

**Virginia Cooperative Extension**

**4-H Honey Bee Youth Project Book II**

# **Veils, Smokers, and Supers: Equipment of Beekeepers**



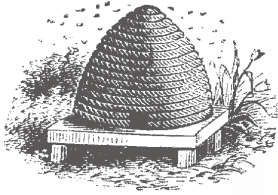
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 **VirginiaTech**  
*Invent the Future*

**VSU**  
VIRGINIA STATE



The Honey Bee Project meets the following Virginia State Standards of Learning (SOLs) for the fourth, fifth, and sixth grades:



## Acknowledgments

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## Grade 4

### English

- 4.1 - The student will use effective oral communication skills in a variety of settings.
  - 4.1a: Present accurate directions to individuals and small groups.
  - 4.1c: Seek ideas and opinions of others.
- 4.6 - The student will demonstrate comprehension of information resources to research a topic. Key concepts include:
  - 4.6a: Construct questions about a topic.
  - 4.6b: Collect information, using the resources of the media center, including online, print, and media resources.
  - 4.6c: Evaluate and synthesize information.
- 4.7 - The student will write effective narratives, poems, and explanations. Key concepts include:
  - 4.7c: Organize a plan of writing to convey a central idea.

### Science

- 4.1 - The student will plan and conduct investigations in which:
  - 4.1a: Distinctions are made among observations, conclusions, inferences, and predictions.
- 4.5 - The student will investigate and understand how plants and animals in an ecosystem interact with one another and the nonliving environment. Key concepts include:
  - 4.5b: Organization of communities

## Grade 5

### English

- 5.1 - The student will listen, draw conclusions, and share responses in subject-related group learning activities. Key concepts include:
  - 5.1c: Summarize information gathered in group activities.
- 5.8 - The student will write for a variety of purposes: to describe, to inform, to entertain, and to explain. Key concepts include:
  - 5.8g: Using available technology to access information.

### Science

- 5.1 - The student will plan and conduct investigations in which:
  - 5.1g: Manipulated and responding variables are identified.
  - 5.1h: An understanding of the nature of science is developed and reinforced.

### Math

- 5.3 - The student will create and solve problems involving addition, subtraction, multiplication, and division of whole numbers, using paper and pencil, estimation, mental computation, and calculators.
- 5.11 - The student will choose an appropriate measuring device and unit of measure to solve problems involving measurement of:
  - 5.11a: Length

## Grade 6

### English

- 6.1 - The student will analyze oral participation in small-group activities. Key concepts include:
  - 6.1a: Communicating as leader and contributor.
- 6.5 - The student will read and demonstrate comprehension of a variety of informational selections. Key concepts include:
  - 6.5a: Identifying questions to be answered.
  - 6.5b: Making, confirming, or revising predictions.
  - 6.5c: Organizing the main idea and details to form a summary.
  - 6.5g: Selecting information sources appropriate for a given purpose.

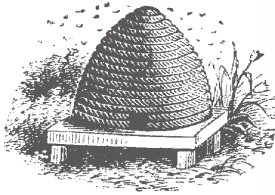
### Science

- 6.1 - The student will plan and conduct investigations in which:
  - 6.1f: A method is devised to test the validity of predictions and inferences.
  - 6.1k: An understanding of the nature of science is developed and reinforced.

### Math

- 6.8 - The student will solve multistep consumer-application problems involving fractions and decimals and present data and conclusions in paragraphs, tables, or graphs. Planning a budget will be included.

The beekeeping project (Books 1- 4) teaches you the basic biology and behavior of honey bees (junior level) in addition to hands-on management skills. The four honey bee project books provide instruction on how to rear honey bee colonies beginning with the purchase of a package of bees, continuing through the first year of colony development, and ending with the extraction of honey (senior level). These project books are intended to provide in-depth information related to honey bee management, yet they are written for the amateur beekeeper, who may or may not have previous experience in rearing honey bees.



### Notes

- Keep a project record book containing answers to each activity to turn in at the end of your project.
- You may not be able to find the resources needed for all activities in this project book in your area. If this is the case, contact your leader or Extension agent for alternative activities.

## Introduction

One lazy afternoon you find yourself looking across a field of flowers. The sun is warm and the breeze rustles through the grasses beneath your feet. Suddenly, at the edge of the field you see a lone figure hunched over a white box. The person is dressed from head to toe in a white, spaceman-looking jumpsuit. You begin to get nervous as you peer closer and notice a helmet covering his head. His gloved hands hold a strange-looking instrument spewing smoke from some internal, smoldering fire. You do not know it, but you are about to witness a robbery by this alien creature. Should you call the police? Should you take matters into your own hands? No! Instead, grab a container and prepare to get some honey! There's a beekeeper hard at work!

The beekeeper you are watching is busy managing a hive of bees. Before we can investigate the process of rearing bees for ourselves, we need a good understanding of the “alien” equipment we will need and how to use it. We will need to know the parts of the beehive and how to assemble them properly to facilitate bee rearing and honey production. The Honey bee Project Book 2 provides you with specific information about beekeeping equipment, tools, and clothing. Soon YOU will look like a thieving alien dressed in a white space suit!

### Caution

If you know you have an allergy to bee stings, you should take special precautions during this project. Follow your doctor's advice.

## Chapter 1

# Honey, I'm Home!: The Bee's Home

Humans keep bees, but honey bees are not considered domesticated in the way that a dog, cat, or cow is. It makes no difference to the bees whether they live in a hollow tree or in a human-made hive in someone's backyard. They are, therefore, not dependent on humans. However, beekeepers can help the bees by managing their living space and stimulating their activity. This bee management helps the beekeeper as well as the bees. One of the beekeeper's first tasks is to get the bees into a living situation where he or she can inspect their progress from time to time. A hollow tree or other natural nest site is not very convenient for inspection; so honey bees are kept in human-made houses called beehives. Throughout this unit, you will study the ins and outs of the bee home, and learn about all of the intricate parts of a beehive.



# Activity 1-1: Racks o' Wax

## BEE Informed!

Bee comb is constructed of wax. The wax comb consists of six-sided cells constructed on both sides of a central rib. These cells are the storage containers for the bee colony and serve as a nursery for rearing young bees. The standard beehive provides 10 wooden frames or racks for the bees to build a comb on. The frames reinforce the comb so it can be handled without fear of breaking the delicate wax. Sometimes horizontal wires are added to further strengthen the comb. These wires are threaded through holes in the frame's end bars, pulled taut with pliers and tied off at small nails hammered in the end bar. The beekeeper often provides a starter sheet of wax on the frame to give the bees a guide for building their comb. This is called the foundation, and sometimes has 10 vertical wires running through it to further strengthen the comb.



Six-sided cells found in bee comb.



Foundation being manufactured for use in beehive frames.

**4th grade**

**English:**

4.6c, 4.7c

**5th grade**

**Math:** 5.11a

**English:**

5.8g

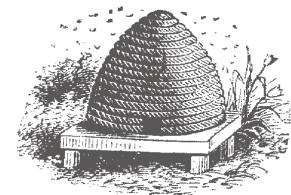
**6th grade**

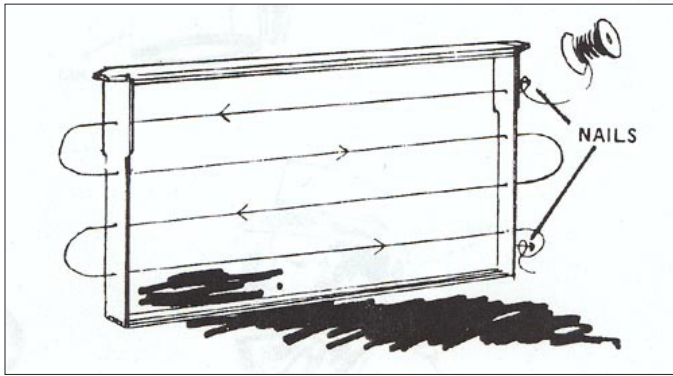
**English:**

6.5a, 6.5e, 6.5g

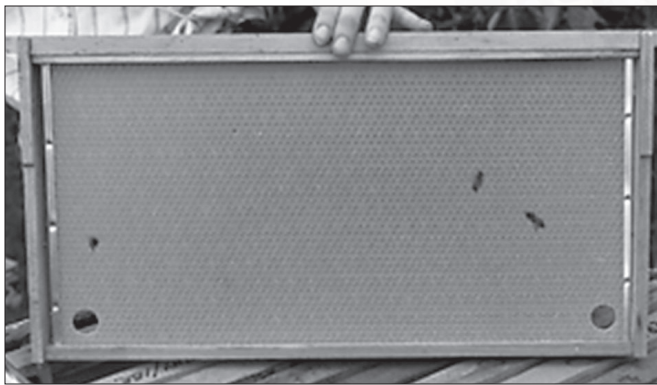
**Life Skill:** Problem solving

**Objective:** to write instructions on constructing a bee frame





How to build a frame with a central wire rib.



Bee frame with a wax comb held in place by a central rib.

## BEEgin!

### Situation:

You have been hired to write the owner's manual for the very inexpensive "BEEasy Does It Wax o' Rama Bee Frame." It is a bee frame that beekeepers can buy online and have shipped to their home. The reason your product is so cheap, however, is because assembly is required by the buyer.

### Task:

Your job is to write the instructions on how to assemble the frame. You may use drawings to help explain your instructions. You will need to do some research in the library or online into what components go into a bee frame, their size, and how they fit together. Consider the following questions while thinking about how you should organize the instructions:

1. What tools does the beekeeper need?
2. What size will the parts be? Which units of measurement will you use?
3. What order will the steps be in?
4. For which steps will drawings be helpful?

## BEE Thoughtful!

1. How do visuals help to get across your ideas?
2. Why do you think products that require assembly are cheaper?
3. What are the advantages and disadvantages of including wires in your frame?
4. Have someone read your instructions. Can they follow them and get the result you wanted? What could you do better to help them understand more easily?

# Activity 1-2: If You Build It, They Will Build ... More!

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## BEE Informed!

Below are some terms you need to know to be a beekeeper:

**Foundation:** Foundation is a thin sheet of beeswax embossed with a honeycomb pattern and usually reinforced by wire. Foundation is used in the frames to encourage the bees to build or “draw” cells. It acts as a pattern for the bees to follow, allowing them to start building their combs faster and more efficiently.

### Foundation types:

***Duragilt:*** Made with plastic inner core and coated on both sides with beeswax and metal edges to reinforce and strengthen.

***Duracomb:*** Made with plastic inner core and coated on both sides with beeswax. Support pins are needed to add strength.

***Crimped wire:*** Made with beeswax and eight vertical crimped steel wires to increase strength. Cross wires are recommended for deep frames.

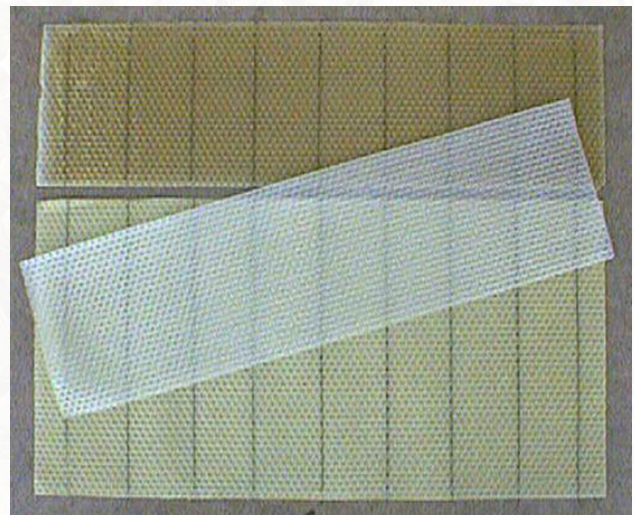
***Plasticell:*** Made of plastic and may be purchased plain or coated with beeswax.

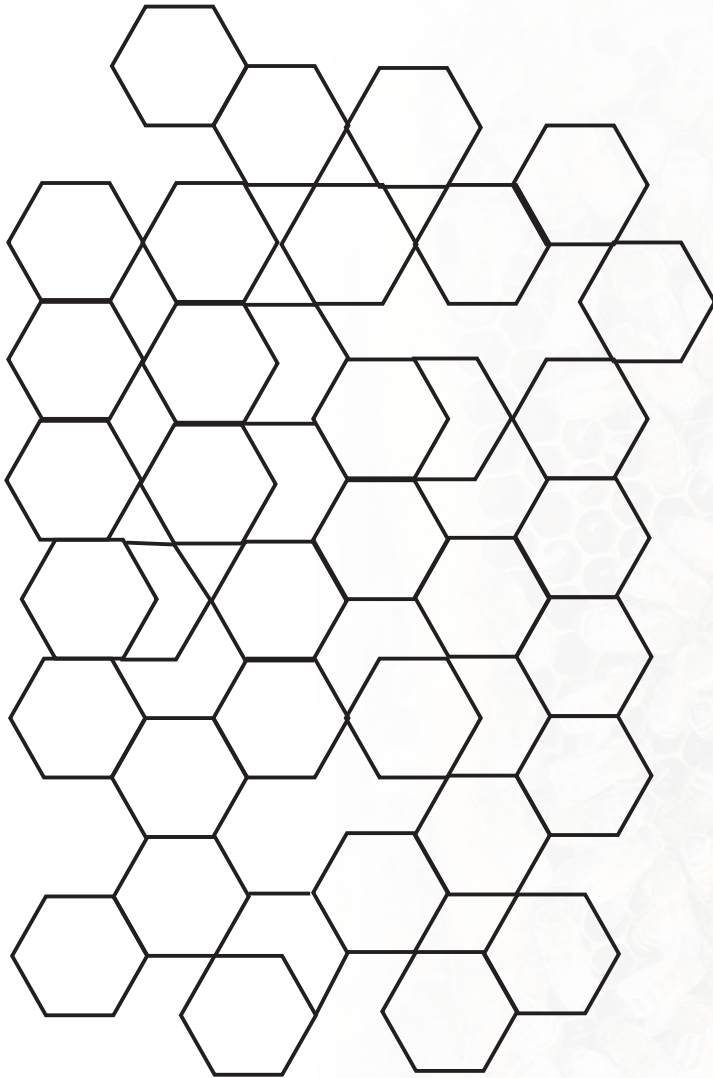
***Medium brood:*** Made with 100 percent pure beeswax. Cross wiring is needed.

***Cut comb and thin surplus:*** Made with 100 percent pure beeswax. Made for chunk honeycomb and comb honey cut from frame.



An unused bee hive with frames and black plasticell foundation installed.





## BEEgin!

1. Use the figure to the left to complete this activity.
2. You will need several clean, white pieces of paper, a pencil, and a stopwatch (or some other type of device that can keep time).
3. On a separate piece of paper, time how long it takes you to draw the pattern you see on the left EXACTLY as you see it. You CANNOT trace it. Be careful, it is tricky! Write down your time. Have someone check your drawing and count up the errors you made. You must deduct 5 seconds off of your final time for every error they find.
4. Write down your adjusted time.
5. On another piece of paper, time how long it takes for you to TRACE the pattern you see on the left. Have someone check your drawing and count up the errors you made. You must deduct 5 seconds off of your final time for every error they find.
6. Write down your adjusted time.

## BEE Thoughtful!

1. Was it more efficient to draw the pattern freehand or tracing it? Why?
2. Can you think of times in your life when you follow a pattern or an example? When is it beneficial? When isn't it beneficial?
3. Why is putting a wax foundation in a beehive an efficient way to raise bees?

### 5th grade

#### Science:

5.1h

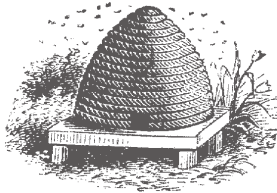
### 6th grade

#### Science:

6.1k

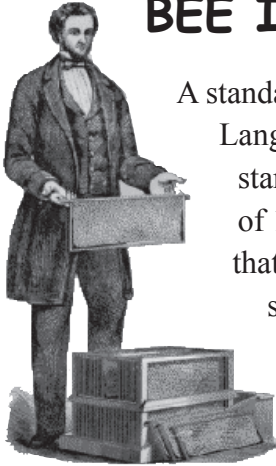
**Life Skill:** Critical thinking

**Objective:** to understand the pattern of bee comb foundations



# Activity 1-3: This Is a "Super" Activity

## BEE Informed!



A standard beehive was developed in 1851 and has changed very little since. L.L. Langstroth discovered the "bee-space" which led him to invent a beehive that is now standard in the United States and many other countries. Langstroth found that a space of 1/4 to 3/8 inch was too wide to induce bees to deposit propolis (a type of glue that bees use to close off areas in the hive) and too narrow for comb building. Yet the space was large enough to permit the free passage of bees. Thus the Langstroth, or standard hive, opens at the top and contains 10 hanging frames inside. Each frame is surrounded by bee-space (1/4"). With this bee-space conserved, each frame that contains comb can be easily removed and inspected without disturbing the rest of the hive.

## BEEgin!

1. Find a local beekeeper who is willing to help you with this activity. Find out if the beekeeper has a clean, unused beehive that he/she can show you and let you use.
2. Ask the beekeeper to show you the parts of the beehive that are mentioned in the BEE Informed! section of this activity. Ask him/her what the purpose of each part of the hive is.
3. Take the beehive completely apart and reassemble it. Do this several times until you can do it without any mistakes. While reassembling the beehive, explain to the beekeeper what each part of the hive is and its purposes.

2. What would happen if the beehive had no queen excluder? No frames? No hive cover? No supers?
3. Suppose you were an inventor. What would you add to a beehive to make it more efficient?

## BEE Thoughtful!

1. Did the beekeeper use all of the parts of the beehive mentioned in the BEE Informed! section? Which ones did he/she not use? Why? Were there parts he/she used that were NOT mentioned below? If so, what were their functions?

### 4th grade

#### English:

4.1a, 4.1c

#### Science:

4.5b

### 5th grade

#### English:

5.1c

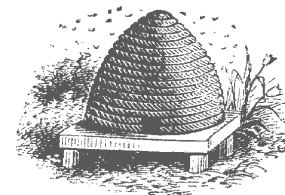
### 6th grade

#### English:

6.1a

**Life Skill:** Communication

**Objective:** to learn about the parts of the standard beehive



## The beehive top to bottom

The following is a list of possible components of a beehive. Many beekeepers will customize their hive to suit their individual needs. They may add additional supers and brood chambers or they may eliminate the hive stand. You are provided an illustration of a basic standard beehive. It is important to familiarize yourself with these basic components and be able to describe their function.

**Telescoping hive cover:** A cover that fits over the sides of the top super to protect the hive and provide proper ventilation. Sometimes has a galvanized metal top.

**Inner cover:** Creates dead air space for insulation from heat and cold. Placed between the outer cover and supers or hive bodies. Also prevents the bees from sealing the top cover onto the super.

**Shallow super:** For surplus honey storage. Bees store their extra honey in these supers for the beekeeper to take. The supers have an inner depth of 5 11/16 inches. They are placed over the queen excluder. Additional supers can be added to accommodate honey flow.

**Medium deep super:** For surplus honey storage or may be used as hive bodies. They are 6 5/8 inches in depth. They are also placed over the queen excluder and additional units may be added as needed. They may also be used as part of the hive body, in which case they are placed under the queen excluder.

**Queen excluder:** Keeps the queen bee in the brood chambers, because she is too large to pass through the excluder. The queen excluder is placed between the hive bodies containing the brood nest or brood chamber and the honey super(s).

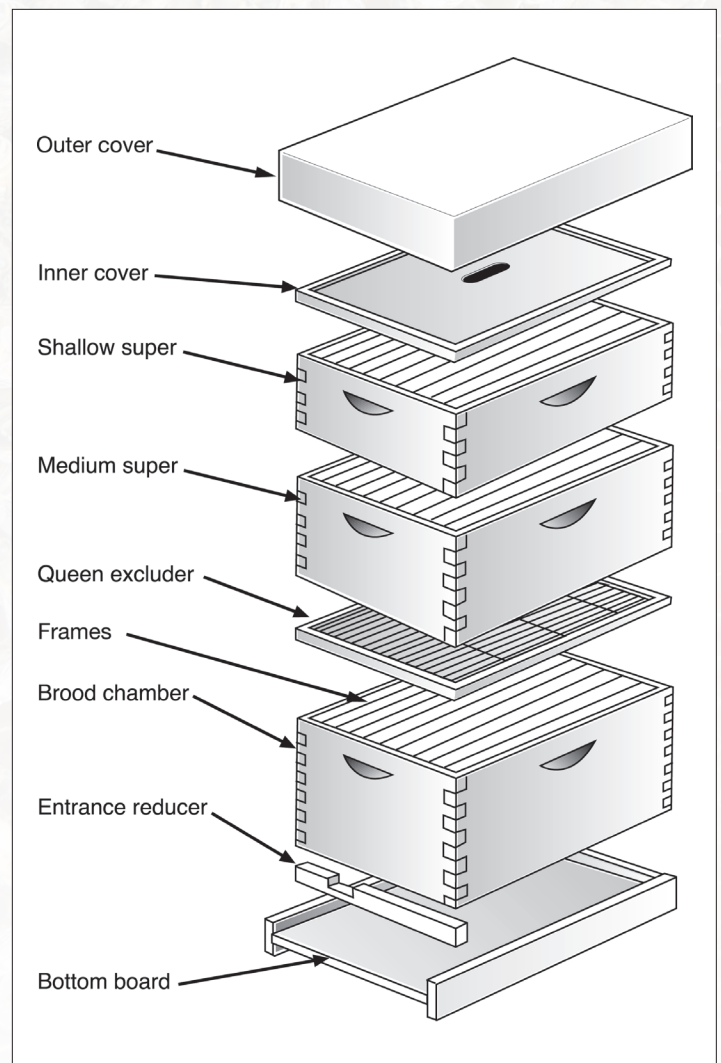
**Frames:** A wooden structure that holds the wax comb foundation. Frames are placed in the hive bodies for brood rearing and in the supers for storing honey.

**Hive body or “brood chamber”:** Where the bees live. The queen lays eggs and the brood is raised in these chambers. Honey is also stored for the bees’ food. It is placed directly above the bottom board. For mature colonies, two hive bodies are needed to provide sufficient space for the bees and brood.

**Bottom board:** Forms the floor of the hive. A wooden entrance reducer is often used to keep out cold and foraging rodents, while still allowing bees to go in and out.

**Hive stand:** Keeps the hive off the ground to keep the hive bottom dry and insulates the hive.

Plumbers need wrenches, firemen need hoses,



## Chapter 2: "Honey" Can You Hand Me a Wrench?: Tools and Clothing for Beekeepers

and carpenters need hammers. Every trade has its tools. Tools are humans' way of making their lives easier. Tools provide a variety of functions that save the user time and effort. Some tools are necessary in order to protect the user from harm. Beekeepers also have their specialized gadgets and clothing for protection and use when working with bees. In this chapter, you will learn all about the tools and clothing used by beekeepers. After all, you will surely want to dress for success!



Hat with veil



Smoker

Hive Tool



### 4th grade

#### English:

4.6, 4.6a, 4.6b, 4.6c

#### Science:

4.1a

### 5th grade

#### Science:

5.1g

### 6th grade

#### English:

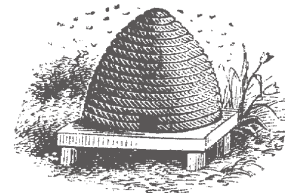
6.5a, 6.5b

#### Science:

6.1f

**Life Skill:** Critical thinking, Decision making

**Objective:** to determine the best material for use in a bee smoker



# Activity 2-1: All Up in Smoke

## BEE Informed!

Some scientists think that when honey bees detect smoke they store large quantities of honey in their stomach to feed off of in case the smoke is from a fire that could damage the hive. Since the bees are engorged with honey, they cannot move as easily or quickly. Therefore beekeepers often use a smoker to calm the bees before opening their hive. Smoking the bees in the beehive reduces their activity level and reduces the chance of a beekeeper being stung by the bees.

Another important tool beekeepers use is the hive tool. These useful gadgets are usually flattened pieces of steel but come in a variety of shapes and colors. Hive tools are needed for prying, scraping, nail pulling, and simple hive repair. For example, beekeepers often need to pry frames apart that have become stuck together with wax, honey, or propolis. In addition, excess wax is scrapped off of the frames and sides of the supers. These simple tools are an important part of any beekeeper's supply kit.

## BEEgin!

1. You must have an adult present throughout this activity. Fire is extremely dangerous and must be handled with extreme caution. Only use fire when a sufficient amount of extinguishing material ( e.g. water, etc. ) is nearby. Only use fire in a well-ventilated area, e.g. outside)
2. You will be performing an experiment in preparation for using a smoker, which is an essential tool in beekeeping. You are going to test which of the following materials makes the best smoke for use with a smoker: dead leaves, dry grass, dead wood, dead pine needles, or paper.
3. Design the experiment and share your design with the adult involved. Consider the following questions while designing your experiment:
  - Where are you going to perform the experiment?
  - What is going to safely hold and contain the burning material?
  - What materials do beekeepers usually use (look it up online or in the library)?
  - How are you going to measure which smoke is "better"?
  - How much material are you going to test? How much fits in a smoker?
4. Perform the experiment with the help of the adult. Record your results.
5. Repeat the experiment twice for each material you are testing.

## BEE Thoughtful!

1. Which material burned the longest? Which made the most smoke?
2. Which material would be the best for smoking bees? Why?
3. How do you know your "best" material is really the best? What if another material did better when you repeated your experiment? How does repeating experiments several times help you determine what is really best?
4. How could you have designed your experiment better?



# Activity 2-2: Dressed for Success



## BEE Informed!

There are three main pieces of clothing you should have as a beekeeper: a bee veil, a bee suit, and gloves. A bee veil is a must. Stings on the lips, scalp, nose, and ears can be very painful. Veils are usually made of some type of thin cloth or nylon mesh. Veils can be purchased separately or attached to a helmet. Bee suits are coveralls designed to keep bees from stinging your body, legs, and arms. It is well known that bees are less prone to sting light-colored, smooth-finished materials. For this reason, khaki clothing is a favorite among beekeepers. Rough materials such as leather and heavy canvas irritate bees, causing them to sting more frequently. In addition, sleeve cuffs should close tightly in order to keep bees from getting beneath clothing. Gloves are not mandatory but are used by many beekeepers. Gloves protect your hands from painful stings, but make handling the beehive more difficult. Usually novices use gloves until they feel more comfortable working around the hives.

## BEEgin!

1. Call and set up an appointment to visit with a fireman in your community. Tell him/her you are interested in learning more about the protective clothing firemen wear and how that clothing is used when fighting fires.
2. Prepare a list of questions in advance that you would like to ask the fireman about his/her clothing.
3. Visit the fireman and ask him/her if you can try on their work clothes.
4. Call and set up an appointment to visit with a beekeeper in your community. Tell him/her you are interested in learning more about the protective clothing beekeepers wear and how that clothing is used when working with bees.
5. Prepare a list of questions in advance that you would like to ask the beekeeper about his/her clothing.
6. Visit the beekeeper and ask him/her if you can try on their work clothes.

## BEE Thoughtful!

1. Compare and contrast the clothing and equipment firemen and beekeepers use.
2. What other occupations must utilize special clothing? Make a list of at least 10 other occupations that use specialized clothing. Explain what kind of clothing they need and why.

**4th grade**

**English:**

4.1c

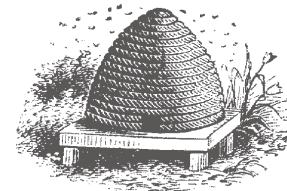
**6th grade**

**English:**

6.5a

Life Skill: Planning/organizing, communication

Objective: to compare and contrast the protective clothing worn in different occupations



# Activity 2-3: This One Will Cost You!

## BEE Informed!

Keeping bees can be an expensive, yet fulfilling endeavor. Before building your own apiary, it would be wise to understand the costs and time commitment associated with keeping bees. It has been estimated that American beekeepers currently spend 62 percent of their beekeeping dollars on equipment. Because of the influx of cheap honey from outside the United States and because of rising equipment within the United States, many beekeepers are no longer in business. If one wants to make a profit selling honey, he or she will also have to be careful with their money.

## BEEgin!

### Situation:

You have just been hired as the head beekeeper for Hives R' US Bee Farm. This is your dream job! You get all the free honey a person would ever want! So, don't mess this opportunity up.

### Task:

The owner has just asked you to set up a new apiary (bee farm) in a field he recently purchased. The owner gives you \$15,000.00 to order equipment and supplies. You are to build the hives and purchase the equipment you will need to inspect the hives. Don't worry about the bees and extracting the honey. That will come later. Just focus on building the hives and purchasing

the tools and clothing you will need to inspect the hives. You are asked to put together a proposed expense report in spreadsheet format to present to the owner before purchasing the equipment. The owner wants to know how much each item cost and the total cost of all the equipment. He also wants to know how many hives you are going to build and how much each of those hives will cost.

## BEE Thoughtful!

1. Where did you find information on how much different pieces of equipment cost? Did different bee equipment suppliers sell equipment for different prices? Which would you choose and why?
2. What was the most expensive piece of equipment? Least expensive?
3. If you were able to sell a 5-pound jar of honey for \$12.00, how many jars of honey would you have to sell in order to pay for the equipment you just purchased? How many pounds of honey would you have to sell? If each hive averages 40 pounds of extra honey each year, how many hives would you need to pay for the equipment within one year? If you were to only use the honey from the number of hives you just bought, how many years would it take to pay off the equipment? What do your answers tell you about beekeeping for profit? Is it easy? Why is keeping business records important?

### 4th grade

#### English:

4.6b, 4.6c

### 5th grade

#### English:

5.8g

#### Math:

5.3

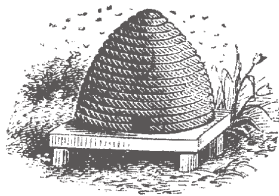
### 6th grade

#### Math:

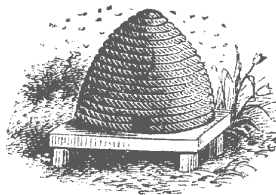
6.8

Life Skills: Wise use of resources, keeping records

Objective: to calculate the costs of commercial beekeeping







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