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Beginning Beekeeping Handbook

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Beginning Beekeeping Handbook

Paul Timm and Marion Ellis

**University of Nebraska
Department of Entomology**

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WHY HONEY BEES? It is a question that many people ask me. I ponder this question from time to time, reflecting back upon my own decision to enroll in a beekeeping course during my last undergraduate semester of college. I had no previous experience with honey bees nor did I know anyone that kept bees. Other than divine providence and a desire to learn about an area of agriculture with which I was unfamiliar, there were no other motivators guiding my decision. However, I am ever so grateful for the decision because it opened a whole new avenue through which I have been able to foster student learning and enrich the life of my family.

So we return to the question at hand, "WHY HONEY BEES?". As an agriculture teacher, student, or parent; there has to be some justification to beginning an enterprise that involves working with thousands of flying insects that can sting. Hopefully, as you read and contemplate the following list of reasons, you will realize both the benefits and possibilities beekeeping holds for you.

- 1) **Development of entrepreneurial and scientific skills.** Beekeeping teaches a variety of skills related to business management, animal husbandry, marketing, interpersonal skills, use of the scientific method, and more. Such skills are invaluable to young people.
- 2) **Versatile for both urban and rural students.** Success in producing honey is largely related to being located near a variety of good nectar and pollen sources that bloom at different times throughout the year. Urban areas often provide just as much, if not more, variety and quantity of flora as do rural areas. Thus, a student with a small backyard or even a strong sturdy rooftop of an apartment building can successfully manage a few hives. There are extra precautions that should be considered before keeping bees in a more populous area such as maintaining good neighborly relations and checking to see that there are no local laws that prohibit beekeeping within city limits.
- 3) **Low initial investment.** Costs can vary; however, a student can start a beekeeping enterprise for comb honey production with approximately \$100 for safety equipment and \$250 per hive stocked with a package of

honey bees. This does not include inputs such as preventative medications and packaging for the comb honey. When compared to other entrepreneurial production areas, beekeeping is relatively affordable for the beginning agriculturalist.

- 4) **Sense of mystery and adventure.** Beekeeping is an interactive subject that grabs one's interests. It can be compared to a good murder mystery. Most individuals know just enough information about the subject to draw their interest, while at the same time it keeps them guessing and learning as they get more engrossed in the story. There is always a small sense of adventure and danger as one works with the potentially defensive insect. As one learns how to behave around honey bees and work with them, just as a person would with other livestock, he gains respect and appreciation for the animal that is providing him with the sweet rewards of a bountiful honey harvest.
- 5) **Naturally lends itself to FFA & 4-H opportunities.** Not only does beekeeping hold the interests of the beekeeper, but it also produces a natural curiosity that catches other people's attention. This makes honey bees and beekeeping a terrific subject for speeches and agriculture demonstrations. It can fit into several proficiency areas including specialty animal production, food science and technology, agricultural sales, agricultural processing, and agricultural service. Enterprises in fruit, vegetable, forage crop, and specialty crop production can also be supported by beekeeping.
- 6) **Gaining knowledge about a crucial sector of the agriculture industry.** Honey bees play a crucial role in the pollination of many U.S. crops. One third of all the food that Americans eat is a direct or indirect product of honey bee pollination. From many fruits and vegetables to the forage crops that feed livestock, the American diet and pocketbook would be severely affected if it weren't for the commercial beekeepers trucking their bees around the country providing pollination services and the scientists that do research on honey bee production practices.

- 7) **Beekeeping will make you unique (great for extroverts).** If you have difficulty striking up a conversation when around a new group of people, just mention you are a beekeeper, and you will have the attention of a group of people for some time. People are naturally fascinated by honey bees and will have many questions to ask you.
- 8) **Profitability.** Beekeeping can be a profitable venture. Just like other livestock enterprises there is always a small amount of risk involved such as disease or unexpected problems. If the student pays proper attention to detail and placed his hives where there are good nectar sources, it would not be uncommon to produce 80 squares of comb honey per hive. Sold at a farmers market for \$5, that would equal a gross return of \$400 per hive. Selling value-added products such as lip balms and crystallized honey could further increase profitability.
- 9) **Enjoyable and Satisfying.** Lastly, beekeeping can be both a business and/or hobby that can be continued throughout life. There are few things more satisfying than producing golden honey and beeswax by working with a creature as fascinating as the honey bee. Beekeeping will increase your awareness of the natural world, it will teach you to be gentle and it will teach you skills that can be applied to many other agricultural enterprises.

Where Do I Begin?

Establishing a honey bee hive for the first time is very exciting! Amidst the excitement there is much to learn and plan in order to ensure success. Three things that help increase the chances of success for a beginning beekeeper include: **1) developing a relationship with an experienced beekeeping mentor; 2) participating in a beekeeping short course; and 3) reading books on beekeeping.**

Many people can identify certain people in their lives that played a role in helping them to refine their skills and encourage them in their current occupation or personal ventures. The importance of finding a beekeeping mentor who can provide answers to questions and insight from his or her experiences cannot be stressed enough. Locating another beekeeper may be as simple as asking people around your community. Grocery store owners, greenhouse operators, and gardeners are a good place to start. The local fire department and extension offices may also have the number of a local beekeeper to call in case a swarm of honey bees shows up in town. The Agriculture Stabilization and Conservation Service may also maintain a list of beekeepers. Another group that was established to promote beekeeping and to help beekeepers share their knowledge and skills with others is the Nebraska Beekeepers Association. They have monthly meetings and are always happy to do what they can to help young people develop their beekeeping skills. It is highly beneficial to become a member and, if possible, to attend their meetings. They will usually be able to help you find a beekeeper near you, or at a minimum, find someone that can answer your questions via phone and computer correspondence. The website for the Nebraska Beekeepers Association is <http://nebraskabeekeepers.org>. Keith Nielson, association newsletter editor, can also be contacted by e-mail at knielson@esu7.org to request a sample newsletter including a membership application.

Participating in beekeeping short courses and other extension programs are an excellent way to learn practical beekeeping knowledge and develop necessary skills. University of Nebraska Extension offers three opportunities in which any young apiarist or beekeeping mentor should participate. The first are *Beginning Beekeeping Workshops*. These workshops are held on two Saturdays, usually one in February or March and one in April. The first Saturday covers a variety of beginner topics including why keep honey bees, beekeeping equipment, honey plant identification, types of products made from honey, and other important information. The second Saturday provides an opportunity to meet other beekeepers, and hands-on experience examining honey bee colonies under the supervision of an experienced beekeeper. In addition to the *Beginning Beekeeping Workshops*, the University of Nebraska also offers a *Value-Added Honey Bee Products Workshop* and a *Master Beekeeping Workshop* for more experienced beekeepers. These are longer, more intensive workshops designed to refine the skills of established beekeepers. They are held during the month of June. The Master Beekeeping Workshop is offered annually. The Value-Added Products Workshop is offered once every 5 years. Information about all three programs can be obtained from Dr. Marion Ellis at the University of Nebraska-Lincoln Department of Entomology. The phone number of the entomology department is (402) 472-2123, and their website is <http://entomology.unl.edu>.

The University of Nebraska Food Processing Center also offers workshops for entrepreneurs who are considering starting a new business. The workshop guides participants in developing a

business plan, label design and many other aspects of starting a new business. Most participants have existing small businesses that they wish to expand. For more information about The University of Nebraska Food Processing Center, their website is <http://fpc.unl.edu/>, and their phone number is (402) 472-2832.

Although much information and experience can and should be gained from hands-on experience, there is no substitute for personal study. Bees and beekeeping are one of the most researched and written about subjects, and it is difficult to know where to begin reading. The following resources are excellent for new beekeepers, and each can be purchased for under \$15.00.

- First Lessons in Beekeeping by Keith Delaplane (published by Dadant and Sons)
- The New Starting Right with Bees by Kim Flottum (published by Root Publishing)
- Honey in the Comb by Gene Killion (published by Dadant & Sons)
- A Book of Honey by Eva Crane (published by Oxford Press)
- A Guide to Managing Bees for Crop Pollination (published by the Canadian Association of Professional Apiculturalists)
- Honey Bee Diseases and Pests, 2nd Edition (published by the Canadian Association of Professional Apiculturists)

Remember that beekeeping is just as much an art as a science, and each author may suggest variations in colony management techniques. It is through developing an understanding of the behavior and biology of honey bees, reading about others' beekeeping methods, listening to the advice of experts and mentors, and experimenting that you will develop your own management style for keeping bees.

Funding Your Honey Bee Enterprise:

You have probably heard of the saying, "*It takes money to make money.*" Beginning any entrepreneurial enterprise requires an initial investment to purchase equipment and materials. Costs will vary depending upon the size of enterprise and the type of products you plan to produce. It is recommended to think big, but start with a reasonable and affordable number of hives. Much of the first year will be spent learning about your bees and how to manage and manipulate your hives. Unit 2 of this publication will help you create a business plan. Part of the business plan will have you answer some questions that will help you create some short and long term goals for the enterprise as well as a budget for your first year.

Once you have completed the business plan, it will then be time to secure a source of funds for your honey bee venture. If you do not think that you will have enough money to purchase the items you need for your first year, possible sources that may be able to help you include:

- The National FFA Organization: Every year in the fall the National FFA Organization awards \$500 Supervised Agricultural Experience grants to students from across the country. An application for these grants can be downloaded at www.ffa.org. To apply you must be between the ages of 14-17, be a member of FFA, show financial need, and have the application signed by your advisor.

- The Nebraska Beekeepers Youth Scholarship: The Nebraska Beekeepers Association has established a scholarship fund for helping students establish themselves with beekeeping enterprises. To seek out more information, contact Keith Nielson association newsletter editor, at knielson@esu7.org.
- The Farm Service Agency (FSA): The Farm Service Agency makes loans to rural youths between the ages of 10-20 to help establish and support income-producing projects of modest size in connection with FFA, 4-H, and other similar organizations. The maximum size loan to be made to an individual is \$5,000. To qualify the person must be a U.S. citizen, live in a town less than 10,000 people, be unable to obtain a loan from another source, and conduct a modest income-producing project in conjunction with some organization where an adult provides supervision and counsel. More information can be found at www.fsa.usda.gov or through your local FSA office.
- Local Bank: Your hometown or local bank is often excited to see young budding entrepreneurs looking to add to the commerce of the community and is usually willing to work with you and your parents/guardians in providing a small business loan.
- Labor Exchange and/or Savings: Do not overlook good old-fashioned hard work. In the case of starting a small number of hives, it may not take long to earn enough money or to pay for the equipment and bees needed to begin your enterprise.

It is important to note that there are specific timelines in which certain items must be purchased in order to be prepared and ready for spring. The fall is the best time to try and secure funds for the following year. Many package bee suppliers require that you put an order in by the end of January in order to receive them in April. Late orders often result in late shipping dates, which will reduce colony productivity

Clothing, Tools, & Materials:

This section highlights the basic tools and equipment you will need to keep honey bees and produce comb honey. Additional items have been listed in the Developing and Adding Value to a Product Unit of this publication.

The Hive

A hive is nothing more than an empty, dry chamber in which honey bees can find protection from the elements, store food, and raise young. The standard hive used by most beekeepers in North America is made up of a series of stackable boxes. The tall boxes are called brood chambers while the medium-sized and shorter boxes are called supers. Each deep or super holds ten wooden frames. A sheet of foundation wax is placed in each frame upon which the bees build their own comb. The set up of deeps and supers makes it easy for the beekeeper to manipulate the frames, add or remove supers, and perform many more important activities. A dual lid system consisting of an inner cover and outer cover is placed over the stack of brood

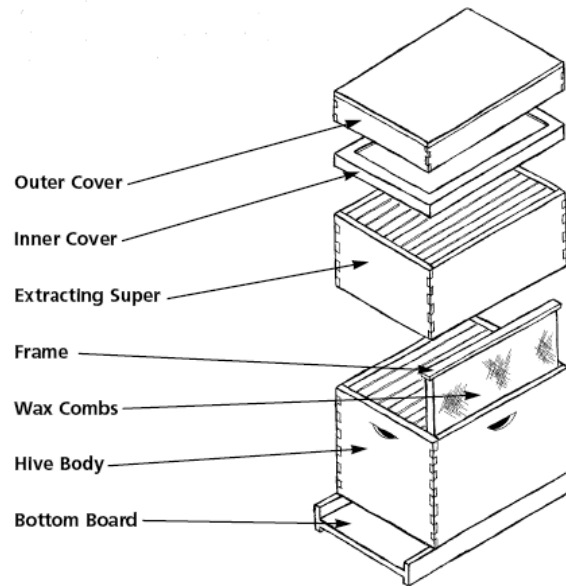
chambers and supers. The best outer cover for cold climates is the telescoping cover. There is one entrance at the bottom of the hive between the brood chamber and the bottom board. The bottom board is placed on a hive stand. The hive stand keeps the hive from having direct contact with the ground and can be made from four 2 x 4's placed in a square and nailed together so the 2" side is in contact with the ground.

The Beekeeper

The clothing beekeepers use varies greatly based upon personal preference for protection against stings and the comfortability of the climate. Some beekeepers wear nothing more than a T-shirt, jeans, and closed-toe shoes. This is not recommended for the beginning beekeeper. As you become more experienced and knowledgeable about honey bees you can then decide what is right for you. Beginning with the head, a bee helmet and bee veil is used. When secured correctly these will keep the beekeeper's head cool and protected from honey bees and direct sunlight. Some veils zip directly into a jacket or beekeeping coveralls. These types of veils and coveralls can be expensive and bulky in warm climates. Others veils, such as a folding veil, tie using string and fit well over a collared shirt. In addition to covering your head, you may want a set of beekeeping gloves to cover your hands. Most gloves are elbow length with elastic at the open ends to fit snugly over the forearm. Cloth or leather gloves are available. Gloves can provide excellent protection to the hands, but make handling of the frames a little more difficult. Duct tape will be quite useful for sealing up any holes in your clothing and closing off open pant legs. Honey bees like to crawl as well as fly, and nothing can be more unnerving than feeling a honey bee crawling up your pant leg as you are checking a hive.

When deciding what clothing to use, there are a few items that should be avoided. Do not wear black or dark colored clothing. Dark clothing can cause stimulated bees to react defensively. Wool or other fuzzy materials should also be avoided. Honey bees can easily become entangled in the fibers and as a result try to sting through the material. Unnatural odors such as perfume, cologne, and hairspray can trigger defensiveness. The smell of alcohol is especially prone to trigger honey bees to sting, so alcohol-based colognes and hand cleaners should be avoided.

There are a few tools the beekeeper will need for checking hives. The first and most important is the smoker. Smoke has a calming affect on honey bees. It causes them to fill up with honey and



Basic Hive



An enthusiastic first year beekeeper holding a frame.

become disinclined to fly, and it interferes with how they communicate alarm by a pheromone or chemical message. A variety of smoker fuels can be used. Some good fuels include untreated burlap, pine needles, and dried grasses. Anything that burns cool and when rolled and compressed will burn for a long time is a good fuel. No chemicals or fire starters such as gasoline or lighter fluid should be used to start the smoldering. In addition to the smoker, a hive tool is needed for prying open hive boxes and frames within the boxes. Bees use a sticky substance called propolis to seal cracks and small spaces in the hive, making the hive tool an essential piece of equipment. A bee brush is also good for brushing bees off of a frame without damaging the bees or the comb.

Other Materials

This section focuses on the remaining materials and tools a beekeeper will need. An entrance reducer is a piece of wood that fits into the entrance of the hive and can be used to reduce the opening to help the honey bees protect the entrance during times of lower activity or population. When harvesting honey from a hive a bee escape is a handy tool that can be placed between the hive body and the supers being harvested. It creates a one-way exit that allows the bees in the supers to move down into the hive body, but prevents them from moving back up. Thus, the beekeeper can return the day after placing the escape on the hive and harvest the supers with the majority of the honey bees already removed. For construction of the hive bodies and frames, the beekeeper will need wood glue, a hammer, nails (3 sizes – one for hive bodies, one for frame construction, and one for wiring frames), and paint. For longevity of equipment life, it is advisable to paint the outsides of the brood chambers and supers with an oil-base paint for the first coat and an outer coat of latex paint. Lastly, you will need containers for packaging your honey. Containers come in a large variety of shapes and sizes. The beekeeper will need to decide what is most desirable to the customers. When starting out, it is always best to keep things simple and attractive.

Abbreviated List of Materials for Comb Honey Production

The following is an abbreviated list of clothing, tools, and materials needed for comb honey production.

- Veil
- Helmet
- Gloves
- Coveralls/outer clothing – light colors, cotton, no holes
- Smoker
- Hive tool
- Bee brush
- Duct tape
- Entrance reducer
- Bee escape
- Spur embedder
- Frame wire
- Nails – hive body nails, frame nails, wiring nails
- Paint - primer oil base paint, latex outer coat
- Wood glue
- Hammer
- Inner cover
- Supers – 5 11/16” tall
- Brood chambers – 9 5/8” tall
- Queen excluder
- Frames – 5 3/8” frames for supers and 9 1/8” frames for brood chambers

- Beeswax foundation comb – must match frame sizes
- Bottom board
- Hive stand

Products Produced from Honey Bees:

There are four products honey bees produce that humans harvest and process for their own use. The first, and probably the most familiar, is honey. Honey begins as nectar, a watery, sugar solution produced by plants to attract pollinators. The honey bee sucks up the sweet nectar with her proboscis and stores it in an internal honey sac, which is much like the crop in a chicken, for transport back to the hive. An enzyme called invertase is added to the nectar to begin a chemical reaction that converts the sucrose in nectar into glucose and fructose. Once back at the hive, the forager bee unloads the nectar to a receiver bee that deposits the nectar in a comb cell. Other bees fan the combs with their wings to evaporate the excess moisture. When the moisture content drops to below 18.5% the nectar becomes honey and the bees seal the cells with a wax capping. Drying and sealing protects the newly formed honey from fermenting.

Honey can be sold in a variety of ways. The form that requires the least amount of processing time and equipment is cut comb honey. Cut comb honey is best produced in 5 11/16" supers. A thin comb honey foundation wax should be used in the 5 3/8" frames for comb honey. The beekeeper should harvest comb honey as soon as the bees have capped off the comb cells to have the whitest, best looking product possible. The greater the amount of time comb is in a hive, the darker it will become as a result of bees walking across it. This is called travel stain. It does not affect the flavor, but it reduces the eye appeal. Each frame should produce four 4 1/8" x 4 1/8" pieces of comb honey, which will fit in standard comb honey boxes. There are a variety of supers and frames for comb honey production that produce different shapes and sizes; however, as a beginner, it is best to start with the standard cut comb honey super. Comb honey should be stored in a freezer after packaging. This will keep it from crystallizing as well as ensure that wax moth larvae do not infest your harvested crop. It is important that it is placed in a freezer and not the refrigerator! The refrigerator will have the opposite affect causing the honey to crystallize at a faster rate.

Liquid honey, also known as extracted honey, is probably the most widely used form of honey. It has been extracted from the comb by a process that removes the wax capping from the comb, centrifuges the honey, and strains/filters out wax pieces and other debris. Additional equipment is required for liquid honey production. The basic equipment for a small operation includes an extractor (hand crank or motorized), cappings scratcher or uncapping knife, uncapping tub, a settling tank, food grade honey buckets with lids, and a double sieve strainer. A solar wax melter can also be built for melting down wax cappings. Some precautions will also need to be taken when processing liquid honey. Cold honey is difficult to extract without breaking combs, and honey is hydrophilic, which means it readily absorbs water. The processing/storage room should have a heater and dehumidifier to warm the honey and to keep humidity low.

Creamed or crystallized honey is a delightful value-added honey product. Crystallization is a natural process that all honey will go through if stored for a period of time. Under normal conditions, most honeys will form large star-shaped crystals. The large crystals give the honey a

gritty mouth feel that most consumers do not like. By initiating and controlling the crystallization process, a beekeeper can bring about the formation of smaller crystals that form a velvety smooth texture with a delightfully sweet taste. Dehydrated fruit powders and spices can be added to produce a variety of flavors. Crystallized honey is usually sold for a much higher price than liquid honey. The process for producing finely crystallized honey spreads is called the Dyce Process.

Numerous honey-based products can be prepared and offered to add-value to your honey such as honey vinegars, mustards, barbeque sauces, and other condiments. If you sell a variety of honey products you will attract more interest than selling only one item. The National Honey Board's Web site (Honey.com) is a good place to start looking for recipes. There are also several good recipe books available from bee supply dealers. Better yet, experiment and create your own unique products.

Beeswax is another product that you will harvest from your bees (typically 2 lbs. beeswax for every 100 lbs. of honey). It is produced by wax glands on the abdomen of the worker honey bee. Being indigestible, there is no nutritive value; however, it can be used in a variety of beauty products, preservatives, soaps, decorative figurines, and candles. As beeswax production is much lower than honey production, beekeepers with only a few colonies may need to buy wax to supplement their own production. Beeswax can be purchased from most honey bee supply stores and from other honey producers. Additional ingredients will likely need to be purchased as well. Heating and handling wax must always be done with the greatest of care. A double boiler setup should always be used, since beeswax is flammable and will combust if heated too high.

Three easily made beeswax products to start with are lip balms, lotion bars and furniture polish. They will require the purchase of additional ingredients such as cocoa butter, almond carrier oil, and shea butter. The lip balm and furniture polish mixtures can be poured directly into the containers that will be sold. The lotion bar will require a separate mold.

Soaps are produced through a chemical reaction called saponification where a fat (beeswax) and a base (such as lye) are mixed to form soap and glycerin. At the appropriate time in the process, the mixture is poured into molds to set. Many attractive and wonderfully smelling soaps can be made and marketed through the use of different techniques and the addition of extra ingredients. Soap making can be dangerous, and the supervision and advice of an experienced soap maker is recommended for beginners.

Beeswax candles have long been considered a highly valued source of light. Unlike tallow candles made from animal fats, beeswax candles burn clean without the formation of ash. As a result, some historic Roman Catholic Churches require their use to protect their valuable artwork. In addition to burning clean, beeswax candles also give off a pleasant fragrance when used. Materials needed in addition to beeswax and pots for melting wax include candle molds, wicking of appropriate size for the diameter of candles being poured, and candle silicon spray to keep the wax from sticking in the molds. Hand dipped tapers can also be made by dipping wicks in a tank of liquid wax.

Another honey bee product that has gained much attention from the health food industry is pollen. Pollen grains are the male gametes produced by flowers. Pollen is a major source of protein, carbohydrates, vitamins, and minerals for honey bees. Its exact make up of these items varies based upon the type of plant and ecosystem in which the plant is grown. Honey bees gather pollen on their body hairs as they move amongst flowers and transfer it to their hind legs during flight where it is stored for transport back to the hive. Beekeepers collect it by placing pollen traps at the entrance of a hive. The honey bees crawl through the pollen trap to enter the hive, and as they do, some pollen pellets are scraped from their legs. The pollen pellets collect in a tray below the crawl space. Pollen is most often sold to humans as a nutritional vitamin/mineral supplement. Its shelf life depends upon its moisture content and storage. Because it is such an important nutrient for honey bees, pollen trapping should be limited to brief periods and may reduce the production of other hive products

The least know honey bee products is propolis. Propolis is a mixture of beeswax and plant resins collected by honey bees. They use propolis to fill in cracks between hive boxes or holes in boxes that might let in intruders or let out valuable heat during the wintertime. They also cover the inside surfaces of the hive with propolis and use it to secure frames of comb in place. A benefit to the bees is that propolis has antimicrobial properties, which helps prevent microbial growth within the hive. The presence of propolis is why a hive tool is necessary to open and examine a hive. Propolis is used in antiseptic ointments and tinctures; however, the demand for it in the United States is relatively low. Collection of propolis for sale requires special inserts that have small openings, which the bees fill with propolis.

Remember to think big, but to start with a reasonable number of hives and products. Make a plan to start producing one or a few items and branch out slowly from there. Do much research and experimentation with recipes and products before deciding to produce them for sale.

ⁱ *The Honey Files: A Bee's Life*. 2001. National Honey Board

Honey Bee Biology & Behavior

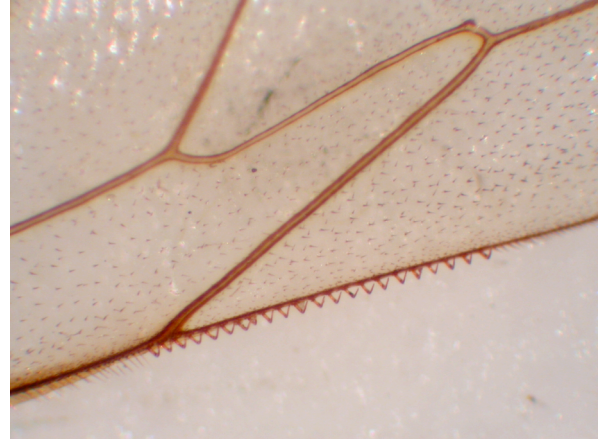
New beekeepers should have a basic understanding of honey bee biology and behavior before receiving their first package of bees. This unit is designed to introduce bee biology and behavior, but new beekeepers should also seek out other sources of information listed in this publication for more detailed instruction.

External Anatomy

There are three kinds, of honey bees within a colony: the queen, workers, and drones. Queens and workers are female and drones are male. It is most common to find only one queen per colony. In comparison, thousands of workers and a few hundred drones exist in a hive. The number of workers and drones will fluctuate during different seasons. Physical similarities and differences in the three castes are apparent to the unaided eye, and new beekeepers should learn to easily identify the 3 types of colony members.

All honey bees have three body regions; head, thorax, and abdomen. The body is supported by an exoskeleton composed of a series of hardened plates connected by flexible membranes. From follicles in the exoskeleton grow thousands of branched body hairs that are coarse in texture. These hairs aid in the gathering and transportation of pollen. Workers are covered with plumose body hair and have pointed abdomens that are covered by their wings. The queen can be identified by the lack of hair on the top of her thorax. The queen also has a long, pointed abdomen. Drones are fat bodied bees that have rounded abdomens and compound eyes that touch at the top of their heads. Workers are narrower in width and have compound eyes that do not touch.

The head has two elbowed-antennae that are used to detect odors associated with flowers, the nest, and odors used for communication (pheromones). Honey bee antennae are much more sensitive than a human nose, with detection thresholds 100 times more sensitive than humans¹. Humans rely more on sight and hearing to orient to their environment, but for bees, smell is the most important sensory system. Honey bees also have two compound eyes and 3 simple eyes or ocelli that are used to detect movement, light, and shape. Honey bees are essentially deaf to airborne sound, but they are very sensitive to vibrations. A bee's mouthparts are external. All three castes have a pair of mandibles for chewing/manipulating objects and a proboscis,

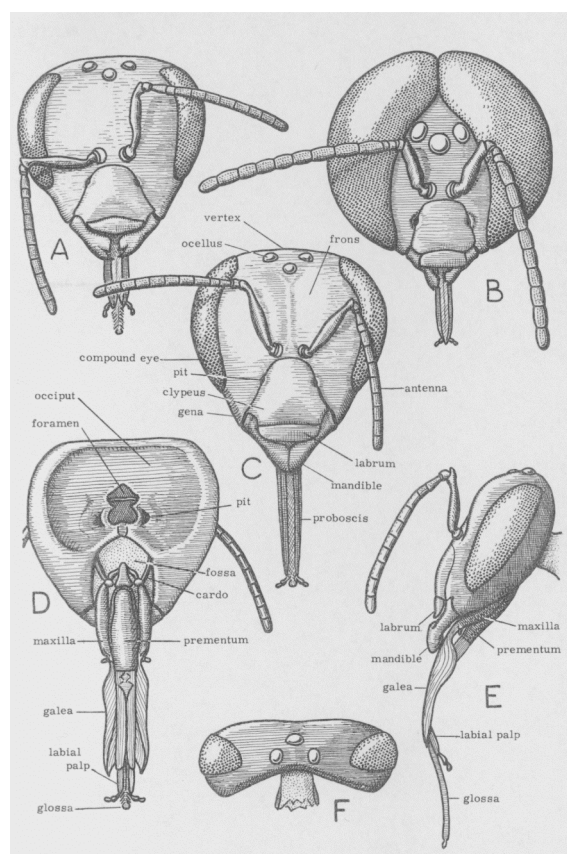
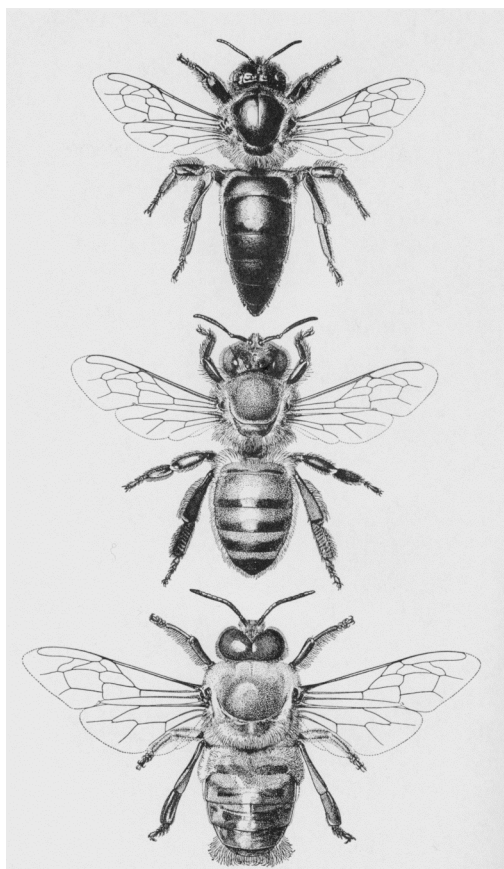


Hamuli on rearwing.



Antennae cleaner on foreleg.

which serves as a feeding tube for ingesting liquids. The mandibles are always visible while the proboscis, when not in use, is folded behind the headⁱⁱⁱ.



Comparisons of worker, queen, and drone honey bees

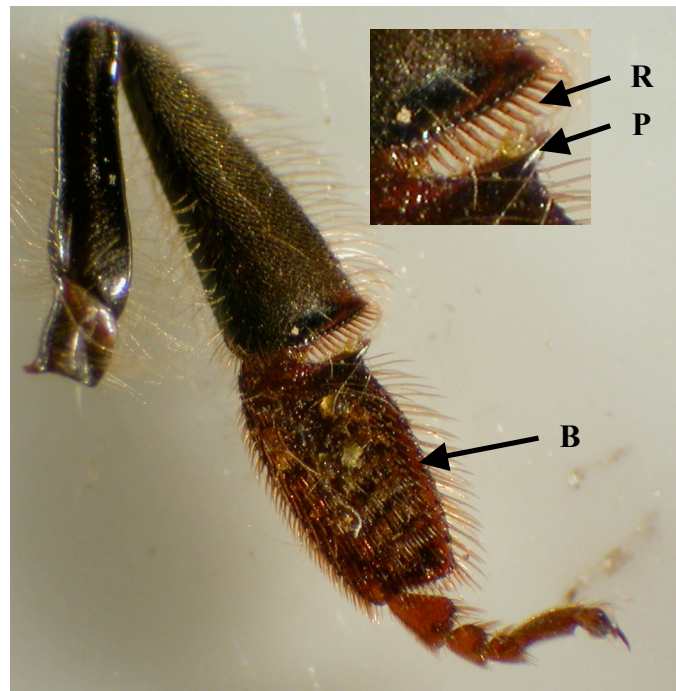
The thorax, which is the middle section of the honey bee's body, holds six legs, four wings, and the most densely packed hair of the three body regions. The wings of the honey bee are paired with each side having a larger forewing and smaller hindwing. During flight the rearwing is attached to the forewing by hamuli, which are specialized hooks on the fore edge of the rearwing. When not in flight, the hindwings can be detached from the forewings. The legs of the honey bee are used for walking, grooming, and gathering pollen. Honey bees contain specialized structures and hairs for grooming pollen from the body. Most notable are the antenna cleaners of the forelegs of all castes and the pollen carrying mechanism on the hindlegs of the workers. The antenna cleaner is located just below the joint between the tibia and the tarsus and can be clamped around the antennae to scrape off pollen and debris. The pollen carrying mechanism of the worker bee rearlegs begins by the bee passing pollen collected by the forelegs to the middle legs. The middle legs pass the pollen from both the forelegs and middle legs to the pollen brushes on the inner tarsi of the rearlegs. During flight, the rearlegs rub the pollen brushes against the pollen rakes of the opposing legs. The clamping of the pollen press

between the tibia and tarsi then squeezes the sticky pollen gathered by the rakes onto the surface of the pollen basket where it remains until the worker returns to the hive.

The abdomen of the honey bee is the longest and largest of the three body regions, located posterior to the thorax. It can be distinguished from the other regions by the strips of dense body hair separated by strips where little body hair exists; thus revealing the abdominal plates that are a part of the honey bee's exoskeleton. Most people know this region for the painful venom that can be delivered from the sting of a worker. Stings are only present in female honey bees and are held internally until an external threat to the hive stimulates the worker to behave defensively. The sting is connected to an internal venom sack, which begins contracting when the sting is inserted into another animal, delivering the venom much like a hypodermic needle. The queen will only use her sting to kill other queens, but displays no defensive behaviors towards other organisms.



Outer surface of rearleg with pollen basket (Ba).



Inner surface of rearleg with pollen brush (B), pollen press (P), and pollen rake (R).

Internal Anatomyⁱⁱⁱ

The head of a honey bee contains two glands that secrete brood food, enzymes for ripening honey, and pheromones. To aid in sucking up liquids through the proboscis, the bee contains a large muscle-lined mouth cavity. By contracting the muscles in the sack a negative pressure is produced causing fluids to flow through the proboscis and into the esophagus. The head also contains a brain that connects to a ventral nerve cord. The cord runs the length of the insect's body. The brain is primarily responsible for receiving responses from the eyes and antennae and relaying these responses to various nerve ganglia on the nerve cord so other parts of the body can respond. Each nerve ganglia on the nerve cord

enables the function of a specific region in the body. Though they work together with the brain to help the organism respond to stimuli in the environment, the ganglia are able to work independently in directing movement and organ function. Thus, the decapitation of a honey bee would not result in its instant death as it would in many other animals.

In addition to the ventral nerve cord, the thorax holds a dorsal blood vessel for blood flow and the esophagus, which delivers ingested fluids to the honey stomach in the abdomen. The thorax is primarily composed of muscles used for flight and walking. The wing muscles of a honey bee are very unique in that they enable the wings to beat up to 230 times per second. This ability is facilitated by the protein resilin, an elastic fiber that allows many wing beats to occur following a single nerve impulse.

The abdomen contains many structures and systems that perform an array of functions. Wax producing glands are present on the underside of the abdomen. Beeswax is secreted as a liquid onto mirror-like plates where it hardens. A scent gland for the production and emission of pheromones is present on the dorsal (topside) surface of the abdomen one exoskeleton plate away from the sting. For respiratory purposes, the body contains a complex arrangement of trachea that connect to evenly spaced openings on the sides of the body called spiracles. The tracheae facilitate gas exchange directly with the internal tissues. This differs greatly from humans who use a circulatory system to deliver oxygen to tissues.

The circulatory system of a honey bee consists of the dorsal blood vessel and heart that pump blood, or hemolymph, forward through the thorax into the head. The nutrient rich hemolymph bathes the organs in the head and flows backwards in an open circulatory system until it reaches the abdomen.



Worker delivering a sting.

The digestive system consists of an esophagus, crop, midgut and hindgut. The crop serves as a storage site where the worker bee can transport nectar or water back to the hive. The bee then transfers the nectar or water to another worker that will take it into the hive. If the resources are for the bee's own use, they will continue through the digestive tract where absorption of nutrients and excretion of waste occurs. Wastes are finally expelled from the abdomen from the hindgut or rectum. Lastly, the abdomen contains reproductive organs, which will be described more in depth in the honey bee reproductive behavior section.

Honey Bee Development

Honey bees are holometabolous, which means that they go through four life stages, a growth process called complete metamorphosis. The egg stage is the first of the four. Eggs are individually laid by the queen at the bottom of wax cells where they remain for three days. The honey bee's sex is determined by whether or not an egg is fertilized. Unfertilized eggs develop into males or drones while fertilized eggs can develop into females (workers or queens). When the eggs hatch, honey bees begin the larval stage. At this point, the bee looks like a small worm coiled at the bottom of the cell floating in brood food secreted by nurse bees.

When the larvae fill the base of the cell, they uncoil and stretch lengthwise in their cells. The pupal stage begins after the cells are enclosed with wax cappings by adult bees. Major transformations occur during pupation. The cells that each of the three castes of bees develop in are different in appearance and size. Worker cells when capped are the smallest in diameter and have a flattened capped appearance. Drone cells are slightly larger in diameter than worker cells, and the capped cells extend beyond the surface of the worker brood. Queen cells are peanut shaped in appearance and will either be hanging vertically at the bottom of the frame or jut slightly outward from the surface of the comb. In either case they hang perpendicular to the comb surface. In the larval stage, queen cell larvae will be floating in a white nutritive substance produced by worker honey bees called royal jelly. This substance aids in the development of the queens reproductive and pheromone producing organs. Adult workers lack these organs due to only being fed a combination of fermented pollen and nectar, called bee bread, during the larval stage.



Honey bee eggs.



Eggs, larvae, and pupa (capped brood).



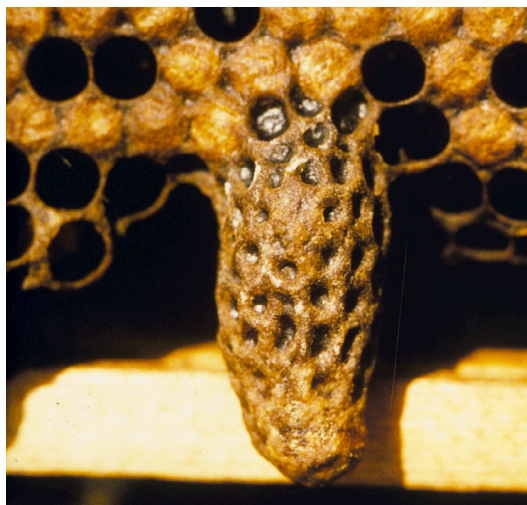
Capped pupa nearly ready to emerge.






Emerging adult worker.

Once honey bees are fully developed, they chew their way through the wax cappings at the end of their cells and emerge as adults. Once honey bees become adults they stop growth and metamorphosis.

Since honey bees maintain a near constant temperature in the hive while rearing brood, development times are fairly predictable. This fact enables beekeepers to make predictions of colony growth rates during the spring based upon the amount and stages of brood present. Learning how to make such calculations becomes easy with practice and can be read about in the Key Seasonal Activities portion of this publication.



Capped queen cell.

	Egg	Larvae	Pupa	TOTAL
Queen 	3	5.5	7	16
Worker 	3	6	12	21
Drone 	3	6.5	14.5	24

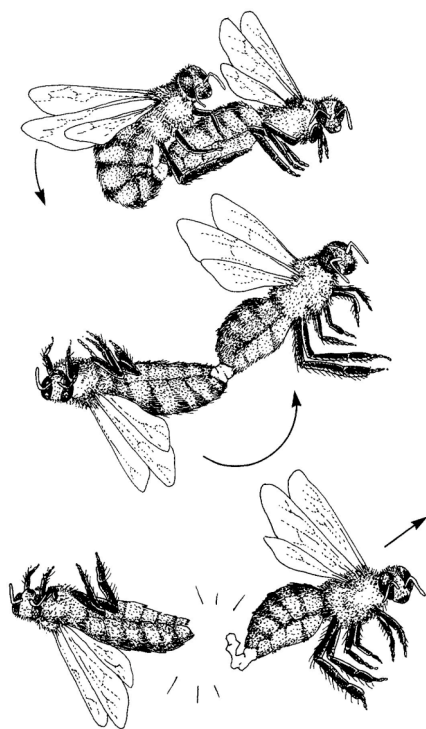
Developmental time of honey bees.

Behaviors of Queen and Drone Honey Bees

The primary duties of the queen are to lay eggs and to produce a pheromone called queen substance with her mandibular glands. The queen is the only fully functional egg laying honey bee in a colony. In the absence of a queen, workers may attempt laying eggs, but will be unsuccessful in fulfilling the queen's roles due to their underdeveloped reproductive systems. Maintaining and growing the population of her continually aging and dying colony is a monumental task that keeps the queen working almost nonstop during the daylight hours from the middle of winter into the fall. Before being able lay eggs, she must establish herself as the reigning monarch and embark on a mating flight. Upon emerging from her wax queen cell as a virgin, she will orient herself to the hive and seek to kill any other developing or emerged queens. If more than one queen cell exists in the hive, the first emerging queen begins "tooting" making a "tee-tee-tee-tee" sound. Other non-emerged queens will answer back with a series of "quacking" sounds. The virgin queen will find the other queen cells, use her mandibles

to open them one at a time, insert her abdomen, and sting the occupant to death^{iv}. If there is another queen that emerges at the same time, she will seek her out, and they will fight until one of the two is killed. The victorious virgin queen will embark on a mating flight when she is about 7 days old. Once she begins egg laying, she will not leave the hive again unless the colony swarms.

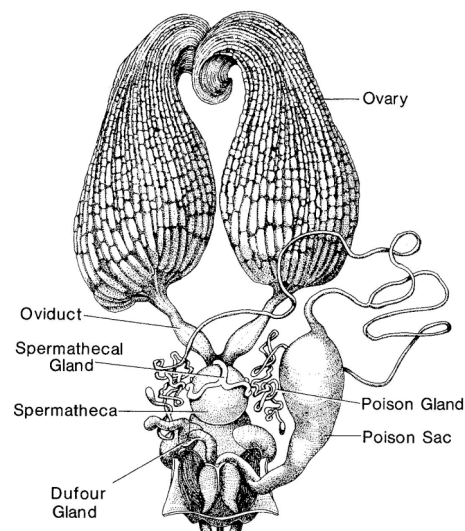
The primary duty of drones is to mate with a queen during her mating flight. Drones do not have in-hive tasks, so most of the day they eat and rest. Each afternoon drones fly and gather in drone congregation areas. When a queen flies past, drones detect her queen substance and are quick to pursue. The drone that catches her will attach himself to her in mid-flight, invert his penis and insert it into the queen's vagina. Upon ejaculation, the penis breaks off and the drone falls to the ground dead. The queen may mate with several more drones, each depositing his semen in the queen. She stores the sperm from each drone internally in an organ called a spermatheca. As a result of mating with several drones, the queen will have a diversity of sperm with which to fertilize eggs. This results in the development of a worker bee population in a colony that comes from the same mother but many different fathers. At the end of her mating flight,



Queen and drone mating during flight.

the queen returns to the hive where attendant worker bees massage her abdomen. Eventually the queen assumes the toilsome duty of laying eggs the remainder of her life^v. Queens have been known to remain viable for several years, but it is a common practice among beekeepers to requeen their hives at least every other year to ensure that the colony is headed by a prolific queen. Drones that are unsuccessful in mating with the queen return to their colony and try again the next day. In the fall resources become more scarce, and the drones that did not mate are forced out of the hive and abandoned to die.

Once the queen begins laying eggs, she uses her front legs as a caliper to measure the diameter of each cell. Worker cells are narrower than drone cells. Upon determining the diameter of the cell, she will place her body above the cell and insert her abdomen to lay an egg. The worker cell receives a fertilized egg while the drone cell receives an unfertilized egg. The queen is capable of laying 1,000 eggs per day^{vi}. The queen is often found surrounded by attendant worker bees that groom and feed her. Throughout her life the queen produces queen substance. This pheromone encourages normal worker behavior in the colony and foraging outside of the colony. It also serves as an indicator of queen productivity to the workers. If amounts of pheromone drop below acceptable levels, the workers will produce queen cells and seek to supersede (or replace) the old queen.^{vii}



Queen reproductive tract.

Behaviors of Worker Bees^{viii}

It is no coincidence that the infertile female honey bees are called workers, for from the time they chew their way out of their wax cell their days are filled with nothing but work. Under normal circumstances, the stimuli that determine which duties are performed by a worker are age and environment. Newly emerged adults begin cleaning out cells and feeding developing larvae that are more than three days old. By the end of the first week of adulthood, the workers transition into feeding larvae that are less than three days old. The glands that produce royal jelly are also developed by this time, enabling them to feed queen larva if any exist in the colony.

After two weeks of age, the duties to fulfill become more numerous and less age driven. Workers begin removing dead bees and debris from the colony. They can also be seen forming long hanging chains called festoons. A festoon begins with one bee clinging to the top of a frame and each successive bee below clinging to the rear legs of the bee above her. As they hang for approximately 24 hours, their wax glands exude liquid wax that dries into plates that are then removed and used by workers for constructing comb.

Much like an industrial shipping dock, workers wait at the entrance to receive resources being returned to the hive by forager bees. As bees receive the resources, guard bees patrol the entrance checking the chemical odor of each returning bee to ensure that they belong to the colony. If an intruder arrives, the guard bees will grab them and eject them from the colony. When honey bees display defensive behavior, they emit a pheromone that alerts the rest of the colony. Upon stinging an intruder, the animal is marked with that pheromone that other guard bees will readily identify and seek to sting it as well. This ensures that the threat to the colony is either killed or chased away.



Guard bee at the hive entrance.

When foragers collect resources, they are taken back into the hive, shared with other workers, and deposited into cells or used within the hive. Nectar has a high moisture content, which if left unprocessed by the bees would ferment and spoil. Workers will cling to the edges of comb and frames using their wings to fan air over the cells in order to evaporate excess moisture. As the moisture evaporates, an enzyme called invertase converts the sugar sucrose, which is naturally in nectar, into glucose and fructose. Invertase is secreted by worker bees, and it is added to nectar to ripen it into honey. On excessively warm days workers will fan their wings to evaporate water collected by the foragers to maintain a constant temperature and humidity in their brood nest. Workers will also fan at the entrance to spread an orientation pheromone that helps returning foragers locate the nest.

Depending upon the needs of the colony and the age demographics of the workers, bees are able to shift from one duty to another. For example, on a very warm day when additional fanning bees are needed to maintain temperature, newly hatched nurse bees can be promoted to fanning for the time they are needed. The reverse is also true. If there were not enough nurse bees to feed the larva, a

portion of older bees that may normally be foraging, could fill the role of feeding the larva to ensure that the larva do not die.

Foraging and Resource Communication

Coordinating the efforts of thousands of worker bees seems like a monumental task; however, through the use of complex systems involving the senses of touch, sight, and smell, the needs of the colony and locations of resources are effectively communicated.^{ix} A fascinating aspect of honey bee biology is that they use a symbolic dance language to communicate the location of resources to their nestmates.

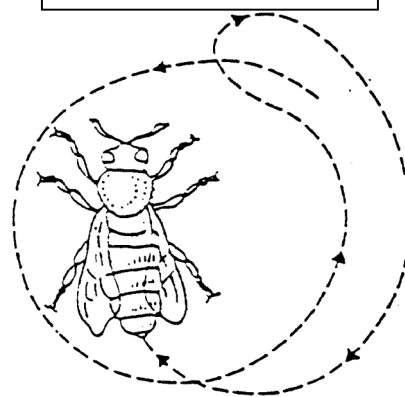
The person who first explained the dance language was Karl von Frisch. His life's work eventually earned him the Noble Prize in 1973. He observed that workers, after going on a flight in search of resources, would return and perform an intricate dance for other bees. Through much observation von Frisch discovered that the bees watching the dance would fly to the same source that had been visited by the dancing bee. Finding resources quickly and communicating their location effectively to the rest of the hive is essential for the colony's survival. Eventually, von Frisch cracked the code. Through the materials provided in the Additional Resources portion of this publication, you can practice using the same code to locate resources.

The three dances to convey the location of resources are the round dance, the sickle dance, and the waggle dance. The round dance is performed when the resource is located within 10 meters of the hive. The bee will enter the hive, climb on the vertical surface of the comb, and dance several circles often reversing her direction and pausing to share a taste of the resource she retrieved. This dance indicates that bees can easily locate the resources by flying in a circle around the hive while searching for the floral odor present on the dancer.

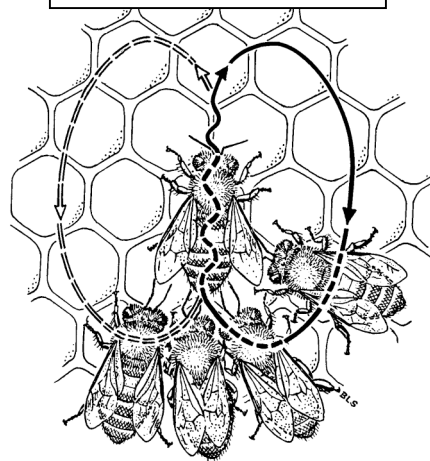
The sickle dance is performed when the resource is located between 10 to 100 meters. The bee dances several crescent shaped formations on the comb instead of round shaped, often switching directions and sharing the resource with her observers. This dance is difficult for an observer to interpret, but the bees use it effectively.

The waggle dance is performed when the resource is located more than 100 meters away and is different from the other two dances in that it communicates both distance and direction. The dance is performed in a figure eight formation. The bee begins vibrating (or wagging) as she walks in a precise direction. Once the vibrating ends, she walks in a circle back to the location where she began vibrating. She repeats her vibrating walk a second time in the same direction. Then she does another

Round Dance^{xi}



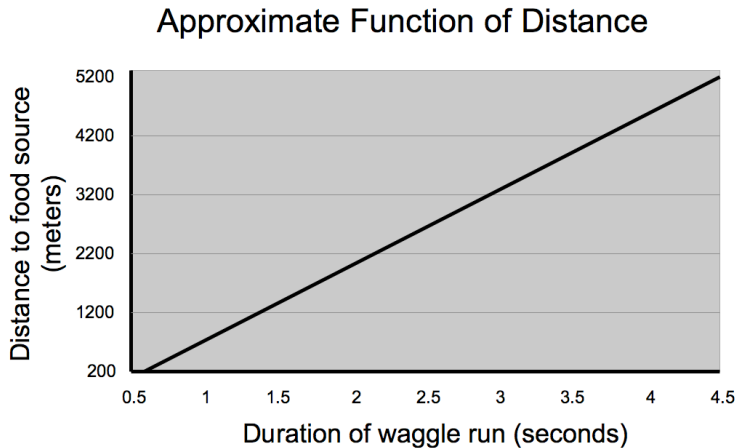
Waggle Dance^{xii}



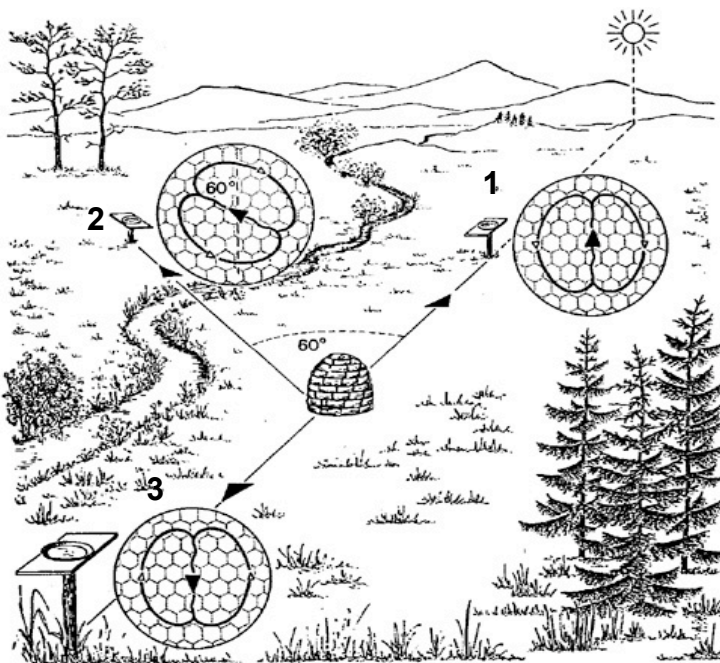
circle in the opposite direction on the opposite side of the vibrating run. She repeats this figure eight several times, pausing to share her resource with observers.

The time duration of the vibrating segment of the waggle dance is directly proportional to the distance

the resource is located from the hive. The only dance that provides a directional component is the waggle dance. The direction of the vibrating component of the waggle dance in relation to the position of the sun in the sky is used to determine the location of a nectar source in relation to the hive. There are three components that determine the location of the sun in the sky: (1) tilt of the earth (time of year), (2) your location on the earth, (3) time of day. Use the image of three sugar sources to seek further understanding on how this phenomenon works.



Relationship between distance and time of waggle.^{xiii}



Three sugar syrup bowls in relation to one hive and the sun.^{xiv}

In the example three bowls of sugar syrup have been placed 200 meters from a hive at different locations. The sun is just coming over the horizon in the east. Sugar bowl #1 was placed directly in line between the hive and the sun. A bee communicating the direction of the sugar bowl would dance vertical on the comb. Sugar bowl #2 was placed 60 degrees to the left of the direction of the sun. Thus, a bee would communicate this by dancing 60 degrees to the left of vertical. A bee communicating the location of bowl #3 would dance 180 degrees from vertical because it has been placed 180 degrees from the direction of the sun. If the bowls were left in the same locations throughout the day, the angle of the bee's dance for all three bowls would change in relation to the changing position of the sun.

Swarming^{xv}

Swarming is the natural tendency of honey bee colonies to reproduce and establish new colonies during the time of year when resources are at peak availability and environmental conditions are most favorable. In Nebraska, this time period is typically in May and June. Conditions in the hive that lead up to swarming are congestion and crowding. Productive colonies become congested with adult bees and brood. Queen cells at the bottoms of the frames are an indication that swarming season is near. As the time for swarming approaches, queen cells will contain developing larvae and the colony will become very quiet and calm. Immediately before swarming, selected worker bees will perform loud “buzzing runs” that excite other workers. It is also common to see a large cluster of bees bearded up on the outside of the hive. As swarming begins, the old queen along with a mass exodus of anywhere from 20,000 to 30,000 bees leave the hive and find a nearby structure or vegetation on which to cluster. While clustered, scout bees will search for cavities with favorable conditions that could serve as a new home. They return to the swarm to perform waggle dances communicating the location of the possible new hive. Several different waggle dances can be taking place on the surface of the swarm at the same time. As the scout bees perform their waggle dances, they recruit other bees to perform the same waggle. Eventually, the majority of the workers are performing the same dance for a preferred location and the cluster disembarks from their hanging point and flies to their new home. Meanwhile, back at the original hive, a virgin queen will emerge from her cell. She will either embark on her own swarming flight with a much smaller group of bees than the prime swarm, or she may seek and kill the remaining queens still in their cells and assume her duties as the new queen of the parent colony. Several after swarms are possible; however, each one will be progressively smaller.



Honey bee swarm^{xvi}.

ⁱ Ellis, Marion. “Beginning Beekeeping Workshop”. 2003.

ⁱⁱ Ellis, Marion. “Beginning Beekeeping Workshop”. 2003.

ⁱⁱⁱ Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 103-169

^{iv} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 346-347

^v Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 242

^{vi} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 349

^{vii} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 356

^{viii} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 276-372

^{ix} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 283

^{xi} Ellis, Marion. “Beginning Beekeeping Workshop”. 2003.

^{xii} Ellis, Marion. “Beginning Beekeeping Workshop”. 2003.

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- ^{xiii} North Carolina State University. *The Dance Language of the Honey Bee*. Retrieved June 5, 2006. http://www.cals.ncsu.edu/entomology/apiculture/Dance_language.html.
- ^{xiv} North Carolina State University. *The Dance Language of the Honey Bee*. Retrieved June 5, 2006. http://www.cals.ncsu.edu/entomology/apiculture/Dance_language.html.
- ^{xv} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 336-341
- ^{xvi} Ellis, Marion. "Beginning Beekeeping Workshop". 2003.

Key Seasonal Hive Activities and Responsibilities of the Beekeeper

Multi-Seasonal Responsibilities

Site selection for hives:

Beekeeping is much like the real-estate business, it is all about “Location, Location, Location!” Selection of a quality site for your honey bee colonies is critical to maintaining colony health and achieving a bountiful honey harvest. When selecting a location (apiary) for your hives, the following should be considered.

- **Southern Exposure:** Honey bees only gather resources during the day and temperature largely affects how early they will begin. Having a southern exposure to the sun will ensure that your bees maximize their foraging efforts during daylight hours.
- **Protection from Wind, Pesticides, and Livestock:** Placing your hives in a location where they are shielded from the prevailing winds will improve winter survival and will reduce the amount of drifting in your apiary. Pesticide damage can also be a problem in both urban and rural areas. Be informed about which pesticides pose risks to honey bees, and ask your neighbors/landlords to notify you before applying pesticides so you can decide if you need to take protective measures such as confining or moving the bees. Bees can only be confined briefly during summer, and if confined, they should be supplied with water and good ventilation. Often risks can be greatly reduced by late evening application when bees are not foraging. Lastly, do not place your hives in pastures where livestock have access to them. Cattle can make a mess of an apiary and honey bees can frighten horses causing them to break through fences or throw their riders.
- **Local Flora: Good apiary locations have a diversity of flora available in spring, summer and fall.** Maintaining good records on the types of flora in your area and the times of year they are in bloom is very important. Such records will help you decide where and when to place your hives. A GOOD APIARIST IS ALSO A GOOD BOTANIST! Practice your skills at identifying the plants in your area, know their life cycles, and learn which species are beneficial to your bees.

Major Nectar Sourcesⁱ

Fabaceae– legume family
Lamiaceae – mint family
Asteraceae – composite family
Rosaceae – rose family
Ericaceae – heath family
Brassicaceae – mustard family
Tiliaceae – basswood family

Magnoliaceae – magnolia family
Polygonaceae – buckwheat family
Malvaceae – mallow family
Scrophulariaceae – figwort family
Asclepiadaceae – milkweed family
Euphorbiaceae – spurge family

Spring Buildup

Willows
Maples
Wild plum
Wild Cherry
Fruit trees
Dandelions
Wild mustard
Gooseberries
Crocus
Mints

Main Honey Flow

Black locust
White Dutch clover
Sweet clover
Purple vetch
Linden or basswood
Alfalfa
Horse mint
Sunflowers
Canola
Purple loosestrife
Soybeans

Fall Plants

Golden rod
Sunflowers
Smartweed
Alfalfa
Partridge pea
Joe Pye weed
Boneset
Asters

A record sheet has been provided that will help you keep track of the plants blooming in your area and other important information.

Good Resources for looking up information on Nebraska flora.

Nebraska State Wide Arboretum: FloraSearchⁱⁱ

<http://citnews.unl.edu/florasearch/region.html>

Weeds of Nebraska and the Great Plainsⁱⁱⁱ

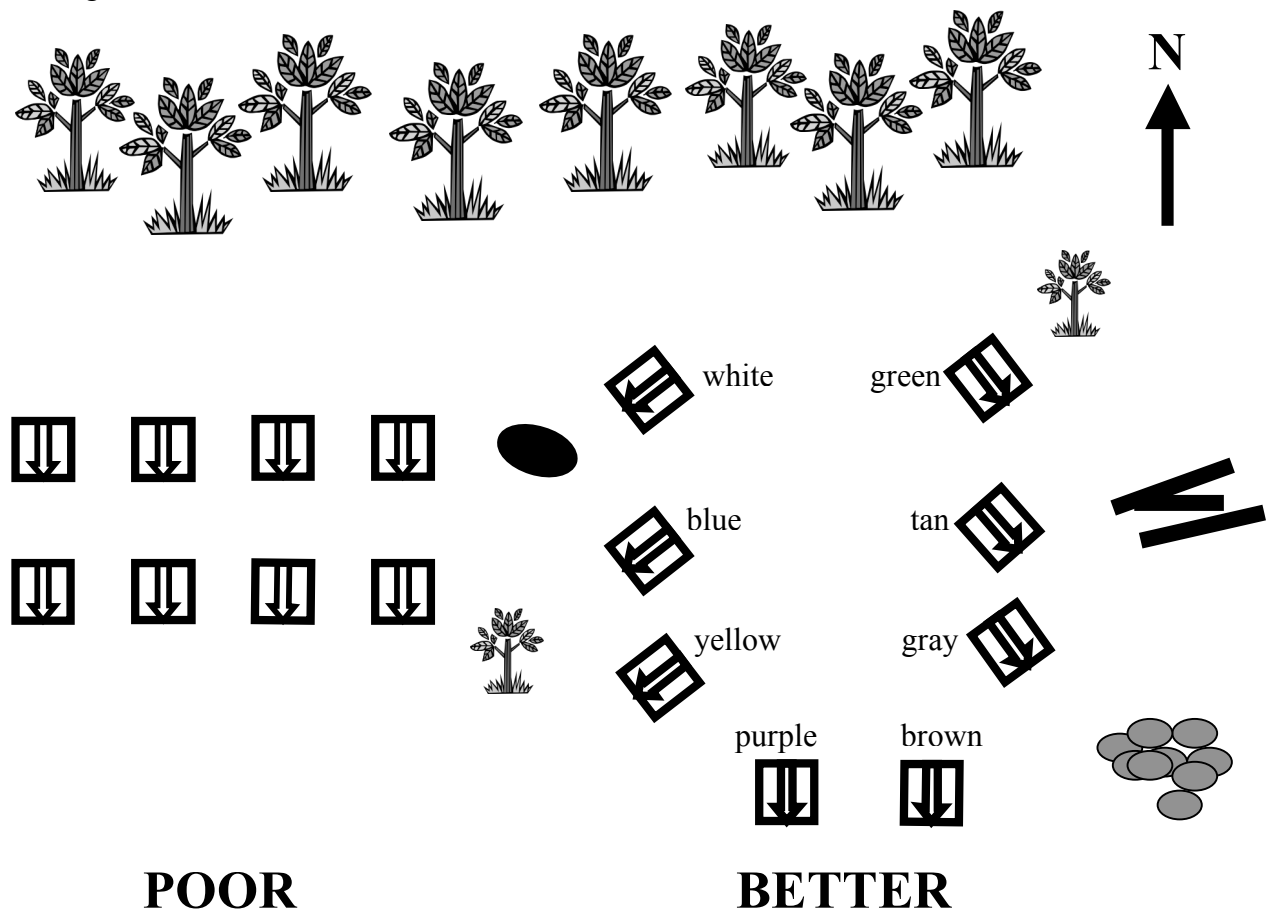
<http://plants.usda.gov/java/invasiveOne?pubID=NEGP>

- **Water:** Water is often a forgotten resource when considering a location for placing hives. A nearby creek or water trough that provides fresh water within a mile of the hives is recommended. If you keep bees in town, you can reduce your bees activity at neighbor's bird baths and pools by keeping a constant source of water near the hives.
- **Accessibility:** When selecting a place to locate your hives, you should be able to access your apiary during all seasons and road conditions. Sometimes your colonies will require timely servicing, and rough, wet or flooded terrain can prove problematic.
- **Vandalism & Neighborly Responsibility:** "Out of site, out of mind" is a good rule to follow when selecting a location for your colonies. Abandoned farm places, pastures away from the roads, or behind a 7-foot tall concealment fence in your backyard are all good places. Hives will not be stolen, vandalized or worried about if they are unseen. It is a good practice to inform your neighbors of your plans to establish an apiary. Be respectful of their concerns. Locate the apiary at least 15 feet from any property lines, provide a source of water near the colonies, and only work them when conditions are ideal. Be informed about which garden and orchard crops are dependent on bee pollination, and include that information in your discussion. Christmas gifts of products

from your hive, such as honey or beeswax candles, are often helpful in producing positive neighborly attitudes towards the bee hives next door.

Site Orientation:

Once the site for your apiary has been selected, additional measures can be taken to ensure that drifting does not become a problem. Drifting is when bees return to a nearby colony rather than to their own colony. Any hive will accept a fully loaded bee, and it occurs most often during a honey flow. When drifting is a problem in an apiary, the overall honey production is reduced. Honey bees orient themselves to their hives according to landmarks, hive color, and entrance orientation.^{iv} Returning foragers may easily select the wrong colony when several hives of the same color are lined up in identical rows all facing the same direction. Drifting can reduce production, increase swarming and cause other management problems. A few simple adjustments will help your bees to orient themselves and reduce drifting. First, arrange your apiary so that the entrances of your hives face different directions. As long as the hives have a southern exposure to the sun, the direction of the entrance will not matter. Second, locate objects around you apiary that the bees can use as landmarks. Take into account natural landmarks that may already be present such as shrubs and trees. Something as simple as a rock sitting next to the entrance of one hive or a nearby brush pile can work as landmarks. Painting your brood chambers different colors or simply stapling large colored plastic cards above the entrance of each brood chamber will also help. Simply placing hives 10 feet apart will greatly reduce drifting.

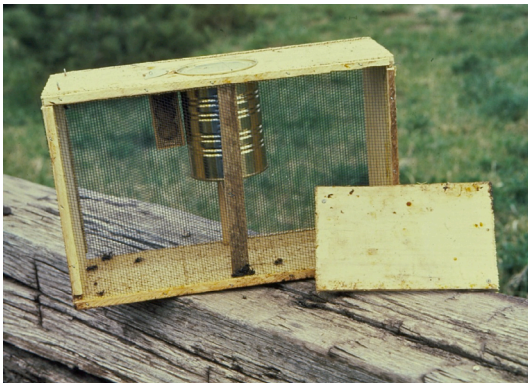


Spring Responsibilities

Ordering, Handling, and Inserting Package Bees:

Inserting your first package of honey bees into a hive can be both an exciting and a nervous experience. There is no substitute for having a mentor present when doing so. However, if you do not have a mentor and your bees will soon be arriving, take relief in knowing that honey bees are very good at surviving despite the mistakes sometimes made with them.

The most important thing you can do for your package bees is to **PREPARE YOUR HIVES AND MATERIALS SEVERAL DAYS BEFORE THEIR DELIVERY DATE!!!** Your bees will have been stressed by confinement and transit, and they should be installed as soon possible. If you cannot install them immediately, store them in a cool, dark place. Packages can be installed in cool weather or during a light rain. If you are installing several packages in the same apiary, late afternoon installation gives them time to organize and orient to their nest site before they begin foraging and will minimize drifting.



Empty package with queen cage and feeding can



Package with honey bees

The standard package of bees contains two or three pounds of worker honey bees, a queen in a separate cage within the larger package cage, and a feeding can filled with sugar syrup. There may be a few drones in the package, but most of the bees should be workers. The packages are sealed securely with wire mesh; however, it is common to have a few “hitchhiking” bees clinging to the outside of the package. On rare occasions a package may have been damaged and some bees will be outside the cage. In either case the bees will not be defensive, but they may alarm postal workers, so prompt pickup is greatly appreciated.

Ordering your package bees through a reliable supplier is important. For beekeepers in Nebraska, orders for package bees should be placed by the end of January to ensure that you receive them between April 15 and May 10 (the best time to start new packages). Suppliers of beekeeping equipment often order truckloads of packages that you can pick up at their warehouses. This is the preferred option as shipping stress will be minimal; however, packages can be ordered directly through the mail if there is no supplier within a reasonable distance. The reason that ordering packages through the mail should be your second option is that it often takes 3-5 days to ship packages from locations like Georgia, California, and Texas where many

suppliers are located, whereas local beekeeping suppliers will have bulk shipments directly delivered by private truck, which will only take 1-2 days. Since adult bees only live 5-6 weeks, prompt delivery and installation is critical to their success. If ordering by mail, the local postmaster should be informed in advance about their delivery date and instructed to store the package in a cool, dark location until it can be picked up.

When ordering your honey bees, you may be given the option of picking a particular race of honey bee. The most commonly used races are Italian and Carnolian bees. There are also several varieties of bees available for each of the races including: Russian bees, Hygienic bees, and Buckfast bees. These varieties of bees have been selected for specific traits.

In preparation for the arrival of your packages, the following checklist can be used to ensure that you have everything ready for when they arrive. All items on this list, except those indicated, should be completed per package of bees **TWO WEEKS PRIOR TO DELIVERY DATE**.

- Obtain all items suggested for purchase in the “How and Where to Begin” Unit
- Purchase Terramycin antibiotic for preventative treatment against Foulbrood
- Purchase Fumagillin for preventative treatment against Nosema
- Purchase 10 lbs. of table sugar
- Purchase a small bag of powdered sugar (one bag can be used for many hives treatment with Terramycin)
- Purchase 2 plastic 1 liter spray bottles (only two bottles for all hives is needed)
- Rinse and clean a gallon milk jug with cap
- 1 Brood chamber, bottom board, inner cover, & telescoping cover constructed and painted
- 10 Brood chamber frames constructed, wired, and crime wire foundation inserted
- Hive stand constructed
- Try on all safety equipment to ensure it fits and you are comfortable with putting it on
- Practice lighting and using smoker

Again, be sure your hive is assembled and painted well before the bees arrive. Your hive stand should be in place, the apiary should be mowed, and you should be prepared to install the bees promptly when they arrive.

The day of pickup, the following items should be taken with:

- All safety clothing
- Hive tool
- Spray bottle filled with sugar water mixed 1 part sugar to 2 parts water by weight
- A spray bottle filled with tap water
- 1 gallon of sugar syrup treated with Fumagillin
- **DO NOT** take your smoker (using smoke during package installation is not necessary and will disorient the bees at a time they need to use chemical messages to orient to their new nest)

Thirty minutes before installation, spray the packages liberally with 1:1 sugar water so that the bees get a good covering. Place the packages in the bed of a pickup out of the wind where they

will not shift or slide around. For driving safety, NEVER TRAVEL WITH PACKAGE BEES INSIDE THE VEHICLE. If there is concern of cold weather or precipitation, a tarp or truck bed-topper should be used. If the trunk of a car must be used, the lid should be propped open to assure that the bees get adequate ventilation.

In the case of extreme weather, package bees may be stored in a cool dark location such as a basement, for 1-2 days until conditions improve. While holding packages, respray them with 1:1 sugar water every morning and evening to protect them from dehydration. If conditions do not improve within a couple days of obtaining your packages, it may be necessary to insert the packages anyway. If precipitation is a problem, the bees can be installed at night in a garage using red light. Once the bees are all in their hive and their feeder is filled, they can be moved outdoors to a temporary or permanent location. (WARNING: Do not leave bees in a building during daylight unless the entrance is screened. It is best to move them outside as soon as they are settled into their hive if indoor installation is necessary.)



Spraying packages with sugar syrup

Before going to the apiary, mix four pounds of beet or cane sugar and four pounds of water in a rinsed gallon container. Add 1 teaspoon of Fumagillin to the sugar syrup and mix thoroughly. Label the syrup as Fumagillin treated syrup, and do not expose it to direct sunlight. One gallon of medicated syrup should be prepared per package. Then obtain a small ziplock bag and mix 1 teaspoon of Terramycin (TM 25) with 5 teaspoons of powdered sugar. Mix thoroughly and label the baggie Terramycin with the marker. One baggie should be prepared for each package. Be careful not to expose the terramycin to sunlight or excessive heat.

Inserting packages is best done during late afternoon, but it can be done at any time of day. Once you are in the apiary, put on your safety clothing, and you are ready to insert your packages. Do not light your smoker for package installation. Smoke reduces bees ability to orient to a new nest. In addition, new packages have very little instinct to exhibit defensive behavior. Follow the steps below:

1. Remove the telescoping and inner covers from the top of the brood chamber.
2. Remove six frames from the center of the hive body.
3. Place an empty division board feeder in the hive. Slide it to one side.
4. Slide one frame against the feeder and place the other three against the opposite side of the hive.
5. Thoroughly spray the bees with warm water. (Do not do this step if the outside temperature is below 55°F).
6. Remove the wooden or cardboard cover from above the feeding can.
7. Loosen the feeding can in the package with your hive tool.

8. Hold the package so the can must be lifted upward out of the package. With one steady quick movement, bounce the bees to the bottom of the package.



Removing queen cage from package

9. Quickly remove the feeding can. Remove the queen cage by sliding the metal tab out of the feeding can hole. **DO NOT OPEN THE QUEEN CAGE YET.** Set it aside in a safe place next to the hive. Mist the bees again with water to reduce flying.
10. Shake the bees into the open hive. Don't be concerned if some of them are flying. If the queen is successfully placed in the hive, they will eventually find her.
11. Remove the cork from the end of the queen cage that is filled with candy and suspend the caged queen between 2 frames with the candy end down. Position queen cage within 2-3 frames of the feeder.
12. Slowly place frames into the hive starting from the outside and working your way in. **DO NOT PUSH DOWN ON THE FRAMES.** This may crush bees. Allow the bees to spread out and crawl up into the space between the frames.
13. Once all nine frames are successfully in the hive, fill the division board feeder with the Fumagillin-treated sugar syrup. **DO NOT FILL THE FEEDER BEFORE ALL NINE FRAMES ARE IN THE HIVE.** Otherwise, the feeder will expand and make it difficult to place all the frames in the hive. Be careful not to spill any syrup as spilled syrup encourages robbing.



Shaking bees into hive



Filling division board feeder with sugar syrup

14. Drop some twigs in the sugar syrup to help prevent drowning.
15. Place the inner cover and telescoping cover on the hive.
16. Place a brick on top of the telescoping cover.

17. Return in a week to fill the feeder with more 1:1 sugar syrup. Check to be sure the queen has been released. If she is still caged, spray her with sugar syrup to prevent her from flying, remove the wire screen covering her cage and dump her onto the top bars of your hive body. If she is out check for eggs to be sure she is laying.

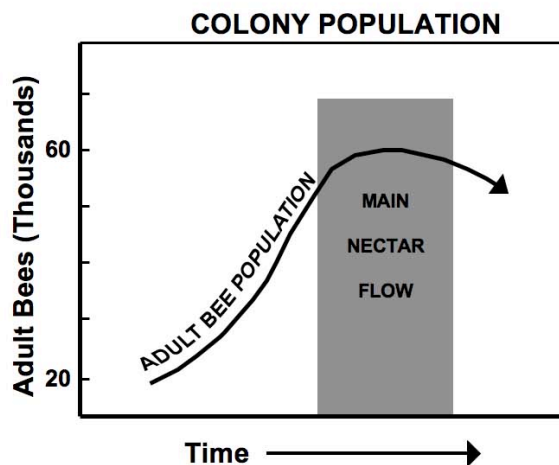
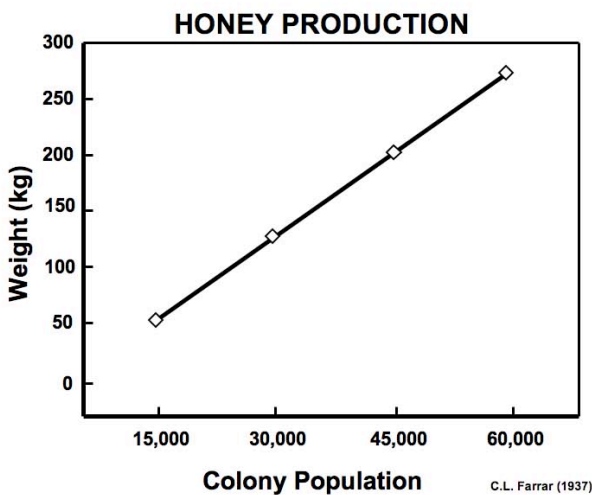
Management of Hives in the Spring:

Spring is a time of excitement and preparation for beekeepers that anxiously anticipate their honey bee colonies becoming more active and the arrival of the honey flow. The five keys to good management for a beekeeper during this time include: (1) adequate honey stores, (2) young and productive queens in all hives, (3) disease free colonies, (4) standardized equipment, and (5) a good location.^v

Whether you are continuing with established hives from the previous year or are beginning with new package bees, spring feeding is an important management practice to encourage egg laying by the queen, wax production for building comb, and to prevent starvation when resources are limited. Deciding when to begin feeding, how much to feed, and for how long a period of time can be a difficult to decide for the established hives that have been wintered, however new packages should be fed continuously until they have drawn out all of their brood combs. Feeding should always be performed with a purpose and a plan. Feeding an overwintered colony too much syrup early in the spring can encourage swarming. Over time you will learn how to successfully utilize this skill for the benefit of your apiary.

When keeping bees, it is important to remember that colony populations will rise and fall during different seasons. As colonies enter into the fall, worker bees eject the drones from the hive. The remaining worker population plus the queen may total anywhere from 20,000 to 40,000 bees as colonies enter winter. Once temperatures drop below 55°F, honey bees cluster together with the queen at the center of the mass. The colder it becomes, the tighter the cluster forms. As winter passes, the bees slowly consume honey reserves to fuel shivering their wing muscles to produce warmth in the hive. During the coldest parts of winter when no brood is being reared, the bee mass temperature will remain around 55°F. When the brood rearing season begins in late winter to early spring, the bees maintain the temperature around the brood at 95°F.^{vi} At this point the colony begins using large amounts of honey. When days start getting warmer and foragers begin collecting pollen, the demand on honey stores becomes even greater. Starvation often takes place in March and early April, but can take place much sooner if a hive is not adequately supplied with honey or sugar syrup in the fall.

Large colonies are more productive than colonies with the same number of bees divided between 2 colonies. Beekeepers must determine when the main nectar flow occurs and then manage colonies to peak their populations for the main nectar flow. Colonies that peak in population before the main flow are prone to swarm, and colonies that peak after the main flow are a hungry liability that will require much feeding to overwinter.



Learning how to peak bee populations at the right time is the key to producing abundant crops of honey. It is both an art and a science that takes time and experience to master. Inadequate feeding can result in stressed bees, poor production, and starvation. Feeding too much early in the spring can result in increasing the population too much before the nectar flow begins and leads to swarming. The main nectar flow usually begins in early to middle June in eastern Nebraska and middle to late June in western Nebraska. This can vary depending upon spring temperatures and precipitation. When populations within a hive get too large early in the season, the workers will raise a series of new queens and swarm. Swarming is nature's way of producing new colonies, but to a beekeeper it is a threat of losing half of your foraging work force before the busiest time of year.

Monitoring the amount of honey usage by bees during winter and spring is important in determining the need for feeding, and if needed, when to begin feeding. Care must be taken when checking hives in cold conditions because chilled brood and frozen adults can result from disturbing a winter cluster. Keeping inspections quick and doing them when temperatures are above 55°F will help reduce the risk of chilling brood. By the end of winter the hive should have at least 30 pounds of honey left to successfully carry the bees through the early spring.^{vii} Lifting a hive can give you a good estimate of the colony's weight. For a closer inspection, the telescoping and inner covers may be removed so the frames can be visually inspected from above. Do not remove individual frames if it is avoidable during cold weather. Each deep body frame filled with honey and pollen weighs approximately 5-6 pounds and each shallow frame weighs approximately 3 pounds.

It is also important to note the location of the bee cluster in the hive as you perform your inspection. Bees move upward through the hive as they utilize food stores. If the cluster is near the top of the inner cover, and the majority of the honey stores are gone, feeding should begin immediately. Full frames from the hive body below or from other amply supplied hives may be removed and placed next to the cluster.

If no food filled frames are available to supplement the overwintered hive, a variety of feeding methods exist and recipes can be found in beekeeping books and online. Most of them can be

categorized into two groups: dry methods and liquid methods. Examples of dry feeding methods include feeding dry granulated sugar or candied patties. Dry methods are recommended when daytime high temperatures are below 50°F. Thin syrup for spring feeding can be made by combining 8 pounds of sugar with 8 pounds of water (1 gallon) to make 1.5 gallons of syrup. Thick syrup for fall feeding can be made by combining 16 pounds of sugar with 8 pounds of water.

To make sugar candy for winter feed, dissolve the 25 pounds of sugar in 1 quart of water by stirring and boiling the mixture until the temperature of the syrup rises to 242°F. Let syrup cool to 180°F, then beat until thick. Pour the candy into molds lined with wax paper. Place a cake of sugar on the top bars above the cluster of bees. You may need to make a wooden rim to accommodate the hard candy.

In the case of an emergency where resource availability or time prevent the beekeeper from making candy, plain dry sugar may also be feed to bees. A wooden rim will be needed to accommodate the sugar. One disadvantage of feeding dry sugar is that much of it will end up on the bottom board.

If you are feeding, you may be asking yourself, “When should I stop?” The answer to that question depends upon the amount of food stores in the hive, the rate at which your colony is increasing in population, and the floral sources that are available to your bees. In the case of newly inserted packages, feeding will most likely continue all the way through the beginning of June. For overwintered hives feeding can stop if it appears that the queen has produced several frames of brood and your rate of population increase is right on track for the honey flow, several pounds of food stores are present to take them to the honey flow, and there are spring plants providing nectar and pollen. In cases where any one of these three items is absent, feeding should continue.

Target Number of Brood
Frames by Date

April 153
April 214
April 285
May 56
May 127



Queen bee surrounded by workers

In addition to spring feeding, maintaining productively laying queens is important for colony population and vigor. Replacement of old queens with new queens on a yearly basis will accomplish this. Queens can be successfully replaced in the spring or fall.^{viii} However, they are easier to find in the spring. Most queen producers live in southern states where climates are warmer. Your beekeeping mentor or package bee supplier should be able to recommend a good queen supplier. Queens will arrive in individual wooden cages that contain a candy plug, a few attendant worker bees, and a wire-

mesh cover on one side. Queen cages should be stored in a moderately cool (60-70°F), dark location, and the screens of the cages should be brushed with water at least twice daily to prevent dehydration until they can be installed. Queens should be installed within 5 days of their arrival.

Installation methods vary greatly; however, the factors that affect queen acceptance by the colony include colony strength, age of bees, status of the honey flow, disturbances, colony odor, and amount of queen pheromone.^{ix} Bees are more likely to accept a new queen when colony populations are low and/or they are distracted by the activity of gathering resources from a honey flow. Queen bees give off queen pheromone that encourages worker productivity in the hive. In addition to queen pheromone levels, every colony has a signature odor that bees use to identify each other as being native to the colony or an intruder from a different colony. Directly releasing a new queen with a different colony odor into a hive where the resident queen has high pheromone levels will almost always prove fatal to your new queen. The following steps may be followed to produce conditions that are beneficial for queen introduction:



Freshly mailed queen cages containing queens and attendant bees

1. Remove the old queen from the hive two days before introducing the new queen.
2. Place the new caged queen in the hive by suspending it between two adjacent frames with the candy end down. Do not remove the cork from either end of the cage.
3. After four days, inspect the queen cage. Try lightly brushing the bees off the surface of the cage. If they are not biting at the wire mesh and gently move aside, they have accepted the queen. If they are biting at it, place the frame back in the hive, wait two days and repeat the brushing technique described in step 3.
4. Spray the queen with sugar water so she does not fly away. Open the wire mesh and release the new queen into the hive. Alternately, you can use a nail to remove most of the candy and return the caged queen to the hive to be released by the bees.

These steps will allow the odor of the old queen to disappear while giving the new queen time to take on the odor of the colony and become the sole provider of queen pheromone in the hive.

A colony provisioned with honey, pollen, wax, and developing brood serves as a good breeding ground for many diseases and pests. It is fortunate for the beekeeper that honey bees are good house keepers and do a good job of maintaining their colonies. An integrated pest management program is important for any beekeeper in assisting their bees in their constant battle against foreign invaders.

Education and observation are important parts of pest management. Many publications through the extension service are available regarding the diseases and pests of honey bees. One such publication that is inexpensive and well worth purchasing is Honey Bee Diseases & Pests, 2nd Edition published by the Canadian Association of Professional Apiculturalists. Once you have

studied the diseases and pests you will begin to make your own observations visually inspecting frames.

The following is a list of common honey bee related diseases and pests.

Brood Diseases

American foulbrood
European foulbrood
Chalkbrood
Sacbrood

Adult Bee Parasites

Nosema
Tracheal mites
Varroa mites
Wax moth
Small hive beetles
Various bee viruses

Management and treatment guidelines change often for diseases and pests. Current information from University of Nebraska-Lincoln Extension should be sought if you have concerns about a particular pest.

As described previously in this unit, Terramycin and Fumagillin should be administered to hives when feeding liquid syrup in the spring and fall or inserting package bees to prevent against American foulbrood and nosema. Varroa mite population levels should be checked in early August. The varroa mite develops when brood is present in the hive and can cause colonies that look strong in mid-summer to crash by late summer. A simple test called the “Sugar Roll Technique” may be used to quickly assess the number of mites in the hive and whether action needs to be taken to reduce the mite population in the colony. The technique is performed by using a canning jar with a fabricated wire mesh top. Approximately 300 bees should be gathered off comb from the hive into the jar. Once the wire mesh lid is on, sprinkle two tablespoons of powdered sugar through the mesh and gently shake the jar upright to coat the bees. Allow to sit for two minutes and then shake the jar like a salt shaker so the powdered sugar collects on a white piece of paper. The mites will come off the bees with the powdered sugar. If nine or more mites result, treatment is recommended.^x



Varroa mites on developing pupa.



Sugar Roll Method

Other problems that beekeepers may encounter that can be confused for disease or parasite infestation are: starvation, chilled brood, pesticide poisoning, toxic plant poisoning, or poor queen. It is important to properly diagnose a problem before you can treat it. When checking your hives, have a record book in which you record your observations and experiences. Such information as

estimated colony population, amounts and types of food stores present, number of frames of brood, appearance of capped brood, presence or absence of queen cells, and any observation that may seem different or peculiar can be helpful in helping to diagnose problems over time.

Summer Responsibilities:

Much preparation and planning go into preparing for the glorious honey flow during the summer. Once it finally arrives, it is now time to let the bees do what they do best...gathering sweet nectar and turning it into honey. Your role as the beekeeper is to ensure that your bees are located in a place with ample resources and to provide empty supers as they build up honey stores. Continued monitoring for health and disease is also important.

Harvesting your first set of full supers is very exciting. As previously mentioned, a bee escape is a handy tool that can be used to remove bees from full supers by placing it the evening before harvest between the full supers on top and the empty supers below. Serving as a one-way entrance, the bees move downward and cannot return to the full supers. Another mechanical method is to use a bee blower that blows the bees out of the super. This is quicker than the bee escape, but can beat up the bees more so than the escape. Chemical methods of bee removal for super harvest are also available. A chemical fumigant is added to a fume board. The fume board is placed on top of the open hive and the fumigant drives the bees downward enabling the beekeeper to remove the supers after a few minutes. One commercial honey bee removal fumigant on the market that works well is BeeGo. The benefit to using chemical methods is they are quick. The biggest drawback is that they often have a very powerful odor that is unpleasant.

As the summer progresses and the types of blooming flora change, it may be necessary to move your colonies to a different apiary. This can be a nervous experience for the beginning beekeeper. Following a few simple guidelines will help the process go smoothly.

- 1) Move bees when weather conditions are favorable. Bees are less defensive on sunny, warm days.
- 2) Ensure that the apiaries are not too moist from previous rains. It is an unpleasant experience being stuck in the mud with a fully loaded truck or flatbed of bee hives.
- 3) Move bees in early evening so the foraging bees are back to the colony.
- 4) Tie hives down securely to the bed and ensure they will not slide around.
- 5) When lifting brood chambers, be sure to use your legs and not your back.



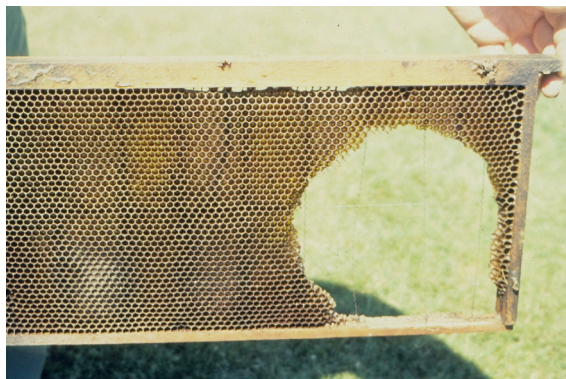
Fall and Winter Management:

The beekeeper's mind must always be thinking about the future and what the bees will require during the upcoming season to prosper. It is easy to be caught up in the excitement of the honey flow during the summer, but as the middle of July approaches the beekeeper should already be making plans for fall management. Some regions in the country have a fall honey flow that produces salable honey. However, Nebraska is not one of those states. All honey supers meant for producing saleable honey should be removed by the middle of August. The little bit of honey and pollen that are produced in the fall should be left in the colonies for winter.

Before going to all the work of preparing colonies for winter, the beekeeper must decide which colonies to keep. Two weak colonies with few food stores can be combined to form one strong colony by getting rid of one queen, placing a sheet of newspaper between the top brood chamber of one hive, and setting the second colony's brood chambers above the first's. By the time the bees eat through the newspaper, they will have had time to get use the odor of the remaining queen. The hive can then be reduced to two brood chambers and a super using a bee escape. The empty brood chambers can be nailed shut and stored from spring. The empty hives can then be restocked with a new package in the spring or used to make "splits". Colonies that are strong with a good queen and honey stores may end up being so strong in the spring that the colony will need to be split so as to make two colonies out of one. This is a good problem to have since the price of a new queen is cheaper than a package of bees. Queens can usually be ordered from the same supplier as your package bees.

To survive the winter a colony will need approximately 60-75 pounds of food stores.^{xi} This weight is in addition to the weight of the bees and hive, which is approximately 40 pounds. Each colony should enter the winter with two brood chambers and one super. The super and top brood chamber should be nearly full of capped honey to accomplish the desired amount of food stores. Fall feeding is often necessary in Nebraska for hives to reach the preferred amount of stores before winter. A mixture of 2 parts sugar to 1 part warm water should be used. Each gallon of 2 to 1 syrup will add seven pounds to the colony. While feeding sugar syrup, each colony should also receive a treatment of Fumagillin and Terramycin as indicated by their fall feeding instructions to help prevent nosema and European foulbrood. Feeders should be removed from the hives when adequate stores are in each colony or nighttime temperatures begin to drop below freezing. Feeders left in the hive half full over winter will cause condensation that collects on the inner cover and drips down over the bees chilling them and increasing mortality.

Selection of a winter apiary that is well protected from the northern and western winds and receives direct sunlight from the sun will greatly increase survivability of colonies. The sun's rays can be further utilized for heating by securely wrapping the sides of the hives with tarpaper. An entrance reducer should be place in the entrance with an intermediate opening during the fall and greatest restriction during the winter. This will help prevent robbing by



Winter mouse damage.

other bees and mice from taking up residence in your hives.

Bees will remove dead bees and periodically fly out of the hive during the winter to void their waste. Heavy snows can trap bees in the hive by blocking their normal entrances. A top entrance can be made by drilling a small hole in the front wall of the super. This will also help keep the hive dry due to increased ventilation.

ⁱ Ellis, Marion. "Beginning Beekeeping Workshop". 2003.

ⁱⁱ Nebraska Statewide Arboretum: FloraSearch. Retrieved 10-28-08. URL:
<http://citnews.unl.edu/florasearch/region.html>

ⁱⁱⁱ Stubbendieck, J., G.Y. Friisoe, & M.R. Bolick. Weeds of Nebraska and the Great Plains. Nebraska Department of Agriculture, Bureau of Plant Industry, Lincoln, Nebraska. Retrieved 10-28-08. URL: <http://plants.usda.gov/java/invasiveOne?pubID=NEGP>

^{iv} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 296-298

^v Ellis, Marion. "Beginning Beekeeping Workshop". 2003.

^{vi} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 88-93

^{vii} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 313-314

^{viii} Graham, Joe M. *The Hive and the Honey Bee*. Dadant & Sons, Inc. 2000. pp. 625

^{ix} Ellis, Marion. "Beginning Beekeeping Workshop". 2003.

^x Ellis, Marion D. & Paula A. Maced. *Using the Sugar Roll Technique to Detect Varroa Mites in Honey Bee Colonies*. NebGuide G01-1430-A. University of Nebraska-Lincoln.

^{xi} Dadant, C. P. *First Lessons in Beekeeping*. Great River Printing Company. Hampton, IL. 1997.

Developing and Adding Value to a Product

As described in the *How and Where to Begin* unit of this curriculum, the four major honey bee products utilized by humans are honey, pollen, beeswax, and propolis. It is recommended that beginning beekeepers focus on producing and marketing honey and wax related products during their first years of production. Honey and beeswax are produced in larger quantities per hive, require less expertise in the production and collection process, and have a greater demand by a broader range of customers. As your beekeeping business prospers with an established collection of mainline products that are your “bread and butter”, then you can consider expanding with more specialized products that target a more specific customer base.



This section provides basic information and simple recipes for honey and beeswax based products that are commonly sold by beekeepers. Keep in mind that selling a processed food product (such as extracted honey) through a retail store requires a food processing license from the State of Nebraska Department of Agriculture. A license is not required to sell honey from your home. A license is also not needed to sell beeswax products such as candles, soaps and furniture polishes from your home or in retail outlets.

Safety should always be considered when preparing a work area and processing honey and beeswax. Beeswax is a flammable substance and will ignite if heated to high temperatures. Its melting point is 145°F (63°C). The following items highlight safety concerns when working with beeswax.

- 1) Since beeswax is flammable, never leave the work space once you begin heating the wax.
- 2) A double boiler or wax melter should be used when heating wax to control uneven heating and possible ignition of the wax.
- 3) If the wax begins smoking it is too hot. Turn off the heat source and allow the wax to cool.
- 4) Do not pour hot wax down the drain. This can cause a clog that is difficult to remove.
- 5) If a fire occurs and cannot be contained by putting the lid on the pot to snuff it out, use a fire extinguisher rated for cooking oil based fires. **DO NOT USE WATER TO PUT OUT A BEESWAX FIRE!**
- 6) Be sure to wear clothing that covers skin and is not too loose. Baggy clothing can catch handles and cause spills.
- 7) Young children and pets should be removed from the area when hot beeswax is being processed.



Double boiler for melting beeswax

Cut Comb Honey:

Cut Comb Honey should be one of the first products that every beginning beekeeper attempts to produce. The benefits of production from a beekeepers viewpoint include minimal financial investment in additional equipment and ingredients required for processing and ease of marketing at a premium price. The one disadvantage of producing cut comb honey is that very little wax is harvested to use in making beeswax products. Do not let this disadvantage keep you from producing cut comb honey. For many beginners that start with only a few hives, cut comb honey is the only product produced by the beekeeper. Beeswax-based products can be made from wax purchased from other beekeepers.

Items Needed for Cut Comb Honey Processing

- Thin sharp knife
- A hot plate or stove top
- Kettle with hot water
- Tub for catching wax and honey
- Queen excluder
- Storage boxes
- Labels

It is important to standardize your beekeeping equipment to the type of products you are producing. The standard size for a square piece of comb honey is 4 1/8" by 4 1/8". Four standard squares of comb honey can be produced from a 5 3/8" frame of filled comb. These frames fit 5 11/16" supers. Comb honey foundation, which is thinner than standard beeswax foundation, should be used for its production. Comb honey must be produced during an intense honey flow. Some plants that provide intense honey flows include white Dutch clover, sweet clover, purple vetch and linden trees. Resources are abundant during intense honey flows and bees will quickly build comb and fill it with nectar. As bees get close to filling the first super, the next comb honey super with frames containing comb honey foundation should be added between the brood nest and the nearly filled super. The bees will begin producing wax to fill the second super while adding to and capping off the first. The first super should be removed once the cells have been capped off. The longer the capped comb is in a hive, the darker it will become as a result of bees walking across it. As previously discussed, this is called travel stain. It does not affect the flavor, but it reduces the eye appeal.

There are two types of 12 ounce boxes in which cut comb honey is packaged. One is a thin plastic clamshell style box that hinges to open. The other is a sturdier, hard plastic with a lid that seals tightly into the base. The sturdier containers, though more expensive, are recommended because they stack and protect the comb during storage. Pieces of cut comb honey cut to fit the two types of plastic boxes will weigh approximately 12 ounces. The clamshell containers will collapse if stacked, and they are only suitable for selling honey directly to the consumer. The sturdier boxes are meant for stacking and can be placed several high on a store shelf.

Before attempting to cut your comb, a template should be prepared that will create a consistent product that will fit your containers. To do so, cut a piece of clear plexiglass that fits the inner

diameter of your boxes. Then glue a small wooden handle on one side of the template. When the glue has dried, the template can be cleaned and sanitized for use.

Fresh comb is delicate and should be handled with care. To cut the comb, first prepare your work area by placing a tub, tray or pan on a table to catch any drip. A cafeteria tray works nicely for this purpose. Place a queen excluder across the tub so that honey and wax can drip into the tub when the honey comb is cut. Lay one of your frames across the queen excluder so that one of the capped sides is against the metal grate of the excluder. Begin by using the thin knife to cut the comb from the frame. Before cutting combs always place the cutting end of the knife in simmering water to heat it. Once heated, remove the knife, shake or wipe off the excess water, and placing the template flat on the comb at one of the frame's ends, cut around the template. Once the first piece is cut, move the template across the comb cutting additional pieces until four pieces have been cut. If there is a section in the comb that is flawed or not saleable, avoid that section and try to cut three quality pieces out of the comb. Keep in mind that you want to provide a quality product, but at the same time, each lost section is a lost sale. In other words be picky, but not too picky.



Specialized cut comb packing tanks are available from bee supply dealers and should be considered if you intend to produce comb honey from more than 2 colonies. Once all four pieces have been cut, remove the frame from the queen excluder, and lightly using your fingers, pick up cut combs one at a time and place them in their box and seal the lid. Once done processing cut

comb for the day, place the boxes in a freezer for 48 hours to kill any wax moth larvae. Comb honey will store in the freezer for several years without crystallizing, however, it is best to sell the current year's cut comb by the end of the season. Crystallization is a problem for comb honey producers and renders comb honey unsalable. Selling comb honey within 6 months of harvest is advisable, but freezing can be used to delay crystallization for up to 2 years. Do not place it in a refrigerator, as refrigerator temperatures will accelerate crystallization. Consumers who appreciate the delicate floral flavors of honey will be devoted customers for your comb honey. Floral flavors are volatile and some are lost in extracting.

Section comb honey equipment can also be used to produce comb honey, however using section supers predisposed bees to swarming, and new beekeepers will have more success with cut comb honey.

Extracted Honey:

Extracted honey is the common staple for beekeepers who keep more than a few colonies. It is difficult to dissuade beginning beekeepers from wanting to produce extracted honey during the first couple years of business, since it is what most people think of when the topic of honey or bees comes up. However, before deciding to extract honey, consider the following points:

- 1) It is difficult to compete with prices that honey packing plants sell their product for in a retail grocery store. Locally-produced honey, unique floral flavors, attractive labels and value-added products are what you should stress in marketing all of your hive products.
- 2) As a small producer, your cost of production per hive will likely be higher than large commercial operations. This will eat into your profit margin.
- 3) Extracted honey will require specialized processing equipment that is expensive.

If you so chose to begin producing liquid honey, you should consider moving your hives to specific flora or locations so you can market the honey as a varietal honey, such as sweet clover honey or Pine Ridge honey. Specific plants will provide unique flavors to the honeys created from their nectar. Diligence in separating the types of honey will pay off in being able to charge more than the price of a generic honey product.

The recommended tools and equipment suggested is for the producer under the size of 20 hives. As the size of your operation increases, larger assembly line equipment that is more automated may be needed.

Tools Needed for Extracted Liquid Honey Processing

- Cappings scratcher
- Heated cappings knife (optional)
- Bottling tank (optional)
- Extractor that handles four - 5 3/8" frames at once
- Extractor stand

- Uncapping tank
- Food grade 5 gallon bucket with lid and honey gate
- Double sieve strainer
- Fine nylon strainer cloth
- Bottling tank or several honey buckets with lids and honey gates
- Dehumidifier (optional)

Your first extracting experience can be an exciting time. If you use a home kitchen, cover the floor with a plastic cloth as propolis and beeswax are difficult to remove. The area that is to be used for extracting must be clean, sanitary, pest free, and dry. As the extracting and bottling process is taking place it is inevitable that some honey may be dripped on counter tops and/or floors. Honey is acidic and can be corrosive to concrete floors if left there for a long period of time. It is always good to have a damp rag available for cleaning up drips. Honey will naturally absorb moisture from its surrounding environment, and if it absorbs too much, it can ferment. Avoid storing combs awaiting extraction in a basement or other damp place. It is best to extract honey within 1-2 days of harvest. It is a good idea to have a dehumidifier if you intend to store unbottled liquid honey or supers of capped honey in the room for more than a few days.

Since you will be lifting and transferring heavy supers, buckets of honey, and uncapped frames filled with honey, equipment should be arranged so that lifting and transferring can be done in the least messy and physically straining way as possible.

The steps to extracting and bottling are as follows:

Uncapping: First the filled frames must have the wax cappings removed so the honey can be centrifuged out of the cells. This is done over the uncapping tub. Several companies make uncapping tubs that are useful. A sturdy plastic tub is adequate, but stainless steel is the best material for honey processing equipment. To remove the cappings, hold the frame vertical on the support located across the top of the uncapping tub and use a honey knife or capping scratcher to remove the cappings.



Using a capping scratcher to remove wax cappings.

Take care not to dig into the foundation, but the same degree of delicacy used for processing cut comb honey is not required with liquid honey frames. The cappings and some of the honey will drop down into the tub. Large cappings should be caught by the large screen grate and smaller pieces of wax and honey will drop to the bottom of the tub. After all of the cappings have been removed, place the frame in the extractor.

Extracting: Once enough frames have been loaded into the extractor to fill it, they must be spun so as to extract the honey from both sides of the frames. Small extractors are either powered by variable electric motors or by a hand crank. Radial extractors extract both sides of the frame at once, but take 12-15 minutes to run a set of combs. Tangential extractors extract one side at a time, and then the frames must be flipped to extract the other side. Though more labor intensive, tangential



Large radial extractor in action.

extractors take less time to extract a set of combs than do radial extractors. Each cycle should start at a slow speed. The mass of the honey in the frames is great enough that if full frames are started out too fast, the foundation wax can blow out making a mess in the extractor. Once some of the honey has been removed, faster speeds can be used to remove the remaining amount. The extractor should be drained after each cycle to prevent the liquid honey from touching the reel or basket.

Straining and Settling: Straining takes place at the outlet of both the uncapping tank and the extractor. A honey bucket with the double sieve strainer should be placed under both outlets. The strainer will help remove small pieces of wax by using a coarse wire mesh for the first layer and a finer wire mesh for the second layer. A fine nylon strainer cloth may be placed between the first and second layers of wire mesh that is disposable and makes cleaning of the wire mesh strainer easier. Once the bucket is full it may be dumped into the bottling tank for settling. Honey should be settled for at least 24 hours to allow the foam and froth introduced during extraction to rise to the top where it can be skimmed. If not allowed to settle before bottling, the air will settle in the bottles giving an unattractive frothy appearance at the top of the container that is unattractive.

Bottling: A variety of bottles and containers are available for liquid honey. The best selling sizes are 12 ounce and 16 ounce bottles. Some customers prefer larger containers, but for the majority these two sizes will be the most marketable. Most bottles come with caps that have an adhesive seal that seals the bottle the first time the cap is secured. Weigh a few test bottles to consistently fill containers with a uniform weight.

The honey should be stored at room temperature, preferably where there is little fluctuation in temperature. Wax cappings collected during the process should be rinsed with water to remove honey residue and then place in a wax melter. For a small beekeeper, a solar wax melter can be built that uses the sun's heat to melt the wax. Plans for building a solar wax melter have been provided in the Additional Resources section of this publication.



Beeswax cappings.

Chunk Comb Honey:

Chunk comb honey is a combination of cut comb honey and liquid honey. It is made by placing chunks of cut comb in a jar and then filling the remainder of the jar with liquid honey. It is a beautiful product with a unique history.

During the early 20th century some dishonest beekeepers blended their liquid honey with other sweeteners to make it cheaper to produce. The honey blends were still marketed as 100% pure honey, and because they looked the same as pure honey, most consumers could not tell the difference. Once customers discovered that this was taking place, they became skeptical of purchasing liquid honey. Honest honey producers discovered that marketing their liquid honey with a chunk of comb honey increased sales. Consumers knew that cut comb honey cannot be artificially produced so they were more willing to purchase a product that contained a honey comb.



No additional tools other than those described in the cut comb section and the extracted liquid honey section are needed to produce chunk comb honey.

Lotions, Creams, and Lip Balms:

There are many cosmetic recipes that utilize honey and beeswax as ingredients. Making such products requires a separate set of common kitchen utensils and the purchase of additional ingredients such as essential oils, extracts, and moisturizers. Another benefit of making honey and beeswax based cosmetic products is that they can be sold at a greater profit margin per unit than many of the edible products.

Tools Needed for Making Lotions, Creams, and Lip Balms

- Double boiler set up
- Glass or plastic mixing bowls
- Mixing spoons
- Plastic/silicone spatula
- Measuring spoons
- Measuring cups
- Emersion blender/hand mixer (optional)
- Blender (optional)
- Containers for products
- Kitchen scale

Lip Balms

Recipe 1ⁱ

Ingredients:

.5 oz beeswax
.6 oz coconut oil
.4 oz cocoa butter
.1 oz almond oil (optional—makes a softer balm—good in winter)
few drops of mint flavoring

Recipe 2ⁱⁱ

2 oz. shea butter
.7 oz. beeswax
10-20 drops essential oil of choice

Recipe 3ⁱⁱⁱ

1 tbsp. shredded beeswax
1 tbsp. petroleum jelly
1 tsp. honey
1 tsp. lanolin
3-4 drops essential oil of choice

Optional ingredients for above lip balm recipes: tea tree oil, aloe vera, glycerine, vitamins A or E.

Lip Balm Directions:

- 1) Melt together using a double boiler at a medium heat.
- 2) Add essential oils after all oils/waxes are melted.
- 3) Pour into small tins.

Lotion Bars

Recipe 1^{iv}

Ingredients:

3 oz beeswax
3 oz cocoa butter
3 oz almond oil

Optional Ingredients:

Scent-essential oil

Grapefruit seed extract, aloe oil, vitamin A or E, tea tree oil (any/all acceptable)

Directions:

- 1) Melt ingredients together at a medium heat with a double boiler setup.
- 2) Pour into 6—2 oz. molds or small tins. Cool 2 hours.
- 3) Store in sealed bag.

Perfect Moisturizing Hand Cream^v

Oil-Based Ingredients:

¾ cup apricot oil &/or sweet almond oil

½ cup coconut oil &/or cocoa butter

1 tsp. anhydrous lanolin

½ oz. grated beeswax

Water-Based Ingredients:

2/3 cup distilled water, rose water, or orange flower water

1/3 cup aloe vera gel

A few drops of the essential oil of your choice

Vitamins A and E (optional)



Directions:

- 1) Heat the oil-based ingredients over low heat in a double boiler until all are melted. Stir gently to mix well.
- 2) Pour the oil mixture into a glass measuring cup and cool to room temperature.
- 3) Place the water, aloe, essential oil, and vitamins in a blender. Turn to the highest speed. In a slow, thin drizzle, pour the oil-base mixture into the center hole of the blending mixture.
- 4) When most of the oil-based mixture has been added and the cream resembles a butter-cream frosting, turn off the blender (you may not need all the oil base mixture). Do not over-beat. The cream should be rich and thick and continue to thicken as it sets up.
- 5) Pour into cream jars/bottles, label, date, and store in a cool place.

Crystallized Honey:

The Dyce Process for Making Crystallized Honey Summary^{vi, vii}

Crystallization is a natural process by which honey forms large star-shaped crystals during the aging process. Naturally crystallized honey, though edible, has a gritty texture and a rough mouth feel. When crystallization is controlled through the Dyce Process, smaller plate-like crystals are formed that produce a velvety smooth spread that commands a premium price.

The Dyce Process was developed and patented by Elton J. Dyce of Cornell University in 1931. The purpose for its development was to reduce the annual losses of honey to fermentation, which can result after natural crystallization occurs. At that time both processes were not completely understood. Crystallization itself does not ruin honey, but when natural crystallization occurs, honey often forms a solid and liquid phase with the liquid phase being higher in moisture and subject to fermentation. On the contrary, honey made by the Dyce Process is smooth in texture and sells for twice as much as extracted honey. Consumers are willing to pay higher prices for crystallized honeys with finer, smoother textures.

Tools Needed for Making Crystallized Honey

- Kitchen scale
- Large mixing bowl/container
- Mixing spoon/Large metal whisk
- Containers for crystallized honey
- Double sieve strainer
- Fine nylon strainer cloth
- Double boiler
- Scrapers/spatulas

The Dyce Process ensures a high quality product that adds value to a beekeeper's honey and variety to his or her product line. The first step is to heat the honey to 120°F using a double boiler. Strain the honey to remove any wax particles, pollen, or foreign matter using a wire mesh strainer that contains 100 squares per square inch. During straining and other steps in the Dyce Process it is important to avoid mix in additional air. Air bubbles can produce a frothy, unattractive appearance that customers dislike. Once strained, the honey should be heated to 140°F for 30 minutes to kill off foreign yeasts.

After 30 minutes, the next step is to rapidly cool the honey to room temperature. Scrapers should be used to remove honey from the edges of the container as it cools so the honey does not form a thickened insulation layer that keeps the rest of the honey from cooling quickly.

Once the honey has reached room temperature (75°F), starter crystals may be added. For the initial batch, non-flavored crystallized honey should be purchased from a grocery store to use as the starter. After the first batch is made, part of that batch may be saved back as starter for future batches. This process of saving back crystallized honey to be used as starter can be done several time over, but every once in a while it is a good idea to start over with purchased starter. The introduced starter should be approximately 10% mass of the total sized batch being made. Using a large spoon or stirring device, slowly mix the starter until it is evenly distributed throughout the honey. Once again, be careful not to incorporate too much air into the mixture as you stir.



Starter crystallized honey added.



Tools used for mixing in starter crystals.



Carefully mixing in starter crystals.

At this time optional colorings, flavorings, and spices may be added to create a flavored product. Ingredients such as freeze dried fruit powders and are popular additives. The National Honey Board at www.honey.com is a good place to start looking for recipes. If freeze dried fruits are used, buy the fruits in small lots because they tend to be expensive and can lose flavor with age. After evenly distributing the starter and optional ingredients, let the mixture settle for 1-2 hours. Any bubbles that settle to the top will appear like frosting. They may be skimmed off the surface after the settling period.

Next, the mixture is to be poured into containers. Container selection for crystallized honey is often a question of function, attractiveness, and personal preference. Clear-sided containers should be avoided until the Dyce Process has been mastered. Air bubbles, unevenly mixed starter, and non uniform set can result in a fractured appearance that leads customers to think there is a problem with the product. After pouring and sealing the lids on the containers, place them at a constant temperature of 57°F. This can be achieved by connecting a refrigerator to a wine cooler thermometer (available from brewing supply stores). The honey will be firm in three days and ready to market in six days.



Pouring newly mixed crystallized honey.

After being at 57°F for six days, the honey should be conditioned by removing it from the refrigerator and placed in a warm room (85°F is ideal) until it is soft enough to be spreadable. This may take up to three days. Once softened, the honey will not return to its harder state. Conditioning ensures that the crystallized honey does not become too hard or pull away from the edges of the container. After conditioning the crystallized honey will maintain its solid state at room temperature, but if it gets too warm it will turn to liquid form. If crystallized honey liquefies, it will not reset. It needs to be reheated and the process started over.

Dyce Process Summary:

- 1) Heat honey in a double boiler to 120°F and strain foreign matter.
- 2) Pasteurize the liquid honey by increasing temperature to 140°F for 30 minutes to kill foreign yeasts and liquefy any crystals that might be present.
- 3) Quickly cool honey to room temperature.
- 4) Blend in about 10% (by weight) finely crystallized “seed” honey and mix until uniform. Flavorings, colorings, dehydrated fruit powders, and other ingredients may be mixed in at this time.
- 5) Place mixture in containers and store upside down for 6 days at 57°F.
- 6) Condition the crystallized honey by heating it in an 85°F room until it spreads easily.
- 7) For longer storage, keep products in a cool location that is above freezing. Too much heat for long periods will lead to liquefaction.

Easy recipe for cinnamon crystallized honey^{viii}

- 9 pounds liquid honey
- 1 pounds of starter
- 2 tbsp + 2 tsp of cinnamon (1/6 cup)

Furniture Polish^{ix}:

Beeswax creates an excellent furniture polish for finished woods. When appropriately applied, it creates a soft and deep shine that will outlast many competing products. Several recipes are available that contain a combination of beeswax and other waxes or oils. Be sure to prepare a set of instructions to provide your customers on its use and applications.

Tools Needed for Making Furniture Polish

- Double boiler
- Mixing spoon
- Bottles for liquid polish
- Funnel for filling polish
- Safety gloves and goggles

Liquid Beeswax Polish

- 4 ounces beeswax
- 2 tablespoons carnauba wax
- 2 ½ cups mineral spirits or Turpentine (can be found at craft stores)

Directions:

- 1) Melt the waxes in a double boiler.
- 2) Remove the waxes from the heat and stir in the mineral spirits.
- 3) Allow to cool to room temperature.
- 4) Bottle the polish.

The liquid polish can be used for finished wood surfaces such as floors, furniture, paneling, and other woodwork. It can also be used to polish metal, chrome, and glass. After waxing these surfaces, avoid dusting them with an oiled cloth, or the surface will have to be buffed with a clean cloth to bring back the shine.

Soaps:

Beeswax soap provides an endless array of recipes for the adventuresome entrepreneur looking to add variety and uniqueness to his or her product line. Soap making involves chemicals (such as lye) that can be hazardous. It is highly recommended to invest time in reading additional books and, if possible, to visit an experienced soap maker before jumping right into the process. An excellent book to read is *The Soapmaker's Companion* by Susan Miller Cavitch^x. Proper research will increase your likelihood of success, and help you to learn how to avoid potential hazards that can be experienced by careless soap makers.



Soap is made through a chemical reaction called saponification. In the reaction, triglycerides from fats and oils react with bases to produce soap and glycerin. There are many different fats and oils from which triglycerides can be obtained. Beeswax is one such source that extends shelf life and increases hardness of soap. Since each source provides unique qualities to the end product, most recipes use a combination of fat and oil sources to create soaps that are appealing in appearance, texture, and lathering ability. Additional ingredients such as moisturizers and fragrances may also be included for special purpose soaps.

The simplest process for creating beeswax soaps is *The Cold Process*. It is so named because once the fats have been liquefied by heat and the base solution (most commonly lye or sodium hydroxide) is added the ensuing reaction will generate heat, requiring no additional warming from an outside source to continue the reaction. The temperature to which the fat/oil mixture and the lye solution are heated before mixing varies with the recipe and ingredients. Follow the recipe directions carefully. As you become more familiar with the process, changes can be made according to your preferences.

As the liquefied fats and oils come in contact with sodium hydroxide, the triglycerides are broken down into fatty acids that bond with sodium ions from the lye. The hydroxide ions then react with the left over glycerol molecule from the triglyceride to make glycerin. Saponification is an exothermic reaction (gives off heat) that can cause painful burns if direct contact with the skin occurs. It is always recommended to wear chemical safety goggles and protective rubber gloves while making and pouring the soap. Clothes that fully cover your arms, legs, and feet should also be worn.

Special consideration must be taken when purchasing and handling lye. It is a caustic base that is often used in drain cleaners and other plumbing products. It is corrosive to all tissues and can cause chemical burns to the skin and blindness if splashed in the eyes. It is equally damaging to internal tissues if swallowed. Treat it with great respect and seek medical attention if contact with skin or eyes occurs.

Lye should be purchased in dry, powdered form. Small amounts can be purchased from supermarkets in the drain cleaner aisle. Red Devil Lye is one such source that comes in a plastic 1 pound canister. Larger amounts can be purchased by mail from chemical companies. Some restrictions may apply to the quantity that can be purchased. Sodium hydroxide should be stored in a dry location. Moisture can cause it to clump and make it hard to handle. DO NOT confuse lye (sodium hydroxide) with agricultural lime (calcium carbonate) or quick lime (calcium oxide). If in question, make sure that the product only contains sodium hydroxide.



Tools Needed for Soap Making:

- mixing spoon
- metal whisk
- stove or hotplate
- 8 quart stainless steel pot
- 2-3 quart heat resistant glass bowl or pitcher
- 2 heavy-duty silicone or rubber spatulas
- kitchen scale that measures both in grams and ounces
- candy thermometer measuring 0-220°F
- trays or molds (5 lbs of soap poured into rectangular tray measuring 15" x 7" makes fifteen bars measuring 2.9" x 2.28")
- heavy-duty waxed freezer paper for lining trays
- masking tape
- a sharp, thin paring knife for cutting and trimmer soap
- safety goggles and gloves

When selecting your equipment be sure that it is made of materials that will not corrode or discolor the soap during saponification. Avoid using equipment made of aluminum, tin, iron, cast iron, Teflon, and weak plastics. Wooden materials work for a while, but as they age, the wood splinters leaving particles in the soap. Rubber and silicone molds hold up longer than wooden ones.

There are some soap making terms that must be understood when seeking out soap recipes. Tracing time is a measure of how much sodium hydroxide reacts with the fats and oils per unit of time. As soap begins to form during saponification, the liquid mixture begins to thicken forming soap. The mixture has reached trace when a trickle of soap dripping off a mixing spoon into the mix leaves a line or texture that does not melt immediately back in. Quick stirring, stronger lye solutions that incorporate little water, and higher temperatures increase the saponification reaction. This reduces that amount of time it takes to achieve trace. Mold time is the amount of

time the soap must sit in the mold to solidify to the point where it can be safely removed from the mold without damage. Cure time is the time needed for all the sodium hydroxide to be used up in saponification. At this point, the soap should be usable and salable.

The following recipe is for making 24 ounces of Honey Oatmeal Scrub Soap. It is a good recipe to start with and as you become more comfortable, larger batches can be made by doubling or tripling the ingredients.

Honey and Oatmeal Scrub—cold process soap^{xi}

Fats and Base Oil Ingredients:

6 oz. olive oil
5 oz. shortening (Crisco)
3 oz. coconut oil
2 oz. palm oil
1 oz. beeswax

Fat temperature: 140-150°F
Lye-water temperature: 140°F
Tracing time: 20 minutes
Mold time: 24 hours
Cure time: 4-6 weeks

Lye and Water Mixture:

2.4 oz. lye***this is sodium hydroxide or caustic soda (NEVER use other drain cleaners)
8 oz. cold water

Additional Ingredients:

½ cup fine oatmeal
1 tbsp. honey
2 tsp. fragrance/essential oil

Assemble desired mold(s). This recipe will make approximately 24 oz. of soap or 6—4 oz. bars. Prepare safety measures (goggles, rubber gloves, vinegar, clear space, remove animals/pets)

Measure all ingredients by weight. Place all fats and base oils in a stainless steel, glass or enamel pot over a low heat. Pour the water into a heavy glass or plastic bowl or pitcher. Carefully add the lye to the water and stir to dissolve. When the oils have melted, remove from heat.

Using a candy thermometer, monitor the temperature of each container. When both solutions have reached the desired temperature, slowly pour the lye into the oil. Stir until the mixture reaches the trace. (The mixture has thickened to the point where you can trickle some soap off the back of a spoon and it will leave a trace line on the surface of the mixture.) This should take about 20 minutes but can take hours for some recipes.

Add the secondary ingredients and stir well to distribute evenly throughout the soap. Pour into desired molds. Cover with a towel or blanket to insulate the soap during the initial cooling. After 24 hours the soap should reach a solid consistency. Place the soap—still in the mold—in the freezer for 1-2 hours before unmolding—allow to stand 15-20 minutes at room temperature. Wearing rubber gloves, remove the soap from the molds and cut into slices or desired shapes. Place soap pieces on a covered surface and lightly cover with a towel. The soap should be

allowed to cure for 4-6 weeks before using. Soap will retain its fragrance longer if stored in an air-tight container.

Candles:

For well over two millennia beeswax candles have been regarded as a high quality source of light. Beeswax produces a slow, clean burn with aromatic qualities that are preferable over paraffin and tallow candles. Amongst the many products that can be made from beeswax, candles provide both exciting challenges and sales for those seeking to pursue the art form. As stated in the book *Basic Candle Making: All the Skills and Tools You Need to Get Started*, the two most important ingredients are time and patience.^{xii} Many of the steps involved in making various candles are similar. Once comfortable with performing the basic steps, the beekeeper can add his or her special touches to achieve a unique product.

The two basic candle types that the beginner should start with are molded and container candles. Once these are mastered, specialty candles such as hand-dipped tapers can be attempted.

Tools Needed for Making Molded and Container Candles

- double boiler wax melter (optional but recommended)
- stove or hotplate with coffee can suspended on pot of water (temporary double boiler melter)
- molds (come in metal, silicone, & plastic)
- tempered glass containers
- mold sealer (gumlike material that seals wick holes in molds)
- wicking (must match the size and type of candle being pored)
- metal wick tabs
- scissors
- mold-release (silicon spray)
- hair pins to center wicks
- long needles for threading wicks in silicon rubber molds
- small scale
- wax paper
- old newspapers



- rubber gloves and oven mitts
- wax removing solvent (turpentine)
- protective clothing to protect against possible hot wax spills
- fire extinguisher rated for cooking oil based fires

The Wax Melter/Double Boiler should be made of stainless steel. Other metals or non-stick containers may discolor that wax or deposit particles in it which will lower the overall appearance.

Both molded and container candles involve pouring heated beeswax into vessels holding a wick at the center that can be burned when the wax hardens. The difference between molded candles and container candles is that container candles remain in the vessel in which they were poured while molded candles are removed from their molds after they cool.

Container candles are easier to make; however, the containers add considerable costs to the candle. Tempered glass or decorative tins are popular containers. Such containers can be purchased through craft stores or specialty candle supply catalogs. Containers made from untempered glass can shatter at high temperatures and should be avoided. Canning jars can make attractive containers and are tempered for high temperatures.

Molds come in all shapes and sizes; however, they are usually made out of metal, silicone, or hard plastic. Metal molds tend to be less intricate in detail and are used for large block candles. Block candles are any candles (square or round) that have been formed through pouring, not dipping like taper candles. They have a long usable life and do not easily warp. Silicone molds that pop-out or peel-back from candles can provide more detail to the surface of the finished candle. They also expand and contract well with temperature fluctuation; thus, extending their usable life. Metal and plastic molds require a mold release spray for easy removal. Silicon spray is not needed for silicone rubber molds and may harm the molds.

Hard plastic molds have the shortest usable life of the three types due to their tendency to warp. However, they are relatively easy to clean and store. They are also less expensive than metal or rubber/silicone molds. Such molds are a good place to start for beginning beekeepers.

Selecting the appropriate wick type and size is important. If the wick is of the wrong type, shape, or diameter, the candle will not burn correctly. The two types of wicks include cotton-core and wire-core. Cotton-core wicks come in either square-braided or flat-braided. Square-braided wick is used mostly for block candles. Though called square-wick, it appears more round than square. It comes in numbered diameter sizes. The larger the number, the larger the wick is. Flat-braided wick is used mostly for taper candles, but can also be used for small pillar candles. Its diameter is measured by the number of plies, or strands in the wick. The higher the number of plies, the larger the wick is. Wire-core wick has wire at the center of the wick, usually made of zinc, so it holds upright during pouring. It is used for container and votive candles. It comes in small, medium, or large size diameter.

Estimating the amount of wax needed for the number of candles you want to make your first few times can be tricky. To make your estimation, plug the wick hole in your mold with mold sealer. Weigh the empty mold on a scale in ounces. Fill the mold with water and weigh it again.

Subtract the full weight from the empty weight. Every 9 ounces of water in a mold equals approximately ½ pound of wax.^{xiii}

An area for making candles should have the following and be prepared accordingly:

- 1) Select a location where there is plenty of counter space/floor space where newspapers with wax paper may be placed over the top for candles to cool. A heat source must also be available.
- 2) Arrange your tools so that there is a natural flow in the work area. There should be limited distance between the locations where the wax is heated to where it is pored and cooled.
- 3) Ensure that the cooling surface the candles will be sitting on is level. Uneven surfaces produce uneven candles.

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Marketing Your Product

Customers can be grouped into three categories: (1) repeat customers with whom you have established a steady relationship, (2) first time buyers, and (3) one time buyers. The first time buyer is one with whom there is the possibility of creating a regular customer, whereas the one time buyer will only buy once due to reasons unrelated to you or your products. It is the hope of the entrepreneur that every first time buyer will become a repeat buyer; and that every sale regardless of the type of buyer is a sizable one.

Quality, creativity, and uniqueness are the three pillars upon which you should build your honey bee value-added products enterprise. As described in the extracted liquid honey section of the Value-Added Products Unit, you can maximize profits by selling unique honey and beeswax products that are not readily available from retail stores. Customers will expect to pay competitive retail prices for items like blended liquid honey. Such prices will produce little profit per item sold. However, products that are unique to your business and are of higher quality than the average products will have greater appeal and sell at prices that are more profitable. The quality and uniqueness of your products will distinguish you as you creatively craft a business image that customers will remember.

Developing a Business Logo and Product Labels:

Part of creating a business image is having a logo that customers appreciate and identify with your products. A good logo is simple, easy to read, often has an image or graphic associated with the product, and uses appealing colors to draw the attention of the customer. Once a logo has been established, individual labels for each product type can be created using the same design principles. The logo is often incorporated in all product labels. Remember that your products may only have a few seconds to make a first impression as customers walk past your stand. Your logo and labels will likely be part of that initial impression. Much can be learned by searching the Internet for examples of different logos and product labels. Take notes on your likes and dislikes, and note labels that emphasize local uniqueness. You must always keep the customer's viewpoint in mind. As you view examples ask yourself, "What is the message you want conveyed to your customers?" After deciding upon a message and getting a general feel for your likes and dislikes, try creating a pencil sketch of what you envision for your logo. After a sketch is made, colors can be added to produce a full effect. The National Honey Board at www.honey.com has several clipart items that are downloadable and may be used for logos and advertising.



A science within the advertising world has been developed based upon researching consumer attitudes and preferences relating to color. Many printed and Internet resources discuss the effects of color upon consumer preference.

Once the business logo and labels have been designed, the next step is to meet with a commercial printing business or to purchase a color laser printer to print your own labels. Ink jet printers can produce beautiful labels, but the ink is water soluble and is easily smudged. A printer will be able to help you match the design and label size to the type of containers being used. The National Honey Board Web site has detailed information about what must appear on labels. While ready to use labels are available from some beekeeping supply companies, a custom label will better distinguish your products.

Advertising Practices:

In order to make a sale, the customer must first know your business exists and the products you provide. Part of your beginning business plan should include an advertising budget. Be creative to keep your costs low. Here are some suggestions to consider.

- Local Newspaper: Contact your local newspaper and ask if they would be interested in hearing your story about the new business you are starting. Public interest stories that involve a new entrepreneur in the community are big hits with readers and provide good exposure at little expense. Have an information sheet prepared for the newspaper representative for the interview that contains a high quality image of your business logo, products sold, and your contact information. It is also a good idea to give the interviewer free samples, such as a box of cut comb honey, so he or she can give personal testimony to its quality.
- Advertising Flyers: Attractive flyers can be created on a word processor and printed on a color ink jet printer. A good flyer draws in the attention of the viewer and provides enough information without being over detailed. If a large number of flyers are to be printed, it may be cheaper to have them made at a local print shop. The flyers should answer the following questions:

(1) *Who owns the business?*

(2) *What products are being sold?* Prices may be included.

(3) *When are appropriate business hours to contact you in person?*

(4) *Where is your business located?* You may provide more than one option depending upon where you sell your products. Many producers sell from their homes as well as have regular farmers market stands during the summer and fall months.

- (5) *Why should the customer buy your product?* This is a question of motivation. It does not require a large explanation, but a small statement that sets your products apart from the average. Phrases such as *value added*, *locally produced*, and *natural* are terms that may motivate people to buy your products over retail competitors. Avoid the term “organic” unless you are producing according to the guidelines specified by the USDA.
- (6) *How does the customer contact you?* In person, by phone, and e-mail are all popular methods of communication. With free e-mail providers such as Yahoo, Google, and Hotmail, it is a good idea to create an e-mail account that you devote to your business and check regularly.

Places of high visibility and traffic flow are good locations for distributing flyers. Convenience stores, post offices, and community centers often have posting boards that can be used with permission. It is your responsibility to remove the flyer once it is outdated. An old flyer can become negative publicity for your business.

- Internet: Several websites exist that allow registered users to create their own personal or business websites. An Internet site can be as simple as providing the same information as a flyer, or it can be as complex as being an online store through which customers can order products, make payments, and have their purchase shipped to them. Some products such as cut comb honey do not ship well by mail and other factors must be considered before attempting to sell online. Setting up an online business is a major undertaking, and there are many things to be considered before doing so. It is recommended that you contact university extension or your local community college to see if they have an upcoming class relating to Internet design and setting up an online business.
- Word of Mouth: Do not disregard the power of promoting your business through personal interaction. Create a list of the social and work-related/school related activities you attend on a regular basis. Decide which ones may provide good opportunities to share and promote your products. Providing refreshments at meetings, social engagements, and family gatherings can open the door to new sales.
- Newsletters: The quarterly or semiannual newsletter can be a powerful tool in maintaining contact with your regular customers. When making a sale to a first time buyer, ask if they would like to provide their mailing and e-mail addresses to receive your newsletters. Newsletters can inform customers about current products, what is happening in your apiary, interesting information about honey bees, and recipes that use your products. A newsletter can create a personal connection with your regular customers and reinforce their loyalty to you and your products.

Seasonality of Honey Bee Products:

Good beekeepers always plan ahead in managing their honey bee colonies. The same is true for the management and sale of honey bee products. Planning ahead by marketing products that meet the following seasonal criteria will provide increased exposure and sales.

- 1. Match the function to the season.** Dry lips and skin are a common problem in colder climates during the fall and winter months. Items like moisturizing bars and lip balms with added moisturizers may sell better during these seasons. Adding an appropriate sun screen can make such products more marketable during summer months. Holidays like Christmas and Hanukkah place a greater demand on taper candles and pillar candles. Think about the different products your business offers and emphasize marketing them to meet seasonal needs. If you identify a time of year where your current product line does not have a great demand, brainstorm some options for expansion with a new product or marketing strategy.
- 2. Match the flavors and aromas of the season.** People often associate certain times of the year with particular flavors and aromas. Strong, heavy herbs and spices such as mint, nutmeg, and cinnamon are popular in winter whereas citrus is a good summer seller. Do some research to see what is popular during different times of the year and think about products that might match consumer preferences.
- 3. Tie the item to the sentimentality of the season.** Many people tie seasons and holidays to different emotions or sentiments. Christmas brings out feelings of generosity and love, while spring brings feelings of revitalization and new life. Independence Day instills a sense of pride in country and celebration of freedom while fall fosters the promise of a bountiful harvest and enjoying the fruits of one's labors. Seasonal sentimentality can become buyer motivation when your products are marketed to match. Patriotic labels and ribbons on certain products around Memorial Day or a flyer reminding people to treat their "sweetheart" to a Valentine's Day basket containing honey products from your business can help boost sales. The following list provides some examples.



January: weight loss, fitness, new year resolutions
February: Groundhog's Day, Valentine's Day
March: Saint Patrick's Day, spring begins
April: rainy day snacks
May: Memorial Day, family barbeque's, Mother's Day
June: Summer begins, Father's Day
July: Independence Day
August: back to school
September: Labor Day, fall begins

October: Halloween
November: Thanksgiving
December: Christmas, Hanukkah, winter begins

- 4. Locate yourself in areas of high seasonal visibility.** The most common locations, other than selling from your home, are local farmer's markets held during the summer and early fall months. However do not limit yourself to farmers markets. The summer time offers a large number of town celebrations and county fairs that can be very profitable. Networking with other entrepreneurs can also be beneficial. A growing number of agritourism businesses such as pumpkin patches and corn mazes have become fall favorites for many families. Christmas tree lots also have a high volume of traffic during a time of year when buying gifts is a common practice, and products packaged in gift baskets sell especially well.

Stand Considerations:

Using a transportable booth or stand enables you to take products to locations where there are potential customers with whom you may not otherwise do business. Setting up in such locations can boost overall sales and provide opportunities to promote your business. The following points should be considered when planning the use of a stand to sell your products.



- 1. Lost Opportunity Cost:** Lost opportunity cost is the value placed on the loss of the next best alternative that could have been chosen if the current choice (i.e. setting up a stand at the county fair) was not selected. In calculating the cost of an opportunity, one must always take into account Financial Cost and Time Cost. Financial expenses can quickly add up if traveling over long distances and overnight lodging is required. Larger fairs and town celebrations charge vendor fees. Will your sales offset the additional costs? Time is also important to consider. Even if your net sales come out ahead, what was your time worth? For example, you work three 10-hour days at an event that is close enough to home that you are able to return home each night. After the event, you calculate that your net profit after expenses being subtracted was \$150. That equals out to \$5/hour, and it does not calculate into the equation the amount of time you put into production of the products, setup and break down time of the stand, taxes, and most importantly what could have been done with that time for the business or you personally if you had not attended the event. Could more money be made per product sold by avoiding the costs of attending the event and patiently selling out your front door? Would the advertising received from working the event gain added value to my time rather than time spent working in the apiary? Such questions should be thought about before filling a calendar to work every local event during the summer and fall months.

2. Location: When attending a large event with many vendors, are you the only stand selling honey, or will you have competitors? In some instances vendor slots are predetermined, but in other cases it is first come first serve. Locations where there is a high traffic flow are best. Shaded locations with electrical and water access nearby are also helpful. Always be prepared with plenty of extension cords, hoses for water if needed, and a way to keep products shaded and cool. In some cases, a generator may be required if no electrical outlets are available.
3. Personal Care in Extreme Weather: Always be prepared for extreme conditions. Pay attention to the weather and have a plan prepared for quickly storing and protecting yourself and, if possible, your products in the case of a sudden thunderstorm. A cool, rainy day or hot, sunny day can also be harmful to your health. It is wise to have sunblock and a changes of clothes for various weather conditions.
4. Care and Storage of Products on Site: Protection from extreme temperatures, precipitation, and animal pests are the three biggest concerns when selling from a stand. All other products besides those being displayed should be stored in boxes and located away from direct sun and heat. Boxes of products should also not be placed directly on the ground to prevent water damage and pest infestation. A pair of parallel 2"x 4" boards works well for simple box stands. If samples of edible products are provided, be attentive to keeping the sampling area clean and containers of products closed. Having two buckets, one with water and one with diluted bleach/water solution and a washcloth for each to periodically wipe down the sampling table is also a good idea.
5. Product Placement and Display Appearance: The display table/shelves should be filled with your products. A smaller table that is filled with products is more appealing to the customer than a large table with empty space and a few products. A table filled with a variety of product types and sizes of each product will also be more interesting to the customer than a display filled with only one type and size. A stand with only 12 ounce bear bottles of honey will have much less appeal than a stand with a diversity of products and packaging sizes. Products should be placed so the labels face the customers and make sure that similar products are grouped together. You will sell more honey from a full table than from a table that is sparsely stocked. A small, visible area of the table should be devoted to providing contact information and educational materials about honey bees. Honey bees spark curiosity and wonder in customers, and a small educational display, such as an observation hive, will increase sales. Remember to keep it simple, and to have your contact information on every piece of literature that is free and available for customers. You must always protect the observation hive from direct sunlight and be sure that it is securely mounted on a table or stand. The observation hive should be sealed (no exit) during the time it is on display. A free flying observation hive in an area where there are many people, is NOT RECOMMENDED.
6. Financial Considerations: A certain amount of start-up money should be prepared and recorded before opening each day. The amount required will depend upon the size of the event and the volume of sales expected. A receipt book with carbon copies is a simple way to keep track of product sales during the day. At the end of the day, the carbon copies can be used to see if the amount of money in the cash box matches the sum total of sales plus the start-up money. They will also help track changes in inventory.

7. Salesmanship: Making a sale is much like applying for a job. Though an application or resume may get you an interview, the interview itself is where you close the deal. Your flyer or catchy logo may attract customers in, but you still have to make the sale. This is especially true when you set up a stand at a public event where there are many vendors trying to attract customers to their booths. Using the following suggestions may help you increase your sales:

- (a) *Appear approachable*. Stay attentive, appear friendly, and make eye contact with passing individuals. Though you may be tired or uncomfortable after a long day, remember you are there to try and make sales. Few people want to buy a product from an individual that has fallen asleep at their stand or appears fatigued.
- (b) *Approach observers*. Approach individuals that have stopped to observe the stand. Introduce yourself while offering a handshake and looking them in the eye. Ask them if they have tried your products, and be prepared to follow that question with suggestions of one or more items.
- (c) *The power of suggestion*. Encourage customers to consider adding another item to their purchase as they pay at the cash register. This can be done verbally suggesting an item or non-verbally by locating a collection of certain items next to the cash register. Honey sticks, lip balms, and beauty products work well for this location.
- (d) *Customer survey cards*. Create a small customer survey that can fit on a postcard. As part of the survey ask them to include their name and address. Also have a box they can check to indicate whether they would like to receive further correspondence regarding your product line. To further motivate individuals to fill out the cards, advertise a drawing for a free bottle of honey to be selected from the postcards that are filled out. This will give you a chance to follow up with customers.
- (e) *Thanking customers for their business*. A very simple way to extend courtesy to your customers is to thank them for their business as their change is handed to them. This is often overlooked by sales representatives, but remembered by customers.

Writing a Business Planⁱ

Risk is a part of every business. An important role of a business owner/operator is to manage risk so as to reduce it to a level that is reasonable while maintaining profitability of the business. A major step in managing risk during the establishment of a business is creating a business plan. A business plan is like a road map that provides direction to a series of desired destinations. It also takes into account the entrepreneur's current financial and physical situation, his or her needs that must be met to be able to successfully make the journey, and a strategy for how to make the journey. Much detail and thought are required to complete a business plan; however, doing so will greatly reduce the risk involved and increases the likelihood of success. Follow the steps below, which will guide you through creating a basic business plan.

- 1) In the space provided, describe how you became interested in beekeeping/honey bee products business.

- 2) What is the name of your business/enterprise?

- 3) List the people that will assist you with your new business, their relationship to you, and describe how they will help you with starting your new business.

Name	Relationship (i.e. parent, mentor, friend, business partner, ect.)	Description of how he/she will be of help to you as a beginning beekeeper.

- 4) Create a list of the types of honey bee products you plan to produce and sell over the next five years.

Year	Honey Bee Products
1	
2	
3	
4	
5	

5) From whom will you purchase your honey bees, equipment, and supplies?

6) Using the table below, estimate your initial startup costs. A suggested list has been provided for a single hive for comb honey production. Additional items will be needed for more than one hive and/or different methods of production.

- | | | |
|------------------------------------|---------------------|-----------------------------|
| -3 lb. package of bees with queen | -1 bottom board | -1 telescoping lid |
| -2 brood chambers with 20 frames | -1 inner cover | -20 sheets deep foundation |
| -3 shallow supers with 30 frames | -paint & primer | - nails |
| -1 hive tool | -1 bee brush | -1/2 gram bottle Fumaglin B |
| -30 sheets thin surplus foundation | -wood glue, | -6.4 oz bag Terramycin |
| -comb honey storage cassettes | -1 bee smoker | -bee helmet |
| -folding bee veil | -leather bee gloves | -entrance reducer |
| -hive stand materials | -frame wire | |

Items to Purchase	Product Number	How Many	Cost

[illegible]

- 7) Create a list of additional operating expenses you will experience this year in operating your business. (Some suggested expense categories have already been provided)

Operating Expenses	Cost
land rent (usually paid in honey)	
machinery rent	
transportation	
insurance	
continuing beekeeper education (books, magazine subscriptions, attending classes or conferences on bees, ect.)	
advertising	
Miscellaneous	
Total	

8) **Estimated Total Start Up Costs**= _____

Estimated Total Operating Expenses for 1st year.....= _____

Sum Total of 1st Year Operating Expenses and Start Up Costs = _____

- 9) Describe your plans for how you will pay for your start up costs and operating expenses during the first year.

Example of Annual Cash Flow Summary Sheet

Items (Year 1)	Quarter of Expense/Purchase					TOTAL	Quarter of Sale					TOTAL SALES
	Jan-March	April-June	July-Sept	Oct-Dec			Jan-March	April-June	July-Sept	Oct-Dec		
CAPITAL PURCHASES												
package bees							Product 1 _____					
brood chambers							Product 2 _____					
supers							Product 3 _____					
brood frames							Product 4 _____					
super frames							Product 5 _____					
brood frame foundation												
super frame foundation												
inner covers												
queen excluders												
bottom boards												
hive stands												
entrance reducer												
processing equipment												
safety equipment												
miscellaneous hardware												
continuing education												
beekeeping books												
beekeeping subscriptions												
OPERATING EXPENSES												
Inputs for Product 1												
Inputs for Product 2												
Inputs for Product 3												
Inputs for Product 4												
Inputs for Product 5												
medications/pest control												
feeding												
advertising												
land rent												
machinery rent												
transportation												
insurance												
misc. management												

10) List the location(s) where you plan to have your hive(s) located according to season. Then list the nectar/pollen producing plants that are available in the local area.

Season	Location	Local Nectar Pollen Producing Plants	
		Plant	Blooming Date
SPRING			

Season	Location	Local Nectar Pollen Producing Plants	
		Plant	Blooming Date
SUMMER			

Season	Location	Local Nectar Pollen Producing Plants	
		Plant	Blooming Date
FALL			

Season	Location	Local Nectar Pollen Producing Plants	
		Plant	Blooming Date
WINTER			

11) Good goals are essential to the success of any new business. List and describe your yearly goals for your beekeeping business for the remaining time you have in school. *Be sure to make them realistic and measurable.*

12) Based upon the goals you have set for your business, complete a three-year cash flow summary that will help you predict your cost and purchases as well as your sales over the next three years. A blank form has been provided in the Additional Resources section of the publication that may be used for planning your cash flow projections.

13) In addition to having detailed goals, a plan for paying your first year's expenses, and an idea of what your expenses will be for the next three years, you also need to have a customer base and plan for how you will market your products. The Marketing section of this publication will help you create detailed plans on how and where to market your product.

ⁱ Nebraska Electronic Recordbook, 2007. Nebraska FFA Association.

Additional Resources

Competencies to be attained by a student developing a 4-year honey bee enterprise for a Supervised Agricultural Experience Program:

Fall Semester Freshman Year:

- Student will read First Lessons in Beekeeping by C. P. Dadant.
- Student will conduct market research on availability and prices of honey/wax related products sold in the area.
- Student will create and administer a survey to assess which honey bee products local residents would be most interested in purchasing.
- Student will research beekeeping equipment for the production of different types of honey bee products.
- Student will select a supplier for beekeeping equipment and package bees based upon price and location.
- Student will identify a local beekeeper that is willing to serve as a mentor and answer any questions related to beekeeping.
- Student will develop a four year business plan for a beekeeping enterprise, which will include a(n):
 - a summary of how the student became interested in beekeeping
 - list of short-term and long-term business goals
 - list of the types of products to be produced and/or sold during the 1st, 2nd, and 3rd year in operation
 - detailed list of materials needed and capital required to begin the business
 - 3-year cash flow and balance sheets
 - marketing plan for where, when, and how the products will be sold
 - business name
 - mission statement detailing the purpose of the business
 - agreement with the local agriculture instructor, beekeeping mentor, parents, and student detailing the responsibilities, roles, and resources each will fulfill and provide in the venture.
 - risk management plan to reduce the risk of swarming, absconding, and supercedure.
 - back up plan for the business incase of swarming, absconding, or supercedure.

Spring Semester Freshman Year:

- Student will read The New Starting Right with Bees published by Root Publishing.
- Student will experiment making value added products using purchased materials.
- Student will demonstrate the proper use of basic beekeeping tools.
- Student will construct hive equipment.
- Student will set up a Nebraska FFA Electronic Record Book for maintaining financial and physical records on his/her hives. The record book will include a(n):
 - income/expense statement
 - operating inventory
 - balance sheet
 - physical observation and important dates page
 - record of antibiotics, pesticides, and practices used

- record of hours invested into the enterprise
- record of new skills and competencies attained
- Student will insert package bees into hives.
- Student will identify by picture seasonal nectar and pollen producing plants that grow in Nebraska.
- Student will select possible locations for apiaries based upon exposure to the sun, location to local flora, and cover from the north and west winds.
- Student will develop a record that runs through the fall of when and where honey and nectar plants begin blooming in the local area.
- Student will mix and feed honey bees 1:1 sugar syrup and use a division board feeder to feed bees for promoting wax and egg production.
- Student will measure out and administer Fumidil-B and Terramycin to bee colonies as part of a disease prevention program.
- Student will describe common honey bee diseases and parasites.
- Student will demonstrate safe handling procedures and use of safety equipment when inspecting a hive.
- Student will demonstrate proper securing and moving of hives to different locations.
- Student will attend UNL's Beginning Beekeeping workshop.
- Student will explain the concept of "bee space".

Summer between Freshman & Sophomore Year:

- Student will read Honey in the Comb by Gene Killion published by Dadant & Sons.
- Student will identify the queen, drones, and workers and explain the roles each performs within a colony.
- Student will describe worker honey bee behavior at the entrance of the hive.
- Student will describe how worker bees use dance language to locate resources.
- Student will describe the appearance of healthy capped brood and uncapped larva.
- Student will describe the differences in appearance of worker, drone, and queen cells.
- Student will explain differences in developmental stages of workers, drones, and queens.
- Student will maintain a routine disease/pest observation program performing and recording observation of frames for evidence of disease and/or parasites.
- Student will calibrate a container for the sugar roll method of assessing a varroa mite population within a colony.
- Student will perform monthly sugar roll counts for varroa mites.
- Student will identify when to add more supers to a hive.
- Student will identify when to remove supers from the hive.
- Student will demonstrate the proper procedures for processing the comb honey in the frames into the products being marketed.
- Student will follow through with the marketing plan, making appropriate modifications when necessary.
- Student will develop a directory of customer contact information for marketing purposes.
- Student will enter one category at the Nebraska State Fair.

Fall Semester of Sophomore Year:

From this point onward, the time period at which certain competencies are developed will depend upon the student's decision to either winter the colonies or to wait until the fall semester of the junior year to winter colonies for the first time. It is the recommendation of this publication not to winter the first year unless the student has a good relationship established with an experienced beekeeper in the local area that can provide input and hands-on mentoring. The competencies have been written as if there is a beekeeper available to advise the student.

- Student will read A Book of Honey by Eva Crane.
- Student will decide which are the strongest colonies to keep for wintering and splitting in the spring.
- Student will select a proper date for removing the weaker colonies from their hives and nailing them shut so as to insert new packages next spring.
- Student will feed strong colonies to prepare them for winter.
- Student will make tarpaper coverings and top entrances for the wintering colonies.
- Student will select a wintering location.
- Student will share his knowledge of honey bees and their importance by developing materials and a presentation for a local elementary classroom.
- Student will attend a Nebraska Beekeepers Association meeting.

Spring Semester of Sophomore Year:

- Student will complete a FFA proficiency application in at least one area related to his beekeeping enterprise.
- Student will complete a resume.
- Student will use his financial records to calculate net cash income, net worth, and the return per hour on his or her labor.
- Student will assess progress towards achieving the original 1st year goals of the business plan and consider any modification to the 2nd and 3rd year goals.
- Student will research other honey bee related products that could be produced during the 2nd year of production.
- Student will use partial budging to weigh the costs and benefits of producing/marketing additional honey bee related products.
- Student will analyze 1st year records to create a second year budget.
- Student will create plan for moving hives throughout the spring, summer, and fall seasons based upon the previous year's record of plant blooming dates and knowledge of plant life cycles.
- Student will analyze the success of the original marketing plan and create a 2nd year plan for where, when, and how to sell that includes a strategy for following up with past customers.
- Student will research and discuss the differences in the common honey bee races used for production in North America.
- Student will create a bibliography for his research on honey bee races.

- Student will compare the production at least two honey bee races by ordering a minimum of one package that is of a different race than he has previously used.
- Student will design an experiment based upon the scientific method that compares the production of at least two honey bee races.
- Student will create a hypothesis for the experiment.
- Student will make predictions about the results of the experiment.
- Student will assess the strength of wintered colonies based upon laying pattern, appearance of capped and uncapped brood, amount of remaining honey stores, and number of adult workers.
- Student will feed colonies to encourage egg laying by the queen and to sustain colony populations.
- Student will split colonies that are strong in April to increase the number of colonies and reduce likelihood of swarming before the honey flow.
- Student will re-queen wintered colonies.
- Student will strengthen weaker colonies by providing an appropriate number of capped brood frames from strong colonies.
- Student will attend UNL's Master Beekeeping Workshop or Value-Added Products Workshop.

Summer between Sophomore and Junior Year:

- Student will maintain financial and production records on all colonies.
- Student will make observations for the honey bee race experiment.
- Student will enter two categories at the Nebraska State Fair.
- Student will spend a day working the Nebraska Beekeepers Association both at the state fair educating attendees about honey bees.

Fall Semester of Junior Year:

- Student will read A Guide to Managing Bees for Crop Pollination published by the Canadian Association of Professional Apiculturalists.
- Student will analyze observations, production records, and health records of the different honey bee races used in the experiment.
- Student will make conclusions based upon his analysis of the health and production records of the different honey bee races.
- Student will help a younger student start a honey bee hive.
- Student will prepare a speech or agriculture demonstration related to honey bees for District FFA Leadership Skills Events.

Spring Semester of Junior Year:

- Student will read Honey Bee Diseases and Pests, 2nd Edition published by the Canadian Association of Professional Apiculturists.
- Student will complete FFA proficiency applications in at least two areas related to his beekeeping enterprise.

- Student will update his resume.
- Student will select a minimum of two topics for research projects.
- Student will develop a minimum of two honey bee research projects to perform during the current year.
- Student will assess progress towards achieving the 2nd year goals of the business plan and consider any modification to the 3rd year goals.
- Student will attend UNL's Master Beekeeping Workshop or Value-Added Products Workshop.

Summer between Junior and Senior Year:

- Student will maintain production and financial records.
- Student will make observations for his honey bee research projects.
- Student will enter four categories at the Nebraska State Fair.

Fall Semester of Senior Year:

- Student will share his knowledge of honey bees through giving a demonstration or speech related to honey bees to a

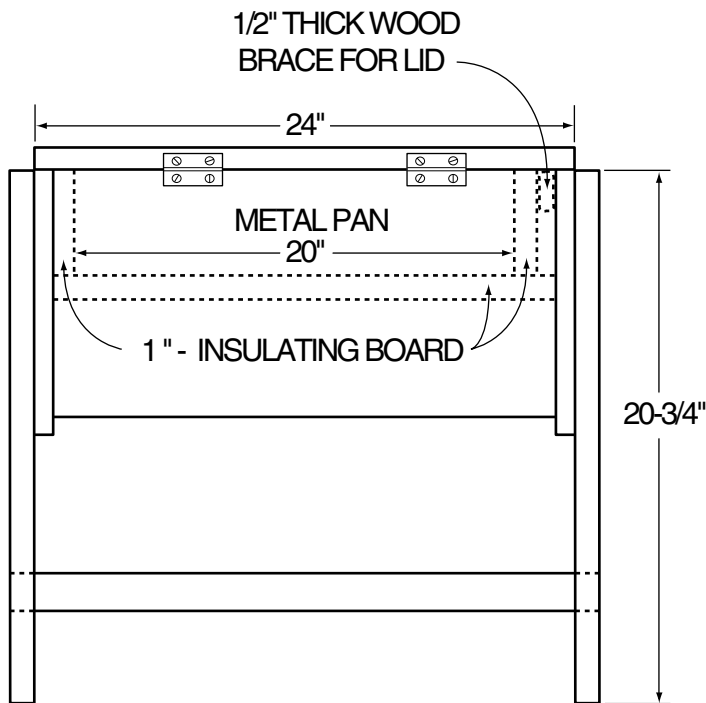
Spring Semester of Senior Year:

- Student will complete FFA proficiency applications in at least three areas related to his beekeeping enterprise.
- Student will complete his application for the State FFA Degree.
- Student will interview with district agriculture instructors for the State FFA Degree.
- Student will assess progress towards achieving the 3rd year goals of the business plan and consider any modification to the 3rd year goals.
- Student will create plans for the beekeeping operation that are compatible with his post-graduate plans.

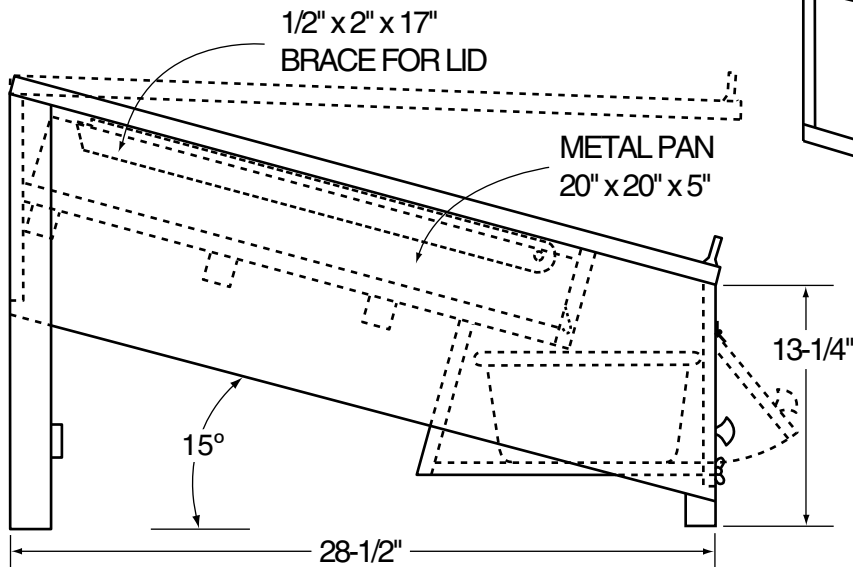
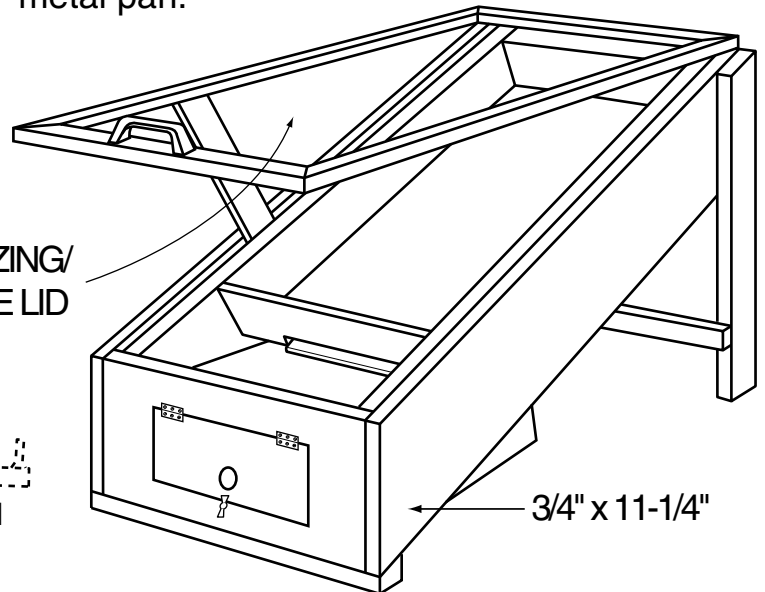
SOLAR WAX MELTER

DETAILS FOR 3/4" LUMBER

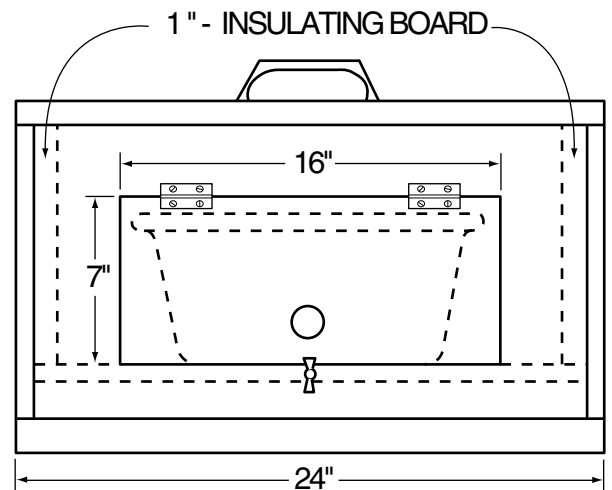
A melter of this size will handle wax rendering from 60 hives. You can modify the dimensions and design to fit your own needs. Melters come in all shapes and sizes and can be made out of just about any used material. The sheet metal pan should be 4" to 6" deep and big enough to accept excluders or at least 2 full-depth frames. Paint the entire unit black for max. heat absorption. You should put a coarse screen across the outlet of the pan to keep debris from getting into the pan of molten wax. Make a cappings basket out of "expanded" metal (wire lath) that will fit into the sheet metal pan.



BACK VIEW



SIDE VIEW



FRONT VIEW