth of the field bee. The house bee changes the nectar into unripe honey. She does this by moving the nectar around in her mouth and mixing it with chemicals called enzymes. After the mixing process, which takes about 20 minutes, the house bee deposits the unripe honey in a cell for ripening. The new honey ripens through evaporation. Just as water left in a glass eventually evaporates into the air, extra water evaporates from unripe honey that is left to sit in the cells. Ripe honey is all that remains. The time it takes for the evaporation process depends on the type of nectar, air temperature and humidity. The bees often use their wings as a fan to speed evaporation.

The honey is ripe when it is less than one-fifth water. Once the honey is fully ripe, house bees cover it with a thin layer of wax to protect it. It takes about 20,000 bees to collect a pound of nectar. A pound of nectar makes about a quarter pound of honey.

Quiz Yourself

- Flowers and the pollinators have a _____ relationship.
- Field worker bees suck up nectar using their _____
- Field worker bees have _____ stomachs.
- Ripe honey has less than _____ water.
- It takes about _____ bees to collect a pound of nectar.
- A pound of nectar makes about _____ pound of honey.

Honey Plants

The starting point in the production of honey is in flowers that produce nectar, so every beekeeper needs a good knowledge of plants and their flowers. Understanding honey plants, which produce the nectar bees use to make honey, helps a beekeeper know where to put the hives. Many crops need bees to pollinate them to produce our food, and some farmers keep bees to pollinate their crops as well as to collect the extra honey they produce.

The best way to determine which plants bees use to make honey is to watch them. Bees get most of the nectar they use from wildflowers, so knowing how much wild land is within a mile of your house is important. Visit these patches and watch for bees. Many flower and vegetable garden plants also attract bees. This list may help you know which flowers to watch.

Trees

- Apple and other fruit tree blossoms
- Basswood
- Black locust
- Box elder
- Silver maple, red maple (note: maples are mostly important for pollen, not honey)
- Tulip poplar

Herbaceous plants with flowers

- Asters (in fall, especially the small, white frostweed aster)
- Blackberry
- Blue vine or climbing milkweed
- Blueberry (bees are important for blueberry pollination)
- Clover (major honey source in the Midwest): small white (Dutch), yellow sweet and white sweet
- Currant and gooseberry
- Dandelion (important in the spring because it blooms early)
- Goldenrod (late summer to fall, different kinds)
- Ground ivy
- Mint
- Raspberry

Honeycomb and Bee Glue

Honeycomb is the inner house of honey bees, where young bees are raised and where the hive's food is stored. Honeycomb is built out of beeswax, which is produced only by young worker bees gorged with honey. Glands on the undersides of the bodies of these young bees can produce tiny pieces of wax. Worker bees chew these small flakes of wax with their mandibles and bend and shape the wax chips to form the comb.

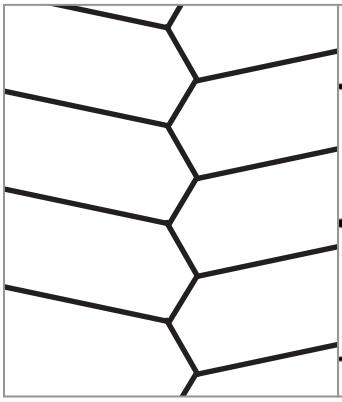
A newly constructed comb is usually beautifully white in color. It may be light yellow when bees get nectar from goldenrod or similar flowers. The comb becomes darker over time because as each new bee is born, it sheds its skin, which becomes part of the cell. Bees also collect propolis, which can make the comb darker. Beeswax combs provide the bees' living quarters, food storage and passageways.

The comb consists of many small, hexagonal (six-sided) cells built side by side. The floor of the cells slopes slightly downward to the bottom and is shaped like a three-sided pyramid pointing away from the cell opening. This small slope ensures that anything put into the cell does not slide out of it. The hexagon shape is one of the strongest used in construction. It provides more storage space than most other shapes and takes the least amount of wax. It takes seven pounds of honey for the bees to make one pound of wax.

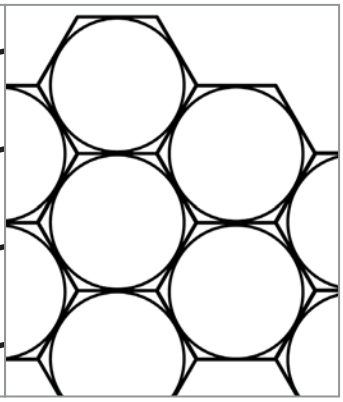
Worker cells that are full of eggs, developing larvae and pupae are usually found in the central part of the comb (brood area). Bordering the brood area is a narrow strip of worker cells where pollen is stored. Pollen is an important food for the larva growing in the brood area cells, because it is the bees' protein source and also rich in fat.

A cell is never completely filled with pollen. Bees pack the pollen into a cell until it is about three-quarters full. Sometimes they add a little honey to the pollen to preserve it. This makes the pollen look wet. This storage method maintains the pollen's freshness for a long time. The outer edges of comb beyond the narrow pollen storage area are used for ripening and storing honey. Between each comb, the bees leave a space about 3/8 inch wide, called **bee space**.

Hives also contain propolis. Propolis is a sticky brown material that the bees use for many purposes — holding down the hive lid, covering the hive's inside walls, fastening frames, strengthening comb, plugging holes and, sometimes, narrowing the entrance. If the space between combs is much wider than the bee space, the bees close it with wax and bee glue. Field bees gather propolis from various plant buds, picking up sticky substances such as pitch from pine trees.



Slope of cells from front to middle of comb.



The economy of the hexagonal shape for making honeycomb cells.

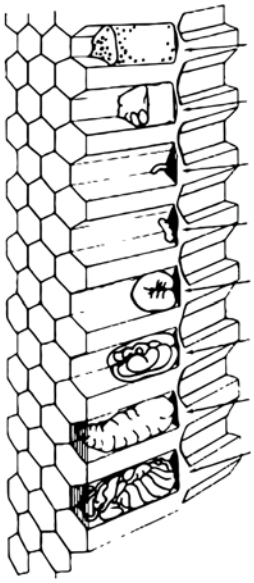
Quiz Yourself

One pound of nectar makes about a quarter pound of honey.

- Seven pounds of honey make about _____ pound of wax

- So, one pound of wax requires about _____ pounds of nectar!

This drawing shows things you can find in honeycomb cells. Draw a line from each of the items below to their place in the honeycomb cell.



- Egg
- Larva (large)
- Pupa, sealed cell
- Stored honey
- Larva (small)
- Stored pollen (two pellets)
- Prepupa, sealed cell
- Larva (medium)

Questions & Answers

- Newly constructed comb is usually_____ in color.
- Honeycomb cells have a _____ shape.
- Why is older comb darker than new comb?

_____

_____

Draw a line from each thing you can find in a honeycomb to its definition.

Pollen ▪	▪ The first stage of metamorphosis of the honey bee
Propolis ▪	▪ Grains formed in the flowers of plants, used as food for developing honey bees
Eggs ▪	▪ Six-sided cells of wax in which honey bees rear their young and store their food
Honeycomb ▪	▪ A sticky brown material used to cement items in the hive

Draw a line from each question to its correct answer.

Q. Describe how bees build comb.	A. The brood is usually in the central part of the comb and consists of worker cells full of eggs, developing larvae and pupae.
Q. Why is a drone cell larger than a worker cell?	A. Because drones are larger than worker bees.
Q. What is the brood, and where is it found?	A. To keep the pollen close, since it is food for the larva growing in the brood cells.
Q. Why is the brood area surrounded by pollen storage cells?	A. Young worker bees build comb out of beeswax. They chew small flakes of wax in glands on the underside of their bodies and form the comb.

Observing the Hive Entrance

The hive entrance of a honey bee colony is like the front door of your house. Just as you go through it on your way to and from school, field bees exit and enter through the hive entrance on their trips to visit flowers. By watching a hive's entrance, beekeepers can learn a great deal about their bees' activity levels.

Observing the hive entrance helps you understand the work going on inside the hive. The more nectar and other supplies the field bees bring in, the busier the house bees are, storing away and using supplies to build new comb and to care for the young bees. You may also be able to follow the bees to find out what honey plants are attracting your field bees.

What's happening at the hive's entrance can also tell beekeepers about the health of their bees. For example:

- If you're too hot in your house, you may sit outside your front door. Bees do the same thing. Clusters of bees gathered on the outside of the hive on a warm evening indicate the hive may need more space. Beekeepers call this "bearding." This is more likely to happen in late summer after the honey has been harvested. It is normal and not a sign the bees are getting ready to swarm.
- When you're cold, you close the front door. Although the bees cannot close their hive entrance, they remain inside, away from the entrance, when they're cold.
- When you don't feel well, you stay inside to rest. Sick bees don't leave their hives, either, unless they are very sick; in that case, they crawl out of the hive and die.

Work with your advisor to find a hive to observe. Watch a hive entrance closely for at least 15 minutes every three weeks during the spring and summer, if you can. Do this at different times of the day. Sit as close to the entrance as possible so you have a clear view of the activities taking place, but don't sit in front of the entrance. The bees will become confused if they see you and won't know where to go. Watch to see if the bees carry anything in or out of the hive.

Record your observations

When you record your observations, include the information below:

- The date and time of day of your observation
- Weather conditions
- A summary of the activities you observed at the hive entrance
- The types and approximate number of bees you saw

Share your report with someone else — a parent, your advisor or a friend. Your advisor will probably be able to answer any questions you have about the hives' activities.

Beekeeping Equipment

Now that you have a basic understanding of honeybees and their activities, you should begin to start thinking about the equipment you'll need to start your own beehive. You can collect some of it now, but we recommend you wait until you have a beekeeping mentor before you purchase your bees and hive. Your mentor can help you decide what's best for where you live and help you find good sources for supplies.

Bee hives consist of a **box**, **frames**, **bottom board** and **cover**. The **hive body** holds the frames and comes in different heights. Some beekeepers prefer a smaller hive body (called honey supers), which are used mostly for **extracted honey**. Some beekeepers use a larger hive body for both brood and honey so they don't have to change equipment. Hive frames must fit the super depths and keep the proper bee space.

The bottom board sits on the hive stand, which keeps it off the ground. It has a cleat (entrance reducer) that's taken out during hot weather to allow maximum air circulation. The cleat is inserted to restrict the opening in cold weather. The hive stand keeps the hive dry, minimizes some pest problems and helps keep the bottom board from rotting.

Beehives usually have two covers: an **inner cover** placed on the top super and the **outer cover**. The inner cover provides insulation and serves as an escape board. The outer cover protects the hive from rain.

You must add a **comb foundation**, a thin sheet of pure beeswax imprinted with a hexagonal honeycomb, to your frames for the bees to build comb on. Reinforce foundations for a brood nest with wires so the comb won't sag, bend or break during extraction. Foundations provide four benefits.

1. They provide beeswax for the bees so they don't need to make it all and can make more honey.
2. They center the comb in the frames.
3. Because they come in two sizes, one for worker bees and one for drones, you have some control of the populations of each.
4. They enable bees to draw out a frame more rapidly than those without foundations.

The second beekeeping manual has more information about obtaining hive equipment and locating your hive. Discuss this information with your beekeeping mentor before you purchase equipment.

Other Equipment

Clothing. A beekeeper must take care to wear suitable clothing. All clothing should be white or light in color. It should not be made of rough, wool-like material. Bees are angered by dark-colored and/or fuzzy material, especially if it smells like an animal. Many beekeepers like to wear white coveralls to protect their clothes and to give them added warmth on cooler days in early spring or late autumn.

- *Leather gloves*. A good pair of leather gloves is especially important for the beginning beekeeper until they are experienced enough to know how to work without angering the bees and to know when the bees are more likely to sting. Many beekeepers prefer special beekeeping gloves that cover the forearm past the elbow. Others like to wear regular gloves along with gauntlets, which are sleeves that extend from the wrist to above the elbow with elastic in each end.
- *Socks*. Cover your ankles with light-colored socks. Ankles are on about the same level as a hive entrance, so angry bees often attack them first. Even gentle bees may crawl up your pants by mistake!
- *Pants*. Wear long pants and tuck your socks in them (or use bicycle clips, large rubber bands or string) to keep bees from crawling up your pant legs.

Hive tool. A hive tool is valuable. This chisel-like instrument is slightly curved at one end. It enables the beekeeper to pry up hive lids, supers or frames glued tightly together with propolis. It is also handy as a scraper and nail puller.

Queen and drone excluder. A queen excluder confines the queen to the brood nest and prevents her from laying eggs where you do not want them. It also keeps drones below it. This is optional, but recommended.

Smoker. The smoker has a firebox and is mounted on bellows. Smoke masks alarm smells from the bees and stimulates bees to gorge on honey. This reduces the chances that they'll fly or sting. Learning to use a smoker takes experience. Too much smoke can cause the bees to panic.

Bee escapes. Bee escapes allow bees to leave an area but not get back in. This is optional, but recommended.

You need the following equipment before you start your hive (item, number needed):

- **Bee veil**, 1
- Bottom board and entrance cleat, 1
- Extracting supers with frames, 2-3
- Foundation, 1 sheet per frame
- Gloves, 1 pair
- Hive body and frames, 2
- Hive cover, 1
- Hive tool, 1
- Inner cover, 1
- Long-sleeved white shirt, 1 (recommended)
- Mouse guard
- Overalls, 1 (recommended)
- Queen excluder, 1 (optional, but recommended)
- Smoker, 1
- Entrance reducer for new hive and cold weather, 1

Keep a list of your purchases and record them in your project report form. Remember to keep your receipts!

Observing a Beekeeper

Your best source of information about beekeeping is to watch and learn from an experienced beekeeper. You now understand enough about the honey bee and beekeeper's equipment to know what questions to ask an advisor or mentor. Ask to observe your beekeeper-mentor as they check a beehive.

Your county Extension educator, state bee association or state apiary inspector may be able to help you find someone willing to work with you. The Resources section of Bee Culture website (www.beeculture.com/) lists U.S. apiary inspectors. An experienced beekeeper may also be willing to lease one of their hives until you decide to purchase your own equipment.

Quiz Yourself

Match each item to its description/purpose.

Bottom board	Allows worker bees to pass through but keeps the queen from accessing an area and laying eggs where you do not want them.
Smoker	Used for prying off covers and supers, removing frames and staples, and scraping propolis.
Hive tool	
Queen excluder	Smoke prevents the bees from smelling alarm pheromone and stimulates the bees to gorge on honey so they are not flying around or stinging.
Clothing a beekeeper must wear when working with hives	Sits on the hive stand, which keeps it off the ground.
Entrance reducer	Helps a new colony or keeps the hive warmer in the winter.
	Veil, light-colored coveralls, gloves and socks.

Sharing Your Knowledge

Now that you have begun learning about bees, you might want to share your knowledge in a poster or demonstration at a 4-H club meeting, school, fair or beekeepers meeting. Check with your local Extension office for guidelines for fair exhibits.

Learn More

Find fact sheets and much more at the United States Department of Agriculture (USDA) website (www.usda.gov/pollinators) and/or the USDA Natural Resource Conservation Service website (www.nrcs.usda.gov/pollinators).

Glossary

Adult: Last stage of bee development after the bee emerges from the cell.

Apiary: A collection of colonies of honey bees; also, the yard or place where bees are kept.

Apiculture: Beekeeping.

Bee bread: A mixture of pollen and nectar or honey. This substance is the main source of food for honey bee workers and larvae.

Bee escape: A device to remove bees from supers or buildings; constructed to allow bees to pass through in one direction but to prevent their return.

Beehive: A box or other structure for housing a colony of honey bees.

Bee space: An open space (1/4 to 3/8 inch) in which bees build no comb and/or deposit a minimum of propolis.

Beeswax: The wax that honey bees secrete from eight glands on the underside of the abdomen, used in building their combs.

Bee veil: A wire screen or cloth enclosure worn over the head and neck for protection from bee stings.

Bottom board: The floor of a beehive.

Box hive: A plain box without **movable frames** used for housing a colony of honey bees.

Brood: Young developing bees found in their cells in the egg, larval and pupa stages of development.

Castes: The different kinds of adult bees in a colony: worker, drone and queen.

Cell: A single compartment in a honeycomb in which brood is reared or food is stored.

Chunk honey: A piece or pieces of comb honey packed in a jar with liquid extracted honey.

Clarification: The removal of foreign particles from liquid honey or wax by the straining, filtering or settling process.

Colony: A community of honey bees having a queen, thousands of workers and, during part of the year, a number of drones.

Comb foundation: Thin sheets of beeswax or plastic used to form a base on which the bees can construct a complete comb of worker cells.

Drone: A male honey bee.

Egg: The first stage of metamorphosis of the honey bee.

Extracted honey: Liquid honey.

Field bees: Worker bees, usually at least 10 days old, that leave the hive to collect nectar, pollen, water and propolis.

Frame: Four strips of wood joined at the end to form a rectangular device for holding honeycomb.

Hive body: A single wooden rim or shell that holds a set of frames. When used for the brood nest, it is called a **brood chamber**. When used above the brood nest for honey storage, it is called a **super**.

Hive cover: The roof or lid of a hive.

Hive tool: A metal tool with a scraping surface at one end and a blade at the other; used to open hives, pry frames apart, clean hives, etc.

Honeycomb: The mass of six-sided cells of wax that honey bees build and in which they rear their young and store their food.

Honey flow: A time when nectar is plentiful, and bees produce and store surplus honey.

House bee: A young worker bee, one day to two weeks old, that works only inside the hive.

Hybridize: Crossbreed or interbreed different races of bees to achieve desired traits and strengths. A **hybrid** is a cross between any two distinctly different populations.

Inner cover: A thin wooden board placed just beneath the hive cover for added protection and insulation from the elements, and to keep the hive lid from being glued to the hive body.

Larva: The grublike or wormlike immature form of the honey bee in its second stage of metamorphosis.

Metamorphosis: The series of changes in form through which an insect passes as it develops. Complete metamorphosis has four stages: egg, larva, pupa and adult. Gradual metamorphosis has three stages: egg, nymph and adult.

Movable frame: A frame of comb that can be easily removed from the hive. It is constructed to maintain a proper bee space, which prevents the bees from attaching comb or fastening it too securely with propolis.

Nectar: A sweet liquid that plants secrete, usually in their flowers, which bees convert into honey.

Nosema: An infectious disease of the adult honey bee that infects the mid-gut or stomach. A protozoan parasite causes it. Symptoms closely resemble those of dysentery.

Outer cover: Protects the hive from rain.

Perennial: Lasts for a long time. Honey bee nests can last for multiple generations.

Pollen: Dust-like grains formed in the flowers of plants in which the male elements are produced. Honey bees use pollen to feed their young.

Proboscis: The tongue of a honey bee.

Propolis: A kind of glue or resin the bees collect and use to close up cracks and anchor hive parts. It is also called **bee glue**.

Pupa: The third stage of a developing bee, during which it is inactive and sealed in its cell. The adult form is recognizable during this stage.

Queen excluder: A device, usually constructed of wood and wire or sheet zinc, with openings large enough for worker bees to pass through but too small for the passage of larger drone and queen bees.

Royal jelly: A milky white secretion of protein, water and fat that oozes from the heads of nurse bees.

Robber bee: A field bee from one colony that takes honey from another colony.

Sealed brood: Brood, mostly in the pupa stage, that the bees have capped or sealed in with a somewhat porous capping of wax.

Section comb honey: Honey in the sealed comb produced in thin wooden frames called sections.

Smoker: A device that burns slow-burning fuels to generate smoke to keep the bees calm while working in their hive.

Sub-species: The biological division below genus comprising organisms capable of interbreeding. Sub-species (in bees, usually synonymous with **race**) have defining **characteristics.**

Super: A receptacle in which bees store surplus honey placed over (above) the brood chamber. As a verb, to add supers in expectation of a honey flow.

Swarm: A large group of worker bees, drones and a queen that leaves the mother colony to establish a new colony.

Symbiotic relationship: Interactions between two or more different species that are mutually beneficial and may be key to their survival.

Unfertilized: An ovum or egg that has not been united with sperm.

NOTES

NOTES

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