PLANTING SEEDS

THE ART & SCIENCE OF POLLINATION

TEACHER'S MANUAL GRADES K-8

Cara Enteles, *Nothing to Eat*, oil on aluminum

Artmobile

Covering the County • Uncovering the Arts

Traveling throughout Bucks County **September 2017 – June 2019**

ARTMOBILE is a traveling museum dedicated to providing the students and adults of Bucks County access to ! ne, original works of art and innovative art education programs through its visits to schools and public sites. Artmobile is a vital component of Bucks County Community College which provides signi! cant cultural outreach programs in accordance with its mission.

Since 1976, Artmobile has been committed to fostering an understanding of art, art making, and the value of art in our lives and communities by exhibiting and interpreting works of art.

This manual was developed to help teachers incorporate the Artmobile experience into their curricula by providing background information and classroom activities related to the exhibition. It is intended to serve as a resource both in conjunction with and apart from the exhibition.

For more information about Artmobile and its programs, call 215-968-8435, email artmobile@bucks.edu or visit www.bucks.edu/artmobile.

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CONTENTS K-8

PLANTING SEEDS
THE ART & SCIENCE OF POLLINATION

BUCKS 1964

Bucks County Community College
275 Swamp Road | Newtown, PA 18940

ACKNOWLEDGMENTS

THIS EXHIBITION had the gestation period of an elephant. It began as a twinkle in my eye (as things sometimes do) and a conversation with Provost Lisa Angelo, then Dean of Science, Technology, Engineering and Math (STEM) at Bucks County Community College. I was looking for a way that Artmobile could collaborate with the College!s STEM Department to bring a STEAM (STEM + Art) exhibition to Bucks County K-12 schools. Lisa shared about several fascinating projects underway, but a faculty-student collaboration with Tyler State Park seemed like the perfect match for Artmobile. The rest, as they say, is history.

I offer my heartfelt thanks to all who helped to make this exhibition a success, especially:

- Liz K. Sheehan for her curatorial skill, unflagging energy and consummate professionalism;
- The artists who graciously loaned their work:

The Beehive Collective	Ellie Irons & Anne Percoco
Anda Dubinskis	Kim Kurki
Cara Enteles	Julia Oldham
Marissa Farra	Eric Schultz
Rose-Lynn Fisher	Judy Simon
Linden Gledhill	Moritz Stefaner & *Scientific American*
Dennis Hlynsky	

- Lisa Buffardi, Carly Noella Nájera and Lisa M. Waibel for curriculum development;
- Ron Dorfman, for the design of the exhibition logo and this manual;
- The Bucks STEM Department, for sharing their considerable expertise, especially Interim Dean Debra Geoghan, faculty Michael Bernarsky, Joann Corn, Kathi Knight, Caryn Babaian and Lee Ann Lippincott, and Biology Lab Supervisor Rochelle Vollmerding; and
- Provost Lisa Angelo, Dean John Mathews and all of my Bucks colleagues.

Finally, I offer my deepest gratitude to my talented, resourceful and dedicated staff! my dream team:

Cayla Belser, Artmobile Assistant;
Jennifer Garey, Exhibitions Assistant;
Cassandra Stancil Gunkel, Ph.D., Artmobile Coordinator;
Melody Hunt, Art Handler;
Eileen Streeter, Exhibit Designer; and
Artmobile Educators Carole Cunliffe, Michelle Kinney and Rachelle Moes

Together, their expertise and enthusiasm will bring *Planting Seeds* to life for more than 35,000 visitors over the course of its two-year tour.

Fran Orlando
Director, Exhibitions and Artmobile
Bucks County Community College

OPTIMIZING YOUR ARTMOBILE EXPERIENCE

OPPORTUNITIES FOR TEACHERS

Our Artmobile Coordinator provides in-service training at schools prior to Artmobile!s visit to help you incorporate the lessons we provide into your curriculum. To schedule in-service training at your school, call 215-968-8435.

Earn Act 48 hours at our Teacher Workshops led by exhibition artists at the art studios at Bucks County Community College.
See www.bucks.edu/ArtmobileWorkshops for a complete listing. Visit often, as we update our professional development opportunities throughout the tour.

PREPARE YOUR STUDENTS

Introduce your students to some of the concepts our educator will address by presenting the Pre-Visit Lesson in this manual.

THE ARTMOBILE EXPERIENCE

Your students will encounter a variety of artworks during their visit to Artmobile. Our educator will engage students in discussion and encourage them to make connections between what they see and what they know. By listening and speaking about the artwork, your students will develop the vocabulary and ideas that they will use later in your classroom.

After the presentation, students will have an opportunity to look at the artwork on their own. They will explore the many interactive displays that reinforce the concepts presented by our educator.

FOLLOW-UP

Post-Visit Classroom Lessons found in this manual will enable your students to synthesize what they have learned in Artmobile with your curriculum. Encourage students to visit the Artmobile website to review the artworks and videos displayed in Artmobile.

EVALUATE

Complete a written evaluation to help us continue to improve and better understand your needs. Download the survey at the bottom of this link: www.bucks.edu/ArtmobileVisit.

THIS MANUAL and the online resources for *Planting Seeds* found at www.bucks.edu/Artmobile or www.bucks.edu/ArtmobilePlantingSeeds provide all you need to incorporate Artmobile into your curriculum with stimulating and effective lessons that directly correlate to Pennsylvania State Academic Standards.

ABOUT THE EXHIBITION

THE IMPORTANCE of pollinators in our environment cannot be overstated. With so much information about the decline in bee and monarch butterfly populations in the news in the last decade, artists have begun to join scientists in the effort to help raise awareness of their endangerment as well as to find solutions to their habitat loss.

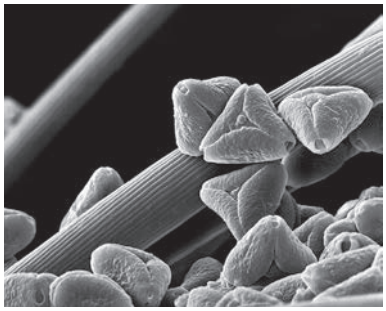
Planting Seeds: The Art & Science of Pollination was inspired by an ecological restoration project currently underway in several meadows at Tyler State Park. With a grant from PECO, faculty and students from the Department of Science, Technology, Engineering and Mathematics (STEM) at Bucks County Community College (BCCC) are removing invasive plant species and seeding native ones, in part to improve the park!s function as a habitat for a broad number of insect and animal species. The Artmobile exhibition will track the progress of this long-term project through photography and other documentary means, as a companion to work by a group of 14 artists and scientists on the theme of pollination.

Geared toward a K-12 audience, *Planting Seeds* is based on STEAM principles, which prove that Art & Design can drive innovation in Science, Technology, Engineering, and Math, and that interdisciplinary approaches are necessary to solve our most pressing environmental problems. Special attention was therefore given in this exhibition to artists who partner with scientists or conduct research as part of their studio practice. Through this exhibition, students will learn about the important roles of a variety of pollinators and about the plant species that sustain them, as well as what they as citizens can do to minimize the human threat to habitat loss.

The structure of the exhibition is as important as the content. With a wide range of methods and media, *Planting Seeds* is designed to introduce students to how and why artists and scientists come together to solve problems and to communicate information. Video, digital, and other time-based media reveal patterns in pollinator movement, make visible the mechanics of pollination, and examine the behavior of different species. Botanical illustrators create drawings at the service of science, using technical accuracy and observational skill to communicate both fact and form. Microphotography reveals how bee and butterfly anatomy is specifically designed to trap and carry pollen. Data visualizations translate complex amounts of research. Other artists employ pattern and expressive style to convey the functional beauty of pollinators and plants.

ABOUT THE ARTISTS

Photographer **Rose-Lynn Fisher** was prompted to study bees when she found that the structure of a bee!s eye matched the hexagonal shape of their honeycomb, and wondered if it was by coincidence or design. Using a camera attached to a powerful microscope, Fisher produces highly detailed topographic images that move between wonder and fact. !As though revealing a secret, the scanning electron microscope presents a realm of structure, design and pattern at a level of intricacy we are oblivious to in our daily experience. In this bizarre frontier our sense of scale is confused, and connections between the micro and macro world become clearer and more tangible. In the myriad forms that constitute one little bee at higher and higher magni! cations is a hint of the unending complexity of nature, the worlds within worlds comprising our reality.! [1] Fisher!s photographs reveal that a bee!s anatomy is designed for function, particularly speci! c to collecting and transporting pollen. *Leg Pollen x1100* shows the bee!s leg magni! ed 1100 times, with pollen grains lodged



in the ! pollen basket! and anchored by the leg hairs. As she explains, ! Using her forelegs and mandibles to loosen pollen from a flower, a foraging bee is dusted in pollen. She cleans her head and mouthparts with foreleg brushes, her forelegs with middle leg brushes, and then, grasping a middle leg with both hind legs, she draws it forward, transferring the pollen through to her hind leg brushes. She rubs her hind legs together scraping pollen from brushes on one leg with the *rastellum* (rake) of the other, on to the *auricle* (ledge) of the pollen press. With a pumping action, she pushes the pollen into the *corbicula* (pollen basket), and through this repeated motion it collects into a pellet. This is all done while hovering in the air.! [2]

This complex series of actions, too fast to be seen with the naked eye, is highlighted in the work of video artist **Dennis Hylnsky.** *A little bumblebee lands on a flower*, 2015, is a one-minute slow-motion video that shows the ! the story of a little dance slowed down enough to let our mind understand the complexity of this everyday event in the garden.! [3] In other pieces such as *Flight of a Small Northern Cloudyspot,* we learn as much about the expressive possibilities of the video medium as we do about the flight pattern of the small butterfly. In this work, a flat background shifts color from gray to blue behind a group of Echinacea flowers rendered in grayscale; this simpli! ed landscape puts the focus on the action, which is both slowed down and endlessly repeated in what Hylnsky variously refers to as "extruded time," "echoes," or "time trails." These studies of flight patterns, which Hylnsky sees as both data and drawings, have had signi! cant impact on the understanding of inter-species communication. As one interviewer recently noted, ! ! while he!s perfectly content in his role as artist, he does hope that projects like his will inspire scientists to look at problems in new ways.! [4]

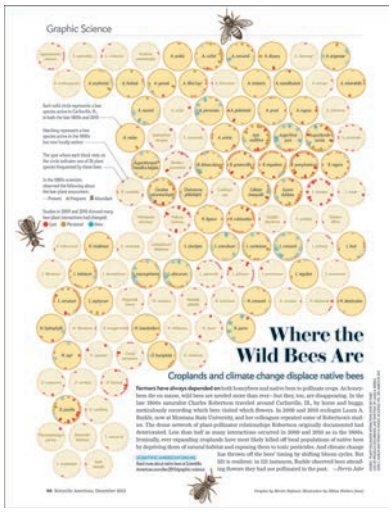
Artist **Julia Oldham** also adds to our understanding of insect behavior, by using her body to mimic the different actions that bees perform. For *Rotations 1 3,* Oldham recorded her performance and then edited the charming and humorous footage to create ! humanly impossible! movements that approximate pollination and the ! waggle dance! ! the name given to the particular body language that bees use to communicate the location of pollen to the rest of the hive. Like many of the artists in *Planting Seeds,* Oldham merges expressive vision with scienti! c observation to create hybrid work that exists between disciplines. Although inspired and influenced by the expertise of entomologists, botanists, horticulturalists, physicists and other specialists, the work is not exactly scienti! c. As Oldham writes, ! I examine the place where science and art must part ways; and I force them back together again.! [5]

Activism on behalf of these vital insects is a recurring theme throughout *Plant ing Seeds.* In the last decade it has been widely reported that pollinators are partly responsible for nearly 30% of the food that we consume in the U.S. One of the biggest threats to bee populations is pesticide use, both by homeowners and by the agriculture industry. Educating people about these threats has become one focus of the **Beehive Design Collective,** headquartered in Machias, Maine, a group of activist-artists that use the idea of pollination as a metaphor for the spread of ideas. Like bees in a hive, they work anonymously and collectively to design and fabricate large-scale posters, or ! graphic campaigns,! that help educate the public about global environmental concerns, including pesticide-based agricultural practices and fossil fuel extraction. The series of prints in the Artmobile exhibition are details from some of their posters in which a variety of insect and animal species are shown working together to combat human intervention into their natural habitats. *Paper Wasp Co Op* imagines a hive as a kind of apartment building where the insects are busy printing posters, washing dishes, and doing other tasks to bene! t

[1] Fisher, Rose-Lynn, *Bee.* New York: Princeton Architectural Press, 2010, page 13.

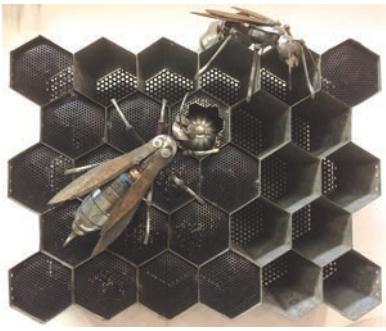
[2] Ibid, page 71.

[3] Artist statement, accessed at vimeo.com

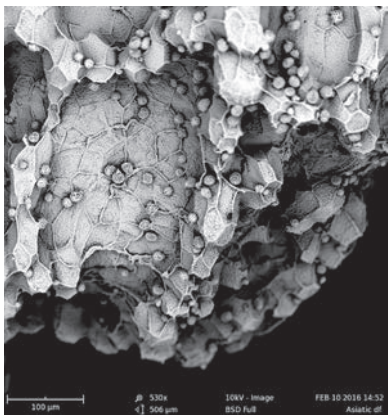


the group. The overall message is that collaboration, communication and adaptation will prevail. Unlike the industrious insects in the Beehive Collective!s graphics, however, our ecosystem is powerless. It is up to us to change our ways.

Designer **Moritz Stefaner** creates information graphics to uncover the ! truth and beauty! [6] hiding in data. In ! Where the Wild Bees Are,! commissioned by *Scientific American* magazine, Stefaner translated a report on the declining number of plant-pollinator interactions observed over 120 years, in Illinois. After determining the key ! nding of the report! that half of the bee species present in the 19th century are no longer observed today! he chose a honeycomb-like design that people would immediately associate with bees, then mapped the pollinator-plant interactions onto the hive in a variety of colors and symbols. Another artist contributed the vintage-style illustrations of bees to convey the passage of time in the original study. In the context of this exhibition, this data visualization is an example of the ways in which artists can help scientists communicate complex research to the public.



Eric Schultz uses found metals to create recycled sculptures that promote environmentalism while creating a sense of playful wonder. The disconnect when we see organic, living creatures rendered in metal makes us stop and think: Schultz's goal is to ! open people!s minds to the diverse function and meaning of the everyday objects we create, by exploring the programmed response and emotional attachment people have to their things.! [7]



There are many artists going beyond inspiration to ! nd real solutions to the disappearance of pollinator habitats and food sources. *The Next Epoch Seed Library* aims to help spread the word about the value of plants often considered weeds, like milkweed and Asiatic dayflower, that are nevertheless beneficial to pollinators. Formed by artists **Ellie Irons** and **Anne Percoco,** the seed library is both an information resource and a conceptual art project that aims to teach others to identify, harvest, and collect seeds from urban areas or marginalized spaces, such as parking lots, where only the hardiest species survive. As part of this project the artists used a scanning electron microscope to make highly detailed enlargements of the seeds of several plants, to better understand how seed structure aids in dispersal and germination. Irons and Percoco developed icons, a poster, brochures and booklets to guide people through the process of collecting and cataloguing seeds; teachers and students might use these tools to contribute to the seed library or to explore school grounds looking for similar plants. ! We!re trying to help validate and help people engage with these wild plants that are often called weeds,! says Irons. !And to think about them as habitat, think about them as these really valuable parts of green infrastructure! that would also be bene! cial for a whole suite of nonhumans, including bees.! [8]

Plants are a focus of illustrator **Kim Kurki,** who has spent her career depicting the natural world in colorful drawings that both educate and delight. *Planting Seeds* includes a series of the many layouts she created for *Your Big Backyard* magazine, each one focusing on a speci! c plant species and its attendant pollinators. Kurki works from photographs, detailing the plant!s anatomy and habitat, the bird and insect populations that feed upon it, and any human use, whether medicinal or edible. *Butter and Eggs,* for example, shows a drawing of this roadside wildflower with bees landing on the bright orange flowers, and explains that only large bees can open the flower petals to access the nectar deep inside. Kurki also writes the short poems that accompany each illustration, using rhyme to teach young readers about each species.

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[4] https://www.wired.com/2014/03/birds-like-youve-never-seen/

[5] Artist statement, accessed at http://legacy.drawingcenter.org/viewingprogram/portfolio.cfm?pf=914

[6] Artist statement, accessed at http://truth-and-beauty.net/about

[7] Artist statement, accessed at http://www.eric-schultz.com/

[8] http://nextepochseedlibrary.tumblr.com/

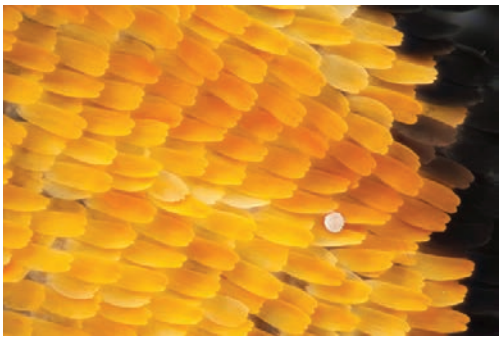
Judy Simon is a botanical illustrator, trained to reproduce speci! c elements of plant anatomy with scienti! c accuracy. Her drawing of a rare *Cypripedium acaule,* or lady!s slipper orchid, conveys the form and color of the plant with near-photographic detail. Simon notes that the successful pollination rate of this orchid is only ten percent, due to the flower's complicated internal structure; despite a design that encourages insects to follow a specific path through the flower, only those of a particular size will pick up pollen on their journey.[9]

Flowers have evolved to attract speci! c pollinator species through their color, scent, and form. Work by two artists in the exhibition serve as analogies to the functional beauty of plants and flowers. Philadelphia artist **Anda Dubinskis** combines abstract botanical patterns found in historic textiles with realistic depictions of insects. The flat, decorative, and often symmetrical backgrounds, rendered in graphite and gouache, serve as an organic field on which bees, butterflies, caterpillars, and other species seem to alight. The naturalistic color and three-dimensionality of the bugs, which derive from the artist!s observations in nature, are a stark contrast to the flat designs. By comparing this work to Kim Kurki's or Judy Simon's, students will gain an understanding of the wide range of realism that encompasses the ! eld of illustration.

Cara Enteles is an expressive painter whose work is inspired by long hours in her rural Pennsylvania garden. Several years ago, she noticed a decline in the number of bees in her yard and began to research Colony Collapse Disorder and other reasons for the population shift. With this information, she turned to her studio to create ! Pollinators,! a series of paintings that feature insects, bats, and birds along with abundant flowers. Like Anda Dubinskis, Enteles shifts between the decorative and the realistic, the flat and the dimensional, in layered compositions that create a dream-like effect. (See cover image.) Ultimately, Enteles hopes her work will raise awareness of the importance of pollinators: ! they are the bellwether of the health of our environment.! [10]

Conservation photographer **Marissa Farra** has the same hopes for her nature photographs. As an environmental educator for Bucks County Audubon Society, she teaches visitors about local ecology and what we as citizens can do to protect it. As an artist, she works in several modes, including documentary work that captures fleeting moments in the landscape, and composite images that merge animal species with images of their habitats. ! The goal of my work is to create a desire to protect the environment by building visual connections between people and nature. All of my wildlife and nature photos tell a story and strengthen bonds that we, as humans, have with our surrounding world.! [11] Farra is also working in Tyler State Park with BCCC STEM faculty to document their meadow restoration project! both the changing landscape and the student activity within it! throughout the two-year run of the Artmobile exhibition.

Where Farra works to contextualize species in the landscape, biochemist and photographer **Linden Gledhill** uses macrophotography to present details of butterfly and moth wings in extreme close-ups that have been compared to ! prismatic quilts! or kaleidoscopes of pattern. In *Swallowtail Wing with Pollen Grain,* we see the tiny scales of the butterfly's wing arranged like rows of flower petals, with a tiny speck of pollen lodged in between. Gledhill uses equipment similar to Rose-Lynn Fisher, but he works at such a close range that we lose sight of the subject entirely. Without an overt environmental agenda, these images instead convey the wonder and beauty of these insects, and! as is the aim of this exhibition! will inspire us to understand, appreciate, and take care of these species and their habitats.



Liz K. Sheehan, *Guest Curator*

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[9] Email exchange with the artist, January 2017.

[10] http://hamptonsarthub.com/2011/11/03/bees-and-trees-and-plexiglas/

[11] Email exchange with the artist, February 2017.

K–8 CURRICULUM INTEGRATION & LESSON PLANS

ALL OF THESE ACTIVITIES are designed to be multidisciplinary, incorporating science, art, math, literature, and technology, among other ! elds. The lesson plans are organized by topic and include extensions for further projects and research. We suggest that all classes complete ! Learning to Look/Learning to See! before visiting Artmobile, and then choose any one or a number of post-visit activities to use in conjunction with the journal they will have made.

PRE-VISIT: All students

MUSEUM MANNERS

Take a moment to review proper museum behavior with your students. Leave food, drinks and bags in the classroom. Do not to touch the artwork or any of the Plexiglas protecting it. Walk, use quiet voices, and respect the Artmobile Educator.

LEARNING TO LOOK/LOOKING TO SEE *(pages 11 12)*

This lesson focuses on the process of observation. How do we take in the information around us using all of our senses? How do we process, record and express this information for ourselves, and for others? Students can make a journal out of recycled materials (or use one they have already) and record their observations, both in Artmobile and in the classroom, through a variety of means! whether drawings, charts, infographics, or descriptive writing practices.

Eric Schultz, *Wasp Nest (detail)*, found objects, metal

POST-VISIT: Choose one or more

POLLINATION: COLLABORATION AND COMMUNICATION *(pages 13 14)*

Bees are an inherently collaborative species, working and communicating to bene! t the hive rather than the individual. Several of the works in Artmobile are similarly collaborative. These lessons will provide an overview of the process of pollination and the symbiotic relationship of plants and insects. Students can discuss what this means and why partnership would be an advantage to problem solving, then embark upon shared projects.

ANATOMY AND AESTHETICS *(pages 15 21)*

The purpose of a flower is to attract a pollinator to reproduce its plant. Plants have evolved in structure and in form to attract particular insect species, and seeds have speci! c shapes and textures to aid in their dispersal. Likewise, pollinators are anatomically designed to ef! ciently collect and distribute pollen from plant to plant. In these lessons, students will investigate the function of beauty in the environment! the role of color, design, smell, form, and structure! and learn the art and value of persuasion.

RESPONSIBILITY AND STEWARDSHIP *(pages 22 25)*

What does it mean to be a good citizen? These lessons focus on our relationship to the environment and why it is important to protect it. Recent studies have shown that nearly a third of the food we eat comes from pollinated plants. What can we do to maintain healthy gardens, yards, and schools? Who are our role models in conservation?

MANY WAYS OF THINKING *(pages 26 29)*

Interdisciplinary approaches and creative thinking is needed to solve some of our most pressing global issues. *Planting Seeds* includes artists and scientists working together to bring different perspectives to the crucial problem of declining bee populations. For example, an infographic distills a complex amount of scienti! c data into a design that is visually compelling and easy to read. In these lessons, students will consider methods of observation, analysis, data collection, and information delivery, whether technical or expressive.

PRE-VISIT LESSON

LEARNING TO LOOK, LOOKING TO SEE

Adapted from *Project Wild K 12 Activity Guide,* Gaithersburg, MD, 1992
www.projectwild.org

This is a good introductory activity to model best practices for observing nature AND experiencing art in the Artmobile collection. It is easily adapted for all ages and abilities.

GRADES K–8

Language Arts, Science, Art

Key vocabulary:
observe, see, appreciate, sense

PA Standards:
ELA 1.4, 1.5
9.2.12L, 9.3.12C, 9.4.12C
Environment and Ecology
4.1F, 4.3C
Art 9.1.12G, 9.1.12G,

Objectives
Students will describe differences seen in an environment as the result of casual and detailed observation. Students will give reasons for the importance of looking closely at any environment.

Method
Students list what they remember seeing in a familiar environment, check their accuracy and discuss the results, and then apply their experiences and new skills to an unfamiliar outdoor setting.

Background
Looking and seeing can be entirely different things depending on who we are, where we are, what we are concerned about and our purposes for looking. We look at our classrooms every school day, but if questioned about simple details we may ! nd that we are totally unaware of the existence of certain objects, colors, sounds and textures. As we walk through our neighborhoods, we have probably learned to notice only those things that are necessary to aid us in getting to our destination. We may not see a soaring hawk although we may be looking at the sky. We may not see a community of flowers even though we drive by them every day on the bus ride to school. During a walk in the woods, we may leave the trail to see a tree better and then not see the wildflower we step on, even though we are looking at the forest floor as we walk.

Each of us can educate ourselves to see. It takes at least three elements: 1) to learn to be a careful observer, even if we do not have sight through our eyes; 2) to be aware of our surroundings; and 3) to recognize any part of our environment as being part of a larger whole. As we enter a natural ecosystem (like the one at Tyler Park as seen in the pictures in Artmobile) we are part of that community, just as we are a part of our school community or neighborhood community. At some level, we are members of any community we enter. As a result, we have an opportunity and an obligation to see our neighbors and to be responsible members of each community we enter.

Linden Gledhill, *Tiger Swallowtail with Detached Scale,* digital macrophotography

Materials
Notebook, notepad or a student-made journal.
(See Creating a Field Journal, *page 28 for complete instructions.)*
Pencils Pens

Procedure
1. Let s practice seeing things. Cover a desk, bulletin board, other wall display, or table with a large sheet before students come to class. Ask the students to write down all the things they thought they saw there before the area was covered. When their lists are completed, ask them to turn over their papers. Remove the sheet. On the backside of their ! rst lists, have the students make a new list of what they see. What kinds of things did they remember? What kinds of things were most often missed? Let them come up with reasons why they think this happened.

Kim Kurki, *Cones,* ink and watercolor

2. Have students go outdoors and pick one spot near a tree, a fence, a brook, a ! eld (or pictures of these if they are not nearby). Each student should ! nd a spot alone, at least some distance from the closest human neighbor. The older your students, the more distance you can give them. If you are outside, the students should look in a broad sense of the word! seeing, touching, listening and smelling. They should record everything they see. Allow 5 to 15 minutes for this, depending on the age of your students for an initial spurt of observations, a plateau, and then another spurt as they begin to realize how much they missed the first time around. (Younger children need only record in their minds, no need to write. Older students can be given the full 15 minutes to observe.) Use an agreed upon signal to indicate when it is time to return to the group.

3. Bring students together for a discussion, centering on the process they went through as well as their list of sightings. Did they focus on any one area for a long time? Did they continue to shift their gaze? How did they focus their hearing and smelling? Cupping hands around their ears to simulate animal hearing has a dramatic effect on abilities to hear. Blindfolding seems to cause a compensation toward better hearing as well. Moistening the undersurface of the nose and the entire upper lip area increases smelling ability (think of dogs! cold wet noses). *NOTE: Our role as teachers is a difficult one in that we are most effective when we teach our students* ***how*** *to look and see without telling them* ***what*** *to see.*

4. Talk with the students about the joy and importance of seeing as fully as we can! as a way of appreciating, respecting and learning about more about the world in which we live. With older students, discuss the importance of careful observation of our environments beginning with the basis of our fundamental life-support systems! air, water, soil, plants, animals.

5. OPTIONAL, with older students: Talk about the process of continuing to develop our senses as being a lifelong process for each of us. We are always learning and can learn even more. Sensing more in our surroundings can help us detect changes in our environment, cause us to become curious and ask questions, and help us to become better, more aware and informed decision-makers.

Anda Dubinskis, *Adelphia Summer,* gouache on paper

Extensions

1. Blur your eyes. What patterns and shapes do you see?
2. What else did you see? Any living things? What were they? Were they plant or animal?
3. Categorize what was observed as living or non-living—and/or as animal, plant or mineral.
4. Play the game !Animal, Vegetable, Mineral! or ! What Am I?!
5. Distinguish between qualitative and quantitative observations. Describe the difference between inferences and observations.

Evaluation

1. Think of three of your friends. Without looking at them, write down the color of their eyes, and a description of what they were wearing last time you were together. Check to see if you were right.
2. Find and observe an insect or plant. Pretend that you are making a report about what you observed to an entomologist (insect biologist). Include detailed observations. Explain the potential value of such detailed observations for two audiences: scientists and the public.

POST-VISIT LESSONS

POLLINATION: COLLABORATION AND COMMUNICATION

BEE A POLLINATOR

Objective
Students will understand a bee!s method of pollination through the use of hands-on activities.

Method
Students will recreate the pollination process using powdered drink mix and their bee creations.

Materials

Pipe cleaners, yellow and black	Googly eyes
Kool-Aid in a variety of colors	Cupcake papers
Construction paper	Crayons, markers, pencils

Background
Pollination occurs when pollen is moved within flowers or taken from one flower to another. The transfer of pollen in and between flowers of the same species leads to fertilization or successful seed and fruit production for plants. Pollination ensures that a plant will produce full-bodied fruit and a full set of viable seeds. In this lesson students will be recreating the pollination method of the bee.

Procedure

1. **Have each student draw a flower** on construction paper and lay it on his or her desk. Place a cupcake liner in the middle.
2. **Students will then create honeybees.** Alternate wrapping black and yellow pipe cleaners around the eraser ends of their pencils. Fold one black pipe cleaner in half and tuck it in the top as antennae. Add googly eyes for aesthetics.
3. **Go around the room and add pollen** (Kool-Aid) to the middle (cupcake liner) of each flower.
4. **Students should dip their bee into their pollen,** collecting as much as possible on the antennae and the body. Mention that the bee!s bodies are designed to carry as much pollen as possible.
5. **Next, have them fly to another flower in the room** and rub their bee on their peer's flower. Then, have them fly back to their seats.
6. **Students should pollinate** at least five other flowers.
7. **Ask students, did all the flowers get pollinated?** What do you think might happen to the flowers that did not?

Extensions
1. What is it about the anatomy of a bee that allows it to be such an effective pollinator?
2. What other types of pollinators are there? Recreate their pollination process.
3. In your notebook or in your ! eld journal *(see* Creating a Field Journal, *page 28 for complete instructions);* draw a diagram of how a bee pollinates a flower. Refer to the videos in Artmobile.

GRADES K–3

Science, Art, Social Studies

Key vocabulary:
pollinators, pollination

PA Standards:
Environment and Ecology
4.1B, 4.1D, 4.4A, 4.4B, 4.4C, 4.4E, 4.5A
Art 9.1.3A, 9.1.3B, 9.1.3H, 9.3.3A
Social Studies 7.1, 7.4

Julia Oldham, *Rotations 3*, video

BEEHIVE COLLECTIVE MURAL

GRADES K–8

Language Arts, Science, Art

PA Standards:
ELA Core 1.5
Science and Technology 3.1.C
Art 9.1.3, 5, 8, 12 A D & J

Objective
Students will collaborate to create one large mural.

Method
Students will create a small piece of a whole mural. Students will then bring all of their individual pieces together to create a large work of art.

Materials
Source image *(Use a print out of a work of art from the Beehive Collective or another interesting photograph from nature. Cut picture into equal pieces, enough for each student in your class.)*
Paper cut to scale *(For example, if you want your mural to be 5X larger than the source image, scale up this paper to be 5X larger than the source image. Size will vary depending on class size and mural size.)*
Pencils Erasers Sharpies Colored pencils, markers, crayons

Background
Examine the work of the Beehive Collective displayed in Artmobile. You may also refer to the pieces in the slide show on our exhibition website www.bucks.edu/ArtmobilePlantingSeeds. In their own words, the Collective is ! a wildly-motivated, all volunteer, activist-art collective dedicated to cross-pollinating the grassroots by creating collaborative, anti-copyright images for use as educational and organizing tools." They work similarly to bees—each individual, no matter how small the contribution, makes the whole work.

Procedure
1. **Randomly distribute a small piece of the divided mural** to each student with a larger-scaled piece of paper
2. **Ask the student to take a close look at the details** from the source image, noticing texture and the scale of everything.
3. **Ask students to draw** exactly what they see from their source image onto their larger paper. They should work to the edges of the paper. Remind students that it should look exactly like the source image, just larger.
4. **After everyone has completed their portion** of the mural, show students the original work of art.
5. **Have students walk around** and put the "puzzle" together to create one large mural.
6. **After seeing it all together,** give students time to discuss the successes and failures and allow them to go back and edit their original large drawings so that lines and images line up appropriately to make a cohesive mural.
7. **After editing,** allow students to color their ! tile! portion of the mural.
8. **Hang the mural** all together as one large piece of art.

The Beehive Collective, *Biotechnology is Pollution,* silkscreen on fabric

The Beehive Collective, *Pollinator Petitioners,* silkscreen on fabric

ANATOMY AND AESTHETICS

JOURNEY TO THE CENTER OF A SEED

Adapted from Journey to the Center of the Seed , GrowLab Activities for Growing Minds, *National Gardening Association, Burlington, VT, 1990 pp. 30 33.*

Duration
Groundwork: 30! 45 minutes; Exploration: 5 to 8 days, 10! 15 minutes per day

GRADES K–5

Language Arts, Science, Art

Key vocabulary: properties, predict, observe, germination

PA Standards:
ELA Core 1.2, 1.4, 1.5;
Science and Technology 3.1A, 3.1B, 3.1C
Environment and Ecology 4.1A, 4.1D, 4.1F, 4.3A C, 4.4A C
Art 9.1.3, 5, 8A; 9.1.3, 5, 8B; 9.3.3, 5, 8A

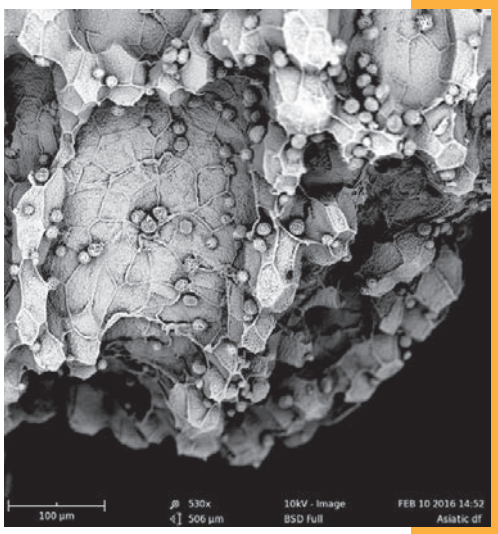
PART 1: GROUNDWORK

Objective
To sort and to classify seeds by external characteristics.

Method
Students observe, sort, and classify a variety of seeds according to different properties, and then take a journey inside a bean seed to predict and observe changes that occur during seed germination.

Materials
Assorted seeds Lima beans (one per student) Cup of water
Hand lens Glue Toothpicks Plastic bag Paper towel
! Seed Bingo! card *(Appendix, page 30)*

Background
If gum is dropped on the ground, will it grow into a gumdrop tree? To help your students distinguish between living and nonliving things, pass around various small objects such as pebbles, marbles, coins, jelly beans, and seeds. Ask students which things they think are alive. What makes something alive? How do you know if an object is alive or not? Have the students plant the different objects and see if they grow. Discuss whether growth is the only way to tell if something is alive or not.



Ellie Irons & Anne Percoco, *The Next Epoch Seed Library (Asiatic Dayflower)*, scanning electron microscope photograph

Procedure
Prior to the activity, obtain a mixture of seeds of different colors, textures, and sizes. Large seeds like beans, corn, peas and squash are easiest for young students to handle. Try to locate some fuzzy or fluffy seeds like tomato, dandelion, milkweed. Old seeds from outdated seed packets are ideal for the Groundwork activities. Small envelopes can be used to store seed mixtures for individual groups.

1. Give each pair or small group of students ten to fifteen assorted seeds. Ask each group to discuss how their seeds are alike and how they!re different, and then to sort seeds into groups according to the way they look. Give some examples for grouping such as rough or smooth, dark or light colored, large or small.

2. As a class, discuss the different properties that the students used to sort the seeds. Put up a class chart with the headings Size, Shape, Color and Texture (and any other properties, such as smell, that might have been suggested). Ask the class under which category each of their descriptive words belongs.

Size	*Shape*	*Color*	*Texture*
huge	oval	brownish	rough
tiny	round	tan	fuzzy
big	bumpy	spotted	smooth
	long	red	bumpy

3. Continue focusing on seed observations by conducting one or all of the following activities:

• Invite small groups to play "I'm thinking of…" with their pile of seeds. One student thinks of and describes a particular seed to the other students, who must carefully observe and guess which seed is being described. Or, have the audience ask ! yes! or ! no! questions about the description of each seed.
• Play Seed Bingo, using the reproducible "Seed Bingo" card in the Appendix. Or, create your own from the descriptive seed word list generated by your students. Give each pair of students a ! Seed Bingo! card, a new mixture of seeds, a hand lens, a cup of water (to float seeds), glue, and a toothpick to apply it. Challenge each pair of students to ! ll its card by gluing a seed onto the matching description in each box. Every pair that ! lls its card is a winner at Seed Bingo!
• Play a seed Memory Game. Have pairs of students carefully observe a mixture of seeds. Then have one student remove and hide just one of the seeds from the group. The other must describe the missing seed.

4. How do you think these seeds with different outsides look inside? What do you think you might ! nd inside a seed? What have you ever observed to make you say that? Give each student a lima bean seed. Ask them to draw a picture or write in their journal what they predict it looks like inside.

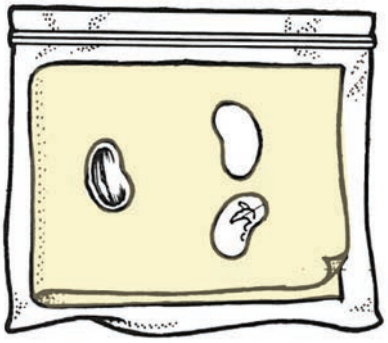
PART 2: EXPLORATION

Objective
To discover what is inside a seed, to predict how seeds will change after sprouting, and to observe the sprouting (germination) process.

Background
Fast Food: Explain to students that seeds contain starch and other nutrients. These get the young plant off to a good start and sustain it until it has true leaves and can make its own food. You could remove different parts (one or both cotyledons) of the seed or emerging plant to see how this affects plant growth. When both cotyledons are removed from a seed or young plant, the plant will lack adequate nutrients to continue growing properly.

Procedure
1. Give each pair of students two lima bean seeds (from Step 3 above), ½ cup of water, and a hand lens. Have them place their seeds in water for twenty-four hours and examine regularly. Be sure to start some extra seeds, in case some don!t germinate. Ask: What do you predict will happen to the seeds while they are soaking?

2. After twenty-four hours, ask: How did your seeds change while they soaked in water? Did they match your prediction? What do you think was happening inside the seed? Have students in each pair help one another carefully peel the outer coat from one of the seeds. Then guide them or help them to pull the coatless seed in half with a ! ngernail.

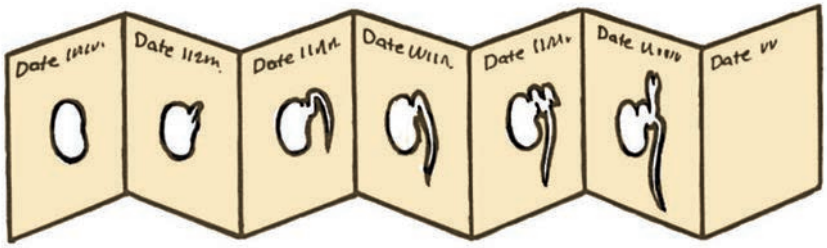


3. On the same drawing or page students made in Step 3, ask students to draw a picture of the inside of one of the split seeds, or write a detailed description in their journal. Ask: How does what you see inside the seed compare to your original prediction? Does any part of the inside of the seed look like a familiar plant part? Which? Do you think a seed is alive? Why or why not?

4. Have students leave their seeds in a moist plastic bag for a week. Ask: What do you predict will happen to the seeds during the week?

5. At the end of the week, discuss findings. Ask: How did different parts of the seeds change during the week? What happened ! rst? Next? Did everyone!s seeds change at the same speed? In the same order?

6. Continue observing the seeds daily for a week. Students should record changes by making new drawings next to their originals. Consider having students make a growth chart to record changes during germination, by folding a long strip of paper like an accordion and clipping it with a paper clip. Draw on one section at a time as the seed grows. When complete, unfold to view the sequence.
Additional note: If you germinate one bean seed every day for the next seven days, you ll end up with all stages of germination at one glance!

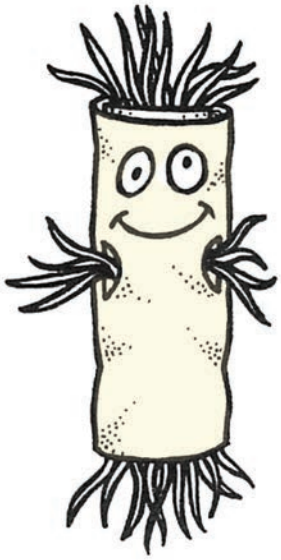


Possible discussion questions:

- *Which different parts of the seeds turned into what you predicted? Did any surprise you? Which?*
- *Do you think seeds are living or non-living? What did you observe to make you believe that?*
- *After exploring seeds inside and out, why do you think seed coats are so hard?*
- *What new questions do you have about your seeds?*

Extensions

- Plant your seeds and continue to observe and measure growth with Unifix Cubes or paper strips.
- Have students secretly line up assorted seeds in certain sequences (smallest to largest) or patterns (rough-smooth-rough). Challenge other students to guess the sequence or pattern.
- Investigate the power of a growing seed. Fill a plastic container (e.g., yogurt) with pea or bean seeds and add water. Seal the container and watch what happens once the seeds have expanded overnight.
- Find out about monocots (e.g., corn and other grasses) and dicots (e.g., bean, pea, tomato). Compare the insides of these seeds and observe differences in early growth.
- You can test cotyledons for starch using iodine, after soaking them for twenty-four hours. Follow this link for more information: https://www.homesciencetools.com/a/starch-test
- Design and construct a chamber, using recycled materials, to view seed growth.
- Generate a list of seeds eaten by humans. Consider those that are eaten whole (rice, peanuts) and those that are processed so they don't resemble seeds (flour).
- Make a list of questions you would ask a young plant as it grows from a seed.
- Act out the process of seeds growing.
- Create seed dolls by rolling up seeds such as grass seed in moist paper towels. Cut out holes for arms and legs. Seeds will sprout from these holes and from the top.



Illustrations from from Journey to the Center of the Seed , GrowLab Activities for Growing Minds, *National Gardening Association, Burlington, VT, 1990 pp. 30 33.*

PETAL ATTRACTION

GRADES K–8

Language Arts, Science, Art

Key vocabulary:
observe, see, appreciate, sense

PA Standards:
ELA Core 1.2, 1.4, 1.5
Science and Technology 3.1A, 3.1B, 3.1C
Environment and Ecology 4.1A, 4.1D, 4.1F, 4.3A C, 4.4A C
Art 9.1.3, 5, 8A; 9.1.3, 5, 8B; 9.1.3, 5, 8E; 9.2.3, 5, 8L, 9.3.3, 5, 8A; 9.4.3, 5, 8C

Duration

Groundwork: 30 minutes
Exploration: Part I! 60 minutes
Exploration: Part II! 30 minutes
Making Connections: ongoing

Materials

Magazine advertisements
Drawing paper and supplies
Miscellaneous classroom and natural materials
(tissue paper, pebbles, sticks, pipe cleaners, foil, etc.)

LAYING THE GROUNDWORK

Objective

Students will understand that many flowers have adapted to "advertise" themselves to pollinators.

Method

Students invent models of flowers and then create advertisements to illustrate how their invented flowers are adapted to attract pollinators.

Procedure

1. Display around your classroom some magazine and advertisements with popular slogans! for example, ! Pepsi, The New Generation! ! and engaging photos. Have students work in pairs to discuss the following questions:

- At what type of audience/person do you think each advertisement is aimed?
- What does the advertiser do to grab the reader's attention and interests (e.g., claims to make them happier and healthier or uses colorful pictures)?
- How do television advertisements do similar things?

2. As a class, discuss some of the students! ideas. Then ask:

- What do you think this discussion has to do with our study of flowers?
- What do you think flowers and advertisers have in common?
- Who are the flower's "audience"?

3. Reveal that many flowers are really brilliant advertisers, luring pollinators who inadvertently transfer pollen from one flower to another. Referring to the background information, highlight that many flowers have specific colors, shapes, mechanisms, or smells or attract speci! c pollinators. Ask:

- What types of "advertising" have you observed in flowers?

EXPLORATION: PART I

Objective

To consider how every part of a flower is designed to help in pollination/reproduction.

Procedure

1. Have students work in small groups to "invent" molds of fictitious flowers. Give each group an assignment (see next page) which should be for their eyes only. Suggest that students in each group have speci! c roles, such as materials, gatherers, reporters, and labelers. All models must:

- Consist of unique, labelled petals, pollen, pistils, and stamens;
- Be made of recycled classroom or natural materials;
- Be a minimum of 8–12 inches in diameter;
- Function as specified in one of the description below.

Kim Kurki, *Butter and Eggs*, ink and watercolor

2. Suggested wild flower ideas:

- Invent a flower that might entice an unsuspecting human to pollinate it.
- Invent a flower that can pollinate itself with the help of gravity.
- Invent a flower that could easily be pollinated by the wind.
- Invent a flower that will make a pollinator think it's approaching a fellow insect.
- Invent a flower that would force bees to follow a particular rout in and out, touching the anthers and stigma on its way.
- Invent a flower that would attract a pollinator with a long beak.
- Invent a flower with an anther that can easily be "tripped" and sprung by an insect, releasing pollen.
- Extra challenge: Create models of specific pollinators that might be adapted to pollinating your particular flower.

3. Have groups decide how to present their inventions to the class. They might choose a spokesperson or make a creative group presentation. Encourage the class to guess the purpose of the different structures of each invented flower.

Judy Simon, *Cypripedium Acoule with Bee Entering,* ink and colored pencil

EXPLORATION: PART II

Objective

To demonstrate understanding of the relationship between flowers and pollinators by creating advertisements for fictional flowers.

Procedure

1. Set the following scene for your students:

- The place: Scentimental Advertisement Agency
- The plot: Groups of students are charged to design a full-page ad for their endangered, invented flower to run in National Pollinating magazine. The purpose is to convince pollinators of the need for their particular flower.

2. Encourage students to consider how they!ll creatively highlight the traits that will attract pollinators to their flower. Suggest that students think about techniques used by human advertisers. To stimulate thinking, ask:
How can your ad! .

- Make the nectar seem plentiful or nutritious?
- Highlight easy access?
- Make your flower more attractive to a specific type of pollinator?

3. Have the group or a spokesperson present the ad to the class. Display ads around the room.

Judy Simon, *Cypripedium Acoule with Bee Leaving,* colored pencil on Duralar

MAKING CONNECTIONS

Possible discussions questions:

- What do you think would happen if…
  Bees and other insects wouldn t detect color?
  Motor oil were splashed on a flower s stigma?
  Pesticides, toxic to bees, were sprayed on plants?
- Although flowers have particular adaptations to attract pollinators, how do people take advantage of these traits (e.g., they use flower fragrance for soaps)?
- Do you think bees or plants benefit more during pollination? (This is a good question for debate, with no right answer!)
- Which parts would you expect to find on flowers pollinated by the wind? Why?
- Why do you think flowers produce thousands of pollen grains, even if they only have a few eggs to be fertilized?

Marissa Farra, *Pollination by Proboscis*, photograph (detail)

Extensions

• Research different types of pollinators (bats, moths, carrion flies, etc.) to find out their flower preferences.

• Try removing different parts of flowers while they're still on the plant. Notice how this affects the plant!s development.

• Write and illustrate a description of a flower of the future. Describe how this flower would be adapted to specific conditions and means of pollination.

• Research how different animals' adaptations, such as coloring and song, enable them to attract mates.

• Write an editorial for National Pollination magazine from a pollinator concerned about pesticide use. First search how pesticides can affect pollinators.

• Research how different cultures use flowers (e.g., in their diets, for medicines, or for dyes).

• On an outdoor walk, try to identify different aspects of flowers' advertisements. Identify those flowers that are probably wind-pollinated.

• Find out about the origins of different flower names or about the historical significance of different flowers. Design cards using flower names and images.

POLLINATION PARADE

GRADES K–8

Language Arts, Science, Art

Key vocabulary:
Pollination, pollinators

PA Standards:
ELA Core 1.2, 1.4, 1.5
Science and Technology 3.1A, 3.1B, 3.1C
Environment and Ecology 4.1A, 4.1D, 4.1F, 4.3A C, 4.4A C
Art 9.1.3A C, 9.1.5A C, 9.1.8A C, 9.2.3F, 9.2.5F, 9.2.8F

Adapted from PROJECT SEASONS, Pollination Parade, *Shelburne Farms, Shelburne, VT, 1995 https://pollinatorlive.pwnet.org/pdf/Pollination_Parade.pdf http://store.shelburnefarms.org/product/179/education_resources*

Objective
Students will explore the relationship between flowers and their pollinators.

Method
Students will match pollinators to the flowers they prefer and learn about how each pollinator has adapted to best collect pollen from each flower.

Materials
Several flowers
! Flower Description Cards! and ! Pollinator Pro! le Cards! *(Appendix, pages 32 33)*
Collection of miscellaneous materials for constructing flowers such as paper plates, drinking straws, toilet paper tubes, crepe paper, assorted scents and flavored extracts, toothpicks, play dough, pipe cleaners, cotton balls, scraps of felt, wire floral stems, and string.

Background
Pollination Partners: Flowers have been !courting! pollinators for a long time. They have evolved speci! c colors, shapes, nectars and perfumes to attract them. The most efficient pollinators have been rewarded with a flower designed just for them. Petals have evolved into flat landing platform shapes for bees; foul odors are emitted to lure carrion beetles and flies; and nectar is hidden deep inside long flower tubes where only hummingbirds, moths, or butterflies can reach it. Certain orchids go as far as resembling the females of certain species of bees and wasps, even producing a scent that mimics the mating pheromone. Male bees and wasps are attracted and attempt to mate with the flower, pollinating it in the process.

One of the most amazing examples of this coevolution of flowers and pollinators is the yucca plant and yucca moth. The female moth only visits yucca flowers, and at each one she rolls up a large ball of pollen. She carries this pollen ball to another yucca flower and deposits it on the stigma, thereby insuring pollination

and seed production. She then lays her eggs in the ovary of this flower, insuring a food source for her hatching larvae which emerge just as the seeds are ripening! It is estimated that the larvae eat only about 20% of the seeds before they chew their way out of the ovary and are on their own.

Procedure

1. Bring in several flowers of different shapes and colors. Ask the students to vote for their favorite flower. When the votes are in, explain that not everyone voted for the same flower as different people have different preferences. Different insects and other plant visitors have flower preferences, too.

2. Explain to the class that the purpose of a flower in the life of a plant is to reproduce the plant. In order to do that, pollen from one flower must be carried to the other flowers and vice versa. The pollen fertilizes the pistil of the plant, producing fertile seeds. These seeds can then grow into new plants. Introduce the class to the idea that different flowers are pollinated in different ways. Explain that flowers have evolved specialized parts, shapes, colors, scents, and other characteristics expressly to attract pollinators—animals, birds and insects that spread pollen from flower to flower. The class will construct their own flowers that are adapted in different ways to attract pollinators. Later they will play the role of the various pollinators.

3. Divide the students into pairs or groups. Give each group a ! Flower Description Card.! Using the materials provided, have the students make a three-dimensional flower that meets the requirements detailed on their card. Stress that the flower should have all the basic flower parts unless the description states otherwise.

4. Place the finished flowers with their description cards in a general location in the classroom. Provide time for students to observe all of the flowers.

5. Pass Pollinator Profile Cards to the groups. Have the students read over their card carefully. Explain that each group will now take on the role of the pollinator described on their card. Review the flower descriptions, and ask the pollinators to choose the one flower that best suits their needs. When you say "Go," the pollinators in each group fly, buzz, or crawl to the flower that is best adapted for pollination by them. Review their choices.

6. Show the students examples or pictures of flowers that are pollinated by the various pollinators and compare them to the flowers they made.

Extension

Have the students conduct a pollination survey. Have them observe a flower over time, noticing the different types and behavior of the pollinators that visit it.

Dennis Hlynsky, *A Little Bumblebee Lands on a Flower*, digital video

POLLINATORS & THEIR FLOWERS

Bat: Organ Pipe Cactus *(Stenocereus)*; Kapok tree *(Ceiba)*, Sausage tree *(Kigelia)*, Calabash tree *(Crescentia)*

Bee: Marsh Marigold *(Caltha palustris)*, Blue Flag *(Iris)*, Foxglove *(Digitalis)*

Butterfly: Wild Blue Phlox *(Phlox)*, Daylily *(Hemerocallis)*, Wild Geranium *(Geranium)*

Carrion fly: Stinking Benjamin *(Trillium)*, Skunk cabbage *(Symplocarpus foetidus)*, Carrion flower *(Stapelia)*

Hummingbird: Cardinal flower *(Lobelia cardinalis)*, Red columbine *(Aquilegia canadensis)*, Fuchsia, Banana

Mosquito: Small flowered orchid *(Habenaria elegans)*

Moth: Spanish Bayonet or Yucca *(Yucca)*; Tobacco *(Nicotiana)*, Evening Primrose *(Oenothera)*

Wind: Paper Birch *(Betula)*, Cottonwood *(Populus)*, Oak *(Quercus)*, and many other temperate trees, also grasses and sedges

Note: Each pollinator has a specific flower type that it pre fers, but it may visit and pollinate many different types of flowers.

RESPONSIBILITY AND STEWARDSHIP

HELP THE BEES

GRADES K–3

Science, Language Arts

Key vocabulary:
habitat

PA Standards:
ELA Core 1.3, 1.5;
Science and Technology 3.1C
Environment and Ecology
4.1A, 4.5B;
Art 9.1.3, 9.3.3

Rose Lynn Fisher, *Sabine 15x*, photograph

Objective
To learn about the importance of maintaining a healthy environment for bees.
Materials
Crayons and/or colored pencils

Method
Read ! Winnie-the-Pooh and the Missing Bees! and discuss what families can do to support bee habitats. Optional extension! complete worksheets on bee anatomy.

Procedure
1. Read the short Winnie the Pooh story about saving bees (pages 1! 3) after visiting Artmobile. (Note that the publisher is British so you may want to translate some of the British terms while reading.) https://www.friendsofthehoneybee.com/wp-content/uploads/2015/06/E2463_BeeBooklet_Web.pdf

2. Discuss with students: What did Christopher Robin discover about the missing bees? How did he bring them back? What can you do to help the bees in your yard? (Plant a variety of flowers, don't use chemical pesticides, leave dandelions and other good flowering "weeds," buy local honey.)

3. Find related coloring sheets and art activities here:
https://www.bbka.org.uk/kids/more_childrens_corner

4. Extension (older grades) worksheets on bee anatomy: connect to the photography of Rose-Lynn Fisher and discuss how the bee!s body is designed to carry pollen. http://2dh8s42c4g0b4fkujgfp4w7a-wpengine.netdna-ssl.com/wp-content/uploads/2014/01/honey-bee-anatomy.pdf

RACHEL CARSON, A FABLE FOR TOMORROW

GRADES K–8

Language Arts, Science, Art

Key vocabulary:
pesticide, stewardship, responsibility

PA Standards:
ELA Core 1.2, 1.3;
Environment and Ecology
4.1, 4.5
Art 9.3.8A D, 9.4.8B, C, D,
9.3.12A D, 9.4.12B, C, D

Adapted from Rachel Carson: Sounding an Environmental Alarm, *produced by Earth Day Network in association with American Experience*
http://www.weta.org/files/1RachelCarson_LessonPlanw_chapters.pdf

Duration
30! 45 minutes depending on the age/level of your students.

Objective
Students will discover who Rachel Carson was and how her book, *Silent Spring,* changed the way we view and use pesticides in the United States. They will gain an understanding of how we all bear a responsibility to take care of our environment.

Method
Students will read and analyze "A Fable for Tomorrow," the first chapter of Carson's book. They will discuss how her choice of words and use of pictures combine to create a strong impact on the reader. They will make drawings based on Carson!s descriptions of the town in the fable, before and after pesticides were introduced.

Procedure
Warm Up: What Compels You?
1. Begin this lesson by asking students the following question: What do you feel so strongly about that you would want to fully dedicate yourself to it, even if this risked your professional reputation and how others thought of you? Allow students to briefly share responses.

2. Explain that Rachel Carson was a biologist in the 1950s! 60s who was compelled to share her concern about pesticides, even at the risk of her professional reputation. This lesson will introduce you to Rachel Carson, her concern, her actions, and the impact on her life and broader society.

3. Introduce students to Rachel Carson by showing the video clip https://whyy.pbslearningmedia.org/resource/amex29rc-soc-pesticide/american-experience-rachel-carson-pesticide-early-warnings/#.WUlCJdyQypo

ACTIVITY 1: READING A FABLE FOR TOMORROW

1. Have students read !A Fable for Tomorrow! either to themselves or out loud as a class. This four-page, ! rst chapter of Rachel Carson!s book *Silent Spring* can be found at your local library or online here: https://wilderness.nps.gov/idea61.cfm

2. Once they are finished reading, ask them to ! ll out the Starter Questions Section on the !A Fable for Tomorrow! Worksheet.

3. Once this section is completed, go over the questions together. Make sure students understand that there are two very different descriptions of the town, and that the change in language began around the mention of the ! strange blight!

5. After going over the Starter Questions, move on to Activity One. Read the directions to the students, and then have them ! ll in the table individually or as a class.

6. Once their tables are filled in, ask for student volunteers to share the descriptions they chose to describe the town before the ! strange blight! Then go over the second column, asking for student volunteers to share the descriptions they chose to describe the town after the ! strange blight!

Anda Dubinskis, *Ghost Spiders,* gouache on paper

ACTIVITY 2: DRAWING TWO TOWNS

Students will use descriptions from Rachel Carson!s fable to visually illustrate how the town changed.

1. They will be drawing two pictures, and the pictures should correspond to the phrases and words they wrote down in the table. For example, their ! Town! picture might include drawings of different birds nesting in trees, while their ! Silent Spring Town! picture might depict fewer birds and other animals.

2. Ask students to think about how the artists and scientists in Artmobile made their drawings! what kind of information did they include?

3. Allow enough time for students to complete their drawings.

4. Ask them to share their pictures, either with the whole class or in groups.

5. Encourage students to discuss why they selected certain descriptions, if the mood changed in their picture, and their thoughts for both pictures.

6. Optional: If you have a copy of *Silent Spring,* look at some of the drawings together as a class and discuss why Rachel Carson included them in the book. What kind of impact do they have on the reader?

Marissa Farra, *Pollination by Slime,* photograph

LENAPE HORTICULTURE

GRADES 7–8

Language Arts, Science, Social Studies, Art

Key vocabulary:
horticulture, agriculture, Lenape, sustainability, organic, monoculture

PA Standards:
ELA Core 5.1
Environment and Ecology 4.1B, 4.1D, 4.4A, 4.4B, 4.4C, 4.4E, 4.5A
Social Studies 8.3
Art 9.3.8C, 9.3.8F, 9.4.8C

Duration
45-90 minutes depending on the age/level of your students. Can be spread out over multiple days.

Purpose
The development of plant cultivation known as horticulture was developed ! ve to seven thousand years ago. Gardening provided a more stable food supply as well as more established, sedentary communities. Native Americans practiced sustainable and organic farming practices that are still used today and are much more bene! cial to ecosystems than monoculture commercial farming.

Objectives
Students will learn:
- How the introduction of gardening made it possible to settle in semi-permanent villages;
- The introduction of gardening provided at least three crops to the Lenape (Legend of the Three Sisters);
- The wild plants that the Lenape foraged to supplement their horticulturally derived crops;
- How the Lenape used sustainable planting and harvesting techniques that are still used today by organic farmers. The Lenape never wasted anything and always gave something back to nature every time they took something.
- How the Lenape protected their gardens and made their gardens attractive to pollinators and natural pest destroyers.

Materials
Computers with internet access. *(If you do not have internet access, then make copies for students of the Background Information found in the Appendix, pages 36 37.)*
White boards Dry erase markers Journals or paper Pen or pencil

Procedure
1. Allow students time to read ! Background Information! *(Appendix, pages 36 37)* or research online, then answer the following questions.

What is horticulture?
What is agriculture?
What tools would be appropriate for digging, planting, harvesting and protecting crops? (at the time of the Lenape and now)
How did the Lenape water their garden and keep their crops moist?
What does sustainable mean?
What does organic mean?

Extension Questions
How are organic farms better in some aspects than the monoculture factory farms of today?
How are organic farming practices more in line with Lenape horticultural practices of 500! 1000 years ago than modern factory farms?

2. Assign group of students to answer some or all of the questions and prepare a PowerPoint presentation, or just write answers on paper.

Cara Enteles, *Pollinating Pair,* oil and silkscreen on acrylic

References

Ewin, Gail, *Lenape Lore*

Kraft, Herbert C., *The Lenape: Archeology, History and Ethnography,* New Jersey Historical Society, 1987

Newcomb, Jr., William, *The Culture and Acculturation of the Delaware Indians*

Peterson, Lee Allen, *A Field Guide to Edible Wild Plants,* Peterson Field Guides, 2000

Tantaquidgeon, Gladys, *Folk Medicine of the Delaware and Related Algonkian Indians,* Pennsylvania Historical and Museum Commission, 1972

Helpful Websites

http://nextepochseedlibrary.com/ Next Epoch Seed Library videos and information on modern seed collecting.

http://www.almanac.com/content/three-sisters-corn-bean-and-squash
Farmers Almanac site speci! cally about the Three Sisters! crops.

https://soilsmatter.wordpress.com/2017/06/01/
how-do-the-three-sister-plants-work-together/
Soil Science Society of America website on companion planting and nitrogen ! xation.

Marissa Farra, *Pollination by Seed,* photograph

MANY WAYS OF THINKING

MAPPING OUR WORLD

GRADES K–3

Science, Art, Geography

Key vocabulary:
navigation, mapping, symbol, orientation, direction

PA Standards:
Environment and Ecology 4.5
Social Studies 7.1, 7.4
Art 9.1.3A C & J, 9.2.3K, 9.3.3A,C & F

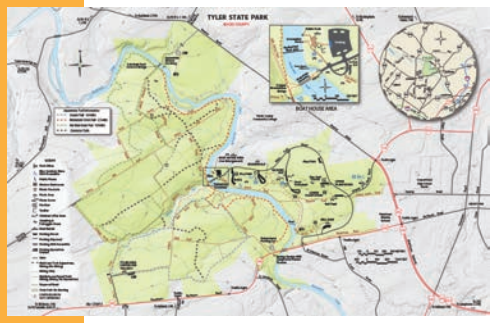
Duration
30 minutes depending on the age/level of your students

Objective
Students will understand why maps are important tools for understanding and navigating the landscape.

Method
Students will study a simple map, discuss the main features, and create their own maps of real and/or imaginary places.

Background
The *Planting Seeds* exhibition was inspired by a project in Tyler State Park where Bucks County Community College faculty are working with students to restore a meadow. This means that they are taking out plants that do not belong in that environment and replacing them with ones that will help a variety of pollinator species, like birds, bees, and butterflies. Part of their process involves making a map of the park area and collecting information about what plants are growing there.

We use maps for many reasons. Maps help us orient ourselves! to ! gure out where we are and where we might need to go next. Map reading and map drawing are important skills to learn in geography. Mapmakers use symbols like lines and different colors to represent features such as rivers, roads, cities or mountains.



Procedure
1. Look at the park map at https://www.nationalgeographic.org/maps/park-map/ online together. Parks, like Tyler, provide places for people in the community and visitors to sit and enjoy nature. Look at the map key to ! nd the symbol for a bench. Find the benches on the map. How many are there? What could you see if you sat on one and looked north, south, east, and west? Ask:

What other places on the map might be a good place to enjoy nature?
What is between one of the slides and a sandbox?
What is the line that circles the pond?
If you were on the seesaw and looked east, what would you see?
What are the swings next to?
In what direction would you walk to get to the duck pond from the benches?
If you walked south on the path, what animal might you run into?

2. Discuss the elements of a map and how they work. What symbols do we see on this map and what do they represent? Why do we use maps? How is a map different from real life?

3. Using paper, pencils, and crayons or other media, have the students create a map of their neighborhood and/or school. Make sure they include a map key with symbols. Then they can trade maps with a partner (or take turns sharing with the class) and ask questions about each other!s maps to explore them. What information did they include, and why? What did they leave out?

Extensions
1. Look together at the Tyler State Park map at http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_003000.pdf. Compare it to the map you just looked at. What is different? What is the same?

2. Compare Google Maps with a paper street map. What are the bene! ts and drawbacks to each? When would one be more helpful than the other?

3. Make a map for an imaginary place. What information did you include? Why? How would someone move around this?

RESEARCH AND WRITING

GRADES K–6

Language Arts, Science, Art

Key vocabulary:
pollination, pollinators

PA Standards:
ELA Core
1.2, 1.4, 1.5
Science and Technology
3.1A, 3.1B, 3.1C
Environment and Ecology
4.1A, 4.1D, 4.1F, 4.3 A C, 4.4A C
Art 9.1.3, 5, 8A, 9.1.3, 5, 8B, 9.3.3, 5, 8A

Duration
Six 30! minute sessions for research and writing

Objective
Students will write a research report about a pollinator and its respective flower and turn that information into poetry or a narrative writing piece.

Method
Using Kim Kurki's magazine layouts showing the combination of illustration and text (both scienti! c writing and prose), students will choose one of the following activities, based on interest.

Materials
Online access for research
Research Questions *(Appendix, pages 38 39)*
Pollination books from library
Paper, pencils

Background

POLLINATORS & THEIR FLOWERS

Bat: Organ Pipe Cactus *(Stenocereus)*; Kapok tree *(Ceiba)*, Sausage tree *(Crescentia)*

Bee: Marsh Marigold *(Caltha palustris)*, Blue Flag *(Iris)*, Foxglove *(Digitalis)*

Butterfly: Wild Blue Phlox *(Phlox)*, Daylily *(Hemerocallis)*, Wild Geranium *(Geranium)*

Carrion fly: Stinking Benjamin *(Trillium)*, Skunk cabbage *(Symplocarpus foetidus)*, Carrion flower *(Stapelia)*

Hummingbird: Cardinal flower *(Lobelia cardinalis)*, Red columbine *(Aquilegia canadensis)*, Fuchsia, Banana

Mosquito: Small flowered orchid *(Habenaria elegans)*

Moth: Spanish Bayonet or Yucca *(Yucca)*, Tobacco *(Nicotiana)*, Evening Primrose *(Oenothera)*

Wind: Paper Birch *(Betula)*, Cottonwood *(Populus)*, Oak *(Quercus)*, and many other temperate trees, also grasses and sedges

Note: Each pollinator has a specific flower type that it prefers, but it may visit and pollinate many different types of flowers.

Procedure
Using the ! Pollinators & their Flowers! chart above each student will choose a pollinator and flower to research (scientific writing) and to create prose. Student will complete a mini-research project for both the pollinator chosen and at least one of the flowers it pollinates. Research can be presented in magazine format using Google templates, with Kim Kurki!s work as a model.

For narrative writing, students may choose one of the following activities: Write from the perspective ! rst of the pollinator, and then from the perspective of the flower, about the process of pollinating or being visited (using senses to describe the process). Dialogue could also be created between the pollinator and the flower and turned into reader!s theatre, if desired.

Helpful websites
http://www.life.illinois.edu/entomology/pollinators/docs/Pollination%20Activity%20Book.pdf

http://www.edenproject.com/learn/for-everyone/what-is-pollination-a-diagram-for-kids#QYDjTbOBbRedLeFC.97

Extension
Teachers may adapt this lesson to suit the grade level of their students and either allow student choice or assign students to specific pollinators and flowers, if desired.

Kim Kurki, *Coneflower*, ink and watercolor

GRADES K–8

Language Arts, Science, Art

Skills:
description, observation (both scientific and casual)

Key vocabulary:
observe, see, appreciate, sense

PA Standards:
ELA Core 1.5
Science and Technology 3.1.C
Art 9.1.3, 5, 8B; 9.1.3, 5, 8C; 9.2.3, 5, 8F; 9.3.3, 5, 8B; 9.4.3, 5,8B

"Watch with glittering eyes the whole world around you, because the greatest secrets are always hidden in the most unlikely places."

~Roald Dahl, *The Minpins*

MAKING A FIELD JOURNAL

Adapted from Simply Rachel *http://www.simplyrachelbyrachel.com/ 2015/04/14/nature journals for kids/*

Duration
25 minutes depending on the age/level of your students

Objective
Students will understand the importance of documenting their experiences like artists and scientists.

Method
Students create ! eld journals to record predictions, observational drawing, and collect samples.

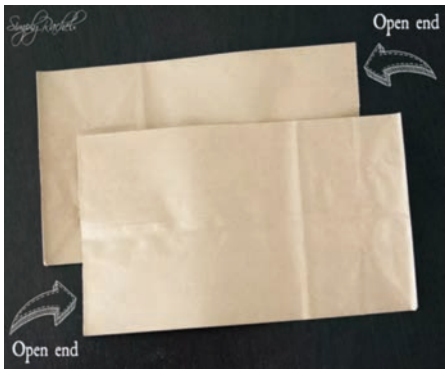
Materials
Brown paper lunch bags
(2 bags will make 8 pages, including the front and back cover.)
Scissors (for cutting your paper pages)
Glue Hole puncher Ribbon or twine Crayons or markers

Background
Science and Art have coexisted naturally since the beginning of time. The methods in which artist and scientist gather data, are in fact, very similar. Artists and scientists observe and document to have a deeper understand of things around them.

The major purpose of this activity is to have students create a ! eld journal/sketchbook. Ask students to observe outdoors! predict what they will see outside ! rst looking at plants/trees/symmetry in nature. Compare and contrast what was actually seen.

Procedure

1. Tape or glue down the flaps on each bag (what would open up to be the base of the bag).



2. Stack however many bags you are using in alternating directions. (One bag will have its opening to the left. The one on top will have its opening to the right. And repeat as you stack! one directly on top of the other)

3. Take your stacked pile and fold over in half, forming the book shape.

4. Hole punch and lace with ribbon or twine. If you are looking for a quicker, easier option stapling is the best choice. You can still dress it up quickly by placing washi tape over the front edge and wrapping it around to the back edge! creating the appearance of a binding.

5. The openings from the bags have now turned into little pockets to store little treasures. Students can collect specimens on nature walks in the pockets!

Photo illustrations from Simply Rachel
http://www.simplyrachelbyrachel.com/2015/04/14/nature_journals_for_kids/

K-8 APPENDIX

All of the worksheets and reproducibles are arranged by lesson.

Seed Bingo Card

B	I	N	G	O
Rough	Small	Spotted	Cone shaped	Hard
Brown	Orange	Smooth	Oval	Yellow
White	Round	FREE	Red	Huge
Soft	Tan	Tiny	Bumpy	Long
Long	Fuzzy	Green	Large	Black

POLLINATION PARADE CARDS

Flower Description

1. I am a bright red flower shaped like a long tube fringed with tiny petals. Hidden deep in the tube is lots of nectar. I am very showy and stand out in a crowd, but I have no scent.

Flower Description

2. I am a bright blue, sweet smelling flower. I am tubular in shape with five flat petals on the top. Peek inside. I am full of nectar.

Flower Description

3. I am a white flower. I look like a bell with five zigzag petals on top and nectar hidden inside. I have a very strong, pleasant odor that I emit after sunset. Ahhhh!

Flower Description

4. We are a cluster of tiny white star shaped flowers with nectar and a little pollen.

Flower Description

5. I am a dark maroon flower with three petals. My color has been compared to red meat. Don t get too close because I smell bad, as if I were rotting. Yuck!

Flower Description

6. I am a bright yellow flower with petals spread open wide. They make a nice landing platform so it is easy to drop in for a visit. Follow the racing stripes on my petals to my nectar supply. Watch out for my anthers, they might dust you with pollen.

Flower Description

7. I am a huge, white, funnel shaped flower on a thick, strong stalk. I smell very sweet and spicy and have lots and lots of nectar and nutritious pollen.

Flower Description

8. We are small green flowers. Nothing fancy, no petals, no sepals, no scent, just anthers full of pollen. We hang around on long stems and dangle in the breeze.

Answers: 1. Cardinal flower, hummingbird pollinator. 2. Wild blue phlox, butterfly pollinator. 3. Yucca, moth pollinator. 4. Small flowered orchid, mosquito pollinator. 5. Stinking Benjamin, carrion fly pollinator. 6. Marsh marigold, bee pollinator. 7. Organ pipe cactus, bat pollinator. 8. Paper birch tree flowers, wind pollinator.

POLLINATION PARADE CARDS

Pollinator Profile

I am a honeybee. I can t see red, but how I love those bright flashy flowers with distinctive patterns on the petals! People often miss the pattern because they can t see like a bee. Just shine an ultraviolet light on that flower and you ll see it as I do. A tisket, a tasket, I love to gather lots of pollen in the baskets on my legs.

Pollinator Profile

I am a little male mosquito. I look for tiny light colored flowers about my size when gathering nectar.

Pollinator Profile

I am a hummingbird. Red is my favorite color. Give me a flower with a long tube full of nectar. Don t bother with fancy perfume, because I can t smell a thing.

Pollinator Profile

I am a bat. I have a big appetite, so give me a flower with plenty of nectar and pollen. I am on the lookout for light colored flowers with strong, sweet and spicy smells, as those flowers are easy to find at night.

Pollinator Profile

I am the wind. I don t care much about how a flower looks or smells. I just like to blow pollen about. Whoosh!

Pollinator Profile

I am a butterfly. Give me a bright colored flower that stands out in a crowd. I just unroll my long drinking straw tongue and sip nectar.

Pollinator Profile

I am a carrion fly. I love smelly things, like dead fish or rotting meat. Yum!

Pollinator Profile

I am a moth. I like flowers that are light in color and have a strong, sweet smell as they are easier to find if you fly by night. My long tongue can find and drink up the hidden nectar.

RACHEL CARSON, A FABLE FOR TOMORROW

Activity 1 Worksheet: Rachel Carson s A Fable for Tomorrow (Part 1)

Name: _____ Date:_____

Vocabulary Matching: Draw a line from the word to its correct de! nition.

Fable	tree from Betula genus
Alder	being in the state of dying: approaching death
Malady	something that impairs or destroys
Migrant	shrubs or trees from honeysuckle family
Viburnum	a narration intended to enforce a useful truth
Blight	a person or animal that moves regularly
Birch	a disease or disorder of the body
Moribund	temperate shrub or tree related to the birch

Starter Questions:

Is this a real town?

When does the story shift? Think of how the author!s description changes.

What caused the destruction of nature and outbreak of sickness?

Activity 1 Worksheet: Rachel Carson s A Fable for Tomorrow (Part 2)

Directions: In the table below, write down key phrases or words from !A Fable for Tomorrow! that you think show the difference between the description of the town at the beginning of the story and how it changed by the end of the story. Place the ! rst set of descriptions under the title ! Town! and the second set under ! Silent Spring Town.!

Example:

Town	Silent Spring Town: *After the Blight*
• white clouds of bloom • great ferns and wildflowers delighted the traveler!s eye	• a strange blight • browned and withered vegetation

Town	Silent Spring Town: *After the Blight*

Activity 2: Drawing Two Towns

Directions: Using the adjectives, nouns, and key phrases you have written in your table, draw and color two separate pictures reflecting how the town changed. The pictures don!t necessarily have to be of towns, but they should reflect Carson's writing.

LENAPE HORTICULTURE

Background Information

IT IS BELIEVED that gardening or horticulture was ! rst introduced in the Lenape woodland community in the Philadelphia, Bucks County area in approximately 1000 A.D. Horticulture was a means of more stable control over the environment. Crops such as corn, squash and beans (known as ! The Three Sisters!) were planted, cultivated and harvested. Gardening marked a change in the social structure of the Lenape. A more stable food source decreased the nomadic lifestyle. Through adaptation and resourcefulness, the Lenape modi! ed horticulture into an intricate part of the woodland community. Foraging and hunting remained a big part of the Lenape life since not all groups practiced horticulture as much as others did.

Planting of Seeds
A dibble stick was used to plant a particular seed into a rounded mound of dirt. The stick was made from a tree branch with a ! re-hardened tip for planting (think of a used marshmallow roasting stick as a dibble stick). Seeds were NOT planted in a straight row.

Cultivation of Soil
Crude hoes fashioned from deer shoulder blades as well as clamshells and stone implements were used in breaking up soil.

Nurturing of Crops
Great time and energy went into maintaining the communal garden. Most gardens were situated close to a water supply where in times of drought, water could be carried in gourds. Proper placement of crops was accomplished through trial and error, adapting a particular technique for a more bountiful harvest.

Protection of Garden
The garden keeper was a basic structure or platform whereby a young child or elder of the village would sit in hopes of frightening birds and animals away that could destroy the crop. They also hung gourds to act as birdhouses to attract birds that feed on insects to the garden area.

PLANTS USED BY THE LENAPE AS FOOD

CULTIVATED PLANTS

Corn (Maize *Zea Mays)*
One of the ! Three Sisters! Corn is the most valuable of all U.S crops and was introduced from Mexico and spread throughout the country. Corn arrived in the eastern U.S. woodlands (this area) about 1000 A.D. which was about a 1000 years after beans and squash. It took over 7,000 years for corn to go from teosinte to a cob as we know it.

De! nition of *teosinte* (from *Merriam Webster Dictionary)* any of several tall annual or perennial grasses (genus *Zea)* of Mexico and Central America that have small dark triangular seeds and include two species *(Z. mays parviglumis* and *Z. m. mexicana* synonym *Z. mexicana)* which are closely related to and often considered ancestral to corn.

The Lenape grew several types of corn: red, white and blue corn were used in the preparation of food. The majority of communal garden was planted with white flour corn. Green corn was boiled or roasted and used for corn bread. Ears were stripped of the husks and hung on poles to dry. Shelled kernels were stored in grass baskets and placed in storage pits. Husks were used to make rope (cordage), for making rugs and roo! ng material. Corn silk was boiled into tea and used for kidney ailments.

Beans
One of the ! Three Sisters!
Many beans including green, snap, string, wax, navy and pinto beans, are members of the kidney bean family. Windsor beans were ! rst brought by early settlers from Europe. Kidney and lima beans come from Central America and soybeans from China. Beans were planted near corn so that the stalks could be used as supports for the bean plants. Ripened beans were shelled and sun-dried for storage. Beans were boiled for eating as well as pounded and mixed with bear grease. Corn and beans cooked together was a favorite dish known as succotash. Beans were also used as game counters for the Lenape children and elders.

Squash
One of the ! Three Sisters!
The Native Americans taught colonists how to grow and cultivate squash. Squash and pumpkins were planted between corn hills. This helped keep the soil moist and cut down on weeds. Squash and pumpkins were boiled and then added to bear grease. Squash and pumpkins could easily be dried and kept in food pits for future use. The seeds of the plant could also be dried providing good sources of protein and vitamins A and C. Gourds were ! rst used as waterproof containers.

Sunflower
The giant sunflower head contains seeds. Once harvested, the seeds are dried and ground into oil for cooking. It was also used as a hairdressing for sheen.

Sun Chokes (Jerusalem Artichokes)
This plant is neither an artichoke nor from Jerusalem! it is related to the sunflower. Once harvested in the fall, the tubers (roots) of the plant are boiled and eaten, or could be stored. The leaves are dried and stored.

FORAGED PLANTS

Pokeweed
This perennial plant is edible in small of amounts of young shoots under one foot tall, however older plants are poisonous. Pokeweed sprouts similar to asparagus, while the leaves are more like spinach. Leaves were boiled twice as food preparation in soups and stews. The purple berries made dye for face paint and other uses. The root was used to treat rheumatism.

Cattail
This aquatic plant provided an abundance of food for the Lenape. The roots of the cattail were dug in the spring and fall. Once dried, the roots were made into flour for cooking. In summer, the flower heads were cooked and eaten similar to corn. Pollen from the plant was used as flour for breads. Young plants were boiled and eaten as celery. The plant leaves were also used to make mats. The fluffy seed down was used as the lining for baby diapers. The root was used as a remedy for kidney stones.

Stinging Nettle
Young plants and leaves were cooked as a green. Stinging qualities were removed with cooking.

Milkweed
Young shoots, leaf tips and flower buds were boiled and eaten as a cooked green. The root was used to treat epilepsy.

Mayapple
The small fruits were collected when slightly yellow and ripe and the outer pulp eaten. The seeds are poisonous.

Lambs Quarters
This annual spinach was ! rst brought by early settlers, however other members of the goosefoot family were present here pre-contact. Once foraged, the wild spinach was either boiled or dried. Flour was prepared from the seeds of the plant. Plants called wormseed were given both to humans and animals to cure intestinal worms. Roots of the plant were grated and used in soups.

Arrowhead
This is an aquatic plant. The Lenape searched in shallow marshes and ponds by using their bare toes to ! nd plant tubers. Once removed from the mud, the tubers floated to the top of the water for easy collection. Arrowhead was roasted much like a potato by being baked in a cooking ! re. The plant was foraged in the spring, fall and winter.

RESEARCH & WRITING

Worksheet: (Part 1)

Name: _____ Date: _____

Pollinator Research Questions

1. What is the name of the pollinator? _____

2. Where does the pollinator live/what is its habitat? _____

_____

_____

3. How does the pollinator collect the pollen? _____

_____

_____

4 How does the pollinator transfer the pollen? _____

_____

_____

5 How does the pollinator use the pollen? _____

_____

_____

_____

6. How has the pollinator adapted to make the collection of pollen easier?

_____

_____

_____

_____

Worksheet: (Part 2)

Name: _____ Date: _____

Flower Research Questions

1. What is the name of the pollinator? _____

2. Where does the flower live/what is its habitat? _____

3. Where is the pollen located in the flower? _____

4. How does the flower attract the pollinator? _____

5. How does the pollinator help the flower? _____

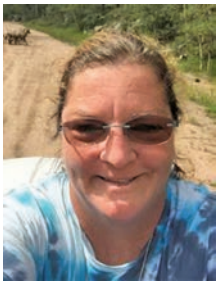
6. How has the flower adapted to make the pollinator's job easier?

Left to right: Jennifer Garey, Eileen Streeter, Cassandra Gunkel, Fran Orlando, Melody Hunt, Cayla Belser

OUR CREATIVE TEAM

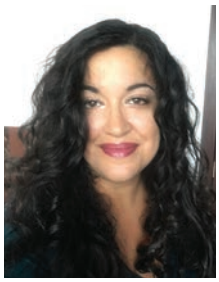
GUEST CURATOR

Liz K. Sheehan is an educator and independent curator of contemporary art with particular interests in public, interactive, and interdisciplinary projects. In 2016 she developed exhibitions for the Hunterdon Museum of Art in Clinton, NJ and the James A. Michener Museum in Doylestown, PA. She is currently working on a monograph and exhibition with photographer, Bruce Katsiff. Sheehan has degrees in Art History and Museum Studies from Bowdoin College and Tufts University.



CURRICULUM WRITERS

Lisa Buffardi, M.Ed, is Pennsylvania Certi! ed in Biology, General Science, Environmental Science and K-12 Special Education, and teaches at Bensalem High School.



Carly Noella Najera has over 8 years! experience in education, teaching high school Art and Literacy classes from Philadelphia to Bucks County. She was the K-12 Art Curriculum Coordinator for Bensalem Township School District where she introduced AP Studio and AP Art History, and co-chair of the PSEA ! Touch the Future! art show. She is member of the Bucks County Intermediate Unit Visual Art Advisory Council. Najera holds a B.F.A. from Tyler School of Art in Painting and Art Education and a M.Ed. in Reading from Cabrini University.

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