UF IFAS Extension UNIVERSITY of FLORIDA

May 2025 | 4H446

HONEY BEE 4-H PROJECT BOOK

Chapter 2: Welcome to the Apiary!

Welcome to the Apiary!

This book was designed to introduce you to the art of beekeeping. The purpose of this publication is to offer a follow-up 4-H curriculum to *Chapter 1: Welcome to the Hive!* The text is most appropriate for junior-, intermediate-, and senior-aged youth (about 8–18 years old) and may serve as a guide for prospective and beginner beekeeping. Here you will find out

- why so many people choose to keep bees,
- how to work safely around them,
- what kind of equipment is needed,
- how to choose and prepare an apiary location, and
- how to keep the colonies healthy.

This book contains what you need to know to start your first honey bee colony. Before you dive in, take a minute to think about why you want to keep bees in the first place. Your answer will help in the goal-setting process and in preparing your colony for that specific purpose. You do not have to be a beekeeper to use this resource. You just need a curiosity about how to keep honey bees. Follow the "Beeline" through each section on your own or with the help of your leader. Some activities you can do by yourself, but most are made for you and a group of friends. You will learn a lot of new vocabulary from the world of beekeeping. These words are in **bold** font when they are first introduced. If in later sections you forget a definition, you can look back to previous sections or use the glossary at the end of this chapter. The end also includes a blank copy of the first activity and an answer key for all other activities. When you get to the end of the "Beeline" in each section, you will have learned lots of new and interesting things about beekeeping.

Figure 1. An overview of an apiary.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

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Follow the Beeline!

Just like honey bees follow a beeline from the hive straight to the nectar, you can follow the bees in these symbols to lead you straight through the activities in this project book as you learn more about beekeeping.

What's the Buzz?

To get things going with each section, a brief introduction to the topic will be given. New vocabulary words will be in bold font. When you see this buzzing bee, take a few minutes and read this section on your own or with your leader so you will be ready to complete the activities in the section.

Foraging for Nectar

Just as honey bees must leave their hive to go out and search for nectar, this bee signals there is an activity to get you up and doing something. When you see this bee, it is your chance to explore the world of beekeeping either with a learning experience or another fun, hands-on activity. Some you can do on your own. For others, you will need your friends.

Return to the Hive

Once honey bees find nectar or pollen, they take it back to the hive and share it with the colony. When you see this beehive, it is time for you to return and bring back what you have learned. Reflect on your experience by answering some thoughtful questions.

Taste the Honey!

Bees do not make honey for nothing—they eat it! Tasting the honey is how bees enjoy the fruits of all their hard work! When you see this pot of honey, this is your chance to see the fruit of your efforts. Take a few minutes to ponder these questions and see what you have learned about beekeeping and how you can use the information in your own life.

The Bees' Knees

When something is neat or interesting people will say it is "the bees' knees." These sidebars offer more information and other interesting facts about honey bees and the things they do.

Pollen Patties

Many beekeepers will give their bees pollen patties as a food supplement to help strengthen the colony. This bee signals closing activities that can be fun and offer deeper learning to strengthen your understanding about a topic. You are not required to complete these activities. They are optional.

Chapter 2.1 Why Keep Honey Bees?

What's the Buzz?

Long before people kept honey bees in boxes, they were honey hunters. They would follow honey bees back to their nest in the wild (Figure 1), then they would harvest the honey and other hive products, destroying the nest in the process. This was not very good for the bees.

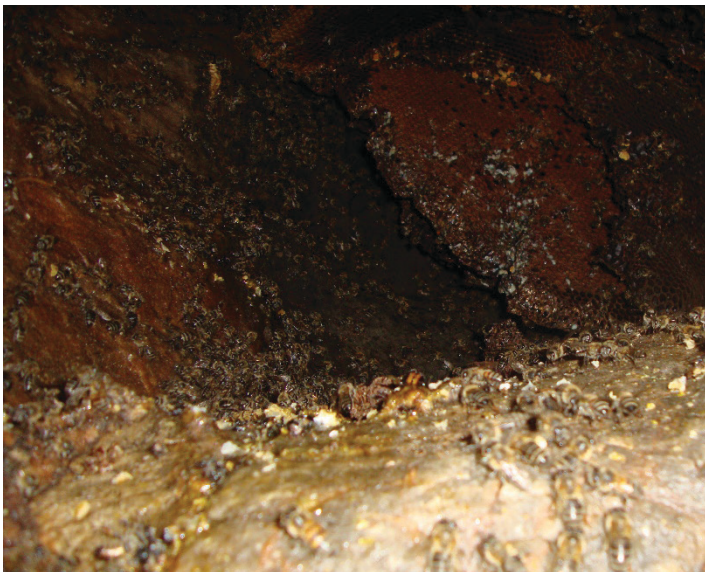

Figure 1. A honey bee nest located inside a cave.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Ancient Egyptians are the first **beekeepers** that humans have on record. Images on stone walls, dating back to 650 BCE, show humans keeping or managing hives of honey bee colonies in clay cylinders (Figure 2). Ever since, beekeepers all over the world have been working to improve the lives and products of bees.

There have been many different containers used to host honey bees throughout the centuries, but the oldest had to be destroyed to harvest the honey. Beekeepers improved the hive designs so they could remove the frames of honeycomb without having to destroy the hive. The **Langstroth hive** (Figure 3) has become the most popular type of hive body used today. This type consists of stackable boxes with removeable frames, allowing beekeepers to keep colonies year after year in the same hive. Today, there are many reasons people become beekeepers. Harvesting honey is only one of them.

Figure 2. Egyptian tomb showing a beekeeper and their honey bees.
Credit: Gene Kritsky, used by permission

Figure 3. A beekeeper inspecting a frame of bees from a Langstroth hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Are You in It for the Products?

Honey is the most popular product from a honey bee colony because it is a delicious treat that can be eaten as liquid honey, chunk honey, comb honey, or creamed honey (Figure 4). **Beeswax**, which bees use to build honeycomb on the frames, is made into products such as candles, lip balms, soaps, crayons, polishes, and much more. Some less common products from bees which may have human health benefits include **propolis**, **royal jelly**, and bee venom.

Figure 4. Various honey products on display at a honey show.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Are You in It for the Pollination?

Honey bees are wonderful **pollinators** (Figure 5). Some people keep honey bees so they can boost **pollination** in their own flower and vegetable gardens or on their fruit trees.

Others build a business out of beekeeping and provide **pollination services** to farmers to help pollinate their crops. This requires managing many colonies at a time, often moving them across the country wherever pollination services are needed.

Figure 5. A honey bee pollinating a flower.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Are You in It for the Knowledge?

Beekeepers and scientists have studied these fascinating little creatures up close for many years. These observations have led to understanding honey bee behavior and how humans, pests, and the environment affect it. We have also learned how to better manage and care for honey bees. Scientists and beekeepers around the world have published their findings for others to understand the best ways to keep honey bee colonies strong and healthy (Figure 6).

Figure 6. Honey bees that are part of a UF/IFAS research project.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Are You in It for the Tradition?

There are many generations of beekeepers who continue the tradition that has been passed down by relatives (Figure 7). These beekeepers say, "I'm a beekeeper like my mother was and her father before her." It is a good hobby or business that allows family members to work together and use their different skills to keep healthy honey bee colonies.

Figure 7. Two generations of beekeepers working together.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Are You in It to Save the Bees?

In recent years, the health issues and decline of honey bee populations have become a critical concern to many beekeepers and scientists. This increased awareness of the threats faced by honey bees has caused humans to take action (Figure 8). Many feel the need to help by becoming beekeepers themselves. By taking care of their colonies as best they can to increase honey bee health, many new beekeepers are helping boost bees' well-being as a species.

Figure 8. A drone honey bee on a beekeeper's thumb.
Credit: Baylee Carroll, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Some people become beekeepers because it is something they enjoy doing in their spare time. Others become beekeepers because observing and working with fascinating creatures is rewarding. Some become beekeepers to make a living (Table 1). Whatever the reason, there are many things to learn about before becoming a beekeeper. Why do you want to keep bees? What do you hope to gain from this experience?

Table 1. Types of Beekeepers in Florida

Identifying Questions	Hobbyist	Sideliner	Commercial
Why do they keep honey bees?	As a fun or relaxing hobby, to harvest some honey, or help save the honey bees.	As a side business to bring in extra money through pollination services or honey production.	As a full-time job selling pollination services, honey production, or honey bee production.
How many colonies do they keep?	1–20 colonies typically, but up to 40.	41–100 colonies	100 or more colonies
Where do they keep their hives?	On their property or someone else's locally.	On their property or someone else's locally.	On their property or someone else's around the country.

Foraging for Nectar

Activity #1 Who Needs a Pollinator?

Many of the food crops grown by humans rely on insect pollinators for pollination (Figure 9). In many cases, the wild pollinators naturally found near a crop field cannot provide enough overall crop pollination. Many farmers rely on managed honey bee colonies to supply pollination services for their crops. Commercial beekeepers often keep or manage thousands, and even tens of thousands, of honey bee colonies for this purpose. These colonies are transported all over the country to supply essential pollination services. There is a good chance that bees helped produce the food that you eat every day (Figure 10), including many fruits, vegetables, nuts, and even cocoa! Honey bee pollination also supports crops fed to livestock, such as alfalfa or clover. As a result, honey bees are partly responsible for many dairy and meat products as well. Beyond farming and agriculture, pollination is also vital in natural, unmanaged **ecosystems**. It leads to the production of seeds and fruits, on which many animals in the food web depend.

Figure 9. These are a few of the vegetables that require honey bee pollination.
Credit: Tyler Jones, UF/IFAS Communications

It is time to brainstorm! With the help of an adult, use the internet to do a search for foods pollinated by honey bees. Try to find at least 26 different kinds of foods that need to be pollinated by honey bees (Table 2). Look over your list and circle the foods that you have eaten. Are you surprised how many there are?

Figure 10. A raised-bed vegetable garden.
Credit: Tyler Jones, UF/IFAS Communications

Table 2. Who needs a pollinator?

1.		14.	
2.		15.	
3.		16.	
4.		17.	
5.		18.	
6.		19.	
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9.		22.	
10.		23.	
11.		24.	
12.		25.	
13.		26.	

Activity #2 Chalk Pollination

HOW POLLINATION WORKS

Pollen is the powdery substance that contains **sperm cells** on the male parts of plants. Pollination is successful when pollen is transferred by pollinators, such as honey bees, from the **stamen** (male reproductive organ) of a flowering plant to the **pistil** (female reproductive organ) (Figure 11). After the pollen reaches the pistil, **fertilization** can take place. This happens as pollen travels down the long portion of the pistil to the **ovary** where it joins with the **ovule** or egg (Figure 12). The fertilized egg then grows into a fruit or seed of the plant.

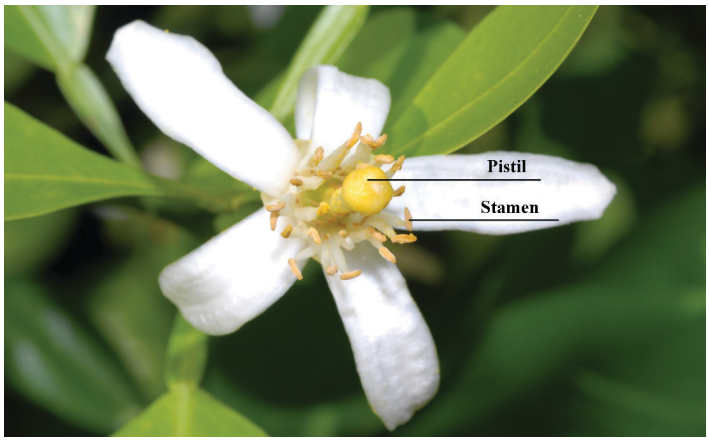

Figure 11. The pistil and stamen of a citrus flower.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

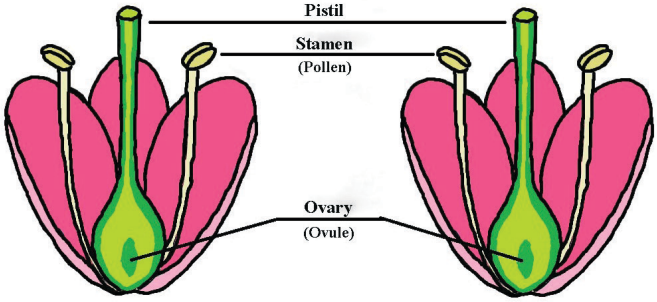

Figure 12. A diagram showing the reproductive parts of a flower.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

In many cases, fruit and seeds will fail to form without enough pollination. Pollination is an essential part of the reproduction of many species of plants. Some plants such as wheat and corn are pollinated by the wind. Many plant species require an animal pollinator, like a honey bee, to physically move grains of pollen from one plant to another. Many of these plants work very hard to attract honey bees and other pollinators to them with bright, showy flower petals, sweet scents, and the presence of nectar, as shown in Figure 13.

Figure 13. A flower with large showy petals and bright colors has attracted a honey bee.
Credit: Kristen Lang Designs, used by permission

These characteristics draw in pollinators, who then touch the flower's pollen-covered stamens. When the bee travels to another flower for more resources, the pollen from the previous flower often contacts the pistil of this new flower, allowing pollination to occur. The plant provides important nutritional resources such as nectar and pollen that benefit the honey bee in exchange for the pollination services she provides. While feeding the colony is the reason that bees collect pollen, their flower visits are also important for the plant's long-term survival. This win-win situation where both organisms help each other is known as a **mutual symbiotic relationship**.

In this activity, you will see how honey bees pollinate flowers through direct physical contact.

Step 1. Collect the following materials for this activity:

- flower worksheet printout (see page after glossary)
- crayons
- scissors
- cotton balls
- chalk of assorted colors

Step 2. Take the flower worksheets and color the petals with crayons.

Step 3. Use scissors to cut out the flower (Figure 14).

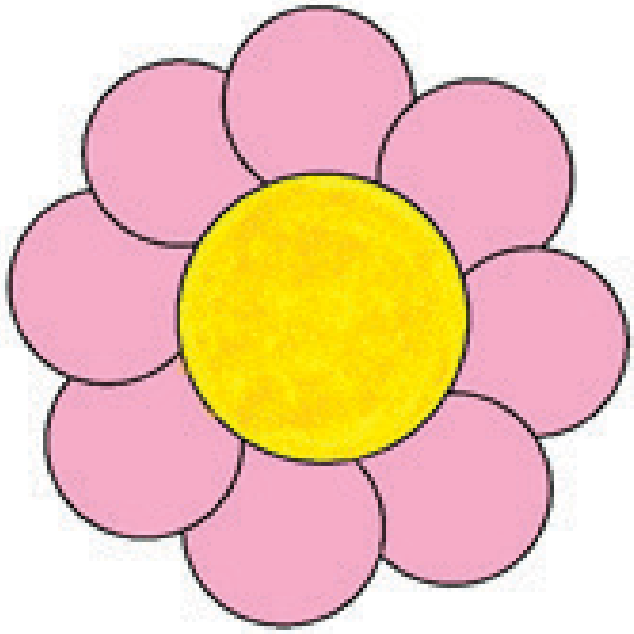

Figure 14. Step 3.
Credit: Emily Helton, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 4. Each person uses a different color piece of chalk to color the center of their flowers. Press down hard enough while coloring to create chalk dust in the center. The chalk dust will represent the pollen.

Step 5. Once everyone has finished coloring the flowers, carefully place them around the room without spilling the chalk off the flower.

Step 6. Hand each person a cotton ball. The cotton ball will represent their honey bee. Everyone "buzzes" around the room with their bee to visit each of the flowers by gently tapping their cotton ball onto the center of the flowers (Figure 15).

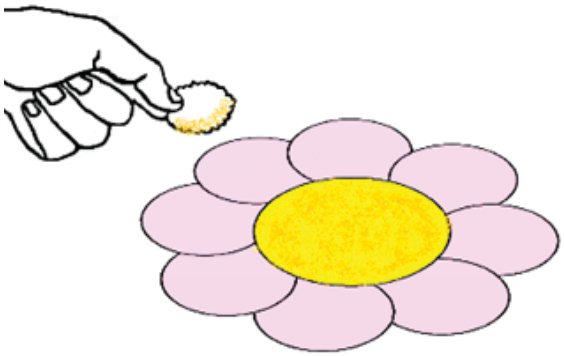

Figure 15. Step 6.
Credit: Emily Helton, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 7. After visiting all the flowers, have everyone observe all the assorted colors on their honey bees. Notice that they picked up various "pollen samples" from all the different flowers they visited (Figure 16).

Figure 16. Step 7.
Credit: Emily Helton, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 8. Find a flower in the room that displays an array of colors showing that it was visited by multiple bees and was successfully "pollinated" (Figure 17).

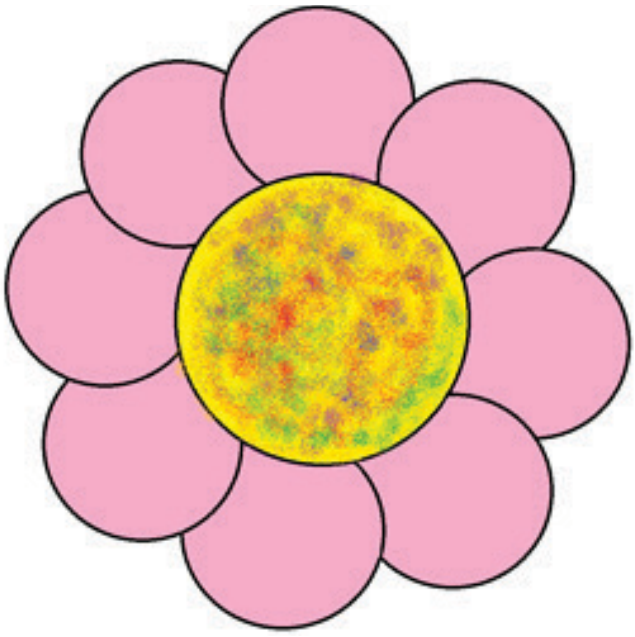

Figure 17. Step 8.
Credit: Emily Helton, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

The Bees' Knees

Pollen is important for growth in the honey bee diet. It is their main source of protein, as well as a source of vitamins, minerals, and fats. How do they collect tiny grains of pollen? The tiny, branched hairs that cover honey bees' bodies help them. As a forager bee lands on a flower, grains of pollen attach themselves to these hairs. This happens because of **static electricity**, which is produced during the honey bee's flight. This electrical charge pulls pollen grains to the hairs of the bee. As the forager continues to buzz from flower to flower, she moves the pollen down into her pollen baskets, located on her hind legs (Figure 18). When her baskets are full, she returns to the hive where workers make pollen into bee bread and store it until it is fed to the colony (Figure 19).

Figure 18. A close photo of a forager honey bee showing its fuzzy hair and full pollen basket.
Credit: Dr. Michael Bentley, used by permission

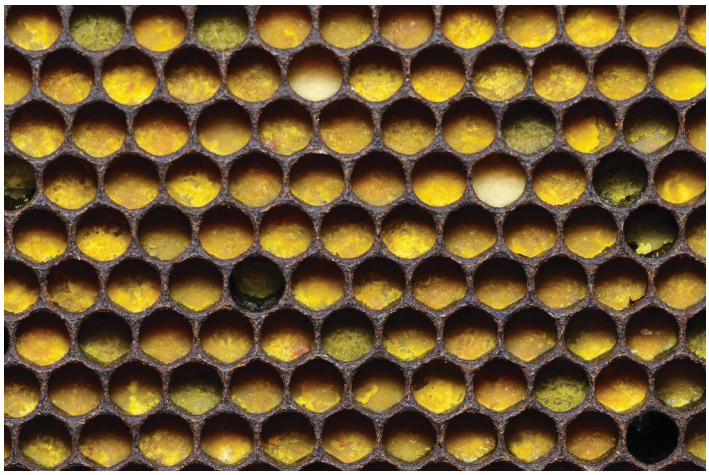

Figure 19. Bee bread fills these cells which the colony will use to feed themselves.
Credit: Dr. Michael Bentley, used by permission

Return to the Hive

1. Name the three types of beekeepers and why they keep honey bees:

2. Pollen is the main source of _____ in the honey bee diet.
3. In your own words, explain how flowers are pollinated by pollinators.

4. Honey bees have a mutual symbiotic relationship with flowering plants (Figure 20). How does each organism benefit in this relationship?

5. How does pollination affect humans?

Figure 20. Honey bee pollinating a beautiful flower.
Credit: Kristen Lang Designs, used by permission.

Taste the Honey

1. What are some foods that you would miss if the plants did not get pollinated by honey bees?

2. What kinds of foods or groups of foods do humans need to eat for proper health and nutrition in their diet?

3. Why are you interested in beekeeping?

4. What types of honey have you tried (different flavors, creamed, chunked, etc., as in Figure 21)?

Figure 21. Different honey products at a grocery store.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Pollen Patties

How does static electricity help honey bees collect pollen? See how it works with this simple experiment using black pepper and a plastic spoon. The pepper granules are posi-

tively charged, while the spoon gains negative electrons from the cloth. Opposite charges are attracted to each other, so the pepper will jump up and stick to the spoon. This is like how a honey bee builds up static electricity in the tiny hairs of its body as it flies from flower to flower. When it lands on a flower, the grains of pollen will stick to the honey bee's body.

Step 1. Collect the following materials for this activity:

- plastic spoon
- black pepper
- piece of cloth
- small plate

Step 2. Pour 1 teaspoon of black pepper into a pile at the center of a small plate as shown in Figure 22.

Figure 22. Step 2.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 3. Rub the spoon with the cloth for 40 seconds to build up static electricity (Figure 23).

Figure 23. Step 3.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 4. Hold the spoon over the pepper (Figure 24), and watch it jump up and stick to the spoon.

Figure 24. Step 4.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Chapter 2.2 Beekeeping Safety

What's the Buzz?

The first thing to understand before you begin your journey in becoming a beekeeper is learning how to work safely around honey bees. Many states have established best beekeeping practices and rules for the safety of the beekeeper as well as the public. You can learn more about these practices by contacting your local UF/IFAS Extension office. These important practices include wearing **personal protective equipment** (PPE; shown in Figure 1), understanding bee sting reactions and how to treat them, and choosing a safe location for your apiary or bee yard.

Figure 1. A beekeeper wearing personal protective equipment, including a veil, gloves, boots, and a full bee suit.
Credit: M. K. O'Malley, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

PPE is special clothing recommended for all beekeepers because it helps reduce the fear and risk of being stung so they can focus on learning the art of beekeeping. PPE for beekeepers is at least a veil but may also include a bee suit or jacket, gloves, and closed-toe shoes.

The Veil

The **veil** is the most important piece of PPE (Figure 2). A veil is a hat with netting that covers and protects the head, face, and neck. The veil is important because bee stings in those areas are not only very painful but can be dangerous. A bee sting to the eye can cause blindness, and a sting near the throat or mouth can cause swelling and make it difficult to breathe. Honey bees, like many other insects, are attracted to the smell of carbon dioxide in the air, which we breathe out from our noses and mouths. So, it makes sense to be extra protective of this area. New beekeepers who are starting their first hive, and longtime beekeepers who have practiced for decades, should always wear at least a veil any time they approach a honey bee colony.

Figure 2. These beekeepers are wearing three different styles of veils.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Bee Suits and Jackets

Bee suits and **bee jackets** can be connected to a veil to provide protection to the arms, legs, and torso. Bee suits are made of a durable cloth material that makes it difficult, but not impossible, for a bee to sting the skin directly. Full bee suits with a veil will cover you mostly from head to ankle with only your hands and feet exposed (Figure 3). A jacket with a veil only covers the head, arms, and torso. Some may choose to wear the jacket instead of the full bee suit, especially if it is hot outside.

Figure 3. New beekeepers wearing full bee suits, gloves, boots, and veils.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Hands and Feet

Beekeepers must also protect their hands and feet. Anyone approaching a honey bee colony should always wear **closed-toe shoes**, such as sturdy tennis shoes or boots, to keep their feet from being stung. When beekeepers stick their hands into hives to pick up frames covered with honey bees, there is always a chance they may get stung. There are special bee gloves made of thick, but flexible, leather that is difficult for bees to sting through (Figure 4). From the veil to the shoes, a beekeeper can be mostly protected, depending on what he or she prefers to wear in the apiary.

Figure 4. A beekeeper wearing bee gloves to protect his hands while inspecting a frame of honey bees.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

The Sting

Honey bees will sting, but only when they feel threatened (see Figure 5 for a close-up of a honey bee stinger). Those who decide to become beekeepers should expect stings to happen. Many people believe they are allergic to stings because they have a reaction *at the sting site*. This is a *normal, non-allergic* reaction. A true allergic reaction is when the body reacts to the sting *away from the sting site*, especially around the face or throat. It is good to know how to tell the difference between the various kinds of sting reactions and symptoms as well as how to treat them.

Figure 5. The stinger of a worker bee.
Credit: Dr. Michael Bentley, used by permission

Table 1. Types and symptoms of bee sting physical reactions.

Reaction Type	Reaction Symptoms
1. Normal non-allergic reaction at time of sting	*At the sting site*, sharp pain, redness, swelling, tender, and white area immediately after the sting.
2. Normal non-allergic reaction after time of sting	*At the sting site*, itching, redness, swelling for hours or days after; small brown or red damage spots.
3. Large local reaction	Fast and severe swelling *around the sting site* that stays swollen for up to 72 hours.
4. Cutaneous allergic reaction	Rash anywhere on the skin; itching, redness, and/or massive swelling *away from sting site*.
5. Non-life-threatening allergic reaction	Swelling around nose or eyes, minor breathing problems, stomach cramps, nausea, vomiting, weakness.
6. Life-threatening allergic reaction	Shock, dizziness, unconsciousness, low blood pressure; severe swelling in throat, face, tongue, or mouth; and rapid pulse.

After receiving a sting, the stung person should leave the apiary and get indoors, if possible. Once the person is safely away from the apiary, the person should remove the stinger as soon as possible, if not done already. The longer the stinger remains, the more venom enters the body. If a sting victim experiences one of the first three reactions (Table 1) *around the sting site*, they should wash the area and apply a cold compress or ice. Taking an **antihistamine** by mouth and applying a **hydrocortisone** cream to the area can help reduce the itching and swelling at the sting site. If a sting victim experiences one of the last three reactions *away from the sting site or on the face*, it is important to seek medical attention immediately.

Apiary Location Safety

There are many things to consider when setting up an **apiary** (sometimes called a bee yard) to make it as safe as possible for the beekeeper as well as the public. The Florida Department of Agriculture and Consumer Services provides safety guidelines for beekeepers to follow. Honey bee colonies must be located more than 15 feet from a property line or behind a **flyway barrier** at least 6 feet in height. A flyway barrier may be a wooden fence or dense bushes or plants, which is placed around a hive and forces the honey bees to fly upward and away from people. This reduces the risk of honey bees interfering with people and stinging them (Figure 6).

Figure 6. The beekeeper has placed the hives against a natural flyway barrier of tall bushes.
Credit: Nico Knaack on Unsplash

Another important guideline for apiaries in Florida is that bees must have access to a convenient water source nearby. This is so they do not have to fly off into other areas where they may not be welcome, such as neighborhood pools. Care should be taken to prevent honey bees from drowning in water sources by placing rocks or floats where they can land. Other safe sources could be a dripping faucet or hive top or front entrance feeders (for example, glass jars with tiny pinholes in the lids as shown in Figure 7).

Figure 7. Hive top feeders allow honey bees easy access to water.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Beekeepers should take all precautions to prevent honey bees and people or other animals from interacting with one another. Apiaries should not be located near public places, such as schools, where there will be lots of people passing by regularly. Apiaries must not be within 150 feet of tied or fenced in animals. This is because the animals would not be able to get away if bees became upset and thought the animal was a threat. Finally, make sure the location you choose for your apiary is not in a neighborhood with rules against beekeeping. Always check with a responsible adult to make sure your apiary will be in a safe location.

The Bees' Knees

Did you know that rooftop beekeeping is becoming extremely popular around the United States in some cities because there are so many flowers available (as shown in Figure 8)? Keeping honey bee colonies on the rooftops of tall buildings is one option for a safe location where the bees can easily be separated from the public or other animals. Rooftop beekeepers still must follow guidelines for safe beekeeping.

Figure 8. A beekeeper examining his hive that is on a rooftop.
Credit: Lance Cheung, USDA, Public Access

Foraging for Nectar

ACTIVITY #1 WHAT IS WRONG WITH THIS APIARY LOCATION?

When a beekeeper chooses a location for their apiary, they have a lot to think about: the safety of colonies from predators and the safety of the public. In this activity, read each description and look carefully at the picture. You will need to decide what could be unsafe about the location and what ways you could make it safer.

Apiary Location #1 (Figure 9)

A beekeeper decides to place his apiary in his backyard where there are tall trees and shrubs between his apiary and his neighbor's house. However, he has not provided a water source for his honey bees.

Figure 9. Apiary location #1.
Credit: Google Earth; copyright Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

What are some ways the beekeeper could make the site safer?

Apiary Location #2 (Figure 10)

The zookeeper decides to place an apiary on zoo property. The apiary site is within 150 feet of the monkey cages on one side and the bear exhibit on the other side. The zoo has many visitors each day.

Figure 10. Apiary location #2.
Credit: Google Earth; copyright Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

What are some ways the beekeeper could make the site safer?

Apiary Location #3 (Figure 11)

A beekeeper lives across the street from an elementary school. She chooses a location for her apiary on her property that is within 10 feet of a sidewalk where children must pass to get to school each day. There is a chain-link fence that is 4 feet tall that separates her property from the sidewalk.

Figure 11. Apiary location #3.
Credit: Google Earth; copyright Airbus, CNES/Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

What are some ways the beekeeper could make the site safer?

Apiary Location #4 (Figure 12)

This beekeeper did not realize his neighborhood prohibits keeping honey bees. He places his apiary in the side yard on the edge of his property. There is no fence between his apiary and his neighbor's property.

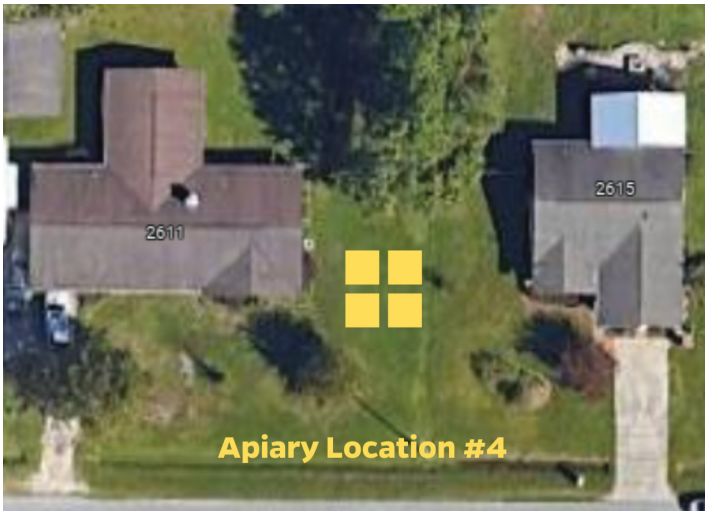

Figure 12. Apiary location #4.
Credit: Google Earth; copyright 2024 Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

_____

_____

What are some ways the beekeeper could make the site safer?

_____

_____

_____

ACTIVITY # 2 PERSONAL PROTECTIVE EQUIPMENT RELAY RACE

Wearing personal protective equipment is especially important for your safety when working with honey bees (Figure 13). It allows you to enjoy the experience and not worry about getting stung. You will get familiar with the parts of PPE for beekeepers in this relay race. To race, you will need at least two teams, or more if you have a larger group. Keep in mind you will need a set of PPE for each team. If you do not have access to beekeeper PPE, use other articles of clothing to represent each piece of the PPE. A simple cardboard box and egg cartons could also be used to represent the hive and frames, if necessary.

Figure 13. Beekeepers putting on their personal protective equipment.
Credit: Tyler Jones, UF/IFAS Communications

Step 1. Collect the following materials for each team:

- A bee veil
- A full body bee suit/jacket
- One pair of bee gloves
- One pair of boots (these should be oversized so they will fit everyone in the group)
- One empty hive with a lid and six to eight frames each (less frames will make it easier to remove)

Step 2. Divide your group into equal teams for the relay race.

Step 3. Set up the relay race. Put a complete set of beekeeper PPE at the start line for each team. Put an empty hive at the turn-around-point for each team. See Figure 14 for an example using two teams.

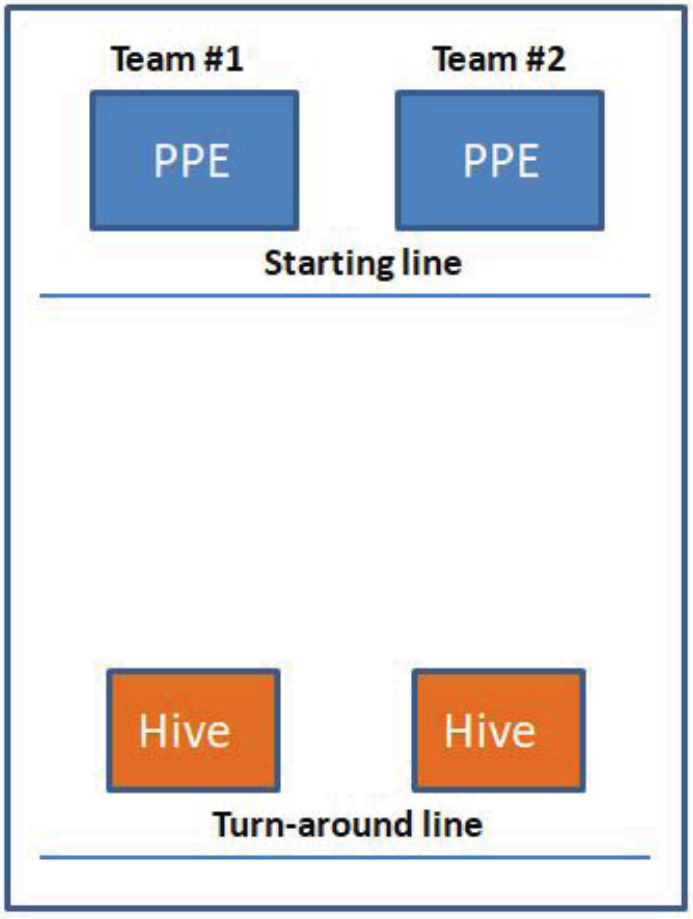

Figure 14. The setup of the relay race.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 4. Race! The first person in line for each team puts on each piece of PPE correctly and then runs down to the hive at the turn-around line.

Step 5. The person removes the lid and each frame from the hive, one at a time, and then puts the hive back together.

Step 6. The person then runs back down to their team, removes the PPE, and gives it to the next person in line.

Step 7. Repeat for each person on the team. The first team with every player to complete their turn wins the race.

Return to the Hive

1. What is PPE? List and describe what protection it provides for beekeepers. (You may refer to Figure 15 for a few ideas.)

2. Explain the difference between a normal non-allergic and a true allergic reaction to a bee sting.

3. Name one important guideline beekeepers must consider when choosing a site for an apiary.

Figure 15. Close-up of a beekeeper wearing a veil and jacket.
Credit: Tyler Jones, UF/IFAS Communications

Taste the Honey

1. Do you play a sport or participate in another activity that requires you to wear any type of PPE? Describe the PPE required for your activity.

2. What are some jobs that you know require workers to wear PPE? Describe the PPE that workers wear and what protection it offers the wearer. (See Figure 16 for an example.)

Figure 16. A picture of a forest fire fighter's protective helmet, fire jacket, and pack.
Credit: Tyler Jones, UF/IFAS Communications

Pollen Patties

Beekeepers have many different options when it comes to choosing the appropriate PPE, as shown in Figure 17. Some beekeepers prefer full suits, while others just wear a jacket. Other beekeepers prefer a pullover veil, while some like a folding veil. With the help of a responsible adult, obtain a beekeeping supply catalog or visit a retailer online. Determine what PPE is right for you! Keep in mind each item's size, material, and exposure amount.

Figure 17. These beekeepers are each wearing different levels of PPE: (from left to right) full suit, jacket, and veil only.
Credit: Rebecca Knox-Kenney, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Chapter 2.3 Beekeeping Equipment

What's the Buzz?

With every hobby or business, there is going to be equipment involved. Becoming a beekeeper requires a lot of equipment and preparation before honey bees can even be purchased. Let's explore the various parts of a beehive and the tools that are used by every beekeeper.

COMPONENTS OF A BEEHIVE

On the outside, a beehive looks like a plain box. However, there are many pieces that fit together to make it the perfect home for honey bees (Figure 1). Starting from the bottom is the **bottom board**. The bottom board is the floor or base which supports the rest of the hive. There are two types of bottom boards: screened and solid. Solid bottom boards are constructed completely of wood while the screened bottom board has a wooden frame with a screened center for better airflow in the warmer months (see Figure 2).

Figure 1. Langstroth hives stacked to different heights.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

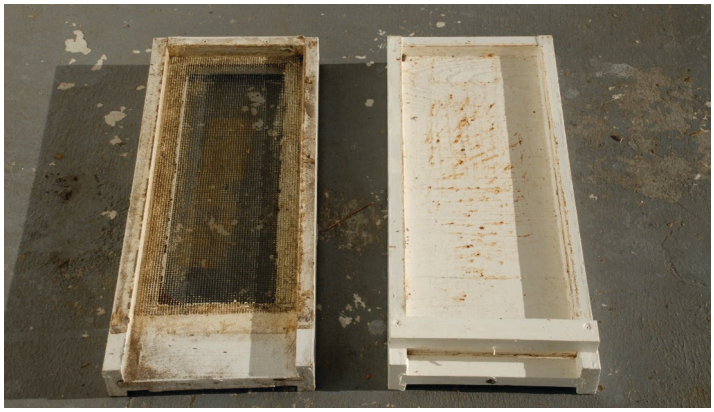

Figure 2. The two types of bottom boards: screened (left) and solid on the (right).
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Entrance reducers are long, thin, wooden blocks with different sized notches cut out (Figures 3 and 4). These pieces cover the hive entrance and make the opening smaller. The reduced size of the entrance makes it easier for weaker colonies to guard and defend their nest. They can also be used in colder climates to help keep cold air out of the hive while keeping the warm air inside.

Figure 3. An entrance reducer (narrow green piece) with a small opening.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Figure 4. An entrance reducer (narrow light blue piece) with an even smaller opening.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Next are the **hive supers**. These stackable boxes may go by a few names: supers, bodies, or chambers. The name of the box depends on what they hold inside. There are **brood chambers** (usually found on the bottom of the stack) where the queen lays her eggs. Then there are **honey supers** where bees make and store honey. Hive boxes come in three different depths or heights: **shallow** (5¾ inches), **medium** (6⅝ inches), and **deep** (9⅝ inches) (Figure 5). However, all boxes are around 16¼ inches wide and 19⅞ inches long. The different depths allow for different amounts of honey to be stored in the supers. Honey can get quite heavy. A deep super that is full can weigh up to 80 pounds! There are smaller sizes to allow for lighter supers, which make it easier for some beekeepers who may not be able to lift heavier boxes.

Figure 5. A stack of supers, ready for use.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Each super can hold eight to ten **frames**, and sizes will vary according to the size of the hive supers. Frames are the structures that hold the honeycomb. They are usually made of four small pieces of wood forming a rectangle, but frames can also be made from plastic (Figure 6). The frames may also have a plastic foundation in the center with a hexagon pattern imprinted on them (Figure 7). That foundation helps the worker honey bees make comb by giving them a base on which to build. Frames can be removed from the supers easily by the beekeeper without destroying the hive.

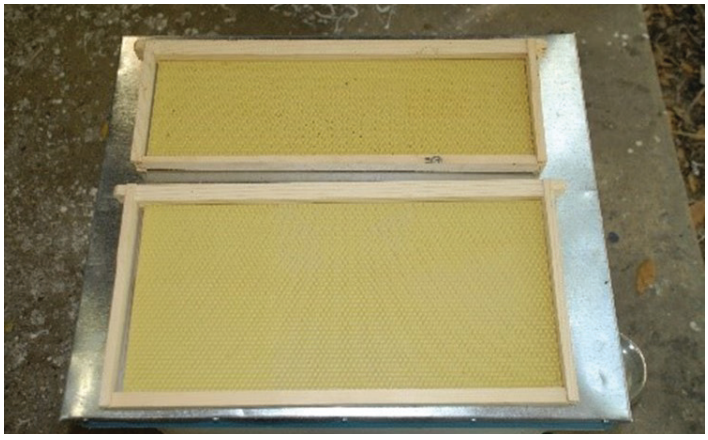

Figure 6. Two wooden frames with plastic foundation. The smaller frame fits into a shallow super and the larger one into a deep super.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Figure 7. A green plastic frame with plastic foundation.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Queen excluders have a very specific purpose. As the name suggests, they prevent the queen from being in certain parts of the hive. An excluder is a flat screen with openings large enough for workers to pass through, but small enough to prevent the queen from passing through. Queen excluders are placed on top of the brood super to prevent the queen from laying eggs in the honey super directly above it (Figure 8). This can be helpful for making honey since it prevents brood from being mixed in with

honey on a frame. Queen excluders are made from either metal or plastic.

Figure 8. A metal queen excluder is being placed on top of the brood super to prevent the queen from moving into the honey super.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

The last pieces of a honey bee hive are the lids or covers. Lids keep the hive covered from rain, snow, wind, and so forth. The two types of lids are known as the **migratory lid** and the **telescoping outer lid** with an **inner cover**. A migratory lid is specially shaped with no overhang on at least two sides, which allows hives to be stacked closely side-by-side and neatly on top of each other (Figure 9). Migratory lids are used on hives of colonies that are moved around a lot for their pollination services, as shown in Figure 10.

Figure 9. A migratory lid does not have overhanging side edges so beehives can be stacked close together for transportation.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Figure 10. Beehives with migratory lids stacked on a trailer ready for pollination services.
Credit: Jason Deeringer, Bee Serious, LLC, used by permission

Telescoping lids are wooden lids with overhang on all four sides, often with a thin piece of metal covering the top. An inner cover, placed on the uppermost super, is often used with the telescoping outer lid (Figure 11). Its purpose is to prevent the bees from using propolis to glue the frames and telescoping lid together. There are also notches in the inner cover to allow for air flow in and out of the colony.

Figure 11. The telescoping outer lid (painted blue) sits on top of the inner cover (unpainted).
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Beekeeping Tools

There are quite a few tools that a beekeeper uses when working colonies. One of the most important tools all beekeepers use is a **smoker**. The smoker, smartly named for its ability to create smoke, masks the pheromones bees use to communicate with one another (see Figure 12). Scientists believe the smoke masks the alarm pheromone that the workers give off when they feel threatened. It works like an air freshener in a smelly gym locker-room. The smoke covers the smell of the pheromone so the bees cannot smell the signal to start stinging. The smoker is a

metal container with a funnel at the top that can direct the smoke when it is puffed. The smoke comes from the burning fuel inside of the container, and beekeepers must make sure the smoke is cool and not hot. Beekeepers use many resources to produce the smoke, from pine straw to wooden pellets, or any long burning, non-toxic material. Proper use of the smoker does not upset the honey bees.

Figure 12. A smoker calms the colony before the beekeeper opens the hive.
Credit: James Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

The second most useful tool for every beekeeper is the **hive tool** (Figure 13). Shaped like a small crowbar, it is used to open the hive, separate supers, and move frames. This is necessary because honey bees produce the extremely sticky substance called propolis, which they use to fill in small gaps and glue pieces of the hive together. The hive tool can easily pry the pieces apart without disturbing the bees too much, allowing for a gentler inspection. It is also useful for cutting away excess comb and scraping off debris on the frames and in the hive.

Figure 13. Beekeeper holding his hive tool while inspecting his hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Feeders are important when nectar sources start to dwindle, when beekeepers are trying to grow a colony, or to provide bees a convenient water source. They distribute food such as sugar water or corn syrup. Some beekeepers use **entrance feeders** or **hive-top feeders** (Figures 14 & 15), which both require an upside-down glass jar holding the food or water outside of the hive. Others may choose to use an **in-hive feeder** which looks like a large plastic frame inside the colony that holds the food.

Figure 14. Beehive with an entrance feeder.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Figure 15. The beekeeper of this apiary uses hive-top feeders.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

The Bees' Knees

Some beekeepers use other special equipment that is not essential but can make beekeeping much easier. One such

piece of special equipment is just for the queen bee. The queen can have a wing clipped and her thorax (middle body segment) marked with paint to help the beekeeper easily find her and keep her from flying too far away. A beekeeper may use a **queen cage** for holding the queen while they are marking her (Figure 16), so she is not accidentally crushed. In addition to the queen marking cage, there are cages that simply hold the queen for her protection while the beekeeper is working in the colony.

Figure 16. A metal queen cage with a queen inside.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

A few other helpful tools a beekeeper may choose to use are a **frame spacer** (Figure 17) and a **bee brush**. A frame spacer is used after a hive inspection when placing all the frames into the super. It helps to space frames evenly apart from each other. A bee brush has soft bristles and gently moves honey bees off a frame without hurting them during a hive inspection (Figure 18).

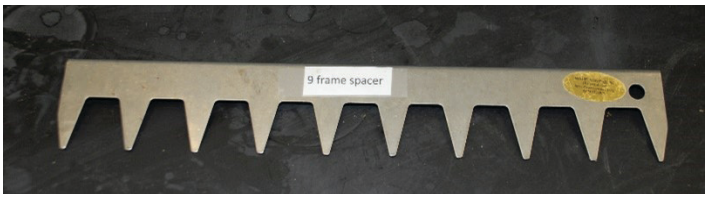

Figure 17. This frame spacer helps to evenly space out nine frames in a super.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Figure 18. This beekeeper is using a bee brush to remove bees from a frame.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Foraging for Nectar

ACTIVITY #1 BEEKEEPING EQUIPMENT CROSSWORD PUZZLE ACTIVITY

Now that you have learned about the essential equipment and tools for beekeeping (as in Figure 19), test your knowledge and solve this crossword puzzle. Use the highlighted vocabulary words from this section as your word bank.

Figure 19. This beekeeper is wearing her veil and using a hive tool as she inspects the colony.
Credit: Bori Bennett, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Across

1. Often constructed from leather, this personal protective equipment protects your hands from stings.

2. Eight to ten of these can fit in the hive and is where honey bees will store their nectar, pollen, and brood.

3. A _____ chamber holds the frames where the queen will lay the eggs.

4. The queen _____is a screen that prevents the queen from passing through to the upper honey supers.

5. This type of bottom board allows for better airflow during the warmer months.

6. A _____lid has overhang on all four sides and is often used with an inner cover.

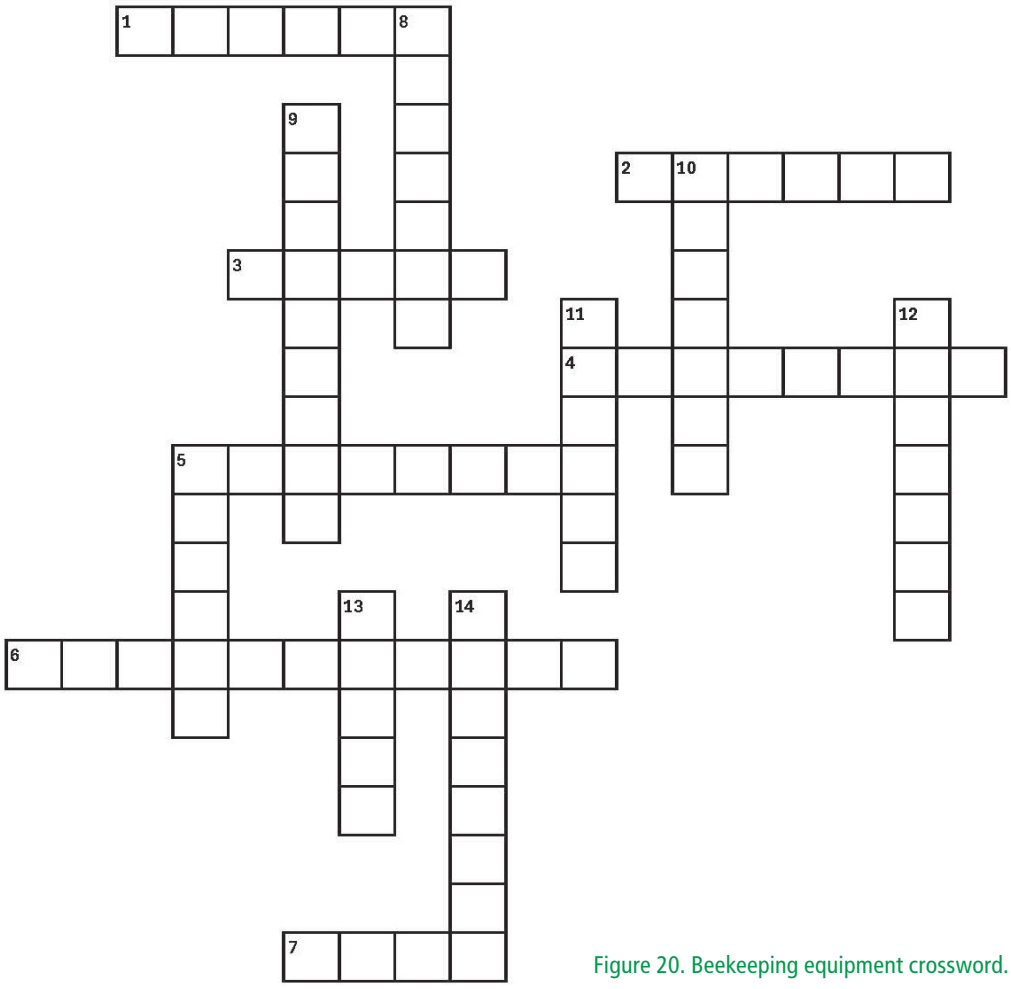

Figure 20. Beekeeping equipment crossword.

7. This personal protective equipment is a hat with netting that covers and protects the head, face, and neck from stings.

Down

5. This tool is used to help calm the honey bees by masking the alarm pheromones.

8. A _____super has a depth of 5¾ inches and is lighter to lift.

9. Beekeepers use this type of lid on hives when many colonies will be transported together for pollination services.

10. Using an entrance _____makes the opening of a hive smaller and easier for weak colonies to guard and defend.

11. A convenient way to provide water for the honey bees is with a _____ , which may be located at the entrance or on top of a hive.

12. Beekeepers can wear a _____to completely cover their arms, legs, and torso from stings.

13. This type of bottom board is made completely from wood.

14. Beekeepers use this device to open the hive, separate supers, move frames, and remove excess comb.

ACTIVITY #2 BUDGET FOR A NEW BEEKEEPER

You have learned about the equipment a new beekeeper would need. It would be wise to do some research and create a budget plan to know exactly what you need to start a beekeeping operation (Figure 21). It is likely a new beekeeper may spend hundreds of dollars just for the hive parts alone. With this activity, you will have the opportunity to do some research and create a plan of your own. Below is a table to get you started. With the help of a responsible adult, do an online search for "honey bee equipment suppliers." Check out a few different sites and compare their prices for equipment, supplies, and tools. The wooden hive components, the supers and frames, can be purchased either fully assembled or unassembled. Assembled hives are more convenient; however, they are more expensive than if you buy the pieces and assemble them yourself. Once you've done your research, fill in the table below to get a realistic idea of what it would cost to start beekeeping.

Figure 21. A wise beekeeper will take time to make a budget and calculate the cost before they buy anything.
Credit: "budget" by 401(K) 2013 is licensed under CC BY-SA 2.0

Table 1. Sample Budget Plan for One Beehive.

Item	Quantity	Cost	Total
Bee veil	1	$	$
Bee gloves	1 pair	$	$
Bee suit/jacket	1	$	$
Smoker	1	$	$
Hive tool	1	$	$
Bottom board	1	$	$
Deep super	1	$	$
Deep frames	1 case of 10	$	$
Deep foundation	1 case of 10	$	$
Queen excluder	1	$	$
Medium super	2	$	$
Medium frames	2 cases of 10	$	$
Medium foundation	2 cases of 10	$	$
Inner cover	1	$	$
Telescoping cover	1	$	$
Bee brush	1	$	$
Feeder	1	$	$
Package of bees	1	$	$
Paint/nails/screws, etc. for building hive		$	$
GRAND TOTAL		$	$

Return to the Hive

1. Name the three sizes of supers used in beekeeping.

2. Name the two most important tools beekeepers use and explain how they are used.

3. What are the three types of hive feeders?

4. What are the benefits of using an entrance reducer (as shown in Figure 22)?

Figure 22. Hives side-by-side showing entrance reducers.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Taste the Honey

1. Beekeepers need specific equipment to do their job. Think of another profession and list some of the specific equipment and tools they use (see Figure 23 for sample equipment a gardener may use).

2. Why would it be difficult to do that profession if you did not have the right tools or equipment?

3. What are some of your current jobs or chores that require specific tools or equipment?

4. Which of the tools that you use would you consider to be the most important? Why?

Figure 23. Tools used by a gardener.
Credit: Tyler Jones, UF/IFAS Communications

Pollen Patties

Have you ever had a "light-bulb moment" (Figure 24)? It is when you have a great idea about a solution to a problem or a way to make a process better. Beekeepers have invented lots of tools and gadgets to improve the beekeeping experience and make it more enjoyable. Think of a task or process you do in your daily routine that you feel needs improvement. Can you think of a tool or new way that would improve and simplify that task or process so it would be less difficult and more pleasant to do? Write down your ideas and then try them out. If you don't have success at first, change your idea until you find a solution that works!

Figure 24. Beekeeper light-bulb moment.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Chapter 2.4 Getting Honey Bees

What's the Buzz?

It is important to know the secret to successful beekeeping is excellent preparation (Figure 1). An important step will be to find an experienced bee mentor from your local beekeepers' **association** or club (see Activity #2). These final stages of preparation will ensure a strong start in your apiary, and your patience will soon be rewarded.

Figure 1. Experienced beekeepers know the importance of preparation.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

PREPARE YOUR LOCATION

Let's take a moment and review the features of a high-quality location for honey bee colonies (shown in Figure 2) with the table below.

Table 1. Features of a Good Apiary Location.

A good apiary site should	A good apiary site should not
Receive morning sun and afternoon shade	Be close to penned animals
Have plentiful foraging resources nearby	Contain junk equipment
Have a wind break if in a windy area	Be close to public areas or property lines
Be easy to maintain, such as cutting the grass	Be in a low-lying area that floods
Have a bear or neighbor fence if necessary	Be without a reliable water source

Figure 2. These hives have been placed in a good location where they receive early morning sunlight and afternoon shade, while secluded from people.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

PREPARE YOUR HIVES

Check your apiary budget plan (refer to Activity #2 in Chapter 2.3) before purchasing your equipment so you will know exactly how many of each item you will need to buy. All the equipment should be purchased and assembled at least one week before installing your honey bees. Most parts of the hive will need to be put together, such as the supers and the frames (Figure 3). Be sure to follow the honey bee supplier's instructions for the proper building process of the hive parts. Once you have assembled the pieces, paint the outside with outdoor latex paint. Never paint the inside of the hive box or the frames. Allow all paint to fully dry before installing your package of honey bees.

Figure 3. Instead of buying assembled hives, this beekeeper is assembling hive bodies or supers.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

The Bees' Knees

Many states require beekeepers to register their colonies every year so they can be inspected by **apiary inspectors** annually. Once registered as a new beekeeper, you will receive a **firm number**, which is used to identify your hives. It is often painted in the upper left-hand corner of the hive boxes with letters of at least a half inch in height (Figure 4). Your local apiary inspector will let you know specific rules for your area.

Figure 4. The firm number has been painted on the outside of this hive box.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

PREPARE TO BUY YOUR BEES

The two options for purchasing honey bees are **nucleus colonies** (called "**nucs**") and **packages** of bees. A nucleus colony, or nuc, is a miniature colony in a small hive box (Figure 5). It comes with three to five frames of honey bees in all stages of development, as well as honey, pollen, and a laying queen. Most commonly, a nuc will have two frames of brood, two frames of honey, and one frame of pollen. Nucs tend to be more expensive than a package of bees and are usually purchased from a local bee supplier or other beekeeper. To transfer the nuc into a full-size colony you simply put the five frames from the nuc in the center of a full-size deep box and fill the rest of the space with four or five other frames.

Figure 5. Two nucs of honey bees.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

A package of bees comes in either a plastic or wooden box that contains 3 pounds or about 10,000 honey bees (shown in Figure 6). The package can be purchased with or without a queen and will have a feeding can with a syrup mixture to feed the colony during shipment. While packaged bees are usually easier to get and are sometimes less expensive, there is also an added process of **installation**, or putting the bees into the hive.

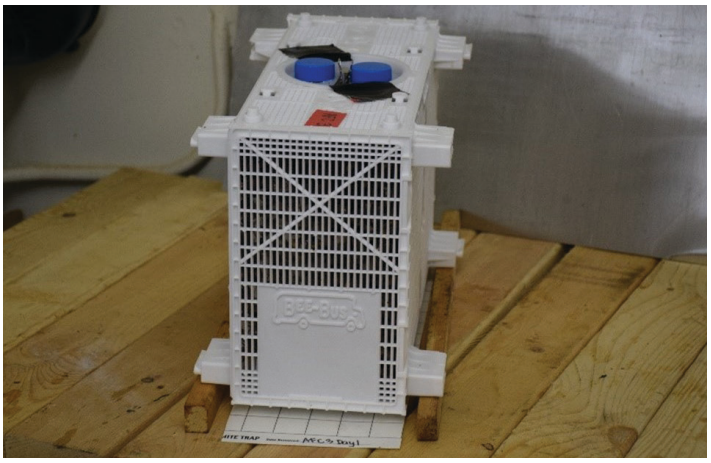

Figure 6. A plastic package of honey bees ready to be installed into a hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

INSTALLATION OF A PACKAGE OF BEES

Now that you have picked the best apiary location, built all your equipment, and your bee packages are ready to

go, it is time to learn how to install your package into your hives. Since a package is not a full colony of bees, you will want to use an entrance reducer. With the addition of this part, the bees will have less space to defend, allowing them to focus on building up numbers. Let's get beekeeping!

First off, you will need to gather a few supplies:

- Spray bottle filled with water
- Hive tool
- Sugar water (2 to 1 mixture, or two parts water to one part sugar by volume; for example, two cups of water may be mixed with one cup of sugar for the right formula)
- Hive feeder
- Staple gun
- String
- Entrance reducer
- Duct tape

Step 1. To easily transfer the bees from the package to the hive, gently spray the bees with water through the screen of the package (Figure 7). Honey bees cannot fly when they are wet.

Figure 7. This beekeeper is using a clean spray bottle of water to wet the bees before installing them into a hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Step 2. There is a wooden lid on top of the package that can be removed using the hive tool. After taking the lid off, the feeder jar and the queen cage can be removed. The lid can then be replaced until the package is installed.

Step 3. Time to install the queen! Attach a piece of wire or string to the queen cage. Attach the opposite end of the wire or string to the top bar of a frame that will be towards the edge of the colony (Figure 8). Do not release the queen on the day of installation. Either remove the cork on the candy end and allow the bees to eat through the candy to release her, or you can come back four days later to open the cage yourself. The workers need to get used to the scent of this new queen so they do not treat her like a stranger and kill her.

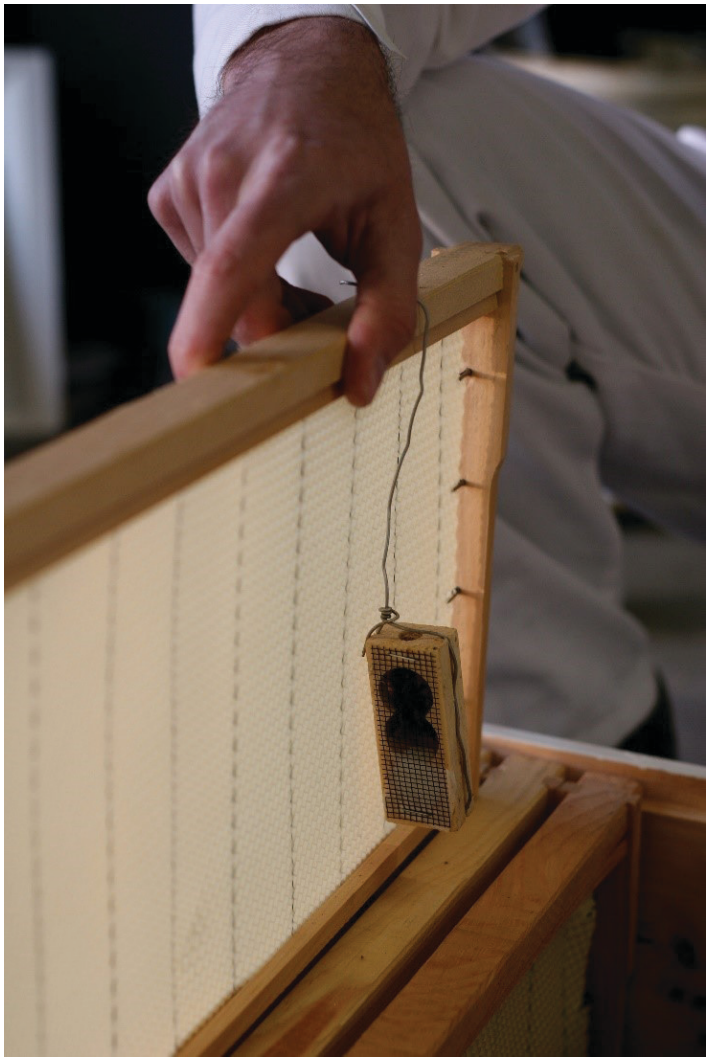

Figure 8. The queen cage attached to the top bar of a frame.
Credit: "Wiring the Queen Cage" by Chiot's Run is licensed under CC BY-NC 2.0

Step 4. Finally, add the bees! There are two ways to get the bees into the hive. First, you can simply remove the five center frames of the hive and place the entire open package (opening facing up) into the hive and allow the bees to crawl out on their own. The second way is to carefully shake the bees into the hive (Figure 9). Lastly, put

the lid on the hive and add a full feeder jar to give them food in their new home.

Figure 9. This beekeeper is installing a package of bees by shaking them into the hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

HIVE CHECK-UP

After about a week, make sure the queen has emerged from the queen cage and is laying eggs (Figure 10). You can remove her cage from the hive if she is no longer in the cage. If you cannot locate the queen or have a difficult time seeing eggs, look for young brood. If you cannot seem to find any evidence of her presence, you may need to purchase a new queen. Be sure to keep the colony well fed using the feeder jar as the growing population needs plenty of food to get a strong start.

Figure 10. This beekeeper is inspecting her colony a few days after installing her bees.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Foraging for Nectar

ACTIVITY #1 WHICH BEES TO BUY?

There are different **honey bee stocks** available in the United States for beekeepers to purchase. The varying stocks have many differences that include strengths and weaknesses (Figure 11). The stock a beekeeper chooses for honey production may differ from a stock chosen for pollination services. Beekeepers must research which stocks would best suit their choice of operation. Below is a table showing some of the more popular stocks available in the United States and how they differ from one another. In the following scenarios, read about the different beekeepers and their specific operations. Then decide which stock of honey bees would best meet their needs. Name one stock each that the beekeeper should and should not consider buying and what honey bee characteristics brought you to that decision.

Figure 11. These honey bees are a gentle stock of bee that are not very defensive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Table 2. Honey Bee Stocks and Their Characteristics

HONEY BEE STOCK	**Italian** *Apis mellifera ligustica*	**Carniolan** *Apis mellifera carnica*	**Caucasian** *Apis mellifera caucasia*	**Buckfast** *Apis mellifera buckfast*	**Russian** *Apis mellifera*	**German** *Apis mellifera mellifera*
Origin	Italy	Alps of east-central Europe	Caucasus mountains in Eurasia, near the Black Sea	Mixed	Primorsky region of eastern Russia	Northern regions of central Europe
Defensiveness	Average	Low	Low	Low-Average	Average	Average-High
Robbing Tendency	High	Low	Average-High	Average	Average	*
Swarming Tendency	Average	High-early in season	Low-later in season	Average	Average	Average-High
Overwintering Ability	Average-large clusters	High-small clusters	Low-Average, especially in colder climates	Average-High	High in small clusters	High
Winter Honey Consumption	High	Low	Low	Low	Low	Average
Spring Colony Growth	Average	Rapid	Slow	Average	Average	Slow
Brood Production	High	Average	Average	Average-High	Average	Average
Disease Tolerance	Average	Average-High	Average	High	Average	Low
Varroa Tolerance	Average	Average	Average	Average	High	Variable
Wax Production	Rapid	Slow, but high quality	Wet cappings	*	*	Average
Honey Production	High	High	Average	Average-High	Average	Low-Average

* Information is not available in the literature related to the given trait.

Scenario #1

Beekeeper A lives in the northern region of the United States where winters are harsh and needs colonies that can deal with long periods of cold temperatures (Figure 12). This beekeeper also prefers working with honey bees that are less defensive.

Figure 12. These colonies must be able to withstand cold and snow during the long winter months.
Credit: "Winter-Apiary Bee-Hives-in-Winter 77108" by Public Domain Photos is licensed under CC BY 2.0

Stock They Should Buy:

Why:

Stock They Should Not Buy:

Why:

Scenario #2

Beekeeper B has a sideline business to produce lots of honey and honeycomb (shown in Figure 13). This keeper has several large apiaries and prefers honey bees that are more disease resistant and less likely to rob from nearby colonies.

Figure 13. Honeycomb is a popular hive product.
Credit: "One beautiful piece of comb honey" by gr8what is licensed under CC BY-SA 2.0

Stock They Should Buy:

Why:

Stock They Should Not Buy:

Why:

Scenario #3

Beekeeper C works in commercial pollination services (as in Figure 14). They need a stock that is less likely to swarm in the spring and that produce lots of brood, so they will have plenty of bees to pollinate crops throughout the summer.

Figure 14. These honey bees are placed in an orchard for their pollination services.
Credit: Jason Deeringer, Bee Serious, LLC, used by permission

Stock They Should Buy:

Why:

Stock They Should Not Buy:

Why:

Scenario #4

Beekeeper D is a hobby beekeeper that lives in a warm climate and is not concerned about cold winters or lots of honey production. However, due to an outbreak of *Varroa* (Figure 15) last year, they lost several colonies. They plan to replace the lost colonies with a more resistant stock.

Figure 15. *Varroa* up close.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Stock They Should Buy:

Why:

Stock They Should Not Buy:

Why:

ACTIVITY #2 FIND YOUR LOCAL BEEKEEPERS ASSOCIATION

Do an online search to find a local beekeepers' association in your area. With your group, arrange to attend a monthly club meeting, or ask someone from the association to give your group a demonstration of basic hive and beekeeping equipment (Figure 16). During the presentation be sure to ask about the benefits and services the club offers beekeeper members. Then answer the questions below.

Figure 16. A group of beekeepers meeting with their local club members for a hive demonstration.
Credit: Mary Bammer, UF/IFAS Honey Bee Research and Extension Laboratory

1. What is the contact information for my local beekeeping association?

2. How often does the local beekeeping association meet?

3. How much does it cost to be a member of the beekeeping association?

4. What benefits and services does the beekeeping association offer to its beekeeper members?

5. Who from the beekeeping association is willing to mentor new beekeepers? What is their contact information?

Return to the Hive

1. List four characteristics of a good apiary site.

2. What are the two common methods of acquiring new bees? Which one is considered easier?

3. What should you do to a package of bees before installing them?

4. Name the two ways you can release the queen into the colony.

5. How soon should you check on the bees after installation (as in Figure 17)?

Figure 17. These beekeepers are inspecting their colonies a week after installing them to make sure all is well.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Taste the Honey

1. When people choose a location for an apiary, they select sites that also make good locations for other things, like a campfire, a baseball field, a park, or a school building. Choose one of these other site types and describe what safety concerns people need to consider for building it.

2. Just as there are specific steps to installing a package of bees, there are many other processes that require us to carefully follow steps. Can you think of other things you like to do where you need to follow a process (as in Figure 18)?

3. Why is carefully following the steps so important?

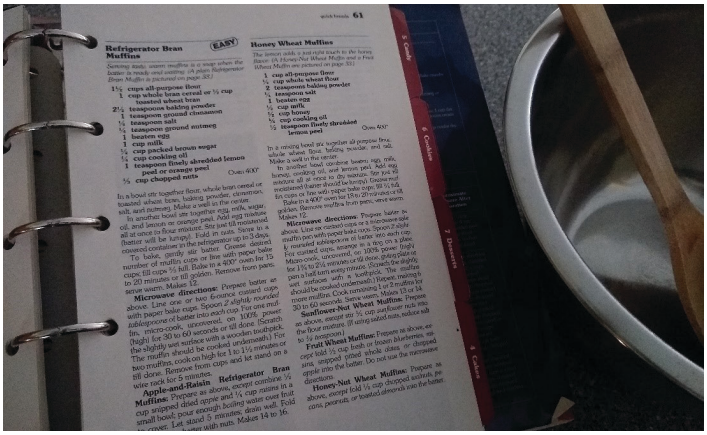

Figure 18. Recipes have step-by-step instructions that need to be carefully followed.
Credit: Megan Hammond, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Pollen Patties

Make it great! Have your group leader choose two to three potential apiary sites in your area. With permission from the landowners, visit these sites as a group. Look them over and discuss the strengths and weaknesses of each location. What aspects of the location make it a good apiary site? Do you see anything that could become a problem in the future? Write your responses below.

Chapter 2.5 Colony Inspection

What's the Buzz?

Your preparation and patience have rewarded you with your own honey bee colony. But now, what do you need to know to keep the colony happy, healthy, and productive (Figure 1)? How do you know the queen is doing her job? Are you feeding them enough? These are a few questions that can be answered when inspecting your hives. New colonies should be checked every two weeks for the first few months and then as needed after that.

Figure 1. By first observing, you can begin to see the health of a honey bee colony even before you open the hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Preparing for Inspection

Remember, beekeeping can be dangerous, so exercise safety first. Put on your veil and your closed-toe shoes before going out to your apiary. Make sure you have enough **smoker fuel**. Using a lighter or a match, light a handful of fuel (pine straw, newspaper, etc.) and carefully put it into the chamber of the smoker (see Figure 2). Puff the bellow until it gives off a thick cloud of smoke. Add more unlit fuel as needed. Grab your hive tool and your checklist with a pen and head out to the apiary.

Figure 2. Process of lighting a smoker.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

External Observations

There are a few things that can be noted before even cracking the lid of the hive. Look at the entrance. Workers should be entering and exiting the hive depending on what is appropriate for the season. There should be a lot of activity in the spring when the weather is warm and the foraging rate is high. However, the entrance activity will most likely decrease as temperatures begin to drop. If there is little to no activity at the entrance of your hive in the springtime, it can indicate a dwindling population or dead colony. Next, check for the opposite of activity. How many dead bees are there at the entrance or on the ground in front of the hive? Many dead bees (50 or more) could mean that they are struggling to survive in their current environment. External hive feeders can easily show you how much the colony is eating (Figure 3). Always check to see if the feeders need to be refilled.

Figure 3. These hive-top feeders make it easy to see how much sugar water each colony is eating.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Watch for **robbing** behavior. Robbing happens when honey bees from stronger colonies steal resources from the hives of weaker colonies (Figure 4). If the nectar

sources are low in the area, workers will do what it takes to keep their sisters fed. At a distance, you may see honey bees cluster around any opening of a bee hive such as the entrance, around the feeder, around the seams of the lid, and between supers. This indicates that they are doing all they can to reach the resources of this neighboring colony. A closer observation can show guard bees attacking the intruder bees at the entrance of the colony. If the colony is robbed of its resources, it will not be able to survive. Attempts to prevent this from happening can include reducing the entrance, cleaning up all excess syrup that may be on the surface of the hive, and minimizing your time in the hive itself.

Figure 4. These honey bees are trying to enter at the seam of a hive to rob a weaker colony of honey and pollen.
Credit: Dr. Michael Bentley, used by permission

Internal Observations

Now it is time to see what is going on inside the hive. You should move around the hive with a slow, steady, and smooth technique (as in Figure 5). This may take time to develop, but it will decrease your chance of being stung. Try not to jolt the frames or drop parts of the hive. It is better to slow down or take a break than to move too quickly, causing the bees to become defensive.

As you look at frames, you will be looking for food supplies, queen activity, pests, and diseases. Frames toward the center of the colony will usually have more bees on them. Brood rearing takes place primarily in the cells on central frames. Food storage areas occur in frames toward the edge of the colony. Using the smoker, puff smoke into the entrance of the colony to cover the worker bees' sensitivity to alarm pheromone (Figure 6).

Figure 5. This beekeeper moves with slow, smooth movements to keep the bees calm.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Figure 6. This beekeeper puffs smoke over the bees before she takes out frames.
Credit: Bori Bennett, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Next, use the hive tool to pry the lid from the top box. When you open the hive, there should be lots of bees on the tops of the frames—a sign of a healthy population. Add another puff or two of smoke to the opened hive just

as an added precaution. Towards the center of the hive, gently wedge the hive tool in the space between two top bars of the frames (Figure 7). Slowly pry to loosen the propolis and lift the frame from the hive. Honey bees should almost completely cover both sides of the frame as another sign of a healthy population, as shown in Figure 8.

Figure 7. Using a hive tool, this beekeeper pries apart the frames from each other.
Credit: Bori Bennett, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Figure 8. This frame of brood is covered with bees, a sign of a healthy colony.
Credit: Bori Bennett, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

While there are honey bees covering the frames, you can lightly blow on them, and they will move out of the way so you may observe the contents of the cells. Locating the queen is a good habit to develop. If you cannot see her, there are a couple of signs that tell you she is present. Look in the open cells to see if there are eggs and **larvae** present. This means there is a healthy laying queen. Also, pay attention to the brood pattern. Is it solid and building outward from the center (Figure 9), or is it spotty and all over the place (Figure 10)? Healthy queens will lay a solid brood pattern.

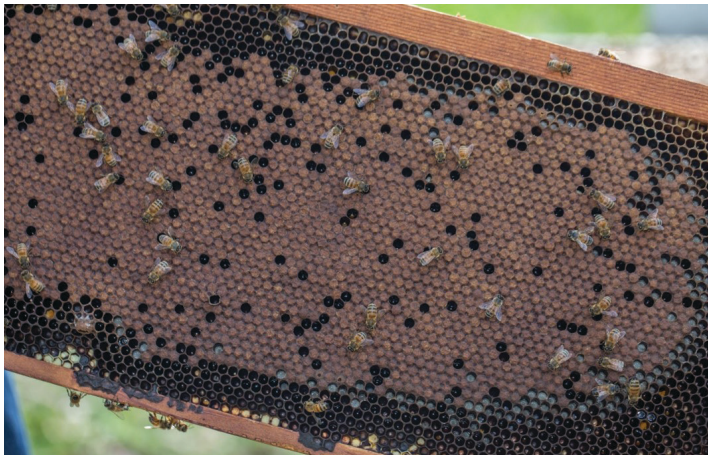

Figure 9. The brood on this frame shows a more uniform, oval pattern, a sign of a healthy queen.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

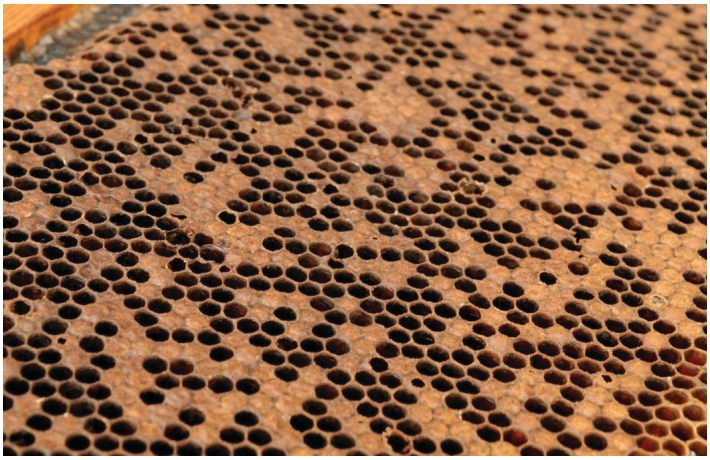

Figure 10. This frame of brood has a spottier pattern all over, a sign of an unhealthy queen.
Credit: Brandi Simmons, UF/IFAS Honey Bee Research and Extension Laboratory

Alternately, there may be signs that the queen is no longer present. If you examine the brood cells and notice that there are multiple eggs laid in one cell, this means that

workers have begun laying eggs (Figure 11). The worker bees will do this if the queen pheromone has grown weak in the hive, usually a result that the queen has left or died. Long, vertical queen cells will begin to appear protruding outwards from the frames to produce a new queen. If, for some reason, you are unable to spot the queen or see no queen cells built for her replacement, order a new queen immediately. Your colony cannot survive long without a queen.

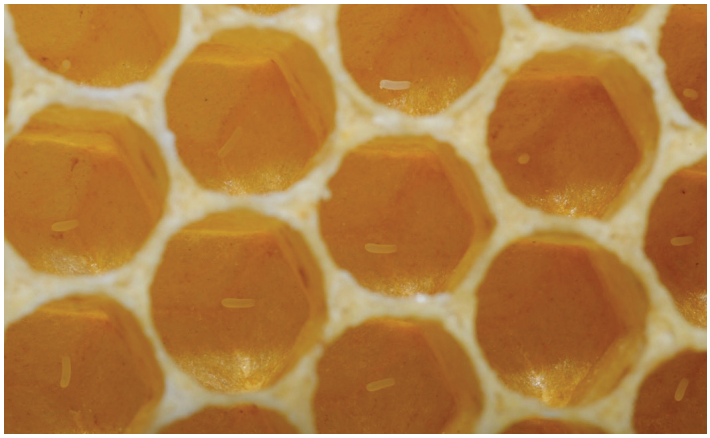

Figure 11. Seeing one egg per cell is an easy way to know that your queen is healthy and present. More than one egg per cell means she is gone, and the workers have begun to lay.
Credit: Brandi Simmons, UF/IFAS Honey Bee Research and Extension Laboratory

After you checked on the queen and the brood, move to the outer frames in the hive to look at the food stored there. The edges of the central brood frames will hold some nectar and pollen, but most of the stores will be in the outer frames (Figure 12). Check to be sure that the workers are filling their cells with enough material from their forage sources. If it seems a bit light, you may choose to supplement with a pollen patty product and continue refilling the feeder jars.

Figure 12. Honey bees will store the capped honey and pollen in the outer frames of the hive.
Credit: Dr. Michael Bentley, used by permission

Through the entire inspection process, you must keep an eye out for pests and signs of disease in the hive. We will discuss this in the next section.

After you have completed your inspection and are satisfied with the results, carefully replace the frames where they need to be, brood towards the center and food towards the outside. Puff a bit of smoke onto the top of the frames so any bees walking around on the edges will move into the hive or fly away. Gently replace the lid so as not to crush any of the workers. Be sure to gather all your equipment and put it away. You can remove your veil once you are safely away from your apiary. Make sure to safely extinguish your smoker and prevent further flames by putting out the fuel.

The Bees' Knees

A smoker, as shown in Figure 13, is a simple device that does an excellent job of keeping your body safe from honey bee stings. Before experimenting with one, however, it is best practice to enlist the assistance of a responsible adult when lighting any flammable material. Knowing how to properly light a smoker is an important skill that beekeepers master over time. Many materials can be used as fuel to ignite your smoker. Common varieties include pine needles, wood pellets, unprocessed cotton fiber, burlap, or even newspaper. The list goes on! When selecting your fuel, it is important to select one that is free of chemicals, plastics, rubber, and paint. If used as a fuel, these could make a smoke that has toxic fumes which could harm or kill your bees! It is always a good idea to have a water bucket handy in case a fire gets out of control.

Figure 13. Smoker.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Foraging for Nectar

Activity #1 Find the Bee

Honey bees have three different major roles within the colony. Most of the hive is made up of worker bees (Figure 14), which are female. These females are non-reproductive, and their bodies are specialized for pollen and nectar collection.

Figure 14. Worker honey bee.
Credit: Dr. Michael Bentley, used by permission

The queen is the only reproductive female in the colony (Figure 15). Her body is specialized to house her reproductive organs, as she is literally the mother of thousands over her lifetime. She is longer than the worker bees, specifically having an elongated abdomen.

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Figure 15. Queen honey bee.
Credit: Dr. Michael Bentley, used by permission

Drones have the third major role in a honey bee colony, and they are the males (Figure 16). The head and thorax are larger than those of the female. His eyes are larger, specialized for flight, and wrap around the top of his head. The drone's job is not to contribute to the colony he came from, but to eventually leave on a mating flight and mate with queens from other colonies.

Figure 16. Drone honey bee.
Credit: Dr. Michael Bentley, used by permission

Now that we know a little bit more about the three types of bees in a colony, can you find the drones, workers, and queen in the following pictures?

Can you tell which is the worker bee and which is the drone in Figure 17? Circle the drone.

Figure 17. Worker and drone.
Credit: Dr. Michael Bentley, used by permission

Circle the queen bee in Figure 18.

Figure 18. Queen with workers.
Credit: Dr. Michael Bentley, used by permission

Circle the queen bee in Figure 19.

Figure 19. Queen on partial frame.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Circle the queen bee in Figure 20.

Figure 20. Queen on frame.
Credit: Dr. Michael Bentley, used by permission

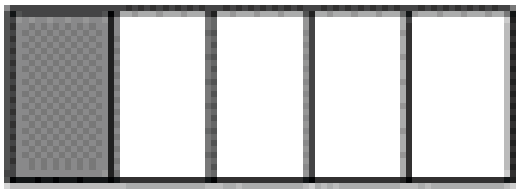
Activity #2 Hive Inspection

When it is time for beekeepers to inspect their hive, they will keep records such as seen in the Table 1 chart. Depending on the beekeeper and the size of their operation, this can be a piece of paper, notebook, binder, or even an app on their phone. Since you know what to look for when you are completing a hive inspection, now it is your turn to complete one! Before we begin, review the hive inspection sheet guide. This will help you understand some of the terminology from the hive inspection sheet.

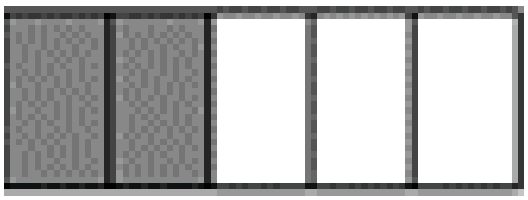
HIVE INSPECTION SHEET GUIDE

Worker population: You can determine the worker population based on the percentage of worker bees on a brood frame.

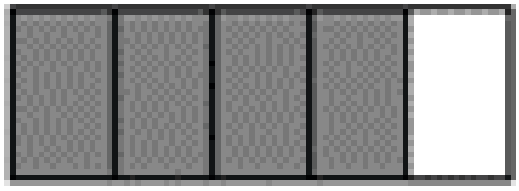
Low: About 20 percent of brood frames covered with workers.



Moderate: About 40 percent of brood frames covered with workers.

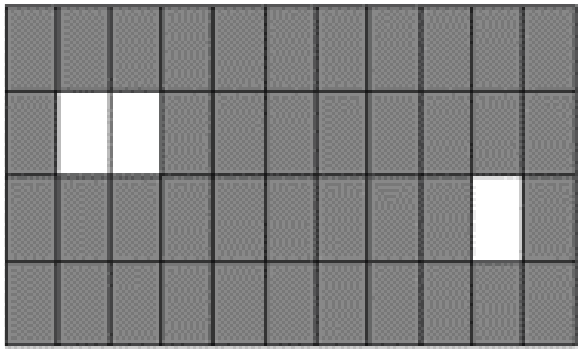


High: About 80 percent of brood frames covered with workers.

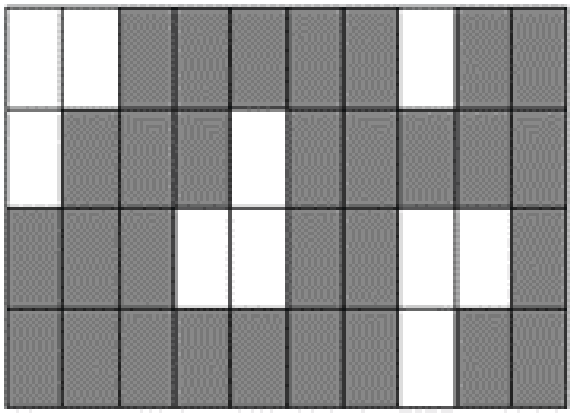


Egg laying pattern: Laying pattern is an indicator of queen health and productivity.

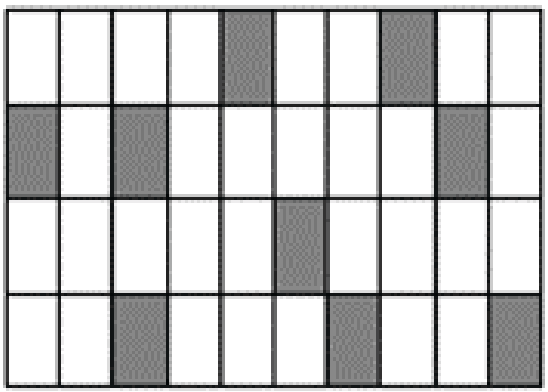
Good: Solid and uniform. Brood frames are not always going to be perfectly filled. A small number of unfilled cells, as pictured below, would still be "good."



Okay: Irregular and random. More cells will be filled than not. The pattern is not solid like a "good" brood frame.



Bad: Spotty. Brood frames are mostly unfilled. Filled cells may be grouped together randomly or completely spaced out.



Small hive beetles present: We will learn more about small hive beetles in the next lesson.

Notes: Use this section to record all other observations during your inspection. This may include, but is not limited to, weather conditions, *Varroa* symptoms, equipment conditions, honey frames harvested, nuc installation, and so forth.

Table 1. Hive Inspection Sheet. For each condition in the left column, circle one of the three qualities or circle yes or no to record the status of the hive.

Hive Inspection Sheet			
Date:		**Hive ID:**	
Worker Population	Low	Moderate	High
Egg Laying Pattern	Good	Okay	Bad
Eggs Present?	Yes	No	
Larvae Present?	Yes	No	
Capped Brood Present?	Yes	No	
Queen Seen?	Yes	No	
Queen Cell Present?	Yes	No	
Hive Temperament?	Calm	Nervous	Defensive
Honey Stores	Low	Normal	High
Pollen Stores	Low	Normal	High
Small Hive Beetles Present?	None	A little	Many
Notes:			

Opening the hive: When we open the hive, we can see right away some signs of overall hive health.

Based on Figure 21, is the worker population

Low Moderate High?

Circle your answer.

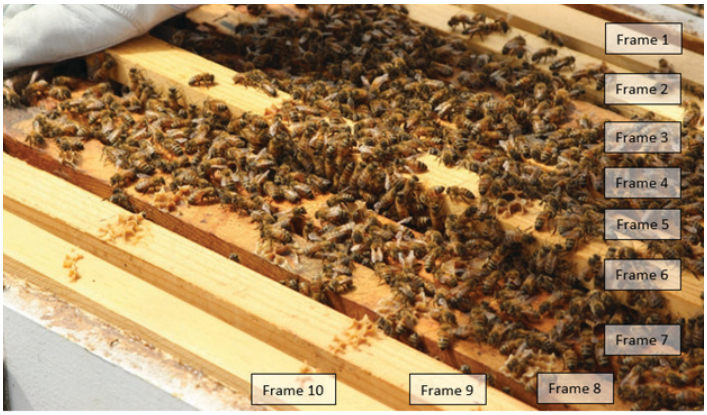


Figure 21. Opening the hive.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #1 (Figure 22)

Frames towards the outside of the hive box will be used last by the colony, so they will have less activity.

What kind of cells do you see in this picture?

Capped Honey

Uncapped Honey

Bee Bread

Brood

Circle each type of cell that you see in the picture and label it.

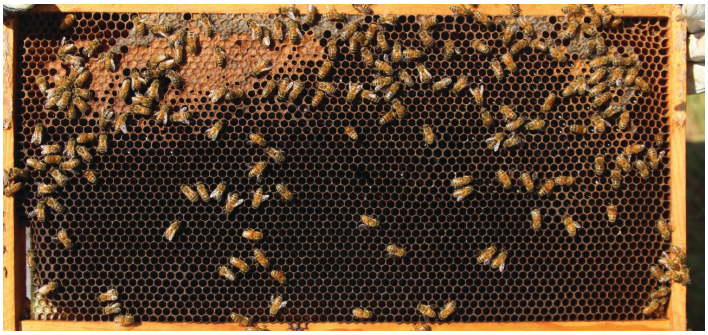


Figure 22. Frame #1.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #2 (Figure 23)

In this photo, we are starting to see more activity and more filled cells.

What kind of cells do you see in this picture?

Capped Honey

Uncapped Honey

Bee Bread

Brood

Circle each type of cell that you see in the picture and label it.

Figure 23. Frame #2.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #3 (Figure 24)

In our third frame, we can see some new type of cells.

What kind of cells do you see in this picture?

Capped Honey

Uncapped Honey

Bee Bread

Brood

Circle each type of cell that you see in the picture and label it.

Figure 24. Frame #3.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #4 (Figure 25)

We are starting to get closer to the middle of the hive. Remember, a typical Langstroth hive contains eight to ten frames total.

What kind of cells do you see in this picture?

Capped Honey

Uncapped Honey

Bee Bread

Brood

Circle each type of cell that you see in the picture and label it.

Figure 25. Frame #4.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #5 (Figure 26)

We have selected a frame from the middle of our hive. The queen has been very busy here.

What kind of cells do you see in this picture?

Capped Honey

Uncapped Honey

Bee Bread

Brood

Circle each type of cell that you see in the picture and label it.

Can you spot the queen? Circle her when you find her!

Figure 26. Frame #5.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

The last five photographs show only half the frames from this sample hive. The opposite side of each frame would look very similar, with more bee activity in the center and less towards the outside of the hive. Now that we have

completed our inspection, fill out the inspection sheet below.

Table 2. Hive Inspections Sheet for Frames. For each condition in the left column, circle one of the three qualities or circle yes or no to record the status of the hive.

Hive Inspection Sheet			
Date:		**Hive ID:**	
Worker Population	Low	Moderate	High
Egg Laying Pattern	Good	Okay	Bad
Eggs Present?	Yes	No	
Larvae Present?	Yes	No	
Capped Brood Present?	Yes	No	
Queen Seen?	Yes	No	
Queen Cell Present?	Yes	No	
Hive Temperament?	Calm	Nervous	Defensive
Honey Stores	Low	Normal	High
Pollen Stores	Low	Normal	High
Small Hive Beetles Present?	None	A little	Many
Notes:			

Return to the Hive

1. How can you begin to understand the colony's health before even opening the hive?

2. What is robbing, and what can it indicate?

3. What is one way you can tell that the queen may be lost or gone (Figure 27)?

Figure 27. Queen cell in frame.
Credit: Geena Hill, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Taste the Honey

1. Beekeepers spend a lot of time inspecting their hives looking for signs of a healthy or unhealthy colony. What are some signs in humans that would show someone is unhealthy or sick?

2. While inspecting their hives, beekeepers hope to see an adequate amount of honey (carbohydrates) and pollen (protein) supplies. What foods do you eat that contain carbohydrates? What foods contain protein?

3. Would climate influence hive health and productivity (see Figure 28)? Why or why not? How can climate influence human health and productivity?

Figure 28. Beekeeper securing hive in preparation for a hurricane.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Pollen Patties

When we are looking at frames, we can tell what a cell is being used for just by looking at it! Much like when you enter someone's house, if you see a room that has a fridge and oven, you know that you are in a kitchen. In a honey bee hive, you may see capped honey, uncapped honey, bee bread, capped worker brood (Figure 29), uncapped worker brood, capped drone brood, and queen cells. Each one looks different from the other and serves a different purpose. With a responsible adult, search the internet for photos of these different types of cells. What is their purpose? What do they look like?

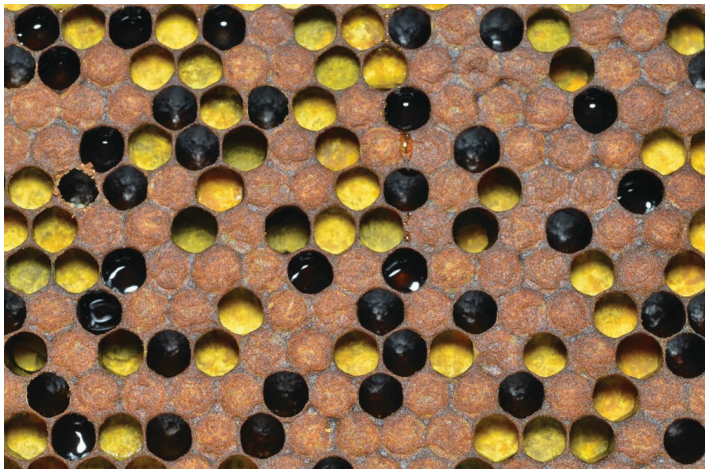


Figure 29. Bee bread and capped brood.
Credit: Dr. Michael Bentley, used by permission

Chapter 2.6 Pests and Diseases

What's the Buzz?

Now we will go into detail about pests and diseases that can be spotted during a hive inspection. Some pests can be seen with the naked eye such as mites (Figure 1), beetles, and ants. Sometimes the hive can give off a foul odor with certain types of diseases. It is important for beekeepers to know what to look for to keep your honey bees as healthy and productive as possible. Something overlooked by mistake could destroy an entire colony. It is rare to find a perfectly healthy population, so learning this information will help you identify, protect, manage, and treat your colonies.

Figure 1. *Varroa* on a baby bee.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Bacteria

American Foulbrood (AFB) is a significant threat to your colonies. AFB is a bacterial disease that can infect bee larvae if they ingest the bacterial spore. It kills infected brood during their capped stage of development. Infected colonies will give off a foul odor, hence the name. If you pull a frame and notice that there are some brood caps that are sunken in with a small puncture hole in the cap, you may very well have AFB. Workers can sense diseased larvae and puncture the cells to abort the infected brood as an attempt to keep it from spreading (Figure 2).

The "rope test" is another evaluation for AFB (Figure 3). Take a toothpick or similar item and stir the contents of a cell which you believe may be infected. If the contents stick to the toothpick creating a "rope" when you pull it out, the dead bee larva had an AFB infection.

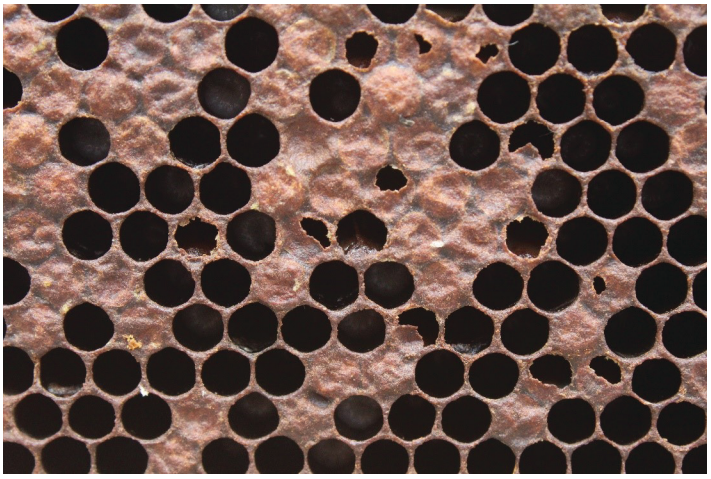


Figure 2. One sign of AFB is brood caps punctured by the worker bees.
Credit: Brandi Simmons, UF/IFAS Honey Bee Research and Extension Laboratory

Figure 3. A beekeeper using the rope test to see if the colony has American Foulbrood.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

The AFB bacteria is extremely hard to eliminate, and a true diagnosis will need to be made by your apiary inspector. If you do in fact have American Foulbrood, you will not be able to cure the infection. Unfortunately, the only sure method of containing spread of AFB is to burn the hive and its contents. Burning the hive effectively stops the further spread of spores. Prevention of an outbreak is possible if you treat colonies with an antibiotic.

European Foulbrood (EFB) poses a moderate threat to colonies. It is like American Foulbrood in that it kills young brood after they have ingested the bacteria. These

infected hives also give off a foul odor. Fortunately, the bacteria associated with EFB is non-spore forming, and colonies can recover from the infection. It can be controlled with an antibiotic or by requeening the colony. If you are unsure whether it is EFB or AFB, be sure to contact your local apiary inspector to address your concern.

Fungi

Nosema ceranae is caused by a group of single-celled fungi called microsporidia. These microbes infect the cells that line the honey bee's midgut, causing dysentery and shorter life spans (Figure 4). *Nosema* can reduce the colony population quickly, especially in the winter. A sign of infection for *Nosema* is bee excrement on the entrance of the hive. This occurs because the infected bees have diarrhea, and they are unable to fly far enough away from the hive to defecate. Unfortunately, there are currently no treatments for *Nosema*. However, keeping your hives ventilated with screened bottom boards and placed in a dry location can help prevent *Nosema*.

Figure 4. Researcher testing for *Nosema* by crushing bees' abdomens in preparation for a microscope sample.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

"Chalkbrood" is another disease of immature bees. The infected larvae die and become covered in a cotton-like **mycelium** that dries, creating a hard corpse like a mummy. Dehydrated "mummies" sitting at the entrance of a hive is a tell-tale sign of this disease (Figure 5). Shaking a frame and listening for the rattle of those mummies still in the capped cells provide a second method to diagnose chalkbrood. Chalkbrood can be controlled by using a resistant stock of honey bees and keeping ventilated hives out of cool, damp areas.

Figure 5. Chalkbrood mummies at the entrance of a hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Varroa destructor

Tiny mites, *Varroa*, are considered the most significant threat to honey bee colonies. *Varroa* are ectoparasites (parasites on the outside of the body) that feed on adult honey bees' fatty tissues. This process can cause shorter lifespans and transmit unwanted diseases. They are very widespread and reproduce inside the hive. You can see these reddish-brown mites without a magnifier (Figure 6), sometimes even loose in the colony.

Figure 6. This honey bee has several *Varroa* on her thorax.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

One way to monitor the number of *Varroa* in your hive is to perform a sugar shake. (In the upcoming section, Foraging for Nectar, you will have a chance to perform a mock sugar shake for Activity #2 Candy Sugar Shake.) The process involves gathering approximately ½ cup of

(about 300) honey bees and placing them into a pint-sized jar with a screen, mesh lid. Adding a spoonful of powdered sugar, the beekeeper will then roll the bees in the sugar until they are coated. (The sugar is harmless, and the bees will easily clean themselves off.) The next step is to shake out the sugar over a white surface through the mesh screen (Figure 7). The bees will stay inside the jar, but the sugar causes the *Varroa* to lose their grip on the bees' bodies and fall off. After counting the number of mites that fall out, you can estimate the number of *Varroa* in your hive. Treatment is recommended if the results show three (or more) mites per 100 bees. After completing, the bees may be returned to the hive.

Figure 7. This beekeeper is using the sugar shake method to find out the *Varroa* population in his colony.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

There are options to control *Varroa*, such as screened bottom boards and the use of drone comb, but some beekeepers prefer to treat chemically. *Varroa* is an inevitable issue, so understanding the signs and appearances of this pest will be helpful in lessening the damage they can cause.

Viruses

Deformed wing virus (DWV) is a serious threat to honey bees and is transmitted by the *Varroa destructor*. Pupae infected with this virus while still in the developmental stages will become adult bees with malformed wings, unable to fly (Figure 8). DWV also reduces the lifespan and body size of the bee. There is no control for DWV. The only way to attempt to prevent it is to treat for *Varroa*.

Figure 8. Worker bee with deformed wing virus. The wings are shriveled, and this bee will never be able to fly.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Another virus transmitted by *Varroa* is Acute Bee Paralysis Virus (ABPV). It poses a moderate threat to a bee colony. Honey bees infected with this virus remain flightless, tremble, and appear shiny due to their lack of hair. Again, there is no control for this virus once it has occurred, but treating the colony for *Varroa* may be a preventative.

Insects

Wax moths can be a moderate threat to a honey bee colony. When they infest a hive, their larvae will tunnel through the wax combs forming a net of webs where it is no longer usable to the honey bees. The moths do not typically affect stronger colonies but can damage weaker colonies. Wax moths can infest equipment and wax frames that are sitting out in the open (Figure 9). To prevent this, some beekeepers will store spare equipment in a freezer.

Small hive beetles are another moderate insect threat (significant in some areas) as seen in Figure 10. The danger to the honey bee colony comes when the beetle larvae feed on the bee brood, honey, and pollen. So, not only are they destroying the young, but they are also stealing resources. Traps and chemical treatments in the hive can control the beetle populations. Bees do take measures on their own to get rid of beetles, such as biting them and herding them out of the hive.

Figure 9. Wax comb being destroyed by wax moth larvae.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Figure 10. Small hive beetle on wax comb.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Ants are other insects that can cause problems for a colony (Figure 11). They can make nests around apiaries, becoming a hazard to unaware beekeepers. On occasion, ants can live in equipment and feed on the honey within a hive or on the supplemental sugar that a beekeeper uses to feed the bees. To reduce the risk of ants finding a hive, beekeepers keep their hives off the ground, placing the hive on a stand. Ant prevention strategies include keeping the vegetation around your hive trimmed down and free of tall grass and weeds.

Figure 11. Ant on a hive.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Other pests

Since we often think of insects when we think of pests, it is easy to forget that mammals can be pests, too. Bears, when present, do pose a moderate threat to honey bee colonies (Figure 12). It is a common misconception that bears invade hives in search of honey. Bears actually go for the meatier part of the colony: the brood. Bears search for high-protein food sources in preparation for their winter hibernation. They can rip an apiary apart and even take hives with them as a snack for later. If you live in an ecosystem that includes bears, it would be wise to surround your apiary with an electric fence.

Figure 12. The hives in this apiary were destroyed by a bear.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Skunks can also become problematic for beekeepers (Figure 13), as they have been known to visit apiaries at night. They target weak hives, scratching at the hive entrance. A few guard bees then rush out of the hive in defense of the colony, only to be eaten by the awaiting skunk looking for a midnight snack. Skunks often come back to apiaries once they discover a hive as an ample food source. When skunks become a problem, beekeepers may place barriers across the hive entrances, preventing the skunks from

entering. As with ants, keeping your hives on stands can also reduce the risk of a small animal bothering your hive.

Figure 13. Skunk in field.
Credit: Bryan Padron on Unsplash

Mice are another minor pest to beekeepers. Mice can nest in unoccupied hive equipment, destroying the wax comb and leaving debris. In colder climates, mice can also form nests in the occupied hives during the winter months. When temperatures drop to 18°C (64°F) or below, honey bees will **cluster** within the nest. Since the bees move towards the center of the hive, tightly compacting themselves to keep warm, this leaves the outside frames free for guests, like mice, to build a nest (Figure 14). Beekeepers located in cooler climates can install mouse guards when temperatures begin to drop to prevent these pests from entering.

Figure 14. Pictured is a sugar glider. Though this is not a common pest in the United States, places like Africa consider these a pest the same way we consider mice a pest.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

The Bees' Knees

When someone says, "honey bee," you probably are thinking of *Apis mellifera*, the most typical honey bee kept within our hives. Did you know there are seven to eleven species of honey bees around the world and even more subspecies? Most of these species live throughout southeast Asia. *Apis mellifera,* and its subspecies, are spread throughout nearly the entire world wherever humans live (Figure 15), being **naturalized** in every continent except for Antarctica. We breed these subspecies to select for specific traits such as temperament, climate adaptability, *Varroa* resistance, honey production, and hygiene.

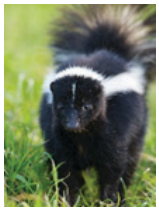
Figure 15. Elevated hives in Africa.
Credit: UF/IFAS Honey Bee Research and Extension Laboratory

Foraging for Nectar

Activity #1 Connect the Pest

Match the picture of the pest with its description (in Table 1 on page 53).

Table 1. Pest matching.

A smaller animal that scratches at hive entrances to lure out guard bees for a midnight snack.	 *Varroa*. Photo Credit: UF/IFAS Honey Bee Lab
A large animal that consumes bee brood found within the hive. They can rip through a hive leaving an apiary destroyed.	 Wax moth larva. Photo Credit: UF/IFAS Honey Bee Lab
An insect who can feed on honey stores and nest in hive equipment. This pest is usually more of a bother to the beekeeper than the honey bee colony.	 Small hive beetle. Photo Credit: Lyle Buss, UF/IFAS
An insect whose larvae tunnels into the wax on a frame, making the wax unusable.	 Bear in trail camera. Photo Credit: UF/IFAS Honey Bee Lab
A small animal that builds a nest within unoccupied hives or in the outer frames of a hive during winter.	 Ant. Photo Credit: UF/IFAS Honey Bee Lab
A small insect that transmits many different viruses. This insect can be found in most hives and feeds on fatty tissues of adult honey bees.	 Mouse. Photo Credit: Joshua J. Cotton on Unsplash
An insect whose larvae feed on bee brood, honey, and honey bee larvae.	 Skunk. Photo Credit: Bryan Padron on Unsplash

In the spaces below, write how you can prevent or reduce the risk of each pest.

Varroa destructor

Wax Moth

Small Hive Beetle

Bears

Ants

Mice

Skunks

Activity #2 Candy Sugar Shake

In "What's the Buzz?" we discussed the purpose of a sugar shake and how we perform this as beekeepers. Now it is time for you to do a candy version of it!

Before we start our Candy Sugar Shake, we need to know what each candy represents. Honey bees are typically 15 millimeters (about 0.59 inches) in length. For this activity, select an oblong candy (fruit chew or licorice) to represent your bees, about 20 millimeters (about 0.79 inches) in length (such as *Mike and Ike* or *Good and Plenty*). The *Varroa destructor* are much smaller than the honey bees. When we do the sugar shake, we are typically seeing the female *Varroa*, which are 1.5 to 1.99 millimeters (about 0.08 inches) long. The nonpareil rainbow sprinkles are going to represent *Varroa*.

Follow along with the instructions as you complete the shake test.

Step 1. Gather your materials. For this activity, you will need

- a mason jar with a lid,
- ½ cup of oblong candies,
- nonpareil sprinkles,
- one colander or strainer (make sure the holes are small enough that the candies won't fall through but the nonpareil sprinkles will),
- 2 tablespoons of powdered sugar,
- ¼ teaspoon of water,
- one sheet of white paper,
- ½ cup measuring cup,
- 1 tablespoon measuring spoon,
- ¼ teaspoon measuring spoon,
- a pencil,
- and a calculator.

Step 2. Add your bees. Add a ½ cup of the "bee" candies into the mason jar.

Step 3. Add your *Varroa*. Add a pinch of sprinkles into your jar. If you would like to measure it out, use your ¼ teaspoon and fill it halfway, then add it into the mason jar.

Step 4. Add the powdered sugar. Add two tablespoons of powdered sugar into your mason jar (Figure 16). Shake your jar gently for 3 seconds to distribute the powdered sugar.

Figure 16. Step 4. Candy "bees," candy "*Varroa*," and powdered sugar in a jar.
Credit: Rebecca Knox-Kenney, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 5. Add water. Add ¼ teaspoon of water into your jar. In a real-world sugar shake, we do not add water. The water will allow the powdered sugar to stick to your candy "bees." Real honey bees have hair covering their body that allows the powdered sugar to stick to them.

Step 6. Shake/Roll. Gently shake/roll your jar for 2 minutes until your "bees" are covered in powdered sugar (Figure 17). Don't shake too hard or fast—you could injure your bees!

Figure 17. Step 6. Add water to candy "bees" in the Candy Sugar Shake, but do not add water to real bees in a sugar shake.
Credit: Rebecca Knox-Kenney, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 7. Allow jar to sit for 2 minutes. This step is not required in our candy sugar shake test. In a real-world sugar shake, this pause gives the bees time to groom themselves, trying to rid their bodies of the powdered sugar. As the bees groom, the *Varroa* lose their grip and fall off them. Now would be a good time to set up your strainer and paper. Place your strainer on top of your white sheet of paper to prepare for the "bees."

Step 8. Pour out your bees. If you have not placed your strainer onto your white sheet of paper, do that now. Pour out the contents of your jar into your strainer. Slowly sift your bees, trying to keep all the powdered sugar on your piece of paper. In a real sugar shake, we would gently hold the jar upside down and shake the powdered sugar out that way. The jar's lid would have holes like your strainer to allow the sugar and *Varroa* to pass through but not the bees.

Step 9. Count your mites. Use a pencil to group all the *Varroa*/sprinkles on your paper (Figure 18). Count how many you had. Record in the space provided on Step 11.

Figure 18. Step 9. This white cutting board allows you to easily see how many candy "mites" were stuck to the candy "bees."
Credit: Rebecca Knox-Kenney, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Step 10. Determine your mite rate. To do this, divide the number of mites you captured by 300. Multiply that number by 100, converting your number to a percent, to get your mite infestation rate. Record your answer in the space provided on Step 11. In a real sugar shake, we cannot count how many bees are in our jar. Beekeepers estimate that there are about 300 bees in a half cup of bees, so we always use 300 when determining our *Varroa* mite rate.

Step 11. Record. It is always important that beekeepers keep a record of how many mites they found. When *Varroa* level exceeds nine mites from a jar of around 300 bees (3% or greater), we know it is time to treat for the pest. It is also important to test after treatment, so we know if our treatment worked or not. Grab your calculator and record your results below.

1. How many *Varroa,* or sprinkles, did you count?
   _____
2. Determine your mite rate.
   Number of *Varroa*/sprinkles counted _____ divided by 300 equals _____

   Multiply that result _____ by 100 equals _____ percent (%)
3. Based on your *Varroa* mite infestation rate (greater than 3%?), should you apply a mite treatment? ☐

Step 12. Return your bees. Beekeepers will return their bees to the hive by dumping them out on top of the frames. We do not need to return our candy bees. Instead, we can eat them!

Return to the Hive

Figure 19. These frames show severe damage from wax moths, one of many threats to colonies.
Credit: M. K. O'Malley, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

1. Explain the difference between American and European Foulbrood and how to treat both.

2. What telltale sign of *Nosema* is visible from outside the hive?

3. *Varroa* feed on what part of the bee's body?

4. How can you prevent bears from invading your colonies?

Taste the Honey

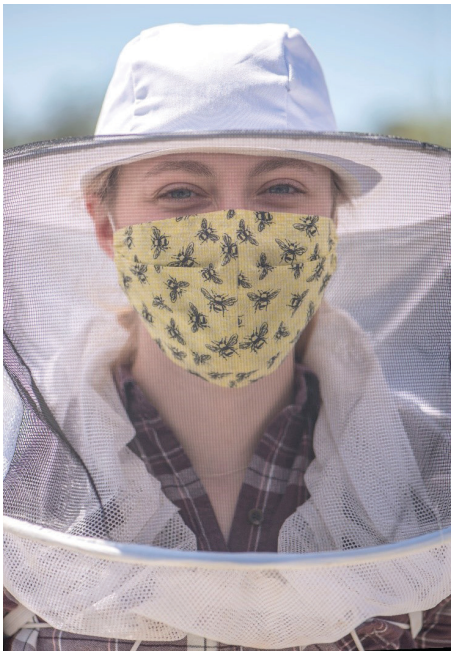


Figure 20. During the Covid-19 pandemic people wore face masks to prevent the spread of the illness.
Credit: Bori Bennett, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

1. What is the difference between preventing disease and illness and treating the symptoms?

2. What are some ways that humans can prevent the spread of viruses like the cold or flu (Figure 20)?

3. What are some ways humans treat the symptoms from viruses like the cold and flu?

Pollen Patties

We have talked about how pests can come in all shapes and sizes. With a buddy, brainstorm three human pests. They can be an insect, a large or small mammal, or even a plant! With your partner, write down three pests in the space below. Describe what they look like, how they are a pest, and practical solutions to either remove them or reduce the amount of that pest.

Chapter 2 Beekeeping Glossary

American Foulbrood (or AFB): A bacterial disease that infects bee larvae. Once the bacterial spore is ingested, death results during the capped pupae stage of development.

Antihistamine: A common medicine taken by mouth that reduces or stops the effects of an allergic reaction.

Apiary: A location where honey bees are kept.

Apiary inspector: A person designated by the state to inspect honey bee colonies for presence of pests or other diseases and to enforce apiary rules and regulations.

Association: A group of people organized into a club that shares a common interest or purpose.

Bee brush: A soft-bristled brush used to gently remove honey bees from frames or other surfaces.

Bee jacket: Jacket made of white, tightly woven cloth worn by beekeepers to protect the arms and torso from stings.

Beekeeper: One who keeps or manages one or more colonies of honey bees.

Bee suit: Jumpsuit made of white, tightly woven cloth worn by beekeepers to protect the arms, legs, and torso from stings.

Beeswax: The wax produced by honey bees to make honeycomb inside the hive.

Bottom board: The floor of a beehive that all the other components build upon. They can have a solid or screened bottom.

Brood chamber: The bottom hive box that contains the bee frames where the queen lays the eggs.

Closed-toe shoe: Any shoe that completely covers the toes, usually required for safety reasons in the workplace.

Cluster: A ball of bees. It can occur during winter as the entire colony comes together to conserve heat or when defending the colony.

Commercial beekeeper: One who makes a full time living by keeping large numbers of honey bee colonies for pollination services or honey bee production.

Cutaneous: Something that deals with or affects the skin on the human body.

Deep super: A hive box that is 9⅝ inches deep.

Ecosystem: A community of living organisms and their physical environment.

Entrance feeder: Small feeding trays with a reservoir to hold syrup placed at the entrance of a hive as a food supplement for honey bees.

Entrance reducer: A wooden or plastic barrier placed at the entrance to a beehive that reduces the size of the opening.

European Foulbrood (or EFB): A bacterial disease like American Foulbrood. Bee larvae that consume the bacteria die during the capped pupae stage. May be treated with antibiotics or by requeening.

Fertilization: Takes place in a flower's ovary when male sperm cells inside the pollen are deposited and joined with the ovule.

Firm number: The number assigned to a beekeeper that has registered their hives with the state. This number must be clearly painted onto the beekeeper's hives for identification.

Flyway barrier: A barricade or fence placed around a hive to direct the honey bees' flight path upward, reducing the chance of interference with people.

Frame spacer: A rectangular tool with notches used to equally separate the frames inside of the super.

Frames: Structures in a hive where bees can draw out comb to store their honey, pollen, and brood. They are removable so that honey and other hive products can be harvested without destroying the hive.

Gloves: Typically made with leather on the hands and heavy canvas for sleeves, worn by beekeepers to protect the hands, wrists, and forearms from stings.

Hive supers: "Super" is short for superstructure. These are hive boxes that come in different depths and can be added or removed from the hive as the colony grows or shrinks.

Hive tool: A handheld, multipurpose tool used in maintaining and inspecting beehives.

Hive-top feeder: Located on top of the upper box of a hive, this large capacity feeding reservoir aligns with a hole in the inner cover.

Hobbyist beekeeper: One who keeps 40 or fewer honey bee colonies for the enjoyment of it and not for financial profit.

Honey bee stock: A combination of traits and features that identify a certain subspecies of honey bee.

Honey super(s): Honey is made and stored in this upper hive box.

Hydrocortisone: A cream applied to the skin to help calm the body's response to an allergic reaction and lessen the pain, itching, and swelling.

In-hive feeder: A reservoir container for feeding honey bees placed inside the hive, replacing one of the frames in the super.

Inner cover: A lid used to provide the correct bee space on the top hive body and provide good airflow within the hive.

Installation: The act of putting a package of honey bees into the prepared hive body.

Langstroth hive: Stacking rectangular hive boxes with eight to ten vertically hanging frames in each box. Each hive has a bottom board with a bee entrance and an outer lid for weather protection.

Larva(e): A stage in some insects' development that occurs between hatching and the adult stage.

Medium super: A hive box that is 6⅝ inches deep.

Migratory lid: A hive lid with no overhang on the sides. This allows many hives used for pollination services to be stacked close together and transported.

Mutual symbiotic relationship: A close relationship between two organisms where the actions of each benefit the other.

Mycelium: A symptom of Chalkbrood disease, it is a white fungal thread that encases the honey bee.

Naturalized: When a species has become established in a region where it did not originate.

Nucleus colony (nuc): A small box with three to five frames of bees in all stages of development, as well as honey, pollen, and a laying queen.

Ovary: Produces and contains the egg or seeds of a plant.

Ovule: The egg or seed inside the ovary of a flower.

Package of bees: A plastic or wooden box with screens on at least two sides used to ship honey bees.

Personal protective equipment (PPE): Clothing and other equipment worn to protect the wearer's body from injury or illness.

Pistil: The name for the collection of female parts of a flower, including the stigma, style, and ovary.

Pollen: Fine powdery substance (usually yellow) produced by certain plants when they reproduce.

Pollination: The movement of pollen from the anther of one flower to the stigma of the same or another flower. This can be done by wind, water, animal, or insect.

Pollination services: Honey bees transported around the country for pollination of agricultural crops.

Pollinator: An animal, insect, or human that aids in the movement of pollen from the stamen of one flower to the pistil of the same or another flower.

Propolis: A sticky, glue-like substance that comes from the resin or sap of trees and plants. Honey bees collect and use it to seal cracks and crevices in the hive, regulate

temperature, and mummify dead pests. Propolis has antimicrobial properties and helps to keep the colony healthy.

Queen cage: A small container that safely holds the queen while she is being marked or while the beekeeper is working the hive.

Queen excluder: A flat screen made from plastic or metal that prevents the queen from going into upper hive boxes while allowing the workers to pass through.

Robbing: When bees from a colony raid a weaker colony to take the honey back to their own hive.

Royal jelly: A milky secretion made by worker honey bees as food for developing queen bees. It is rich in carbohydrates, proteins, vitamins, and minerals.

Shallow super: A hive box that is 5 ¾ inches deep.

Sideliner beekeeper: One who keeps between 41 and 100 honey bee colonies with the intention of making extra income, in addition to working another job.

Smoker: A tool for blowing smoke into a hive to calm the honey bees before working about the hive.

Smoker fuel: Pine straw, cotton, wood pellets, or other material that is non-toxic and, when ignited, produces a thick, white cloud of smoke.

Sperm cells: Male sex cells needed for reproduction in living organisms.

Stamen: The name for the collection of male parts of a flower, including anthers and filaments.

Static electricity: The buildup of electrical charges on the surface of an object created by friction that causes an imbalance between positive and negative charges.

Sting: A small but painful injury caused when an insect or animal makes a small hole in the skin of its victim.

Sugar shake: A non-lethal test to determine *Varroa destructor* (mite) population in a honey bee colony.

Telescoping lid: A hive lid with overhang on all four sides and a thin metal outer covering that protects the colony from wind, rain, and snow.

Veil: A hat with netting that covers and protects the head, face, and neck from stings.

Chalk Pollination Flower

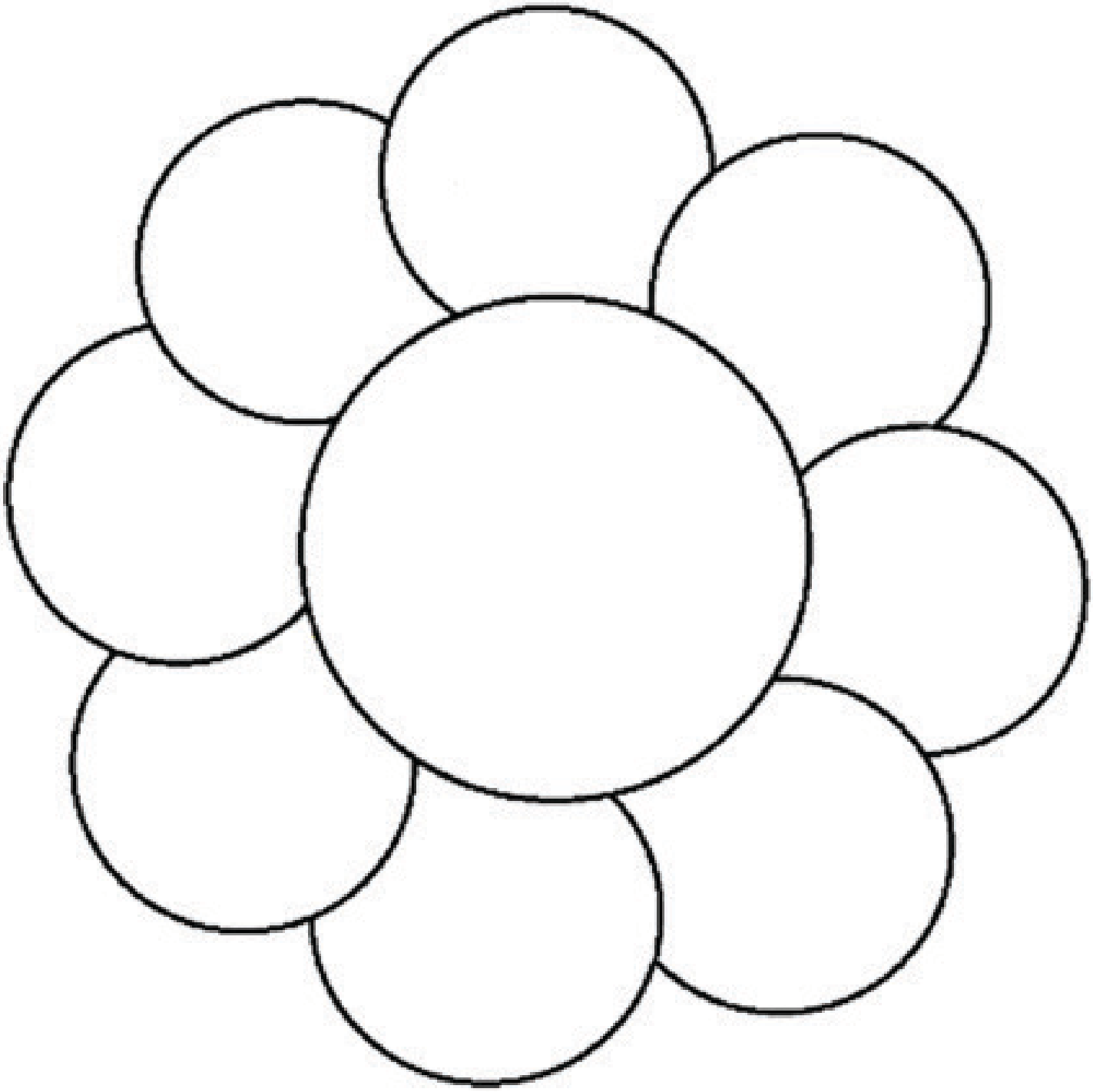


Figure 1. Blank flower handout.
Credit: Megan Hammond, formerly UF/IFAS Honey Bee Research and Extension Laboratory

Chapter 2 Beekeeping Answer Key

Chapter 2.2 Activity #1 What is Wrong with this Apiary Location?

APIARY LOCATION 1:

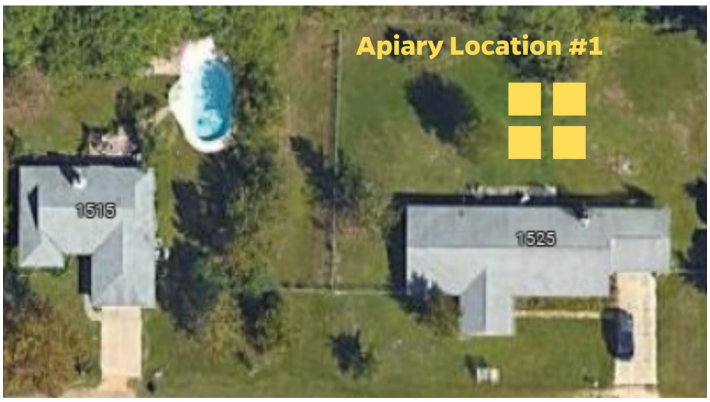


Figure 1. Apiary Location #1
Credit: Google Earth; copyright Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

While there is a flyway barrier made by the trees and shrubs, if there is no water source provided by the beekeeper, the honey bees will go to the neighboring pool for water. The neighbor may become upset with the increased risk of getting stung when they swim in their pool.

What are some ways the beekeeper could make the site safer?

The beekeeper must provide a safe source of water such as tubs of water with wood floats, dripping faucets, or hive-top or front-entrance feeders.

APIARY LOCATION 2:

Figure 2. Apiary Location #2
Credit: Google Earth; copyright Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

This location is too close to animals in confined spaces and their water sources. The honey bees could also interfere with and be a nuisance to people visiting the zoo.

What are some ways the beekeeper could make the site safer?

It would be best to find a completely different location further away from the zoo animals and guests.

APIARY LOCATION 3:

Figure 3. Apiary Location #3
Credit: Google Earth; copyright Airbus, CNES/Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

This location is too close to the sidewalk where elementary school children would be outside playing and walking and may get stung. There is no flyway barrier tall enough to direct the honey bees away from the children and other people at the school.

What are some ways the beekeeper could make the site safer?

The hives could be moved to another location on the property further from the sidewalk, and a flyway barrier could be built to direct the honey bees away from people.

APIARY LOCATION #4

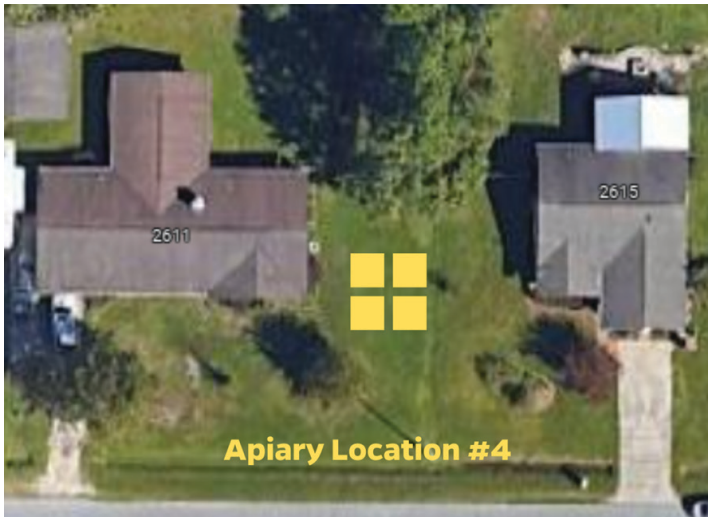


Figure 4. Apiary Location #4
Credit: Google Earth; copyright 2024 Airbus, Maxar Technologies. Map Data copyright 2024.

What could be unsafe about this location?

Not only is the apiary too close to the property line and lacking a flyway barrier but the homeowner is breaking neighborhood rules. This increases the risk of one of the neighbors getting stung and the beekeeper getting in trouble over the neighborhood rules.

What are some ways the beekeeper could make the site safer?

Before ever purchasing their bees or equipment, the beekeeper should investigate the rules and regulations of their neighborhood for beekeeping. If beekeeping is allowed, the hives could be moved further from the property line and a flyway barrier could be built to direct the bees up and away from the neighbor's yard.

Chapter 2.3 Activity #1 Beekeeping Equipment Crossword Puzzle

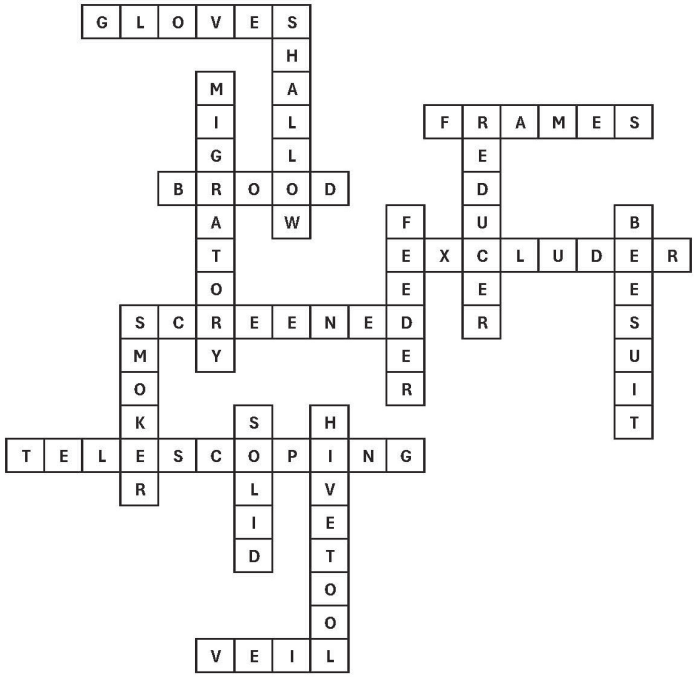


Figure 5. Beekeeping equipment crossword answer key.

Chapter 2.4 Activity #1 Which Bees to Buy?

(Answers may vary according to which characteristics you choose to focus on.)

Scenario #1

Stock They Should Buy: **Carniolan**

Why: **High overwintering ability and low defensiveness**

Stock They Should Not Buy: **Caucasian**

Why: **While they do have low defensiveness, they are less likely to survive winter due to low overwintering ability.**

Scenario #2

Stock They Should Buy: **Carniolan**

Why: **They rank high in honey production, have good disease resistance, and low robbing tendencies.**

Stock They Should Not Buy: **German**

Why: **They have low to average honey production and have low disease resistance.**

Scenario #3

Stock They Should Buy: **Italian or Buckfast**

Why: **They produce a lot of brood and have only an average tendency to swarm.**

Stock They Should Not Buy: **Carniolan**

Why: **While they have rapid growth in the spring, they have a high tendency to swarm and then only average brood production.**

Scenario #4

Stock They Should Buy: **Russian**

Why: **They have the highest tolerance to *Varroa*.**

Stock They Should Not Buy: **German**

Why: **Not only is their resistance to *Varroa* variable, but they have a low tolerance to other diseases.**

Chapter 2.5 Activity #1 Find the Bee

Photo 1: Can you tell which is the worker bee and which is the drone? Circle the drone.

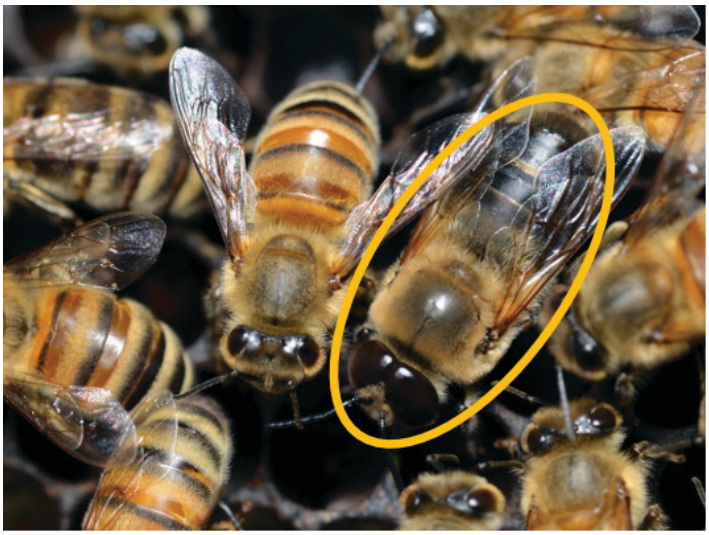


Figure 6. Photo 1, originally from Chapter 2.5 Figure 17.
Credit: Dr. Michael Bentley, used by permission

Photo 2: Circle the queen bee.

Figure 7. Photo 2, originally from Chapter 2.5 Figure 18.
Credit: Dr. Michael Bentley, used by permission

Photo 3: Circle the queen bee.

Figure 8. Photo 3, originally from Chapter 2.5 Figure 19.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Photo 4: Circle the queen bee.

Figure 9. Photo 5, originally from Chapter 2.5 Figure 20.
Credit: Dr. Michael Bentley, used by permission

Chapter 2.5 Activity #2 Hive Inspection

Opening the hive:

Figure 10. Working population answer: Moderate-High. Originally from Chapter 2.5 Figure 21.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #1:

Figure 11. Frame #1 description answer key. Originally from Chapter 2.5 Figure 22.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #2:

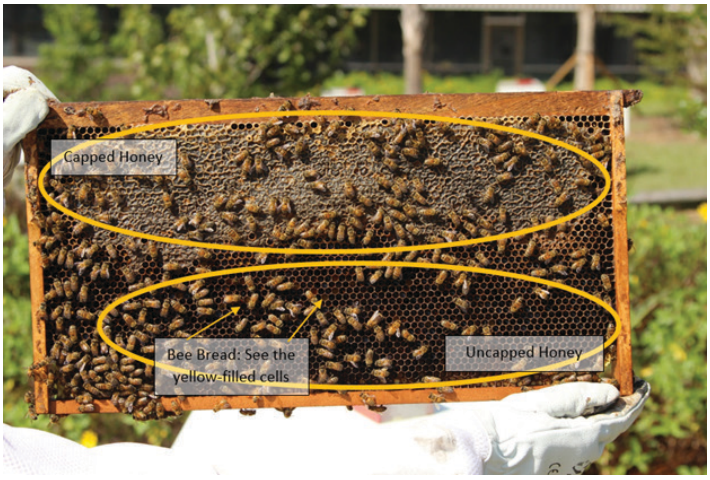


Figure 12. Frame #2 description answer key. Originally from Chapter 2.5 Figure 23.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #3:

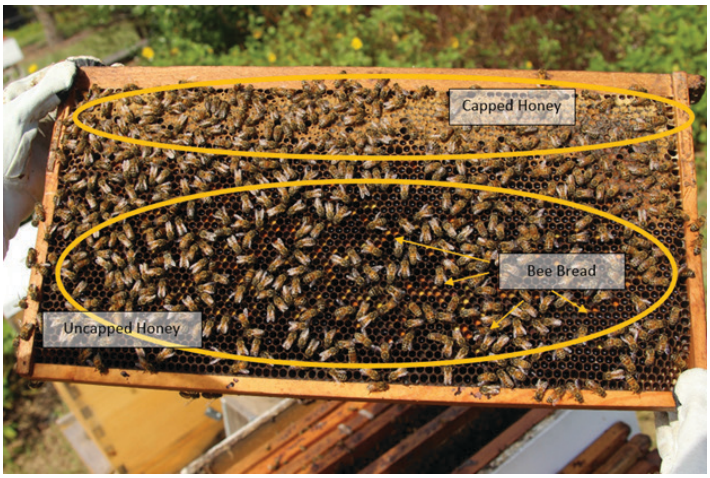


Figure 13. Frame #3 description answer key. Originally from Chapter 2.5 Figure 24.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #4:

Figure 14. Frame #4 description answer key. Originally from Chapter 2.5 Figure 25.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Frame #5:

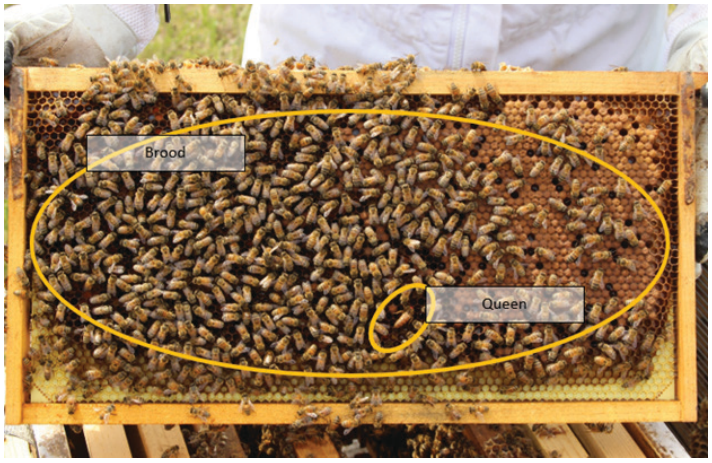


Figure 15. Frame #5 description answer key. Originally from Chapter 2.5 Figure 26.
Credit: Kassidy Robinson, formerly of UF/IFAS Honey Bee Research and Extension Laboratory

Chapter 2.6 Activity #1 Connect the Pest

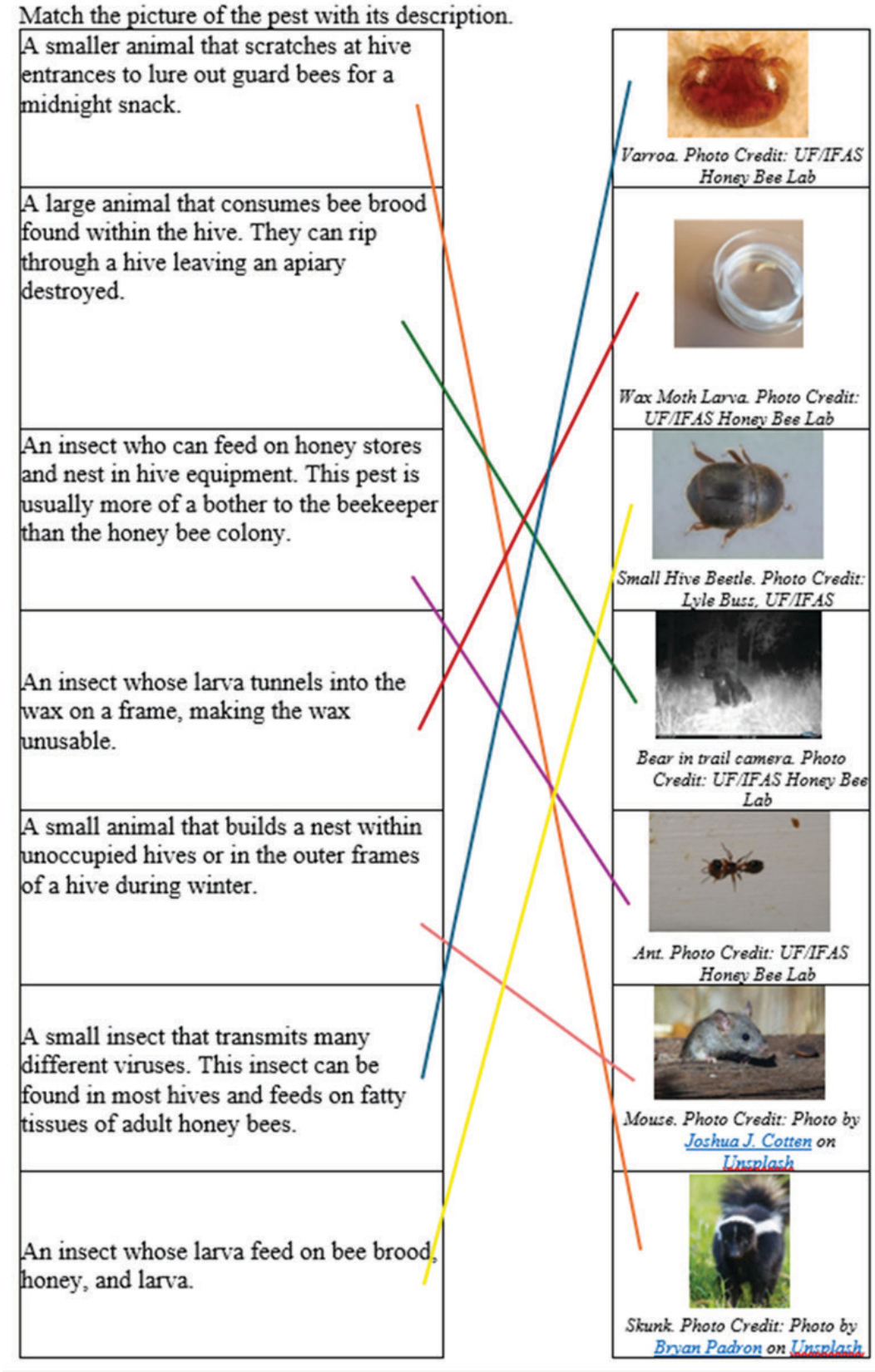


Figure 16. Pest matching answer key.