Greensgrow Garden Activities:
Engaging urban youth in experiential environmental learning

In collaboration with:
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Abstract

Greensgrow is an urban farm located in Philadelphia whose mission is to provide an essential connection to food and nature in an urban community, connecting wellness through green space and promoting the greening of Philadelphia’s homes and gardens. As they grow and develop as a non-profit, they are seeking to build more extensive educational opportunities at their farm. This project builds off a previous work creating activities for a somatic curriculum for Greensgrow. Last semester, three environmental studies seniors created 8 activities, to which we will add 15 more to create a more comprehensive booklet for Greensgrow to run activities starting in fall 2021. Through this work, we hope to connect urban-living students with nature, expanding their knowledge of and connection to the land. Through movement-based activities, students will gain a greater understanding of a variety of environmental topics such as pollination, water, plant identification/characteristics, and more. Ultimately, students should feel empowered and passionate about making their urban environments more green and connected with nature.
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Introduction

Greensgrow is a non-profit that is both an educational urban farm and a demonstration garden. Co-founded by Mary Corboy and Tom Sereduk in 1997 Greensgrow, has been focused on working towards supplying urban communities with organic foods and access to nature. Today, the organization is looking to expand itself through its formalization of youth education. The purpose of this project is to build an engaging and interactive curriculum that is centered around agriculture and environmental education.

Our role in this project is to create a curriculum that inspires students to care for the world around them moving forward while simultaneously fostering a desire to learn more on their own. We break down complex environmental topics through approachable and engaging activities. The primary aim of this project is to create a portfolio of environmental activities that will engage the local community in gaining a stronger connection to the land and enhance their environmental education foundation.

This project will cover several environmental topics, including, but not limited to:

- Species diversity
- Water Quality and Management
- Mycology
- Waste and Composting
- Plant Physiology and Anatomy
- Pollination
- Food Web Interactions

Goals

- To educate students through play and other intrinsically motivated activities - to move away from traditional classroom structures
- Somatic education - to incorporate physicality, movement, and embodiment into the learning process
- To inspire students to seek out environmental education and connections to the environment in their daily lives
Relevant Literature


https://doi.org/10.5032/jae.2016.04174

“Cultivation construct had the greatest positive outcome on urban middle school youth; students who had a family garden were more interested in participating in the school garden; and students greatly enjoyed the culinary aspects of school garden programs.” This paper gives good insight into using gardens for middle school students and knowing what works best and what is less effective.


Awesome article about using community gardens for environmental and science education. Shows how it can integrate so many important topics into educational programming and helps put an emphasis on diversity, trust building, cultural awareness, etc. Gardens can teach students many many important life skills!


https://dspace.library.uvic.ca//handle/1828/11694

Super cool project (Indigenous Garden Project) where students created this project/curriculum centered around learning about and growing native plants and using indigenous techniques, honoring historical values and creating sustainable practices. Includes recommendations for educators who want to start a garden-based learning space. Also talks a
lot about decolonization in education and issues regarding racism and settler colonialism in outdoor education vs. garden-based education. Super interesting.

*Garden lesson plans—Growing Minds.* (n.d.). Retrieved March 6, 2021, from

https://growing-minds.org/garden-lesson-plans/

List with lots and lots of cool garden lesson plans!

Urban Farms in Philly doing awesome educational work:

1. Philly Peace Park
   a. https://www.phillypeacepark.org/
2. Food Moxie
3. Farmer Jawn Philly
   a. https://www.farmerjawnphilly.com/
4. Mill Creek Farm
   a. https://www.millcreekurbanfarm.org/
ACTIVITIES
Monarch Butterfly Life Cycle and Migration

Bucket Topic(s): Butterflies, Ecosystem, Diversity, Species interaction

Background: Monarch butterflies are the most familiar butterfly in North America for many people. They are important pollinators, and while they feed on a variety of plants as adults, they require milkweed plants as larvae in order to grow into adults. Because of urbanization, pesticides, and other anthropogenic causes, many plant species, including milkweeds and other nectar plants are declining in number, making it more difficult for monarch butterflies to find food sources.

Materials:
- Cups
- Soil
- Milkweed seeds
- Open field space

Objective: To plant individual milkweed plants students can bring home; to learn about butterflies, native insects, pollination and monarch butterfly migration patterns.

Steps:

Part 1: Planting Milkweed and Butterfly Life Cycle
1. Give each student a cup, have them fill it with soil
2. Give each students 3 milkweed seeds to plant in their cup
3. Play a game to learn about the butterfly life cycle!
   a. Everyone gets on the ground and can only use their fingers and toes to propel their movement around - this is the caterpillar stage
   b. Next stage is chrysalis -- two students grab each other’s arms, locking them together, and one student hangs from the arms to demonstrate a chrysalis hanging from a leaf/stem/branch
   c. Evolving into a butterfly, students can run around the field flapping their arms like a butterfly

Part 2: Monarchs and Monarch Migration
• Read a children’s book about monarch butterflies (alternatively just teach students about monarchs as a
native butterfly to North America and their migration patterns yourself by talking to them, can use
resources below or other images or videos if necessary!)
  a. Good options:
     ■ Gotta Go! Gotta Go!
     ■ Hurry and the Monarch,
  b. Sign up as an educator to get free pdf access to Monarch Butterfly:
     ■ They are the only butterfly known to make a two way migration like birds
     ■ Eastern North America monarchs travel to Mexico for winter
     ■ Western North America monarchs travel to California for winter Migrate south (to
       Mexico) in autumn
  4. Play a game to learn about monarch migration!
    a. In a large open space, designate different area to represent different areas where monarchs live
       (northeast North America, southeast, northwest, southwest)
    b. Assign half of the students to the east population and the other half to the west population.
       Send them to their respective sides of the field.
    c. Call out different times of the year, the students must run to the section where the monarchs
       live during that year (north or south). Students must flap their arms like a butterfly flying to
       another location when moving from spot to spot.

Additional Resources:

https://www.monarchwatch.org/
An award-winning educational web site and outreach program from the University of Kansas that “engages
citizen scientists in large-scale research projects,” whose collected data assists conservation efforts. Monarch
Watch provides a wealth of information on the biology and conservation of Monarch butterflies, and its tagging
program, and suggestions to grow butterfly gardens and waystations involve children of all ages in science.

https://scoutlife.org/hobbies-projects/funstuff/168358/monarch-butterfly-habitat/
To build a monarch butterfly sanctuary.

https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/migration/#:%3A:text=The%20monarch%20is
%20the%20only%20way%20migration%20as%20birds%20do.&text=Using%20environmental%20cues%20the
%20monarchs%20reach%20their%20winter%20home
More about migration.
Higher Level Ideas:

- Learn more about native species and pollination in a game
  - Assign half of the students to be plants (male and female plants), the other half to be pollinators
  - Male students start with all the pebbles
  - Pollinator students run to the males, takes some pebbles and bring them to female plant students
  - Females produce seeds and foods once they receive enough pebbles
  - Everyone can share the food that was used for the game at the end
Making Mycelial Connections

**Bucket Topic(s):** Ecosystems, Symbiosis, Non-Human Cognition, Biomimicry

**Background:**

Though all you see aboveground are the mushrooms, the true bodies of fungi are much, much, larger. Most of the fungus is made up of thread-like strands called **hyphae** that spread through the soil, looking for food. These hyphae form complicated webs under the ground. The largest single fungal web scientists have ever found covered 3.4 square miles - that’s a single fungus covering almost 1,600 city blocks and weighing as much as 3 blue whales!

But why are fungi so big, and so complicated? It’s all about food. Foods that fungi can eat aren’t spread out evenly through the soil. For example, some fungi might need a nice rotting stump to digest, while others feed among the roots of very specific partner plants. To keep growing, the fungus needs to make a path connecting all of these different food sources in its environment, so it can feed on all of them at once. It also wants to make this path as **efficient** as possible - that means it wants to get as much food as it can, doing as little work as it can. Growing new hyphae is a lot of work, so it would be great for the fungus to connect all the different food sources in its environment by the shortest path possible.

Finding these very short paths turns out to be a really tricky problem. For example, the shortest path to connect the corners of a square looks like this:

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     /
   /  
______/______
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**Materials:**

- 8 large wooden stakes
- 1 spool of twine per 4-5 students
- Yardstick

**Objective:** To inspire students to think about “simple” organisms around them (i.e., mushrooms and fungi) as complex problem-solvers.
Steps:

- In advance, drive the wooden stakes into the ground in a random pattern, leaving enough length sticking above the ground to tie the twine to.

- Explain the background information through a short mini-lecture/discussion. The description above can be used as a script, modified according to time and student interest.

- Divide students into groups of 4-5 and provide each group with a spool of twine. Instruct students that their job is to connect the “mushrooms” (wooden stakes) with the shortest length of “hyphae” (twine) that they can. Each group should spend ~5-10 minutes stringing together their “mushrooms” while the other groups rotate through other short activities.
  - To create a point where 3 hyphae meet, follow the diagram below:

1. Connect 2 of the stakes with slack in the string
2. Pull the connecting string tight
3. Tie the string from the third stake around the bend in the other string

- When each group has finished, photograph their “mycelium” and unstring it to prepare for the next group. Save each group’s twine separately. Once all groups have made their mycelia, have them measure the length of twine they used with the yardsticks. The group with the shortest length wins!

- Discuss with students whether they found this to be difficult or easy, what kinds of challenges they faced. Point out that fungi do this kind of thing every day without even having a brain to think.
For higher levels:

Networks in nature aren’t just efficient: they’re also resilient. Natural environments are full of things that could mess with hyphal threads: munching earthworms, flash floods, even human activity. However, fungi can adapt to this challenge by creating resilient networks. This means that even if you sever one of the threads, the network as a whole still holds together. The square network above is not resilient: cut any of the threads, and you’ll be cutting off at least one of the green dots from the others. As an extra challenge for more advanced learners, have students try to incorporate this property of resilience into their hyphal networks, while still keeping them as short as possible.
Grow A Carrot Top
Bucket Topic(s): Recycling, Plant Growth

Background: Have you ever observed a plant grow overtime? Did you know that you can use your old veggie scraps to grow something new? This activity is a wonderful way to teach students about plant growth while simultaneously showcasing that out of old carrot scraps, new growth can sprout. It’s important to note that the carrot top plan will not produce another carrot, but instead your students will have a beautiful house plant.

Materials:
- Carrot top (2-3 cm from stem with some root growth remaining on the top)
- A shallow petri dish
- 10 cotton wool pads
- Water
- Sun
- Journal
- Pencil

Objective: This activity will educate students on how root vegetables are grown as well as provide them with an understanding of how food scraps can often be recycled and can re-grow. This activity will help strengthen students' observational skills.

Steps:
- Either buy a few carrots and chop off the carrot tops or find a few leftover scraps with the carrot top still intact.
- Place several cotton balls on a plate or shallow dish and add water until the cotton is moist.
- Place the carrot top on the wet cotton, orange side down.
- Add water as needed day to day.
- Have students log the changes they observe over time in their journals.
- Ask students to include illustrations week to week.

Higher Level Idea: This higher-level activity is for older students to learn about absorption and how plant roots absorb water. For this activity, use the entire carrot, but cut the tip of the carrot off and place it into a jar filled halfway with water. Put ten drops of any food coloring into the glass of water with the carrot inside. Leave it overnight. The next day using a cutting board cut the carrot in half, and students will be able to observe the food coloring in the leafy green part of the carrot and inside of it. Explain to students that the colored areas in the carrot show how water travels and absorbs from the tip of the carrot to the leafy green part; these pathways are called xylem.
Winter

Setting Up a Worm Compost Bin

(adapted from: https://www.cvswmd.org/uploads/6/1/2/6/6126179/do_the_rotThing_cvswmd1.pdf)

Bucket Topic(s): Composting, Worms

Background: ‘Worm composting is a fun, low maintenance way of recycling your organic kitchen scraps. Worms eat your vegetative food scraps, turning them into a high quality fertilizer known as worm castings. You provide the living environment for the worms—the bin, bedding, and food—and the worms do the rest. Worm composting can be done inside or outside (depending on climate), requires no turning, is odorless if done correctly, and can be done in small spaces. Worm composting is most appropriate for food scraps. The compostable matter we throw away—such as apple cores, melon rings, and soggy bread—are things that worms like to eat. Red Worms eat food scraps and break them down into rich, dark brown, earthy-smelling material called worm castings. Castings, which are nitrogen-rich fertilizer, can be returned to the earth and are good for lawns, gardens, and houseplants.”

Materials:

- Worm bin
- Bedding materials
- Handful of soil
- One pound of worms
- Water
- Collection container
- Worms at School worksheet

Objective: Set up their own worm composting bin and learn about the importance of worms in relation to composting, soil, and garbage.

Steps:

1. Teach students about worms and their importance!
   - Ex: “Worms are incredible decomposers. The worms we use for composting in boxes are surface feeders called *Eisenia fetida*. They are also called manure worms, red wigglers, or redworms.”
Over 7,000 species of worms inhabit the world, and they are important to ecosystems. In ancient Egypt under Cleopatra’s rule, it is reported that anyone who knowingly killed a worm would be sentenced to death. Today, there are engineers in India who are learning how to clean sewage water using worm systems. There are lots of fun facts to know about redworms. They have five pairs of hearts, no eyes, and no teeth. They breathe through their skin, and need dark, moist surroundings. Eight adult redworms can produce 1,500 offspring within six months, if conditions are favorable. Each worm is both male and female and can eat over half of its weight in food every day.”

2. Buy, scrounge, or build a worm bin:
   - A worm bin can be made of wood, plastic, or other materials.
   - The size of your classroom worm bin should be at least 1½ square feet, and about 16 inches deep.
   - Good ventilation is essential for aerobic decomposition and a healthy environment for worms.

3. Prepare Worm Bedding:
   - Tear newspaper into ½” to 1” wide strips (tear lengthwise, with the grain).
   - Dunk newspaper strips in water and add to bin.
   - Add a handful of soil and fluff.
   - Toss everything like a big salad.

4. Add worms and food:
   - Purchase or obtain about 1 pound of red worms (about 500 to 1,000 worms)
   - Gently place worms in the moist newspaper bedding near the bottom of the bin.
   - Put a handful or so of food waste near the worms and cover well with the moist newspaper bedding.
   - Add more dry shredded newspaper to fill the bin, and then a layer of burlap or cloth.

5. Explain to participants that using worms to compost our food scraps makes sense for a lot of reasons:
   - We will reduce the amount of garbage we create.
   - Compost improves the soil and makes it hold water better.
   - Using compost reduces the need for chemical fertilizers, which helps prevent the creation of more pollution.
   - Composting with worms is fun!

6. Let your worm bin rest by not adding additional food for 1-2 weeks. This allows the worms a chance to get used to their new environment and for the food to begin to decompose.
7. For ongoing maintenance, feed every three to seven days, always burying the food under paper. Do not overfeed. Bad smells or large amounts of uneaten food indicate overfeeding. Add more paper as needed to cover food.

8. Harvest castings after three to six months. (See “Harvesting a Worm Bin,” p. 36.)

** If you start this in late winter, compost can be ready for spring planting season!
(see pdf for more)
Spring

Making a Mini Ecosystem

Bucket Topic(s): Ecosystem, diversity, species interaction

Materials:

- Clear jar or empty 2L bottle
- Small rocks/pebbles
- Dirt/soil
- Moss
- Large rocks
- Variety of small plants

Objective: To allow students to build a diverse ecosystem. To learn about habitats, including biotic and abiotic factors and what each organism needs to survive and how they can help one another.

Steps:

1. Add rocks and soil to the bottom of a jar or plastic bottle
2. Add damp moss or other lichen -- this can be found naturally or purchased-- onto the soil
3. Accessorize: add in larger rocks and plants to your liking
4. Seal the lid and leave outside or near a window!
Higher level ideas:

- Make a more advanced ecosystem that includes two levels—water with a fish in bottom and plants on top. Consider using seed shrimp or freshwater isopods to create a longer term, easier to maintain ecosystem.

- Discuss mutualistic relationships in biology—how different organisms interact with one another within habitats. Point out the biotic and abiotic things in the ecosystem. Use this handout. Act out the relationships between different organisms.
Designing A Rain Garden

Bucket Topic(s): Water cycle, Native Plants

Background: As more regions across the United States become increasingly more urbanized, towns and cities develop more impervious surfaces that don’t allow for water to be absorbed. This can increase stormwater runoff that can enter and pollute our waterways through storm sewer systems. Rain gardens can assist in directing water through the soil as well as be used to harvest water to help keep fertilizers or other pollutants from getting into our waterways.

Materials:
- Pencil and journal
- Coloring pencils
- A book or guide to plants native to Greensgrow’s Garden

Objective: Guide students in thinking more deeply about how rainwater can be filtered into their surroundings. A tool to teach students more in depth about the water cycle, storm water drainage, water quality, and the environmental impacts of urbanization.

Steps:
- Guide the students to walk around the garden. Instruct them to find a location for their imaginary garden.
  - Keep in mind that when choosing a location for your imaginary garden students need to look for areas where there are natural dips in the earth and they need to make sure it is located at least 10 feet from a house or building.
- Figure out a reasonable size and shape for your garden.
- Ask students to now walk around and observe the types of native plants in your area.
- Identify a few perennial plants. Encourage students to take notes as they find plants for their gardens.
- Give students 10-15 minutes to sketch their rain gardens in their journals. The following questions should be highlighted in there drawings:
  - What types of plans have you chosen for your garden and why?
  - What types of pollinators do you suspect might gravitate to your rain garden?
  - Why did you pick this specific location?
  - What is already in or near the space of your rain garden?
- Note: Refer to this activity handout for guiding questions, as well as in-depth instructions.
**Level 2:** Now that you have a well designed diagram of your rain garden, assist your students in actively creating a rain garden. You can find instructions on how to construct a rain garden [here](#).

**Note:** Building your own rain garden might take a few hours and this activity requires additional materials that were not included in the primary level of this activity.
Making Your Own Field Journal

Bucket Topic(s): Observation, Scientific Inquiry, Biodiversity

Materials:
- Paper
- Needles
- Sturdy thread
- Cardboard
- Glue
- Miscellaneous art supplies
- Magnifying glasses

Objective: Students will learn to bind a simple book to record their observations of nature in order to promote multi-sensory engagement and personal investment in the process of scientific observation.

Steps:

- Explain the importance of field notebooks to real scientists - making observations, noticing small details, keeping good records, etc. For higher levels: additionally, discuss the importance of scientific illustration vs photography, and some of the benefits illustration has for researchers.

- Explain to students that they will be making their own field journals to record observations of the local nature. Provide them with paper, cardboard, needles, and thread, and walk them through the process of binding a pamphlet book:
  - Gather together as many sheets of paper as you want for your book, then fold them all in half together.
  - Mark five evenly-spaced spots on the spine of the book, referred to as 1 through 5, and pierce through them with the needle.
  - Thread the needle with a length of thread about equal to your arm span, and tie the ends of the thread together to make a large loop. Pull the knot so it is at the opposite end of the loop as the needle.
  - Open the book to the exact middle and put the needle through hole 3 (the middle hole), going from the inside of the book to the outside. Don’t pull all the way through - leave the know and a bit of the loop on the inside of the book. Then go back in through hole 5, out through 2, in through 4, out through 1, and back in through hole 3.
Pull the needle through the bit of loop you left in the previous step, then pull the thread tight. Tie the thread around that loop, cut off the extra, and you’re done!

This is called a pamphlet stitch book - many variations for increased or reduced complexity can be found online.

Once the books have been bound, students can decorate and personalize the covers however they want. Suggested decorations: flowers and leaves that can be modge-podged onto the cardboard cover of the journals.

During any downtime, students can use their journals to make observations of any interesting finds they come across at Greensgrow - plants, insects, birdsong, etc. Encourage students to be as detailed as they can in their observations, using whatever format (sketches, written descriptions, etc) is most meaningful and interesting to them.

**Suggested Extension: Plant stamps**

- Provide students with a selection of plants from which a small number of leaves and flowers can be removed. **For higher levels:** use this as a jumping-off point to discuss sustainable harvest from wild/foraged plants.

- Using a paint roller, students should roll acrylic paint onto the underside of their chosen leaves & flowers.

- Use a rolling pin to press the painted surface of the leaves onto the covers of the students’ journals.

**Suggested Extension: Pollinator web**

- Ask students to record in their field journal any time they observe a pollination interaction. This could be at Greensgrow or at home. They should draw the plant carefully for identification later, and get as much detail as they can about the pollinator to make a guess at the species. Students should mark these pages in whatever way is easiest for them to remember.

- At the end of the program, print out photographs of any species students observed as part of a pollination event and pin them to a cork board. Have students use string to connect any pollinator/plant pairings they observed in their field journal to create an ecological web of pollinator interactions at Greensgrow. Students should put a separate string for each individual observation, so the strengths of the mutualistic relationships can be seen.
Prehistoric Plant Activity

Bucket Topics(s): Plant Identification

Materials:

- Sample of a fern
- Sample of a gymnosperm
- Sample of an angiosperm
- Sample of a bryophyte
- Paper
- Pencil

Objective: Through observation, students will learn to identify the common features of ferns, gymnosperms, angiosperms, and bryophytes. Through discussion, they will learn about how these specific characteristics assisted in the way they adapted to their environment over time.

Steps:

- Have instructors provide samples of the four types of plants, as well as this additional handout to provide students with a clear understanding of the following plant types.
- Introduce students to the common characteristics of each plant type.
- Ask students to call out a few similarities and differences they have found through observation.
- Have students split into groups and walk around the garden and identify and choose four samples of each type of plant. Bring along a guide book if necessary to help assist in identifying the plants.
- Have each group create a plant comparison chart that clearly bullet points the differences and similarities between each plant type.

For higher levels: Evolutionary timeline

- Have each student choose one of the prehistoric plants they found during the activity. At least one member of each major group - bryophytes, ferns, gymnosperms, and angiosperms should be chosen.
At home: students should research the plant they chose to find out when members of its group first evolved. They should try to be as specific as they can: for example, gymnosperms as a whole are at least 330 million years old, whereas the pine family specifically is only 200 million years old. The activity is more fun the more specific they can be, but they shouldn’t get too hung up on it.

Additionally, have students research one prehistoric organism of their choice, from any time period, and find out when it evolved.

During the next session at Greensgrow, unroll a sheet of butcher paper along the ground - the longer the better. Get a student volunteer to draw a long line in marker all the way from one end of the paper to the other. Label one end “500 Million Years Ago” and the other end “Today”.

Have students illustrate their chosen plant and their additional organism in roughly the right spot on the timeline - tick marks every 50 million years along the timeline might help with placement. Encourage them to have fun with their drawings, and not to worry if two people pick the same organism. These things existed for many millions of years, not just at one point in time, so duplicates are fine. Circulate around the timeline to ask students if they found anything interesting in their research.

Hang up the timeline somewhere at Greensgrow. 
Plant Features Scavenger Hunt

Bucket Topics: Plant Observation and Identification

Materials:

- Close up photos of different plants on the grounds/in the farm printed out onto sheets of paper
- Plant features information sheet

Objective: To teach participants to pay more attention to the plants around them and make observations about parts of plants they may usually overlook.

Steps:

In advance of activity

- Choose a few different plants on the grounds and take photos of their different features.
- The photos taken should be solely of micro features of each plant, such as leaf veins, leaf edges, and budding patterns. The photos should be close up and very detailed, avoiding showing large sections of the plant or immediately identifiable structures (e.g., if a participant’s identification target is a tomato plant, don’t add a picture of a tomato to their sheet, only micro features), so it requires close observation of each plant to identify.
- Put the photos for each individual plant to find on a sheet of paper. (you may give participants a single plant or multiple plants to identify, depending on how long you want the activity to last)

During Activity

- Hand out the identification sheets to each participant.
- Instruct them to use the photos on the sheet to identify the plant being shown on it.
- Let the participants out into the grounds to search and observe each plant closely so they can find the plant(s) on their sheet.
- Ask participants to show you the plant(s) they found and point out the features that match those on their identification sheet and why they believe it is the same plant. If they are right, tell them the name of the plant (you may tell them some fun facts about it). If they identified the wrong plant, ask them to continue searching until they’ve found the right one (you may give them pointers about what they need to pay more attention to on their sheet and the plants).
- Ask participants to think about why that plant has those features. How does it benefit them? How does it work? Ask them to act it out.
**For Lower Levels:** You may restrict participants to a small area of the grounds, and give them a certain section or specific plants to search, narrowing down the amount of plants they will have to observe to find the plant in their identification sheet.

**For Higher Levels:** With their identification sheets, give the names of the types of structures in each photo, such as what the plant vein style is called. You may write some extra information (not especially identifiable) on the sheets about the plants, such as what type of plant it is or where in the world it comes from. After the plant search is over give more detailed information of the plant.

Plant Morphology Sheet Example:
Flowering Plant Classification

**Bucket Topic(s):** Botany, Biodiversity, Taxonomy, Evolution

**Materials:**
- Magnifying glass
- Scissors
- Pencil
- Field journal

**Objective:** Students will learn the major features that distinguish monocot plants from dicot plants, and will be able to identify wild flowering plants as belonging to either the monocot or dicot group. This will allow students to engage scientifically with many kinds of plants they come across without having to memorize in-depth identifications.

**Steps:**
- Present students with an explanation of the two major angiosperm groups, monocots and dicots, and a description of the differences that distinguish the two groups. Pass around samples of plants demonstrating each trait. The stem cross section features may best be shown with magnified photos.
  - **Leaf veins**: monocots and dicots have different patterns of veins in their leaves. Monocots have long, straight veins running parallel to each other, whereas dicots have a complex, net-like pattern of veins.
  - **Petal number**: monocots tend to have numbers of petals that is a multiple of 3, whereas dicot petals usually come in multiples of 4 or 5. This is not a hard and fast rule, though.
  - **Stem cross-section**: this is best seen under a magnifying glass. Plant stems are full of tubes called xylem and phloem, and these are arranged differently in monocots and dicots. In monocots, the tubes are scattered randomly through the stem, whereas in dicots they form a neat ring around the center.
- Provide students with magnifying glasses and tell them to explore the garden looking for examples of monocots and dicots. When they find a plant they like, they should draw the key identifying features in their field notebook, and try to classify it as a monocot or a dicot. Students should observe and classify 3-5 examples of each group.
Observation Matching

Bucket Topics: Biodiversity, Teamwork, Observation

Materials:
- Clipboards
- Pencils
- Notebook or printer paper

Objective: Students will develop their observation and communication skills, both visual and verbal, in order to help them notice and appreciate the biodiversity around them.

Steps:
- Sort students into two roughly equal groups based on whether they would prefer to write or draw. This activity should be done for at least two rounds, time permitting, so that all students have the opportunity to try both the writing and drawing versions.

- Give students time to explore the garden and find plants that interest them. Instruct them to create descriptions of the plants they like, in the form of detailed written notes for the writing group and detailed illustrations for the drawing group. Each observation should be on a separate sheet of paper. On the back of the sheet, students should write the name of the plant. Give the students a target number of plants to describe based on available time, assuming 3-5 minutes per plant (can be adjusted if students go much faster or slower than anticipated).

- At the end of the observation period, have students gather back together and lay their observation sheets across a large table. The instructor should number (lightly in pencil, so that it can be erased) each of the sheets. Then, students should read/look at all of the observations, and try to identify which pairs of observations were made of the same plant. Encourage students to discuss their thoughts with each other, but for students who made any particular observation not to drop too many hints.

- Reveal the identities of each observed plant. Optionally, give out small prizes to students who made the most correct identifications.

- Swap the drawing and writing groups, and repeat for as long as students are enjoying themselves.

Notes:
Each round of the activity should focus on a different sub-area of the garden. This ensures that within each round, there are duplicated observations between the two groups, but that the same plants won’t appear across successive rounds.

This activity would pair well with the Plant Features Scavenger Hunt, or with Flowering Plant Classification.

**For higher levels:** Combine with a workshop on plant anatomy and terminology. See [Plant Features Scavenger Hunt](#) for diagrams of plant anatomy terms. Walking around the garden, show students examples of each of these terms in living plants, and encourage them to pay special attention to depicting these features accurately in their observations.
Water Filtration Experiment

Bucket Topics: Water cleaning and filtration

Materials:

- Large jugs (at least 3, more depending on needs)
- Small cups (same amount as jugs)
- Dirt
- Grass seed
- Organic material (dead leaves, grass clippings, pine needles, etc)
- Puddle water (collected street water or other dirty water, needs to have impurities in it)
- Optional
  - Gravel
  - Sand
  - Clay
  - Other inorganic materials
  - Other small plant seeds

Objective: Teach participants about the role plants and other organic factors have on water filtration, and how plants and organic materials are important to cleaning water, especially in cities.

Steps:

- Give participants the large jugs and instruct them to fill them with the designated materials (contents/number of jugs can vary as you wish). Suggested set up is:
  - Jug 1: dirt mixed with organic material. Plant grass seed (or other small plant/mix of plants). If you don’t have time to wait for the grass to grow, you can have it all pre-planted for observation.
  - Jug 2: dirt mixed with organic material (no living plants)
- Jug 3: dirt (or other mix of earth) without any plants or organic material
- More jugs as needed can contain different mixtures or layers of sand, gravel of varying sizes, or other combinations of materials
- Cut a small hole near the bottom of the jug to drain water and place small cups underneath to catch the runoff.
- Let the participants water the jugs (with the dirty puddle water, or similarly impure water) and observe the color of the water that collects in the cups.
- Keep doing this as the grass seeds grow, and observe whether the color of the collected water changes over time. Compare it to the other jugs.
- Ask participants to describe what this experiment shows, and then explain the importance of plants to clean water.

**For Higher Levels:** Let the participants experiment with the contents of the jugs, mixing materials as they want to experiment with how well it filters the water. Let them try and come up with a mix that makes the cleanest water.

Give participants pH tests and let them find the pH of the puddle water, then the pH of water that collects in the cups after filtering through the various jugs. Teach them about different pH levels and what they mean.

**Notes:** This activity can also be used to teach about erosion, and how plants are useful in keeping the ground from eroding away and causing things like landslides.
Species Identification & Art

Bucket Topic(s): Plant identification, art and creativity

Materials:
- Notebook/paper + clipboard
- Pen or pencil, colored pencils/markers/crayons

Objective: Engage with the farm and learn about identifying various plants that grow on the farm.

Steps:
- Walk through the garden, give a tour of various plants around the garden (teach them about each plant a little bit - can go more in depth for higher level age groups)
- Let the students walk around and pick their favorite plant in the garden
- Each person sits down by the plant with their paper and pencils
- Let them create a depiction of their plant for 30 minutes (draw an image of the plant as best as they can, write a poem about it, something that inspires them in their spot, some observations about their plant)
- Group comes back together and everyone presents their drawing and the things they observed/came up with
- Game time!
  - Compile all the papers in a pile.
  - One person comes up in front of the group at a time. Person at front picks a paper from the pile. They have to verbally describe the plant (Younger kids -- it has big green leaves, it’s fruit is round and leafy, etc. Older kids -- it is from X family, it’s roots are X, more scientific descriptions than younger kids). All other students have to guess which plant they’re describing (this can be done in one large group or split into two competing groups)
  - Can be done in a second round where students are acting out the plants, and can’t talk. This is a fun/silly way to end the activity.

Higher level ideas:
- Incorporate inaturalist into identifications (if they have smartphones)
- Teach more about physiology and science of each plant (option to make them do a drawing before learning and another drawing after learning to see if they notice things about the plant differently)
Color-Changing Flowers

Bucket Topic(s): Plant physiology, science, art

Materials:
- Cups
- Carnations
- Food coloring
- Water
- Optional: other flowers if you want to do an experiment to see if it works with other types of flowers/plants

Objective: To learn about how leaves are the driving force to the absorption of water in plants.

Steps:
1. Trim the stems of the carnations really short
2. Fill the cups with water, add 15 drops of food coloring, stir to mix
3. Place the stems into the cup (only the stem should be submerged, not the petals)
4. Let them sit for a couple hours to see changes in petal color
5. While plants are sitting in cups, learn about the parts of a plant (see worksheet below to label the parts of a plant -- could do drawings on white boards as a class and make engaging or can be done independently or in small groups)
6. Also can spend time learning about how leaves are the main driver of water absorption in plants - transpiration from leaves mean that water wants to travel there because it goes naturally from places of high water concentration to low (to read more: https://www.nature.com/scitable/knowledge/library/water-uptake-and-transport-in-vascular-plants-103016037/)
7. Allow students to take a cup with a flower home if they'd like
Parts of a Plant Worksheet:

Name: ______________________  Date: __________

Label the

Parts of a Plant

[Diagram of a plant with labeled parts]

Word Box

Flower  Fruit
Stem  Leaf  Root
Higher level ideas:

- Learn about the genetics of codominance when an organism gets a mixture of the alleles (ex. Red + white flower make a pink flower, spotted/roan cows)
- Could also do a comparative, using plants other than carnations to see what (if anything) happens
Trash, Recycling, & Compost Sorting Competition

Bucket Topic(s): Composting, recycling, trash sorting

Materials:
- Trash, recycling, and compostable items
- Optional:
  - Cardboard boxes
  - Folding table
  - Gloves

Objective: To learn more about what can typically be recycled, thrown away, and composted (regulations vary depending on where you live so take this into consideration when forming your rules).

Steps:
1. Collect (yourself or from students) an assortment of trash, recyclable, and compostable items (try to have at least 30 total items) -- they can be used or unused (ex. full bag of chips, empty bag of chips, uneaten fruits, etc.)
2. Place all the items into a cardboard box in the middle of a folding table
3. Bring two students up to the table at a time
4. Count them down... “ready, set, go” and they will start pulling things out of the larger box and sort them into three piles on their side of the table - one for recycling, one for composting, one for trash. They will take as much as they can as quickly as possible, it’s a race
5. Once they run out of things to grab from the main bin, they have to stop and the judge will assess their sorting skills: +1 for all correct items sorted, -1 for incorrectly sorted items. Their points will be tallied up and the person with the highest score wins.
6. Tell them why the things they sorted incorrectly are wrong and tell them why each thing is correct.

Higher Level Ideas:
- Teach students about the mechanics of composting - the timeline, how it actually works, different ways of composting, ways in which it’s beneficial
- Have students each pick one thing that can or can’t be composted and teach everyone else about it, then do an interactive guessing game, calling the names of things out and having them yell out or raise hands to decide if it can be composted or not
Examples sorting guidelines (remember that different areas of the country accept different things in their recycling and some places don’t offer composting so there are differences between composting at home and at a facility):

**Recycling**

You may place the following items in the blue recycling bins on campus:

- newspaper
- cardboard
- paperboard
- office paper (all colors, staples are fine)
- magazines
- catalogs
- telephone books
- envelopes (plastic/wax paper windows are fine)
- books (paper only — please remove hard covers/binders)
- aluminum cans
- glass bottles, cans (green, brown, clear)
- metal cans
- plastics 1-7

Please do not recycle any of the following:

Putting these in recycling bins will cause contamination and may cause all of the bin’s contents to be thrown away.

- no pizza boxes
- no glass cups
- no aluminum foil
- no light bulbs
- no blue glass
- no aerosol cans
- no take out containers
- no waxed cartons

Thank you for recycling at Haverford!
What To Compost

- Fruits and vegetables
- Eggshells
- Coffee grounds and filters
- Tea bags
- Nut shells
- Shredded newspaper
- Cardboard
- Paper
- Yard trimmings
- Grass clippings
- Houseplants
- Hay and straw
- Leaves
- Sawdust
- Wood chips
- Cotton and Wool Rags
- Hair and fur
- Fireplace ashes

What Not To Compost and Why

- Black walnut tree leaves or twigs
  - Releases substances that might be harmful to plants
- Coal or charcoal ash
  - Might contain substances harmful to plants
- Dairy products (e.g., butter, milk, sour cream, yogurt) and eggs*
  - Create odor problems and attract pests such as rodents and flies
- Diseased or insect-ridden plants
  - Diseases or insects might survive and be transferred back to other plants
- Fats, grease, lard, or oils*
  - Create odor problems and attract pests such as rodents and flies
- Meat or fish bones and scraps*
  - Create odor problems and attract pests such as rodents and flies
- Pet wastes (e.g., dog or cat feces, soiled cat litter)*
  - Might contain parasites, bacteria, germs, pathogens, and viruses harmful to humans
- Yard trimmings treated with chemical pesticides
  - Might kill beneficial composting organisms

* Check with your local composting or recycling coordinator to see if these organics are accepted by your community curbside or drop-off composting program.
Symbiosis and Relationships

Bucket Topics: Symbiosis, relations with plants, and biological interactions

Materials:

- Paper, colored pencils, assorted craft objects (Optional)

Objective: To teach about relationships in nature and get participants to think about how they and others interact with nature.

Steps:

- Define symbiosis, and various types of relationships. (See link- mutualism, parasitism, commensalism, predation)
- Name a few symbiotic plants/relationships illustrated on the worksheet and describe how the two organisms benefit.
- Assign participants to different plants and animals.
- (Optional) Hand out craft objects so participants can create costumes or props that represent their plant or organism.
- Let participants act out the relationships they imagine or see between the organisms. (Optional: If someone doesn’t want to act it out, hand out paper and pencils and let them draw out or write interactions.)
- Group participants up and let them play team building activities to show how mutualistic relationships are beneficial. Activity Examples