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The Friends of Flight 93 National Memorial is the official 501(C)3 non-profit affiliated with the Flight 93 National Memorial. The lessons and activities below were created for teachers and/or parents to teach children (or themselves!) about the role pollinators play in the world and about the pollinators themselves.

To help cultivate the living memorial landscape that honors the 40 passengers and crew member of Flight 93 every day, the Friends of Flight 93 have partnered with Powdermill Nature Reserve in setting up and maintaining 8 bee hives at Flight 93 National Memorial. These 8 hives are home to over 500,000 bees. According to surveys done at the memorial in both 2016 and 2017, Flight 93 National Memorial is home to at least 63 different species of bees!

Bees play an extremely important role in balancing natural biodiversity. The symbiotic relationship between bees and all flowering plants is what balances our ecosystems. Flight 93 National memorial is a former surface coal mine. The bees help to restore the memorial grounds and the crash site to its natural state. When Flight 93 crashed on September 11, 2001, it burned a small hemlock grove located on the nearly 40 acres of ground that became the crime scene investigation area. This area is now considered sacred ground and the final resting place of the 40 passengers and crew members. The Pollinator Program will help ensure that the natural habitat and ecosystems of the memorial are environmentally restored and will help create a living memorial landscape that will continue telling the story of Flight 93 for generations to come.

Several [passengers and crew members](#) on United Flight 93 were passionate about the environment and a handful were traveling for personal trips that involved the outdoors. Alan Beaven was an ardent environmental litigator who prosecuted Clean Water Act violators. Richard Guadagno spent 17 years in environmental protection as a member of the U.S. Fish & Wildlife Service. Christine Snyder was an arborist and worked for The Outdoor Circle, Hawaii's oldest nonprofit environmental group. Four passengers were traveling to Yosemite National Park (William Cashman, Patrick Driscoll, Donald & Jean Peterman) to hike and enjoy the beauty. Donald Greene was headed to Lake Tahoe for the same reasons. As the living memorial landscape at Flight 93 National Memorial is restored, we honor all 40 passengers and crew members. The Friends of Flight 93 National Memorial website provides a wealth of additional information, about the events on 9/11, the story of Flight 93, and Flight 93 National Memorial. We encourage you to explore this online learning tool for further education resources at <https://www.flight93friends.org/>.



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Age Range: PreK thru Grade 2

## **Pollinate!**

### **Goal:**

Children are to collect “pollen” in the margarine dish that is placed at the start of their relay line. By collecting pollen from both “flowers,” the tub will contain a mix of white and red pollen and should appear pink – this demonstrates to children how cross-pollination occurs.

### **Prior Knowledge:**

- Understanding of pollen and parts of a flower that contain pollen.
- Pollination – that it must travel from flower to flower for plants to grow.
- Bees gather pollen when they visit flowers.

### **Supplies:**

1. Four (4) plastic tubs or containers
2. Red pompoms
3. White pompoms
4. Two (2) cardboard outlines of a flower
5. “Bee Glove” with Velcro (barbed side) attached to pointer finger – One or two gloves needed per team

### **Set Up:**

1. Place red pompoms in one margarine container and place on top of a flower outline. The container of pompoms represents the stamens producing pollen for the flower.
2. Repeat step 1 with the white pompoms and second flower outline.
3. Divide students into 2 relay teams, placing flower outlines with pompoms at the far end of the relay space.

### **Student directions:**

1. Each child on the team with run to EACH TUB at the end of the relay area.
2. Child will wear Bee Glove to the tub and gather “pollen” on it.

3. Child returns to team tub to deposit “pollen,” being careful not to drop any on the return trip.
4. Child makes second trip for pollen, to the other tub, and repeats the pollen collection process.
5. After child has collected both red and white “pollen,” the Bee Glove is handed to the next student in line, who repeats this process.
6. All students on team must collect pollen.
7. *Teacher decision on winner: the fastest team of pollinators (finished first) or the team of BEST pollinators (gathers the most pollen).*

Follow-Up:

1. How could we, as the bees, gather MORE pollen when we visit the flowers?
2. How could we pollinate faster (visiting more flowers)?
3. Can a bee pollinate more than just two flowers?
4. How could we change our game to show more flowers being pollinated?

*Teacher may want to be prepared to alter the relay in several ways, based on some expected student answers:*

1. Additional flower outlines and pompom colors.
2. Additional Velcro pieces on Bee Glove for a student to wear (increase in pollen).
3. Allowing more than 1 student to gather pollen at a time – would require additional Bee Gloves (speed of pollination).



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Age Range: PreK thru Grade 2

### **Feed and Observe the Pollinators!** (Build a Pollinator Garden!)

Children and families can find online plans for building and planting a pollinator garden either at home or at school. Free plans are available online. These plans (<https://www.gardeners.com/how-to/pollinator-garden-design-for-bees/9144.html>) build a contained, raised garden and include a plant list. This site also offers plans for butterflies and hummingbirds – which are also pollinators! The Pollinator Partnership also offers garden “recipe” cards for free (<https://www.pollinator.org/gardencards>) to help in choosing plants appropriate to your geographical area.

**\*\*SPECIAL THANKS to Powdermill Nature Reserve for offering us a link to this Virtual Garden Timeline!\*\***

By visiting a Virtual Garden, students may view the plants REGARDLESS of the current season! This [Virtual Garden Timeline](#) has a list of native plants (growing area 5), their blooming periods, and preferred habitats!



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Age Range: PreK thru Grade 2

## **Honey Bee Anatomy (STEAM)**

Goal: Utilizing polymer clay to create portions of the honey bee's anatomy, children will learn about the different body parts of a bee (head, thorax, abdomen, wings, eyes, antennae)

Supplies:

1. polymer clay in white, and either black and yellow, or in brown and tan
2. small paper clips (2 per student)
3. wire cutter
4. tweezers or needle-nosed pliers
  - a. \*NOTE: with younger children, it is recommended that adults/teachers utilize the wire cutters and needle-nosed pliers to prepare the paperclips as a safety measure.
5. baking sheets
6. oven access
7. body part diagram (1 per student) - [printed copy of the pattern page](#)
  - a. NOTE: This diagram only shows bees as having 2 wings, when in fact bees have **4 WINGS**. This simplified diagram is used due to the age of the children and to simplify the project.
8. coloring sheet for extension (1 per student) - [printed copy of the pattern page](#)
9. Bee or flower stickers

Steps:

1. To make the bee, first create the shapes for the wings, body, head, stripes, and eyes. You can use a [printed copy of the pattern page](#) to guide you on shapes. You may make the bee smaller, if you like.
2. Put the pieces together to make your bee. To make the body parts stay connected, straighten out a small paper clip and "thread" the parts onto it like beads on a string.
3. After you have rolled a small piece of black clay into the skinniest "snake" possible for the stripes, wrap it around the bee's abdomen, pinching off the length you need. Make three or four stripes, if you can.

4. Gently press on the tiny eyes.
5. Straighten out the other small paper clip and ask the teacher to use wire cutters and cut two short pieces from it for the antennae. Use tweezers or needle-nosed pliers to curl the tips. Stick the antennae above the eyes or, more accurately, between the eyes.
6. When you are happy with your bee, place her on a piece of foil on a baking sheet.

#### Adult Instructions for Baking:

1. To bake, preheat oven to 275°. Use an oven thermometer to make sure of the correct temperature.
2. Bake 30 minutes. After baking time is up, turn off the oven, but leave the bee inside to cool off slowly.

#### Extension:

1. Students will receive an anatomy identification sheet from the Honey Bee Life Cycle packet (1 per student) – available for download: (<https://www.livinglifeandlearning.com/honey-bee-life-cycle-worksheets.html>) that shows the parts of the bee they just created out of polymer clay. Students may work on this sheet as other students continue working with clay.
1. Teacher should review vocabulary words as well as the location of the body part on the bee.
2. Once students have completely colored the picture, they may take it to the teacher for individual review of anatomy names and location.
3. When student has correctly identified all anatomy pieces, place a bee or flower sticker on the paper.
4. Encourage students to share with parents at home.

#### Tips for working with polymer clay:

- Read instructions that come with the polymer clay.
- Work with lighter colors first.
- Keep sculptures small. Use every scrap and throw nothing away!
- Look on the floor for stray pieces.



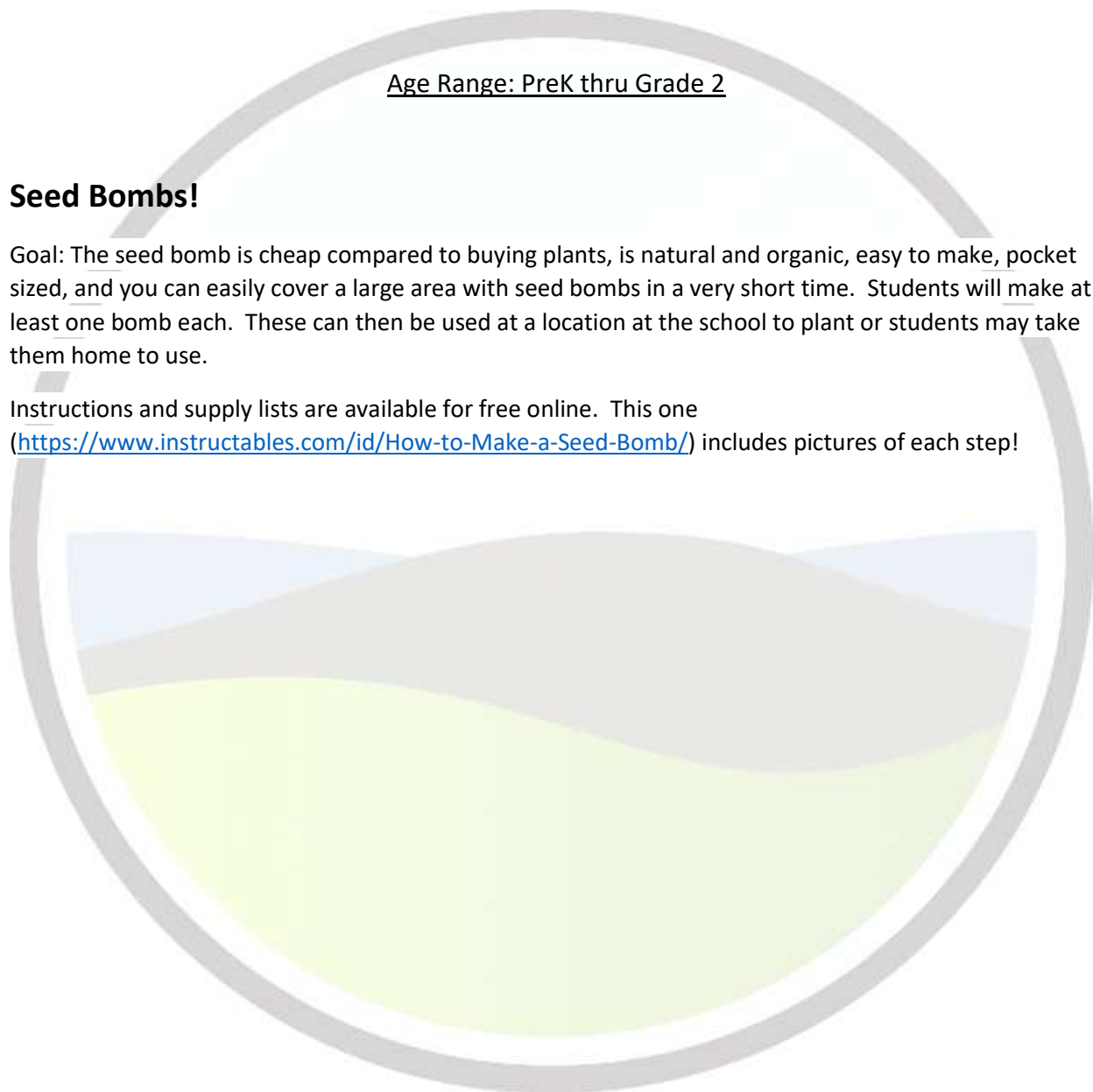
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Age Range: PreK thru Grade 2

## **Seed Bombs!**

Goal: The seed bomb is cheap compared to buying plants, is natural and organic, easy to make, pocket sized, and you can easily cover a large area with seed bombs in a very short time. Students will make at least one bomb each. These can then be used at a location at the school to plant or students may take them home to use.

Instructions and supply lists are available for free online. This one (<https://www.instructables.com/id/How-to-Make-a-Seed-Bomb/>) includes pictures of each step!





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Age Range: PreK thru Grade 2

## **Bee-Based Food Chains**

Goal: Students will be able to construct a food chain showing how bee-pollinated fruits and vegetables benefit humans. This may be used as a small lesson, a stand-alone activity, or a center.

Supplies:

1. Small toy farm animals (chickens, cows, sheep, goats, pigs)
2. Collection of plastic bee-pollinated foods (many lists are available online; for example: <https://honeylove.org/list-of-food/>)
3. Collection of cloth, cardstock, or other material to create paper/cloth arrows

Extension Questions:

1. What is your favorite food from the list?
2. How do the farm animals that eat some of these foods help people?
3. Let's find a recipe that uses your favorite food from the list to try at home!





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Age Range: PreK thru Grade 2

## Honey Bee Life Cycle

Goal: Students will be able to describe the life cycle of a honey bee using the appropriate vocabulary.

Supplies:

1. Honey Bee Life Cycle packet (1 per student) – available: <https://www.livinglifeandlearning.com/honey-bee-life-cycle-worksheets.html>
2. Scissors
3. Glue stick
4. Crayons
5. Technology for watching video
6. “Life Cycle of a Honey Bee” Video - available: <https://www.youtube.com/watch?v=xD5tdykIJB1>

Steps:

1. Watch the video “Life Cycle of a Honey Bee” (<https://www.youtube.com/watch?v=xD5tdykIJB1>).
2. Using the “Bee Life Cycle” page from the packet, allow students time to cut out the images and names.
3. Replay the video as needed for students to place images in the correct order. Or teacher may utilize the site <https://bees.techno-science.ca/english/bees/life-in-a-hive/stages.php?image=image4> to go through the stages one at a time to assist students.
4. Students use glue sticks to attach images.

Extension:

Using egg cartons cut into sections of 4 cups, students will build a model of the honey bee life cycle.

Supplies:

1. Egg carton 4 cup (1 per student)
2. White polymer clay
3. Black polymer clay
4. White rice
5. Press N’ Seal

6. Small bee (1 per student) (example available: <https://www.amazon.com/slp/tiny-bees/5abmeur2eq2h3o7>)

Steps:

Using the completed life cycle diagram, students will create an example of each stage to place in the egg carton. The white rice represents the egg and is glued to the bottom of the first egg cup. The larva is made from white polymer clay and is glued to the second egg cup. The pupa is made of white polymer clay and black polymer clay for the eyes. After placing the pupa in the third egg up, the student should use a piece of Press N' Seal to cover the cup to represent the capped brood. Each student should be given a small bee to place crawling out of the fourth egg cup as the emerging adult.





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Age Range: PreK thru Grade 2

## **Which Way to the Flower?**

Goal: Students will learn how bees communicate without words and the difference between the waggle dance and the round dance.

Supplies:

1. Digital device per student
2. Video: <https://youtu.be/zc9DtMtHeSk>
3. Website: <https://askabiologist.asu.edu/bee-dance-game/>
4. Website: <https://askabiologist.asu.edu/sites/default/files/virtual-reality/Beehive-VR-360/>

Steps:

1. Students will watch "Earth to Luna!" episode about honey bee communication.
2. Teacher will review information about the dances, using the website <https://askabiologist.asu.edu/bee-dance-game/introduction.html>
3. Teacher will review how to play the Bee Dance Game: <https://askabiologist.asu.edu/bee-dance-game/how-to-play.html>
4. Teacher will demonstrate playing the Bee Dance Game: <https://askabiologist.asu.edu/bee-dance-game/play.html>
5. Students will play game themselves, utilizing what they have learned to earn higher scores.
6. As students master the game, have them open the Virtual Bee Hive Tour <https://askabiologist.asu.edu/sites/default/files/virtual-reality/Beehive-VR-360/> for the chance to be the bee!