Creating successful pollinator gardens in your community

Image by Peggy Macnamara

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1) Setting goals for your community pollinator garden

There are many types of gardens including vegetable gardens, rain gardens, rose gardens and others. This guide focuses on the cultural and environmental benefits of creating gardens for pollinators (and people). This booklet is intended for anyone interested in the process of creating a garden in a shared space such as a school, library, or place of worship. It takes a team wearing a number of hats to make a successful garden.

Pictures: top left - a common space at UIC greenhouse; top right - a school garden at Sadlowski School, bottom left a transformed parkway, middle a small garden along a fence, bottom right a raised bed planting at Instituto Del Progreso Latino.

Why pollinator gardens?

Most flowering plants (including one-third of the food we eat!) depend on butterflies, bees, and other animals to move pollen from one flower to another of the same species, which produces fertile seeds. Pollinators play an important role in our ecosystem and in our food system, but they're in decline--due in large part to a loss in habitat. As the world continues to urbanize--at this point, 80 percent of the US population live in cities or suburbs--more people are thinking about how we can create habitat for pollinators and other wildlife in urban areas. Along with the benefits for pollinators come benefits for people, too: gardens offer peace and quiet, beauty, novelty, hands-on science education opportunities, and so much more. Creating a garden can build community and bring green space to neighborhoods further from large parks and forest

preserves, which are unfortunately not evenly distributed throughout the Chicagoland area. In this context, gardens at schools, places of worship, libraries, apartment complexes, and other shared spaces are emerging as a way to create badly needed habitat for wildlife *and* to increase access to nature and the place-based environmental science learning opportunities it offers.

However, not all of these gardens have withstood the test of time: they can suffer from not fully accounting for the long-term needs for water, soil, light, maintenance, and community support. We've created this guide to help you and your community groups create a garden that's an oasis and learning resource for years to come.

What is a pollinator garden?

A pollinator garden is an area--as big as a city block or as small as few planters--that contains plants that benefit local insects. Over the last few decades insects have experienced steep population declines due to use of pesticides, habitat destruction and fragmentation, invasive plants and climate change. These stressors have led to a lack of food and shelter for native pollinator species and their consequent decline. We can mitigate this ongoing negative trend by creating places where butterflies, bees, beetles and other insects can nest and find appropriate food sources. Over centuries local pollinators evolved with local plants: the insects depend on these plants for food and shelter, and other animals like birds depend on the insects for food. By creating a garden using native plants--those plants that are adapted to our local conditions--we help to support local ecosystems and food webs.

Why a pollinator garden at *your* community space?

What makes you want to establish a garden? The goals you have for your garden will largely determine the process by which you go about creating it. Consider the following questions. Perhaps in a group setting have each individual take time to answer these questions and then answer them as a group.

- What are the short and long-term goals of the project?
- How will the site be used? What kinds of activities will most commonly occur there?
- Who will be involved in creating and using the garden? How many students, teachers, and others? Is there sufficient capacity to create and maintain the garden?
- What age groups of youth will use the site? What are their needs?
- How will the process of creating the garden be organized and communicated in an ongoing way to stakeholders, such as the school administration, teachers, students, parents and other community members, and local officials?

- Are there any features of the site that would make gardening there difficult? Use the site evaluation form below to think through this question.

Pollinator Garden Site Evaluation

The purpose of this evaluation is to prepare for planning your garden and to consider how the site can meet your short and long term goals. You must visit your site to complete this evaluation.

These criteria are a rough guideline for considering viability. If a number of barriers seem to make the project difficult to bring to fruition, you may decide to reconsider that site. However, if your prospective site has access to water and is relatively free from large scale dumping, there is always hope!

Adapted from Green Corps Training Materials

Is your proposed site currently used as a garden? [ ] Yes [ ] No

1. Is there a water source on the site? [ ] Yes [ ] No

   This could be a deal-breaker.
2. If yes, please describe:
3. Is the garden easily accessible or can it be made easily accessible for participants?

   [ ] Yes [ ] No

   Notes: _____
4. Does the site location have sufficient sunlight to support a garden? [ ] Yes [ ] No

   Consider that there are shade-loving native plants as well as ones that have full sun requirements like many vegetables.
5. Is the site level? [ ] Yes [ ] No

   The site doesn't have to be perfectly flat. But topography will affect drainage, soil runoff, plant choice.
6. Is the proposed area set back from walkways? [ ] Yes [ ] No

   Consider planting a few feet back from sidewalks or planting low-growing groundcover along pathways or sidewalks so as not to obstruct walkways.
7. Is there garbage or debris on the site? [ ] Yes [ ] No
8. Is the garbage issue one that can be addressed? [ ] Yes [ ] No

   Leave time and resources to clear the garbage before beginning your garden.

9. Please list any garbage and/or debris that can be removed by hand, such as bricks, rocks, furniture or tires.
10. Is there graffiti anywhere on the site? [ ]Yes [ ] No
11. Are there rodent problems on the site? [ ] Yes [ ] No

    Leave time and resources to resolve this issue first, working with the city.
12. Are there fallen trees on the site? [ ] Yes [ ] No

    Decide whether you'll incorporate the tree into the garden design, or work with the city or a contractor to remove it.
13. Describe the condition of the soil—sandy, clay, topsoil present, rocky, high quality, low quality, etc. [Learn more about soil management] Consider having soil tested by a lab for heavy metals or other toxins if children will be working extensively in the soil or if any edible plants will be incorporated into planting design. [Testing info available here and here]

    Other: _____

    This will affect plant choice. If soil is poor quality, you might want to add compost and mulch to improve.
14. Is the site used as a hangout? [ ] Yes [ ] No
    a. If yes, by whom?

You might consider adding benches to make the space inviting and social. Consider a shade tree.

15. If the site is used for any other purpose, please describe:

Support Network

Map out your support network. Who are all the people who will use the garden and help ensure it's maintained in the future? An example of what this might look like specifically at a school garden is below.

Institutional/ Administrative Administrative support can ensure that the garden becomes an integral part of the programming and/or curriculum and is cared for appropriately by maintenance staff.	**Staff** Multiple staff and community members' efforts are necessary for long-term sustainability to avoid the consequences of staff changes on garden viability.	**Community** Nonprofits, community school liaisons, and other groups can offer resources and support (e.g. Green Teacher Network, Master Gardeners and Master Naturalists) (See resources at end.)	**Parents** Parents can help with summer maintenance, fundraising and organization.

Each of these groups needs to be involved and buy in to the project. Consider holding Q&A sessions and garden design meetings to address any concerns stakeholders have.

Youth Involvement

Involving young people in the development, creation, installation, and care of the garden supports the long-term sustainability of the garden. If your garden is at a school, multiple grade levels should be involved to account for staff attrition and in a way that engages students as they move up in grade levels. Ask youth participants to research potential plants or draw their ideas for the garden. Involving community youth in planting during installation and, in the case of a school garden, weekly classroom use will help foster a sense of ownership of and responsibility for the garden. Consider forming a garden club to build up a crew for after-school maintenance, planting, or seed collection.

Maintenance considerations

- How will the area be managed or maintained in both the short and long term?
- What will be done to prevent invasive non-native plants from out-competing the native plants?
- Who will be responsible for maintenance and when?
- Develop a maintenance schedule for watering, weeding, and mulching.

Other Considerations

- **Funding:** Funds or supplies are needed to supplement new plants, lost or broken tools, seeds, etc. Many local and national grants can provide these funds. Parent-run fundraisers are an option as well.
- **Time:** Who will maintain the garden and when will they do so? Will a maintenance schedule be developed? In the case of a school garden, time during the school day should be allotted to classrooms to engage in outdoor learning. For this reason, it's critical to involve school administration so that academics can be oriented to outdoor learning.

Curricula

A garden can enhance and even drive school or other curricula, especially science. Young children learn best through experience; working seasonally in the garden can be a great way to teach them about life cycles and characteristics of living things. The garden functions as an outdoor laboratory where students use all of their senses to observe and interact regularly with local flora and fauna. Creating native gardens next to a school should naturally result in incorporating the space into various curricula (see Resources at the end for ideas). In addition to science where kids can learn about life cycles, food webs etc, weather patterns,etc.,students can also benefit academically from the installation. Arts classes can use the green space for inspiration. Students can learn about the traditional cultural uses of plants as a part of social studies. And kids can learn math skills though calculating area, volume of mulch needed, predicting the number of seeds based on a small sample, and statistics by comparing metrics from year to year.

Grades K-2: Students of these ages can study plants, birds, and insects by observing them firsthand in the garden.
Grades 3-5: You can introduce these students to seed life cycles, adaptations and native and non-native plants and their effect on ecosystems.
Grades 6-8: To complement math lessons, these students can measure and calculate the area and perimeter of proposed gardens. They can also maintain compost bins and learn about weeds, plant identification, plant life cycles and needs, and growing seasons. They can create field guides or labeling for plants, and adopt trees in the school yard to research, monitor and care for.

For students of all ages, nature study provides a prompt for creative writing or visual art. As research has shown, integrated content based units enhance learning opportunities for English language learners, as well as for underserved students in general. School gardens can be used in a variety of interdisciplinary and intercultural ways.

What does success look like?

A community pollinator garden fulfills many objectives. Gardens can:

- provide a hands-on learning laboratory
- deepen kids' curiosity
- connect schools to the surrounding neighborhood
- offer an oasis of calm for students, teachers, and staff
- absorb carbon and stormwater to ameliorate effects of climate change
- provide a home for local wildlife
- reduce urban heat island effect

To monitor the overall success of the garden, the initial goals of the project should be considered. Below is a list of a few metrics that can help to determine whether a garden has been a success.

Each criteria grid can be scored from 0-2 where the value of 0 means criterion is non-existent, 1 means some of the criteria is implemented, and 2 is the criteria is fulfilled. For a visual, the grid can be filled with colors: such as red (no progress yet), yellow (some progress has been made) and green (criterion fulfilled).

Institutional buy-in

Institutional support is crucial for long term longevity of the project. Having all stakeholders aligne ensures that if one member of the group is inactive (moves, loses interest, burns out, etc.) the project will still continue, because there are others committed to the work.

	at time of the idea inception	at the time of planting	1 year post planting	3 years post planting	5 years post planting
A group of community members or school staff are committed to the garden's success					
If a school, administration is on board [1]					
A committee consisting of various stakeholders is active in the planning, development and maintenance of the					

[1] This varies by the administration. Concerns of the administration can be addressed by presenting them with a group of committed volunteers and a plan, or showing openness to talk to various affected groups like maintenance crews. (draft up initial plan and secure support from beginning project team, begin initial discussion with administration, share resources to address concerns and that highlight benefits of pollinator plantings)

garden					
There's an active effort to incorporate the garden into learning opportunities for local youth whether in formal or informal learning settings					
There's an active effort to provide information and signage					
There's a plan for communication					
There's a plan for maintenance					
There's a plan for involving local community					

Ecological success

One of the reasons for creating a native garden habitat is to provide food and shelter for insects and birds and other animals who rely on plants with which they developed an evolutionary relationship over millennia. Research shows that a higher diversity of plants will support a larger number of insects. Access to nature in daily settings also can benefit physical and mental health. Preliminary research points out that greater biodiversity - number of organisms present at a given place - is more beneficial for mental health. (*Green School Yards Report*, Children & Nature Network, 2016). In addition, ecological benefits for humans include cleaner air and better rainwater retention (leading to less water in our basements). Ecological success does not happen overnight, and is a process that is long and should be monitored through time. There are many ways to measure ecological success; below are a few suggestions.

Just as above, you may use the score of 0-2 or use red, yellow and green to visually show progress.

	at the time of planting	3 months after planting	1 year post planting	3 years post planting	5 years post planting
Garden is visited by a variety of pollinators: bees, flies, wasps, butterflies					
Garden is visited by non-pollinator fauna: birds, beetles, insect predators					

Garden supports pollinators at all lifecycle stages (see below)					
- Host plants are present such as milkweeds, golden alexanders, asters, cherry trees, oaks, grasses, tick-trefoil and other legumes					
- Flowers with different shapes and colors throughout the growing season are present					
- Thick grasses or other dense vegetation for shelter is available					
- Basking spots and moist areas are present					
Garden is in constant bloom from April to end of October					
Garden supports overwintering of insects from fall to late spring					
- plant material is left standing for fall					
- plant material is not cleaned from the garden in spring until 10 consecutive days of temperatures of 50F or more					
Garden is studied through Community Science or other protocols that can confidently be repeated year after year					

Just as above you may use the score of 0-2 or use red, yellow and red to visually show progress.

Educational success	at the time of planting	3 months after planting	1 year post planting	3 years post planting	5 years post planting

Garden is used for science education					
Garden is used for arts education					
Garden is used for math education					
Informative signage in the garden exists					
Monitoring data is interpreted by the students					

All the checklists above determine the success of the garden in the school setting. However to ensure that the garden thrives and that the needed changes are undertaken, a few other metrics should be considered for the vitality of the garden. Some of the metrics refer to previous considerations of success and whether the needed changes were addressed. This rubric aims at ensuring vitality of the garden for years to come.

Viability of the garden	3 months after planting	1 year post planting	3 years post planting	5 years post planting
Garden continues to draw interest and visitors				
Garden attracts visitors during summer, when school is not in session				
Flowers in the garden continue to bloom				
Garden is maintained - looks neat and inviting				
Garden has a low amount of weeds present				
Plant species remain and bloom in year 2 and beyond				

Success rubrics are visited frequently and results interpreted				
Adaptive management - needed changes are implemented				

2) Planning the garden

Determining the planting conditions

Before any work begins, it is crucial to understand characteristics of the future garden site that will determine plant selection and placement. The committee or group of students can do it by answering questions such as

- **How wet or dry is the site**? Is there standing water after a large rain event? Is the garden on a hill and water drains quickly? Is there a spot where water pools?
- **How much sun does the site get**? Is it in a shady place under some trees? Does the school building cast a shadow on it for a large portion of the day? Does the garden have southern exposure with many hours of sunlight?
- **What is the soil like**? Is it compacted urban soil where water has a hard time percolating through? Is it sandy soil that drains quickly? Is it clay capturing most rain water?Have you tested your soil for heavy metals or contaminants? Have you tested your soil for heavy metals or contaminants?

Knowing the answers to these questions will allow you to better select plants to mimic natural plant communities such as prairies for full sun, savanna for part shade, woodland for shady spots, wetland for wet areas, mesic prairie for medium moisture etc.

Biodiversity

To attract the greatest amount of butterflies, moths, bees, beetles and other pollinators plant a variety of different plants. Biodiversity is more than just the number of different species; it is ensuring heterogeneity on multiple levels.

Form and function - ensure that a selection of plants in the garden have different colors, flower shapes, heights and blooming strategies. Many of our native bees are specialists when it comes to collecting pollen and they can only take advantage of a given flower structure. Also make sure you have plants that play different roles in the garden such as legumes (nitrogen fixers), grasses and sedges for structure and shelter, shrubs etc.

Phenological diversity - ensuring blooms from April to end of October is important to provide a constant food source for pollinators. Consider early blooming species such as spring ephemerals (prairie smoke, shooting star, trilliums or some shrubs like willows) and late blooming asters and goldenrods.

Host plants - some species are tightly tied to a life cycle of insects (usually butterflies and moths) in that the larval stage only feed on species of a particular plant. Including these species in your garden greatly increases changes of attracting and supporting the given insect.

Some examples are milkweeds and the monarch butterfly, plants in the carrot family (like golden alexanders or cilantro and dill) and the swallowtail butterflies. For a more comprehensive list, click here.

Supporting the entire life cycle - apart from host plants, insects need pollen and nectar, water to drink and shelter to rest and hide in. Creating discrete water features or places where water can pool (a little container with sand put in the middle of the patch), dense vegetation and grasses for shelter, and leaving much of the plant material through winter will ensure that the entire life cycle of an insect is supported.

When making **plant choices** try to stay away from cultivars of native plants - also known as nativars. These usually have a description added to the common name, such as little bluestem "jazz" or goldenrod "firework". These extra names mean that the plant has been cultivated for an unusual characteristic. Although some of these characteristics can be found in the wild, they are rare. The effects of nativars are still not fully understood, but research points that some nativars might provide a smaller amount or less nutricional nectar or pollen than the regular species, which in turn can have negative effects on pollinators. Project Budburst, a community science project led by the Chicago Botanic Garden, has a component that compares regular and nativar variations of the species and can be incorporated into curricula (see information in curriculum).

Plant choices

Aim for a variety of plants when it comes to species, and also in the age of the seedlings, size of plants etc. You may choose a fewer older plants (2nd and 3rd year plant plugs) which are usually more expensive, and/or a greater amount of less expensive first year plugs, which most likely will not bloom the first year. The rule of thumb is to plant one small plug per 1 ft^2 or one mature plug per 1.5-2 ft^2. Be cautious regarding the size and spread of shrubs you use and which plants you plant under their current and future canopy.
This document provides some plant recommendations, more plant choices can be accessed in NWF's Plant Finder. You can also access a document that documents bloom time and habitat preference here.

Signage

Signage is an important part of the garden and can inform others of the specific plant choices, goals of the project, community involvement etc. Signage can have different forms, from official designed signs that are horizontal or vertical to art projects. Certifications are another option - more information provided under Garden maintenance.

Tracking ecological progress

To demonstrate ecological progress, it is important to know what was present at the site **before** work began. If you are planning to count pollinator visits or blooming plants with students, it is useful to obtain baseline data by conducting a count before the garden goes in, using the same methods. Depending on the method used, monitoring can involve everyone from young kids to seniors. Monitoring may include taking photos, counting pollinator visits during a given time period, counting plants present, setting beetle traps (see information in curriculum), and calculating percentage of plant cover or plant density.

3) Planting the garden

Garden installation is a wonderful opportunity to create community and make participants feel invested in the project and process. Involve people from different walks of life, from a local business, place of worship, school, local garden club to people who are young and old. Working with a local neighborhood association or searching local groups on social media platforms might be a good place to spread the word. Early on in the development and design, create a clear communications channel.

Before you plant: Community involvement

- The community should have a say in the plant choice, whether in person or via an on-line form. A date that best accommodates most participants should be picked for the planting day.
- A drawn out garden design will help the participant understand the vision and will aid in sticking to the plan; it will have an added bonus of knowing what was planted where in the years to come. For feedback, mount the drawing(s) in places where people can add sticky note comments or questions before settling on the final design.

Logistics

- If the garden or the number of participants is large consider inviting people to work in shifts. That way you can spend more time with each group.
- One person should be in charge of distributing the plants (or placing them in the appropriate area). Another person should be available to answer questions and keep an eye on the event while mingling.
- If possible create plant signs that would inform the public of what grows where. This could be done ahead of time and in conjunction with an art class at a local school or an art club.

Day of Planting/Installation

- The organizers should have enough:
    - trowels
    - gloves
    - rakes
    - water and a light snack
- The garden design can be marked using spray paint on the ground or flags. Mark the area where a given species, or mix of species will be placed, AND note the number of plants per that area. That way the participants will know how to space them apart. A one-foot distance is recommended.
- Do not assume that everyone knows how to plant a plant. Perform a demonstration.

After Planting/Installation

- Water all the plants generously after planting.
- Establish watering shifts for the months to come, and schedule volunteer days to weed the garden. Don't forget to take pictures (preferably from the same spot) during those activities.
- Afterwards, thank everyone for their participation. Follow up with email or a facebook group invite that can keep people up to date on progress and needs.

4) Maintaining the garden

Although many think that having a native pollinator garden means no follow up work and maintenance, that is not completely true. Keeping up with the garden will be necessary - but the work might have many facets and will be less demanding than a traditional garden. A common saying in native gardening is that, “the first year they sleep, the second year they creep, the third year they leap.” Note that as the garden establishes itself, the vegetation will fill in and thrive. Below are a few tasks to be considered.

Certifications and signage

Certifications are a way to communicate the garden’s goals to the public and demonstrate its value to the neighboring community. Many of the certifications come with a sign that can be posted, which sends a signal that the space was intentionally planted and is being actively cared for. Signs can be purchased though popular sites like Etsy or distributors of native plant material like Prairie Moon.

Certification Opportunities:

Conservation @ Home - local program, in Cook, DuPage and Lake Counties run by the Illinois Extension Office in partnership with Forest Preserves of Cook County and the Conservation Foundation. The program certifies schools based on native plants and their maintenance, water conservation, including environmental education into the curriculum, and minimal use of pesticide and fertilizer.

Monarch Waystation - allows schools and private homeowners to register their garden with an option of purchasing a metal sign. Although no requirements are demanded it is suggested that a community garden be at least 100 ft^2 and have 10 milkweed plants -consisting of two different species- along with nectaring sources.

National Wildlife Federation Certified Wildlife Habitat - certification requires inclusion of native plants for wildlife food, water sources, cover, places to raise young and sustainable practices. There is an option of purchasing a metal sign, including this Illinois-specific one.
Xerces Society Pollinator Protection Pledge - show your support for pollinators and commitment to the work to protect their health by pleading and registering your garden. The sign can be obtained with an additional donation.

Spring and fall clean up

Follow these best practices to provide pollinators with the food and shelter they need to survive:

1. During spring clean up, leave the garden's leaf litter until the temperature is above 50℉ for 10-12 consecutive days. Leave a year's growth (like old stems cut at various heights, etc.) Many insects overwinter in the plant material as adults, eggs, or in their pupa stage. The insects that overwinter burrowed in the soil need the blanket of plant material to protect them from rapid temperature shifts.
    a. If stems must be cut earlier, they should be bundled and left standing upright in a hard-to-see area so that insects that overwintered in them have a chance to emerge.
2. Limit mulch. Although it prevents weeds from spreading it also prevents native plants from self seeding and native bees from burrowing in soil. If mulch is used, it should not be applied until mid-May to allow all burrowing insects to emerge from the ground.
3. In preparation for winter, leave much of the plant material standing. It becomes a shelter for many of the local insects and allows them to overwinter.
4. The cut plant debris can and should be used for natural mulch - especially in the winter. The natural mulch protects the ground from freezing while at the same time does not block soil from bees that nest in the ground.
5. Diseased plant material should be removed, taken out of the garden, and disposed of in the garbage.
6. No insecticides should be used in the garden.
7. Herbicide should only be applied as a last resort and to treat invasive species (such as Canada thistle) that one cannot remove by mechanical means.

Mulch

As indicated earlier, continuous use of mulch is discouraged as it covers the ground and prevents ground nesting insects from utilizing the site. However, the year the garden is created, mulch can be applied to prevent other plants from coming in, and giving the native species an advantage. The mulch should become less visible within a few years.

To reduce the need for mulch, pre-treat the site, removing the lawn and turf grass. Grass can be dug up, sprayed with herbicide or killed with the help of paper bags lining the area of the future garden for a few weeks.

Maintenance and watering during the summer

Native gardens require less maintenance as they get established. However, like any other garden, it is never maintenance free. In the first year watering is important to allow plants to

establish, and weeding is crucial to give the native plants a fighting chance. As the garden matures, watering and weeding will be less important, but thinning might become a necessity. Some native plants, especially in a less competitive garden setting, grow more vigorously than in the wild.

Potential small burns

Local flora evolved with landscape fires, and small, spot burns can help imitate the effects of it. Wait for the garden to be 3 years or more before you burn. To do the spot burn you have to have a permission from the land owner, obtain city permits, obtain county permits, potentially obtain state of IL burn permits. It is very helpful to have an experienced person with you.You can use a drip torch to set a fire and not let it get out more than 3-4 feet in radius, extinguish with water and fire flapper that cuts off oxygen access. Contact your local fire department and notify them of your intentions and potential dates.

An alternative to burning might be low cutting/mowing every few years.

Tracking

Maintain a journal to log ideas, events and maintenance such as:

- trash, vandalism/ graffiti
- ideas for garden artwork - murals, sculptures, tiles, or other artwork
- condition of raised beds, paths, edging, mulch, condition of plant material--trees, shrubs, perennials, etc.
- pictures - throughout season or at peak bloom, included with plant detail or in separate section
- garden plan - to scale on graph paper, or drawn free-hand, laying out beds and plantings
- plant phenology
- wish list - plants to consider for the future, possible architectural considerations like a pergola, hut, water feature or dry river bed, tools that are needed
- inspiration thoughts
- websites you like and why
- supplier notes - which you like and which you don't; what brand of tools held up and what brand did not? Are the dollar store trowels really worth it?
- costs – like most projects it is wise to keep a tab on all your costs

5) School gardens: Connecting the garden to curriculum

If your garden is at a school, it will have more success if it can help accomplish teacher's goals for their students' learning. Below are some suggested ways to structure time in the garden so that it conveys concrete lessons in science and other subjects.

Community science projects

Several community science (sometimes referred to as "citizen science") projects exist that support monitoring your school yard garden(s):

Phenology: The monitoring of seasonal changes in plants can be conducted through the Chicago Botanic Garden's *Project BudBurst*--https://budburst.org/. Monitoring seasonal change is of particular interest in regards to climate change. Record simple one-time, or more involved observations on various plant species throughout the year. Additionally, the project has a more advanced version for observing pollinators.

> *What do you need: a plant to observe (can be a tree in your parkway!) and internet access to enter data.*
> *What it takes: Identify the plant you are observing, watch the on-line training, notice changes in the like buds opening or leaf out, record your observations.*
>
> *"Budburst brings together researchers, horticulturists, and citizen scientists on a shared journey to uncover the stories of plants affected by human impacts on the environment. Budburst tells these stories through data collection, data sharing, education, and personal connections."*

Monarch Butterfly monitoring: There are several monitoring protocols available that allow students and teachers to record data on adult monarchs nectaring in the garden or on larval reproduction. https://monarchjointventure.org/mjvprograms/science/immp

> *"The Integrated Monarch Monitoring Program (IMMP) is a national program to collect milkweed, nectar plant, and monarch use data from a variety of land-use types and regions. This information is vital to shaping our understanding of how monarchs interact with their environment, documenting conservation efforts, and tracking the population and its habitat as they change over time."*

Monarch Community Science Project: help to determine how successful urban milkweed plants are in supporting the monarch butterfly

What do you need: a milkweed plant (does not have to be at home), ability to make an online account, either a computer or printed out data sheets, attend an in-person or virtual training.
What it takes: observe the same milkweed plant/patch throughout the summer on a weekly basis and count the number of monarch eggs and caterpillars.

Journey North offers monitoring protocols that tie phenology and migrations. In its 25th year, Journey North helps monitor the seasonal movements of mammals, birds and insects across North America. Record when you observe changes in nature (such as leaf out) and when species migrate through your area. Check out the maps created with your data!

What do you need: a way to enter data (phone or computer), a curious and observant approach to nature
What it takes: Be on a look out for the species Journey North records such as robins, monarch butterflies, hummingbirds and other first signs of spring. Record them when you see them.

"Journey North provides an easy entry point to citizen science, with simple protocols, strong online support, and immediate results. Reported sightings are mapped in real-time as waves of migrations move across the continent. People report sightings from the field, view maps, take pictures, and leave comments."

iNaturalist runs many projects on its platform, such as the sidewalk botany project. One can find a project to which to contribute observations while in the garden.

Take pictures of any life forms, upload them with or without identification, wait for others to confirm your observation or identify them

What do you need: a phone/camera and an ability to upload pictures
What it takes: curiosity, getting outdoors or to your garden and snapping pictures of things that interest you

Seek from iNaturalist is a kid-friendly nature identification application for smartphones.
No registration is required, and no user data is collected.
https://www.inaturalist.org/pages/seek_app

Seek asks permission to turn on location services, but obscures location while still allowing species suggestions from your general area. Seek image recognition technology is based on observations submitted to iNaturalist.org and partner sites, and identified by the iNaturalist community.

Other Insects:

Lost Ladybug Project- Look for ladybugs in your garden or in the field, take pictures and upload.

What do you need: a keen eye to spot ladybugs or a bug net, a camera, ability to upload pictures

What it takes: willingness to scoop plants for ladybugs, then cooling them for a limited time (refrigerator or cooler) to take good pictures

Bee Spotter - Snap pictures of the honeybees or bumblebees around you and upload your pictures to answer questions on bee health.

What do you need: a way to take pictures (phone or camera) and upload it (computer or phone with internet)

What it takes: ability to take pictures, can be from different angles, of the honeybee and bumblebees

Environmental Science Curricula and Activities

In addition to community science monitoring, the science of ecology also offers many useful learning activities. Project Learning Tree is one of the premier fee-based curricular sources available for teaching elementary ecology and environmental science. Some material is available online for free. https://www.plt.org/curriculum-offerings/

In addition, the Illinois Department of Natural Resources offers a free downloadable collection of environmental science lessons. The lessons are available in PDF format: https://www2.illinois.gov/dnr/publications/Documents/00000289.pdf

Quadrats and Transects

Quadrats and transects are two ways by which environmental scientists study the biodiversity of an area. Oregon State University offers a useful PDF explaining how to conduct a quadrat and transect study and also provides data sheets. https://smile.oregonstate.edu/sites/smile.oregonstate.edu/files/schoolyardquadrats.pdf

Bio-Blitz

A BioBlitz is an intense period of biological surveying to attempt to record all the living species within a designated area. In a schoolyard BioBlitz, groups of students conduct a comprehensive study over a continuous time period, such as a 60 minute science period or even an entire school day. Professional BioBlitzes are often conducted over 24 to 48 hours. iNaturalist https://www.inaturalist.org/pages/bioblitz+guide and National Geographic https://www.nationalgeographic.org/projects/bioblitz/ both offer tips and information on conducting a BioBlitz.

You can also use the iNaturalist app to assist students in their observations during a BioBlitz. See also Backyard BioBlitz from Illinois Biodiversity Basics, Illinois Department of Natural Resources, Chicago Wilderness, World Wildlife Fund, p. 30-41

Observation Skills

Developing students' observation skills and ability to record, track and analyze data is a benefit of establishing a school garden. A useful publication is *Fostering Outdoor Observation Skills*, offered by the Association of Fish and Wildlife Agencies (available online in PDF format, 2011). The guide offers many suggestions and lessons for the teacher.

Scientific drawing

Scientific drawing teaches observation skills and promotes hand-eye coordination for all age groups (see pp. 6-8 for younger students and pp. 72-73 for older students in the guide).

Beginner Field Guides and nature observations

The Field Museum offers free, downloadable Beginner Field Guides for the Chicago Region, that include a space for noting student observations

Scientific notebook keeping

Science notebooks are an important way for students to work like scientists, observing, sketching and monitoring. School gardens offer myriad opportunities for observation and data collection. Students should be encouraged to record the date and time in their notebooks along with any other important headings or titles for their work. This will add purpose to their work and allow students to return to previous entries to determine how their thinking has changed over time. Students should be introduced to the notion that the science notebook is their record of what was observed or measured and that this information is available for future use.

STEMS: Stems support student science writing by providing scaffolds for thinking

My question: _____ (Question)

Today I (or we) want to find out_____ (Problem)

I think _____ will happen because _____ (Prediction)

I noticed (or observed) _____ (Observation)

Today I learned _____ (Conclusion)

I wonder _____ (Reflection)

Questions I have now are _____ (Next Steps/New Questions)

For more ideas on stems, visit the Valle Imperial Project in Science website at www.vipscience.com. Additional websites such as the East Bay, Rhode Island Collaborative at www.ebecri.org/custom/toolkit.html and the North Cascades and Olympic Science Partnership at www.sciencenotebooks.org offer resources to help classroom teachers get started using science notebooks.

Insect Census--Observing Insects

Materials and procedure:

- white sheet or any light colored sheet; or large piece of paper
- place it under a bush and spread the sheet out.
- shake the tree and the branches vigorously
- Examine the insects and identify them.

Place the sheet under different types of trees. Tally how many animals you get from each tree. How many different kinds of insects were found? Try another plant and see if the insects are the same or different. Why does one tree have more bugs than another?

Insect Census-Pitfall Traps

Pitfall traps are easily constructed from plastic cups or deli containers. There are many different resources on the web that guide teachers through the process. Science Friday on National Public Radio offers this version: Protected Pitfall Traps

The Insect Hunter also offers a YouTube video tutorial

6) Resources

- Resources for Building a School Garden from The Nature Conservancy
- Curricular resources on habitats and pollinators from The Nature Conservancy
- Urban Habitat: Biodiversity in Our Cities from The Nature Conservancy
- Building Your Soil from Chicago Botanic Garden
- Climate Victory Gardens from Green America
- Garden Design Certificate Program from Chicago Botanic Garden
- Prairie Garden Maintenance Guide | Sustainability | University of Illinois at Chicago
- Field Museum Field Guides, especially Creating monarch habitat in your Midwestern garden
- Kids Gardening covers everything from starting a garden committee to running a school farmers' market.
- University of Illinois Master Gardeners are a good resource for questions and garden support.

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