



University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service



4-H Youth Development

4-H Bee Ambassador Program





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Overview

The 4-H Bee Ambassador Program addresses key concepts related to bees, pollination, beekeeping, and honey. Kentucky 4-H agents, assistants, and volunteer leaders are encouraged to incorporate lessons and activities related to bees and honey in their clubs, school enrichment programs, and community outreach events. An example calendar is provided on page 7. Twelve lessons are included in this guide, each are geared towards youth ages 9 to 18 years old.

Each program year (September 1 – August 31), points will be given to counties that participate in the 4-H Bee Ambassador Program. At the end of that program year, county Extension offices that have a total of 25 or more points will be certified as 4-H Bee Ambassadors and “The Place to Bee” in your county. Certified counties will receive a sign to install at their county office and a logo for their county webpage stating they are 4-H Bee Ambassadors.

Points for Pollinator Programming

For each 1-hour of programming provided, 1-point will be given.

Examples:

- 4-H cooking club conducts a lesson on foods and pollination for 2 hours = 2 points
- 4-H art club builds mason and butterfly houses for 3 hours = 3 points
- Pollination is discussed at a school enrichment event that lasts 1 hour 30 minutes = 1.5 points
- Teen club members present an activity about bee adaptations to a Cloverbud Club for 45 minutes = .75 points

To receive points, complete a 4-H Bee Ambassador Entry Form and submit to Ashley Osborne at ashley.osborne@uky.edu. Forms are available on the 4-H Bee Ambassador website. Forms are due to Ashley Osborne by August 31 of each program year.

Entry Form:

<https://entomology.ca.uky.edu/files/4hbeeentryform.pdf>

Larger Projects

In addition to points earned through programming, each office is also encouraged to implement at least one larger project or event each year. The goal with these larger projects is to create a permanent pollinator-resource that can be maintained for years to come. Examples of larger projects are provided below. Many of these would be excellent to offer as service projects or culminating events. To receive points for larger project, complete the 4-H Bee Ambassador Entry Form and submit to Ashley Osborne. Projects and events (and corresponding points) are listed below:

- **Installation of a working honey bee hive at a county Extension office or other locations (20 points).** A honey bee hive requires work and maintenance, but it is a great resource for pollinator education. A hive will require volunteers or staff who are knowledgeable about beekeeping and willing to work with the hive for many hours each year. There are also potential safety concerns, so a hive will need to be located in a safe place. If you are interested in pursuing a honey bee hive, contact Blake Newton or Ashley Osborne for suggestions on how to get started, including

recommendations for hive-equipment that is suitable for young beekeepers as well as information on liability issues, insurance, waivers, etc.

For More information on getting started with honey bee hives:

<http://www2.ca.uky.edu/agcomm/pubs/ent/ent41/ent41.pdf>

- **Installation of mason bee houses at a county Extension office or other locations (2 points per house).** Mason bees are small native bees that do not live in colonies and do not make honey, but are very important pollinators. Mason bee houses are simple carpentry projects that can help boost mason bee populations in an area. Because mason bees are not hive-dwellers, they are also much less likely to sting than honey bees (and they are unable to swarm), and so—unlike honey bee hives—their houses are not considered a safety risk. Mason bee houses can be installed in virtually any outdoor location. One of the activities in this guide discusses the building and maintenance of mason bee houses—use the design presented there, or one of many mason-bee house designs available online. On your entry form, record where you placed the houses and how you plan to maintain them over the coming years.
- **Monarch tagging (5 points).** Monarch tagging is an annual citizen-science project organized by Monarch Watch. Each year in the late summer and early fall, thousands of people around the U.S. capture, tag, and release monarch butterflies. This allows researchers to track their migration and monitor their population levels. Tagging in Kentucky occurs when the monarchs are migrating south in September and early October. Tagging can be a single public event or can be accomplished with volunteers over several days. Tagging is easy, but requires some planning and organization due to supplies that need to be ordered well in advance of late summer. For more information and for tagging kits, visit <http://monarchwatch.org/tagmig/tag.htm>.
- **Installation of a certified Monarch Waystation (8 points).** A Monarch Waystation is any garden that has been certified by the Monarch Watch organization. The waystation will consist of milkweed and other pollinator plants, and is typically at least 100 square feet. A Monarch Waystation is a great project because it does not require much space and it helps other pollinators too (not just butterflies). Most existing gardens can be converted to a Monarch Waystation with just a few modifications. If you install a Monarch Waystation, send documentation, along with your entry form showing that it has been certified by Monarch Watch. The website for the Monarch Waystation program, along with instructions on how to get your garden certified, is: <http://www.monarchwatch.org/waystations/>
- **Installation of a pollinator resource and demonstration garden (15 points).** Your office may consider installing something more substantial than a Monarch Waystation. A Pollinator Resource and Demonstration Garden will need to be at least 300 square feet and should consist of multiple flowering plants and caterpillar host-plants. Ideally, a pollinator resource garden will include a variety of annual and perennial plants (native or non-invasive) with different species that flower in the spring, summer, and fall and will include interpretive signage. To acquire points for your pollinator resource garden, send a brief description including dimensions, plantings, and a summary of signage, along with long-term maintenance plans for your garden with the entry form. For help selecting plants to include in your garden, visit the “pollinator gardens” section of the 4-H Bee Ambassador website: <https://entomology.ca.uky.edu/content/4-h-bee-ambassador-program>
- **Install a honey extractor at a county Extension office or other location (15 points).** A honey extractor is a costly investment for an individual beekeeper but a valuable addition to a community of beekeepers. A honey extractor housed and maintained at a county Extension office can be used by dozens of beekeepers and may even be used to raise revenue for the office. For recommendations on the selection and installation of a honey extractor, contact Blake Newton or Ashley Osborne.
- **4-H honey projects and clubs (variable).** Active honey clubs and completed 4-H honey projects are also eligible for points! Earn 1 point for each hour of programming and an additional 1 point for each completed youth honey project (Division 6026 - Classes 692, 693, 694, 695, or 696) submitted at the county level by youth who actively participated in your program.

Find the 4-H Honey St. Fair entry rules here:

https://4-h.ca.uky.edu/sites/4-h.ca.uky.edu/files/6026_entomology.honey_0.pdf

- **Have an idea for a project?** Email Blake Newton or Ashley Osborne. Examples might include: working with local livestock farmers to convert acreage to pollinator-friendly forage plants (like clover); creating a semi-permanent or permanent pollinator education display in a local library; combining other 4-H St. Fair projects or curricula, such as Communications and Expressive Arts, with pollination or bee content; etc.

Existing Pollinator Resources

Does your county already have a honey bee hive, pollinator garden, or other pollinator resource? Those existing resources will count fully toward your county's point total. Just tell us what they are and how you maintain them from year-to-year.

Bee an Ambassador... Forever

To maintain your office's status as the "Place to Bee" in your county, simply follow the guidelines above to obtain an additional 25 points each program year (September 1 – August 31). Because permanent installations (like pollinator gardens and honey bee hives) will count for full points each year they are maintained, your 4-H Bee Ambassador status should be secure with minimal planning and additional programming each year. Just remember to send the 4-H Bee Ambassador Entry Form to Ashley Osborne by August 31 to receive points each year.

Kentucky Pollinator Protection Plan

In 2017, stakeholders from around the Commonwealth worked together to build a comprehensive plan to help protect pollinators that focuses on best practices that facilitate the preservation and creation of pollinator habitat. The 4-H Bee Ambassador Program was developed in support of this plan. Download and read the plan to learn more about statewide goals for pollinator protection: http://www.kyagr.com/statevet/documents/OSV_Bee_Pollinator-Handout.pdf

UK Nutrition Education Program

Several of the 4-H Bee Ambassador activities include food preparation and physical activity. For information regarding if the activity meets Supplemental Nutrition Assistance Program (SNAP-Ed) and/or the Expanded Food and Nutrition Education Program (EFNEP) please contact the Kentucky Nutrition and Education Program (KNEP) at (859) 257-2948.



Pollination Basics

What Is Pollination?

Pollination is the transfer of pollen grains from one flower to another. Without pollination, many plants cannot reproduce. Some plants can pollinate themselves from their own flowers (called self-pollination), but many need pollen from a separate plant of the same species (called cross-pollination). In some plants (like many trees and grasses), cross-pollination is accomplished by the wind. For other plants—including most plants with showy, colorful flowers—cross-pollination requires a pollinator.

What Is a Pollinator?

Pollinators include many kinds of insects, birds, and mammals. These pollinators typically have sticky hairs or other structures that help to grab pollen and spread it from flower to flower. The best and most important pollinators in Kentucky are bees, including honey bees, bumble bees, and dozens of solitary (non hive-dwelling) bee species.

Why Are Bees So Important?

Bees are believed to be the best pollinators because they are the only group of animals that are adapted to feed solely on nectar and pollen. Their life cycle depends on visiting multiple flowers to collect pollen and nectar for themselves and for their larvae. Bees are the only animals that have “pollen baskets,” which are densely-packed batches of branched hairs that are adapted to grab pollen. Bees and flowering plants appeared on earth at about the same time, during the Cretaceous Period over 100 million years ago. It is thought that flowering plants (as we know them) and bees could not exist on the planet without the other. Pollination is an example of an “ecosystem service.” An ecosystem service can be thought of as an important job performed by a plant or animal (or even a non-living thing, like water or wind). These are services that might cost thousands, millions, or even billions of dollars if they were done by people. A well-known example of an ecosystem service is the storm-protection provided by mangrove swamps in the southern U.S.A. Other important ecosystem services include decomposition, oxygen-production, and erosion control.



The pollen basket on the hind leg of this bee is filled with golden pollen grains (David Cappaert, Bugwood.org)

Are There Different Kinds of Bees?

There are hundreds of different species of bees in Kentucky. While many people are familiar with hive-dwelling bumble bees and honey bees, most of our bee species are solitary. These solitary bees live and work alone and most of them are smaller than honey bees and do not make honey. Honey bees are very important economically for the pollination of many crops, but many solitary bees pollinate crops as well. All kinds of bees are critical for pollination in all Kentucky ecosystems. Humans make a big impact on bees, and all bees can benefit from the same kinds of resources and can suffer from the same adverse environmental conditions.

Are Pollinators in Trouble?

All around the world, scientists are learning that our pollinators—especially bees—are declining in numbers. There are many causes, including pollution, pesticides, and diseases that are spread among bees. A critical factor, though, is habitat loss and fragmentation. When wild habitats are broken up or urbanized, plant diversity decreases and this impacts pollinators. When pollinators are negatively impacted plants can suffer too: many plants, including many food crops, cannot make seeds or fruits efficiently unless they visited by a pollinator.

How can Extension Offices Help Pollinators?

Extension offices can help by educating the public about the need for pollinator conservation, especially the conservation of pollinator habitat. The good news is that even urban areas can be reconditioned to help pollinators. Pollinator-friendly plants can be installed in lawns, hedgerows, and other urban greenspaces that may lack flowering plants. Several of the activities in this manual will touch upon pollinator habitats, including their characteristics, where they are found, and how to conserve them.

Go Native!

While many flowering plants can be beneficial to pollinators, flowering plants that are native to Kentucky are believed to be the best, both for honey bees and for our many native bee species. For this reason, we encourage you to emphasize native plants whenever discussing pollinator habitats.

Pollinating For Dollars

Honey bees are also an important economic force in Kentucky. Beekeepers rent their hives to crops that need pollination. They also sell honey, wax, and other products. One of the goals of this project is to support and expand beekeeping in Kentucky.

Sample Calendar

This sample calendar identifies 4-H Bee Ambassador activities for each month as well as additional pollinator ideas to incorporate into your club and county programs. Several of the 4-H Bee Ambassador activities are seasonal in nature and/or are designed to follow one another. However, you can choose to do the activities in a different order to better suite your programming needs. The calendar is only provided to help you organize activities and spark new ideas. Remember that you do not have to do all of the activities in this document, you can choose among them to achieve 25 points toward the 4-H Bee Ambassador Program. 4-H Bee Ambassador activities are bolded.

<p style="text-align: center;">September</p> <p>-Honey Tasting Activity -Bee Safe Activity</p> <p>September is National Honey Month.</p> <p>The North American Mite-A-Thon takes place in September. This is a national effort to collection <i>Varroa</i> mite infestation data in honey bee colonies. Visit their website at http://pollinator.org/miteathon for more information.</p>	<p style="text-align: center;">October</p> <p>-Bee Business Activity -Beekeeper Activity</p>	<p style="text-align: center;">November</p> <p>-Pollination and Foods Activity</p>	<p style="text-align: center;">December</p> <p>-Mason Bee House Activity</p> <p>Mason bee houses, beeswax candles, and beeswax lip balm make wonderful gifts for Christmas!</p>
<p style="text-align: center;">January</p> <p>-4-H Speeches and Demonstrations Activity</p>	<p style="text-align: center;">February</p> <p>-Bee Leadership Project Activity (Identify and plan a project related to bees, pollinators, and/or honey.)</p> <p>Make beeswax lip balm for Valentine’s Day! For information about beeswax lip balm see the <i>Additional Resources</i> section.</p>	<p style="text-align: center;">March</p> <p>-Produce a Pollinator Activity</p>	<p style="text-align: center;">April</p> <p>-Pollinator Plant Hike Activity</p> <p>Celebrate Earth Day (April 22) and Arbor Day (fourth Friday in April) by planting pollinator-friendly plants, trees, and shrubs. <i>Grow Wise. Bee Smart.</i> has a pollinator planting list available (see the <i>Additional Resources</i> section).</p>
<p style="text-align: center;">May</p> <p>-Pollinator Scavenger Hunt and Habitat Comparison Activity</p>	<p style="text-align: center;">June</p> <p>-Bee Reality Store Activity</p> <p>Sponsor-a-Hive – Create a plan to raise funds for the Sponsor-a-Hive Program.</p>	<p style="text-align: center;">July</p> <p>-Bee Leadership Project Activity (Implement the project.)</p> <p>Enter your bee, pollinator, and/or honey projects in your county and/or state fair.</p>	<p style="text-align: center;">August</p> <p>Attend the Kentucky State Fair.</p> <p>Sponsor-a-Hive – Implement the plan.</p>

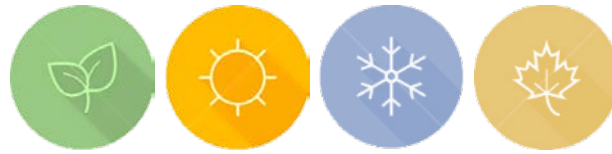
Honey Tasting

LIFE SKILLS



**Teamwork
Communication**

RECOMMENDED SEASON



Any Season

OBJECTIVE

Youth will be able to explain how honey is made after participating in this 2-part activity.

BACKGROUND INFORMATION

A worker bee is a female honey bee tasked with building and guarding the hive, collecting food, and taking care of the queen. A worker bee has a long tube-like tongue called a proboscis. She uses the proboscis like a straw to suck nectar from a flower. She then stores the nectar in a stomach-like organ called a honey sac. When she returns to the hive, she passes the nectar to other worker bees who mix the nectar with enzymes. (Worker bees that collect nectar are referred to as foragers while worker bees that remain at the hive are referred to as house bees.) The mixture is placed into a cell in the hive. Water in the mixture evaporates, and the mixture becomes honey. To speed up the evaporation process, bees fan their wings near the cells. These cells are then capped with beeswax. The honey is used as a fuel source for the bees.

Bees are not the only ones who enjoy honey. Honey is enjoyed by people as well! The source of nectar collected by the bees will influence the color and the flavor of the honey. The color of honey can vary from almost colorless to a dark brown. In most cases, lighter-colored honeys tend to be milder whereas darker-colored honeys tend to be bolder. Honey can be purchased in liquid, whipped, or comb honey form.

NEXT GENERATION SCIENCE STANDARDS (NGSS) CONNECTION

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

PRIOR TO THE ACTIVITY (Part 1)

1. To represent nectar from a flower, add food coloring to water.
2. Youth will be broken up into teams. Each team will need the following:
 - a. Container of colored water labeled "flower" to represent nectar in a flower (one per team)
 - b. Straws which represent a bee's proboscis (one per forager bee) – (instead of straws, eye droppers can also be used)
 - c. Plastic cups labeled "Honey-sac" (one per forager bee)
 - d. Plastic cups labeled "Nectar + Enzymes" (one per house bee)
 - e. Plastic spoons (one per house bee)
 - f. Plastic cup labeled "Cell" (one per team)

CORE AREAS



Agriculture



Natural Resources



**Family & Consumer
Sciences**

What's the buzz?

Rosh Hashanah, the Jewish New Year festival, is celebrated in September. One of the traditions is to eat apples dipped in honey to symbolize the hope of a sweet new year.

DO THE ACTIVITY (Part 1)

1. Break youth into teams. In each team, have an equal number of youth represent forager bees and house bees.
2. Have each teams' forager bees and house bees form a separate line.
3. Explain that one forager bee from each team will fly to the flower (container) and use their proboscis (straw) to gather nectar (colored water) and place nectar (colored water) into the honey-sac (plastic cup). The forager bee is then to fly over to their line of house bees. The forager bee is to transfer the nectar (colored water) to the first house bee by pouring it into the cup labeled "Nectar + Enzymes". After completing this, that forager bee will then tag the next forager bee in line and that forager bee will repeat the entire process.
4. After receiving the nectar (colored water) from the forager bee, the house bee is to use a plastic spoon to stir the colored water representing the adding and mixing of enzymes into nectar. The house bee is then to pour the mixture into the next house bee's plastic cup labeled "Nectar + Enzymes". That house bee will then stir the mixture using a spoon. The house bees will continue to pass the mixture until the last house bee in line is reached. The last house bee will then pour the mixture into the plastic cup labeled "Cell". The team that has the most honey (colored water) in their plastic cup labeled "Cell" after one minute is considered the winning team.
5. After completing the activity discuss the process of how honey is made with youth.
6. Divide youth up into small groups. Have each group choose one structure of a worker or house bee (such as proboscis, honey-sac, wings, etc.). Allow youth time to further research and create a poster display highlighting their structure.
7. Have each small group share their poster.

PRIOR TO THE ACTIVITY (Part 2)

1. Purchase different honeys from the local farmer's market or grocery store that vary in color, etc.
2. Give each different honey a numerical number (so you can keep track of which honey is being tasted).
3. Have one piece of wax paper for each participant.
4. On each piece of wax paper use a permanent marker to write numbers to correspond with the different honeys that will be taste tested.
5. Place one spoonful of each honey next to the honey's corresponding number on the wax paper.
6. Have one glass of water available for each person to use between tasting different honeys.

DO THE ACTIVITY (Part 2)

1. Discuss how the color and the flavor of honeys may differ depending on the source of nectar collected by the worker bees.
2. Give each person a piece of wax paper with honey samples and a glass of water.
3. Provide each person a *Honey Taste Test* handout.
4. Have participants sample honey and complete the handout. Remind participants to drink water between sampling different honeys.
5. Reveal the different honeys sampled. Discuss the handout.

MATERIALS (Part 1)

- Water
- Food coloring
- Plastic containers
- Straws
- Plastic cups
- Plastic spoons
- Poster board
- Markers

MATERIALS (Part 2)

- Different honeys varying in color
- Plastic spoons
- Waxed paper
- Permanent marker
- Plastic cups
- Water (for drinking)
- *Honey Taste Test* handout (1 per person)

What's the buzz?

University of California, Davis has a Honey Flavor Wheel available for purchase. The wheel can be used when describing the tastes and aromas of different types of honey. Information is available at the UC Davis Store, <http://ucdavisstores.com>.



Honey Taste Test

For each honey sample, make notes about the honey's color, smell, texture, and taste.

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Color					
Smell					
Texture					
Taste					

Questions:

1. Which honey sample had the lightest color? Which had the darkest?
2. Did the honey sample with the lightest color have the mildest flavor? Did the honey sample with the darkest color have a bolder flavor?
3. Did the honey samples smell the same or different?
4. Did the honey samples have the same or different textures?

FOLLOW UP

- Using the same honey samples, have youth describe each honey utilizing the UC Davis Honey Flavor Wheel.
- Encourage youth to prepare a honey recipe with their family. Several honey recipes are available on the National Honey Board's website at <https://www.honey.com/recipes> and the What's Cooking? USDA Mixing Bowl recipe database website at <https://snaped.fns.usda.gov/recipes-menus>.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What is the role of a forager bee?
- What is the role of a house bee?
- How is nectar collected?
- How is honey made?

ADDITIONAL RESOURCES

How do bees make honey? PBS Video available online at <https://www.pbs.org/video/its-okay-be-smart-honey/>.

REFERENCES

Boettcher, Alyssa. 2001. The Honey Files: A Bee's Life Teaching Guide. National Honey Board. Available online at https://utah.agclassroom.org/estore_files/honey_files.pdf.



Bee Safe

LIFE SKILLS



Personal Safety

RECOMMENDED SEASON



Any Season

OBJECTIVES

Youth will learn the basics about stinging insects, including why they are dangerous, how to recognize stinging insects, and how to stay safe. Youth will also learn that most other insects are harmless to people.

BACKGROUND INFORMATION

Pollinating bees are among the most important animals on earth. Without them, many of our fruits and flowers could not exist. However, for some people, insects can be alarming. For individuals who are sensitive to their stings, some insects can be dangerous and even deadly. Bees and wasps are very common though, and we must learn to live with them. With a little knowledge, youth can learn which insects are likely to sting and which are not, and how to avoid dangerous encounters.

CORE AREAS



Agriculture



Natural Resources



Health

SIMPLIFY

This activity takes about one hour. If you are working with younger youth or if you do not have enough time for the whole activity, simply hand out the *Bee Safe* and *Bee Square* handout and go over the basics of sting safety.

DO THE ACTIVITY

NOTE: This activity is designed to prepare 4-Hers for basic outdoor safety regarding stinging insects. Those youth working directly with bee hives and honey production will require additional training.

1. Ask youth if anyone has ever been stung by a bee or wasp before. It is likely that most of them have, so they will know that bee and wasp stings can hurt. Ask them if they know that bees and wasps can also be very dangerous or even deadly to some people.
2. Explain that, in the U.S., bees and stinging insects are responsible for more deaths and injuries than many other “dangerous” animals, including venomous snakes, sharks, and crocodiles (Ingraham, 2015).

MATERIALS

- Chalkboard/dry erase board with chalk or markers
- Color copies of *Stinger* and *Non-stinger Cards*
- Copies of the *Bee Safe* and *Bee Square* handout (1 per person)

DO THE ACTIVITY CONTINUED...

3. On a board, create two columns, one for “bees and wasps” and one for “venomous snakes.” Now that they know that bees and wasps cause more injuries than snakes, ask youth to think of some characteristics of bees and wasps that might make them more dangerous than venomous snakes, and some characteristics of snakes that might make them less dangerous. Some characteristics that youth might think of include:
 - a. Bees and Wasps: very common around people and homes; can fly; work together in groups to sting a single person; will chase a person that they identify as a threat; each sting from each bee or wasp contains venom; some people are highly allergic to stings
 - b. Venomous Snakes: not common around homes; cannot fly; only one snake will bite a person (snakes do not work together as a group to defend themselves); will not chase a person; snake-venom allergy is extremely rare.

NOTE: remind youth that even though bees and wasps cause more injuries than venomous snakes, an individual venomous snakebite—while very rare—can be extremely dangerous.
4. Explain that, while most animals in the world are camouflaged with their surroundings, many venomous and poisonous animals around the world use warning colors or patterns to keep humans and other dangers away. Ask youth if they can think of any examples of warning colors in the animal world? Examples might include: brightly colored poison dart frogs; brightly colored venomous snakes (such as the coral snake); black widows, with black-and-red markings; brightly colored butterflies and caterpillars (which are poisonous to birds).
5. Explain that, while many kinds of bees and wasp can sting, the species that live in colonies or hives are generally more dangerous and more likely to sting than solitary bee and wasp species. It is fairly easy to identify the hive-dwellers, though, because there are not many different kinds. Hive dwelling bees and wasps in Kentucky include: honey bee, bumble bee, paper wasp, yellow-jacket, European hornet, and bald-faced hornet. Some solitary wasps and bees include: sweat bees, cicada killer wasps, carpenter bees, and mud-dauber wasps.
6. (Optional) Show a brief slideshow with pictures of some of Kentucky’s most important stinging insects, in particular the hive-dwellers. These images can be gathered from a basic internet image search, or UK Entomology can help create this for you. Look for images of the creatures mentioned in Step 5. Be sure to note which images are hive-dwellers and which are not.
7. Ask youth if they can think of any other insects that are dangerous or which can cause painful bites or stings. List these on the board. Examples might include: stinging caterpillars, mosquitoes and ticks (which may transmit disease), horse flies, ants, and spiders. A few unusual examples might include assassin bugs and robber flies (which can bite but are not serious threats). Emphasize that these other creatures are all very different from stinging bees and wasps. None of them live in hives or colonies, for instance. And, other than black widows and (rarely in Kentucky) stinging ants, none of them are likely to be the cause of an immediate first-aid emergency like bees and wasps. **OPTIONAL:** Later, go over safety topics related to these other dangerous insects and spiders (see “Follow Up” at the end of this lesson for links to factsheets that discuss insect, tick, and spider safety).
8. Ask youth if they know that some bees and wasps are solitary and do not live in hives. Sweat bees and mud daubers are examples. Ask youth if they can think of why solitary bees and wasps are less likely to cause serious injury. Answers might include: solitary bees and wasps don’t swarm because they do not work together to protect a hive; solitary bees and wasps have less powerful stings because they are not adapted to protect hives.

9. Ask youth if they can think of any insects that might look like bees and wasps that are not dangerous. Examples might include flies, dragonflies, or fireflies. Mention that there are a few flies which look almost exactly like bees and wasps. It is very hard to tell the difference, but flies always have two wings, while bees and wasps always have four wings. But if they are not sure and they see something that looks like a bee or a wasp, they should treat it with care.
10. Ask youth if they can think of examples of any kind of insect that cannot harm people. Examples might include: butterflies, moths, beetles, stink bugs, most ants, flies, dragonflies, grasshoppers, crickets, termites, and most insects other than bees and wasps and the ones mentioned in Step 7.
11. Ask youth if they can think of ways to *Bee Safe* when they are outdoors. Go over these questions using the board:

NOTE: Remind youth that these are general safety tips for outdoor activities. *Additional safety protocols should be followed when managing active bee hives for honey production.*

Where are bees and wasps likely to be encountered? Areas with lots of flowers, dry protected areas where wasps build nests (barns and sheds), tree limbs where hornets can build nests, holes in the ground where bumble bees or yellow-jackets build hives.

What are some signs that a bee or wasp hive is nearby? Loud buzzing sounds, lots of insects flying into and out of a single area, such as a hole in the ground, a space between boards, or a part of a tree.

If you find yourself close to an active bee or wasp hive, what should you do? Do not touch the hive, do not get any closer to the hive, walk but do not run away from the hive, do not swat at any insects that get close to you, tell an adult right away.

If a wasp or bee lands on you, but does not sting you, what should you do? Do not swat it, do not blow on it, watch it until it flies away, slowly walk toward adults or a safe area—the wasp or bee is likely to leave as you slowly move away from its territory.

If you or someone gets stung by a bee or wasp, what should you do? Do not panic, swat, or make sudden movements because you might be near a hive; if there are a few insects still flying around move slowly away from the area with your face and eyes covered; if dozens or hundreds of bees or wasps are surrounding you, run away to safety as quickly as possible; find an adult; use an epinephrine injector (“epipen”) if the victim is allergic to stings (the injector will have instructions on it); call 911 if an epinephrine injector was used or if the victim is having a serious reaction; if emergency treatment is not required, apply ice to the stung area.

What are some signs of a serious reaction to a sting? Swelling around the mouth, especially if the person was not stung there; difficulty breathing; nausea; dizziness or fainting; itching.

Should you try and remove a bee stinger? Yes, a honey bee will leave behind its stinger and it can be scrapped away with something like a credit card. Other bees and wasps will not leave a stinger behind, though.

What are some steps you can take which might reduce the chances of bee and wasp stings? Watch where you are walking, especially in fields with flowers or inside barns and other out-buildings; if you are especially concerned about stings, avoid wearing brightly colored clothing and perfumes, which can attract bees and wasps.

12. Hand out a copy of the *Bee Safe and Bee Square* handout. Go over the four squares, which are simply a re-organization of the safety information discussed in Step 10.
13. Stingers and Not-Stingers. Cut out the color images (**pages 20-21**) and have youth sort them into three groups (feel free to find and use additional images as well). Remind the youth about warning colors and other characteristics of hive-dwelling stinging insects (hairy or ant-like bodies; four wings):
 1. Definitely a stinging insect
 2. Definitely not a stinging insect
 3. Not sure

Important: always remind youth that hive-dwelling bees and wasps will never sting without a reason. They only sting when threatened, or when they perceive a threat to their hive.

INSECT NAMES, NOTES, AND PHOTO CREDITS

1. Honey Bee (stinger) - Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org
2. Ground Beetle (non-stinger) - Jim Jasinski, Ohio State University Extension, Bugwood.org
3. Hummingbird Moth (non-stinger) - David Cappaert, Bugwood.org. Notes: These moths resemble bees (even to experts), but they are larger and lack chewing mouthparts. When you see something like this that you are not sure of, it is best to avoid it. No moths or butterflies can cause harm to humans.
4. Lady Beetle (non-stinger) - Scott Bauer, USDA Agricultural Research Service, Bugwood.org. Notes: Lady beetles have bright coloring, but no beetles are able to cause serious harm to humans.
5. Horse Fly (non-stinger) - Sturgis McKeever, Georgia Southern University, Bugwood.org. Notes: Some horse flies are able to cause painful bites, but serious reactions to horse fly bites are extremely rare and horse flies do not swarm.
6. Crane Fly (non-stinger) - David Cappaert, Bugwood.org. Notes: Crane flies are very large non-biting flies. They are very common in Spring. Some resemble wasps (some even have bold colors) but they have two wings instead of four and they do not have an ant-like body.
7. Ant (sometimes a stinger) - David Cappaert, Bugwood.org. Notes: Kentucky lacks any ant species which commonly cause serious injury, but some of our ants can sting and can possibly be a threat to people who are sensitive to stings (this is very rare).
8. Stink Bug (non-stinger) - Kevin D. Arvin, Bugwood.org. Notes: Some stink bugs are brightly colored but none can sting or cause dangerous bites.
9. Praying Mantis (non-stinger) - Allen Bridgman, South Carolina Department of Natural Resources, Bugwood.org. Notes: Mantids are not able to sting or cause serious injury, but may scratch skin with their front legs.
10. Grasshopper (non-stinger) - David Riley, University of Georgia, Bugwood.org. Notes: While some grasshoppers have bold colors and some may nip with their mouths, none can cause serious injury.
11. Cricket (non-stinger) - Joseph Berger, Bugwood.org. Notes: Some crickets may have long appendages on their abdomens which look like stingers, but all crickets are harmless.

INSECT NAMES, NOTES, AND PHOTO CREDITS CONTINUED...

12. Armyworm Caterpillar (non-stinger) - John Capinera, University of Florida, Bugwood.org. Notes: Although some hairy or spiny caterpillars are able to sting, their stings are much different than wasp and bee stings and extremely unlikely to cause a serious reaction.
13. Flower Fly (non-stinger) - Steven Katovich, USDA Forest Service, Bugwood.org. Notes: Although some flies mimic bees or wasps, they are not able to harm people. Identification is difficult, though, even for experts, so stay away if you are not sure. Some things to look for: flies have two wings instead of four, flies have much shorter antennae than wasps and bees, many of the very common small flower flies are able to hover in place for a few seconds; bees and wasps cannot hover like this.
14. Sweat Bee (stinger) - David Cappaert, Bugwood.org. Notes: Sweat bees are solitary (non hive-dwelling) and although they are able to sting, they do not swarm. Their stings are mild and unlikely to cause serious reaction, although it is possible in sensitive individuals.
15. Mud Dauber (stinger) - Johnny N. Dell, Bugwood.org. Notes: Mud daubers are able to sting, but they do not live together in hives. Their stings tend to be milder than those of hive-dwelling bees and wasps, although stings can be serious in sensitive individuals.
16. Longhorn Beetle (non-stinger) - Jon Yuschock, Bugwood.org. Notes: Some longhorn beetles can resemble wasps, but still have the smooth hard shells of beetles. No beetles can cause serious harm to humans.
17. House Fly (non-stinger) - Johnny N. Dell, Bugwood.org

Bee Safe and Bee Square!

<p>Prepare</p> <p>Bees and wasps are all around us in Kentucky. Be prepared for possible stings when going outdoors.</p> <ul style="list-style-type: none"> • pack general first aid equipment • if you have had a reaction from stings before, talk to a physician about sting allergies and wear a medical ID bracelet • carry an epinephrine injector if you have reactions to stings • learn how to use an epinephrine injector even if you are not sensitive to stings • work with an adult to inspect an outdoor area for bee and wasp hives prior to outdoor activities 	<p>Identify</p> <p>Learn to identify hive-dwelling bees and wasps, which are the kinds of insects that are most likely to cause injury in Kentucky. Characteristics of hive dwellers:</p> <ul style="list-style-type: none"> • bold patterns with black, yellow, white, gold, and orange colors • hairy bodies (bees) or shiny ant-like bodies (wasps) with visible antennae • hives found in holes in the ground, inside the walls of buildings, under eaves, and in trees • loud buzzing sound of many insects all at once • insects coming and going from a single spot
<p>Avoid</p> <p>Learn how to avoid stings in areas where bees and wasps might occur.</p> <ul style="list-style-type: none"> • avoid brightly colored clothing and perfumes • watch out for bees and wasps on sweets drinks and fruits • wear shoes • watch your step in areas with flowers • be especially careful around the eaves of buildings and underneath man-made objects, where paper wasp nests are very common • if you see an active hive, walk away slowly and tell an adult 	<p>React</p> <p>There are things that you can do to help yourself and others if stings occur.</p> <ul style="list-style-type: none"> • if a sting occurs, walk slowly from the area because a hive might be nearby • if multiple stings occur and many insects are swarming, run to a safe area as quickly as possible • for honey bee stings, scrape away the stinger with a credit card, forceps, or similar blunt object • apply ice to the stung area • recognize the signs of a serious reaction and use an epinephrine injector if the victim carries one • call 911 if a serious reaction occurs • alert an adult

Signs of a Serious Reaction:

- Person has a history of reactions to insect stings
- Swelling around mouth or throat, even if sting was elsewhere on the body
- Difficulty breathing
- Nausea, dizziness, or fainting
- Itchiness



Bees: four wings, often hairy, bold black-and-yellow or gold-and-black patterns



Paper Wasps, Hornets, Yellow-Jackets: often smooth and shiny, ant-like bodies, four wings, bold patterns with black, yellow, white, or orange

FOLLOW UP

1. Introduce safety topics related to other biting and stinging insects and spiders in Kentucky. Although most Kentucky insects and spiders are not dangerous, other medically important examples include:
 - Ticks and diseases
<https://entomology.ca.uky.edu/ef618>
 - Mosquitoes and diseases
<https://entomology.ca.uky.edu/ef005>
 - Stinging caterpillars
<https://entomology.ca.uky.edu/ef003>
 - Bed bugs
<https://entomology.ca.uky.edu/ef636>
 - Black widow and brown recluse spiders
<https://entomology.ca.uky.edu/ef623>
2. Work with youth to put together a Bee Safety First Aid Kit or modify an existing first aid kit. A kit should include basic first aid supplies (e.g., bandages, antiseptic wipes), one or more unexpired epinephrine injectors and a sheet with instructions for use, and blunt plastic forceps to remove stingers.

EVALUATION

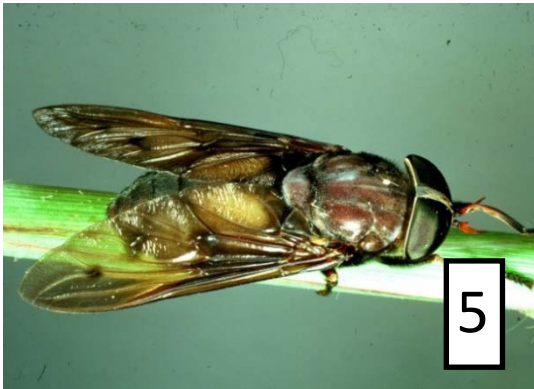
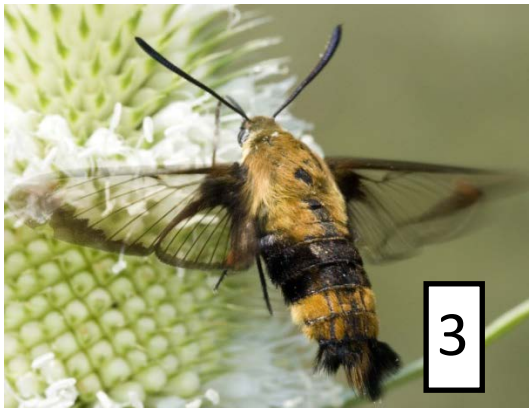
Key questions/statements to ask to gauge youths' understanding.

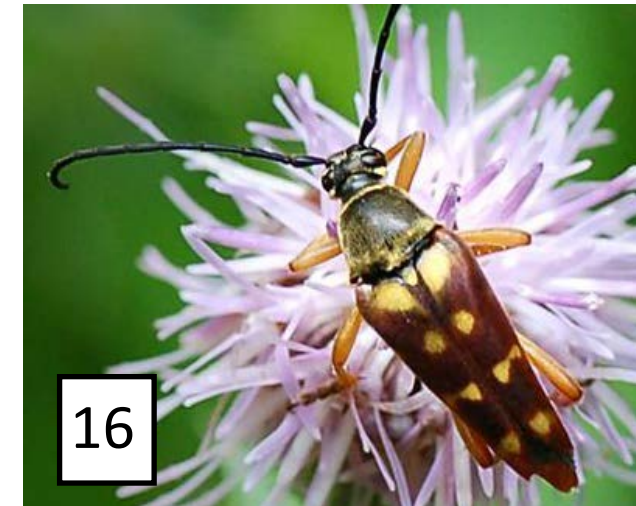
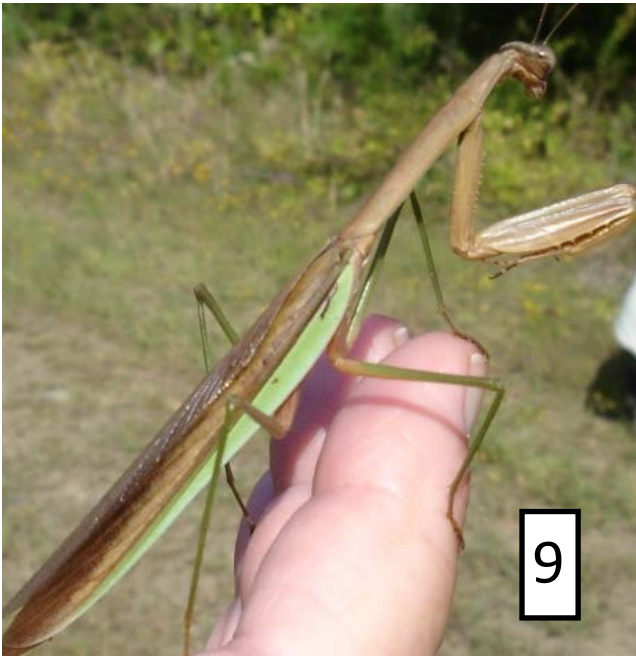
- What is a hive?
- What is a solitary bee or wasp?
- What is an example of an insect that cannot sting?
- What are signs of a serious reaction to a sting?
- What is one way to properly react if someone has a serious reaction to a sting?

REFERENCES

Ingraham, Christopher. 2015. Chart: The animals that are most likely to kill you this summer. The Washington Post. Available online at https://www.washingtonpost.com/news/wonk/wp/2015/06/16/chart-the-animals-that-are-most-likely-to-kill-you-this-summer/?utm_term=.1c74a8d757e1.

See references for photographs in the *Insect Names, Notes, and Photo Credits* section of this activity.







LIFE SKILLS



Record Keeping

RECOMMENDED SEASON



Fall

OBJECTIVES

In this activity, youth learn about plant pollination. They review the process and demonstrate the sequence of plant pollination and describe the relationship between bees and flowers. They also compare the effects of various conditions on pollination.

BACKGROUND INFORMATION

Honey bees have a lot of work to do! They build hives, collect nectar, make honey, and raise big colonies. People who work with honey bees are busy, too! In this activity, youth will play a game where they pretend to be honey bees and apple trees. The activity shows some of the steps involved in honey production and fruit pollination.

DO THE ACTIVITY

1. Ask youth to tell you what they know about bees and why bees are important to people. Explain that honey bees are insects that live in colonies. In the colony live three kinds of honey bees: queen, drone and worker (see Supporting Information). Hand out or display *Parts of a Flower* and *Parts of an Insect* sheets. Briefly explain the process of plant pollination. Ask youth:
 - a. Why do bees visit flowers? What do they get from a flower? (nectar and pollen)
 - b. What does a bee get on its legs and body hair when it flies into a flower to get its nectar? (pollen)
 - c. How? (Pollen from the anther is transferred onto the bee because of its movement.)
 - d. What happens to the pollen collected on a bee's body hair when it flies into another flower? (Some pollen falls into the new flower, causing pollination or seed set.)
 - e. What happens when a flower is pollinated? (Pollen is transferred from the stamen [male part] to the pistil [female part]. It sets things in motion for fertilization to take place so seeds or fruit can be produced.)
 - f. What would happen if the flower did not get pollinated? (No seeds or fruit would be produced.)
 - g. What are the steps involved in bee pollination? (Bee enters flower for nectar, pollen, and water. Bee lands on the anther and gets pollen on its body hairs and legs. Bee moves to stigma of same or another flower and leaves pollen behind. Pollination stimulates fertilization and the production of seeds and fruits.)

CORE AREAS



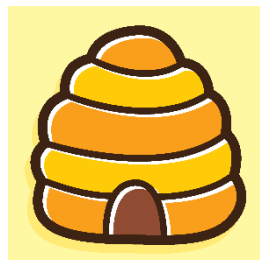
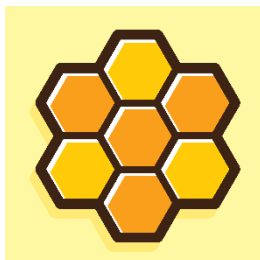
Agriculture

MATERIALS

- Pictures of bees
- 300 or more 2" x 5-1/2" paper strips
- Popsicle sticks or big bag of popped popcorn
- Paper or plastic bags
- Paper clips or clothes pins
- Envelopes
- Transparent tape
- Copies of *Parts of an Insect*, *Parts of a Flower*, and *Graphing Apples* sheets (included in activity)
- Optional: headbands for each youth and one hat for the apple producer (see *Do the Activity* section for details)

DO THE ACTIVITY CONTINUED...

- h. After a flower is pollinated what occurs? (Pollen tube develops, sperm from pollen grain travels down tube and unites with egg in ovule, and fertilization occurs.)
2. Play a game with youth to dramatize how flowers are pollinated. Each youth plays the role of either an apple tree, a honey bee, or the apple producer. Youth can wear headbands of different colors to differentiate the roles. Designate one youth as the apple producer who owns the orchard. Give the apple producer the hat. Designate 10 youth as apple trees and give them each the same color headband to wear. Give each apple tree about 30 paper strips or a handful of popcorn (more than enough to accommodate the total number of honey bees) to hold and a paper or plastic bag. Use a paper clip or clothespin to attach a paper bag to the collar or neckline of each tree. Or, tie a plastic bag to a belt or belt loop of each tree. The bags will be used to collect paper strips from the honey bees in Step 4. All other youth are honey bees. Give honey bees headbands of the same color to wear.
3. Designate a spot as the beehive. Younger youth can practice how honey bees fly and get nectar out of a flower to dramatize the pollination process.
4. To play, each honey bee buzzes and flies from one tree to another. The honey bees take one paper strip or piece of popcorn from the tree they visit and place it in the bag of another tree. They then receive another paper strip or piece of popcorn from that tree. (At the start of the game when visiting the first tree, the honey bees only receive a paper strip or piece of popcorn, since the honey bees do not have anything to leave yet. After that, the honey bees must leave one strip of paper or piece of popcorn in the bag of the tree they visit.) One minute represents one growing season. Allow only one minute for the honey bees to fly from one tree to another, leaving and receiving a paper strip or piece of popcorn. On a designated signal, the honey bees return to their hive, leaving their paper strip or piece of popcorn in the bag of the last tree they visited.
5. The apple producer tells the trees to count the number of paper strips or pieces of popcorn in their bag. Include only the strips of paper or popcorn in the bag, not any of the strips or popcorn pieces the trees have in their hands! Tell youth the strips or popcorn pieces represent the number of apples a tree can grow for that season. Each strip or popcorn piece represents a blossom pollinated and fertilized by the bees.
6. After each tree has counted his/her strips, have the tree individually tell the apple producer their total. (They will use the strips or popcorn in the next growing season.) The producer writes each total in a visible place and totals the number of "apples" produced by all the trees. The apple producer graphs that number on the *Graphing Apples* sheet above the first growing season. (Optional: Older youth can graph the total number of apples produced each growing season on their graphs or copy all the growing seasons onto their graph at the conclusion of the game.)
7. Play the game numerous times for one-minute intervals. Remind youth that each minute represents a growing season. Be sure that at the end of each minute, the trees total the apples produced. Remind the producer to record and graph the figures. Challenge youth to describe how and why the trees are able to produce their fruit. The blossoms pollinated by bees will generally lead to fertilization and fruit production.
8. Play the game for at least three more seasons, but vary the pollination conditions (see below). You can choose one or more conditions from the list. The group adjusts its role playing to match the pollination condition. Growing seasons continue to be one-minute intervals.



DO THE ACTIVITY *CONTINUED*...

Some Pollination Conditions

- a. The weather has been especially cold, so the honey bees are slow and sluggish - flying at only about half speed.
 - b. The winter was harsh. A virus killed many of the honey bees in the hive. Only half the honey bees are left to do the job. Have half the honey bees sit on the floor or stay at the hive.
 - c. Since the hive was overcrowded, half the honey bees swarmed (left the area entirely). There are not as many honey bees left to do the pollination job.
 - d. The apple trees were damaged in an ice storm. (Only half of the tree branches have pollen. Cut the pollen strips available in half.)
 - e. A late frost hit the orchard. (They may have been pollinated, but then damaged. Go around and collect the paper strips from some of the trees.)
 - f. A very brisk wind has been blowing. Honey bees either stayed in the hive or stopped working in the field. They will find shelter until the wind stops.
9. Graph the total number of apples produced on a copy of the *Graphing Apples* sheet. Indicate the weather conditions. Compare the data for all the growing seasons. The totals should vary from season to season. Ask youth to explain possible causes for the differences by asking:
- a. What do you notice about the number of apples produced during each season?
 - b. Did the total number of apples produced during each growing season stay the same? Why or why not?
 - c. Why do you think the totals are different? (Discuss any specific circumstances for individual growing seasons and the effects on the total number of apples produced.)
 - d. What does this tell you about the relationship between bees and flowers? (The bees need the flowers for food and the flowers need the bees to be able to produce seeds and fruit.)
 - e. Why are bees important to agriculture? (Many fruits and vegetables develop as a result of pollination and fertilization of flowers. Bees change nectar from flowers into honey.)
 - f. If you were an apple producer or orchard owner, what would you do to assure good pollination and fertilization for your apple trees? (Rent and release bees in the orchard at the first sign of bloom.)
 - g. What is the most interesting thing you learned about bees and pollination?

Optional for Older Youth

1. Play the game this time with honey bees gathering nectar and pollen. At the end of the game youth determine the amount of honey produced and pollen gathered. Using scotch tape or paper clips, have the bees attach an envelope to each leg (representing pollen baskets) and an envelope to their stomachs (representing the honey stomach). When bees take a paper strip from the tree, have them tear off two small pieces of paper (one to put in one of their pollen baskets and one to put in their honey stomach). The rest of the paper strip goes in the tree's bag. Play the game for several minutes. At the end, the honey bees return to the hive. Ask one honey bee at the hive to collect the pollen and nectar pieces as each honey bee empties their pollen baskets and honey stomach. (You may want to have two piles - one for pollen and the other for nectar - keeping the pollen and nectar separate.)
2. Have youth determine how much nectar was gathered and made into honey. Tell youth that 12 pieces of nectar paper represents one teaspoon of honey. Since six teaspoons equals one ounce, how many ounces of honey did the honey bees produce? How many pounds?
3. Have youth determine how much pollen was gathered. Tell youth that 72 pieces of pollen paper represents one ounce of pollen. How many ounces of pollen did the honey bees gather? How many pounds? A honey bee colony uses 50 to 75 pounds of pollen each year. Did the honey bees gather enough pollen for the colony to survive?

FOLLOW UP

- Ask local grocery stores or florists to save discarded flowers of various varieties, or find flowers in a garden or yard. Have the youth use hand lenses to study the parts of the flower. Ask them to look for pollen and then take apart the flowers. Have them draw and label the different parts of the flower.
- An apple that has been adequately pollinated will generally have 10-12 seeds. Bring in locally produced apples from surrounding counties. Cut apples open and have youth count the number of seeds per apple. If an apple does not have 10-12 seeds, why (what happened)? Have youth discuss possible answers.
Instructor's Notes: Possible answers may include that they were not enough bees to pollinate the apples due to drought, pesticide drift, etc.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- Have youth draw a sequence story of the Bee Business Game, including how plants are pollinated.
- Give youth a graph showing 15 apples produced in the first season, seven in the second season, and 14 in the third season. Have youth describe conditions that might have affected the pollination.

REFERENCES

This activity was adapted from "Buzzy, Buzzy Bee" Project Food, Land, and People, 2003.

Parts of a Flower

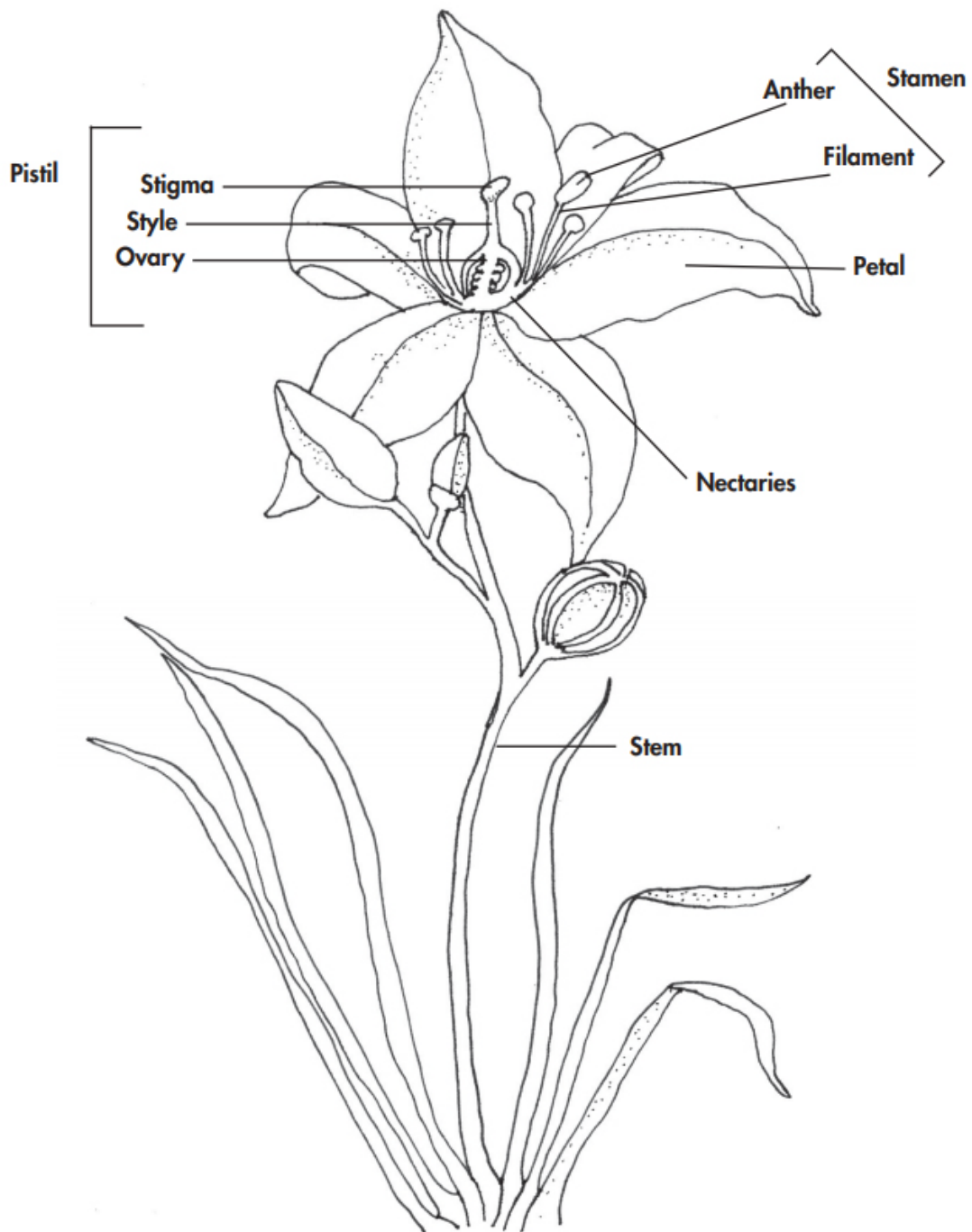


Image: Project Food, Land, and People, 2003

Parts of an Insect

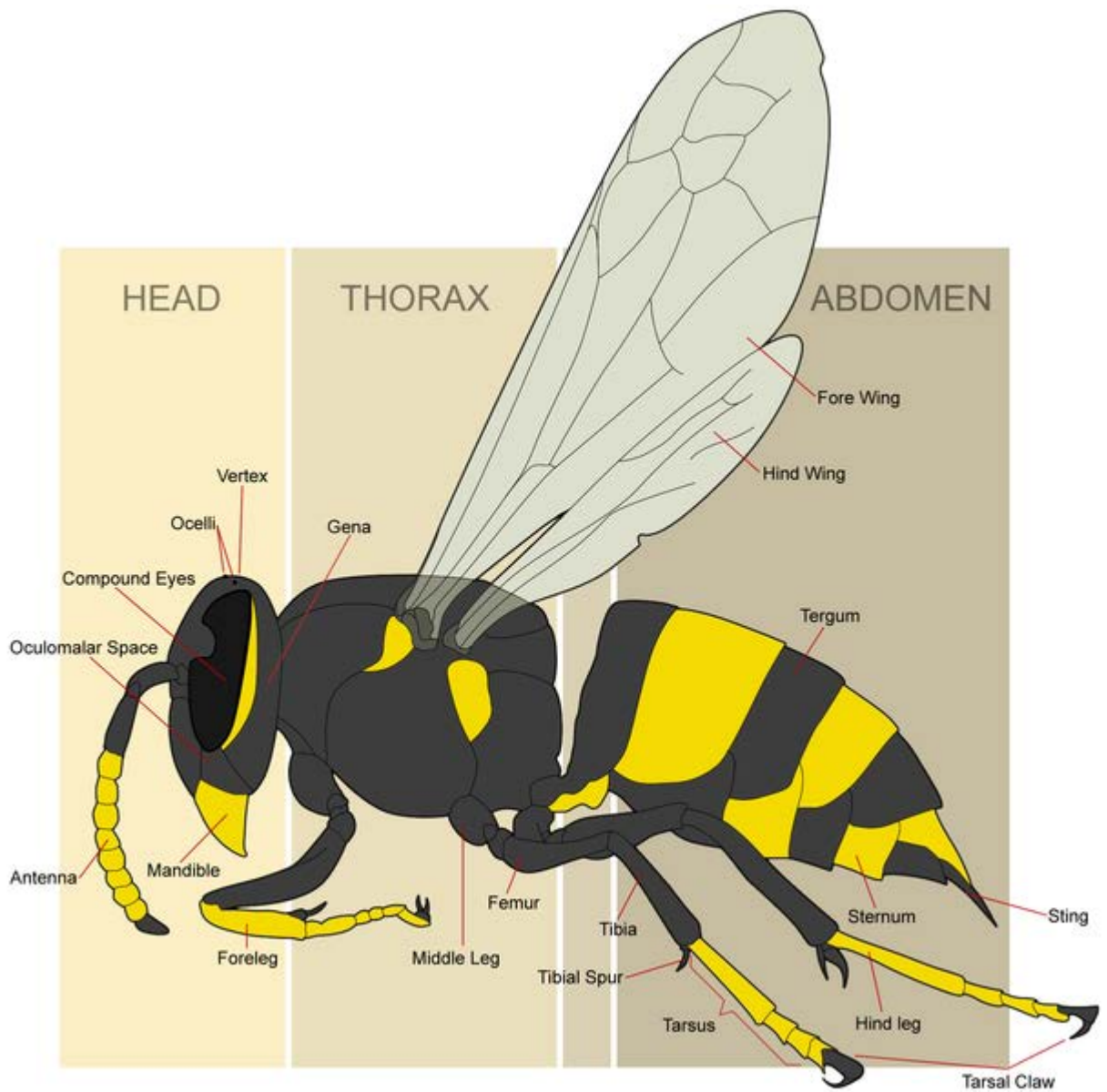
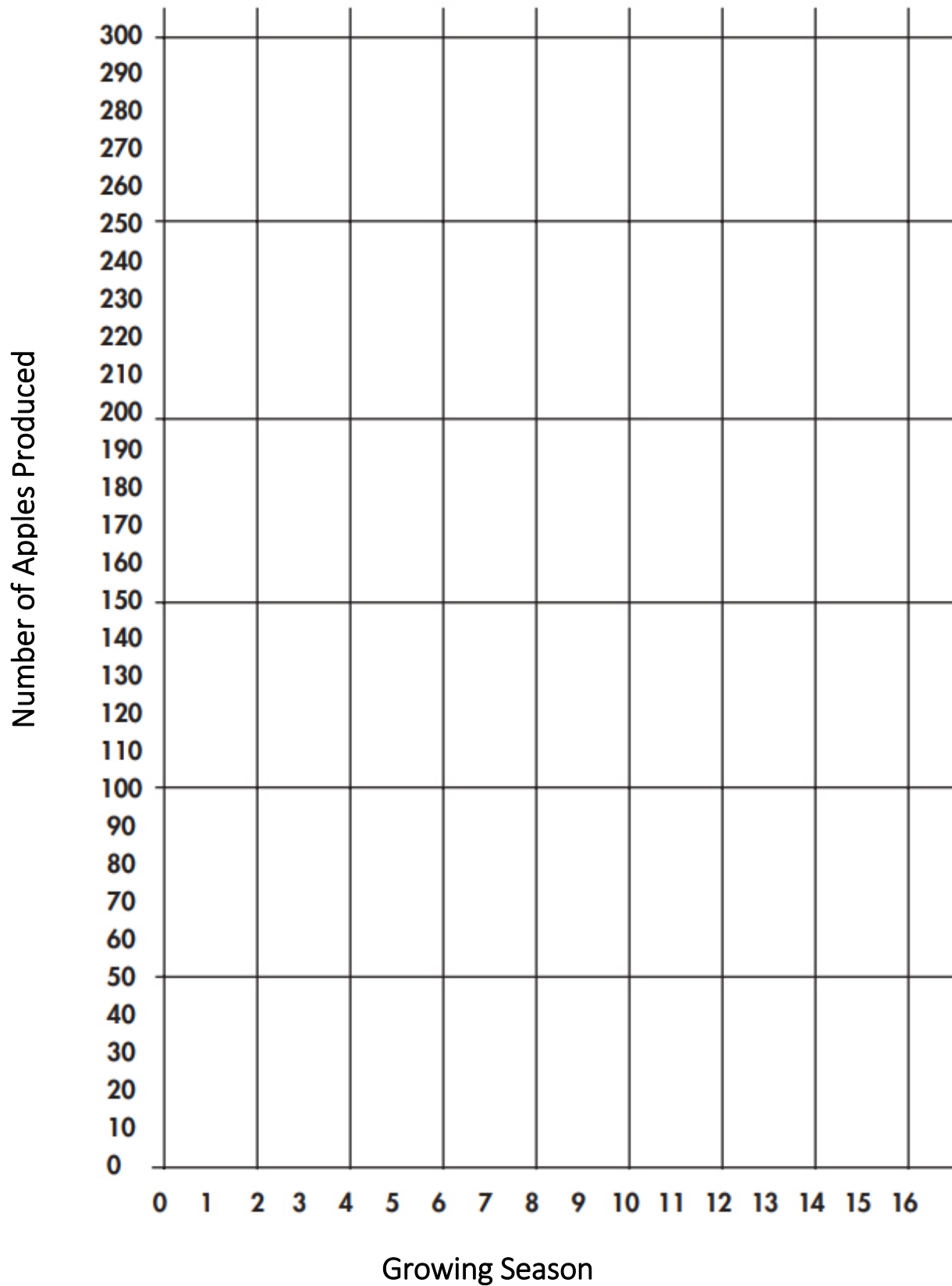


Image: [WikipedianProlific at the English Language Wikipedia](#)

Graphing Apples





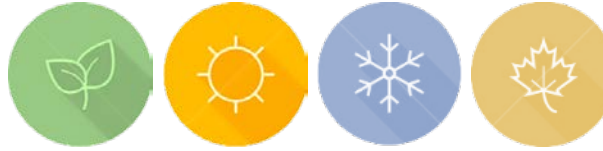
Beekeepers

LIFE SKILLS



**Communication
Teamwork**

RECOMMENDED SEASON



Any Season

OBJECTIVES

Youth will have a greater understanding of beekeeping and the tools and equipment needed to care for and maintain a hive.

CORE AREAS



Agriculture

BACKGROUND INFORMATION

Honey bees live in colonies. A beekeeper provides a hive as a home for a colony to live. See the image below which outlines the basic components of 10-frame hive used in beekeeping. A beekeeper uses various equipment and gear to care for and maintain his or her collection of hives, also called an apiary. Examples of equipment and gear used include a hive tool, smoker, bee brush, bee suit, veil, helmet, and gloves. A beekeeper collects excess honey (that is not needed by the bees for overwintering) and processes the honey to use or sell.

In this activity, youth will interview a local beekeeper at his or her apiary and write a news article or create an exhibit highlighting what they learned.

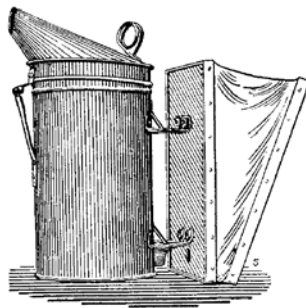


Image of Smoker: University of Kentucky Entomology Department

A smoker is an important piece of equipment for a beekeeper. The smoker is used to puff smoke into the entrance of a hive before the hive is opened and blow smoke over the frames of the hive after the hive is open. The smoke helps to conceal scents (such as lotions) the beekeeper may be wearing. The smoke also causes the bees to consume lots and lots of honey, which causes the bees to be gentler. However, the smoke must be used carefully as too much smoke can drive the bees from the hive.

MATERIALS

- Flipchart paper
- Paper
- Markers, pens, and pencils
- Camera

What's the buzz?

A list of beekeepers in Kentucky interested in helping 4-H'ers complete this activity is available at the end of this section. If you know a beekeeper that is not on the list but willing to work with youth please contact Ashley Osborne or Blake Newton.

PRIOR TO THE ACTIVITY

1. A list of Kentucky beekeepers interested in talking to 4-H'ers is available at the end of this activity. Also, you can contact the Kentucky State Beekeeper's Association to learn about local beekeepers and hives in your area. Kentucky State Beekeeper's Association website: <http://www.ksbabeekkeeping.org/>
2. Plan a field trip for youth to visit a local hive and interview a beekeeper. Explain to the beekeeper that youth will be asking questions related to beekeeping equipment, the components of a hive, how to care for and maintain a hive, and how to collect, process, and use the honey. Explain that youth will be creating a news article or display from the information and photographs gathered during the interview and field trip.

DO THE ACTIVITY

1. Have youth brainstorm questions to interview a local beekeeper. Use flipchart paper, paper, markers, pens, and pencils to record questions. Encourage youth to ask questions related to the beekeeping process such as the components of a hive, equipment and gear, care and maintenance, honey collection, processing, and use, and business-related questions (such as record-keeping).
2. Once youth have finalized their interview questions, have them determine as a group who will ask which question, who will record (write-down) information, and who will take photographs.
3. Visit the hive and have youth interview the beekeeper.
4. Have youth thank the beekeeper for the interview and field trip.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What are the components of a hive?
- What equipment and gear does a beekeeper need to care for and maintain a hive?
- How is honey collected and processed?
- What challenges might a beekeeper experience? (Weather conditions, drought, urbanization, equipment failure, disease/viruses, pests, etc.)

FOLLOW UP

After interviewing a beekeeper and visiting his or her apiary, have club members develop an article for a local paper or newsletter, or an exhibit to display at the county Extension office highlighting their interview and experience. (Please share the article or a picture of the exhibit with the State 4-H Office to include in the monthly 4-H update and social media outlets.)

RESOURCES

Bessin, R.T. and L.H. Townsend. 1996. Beginning Beekeeping for Kentuckians ENT-41. University of Kentucky. Available online at <http://www2.ca.uky.edu/agcomm/pubs/ent/ent41/ent41.pdf>

Boettcher, Alyssa. 2001. The Honey Files: A Bee's Life Teaching Guide. National Honey Board. Available online at https://utah.agclassroom.org/estore_files/honey_files.pdf.

Pollination and Foods

LIFE SKILLS



Communication • Teamwork

RECOMMENDED SEASON



Fall

OBJECTIVE

Youth will be able to:

- Explain the process of plant pollination.
- List vegetables and fruits that require pollination.

BACKGROUND INFORMATION

Honey bees, sometimes referred to as the “angels of agriculture”, and other pollinators are extremely important to food production in the United States. Honey bees contribute about \$15 billion to the U.S. economy every year by helping pollinate many of our crops. As bees move from flower to flower gathering pollen and nectar, they transfer pollen from one flower to another using pollen baskets (see image). Pollen Baskets are bunches of specialized branched-hairs on the back legs of bees. These baskets help the bees gather lots of pollen as they move from flower-to-flower. Bees are the only creatures on earth with pollen baskets. Without this pollen transfer, many plants would not be able to produce seeds. At the end of the activity, a list includes examples of pollinated foods. Some foods listed are self-pollinated (the pollen of the same plant is used during pollination) while other foods are cross-pollinated (the pollen of different plants is needed during pollination; pollen is transported by external agents, such as insects, birds, bats, and wind).

For additional information view *The Bounty of Bees*, a short video (3:51 minutes) available online. This video may also be shown to youth. (See Resources section for link).

Image: David Cappaert, Bugwood.org



Pollen Basket

CORE AREAS



Agriculture



Family & Consumer Sciences

What’s the buzz?

Print out and laminate the Printable Honey Bee Cards provided at the end of this activity. At each event or meeting where food and drinks are provided, place a Honey Bee Card next to each food and drink item that requires pollination.

DO THE ACTIVITY

1. Prepare recipe with youth. After preparing the recipe, do Part 2 of the activity while the crisp is baking. For materials needed, see recipe.

APPLE CRISP RECIPE

Reprinted with permission from the Super Star Chef Kneads a Little Dough UK Cooperative Extension Service Curriculum.

Servings: 16

Ingredients:

- $\frac{3}{4}$ cup all-purpose flour
- $\frac{1}{4}$ cup brown sugar, lightly packed
- $\frac{1}{2}$ teaspoon salt
- $\frac{1}{2}$ cup honey + $\frac{1}{4}$ teaspoon of baking soda*
- $\frac{1}{2}$ cup butter, cut into pieces
- 1 cup rolled oats
- 3 pounds apples, peeled, cored, and cut into $\frac{1}{2}$ -inch chunks
- 2 tablespoons lemon juice
- $\frac{1}{2}$ teaspoon cinnamon

*Honey was substituted for sugar. The original recipe called for $\frac{1}{2}$ cup sugar + 2 tablespoons sugar. When substituting honey for sugar, use 1 part honey for every 1 $\frac{1}{4}$ cups of sugar and add $\frac{1}{2}$ teaspoon of baking soda for every 1 cup of honey (the baking soda helps to reduce the acidity and weight of the honey) (Hongu et. al, 2017).

Instructions:

1. In a large mixing bowl combine flour, brown sugar, salt, and 2 tablespoons sugar. Cut butter into flour mixture, using a pastry blender. Add oats and use your clean hands to toss and squeeze mixture until large, moist clumps form. Chill while you prepare apples.
2. In a 2 quart baking dish, combine apples with lemon juice, cinnamon, and remaining $\frac{1}{2}$ cup sugar. Sprinkle with oat mixture.
3. Place baking dish on a cookie sheet and bake the crisp at 375°F for 55 to 60 minutes, or until golden brown and bubbling. Cool for 10 minutes before serving warm.

Nutrition Analysis (1 serving): 120 calories, 29 g carbohydrates, 2 g protein, 6 g fat (45%)

Try these other recipes!

- 4-H Cooking 101: Baked Apples Recipe
- Teen Cuisine: Apple Fruit Salad Recipe
- Super Star Chef: Apple Tart Recipe

MATERIALS (Part 2)

- Chairs (1 per person)
- Brown paper bags
- Bee and apple blossom cutouts
- Tape or glue
- Strips of paper (at least 4 per person)
- Supplemental PowerPoint slides

PRIOR TO THE ACTIVITY (Part 2)

1. Have one chair per participant, and place chairs in a circle or oval (as if playing musical chairs).
2. Each chair will represent one apple tree. For each chair, have a brown paper bag with the apple tree cutout taped or glued to the outside of the bag. Tape or hang one bag on the back of each chair. These bags represent the apple blossoms on each tree.
3. Place several strips of paper in the seat of each chair (enough strips for each participant to have at least four).
4. Have one brown paper bag with the bee cutout taped or glued on the outside of the bag for each participant.

DO THE ACTIVITY (Part 2)

1. Explain pollination, self-pollination, and cross-pollination. Use supplemental slides if needed to show photographs of bees.
2. Tell youth that they each will be a bee. Provide each “bee” with a brown paper bag with a bee cutout. Explain that the bag represents their pollen basket.
3. Tell youth that each chair represents an apple tree, and the brown paper bag with the apple blossom cutout attached to each chair represents apple blossoms on the tree. The strips of paper in each seat of the chairs represent pollen from the apple blossoms.
4. Similar to musical chairs, have youth (“bees”) circle the chairs (“apple trees”).
5. When you yell “collect” have youth sit down in one of the chairs. As they sit down, each youth should collect one strip of paper and place it in their “pollen basket” bag.
6. When you yell “buzz” have youth stand up and circle the chairs again.
7. When you yell “collect” have youth sit down in one of the chairs again. As they sit down, have youth place one strip of paper from their “pollen basket” bag into the “apple blossom” bag attached to the chair. After doing this, have youth collect one strip of paper from the seat of the chair. This represents the bees collecting and transferring pollen from apple tree to apple tree.
8. Continue with one or two more rounds.
9. After the last round, have each youth count the number of strips of paper in the “apple blossom” bag attached to the chair they are sitting in. Explain that each strip of paper represents pollen that was transported by a “bee” to an “apple blossom” which will result in a delicious apple!

Extension: Explain that drought has resulted in some of the apple trees dying. Take two or more of the chairs away. Do another round. The youth who do not have a chair to sit in will have to continue to fly around until another round starts. Discuss other situations that may result in loss of apple trees or loss of bees.

MATERIALS (Part 3)

- Chalkboard or white board
- *Examples of Pollinated Foods* Handout
- Eating Utensils
- Plates
- Napkins

DO THE ACTIVITY (Part 3)

1. Have youth list ingredients used in the apple crisp recipe on a chalkboard or white board.
2. Provide youth with the *Examples of Pollinated Foods Handout*. Have youth identify which ingredients require pollination.
3. Discuss which ingredients are cross-pollinated and which are self-pollinated.
4. Have youth draw a bee next to each ingredient that requires pollination by cross-pollination.
5. Allow youth to eat their dish.

RESOURCES

Bounty of Bees Video Segment:

<https://ket.pbslearningmedia.org/resource/kqed07.sci.life.oate.producers.betterb/the-bounty-of-bees/#.Walab7KGPIV>

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What is pollination?
- Why is pollination important?
- List examples of fruits and vegetables that require pollination.

Have youth complete the *Food for Thought* handout. Discuss how many (if not all) of their favorite foods require pollination.

REFERENCES

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Project Food, Land, and People. 2008. Buzzy, Buzzy Bee. Available at http://www.americasheartland.org/education/teachers/004_buzzy_buzzy_bee.pdf.

Pollinator Partnership. n.d. List of pollinated foods. Available at http://pollinator.org/list_of_pollinated_food.htm.

Seltmann, Katja and Blake Newton. 2005. Bees. University of Kentucky Department of Entomology. Available at <http://www.uky.edu/Ag/CritterFiles/casefile/insects/wasps/bees/bees.htm>.

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BEE AND FLOWER CUTOUTS FOR ACTIVITY

Bee Image: David Cappaert, Bugwood.org





EXAMPLES OF POLLINATED FOODS

Food	Pollination
Alfalfa	Cross-pollination
Almond	Cross-pollination
Anise	Cross-pollination
Apple	Cross-pollination
Apricot	Cross-pollination
Avocado	Cross-pollination
Banana	Cross-pollination
Blueberry	Cross-pollination
Broccoli	Cross-pollination
Cardamon	Cross-pollination
Carrots	Cross-pollination
Cashew	Cross-pollination
Cauliflower	Cross-pollination
Cherry	Cross-pollination
Chocolate	Cross-pollination
Cinnamon	Cross-pollination
Coconut	Cross-pollination
Coffee	Cross-pollination
Coriander	Cross-pollination
Corn	Cross-pollination
Cranberry	Cross-pollination
Cucumbers	Cross-pollination
Eggplant	Cross-pollination
Fig	Cross-pollination
Grape	Cross-pollination
Grapefruit	Cross-pollination
Kale	Cross-pollination
Kiwifruit	Cross-pollination
Lemons	Self-pollination

Food	Pollination
Lettuce	Cross-pollination
Macadamia nut	Cross-pollination
Mango	Cross-pollination
Melon	Cross-pollination
Nutmeg	Cross-pollination
Oats	Cross-pollination
Onions	Cross-pollination
Oranges	Self-pollination
Papaya	Cross-pollination
Peach	Cross-pollination
Pear	Cross-pollination
Peas	Self-pollination
Peppermint	Cross-pollination
Pumpkin	Cross-pollination
Pumpkin	Cross-pollination
Raspberries and Blackberries	Cross-pollination
Rice	Cross-pollination
Sesame	Cross-pollination
Spinach	Cross-pollination
Squashes	Cross-pollination
Strawberry	Cross-pollination
Sugarcane	Cross-pollination
Swiss chard	Cross-pollination
Tea plants	Cross-pollination
Tomatoes	Self-pollination
Vanilla	Cross-pollination
Watermelon	Cross-pollination
Wheat	Self-pollination

*Other foods, such as hamburger, do not require pollination directly, but are impacted by pollination. For example, hamburger comes from cows. A cow's diet consist of grass, hay, and other plants such as corn and soybeans. The plants that makeup a cow's diet do require pollination.

FOOD FOR THOUGHT


1. List five of your favorite foods.


Example: Chocolate covered strawberries

2. List the ingredients of each food. Draw a bee beside the ingredients that require pollination.

Example: Chocolate covered strawberries

Ingredients:

Chocolate 

Strawberries 

PRINTABLE HONEY BEE CARDS

Image: Vecteezy.com





Mason Bee House

LIFE SKILLS



Responsible Citizenship

RECOMMENDED SEASON



Winter

OBJECTIVE

Youth will learn about mason bees. Youth will work with adults to build a mason bee house using wood. Youth may then offer these houses to family members as gifts or offer to install them into local gardens or other greenspaces.

BACKGROUND INFORMATION

Like honey bees, a mason bee (also called “orchard mason bee”) is an important pollinator of many plants. Otherwise, a mason bee and a honey bee have little in common. A mason bee is a solitary bee that does not live in a hive. Instead, the mason bee lives in a small tube where she rears her larvae by feeding them pollen and nectar. Unlike honey bees, which are originally from Europe, mason bees are native to North America.

Because the mason bee is a solitary bee, it is much less likely to sting (and is unable to swarm, or attack as a group). A sting is generally much less painful than a sting from honey bee or wasp and less likely to cause a serious reaction. Because it is less likely to cause a threat, a mason bee house is often welcome in urban gardens, where it can help to increase the pollinator population. A mason bee house may take many forms, but to most essential elements are hollow wooden tubes or holes in wood that are about 6” deep with a 5/16” diameter.

MATERIALS

- Scrap wood pieces that are at least 7 inches deep along with additional pieces to make roofs and other decorations (roofs and decorations are optional). Make sure to use dry, untreated wood.
- ½ inch hardware cloth (a.k.a. “chicken wire”) (optional)
- Craft paint and supplies for decorating (optional)
- Drills, drill bits, hammers, nails, staple guns, and other basic woodworking tools, along with an adult that is trained to supervise tool use

CORE AREAS



Agriculture



Leadership

What’s the buzz?

Did you know that there is a business in Washington that rents mason bees? Individuals can rent small, medium, or large mason bee kits to install in their yard. The kit includes a wood house, nesting block, white emergence tube, and bee cocoons in an emergence tube (number of cocoons vary depending on kit size).

DO THE ACTIVITY

1. Remind youth of the importance of bees and pollinators. Explain that there are many species of bees besides honey bees and bumble bees, and that most bee species are solitary instead of hive-dwelling. Discuss the importance of all bee species and that they are critical for pollination. Discuss mason bees (see *Background Information* section and photographs at the end of this activity). A solitary bee is not as aggressive as a hive-dwelling bee or wasp, and is much less likely to sting than hive-dwelling bees and wasps.
2. Build the mason bee houses (instructions adapted from National Wildlife Federation <http://www.nwf.org/Garden-For-Wildlife/Young/Build-a-Bee-House.aspx> ; many other designs are possible)
 - a. Collect lumber scraps. Make sure to look for dry lumber that has not been treated with insecticides or other chemicals. A local lumberyard or hardware store may have scraps available at no charge, especially if the youth approach as a group and explain why they need the lumber. Pieces that are similar in size to a shoebox (at least 4 inch deep or more and a few inches tall and wide) are ideal, but many sizes will work.
 - b. With help from adults, use drill bits (5/16th inch works best for mason bees) and drill holes 6 inches deep, but not all the way through the wood. Example: a 7 inch by 7 inch by 10 inch piece of wood with holes that are 6 inch deep. Space the holes at least ½ inch from one another and take care to drill straight holes, so that the holes do not cross one another inside the wood. Make as many holes as the piece of wood will support.
 - c. (Optional) Use glue or carpet nails with wood scraps to fashion a roof that will help protect the holes from direct rainfall. A roof will not be needed if the house is placed under an existing roof or some other protection from rainfall.
 - d. Youth may decorate the mason bee house anyway they like. Use paints that are waterproof. Simple shapes of different colors may be painted above each drilled hole so that each hole is marked by a different color-and-shape combination; these shapes and colors may help mason bees find their individual holes more quickly.
 - e. (Optional) Hardware cloth may be attached to the wood to prevent bird attacks. The wire should be about 1 inch above the drilled hole.
 - f. With the piece of wood oriented vertically so that the holes are parallel with level ground, securely place the house (so that it does not sway or vibrate) at least 3 feet high on the south side of buildings, fence posts, or trees. The house should be placed before spring begins. Try to mount the house in a place that is close to flowering plants and also a source for water and/or mud.
 - g. Do not move bee houses after they are in place until the following December.
 - h. Do not spray insecticides on or around bee houses.
 - i. Watch for tubes to become plugged with mud; this means that mason bee pupa are inside.
 - j. In December, take down the box and place it in a dark, unheated barn or similar dark, unheated indoor location.
 - k. Replace the wooden house just before spring. The bees that have been pupating inside the house (under the mud plugs) will emerge from last years plugged tubes.
 - l. This “drilled block” design is meant to be used for a single year. In spring, when last-years bee house is placed outside, a new drilled-block may be placed next to it. In this way, last year’s bees will emerge from the old block and use the new block for their offspring. Once last year’s bees have emerged from the old block, simply remove it and use as firewood.

RESOURCES

Other Mason Bee House Design Suggestions:

<http://www.hobbyfarms.com/make-a-mason-bee-house/>

<http://www.instructables.com/id/Mason-Bee-House/>

Videos from “Bee Built” about solitary bees and the keeping of mason-bee houses:

<https://www.youtube.com/watch?v=vf8QyIF3eoY&t=38s>

https://www.youtube.com/watch?v=QGEpJ7F_ZuU&t=33s

More Tips and Mason Bee Lifecycle Notes:

<http://www.ecolandscaping.org/03/beneficials/attract-mason-bees-no-protective-gear-needed/>

<http://www.raintreenursery.com/plantcare/2012/10/october-growing-tips-take-care-of-mason-bees/>

EXTENSION

Many kinds of solitary bees and wasps make mud nests around homes and barns in Kentucky. These mud nests are not dangerous in the winter (hive bees and wasps make paper nests; most of these are not dangerous in the winter either but mud nests are always safe to approach from January-February in Kentucky). Youth may look for these, take pictures, and bring the pictures in to show the group.



Figure 2 Mud Dauber Nest (photo: Howard Ensign Evans, Colorado State University, Bugwood.org)

EVALUATION

Key questions/statements to ask to gauge youths’ understanding.

- What are some differences between solitary and hive-dwelling bees?
- What are some characteristics that make mason bees (and all bees) good pollinators?



Figure 2 Potter Wasp Nest (photo: Pollinator at the English language Wikipedia)

REFERENCES

Build a Bee House from The National Wildlife Federation. Available at

<http://www.nwf.org/Garden-For-Wildlife/Young/Build-a-Bee-House.aspx>

Mason Bee Image: Joseph Berger, Bugwood.org





Speeches and Demonstrations

LIFE SKILLS



Communication

RECOMMENDED SEASON



Winter

OBJECTIVE

Youth will prepare and give a speech or demonstration on a topic related to bees or honey.

BACKGROUND INFORMATION

Each 4-H member is encouraged to choose a topic related to bees and/or honey, and research his or her topic in preparation for their speech or demonstration. The *4-H Speeches Publication* (4KA-04PO) and the *4-H Demonstrations Publication* (4KA-03PO) provide information and a planning guide for preparing and delivering a speech or demonstration.

CORE AREAS



Communications and Expressive Art

DO THE ACTIVITY

1. Provide each 4-H member with a copy of the *4-H Speeches Publication* and the *4-H Demonstrations Publication*. These publications are available online at <https://4-h.ca.uky.edu/content/public-speaking>.
2. Discuss with youth how to plan, prepare, and deliver a speech or demonstration.
3. Encourage youth to choose a topic related to bees and/or honey. Have youth brainstorm ideas. (See examples on next page.)
4. Provide 4-H members with information on entering the local 4-H speech and demonstration contest.

If possible, ask a successful past participant to give his or her speech or demonstration to the club.

MATERIALS

- *4-H Speeches Publication* (4KA-04PO)
- *4-H Demonstrations Publication* (4KA-03PO)
- Post-it Notes (for evaluation)
- Markers (for evaluation)

When a former 4-H member is asked, "What did you gain through 4-H that has made the most impact on your career success?" the skill most often mentioned is public speaking.

Examples of Speech Topics

- The life cycle of a bee
- The role of drones, worker bees, and queen bees
- Pollination: what is it and why is it important?
- Bee behavior (e.g., waggle-tail dance, round dance)
- What is royal jelly and why is it important?
- What can we do to help pollinators?
- Uses of beeswax
- Solitary bees vs. honey bees
- Uses of honey

Examples of Demonstration Topics

- How to build a mason bee house
- How to prepare a recipe using only foods that require pollination
- How to prepare a recipe using honey
- How to properly plant a native-flowering plant for bees
- How to lead an activity that educates other about bees
- How to use beekeeping equipment when caring for a hive
- How to use beeswax (for candle making, etc.)

FOLLOW UP

Encourage youth to enter the Kentucky Honey Bee Essay Contest. The winner of the state contest will be entered into the national contest.

- For information on the Kentucky Honey Bee Essay Contest visit the Kentucky State Beekeepers Association website <http://www.ksbabeekkeeping.org/>, and click on “news”.
- For information on the National 4-H Beekeeping Essay Contest visit the Foundation for the Preservation of Honey Bees, Inc. website at <http://preservationofhoneybees.org/>, and click on “4-H Essays”.

EVALUATION

Key questions/statements to ask to gauge youths’ understanding.

- Write “Strongly Agree”, “Agree”, “Disagree”, and “Strongly Disagree” on four post-it notes (one category per post-it).
- Place post-it notes on different areas around the room.
- Provide each 4-H member with one blank post-it note.
- Ask the question listed below and have youth place their blank post-it note in the appropriate category (e.g., “Strongly Agree”, “Agree”, etc.). Count the number of post-it notes per category.
 - Did you improve your communication skills at today’s club meeting?
- Additional questions can be asked using the same method.



Bee Leadership Project

LIFE SKILLS



Planning/Organizing
Communication
Community Service/Volunteering
Leadership

RECOMMENDED SEASON



Any Season

OBJECTIVE

Youth will identify, plan, and implement a project related to bees, pollinators, and/or honey.

CORE AREAS



Leadership



Communications and Expressive Art

BACKGROUND INFORMATION

In this activity, 4-H members will work as a team to identify, plan, and implement a project related to bees, pollinators, and/or honey.

DO THE ACTIVITY

1. Have youth brainstorm ideas of projects their club can plan and complete together. Use the flipchart paper, post-it notes, and markers, pens, and pencils to jot down ideas and make notes. See examples of projects listed on the next page.
2. Have youth identify a project.
3. After youth have identified a project, have them work together to develop:
 - a. Objective(s)
 - b. List of materials and resources needed (including money)
 - c. Assignments for each club member
 - d. Timeline



MATERIALS

- Flipchart paper
- Post-it notes
- Markers, pens, and pencils

What's the buzz?

Did you know ... compared to their peers, 4-H'ers are nearly **4x** more likely to give back to their communities and **2x** more likely to be civically active! (Lerner et al., 2013)

EXAMPLES OF PROJECTS

- Plan and install a pollinator garden.
- Prepare and give a presentation on bees, pollinators, and/or honey at an Extension event (such as a Master Gardener’s meeting, Homemaker’s meeting, etc.) or local community event (such as Chamber of Commerce, library, farmer’s market, garden club, etc.).
- Prepare and lead a Cloverbud activity related to bees and pollination.
- Prepare a bee-related display to exhibit at a field day event or at the local Extension office.
- Organize a showing of a bee-, pollinator-, or honey-related documentary (such as Disney’s Wings of Life, Vanishing of the Bees, More Than Honey, etc.). Have a discussion after the showing. Provide honey-themed and/or pollinator-themed foods. (Remember to check on screening/viewing fees during the initial planning stages!)
- Organize a bee festival featuring presentations, exhibits, and activities on the importance of bees, how to care for and maintain a hive, cooking with honey, etc.

FOLLOW UP

After the completion of the project have club members develop a newsletter article or social media post about the project. (Please share the article or post with the State 4-H Office to include in the monthly 4-H update and social media outlets.)

EVALUATION

Key questions/statements to ask to gauge youths’ understanding.

- Assist youth in evaluating their project.
 - Did youth successfully complete their project? Discuss why or why not.
 - What could have been done differently to improve the success of the project?

REFERENCES

Lerner, Richard M., Jacqueline V. Lerner, and Colleagues. 2013. National 4-H Council. Available at <https://4-h.org/wp-content/uploads/2016/02/4-H-Study-of-Positive-Youth-Development-Full-Report.pdf>.

Produce a Pollinator

LIFE SKILLS



Critical Thinking

Problem Solving

RECOMMENDED SEASON



Spring • Winter

OBJECTIVE

Youth will learn about the adaptations needed by insects for pollination.

CORE AREAS



Agriculture



Communications and Expressive Art

BACKGROUND INFORMATION

Pollinating insects have a very complex relationship with flowering plants. The fossil record suggests that pollinating insects (such as bees) and flowering plants appeared at about the same time over 100 million years ago. Before pollinating insects appeared, most pollination was accomplished by the wind, a process which does not require a colorful flower or nectar. Pollinating insects move dust-like pollen from one flower's reproductive parts to another's. This allows plants to produce much less pollen than they would if they were wind pollinated. To attract pollinating insects, flowers have bright colors and produce sugar-filled nectar—a substance that exists solely to attract pollinating insects.

While many insects (including ants, beetles, and many others, even spiders) can wander onto a flower, take some nectar, and then wander to another flower (and accidentally move some pollen during this process) only a few insects have special external adaptations that help them to survive an existence based on pollinating flowers. Bees and butterflies, in particular, are wholly dependent on flowering plants and cannot live without them. This activity explores the adaptations needed by pollinating insects to survive in a habitat full of flowering plants.

NEXT GENERATION SCIENCE STANDARDS (NGSS) CONNECTION

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MATERIALS

- Chalk board or dry-erase board and chalk/markers
- Honey bee and monarch butterfly images (provided)
- Pollinator “costume” materials; see *Do the Activity* section for items needed

DO THE ACTIVITY

1. Remind youth of the importance of bees and pollinators. Explain that bees and butterflies, in particular, are dependent on flowering plants for much of their food and cannot live without flowering plants and the pollen and nectar that they provide (bees provide both pollen and nectar to their larvae; butterflies consume liquid nectar as their only food source while their larva eat leaves from a variety of plants).
2. Ask youth to think of some of the actions that a pollinator needs to survive. Write these actions on the board, with space underneath each action. Some actions that youth might think of could include:
 - a. Find flowers
 - b. Move from one flower to another
 - c. Pick pollen up on their body
 - d. Drink nectar
 - e. Defend themselves from predators
3. Ask youth to think of one or more physical adaptations that a pollinator might possess to accomplish each of the actions listed. Write those adaptations under each action.
 - a. Find flowers: eyes and other sense organs
 - b. Move from one flower to another: wings, legs
 - c. Pick pollen up on their body: hair
 - d. Drink nectar: tongues, mouths
 - e. Defend themselves from predators: stingers, camouflage, warning colors, “autotomic” parts (parts that fall off, like a lizard’s tail), poisonous or foul-tasting chemicals
4. Show a picture of a bee. This image from Bugwood.org could be used (a larger version of this image is provided at the end of the activity). This image shows many of a typical bee’s adaptations for pollination, including: eyes, antennae, hairy body, wings, legs, warning coloration (gold and black stripes), and pollen baskets (dense packs of hair on the legs; bees are the only animals with pollen baskets):



5. Ask for a volunteer to “become” a bee. This person will stand in front of the class and wear the “costume” items that represent the adaptations that helps a bee to survive as a pollinating insect.
6. Give a box of pre-selected costume items to youth. Some items to include (the same box of costume items may be used for both the “bee” and the “butterfly”):
 - Eyes: pair of plastic sunglasses OR novelty glasses with multiple “facets” that mimic insect-vision (may be purchased online)
 - Antennae: bees and butterflies use antennae to taste and smell nectar. Use pre-made novelty antennae from a costume shop or modify a standard fashion headband by attaching chenille stems (pipe-cleaners).

- Wings: use something with four wings (all bees and butterflies have four wings, two on each side). Possibilities might include: strap on fairy wings from a costume shop; a poncho, shirt, or jacket with the back cut into four “wings.” You may want to have two sets of wings, one to represent a bee (bee wings are largely transparent... a clear poncho with the back cut might work for this) and one to represent a butterfly (butterfly wings are colorful... a T-shirt with the back cut and colored with markers might work).
 - Legs: all insects have six legs. Legs help a butterfly or a bee hold onto a flower while collecting nectar or pollen. An old pair of pants could be cut and modified so that they may be strapped around a person’s waist; these extra legs—along with the person’s two arms and legs—make six.
 - Hair: pollinating insects are hairy. The hair allows them to move pollen from one flower to the next. A novelty wig may be used for this, or a faux fur jacket.
 - Pollen baskets: bees have pollen baskets on their legs, but butterflies do not. A pollen basket is a particularly dense patch of hair on a bees legs that are used to pack lots of extra pollen. Frilly cowboy chaps, oversized boots with frills attached, or an old pair of pants that have been cut into chaps might work to represent pollen baskets.
 - Tongue: bees and butterflies have long tongues that help them to drink nectar. A bee has a long, relatively straight tongue which could be represented by a drinking straw or a snorkel. A butterfly has a flexible tongue that can coil and uncoil: a “party blower” may be used, or a long coiled flexible plastic tube.
 - Stinger: bees have stingers on the ends of their abdomens to defend themselves. Use a long piece of fabric or oversized belt that can be strapped around a waist; attach a plastic knife or fork, or perhaps a plastic feeding syringe (or any kind without a metal needle) at the end of the material to represent a stinger.
 - Warning colors: many bees have warning colors to help prevent predators from attacking them. Use a brightly colored vest for this, preferably one with wide, alternating black and yellow stripes. (this item will need to be large enough to fit over any items used to represent “hair”)
 - Camouflage: generally, pollinating insects do not have conspicuous adaptations for camouflage. Bees have bright warning colors and butterflies use bright colors to attract mates. You might want to include camouflage items, though, to discuss the differences between warning colors, mating colors, and camouflage, and the advantages and disadvantages of these different colorations.
 - Autotomy: butterflies have scales on their wings which give them their color and which also flake away easily, which is a type of “autotomy.” Autotomy is the phenomenon of a body part falling off so that a creature may escape predation (other examples include lizard tails and the legs of daddy-long-legs). Butterfly scales help them to escape from spiders and spider webs, especially, which are very common among flowering plants. Confetti or sequins might be used to represent butterfly scales: these can be shaken over a person; some will stick and some will fall away.
 - Poisons: many butterflies have chemicals in their bodies that make them foul-tasting or poisonous to predators. A bottle of lemon juice may be used to represent this.
7. Ask the youth to examine the collection of costume items and see if they can find any that they can use to outfit the “bee” (the person selected above). Remind youth to refer to the image of the bee to examine its anatomy. Some adaptations of bees: eyes, antennae, transparent wings, legs, hair, pollen baskets, straight tongue, stinger, warning colors.
 8. Have youth take turns to “dress” the person who is playing the bee. Each youth should add one item, if possible, and explain how the adaptation is related to surviving as a pollinator. Make sure that each youth remembers which part that they added.
 9. Once the bee is “dressed,” add and explain any additional items that the group may have missed, or remove and explain any items that were added erroneously.
 10. Remove the costume from the volunteer-bee and ask for a volunteer to act as a butterfly.

11. Show a picture of a butterfly. This image from Bugwood.org could be used (a larger version of this image is provided at the end of the activity). This image shows some of a butterfly's adaptations, including eyes, antennae, legs, hairy body, tongue (extended in this image), warning coloration (this monarch butterfly, like many butterflies, is poisonous to birds and uses warning coloration to protect itself).



12. Repeat the exercise with the costume parts and ask the youth to examine the items and see if they can find any that they can use to outfit the "butterfly." Some adaptations of butterflies: eyes, antennae, colorful wings, legs, hair, coiled tongue, warning colors, poison.
13. Have the youth take turns to "dress" the butterfly. Each youth should add one item, if possible, and explain how the adaptation is related to surviving as a pollinator. Make sure that each youth remembers which part that they added.
14. Once the butterfly is "dressed," add and explain any additional items that the group may have missed, or remove and explain any items that were added erroneously.
15. Have each member of the group remove one adaptation from the butterfly (this may also be done after Step 9 with the bee)—make sure it's an adaptation that they didn't add themselves. They may then make an argument why the pollinator wouldn't be able to survive without that adaptation.
16. Break the group into a few small groups. Ask them to imagine that they need to redesign a bee or a butterfly (each group's choice) so that it can survive in a different real-life environment on earth—one without many (or any) flowering plants. Each group should first decide on a different environment and then remove and add any adaptations that they like and make an argument as to why the new set of adaptations will allow their creature to survive in a habitat without flowering plants (note: the habitat that they pick should be a real one, like a dessert, the artic, the ocean, or a pine forest, but the creature that they make will be fictitious). They may add additional "internal" adaptations as well, such as "ability to digest live insects" or "ability to survive cold." Each group should present their new creature and the habitat where it lives to the class.



FOLLOW UP

- Have youth recreate this activity with a younger audience, such as a Cloverbud club.
- Have youth go outside and find natural items that could be used as simple representations of pollinator adaptations. Ask them to assemble a simple “pollinator” model using these items. Examples might include: sticks for legs, thorns for stingers, leaves for wings, feathers for pollen baskets.

EVALUATION

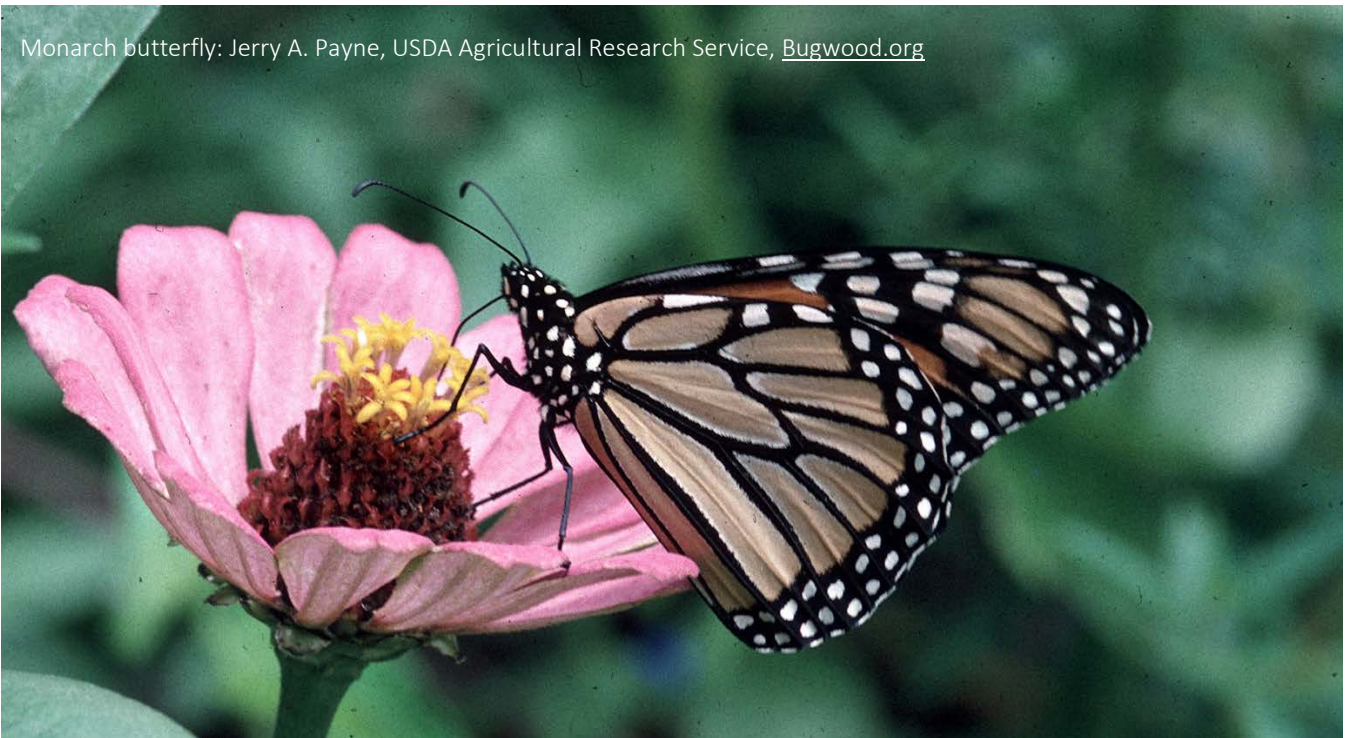
Key questions/statements to ask to gauge youths’ understanding.

- What is an adaptation that humans have that is similar to a bee?
- What are some adaptations that bees and butterflies have in common?

Honey bee: David Cappaert, Bugwood.org



Monarch butterfly: Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org





Pollinator Plant Hike

LIFE SKILLS



Critical Thinking

RECOMMENDED SEASON



Spring • Summer • Fall

OBJECTIVE

Youth will identify and make predictions about pollinators by investigating and comparing multiple outdoor habitats using cameras to survey pollinators.

BACKGROUND INFORMATION

Pollinators are important and common in Kentucky, but, like all animals, they cannot exist without appropriate resources and habitats. The good news is that pollinator resources occur naturally in most parts of Kentucky, even in urban areas. Youth can easily find and identify these resources if they look for them with a critical eye.

CORE AREAS



Agriculture

HEALTH CONNECTION

This is an outdoor activity that involves approximately one hour of outdoor walking. Provide youth with pedometers and measure the number of steps taken during the hike.



Health

PRIOR TO THE ACTIVITY

Remind youth about the basics of pollination. They should understand that insects visit flowers for food (pollen and nectar) and in return they help flowers to reproduce by moving pollen from one flower to another. Flowers have adaptations, such as bright colors, scents, and nectar, which make them attractive to insects. The only purpose for nectar, for instance, is to attract insects. They should understand the importance of pollination: all fruits start as flowers, so without pollinating insects (especially bees) many of the world's fruit species could not exist.

MATERIALS

- Copies of Resource Checklist handout
- Clipboards
- Pens and pencils
- Chalkboard/dry erase board with chalk or markers
- Dry, sunny, warm day in late spring, summer, or early fall

DO THE ACTIVITY

1. After reminding youth about pollinating insects and how pollination works, ask youth if they can think of resources that pollinators might need. Write these resources on a board. Remind youth that pollinators will need most of the things that any animal needs: food, water, and protection. What are some things that they need protection from? Heat? Cold? Humans (especially, mowing and habitat removal)? Other insects? What habitat features or land-management policies might provide protection from such things? Discuss how pollinators' needs are unique (such as how pollen and nectar from flowering plants are needed). Ask youth where they have seen flowers before. Can they find them in lawns? Flower pots? Farms? Trees? ANY kind of visible flower is a potential resource for pollinators.
2. Ask youth if they know what a habitat is. A habitat is simply the home of any animal, plant, or other organism. A habitat can be large or small. A habitat with the features discussed above is good to support pollinators. For the purposes of this activity, a habitat can be any area of land that the youth can provide a name for, and these are often defined by the types of plants growing there and the way that these places are used by humans. Lawn, garden, farm, forest, park... all of these places are different habitats where pollinators might be found. Some of them will have more pollinator resources than others.
3. Work with the youth to agree on four features or resources (discussed above) that they think are the most important resources for pollinators in any given habitat. Examples might include: lots of flowers; water source; shade source; protection from mowing, cars, and other human activities; lots of unbroken space (unbroken by roads, buildings, and sidewalks for instance); presence or absence of other kinds of animals; proximity to a wild area (such as a forest or a place that is never mowed); human-provided pollinator resources (such as a hummingbird feeder).
4. Complete the resource checklist sheet by filling out the four most important resources that the youth identified. Bring multiple copies of the checklist in case you see many habitats. Assign the checklist to one person with a clipboard. This person will work with the group to fill out the checklist as you hike.
5. Pick an area to hike. Try to go to an area with multiple habitats. The grounds around many Extension offices will have multiple habitats (lawn, vegetable garden, flower garden, and unmowed fence line are all distinct habitats, for instance).
6. Hike for at least 20 minutes, or longer if you have time and have a large area to study.
7. Encourage youth to identify and name distinct habitats (based on the way that the land and plants look) and survey the habitats for the four pollinator resources that they identified earlier.
8. Have youth briefly describe each resource at each habitat (for instance, if they found a "water source," what was it?). Also, provide a quick general description of the habitat and note if there are any pollinators visiting any flowers. They can name the pollinators if they think they know what they are.
9. Back in the instruction area, see if the youth can come to a consensus: of the areas visited, which looked like it was the best for pollinators? Which was the worst?

NOTE: this step can lead to the *Pollinator Scavenger Hunt and Habitat Comparison* activity.

SIMPLIFY

If you are working with younger youth or if you do not want to use the checklist, you can simplify by hiking through an area and have the youth look for any flowers and pollinators.

Pollinator Hike: Resource Checklist

Instructions: while walking through an area, try to find a few distinct habitats in that area. For example, you might walk through a lawn and then a garden and then a forest. For each of those three (or more) habitats, see if you can find the four resources that your group identified as the most important resources for pollinators. Check these resources off and briefly describe them as you find them. Check multiple times if you find more than one example of that resource. Also briefly describe each habitat and note any pollinators that you might have seen. Use more than one page if you see many distinct habitats.

Date: _____ Time: _____

Hike Location (address or place name): _____

Habitat Name	Resource 1	Resource 2	Resource 3	Resource 4
	_____	_____	_____	_____
Check resources off when you find them:				
Habitat description and notes about any pollinators:				

Habitat Name	Resource 1	Resource 2	Resource 3	Resource 4
	_____	_____	_____	_____
Check resources off when you find them:				
Habitat description and notes about any pollinators:				

Habitat Name	Resource 1 _____	Resource 2 _____	Resource 3 _____	Resource 4 _____
Check resources off when you find them:				
Habitat description and notes about any pollinators:				

Habitat Name	Resource 1 _____	Resource 2 _____	Resource 3 _____	Resource 4 _____
Check resources off when you find them:				
Habitat description and notes about any pollinators:				

Habitat Name	Resource 1 _____	Resource 2 _____	Resource 3 _____	Resource 4 _____
Check resources off when you find them:				
Habitat description and notes about any pollinators:				

FOLLOW UP

After the activity, youth can investigate their own yard using the Resource Checklist handout to see if it has any of the resources that pollinators need.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What is a habitat?
- What are resources that all animals need?
- What special resources do pollinators need from a habitat?
- Are the resources needed by pollinators available throughout the year?



Pollinator Scavenger Hunt and Habitat Comparison

LIFE SKILLS



**Critical Thinking
Problem Solving**

RECOMMENDED SEASON



Spring • Summer • Fall

OBJECTIVE

Youth will identify and make predictions about pollinators by investigating and comparing multiple outdoor habitats using cameras to survey pollinators.

BACKGROUND INFORMATION

There are many kinds of pollinating insects in Kentucky. Although bees are the most important pollinators, a pollinating insect is any species that regularly visits flowers, so that it can move pollen from one plant to the other. Examples include many kinds of butterflies, beetles, wasps, ants, and flies. There are also many types of bees, including familiar honey bees, bumble bees, and dozens of solitary bee species.

Pollinators are common throughout the spring, summer, and fall in Kentucky, but they require certain resources. Therefore, they can be more common in some habitats than others. In this activity, youth will study our most important pollinators, learn about what resources they need, and investigate and compare the pollinators in multiple habitats.

CORE AREAS



Agriculture



Health

NEXT GENERATION SCIENCE STANDARDS (NGSS) CONNECTION

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less, and some cannot survive at all.



MATERIALS

- Copies of *Pollinator Identification Sheet* (in color if possible) and *Pollinator Habitat Comparison Data Sheet*
- Clipboards
- Pens and pencils
- Chalkboard/dry erase board with chalk or markers
- Digital cameras or phone cameras (with macro lens if possible)

PRIOR TO THE ACTIVITY

Remind youth about the basics of pollination. They should understand that insects visit flowers for food and liquid (pollen and nectar) and in return they help flowers to reproduce by moving pollen from one flower to another. Flowers have adaptations, such as bright colors, scents, and nectar, which make them attractive to insects. The only purpose for nectar, for instance, is to attract insects. Youth should understand the importance of pollination: all fruits start as flowers, so without pollinating insects (especially bees) most of the world's fruit species could not exist.

Complete the *Pollinator Plant Hike* prior to this activity, if possible.

DO THE ACTIVITY











1. Ask youth if they can think of any insects that often visit flowers. Youth may think of honey bees, bumble bees, and butterflies. Flies, wasps, ants, beetles, and many other insects will also visit flowers. Write the names of all of these insects on a display board. Explain that insects often visit flowers to drink nectar, and that almost any insect that visits a flower can be a pollinator. Bees, though, are the best pollinators because they are covered with dense sticky hairs that are very efficient at moving pollen from flower to flower. Mention that there are many kinds of bees in addition to honey bees and bumble bees but that **all** bees are specialized for pollination.
2. Ask youth if they can think of things that a habitat might need in order to have lots of different kinds of pollinators. Hint: it will be the same things that flowering plants need, because flowering plants are the most important resource for pollinators. Youth might think of: sunlight, space, water, soil, protection. Write these things on a display board. Ask youth: which type of habitat will have lots of different kinds of pollinators, a habitat with lots of different kinds of flowers or habitat with lots of the same kind of flower? What about a habitat with lots of flowers that is mowed regularly? Habitat Definition: for the purposes of this activity, a habitat can be just about any outdoor area that the youth can define or name. A garden, a lawn, a forest, a farm, the area next to a creek or a pond: these are all different habitats.
3. Have youth think about local OUTDOOR habitats that they know, perhaps some that are adjacent to the Extension office or other habitats that you might be able to visit as a group. Distinct habitats might include: the Extension office garden, the Extension office lawn, the grasses and weeds along a creek or pond, a local forest, a local park, a local farm. On a display board, make two columns and have youth make two lists based on their predictions: Which of those habitats should have most types of pollinators? And which should have the least? Also discuss: what characteristics do those habitats have that might make them good or bad for pollinators? Lots of sun? Lots of different kinds of flowering plants?
4. From the two columns, pick one habitat each; one that the youth predict will have a lot of different kinds of pollinators, and one that the youth predict will have few types of pollinators. Make sure that the two habitats that are chosen are ones that you can visit as a group and spend about 30 minutes at each location. You do not have to visit both habitats on the same day, but they should both be sunny, warm days and the visits should be less than two weeks apart. **Habitat tip:** the habitats can be close together as long as they are distinct from one another and similar in size. For example, the Extension office vegetable and flower garden could be one habitat, and a similar-sized block of grass in the Extension front lawn could be the second habitat.
5. Introduce youth to the *Pollinator Identification Sheet*. Provide copies of this sheet to youth so that they take the sheet with them while they search for pollinators in each habitat. Explain that this sheet is only a guide: youth are to find and photograph (if possible) EVERY type of insect that they see visiting a flower. Explain that it is okay if they don't know what kind of insect it is: the idea is to see how many different kinds they can find and compare between the two habitats.

6. Introduce cameras to youth. They can use handheld digital cameras or their own cell phone cameras. Use macro settings (often designated with a flower symbol 🌸) if possible, or inexpensive attachable macro lenses for cell phones. Regular lenses and settings may work too. Youth may need some time to practice with taking pictures of small objects up close, such as rocks or flowers (this is called macrophotography). Explain that the insects on flowers will often move when you are trying to take a picture: just be patient and try again. The insect will often return somewhere close by.
7. BEE SAFE! Many bees and wasps can sting, and stinging insects can be dangerous to people. Stinging insects are around us all the time, however, so we can learn to be safe around them. While hunting for pollinators, youth should avoid touching any stinging insects (wasps and bees) and stay one foot or more away from them when taking pictures for this activity. Also, ask youth to avoid stepping on flowering plants directly. Stinging insects that are visiting flowers are generally not very aggressive and will usually not sting if accidentally touched or if flowers are jostled, but they will sting if grabbed, stepped on, or trapped under clothing. Leaders should consider keeping first-aid for stings (including first aid for anaphylactic shock) handy for this exercise (as with all outdoor activities; stinging insects are around us all the time in Kentucky).
8. Travel to each of your two selected habitats. Spend 30 minutes at each habitat. Youth should work together to take pictures of as many DIFFERENT KINDS of pollinating insects as they can. Remember: any insect visiting a flower may be considered a pollinator. Because youth are looking for diversity, only one photograph of each type of insect found is needed (for example, if youth find five ants, they only need to photograph one ant).
9. Return to your indoor instruction area. Look through all of the images, either by downloading them onto a computer or looking at the image viewers on the phones or cameras. Use the *Pollinator Habitat Comparison Data Sheet* to record each type of pollinator that was captured by the cameras. Do not count any images if the insect is too blurry or too far away to identify. Remember: for this comparison, we are comparing the number of DIFFERENT KINDS caught, not the total number of pollinators. So if one habitat has hundreds of honey bees but no other type of pollinator, and the second habitat has one honey bee, one bumble bee, and a few types of butterflies, the second habitat would be the one with the most different kinds of pollinators.
10. Based on the results, the youth should re-examine their predictions. Were they correct about which habitat they thought would have the most kinds of pollinators?
11. Youth should construct an argument using evidence from their survey and what they remembered about each habitat to explain how they got their results. Did the habitat with the most kinds of flowers actually have the most kinds of pollinators? What other habitat features (other than flowers) might have contributed to pollinator diversity? (Hint: just like all animals, pollinators need other things besides flowers, including water, shade, protection from predators, and protection from human activities like mowing, cars, and pesticide use.) Youth should also be able to use the same evidence to make an argument that describes an imaginary **worst** possible habitat that they can think of—one that wouldn't support pollinator life at all.

SIMPLIFY

This is a multi-part, Next Generation Science Standards (NGSS) -aligned activity that compares multiple habitats, and should take about two hours to complete. You can simplify the activity or adapt for younger 4-H'ers by simply taking the pollinator identification sheet outside to an area with flowers on a warm, sunny day and checking off the types of pollinators that youth can find over a span of time (20 minutes, for instance).

POLLINATOR IDENTIFICATION SHEET

	<p>Honey bees are about one inch long with gold and black strips. Able to sting. Honey bees and bumble bees are the only true hive-dwelling bees in Kentucky.</p>		<p>Ants are common visitors to flowers.</p>
	<p>Bumble bees are a little larger than honey bees with yellow and black colors. Able to sting. Bumble bees have furry abdomens; carpenter bees have smooth abdomens.</p>		<p>Butterflies are very common on flowers. There are many species and colors. Try to take a picture of each kind that you see.</p>
	<p>Small Solitary bees like this sweat bee are very common in Kentucky. There are many species and colors, but common ones are shiny green or black. Others look like smaller, less colorful honey bees. Most are small—about the same size as an ant. Able to sting, but stings are less painful than honey and bumble bees.</p>		<p>Beetles like this Soldier Beetle are often found on flowers. Some beetles will be long and narrow like this one. Others will be compact and dome-shaped. Beetles can be colorful or brown, gray, or black, depending on the species.</p>
	<p>Carpenter bees are also solitary bees, but they are very large and resemble bumble bees except that they have smooth abdomens. Able to sting, but stings are less painful than honey and bumble bees.</p>		<p>Here is another Beetle, a tumbling flower beetle. This is an example of one of the many small, dark-colored beetles that can be found on flowers.</p>
	<p>Wasps are related to bees but are usually more slender and less hairy. There are many kinds of wasps, including yellow jackets and hornets. All visit flowers. Able to sting.</p>		<p>Flies are common on flowers. Some, like this Flower Fly, look a lot like bees or wasps. The difference is that all flies have two wings only, while all bees and wasps have four wings. Regular house flies will also visit flowers.</p>

Photos:

Honey Bee: Lesley Ingram, Bugwood.org; Bumble Bee: David Cappaert, Bugwood.org; Sweat Bee: Joseph Berger, Bugwood.org; Carpenter Bee: David Cappaert, Bugwood.org; Paper Wasp: David Cappaert, Bugwood.org; Ant: Joseph Berger, Bugwood.org; Pearl Crescent: Steven Katovich, USDA Forest Service, Bugwood.org; Soldier Beetle: David Cappaert, Bugwood.org; Tumbling Flower Beetle: Jon Yuschock, Bugwood.org; Flower Fly: David Cappaert, Bugwood.org

Pollinator Habitat Comparison Data Sheet: Habitat 1

Date: _____ Time: _____

Hike Location (address or place name): _____

Habitat Description: _____

Of the two habitats, did the group predict that this one would have (check one):

More Kind of Pollinators Fewer Kinds of Pollinators

Why? _____

Pollinator Survey Checklist: When you are finished surveying each habitat, use this section to check whether or not you found each type of pollinator. For butterflies and beetles, try to tally how many different kinds were photographed. The blank spaces are for any additional insects that were found on flowers that do not appear on the ID sheet. Examples might include dragonflies, grasshoppers, moths, or stink bugs.

Pollinator Type	Check if Present	Pollinator Type (such as dragonflies, grasshoppers, etc.)	Check if Present
Honey Bee			
Bumble Bee			
Solitary Bee			
Carpenter Bee			
Wasp			
Ants			
Flies			
How Many Kinds?			
Butterflies			
Beetles			

Pollinator Habitat Comparison Data Sheet: Habitat 2

Date: _____ Time: _____

Hike Location (address or place name): _____

Habitat Description: _____

Of the two habitats, did the group predict that this one would have (check one):

More Kind of Pollinators Fewer Kinds of Pollinators

Why? _____

Pollinator Survey Checklist: When you are finished surveying each habitat, use this section to check whether or not you found each type of pollinator. For butterflies and beetles, try to tally how many different kinds were photographed. The blank spaces are for any additional insects that were found on flowers that do not appear on the ID sheet. Examples might include dragonflies, grasshoppers, moths, or stink bugs.

Pollinator Type	Check if Present	Pollinator Type (such as dragonflies, grasshoppers, etc.)	Check if Present
Honey Bee			
Bumble Bee			
Solitary Bee			
Carpenter Bee			
Wasp			
Ants			
Flies			
How Many Kinds?			
Butterflies			
Beetles			

FOLLOW UP

After the activity, youth can investigate their own neighborhoods and identify at least one habitat that should support pollinator diversity.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What is a habitat?
- What is an example of a pollinator that is not a honey bee?
- What is a characteristic of a habitat that should support a lot of pollinators?



Beekeepers Reality Store

LIFE SKILLS



Planning/Organizing

RECOMMENDED SEASON



Any Season

OBJECTIVE

Youth will learn about the costs associated with starting a beehive.

CORE AREAS



Agriculture

BACKGROUND INFORMATION

Honey bees live in colonies. A beekeeper provides a hive as a home for a colony to live. See the image provided on the next page, which outlines the basic components of hive used in beekeeping. A beekeeper uses various equipment and gear to care for and maintain his or her collection of hives, also called an apiary. Examples of equipment and gear used include a hive tool, smoker, bee brush, bee suit, veil, helmet, and gloves. The factsheet, *Beginning Beekeeping for Kentuckians ENT-41*, (available online at <http://www2.ca.uky.edu/agcomm/pubs/ent/ent41/ent41.pdf>) provides information on basic beekeeping equipment. A beekeeper collects excess honey (that is not needed by the bees for overwintering) and processes the honey to use or sell. Generally, beekeepers cannot take honey until the second year because the bees will need any honey made in the first year to make it through the winter. On average, a honey bee colony will need 120 pounds of honey (60 pounds for the summer, 60 pounds for the winter).

In this activity, youth learn about the costs associated with beekeeping. Each participant will pretend to be a new beekeeper and purchase items needed to start their hive. Price cards provide estimated costs for items needed to start a hive. Chance cards have real life scenarios that may require the participant to purchase additional items (for example one Chance Card states that the queen bee in the hive has died, and a new queen bee must be purchased). A recordkeeping form is to be used by participants to calculate expenses.

An article by Iowa State University titled Enterprise Budget for Beekeeping (available online at https://lib.dr.iastate.edu/extension_pubs/41/) provides additional background information on costs associated with beekeeping.

MATERIALS

- Price cards
- *Beekeepers Reality Store Recordkeeping Form* (1 per person)
- Chance cards

What's the buzz?

A list of major beekeeper suppliers is available on the Kentucky Department of Agriculture's website at <http://www.kyagr.com/stat/evet/honeybees.html> (see Forms and Documents section).

PRIOR TO THE ACTIVITY

1. Print and cutout the price cards and chance cards provided.
2. Organize stations throughout the room. Stations should include: hive parts, bees, hive tools, protective clothing, and chance cards. If possible, obtain pictures for each of the items (using the Internet, catalogs, etc. - - this would be an excellent project for a teen leader).
3. Print out one recordkeeping form per participant.
4. Contact a local beekeeper to speak about the components of a hive and assist with the activity (optional). A listing of local bee associations is available on the Kentucky State Beekeepers Association website at www.ksabeekeeping.org.

DO THE ACTIVITY

1. Tell participants that they are new beekeepers, and will be purchasing items to start a beehive.
2. Review the components of a beehive using the image below. If possible invite a local beekeeper to speak about the components of a hive and assist with the activity. Ask the beekeeper to bring examples of the various components and tools for the participants to see.
3. Give each participant a recordkeeping form. Have participants complete #1 (Projected Cost). For #1, youth will record how much they think it will cost to start a beehive.
4. Explain that stations are set up around the room for each participant to record the cost of each item needed for their hive. At some stations, participants will have to decide which item they want to purchase (for example do they want to purchase the assembled super or the unassembled super which will require them to assemble). Each participant should purchase all the necessary components to start and maintain a hive (refer to the hive image to the right which lists all components). Each participant is also required to visit the Chance Card station and pick one Chance Card.
5. After visiting each station and recording the cost associated with each item, have participants complete #2 and #3 on the recordkeeping form.
6. Review the recordkeeping forms with the entire group. Discuss differences in total costs (why were some participants' total costs higher than others).

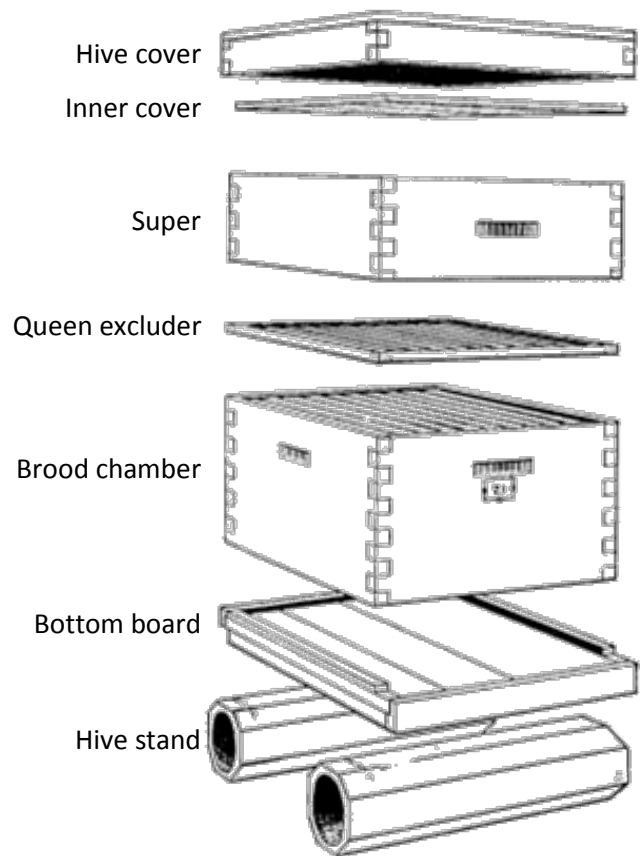


Image: University of Kentucky

Price Cards

Queen Bee

Unmarked Queen Bee	\$25.00
Marked Queen Bee	\$29.00

An important part of hive maintenance is inspecting the hive to check the condition of the bees (including the queen). A marked queen can generally be identified more easily than an unmarked queen.

Bees

Swarms	Free
Package Bees (3 pounds)	\$120.00
5 Frame Nuc with Bees and Laying Queen	\$175.00

A nucleus colony referred to as a "nuc" includes honey, pollen, bees at various stages of development, a queen that is laying eggs, and frames. Package bees include bees and generally a queen, and require that the beekeeper feed the bees sugar water. Generally, nucs are a better way to start a hive for a beekeeper because the beekeeper gets overlapping generations.

Bottom Board

Screened Bottom Board 8-Frame (assembled)	\$22.00
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Extracting Super

8-Frame Medium Honey Super (unassembled)	\$11.00
8-Frame Medium Honey Super (assembled)	\$18.00

Frames

Frames (unassembled)	\$1.75
Frames (assembled) 10-count	\$11.50
Frames (assembled) 50-count	\$50.00
Frames (assembled) 100-count	\$80.00

For an 8-Frame Hive, 8 frames will be needed for the hive body (also called a brood chamber) and 8 frames will be needed for the honey super.

Hive Tool

Standard Hive Tool	\$4.50
J Hook Hive Tool	\$9.50

Hive Body (Brood Chamber)

8-Frame Deep Honey Super (unassembled)	\$15.00
8-Frame Deep Honey Super (assembled)	\$25.00

Inner Cover

Inner Cover 8-Frame (assembled)	\$8.00
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Outer Cover (Hive Cover)

8-Frame Top Cover (assembled)	\$21.00
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Queen Excluder

8-Frame Plastic	\$3.25
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Wax Foundation

Wired Wax Foundation 10-Count	\$8.50
Wired Wax Foundation 50-Count	\$37.25

Smoker

4X9 Smoker \$36.50

Smoker Fuel (options)

Jute Burlap Roll (3.9 pound roll) \$19.95

Wood Pellets (40 pound bag) \$11.60

Cotton Fibers (1 pound bag) \$3.06

Pine needles \$0.00

Smoker fuel is a matter of personal preference. Pine needles can be collected and used from local home and property owners (always ask the home and property owner for permission before collecting).

Protective Clothing

Coverall and Hat Veil Combo \$65.00

Jacket \$52.50

Ventilated Jacket \$92.50

Drawstring Veil Attached Hat \$14.95

Helmet \$18.00

Gloves (goatskin) \$19.95

Gloves (leather) \$22.00

Gloves (economy) \$11.50

Bee Brush

Bee Brush Tool \$4.95

Nails

100-Pack \$4.50

Nails are needed if you purchased unassembled supers.

Chance Cards

Your queen bee dies and you have to purchase a new queen bee.
Cost = Price of a new queen.

Your bee colony has an infestation of Varroa mites, an external parasite that negatively affects the health of the colony and honey production. You must purchase Mite Away Quick Strips (a pesticide) used to treat Varroa mite infestations. All hives must be treated. Two strips are needed per hive. Cost = \$14.37 (2 doses); \$51.45 (10 doses); \$108.10 (25 doses). You will also need to apply oxalic acid in the winter to clean up whatever mites are left. This will require oxalic acid and a vaporizer. Cost = \$100 for the vaporizer and \$5 for the oxalic acid.

Your colony has an infestation of European foulbrood, a disease that can negatively affect larvae in the colony. You will need to remove the queen from the hive to stop the production of larvae. After 24-48 hours you will need to place a new queen in the hive. Cost = Price of a new queen.

Your bee colony swarmed (swarming is when your queen bee and worker bees leave the colony). You need to purchase a new queen and bees.
Cost = Price of a new queen and bees.

You misplaced your hive tool. Cost = Price of a new hive tool.

The nectar flow has been good this year and you need to add an additional super. Cost = a new super and frames.

Your hive has become weak and other bees are starting to rob it. You will need to purchase a robbing screen. Cost = 20.00

You realize that you need more education. You join the local bee association and purchase a subscription to a bee journal. Cost = \$120.00 (due for one year membership) + \$30 (cost for subscription for one year to bee journal)



FOLLOW UP

- Invite a local representative from the USDA Farm Service Agency (FSA) to speak to participants about Rural Youth Loans. Information about FSA Rural Youth Loans is available online at https://www.fsa.usda.gov/Internet/FSA_File/loanyouth.pdf.

EVALUATION

Key questions/statements to ask to gauge youths' understanding.

- What are the components of a hive?
- What equipment and gear does a beekeeper need to care for and maintain a hive?
- What unexpected costs may occur? (see Chance Cards)

REFERENCES

University of Kentucky. 2016. Varroa Mite Infesting Honey Bee Colonies. Available online at <https://entomology.ca.uky.edu/ef608>.

Prices for price cards were obtained from:

Dadant and Sons, Inc. 2017. Available online at <https://www.dadant.com/>.

The Honey and Bee Connection. 2017 Beekeeping Supplies Catalog. Available online at <http://thehoneyandbeeconnection.com/shop/>.

Honey and Pollinator – Additional Resources

Kentucky Resources:

4-H Bee Ambassador Program Webpage

<https://entomology.ca.uky.edu/content/4-h-bee-ambassador-program>

4-H Entomology Project (4DC-03PA)

Includes information about the order Hymenoptera (which includes bees) and an activity on identifying the body parts of a honey bee, wasp, and ant.

<https://entomology.ca.uky.edu/files/deptimages/oldunit3.pdf>

Kentucky State Beekeepers Association (KSBA)

Includes a list of local beekeeper associations around the state.

<http://www.ksbabeekkeeping.org/>

Current State Apiarist for Kentucky

Dr. Tammy Horn Potter, Kentucky Dept. of Agriculture, Frankfort, KY

Office phone: 502-573-0282

Email: tammy.potter@ky.gov

Website: <http://www.kyagr.com/statevet/honeybees.html>

Kentucky Beelines Newsletter

Monthly newsletter coordinated by Dr. Tammy Horn Potter, State Apiarist.

<http://www.kyagr.com/statevet/honeybees.html>

Pollinator-Friendly Plant List (Grow Wise. Bee Smart.)

Pollinator-friendly tree and shrub plant list for the Ohio Valley Region.

<http://growwise.org/wp-content/uploads/2017/02/HRI-Pollinator-BeePlantLists-February2017.pdf>

National Resources:

4-H Essay Contest (Foundation for the Preservation of Honey Bees, Inc.)

<http://preservationofhoneybees.org/essays>

American Beekeeping Federation

<https://www.abfnet.org/default.aspx>

Foundation for the Preservation of Honey Bees, Inc.

<http://preservationofhoneybees.org/>

National Honey Board

<https://www.honey.com/>

Pollinator Partnerships

<http://pollinator.org/>

Articles and Activities:

Beekeeping and Honey Production (University of Kentucky Center for Crop Diversification)

<http://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/honey.pdf>

Beeswax Lip Balm Recipe (Oklahoma Ag in the Classroom)

<http://aitc.okstate.edu/lessons/extras/recipes/lipbalm.pdf>

Beeswax: Not Just Honey! Article (North Carolina Cooperative Extension)

<https://cleveland.ces.ncsu.edu/beeswax/>

Beginning Beekeeping for Kentuckians ENT-41 (University of Kentucky Extension)

<http://www2.ca.uky.edu/agcomm/pubs/ent/ent41/ent41.pdf>

Enterprise Budget for Beekeeping (Iowa State University)

https://lib.dr.iastate.edu/extension_pubs/41/

Images:

Insect Image Database: Center for Invasive Species and Ecosystem Health

Includes many images that may be used for educational purposes. Visit their “Using Images” tabs for image use and citation requirements.

<https://www.insectimages.org/>

BugGuide

User-created and moderated identification guide for North American insects.

<https://bugguide.net/>

4-H Pollinator Facts

For use with social media.



Honey Bees are one of the most important animals in the world. They contribute about \$9 billion to the U.S. economy every year by helping to pollinate many of our crops... if the flowers don't get pollinated, they won't turn into apples, oranges, or grapes! Honey bees are threatened by diseases, mites, habitat loss, and other factors. Help them by planting lots of native Kentucky flowers in your garden.

Photo: Joseph Berger, Bugwood.org



Sweat Bees are the little dark-colored bees that sometimes give us minor stings on summer days. But did you know that they are important pollinators? They live everywhere and they are crucial for the pollination of many fruits. Most do not live in big hives like honey bees; instead, female sweat bees dig tunnels in the soil where they care for one larva at a time.

Photo: David Cappaert, Bugwood.org



Pollen Baskets are bunches of specialized branched-hairs on the legs of bees. These baskets help the bees to gather lots of pollen as they move from flower-to-flower. Bees are the only creatures on earth with pollen baskets and it is what makes bees different than wasps.

Photo: David Cappaert, Bugwood.org



Did you know that flies pollinate too? **Flower Flies** like this one look like bees, but they cannot sting. In fact, they are highly beneficial: the adults help pollinate while the larva (which look like tiny green slugs!) are important predators that kill tons of aphid. Flies are not quite as good at pollinating as bees though: they lack the specialized branch-hairs that make bees the best pollinators in the world.

Photo: Steven Katovich, USDA Forest Service, Bugwood.org



Honey bees did not originally live in the United States, but most of our **Bumble Bees**, like this one, are native and have been here for thousands of years. Like honey bees—and unlike most other kinds of bees—bumble bees live in large colonies or hives, where the adults work together to care for the helpless larva.

Photo: David Cappaert, Bugwood.org



Just like bees, butterflies like this **Spicebush Swallowtail** depend on nectar from flowers. Butterflies also help to pollinate flowers, but they do not have the specialized pollen-baskets and branched hairs that bees have. Butterflies face many of the same challenges as bees, especially habitat loss. Anything that you do to help bees—especially planting lots of native flowers—helps butterflies too!

Photo: Sturgis McKeever, Georgia Southern University, Bugwood.org



Did you know that wasps and bees are very closely related? In fact, bees are just a special kind of wasp that specializes in nectar and pollen, while most wasps are predatory. Wasps sometimes pollinate, though: this **Scoliid Wasp** is drinking nectar for some quick energy, and its hairs help to spread pollen. Wasps don't have the special branched hairs that bees have though, and so they aren't as efficient at pollination. Scoliid wasps are highly beneficial though: their larva feed on the grubs of destructive beetles!

Photo: Johnny N. Dell, Bugwood.org



Although many honey bees live in wooden hive-boxes that are managed by humans, **Wild Bees**, also called Feral Bees, are common too. These honey bee colonies have escaped from local hives and can persist for a few years. They will usually build their colonies inside hollow trees or similar places, such as the wall voids of a building. Sometimes, though, they will build a part of their comb right out in the open, as seen here. Just like hornets, feral bees can be very aggressive... observe from a distance!

Photo: Dennis Riggs, Denrig, Inc., Bugwood.org



You may have heard about **Monarch Waystations**. These are small gardens that provide milkweed plants for monarch butterflies and their caterpillars. Did you know that they are great for bees too? Milkweed plants have large flowers that provide lots of nectar and pollen for all kinds of pollinators—not just monarchs! And a monarch waystation can be placed almost anywhere: a small yard, the lawn in front of a bank, a public park, or a schoolyard. Learn more about monarch waystations and get yours certified at Monarch Watch: <http://www.monarchwatch.org/waystations/certify.html>



Moths are pollinators too! This **Hummingbird Clearwing Moth** looks a lot like a bumblebee, but it is a moth and it cannot sting. It can also hover in place just like a hummingbird. Like butterflies, moths depend on the nectar from flowers as their primary food source. Many moths fly at night, but hummingbird clearwing moths visit flowers during the day.

Photo: David Cappaert, Bugwood.org



They are not as familiar as honey bees, bumble bees, and sweat bees, but **Long-Horned Bees** are very common in Kentucky too. Named for the long antennae of males, there are many species of long-horned bees in our area. Like most native Kentucky bees, they are solitary: females care for their larvae in tunnels that they dig underground, but (unlike hive-dwelling bees like honey bees) the females do not work together or help one another. Like all bees, long-horned bees are very important pollinators.

Photo: David Cappaert, Bugwood.org



Small **Hover Flies** like this one are often called “sweat bees.” In the summer, they hover near people and land on their skin to grab a drink of water (sweat!). But these aren’t bees and they can’t sting you! True sweat bees are usually shiny black and cannot hover. Like bees, hover flies pollinate our flowers, although they not as good at pollinating as bees because they do not have special branched hairs.

Photo: Susan Ellis, Bugwood.org

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