



# BeeAware!

## Curriculum



By Nora Spratt

Girl Scout Gold Award Project 2021

*In Collaboration with:*

Blue Hill Heritage Trust &

Blue Hill Peninsula Explorers 4-H Club



## Program Context:

The BeeAware! program's purpose is to raise awareness of the declining native bee population, educate about the native bees and their importance, and empower others to take positive action towards helping the existing native bee population. This interactive and hands-on educational program is adaptable for the widespread use by individuals and organizations. The original version is designed for youth groups ranging from first through eighth graders and through its trial run did well to engage all participants in this age range.

The original program framework is based on a series of four two-hour workshops where participants learn about the following:

- native bees and pollinators, including their problems, importance, and how to help them
- construct two types of bee houses and learn about their maintenance
- contribute to citizen science projects by observing wild bees outside
- plant native pollinator-friendly flowers
- bee-themed activities, games, and crafts

These units and their contents are intended to be adapted to meet your needs.

The materials for this program are split into the following categories:

- Curriculum (Units 1-4)
- Slide Show Presentation (Units 1-4)
- Participant Binder (Units 1-4)

To teach each unit, you will need to refer to the Curriculum, Slide Show Presentation, and the Participant Binder. You can find these resources on the [BeeAware! Webpage under "Links/Resources, BeeAware! Program Documents" \(as shown below\)](#): Document titles with links to the webpage will be provided throughout the curriculum so that you can access the most updated document version online.



## Links/Resources

### BeeAware! Program Documents:

- [Curriculum \(Ver 1\)](#)
- [Presentation BeeAware! \(Ver 1\)](#)
- [Participant Binder \(Ver 2\)](#)

### BeeAware! Supporting Documents:

- [Milk Carton Bee Houses \(Ver 3\)](#)
- [Bee House Materials List \(Ver 3\)](#)
- [Installing the BeeAware! Bee House \(Ver 5\)](#)
- [House Maintenance Instructions \(Ver 2\)](#)
- [Stewardship Agreement \(Ver 7\)](#)

NOTE: The information used and referenced in the BeeAware! Program is cited throughout. A significant amount of the Program's material came from "[The Bees In Your Backyard, A Guide to North America's Bees](#)" by Joseph S. Wilson and Olivia Messinger Carril.



## Program Unit Outline

Below is how the four original two-hour workshop programs were run and how this program was organized; feel free to adapt this to meet your needs.

### Unit 1

- Native Bees' importance/problems/how to help,
- Pollination,
- Bee identification,
- Anatomy,
- Electrostatic activity,
- Life cycle,
- Habitat,
- Plant native pollinator-friendly flowers

### Unit 2

- Local guest bee expert speaker,
- Construction of milk carton bee houses,
- Flower anatomy and dissection activity,
- Bee bath assembly

### Unit 3

- Citizen science field trip to observe native bees

### Unit 4

- Native Bees' importance/problems/how to help,
- Construct wooden bee houses,
- Introduction of BeeAware! Stewardship Program

All program information and resources are available on the [BeeAware! Webpage](#) Please email [beeawaremaine@gmail.com](mailto:beeawaremaine@gmail.com) with questions and feedback!



# 1. Introductory Unit BeeAware!

## Unit # 1 - General Outline

1. Arrival, welcoming, and warm up activity (~10 mins)
  - a. Covid sign in/precautions, nametags, general (bathrooms, hand-sanitizer, etc.)
  - b. Other safety things (emergency exits, where to go in case of fire, etc.)
  - c. Please drink water! Use sunscreen! Stay in the shade... watch for ticks!
  - d. Reminder; BEE KIND!
  - e. [Pipe Cleaner Bee Craft](#) {Binder 6} as warm up activity (have pipe cleaner supplies for each participant- info sheets are located in their Binders)
2. Program Introduction (~5 mins)
  - a. Information on presenter and organization
  - b. BeeAware! project goal and general plan of workshop sessions (highlights!)
3. Program Curriculum (~80 mins)
  - a. Native Bee Importance and How you can Help
  - b. Bee lesson and activities (electrostatic electricity experiment, head/thorax/abdomen song, bee anatomy diagram, life cycle card-arranging activity)
4. Planting bee-friendly flower seeds (~20 mins)
5. Closing Circle (~10 mins)
  - a. Quick reflection on what they learned/liked during today's workshop?
  - b. Departure, Cleanup



## Unit # 1 - Materials List

### BeeAware! Presentation

- Present the BeeAware! Presentation (see “BeeAware! Presentation” on the the [BeeAware! Website page](#))

### BeeAware! Participant Binder

- Print a copy of the BeeAware! Participant Binder for each participant to follow along with the program’s worksheets (see “Participant Binder” PDF on the the [BeeAware! Website page](#))
- Pre-cut and paperclip Binder pages 9 & 10 (bee and flower life cycles) to complete a life cycle activity (rearranging the pieces in the correct order).
- Print out “How to Help Native Bees” on the [BeeAware! Website page](#) for participants to have

### [Pipe Cleaner Bee Craft](#)

- Pipe Cleaners for the pipe cleaner bee craft (yellow, black, white are essential; but you can also include other colors, too!)
- 3 pipe cleaners per bee (2 to be twisted into the body, and 1 for the wings)
- 1 safety pin per bee

### Electrostatic Electricity Pollination Activity

- Latex Balloons
- Shredded or Hole-Punched Dot Paper

### Planting Pollinator-Friendly Flowers

- Native, pollinator- friendly flower seeds
- Potting Soil
- Water
- Labels



## Unit # 1 - Program Curriculum

The written Curriculum content supports the Slide show Presentation. Please open the Slide Show Presentation and follow with the Slide numbers [Slide #]. Please also have the participants refer to their printed Participant Binders with corresponding worksheets, activities, and resources according to the page numbers {Binder #}.

### Arrival

- Covid precautions, nametags, getting used to the place (bathrooms, etc.), any other safety things (sign in, symptom check)
- “Bee Safe” safety statement: “yes, bees have stingers, but they will not disturb you unless you disturb them!”

### (Start Slideshow presentation)

(see “BeeAware! Presentation” on the [BeeAware! Web page](#))

[Slide 1]

[Slide 2] {Binder 2-3}

[Pipe Cleaner Bee Craft](#) (have volunteers help and guide)

- Pipe Cleaners (yellow, black, white are essential; but you can also include other colors to illustrate the native bees’ color diversity)
- 3 pipe cleaners per bee (2 to be twisted into the body, and 1 for the wings)
- 1 safety pin per bee (to make into pins)

[Slide 3] (say: “bees come in all different sizes, shapes, and colors; and so can your pipe cleaner bees!”)

[Slide 4]

[Slide 5]

### **Program Introduction**

#### Info on presenter & organization

Instructor speaks to who they are and why they are doing this program

#### Project goal and general workshop session plan

- Nora Spratt’s Gold Award Project “Bee Aware” focuses on: Addressing the issue of the declining native bee population. These wild bees are often overlooked due to lack of awareness, as most people often think of the iconic honey bee first! The decline in the native bee population is due to Global Warming, Neonicotinoid pesticides, habitat loss and fragmentation, and parasites and diseases.
- Nora Spratt’s Gold Award Project “Bee Aware” Program goals: to raise your awareness about the native bees, to educate you about native bees and pollinators, empower you



to help the native bees by taking positive action, and encourage you to share what you learned with everyone!

Workshop Unit Outline Highlights (below is how the original four two-hour workshop program was run and how this program is organized; feel free to adapt this to meet your needs!):

- Unit 1 (~2 hours)
  - Native Bees' importance/problems/how to help, pollination, bee identification, anatomy, electrostatic activity, life cycle, habitat, plant native pollinator-friendly flowers
- Unit 2 (~2 hours)
  - Local guest bee expert speaker, construction of milk carton bee houses, flower anatomy and dissection activity, bee bath assembly
- Unit 3 (~2 hours)
  - Citizen science field trip to observe native bees
- Unit 4 (~2 hours)
  - Native Bees' importance/problems/how to help, construct wooden bee houses, introduce BeeAware! Stewardship Program

[Slide 6]

Big Rule: Bee Kind; what does that mean? (being kind and respecting each other, the instructor, the course materials, and, of course, the native bees!)

## Program Lessons

### The Importance of Native Bees

[Slide 7]

Discussion: "Why Native Bees?" ... because of pollination! (if the bees die, we're in huge trouble!)

"Scientists have estimated that globally, 1 in 6 bee species is regionally extinct and more than 40 percent are vulnerable to extinction. Unfortunately at least 23 percent of U.S. native bees have declined, with bees in areas with heavy commodity-crop production particularly hard hit due to habitat loss and pesticide use." (Source:

<https://www.biologicaldiversity.org/campaigns/saving-the-insects/native-bees.html>)

The world's pollinators are vital to the environment and are especially crucial to the global food supply. This is because according to the USDA, one in every three bites of food that we eat is thanks to the work of pollinators (and they "... increase our nation's crop values each year by more than \$15 billion..." from their webpage "US Pollinator Information"). Also, pollinators help to account for one-third of the global food crop production and that "Most of the world's crops depend on honeybees and wild bees for pollination, so declines in both managed and wild bee populations raise concerns about food security...". The bee population is declining- scientists





have found “...degradation of interaction network structure and function and extirpation of 50% of bee species...” over the past 120 years. What’s terrifying about this is that as the bee population is decreasing, the human population of 7.8 billion is growing- and so is the global demand for food!

(Sources: (University of California - Berkeley. "Pollinators Help One-third Of The World's Food Crop Production." ScienceDaily. ScienceDaily, 26 October 2006. [www.sciencedaily.com/releases/2006/10/061025165904.htm](http://www.sciencedaily.com/releases/2006/10/061025165904.htm) ScienceDaily, 28 July 2020.), (Rutgers University. "Decline of bees, other pollinators threatens US crop yields: Largest study of its kind highlights risk to global food security." ScienceDaily. <[www.sciencedaily.com/releases/2020/07/200728201558.htm](http://www.sciencedaily.com/releases/2020/07/200728201558.htm)>.), (Burkle, et al. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. Science339(6127):1611-5.doi: 10.1126/science.1232728.))

We absolutely need the pollinators to survive- so let’s learn all about them, take action and enhance the native bee habitat and population around us, and share what we learned with others to help save the bees!

### The Native Bees’ Problems

[Slide 8] {Binder 2-4}

First, let’s learn about the Native Bee’s Problems: There are five major root causes at play when it comes to the declining population, diversity, and distribution of the Native Bees.

#### 1. Parasites, viruses and diseases among the native bees

- Native Bees naturally struggle with parasites, viruses and diseases.

#### 2. Climate Change

- The shifting temperatures cause changes in their native plant food source availability and distribution, and therefore the native bees distributions are shifting as well

#### 3. Neonicotinoid Pesticides

- Neonicotinoid Pesticides are very strong commercial pesticides used on crops that are Nicotine derived
- The agricultural industry does not pay enough attention to the detrimental effects of this widespread practice on the Native Bees, as stated in the research paper that found in their experiments that neonicotinoid treated seeds “...reduced wild bee density, solitary bee nesting, and bumblebee colony growth and reproduction under field conditions. Hence, such insecticidal use can pose a substantial risk to wild bees in agricultural landscapes, and the contribution of pesticides to the global decline of wild bees may have been underestimated.” [Rundlf, M., Andersson, G., Bommarco, R. et al. Seed coating with a neonicotinoid insecticide negatively affects wild bees. Nature 521, 77–80 (2015)<https://doi.org/10.1038/nature14420>]



- Domestic pesticide use on gardens and orchards is devastating to the native bees as it deters them from pollinating (which is their food source) and can even kill the bees (which both in turn negatively affect harvests!).

#### 4. Habitat Loss and Habitat Fragmentation

- As global urbanization continues, native bee habitats are divided if not destroyed [by buildings, roads, cities, etc.], AND by our mainstream backyard landscaping practices as we disturb if not destroy their food sources and habitat- by keeping our lawns "tidy" from cleaning up fallen leaves and sticks in the spring and fall, we are disturbing and removing those essential nesting habitats.
- By mowing our lawns in the spring we cut the majority of natural, native wildflowers that the bees depend on as they wake up from their winter hibernation.

#### 5. Lack of Awareness

- Many of these are related to the deeper root cause that the majority of people have never heard of Native Bees and are unaware of their importance, and even how they could unintentionally be harming them! This means that the declining population goes largely unnoticed.

Addressing these root causes:

The declining native bee population, diversity, and distribution is a many-sided issue without only one cause or solution. There are many causes that we won't be able to solve with this program, BUT there are some very important things that we can do that will have a positive effect on the native bees.

[Slide 9] {See the BeeAware! How to Help Native Bees Document}  
Let's focus on how YOU can Bee Helpful to the Native Bees!

[Slide 10]

5 Ways How you can Bee Helpful!

(see "How to Help" on the [BeeAware! Website page](#))

- 1. Educate Yourself and SHARE with others!
  - Learn about the declining population of the native bees and pollinators, and spreading the buzz! This directly addresses the root cause of lack of awareness.
    - You are already working on this one by becoming educated about the native bees with this workshop series; way to go! Even after there will still be plenty to learn, but you will have learned a lot! This is important because with a solid understanding of the native bees and pollinators and their importance, you can take educated steps to helping the native bee population.
    - Soon it'll be your turn to share the buzz! Talk about what you learned with your friends, family, and community! Even something as simple as talking



to your friends about Native Bees is helpful because you are raising their awareness, too. The hope is that they would go learn more and then take action to help the bees. Along the way, they'd tell others too- and continue to raise awareness! In this way you can help to create a great ripple-effect of awareness. The more people who learn about the bees and take positive action, the better chance we have of helping the native bees.

[Slide 11]

- 2. Provide Habitat

- Build, install, and maintain the milk-carton bee houses and wooden bee houses that we will make in these workshops. These bee houses will provide much-needed nesting habitat for the existing bee population and foster homes for generations to come, addressing the major root cause of habitat loss and fragmentation.

Show them off and share the blueprints with others for them to make their own. All of the information can be found online on the [BeeAware! website page](#).

Providing Nesting Areas:

- Forget about Fall cleaning and wait to do your Spring Cleaning; Bees hibernate through the winter in organic debris, like fallen leaves, sticks, and garden beds - so please don't do any fall cleaning so that they have this habitat and wait to do your spring cleaning until there has been a week of consistent temperatures above 50 degrees Fahrenheit! This allows the pollinators enough time to wake up and emerge from their hibernation- if you move or remove the brush, leaves, and sticks then you could be killing the next generation of super pollinators!
- Provide areas for ground-nesting bees with exposed areas of dirt and mud
- Provide habitats for twig nesting bees by leaving a stick and brush pile along the side of your yard.

Building Other Bee Houses:

- Build and maintain a bee block (which is another form of bee house with holes drilled into wood instead of nesting tubes)
- Build and maintain a nest bundle of drilled twigs, paper straws, hollow reeds, etc.
- Build and maintain a bumblebee nest!

[Slide 12]

- 3. Provide Good Food All Season

- Plant a variety of native, pollinator-friendly flowers and/or a "pollinator strip" of wildflowers in your garden. Bees and pollinators depend on flower's nectar to survive, and you'll be feeding them! Also, by attracting bees you can actually significantly increase your garden or orchard's harvest yield!
  - You want your pollinator garden to have flowers in bloom all season long, from May- September (so the different bees can eat all summer long!)
- Participate in No Mow May- try to go as long as you can during the month of May without mowing your lawn. This allows the wildflowers to take over and feed the awakening pollinators with critical nectar! This is greatly helpful with increasing



flower diversity. Ideally, mow your lawn as little as possible (once a month) to allow for wildflowers to grow, and even leave a patch of grass to grow long for the bees!

- (Source: <https://www.gardensillustrated.com/feature/lawn-mowing-when-flowers-may/>)
- Use your Bee Bath to provide a safe drinking source for the bees

[Slide 13]

- 4. Avoid all Pesticides, especially Neonicotinoid pesticides!
  - Don't use pesticides in your backyard gardens! Instead, use natural alternatives.
  - Pesticide use is growing, and so are their negative effects on the pollinators!

[Slide 14]

- 5. Climate Change
  - Reduce your Carbon Footprint
  - Eat local, organic foods without pesticides

[Slide 15]

#### Introduction to Pollination!

- What is Pollination?
  - Watch the brief video on [flower pollination](#).
  - Watch the video on [Beneficial Pollinators](#) and check out the [Solitary Royals](#) video to learn about solitary bees.
  - [This Bee Gets Punched by Flowers For Your Ice Cream](#)
  - [Buzz Pollination video](#)

[Slide 16] {Binder 6}

- After each video - what did you think?
- Cheeto example of pollination with fingers - when you're eating cheetos and your fingers become covered in the cheeto dust, and then you touch something and spread the cheeto dust - you're just like a pollinator, eating the nectar (or cheetos for us!) and then spreading all of the pollen (or cheeto dust) from plant to plant!
- Ask and discuss- "Why is pollination important? What would life be like without pollinators?"

In some areas of the world, such as Southern China's apple orchards, they have unintentionally eradicated their bees and now must hand pollinate- which is most definitely not an effective, efficient option for them nor the rest of the world. This is a scary reality that we may also be heading towards if we do not act. There are already recently extinct bee species in the United States, and many are at risk or endangered today. The worst thing is that because the native bees don't receive much attention, and we don't know a lot about the 4,000 or so native bee species of North America, scientists truly don't know just how bad things are for them through lack of research - like if some species are facing extinction and if they are already gone.



With bees being the best pollinators, and with native solitary bees being super pollinators as a single native solitary bee can be “... as effective as hundreds of honey bees.” according to Crown Bees, we absolutely need to help the native bee population! (Source: <https://crownbees.com/superior-pollinators>)

Without pollinators, our world would be dramatically different in many ways- as the importance of pollinators does not only pertain to our food! “Of the foods and beverages that we consume daily, over 30% rely on or benefit from a pollinator. Pollinators even help milk production: the alfalfa and clover cows graze is replenished by seed pollinated by bees. Worldwide, production of animal-pollinated crops is valued at over \$235 billion annually. The loss of pollinators would negatively affect both farmers and consumers who would be faced with reduced crop yields and lower quality products. Moreover, insect-pollinated foods contain many key nutrients, such as vitamin E, essential to our diet. A world without pollinators would not only leave us with fewer food choices, but would make it substantially harder to find the nutrition we need to survive.” According to the XERCES SOCIETY. Keep in mind that pollinators also pollinate plants used for fibers like cotton and flax- so our clothing and textile industry would also change! If we did have to resort to hand pollination, “Farmers would stop growing insect pollinated crops if they didn't have bees - it just wouldn't be economic to do it in most parts of the world. All we'd be left with are things that are wind pollinated, so that's basically wheat, barley, rice and corn. So we'd have to live off bread and porridge and rice if we lost our bees, and we really don't want to go down that road.” According to Dave Goulson, University of Sussex bumblebee specialist, from “Pollinating by hand: doing bees' work” by Natalie Muller. (<https://www.dw.com/en/pollinating-by-hand-doing-bees-work/a-17822242>). (<http://www.xerces.org/pollinator-conservation/whats-at-stake>)

And, of course, the world would not be nearly as beautiful without its flowers (that would disappear without having pollinators to attract)!

[Slide 17] {Binder 4}

Introduction Native Bees (participants are now “Bee-coming Aware”!)

- Native Bee Intro

[Slide 18] {Binder 4}

- 4,000 species in the US/Canada, over 20,000 species worldwide
- Scientists predict there may actually be about 30,000 species worldwide (as new species are discovered every year!)

[Slide 19]

- When you hear me say the word bee, I'm guessing that most of you think of the iconic reddish-brown honey bee. And you know what, that's what I first thought of too! But bees can come in many shapes and sizes, and many beautiful colors!

[Slide 20]

- Blue and green jewels like *Osima* and *Agapostemon*,
- Fire-engine red *Nomada*,



- Jet-black fuzz balls like *Anthophora*,
- and the zebra-striped *Anthidium*

[Slide 21]

- North America is home to some of the smallest bees in the world - like the *Perdita*, that is about 0.1 inches; which is smaller than George Washington's nose on a quarter!
- At the same time, North America is also home to the giant bumbling carpenter bees - *Xylocopa*! At more than an inch long, they sound like miniature helicopters as they hover near flowers!

[Slide 22]

- 1.1 What is a bee? (engaged learning)
- Bee vs Wasp vs Flies

[Slide 23]

- Bees
  - Pollen Eaters (NECTAR)
  - Collect pollen from flowers to feed their young
  - Bees are hairy to collect pollen (pollen sticks to hair), and "many species look like cotton candy with wings!" (pg. 9 "The Bees in Your Backyard" by Joseph S. Wilson and Olivia Messinger Carril )
  - "Rooting around in flowers is messy business, and a few minutes rummaging among floral parts leaves a bee coated in hundreds of tiny grains of pollen. Using her many legs, the bee grooms herself, wiping all the pollen to the back of her body, where she stuffs it into the spaces between special stiff bristles on her legs or belly. These tufts or masses of special hairs are called Scopa. Quite opposite of the furry bee, wasps look like Olympic Swimmers, without any hair, skinny waisted, and with long spindly legs." (pg. 9 "The Bees in Your Backyard" by Joseph S. Wilson and Olivia Messinger Carril)
- Wasps
  - Meat Eaters
  - Attack other insects and bring them back to their nest for their young
- Both
  - Visit flowers for Nectar (the "energy drink" of the insect world!)
- Flies
  - Without stingers, it's super helpful to look like bees! Some flies are bee copycats, doing their very best to pretend to be bees so that they aren't eaten by predators! Some have even evolved to have fake pollen-collecting hairs on their legs! (like dressing up for halloween!)

[Slide 24]

- 1.2 Honey Bee V.S. Everyone Else



- Engage audience; ask them what they think of when we talk about bees “What is a bee? What do they make? Where do they live? What colors are they? Do they sting!” Etc. [all thinking about honey bees- you’re broadening their understanding!]
- 1. 70% of all bees live in the ground (including bumblebees!)
- 2. Honey bees and bumblebees are social and work together to build their hive nest; but most other kinds of bees work alone and are solitary!
- 3. Honey bee and bumblebee mothers meet their offspring, but the majority of bee mothers never encounter their young!
- 4. Honey bees and bumblebees make and store honey to eat in the winter, which few other bees do!

Did you know that Honey bees and bumblebees make up only 1% of all bee species?!

[Slide 25] {Binder 4}

- What are Native Bees?
  - Solitary
    - Each female builds her nest, lays the eggs, and gathers all pollen.
    - She doesn’t usually meet her offspring
  - Short Lived
    - Fly for about 5-8 weeks of the year
  - Many Specialists
    - Collect pollen from one genus or family of plants
  - Most are ground nesting
    - Others live in pre-existing cavities, often in wood
  - Manipulated for pollination, but not domesticated

[Slide 26] {Binder 5}

- 1.2 A Bee’s Body
  - Patterns, bodily structure, etc. is how you identify bees!

[Slide 27] {Binder 5}

[Slide 28] {Binder 5}

[Slide 29] {Binder 5}

- Head
  - Antennae
    - The bees use their antennae to “smell” the world around them with these incredible sensors!

[Slide 30] {Binder 5}

- Mouthparts (tongue)
  - Tongue
    - This is how the bees “taste” the world!



- Short tongued or long tongued
- Used to slurp nectar, “painting” the inside of their nests, grooming, and communicating- most of their sensory receptors for understanding the environment are on their tongues!
- And yes, from time to time bees lick each other!

[Slide 31] {Binder 5}

- Mandibles
  - The bee version of our opposable thumbs
  - These work like “Jaws” do, and they have either sharp or rounded “teeth” along the inside
  - Used for sparring with enemies, building nests, filling nests with leaves, carrying pebbles, and even hanging on the stems of plants (because males do not have nests, they’ve got to sleep somewhere!)

[Slide 32] {Binder 5}

- 2 sets of Eyes
  - Simple Eyes
    - Top of Head
    - One lense
    - Used for orientation, triangulating the position of the sun and the sky and using this information to guide them towards their nests.
  - Compound Eyes
    - Made of thousands of individual lenses, and each of these lenses see the same view but from a slightly different angle- meaning that the bee’s brain must compile all of those images to be able to see the world around it!
    - They are incredible at sensing movement because they process these thousands of images 15 times faster than our own eyes! This means that when something is moving so fast that we only see a blur, they can see whatever just happened in great detail.

[Slide 33] {Binder 5}

- Thorax
  - Contains the wings and legs
  - Wings
    - Two wings on either side of their bodies; forewing/hindwing
    - These wings are supported by veins
    - Their wings are quite strong
      - Big, heavy Bumblebees have been known to travel 5 miles!





[Slide 34] {Binder 5}

- Legs
  - Three pairs of legs, making them have 6 legs total (meaning that they are indeed an insect!)
  - Foreleg, Midleg, Hind Leg
    - The bees use static electricity to carry their pollen- just like how when you rub a balloon on your hair, your hair sticks? Or like if you rub your socks against a carpet you can generate a static charge and shock yourself? It's the same sort of thing! The bees are covered in hairs that create a static charge as they fly in the air. Then, when they go to drink their nectar from flowers, the dry pollen sticks to their bodies!

[Slide 35] {Binder 5}

- These charged pollen-collecting hairs are called Scopa, and they are located either on their hind legs or the underside of their abdomen.
- Honey Bees, Bumblebees, and some solitary bees have pollen baskets on their legs that allows them to carry wetter pollen.

[Slide 36] {Binder 5}

[Slide 37] {Binder 5}

### **Activity Break - How do bees carry pollen?** Electrostatic Pollen Experiment

- Materials Needed: balloons, shredded paper/hole-punched paper dots

Goal: Model the leaping of pollen from a flower to the charged surface of a bee.

1. Tear tiny pieces from a sheet of paper. Separate the paper pieces on a flat surface, such as table (or large aluminum tray for cleanup purposes)
2. Inflate and tie a 9 inch round balloon.
3. Rub the inflated balloon back and forth on your hair 4 or 5 times.

***Troubleshooting:*** *Your hair must be clean and dry. Instead of your hair, you can use a piece of fur, a wool scarf, or a polyester material.*

4. Immediately hold the balloon near but not touching the paper pieces. ZAP!!! The paper pieces leap to the balloon and stick to its surface much like pollen grains can leap to and stick to the body of a bee.

What's Happening?



You may have learned this in science class, but everything in our universe is made of atoms. In these atoms are an equal amount of positive protons and negative electrons, so the atom has no charge. When an atom gains or loses electrons, it becomes a negatively or positively charged ion. These negative and positive charges attract and repel each other.

“All materials have an equal number of positive and negative charges, thus they have no net charge and are said to be neutral. When two materials move against each other, the friction of this motion causes electrons to be brushed off of one material giving it a positive static charge. The other material gains the electrons, thus giving it a negative static charge.

Rubber is a material that tends to gain electrons while human hair, animal fur, wool, and polyester are materials that more easily lose electrons. Thus, when you rub the balloon on your hair, the balloon becomes negatively charged leaving your hair positively charged.

The pieces of paper have no charge, but the nearness of the negatively charged balloon repels the electrons near the surface of the paper. This leaves the surface with a positive charge. This is called an induced charge.” As opposites attract, the positively charged paper surface is attracted to the negatively charged balloon and that’s why they stick together! The same thing happens with bees and pollen!

“Bees as well as other flying insects develop a positive charge on their bodies as they fly through the air. This happens because as they fly, the friction between their bodies and air molecules rubs off electrons.”

Flowers have a negative charge, thus pollen grains on flowers have a negative charge. The bee shown is covered by pollen because of the attraction of the negative charged pollen and the positively charged surface of the bee. **This is all important because flowers are pollinated as the pollen-coated bee flies from one flower to another to drink the flower’s nectar.**

(source: <https://homeschool.scienceprojectideasforkids.com/2021/static-electricity-pollination/>)

### (Back to the Slideshow Presentation)

[Slide 38] {Binder 5}

- Thorax
  - Made from a series of plates that are fused together
  - Useful for bee identification!

[Slide 39] {Binder 5}

- Abdomen
  - The abdomen is covered in a series of telescoping plates.
  - Females have 6 and males have 7 plates on top- the male’s abdomen is slightly larger and more curved because of this!



[Slide 40] {Binder 5}

- Ground-nesting bees have a Pygidial Plate located underneath the abdomen at the tip. The Pygidial Plate is used to smooth the walls of their underground nests!

[Slide 41] {Binder 5}

- Stinger
  - Male solitary bees do not have stingers, and female solitary bees do have stingers- however, native solitary hole-nesting bees are some of the most gentle bees that rarely ever sting! Plus- unlike the honeybee- they do not have toxins in their stings, so if you are stung, you are very unlikely to have an allergic reaction!

[Slide 42]

**Activity Break - Bee Anatomy Song:** Have everyone sing and dance to the [Head, Thorax, Abdomen song!](#)

{Binder 5}

**Activity Break - Bee Anatomy Diagram:** Have participants complete their Bee Anatomy [diagram/coloring](#) pages from their Participant Binders!

[Slide 43]

- 1.3 [Life Cycles](#)

[Slide 44]

- Intro: [Honey Bee in Larva/Pupa stage video](#)

[Slide 45]

- Adults live for about a year, 3-6 weeks zipping around from flower to flower for nectar and pollen
- Human: baby, toddler, teen, adult = Bee: egg, larva, pupa, adult
- Their life cycle is similar to a butterfly's; and some even spin cocoons!
- **Complete Metamorphosis:** (scientific way of saying "really big change"!)
- Adult:
  - Bee emerges from nest anytime between February/September (species/flower season dependant!).
  - Male bees typically emerge before females, and wait nearby for the ladies to show up!
  - Eggs are laid inside individual nest cells, and each nest typically has many nest cells. Next to each nest cell the mother places a large ball of pollen mixed with nectar for the larva to eat when hatching! These are referred to as "pollen loaves"
  - Most mother bees don't get to meet their young because once their job is done, they disappear! (die... :( )
- Egg:



- The egg stage is the shortest stage in a bee's life, and most eggs "hatch" just a few days after they are laid!
- Eggs can vary in size, from a pinhead to almost  $\frac{2}{3}$  of an inch long!
- The eggs are encased in a soft, white, outer shell in the shape of an oval. When the eggs "hatch", the outer layer either dissolves or is shed- unlike how a chicken egg is cracked open! (This outer layer is also called a chorion)
- Larva:
  - A bee larva is soft and white with a mouth, tiny nubs for their antennae, and a caterpillar-like body!
  - These "grubs" have only two jobs; to eat their pollen balls and grow! They molt 5 times, and they don't poop; but during their last larval stage, they make one big dump immediately before they transition to their next stage!
  - Their poop is called Frass!
  - After their big frass, they spin a silky cocoon around themselves- like butterflies and moths do- and make a mouth-made sweater to keep them protected as they transform into pupae!
  - *They can stay in their 5th stage-repupal stage- for a small or great amount of time-even years! (Bet-Hedging)*
- Pupa:
  - The bee pupa looks very similar to the adult, with legs, antennae, eyes, and three body sections (but no full wings yet- they just have wing buds!).
  - They are a light grey to milky white color, and do not have their bright colors or fuzz yet!
  - This period doesn't last very long, because their wings and fur grow and pretty soon they are a fully formed adult!
  - Then, the new adult bee chews and digs its way out of its nest and begins its life as an adult bee!

[Slide 46]

- Of course, every bee species has evolved a unique spin on the general bee lifecycle - like how the mason bees use mud for their cocoons, and how leafcutter bees use leaves!
  - An **egg** is laid by a female solitary bee on top of a pollen ball.
  - After a few days the egg will hatch and become a **larva** that quickly eats the food source left by the female.
  - The larva grows and eventually becomes a **pupa**. The pupa is the transformation stage when cells in the body rearrange and mature and the bee starts to look like the adult bees we are familiar with seeing. The pupa hatches from its case and then emerges from the nest by chewing its way through leaves or mud.
  - An **adult bee** emerges from the nest! This bee then mates and the cycle is ready to start all over again.
  - Once a female has mated she works all day **foraging**, visiting flowers collecting pollen and nectar that she will use to build pollen balls. A female solitary bee makes 15–20



flower visits to complete just one cell in a nest. Pollination occurs as the female bumps into the flower's anthers and stigma during these visits.

- Once a female has built all of her cells in one **nest** she seals off the end and leaves to start another nest.
- (source: <https://www.pollinator.org/learning-center/bee-issues>)

[Slide 47]

Observe and discuss the Flower Life Cycle

{Binder 7} {Binder 6}

**Activity Break - Life Cycle of Bees:** Have volunteers cut out the bee and flower life cycles in the Participant Binders and have the participants arrange the pieces in order to complete the life cycles. These can be glued to a blank page. Refer back to the slideshow presentation for the answers!

### (Back to the Slideshow)

[Slide 48]

- 1.4 Where do bees live?
  - Mother bees almost never meet their offspring, but they work super hard to provide her babies with everything they need to thrive; including a safe home! These mother bees spend a lot of their time choosing the perfect nesting location and constructing a protective nest.
  - I'm sure you all have seen those cartoons when someone runs into a bee nest hanging from a tree, right? And you have all seen how beekeepers keep their hives in those big boxes with trays? Well, bees live all around the world, and just like how we learned that there are many many different types of bees; there are also many different and unique types of nests, too! There are three major categorizations for bee nests; Hives, Underground Nests, and Above-Ground Nests.

[Slide 49]

- Hives
  - Honey Bees and BumbleBees live in big hives that they make with beeswax and saliva!
- Underground
  - 70% Bee Species live underground in either pre-made tunnels from other creatures or in underground tunnels that the females dig themselves- gopher style!
  - These nests can range from a few inches deep to even 10 feet deep!
  - These nests are made typically south/east facing for the sun in an exposed patch of soil, and they are often built in nest



aggregations- the biggest one ever found was built by the hairy-legged bee and contained over 12 million nests!

- These tunnels can be straight down with the eggs at the bottom, or they can have many other tunnels branching off with even more eggs inside!
- The female bee smooths the tunnel walls with her pygidial plate- or a special body part she has on the tip of her abdomen.
- Some bees paint the walls with a waxy cellophane-like material that they produce to keep out moisture and bacteria.
- Other bees line their nests with leaves, hair from the leaves, and sometimes even flower petals!
- Once their tunnel masterpiece is complete, the female bees gather pollen and nectar from flowers and carry them back to make pollen “loaves” for their baby bees to eventually eat!
- Once her eggs are laid and each “egg cell” has been maid, the mother bee back-fills the tunnels with some debris and soil and then she caps off the tunnel entrance with mud or plant materials.

[Slide 50]

- Above Ground
  - 30% of the bee population lives above ground in the hollowed-out insides of reeds, sticks, and other woods.
  - Includes the mason and leafcutter bees (as well as some bumblebee species and honeybees!)

[Slide 51]

- Cute little bee! (They're resourceful!)

[Slide 52]

- Questions?

[Slide 53]

- End Slideshow Presentation
- **Plant the native pollinator-friendly flower seeds!**
- **Closing Circle-** everyone returns materials, Quick reflection on what they learned/liked during today's workshop
- **Departure! Cleanup!**

Sources: The majority of this program's material came from "[The Bees In Your Backyard, A Guide to North America's Bees](#)" by Joseph S. Wilson and Olivia Messinger Carril.

---



## 2. Special Guest; Local Bee Expert

### Unit #2 - General Outline

1. Arrival (~10 mins)
  - a. Covid sign in/precautions, nametags, general (bathrooms, hand-sanitizer, etc.)
  - b. Other safety things (emergency exits, where to go in case of fire, etc.)
  - c. Please drink water! Use sunscreen! Stay in the shade... watch for ticks!
  - d. Reminder; BEE KIND!
  - e. “The Bees Buzz If...” icebreaker game to start off
2. Program Introduction (~10 mins)
  - a. Quick overview/plan for today’s session
  - b. Introduce local bee expert
3. Local Bee Expert Presentation and Activities (~50 mins)
  - a. Science Behind Pollination
    - i. Flower Dissection (found in Participant Binder pg. 8: “[Flower Dissection Sheet](#)”)
    - ii. Flower Anatomy Worksheet Page (found in Participant Binder pg. 9)
  - b. A Closer look at Native Bees
    - i. Observing bees under microscopes/hand lenses
    - ii. Draw your own Native Bee activity (They create their own bees based on what they’ve learned and the backyard bee poster in their Participant Binders on pg. 4)
  - c. **Optional** Bee observation
    - i. Citizen Science using iNaturalist on iPads or [observation sheets](#) Participant Binder pg. 10)
    - ii. Log your sightings on the [Great Sunflower Project](#) or [Bumble Bee Watch](#) websites!
4. Activities (Bee Baths, “The Queen’s Coming” game) (~20 mins)
5. Assembly of Milk Carton Bee Houses (~20 mins)
  - a. Including their installation, care/maintenance
6. Closing Circle (~10 mins)
  - a. Quick reflection on what they learned/liked during today’s workshop?
  - b. Departure, Cleanup



## Unit #2 - Materials List

### BeeAware! Presentation

- Present the BeeAware! Presentation (see “BeeAware! Presentation” on the [BeeAware! Website page](#))

### BeeAware! Participant Binder

- Print a copy of the BeeAware! Participant Binder for each participant to follow along with the program’s worksheets (see “Participant Binder” PDF on the the [BeeAware! Webpage](#))

### Flower Dissection Materials

Per Group:

- 2 daffodils
- 1 hand lens
- Gloves (as daffodils are toxic!)

Volunteers:

- 1 scalpel or sharp knife
- cutting board
- Gloves (as daffodils are toxic!)

### Milk Carton Bee Houses

- Cartons
- Twine
- Duct Tape
- Scissors
- Markers (for names)
- “Milk Carton Sign” (expiration date for houses) (found on the [BeeAware! Website page](#))
- Packaging Tape (printed signs and Packaging Tape)
- 70 Nesting tube paper straws per house; buy [8mm](#) and [6mm](#) straws

### Bee Bath Materials

- [Terra Cotta Saucers](#)
- craft store gems, rocks, seaglass, seashells, etc.

### Optional Observing Bees Under Microscopes/Hand Lenses

- Microscope/Hand Lenses
- Bees to observe under the microscope





## Unit #2 - Program Curriculum

### Arrival

- “The Bees Buzz If...” icebreaker game to start off
    1. Everyone stands or sits in a circle and one person is in the middle.
    2. The person in the middle yells out “the bees buzz if you \_\_\_\_\_”. Everyone who matches up with what they said has to get up and swap spots with someone else (who isn't next to them), like musical chairs. While this is happening, the person in the middle would also try to steal a spot. Inevitably someone will be left in the middle and the process continues (the last person).
      - Some examples of what the person in the middle could say are:
        - The bees buzz towards people who have a younger sibling.
        - The bees buzz towards people who have been overseas.
        - The bees buzz towards people who play basketball.
        - The bees buzz towards people who have a name that starts with B.
        - The bees buzz towards people who have blonde hair.
- (source: <https://youthgroupgames.com.au/games/where-the-wind-blows/>)

### (Start Slideshow presentation)

(see “BeeAware! Presentation” on the [BeeAware! Web page](#))

### [Slide 54]

- Covid sign in/precautions, Nametags, general (bathrooms, hand-sanitizer, etc.), any other safety things (plz drink water! Sunscreen? Stay in the shade... watch for ticks!)
- Info on instructor/program

### [Slide 55]

- Reminder; BEE KIND! (respect guest speaker and her equipment, eachother)

### Program Introduction

- Quick overview/plan for today’s session (Guest speaker, learn about pollination and dissecting a flower, learn about native bees and observe some bees under microscopes, and Build Bee Baths and Milk Carton Bee Houses!)
- Introduce Local Bee Expert

### Quick recap;

- Ask and discuss “What are native bees and why are they important?”.

### [Slide 56]

- What are the different types of pollinators?

### Local Bee Expert’s Presentation

1. Science Behind Pollination
  - Flower Dissection (By [Science World](#)):



- The 4 main sections of a complete flower are the **sepals** (generally green), **petals** (generally colourful), **stamens** (male parts), and **pistils** (female parts).
  - **Petals** function to attract pollinators to the flower using colours, scents, heat, and different patterns visible under both ultraviolet and visible light.
  - **Sepals** surround and protect the developing flowers.
  - Once the pollinator lands on the flower, it will search for the nectar found inside of the flower. As they search for nectar, pollinators brush up against the **stamens** (male parts) and pollen sticks to their bodies.
  - Later, as pollinators travel to other flowers, they may transfer this pollen to other flowers and some will likely land on the top of a **pistil** and migrate downward to fertilize the **ovules** (eggs) at the bottom of the **pistil**. These fertilized **ovules** will then develop into seeds.

[Slide 66-70] {Binder 8-9}

Flower Dissection:

- Materials
  - Per Group:
    - 2 daffodils
    - 1 hand lens
    - Gloves (as daffodils are toxic!)
  - Volunteers:
    - 1 scalpel or sharp knife
    - cutting board
    - Gloves (as daffodils are toxic!)

**Activity Break- Flower Dissection:** {Binder 8-9}

1. Have the students label the dissection worksheets.
2. Have the students observe the whole daffodil, and have them make “I observe” statements.
3. Have students find the petals and the sepals, if possible. Think of how petals might help bring a pollinator to the flower.
4. Have students tap the flower to see where pollen falls off from.
5. Next, have students examine the pistil. Have them touch the top of the pistil on the stigma. This sticky part is where pollen will land with the aid of pollinators. See if some pollen will stick to the pistil.
6. Finally, have students look at the cut halves. Notice how they are mirror images. Have them look in the centre of the flower half to locate any unfertilized eggs.
7. Have the students tape the different flower parts to their “[Flower Dissection Sheet](#)”.

Key Questions

- How do petals help attract pollinators?



- How many petals did you see?
- What did you notice about the male parts?
- What about female parts of the flower?
- Does pollen come from the male part or the female part?
- Could you find the eggs (ovules)/future seeds?
- How many ovules did you see?
- Where would the seeds grow from?
- If fruit have seeds in them, what might be a part that develops into a fruit?

Extra: Look at parts of the flower under a microscope or handheld magnifying lenses.

{Binder 4}

## 2. Observing Bees and then “Beeing Creative” by designing your own bee!

[Slide 57-65]

- Observe Bee Close-Ups
  - Observe bees under microscopes and/or handheld magnifying lenses
  - Draw your own Native Bee
    - Use your Bee ID charts (Participant Binder pg. 4) and what you know about bee anatomy to design your own bee!
      - Name?
      - Purpose?
      - Where does it live?
      - Special Characteristics?
      - What does it eat?
      - Colors?
  - Color the native bee and pollinator coloring pages {Binder 39-45}
- 3. **Optional:** Bee observation (Maybe dependant on flower bloomage and pollinator activity)
  - Explain how to make safe bee observations (appropriate behavior, keeping a distance, no sudden movements, not disturbing the bees, etc.) and the importance of citizen science.
  - What is meant by the term citizen science?
    - According to [NationalGeographic.org](https://www.nationalgeographic.org) - “*Citizen science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through citizen science, people share and contribute to data monitoring and collection programs.*”
  - Demonstrate the method for making the observations
    - Paper [observation sheets](#) with clipboards and colored pencils
    - iNaturalist on iPads/phones
    - Log your sightings on the [Great Sunflower Project](#) or [Bumble Bee Watch](#) websites!
  - Provide hand held magnifying lenses for a closer look!



- Provide Bee Identification cards ([Bee Identification Cards](#)- You can download them by logging in)

Students explore and make their own observations!

- Assist and guide students with observations
- Encourage them to ask questions and draw their own conclusions
- Students are free to nature journal in their participant Binders during this time as well (blank paper should be provided).

#### 4. Making Bee Baths!

[Slide 76-77] {Binder 17}

#### **Activity Break - Bee Baths**

From the article [“How to Make a Bee Waterer for Your Garden for \\$5 or Less”](#) By Carly Fraser

Not many people are aware that bees drink water. They also don't know that bees need a safe source to access so that they don't drown.

Imagine how hard just one bee works in a single day. Tending to over 2,000 flowers daily, beating their tiny wings over 10,000 times per minute, and carrying pollen.

Sounds like quite the exhausting task, right? As a result, bees get thirsty and need safe water sources.

Since bees can't drink while flying, they have to land in order to do so. However, this brings up the conundrum of how to land safely near a spot of water without drowning, and without getting eaten alive.

Bees often risk drowning in birdbaths or being eaten at rivers and lakes among birds, fish, frogs and other wildlife, and if they fall in it's very difficult for them to get out of the water!

This is why bees often fly around our clotheslines, and may even land on us if we are in an outdoor pool on a hot day. They're seeking out safe water sources, and simply doing the best they can while trying their best to avoid uncertain death.

Before we get into how to make a bee waterer (and there are many different versions you can make), let's delve a little into why bees need water and why you shouldn't add sugar to the water.

#### **Do Bees Drink Water?**

Bees need water just like every other life form on earth.

Maybe you've seen bees drinking water before with their curly tongues!



(Like most animals-including you and me!), the majority of a bee's body is made up of water. Bees use water for all sorts of things, from honeybees making their perfect honey, to their digestion of food, and, of course, cooling off!

Can you bee-lieve that bees will even fly up to nearly **five miles** to find a safe water source?! That's crazy!

So, it's super important that we help our bee friends out by providing them with a safe source of water.

### **Don't Feed Sugar Water to Bees**

Bees actually do not need to be fed sugar water and will benefit more from plain water in a bee waterer... and here's why it's bad for the bees!

Feeding bees sugar water means the bees will by-pass their instincts to gather pollen and nectar from flowers. If they know an easy sugar source is nearby, they'll go for that instead!

Sugar water is the equivalent of feeding insects junk food. It is full of carbohydrates, which will give them a burst of energy, but it has no nutritional value (unlike pollen). It also weakens the larvae bees, and it'll even water down honeybee's honey.

Overall, it's not a good idea. Leave out the sugar, and stick to water.

### **How To Make a Bee Waterer {Binder 17}**

There are a few different ways you can make a bee waterer, but we will be making the most simple (and prettiest!) of the designs.

Materials:

We used [these Terra Cotta Saucers](#) with pretty craft store gems, rocks, seaglass, seashells, etc.

1. Take your saucer and fill it with a mix of gems, stones, seashells, seaglass, etc.
2. Place in a shady spot in your garden near your bee house, preferably off the ground
3. Add water as needed (every other day or so), and clean it out weekly to make sure there's no mosquitos growing in there!

[Slides 71-75] {Binder 11-14}

**Assembly of Milk Carton Bee Houses** (including their installation, care/maintenance) (~30 mins)

See the BeeAware! Milk Carton Bee House document on the [BeeAware! Webpage](#))

Notes:



- Kids fold & roll the ends of their own straws (with help from volunteers!)
- Carton tops need to be cut ahead of time
- Volunteers in charge of Duct Tape
- Volunteers help with the “stickers”
- Expiration date one year after you install it (once all of the bees have emerged!) [this is to ensure that we are in control of the bee diseases/parasites/fungi/bacteria without having to thoroughly clean everything!]

#### Materials:

Cartons  
Twine  
Duct Tape  
Straws  
Scissors  
Markers (for names)  
“Stickers” (printed signs and Packaging Tape)  
70 Nesting tube paper straws per house; buy [8mm](#) and [6mm](#) straws

#### Instructions:

1. Take a cleaned cardboard and wax milk/juice carton and cut off the top.
2. Poke a hole in one of the bottom corners and run your piece of twine through it and (so that it comes out the front and goes through the back). Tie the string together to allow it to be hung. (More holes can be made in the different corners to better secure the house).
3. Take your paper and wax straws and fold-over one of the ends, basically sealing the end. This will also make the straw is shorter than the carton edge when placed inside (so that the tubes do not get wet!). You want the straws to be 6-7" long.
4. Stuff your milk carton full of straws so that they are secure and do not Slide out when tipped over.
5. Print, fill out, cut, and tape the informational Bee Aware Caution Sign to the bottom of the carton with packaging tape. The expiration date is one year after you install it (once all of the bees have emerged!). Use this expiration date if you cannot maintain the house-[this is to ensure that we are in control of the bee diseases/parasites/fungi/bacteria without having to thoroughly clean everything!].
6. **Optional** - Wrap the outside of the milk carton with duct tape. (Note- this helps to further weatherproof and decorate the house, however it makes the house no longer biodegradable!).

#### Installation:



Ultimately, secure the house (so that it isn't moving around in wind) about 3-5 feet above the ground facing the morning sun. This is so that the bees can receive the most sun to warm them up. Make sure that the house is slightly angled down so that rain will trickle off and not into the nesting tubes.

By making these we are providing much-needed habitat for these bees, and one house can have generations of bees inside!

Season- Emerge in May, all out and about making their nests and pollinating through the summer until Sept, and then they hibernate all winter until it's spring again!

It is super important that you remove/replace the tubes that are gross and diseased during the summer and after the bees have emerged next spring!

Please Please Please do your very best to maintain these bee houses- because otherwise, they will become a bee death trap!

If these bee houses are left out for too long without being cleaned, bacteria, diseases, parasites, and fungi can all find their way into your houses and end up growing out of control and spreading to all of the bees living inside! Think of it like this- when you go to a hotel, you want the room to be clean, right? Imagine if the hotel rooms were never cleaned between guests and how gross that would be! The same thing goes for your own little bee hotel- make sure to be a good hostess!

***---> I would much rather you not put up your bee house than leave it up for a long time and have it not be maintained! I know that we can all be busy bees ourselves, but it is your responsibility to make sure that you are being kind to these bees by removing the diseased tubes and getting a new container after a year!)***

**Closing Circle-** Quick reflection on what they learned/liked during today's workshop, Playing "The Queen's Coming!" game as kids leave

**Play:** The Queen's Coming! Game (same rules as "Captain's Coming" or "Simon Says", but with a bee theme!) (Source: <https://www.beyondthechalkboard.org/activity/captains-coming/>)

1. This game is played with the entire group of children together. For this first round, you will stand at the front of the group and you will be the "caller". Everyone must do whatever the caller says.
2. Next, give your students the other instructions which they'll need to follow (see list below), and end by explaining the most important rule—what to do when the Queen Bee is coming. When the caller yells out "Queen Bee's Coming!", it means that the Queen Bee is in the hive, and the group needs to stand at attention, saluting her/him. When everyone is standing at attention, no one is allowed to move until the caller says "at ease". If the caller gives an instruction while the group is at attention, and the caller has



not said “at ease” yet, then anyone who moves is out of the game for that round. This is where careful attention to what the caller is saying is really important. Just like in the game “Simon Says” where the caller can try to trick players by giving commands without saying “Simon says”, the caller in this game can yell “Queen Bee’s Coming!”, then try to give another command before saying “at ease” in an attempt to fool the players.

3. Play continues with the caller giving the commands listed below, and the students must act them out. The last one to perform the task is out, or if they mistakenly do the wrong action.
4. As students are tricked, too slow, or mess up, they are eliminated and the last player standing wins! They can become the next caller (or not).

These are the directions the caller can give:

Honeybee (students run around saying “Honey, Honey!” as a bee)

Bumblebee (students extend their arms to be as big as possible and mozy around while buzzing loudly)

Leafcutter Bee (students “snip leaves” with their mandibles- aka fingers as “scissors”)

Mason Bee (students make imaginary mud pies)

Baby Bee Burrito (students curl up on the ground in the shape of a burrito- just like the babies in the nesting tubes!)

Flower (students show off like an attractive flower saying “come here, little bee little bee!”)

Pesticides (students go “cough cough” and dramatically die by laying on ground)

Pollinate (students busily spreading pixie dust all around)

Bee Keeper (students pretend to put on and stomp around in their imaginary big bee suits- like zombies!)

## **Departure, Cleanup**

Sources: The majority of this program’s material came from “[The Bees In Your Backyard, A Guide to North America’s Bees](#)” by Joseph S. Wilson and Olivia Messinger Carril.

---





### 3. Bee a Citizen Scientist and Explore!

Location: This can be done as a field trip to a local garden or meadow, or simply done outside!

Leaders: Recommend to have a naturalist/environmental scientist/science teacher/local bee expert to come with the group to further enhance the experience.

#### Unit # 3 - General Outline/Program Curriculum

1. Arrival, welcoming, and warm up activity (~15 mins)
  - a. Covid sign in/precautions, nametags, general (bathrooms, hand-sanitizer, etc.)
  - b. Other safety things (emergency exits, where to go in case of fire, etc.)
  - c. Please drink water! Use sunscreen! Stay in the shade... watch for ticks!
  - d. Reminder; BEE KIND!
  - e. Play the honeybee ["waggle dance game"](#), or can choose from "the Bees Buzz if..." or "Queen Bee's Coming" {Binder 20-22}
2. Session Info (~15 mins)
  - a. Explain how to make safe bee observations (appropriate behavior, keeping a distance, no sudden movements, not disturbing the bees, etc.) and the importance of citizen science.
  - b. Demonstrate the method for making the observations
    - i. Paper [observation sheets](#) with clipboards and colored pencils
    - ii. iNaturalist on iPads/phones
    - iii. Log your sightings on the [Great Sunflower Project](#) or [Bumble Bee Watch](#) websites!
  - c. Provide hand held magnifying lenses for a closer look!
  - d. Provide Bee Identification cards ([Bee Identification Cards](#)- You can download them by logging in)
3. Students explore and make their own observations! (~75 mins)
  - a. Assist and guide students with observations, encourage them to ask questions
  - b. Students are free to write nature journals in their participant Binders during this time as well (blank paper should be provided).
4. Closing Circle (~15 mins)
  - a. Quick reflection on what they learned/liked during today's workshop, observations they made
  - b. Everyone returns materials
  - c. Departure, Cleanup



## Unit # 3 - Materials List

- NO slides or presentation aide with this unit

BeeAware! Participant Binder

- Print a copy of the BeeAware! Participant Binder for each participant to follow along with the program's worksheets (see "Participant Binder" PDF on the the [BeeAware! Website page](#))

Observation Tools:

- [observation sheets](#)
  - Pencils
  - Paper
  - Clipboards
  - Hand Held Lenses
  - Cameras
- iPads or other electronics to upload citizen science data
  - [Great Sunflower Project](#)

You can [register here](#). Basic instructions can be found on a video [here](#) and the [Quick start guide](#). Data sheets are under [Downloads](#). [Data sheet for kids](#). [Bee Observer Cards](#). [Bee Identification Cards](#)- You can download them by logging in and then clicking [here](#).

---



## 4. How to Help (Bee Helpful!)

### Unit # 4 - General Outline

1. Arrival, welcoming, and warm up activity (~10 mins)
  - a. Covid sign in/precautions, nametags, general (bathrooms, hand-sanitizer, etc.)
  - b. Other safety things (emergency exits, where to go in case of fire, etc.)
  - c. Please drink water! Use sunscreen! Stay in the shade... watch for ticks!
  - d. Reminder; BEE KIND!
  - e. Choose from the “Queen’s Coming” game, making pipe cleaner bees, bee baths, more milk carton bee houses, the “Bees Buzz if...” game, the honeybee “Waggle Dance” game, bee observations, etc. {Binder 20-22}
2. Curriculum (~20 mins)
  - a. Now that you’ve learned all about bees, let’s learn the most important thing; what their problems are, and how to help the bees!
3. Construction of the Wooden Bee Houses (~50 mins)
  - a. Each group of two participants gets a house kit to build (have wood pre-cut, starting holes drilled, sanded, and grouped into individual house kits)
  - b. Each group gets printout instructions of bee house construction (see “Bee House Drawing Reduced” PDF on the [BeeAware! Website page](#))
  - c. One hammer/mallet per group
  - d. Provide 25 2", 6d siding nails w/ annular ring shank per group- (only 20 are required, includes 5 spare)
  - e. One Volunteer to two groups of participants to guide (if possible)
  - f. **Optional:** Have Pre-Built Demo House on display
4. BeeAware! Stewardship Program (~10 mins)
  - a. Info on Stewardship Program
  - b. “Stewardship Agreement” document ” on the [BeeAware! Website page](#)
5. Planting of the Pollinator-Friendly Flowers from Unit 1 In garden (~20 mins)
6. Closing Circle (~10 mins)
  - a. Quick reflection on what they learned/liked during today’s workshop, observations they made
  - b. Return materials
  - c. Honey Sticks as a treat!



## Unit # 4 - Materials List

### BeeAware! Presentation

- Present the BeeAware! Presentation (see “BeeAware! Presentation” on the the [BeeAware! Website page](#))

### BeeAware! Participant Binder

- Print a copy of the BeeAware! Participant Binder for each participant to follow along with the program’s worksheets (see “Participant Binder” PDF on the the [BeeAware! Website page](#))
- Print out “How to Help Native Bees” on the [BeeAware! Website page](#) for participants to have

### Wooden Bee Houses

- (optional) Pre-Built Demo Wooden Bee House on display
- Each group of two participants get a house kit to build (have wood pre-cut, starting holes drilled, sanded, and grouped into individual house kits)
- Each group gets printout instructions of bee house construction (see “Bee House Drawing Reduced” PDF on the the [BeeAware! Website page](#))
- One hammer/mallet per group
- Provide 25 2", 6d siding nails w/ annular ring shank per group- (only 20 are required, includes 5 spare)
- 70 paper nesting tube straws needed per house; buy [8mm](#) and [6mm](#) straws
- Optional: wood glue to seal outside

### Planting Pollinator-Friendly Flowers

- Flower Seedlings from first workshop session
- Trowls
- Potting Soil
- Water

Special celebratory honey stick treat for participants at the end!



## Unit # 4 - Program Curriculum

### (Start Slideshow presentation)

(see “BeeAware! Presentation” on the [BeeAware! Web page](#))

[Slide 78]

#### Arrival

- Covid precautions, nametags, getting used to the place (bathrooms, etc.), any other safety things
- (can choose from the “Queen’s Coming” game, making pipe cleaner bees, bee baths, more milk carton bee houses, the “Bees Buzz if...” game, the honeybee “Waggle Dance” game, bee observations, etc.) {Binder 20-22}

[Slide 79]

#### Program Introduction

- “Now that you’ve learned all about bees, let’s review the most important lesson; what their problems are, and how to help the bees!”
- Make sure to check out the resources in the back of the participant Binders {Binder 30-45}

[Slide 80]

#### Review of Program’s Most Important Information

- Appreciating Bees
  - Why are bees important? (ask participants and have a discussion)
  - Life without bees

In some areas of the world, such as Southern China's apple orchards, they have unintentionally eradicated their bees and now must hand pollinate- which is most definitely not an effective, efficient option for them nor the rest of the world. This is a scary reality that we may also be heading towards if we do not act. There are already recently extinct bee species in the United States, and many are at risk or endangered today. The worst thing is that because the native bees don't receive much attention, and we don't know a lot about the 4,000 or so native bee species of North America, scientists truly don't know just how bad things are for them through lack of research - like if some species are facing extinction and if they are already gone.

[Slide 81]

With bees being the best pollinators, and with native solitary bees being super pollinators as a single native solitary bee can be “... as effective as hundreds of honey bees.” according to Crown Bees, we absolutely need to help the native bee population! (Source:

<https://crownbees.com/superior-pollinators>)

[Slide 82]

Without pollinators, our world would be dramatically different in many ways- as the importance of pollinators does not only pertain to our food! “Of the foods and beverages that we consume daily, over 30% rely on or benefit from a pollinator. Pollinators even help milk production: the alfalfa and clover cows graze is replenished by seed pollinated by bees. Worldwide, production



of animal-pollinated crops is valued at over \$235 billion annually. The loss of pollinators would negatively affect both farmers and consumers who would be faced with reduced crop yields and lower quality products. Moreover, insect-pollinated foods contain many key nutrients, such as vitamin E, essential to our diet. A world without pollinators would not only leave us with fewer food choices, but would make it substantially harder to find the nutrition we need to survive.” According to the XERCES SOCIETY. Keep in mind that pollinators also pollinate plants used for fibers like cotton and flax- so our clothing and textile industry would also change! If we did have to resort to hand pollination, “Farmers would stop growing insect pollinated crops if they didn't have bees - it just wouldn't be economic to do it in most parts of the world. All we'd be left with are things that are wind pollinated, so that's basically wheat, barley, rice and corn. So we'd have to live off bread and porridge and rice if we lost our bees, and we really don't want to go down that road.” According to Dave Goulson, University of Sussex bumblebee specialist, from “Pollinating by hand: doing bees' work” by Natalie Muller. (<https://www.dw.com/en/pollinating-by-hand-doing-bees-work/a-17822242>). (<http://www.xerces.org/pollinator-conservation/whats-at-stake>)

And, of course, the world would not be nearly as beautiful without its flowers (that would disappear without having pollinators to attract)!

[Slide 83]

**Bee's Problems:** There are five major causes at play when it comes to the declining population, diversity, and distribution of the Native Bees.

[Slide 84]

1. Parasites, viruses and diseases among the native bees

2. Climate Change

- The shifting temperatures cause changes in their native plant food source availability and distribution, and therefore the native bees distributions are shifting as well

3. Neonicotinoid Pesticides

- Neonicotinoid Pesticides are very strong commercial pesticides used on crops that are Nicotine derived
- The agricultural industry does not pay enough attention to the detrimental effects of this widespread practice on the Native Bees, as stated in the research paper that found in their experiments that neonicotinoid treated seeds “...reduced wild bee density, solitary bee nesting, and bumblebee colony growth and reproduction under field conditions. Hence, such insecticidal use can pose a substantial risk to wild bees in agricultural landscapes, and the contribution of pesticides to the global decline of wild bees may have been underestimated.” [Rundlf, M., Andersson, G., Bommarco, R. et al. Seed coating with a neonicotinoid insecticide negatively affects wild bees. Nature 521, 77–80 (2015)<https://doi.org/10.1038/nature14420>]



- Domestic pesticide use on gardens and orchards is devastating to the native bees as it deters them from pollinating (which is their food source) and can even kill the bees (which both in turn negatively affect harvests!).

#### 4. Habitat Loss and Habitat Fragmentation {Binder 23-26}

- As global urbanization continues, native bee habitats are divided if not destroyed [by buildings, roads, cities, etc.], AND by our mainstream backyard landscaping practices as we disturb if not destroy their food sources and habitat- by keeping our lawns "tidy" from cleaning up fallen leaves and sticks in the spring and fall, we are disturbing and removing those essential nesting habitats.
- By mowing our lawns in the spring we cut the majority of natural, native wildflowers that the bees depend on as they wake up from their winter hibernation.

#### 5. Lack of Awareness

- Many of these are related to the deeper root cause that the majority of people have never heard of Native Bees and are unaware of their importance, and even how they could unintentionally be harming them! This means that the declining population goes largely unnoticed.

Addressing these root causes:

The declining native bee population, diversity, and distribution is a many-sided issue without only one cause or solution. There are many causes that we won't be able to solve with this program, BUT there are some very important things that we can do that will have a positive effect on the native bees.

Let's focus on how YOU can Bee Helpful to the Native Bees!

[Slide 85]

#### **5 Ways How you can Bee Helpful!**

(see "How to Help" on the [BeeAware! Website page](#))

[Slide 86]

- 1. Educate Yourself and SHARE with others!
  - Learn about the declining population of the native bees and pollinators, and spreading the buzz! This directly addresses the root cause of lack of awareness.
    - Check!- You have all become educated about the native bees with this workshop series; way to go! There's still plenty to learn, but you already know a ton! This is important because with a solid understanding of the native bees and pollinators and their importance, you can take educated steps to helping the native bee population.
    - Now it's your turn to share share the buzz! Talk about what you learned with your friends, family, and community! Even something as simple as talking to your friends about Native Bees is helpful because you are



raising their awareness, too. The more people that are aware about the native bees and their importance, the better! The hope is that they would go learn more and then take action to help the bees. Along the way, they'd tell others too- and continue to raise awareness! In this way you can help to create a great ripple-effect of awareness. The more people who learn about the bees and take positive action, the better chance we have of helping the native bees.

[Slide 87] {Binder 23-26}

- 2. Provide Habitat
  - Build, install, and maintain the milk-carton bee houses and wooden bee houses that we made in these workshops. These bee houses will provide much-needed nesting habitat for the existing bee population and foster homes for generations to come, addressing the major root cause of habitat loss and fragmentation. Show them off and share the blueprints with others for them to make their own. All of the information can be found online on the [BeeAware! website page](#).

Providing Nesting Areas:

- Forget about Fall cleaning and Wait to do your Spring Cleaning; Bees hibernate through the winter in organic debris, like fallen leaves, sticks, and garden beds - so please don't do any fall cleaning so that they have this habitat and wait to do your spring cleaning until there has been a week of consistent temperatures above 50 degrees Fahrenheit! This allows the pollinators enough time to wake up and emerge from their hibernation- if you move or remove the brush, leaves, and sticks then you could be killing the next generation of super pollinators!
- Provide areas for ground-nesting bees with exposed areas of dirt and mud
- Provide habitats for twig nesting bees by leaving a stick and brush pile along the side of your yard.

Building Other Bee Houses:

- Build and maintain a bee block (which is another form of bee house with holes drilled into wood instead of nesting tubes)
- Build and maintain a nest bundle of drilled twigs, paper straws, hollow reeds, etc.
- Build and maintain a bumblebee nest!

[Slide 88] {Binder 27-32} {Binder 33-38}

- 3. Provide Good Food All Season
  - Plant a variety of native, pollinator-friendly flowers and/or a "pollinator strip" of wildflowers in your garden. Bees and pollinators depend on flower's nectar to survive, and you'll be feeding them! Also, by attracting bees you can actually significantly increase your garden or orchard's harvest yield!
    - You want your pollinator garden to have flowers in bloom all season long, from May- September (so the different bees can eat all summer long!)





- Participate in No Mow May- try to go as long as you can during the month of May without mowing your lawn. This allows the wildflowers to take over and feed the awakening pollinators with critical nectar! This is greatly helpful with increasing flower diversity. Ideally, mow your lawn as little as possible (once a month) to allow for wildflowers to grow, and even leave a patch of grass to grow long for the bees!  
(Source: <https://www.gardensillustrated.com/feature/lawn-mowing-when-flowers-may/>)
- Use your Bee Bath to provide a safe drinking source for the bees

[Slide 89]

- 4. Avoid all Pesticides, especially Neonicotinoid pesticides!
  - Don't use pesticides in your backyard gardens! Instead, use natural alternatives.
  - Pesticide use is growing, and so are their negative effects on the pollinators!

[Slide 90]

- 5. Climate Change
  - Reduce your Carbon Footprint
  - Eat local, organic foods without pesticides

[Slide 91-94] {Binder 15-16, 18-19}

### **Construction of Wooden Bee Houses**

- Pre-Built Demo/Prototype House on display
- Each group of two participants get a house kit to build (have wood pre-cut, starting holes drilled, sanded, and grouped into individual house kits)
- Each group gets printout instructions of bee house construction (see "Bee House Drawing Reduced" PDF on the [BeeAware! Website page](#))
- One hammer/mallet per group
- Provide 25 2", 6d siding nails w/ annular ring shank per group- (only 20 are required, includes 5 spare)
- One Volunteer two groups to guide (if possible)
  
- Installation: See "Mounting Bee House Instructions" on the [BeeAware! Website page](#)
- Maintenance: See "BeeAware! House Maintenance" Instructions on the [BeeAware! Website page](#)

[Slide 95-97]

### **BeeAware! Stewardship Program Info and Sign-Ups**

- With the wooden bee houses you just made, you can become a "Bee Aware Steward" by committing to "adopt a bee house" by seasonally maintaining it!
- Become a Steward by completing the "Stewardship Agreement" document in your participant binders on pg. 25 (also found on the [BeeAware! Website page](#)) and emailing it to [beeawaremaine@gmail.com](mailto:beeawaremaine@gmail.com)!



- Maintenance- aka replacing the used nesting tubes after every spring emergence- is ***absolutely necessary*** with bee houses because if the nesting materials are not seasonally cleaned they can easily become a death trap by harboring parasites, diseases, and molds and funguses!
- IF YOU CANNOT MAINTAIN THE BEE HOUSE, DO NOT INSTALL AND USE IT!!!

### **Planting of Native, Pollinator- Friendly Flower seedlings from first workshop**

### **BeeAware! Program (Slideshow and curriculum) Feedback and Evaluation**

- Comments? Questions? Feedback? Improvements?
- Participants and instructors alike, please send it all to [beeawaremaine@gmail.com](mailto:beeawaremaine@gmail.com) so that this program can continue to be improved!

### **Wrap-Up and Departure!**