PURDUE UNIVERSITY | Extension - 4-H Youth Development

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Advanced Beekeeping

The 4-H Beekeeping project guides you as you learn about raising honey bees. Beekeeping offers many exciting educational experiences, from learning about bees and honey plants, to raising bees and producing honey and other bee products.

This is the third of three 4-H beekeeping manuals. The first, *Learning About Beekeeping,* covers basic information on beekeeping: types of bees, the honey and wax they produce, plants that attract bees and the beekeeper's equipment. The second manual, *Working with Honey Bees*, offers guidance as you acquire a beehive, care for it throughout the year and keep good records of your beekeeping work.

This manual includes more detail on some things you have already learned and introduces more advanced beekeeping topics: increasing the number of your honey bee colonies, increasing honey production, producing special kinds of honey, managing disease and more about bee societies.

The directed experiences in this manual are suggestions to help you to learn more about apiculture. Learning all you can and taking responsibility for your bees' health as you expand your apiary is important. Use this manual as a resource for problems you may have or areas that you want to learn more about, rather than a how-to guide. You'll learn most by doing and keeping notes so you remember what worked and what didn't with your bees. Stay current with local practices and concerns by talking to others who raise bees. Local beekeeping organizations can be a great place to learn. The internet has a wealth of resources and has made it much easier to connect with other beekeepers in your state, the country and around the world.

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CONTENTS

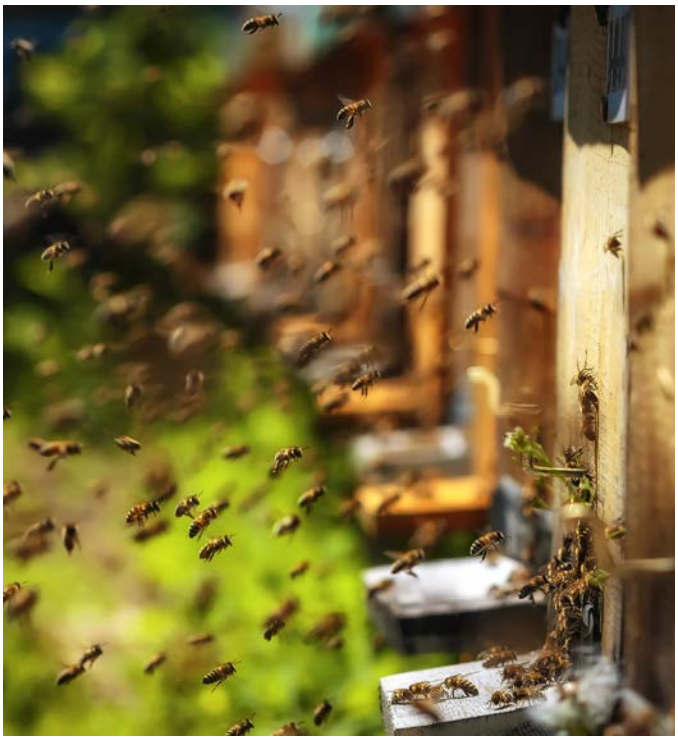
Expanding Your Apiary

Once you feel confident in your ability to maintain a beehive throughout the year and have successfully produced surplus honey, you're ready to take on more complex and difficult projects with your bees. You will continue to develop your skills as a beekeeper with the help of this manual. Good beekeepers not only care for their colonies but also manage them to increase honey production. Your goals should now be to:

- Keep strong, populous colonies with young queens.
- Continue to improve your understanding of the ways of bees.
- Increase honey production.
- Experiment to learn better ways to improve your apiculture skill.

As your beekeeping experience increases, your ability to work more quickly and competently also increases. You will be able to add new hives to your original apiary until it contains the maximum number of hives that you can care for. Good beekeepers know what their maximum apiary size should be and don't overextend themselves. Your decision is based on many factors, including your available time, expense, space considerations, physical condition, interests and local climate. The maximum number of hives a beekeeper can care for differs from beekeeper to beekeeper. Your maximum may be two hives as a hobbyist, while a farmer might have 200 hives.

Your beehive is a dynamic, changeable system with great potential for growth. Be alert to apiary operations that can be improved, and consider experiments to help you understand more about your bees and how to care for them. We recommend you use the scientific method for experiments (Appendix B). The more you learn, the better you'll be able to help your bees produce more honey.



Beekeeping is a lifelong learning process. Talking with other beekeepers helps you learn. Advice from more experienced people is as valuable now as it was the first time you watched a beehive being opened. Continue to read all you can about bees and beekeeping. Take your questions to your beekeeping advisor, local bee inspector, and local and state associations. Subscribing to a beekeeping journal can introduce you to topics of interest you haven't even thought of!

You are now in charge of your learning. No one is telling you what to do and when to do it, and no one is asking you questions that show your understanding of a concept or procedure. You are mostly on your own with the help and advice of other beekeepers. You choose your activity, do it and when you believe you have mastered it, move on to another. Most of all, enjoy the journey!

Records

Keeping accurate records is especially important as you expand your apiary. Records help you remember what you did, evaluate the success of your work and reduce the chance of making the same mistake twice. They also help you track how much time and money you're spending on your beekeeping project. You can continue with the record-keeping format you used when you started (templates are included in Appendix C), or you can use the templates as guides to create your own record sheets.

Managing Honey Bee Colonies

Choosing a Good Apiary Site

The site you choose for your apiary should have plenty of floral sources within two miles of your hives. Wild clover is a major source of nectar for bees in much of the Midwest. Any place that has a mixture of trees and unplowed fields is good. You can ask people in your neighborhood, school or church if you don't have a place to keep a hive. Most will agree to help you, especially if you offer them honey.

Water should be available within a quarter-mile of the hives. Bees can collect water from dew and puddles, but even dew may be scarce during a hot, dry summer. A bird bath works well for providing water. Bees must have water to air-condition the hive and dilute royal jelly for feeding brood, so you must provide it if it's not naturally available.

The apiary should be accessible at all times of the year. Place the hives on hard, dry ground so you can drive up to your apiary without having to carry your equipment long distances. Place the bees near some trees that block the wind from the west and on a slight hill to avoid frost pockets. A protected site with good air drainage improves your bees' survival chances over the winter.

Increasing Your Colonies

You can increase your colonies by buying nucs, installing package bees or dividing your existing colonies.

Removing the queen cage

Purchasing nucleus hives (nucs) is a good way to increase your colonies. The nuc is a small hive of three to five frames containing comb with bees, brood, honey and pollen. A nuc builds up more quickly than a package of bees installed on foundation because it already has some capped brood and empty cells where the queen can lay eggs. Nucs purchased locally are more likely to have queens that produce bees adapted to your local conditions. Ask at beekeeper meetings or look online for beekeepers that sell nucs or local queens. You usually need to supply the brood box and enough frames with foundation or comb to fill out the box. One concern with a nuc is that beekeepers often get rid of the oldest frame and any disease there can spread, so be sure to get your nuc from a reputable company.

Installing packages

Sometimes you cannot find a provider of nucs, or they aren't available early in the year when you want to get your bees. In this case, buying package bees is a good option. Package bees are produced in southern states early in the year for shipment up north. They can be purchased from a supplier and shipped to you directly, or you can collaborate with someone who is planning to bring a truckload of packages to your area. Follow these steps when ordering a package.

Shaking the bees onto the hive

1. Order a 2- to 3-pound package of bees with a marked queen to arrive at a specified date. Order early, preferably by January, before they sell out. Packages can usually be installed when plants are starting to bloom so the bees have enough resources. This may be any time between April 1 to mid-May in the Midwest and northern states.

2. Prepare your equipment before your bees arrive. You need the following things for each colony.

   - Hive stand to keep the hive bottom off the ground
   - Two deep brood boxes with 10 frames of foundation each (or 9 to 10 frames with comb)
   - Bottom board
   - Entrance reducer
   - Inner cover
   - Two supers for the honey flow
   - Cover
   - A way to feed the bees (a friction pail or gallon jar with small holes in the lid both work well)
   - Division board feeders (these can be used with floats to keep the bees from drowning. Entrance, or Boardman, feeders are convenient but don't work well in temperatures below 40°F.) Top feeders work well because they are enclosed in the hive and easy to refill in bad weather. Division feeders also work well for warm weather.

3. When the package arrives, check to make sure the bottom is not covered with dead bees. If it has 2 to 3 inches of dead bees, notify the shipper and ask for compensation. Keep the package in a dark place at temperatures of 50° to 70°F. Spray the bees with 1:1 sugar syrup, but do not soak them too much. If you need to wait a day or two before installation, spray with sugar syrup twice a day.

   - Install your package as soon as possible. Just before dusk is ideal. Packages can be installed at other times of the day if it is raining or cool (45°F or less).
   - Installing in the evening keeps the bees from leaving the hive and drifting to another hive. If you only have one hive, this isn't an issue.
   - If you are installing during the day, block the entrance with some grass for an hour or two to keep the bees in the hive. Otherwise, the bees tend to drift into the most visible hive (usually the one on the end).
   - Remove the grass after a few hours (or the next morning if you installed late evening).

4. Installation

   - Using smoke when installing a package usually isn't necessary, but it's a good idea to have a smoker lit in case you need it. It may encourage the bees to go down into the hive. Knock the bees down to the bottom before removing the can so they are less likely to fly when you remove the queen.
   - Pry out the syrup can with your hive tool and set it aside.


Introducing the queen in the cage

- Remove the queen cage and place her between the frames in the hive between two frames.
- Spraying the bees with 1:1 sugar syrup right before shaking them into the box can help keep them from flying.
- Jar the package sharply to knock the bees down to the bottom. Turn it over and shake it vigorously from side to side to get the bees into the box. You may need smoke to encourage the bees to go down between the frames.
- Place the queen in the hive. Let the bees release the queen by eating the candy. Remove the cork from the candy and put a small hole in it with a frame nail (being careful not to stab the queen). Then position the cage at an angle between the middle frames with the screen facing down so the bees can feed the queen. Put the candy end of the cage at the bottom, in case it gets wet. This prevents it from flowing onto the queen.
- Check the hive after three days to make sure the queen was released. The bees may take longer to release the queen with a candy plug. You may have to remove the plug at this point. Check back again in a day or two to make sure the new queen is laying eggs. Remove the queen cage once it is empty.

  Note: Make sure the bees are not biting the cage if the queen is still in it. You can easily push them aside with your finger unless they have latched onto the cage with their mandibles. If you can push the bees aside, pry off the screen and allow the queen to walk between the frames. If the bees are latched onto the cage, do not release the queen, or they will kill her. In this case, you may have another queen in the colony, or the introduction may require more time. If the bees already released the queen, check for eggs in the bottom of the comb by tilting the cells up to the light. If there are no eggs and no queen, you may need to order a new queen. It's also possible that she just hasn't laid any eggs yet because she is too young or because there are no cells to lay them in, and you just can't find her!

5. Feeding the bees after installing the package is important. Your colony will decline in population until the new brood hatches, and the queen needs comb to lay eggs in. Feeding allows them to draw out the comb from the foundation. Feed


Bottle feeder


Division board feeder

the bees with a gallon jar of 1:1 sugar syrup (at least 50 to 60 percent sugar by volume) inverted over the hole in the inner cover. Have about six small holes in the lid so the bees can feed on it. In cold weather, consider adding the medication fumagillin (sold as a powder called Fumadil-B) to the first two gallons of syrup to prevent dysentery (Nosema). Place the feeder jar over the inner cover hole, leaving a space for bees to come out. Cover the jar with an empty hive body. Check the feeder jar regularly and refill it whenever it's empty. You may need about 5 to 7 gallons of 1:1 sugar syrup per package if installing the package onto foundation. Installing the package onto comb requires much less syrup. It's also possible to feed the hive with a division board feeder or Boardman feeder. Check the feeder the next day to make sure your bees have consumed some syrup. If the bees are not clustered in the middle, rearrange the empty frames so the bees are in the middle.

Caring for the hive after installation

Check the bees one week after installing the package. Always carefully remove an outer frame first to avoid crushing the queen. Look for drawn comb containing eggs. If there are no eggs, search for the queen. If you cannot find her, you need to buy a replacement queen.

Inspect the bees every 7 to 10 days to make sure there are eggs and a queen. Observe the expansion of the brood nest, but do not disrupt the nest by rearranging the frames. Replace the frames in roughly the same configuration.

When all the comb is drawn from the foundation in the first box, or the bees have at least started it, add a second deep box. You can take one or two outer frames of drawn comb that have little or no brood from the first box and place them toward the center of the upper box to encourage the bees to move up and draw out the foundation and expand the nest.

Watch. Give the bees new boxes as soon as they fill up the old ones. When adding supers that contain foundation, place them directly above the brood nest even if you have one super of drawn comb and honey in place already. This encourages the bees to draw it out.

Supers with foundation should have 10 frames; those with comb can have eight or nine frames if properly spaced.

Splitting Colonies

Two of the many ways to divide colonies are explained below. Complete these preparations before using either method.

- Choose strong colonies to divide. The best time is four to six weeks before swarming usually occurs. This is early to mid-April for most Midwestern states.
- Be sure to use enough smoke.
- The colony should ideally have brood on eight to 10 frames or more.
- Arrange for a new queen to be delivered either the day before or the same day you want to divide the colony. She will be shipped in a cage with candy and worker "attendants." If the queen of the strong colony is more than a year old, you may want to

Strong hive ready to split

order two queens and replace the older queen with a new one. If necessary, a queen can be kept in the cage with the attendants for several days to a week in a location that is 65–70°F. Give them a tiny droplet of water with your finger once or twice a day on the screen, but don't let them get wet.

- Have your equipment ready for the new colony. You need the following items:
  - Another hive stand
  - A bottom board
  - Top and inner covers
  - Two deep hive bodies with combs or frames with foundation
  - A feeder. This is optional but recommended if no nectar is coming in from the flowers or you are adding foundation instead of drawn comb. (Use a division board feeder or gallon jar with a few nail holes in the lid and 1:1 sugar syrup.) You also need an empty, deep hive body to enclose the feeder.

Note: For the double-screen method below, you also need a double screen and a queen excluder if you're not taking the time to find the queen.

Simple divide method

Four days before the queen you ordered is to be delivered, open the hive using your smoker and divide the brood equally between two boxes of the existing hive. If you find the queen, put her in the bottom box or a queen cage while you prepare to remove the top box and move frames around. This is the safest way to avoid hurting her. If you don't see the queen, you can put a queen excluder between the boxes. The presence of eggs four days later will tell you where the queen is.

Once you divide the brood, remove the queenless box to a new location and introduce a queen the next day. Make as even a split as possible and move the divide at least a mile away to keep foragers from returning to the original location; however, this may be impractical. If placing the divide in the same apiary, put all the oldest brood (capped brood about to emerge as adults) and one frame of very young (larvae in uncapped cells) into the upper box that you're going to remove. You can tell if brood is nearing emergence by uncapping some cells

Splitting a colony with three brood chambers.

and looking for older pupae. Make sure both boxes contain pollen and honey. You can also put extra brood into the new hive from other colonies later. The new adult bees help make up for the loss of foragers that return to the original hive.

Introduce the new queen with the candy cage 12 to 24 hours after you make the divide. If you are requeening the other hive, wait 12 to 24 hours after de-queening before introducing the new queen.

Double-screen method

This method isn't commonly used. It's similar to the simple divide and can be used for making splits or for making up nucs. Double screens are frames that have a screen on each side and that fit over the brood box.

You can make or buy double screens. Use one that has movable pieces of wood to create an upper entrance. You also can make your own double screen by stapling window screen over both sides of the hole in an inner cover and making a notch in the side of the inner cover to provide an entrance for the bees in the top box.

The double screen fits over the brood chamber of the old hive and has a slot that provides an upper entrance for the bees. It allows heat and the hive's odor to be transmitted to the upper part. The heat from the lower box helps warm the brood in the upper box. The double screen does not permit queen pheromone to pass to the queenless box because the bees cannot touch each other, so the bees in the queenless box are soon ready to accept

Double screen on top of a hive. The back is open to make an upper entrance.

a queen. If the upper hive does not accept the new queen, the screen can be removed and the hive merged again with no fighting, because the bees still share a common colony odor.

Double screens are also used in queen-rearing operations to produce queen cells.

This method allows you to make up many nucs or splits, because you do not have to find the queen. When you go back to inspect it later, the queenless box will probably be buzzing more and will not have eggs.

Choose a strong hive and decide which brood frames you want to move to the top box to make the nuc or split. Use one or two frames of young, uncapped brood and most of the frames of sealed brood that are about to emerge as adults.

Inspect the frames for brood and honey and decide which ones you want to go in the upper box. Bring an empty box to set frames in, or lean them on end against the hive. Replace the frames that you removed from the bottom box with frames from the top box. You can also temporarily add a third brood box and replace frames you move with new frames of comb or foundation. If using frames with foundation, place them between frames containing comb that do not contain much brood. Try to keep the brood in the center of the nest.

Then place a double screen over the bottom brood chamber and put the box containing older brood, honey and pollen above it. Or, if you happened to find the queen, put the frames of brood in the upper box and the queen in the lower box, and place the double screen in between the top box and the original brood chamber. Make sure the upper box has an entrance, and face it opposite the direction of the lower entrance.

Introduce a queen to the queenless box one to four days after the double screen separates the brood chambers. It takes three days for an egg to hatch, so if you don't know where the queen is in the beginning, you'll know which box is queenless in three to four days — the one without eggs.

Check the box with the new queen within a week after introducing her. If the queen was accepted, the box can be moved it to a new location with a new bottom board and covers. If it needs more bees, you can shake some into it from the bottom box, but be careful you don't shake the old queen into your box!

Taking Care of Your Queens

The key to having productive colonies is to always have vigorous queens in disease- and mite-free colonies. Young queens are productive egg layers and much less likely to swarm. Checking all your hives, even briefly, every 10 days is a good idea. At the very least, check them during critical times — early spring, just after harvest when treating for mites and before winter.

Check for eggs, lots of brood in the combs and a good laying pattern (not a scattered brood pattern). Requeening once a year ensures you always have young queens. Some beekeepers leave the queen in for two seasons if she is still laying a good brood pattern the second season, but they run the risk that she will begin to fail during the colder months. Keep a record of marked queens so you know how old each queen is and where she came from.

Marking Queens

If you have a **supersedure queen**, you can mark the queen yourself with just a little practice. A marked queen makes her easier to find if you want to replace her and helps avoid hurting her while you work with the hive. If you later find an unmarked queen, you will know she was superseded.

A marked queen is easy to spot.

The first step in marking a queen is to catch her by grabbing her wings as she walks on the comb. Don't be afraid to hold her in your hand. She won't sting you because queens sting only other queens. Hold your queen gently against your clothes between your thumb and forefinger firmly on either side of her thorax. Have an open bottle of enamel paint (e.g., Testor's) and an open queen cage ready. Use a blade of grass to put a small spot of paint on her thorax, rubbing it into the hairs. Be careful not to use too much or to get paint on other parts of her body, especially her eyes and antennae.

An easier way is to use enamel-paint marking pens or special queen-marking cages. Purchase a marking pen at a hobby store or from a bee supply catalog. Let the queen dry off in a queen cage for about five minutes before releasing her back into the colony to keep the workers from removing the paint. Plastic roller cages are convenient because they have a hinge and large opening. Record the date, where the queen is from and the color you used to mark the queen. The standard queen color coding system is based on the last digit of the year.

Queen marking key

Use the color listed if you mark your queen in a year ending in:

- 2 or 7 Yellow
- 3 or 8 Red
- 4 or 9 Green
- 5 or 0 Blue

A few beekeepers clip off the tip of one of the mated queen's front wings to prevent the queen from flying away with a swarm. That way, if the colony swarms, the queen may be lost in the grass, but the bees return to the hive with a new queen. They may, however, still swarm again with a virgin queen if you do not relieve the crowding of the brood nest. Warning: Make sure the queen is mated before you clip her wing! If you clip a virgin queen's wing, she cannot fly out and mate.

Tagged queen laying an egg

Bees accept young queens more readily than older queens. Queens also are more likely to be accepted in small colonies, and finding the old queen to remove her is easier in a small hive than in a hive with lots of bees. It's therefore easier to requeen in the spring when the colony population is lowest.

On the other hand, requeening during the summer in northern states has several advantages. Northern-bred queens may be better adapted to your conditions, and these queens are only available in the summer. For example, someone raising their own queens in the Midwest may have new queens by about the first of June, when good weather for mating queens is more likely than earlier in the year. Plenty of drones for the queens to mate with should

be available as the strong colonies prepare for swarming. Introducing queens during the summer also can also ensure you have young queens likely to start laying eggs earlier in the year the following spring. Further, young queens are less likely to swarm or be superseded than old queens. If you're trying to maximize honey production, you may want to wait until just after the honey harvest to requeen, or you may want to do it gradually over the summer.

Requeening Methods

A number of requeening methods are described below.

The first step in replacing the queen is to find and kill the old queen. Replace the weakest queens if you are requeening only some of your colonies. This includes queens that are no longer laying large patches of brood, those you know are old and those that never produced big colonies. The usual method of killing a queen is to pinch her head. **Do not try to introduce a new queen until the old queen has been out of the colony for at least 12-24 hours**. In some cases, you can wait longer. Do not wait more than four days, however, if possible.

Queen in a roller cage

Check for laying workers before introducing a new queen. Combining hives or trying to introduce a new queen may cause a problem because the workers may kill the new queen. Also knock off any queen cups if you are introducing a queen in a cage. It may take a long time before the queen is safe to release, and queen cups may be made while you wait.

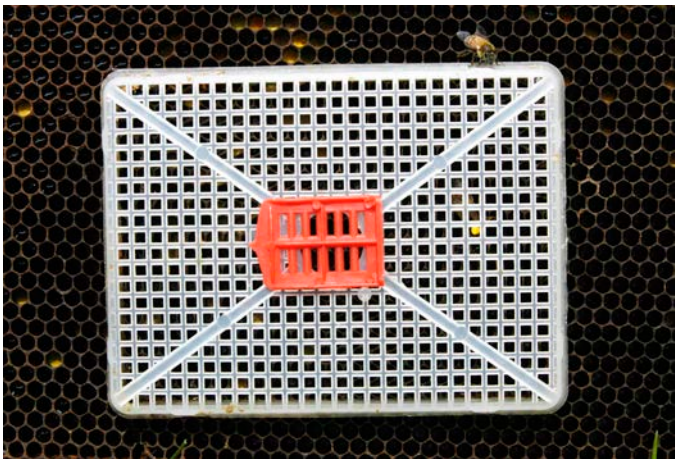
Queen and attendants in a candy cage. The candy is put at one end.

1. *Candy cage.* This is the most common method used to introduce a new queen. The introduction is done as described for installing a package. Queens are usually shipped in candy cages. You can make your own queen cages and candy if you are raising queens. Make the candy by mixing high-fructose clear corn syrup or honey with powdered sugar. (This takes a surprising amount of powdered sugar.) The candy must be soft but firm. If it's too soft, it will melt in the heat of the hive and kill the queen by covering her. Put a piece of wax paper between the candy and the screen of the cage to keep it from drying out, and then staple on the screen. The hole in the non-candy end of the cage is sealed with a cork or piece of wood.

A small hive, or nuc

2. *Nucs*. Because queens are more easily accepted into small colonies, one method of requeening is to make up small nucs to introduce the new queens into. A nuc can also be used for introducing virgin queens and queen cells that you find in your other colonies. It then serves as a mating nuc as the queen flies out and mates. Once the queen is accepted and laying, combine the nuc with a larger colony that you made queenless one to two days before merging them.

3. *Newspaper method.* Perhaps the safest way to merge colonies is to put a sheet of newspaper between them. This allows time for the two boxes of bees to acquire the same colony odor, which prevents fighting. To do this with a nuc, first place the frames from the nuc into a deep hive body. Put one sheet of newspaper over the open hive you're going to merge it with, and place it on top. Use your hive tool to make some slits in the newspaper so the bees can chew their way through it more quickly.



Queen under a push-in cage

4. *Push-in cage*. Make a rectangular cage out of 8-mesh hardware cloth (eight openings per inch), 3 inches by 5 inches, to push into the comb with the queen underneath. This method is often used when introducing artificially inseminated queens. When done properly, it is the safest method. You can also buy plastic push-in cages that work a little better, because the bees are less likely to chew around the edges and enter the cage. The advantage of a push-in cage is that it allows the queen to begin laying eggs before she is released. Shake the bees off the comb that is fairly dark (they are stronger). Place the cage in an area with a little open nectar or honey and (preferably) over a small patch of emerging brood so the bees that emerge will tend the new queen. The cage doesn't have to be over brood, but there should be a few cells of honey. The push-in cage *must* be pressed in firmly. Check it in three to five days to make sure the bees have not chewed underneath. If they have, move the cage. Once the queen is laying eggs or you are satisfied the bees are not biting the cage, you may release the queen directly. Remember: If the bees have clamped their mandibles on to the cage, dislodging them with your finger will be difficult. Never release a queen if they are biting the cage.

5. *Virgin queens*. Virgin queens can be introduced the same way as other queens, but they are sometimes more difficult because they are less attractive to the bees. They also tend to run around and are harder to catch. They may fly away during the process but will probably return to the hive. A new queen takes five to 10 days to take her first mating flight and another week after that before she is laying lots of eggs. If she doesn't mate in 14 days, she is getting too old to properly mate. Expect a two-week break in brood rearing with a virgin queen. For this reason, you may want to consider introducing her to a mating nuc before killing the old queen and introducing her to the main hive. Another good alternative is to introduce her *above* the old hive. To introduce a virgin queen above the old hive:

   - Take a notched inner cover and place it with the notch up and facing the back of the hive to provide a second entrance. Take two frames of brood and bees and one frame of honey (but not the queen) and put them in a deep box above the inner cover. Seal the hole in the inner cover with a double screen.
   - After 24 hours, introduce the virgin in the top box.

- In two weeks, check for eggs and brood. You can then use the newspaper method to merge the two colonies, or you can just remove the double screen and allow them to merge. The new queen should be the one that survives, but removing the old queen first is the safest method.

6. *Queen cells*. Queenless hives accept queen cells very well. Find a dark comb in the middle of the nest and mash down some cells with your fingers. Carefully push the thickened bottom portion of the queen cell into the comb and use the mashed area to allow space for the cell to hang downward. The bees attach the cell to the comb, and the queen should hatch out and be accepted. Handle queen cells carefully to avoid damaging the queen; she is sensitive to mistreatment at certain stages of development. Do not bend the cell at all when attaching it in a perpendicular position. Try to keep the cell warm during transport: 75° to 90°F is best, but don't let it dry out, either. If the weather is cool (below 60°F), the best place to attach the cell is in the middle of the brood nest near the top of the comb.


Sealed queen cell

Seasonal Management

With the problems we now face with **Varroa destructor** mites, beekeepers are finding they need to be more flexible on the timing of certain operations, such as administering medications, queen introductions and the honey harvest. Each spring brings a swarming season and a nectar flow that depends on the weather and its influence on flowers. Be aware of the weather and know what important flowers are blooming. This makes you a better beekeeper who is prepared to help your bees at the right time. And it keeps you in touch with nature. Some suggestions for a seasonal management schedule are given below. The dates are typical for the Midwestern region, so adapt your schedule to your local climate and each year's weather as needed.

December to February

Downtime. Work on equipment and read beekeeping magazines and books.

February

This is a time when you can check your bees, but only when the temperature is above 40°F and there is no wind. Check your hives briefly. If a hive is dead, it can be marked as such or stored. Protect the comb from wax moths by putting moth crystals on it or storing it in a cold place once the temperature is above 60°F. If there is any brood, immediately close the hive to keep from chilling the brood.


An apiary in winter

Brief inspections of brood can be done on days that are above 50°F with no wind or above 55°F with light wind. This could be a time to reduce your Varroa mite levels, but this is usually done after the honey harvest. If there is no sealed brood, all the mites are exposed to the miticide because they cannot hide beneath the cell cappings. The need for mite control depends on mite populations, but one treatment per year is usually required as soon as honey is removed. Mite treatments that rely on evaporation, like thymol, must done when the weather is warm enough. Read the directions for the product you're using. You can just open the lid and peek under the inner cover to look at cluster size or to introduce feed when the outside temperature is below freezing without harming the colony.

Hives should be inspected for food stores about the time that bees are beginning to rear brood (usually January or February, weather permitting, or this may be put off until March). Colonies that did not have adequate stores going into winter may be starving in February, even without brood rearing. Colonies can be fed in cold weather by putting granulated white sugar on the inner cover. Another efficient feeding method for the winter is to make a cake of hard candy following the recipe below. These are also called candy boards.

Winter Bee Candy

Ingredients

- 15 pounds granulated sugar
- 3 pounds clear high-fructose corn syrup
- 4 cups water
- 1/3 tablespoon cream of tartar

Directions

- Mix the sugar, syrup, water and cream of tartar.
- Heat the mixture to 242°F, using a candy thermometer to determine the exact temperature.
- Pour the heated mixture into molds to make flat cakes that fit on top of an inner cover. Let them cool and harden.
- Place the hardened cakes over the inner cover (keeping the opening free for the bees to feed). Some people use special boards that take the place of the inner cover.

Pollen patties can provide much-needed protein.

Late February or early March is usually the best time to add pollen substitute in the Midwest, if supplemental feeding is planned to stimulate earlier egg laying by the queen. Pollen feeding should be done about six weeks before reliable sources of nectar can be obtained from early flowers (like maple trees and dandelions). Purchase pollen substitute from a bee supply company. Unless you buy prepared patties, you need to mix it according to the directions. Some people trap bee pollen and store it in their freezers to add to their pollen substitute and make it tastier for the bees.

Hint: Make pollen substitute the day before you intend to use it so it doesn't get too hard or soft when it sets up. If it gets hard or dry, the bees won't eat it. Putting the pollen substitute between wax paper keeps it from leaving a mess on the frames and makes it easier to apply.

March

Honey bees often get their first fresh pollen in March from maple trees and willows. Make sure your hives have adequate food. More colonies starve to death in March than in any other month because as bees begin rearing brood, they eat up a great deal of honey and pollen. A convenient way to feed bees is with a division board feeder, which takes the place of a frame inside the hive so bees have easy access to the syrup. Give the bees equal volumes of sugar and water in the spring.

Combine weak colonies with stronger ones. Equalize colonies somewhat by stealing a frame of brood from each of the strongest hives and giving them to the weakest hives. Colonies that need honey can be given a frame from the stronger hives or fed syrup. Don't take too many resources from a strong colony or it will only weaken the hive. Some beekeepers recommend switching the position of the two hives. The bees from the stronger colony think the weak hive is now home, which can help improve it.

Some beekeepers do a preventive treatment for American foulbrood disease at this time. This is no longer recommended unless your colonies have had this problem in the recent past or show foulbrood symptoms. There have also been occasional problems with European foulbrood, and both types of disease usually can be cleared up with a treatment of one 6.4 ounce pack of terramycin mixed with 2.5 pounds of powdered sugar. Note: This requires a veterinary feed directive. Feed this to the bees in three doses, each five days apart. Each feeding should consist of about 3 tablespoons of sugar/terramycin mix sprinkled on top of frames at the edge of the hive.

Treating a hive with antibiotics in powdered sugar

Overuse of antibiotics may select for antibiotic-resistant foulbrood, and terramycin-resistant American foulbrood has already been reported. If you inspect your hives regularly, you will see when a foulbrood problem occurs and can cure it before it gets out of control. If you only see a few cells showing the problem, inspect again to see if it clears up. Bad weather often causes poor brood or chilled brood that may look like disease, but later the problem resolves itself. Combs with a lot of foulbrood should be burned or put in a well-sealed garbage bag and thrown away to prevent spread of the disease.

April

Continue to ensure adequate food, especially if your weather is cold or rainy. A strong colony occupying two boxes should have at least three full frames of honey. Feeding in bad weather stimulates more rapid brood rearing and in some cases, may be necessary to prevent starvation. If the weather is good, however, and honey isn't available, your bees should be able to forage on dandelions and spring flowers and get by.

It's a good idea sample for Varroa mites so you know if your fall treatment was successful or if your colony has become re-infested. See the notes under the August entry for more information on sampling.

Begin swarm control in April. Split the strong colonies if you have the extra equipment to start new ones. You can use your own equipment if you had winter losses as long as it is disease-free. Some beekeepers reverse the brood boxes to stimulate the cluster to move up and expand the brood nest. The brood nest is usually at the top of the hive at the end of winter. Placing this box on the bottom board and putting the nearly empty bottom box above it should reduce crowding of the brood nest and may prevent swarming. You can also put a super with empty combs underneath the brood nest. This provides room for returning foragers to stay and helps reduce crowding of the brood nest if it extends to the bottom. You may want to use a queen excluder to keep the brood out of that box.

If the swarming instinct is not curtailed, only the most tedious methods can prevent swarming. For a hobby beekeeper with a few colonies, these methods are feasible but not always successful. Once the bees start constructing swarm cells at the bottoms of the frames, go through the colony every 7 to 10 days and cut all the cells. **Be careful!** Before you cut cells, make sure you see eggs in the colony. The queen may have stopped laying eggs and is about to swarm, or she may have already swarmed and you didn't notice there are fewer bees. You do not want to make the mistake of cutting all the cells and leaving your colony hopelessly queenless!

May

Make sure your bees have plenty of room. Reduce crowding by giving them new brood chambers or supers before they need them. The extra empty comb stimulates increased foraging and honey production. Flowers are starting to give nectar — dandelions, autumn olive, Asian honeysuckle, tulip poplar and others. Sometimes black locust trees produce a short nectar flow at the end of May, and basswood trees can produce honey in late May or June.

If you are raising your own queens, May is usually the best time to start because it is swarming season and the bees have the instinct to raise queens. You can also carefully remove swarm cells and add them to queenless hives by hanging them between the frames or attaching them gently to the side of a brood frame, hanging down in their natural orientation. There should be plenty of drones for the queens to mate with when they are ready this time of year.

June

The honey flow really starts this month. Clovers are producing nectar and should be in full vigor by the end of June or early July. Make sure all the supers are on your hive. If you raised your own queens in May, you could introduce them to small nuc hives and let them mate in late May or June.

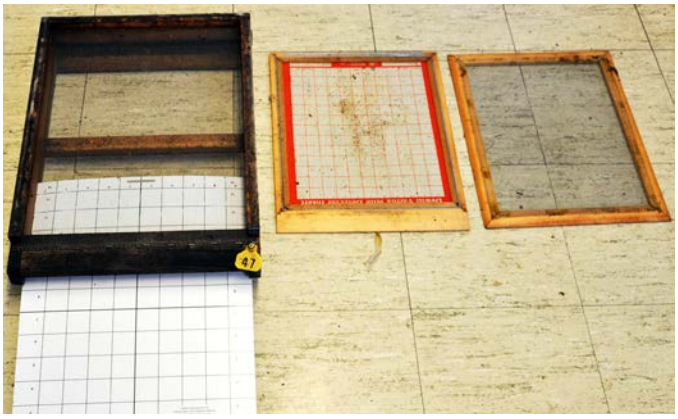
Honey bee on a clover blossom

July

The honey flow from clover usually stops about the end of July or the first two weeks of August in the Midwest. If you're raising queens, you could remove the queens from some of your hives when you have time toward the end of the nectar flow. Replace the queens that show poor brood patterns, those that are not laying enough eggs, and/or queens from colonies that show signs of disease. Finding queens in big colonies is difficult, so keep marked queens! The day after the old queen is removed, fuse the nuc with the large queenless colony to introduce the new mated queen, or introduce her with some other method such as a candy cage. You may need to feed your bees in July or August if dry weather has reduced levels of pollen and nectar.

August

The real honey flow is often done by the end of the first week of August. Perhaps the most critical thing you can do to help your bees survive the winter is to get the honey off as early as possible and treat for Varroa mites.



Two kinds of holders for sticky boards to check mites

Monitor your hive for the severity of Varroa mite populations with sticky boards, alcohol wash or powdered sugar roll so you have a good idea of whether you need to treat them. This also helps you know which hives need to be treated.

You can purchase the sticky boards or make them by cutting 3/8-inch doorstop wood strips and constructing a rectangle to which you staple screen that the bees can't get through. Put contact paper on the back and spray it with vegetable oil before sliding it in the colony entrance. Count the number of mites that fall in a 24-hour period, or put it in for three days and divide by the number of days so you have a 24-hour average. The average gives you more accurate data.

You can also check for mites on adult bees with the powdered sugar shake method. The sugar shake is done by putting half a cup of bees (about 300 bees) in a quart jar with a screened lid. Put several tablespoons of powdered sugar on them, let them set for two minutes, then shake the mites onto a white sheet and count them. Treat for Varroa mites if more than 10 percent of your drones are infested.

If you find you need to treat for mites, choose the method of mite control convenient for you. As soon as the supers are off, hives that have high mite levels should be treated. A number of products are available. Apivar strips contain amitraz, which is a good miticide. If you want to avoid pesticides, you can use a softer chemical such as thymol (synthetic oil of thyme) that is available in several products. (Apilife-Var and Apiguard use thymol and eucalyptus oil.) Always follow the manufacturer's label instructions for all products.

Controlling the mites now ensures that healthy bees are raised during September and October. They are your "winter bees" and must live all winter long and still be strong enough to forage and feed the brood in the spring. The nurse bees feeding brood normally are young bees, so the old winter bees must be healthy and rejuvenate their brood food glands in the spring. Brood food glands are the glands in the heads of nurse bees that make royal jelly to feed larvae. In contrast, working bees in the summer only live about six weeks or less.

Once the honey supers have been harvested, the honey needs to be extracted and bottled. The wet supers can be returned to the hives (after mite treatments are completed) to let the bees clean them up. Sometimes beekeepers just set the supers out in a shady place and let the bees rob them out. Some people store their supers wet, which is OK, but they will smell sour from fermentation and may have a little mold, which is also acceptable. The bees clean them up in the spring, but this makes extra work for them. Stored comb requires paradichlorobenzene (PDB) moth crystals when the weather is warm (above 60°F).

Place extracted comb in a freezer if you suspect it contains pests other than robber bees. This kills the pests but not the eggs. Preserve the eggs after they have been in the freezer for 48 hours by wrapping them in plastic or putting them in an airtight container. Place them in an airtight container in the basement (climate controlled) until spring.

It is important that you reduce the entrances of any weak colonies that may get robbed by stronger colonies when the nectar flow stops. Do not leave honey exposed too long when you work your bees, or they'll get used to robbing from each other.

September to November

Hopefully your bees found lots of nectar in goldenrod and aster flowers in late August and early September and are storing pollen for winter. The small, white asters are often important for the fall flow in the upper Midwest, but the fall flow is not dependable.

Stores of bee bread are important when winter comes.

Weak colonies should be combined with stronger ones before the winter. Colonies that are merged should be reduced to two or three deep boxes. You could use three boxes for strong ones that you will split next year. Store extra boxes and comb in an unheated building with covers on the top and bottom.

Note on equipment storage in hot weather: Wax moths can destroy the comb in two weeks. Store empty comb, especially during warmer months when wax moths are active, with several tablespoons of paradichlorobenzine (PBD) moth crystals. (Do not use naphthalene crystals!) Stack the boxes, putting the PBD crystals on newspaper on the tops of the frames every four to six boxes.

Either nail wooden entrance reducers in place leaving the smallest opening (3/8-inch high), or staple 3/8-inch hardware cloth across the entrance.

The 1/2-inch hardware cloth also works and is easier to find, but some mice are small enough to get through it.

If your colonies do not have at least six deep frames of honey for the winter, feed them 2:1 syrup (twice as much granulated sugar as water, by volume). Dissolve the sugar in hot water. You can add Fumidil-B powder to help control for Nosema disease (dysentery), but this is costly and the benefit may not be worth the expense. It's only necessary to feed your bees in the early spring or late fall, or when you're trying to get them to draw comb on foundation. Bees in the Midwest often make enough fall honey for themselves and we do not have to feed them. Put mouse guards on your hives. The easiest way is to staple 1/2-inch hardware cloth over the entrance or just bend it lengthwise and shove it in the entrance. Remove this in the spring so the workers can more easily take out the dead bees.

Colony Troubleshooting

Your primary concerns should be the presence and well-being of your queens and the levels of Varroa mites. Finding the queen is often unnecessary. Look for eggs by letting sunlight shine into the bottom of the cells if you do not see her. If eggs are present, a queen was there within the last three days because it takes three days for an egg to hatch.

The position of the eggs is also a clue. A laying worker deposits multiple eggs on the side of the cells, a signal that there is no queen.

Also look for queen cells. Swarm cells are queen cells made in preparation for swarming in the spring and are usually found toward the bottom of the comb. Emergency and supersedure queen cells are usually found toward the middle of the comb. When a queen is failing and the bees make a supersedure queen cell, it's sometimes best to let the bees replace her. This may cause a break in brood rearing for two to three weeks, however.

Common Problems and Recommendations

1. Problem: I can't find any eggs or brood!

Possible causes and solutions:

- The queen has quit brood rearing because of the season (winter or about to swarm). No action is needed in winter. But if your bees are about to swarm, only the most tedious methods can prevent it. See the April calendar section for more information on swarms.
- No queen. Buy and introduce a new queen as soon as you can.
    - Optional test: Add a frame of eggs and young larvae from another hive. Check for the start of queen cells on the third day. Finding queen cells indicates the hive was probably queenless and will now raise a new queen.

- A new queen is present but not yet laying. (You may find some sealed brood left from the last queen). Be patient. Queens normally begin laying eggs roughly two weeks after emerging from the cell.
- An extended shortage of pollen has caused the queen to stop laying eggs. Supplemental feeding may be necessary.

2. Problem: Eggs are present, but no other brood.

Possible cause: Brood rearing has just resumed after being halted. Perhaps the bees raised a new queen that just mated.

Solution: This is good! No action needed.

3. Problem: You see wet-looking pollen.

Possible cause: When pollen isn't needed immediately, bees put nectar and honey on it. This is called bee bread and is normal. Yeasts in the bee bread make processed food for the bees.

Solution: No action is needed.

4. Problem: Clean, shiny-looking cells in the middle of brood nest.

Possible cause: The workers have prepared the cells for egg laying. They should look clean and shiny on the bottom.

Solution: No action needed unless there is no queen.

5. Problem: I see eggs, but more than one egg per cell.

Possible causes and solutions:

- The queen is freshly mated, or not mated — be patient. She soon learns to put only one egg per cell. However, check again in 5-10 days, and replace the queen if this is still happening.
- If the colony has been queenless for two weeks or more and you're seeing new eggs, you probably have a laying worker colony. Some of the workers' ovaries have developed, and they are laying drone eggs. Do not introduce a new queen to this colony. Laying workers usually kill introduced queens. The laying worker colony usually is weak and can be combined with another colony without too much danger to the queen. Use one of the following methods:
  - The easiest and probably best remedy is to merge the colony with another colony. Use the newspaper technique and place the laying worker colony above the one it is to be merged with.
  - Try to introduce a queen. Set up the hive in its original position. Introduce a queen in a push-in cage pushed into dark comb that contains some open honey and possibly a little capped brood. Push the cage well into the dark comb. Plastic push-in cages seem to work better because bees are less likely to chew around them. Release the queen in three days if the workers are not biting the cage. (They cling to the cage with their mandibles when biting it and are not easily brushed aside.)

6. Problem: The brood is scattered in an uneven pattern.

Possible causes and solutions:

- The queen is running out of sperm. If this is the cause, requeening is advisable. If nothing is done, the bees will raise a new queen and her daughter will supersede the current queen.
- Something is killing the brood. Cold nights in the spring can kill some brood. Rarely, pesticides and poisons may cause the brood to have an uneven pattern. Or the problem could be mites or disease.
  - Check for possible sources of pesticides or other poisons if you haven't had cold nights recently.
  - Check for disease symptoms of foulbrood, chalkbrood and parasitic mite syndrome.
  - Clue: Is one colony showing the symptoms, or are several? If it's just one, the first situation of the queen running out of sperm is more likely. If several show symptoms, something killing the brood is more likely.

7. Problem: I found the queen, but I also see a new queen cell that has a neat, round opening at the bottom.

Possible causes and solutions:

- A virgin queen recently emerged from this cell.
- If the old queen is present, doing well and you want to keep her, try to find the virgin queen and kill her. Otherwise the virgin will probably kill the old queen and a break in brood rearing will result. New queens usually take less than two weeks to mate and begin laying eggs, so no eggs are laid for a time.
- Another possibility is that the old queen is not performing well. Evaluate the brood to make sure she is still laying lots of eggs and filling frames with brood.
- If the brood is spotty, it may be best to let the new queen take over.

7. Problem: I opened my hive and suddenly found virgin queens emerging from several cells!

Possible cause: Your colony is preparing to swarm. When bees are going to swarm and have multiple queen cells, the worker bees prevent the queens from emerging too soon by sitting on the cells and thumping them. Sometimes the queens still begin to chew their way out, but the workers re-seal the opening before the queen can emerge.

Solution: It's too late to prevent the bees from swarming, if they haven't already. This is a good opportunity if you want queens to requeen other hives. You can capture some of these queens and put them in cages with attendant bees. Add some bee candy (made of powdered sugar and honey or white corn syrup) or give them a drop of honey and put them right into new queenless hives. Wait 24 hours after dequeening before introducing the new queen to a hive. Give them a droplet of water twice a day if you're keeping them in cages for a while. You can keep them in the cage with candy for about a week. These queens can also be mated in small nucs and kept for colonies that need new queens later.

Developing a Business Plan

When your bee colonies are healthy and growing, you'll have more honey than your bees and you can use each year. You will need to decide what to do with the extra that your bees produce. Honey and other bee products make great gifts for family and friends.

Another option is to market honey in one of three forms: extracted, chunk or cut comb honey. Chunk honey is a piece of comb honey packed in a jar with liquid or extracted honey. Cut comb honey is a square of comb honey cut from a shallow, super-size frame of sealed honeycomb, then packaged in clear plastic. These can help make your beekeeping hobby a profitable business.

Developing a business plan will help you sell your product. Honey is a valuable commodity, and its commercial value is increasing as more people realize the benefits of using it. To make it profitable, a good beekeeper must also be a good business person who knows how to package their product efficiently and attractively and offer it in a way that appeals to the public.

Developing a business plan can be quite complex. Some resources can help you get started. The website Strategic Business Planning (https://ag.purdue.edu/agecon/fambiz/Pages/SBP.aspx) from the Purdue Institute for Family Business, contains a wealth of information.

From the Strategic Business Planning website:

"Coming up with business plans and structuring a family business correctly are critical steps in the planning process. Doing these correctly can set the stage for a smooth and efficient business operation. Check out the business planner (interactive business planning program) along with publications to help you formulate your own business plan!"

The Business Planning link on the Strategic Business Planning website contains an online tool, Purdue INventure Business Planner (www.purdue.edu/newventure/), that can help you get started. This website helps you write a business plan using a question-and-answer format. You must register to use the software. Registration is free.

You also need a marketing plan if you intend to sell your bee products. A publication called Complete Marketing's Four P's: First Steps for New Entrepreneurs, is available for free from Purdue Extension's Education Store (www.edustore.purdue.edu). Enter the product code EC-730 in the Search box on the right. This publication explains the four P's of marketing: product, price, place and promotion, and includes a set of worksheets to help you tailor your marketing mix. Note:

- If you decide to sell honey, you must follow all state guidelines for your product.
- Labels on your jars of honey describe the contents and tell whose bees produced it. These labels should be as attractive as possible. Design your own and have them printed, or purchase labels. Bee equipment companies sell a variety of labels with space for you to write or stamp your name and address.
- Some states require food safety training before you can market or sell honey. These classes teach you any rules or regulations required in your state.

Short Guide to Using Honey Bees in Pollination

General Considerations

Why use honey bees?

Many crops depend on pollination by bees for adequate fruit set. North America has over 3,000 **species** of wild bees. Some of these species are much more efficient than honey bees for pollinating specific plants on a per-bee basis. However, almost all wild bees are solitary. A single female makes a nest, forages and cares for the brood, so solitary bees do not have colonies. Many wild bees visit only specific kinds of plants or are active for part of the season. Honey bees, on the other hand, are social — they have a colony containing one queen that lays all the eggs, and tens of thousands of worker bees to do the foraging.

The three primary pollinator bees and their benefits are:

- Orchard mason bees are active during the spring and are efficient pollinators of apples. Mason bees can be encouraged to nest in plastic straws or holes drilled in wood. Their progeny will return to the same orchard each year.
- Bumble bees are large, active foragers and are also social. They live in small colonies that are active throughout the season.
- Honey bees have large colonies and are active throughout the growing season. Worker honey bees visit any flowers that provide good amounts of nectar or pollen, the two resources bees need for energy and protein. The main advantage of using honey bees to pollinate agricultural crops is that you can manage colonies with tens of thousands of bees to serve as mobile pollination units.

What is a good pollinating hive?

A good pollination unit is a strong hive, meaning it contains lots of bees. A strong hive has many bees coming and going from the entrance on a warm day. If you take the lid off, bees should be filling at least one or two large brood chambers, with a carpet of bees covering the tops of the frames. A good pollinating unit has at least one deep brood chamber full of bees, brood and eggs (indicating that they have a queen).

A hive started from just shaking a package of bees onto a foundation is not a good pollination unit, because the population is low and will continue to decline for at least a month while the bees draw comb for the queen to lay eggs in and the first new workers hatch out.

Hives ready for almond orchards in California, the largest managed pollination event in the world

When do you move your hives?

Bee hives are usually moved after sunset to avoid losing foraging bees. Beekeepers that move only a few hives usually just screen off the entrances and load the hives individually on a truck. Straps ensure the boxes don't come apart if the hive is knocked over. Beekeepers with larger operations often move hives on pallets with four hives per pallet. If you are moving hives for a grower's use, let the grower know you'll deliver them at night and discuss where the hives should be placed. Before you arrive make sure the site has adequate access and water for your bees.

How do you time the move?

Timing depends on what flowers are competing for the bees' attention. One thing to consider is the attractiveness of your crop as a nectar source. Bees are good at locating the sweetest nectar in the area. Often this comes from weeds in the surrounding fields. Bees like to forage within 300 feet of the hive but will travel two miles or more for a good nectar source. It's best to move the bees into the crop just as flowering has started in earnest so they don't get used to foraging on the nearby weeds. If they're moved in too soon, enough of the crop may not be blooming to effectively compete with the weeds.

The pollination contract

When contracting your bees to pollinate a crop, the beekeeper and grower should discuss the following details before the bees are delivered to a field. A signed formal contract protects both the grower and the beekeeper. Two primary items should be included:

- Pesticides. Will any pesticides be used while the bees are present? If so, what pesticides? Bees are extremely sensitive to sprays on flowers. A beekeeper could lose all 300 of their colonies in one week to pesticide-poisoning during pollination. The beekeeper and grower should know which pesticides are most toxic to bees.
- Access. The beekeeper should always have access to the colonies to inspect them and make sure they still have queens and are healthy.

The contract should also include the location of the field and apiary, crop to be pollinated and acreage, and the number of hives to be delivered.

Beekeepers sometimes repay a landowner with honey in non-commercial situations.

How many hives are needed?

The number of hives that a grower needs depends on the crop. Crops with more than one seed per fruit benefit from multiple bee visits to the flowers to get large fruit. Examples of such crops are apples, cucumbers, melons and blueberries. Blueberries need perhaps the most hives per unit of area because they are not that attractive to the bees. Table 1 shows some estimates of the optimal number of hives per acre.

Table 1. Number of hives needed for different crops

Crop	Hives/acre
Apples	1.2
Blueberries	4.0
Cantaloupe	2.4
Cucumber	2.1
Squash	1.0

Pesticides and Bees

Pesticide toxicity

The acutely toxic effects of pesticides to bees are measured by experiments in which the test compound is administered to bees as a contact pesticide in a controlled way. Table 2 indicates how pesticides are rated based on their LD50s, or the lethal dose needed to kill 50 percent of the test bees (concentration in microgram/bee, or µg/bee).

Table 2. Classification of toxicity based on LD50s (µg/bee)

LD50s (µg/bee)	Toxicity
< 100	Virtually non-toxic
11–100	Slightly toxic
2.0-10.99	Moderately toxic
> 2.0	Highly toxic

Residue exposure

Some pesticides are highly toxic to bees but can still be applied to the blossoms in the evening, because they rapidly decay to less toxic compounds. The residual activity of pesticides is expressed as an RT25 value (RT = residual time; 25 = percent of initial mortality). RT is the time needed for the pesticide to degrade enough to reduce bee mortality to 25 percent of the initial mortality of the freshly applied product.

This test is done by spraying the pesticide on alfalfa leaves and keeping the leaves in a cage with bees at 75°F. Cooler temperatures can dramatically increase the time needed for residues to become nontoxic to bees, so be especially careful with pesticides when the weather is cool. For more information, read *Protecting Honey Bees from Pesticides* (product code: E-53-W at Purdue Extension's Education Store, www.edustore.purdue.edu).

Projects to Develop Your Skills

Now that you are an experienced beekeeper, you know there is much more you can learn and many more projects you can do with your bees. Some topics and project suggestions are listed below. These are intended to develop your beekeeping skills. Choose a beekeeping project that fits both your interests and the needs of your bees. Read more about your project before you begin. Then complete the Project Record (Appendix A) before you begin. Use the scientific method (Appendix B) if you decide to do a research study.

Project suggestions

- Bee behavior
- Bee hunting
- Collecting pollen for supplemental feeding
- Constructing a simplified pollen trap for use on colonies of honey bees
- Constructing an observation hive
- Designing and building a hive stand
- Developing a business plan
- Dividing colonies for increase
- Dividing hives
- Double queening
- Fall management
- Hive increase
- Hive swarms
- Home-built beekeeping equipment
- Introducing a queen to a hive
- Pollination of agricultural crops

- Processing and uses of beeswax
- Protecting honey bees from pesticides
- Queen production and rearing
- Research on honey bees and pesticides
- Section comb honey production
- Selective honey gathering
- Summer management
- The bee language
- The history of hive bodies
- The value of the honey bee as a crop pollinator
- Two-queen system of honey production
- U.S. standards for grading honey
- Uniting hives
- Use of honey bees for crop pollination

Take on as many project activities as you think you'll be able to complete, but try to do at least two projects each year. Some projects will take much more time than others. Keep a notebook with an up-to-date description of your work with your other records. Write a detailed report explaining your project from start to finish so you have it for future reference. Consider taking photographs, making drawings or otherwise adding to the explanation of your activities.

Resources

Books

Two books are recommended for the serious beekeeper: *Honey Bee Biology and Beekeeping* by D. M. Caron and *The Hive and the Honey Bee* edited by J. M. Graham. These books are expensive but contain a lot of information about bee biology and products of the hive — in fact, most of the information a beekeeper would ever need. It is therefore a good idea to purchase one of these books or check whether your local library has one. *Honey Bee Biology and Beekeeping* is our recommendation for the advanced 4-H beekeeper.

Recommended magazines, available online

- *American Bee Journal*, www.dadant.com/journal/
- Auburn University Bee Laboratory, https://agriculture.auburn.edu/research/enpp/bee-lab/
- *Bee Culture*, www.beeculture.com/
- DriftWatch website https://driftwatch.org/ (requires a logon)
- The Complex Life of the Honeybee, product code PPP-116, The Education Store, www.edustore.purdue.edu
- The University of Florida Bee Lab, https://entnemdept.ufl.edu/honey-bee/

Glossary

Afterswarms: Swarms that leave a colony with a virgin queen after a swarm of the same season has already left the hive.

American foulbrood: An extremely contagious disease of bees caused by the bacteria *Bacillus larvae* that affects them in the larval (worm) stage of development.

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

Apiculture: Beekeeping.

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

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

Bee space: An open space (1/4 to 3/8 inch) that permits free passage of a bee but is too small to encourage comb building.

Beeswax: The wax honey bees secrete from eight glands on the underside of their abdomen and use to build their combs.

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

Bottom board: The floor of a beehive.

Brace comb: Small pieces of comb built between combs and the hive.

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

Burr comb: Small pieces of wax built on a comb or on a wooden part of a hive but not connected to another comb or part.

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

Cell: A single compartment in a honeycomb in which bees rear brood or store food.

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

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

Cluster: A large group of bees hanging together, one on another.

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

Cut comb honey: Squares of honey in the sealed comb it was produced in, cut from a shallow, supersize frame of sealed honeycomb and then packaged in clear plastic.

Deformed wing virus (DWV): An extremely common virus often associated with Varroa mites that can also transmit it. Bees may show no symptoms or may have deformed wings, part of the symptoms of parasitic mite syndrome.

Drifting: The return of field bees to colonies other than their own.

Drone: A male honey bee from unfertilized eggs of queens or workers.

Dysentery: A disease of honey bees causing an accumulation of excess waste products that are released in and near the hive.

European foulbrood: An infectious disease affecting honey bees in the larval (worm) stage of development; caused by the bacteria *Streptococcus pluton*.

Extracted honey: Liquid honey.

Extractor: A machine that uses centrifugal force for removing honey from the comb without destroying the combs.

Field bees: Worker bees, usually at least 16 days old, that leave the hive to collect nectar, pollen, water and propolis.

Foundation: Used to form base on which bees can construct complete comb, made of either wax or plastic and imprinted with hexagons.

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

Granulated honey: Honey that has crystallized, changing from a liquid to a solid.

Hive: Worker bees available for purchase. As a verb, to put a swarm in a hive.

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

Hive cover: The roof or lid of a hive. Usually these are telescoping covers, meaning they have an overhang around the edges.

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

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

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

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

Inner cover: A thin wooden board placed just beneath the hive cover for added protection and insulation from the elements.

Job shadowing: Learning from others by following, watching and studying what they do in their jobs.

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

Metamorphosis: The series of stages through which an insect passes: egg to larva to pupa to adult.

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

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

Nosema: An infectious disease of the adult honey bee that infects the mid-gut or stomach, caused by a protozoan parasite. Symptoms closely resemble those of dysentery.

Observation hive: A hive made mostly of glass or clear plastic to permit observation of the bees at work.

Pesticide: A general name for materials used to kill undesirable insects, plants, rodents or other pests.

Pollen: Dust-like grains formed in the flowers of plants in which the male elements are produced. Honey bees use pollen as a protein food for their young.

Proboscis: The tongue of a honey bee.

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

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

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

Robber bee: A field bee from one colony that takes, or tries to take, honey from another colony.

Sacbrood: A slightly contagious disease of brood caused by sacbrood virus, often associated with Varroa mites.

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

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

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

Solar wax extractor: A glass-covered box for melting beeswax by the heat of the sun.

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

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

Supersedure: Rearing a new queen to replace the mother queen in the same hive.

Supersedure queen: Replacement of a reigning queen by her workers.

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

Tracheal mites: Microscopic *Acarapis woodi* that infest the breathing tubes inside a bee's thorax. Most bees are resistant to this parasite.

Travel stain: The darkened appearance on the surface of comb honey when left in the hive for some time; caused by bees tracking propolis over the surface as they walk over the comb.

Uniting: Combining two or more colonies to form one large colony.

Varroa destructor: Commonly called the Varroa mite, considered the most serious cause of colony winter losses.

Virgin queen: An unmated queen.

Wax moth: A moth whose larvae feed on and destroy honeycomb. Also called lesser wax moth.

Appendices/Attachments

Appendix A. Project Template

Project title:

Goal (what you want to find out):

Hypothesis:

How I plan to set up my experiment:

When I will collect data (start and end date):

Data I will keep (for example, date, time, temperature, humidity, cloud cover, number of bees, observed bee response):

How I will interpret my data (for example, you might use averages, charts and graphs, written observations):

Conclusions:

Appendix B. The Scientific Method

The scientific method is an organized way to address a problem you are having with your bees.

It will help you organize your thoughts, conduct an experiment and analyze data.

Stating the problem: Think about what you want to learn.

1. Form the hypothesis – After you choose a problem to study, describe what you think is happening.
2. Observe and experiment – Observe or set up an experiment to test your hypothesis. Tally your data. You can make your own charts by hand or on the computer.
3. Interpret data – Once you have collected your data, you need to understand what it tells you. You can interpret the data by comparing numbers visually or in graphic form.
4. Draw conclusions.

Consider how your observations and/or experiments affect your hypothesis. Do your observations and experiments support or reject the hypothesis? How do the results give you ideas for future studies and a new hypothesis? Should you run your experiment again? Should you change one of your variables?

On your worksheet:

1. State the problem.

2. Write a hypothesis.

3. Observe and experiment (create a data sheet).

4. Tally, study and interpret your data.

5. Draw conclusions.

   a) Was your hypothesis supported, or not? (Circle one) Yes No

   b) What else did you learn?

Appendix C. Record Templates

The following tables are suggested templates for your records. Adapt them to suit your needs and preferences. You can develop them in a Word (or other) software program or use Excel (or other) program so you can easily tally each column (number, cost, value, etc.).

Beekeeping Equipment Inventory

Date Obtained	Item	Number	Cost
		Total	

Receipt List

Date Obtained	Item	Value (used at home)	Value (sold)
		Total	

Financial Summary

Assets

	Value of bees, equipment on January 1
	Value of supplies, equipment purchased during the past year
	Miscellaneous expenses during year – describe
	Total

Inventory

	Value of bees and equipment on January 1
	Value of bee products (number of bottles of honey and amount of extracted, chunk or cut comb honey) on December 31
	Total

Labor Record

Record all the time you spent working.

Date	Location	Kind of work	Time (hrs)
		Total	

Apiary Record

Maintain a record book for your hives with a chart for each individual colony. Make a table like the one below, or adapt this template to suit your needs and preferences. Print a number of record sheets so you can keep one for each colony in your notebook.

Colony Number:						
Date	**Queen**	**Brood amount**	**Amount of pollen**	**Amount honey**	**Bee population**	**Honey removed**
	Equipment					
	Notes					

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