Theme-based Garden Design and Education in a Pollination Garden

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Chicago's North Shore

Carrie Whitacre, Assistant Curator, Herbaceous Gardens

Candace Lutzow-Felling, Director of Education

Emily Ford, Lead Environmental Educator

BLANDY EXPERIMENTAL FARM

University of Virginia

Workshop Outline

- Introduction
- Background
- Redesigning the Garden
- Identifying themes
- Model an activity
- Reflect & Share

- Blandy Experimental Farm is a 712-acre University of Virginia environmental science research facility.
- The State Arboretum of Virginia occupies the central 172 acres of Blandy & is open to the public 7 days a week, year-round.
- Located in Boyce, Virginia.

Our Mission:

To increase understanding of the natural environment through research & education

Pollination Garden Redesign Goals

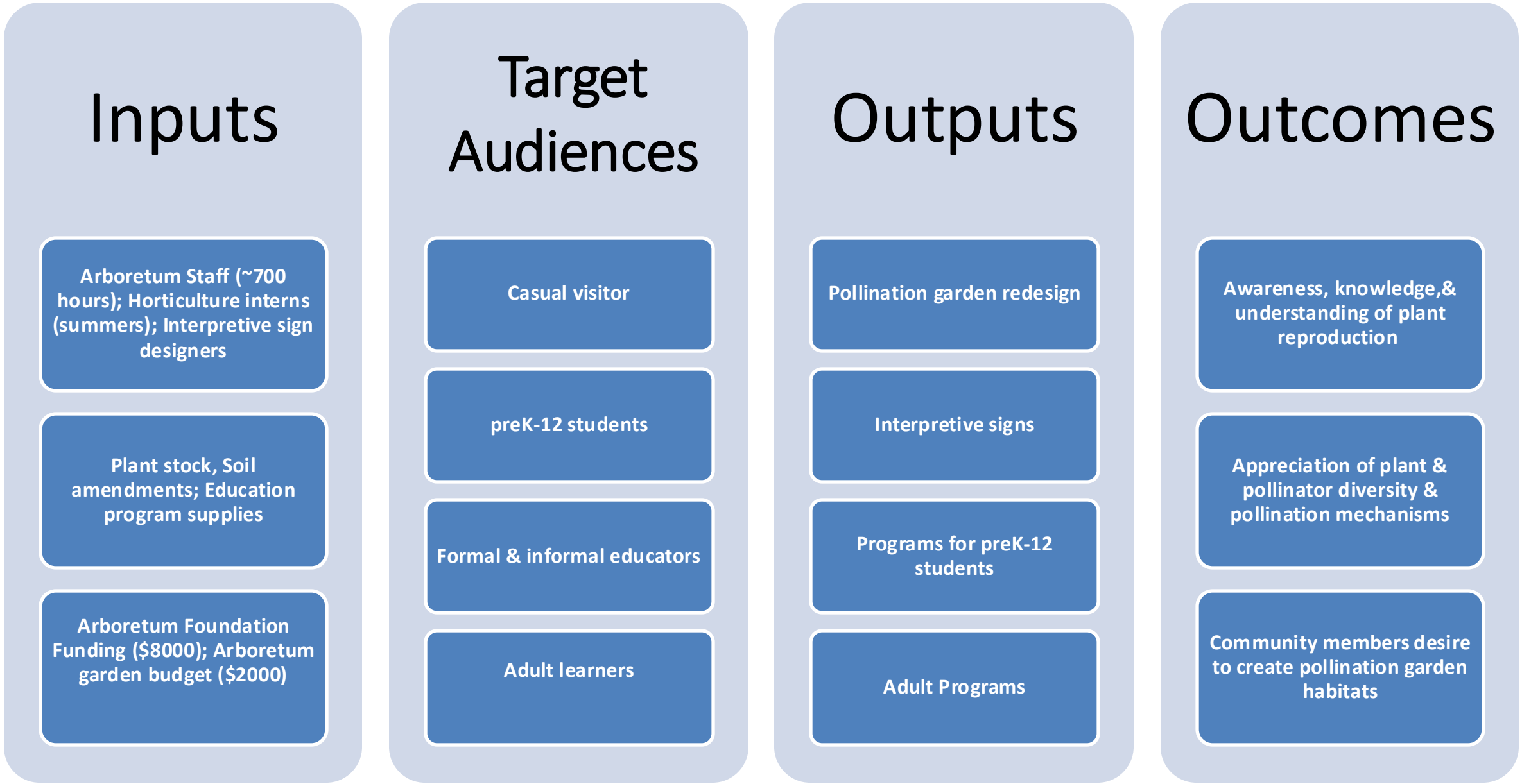
Overarching goal: Increase the garden's education & outreach impact

Create a pollination garden that:

1. **Serves as a showcase for pollinator-attracting native plants**
2. **Is interesting & accessible for a variety of age groups**
3. **Increases visitor knowledge & appreciation for floral diversity, pollination mechanisms, & plant-pollinator adaptations**
4. **Provides a meaningful education resource for the Arboretum's preK-12 school programs**

Pollination Garden Design: Pollination Themes

1. What is pollination & how does it happen?
2. What is a pollinator & why do they visit flowers?
3. Why is pollination important to people?
4. What adaptations do pollinators have to promote pollination?
5. What adaptations do plants have to promote pollination?
6. How do I create a pollination garden in my yard?



Pollination Garden Redesign Logic Model

The Original Pollination Garden Design

BED 1

This bed is a general overview of pollination featuring shade plants.

BED 2

This bed highlights pollinator attractants.

BED 3

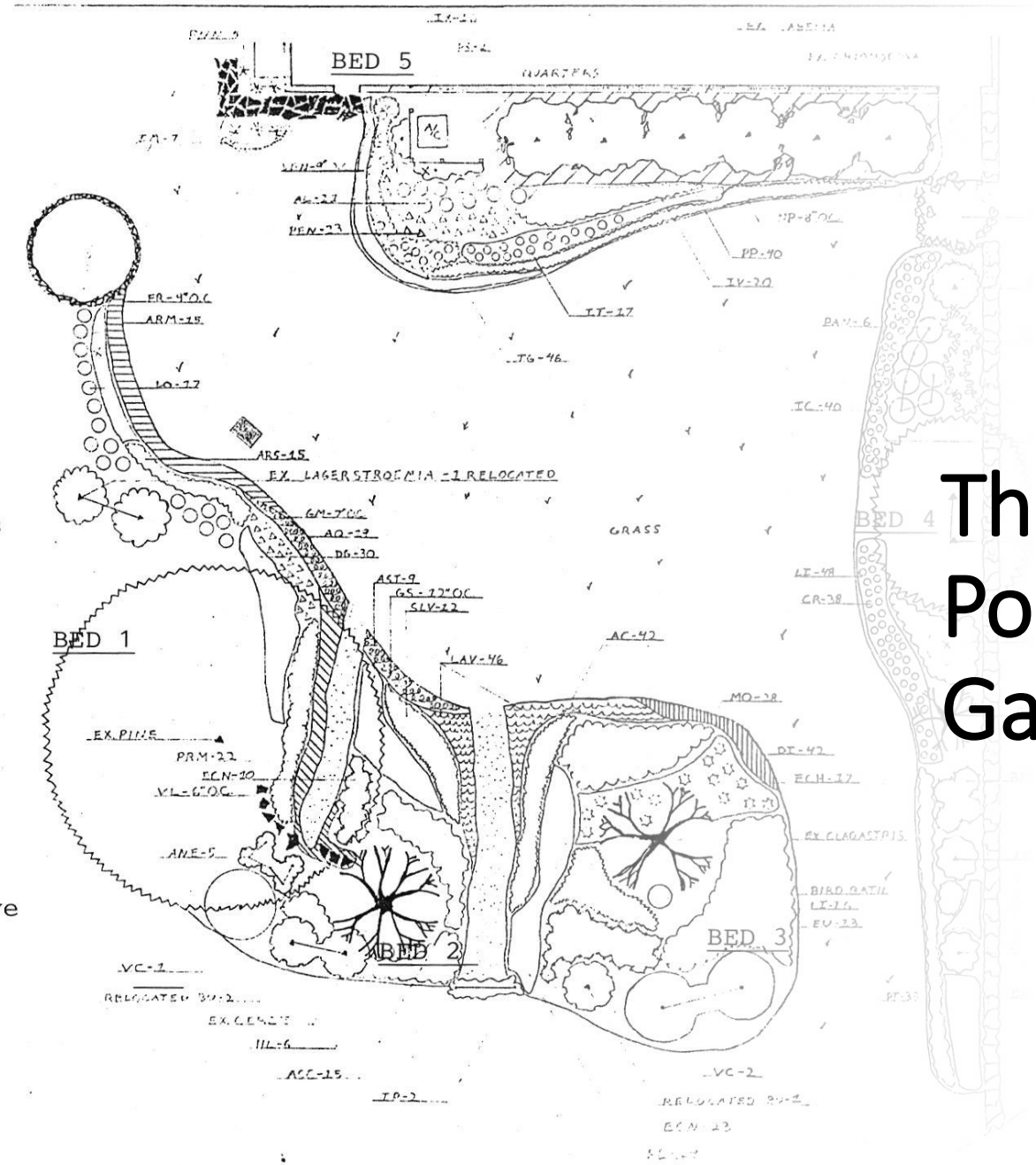
This bed has an emphasis on plants which offer nectar sources.

BED 4

This bed features larva host plants.

BED 5

This bed depicts the results of man as selective pollinator (hybridizer).



The Garden in 2010

Prior Plant Selection

Nonnative plants:
Montauk daisy
Nipponanthemum nipponicum

Woodland sage
Salvia nemorosa
'Rose Queen'

Montauk daisy
Photo by: Leonora (Ellie) Enking
http://creativecommons.org/licenses/by-sa/2.0

Woodland sage
Photo by David J. Stang
CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

Prior Plant Selection

Invasives:
Butterfly bush
Buddleia davidii

Italian arum
Arum italicum
'Pictum'

Butterfly bush

Italian Arum

Prior Plant Selection

Relying on annuals

Collaboration

The Team:

- Research Professor/Curator
- Public Programs Director
- Education Team
- Assistant Curator/Horticulturist

Goals Set for the Garden:

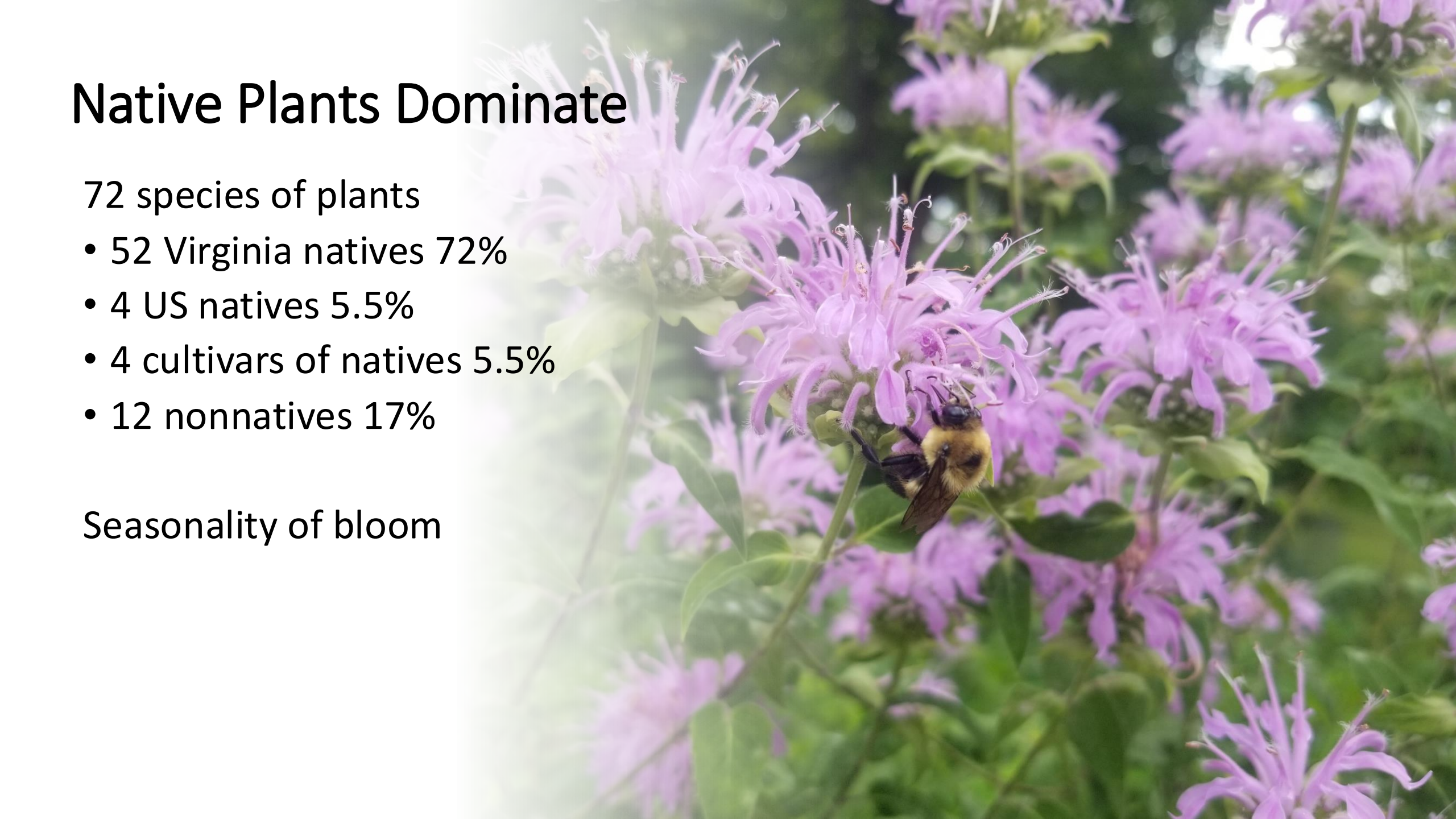
- Virginia native plants dominate
- Seasonality of bloom
- Design for better access for closer observation
- A call to action

Native Plants Dominate

72 species of plants

- 52 Virginia natives 72%
- 4 US natives 5.5%
- 4 cultivars of natives 5.5%
- 12 nonnatives 17%

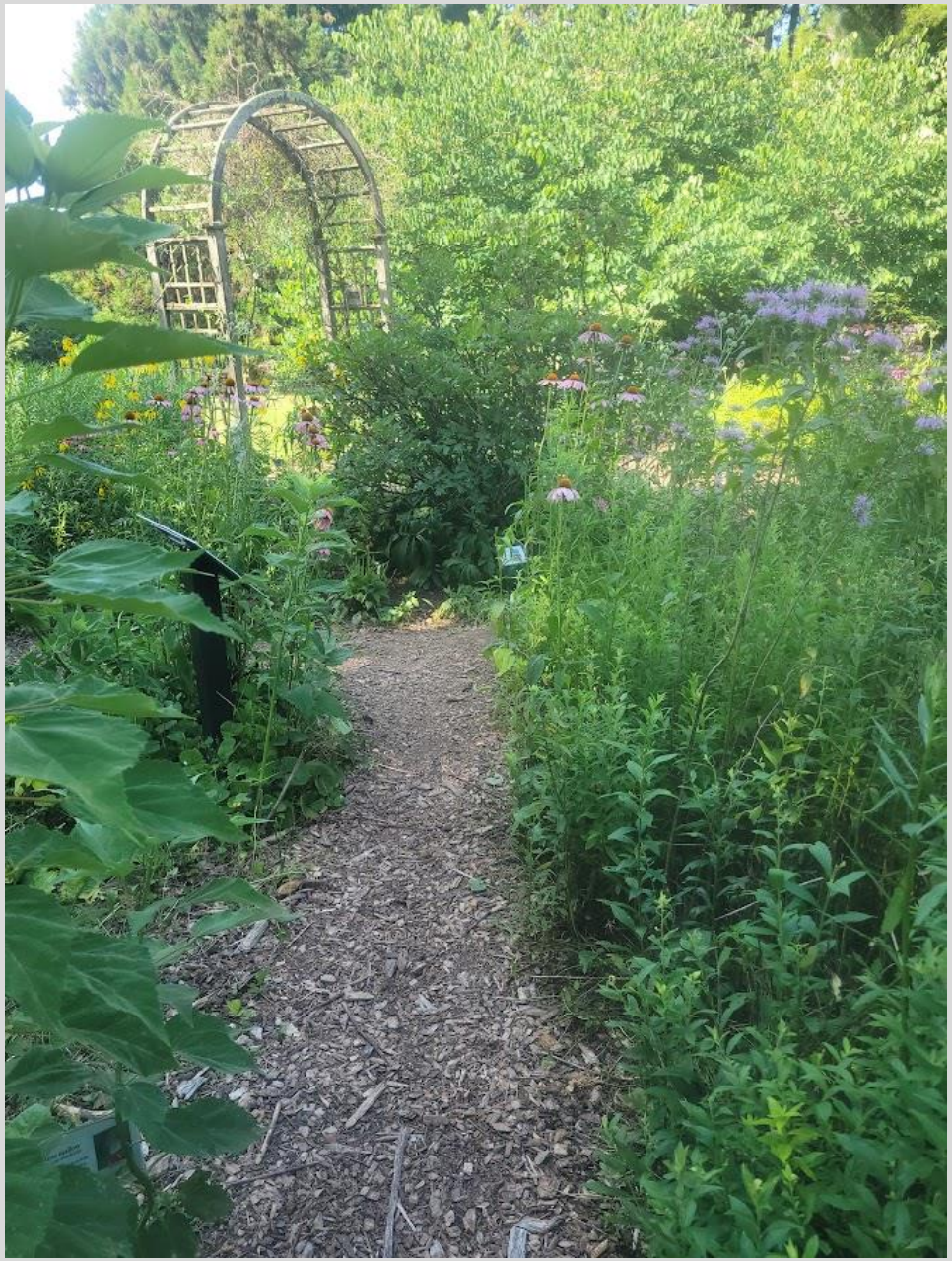
Seasonality of bloom



Design for Better Access

Paths allow better observation of interactions.

Feel a part of the garden instead of looking in from the outside.



A Call to Action

Inspire people to appreciate the importance of pollinators.

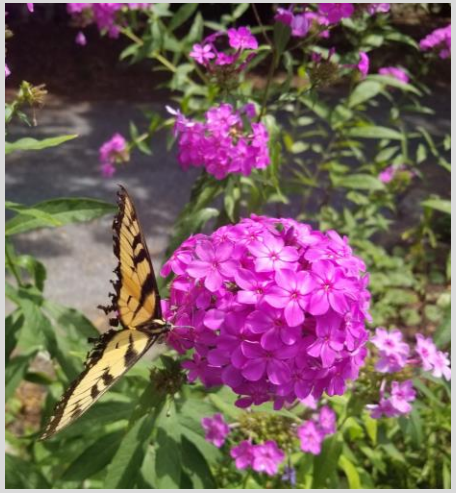
Encourage best practices and the planting of natives in home gardens.

Never use pesticides

https://www.mtnbrook.org/mbee/page/how-are-pesticides-insecticides-herbicides-harmful-pollinators

Plant large swaths of perennials

Easy to find and grow perennials



Perennials that bloom spring to fall

Maintenance and Future Plantings

Changed maintenance season
Plants that seed

Always adding new perennials
Still moving things around

Goals for Education

- Identify themes
- Communicate themes effectively
- Audience accessibility

Identifying Themes

What is pollination & how does it happen?

- Scientifically accurate but also a sufficiently broad definition to encompass most pollination mechanisms
- Simply put…pollination is the transfer of pollen from one flower to another flower.

What is Pollination?

Pollination is the transfer of pollen from flower to flower.

Have you ever seen a bee land on a flower? It is collecting pollen and nectar for food.

As bees search for food, they carry pollen from the male part (anther) of one flower and deposit it onto the female part (stigma) of another flower.

Female
Stigma
Style
Ovary containing ovule

Male
Anther
Filament

Magnified pollen grain

A pollen tube forms, allowing the male cell to travel to the female cell in the ovule, resulting in fertilization.

The fertilized ovule forms a seed and the ovary develops into a fruit to protect the seed. Many of these seeds and fruits are foods we like to eat.

Bees are just one type of pollinator. Come meet my pollinator friends!

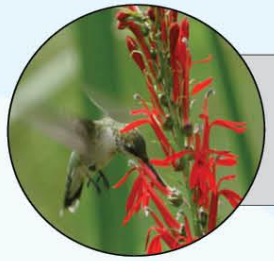
Identifying themes

What is a pollinator and why do they visit flowers?

- Pollinators grouped by type both in the garden beds and the signs
- Emphasized pollinator diversity
- Pollinators need support throughout their life cycles, not only as adults
- Used photographs and phrases that are accessible
- Regionally accurate (As in, Virginia does not have bat-pollinated plants, so we did not include bats as a pollinator in the garden redesign.)

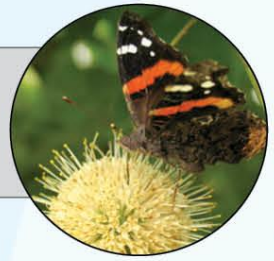
Meet the Pollinators

Bees pollinate many of the fruits and vegetables we like to eat.



Hummingbirds accidentally get a face full of pollen when feeding on flower nectar. Photo: US Fish & Wildlife Service

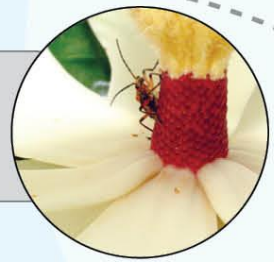
Butterflies are dusted with pollen while sipping nectar from flowers.



Moths get covered in pollen while using their tongues like straws to sip nectar.

My pollinator friends include many insects, birds, and even the wind.

Beetles were one of the first pollinators to evolve. They pollinate large, open flowers like magnolias.



Ants aren't very efficient pollinators, but some flowers rely on them for pollination.
Photo: Nicholas Rivell

Wind moves the pollen of grasses, conifers, and many other trees. Much of this pollen lands in the wrong place, like our noses, causing us to sneeze.

Flies are often considered pests, but some species are valuable pollinators.

Identifying themes

Why is pollination important to people?

- Awareness
  - A diversity of pollinators
  - food production and food security
  - More than honeybees pollinate
- Stewardship
  - How people can help pollinators
- Accessibility of plants in this garden
  - Easy to purchase and grow
  - Easy to maintain

Pollination & People

Pollinators are necessary for human survival but they need our help.

Pressures on pollinators include:

- Habitat loss
- Loss of food plants
- Invasive plants and animals
- Climate change
- Misuse of pesticides and other chemicals
- Pollution
- Diseases and parasites

Without pollinators we wouldn't have many of our favorite foods:


Apples


Tomatoes

Honey


Pears


Oranges


Peppers


Almonds


Coffee


Cherries


Strawberries

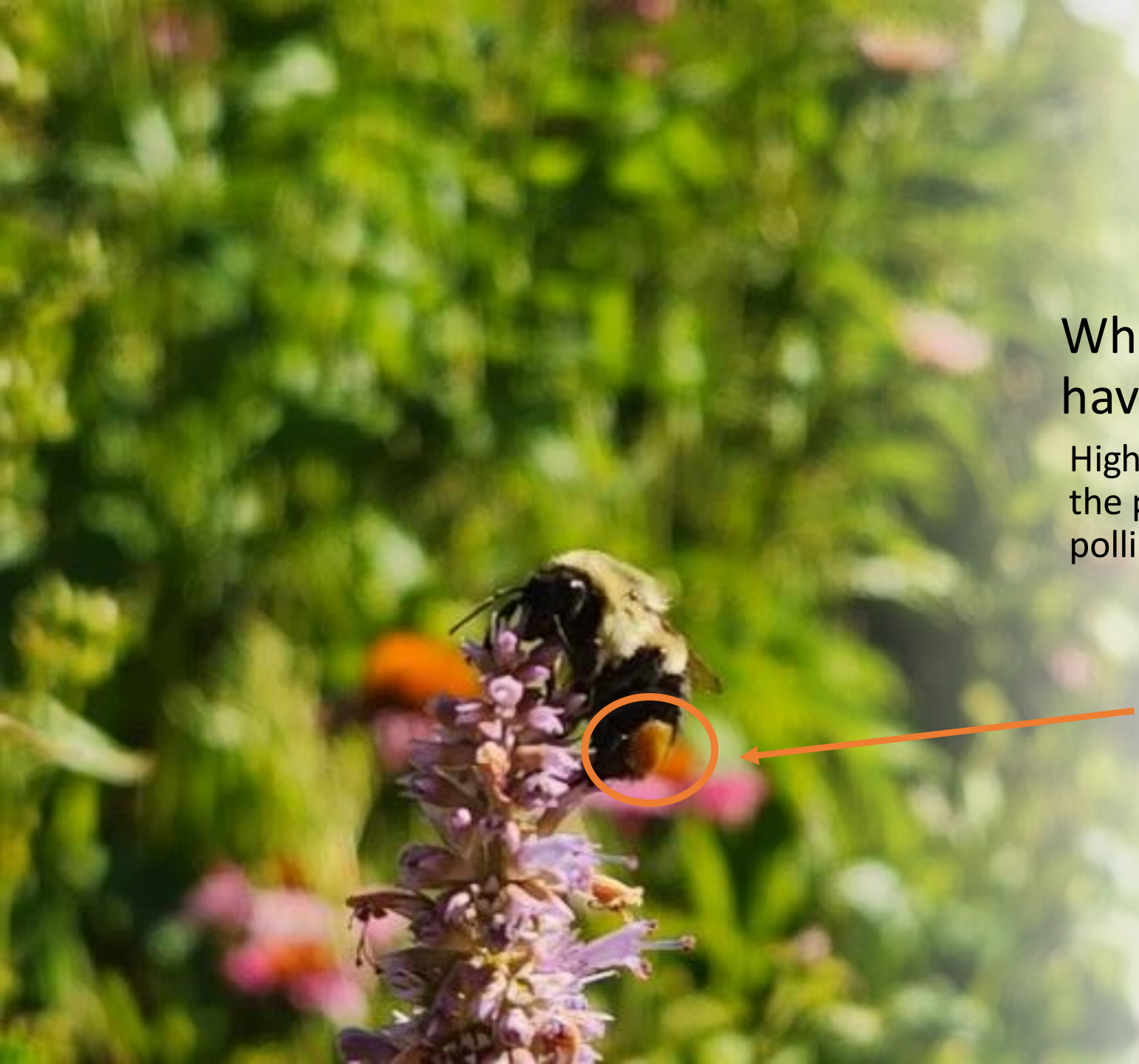

Chocolate


Watermelons

Photos Via Flickr: Apple, Alan Sheffield; tomato, Lee Ann Barker; honey, John Spooner; pear, Joe King; oranges, Pamela Caris; pepper, Liz West; almonds, HealthAliciousNess.com; coffee, waferboard; cherries, Keith Williamson; strawberry, Liz West; cake, Chad Nitwick; watermelon, Jessica Alpern.

How you can help:

- Grow native flowering plants that provide food, nesting sites, and shelter for pollinators
- Avoid using pesticides
- Don't plant invasive species
- Support conservation efforts
- Encourage others to do the same



Identifying Themes

What adaptations do pollinators have to promote pollination?

Highlight several adaptations that the pollinator groups use to ensure pollination

- Highly adapted mouthparts
- Hairs
- Pollen baskets
- Buzz pollination

Small Bees Have Big Jobs

Bees rely on pollen as their primary source of protein, and nectar or floral oil for energy.
They evolved to collect this food from flowers, often pollinating them while doing so.

Collecting Nectar

Bees use their proboscis (tongue) to collect nectar for themselves and their offspring.

Large bees with **long tongues reach** all the way into the flower, like this bumble bee.

Small bees with **short tongues crawl** into the flower, like this sweat bee sticking its head in a squash flower.

Large bees with short tongues, like this carpenter bee, **bite a hole** in the bottom of the flower and "rob" the nectar without pollinating the flower.

Raising Young

Adult females collect pollen and nectar to bring back to the nest.

In most species, the pollen and nectar are put in a pile and an egg is laid on top.

The egg hatches and the bee larva eats all the pollen and nectar.

After eating, the larva pupates and begins to mature. An adult bee emerges three weeks to a year later.

Carrying Pollen

Bees use several methods to carry pollen. Look closely for bees transporting pollen in these ways:

Most bees, like the sunflower bee, collect pollen on **dense hairs on their back legs.**

Honey bees and bumble bees collect pollen in a **pocket on the outside of their rear legs.**

Mason and leaf cutter bees collect pollen **underneath their abdomens.**

Identifying Themes

What adaptations do plants have to promote pollination?

Highlight several adaptions that plants use to ensure pollination occurs.

- Entrapment
- Shape of flower and petals
- Location of pollen a "secret handshake"
- Color and scent

Some Flowers are for the Birds

Smart Pollinators

Hummingbirds learn which flowers provide nectar, no matter what color and shape the flowers are.

Reliable Friends

Virginia's hummingbirds migrate to Mexico and Central America in the fall, but return here each spring. They often nest in the same places and visit the same plants each year.

Seeing Red

Ruby-throated hummingbirds, the most important bird pollinator in the Eastern United States, typically pollinate **red, odorless, tubular** flowers that provide lots of **nectar.**

Most insects can't see red, so an odorless red flower is hard for them to find, leaving the nectar for hummingbirds.

Photo: Bill Buchanan, USFWS

Premium Services

Hummingbirds move pollen farther between flowers than insects, and unlike bees, do not eat pollen that flowers need to make seeds.

Premium Costs

Hummingbirds require large amounts of nectar for food, because they expend so much energy flying. Flowers must produce lots of nectar to attract hummingbirds, costing the plant more energy.

Identifying Themes

Interactions between pollinators and plants... and more!

- Specialists
- Generalists

A Diversity of Bees

Diverse Lifestyles

Social bees live in colonies. The queen lays eggs and the workers gather food and protect the colony.

Bumble bee colony

Solitary bees live alone. One female makes a nest and gathers all the food.

Mason bee grooming

Freeloader! Cuckoo bees do not make their own nests. Instead they lay their eggs in other bees' nests.

Cuckoo bee sipping nectar

Look for these common bees:

- ***a*** *carpenter bee*
- ***b*** *bumble bee queen*
- ***c*** *blue mason bee*
- ***d*** *honey bee*
- ***e*** *squash bee*

How Many Kinds of Bees Are There?

At Blandy: 150-200
In the Eastern U.S.: 1,000
In the World: 20,000

Diverse Food Plants

Bees visit flowers to collect pollen and nectar for food.

Generalists visit many types of flowers.

Golden northern bumble bee

Honey bee

Specialists visit specific flowers.

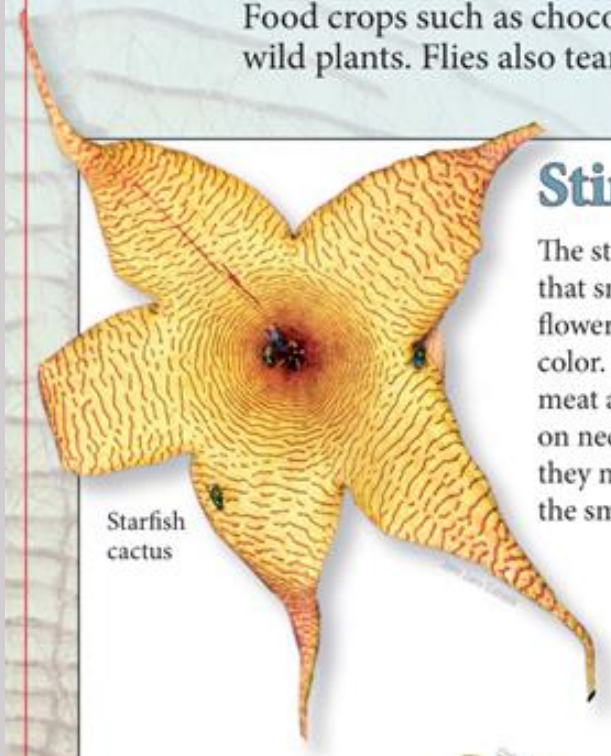
Female squash bee

Sunflower bee

Communicating effectively

Flies: The Little-Known Pollinator

Flies are the **second most important** pollinator group worldwide. Only bees pollinate more flowers. Food crops such as chocolate, tea, cashews, mangos, and onions depend on flies, as do many of our wild plants. Flies also team up with bees to bring us carrots, raspberries, and coffee.



Starfish cactus

Stinky Attraction

The starfish cactus has large, pale-colored flowers that smell like **rotten meat**. The red trillium flower has an **unpleasant odor** and dark red color. These traits attract flies that feed on rotting meat and other decaying materials. Flies also feed on nectar and become covered in pollen. When they move to another flower, often attracted to the smelly odors, they transfer pollen.

Can you find flowers in this garden with traits that could attract flies?

Fungus gnat

A Trick with No Treat

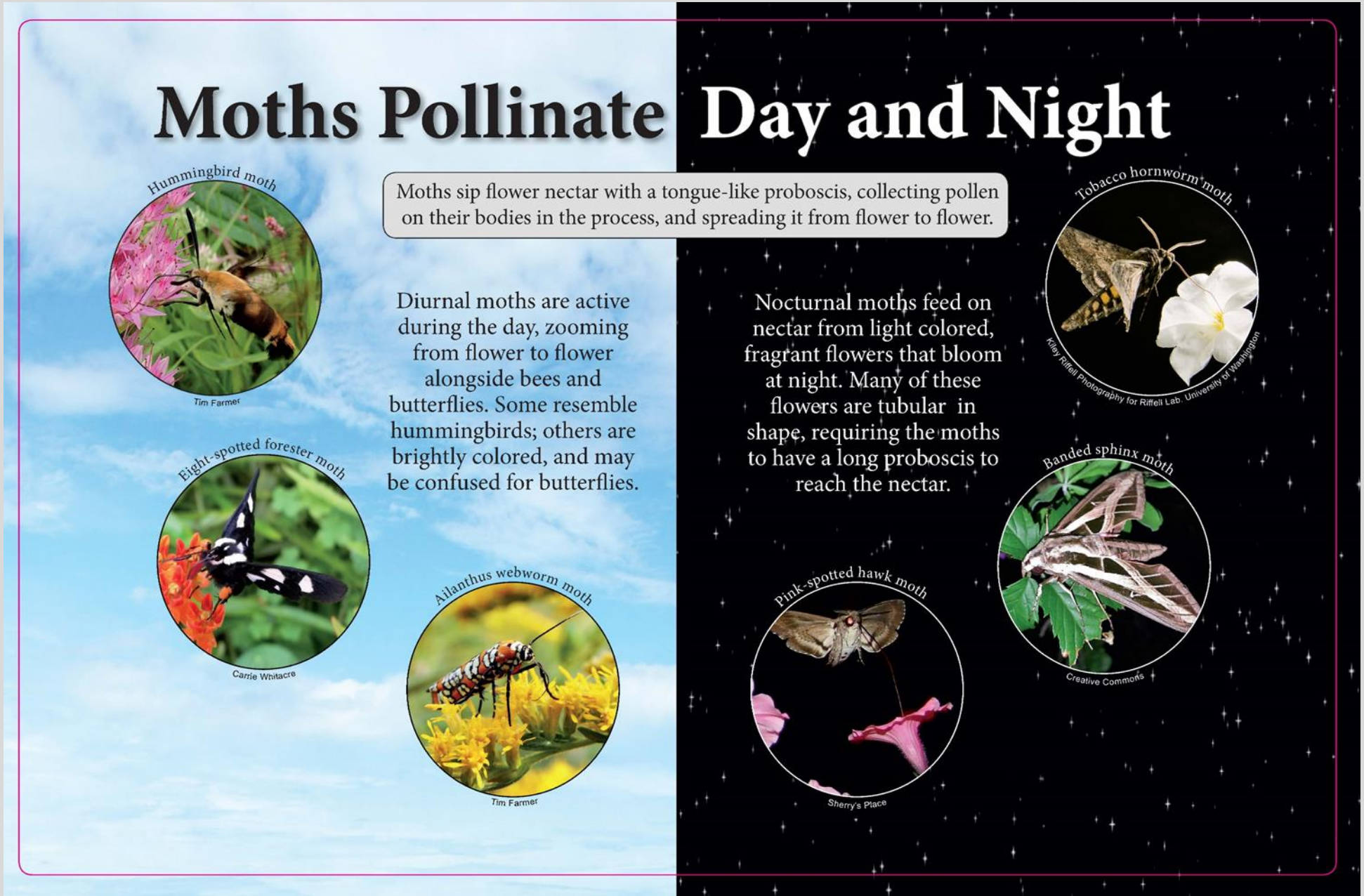
Jack-in-the-pulpit uses its fungus-like smell to attract fungus gnats, a small fly. Fungus gnats fly into male Jack-in-the-pulpits looking for a place to lay their eggs. They often get stuck because the sides are slippery and the hood at the top makes flying out difficult. Gnats get covered in pollen while looking for a way out. Usually they discover a small hole at the base allowing them to escape.

Jack-in-the-pulpit

When the pollen-covered gnat enters a female it's not so lucky. The female Jack-in-the-pulpit traps the gnat, but doesn't provide a hole for escape. The fungus gnat pollinates the flowers, but the fly is tricked and ends up dying inside.

Communicating effectively

Reaching a broad audience



Communicating effectively

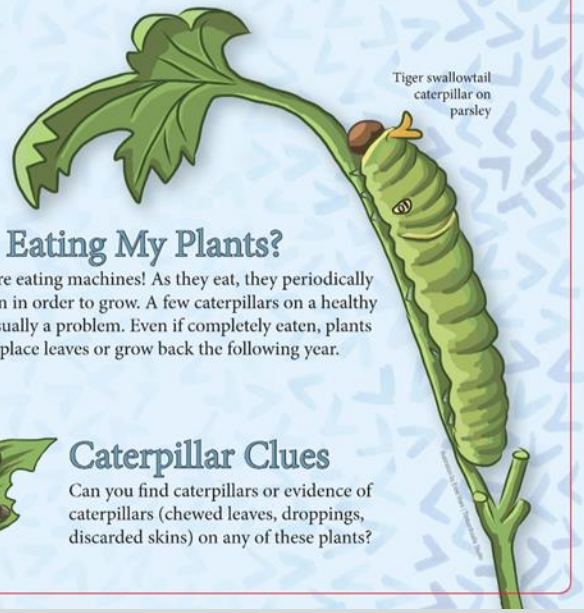
Caterpillars Raised Here

Female butterflies and moths lay their eggs on the leaves of **host plants**. When the eggs hatch into **caterpillars** (larvae), host plants provide the food they need to live and develop into adults.

Specialists and Generalists

Most caterpillars are **specialists**, eating only leaves from one or a few related plant families. You might say they are picky eaters.

Other caterpillars are **generalists** and feed on a larger variety of plants. If you want butterflies in your garden, plant a diversity of host plants.



What's Eating My Plants?

Caterpillars are eating machines! As they eat, they periodically shed their skin in order to grow. A few caterpillars on a healthy plant aren't usually a problem. Even if completely eaten, plants can usually replace leaves or grow back the following year.

Caterpillar Clues

Can you find caterpillars or evidence of caterpillars (chewed leaves, droppings, discarded skins) on any of these plants?

Flower Nectar Feeds Butterflies

Many flowers produce **nectar**, the main **food** source for adult butterflies. The sweet liquid provides **energy** for butterflies, as well as vitamins, salts, oils, and other nutrients.

Sweet Rewards

Butterflies prefer flowers that occur in **clusters**. These clusters provide a **landing area** and lots of flowers close together. While probing the flowers for nectar, butterflies pick up pollen on their legs and proboscis and move it to other flowers they visit.

Look closely at the flowers in this bed. Some, such as asters, look like single flowers but are actually clusters of small flowers.

Sipping Nectar

Butterflies have a long, straw-like **tongue** called a **proboscis** that allows them to sip nectar from flowers. When not feeding, they coil their tongue under their head. Can you think of an advantage to coiling up a long tongue when not feeding?

Successes and Challenges

Challenges developing the interpretation?

- Team was large and diverse
- Reaching diverse audiences
- Complex processes explained in a simple way
- Editing and illustrating
- Funding

Education Activities

Share your Discoveries

How can you apply ideas & resources used here in your learning habitat?

USDA and Forest Service: Learn about Lichens

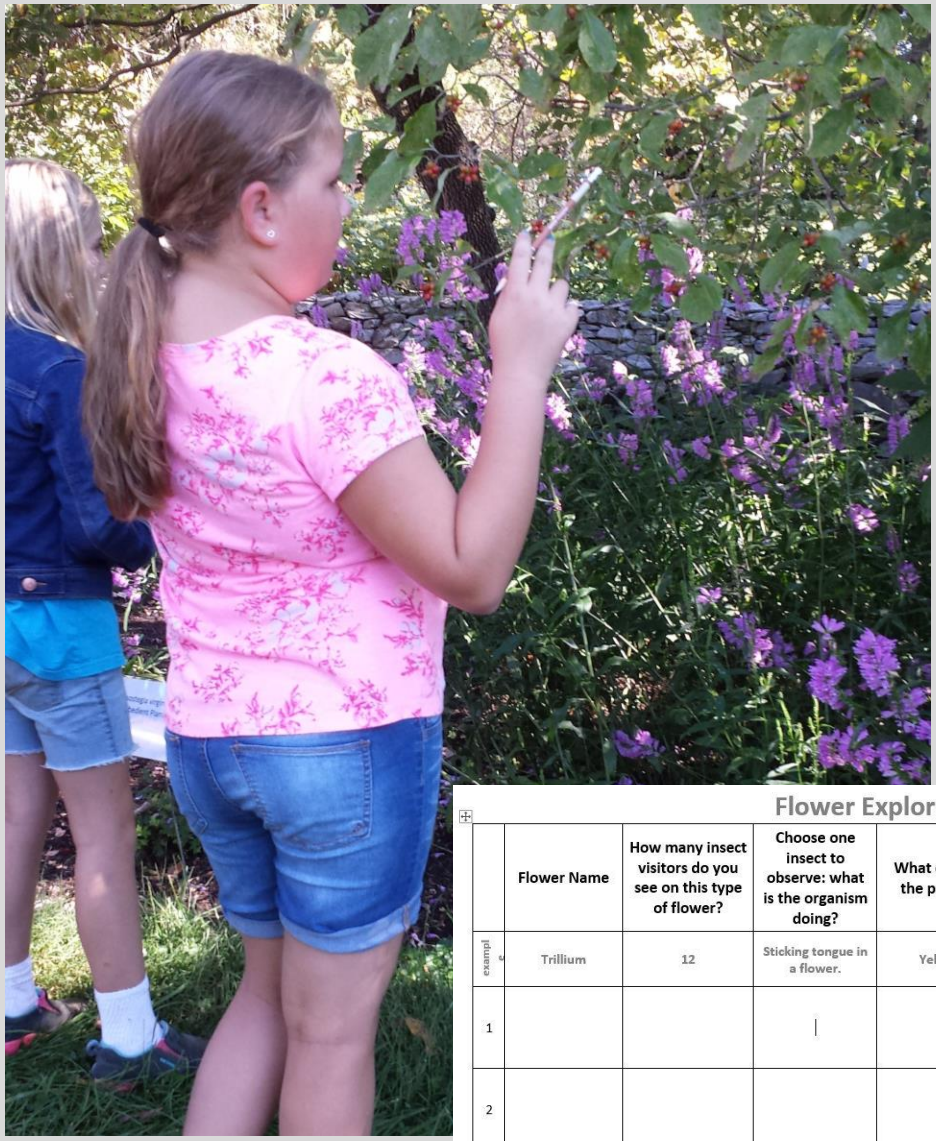
Education Activities

- **The collaborative nature of the Pollination Garden redesign facilitated new education activities as well as revision and refinement of existing education activities.**

- **Plant Parts & Functions for early elementary**

Education Activities

- **The collaborative nature of the Pollination Garden redesign facilitated new education activities as well as revised and refined education activities.**
- **Flower Functions & Diversity for upper elementary**



Flower Explorations

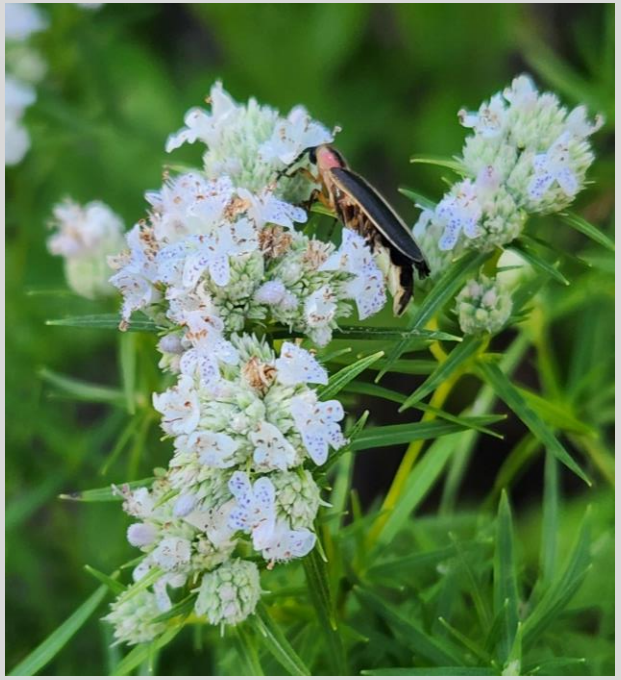
	Flower Name	How many insect visitors do you see on this type of flower?	Choose one insect to observe: what is the organism doing?	What color is the pollen?	What evidence can you find of pollen being moved from flower to flower?	Number of Sepals	Number of Petals	Number of Stamens	Number of Pistils
						If more than 10, write "many"			
example	Trillium	12	Sticking tongue in a flower.	Yellow	Petals have fallen off the flower	3	3	6	3
1									
2									
3									
4									
5									

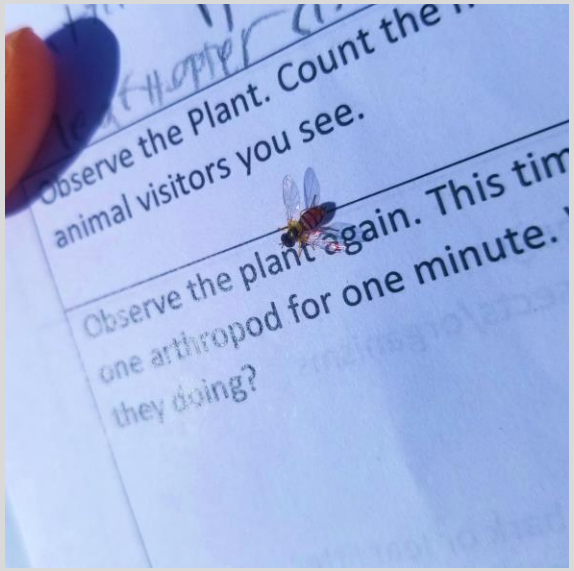
Developed by Education Programs at Blandy Experimental Farm 540-837-1758 https://blandy.virginia.edu/

Education Activities

- **The collaborative nature of the Pollination Garden redesign facilitated new education activities as well as revised and refined education activities.**

- **Pollinator Diversity Study for Middle School**
- **What Plant Where? for upper elementary and middle school**





Pollination Station: Flower Pollinators

Student Names _____

Record Plant Name from label	
Observe a cluster of flowers for 30 seconds. Count the **number of all animal visitors** you see on the flower.	
Observe the same cluster of flowers for one minute. **Count the different types** of visitors (ex. Big bumblebee, red butterfly, stink bug.) You are not counting each organism but type.	
Choose **one insect** visiting the flower you are observing and **observe** it for **one minute**.	
What is the organism **doing**?	
Is the animal getting nectar or pollen? Doing something else?	(circle one) Nectar Pollen
Do you see **pollen** on the animal?	Yes No
Where is the pollen located?	
Describe any evidence that pollen is being moved from the flower.	

Encourage Inspire Empower

Online Resources

Blandy Web Pages & Resources https://blandy.virginia.edu
Blandy Education Activities https://blandy.virginia.edu/content/ed-programs-activities-and-lessons
Xerces Society https://xerces.org/
Pollinator Partnership https://www.pollinator.org/
National Association for Interpretation https://nai-us.org/
Your state native plant society

Thank you!

BLANDY
EXPERIMENTAL FARM

University of Virginia

Carrie carriewhitacre@virginia.edu
Candace lutzow-felling@virginia.edu
Emily emilyford@virginia.edu