

Connecting the Garden to the Classroom

There are many factors that contribute to the success of a school garden program including a strong garden committee, carefully planned designs, enthusiastic volunteers, and financial support. However, even when all of these elements are in place, if the garden is not deliberately integrated into the academic structure of your school as a tool for teaching required curriculum, over time it will become a struggle to sustain. When the garden becomes enmeshed into the everyday life of a school it will become a permanent feature and will be maintained even as teachers, students, and parents change each year. Conversely, a garden that is seen as a special interest project may lose steam and support when the founding educators or parents move on.

Whether your school uses the prominent Common Core State Standards and Next Generation Science Standards or your own state or district level standards, all it takes is a little planning and creativity to find ways to tie your garden activities to your teaching goals. Here are some specific ideas for ways to use your garden as a multidisciplinary teaching tool:

Science

Connections between the garden and your science curriculum are plentiful and diverse. The garden is a living laboratory offering real world opportunities for observation and experiments. In addition to hands-on lessons relating to plant growth and life cycles, the garden provides a space to investigate environmental studies, habitats, soils, weather, and much more. Here are is a list of a few of the core science topics that can be introduced through a gardening program:

- *Plant life cycles and structure* – An obvious connection; there is no better place to study plant basics than in a garden setting. More effective than any text book, video, or website, the garden allows for firsthand observation, provides samples for dissection, and offers ample opportunities for teacher or student designed experiments.
- *Soil structure and function* – Studying soil, the foundation of the garden, provides opportunities for students to learn about soil formation, components, and structure and how soil characteristics impact the garden in a practical way by observing their effect on plant growth and health.
- *Adaptation* – Plants display many adaptations to ensure success in their environment. Studying these adaptations creates a platform for discussing species survival and also an opening to discuss inheritable traits.
- *Weather* – Weather has a great impact on the garden. Setting up a simple weather station to track rainfall and temperature and then comparing the data collected to the health and growth of your garden is a great way to make the measurements relevant. It also provides students with an understanding of some of the challenges of farming.
- *Ecosystems* – A school garden provides a model ecosystem where students can observe and learn about the relationships between living (plants and animals) and nonliving (soil and water) elements. Watching beneficial insects control garden pests, discussing how decomposers break down organic matter in a compost pile, observing pollinators at work, or tracking the flow of rain water runoff into a rain garden serve as models for understanding how larger ecosystems function.
- *Sustainability* – To efficiently use the resources available, gardeners must implement sustainable gardening practices. Learning how to enrich the soil naturally, conserve water, minimize insect and disease problems, and recycle nutrients through composting are examples of lessons students learn through gardening that aid in the understanding of sustainability of natural resources.
- *Experimental design* – Gardens offer ample opportunities for constructing and conducting scientific experiments. There are even opportunities for students to participate in collecting data for professional scientists through citizen science projects. Journey North is an excellent example, where students provide data to track seasonal changes in plants and animal migration throughout the country.

English Language Arts and Literacy

Combining language arts and gardening activities brings a hands-on element to a subject normally taught lecture-style, providing inspiration and motivation for students who struggle to focus in traditional classroom settings. When students can listen to and/or read garden stories and then translate their literary experiences into real life experiences, reading takes on new meaning and becomes less abstract. From garden journals to newsletter articles, there are many opportunities for students to practice their writing skills while sharing their work and observations in the garden with others. Here are a few suggestions for combining garden and writing/reading activities:

- *Keep a garden journal* – Writing about observations and experiences hones communication and science skills. Reflecting on these entries can help with planning future gardens and improving the garden program.
- *Write a garden article* – Ask students to write an article about the garden for a newsletter, website, or blog. Not only will they sharpen their skills, the article will help promote the garden program, potentially increasing supporters and attracting volunteer help.
- *Act out a story* – As a class, read a book with a garden storyline. Link the book to the garden by performing the same tasks as the book's characters or growing the same plants mentioned in the book. The Junior Master Gardener Program and the American Horticultural Society have created an excellent list of plant-, garden- and ecology-themed fiction for children through their Growing Good Kids - Excellence in Children's Literature Awards Program.
- *Design your own story garden* – Design a garden around the theme of a book. Many a school has launched into gardening thanks to Beatrix Potter's Peter Rabbit, planting the vegetables mentioned in the book and populating their plot with rabbit statues. Who knows? You might even end up with a real, live bunny (and learn how farmer McGregor felt!). Others, after reading *The Secret Garden* by Frances Hodgson Burnett, have been inspired to create their own cozy green hideaways. High school students may design a Shakespeare garden around the plants mentioned in his various plays and poetry.
- *Get to know fiction and facts* – Fiction whets kids' interest in reading, making it easier to segue into nonfiction and instructional reading. One effective way to encourage students is to have them brainstorm questions they have about their garden and then use garden resource books to find the answers (tell them it's a scavenger hunt!). This way students can become comfortable using reference books as a source of factual information, which they incorporate into planting guides or brochures describing their garden, and use when planting new garden areas.
- *Discover every gardener's favorite reading material* – Collect seed and nursery catalogs to distribute to students. (Local gardeners usually have a healthy supply of them to donate, or students can write to seed companies asking for donations for your activity.) Ask students to use the catalogs to find specific information about certain plants. They can learn how to use an index and also how to scan pages for details.
- *Relax and read in the garden* – The garden provides a relaxing and inspiring environment, especially for students uncomfortable in the traditional classroom setting. Read books and poems while sitting in the garden to associate the activity of reading with a comforting atmosphere.

Math

The garden provides a plethora of opportunities to practice basic mathematical functions such as calculations, comparisons, and measurements using hands-on activities. You can then translate collected data into a wide variety of charts, graphs, and reports. Unlike textbook examples that may not relate to students' experiences, math becomes both practical and relevant when students implement concepts they have learned in the classroom in a real-life garden setting. This is especially true when they see how applying math, such as calculating how many seeds to plant in a pot or determining the amount of fertilizer to use, affects the growth of their plants. The following ideas demonstrate ways to integrate the garden program into the math curriculum:

Number and operations

- Plant lettuce seeds in a flat or pot, carefully keeping track of the number planted. Count the number of seedlings as they emerge. Use these two numbers to calculate the germination rate (number of seedlings divided by number of seeds planted, multiplied by 100).
- Ask students to estimate the number of seeds in a tomato, then slice it open and count the number of seeds actually present. Compute the difference between the estimate and actual number of seeds using subtraction.
- Collect five to ten flowers from the same plant in your garden. Count the number of petals on each flower and create a chart to display your results. Repeat with other types of flowers in the garden. What do the results say about the characteristics of plants?

Algebra

- Use algebraic formulas to compute a variable, such as the amount of soluble fertilizer to add per quart or liter of water. (Most fertilizer packages indicate how much to add per gallon of water.) Collect various dry bean seeds or plant leaves, and ask students to sort them by size, shape, color, and number.
- Plant lima bean seeds in small pots. Place half the pots in a bright window and half in a dark closet. Measure growth daily. After two weeks, compile information into a chart and determine the average growth rate of plants grown in the light versus the dark. Discuss and calculate the effect of the variable of light on the variable of plant growth.

Geometry

- Estimate the number of pots that will fit on your windowsill or under your grow lights. Calculate using different sizes of pots.
- Plant a classroom window box. Determine the volume of soil you will need to fill your box. As you prepare the potting soil, first determine the weight and volume of potting mix when it is dry, then recalculate the weight and volume of moistened mix
- Complete a scavenger hunt in your garden. Look for objects representing different geometric shapes such as circles, squares, and triangles.

Data analysis and probability

- Cucumber plants produce separate male and female flowers. As the flowers open, determine if they are male or female (the female flowers have what looks like a miniature cucumber at their base; this isn't present on male flowers) and then gently attach a piece of tape (using two different colors, one for male and one for female) around the stem near the flower to mark those you counted (be careful not to damage the stems). Count the total number of flower buds on each cucumber plant and also keep track of how were male and how many were female A few weeks later, examine your marked flower buds and look for signs of baby fruit. Figure out what percentage of the flowers were female and what percentage of female flowers produced fruit. Discuss the overall probability of a cucumber flower producing a fruit.
- Host a bean race. Plant a number of beans at the base of a trellis and track their growth on a chart. Determine the rate of growth. Award the fastest growing plant a blue ribbon.
- Measure the height of a group of plants and determine the mean, median, and mode.

Measurement

- Calculate serving sizes of common fruits and vegetables using measuring cups.
- Make a recipe using harvest from the garden requiring different measuring techniques.
- Measure the height of garden plants using standard (inches and centimeters) and nonstandard (such as pencil lengths or hand widths) measuring techniques. Chart, compare, and discuss your results.

- Plant bean seeds and let them grow for a few weeks. Remove from the soil and carefully wash soil away from the roots. Measure part of the root system. Estimate the percentage of total roots you measured and then estimate the length of the entire root system on that plant. After estimating, measure the rest of the roots and compare to your length estimate.

Problem Solving

- Create a planting schedule for your garden. First, determine the desired harvest date for each crop. Next, find the days-to-maturity for each, and count backwards from the harvest date to decide when each crop should be planted.
- Track the cost of garden supplies against the amount of produce you harvest. Figure out the cost per unit (weight, volume, piece) of fruit or vegetable. Compare your cost to the cost of similar produce at the supermarket.

Reasoning and Proof

- Plant a variety of seeds. Find out the number of days it usually takes for them to germinate (often this is listed on the seed packet). Chart the researched data, then track the actual time for germination and compare the results. Discuss the accuracy of the researched information and how seed producers may have arrived at those numbers. Discuss variables that may have affected your results.

Communication

- Find out how much money your school spends on cafeteria waste removal. Spend a number of days weighing the food waste and chart the data. Write a report and publish the results within the school, and/or do a presentation for students and staff on saving money by reducing food waste and composting the waste you can't avoid. You could take it the next step and figure out the expenses versus savings of different composting options (e.g., worm composting, sheet composting) and share these with the school board!
- Participate in the Journey North Tulip Project. Track the appearance of tulip bulbs in your schoolyard and share the data with other students and teachers participating throughout the country.

Connections

- Complete a site analysis of your garden. Measure the perimeters of the entire garden, various beds, paths, and other features. Compute the overall area of garden and garden beds. Draw a map to scale using graph paper. Use the map to plan new garden designs.

Representation

- Track weather conditions, such as temperature, rain, wind and humidity, over time. Graph and chart data to summarize your findings.
- Complete a market survey of students and parents regarding garden products you might want to sell. Summarize and interpret data to help you set the foundations for a school garden business.

History and Social Studies

Growing plants both for survival and profit is a shared experience across cultures and throughout history. A garden program provides opportunities for students to model this important aspect of past and present life. Here are a few examples of practical ways to introduce history and social studies topics in the garden:

- *Introduce different eras* – Grow crops or gardens that were significant to a particular historical time frame using the methods employed by the people of that age. For example, plant a Colonial Garden designed to replicate the gardens American colonists relied on for survival in the New World. Teach students about the World War II era by planting a Victory Garden. During the war there was a major strain on the American food supply because large quantities of food were shipped overseas to feed the troops. At the same time, many farmers and farm workers had joined the military, which led to a decrease in crop production. As a way to overcome this predicament, the government created a Victory Garden campaign to promote home gardening and increase the food supply.

- *Introduce a culture* – Every culture has developed unique agricultural practices and traditional crops. Exploring the common plants and foods of a culture is a great entry point for gaining understanding and appreciation for a culture as a whole. Students can grow traditional crops of the culture they’re studying and then harvest them to prepare and enjoy special cultural meals. To grow a garden that introduces both culture and history, plant a Three Sisters Garden demonstrating the Native Americans’ technique of planting corn, beans, and squash (referred to as the “three sisters”) together in mounds.
- *Explore a historical event* – Plants have played a major part in historically important events. Growing these plants helps the event come alive to students. For example, you can plant potatoes and discuss the Irish Potato Famine. Potatoes originated in Peru, but thanks to their high nutrient content and ease of production they became an important staple food in Europe. In fact, people became too dependent on the potato, which is well documented by the tragedy of the Irish Potato Famine, when a blight killed potato plants throughout the country, leading to a multi-year famine. Hundreds of thousands of people starved and millions more immigrated to other countries. This highlights not only the importance of diversified agricultural practices, but also demonstrates the potential devastation of introduced diseases on plant species.
- *Study important historical figures* – Another way to put a face on plant-related history is to learn about famous historical figures who furthered our understanding and appreciation of plants through their dedication to gardening and/or science. Some prominent examples include George Washington Carver, Thomas Jefferson, and Dr. Norman Borlaug.
- *Pursue botanical biographies* – Just like people, every plant species has its own story, inspired by its unique structures, growth habit, growing requirements, native region, cultural uses, and a log of its travels (as people transported it around the world). Investigate plant origins and historical uses.

Choosing a Garden Curriculum

The suggestions above are just a sampling of educational activities you can use for your gardening program to make the connection between your garden and the curriculum. Fortunately there are many resources available to help you find lessons to fit your needs. Check out the following curriculum books published by KidsGardening that contain detailed lesson plans and background information to further support your educational program planning:

- *GrowLab* – Developed by NGA and written and field-tested by educators, this curriculum focuses on exploring plant life cycles, examining plant diversity, and investigating the interdependence of plants, humans, and other living and non-living things. This easy-to-follow resource will help you plan and plant an indoor garden and guide you through conducting specific indoor gardening projects.
- *The Growing Classroom* – Developed by the Life Lab Science Program, this is an excellent collection of classic garden activities. Over 450 pages, includes K-5 activities using science, math, and language arts, along with helpful youth gardening tips and instructions.
- *Math in the Garden* – Developed using funding from the National Science Foundation by UC Botanical Garden at Berkeley and Lawrence Hall of Science, this K-8 curriculum was extensively trial-tested by educators nationwide. It includes dozens of hands-on activities to sharpen math skills and promote inquiry, language arts, and nutrition.
- *LiFE Curriculum* – Written by educators at the Teachers College at Columbia University, the LiFE (Linking Food and the Environment) curriculum is designed to teach science through the study of our food system. The series currently includes three books: *Growing Food* (Grades 4-6), *Farm to Table & Beyond* (Grades 5-6) and *Choice, Control & Change* (Grades 6-8). Students participate in higher level-thinking, which poses questions about choice regarding food, processing, agriculture, and environment.

The garden is a versatile educational tool that can be used to teach a range of topics. In order to maximize the impact of the garden, educators should work with their garden committees to customize programming materials and activities to meet the educational needs of their students. Integrating the garden into the curriculum takes some planning and preparation, but it is well worth the effort and will ensure that the garden program will be sustained over time.